

APPENDIX 5.7 BIG-1

GEOLOGY, SOILS, AND SEISMICITY TECHNICAL REPORT

Barstow International Gateway Geology, Soils, and Seismicity Technical Report

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Prepared by:
Shannon & Wilson
Geotechnical and Environmental Consultants

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ACRONYMS AND ABBREVIATIONS

AREMA	American Railway Engineering and Maintenance-Of-Way Association
bgs	Below Ground Surface
BIG	Barstow International Gateway
BNSF	BNSF Railway
BMP	best management practice
CBC	California Building Standards Code
CGS	California Geological Survey
CWP	Countywide Plan
CalGEM	California Geologic Energy Management Division
Caltrans	California Department of Transportation
DSOD	Department of Safety of Dams
DWR	Department of Water Resources
ECSZ	Eastern California Shear Zone
EIR	Environmental Impact Report
FRA	Federal Railroad Administration
IBC	International Building Code
km	kilometers
kV	kilovolt
NRCS	Natural Resource Conservation Service
OSHA	Occupational Safety and Health Administration
PRC	Public Resources Code
SCE	Southern California Edison
USGS	U.S. Geological Survey

1.0 PROJECT SUMMARY

This Report has been prepared to analyze the proposed Barstow International Gateway (“BIG”) and associated off-site improvements. BIG is located in the City of Barstow (“City”) and in unincorporated territory in the County of San Bernardino (“County”), California (see **Figure 1: Regional Vicinity Map** and **Figure 2: Local Vicinity Map**). BIG consists of a rail yard with an intermodal facility¹ and “block swap” facility², a transload warehouse center³, and a solar farm.

Additionally, to serve the proposed rail yard and transload warehouse center, BNSF Railway Company (BNSF) proposes off-site rail improvements (including lead track extensions), and off-site non-rail improvements (including drainage, utilities, and roadways).

BIG’s proposed components are depicted on **Figure 3: Barstow International Gateway Conceptual Site Plan**, **Figure 4: BIG Off-Site Improvements, West**, and off-site improvements are depicted on **Figure 5: BIG Off-Site Improvements, East**.

1.1 Project Location and Setting

BIG totals approximately 5,000 acres⁴, and includes approximately 680 acres which would remain ungraded/undisturbed (“Mojave River buffer area”). BIG’s Specific Plan area totals approximately 4,300 acres and is generally bounded by the Mojave River to the north, Main Street (also referred to as National Trails Highway or Route 66) to the south, Lenwood Road to the east, and Hinkley Road to the west.

Most of the BIG footprint is within unincorporated County lands, while the remainder is within Barstow City limits. The BIG footprint is generally flat and gradually slopes north to the Mojave River. Off-site improvements are generally within existing BNSF rail and City/County street rights-of-way. The BIG footprint is primarily vacant undeveloped land, which is traversed by an existing BNSF railroad, and which contains scattered residential, commercial, and industrial land uses. This area is mostly devoid of tall vegetation and trees, with structures and other elements of the built environment scattered throughout. Existing land uses within BIG’s footprint are listed in **Table 1: Existing Land Uses**. There are approximately 108 dwelling units and approximately 94,000 square feet of non-residential land uses (i.e., commercial and industrial) within the BIG footprint. Additionally, a private airstrip (“Depue Airport”) is within BIG’s proposed solar farm footprint. Under BIG, this private airstrip would be demolished and replaced with the proposed solar farm.

¹ “Intermodal facility” refers to a rail yard where containerized goods are transferred between trains and trucks. Trucks arrive to either pick up containers from arriving trains or deliver containers for departing trains. However, unlike traditional intermodal facilities, at BIG the majority of containers would arrive by train and be transferred to and from electric hostlers.

² “Block Swap” refers to transferring a block of intermodal train cars between trains. In effect, the entire block of cars remains coupled together and is moved en masse to another train.

³ “Transload” refers to the transfer of goods from one container to another. In this document, it specifically refers to the transfer of goods from 40-foot international containers to 53-foot domestic containers. The transload warehouse center at the BIG is designed to serve goods transported to and from the intermodal facility by rail.

⁴ Although the BIG Specific Plan acreage is 4,335 acres, throughout this technical report, the BIG Specific Plan acreage is referred to as 4,300 acres. Note: all acreages in this report are preliminary and based on GIS data. Acreages will be refined with site survey.

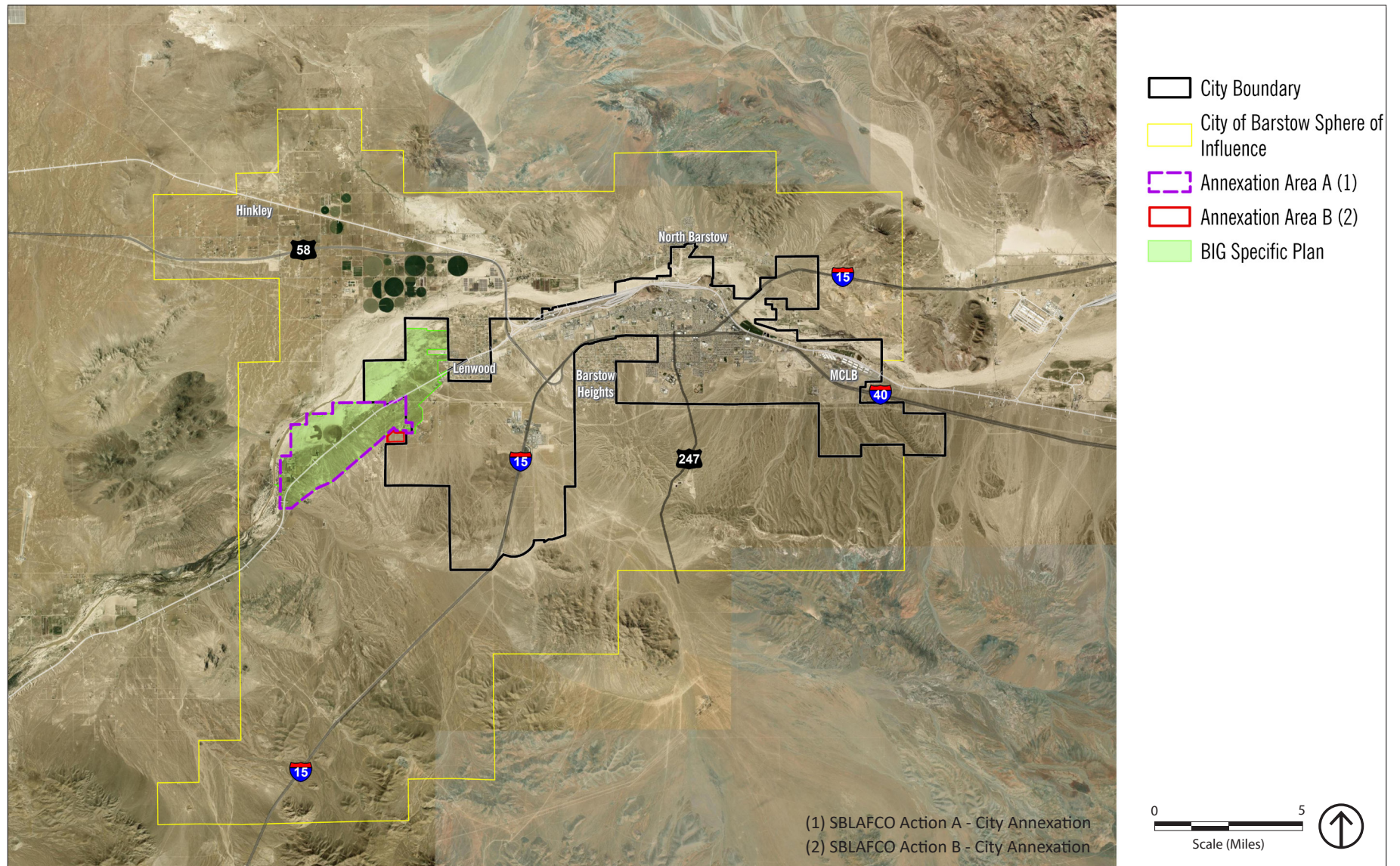
Table 1: Existing Land Uses					
Description	Residential (DU)	Commercial (SF)	Industrial (SF)	TOTAL (DU)	TOTAL (SF)
Existing Land Use	108	85,887	7,837	108	93,724

Regional vehicular access to BIG is provided by Main Street from the south, I-15 from the southeast, and SR-58 from the east. Local access to BIG is primarily provided by Lenwood Road and Hinkley Road from the east and west, respectively, in addition to various unpaved roads along Main Street. Regional rail access is provided from the north by BNSF's Mojave subdivision, from the west by BNSF's Cajon subdivision, and from the east by BNSF's Needles subdivision.



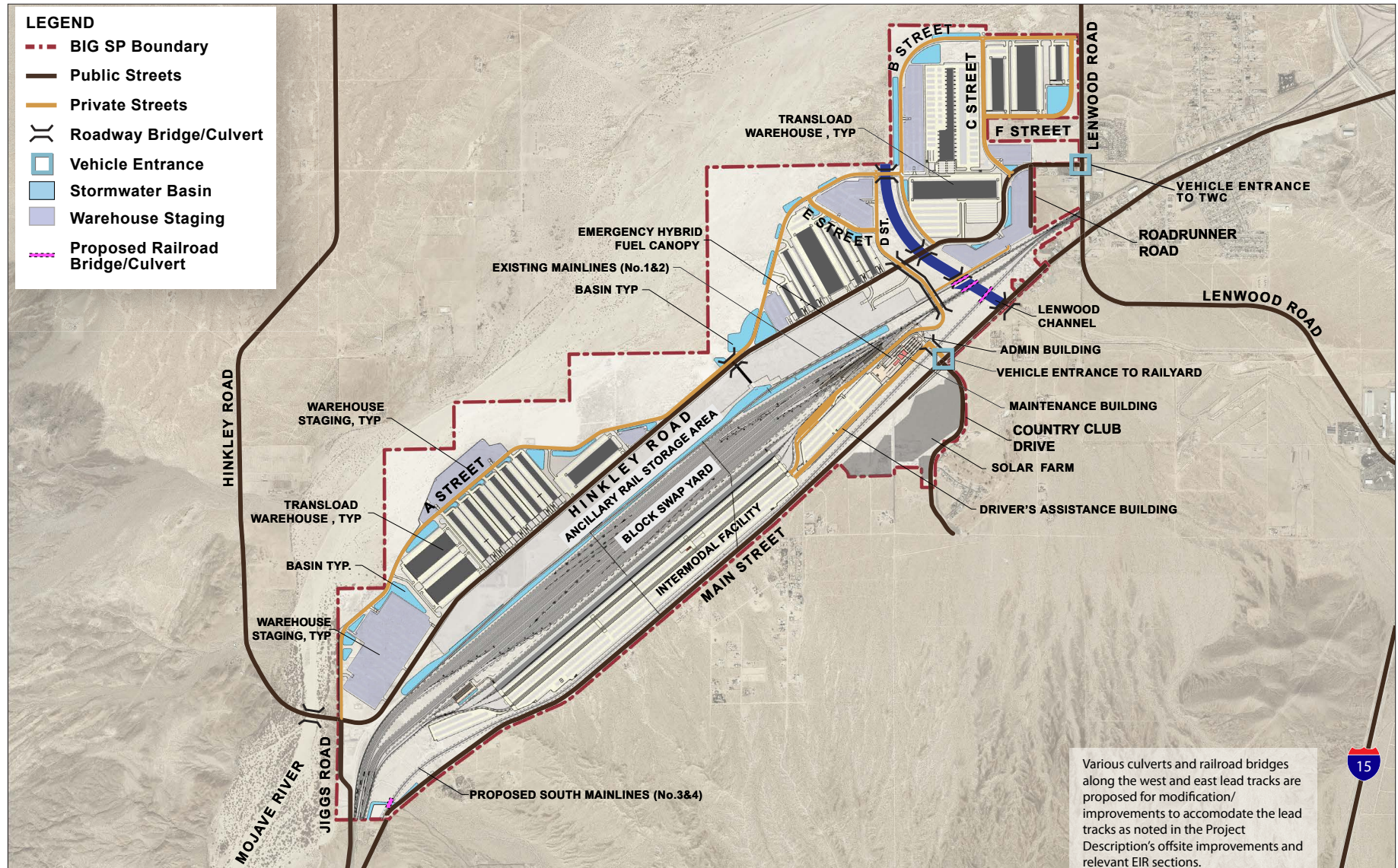
Sources:
City of Barstow , City Boundaries, 2024.

Figure 1
Regional Vicinity Map



Sources:
County of San Bernardino, 2023; City of Barstow, 2024.

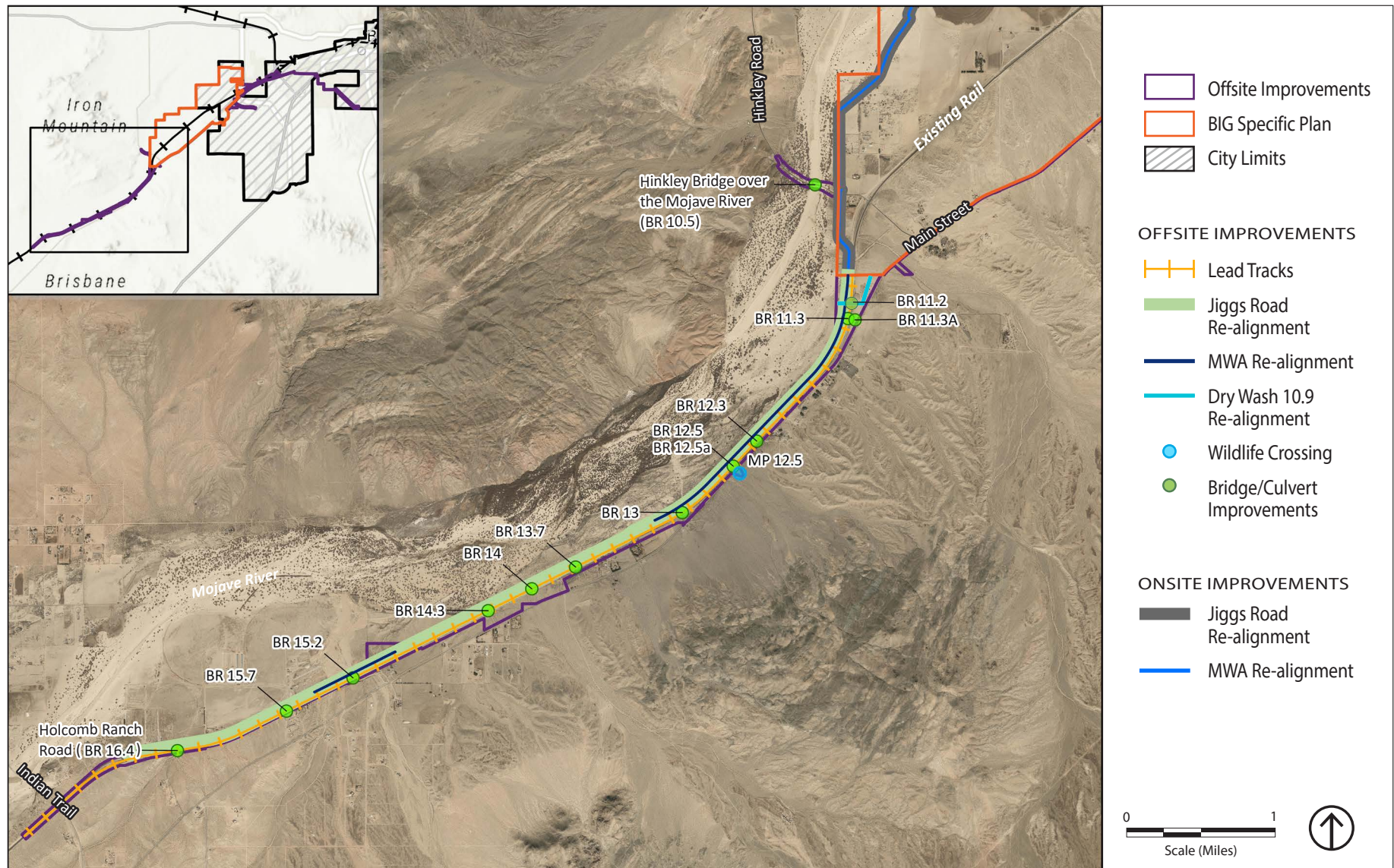
Figure 2
Local Vicinity Map



Sources:
Transsystems, 2025.

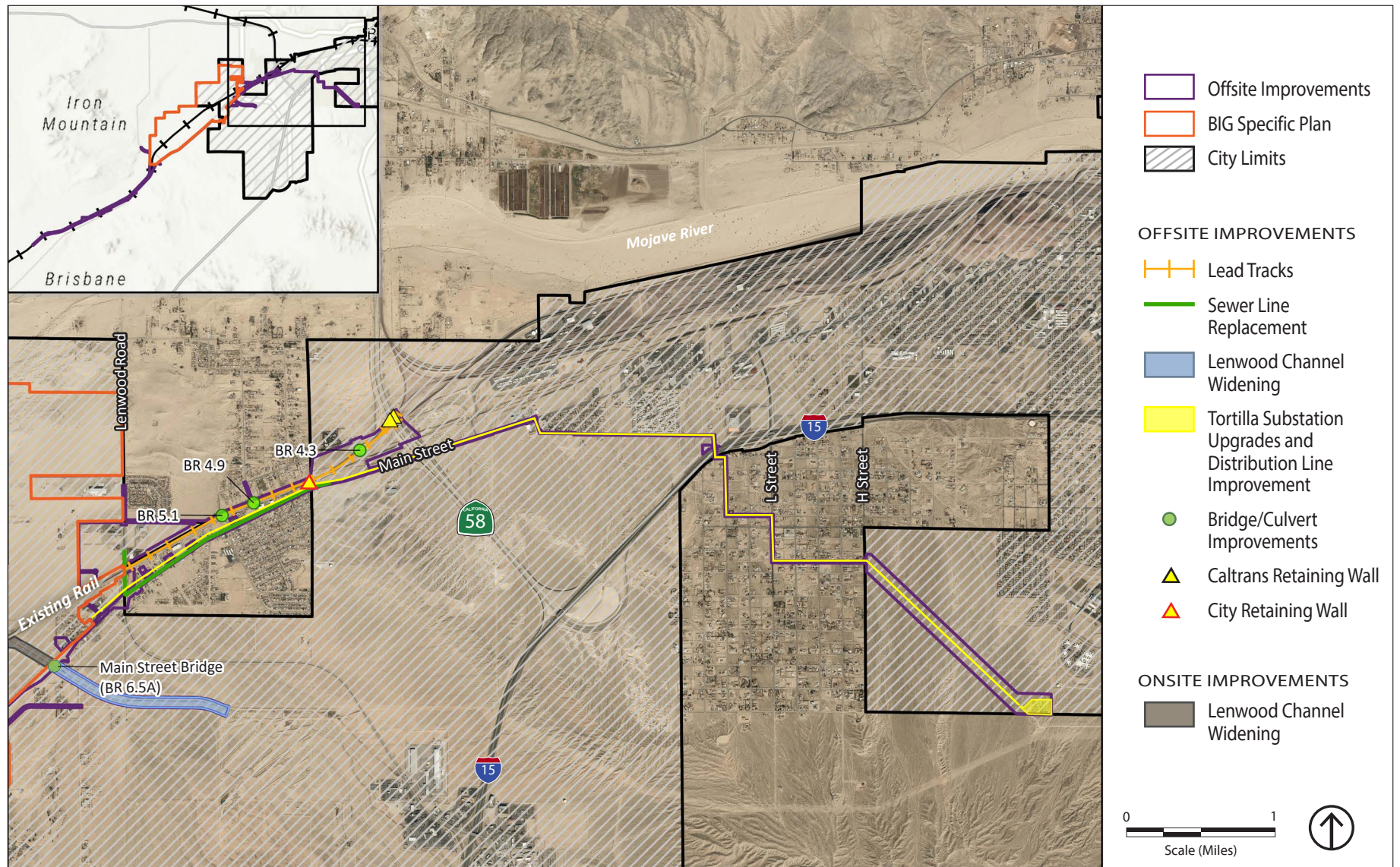
Note: Specific details set forth in the Specific Plan pertaining to the rail yard are considered definitive. The conceptual site plan for the transload warehouse center is for illustrative purposes only. The final site plan presented for entitlement approval may differ based on final design with building square footages not to exceed 9 MSF.

Figure 3
Barstow International Gateway Conceptual Site Plan



Sources:
TransSystems, 2025.

Figure 4
BIG Offsite Improvements, West



Sources:
TransSystems, 2025.

Figure 5
BIG Offsite Improvements, East

1.2 Project Components

Rail Yard

Overview

The rail yard would be generally bound by the existing mainline to the north, Main Street to the south, Lenwood Road to the east, and Hinkley Road to the west. The rail yard would consist of an intermodal facility (i.e., where cross-dock intermodal operations and other intermodal facility operations would occur and where support intermodal facility uses would be located), a block swap yard, and ancillary rail areas (i.e., container yard, chassis storage, and ancillary rail storage area), as described below.

BIG's proposed rail yard would operate 24 hours per day, 365 days per year. The rail yard would have approximately 860 employees during Opening Year (2028), 1,010 employees in Interim Year (2033), and 1,125 employees during Horizon Year (2048)⁵, which would accommodate both the block swap yard and intermodal facility operations. Employees would be split evenly between three shifts.

While the block swap yard would change the number of trains that would arrive or depart BIG by optimizing for end destinations, it would not increase the number of containers. BIG's intermodal facility would, through the cross-dock intermodal operation, add a new volume to the BNSF network, totaling approximately 3.2 trains per day on average in 2028, approximately 4.3 trains per day on average in 2033, and approximately 4.9 trains per day on average in 2048. These train counts include eastbound and westbound trains, and as described elsewhere, trains between the Ports and the BIG intermodal facility would be comprised of dedicated Tier 4 locomotives.

Intermodal Facility

BIG's intermodal facility is proposed at the southern extent of the BIG Specific Plan area and its operations would consist of two types: cross-dock intermodal and "other" operations. BIG's intermodal facility would operate differently than typical intermodal facilities in that most of the containers processed at BIG intermodal facility would not arrive or leave externally by heavy-duty trucks. Instead, almost all of the containers would arrive or leave by train and be processed via BIG's unique "cross-dock intermodal" operation. The intermodal facility's primary purpose would be to transfer containers between railcars and electric hostlers⁶ for cross-dock movements at the on-site proposed transload warehouse center, and vice versa, though a small portion would arrive by heavy-duty truck. The electric hostlers would be used to transport containers within the rail yard, and between the rail yard and transload warehouse center. The electric hostlers would be zero-emission and would not leave BIG. This differs from the operations at a traditional intermodal facility where the primary purpose is to transfer containers from heavy-duty trucks⁷ to railcars, and vice versa (defined as "other" operations). BIG also includes a dedicated fleet of Tier 4 linehaul locomotives⁸ to move containers between the Ports and the BIG intermodal facility.

⁵ A "Horizon Year" is the last year of analysis. BIG's Horizon Year is 20 years after opening.

⁶ Electric hostlers are trucks used for moving trailers and containers short distances within freight terminals, rail yards, and warehouses. Electric hostlers would not use public roadways outside of BIG footprint.

⁷ "Heavy-duty" trucks are conventional highway trucks that travel on public roads and carry containers intra- and inter-state.

⁸ "Tier" refers to emissions standards set by regulatory agencies for engine emissions, with Tier 0 referring to the oldest and having the highest emissions, while Tier 4 is the latest, more stringent standard with the fewest emissions.

BIG's intermodal facility would be composed of various components including railroad tracks, cargo handling equipment, an automated gate system, circulation roadways, yard equipment parking, container parking, stormwater detention ponds, electric vehicle charging stations, and buildings and ancillary rail facilities. Containers would be stored in parking spaces and low stacks at the intermodal facility, along with the ancillary rail area, and transload warehouse center (each described further below). Although electric lift equipment would be utilized to the extent commercially feasible within BIG's intermodal facility, a small 5,000-square-foot fuel canopy would be constructed in the electric hostler maintenance area to accommodate fueling of hybrid equipment. Hybrid and diesel equipment would include rubber-tired gantry cranes, seven air compressors, welders, railcar wheel change machines, and heavy-duty truck transport refrigeration units. The fuel canopy would be served by a 10,000-gallon unleaded fuel aboveground storage tank and a 20,000-gallon diesel fuel aboveground storage tank, with both controlled by an electronic fuel control system. In addition, starting in BIG opening year 2028, BNSF would increase the renewable diesel composition within their existing southern California fueling sites, including the existing fueling sites at the Ports and Barstow classification yard from 1 percent to 10 percent, a 900 percentage point increase in renewable diesel. This would improve the emissions of all BNSF trains fueling at the Ports, including those BNSF trains that would not stop at BIG.

BIG's intermodal facility proposes approximately 134,000 square feet of support buildings and structures, as detailed in **Table 2: BIG Intermodal Facility Structures**. As described below, final building sizes may vary slightly, this EIR conservatively analyzes up to 150,000 SF of support buildings and structures.

Table 2: BIG Intermodal Facility Structures	
Building/Canopy	Square Footage
Administration Building	23,000
Electric Hostler Employee and Maintenance Building	39,000
Drivers Assist Building	5,000
Crane Maintenance Employee and Storage Building	5,000
Crane Maintenance Canopies	22,500
Container Safe Haven Canopies	2,500
Quick Repair Canopy	10,000
AGS Kiosk Canopies	20,000
AGS Portals	2,000
Emergency Fuel Station Canopy for Hybrid Vehicles	5,000
<i>Total</i>	<i>134,000</i>
<i>Assumed Building Total for Final Design</i>	<i>150,000</i>
Note: The square footage described is an estimate and may vary up to 10% depending on the final engineering, therefore, the total square footage for planning purposes is estimated at approximately 150,000 sf.	

Block Swap Yard

The block swap yard is proposed within the middle portion of the BIG Specific Plan area, on approximately 410 acres of the rail yard's total approximately 1,950 acres. The proposed block swap yard would allow for the transfer of multiple railcars, or "blocks" of intermodal rail cars between trains via Tier 4 switcher locomotives. A block is defined as rail cars of a similar type moving to a similar destination that are already connected and can be combined with other blocks intended for similar destinations to produce more efficient train movements. The entire block of rail cars would remain coupled together and be moved en masse, permitting the synchronizing of blocks to their destinations, so that each train would be compiled

of rail car blocks traveling to similar destinations. Blocks could be assembled from inbound trains or trains processed at the intermodal facility carrying containers processed at the transload warehouse center. Certain train blocks may stage at the block swap yard until another train arrives with similar destination. The block swap yard would facilitate switching and transfer of lengthy rail car blocks between tracks for assembling departing trains. Thus, by synchronizing trains to their destinations, the block swap yard would improve train efficiency eastbound and westbound. The rail car blocks within the block swap yard would include containers from BIG's intermodal facility and containers processed at the transload warehouse center, combining as needed based on their destination.

The block swap yard's function is unique compared to a typical classification yard, such as the existing Barstow classification yard. Classification yards are where trains being processed are made up of non-intermodal railcars (i.e., individual boxcars, gondolas, open and closed hopper cars, automobile railcars, and tank cars), rather than intermodal railcars. BNSF designates these types of trains with a different train identification than those that would be processed at BIG. Further, BNSF uses different equipment to process these trains than would be used at BIG. While there is a small intermodal facility component adjacent to the existing Barstow classification yard, that intermodal facility is only used to process overflow from other BNSF intermodal facilities. By contrast, BIG's block swap yard would disassemble and assemble lengthy blocks of railcars with intermodal containers to similar destinations utilizing Tier 4 switcher locomotives. The existing Barstow classification yard also utilizes switcher locomotives as part of its operations, although they are currently Tier 0/0+/1+ switchers. Starting in BIG opening year 2028, BNSF will voluntarily retire all existing Tier 0/0+/1+ switcher locomotives at the unrelated existing Barstow classification yard, and in their place add six Tier 4 switcher locomotives.

Ancillary Rail Area

The ancillary rail storage area is an approximately 400-acre area north of the existing mainline and would be graded and covered with aggregate to be used for numerous purposes, including a container yard, truck chassis storage, and storage of maintenance equipment. A container yard would support the storage of empty containers awaiting loading while chassis storage would be used to provide parking for empty chassis awaiting use for loading, unloading, or draying of containers. The ancillary rail storage area would also be used for storage of spare parts and equipment for track maintenance, including rail, ties, turnouts, and other track material.

Mainline Improvements

BIG would retain the existing two rail mainlines ("north mainlines") within their current alignments, except at bridge crossings, which would be upgraded. BIG also proposes to construct two new mainlines ("south mainlines"), which would traverse the proposed rail yard in an east-west orientation, extending from Lenwood Road on the east to Hinkley Road on the west. During the construction phase, the south mainlines would be used to divert train traffic from the existing mainlines while they are upgraded. During BIG operations, half of the trains which would bypass BIG would use the north mainlines and half would use the south mainlines to balance train counts between the mainlines. BIG would also upgrade various bridge crossings including replacement of the crossing at Lenwood Channel to accommodate the

proposed Lenwood Channel widening; removal of existing culverts⁹ to accommodate proposed culverts for the overall rail yard; and replacement of two structures to meet BNSF standards regarding 50- and 100-year flood conditions.

Transload Warehouse Center

The transload warehouse center is proposed at the northern extent of the BIG Specific Plan area, on approximately 1,330 acres of BIG SP's total approximately 4,300 acres. The transload warehouses would be designed to process the contents of containers from cross-dock intermodal operations, with a small percentage dedicated to processing the contents of containers that have a portion destined for the Inland Empire (the remainder of the container's contents would be placed on trains destined eastward). A small percentage of containers processed at the transload warehouse center would arrive/leave by heavy-duty trucks, primarily from/to the Inland Empire. The transload warehouse center would process most of the containers within an on-site "closed loop" operation between BIG's intermodal facility and the transload warehouse center. The transload warehouse center would include approximately 9.0 million square feet of transload warehouses. The transload warehouse center would be fully built during construction, but operations would gradually increase as customers relocate to BIG. Transload warehouse center operations would include approximately 2,767 employees in Opening Year, approximately 3,660 employees in Interim Year, and 4,248 employees in Horizon Year.

The transload warehouse center would be composed of multiple buildings of various configurations and sizes, depending on tenant needs. As such, **Figure 4: Barstow International Gateway Conceptual Site Plan** provides a conceptual site plan for illustrative purposes showing potential transload warehouse buildings, locations, and sizes. Final transload warehouse buildings, locations, and sizes may differ from those proposed and would be processed with the City, as development occurs. Each transload warehouse would include container parking/storage areas, employee parking, stormwater/hydrology improvements, and landscaping. Finally, emergency generators are proposed throughout the transload warehouse center to provide electric power in the event of a power outage.

There would also be several areas distributed around the transload warehouse center, adding up to approximately 275 acres, for staging/overflow parking of containers accessing the transload warehouse center. These warehouse staging areas would be for truck containers only; truck "hoteling"¹⁰ would not occur, as electric hostlers would transfer containers to/from these areas, thus, heavy-duty truck trailers would not enter or exit these areas.

Hydrology/Stormwater Drainage Improvements

BIG would construct various infiltration basins and drainage outlets to the Mojave River that would be designed for 100-year flood events. Preliminarily, BIG proposes detention ponds of various sizes throughout BIG footprint totaling approximately 165 acre-feet of storage volume, which would accommodate the 100-year flood conditions.

⁹ Culverts are drainage features, typically a pipe or arch, used to convey water under a road or rail tracks.

¹⁰ Truck "hoteling" refers to when a heavy-duty truck parks for the driver to rest within the cab.

In addition to various ephemeral washes throughout BIG footprint, three other primary hydrologic features traverse BIG footprint, as detailed below.

Unnamed Stream (Milepost 10.9): This feature is a dry wash from Main Street to the Mojave River that includes a sharp western bend. This feature would be realigned to accommodate track mains, sidings, and support tracks and improved with a combination of bridges and box culverts spanning the channel (Bridge 10.9a and Bridge 11.2, respectively).

Hinkley Road Bridge at Mojave River (Milepost 10.5): The existing Hinkley Road Bridge, which the County owns and maintains, is at a narrowed section of the Mojave River and crosses via a concrete pier structure. Based on discussions with the County, the existing Hinkley Road Bridge over the Mojave River is experiencing structural issues and is at risk of being over-topped from seasonal flooding. Hydrology and hydraulic analyses have indicated the existing bridge is undersized. To maintain a roadway connection to Hinkley Road from the transload warehouse center, BIG proposes to replace the existing bridge with a longer structure to better match the channel width of the Mojave River at that location. The channel beneath, and immediately adjacent to, the existing bridge would be excavated and widened to match the natural channel width more closely. Portions of Hinkley Road immediately east and west of the bridge would be raised to reduce exposure to Mojave River flood events. These proposed improvements at Hinkley Road Bridge would reduce flooding compared to existing conditions. As part of the improvements, the existing at-grade crossing would be abandoned, and vehicles would instead utilize the proposed Hinkley Road extension through the transload warehouse center.

Lenwood Channel (Milepost 6.5): A portion of the BIG footprint along Lenwood Channel is currently within the FEMA 100-year flood zone due to existing flooding concerns. Lenwood Channel is a north-south earthen channel used to convey water from the southeast to the Mojave River and maintained by San Bernardino County Flood District. Lenwood Channel would be widened by approximately 60 to 100 feet throughout the Specific Plan area for a length of 1.1 miles, continuing offsite south of Main Street, for an additional 1 mile. The widened channel would improve flooding compared to existing conditions. Preliminary BIG design requires the Lenwood Channel to be spanned at three locations for additional track east leads, mains, and sidings, as well as three roadway crossings: Main Street, Hinkley Road, and the private road between the intermodal facility and transload warehouse center.

Utility Improvements

To accommodate the proposed rail yard and transload warehouse center, BIG would require both relocations of existing facilities and construction of new/expanded facilities (i.e., water, wastewater, electric power, natural gas, and telecommunications). The utility improvements proposed within BIG's footprint are discussed below.

Water

BIG's construction phase water demand includes non-potable water for construction activities and potable water for on-site construction workers. To provide non-potable water during the construction phase, up to eight new private on-site temporary groundwater wells would be constructed within BIG's transload warehouse center portion.

Temporary aboveground connections from Golden State Water Company existing mains within Main Street to BIG would be constructed to supply potable water to the construction sites. Additionally,

Mojave Water Agency owns and operates a 48-inch recharge water line that crosses the BIG Specific Plan area. BIG proposes to relocate this existing line to the north to avoid conflict with rail yard and transload warehouse center improvements.

Operational potable water and fire flow water would be provided by directly connecting to facilities owned and operated by the Golden State Water Company. Fire flow would be supplemented by on-site water tanks and fire pumps if necessary to meet the fire flow requirements. Power to water tanks and fire pumps would be supported by the transload warehouse diesel backup generators in the case of an emergency. Water tanks would be placed entirely within the BIG footprint. The transload warehouse center would connect to an existing water main in Jasper Road on the east end of the BIG Specific Plan area. The rail yard would connect to an existing water main on the east end of the BIG Specific Plan area near Lenwood Road on the south side of Main Street. A new public 12- to 16-inch looped water main would be constructed from the existing connection in Main Street, extending west to the edge of rail yard, north to Hinkley Rd, and then continue east in Hinkley Road to the existing connection point near Lenwood Road. A second connection from the looped water main would be provided at the northeast corner of the Specific Plan at Lenwood Road. The new on-site public water mains total approximately 10 miles in length.

Wastewater

BIG's construction-related wastewater generation would be from construction workers. Temporary portable facilities (i.e., portable restrooms and portable handwash stations) would be utilized during the construction phase.

BIG's operational wastewater generation would be from transload warehouse center and rail yard employees, and the rail yard wash bays and track pans. Wastewater generated by BIG would discharge to the City's existing wastewater system at three connections points. The transload warehouse center would discharge to the proposed new sewer main in Hinkley Road. A new 8-inch wastewater line is proposed within the Hinkley Road extension from the west end of the transload warehouse center to the northeast end of the transload warehouse center and would connect to the existing sewer main in Lenwood Road. Within the transload warehouse center, west of the Lenwood Channel, 8-inch lines would extend north in C Street to serve the transload warehouses connecting to Lenwood Road via B Street. The rail yard would include new wastewater lines and force mains at the southern portion of the rail yard, conveying wastewater to the east and connecting to the existing sanitary sewer main in Main Street near Country Club Drive. BIG's wastewater would be conveyed by gravity flow to and treated at the Barstow Regional Wastewater Treatment Facility, which is owned and operated by the City. Wastewater conveyance and treatment would be coordinated with the City.

Electrical Power

BIG construction activities would generate temporary electric power demand from construction equipment, tools, lighting, and other necessary facilities (e.g., temporary offices). The electric power for construction activities would be supplied through connections to existing Southern California Edison (SCE) facilities.

BIG operations would generate permanent electric power demand from the transload warehouse center (lighting, electric vehicle charging for material handling, and forklifts) and rail yard (lighting, buildings,

cranes, and electric hostlers (used to move containers between the rail yard and the transload warehouse center). BIG operational electric power demand would be met through connecting to the SCE Tortilla Substation and supplemented with on-site electrical generation (i.e., an approximately 140-acre, approximately 21 megawatts solar power generation facility (i.e., solar farm), which is described further below. BIG proposes to construct the following on-site electric power facilities to serve BIG:

Three substations: two substations at the eastern and western extents of the rail yard; and one substation within the solar farm.

- Additional 33 kilovolt (kV) distribution lines connecting via underground duct banks in a loop around the west end of the intermodal facility and north end of the transload warehouse center. These proposed 33KV distribution lines would total 23 miles of ductbank within the BIG Specific Plan area.
- An approximately 140-acre solar farm is proposed south of BIG rail yard, at the southwest corner of the Main Street at Country Club Drive intersection. The solar farm is estimated to generate approximately 21 megawatts to serve BIG. The solar farm would include a battery electric storage system and a new substation at the northwest corner to route power from the solar farm to BIG rail yard. The solar farm would be fenced to prevent trespass and would include internal roadways for maintenance vehicles. The solar farm would require minimal grading to level the site as existing topography is utilized wherever possible and excavation limited primarily to stormwater detention to capture runoff. Additionally, BIG would comply with CalGreen regulations requiring that rooftop solar generation be installed on the industrial warehouse rooftops (Title 24, Section 140.10). Based on 9.0 MSF of transload warehouse, BIG would include approximately 6.4 megawatts of rooftop solar generation for Title 24 compliance.
- Emergency diesel generators are proposed at various locations across the rail yard and transload warehouse center to provide backup power in the event of Tortilla Substation service interruptions. Rail yard generators would only be used if a power outage were to occur at nighttime, as the proposed solar farm would provide sufficient power during daytime in the event of a power outage. The rail yard would include up to 10 generators at the far western extent, while the transload warehouse center would include up to 29 generators dispersed throughout. Generators would require up to 50 hours of testing and maintenance operations per year.

Solar farm maintenance would consist of cleaning, inspecting, and replacing solar panels, equipment, and other system components. Maintenance trips associated with these activities would be limited to trucks transporting materials, equipment, and supplies to and from the farm. To maintain uninterrupted power generation for BIG, maintenance activities would occur incrementally. The solar farm would also require vegetative maintenance (e.g., mowing and weeding, and other grass control measures). No grading would occur during solar farm maintenance.

Natural Gas

BIG construction activities would not require construction of new natural gas facilities, although protection in place or relocation of existing natural gas facilities would be required to accommodate BIG.

Stormwater

To collect stormwater runoff, BIG proposes stormwater basins that would detain any stormwater in excess of predevelopment flows then discharge to existing drainageways through stormwater best management practices. BIG would include various outlets to the Mojave River. Exact sizing and locations of transload warehouse center basins would be dependent on final transload warehouse location, layout, and sizing. In addition, Lenwood Channel would be modified as discussed above.

Solid Waste

BIG would result in solid waste generation from construction (demolition debris, broken or excess materials, packaging, and other construction waste), as well as during operations from the rail yard and transload warehouse center. BIG's solid waste would be collected within on-site trash bins and be disposed of at the Barstow Sanitary Landfill, with 65 percent being recycled (for instance, demolished concrete foundations can be crushed and re-used onsite as aggregate).

Telecommunications

Telecommunication lines cross BIG footprint along Lenwood Road and along the southern edge of the existing tracks. Underground utilities may also be present. All underground communication facilities are assumed to have shallow depths except those crossing under existing features such as underpasses and creeks. Lines within BIG footprint may be relocated adjacent to/within existing and proposed rights of way or abandoned. In addition, BNSF Telecommunications would install approximately 12 communication towers with heights generally between 100 - 120 feet, though two communication towers would be 160 feet tall. Additionally, various existing telecommunications lines owned by Frontier Communications and Lumen would be removed from within BIG footprint, and, in their place, new communications line would be run beginning at the Jasper Road at Lenwood Road intersection, running to the western extent of the BIG Specific Plan area, and then running eastward back to Lenwood Road in a "loop."

On-Site Circulation Improvements

BIG would include various on-site circulation improvements as discussed below.

Hinkley Road Realignment: BIG would vacate Hinkley Road between the south side of the Mojave River bridge crossing and Main Street, closing the existing at-grade rail crossing. Hinkley Road would be realigned beginning at the north side of the Mojave River bridge crossing to connect through the transload warehouse center to the Jasper Road/Lenwood Road intersection. Transload warehouse center employees and heavy-duty trucks destined for the transload warehouse center would enter from the Lenwood Road/Hinkley Road/Jasper Road intersection.

Internal private roadways: In addition to the realigned public Hinkley Road (discussed above), BIG would include four dedicated internal private roadways for electric hostlers (private streets A, B, D, and E), and two internal private roadways for employee, visitor, and truck access (private streets C and F).

Country Club Drive: Country Club Drive would be widened along the solar farm frontage for approximately 400 feet to the proposed realignment of Sweeten Lane. A new stop-controlled intersection is proposed at the Country Club Drive at Sweeten Lane intersection.

Main Street: Rail yard employees and heavy-duty trucks destined for the intermodal facility would enter BIG's rail yard from a new driveway on Main Street across from Country Club Road. Main Street would be

widened from two lanes to four lanes for approximately 0.5 miles east of Country Club, resulting in a consistent four-lane roadway width through Barstow. Additionally, the existing two-lane Main Street over Lenwood Channel low water crossing would be replaced with a new four-lane bridge that accommodates the 100-year flood condition, substantially reducing the existing flood conditions. Main Street would be raised over Lenwood channel, modifying the vertical alignment of Main Street for approximately 0.8 mile. The intent of this design is to keep flood waters contained in Lenwood Channel and convey the flow to the Mojave River under the bridge at MP 6.5, avoiding the overflow of the bank that can occur under existing conditions.

To accommodate BIG, various on-site public rights-of-way within the City and unincorporated San Bernardino County would also need to be vacated.

Off-Site Improvements

In addition to the on-site improvements described above, BIG also proposes off-site rail and non-rail improvements, as discussed below:

Off-Site Rail Improvements

BIG proposes lead track extensions to the east of approximately two miles and lead track extensions to the west of approximately seven miles (“east lead track” and “west lead track”). These off-site rail improvements would be primarily within existing BNSF right-of-way. These improvements would enable trains to safely enter and exit the mainline at mainline speeds, rather than slower “yard” speeds and risk fouling the track.¹¹ BIG east and west lead tracks would require modifications to existing culverts within the footprint; see also *Stormwater Drainage* discussion below.

Off-Site Non-Rail Improvements

BIG proposes ancillary and related stormwater drainage, utility (i.e., water, sewer, electric power, natural gas, and telecommunications), and circulation/roadway improvements and modifications, described below.

Water. North of transload warehouse center, an existing Mojave Water Agency 48-inch recharge line would be relocated. The relocated line would stretch along the north side of the transload warehouse center to the west end of the BIG Specific Plan area, then continue along the north side of the mainline and lead tracks for a total of 8.3 miles.

Wastewater. An existing approximately 27-inch sanitary sewer line is within existing BNSF ROW for approximately 1.6 miles between Lenwood Road and Pettit Road. This line includes multiple north/south lateral connections to serve the land uses between Main Street and the existing BNSF tracks. BIG would relocate this line at Phillips Street south to within Main Street. Additionally, the transload warehouse center will connect to City sewer via a new 27-inch sewer line within Jasper Road extending to north of Paris Avenue.

¹¹ “Fouling the track” means the placement of an individual or an item of equipment in such proximity to a track that the individual or equipment could be struck by a moving train or on-track equipment, or in any case is within four feet of the field side of the near running rail (49 CFR Part 214). When a rail network becomes congested, trains can foul the track by moving slower than a train behind them.

Electric Power. Electrical demand would be handled through connecting to the Southern California Edison Tortilla Substation, located approximately 0.4 mile south of the Veterans Parkway at Diamond Avenue intersection. Three underground duct banks with electrical conductors would connect BIG to the Tortilla Substation utilizing existing franchise agreements with the City and County on a route following Main Street, Sunrise Road, N Street, and Bonanza Road before utilizing existing easements between Bonanza Road and the substation. This proposed 33KV distribution route would extend approximately 7.1 miles underground from the Tortilla Substation to the intermodal facility's eastern extent at Country Club drive, then continue overhead approximately 3.5 miles from Country Club Drive to approximately Hinkley Road. For the 33kv line segment from Tortilla Substation to BIG, the 33kv circuits would be in underground utility lines resulting in an approximately 30-foot-wide disturbance to account for construction access and temporary spoils. From Tortilla substation to H Street (approximately 1.2 miles), the 33kv conduit could occur within a 450-foot-wide corridor, inclusive of the existing 150-foot wide SCE easement along Bonanza Road. However, the exact alignment is presently unknown and is being coordinated with SCE. Therefore, this EIR analyzes an approximately 30-foot wide disturbance within the 450-foot wide corridor ("33kv distribution corridor"). This EIR analyzes the "worst-case" environmental impacts within the 33kv distribution corridor. SCE would make modifications, which include constructing new feeders and new power distribution lines. Within the Tortilla Substation's existing fence line, SCE would also make modifications to supply the new feeders from their existing 115kV-33kV transformers. Various off-site existing electric power lines could be relocated, modified, or extended to accommodate BIG improvements.

Natural Gas. Various off-site existing natural gas lines could be relocated to accommodate BIG improvements.

Telecommunications. No off-site telecommunications improvements are proposed. Various minor existing telecommunications lines would be relocated toward the eastern end of the lead track improvements. Existing telecommunications lines passing through the intermodal facility and block swap yard would be relocated to the north side of the Main Street ROW.

Stormwater Drainage. As described above, the Lenwood Channel widening would continue offsite, south of Main Street. It would be widened by approximately 60 to 100 feet for a total of approximately 2.1 miles (of which 1 mile would be offsite) to improve flooding compared to existing conditions. At the Main Street crossing at Lenwood Channel, BIG would replace 0.8-mile of the existing Main Street low water crossing of Lenwood Channel with a bridge and raise and widen the road through this stretch west to the new intermodal facility entrance. These improvements accommodate the City/County master plan and improve flooding compared to existing conditions.

Other. To accommodate wildlife crossings from south of Main Street to the Mojave River without potential conflict with vehicular or train traffic, BIG proposes an underground wildlife crossing under Main Street west of the existing Hinkley Road.

Circulation/Roadway. Jiggs Road would be realigned generally from just east of Indian Trail to Hinkley Road to maintain emergency access from Indian Trails to Hinkley Road. In addition, a maintenance road would be constructed alongside the mainline to provide maintenance access to the tracks, generally from just east of Indian Trail to Hinkley Road. Various circulation and roadway improvements and modifications are proposed outside the BIG Specific Plan area. All circulation improvements would be

permanent, except a temporary Main Street bypass. The temporary bypass would be constructed to maintain access along Main Street during Lenwood Channel Bridge reconstruction. To maintain access for adjacent residents, the temporary Main Street bypass would include private driveways for adjacent residential uses and would be open for the approximately 18-month bridge reconstruction period. Once the Lenwood Channel Bridge reconstruction is complete, the bypass would be removed and the site restored to its original condition. Additionally, construction of additional lead tracks over Pettit Road (approximately 1,100 feet west of SR-58) would require the road to be lowered by approximately 2.0 feet. BIG would also vacate various ROW within the City and County. Finally, Sweeten Lane would be vacated and realigned to eliminate the existing unimproved intersection with Main Street. A new paved access would extend from Country Club east approximately 1,000 feet and connect to the unimproved Sweeten Lane.

Maintenance Activities

While “light maintenance activities”¹² could occur at BIG, major maintenance activities¹³ would still occur at the existing Barstow classification yard, thus, requiring short-distance trips via BNSF’s existing mainline to and from the existing Barstow classification yard for heavy maintenance. Locomotive trips associated with maintenance activities would be based on the number of linehaul locomotives needed to move trains between the Ports and BIG intermodal facility, and the number of switcher locomotives needed to haul rail cars within BIG intermodal facility and block swap yard. All switcher locomotives at BIG would be Tier 4 locomotives, and BNSF would also retire all existing Tier 0/0+/1+ locomotives at the unrelated existing Barstow yard and, in their stead, add six Tier 4 switcher locomotives.

1.3 Project Construction Activities and Phasing

For analysis purposes, construction is anticipated to occur over approximately 34 months beginning in the third quarter of 2025 and ending in the third quarter of 2028. The entirety of BIG’s construction activities, including off-site improvements, are analyzed in this report and described below. The anticipated construction phase timing is shown in **Table 3: BIG Construction Schedule**. However, the current construction schedule anticipates that BIG construction would begin approximately August 2026, and end approximately July 2029, for an approximate 13-month shift from the schedule shown in **Table 3: BIG Construction Schedule** and analyzed in this technical report. However, construction duration (34 months) would remain unchanged. Further, given fleet turnover and compliance with increased regulatory requirements, construction and operational air quality emissions would improve over time as is reflected in CalEEMod, the California Air Resource Board’s air quality emissions modeling platform.

During peak construction periods, work would be under way at several locations within BIG footprint simultaneously, with overlapping construction of various elements. Construction working hours and the number of workers present at any time would vary depending on the activities being performed. BIG construction would require approximately 8,177 construction workers per year.¹⁴

¹² “Light maintenance activities” means routine locomotive servicing (e.g., window washing, fueling, inspecting fluid levels and topping off fluids, stocking cabins with crew equipment such as water and trash bags, toilet servicing) and minor railcar servicing (e.g., wheel changes, brake and friction shoes, and loose or missing bolts)

¹³ “Major maintenance activities” means repair of railing and platform, railcar suspension, hitches, engine, etc.

¹⁴ Based on 23,200 construction worker “job years”

Table 3: BIG Construction Schedule		
Phase	Start Date	End Date
South Mainlines	8/7/2025	10/2/2026
Intermodal Facility	8/7/2025	1/4/2027
Block Swap Yard	1/22/2026	6/8/2028
North Mainlines	5/27/2027	6/8/2028
Transload Warehouse	2/5/2026	12/6/2027
33 kV Distribution Undergrounding	9/13/2025	5/7/2027
Solar Site	3/20/2026	2/27/2027

Nighttime construction could occur throughout the BIG footprint except where within 300 feet of sensitive receptors (along the 33kv distribution line). To avoid potential noise and vibration impacts from pile driving, BIG proposes to establish a buffer of 1,800 feet for nighttime pile driving and 500 feet for daytime pile driving from sensitive receptors. Additionally, nighttime construction would be necessary for track work adjacent to the existing mainline where lead tracks would tie into the mainline. All construction activities would occur within BIG footprint.

BIG components would involve the following construction activities:

Demolition and Grading

The BIG footprint is primarily vacant, undeveloped land traversed by an existing BNSF railroad and containing scattered residential, commercial, and industrial land uses. Existing land uses within BIG's footprint are listed in **Table 1: Existing Land Uses**. All existing land uses not demolished during acquisition to avoid trespassing and safety concerns would be demolished prior to, or during, mass grading. In addition, existing utilities (underground and aboveground) within BIG footprint would be removed or temporarily relocated as needed.

Six culverts/bridges would need to be demolished within the existing BIG footprint. Demolition would involve excavators to break apart bridge abutments and foundations.

Mass grading would occur in one phase across the BIG footprint and require approximately 26 million cubic yards of cut and fill. Mass grading would be typified by large construction equipment establishing the area's general grading contours. For locations supporting future buildings, roadways, or track, mass grading would include watering and compaction of soil to provide a stable subgrade. Earthwork onsite would be balanced, with excess cut from the rail yard being used as fill within the transload warehouse center.

Fine grading would include site-specific grading for the transload warehouse center, as well as finish grading around buildings, parking areas, curb and gutter, etc.

Construction of Rail Yard (Intermodal Facility and Block Swap Yard)

The likely sequence for BIG rail yard construction (intermodal facility and block swap yard) would include mass grading; compacting the rail bed and internal roadways/parking areas; installing underground improvements/utilities; fine grading; installing crushed rock subballast; laying track and ballast; and installing train signals and communications systems. To reduce construction trucking, BIG would bring rail ties, welded rail, and rail ballast in via train.

Rail yard construction elements would include surface and elevated track work where the track would cross a water feature, a grade-separated roadway crossing for electric hostlers to access (and return from) the transload warehouse center, and installation of an intermodal facility. Major construction activities would include grading and excavation support, underground utility installation, systems construction, bridge construction, and railway systems construction (including trackwork, signaling, and communications). High-mast lights (up to 120 feet in height) would be constructed throughout the rail yard, including foundation work, conduits, and security camera positions. Rail yard construction would also include foundations and tracks for gantry cranes.

Furthermore, the proposed rail yard area would be excavated to result in a nearly-level grade between the east and west ends. With the proposed grading, most of the rail yard would be approximately 30-45 feet below Main Street. Various key BIG elements are also shown below.

Rail materials such as rail ties, welded rails, and ballast would be delivered by train. As noted above, the two existing north mainlines would be protected in place except at the bridge crossings, and two new south mainlines constructed. The south mainlines would be constructed first, and, during the first year of construction, existing rail traffic would use the new south mainlines so that the existing mainlines can be rebuilt and their bridge crossings upgraded. Mainline, rail yard, and lead track construction would utilize a Track-Laying Machine for approximately 20 months to lay track.

Intermodal facility construction would include various administrative and support buildings and substantial paving for the container parking and storage.

Solar Farm Construction

Solar farm construction, which would occur in a single phase, would require minimal grading to level the site as existing topography is utilized wherever possible and excavation limited primarily to stormwater detention to capture runoff. Fencing would be installed around the solar farm's perimeter of the solar farm, internal drive-aisles would be graded and paved, and the proposed substation would be constructed per SCE standards.

Construction of Transload Warehouse Center

Construction elements for the transload warehouse center would include grading, over-excavation,¹⁵ footing and foundation excavation and pouring, tilt-up panel concrete construction, parking lot grading and paving, utility installation and undergrounding, and hydrology/drainage improvements.

Construction of On-Site Bridges and Roadway Improvements

Railroad bridge and roadway construction may use various methods including segmented pre-cast, cast-in-place, box girder or pre-cast, and span-by-span techniques.

Pre-construction activities would occur during final design and would include geotechnical investigations, identification of staging areas, initiation of site preparation and demolition, relocation of utilities, and implementation of temporary, long-term, and permanent road closures. Two bridges would be

¹⁵ "Over-excavation" refers to removal and re-compaction of soil.

constructed over Lenwood Channel (BR 6.5D, 6.5E, and BR 6.5F) to enable traffic to flow from either side of Lenwood Channel.

Construction of Off-Site Rail Improvements

Off-site rail improvements would include clearing and grubbing, bridge crossing construction, ballast placement, track laying, and connection to the mainline. Off-site rail improvements would parallel the existing mainline and primarily be within existing BNSF right-of-way. BIG's rail deliveries of rail ties and ballast would include materials for construction of off-site rail improvement.

Construction of Off-Site Non-Rail Improvements

Off-site non-rail improvements would include construction of drainage, utility, and roadway improvements.

Drainage. Lenwood Channel improvements would consist of scouring and widening the channel. Construction equipment would be within Lenwood Channel in order to accomplish the widening.

Utilities. Additionally, off-site construction would include utility improvements including the 33kv distribution/Tortilla Substation improvements. Construction processes are anticipated to include clearing and grubbing, saw cuts and demolition of existing pavement, excavation to approximately 10 feet below ground surface (bgs) installation of temporary shoring, placement of circuits and distribution lines, fill placement and removal of temporary shoring, and roadway repair.

Roadways/Intersections. A bridge over Lenwood Channel for Main Street would be constructed to replace the existing low water crossing and accommodate widening of Main Street in that immediate area. Additionally, BIG proposes roadway/intersection improvements/modifications, including the installation of traffic signals at various intersections.

Typical construction processes for these off-site non-rail improvements would include clearing and grubbing, over-excavation, bridge construction, traffic signals with associated underground conduits and cabling, and restriping and asphalt or concrete pavement placement, where needed.

2.0 REGULATORY SETTING

Key federal, state, and local jurisdictional laws and regulations that pertain to geology, soils, and seismicity that are most relevant to BIG are summarized below.

2.1 Federal

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act of 1977 (Public Law 95-124) established the National Earthquake Hazards Reduction Program which is coordinated and lead by the National Institute of Standards and Technology. Other agencies with a role in implementing the National Earthquake Hazards Reduction Program include the Federal Emergency Management Agency, the U.S. Geological Survey (USGS), and the National Science Foundation. Congress reauthorized the program in 2018 (Public Law 115-307). The purpose of the National Earthquake Hazards Reduction Program aims to understand earthquake hazards and reduce earthquake risks in the United States (Congressional Research Service, 2021, p. 2).

Since Reauthorization, the National Earthquake Hazards Reduction Program has focused on earthquake early warning systems, improved building codes and building standards, functional recovery methods for structures, pathways to community resilience, and continued basis research to understand earthquake hazards and risks.

Occupational Safety and Health Administration Regulations

The Occupational Safety and Health Administration's (OSHA) Excavation and Trenching standard, Title 29 of the Code of Federal Regulations, part 1926, Subpart P, contains requirements for the excavation and trenching operations. The standards apply to all open excavations made in the Earth's surface. Following the OSHA requirements of the standards will prevent or greatly reduce the risk of cave-ins and other excavation-related incidents (OSHA, 2015, p. 1).

Soil and Water Resources Conservation Act

This Act gives the U.S. Department of Agriculture assessment and planning authority to conserve, protect, restore, and enhance soil, water, and related natural resources. Protection and restoration activities include prevention of harmful soil changes, rehabilitation of contaminated soil and water, and precautions against negative soil impacts. Disruptions of natural soil functions, including the function as an archive of natural and cultural history, should be avoided as far as practicable. In addition, the federal Water Pollution Control Act (also referred to as the Clean Water Act) requirements, through the National Pollution Discharge Elimination System permitting process, provide guidance for protection of geologic and soil resources.

2.2 State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code (PRC) 2621-2624, Division 2 Chapter 7.5) was passed in 1972 to mitigate the hazard of surface faulting to structures intended for human occupancy. The Alquist-Priolo Act's main purpose is to prohibit siting buildings used for human occupancy across traces of active faults that constitute a potential hazard to structures from surface

faulting or fault creep. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones, known as “Earthquake Fault Zones,” delineating appropriately wide earthquake fault zones to encompass potentially active and recently active traces of faults. Local agencies must regulate most development projects within these zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed human occupancy structures would not be constructed across active faults. A licensed geologist must prepare an evaluation and written report of a specific site. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (typically at least 50-foot setbacks are required).

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (PRC, Chapter 7.8, § 2690-2699.6) directs the Department of Conservation, California Geological Survey (CGS) to identify and map areas prone to liquefaction, earthquake-induced landslides, and amplified ground shaking. The purpose of the act is to minimize the loss of life and property through the identification, evaluation, and mitigation of seismic hazards.

The Seismic Hazards Mapping Act provides a statewide seismic hazard mapping and technical advisory program to assist Cities, counties, and state agencies are directed to use the seismic hazard zone maps in their land-use planning and permitting processes. This act requires that site-specific hazards investigations be conducted by licensed professionals within the zones of required investigation to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most developments designed for human occupancy. Evaluation and mitigation of seismic hazards are to be conducted under guidelines established by the California State Mining and Geology Board (CGS, 2008).

The CGS plans to map California’s principal urban and major growth areas (CGS, 2023). CGS has not evaluated the land within the BIG footprint for seismic hazard zones and therefore the regulations under the Seismic Hazards Mapping Act do not apply to BIG.

California Seismic Hazards Program

The Seismic Hazards Program delineates areas prone to ground failure and other earthquake-related hazards including surface fault rupture, liquefaction, earthquake-induced landslides, and tsunami inundation. Cities and counties are required to use these maps in their land-use planning and building permit processes to identify and mitigate these hazards for development projects prior to the next major earthquake.

Seismic Hazards and Zones of Required Investigation. The Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act direct the State Geologist to delineate regulatory "Zones of Required Investigation" to reduce the threat to public health and safety and to minimize the loss of life and property posed by earthquake-related ground failures and other hazards. Cities and counties affected by these zones are required to regulate certain development projects within them. These Acts also require sellers of real property (and their agents) within a mapped hazard zone to disclose at the time of sale that the property lies within such a zone.

The zones of required investigation listed below for potential earthquake faulting, liquefaction, landslides, and tsunamis are delineated and distributed to cities, counties, and State construction agencies to help identify where higher building standards may be necessary for safe development. Statutes require that cities and counties use all four of these zones as part of their construction permitting process.

- Alquist-Priolo Earthquake Fault Zones: These zones are intended to prevent buildings for human occupancy from being constructed upon active faults.
- Seismic Hazard Zones
 - Liquefaction Zones: These zones identify where the stability of foundation soils must be investigated, and countermeasures undertaken in the design and construction of buildings for human occupancy.
 - Earthquake-Induced Landslide Zones: These zones identify where the stability of hillslopes must be evaluated, and countermeasures undertaken in the design and construction of buildings for human occupancy.
 - Tsunami Regulatory Zones: These zones identify where impacts from tsunami inundation and related hazards must be evaluated and countermeasures (e.g., evacuation and engineering design) be developed to protect the human occupants.

California Public Resources Code

The PRC protects paleontological resources in specific contexts. In particular, PRC § 5097.5 prohibits knowing and willful excavation, removal, destruction, injury, and defacement of any vertebrate paleontological feature on public lands without express authorization from the agency with jurisdiction. Violation of this prohibition is a misdemeanor and is subject to fine or imprisonment (PRC § 5097.5(c)), and persons convicted of such a violation may also be required to provide restitution (PRC § 5097.5(d)(1)). Additionally, PRC § 30244 requires “reasonable mitigation measures” to address impacts on paleontological resources identified by the State Historic Preservation Officer.

California Geological Survey

The CGS (PRC Division 2 Chapter 2) provides geologic information about California’s diverse nonfuel mineral resources and their related hazards through maps, reports, and other data. The CGS assists governmental agencies, mining companies, consultants, and the public in recognizing, developing, and protecting important mineral resources. CGS produces Mineral Land Classification studies that identify areas with potentially important mineral resources that should be considered in local and regional planning.

The California Geological Survey Special Publication 42

The CGS Special Publication 42 provides guidelines for affected permitting agencies and their reviewers, as well as for geoscience consulting practitioners representing property owners and developers (CGS, 2018). The purpose of these guidelines under the Alquist-Priolo Earthquake Fault Zoning Act is to regulate development near active faults so as to mitigate the hazard of surface fault rupture. Special Publication 42 and associated maps and published reports that delineate Earthquake Fault Zones were reviewed for the impact analysis below.

California Geologic Energy Management Division

The California Geologic Energy Management (CalGEM) (PRC §§ 3000 through 3473) Division within the California Department of Conservation oversees the drilling, operation, maintenance, plugging or abandonment of oil, natural gas, and geothermal wells. The California Geologic Energy Management Division’s regulatory program emphasizes the wise development of oil, natural gas, and geothermal

resources in the state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety.

State Mining & Geology Board

The SMGB provides professional expertise and serves as a regulatory, policy, and hearing body representing the state's interest in the development, utilization, and conservation of mineral resources, the reclamation of mined lands, and the development and dissemination of geologic and seismic hazard information.

California Building Standards Code

The CBC (PRC Title 24) governs the design and construction of buildings, associated facilities, and equipment and applies to buildings in California. The main purpose of building codes is to protect public health, safety, and general welfare as they relate to the construction and occupancy of buildings and structures. These codes provide minimum standards to protect property and public safety by regulating the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions.

Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the CBC within 180 days of its publication. The publication date of the CBC is established by the CBSC, and the code is also known as Title 24, Part 2 of the California Code of Regulations. The most recent building standard adopted by the legislature and used throughout the state is the 2022 version of the CBC, often with local, more restrictive amendments that are based on local geographic, topographic, or climatic conditions. The 2022 CBC, effective January 1, 2023, is based on the 2021 International Building Code (IBC).

Given the regional susceptibility to seismic events, CBC's seismic standards are heavily regarded by local agencies. CBC Chapter 16 addresses structural design requirements governing seismically resistant construction (CBC § 1604), including (but not limited to) factors and coefficients used to establish seismic site class and seismic occupancy category for the soil/rock at the building location and the proposed building design (CBC §§ 1613.5 through 1613.7).

CBC Chapter 18 includes (but is not limited to) the requirements for foundation and soil investigations (CBC § 1802 and § 1803); excavation, grading, and fill (CBC § 1804); allowable load-bearing values of soils (CBC § 1806); and the design of footings, foundations, and slope clearances (CBC §§ 1808 and 1809), retaining walls (CBC § 1807), and pier, pile, driven, and cast in-place foundation support systems (CBC § 1810).

CBC Chapter 33 includes, but is not limited to, requirements for safeguards at worksites to ensure stable excavations and cut or fill slopes (CBC § 3304). BIG construction and operations are subject to occupational safety standards as specified in California OSHA regulations (Title 8 of California Code of Regulations) and Chapter 33 of the CBC.

Oil and Gas Conservation

The CalGEM (PRC §§ 3000-3473) within the Department of Conservation oversees the drilling, operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells. CalGEM's regulatory program emphasizes the wise development of oil, natural gas, and geothermal resources in the

state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety.

2.3 Local

County of San Bernardino Countywide Plan (CWP)

The County adopted the CWP in October 2020. The CWP Policy Plan addresses the physical, social, and economic issues facing the County's unincorporated portions. **Table 4: Countywide Plan Policy Plan Relevant Goals and Policies** includes the geology, soils, and mineral resource-related goals and policies relevant to BIG:

Table 4: Countywide Plan Policy Plan Relevant Goals and Policies	
Number	Goal or Policy
HAZARDS ELEMENT	
Goal HZ-1	Natural Environmental Hazards. Minimized risk of injury, loss of life, property damage, and economic and social disruption caused by natural environmental hazards and adaptation to potential changes in climate.
Policy HZ-1.1	New subdivisions in environmental hazard areas. We require all lots and parcels created through new subdivisions to have sufficient buildable area outside of the following environmental hazard areas: ▪ Flood: 100-year flood zone, dam/basin inundation area ▪ Geologic: Alquist -Priolo earthquake fault zone; County-identified fault zone; rockfall/debris-flow hazard area, existing and County-identified landslide area
Policy HZ-1.2	New development in environmental hazard areas. We require all new development to be located outside of the environmental hazard areas listed below. For any lot or parcel that does not have sufficient buildable area outside of such hazard areas, we require adequate mitigation, including designs that allow occupants to shelter in place and to have sufficient time to evacuate during times of extreme weather and natural disasters. ▪ Flood: 100-year flood zone, dam/basin inundation area ▪ Geologic: Alquist -Priolo earthquake fault zone; County-identified fault zone; rockfall/debris-flow hazard area, medium or high liquefaction area (low to high and localized), existing and County-identified landslide area, moderate to high landslide susceptibility area) ▪ Fire: high or very high fire hazard severity zone
Policy HZ-1.7	Underground utilities. We require that underground utilities be designed to withstand seismic forces, accommodate ground settlement, and hardened to fire risk.
Policy HZ-1.8	Wind erosion hazards. We require new development in medium-high or high wind erosion hazard areas to minimize the effects of wind-blown soil through building and site design features such as fencing, surface treatment or pavement, attenuation or wind barriers, architectural features, building materials, and drought resistant landscaping.
Policy HZ-1.9	Hazard areas maintained as open space. We minimize risk associated with flood, geologic, and fire hazard zones or areas by encouraging such areas to be preserved and maintained as open space.
NATURAL RESOURCES ELEMENT	
Policy NR-2.5	Stormwater discharge. We ensure compliance with the County's Municipal Stormwater National Pollutant Discharge Elimination System Permit by requiring new development and significant redevelopment to protect the quality of water and drainage systems through site design, source controls, stormwater treatment, runoff reduction measures, best management practices, low impact development strategies, and technological advances. For existing development, we monitor businesses and coordinate with municipalities.
<i>Sources: County of San Bernardino. (2020). Countywide Plan. Retrieved August 2022, from https://countywideplan.com/policy-plan.</i>	

The CWP Policy Plan includes the following Policy Maps that address geology, soils, and mineral resources:

- Policy Map HZ-1 Earthquake Fault Zones: This map depicts Alquist-Priolo and County designated fault zones;
- Policy Map HZ-2 Liquefaction & Landslides: This map depicts County areas with:
 - Suspected, low, medium, or high liquefaction susceptibility,
 - Low to moderate and moderate to high landslide susceptibility, as well as existing landslides,
 - Rockfall/debris-flow hazard
- Policy Map HZ-11 Wind Erosion Hazards: This map depicts County areas with low, low-medium, medium, medium-high, and high wind erodibility potential.

Codified Ordinances of the County of San Bernardino Municipal Code

The Codified Ordinances of the County of San Bernardino (County Code) regulations addressing geology, soils, and mineral resources are provided below.

County Code Chapter 82.15: Geologic Hazard (GH) Overlay. This Chapter was created to provide greater public safety by establishing investigative requirements for areas that are subject to potential geologic problems, including active faulting and sliding, debris flow/mud flow, rockfall, liquefaction, seiche, and adverse soil conditions. County Code Title 8, Chapter 82.15.040 (a), seeks to prevent construction or major rehabilitation of structures used for human occupancy within 50 feet of an active fault. County Code Chapter 82.15.040(b) requires that structures used for critical facilities be at least 150 feet from any active fault trace.

County Code Chapter 83.04: Conditional Grading Compliance. The purpose of this Chapter is to ensure compliance with conditions of approval on projects involving earthwork grading. The provisions in this Chapter regulate on-site continuous inspections that are required by the Building Official of grading projects or developments for which adopted conditions of approval:

- Require any specific or general features to be incorporated into the earthwork; or
- Restrict or limit the earthwork in any way that is more restrictive than the grading provisions prescribed in the California Building Code.

County Code Title 6 Chapter 1: California Building Code. The County's building regulations are found in this Chapter. The County adopted the 2022 CBC. State law permits jurisdictions to amend State building codes to address local geographic, topographic, or climatic conditions. The CBSC publishes all code amendments adopted by local agencies. The County amended the 2022 CBC for administrative provisions and included excavation and grading requirements that were not in the original 2022 CBC. No other local amendments were made.

City of Barstow General Plan

The City adopted the City of Barstow 2015-2020 General Plan (2020 General Plan) in February 2015. The 2020 General Plan is the overarching guide for implementation of the Development Code, which defines development regulations and establishes zoning districts throughout the City.

Table 5: 2020 General Plan Relevant Goals and Policies – Geology, Soils, and Mineral Resources includes the geology, soils, and mineral resource-related goals and policies relevant to BIG:

Table 5: 2020 General Plan Relevant Goals and Policies – Geology, Soils, and Mineral Resources	
Number	Goal or Policy
SAFETY ELEMENT	
Goal 1	Public Safety Goals, Policies and Strategies. Maintain a comprehensive Emergency Operations Plan for the City, ensuring a high level of responsiveness to natural and human-caused disasters and other emergency situations.
Policy 1A	Periodically update the Emergency Operations Plan and implement the plan’s provisions on an ongoing basis.
Goal 2	Emergency Preparation Goals, Policies and Strategies. Continue to actively participate in regional and statewide emergency preparation efforts.
Policy 2A	Cooperate and coordinate with San Bernardino County Emergency Services, Golden State Water Company, Southern California Edison, and Southwest Gas Company and other agencies and utilities in the development and dissemination of information and instructions on appropriate actions in the event of a local disaster or emergency.
Goal 3	Emergency Preparation Goals, Policies and Strategies. Ensure that all development occurring under the General Plan is designed and built in accordance with current standards for seismic safety, fire protection and defensible space.
Policy 3.1	Consider and assess vulnerability to natural and manmade disasters or emergencies when reviewing proposals for the siting and development of public/quasi-public facilities such as schools, water towers, and power and communication transmitters.
RESOURCE CONSERVATION AND OPEN SPACE ELEMENT	
Goal 4	Strive to preserve and protect important features and sites (historic, archaeological, and paleontological), as defined under this Element’s Cultural Resources Management Plan, from degradation or destruction.
Policy 4A	The City shall encourage efforts to collect and preserve available local historical resources.
Sources: City of Barstow, <i>2015-2020 General Plan</i> , Available https://www.barstowca.org/home/showpublisheddocument/5359/636607004808630000 , Accessed February 2023.	

The Code of the City of Barstow

The Code of the City of Barstow (Barstow Code) regulations addressing geology, soils, and mineral resources are provided below.

Barstow Code Title 15: Buildings and Construction. This title includes various regulations concerning erection, construction, maintenance, etc. of all buildings and/or structures in the City.

Barstow Code § 15.08.010: Building Codes. Codes Adopted specifies the various state Codes the City has adopted, including among others the CBC 2019 Edition, the California Existing Building Code 2019 Edition, and the California Referenced Standards Code 2019 Edition.

Barstow Code Chapter 15.12: Grading. Grading provides provisions for grading, excavation, and earthwork construction, including fills and embankments and the control of grading site runoff, including erosion sediments and construction related pollutants. This purpose of this chapter is to safeguard life, limb, property, and public welfare by regulating grading on private property. Barstow Code § 15.12.040: Permit Application Submittals specifies the following requirements for engineered grading:

- **Soil Engineering Report.** The soils engineering report shall include data regarding the nature, distribution and strength of existing soils, conclusions and recommendations for grading procedures and design criteria for corrective measures, including buttress fills, when necessary,

and opinion on adequacy for the intended use of sites to be developed by the proposed grading as affected by soils engineering factors, including the stability of slopes. Supplemental reports and data may be required as the building official may deem necessary. Recommendations included in the reports and approved by the building official shall be incorporated in the grading plan or specifications.

- *Engineering Geology Report.* The engineering geology report shall include an adequate description of the geology of the site, conclusions, and recommendations regarding the effect of geologic conditions on the proposed development, and opinion on the adequacy for the intended use of sites to be developed by the proposed grading, as affected by geologic factors. The engineering geology report shall include a geologic map and cross sections utilizing the most recent grading plan as a base. Supplemental reports and data may be required as the building official may deem necessary. Recommendations included in the reports and approved by the building official shall be incorporated in the grading plan or specifications.

City of Barstow Emergency Operations Plan

The Barstow Emergency Operations Plan (2015) provides guidance for the City's response to extraordinary emergency situations associated with natural, human-made, and technological disasters.

3.0 METHODS FOR EVALUATING IMPACT EFFECTS

This section identifies the methods used to evaluate the effects of BIG on geology, soils and seismicity within boundary limits and methods for the impact effects analysis.

3.1 Definition of Study Area

The BIG footprint is the area that would be physically affected by BIG construction, operations, and maintenance (including temporary disturbance) and the location of permanent improvements, including the existing railroad alignment, column sites for aerial structures, road overcrossing and undercrossing sites, construction-related facility sites, such as equipment staging area, borrow and disposal areas, access roads, and utility yards or components. The BIG footprint includes the limits of cut-and-fill plus all access roads and areas required for operating, storing, and refueling construction equipment and areas for construction. Within the BIG footprint are the elements needed to construct, operate, and maintain all permanent project features.

The BIG footprint includes the area where BIG could directly or indirectly and temporarily or permanently affect geologic resources, soil conditions, and be susceptible to seismic effects. The seismic effects include the regional extent of earthquake faults, ground shaking or dam failure inundation areas.

3.2 Methodology for Impact Analysis

Effects related to geology, soils, and seismicity have been analyzed, based on a thorough review of published soils and geologic information concerning the land area that would be affected by BIG, in-house geotechnical data from prior projects within the BIG footprint and surrounding vicinity, and professional judgment. Our analysis is in accordance with the current standard of care for geotechnical engineering and engineering geology in southern California. The analysis focuses on BIG's potential to increase the risk of personal injury, loss of life, and damage to property, including new facilities, as a result of existing geologic conditions within BIG, including construction effects.

The analysis evaluates the area directly within BIG's boundaries and the regional extent of earthquakes and earthquake faults within 62 miles (100 kilometers) from BIG. The distance of 62 miles (100km) was chosen because significant past $M > 7$ and faults with the potential for generating very strong ground motions are within this distance.

The analysis of impacts examines both the temporary (construction) and the permanent (operational) effects based on the application of the significance criteria presented below. The impact conclusions consider the potential for changes in the environmental conditions and compliance with the federal, state and local regulatory framework.

Qualitative and quantitative analyses included the review of the primary and secondary hazard effects. Analysis included review and assessment of published maps, professional publications, and reports pertaining to the geology, soils, and seismicity of BIG to describe the environmental setting and evaluate the potential environmental effects of BIG on geology, soils, and seismicity. The below analysis evaluated if the effects would directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death.

A summary of sources used in this report to evaluate potential effects include:

- USGS topographic maps
- USGS and CGS [Previously California Division of Mines and Geology] maps, reports and other publications
- Natural Resources Conservation Service (NRCS) soils maps and data
- DWR groundwater data
- DWR, Division of Safety of Dams (DSOD) dam failure inundation maps
- Previous Shannon and Wilson reports prepared for other projects in BIG's vicinity (2019, 2021, 2024 a, b, c, d, e)

3.3 Determining Significance Criteria under California Environmental Quality Act

Based on State California Environmental Quality Act Guidelines, BIG would result in a significant effect on the environment if it would:

- Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to California Geological Survey Special Publication 42.
 - Strong seismic ground shaking.
 - Seismic-related ground failure, including liquefaction.
 - Landslides.
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or soil collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property;
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater; or
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?
- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

4.0 ENVIRONMENTAL SETTING

This section is organized to discuss the geologic, soils, and seismic setting of BIG and provides evaluations of geologic hazards within the BIG footprint.

4.1 Regional Geologic Setting

The BIG footprint is in southern California, an active tectonic region where the interaction between the North American Plate and Pacific Plate is considered to take place across a wide area, between the Eastern California Shear Zone (ECSZ) in the Mojave Desert, the San Andreas fault zone and active faults located in the Pacific Ocean, tens of miles offshore. The Mojave Desert is bounded by major active tectonic structures in California that include the left-lateral Garlock Fault at its northern boundary and the right-lateral San Andreas Fault at its southern boundary. The Mojave Desert topography within this portion of California is controlled by an over 60-mile-wide network of northwest-trending, right-lateral, strike-slip faults and secondary east-west-trending faults. These faults are accommodating ongoing tectonic deformation in the region known as the Mojave section of the ECSZ. This deformation creates the hill and valley topographic conditions in this part of California.

Physiography

The BIG footprint is within the Mojave Desert physiographic province and parallels the northeast trending Mojave River drainage basin. It is located along and adjacent to the existing BNSF main lines and the historic National Trails Highway (Main Street). Developed residential and commercial properties are adjacent to the northeasterly end of BIG within the City and unincorporated Lenwood. South and west of Lenwood, the terrain near the existing main lines are surrounded with undeveloped land. The community of Hodge is adjacent to the central portion of the BIG footprint that runs south of Iron Mountain. The southwesterly end of the BIG footprint alignment extends into the north end of Brisbane Valley.

The BIG footprint is located at the junction of the Mojave River floodplain and adjacent ascending elevated alluvial plains. In the western half of the BIG footprint, the topography is relatively level between the existing main lines and Mojave River with low, hummocky terrain at some locations, especially near the southwesterly end near Hinkley Road. The west lead track extensions of BIG are aligned on relatively level terrain at the southern edge of the Mojave River plain. In the eastern half of the BIG footprint, in the vicinity of the proposed rail yard and transload warehouse center northern industrial park area, the topography is relatively level within the Mojave River plain with localized hummocky sand dunes. From the river plain, the topography ascends an elevated alluvial plain to the southeast with the highest elevations adjacent to Main Street.

Geology

Regional geologic maps (Dibblee and Minch 2008a; Dibble and Minch 2008b) shown in **Figure 6: Geologic Map** and soil samples reviewed during previous subsurface explorations (Shannon & Wilson 2019, 2021) show BIG to be underlain by:

- Very late Pleistocene and recent young alluvium,
- Pleistocene-aged older alluvium,
- Older fanglomerate gravels,

- Older clay deposits,
- Wind-blown dune sand,
- Mojave River channel,
- Quartz latite-dacite; and,
- Quartz monzonite.

Young alluvium consists of unconsolidated surficial sediments described as light gray alluvial sand that is arkosic, coarse to fine grained that grades to mostly gravel and sand near hills. The dune sand is described as nearly white, well-sorted fine sand deposited by prevailing westerly winds. The Mojave River channel deposits are described as nearly white, fine to coarse sand with some pebble and cobble gravel.

The older alluvium is weakly consolidated, dissected sediments described as light gray, poorly bedded gravel, sand and silt. Older fanglomerate and gravel are massive to poorly bedded, boulders, cobbles, and pebbles in a weakly to moderately consolidated sandy matrix. The base of the fanglomerate includes lenses of white caliche, greenish sandy clay and calcareous caliche at base. The older clay and marl deposits consist of light greenish-gray silty clay, minor amounts of silty to pebbly interbedded white caliche marl.

Miller, et al. (2020) shows some areas in the BIG footprint as Made Land that is defined as the material moved for construction purposes and agricultural disturbances significant enough of make it difficult to identify the original natural landforms and deposits.

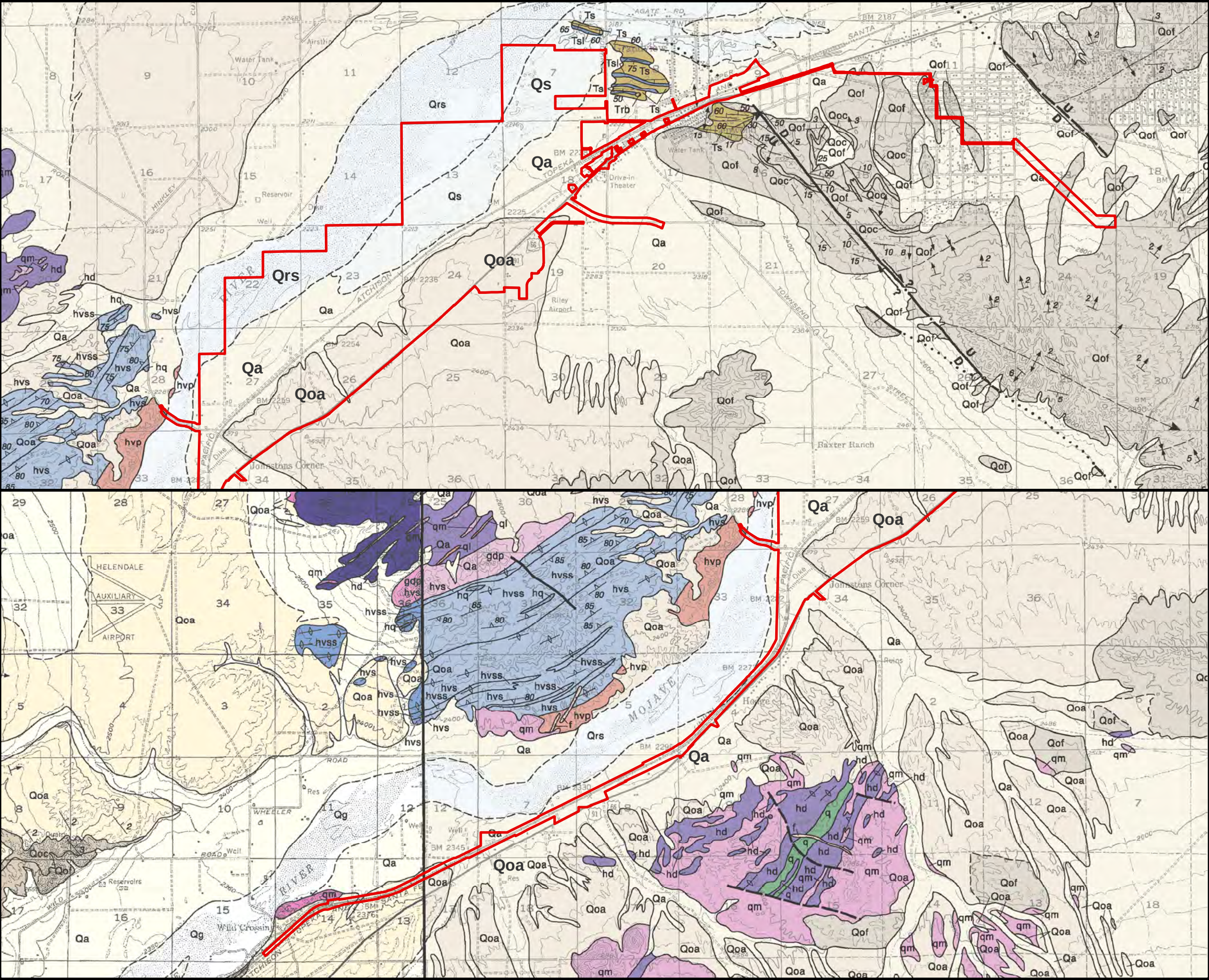
At the northeastern end of the BIG footprint, Pliocene-age sedimentary bedrock is mapped in the elevated terrain adjacent to the main lines. The bedrock is described as interbedded shale, sandstone, limestone, and minor volcanic rocks of the Barstow Formation (Dibblee and Minch 2008a; Miller et al. 2020). Bedrock underlying the main lines is anticipated to be at a shallow depth in this area. The bedrock structure consists of steeply dipping bedding that dips to the south and south-southeast at 60 to 75 degrees.

In the central portion of the BIG footprint, west of the Hinkley road crossing, the project is underlain by a volcanic rock mapped as quartz latite-dacite. This rock is part of the metamorphosed volcanic rocks known as the Hodge Volcanic Series exposed on the southern flanks of Iron Mountain (Boettcher and Walker, 1993). Quartz monzonite bedrock is located at the west end of the western lead track extensions.

Soils

Surficial soils (roughly within the upper 5 feet of the ground surface) are mapped by NRCS and are typically considered for their resource value in agricultural production or for their potential development characteristics or constraints. Depending on type, some soils are susceptible to erosion or expansive behavior, and some can cause corrosion to steel and concrete, while others are more suitable for construction. The NRCS maintains a database known as the Web Soil Survey (NRCS, 2022) of the soil types that have been mapped within the region. **Figure 7: Soils Map** shows the soil map units for BIG.

Review of data available from the NRCS regarding these surficial soil deposits indicates that the soils may have constraints that could affect BIG. Constraints associated with these soils include expansion, corrosion, and erosion. These constraints and the potential effects are discussed in more detail below in **Section 4.2.3, Poor Soil Conditions**.



LEGEND

- BIG Footprint
- Qa Alluvium
- Qs Windblown Sand
- Qrs Mojave River Channel Sand
- Qoa Older Alluvium
- Qoc Older Clay and Marl
- Qof Older Fanglomerate and Gravel
- Ts Shale and Sandstone, interbedded
- Tsl Limestone
- qm Quartz Monzonite
- gdp Granodiorite
- hd Hornblende
- hvp Quartz Latite-Dacite
- hvs Schistose Meta-Quartz Latite
- hvss Sericite and Muscovite Schist
- hq Quartzite



0 5,000 10,000 Feet
1 inch = 5,000 feet

Map adapted from Geologic map of the Barstow & Daggett 15 minute quadrangles, San Bernardino County, California, by Dibblee, T.W., and Minch, J.A., 2008 and Geologic map of the Kramer & Hawes 15 minute quadrangles, San Bernardino and Los Angeles County, California, by Dibblee, T.W., and Minch, J.A., 2008

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San Bernardino County, California

REGIONAL GEOLOGIC MAP

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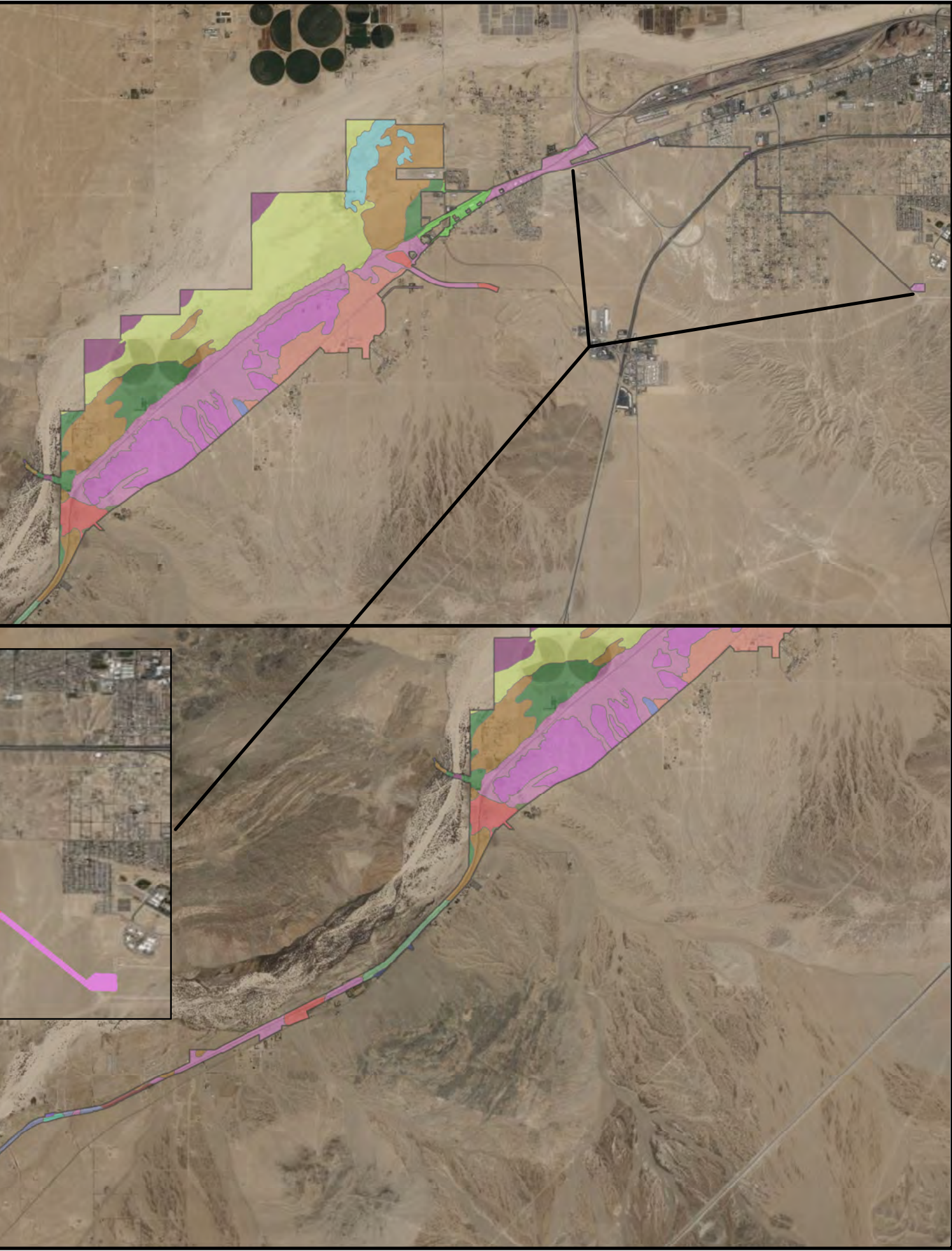
FIG. 6

LEGEND

 BIG Boundary

Name

-  BRYMAN LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES
-  CAJON GRAVELLY SAND, 2 TO 15 PERCENT SLOPES
-  CAJON LOAMY SAND, 5 TO 9 PERCENT SLOPES
-  CAJON SAND, 0 TO 2 PERCENT SLOPES
-  CAJON SAND, 2 TO 9 PERCENT SLOPES
-  CAJON-ARIZO COMPLEX, 2 TO 15 PERCENT SLOPES*
-  CAJON-WASCO, COOL COMPLEX, 2 TO 9 PERCENT SLOPES*
-  CAVE LOAM, DRY, 0 TO 2 PERCENT SLOPES
-  DUNE LAND
-  HELENDALE LOAMY SAND, 0 TO 2 PERCENT SLOPES
-  HELENDALE LOAMY SAND, 2 TO 5 PERCENT SLOPES
-  JOSHUA LOAM, 2 TO 5 PERCENT SLOPES
-  KIMBERLINA LOAMY FINE SAND, COOL, 2 TO 5 PERCENT SLOPES
-  LAVIC LOAMY FINE SAND, 0 TO 5 PERCENT SLOPES
-  LOVELACE LOAMY SAND, 5 TO 9 PERCENT SLOPES
-  NEBONA-CUDDEBACK COMPLEX, 2 TO 9 PERCENT SLOPES*
-  NOROB-HALLORAN COMPLEX, 0 TO 5 PERCENT SLOPES*
-  RIVERWASH
-  ROCK OUTCROP-LITHIC TORRIORTHENTS COMPLEX, 15 TO 50 PERCENT SLOPES*
-  VICTORVILLE SANDY LOAM
-  VILLA LOAMY SAND
-  VILLA LOAMY SAND, HUMMOCKY
-  YERMO-KIMBERLINA, COOL, ASSOCIATION, SLOPING



0 6,750 13,500 Feet
1 inch = 6,750 feet

Reference: Map adapted from Web Soil Survey,
by USGS, accessed 02-11-2025.
[https://websoilsurvey.sc.egov.usda.gov
/App/HomePage.htm](https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).

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SOILS MAP

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Groundwater

The BIG footprint is in the Centro Subarea of the Mojave River groundwater basin (Basin). The Basin supplies water for the western Mojave Desert (Thompson, 1929; Stamos et al., 2001). The river and aquifer systems are in hydraulic connectivity in many areas, and the Mojave River is the major source of surface water and groundwater recharge to the Basin (Lines, 1996, p. 41).

The river is unreliable for direct water supply along its 100-mile reach except for a short reach of perennial flow and periods of flow after intense storm events. The Basin is over-drafted from long-term groundwater production and efforts to manage water levels in the Basin were initiated in 1990 (Stamos et al., 2001, p. 3). Basin groundwater levels are monitored by the USGS and Mojave Water Agency and data is publicly available (Dick, 2017; USGS, 2019a).

Estimated groundwater depth is based on wells within or near BIG. Groundwater information available from the USGS provide current information on groundwater depths bgs. **Figure 8: Groundwater Map** shows locations of existing wells and the fluctuating depth to groundwater from the USGS National Water Information System (USGS, 2019b). The depth to groundwater generally deepens to the northeast toward Lenwood at the east end of the BIG footprint. Groundwater is relatively shallow from Hodge to the west end.

Shannon & Wilson (2024a) developed groundwater maps of BIG based on current and historical groundwater levels encountered during subsurface explorations and available well data. These groundwater maps confirm the general groundwater trends. This information was used to develop median groundwater levels for evaluation of the liquefaction seismic hazards discussed below.

4.2 Geologic Hazards

A geologic hazard area is defined as an area that poses a potential threat to the health and safety of citizens when incompatible commercial, residential, or industrial developments are located in areas of substantial geologic hazard. Two broad categories of geologic hazards exist: seismic and non-seismic. The following sections address the types of non-seismic hazards that could be considerations for BIG.

Specific geologic hazards in this section address non-seismic hazards that could affect BIG include landslide hazards, ground subsidence, loss of topsoil, unstable geology, poor soil conditions and expansive soils.

Landslide Hazards

A landslide refers to the downslope movement of materials such as rock, soil, or fill under the direct influence of gravity. This downward movement can occur along a surface (glide plane, landslide plane, or discrete slip surface) or without a distinct failure surface. These slope movements are usually categorized as being either falls, topples, slides, spreads, or flows. Landslides may occur in areas of generally moderate to steep topography (e.g., commonly, slopes steeper than 4:1 horizontal to vertical) where a combination of geologic factors, including strength of soil and rock materials, structure, and groundwater conditions, result in ground movement. Landslides can be initiated by soil saturation, earthquakes, volcanic activity, changes in groundwater elevations, change of a slope by construction activities, or any combination of these factors.

In general, they are usually triggered by the following forces that disrupt slope equilibrium:

- Adding weight (adding driving force) to the top of a potential slide area,
- Removing mass (removing toe support or resisting force) from the base of a potential slide area,
- Increasing the volume of water to create heightening of pore water pressures within a potential slide area; and,
- Vibrations from earthquakes, which can also serve to heighten pore water pressures.

Due to the relatively level to gently sloping terrain and geology in the BIG footprint, pre-existing landslides are not present (USGS, 2022c). Unstable slope conditions can be created during grading without appropriate design and best management practices (BMPs) employed during grading. Grading of steeper slopes within BIG would be designed and performed in accordance with building code requirements and standard construction practices. This would result in stable slope conditions and eliminate potential slope stability hazards within BIG.

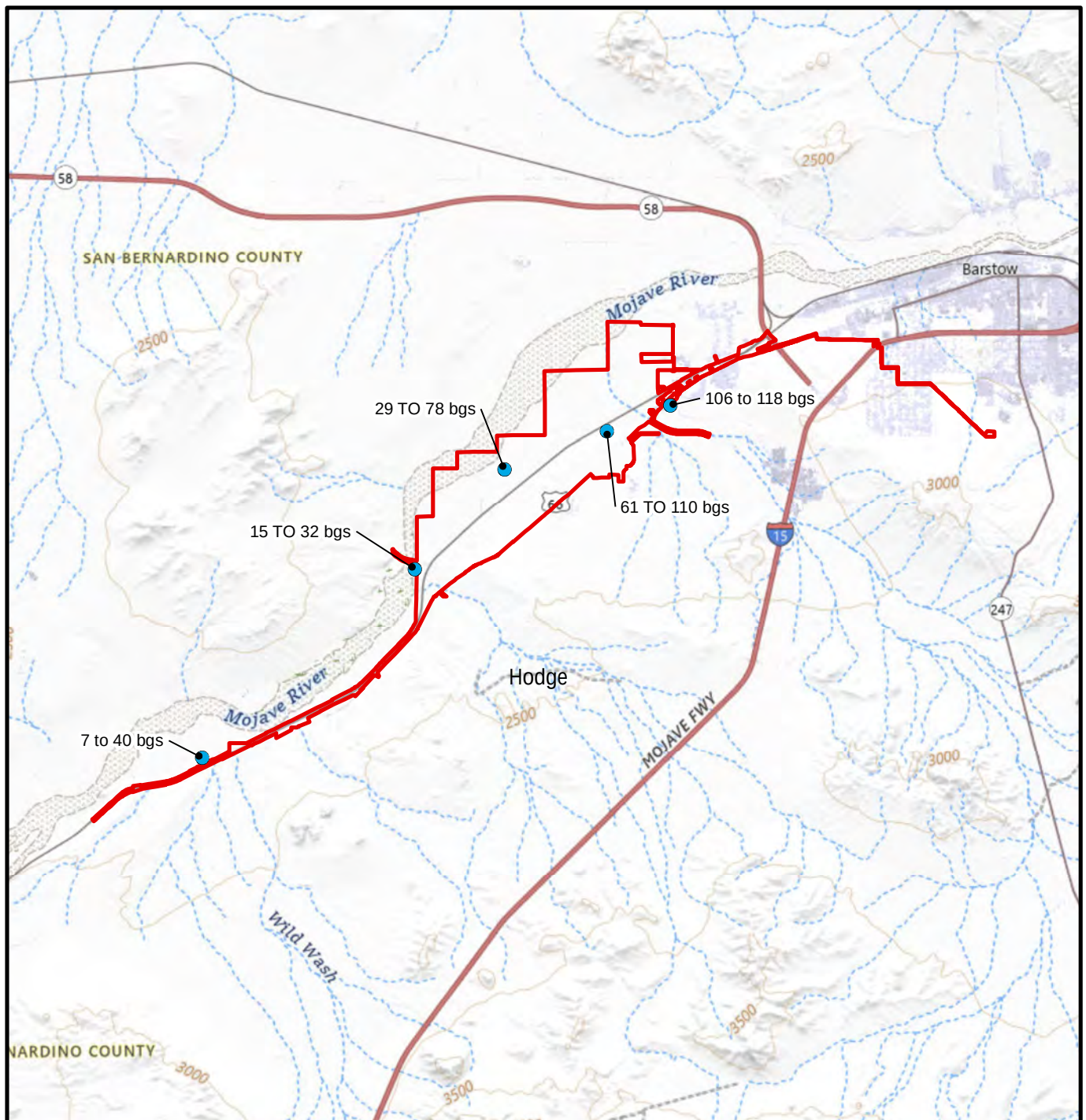
Ground Subsidence

Subsidence is the vertical displacement of the ground surface, which can be localized or over a broad region. Land subsidence is a form of ground settlement that usually results from change in fluid content within soil or rock. The volume change can result from localized dewatering of peat, organic soils, or soft silts and clay. Ongoing decomposition of organic-rich soils may also result in land subsidence. This type of subsidence generally occurs in localized areas. There are no known peat deposits within the BIG footprint. Organic soils and soft silts and clays are also unlikely within the BIG footprint.

A second type of land subsidence is from a regional withdrawal of groundwater, petroleum, or geothermal resources from sediments or sedimentary source rocks, which can cause the collapse of the pore space previously occupied by the removed fluid. The compaction of subsurface sediment caused by fluid withdrawal can cause subsidence of the ground surface overlying a pumped reservoir or well. If the volume of water or petroleum removed is sufficiently great, the amount of resulting subsidence may suffice to cause damage to nearby engineered structures.

Land subsidence can occur in valleys containing aquifer systems that are in part made up of fine-grained sediments and that have undergone extensive groundwater development. The loss of fluid-pressure support during fluid withdrawal increases the effective stress on basin sediments and can result in deformation of soil structure in the aquifer. This deformation can result in an irreversible reduction of pore volume and inelastic consolidation of the aquifer system.

The Mojave River and Morongo groundwater basins in San Bernardino County are known for historical ground subsidence due to the withdrawal of subsurface groundwater (Sneed et al. 2003; Stamos 2007; Brandt and Sneed 2017). The Mojave River groundwater basin has undergone continuous groundwater consumption since the early 1900s, causing groundwater levels in nearby wells to decline more than 100 feet between the 1950s and 1990s. Lowering of the groundwater level has resulted in localized subsidence near dry lakebeds in the areas studied, including Harper Lake approximately 6 miles northwest of BIG. (Sneed et al., 2003, p. 2).



LEGEND

- Depth to Groundwater*
- Big Boundary

*Groundwater Measurement Site with Approximate Depth of Water Below Ground Surface (bgs) in Feet.

Reference: Map adapted from USGS National Water Information System, Downloaded 11-17-2022.

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GROUNDWATER MAP

February 2025

110111-002

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FIG. 8

The BIG footprint is within a region of long-term groundwater withdrawal and the studies discussed above do not indicate subsidence in the BIG footprint. Regional groundwater management and active groundwater recharge in the Mojave River basin may reduce the potential for future subsidence in the region. Therefore, the potential for future ground subsidence of BIG under current regional groundwater management is considered low.

Poor Soil Conditions

Certain physical and chemical properties of soils may have a negative effect on engineered facilities depending upon the soil property characteristics. These property characteristics are presented below. Surficial soil conditions generally considered to have a negative impact on engineered facilities include expansivity, corrosion potential, collapsible properties and erosion potential. Analysis of these attributes are based on the NRCS (2022) soils data and the geologic conditions of BIG. **Table 6: Soils within BIG and Associated Hazards** provides a list of the specific soil units and associated soil hazards.

Table 6: Soils within BIG and Associated Hazards		
Soil Series Map Unit	Landform Groups	Soil Hazards
Bryman Loamy Fine Sand	Fan remnants and backslope	▪ Moderate shrink-swell potential¹ ▪ Moderate corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion² ▪ Moderate potential for water erosion³
Cajon Sand	Alluvial fans and backslope	▪ Low shrink-swell potential¹ ▪ Low corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion ▪ Low potential for water erosion
Cajon Gravelly Sand	Alluvial fans and backslope	▪ Low shrink-swell potential ▪ Low corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion ▪ Low potential for water erosion
Cajon Loamy Sand	Fan Remnants and backslope	▪ Low shrink-swell potential ▪ Low corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion ▪ Moderate potential for water erosion
Cajon-Arizo Complex	Alluvial fans and backslope	▪ Low shrink-swell potential ▪ Low corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion ▪ Low potential for water erosion
Cajon-Wasco, Cool Complex	Alluvial fans and backslope	▪ Low shrink-swell potential ▪ Low corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ High potential for wind erosion ▪ Low potential for water erosion
Cave Loam	Fan remnants and backslope	▪ Low shrink-swell potential ▪ Moderate corrosivity to uncoated steel ▪ Moderate corrosivity to concrete ▪ Moderate potential for wind erosion ▪ Moderate potential for water erosion

Table 6: Soils within BIG and Associated Hazards

Dune Land	Dunes and backslope	Soil data was not available for this soil unit
Helendale Loamy Sand	Fan remnants and backslope	- Low shrink-swell potential - Moderate corrosivity to uncoated steel - Low corrosivity to concrete - High potential for wind erosion - Low potential for water erosion
Joshua Loam	Fan remnants, backslope, and summit	- Moderate shrink-swell potential - High corrosivity to uncoated steel - High corrosivity to concrete - Moderate potential for wind erosion - High for water erosion
Kimberlina Loamy Fine Sand, Cool	Fan aprons and footslope	- Low shrink-swell potential - Moderate corrosivity to uncoated steel - Moderate corrosivity to concrete - High potential for wind erosion - Moderate potential for water erosion
Lovelace Loamy Sand	Alluvial fans and backslope	- Low shrink-swell potential - Moderate corrosivity to uncoated steel - Moderate corrosivity to concrete - High potential for wind erosion - Moderate potential for water erosion
Lavic Loamy Fine Sand	Fan skirts and fan aprons	- Low shrink-swell potential - High corrosivity to uncoated steel - Moderate corrosivity to concrete - High potential for wind erosion - Moderate potential for water erosion
Nebona-Cuddeback Complex	Fan remnants and toeslope	- Moderate shrink-swell potential - High corrosivity to uncoated steel - High corrosivity to concrete - Moderate potential for wind erosion - Moderate potential for water erosion
Norob-Halloran Complex	Fan remnants and summit	- Moderate shrink-swell potential - High corrosivity to uncoated steel - High corrosivity to concrete - High potential for wind erosion - Moderate potential for water erosion
Riverwash	Channels	Soil data was not available for this soil unit
Rock Outcrop-Lithic Torriorthents Complex	Mountains, backslope, and summit	Soil data was not available for this soil unit
Victorville Sandy Loam	Floodplains and toeslope	- Moderate shrink-swell potential - Moderate corrosivity to uncoated steel - Moderate corrosivity to concrete - Moderate potential for wind erosion - Low potential for water erosion
Villa Loamy Sand	Floodplains and toeslope	- Low shrink-swell potential - Moderate corrosivity to uncoated steel - Moderate corrosivity to concrete - High potential for wind erosion - Moderate potential for water erosion

Table 6: Soils within BIG and Associated Hazards		
Villa Loamy Sand, Hummocky	Floodplains and toeslope	▪ Low shrink-swell potential ▪ Moderate corrosivity to uncoated steel ▪ Moderate corrosivity to concrete ▪ High potential for wind erosion ▪ Moderate potential for water erosion
Yermo-Kimberlina, Cool Association	Hills and backslope	▪ Low shrink-swell potential ▪ Moderate corrosivity to uncoated steel ▪ Low corrosivity to concrete ▪ Moderate potential for wind erosion ▪ Low potential for water erosion
Notes: ¹ Shrink-swell potential based on Unified Soil Classification System classification and plasticity index. ² Potential for wind erosion based on wind erodibility groups: 1-2 = high, 3-6 = moderate, 7-8 = low. (NRCS, 2002) ³ Potential for water erosion based on K factor (whole soil) values: 0-0.2 = low; 0.2-0.4 = moderate; >0.4 = high (Michigan State University, 2002) Source: NRCS, 2022		

Expansive Soils

Expansive soils are characterized by specific clay particles in soil that interact with water and their ability to undergo substantial volume changes (shrink or swell) due to variations in moisture content. This phenomenon generally decreases in magnitude with increasing confining pressure. These volume changes may damage lightly loaded shallow foundations, pavement, and other shallow improvements and should not be used as engineered fill. Changes in soil moisture content can result from precipitation, utility leakage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

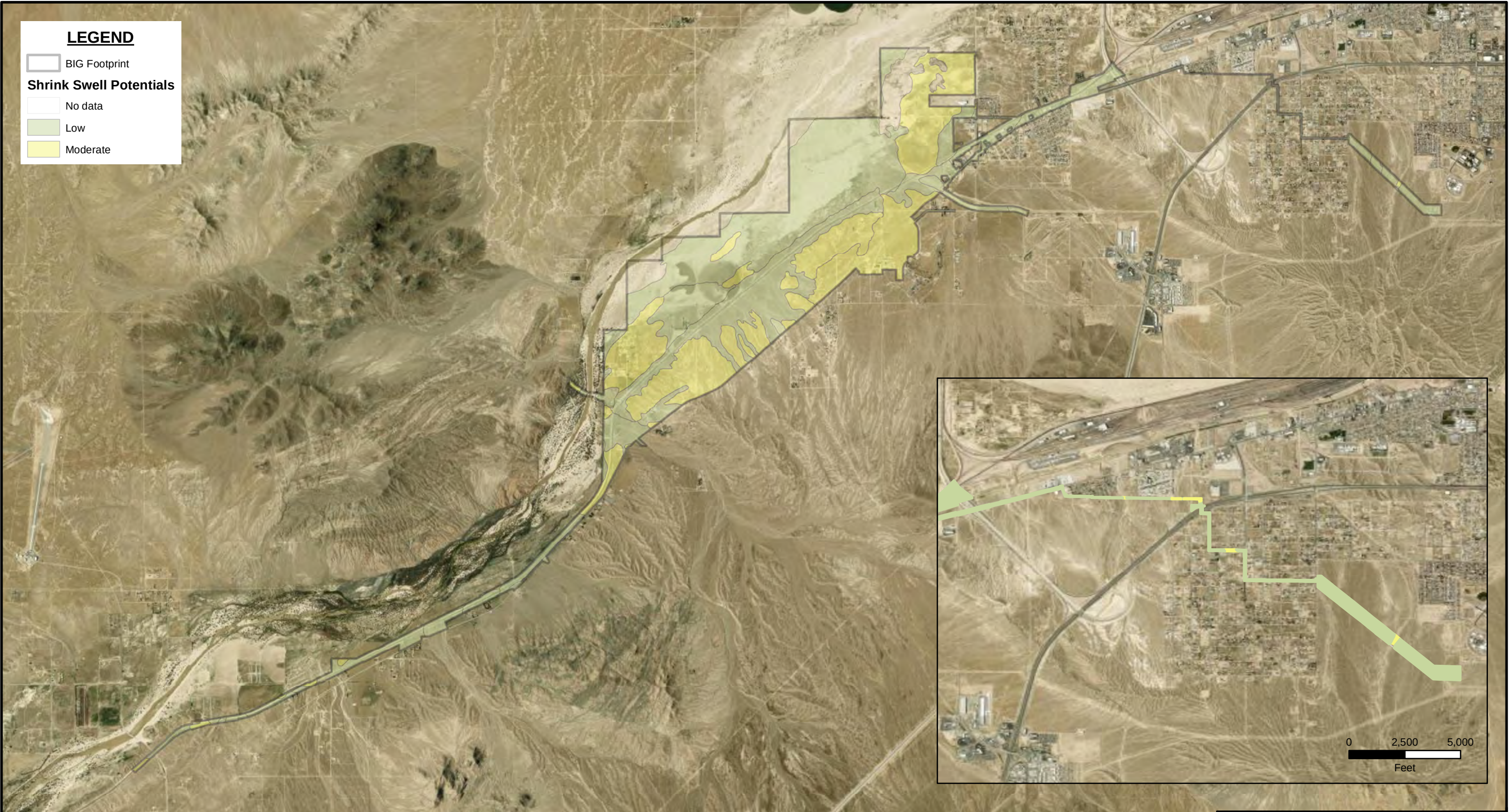
Expansive soils as defined by NRCS (2022) are generally classified as having low, moderate, and high expansive potentials, where the type and percentage of fine-grained clay particles present in the soil are indicative of the soil's expansion potential. These classification values qualitatively correspond with the expansive soil values defined by the CBC.

The BIG footprint is in an area where many of the surficial soils consist of coarser-grained materials with low shrink-swell potential. **Figure 9: Shrink / Swell Potential - BIG** shows NRCS soil types that have low shrink-swell and those soils with finer-grained soil layers having moderate shrink-swell potential.

Soil Corrosivity

Soil corrosivity measures the potential of corrosion of concrete and steel caused by contact with some types of soil under certain environmental conditions. Knowledge of potential soil corrosivity is often critical for the effective design parameter associated with cathodic protection of buried steel and concrete mix design for plain or reinforced concrete buried project elements.

Factors—including soil composition, soil and pore water chemistry, moisture content, and pH—affect the response of steel and concrete to soil corrosion. Soils with high moisture content, high electrical conductivity, high acidity, high sulfates, and high dissolved salts content are most corrosive. Generally, sands and silty sands do not present a corrosive environment. Clay soils, including those that contain interstitial salt water, can be highly corrosive. **Figure 10: Corrosion of Steel** and **Figure 11: Corrosion of Concrete** show soils within portions of the BIG footprint (based on prior borings and NRCS soil survey data), which could react adversely to buried steel and concrete.



LEGEND

 BIG Footprint

Shrink Swell Potentials

 No data

 Low

 Moderate

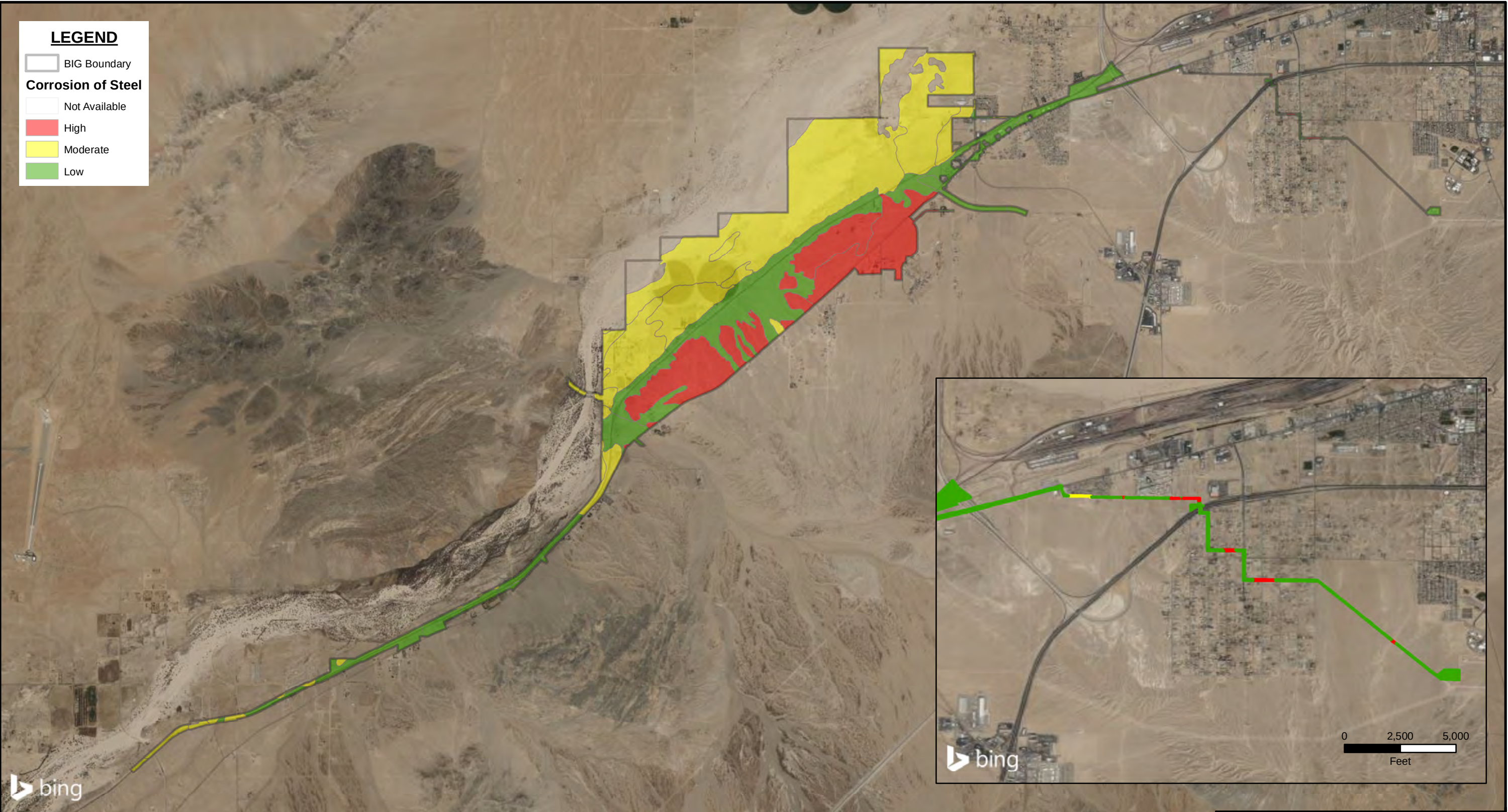
0 2,750 5,500 11,000 Feet

1 inch = 5,500 feet



Reference: Map adapted from Web Soil Survey, by USGS, accessed 09-30-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

Barstow International Gateway San Bernardino County, California	
SHRINK / SWELL POTENTIAL	
September 2025	110111-002
 SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	FIG. 9

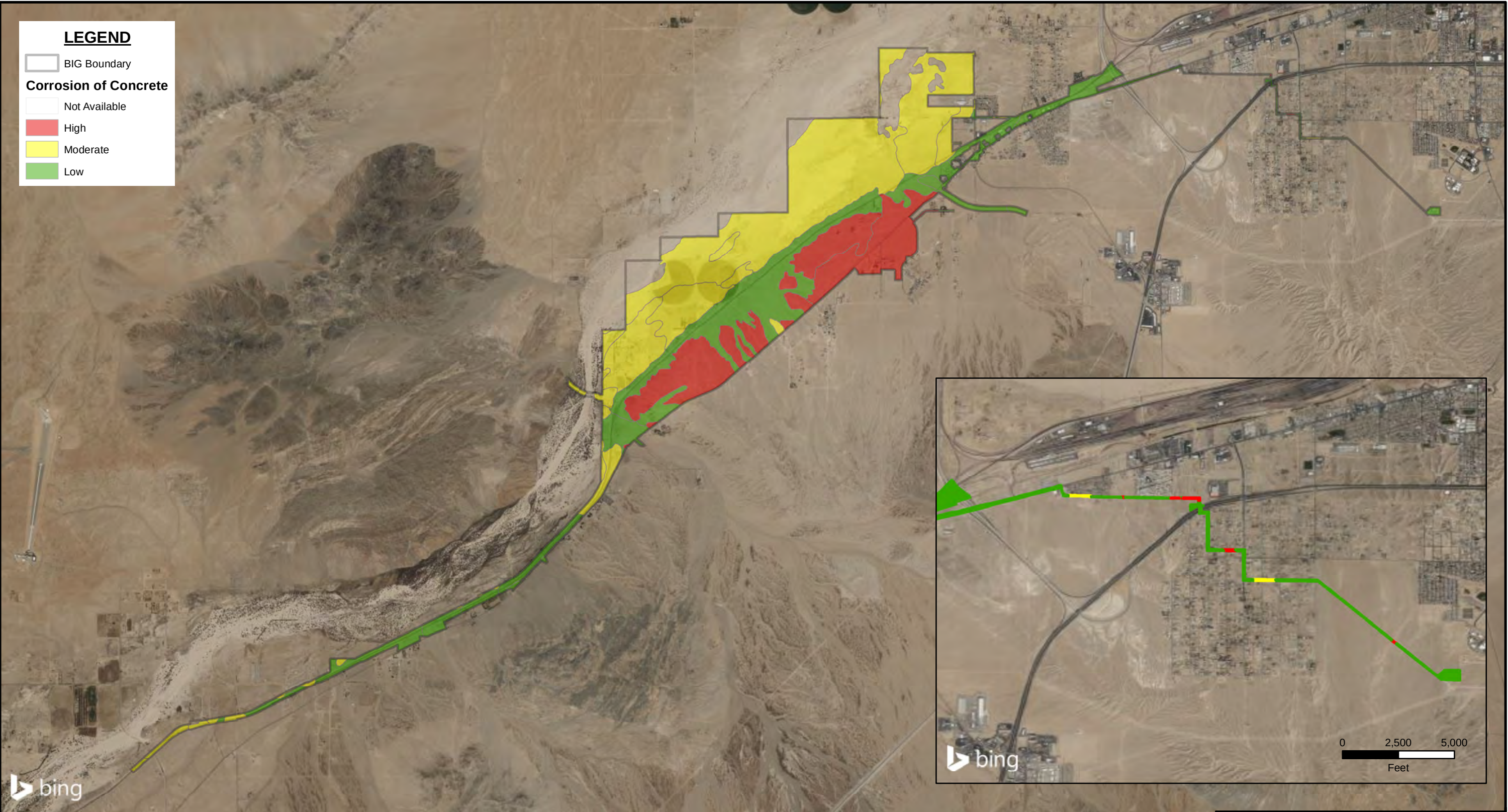


0 2,750 5,500 11,000 Feet
1 inch = 5,500 feet



Barstow International Gateway San Bernardino County, California	
CORROSION OF STEEL	
February 2025	110111-002
 SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	FIG. 10

Reference: Map adapted from Web Soil Survey, by USGS, accessed 02-12-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.



Reference: Map adapted from Web Soil Survey, by USGS, accessed 02-11-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

Collapsible Soils

Collapsible soils are soils that undergo settlement upon wetting, even without the application of additional load. These soils are characterized by low density and low moisture contents. The soil grains in collapsible soils are not packed tightly together. While strong in a dry state, the introduction of water into these dry soils causes the binding agents between grains to quickly break, soften, disperse, or dissolve. The soil grains then shift and shear against each other to re-orient into a denser configuration. This relatively rapid densification of the soil causes a net volume loss of the soil deposit, which is manifested at the ground surface as subsidence or settlement.

There are no references regarding collapsible soils within this portion of San Bernardino County. However, the BIG footprint is located at the junction of the Mojave River floodplain and adjacent alluvial fans. There may be deposits underlying BIG that are susceptible to collapsible soil. Shannon & Wilson (2019) reported that there is the potential for collapsible soil in the upper 15 feet of very loose to loose alluvial soils. Shannon & Wilson (2024b) encountered collapsible soil at one exploration test pit in the Mojave River floodplain at a depth of 10 feet below the ground surface within the BIG grading limits. This material is limited to one location and was not encountered at other exploration locations. The potential for collapsible soil is localized and the risk potential is considered low for most of the BIG Project.

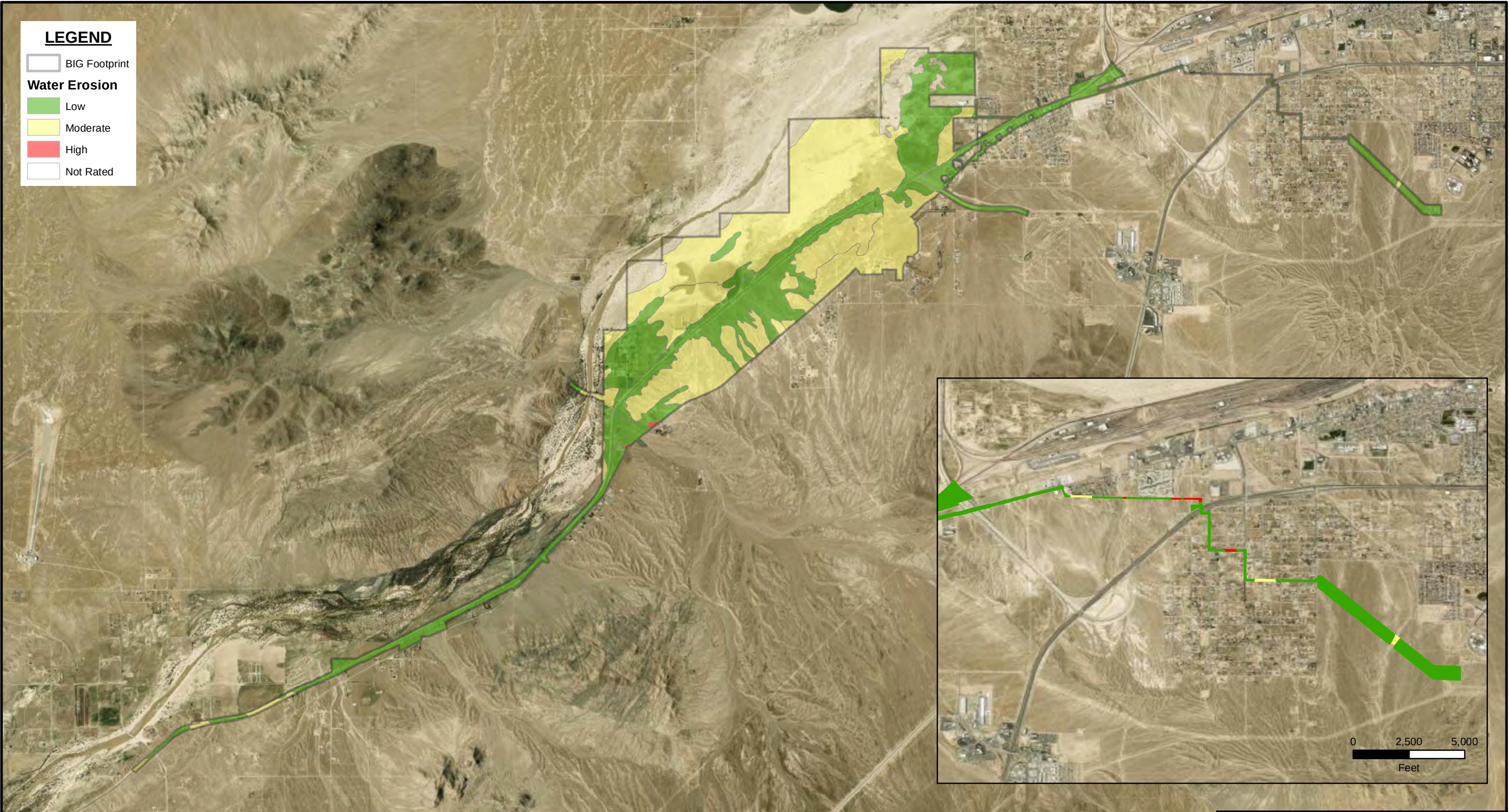
Erodible Soils

Erosion includes detachment and transportation of soil materials by wind or water. Rainfall and potential surface runoff may produce different types of erosion. Potentially erosive conditions are identified as areas having a combination of potentially erosive soils and uncovered slopes.

Soil erodibility depends upon many factors, including grain size, organic matter content, structure, permeability, and percentage of rock fragments. The K factor is a soil erodibility factor that represents both susceptibility of soil to sheet and rill erosion by rainfall. Soils with a low K factor values are less susceptible to sheet and rill erosion. An increase in the K factor value results in a greater susceptibility to erosion.

Soils high in clay content have low K values (between 0.05 to 0.15) because they are resistant to detachment. Coarse textured soils, such as sandy soils, also have relatively low K values (between 0.05 to 0.2). While these soils are easily detached, they generally produce low runoff. Medium textured soils, such as silt loam soils, have moderate K values (between 0.25 to 0.4) because they are moderately susceptible to detachment and produce moderate runoff. Soils having high silt content are the most erodible of all soils. They are easily detached and tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4 (Michigan State University, 2002). High intensity rainfall events can contribute to soil erosion, especially at sloped banks along existing drainage channels or in cut and fill slopes created during grading. **Figure 12: Water Erosion Potential – BIG** shows the susceptibility to water erosion for BIG soils.

Wind and rain erosion pose a potential concern for surficial soils and project engineered fills exposed during grading. Seasonally strong winds within the BIG footprint contribute to wind erosion causing soil deflation in some areas, sand movement, and soil accumulation in others. These effects are indicated by the general west to east sand dune movement on the north side of the main tracks. Under these conditions, the BIG footprint is in an area susceptible to wind erosion. **Figure 13: Wind Erosion Potential – BIG** show the susceptibility to wind erosion for BIG soils.



LEGEND

BIG Footprint

Water Erosion

Low

Moderate

High

Not Rated

0 2,750 5,500 11,000 Feet

1 inch = 5,500 feet



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San Bernardino County, California

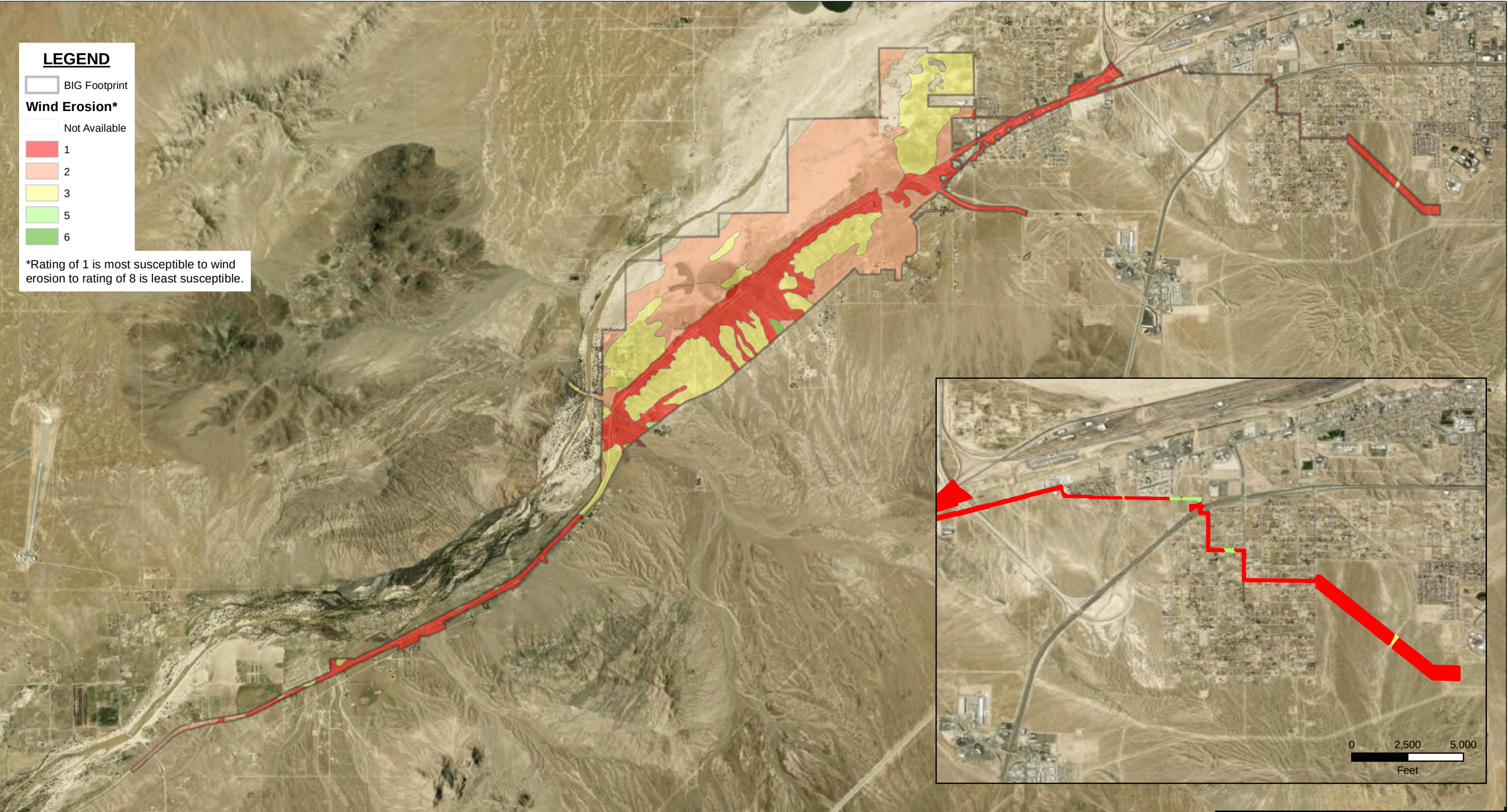
WATER EROSION

September 2025 110111-002

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FIG. 12

Reference: Map adapted from Web Soil Survey, by USGS, accessed 09-30-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.



LEGEND

BIG Footprint

Wind Erosion*

Not Available

1

2

3

5

6

*Rating of 1 is most susceptible to wind erosion to rating of 8 is least susceptible.

Reference: Map adapted from Web Soil Survey, by USGS, accessed 09-30-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

Barstow International Gateway San Bernardino County, California	
WIND EROSION	
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SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	FIG. 13

Scour or soil erosion at the base of a bridge, may be a design concern for the proposed bridges crossing unlined river or stream channels. Bridges within the BIG footprint include crossing Lenwood Channel and an unnamed tributary to the Mojave River. The potential for scour involves a complex interaction of the power of flowing water and the resistance of soil material forming the bed and banks of the channel. Evaluating scour is a multidisciplinary process performed by hydraulic engineers, geotechnical engineers, and engineering geologists. The potential effect of scour on bridge foundations and abutments also involves bridge structural engineers and cannot be estimated without site-specific analyses at bridge sites. The alluvial soils near these stream channels are considered potentially susceptible to scour. The tracks would be supported on bridges designed specifically with scour in mind.

Areas of Difficult Excavation

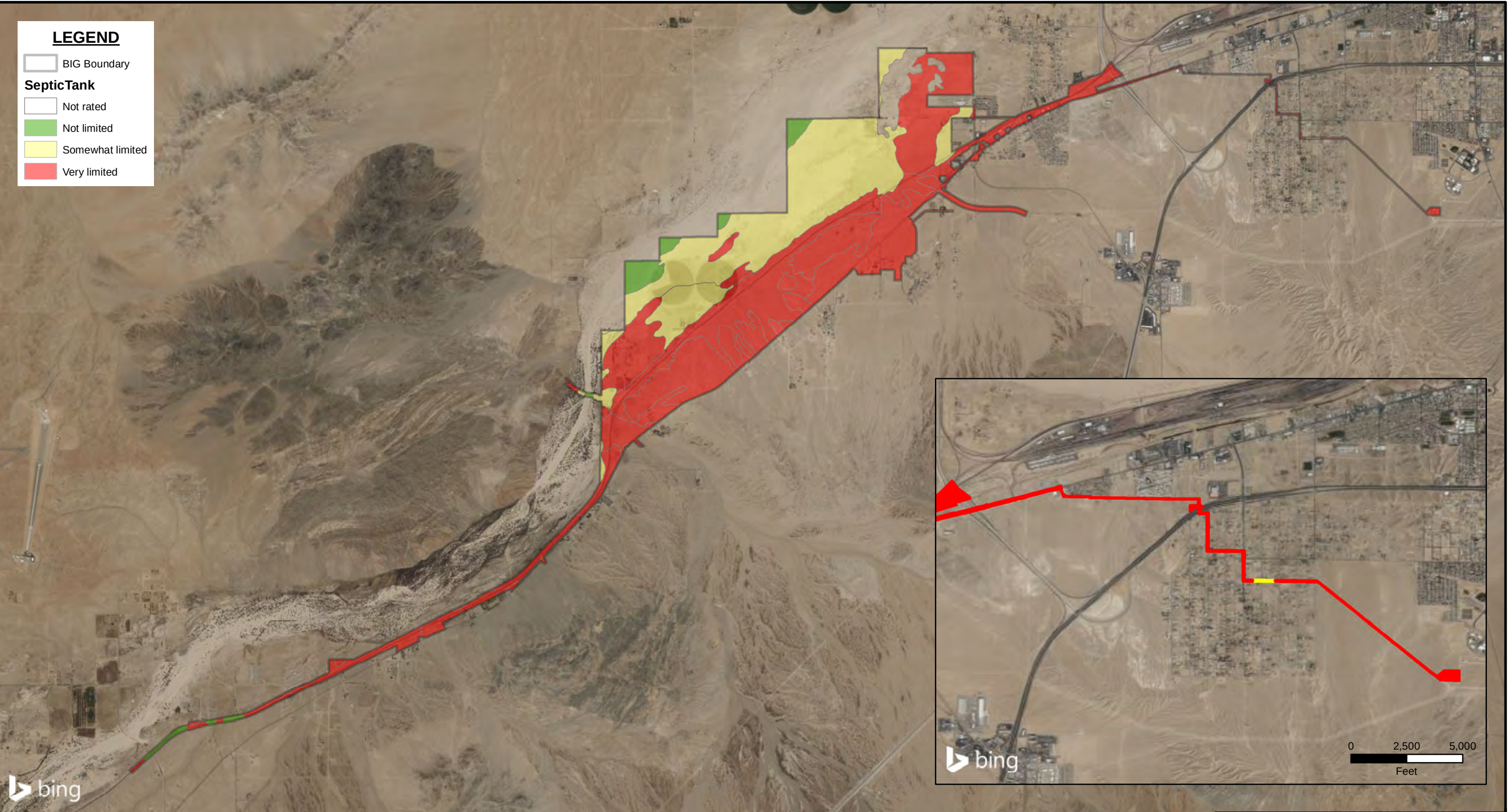
Due to the presence of predominantly Quaternary sediments in the BIG footprint, areas of difficult excavation along BIG's alignment (including drilled piers or driven piles) are not anticipated. However, some soils with zones of gravel or cobbles and calcium carbonate cemented sediments may locally pose excavation issues, depending on the thickness of these deposits. Difficult excavation is defined herein to mean requiring the use of excavation tools and equipment, such as rock core barrels or casing, beyond those normally used for standard earthwork conditions.

Soils Capable of Supporting Wastewater Disposal Systems

Review of NRCS (2022) soils data for soils from 24 to 60 inches in depth below the ground surface show that over 60% of the mapped soils are very limited for use as septic tank absorption fields, as shown in **Figure 14: Septic Tank Absorption Field Limitations**. The ratings are based on the soil properties that affect the absorption of the effluent, construction and maintenance of the system, and public health.

Measured properties that affect absorption include saturated hydraulic conductivity (K_{sat}), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding. The rating reasons given by the NRCS (2022) for the very limited soils include filtering capacity, depth to cemented pan, slow water movement, depth to bedrock, slope and flooding. The somewhat limited soils rating is based on the depth to a saturated zone and the potential for flooding.

Where BIG is underlain by uncemented coarse-grained sediments and a deep groundwater table, the soils would be capable of supporting wastewater disposal systems. However, some soils are fine-grained or have limiting soil types that may reduce the transmission and filtration of wastewater. An example of failed wastewater disposal systems in the same soil types adjacent to BIG footprint is the High Desert Estates residential development directly east of Lenwood Road and just north of the BIG footprint alignment in Lenwood. Past shallow perched groundwater conditions were caused by failed effluent disposal systems for the development (Tom Dodson & Associates, 2001, p. 9). The effluent reached a less permeable strata, resulting in the shallow perched groundwater condition. During excavation to replace some of the failed systems, the report notes shallow effluent water surfacing in trenches.



0 2,750 5,500 11,000 Feet

1 inch = 5,500 feet

Reference: Map adapted from Web Soil Survey, by USGS, accessed 02-11-2025, <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

Barstow International Gateway
San Bernardino County, California

**SEPTIC TANK ABSORPTION
FIELDS LIMITATIONS**

February 2025

110111-002

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FIG. 14

4.3 Primary Seismic Hazards

The BIG footprint lies within a seismically active region. The potential seismic hazard severity is related to the area's geology, distance from the seismic source, and magnitude of the earthquake generated by the seismic source. Primary seismic hazards are those hazards directly associated with earthquakes, including ground surface fault rupture and strong ground shaking.

Surface Fault Rupture

Surface fault rupture is the result of fault movement that breaks to the surface of the Earth either suddenly during earthquakes or slowly due to a process known as fault creep. Surface fault rupture is the result of tectonic movement that originates deep in the Earth. The energy released during an earthquake is a direct result of fault rupture at depth, and when that rupture extends to the ground surface it manifests as ground displacements expressed as fractures, fissures, offsets, and related tectonic deformation (CGS, 2018, p. 6). Surface fault rupture causes damage to structures astride the rupture zone.

To help identify and reduce the hazard of surface fault rupture, the Alquist-Priolo Earthquake Fault Zoning Act is a state law enacted to regulate certain development projects near active faults. The Act's purpose is to prohibit the location of most structures intended for human occupancy across the trace of an active fault. The Act requires that development permits for projects in Earthquake Fault Zones be withheld until geologic investigations demonstrate that the sites are not threatened by surface displacement from future fault rupture. To be zoned under the Act, a fault must be considered active, or both sufficiently active and well-defined (CGS, 2018, p. 72).

The CGS (2018) defines an active fault as one that has had surface displacement within Holocene time (about the last 11,700 years); and a sufficiently active fault as one that has evidence of Holocene surface displacement along one or more of its segments or branches (CGS, 2018, p. 9). The CGS considers a fault to be well defined if its trace is clearly detectable as a physical feature at or just below the ground surface. Another term defined by the CGS is a pre-Holocene fault, which is a fault whose recent past movement is older than 11,700 years and thus does not meet the criteria of Holocene-active fault (CGS, 2018, p. 2).

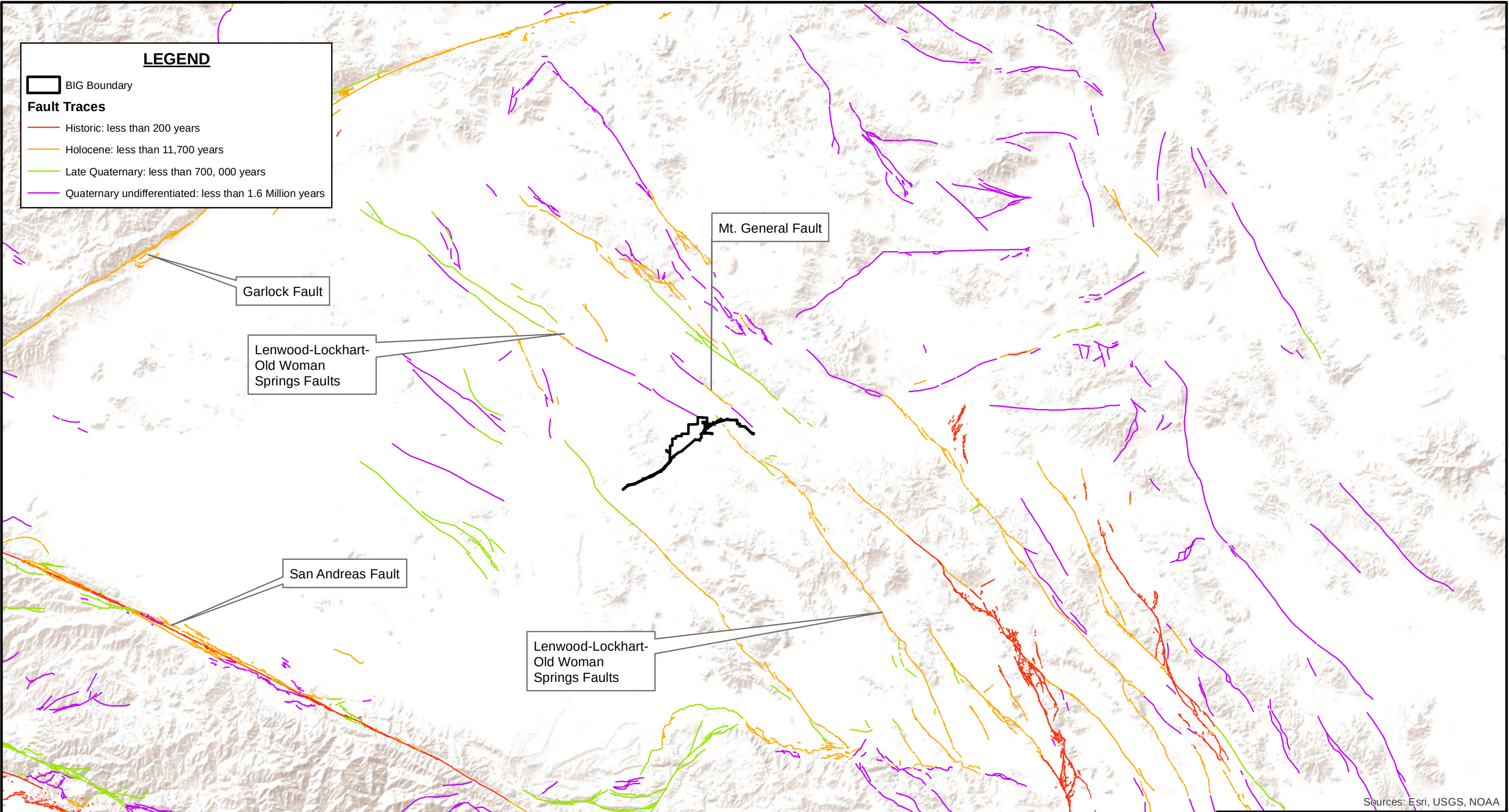
The Mojave Desert physiographic province is a region with historically active faults that generally trend northwest through the region. **Figure 15: Fault Activity Map** shows the Holocene active (red and orange colored) and Pre-Holocene faults (green and purple colored) in the region adjacent to BIG. Holocene active faults are specifically regulated by the State Alquist-Priolo Act. The faults shown are divided and color coded to show four age categories, based on information of when they last ruptured:

- Red—Historic displacement (last 200 years),
- Orange—Holocene displacement (last 11,700 years),
- Green—Late Quaternary displacement (last 700,000 years), and
- Purple—Undifferentiated Quaternary displacement.

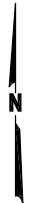
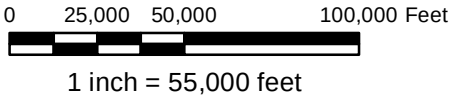
Nearby Holocene active and Pre-Holocene active fault zones include the Lenwood-Lockhart-Old Woman Springs fault zone, Gravel Hills, Harper fault zone, and the Helendale-South Lockhart fault zone. The closest Holocene active faults are the Lenwood and Lockhart faults and the Mt. General fault. Shannon & Wilson (2024c) report several traces of the Lenwood and Lockhart faults mapped by others as crossing

the east end of the BIG footprint, including a reported creeping¹⁶ section of the Lenwood fault shown in red on **Figure 16: Local Fault Map – BIG**. **Table 7: Summary of Active Faults within the Region** lists regional faults considered to be active that are part of the most recent regional fault model used for seismic hazard analysis (USGS, 2022e). These listed faults and fault zones are those considered to cause potentially damaging earthquakes in the region. **Table 7: Summary of Active Faults within the Region** lists the fault distance and direction from BIG and other fault parameters.

¹⁶ Slow, more or less continuous movement occurring on faults due to ongoing tectonic deformation. Faults that are creeping do not tend to have large earthquakes.



Sources: Esri, USGS, NOAA



Reference: Map adapted from USGS, Quaternary Fault and Fold Database of Unites States, GIS files, accessed August 10, 2020.

Grading and Yard Infrastructure
Barstow International Gateway
San Bernardino County, California

FAULT ACTIVITY MAP

February 2025

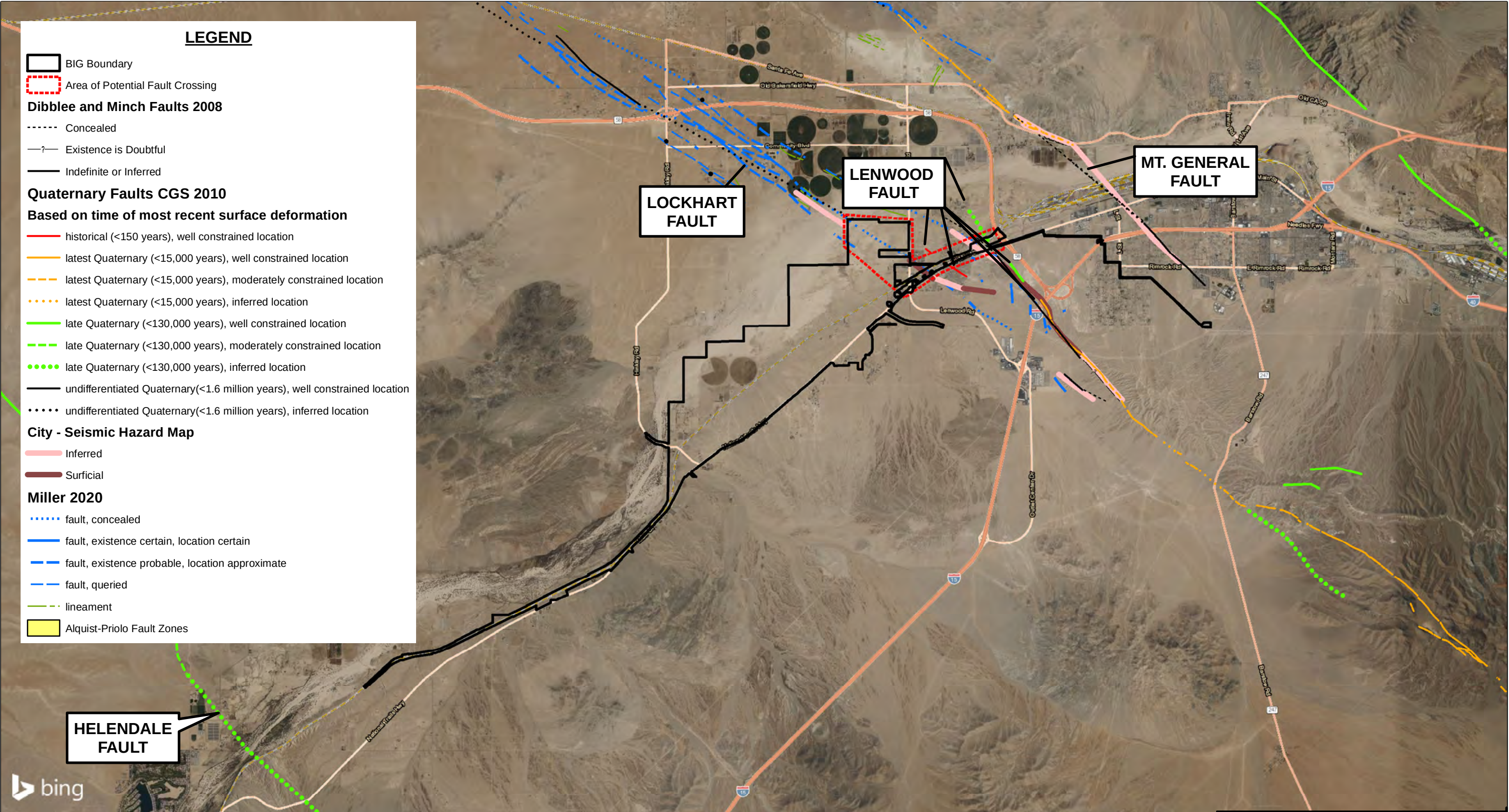
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FIG. 15

Table 7: Summary of Active Faults within the Region					
Fault	Approximate Distance to BIG (miles)	Direction from Footprint	Fault Geometry	Approximate Fault Length (miles)	Best Estimate Slip Rate (mm/yr)
Lenwood-Lockhart-Old Woman Springs	0.0	NE	Strike-Slip	90.2	1.0
Helendale-South Lockhart	1.0	SW	Strike-Slip	83.9	0.6
Gravel Hills-Harper Lake	5.5	N	Strike-Slip	40.5	0.7
Blackwater	9.5	N	Strike-Slip	39.3	0.5
Camp Rock 2011	10.0	E	Strike-Slip	28.1	0.6
Calico-Hidalgo	11.5	E	Strike-Slip	73.4	1.8
Coyote Lake	14.0	NE	Strike-Slip	32.5	0.01
Manix-Afton Hills	19.0	ENE	Strike-Slip	36.6	0.01
Paradise	21.0	NE	Strike-Slip	34.1	0.39
North Frontal (West)	25.0	S	Thrust	30.3	0.1
Cady	25.0	ENE	Strike-Slip	19.8	0.6
Emerson -Copper Mtn 2011	29.5	SE	Strike-Slip	45.0	0.39
Goldstone Lake	30.5	NNE	Strike-Slip	21.6	0.01
Johnson Valley (North) 2011 rev	32.0	SE	Strike-Slip	32.3	0.39
Cleghorn	33.0	S	Strike-Slip	16.1	0.45
Coyote Canyon	34.5	NE	Strike-Slip	23.1	0.01
Garlic Springs	34.5	NE	Strike-Slip	8.5	0.01
Pisgah-Bullion Mountain-Mesquite Lake	34.5	ESE	Strike-Slip	56.4	1.0
Bicycle Lake	36.0	NE	Strike-Slip	12.5	0.01
San Andreas (Mojave S)	37.0	SW	Strike-Slip	60.7	34.0
North Frontal (East)	37.5	SE	Thrust	17.6	0.1
San Jacinto (San Bernardino Valley) rev	37.5	S	Strike-Slip	23.0	6.0
San Jacinto (Lytle Creek Connector)	38.5	S	Strike-Slip	14.4	2.5
Nelson Lake	39.5	NNE	Strike-Slip	31.9	0.01
Homestead Valley 2011	40.0	SE	Strike-Slip	28.4	0.39
San Gabriel (Extension)	40.5	SW	Strike-Slip	38.8	0.01
Cucamonga	42.0	SSE	Thrust	18.1	1.5
Hector Mine	42.0	ESE	Strike-Slip	17.3	0.3
McLean Lake	42.5	NNE	Strike-Slip	33.2	0.01
Fontana (Seismicity)	44.0	SSW	Unassigned	14.9	0.39
Red Pass	48.0	ENE	Strike-Slip	15.8	0.01
Garlock (East)	50.0	NNE	Strike-Slip	28.1	3.0
Ludlow	50.0	E	Strike-Slip	44.4	0.3
Garlock (Central)	51.0	NNW	Strike-Slip	69.0	7.0
San Jose	51.0	SW	Strike-Slip	12.2	0.39
Owl Lake	51.0	NNE	Strike-Slip	15.7	2.0
Panamint Valley	51.5	N	Normal	68.2	3.0
Bullion Mountains	53.0	ESE	Strike-Slip	23.6	0.01
Tank Canyon	53.5	N	Strike-Slip	21.8	1.0

Table 7: Summary of Active Faults within the Region					
Fault	Approximate Distance to BIG (miles)	Direction from Footprint	Fault Geometry	Approximate Fault Length (miles)	Best Estimate Slip Rate (mm/yr)
Kickapoo	53.5	SE	Strike-Slip	3.9	0.39
Garlock (West)	53.5	WNW	Strike-Slip	60.7	6.0-7.6
San Geronio Pass	55.7	SSE	Thrust	17.9	1.8
Little Lake	56.5	NNW	Strike-Slip	27.2	0.6
Mission Creek	57.5	SSE	Strike-Slip	19.5	1.25
Baker	58.5	NE	Strike-Slip	54.5	0.01
Pinto Mountain	63.0	SSE	Strike-Slip	51.7	2.5
Notes: E = East ENE = East-northeast ESE = East-southeast mm/yr = millimeters per year N = North NE = Northeast NNE = North-northeast NNW = North-northwest S = South SE = Southeast SSE = South-southeast SSW = South-southwest SW = Southwest WNW = West-northwest					
Source: USGS, 2022e; Dawson and Weldon, 2013					



LEGEND

BIG Boundary

Area of Potential Fault Crossing

Dibblee and Minch Faults 2008

Concealed

Existence is Doubtful

Indefinite or Inferred

Quaternary Faults CGS 2010

Based on time of most recent surface deformation

historical (<150 years), well constrained location

latest Quaternary (<15,000 years), well constrained location

latest Quaternary (<15,000 years), moderately constrained location

latest Quaternary (<15,000 years), inferred location

late Quaternary (<130,000 years), well constrained location

late Quaternary (<130,000 years), moderately constrained location

late Quaternary (<130,000 years), inferred location

undifferentiated Quaternary(<1.6 million years), well constrained location

undifferentiated Quaternary(<1.6 million years), inferred location

City - Seismic Hazard Map

Inferred

Surficial

Miller 2020

fault, concealed

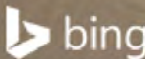
fault, existence certain, location certain

fault, existence probable, location approximate

fault, queried

lineament

Alquist-Priolo Fault Zones



0 4,250 8,500 17,000 Feet



1 inch = 8,500 feet



Barstow International Gateway
San Bernardino County, California

LOCAL FAULT MAP

February 2025

110111-002

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 16

Seismic Sources

The topography within the Mojave Desert physiographic province is controlled by an over 60-mile-wide network of northwest-trending, right-lateral, strike-slip faults and secondary east-west-trending faults. These faults are accommodating ongoing tectonic deformation in the region known as the Mojave section of the ECSZ (Frankel et al., 2008, p. 45). As discussed above and shown in **Figure 15: Fault Activity Map** and **Figure 16: Local Fault Map**, BIG is crossed by the potentially Holocene active northwest-trending Lenwood-Lockhart fault zone.

Figure 17: Historic Earthquake Magnitude shows that the seismically active ECSZ has historically active fault ruptures that generated earthquakes greater than Magnitude 7.0. Seismological and paleoseismic data show this region to be actively releasing crustal strain at a relatively rapid rate. The most recent substantial fault ruptures in the Mojave section of the ECSZ include the 1992 M 7.3 Landers and the 1999 M 7.1 Hector Mine earthquakes (Frankel et al., 2008). The most recent large magnitude July 2019 M 6.4 and M 7.1 Ridgecrest Earthquakes are outside of the Mojave section but are within the ECSZ.

Seismic Ground Motion

Ground shaking occurs in response to energy released during a fault rupture. The energy travels through subsurface rock, sediment, and soil materials, resulting in motion experienced at the ground surface. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the source of energy release, and the type of rock or sediment through which the seismic waves travel. Depending on the level of ground motion and the stiffness of the soil, the ground motions can amplify or de-amplify.

The BIG footprint could experience strong ground shaking during an earthquake along faults in the region. The intensity of earthquake motion and seismic hazards that may affect BIG would depend on the characteristics of the generating fault including distance to the earthquake fault, earthquake magnitude, earthquake duration, and site-specific geologic conditions. As discussed previously, potential sources for strong ground motion are nearby known active faults (e.g., the Lenwood-Lockhart Fault and Helendale Fault).

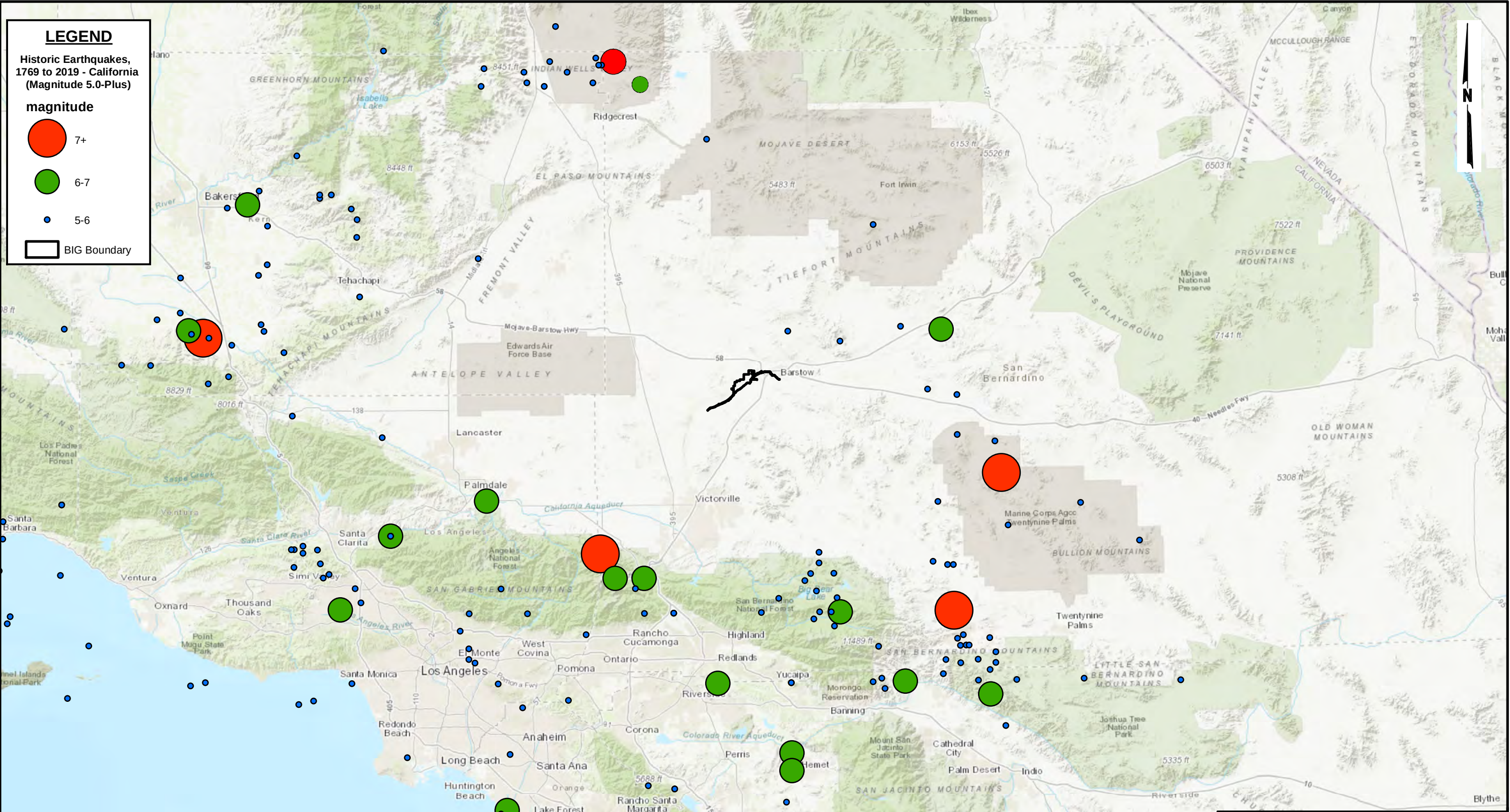
Ground motions induced by a seismic event are characterized by a value of horizontal peak ground acceleration that is expressed as a percentage of the acceleration of gravity. Either deterministic or probabilistic methods are used by geoscientists and geotechnical engineers to estimate the level of shaking that can be expected at a site.

Historic Seismicity

Several earthquakes of moderate to large magnitude (greater than 5.0) have occurred in the southern California region within historical time as shown in **Figure 17: Historic Earthquake Magnitude** (CGS, 2022c). A list of substantial historic earthquakes of M 6.0 and greater within about 62 miles (100 kilometers) of BIG are included in the **Table 8: Summary of Substantial Historic Earthquakes in the Region within 62 miles (100 km) of BIG**.

Table 8: Summary of Substantial Historic Earthquakes in the Region within 62 miles (100 km) of BIG

Date	Earthquake Name	Magnitude	Epicentral Latitude (degrees)	Epicentral Longitude (decimal degrees)
1812-12-08	Wrightwood Earthquake	6.9	34.37	-117.65
1858-12-16	San Bernardino Earthquake	6.0	34.2	-117.4
1899-07-22	Cajon Pass Earthquake	6.4	34.3	-117.5
1923-07-23	North San Jacinto Fault Earthquake	6.0	34	-117.25
1947-04-10	Manix Earthquake	6.5	34.983	-116.532
1992-06-28	Landers Earthquake	7.3	34.2	-116.437
1992-06-28	Big Bear Earthquake	6.3	34.203	-116.827
1999-10-16	Hector Mine Earthquake	7.1	34.603	-116.265
2019-07-04	Ridgecrest Earthquake	6.4	35.705	-117.504
2019-07-06	Ridgecrest Earthquake	7.1	35.770	-117.599
Source: USGS, 2022f				



4.4 Secondary Seismic Hazards

A number of secondary seismic hazards could occur if there is strong ground shaking at the BIG footprint. The strong ground shaking could result from either nearby or distant earthquakes, depending on the combination of earthquake magnitude and distance from the BIG footprint. These secondary hazards include liquefaction, seismically-induced slides or slumps, earthquake-induced flooding, and floods resulting from seismically-induced dam failure. The following subsections discuss these hazards and identify their possible locations.

Liquefaction

Liquefaction describes the phenomenon in which saturated, cohesionless, or low-plasticity soils temporarily lose shear strength (quicksand-like conditions) due to increased pore water pressures induced by strong, cyclic ground motions such as during an earthquake. The loss in shear strength may generate ground settlement, lateral spreading (ground movement on gentle slopes), bearing capacity failures, and/or landslides. Liquefaction potential is greatest where loose granular soil (sand and non-plastic silt) is present below groundwater and is more likely to affect structures when the potentially liquefiable soils are present at depths shallower than 50 feet. Liquefaction potential decreases as the fines (clay and silt) content of soil increase and increases as ground shaking increases.

Groundwater is relatively deep along the eastern half of the BIG footprint where historical groundwater levels are greater than 50 feet and the soils would not be considered liquefiable. Areas most likely to have a shallow enough groundwater table to allow seismic liquefaction to occur would be adjacent to the Mojave River in the western portion of the BIG footprint. Areas where groundwater levels have been within 50 feet of the ground surface would require analysis to determine liquefaction potential. Shannon & Wilson (2024a) groundwater maps were used to evaluate specific areas within the BIG footprint for liquefaction. Shannon & Wilson (2024d) encountered the potential for liquefaction at localized locations within the BIG footprint where the median groundwater levels are shallower than 50 feet. Lateral Spreading

Continuous liquefaction below gently sloping ground adjacent to a free face (e.g., riverbank or artificial embankments) may generate lateral spreading. Lateral spreading consists of the displacement of a soil mass when static driving shear stresses, such as the weight of a riverbank and overlying structures, is greater than the underlying shear strength of liquefied layers. Non-liquefied “crust” layers above liquefied layers can be subject to lateral spreading and can apply larger lateral forces to foundations and retaining structures.

Groundwater is relatively deep under most of the BIG footprint; however, at the western end, adjacent to the Mojave River, groundwater has historically been within 15 feet of the ground surface. Although the ground surface is relatively level in this portion of the BIG footprint, there is a slight slope down towards the Mojave River. As discussed above, studies by Shannon & Wilson (2019, 2021) of specific areas within the BIG footprint indicate most areas are not susceptible to liquefaction, thereby indicating that lateral spreading is not a concern at the BIG footprint. However, where localized liquefaction was encountered (Shannon & Wilson, 2024d) near the Mojave River, there is the potential for lateral spreading to occur during strong seismic shaking.

Seismic Compression

Seismic compression occurs in loose, granular soils above the groundwater table during strong ground shaking. The ground motion causes the grains to rearrange into a denser configuration, which results in settlement. Portions of the BIG footprint are underlain by recent alluvium that may be very loose to loose granular poorly-graded sands above the water table that may be susceptible to seismic compression.

Shannon & Wilson (2019, 2021, 2024d, 2024e) reports that due to the likely potential for strong seismic ground shaking in the region, there is the potential for seismic compression in the upper very loose to loose granular soils within the BIG footprint. These deposits are typically those within the alluvium, Mojave channel river sands, and dune sands.

Seismically-Induced Landslide Hazards

Seismically-induced landslides occur when shaking from an earthquake causes pre-existing landslides to reactivate or triggers new landslides along planes of weakness in bedrock or soil materials. Marginally stable slopes may be subject to landslides caused by seismic shaking. In most cases, this is limited to relatively shallow soil failures on steeper natural slopes, although deep-seated failures of over-steepened slopes are also possible.

Earthquake triggered landslides have historically been a substantial cause of damage in California. The BIG footprint is located in relatively level to gently sloping terrain and existing landslides are not known to be present. The hazard of seismically-induced landslides is considered very low.

Seismically-Induced Flood Hazards

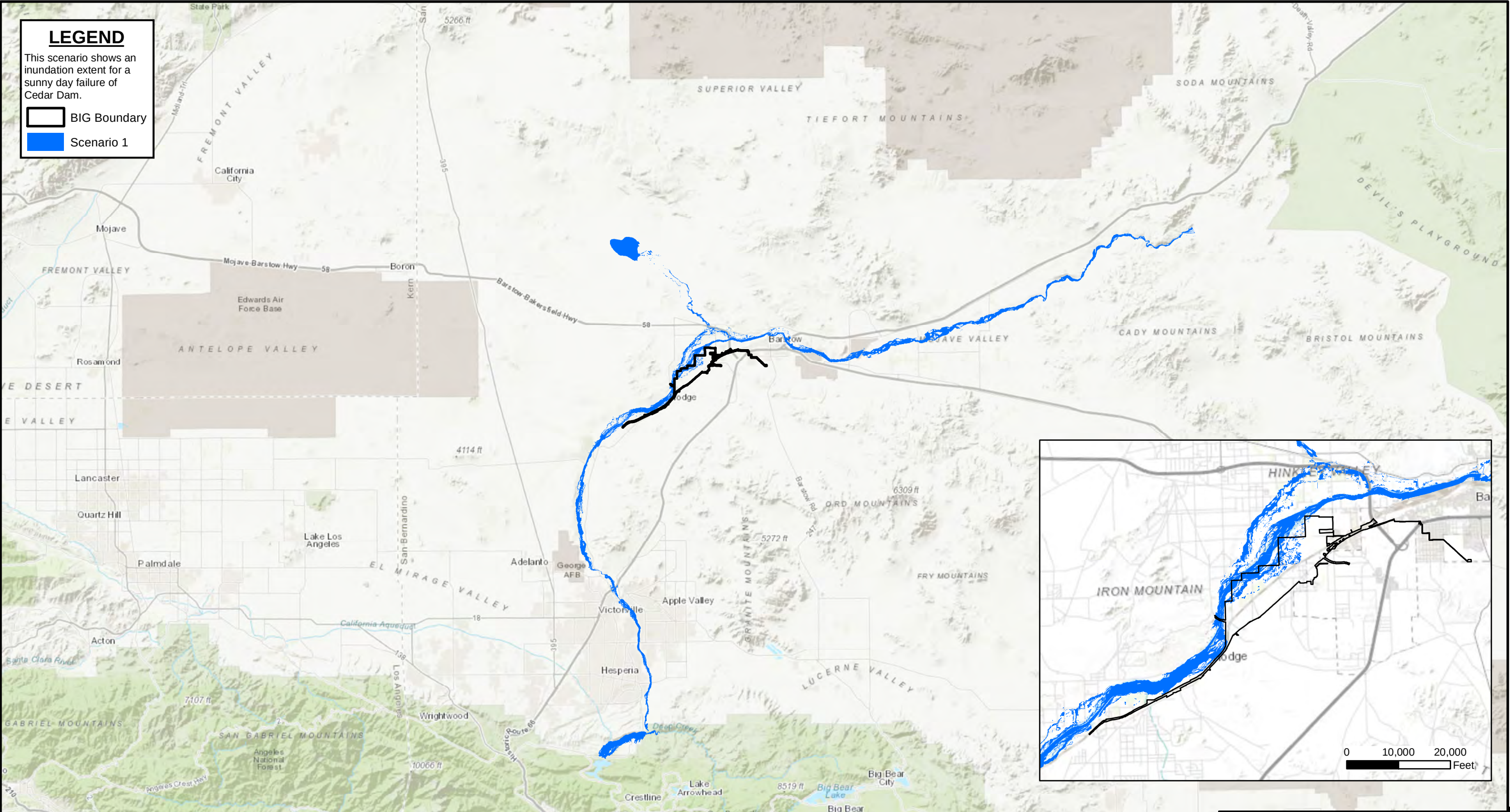
Seismically-induced flooding is defined as flooding caused by failures of dams or other water-retaining structures caused by seismic shaking, resulting in damage to structures and properties located downstream and possible injuries or loss to life. However, failures of dams are more often caused by foundation failures, piping and internal erosion, overtopping caused by floods and inadequate capacity or inadequate spillways, and poor construction. Seiche or tsunami waves are another type of seismically-induced flooding. The statutes governing dam safety in California are included in Division 3 of the Water Code and place responsibility of dam safety under the jurisdiction of the California Water Resources DSOD.

Dam inundation maps for California dams are under the jurisdiction of the California Office of Emergency Services, whose Dam Safety Program coordinates with other state and federal agencies to assure effective dam incident emergency response procedures and planning. Inundation maps are approximations of the maximum water surface extent resulting from a complete dam breach and draining of the full reservoir. The resultant maps are to be used to identify risk for planning purposes as they represent the worst-case scenario for a total failure of a dam.

As required by California Water Code section 6161, DWR DSOD reviews and approves inundation maps prepared by licensed civil engineers and submitted by dam owners where the seismic hazard is considered extremely high, high, and significant to dams and their critical appurtenant structures. Inundation maps approved by DSOD are a tool used to develop emergency action plans, and the maps are intended to provide general information for emergency planning (DWR, 2022a). Review of the California Emergency Management Agency's dam inundation maps shows that BIG is located within a potential inundation area

for reservoir failure (DWR, 2022b). **Figure 18: Dam Failure** is the inundation map for Cedar Springs Dam and shows the resultant flooding within the northern boundaries of the BIG footprint along the Mojave River. **Figure 19: Dam Failure Water Depth** shows the potential depth of flooding within the BIG footprint in the event of this catastrophic failure.

A seiche refers to the movement of an enclosed body of water such as a bay, lake, river, or reservoir due to periodic oscillation. Seiches commonly occur as a result of intense seismic shaking or catastrophic landslides displacing large amounts of water in a short period of time. The period of oscillation varies and depends on the size of the water body. The period of a seiche can last for minutes to several hours, and depends on the magnitude of oscillations, as well as the geometry of the water body. Seiches have been recorded to cause substantial damage to nearby structures, including dams, shoreline facilities, and levees or embankments. Due to the seasonal and limited flow of the Mojave River the potential for seiche is considered low to negligible in the BIG footprint. Tsunami impacts from ocean generated waves are negligible given BIG's inland location.



LEGEND

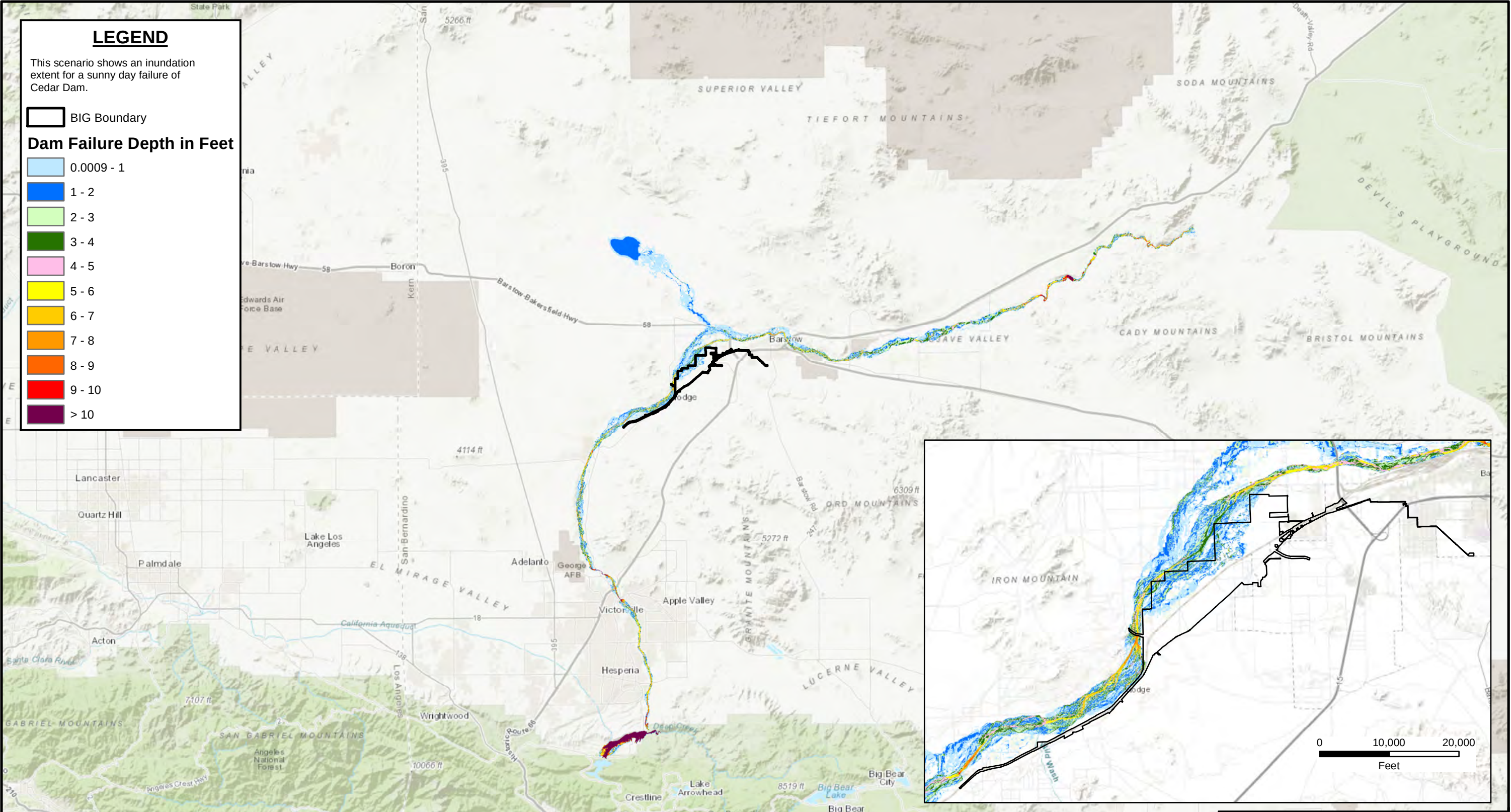
This scenario shows an inundation extent for a sunny day failure of Cedar Dam.

 BIG Boundary

 Scenario 1

Reference: The State of California and the Department of Water Resources' Division Safety of Dams (DSOD)
- <https://fmds.water.ca.gov/webgis>

Barstow International Gateway San Bernardino County, California	
DAM FAILURE	
February 2025	110111-002
 SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	FIG. 18



Reference: The State of California and the Department of
Water Resources' Division Safety of Dams (DSOD)
- <https://fmds.water.ca.gov/webgis>

Barstow International Gateway
San Bernardino County, California

DAM FAILURE WATER DEPTH

February 2025 110111-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 19

4.5 Geological Resources

Geological resources in California include oil and gas fields, geothermal fields, and a wide range of mineral and aggregate resources. The principal constraint associated with oil, gas, geothermal, mineral and aggregate resources is the need for planning to ensure that construction of new facilities would not conflict with the removal of economically important resources. In addition, the presence of even small (non-economic) quantities of oil or gas in the subsurface can pose toxic or explosive hazards during construction, requiring specific precautions, and may also necessitate special designs and monitoring during the operation of subsurface structures.

Fossil Fuel Resources (Oil and Natural Gas)

Review of CalGEM Oil, Gas and Geothermal Fields in California map (DOGGR, 2001) and the CalGem Well Finder database (CalGem, 2022) shows that the BIG footprint is not in or near oil or natural gas fields or wells.

Geothermal Resources

Review of the CalGEM California Geothermal Map (DOGGR, 2001) and CalGEM Well Finder database (CalGEM, 2022) show that BIG is not in or near a Geothermal Resource Area as classified by CalGEM. No producing or abandoned geothermal wells or geothermal springs are within the BIG footprint.

5.0 IMPACT ANALYSIS

5.1 Introduction

This section presents the impact analysis relating to geology, soils and seismicity, and paleontological resources for BIG. This analysis reviews both the temporary construction phase and the permanent operation of BIG; and the potential for both to directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death.

5.2 Impacts

Impact 1	<i>Would the Project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.</i>
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The CGS Special Publication 42 provides state-of-the-practice guidelines for affected permitting agencies and their reviewers, as well as for geoscience consulting practitioners representing property owners and developers (CGS, 2018, p. 5). The purpose of these guidelines under the Alquist-Priolo Earthquake Fault Zoning Act, as described in **Section 3.0 - Surface Fault Rupture**, is to regulate development near active faults so as to mitigate the hazard of surface fault rupture. Special Publication 42 and associated maps and published reports that delineate Earthquake Fault Zones were reviewed for this impact analysis as discussed below.

The surface fault rupture hazard was evaluated based on whether any portion of the BIG footprint crosses a mapped trace of any active fault as delineated on either the most recent Alquist-Priolo Earthquake Fault Zoning Maps or Fault Activity Map of California. The effect of surface fault rupture includes the potential for injury or death and financial losses as a result of facility damage or collapse. Based on a review of the most recent Alquist-Priolo Earthquake Fault Zoning Maps, the BIG footprint does not traverse an Alquist-Priolo, Earthquake Fault Zone. Based on the Fault Activity Map of California, and available geological data, a historical “creeping” fault within the Lenwood-Lockhart fault system is reported to cross the BIG footprint as shown on **Figure 15: Fault Activity Map** and **Figure 16: Local Fault Map**.

Surface fault rupture is a potential impact where the Lenwood-Lockhart fault system crosses the eastern portion of the BIG footprint. The faults crossing the BIG footprint in **Figure 16: Local Fault Map** are not mapped within an Alquist-Priolo Earthquake Fault Zone because there is not sufficient evidence to place them within a Zone as determined by Bryant (1987). One trace is mapped as a historically active fault with reported anecdotal evidence of creep that was not confirmed by the California Geological Survey (Manson 1986; Bryant 1987). Shannon & Wilson (2021) field checked the mapped features in Manson (1986) and confirmed that there is no evidence of fault creep at the location of these features adjacent in the BIG footprint. Additionally, the City does not have records that evaluate fault creep on the Lenwood fault (D. Gonzales, personal communication, May 12, 2021).

Unconfirmed anecdotal evidence of a fault reported in Manson (1986) is not substantial evidence to properly delineate the fault on a map.

However, as shown in **Figure 16: Local Fault Map** the eastern lead track extensions and proposed Transload Warehouse Center of BIG cross an area that is in-line with the general trend of the Lenwood-Lockhart fault system that is potentially Holocene active. A future earthquake on this fault system may result in surface ground rupture or ground deformation across the eastern end of the BIG footprint during an earthquake on this fault system. Existing and proposed structures within the area of potential fault crossings include:

- Existing and proposed bridges at Mileposts 4.3C and 4.3D
- Proposed retaining wall at Milepost 4.5
- Proposed warehouses and associated improvements including access roads and parking lots
- Proposed culverts
- Existing and proposed tracks

BNSF would conform to guidelines and standards specified by relevant transportation and building agencies and codes, requiring contractors to account for the potential of surface fault rupture during BIG's design and construction and thereby reduce to a low level the risks associated with ground surface fault rupture within the BIG footprint.

The following lists the current building and seismic design guidelines and standards that would be used during BIG's design and construction which would minimize the effects from ground surface fault rupture, and the effects of other hazards described in later sections:

- **The American Association of State Highway and Transportation Officials (AASHTO) 2014 AASHTO LRFD [Load and Resistance Factor Design] Bridge Design Specifications (7th Edition with 2015 and 2016 Interim Revisions) and the 2011 AASHTO Guide Specifications for LRFD Seismic Bridge Design (2nd Edition with 2012, 2014, and 2015 Interim Revisions):** These documents provide guidance for characterization of soils, as well as methods to be used in the design of bridge foundations and structures, retained cuts and retained fills, at-grade segments, and buried structures. The design specifications provided are minimum specifications for evaluating the seismic response of soil and structures.
- **Federal Highway Administration Circulars and Reference Manuals:** These documents provide detailed guidance on the characterization of geotechnical conditions at sites, methods for performing foundation design, and recommendations on foundation construction (e.g., Soils and Foundation Reference Volumes I and II; FHWA-NHI-06-088 and FHWA-NHI-06-089). They are guidance documents that include methods for designing retaining walls used for retained cuts and retained fills, foundations for elevated structures, and at-grade segments. Some of the documents include guidance on evaluating scour at bridges.
- **The American Railway Engineering and Maintenance-of-Way Association's 2018 Manual for Railway Engineering:** Although these guidelines cover many of the same general topics as the AASHTO guidelines, they are more focused on best practices for rail systems. The manual includes

principles, data, specifications, plans, and economics pertaining to the engineering, design, and construction of railways.

- **California Building Code (CBC):** The 2022 CBC is based on the 2021 IBC. This code contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance.
- **IBC and American Society of Civil Engineers:** These codes and standards provide minimum design loads for buildings and other structures. Sections in the IBC and American Society of Civil Engineers provide minimum requirements for geotechnical investigations, levels of earthquake ground shaking, minimum standards for structural design, and inspection and testing requirements.
- **California Department of Transportation (Caltrans) Design Standards:** Caltrans has specific minimum design and construction standards for all aspects of transportation system design, ranging from geotechnical explorations to construction practices. Caltrans design standards include state-specific amendments to the AASHTO LRFD Bridge Design Specifications and Guide Specifications for LRFD Seismic Bridge Design. These amendments provide specific guidance for the design of deep foundation used to support elevated structures, for design of mechanically stabilized earth walls used for retained fills, and for design of various types of cantilevers (e.g., soldier pile, secant pile, and tangent pile) and tie-back walls used for retained cuts.
- **BNSF Track and Bridge Standards:** BNSF has specific minimum design and construction standards for all aspects of their projects including guidelines ranging from geotechnical explorations to construction practices. These guidelines contain minimum requirements for geotechnical investigations, levels of earthquake ground shaking, standards for structural design, and inspection and testing requirements.
- **BNSF Engineering Instructions (BNSF 2022) and Systems Special Instructions No. 10 dated June 5, 2019 (BNSF 2019):** BNSF has specific rules and requirements for evaluating track and structures following earthquake events. The areal extent of inspections is dependent on the magnitude and location of earthquake events.

With these design and construction guidelines, standards, measures and practices, construction of BIG would neither directly nor indirectly cause potentially substantial adverse effects, including the risk of destruction, injury, or loss of life because of ground surface fault rupture.

Construction

Surface fault rupture and associated ground deformation during construction is low given the relatively short duration of construction activities. The fault traces as presently mapped are shown in **Figure 16: Local Fault Map**.

If fault rupture occurs during construction, the impacts could be repaired with track realignment and additional grading during BIG construction. The actual measures taken would depend on the severity of the earthquake and the extent of ground deformation. Shutting down construction temporarily during or after a potentially damaging earthquake would minimize the risk of construction personnel or equipment encountering structures that have been compromised by seismic activity.

Operations

A large earthquake could occur during BIG operations. If the source of the earthquake is the Lenwood-Lockhart fault zone, surface fault rupture could occur within the BIG footprint. If an earthquake were to occur, potential effects could range from no effect to the potential for built structure damage due to significant ground deformation. The magnitude of the effect would depend on the size of the earthquake and the location and orientation of the various BIG features with respect to the source of the earthquake. Surface fault rupture during operations could cause risk of property damage, injury, or loss of life from potential train derailments because of surface fault rupture from the Lenwood-Lockhart faults at or near BIG's tracks.

To protect personnel and property safety and project integrity in case of an earthquake during operations, BNSF would implement its existing operating procedures to slow down or shut down operations temporarily during or after a potentially damaging earthquake in the area to reduce risks.

The BNSF Engineering Instructions (BNSF, 2022) and Systems Special Instructions No. 10 (BNSF, 2019) requires special track inspections when an earthquake is reported with a magnitude 5 or greater. These instructions require trains to proceed at restricted speeds or stop entirely, depending on the magnitude and distance to the earthquake. Coseismic ground surface rupture does not typically occur in earthquakes with a magnitude less than 5 (Bonilla, 1988, p. 17). American Railway Engineering and Maintenance-of-Way Association (AREMA) (2018) provides general guidelines for post-earthquake inspection of facilities and infrastructure. Post-earthquake inspection of bridges requires following the procedures contained in Chapter 14 of the AREMA Bridge Inspection Handbook.

A historical example of these measures being implemented occurred when BNSF performed post-earthquake assessments of track and facilities following the 1999 magnitude 7.1 Hector Mine earthquake. Track and bridge damages were encountered within 15 miles of the epicenter of the earthquake. BNSF completed their post-earthquake serviceability inspections within 8 hours of the event (Byers, W.G., 2001).

The measures taken would depend on the severity of the earthquake and the extent of ground deformation, if present. Shutting down operations temporarily during or after a potentially damaging earthquake would minimize the risk of a moving train encountering rail and structures that have been compromised by seismic activity. If fault rupture disrupts the tracks or structures, the impacts could be repaired with track realignment to restore service, minor grading to repair adjacent disrupted ground surfaces and assessment of the serviceability of structures, if affected.

Implementation of the guidelines and standards described above and City staff review of the grading and building plans would result in potential impacts associated with rupture of a known earthquake fault to be less than significant for both construction and operations.

Impact 2

Would the Project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking?

As discussed in **Section 1.13 – Primary Seismic Hazard**, evidence from historical seismicity indicates that strong ground shaking would likely occur during operation of BIG. Faults in the region are capable of producing earthquakes with intense ground shaking. This level of shaking would result in substantial loads to structure supported on the soil. Strong ground shaking could result in secondary seismic hazards such as liquefaction and seismic compression within and adjacent to BIG.

The USGS has developed a probabilistic seismic hazard model for the United States (Petersen et al., 2014) that is useful to determine an estimate of ground motions. The maps generated from this model display earthquake ground motions for various probability levels and represent an assessment of the best available science in earthquake hazards. The anticipated level of strong ground motions can be determined from the data in this model by the USGS Unified Hazard Tool (USGS, 2022h). The model indicates that BIG will likely be exposed to strong seismic ground shaking.

Construction

The potential for strong seismic ground shaking during construction is relatively low compared to operational impacts described below given the relatively short duration of construction activities. Construction activities involving grading excavation, earth stabilization, and erection of structures could be affected by strong ground shaking. To protect personnel and property safety and project integrity in case of earthquake during construction, BNSF through its Engineering Instructions (BNSF, 2022) and Systems Special Instructions No. 10 (BNSF, 2019) must perform facility inspections when an earthquake is reported with a magnitude 5 or greater and requires trains to proceed at restricted speeds or stop entirely, depending on the magnitude and distance to the earthquake. BNSF would implement these existing operating procedures to slow down or shut down construction activities temporarily during or after a potentially damaging earthquake to reduce risks described above. The measures taken would be dependent upon the severity of the earthquake. Shutting down construction temporarily during or after a potentially damaging earthquake would minimize the risk of construction personnel or equipment encountering structures that have been compromised by seismic activity.

Damage to structures under construction would be evaluated by BNSF prior to resumption of construction activities. Repairs would be incorporated into the construction process. Damage to track under construction could be repaired with track realignment and related grading to restore the original track design.

Operations

Large earthquakes have historically occurred within 62 miles (100 km) of BIG as discussed in **Section 3.0 - Historic Seismicity** and are anticipated to occur during BIG operations. BNSF would design structures and graded land in accordance with the applicable guidelines and standards presented in **Impact 1** to withstand the design seismic event, and thereby reduce the risks associated with strong seismic ground shaking. BIG would neither directly nor indirectly cause or accelerate the potential for seismic ground shaking. Therefore, it would not increase the potential for substantially adverse effects, including potential loss of life, injuries, or destruction as a result of seismic ground shaking during operation.

BNSF would also implement its Engineering Instructions (BNSF, 2022) and Systems Special Instructions No. 10 (BNSF, 2019) to perform track and facility inspections when an earthquake is reported with a magnitude 5 or greater and requires trains to proceed at restricted speeds or stop entirely, depending on

the magnitude and distance to the earthquake. These existing operating procedures would slow or shut down operations temporarily during or after a potentially damaging earthquake, to reduce risks to personnel and property safety and project integrity in case of an earthquake described above. The measures taken would be dependent upon the severity of the ground shaking. Shutting down operations temporarily during or after a potentially damaging earthquake would minimize the risk of a moving train encountering structures that have been compromised by seismic activity. Facilities evaluated per the BNSF (2019, 2022) Instructions described above would allow assessment and applicable repairs be made before resuming operations.

BNSF would conform to guidelines and standards specified by relevant transportation and building codes presented above in Impact 1. The guidelines and standards incorporate current seismic design standards that would be used during BIG's design which would minimize the effects from seismically induced ground shaking requiring contractors to account for geotechnical properties during BIG's design and construction and thereby reduce to a low level the risks associated with seismically induced ground shaking. AREMA (2018) provides general guidelines that may be used for developing a post-earthquake inspection of facilities and infrastructure. Post-earthquake inspection of bridges requires following the procedures contained in Chapter 14 of the AREMA Bridge Inspection Handbook.

With these design measures and practices, BIG construction and operations would neither directly nor indirectly cause potentially substantial adverse effects, including the risk of destruction, injury, or loss of life because of seismic ground shaking. Implementation of the guidelines and standards described above; and City staff review of the grading and building plans would result in potential impacts associated with strong seismic ground shaking to be less than significant.

Impact 3	<i>Would the Project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction?</i>
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Liquefaction, lateral spreading, and seismic compression were evaluated by Shannon & Wilson (2019, 2021, 2024b, 2024d, 2024e) in areas that cover BIG. Seismic related ground failure would be an issue at the western half of the BIG footprint where historical groundwater levels are reported up to 15 feet bgs and where BIG is closer to the Mojave River channel. The potential for liquefaction was encountered at Bridges 10.5 and 14.3. The effect of these secondary seismic hazards would vary depending on where they are located. Retained fills, embankments, and at-grade structure could be affected by loss of bearing support. Elevated structures on deep foundations, such as bridges, are capable of withstanding near surface liquefaction.

The potential for seismically-induced ground failure was evaluated in the project geotechnical investigations by Shannon & Wilson (2019, 2021, 2024b, 2024d, 2024e). The geotechnical analyses used a screening procedure to identify soil conditions potentially susceptible to liquefaction. The soils evaluated along the alignment at railroad bridges and the Hinkley Road grade separation are not considered susceptible to liquefaction. The transload warehouse center is in an area underlain by loose to very loose soils within the upper 15 feet of the ground surface. However, groundwater is below 50 feet bgs in this area so liquefaction is not anticipated to be a concern.

Bridges and structures constructed under the guidelines and standards presented in Impact 1 would result in structures built to withstand the design seismic event. Geotechnical design (Shannon & Wilson 2019, 2021) and construction would follow these guidelines and standards and would minimize the potential for seismically induced ground failure.

Geotechnical design for BIG includes recommendations to mitigate the risk from secondary seismic hazards (Shannon & Wilson 2019, 2021, 2024b, d, e). BNSF would document how the current seismic design criteria were used in the design of constructed facilities and structures at the intermodal and block swap facilities, transload warehouse center and bridges supported in or on the ground. Site-specific geotechnical investigations would be carried out as the design work progresses to determine whether the type and density of the soil could result in conditions that would be susceptible to liquefaction and are in need of stabilization measures. These measures would utilize the design standards presented in Impact 1, using site-specific geotechnical data to reduce risk of ground movement at structures as a result of seismic activity. Localized instabilities that may occur would be handled as a maintenance issue for track, roadways, and other non-structural features.

BNSF would conform to guidelines specified by relevant transportation and building codes presented in Impact 1, requiring contractors to account for geotechnical properties during design and construction. These requirements would address risk factors associated with seismically induced ground failure. Designing these guidelines, standards, and geotechnical recommendations (Shannon & Wilson 2021, 2019) would reduce the severity of the earthquake damage to structures.

Construction

BNSF would design structures to withstand design seismic hazards in accordance with the previously discussed guidelines and standards, minimizing the risks associated with liquefaction and other types of seismically induced ground failure.

Construction activities would not cause a regional increase in groundwater elevations or reduce the strength of underlying soil deposits. Therefore, construction activities would neither directly nor indirectly cause or accelerate the potential for liquefaction or other types of seismically induced ground failure. Overall BIG construction would not increase the potential for substantially adverse effects, including the risk of destruction, injury, or loss of life because of potential liquefaction or other types of seismically induced ground failure during construction.

Operations

In addition to designing the rail yard facilities and the transload warehouse center for potential seismic activity, BNSF would implement its existing operating procedures to slow down or shut down BIG's rail operations temporarily during or after a potentially damaging earthquake to reduce risks described above. The measures taken would be dependent upon the severity of the earthquake. Shutting down rail operations temporarily during or after a potentially damaging earthquake would minimize the risk of a moving train encountering structures that have been compromised by liquefaction and ground failure.

As stated above, BIG would neither directly nor indirectly cause or accelerate the potential for liquefaction or other types of seismically induced ground failure. Therefore, BIG would not increase the potential for substantially adverse effects, including the risk of destruction, injuries, or loss of life because of potential

liquefaction or other types of seismically induced ground failure during operation. Implementation of the guidelines and standards described above; and City staff review of the grading and building plans would result in potential impacts associated with seismic-related ground failure, including liquefaction, to be less than significant.

Impact 4 *Would the Project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?*

As discussed in **Section 4.1, Geologic Hazards – Landslide Hazards** and **Section 4.1, Geologic Hazards – Areas of Difficult Excavation**, known preexisting landslides are not present within or near the BIG footprint. There would be no exposure to slope failure hazards associated with preexisting landslides. Geotechnical design measures would be implemented that would reduce the potential for landslides or slope failures in graded cut and fill slopes.

Unstable soils consist of loose or soft deposits of sands, silts, and clays that are not adequate to support the planned structures and fill loads or grading cuts. These soils exhibit low shear strength and, when loaded or undercut, can fail through bearing failures or slope instabilities, depending on the extent to which construction would occur on unstable soils resistant to risk reduction. During construction, after vegetative and other cover have been removed, exposed soils within BIG would be potentially subject to erosive forces. The longer the period of exposure to erosive forces, the greater is the potential for unstable soil failures.

Engineered ground improvements, such as regrading, would stabilize soft or loose soils where they occur. In addition, design would improve the stability of deep unstable soils by replacing unstable soils with competent soils, strengthening replacement materials with geotechnical design measures, such as the use of geosynthetics, stone columns, or vertical drains. These methods would improve the stability of designed cut or fill slopes where they are different from the existing slopes.

Construction

Temporary construction effects from grading in soft or loose soils could result in on-site or off-site slumps and small slope failures at stream crossings, instability of cut-and-fill slopes, or collapse of retaining structures used for retained fills or retained cuts. BNSF would design and construct cut or fill slopes in accordance with the previously discussed guidelines and standards in **Section 4.1, Geologic Hazards – Areas of Difficult Excavation**, minimizing the risks associated with unstable soils.

In accordance with the previously discussed guidelines and standards, engineered ground improvements, grading, or groundwater controls would stabilize soft or loose soils where they are encountered during construction. In addition, design would improve the stability of deep unstable soils by replacing unstable soils with competent soils, strengthening replacement materials with geosynthetics, and/or placing ground improvements such as stone columns or vertical drains.

BIG's geotechnical design would improve loose and unstable soils or would use alternative designs to avoid effects on graded cuts, fill embankments, and structures. BIG would not increase the potential for substantially adverse effects, including destruction, injuries, or loss of life, associated with landslides within cut and fill slopes during construction.

Operations

Cut or fill slopes could fail during BIG's operation if a large earthquake were to occur during operations. If an earthquake were to occur, potential effects could range from no effect to the potential for built structures or slopes to fail. The magnitude of the effect would depend on the intensity of ground shaking from the earthquake and proximity to structures and track from cut or fill slopes.

The majority of the rail yard and transload warehouse center areas and structures would be within relatively level terrain and landslides would not be a hazard. The potential for landslides in the cut and fill slopes constructed on the margins of the level areas would be minimized based on the results of geotechnical slope stability analyses. These analyses would be performed during the geotechnical design and the appropriate measures implemented during construction of the graded cut and fill slopes. In addition, cut and fill slopes for the construction and operation of various BIG components would be designed in accordance with commonly accepted geotechnical engineering procedures and follow guidelines in the AREMA Manual (2018) and requirements of the 2022 CBC.

To protect personnel and property safety and project integrity in case of earthquake during operations, BNSF would implement its Engineering Instructions (BNSF, 2022) and Systems Special Instructions – No. 10 (BNSF, 2019) and perform special track inspections when an earthquake is reported with a magnitude 5 or greater and requires trains to proceed at restricted speeds or stop entirely, depending on the magnitude and distance to the earthquake. AREMA (2018) provides general guidelines that may be used for developing a post-earthquake inspection of facilities and infrastructure. Post-earthquake inspection of bridges requires following the procedures contained in Chapter 14 of the AREMA Bridge Inspection Handbook.

Additionally, as part of routine maintenance, BNSF would implement corrective measures related to erosion including treating, recompacting, or otherwise stabilizing the soil in accordance with our design recommendations and applicable AREMA guidelines. Therefore, BIG construction and operations would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of landslides or slope failure hazards associated with cut and fill slopes during operations. Implementation of the guidelines and standards described above and City staff review of the grading and building plans would result in potential impacts associated with landslides to be less than significant.

Impact 5	<i>Would the Project result in substantial soil erosion or the loss of topsoil?</i>
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Potential soil erosion is discussed in **Section 4.1, Geologic Hazards – Erodible Soils**, and the particularly susceptible areas are illustrated in **Figure 12: Water Erosion** and **Figure 13: Wind Erosion**. The Potential for soil erosion, especially from wind erosion, exists.

Construction

BIG construction would involve excavation of surface and near surface soils during grading in areas of cut or where over-excavation and re-compaction with engineered fill may be required. Grading, excavations and trenching required for BIG's construction could result in soil erosion if exposed to high winds or heavy rainfall events.

Accelerated soil erosion, including loss of topsoil, could occur as a result of construction. The potential for more surface water runoff exists during construction when existing vegetation is removed, and the unprotected soils are exposed to both wind and water erosion. Increased surface water runoff could also result from temporary, impermeable work surfaces. The BIG footprint is known for strong westerly winds that could erode exposed surficial soils.

If exposed soils are not protected from wind or water erosion, such as when vegetation is cleared for work areas and material stockpiles, both the exposed work areas and any stockpiles could erode and result in decreased air and water quality and loss of high-value soil.

During construction, BIG would comply with City Code of Ordinances, particularly Chapter 15.12. – Grading, that requires BMPs be incorporated into a grading plan. The effects associated with soil erosion would be minimized with design measures in the grading plan and include the use of BMPs and adherence to the relevant transportation and building agency guidelines and standards previously discussed in Impact 1 that would take into account soil properties and minimize soil erosion hazards.

BIG would implement a dust control plan in accordance with the rules and regulations, particularly Rule 403, of the Mojave Desert Air Quality Management District to reduce impacts related to wind erosion.

Grading BMPs could include soil stabilization, watering for dust control, perimeter silt fences, and sediment basins that would be incorporated into the grading plans. Implementation of local and state regulations regarding soil erosion, using stormwater BMPs and temporary soil erosion guidelines, would be followed in the design and construction of the project. These measures would reduce erosion and runoff from the BIG footprint and hold topsoil in place during grading activities.

Design methods for finished grade surfaces would minimize water and wind erosion through adoption of BMPs, that may include use of stabilizers, mulches, revegetation, and covering areas with biodegradable geotextiles. BNSF would also document the incorporation of specific guidelines and standards, as identified by relevant transportation and building agencies and codes, into design and construction in accordance with the best available practices. In complying with these guidelines and standards, BNSF would take soil properties into account for design and construction and reduce the potential for effects associated with wind and water erosion during construction.

Operations

There would be the potential for soil erosion hazards as a result of operations, and long-term effects related to maintenance, landscaping, and improvements. A significant portion of the BIG footprint will be covered with buildings, track and pavements that would reduce the potential for soil erosion. Continued maintenance of the designed features would minimize water and wind erosion through adoption of BMPs, including use of stabilizers, mulches and revegetation, and covering areas with biodegradable geotextiles; and BMPs incorporated into the facility design plans for control of stormwater runoff. Standard maintenance practices would reduce to a low level the potential for erosion hazards during the operation phase, including maintaining soil stabilization and vegetation in the operation area and controlling erosion while the vegetation is established.

Implementation of the guidelines and standards described above; and City staff review of the grading and building plans would result in potential impacts associated with soil erosion or the loss of topsoil to be less than significant.

Impact 6 *Would the Project be on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-site or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?*

Review of the environmental setting shows that BIG is located within a seismically active area and located near an active fault zone. BIG would be designed in accordance with applicable state and local design standards to withstand effects from strong seismic shaking and would implement design considerations to ensure that constructed works are not subject to collapse and mitigate the impacts of faulting, if present.

The Shannon & Wilson (2019, 2022, 2024b, 2024d, 2024e) geotechnical design reports indicate that the soils underlying the rail yard, bridges, and transload warehouse center would not become unstable as a result of BIG. The BIG footprint is located in a relatively level to gently sloping terrain and would be constructed so that graded cut and fill slopes in the underlying alluvial and older alluvial soils underlying the rail yard would not be susceptible to landslide or cause significant erosion that would result in a landslide.

The existing geotechnical information discussed above indicates that the risk for collapsible soil and liquefaction in the alluvium underlying most of the BIG footprint is considered low and implementation of geotechnical design measures would reduce the potential for liquefaction or collapsible soil to less than significant. For liquefaction, localized exceptions are noted in areas of higher groundwater near the Mojave River towards the western portion of BIG. Given this and the relatively level terrain along the Mojave River, the potential for lateral spreading would be negligible for the transload warehouse center and rail yard areas. Where liquefaction occurs in areas of structures (e.g., bridges and warehouses), specific recommendations such as over-excavation, shoring, engineered soil, drainage systems, and foundation design would be provided.

Groundwater withdrawal is the cause of subsidence within this region of the Mojave Desert. Studies discussed in **Section 4.1, Geologic Hazards – Ground Subsidence** do not indicate subsidence in the BIG footprint. Regional groundwater management and active groundwater recharge in the Mojave River basin may reduce the potential for future subsidence in the region. Therefore, the potential for future ground subsidence of the BIG footprint under current regional groundwater management is considered low.

Construction

BNSF would conform to guidelines specified by relevant transportation and building agencies mentioned in Impact 1 and specifically the Code of Ordinances previously discussed is **Section 2.0, Regulatory Setting – The Code of the City of Barstow**, requiring contractors to account for geotechnical properties during BIG's design and construction and thereby reduce to a low level the risks associated with seismically-induced ground shaking. With these design measures and practices, construction of BIG would neither directly nor indirectly cause potentially substantial adverse effects, including the risk of destruction, injury,

or loss of life because of landslides, seismic ground shaking induced liquefaction and lateral spreading or collapse.

Operation

BIG operations would neither directly nor indirectly cause or accelerate the potential for unstable soils underlying constructed works. Therefore, BIG would not increase the potential for substantially adverse effects, including potential loss of life, injuries, or destruction as a result of landslide, seismic ground shaking induced liquefaction and lateral spreading or collapse.

Implementation of the guidelines and standards described above; and City staff review of the grading and building plans would result in potential impacts associated with unstable soils to be less than significant.

Impact 7	<i>Would the Project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?</i>
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A review of the NRCS soil survey discussed in **Section 4.1, Geologic Hazards – Expansive Soils** and the geotechnical evaluations by Shannon & Wilson (2019, 2022, 2024b,) show that mapped soils within the BIG footprint generally have low shrink-swell potential. The shrink-swell potential of a soil is a gauge of their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. There are some soil types within the BIG footprint with soil profile layers that have a moderate shrink-swell potential, interlayered with low shrink-swell potential layers. Due to this and the lack of highly expansive soils, the effect from expansive soils is considered low.

Design would avoid effects of soils with moderate shrink-swell potential through adherence to standard construction practices that address the risks associated with expansive soils. Although not anticipated, in locations where expansion potential is moderate, soil additives may be mixed with existing soil to reduce the expansion potential, or soil layers that exhibit moderate expansion potential may be mixed with soils of low expansion. Additionally, BNSF would document the incorporation of specific guidelines and standards specified by relevant transportation and building agencies and codes into design and construction to build BIG in accordance with the best available practices. These guidelines characterize soils and thus address risk factors associated with expansive soils, thereby minimizing the risk of construction on soils with moderate shrink-swell potential.

Construction

BIG's design would include measures to design for expansive soils and implement best available practices as specified by relevant transportation and building agencies and codes described in Section 2, including the most current CBC requirements, which would minimize the effects associated with expansive soils. There are no soil layers reported with high shrink-swell potential within the BIG footprint. The lack of high shrink-swell soils and the few moderate shrink-swell soil layers in surficial soil units indicate that the potential for adverse effects from expansive soils is considered low within the BIG footprint.

Operation

Risk from expansive soils during operations would be minimal because the design characteristics include mixing expansive soils layers with non-expansive soils, or otherwise avoiding the effects of expansive soils that would present a risk to BIG's infrastructure, people, and property.

Implementation of the guidelines and standards described above; and City staff review of the grading and building plans would result in potential impacts associated with expansive soils to be less than significant.

Impact 8	<i>Would the Project have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?</i>
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BIG proposes to connect to City wastewater services, thus, would not propose septic or alternative wastewater disposal. Thus, BIG would not result in impacts concerning soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems. Therefore, no impact would occur and no mitigation is required.

6.0 CUMULATIVE IMPACTS

The construction of present and foreseeable future projects are not anticipated to alter the risk of geologic hazards to BIG and would not result in significant unavoidable impacts to BIG related geology, soils, and seismicity impacts when applicable mitigation measures are implemented. BIG and foreseeable future projects must be constructed in accordance with the CBC and other applicable design codes and standards.

Therefore, cumulative effects related to geology, soils, and seismic hazards would not cause significant damage to built structures provided appropriate design and construction are implemented and follow the codes, guidelines, standards presented in **Section 2.0, Regulatory Setting - Local** and **Impact 1**. Cumulative impacts to paleontological resources would be reduced by implementation of County goals and policies. The overall contribution of BIG to the significant cumulative regional geotechnical effects associated with future foreseeable projects and improvements would be less than cumulatively considerable.

7.0 MITIGATION MEASURES

No mitigation is required.

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8.1 Persons and Agencies Consulted

Domingo Gonzales, Engineering Services Administrator, City of Barstow, oral communication May 12, 2021.

8.2 Preparer Qualifications

Preparer	Qualifications
Sean Wilson, PG, CEG, <i>Licensed Engineering Geologist</i>	▪ 29 years of experience ▪ B.S. in Geology, University of California, Los Angeles ▪ M.S. in Geology, Portland State University