Electrification of the BNSF Needles Subdivision

(Barstow to Needles, California and Seligman Subdivision - Needles to Kingman, Arizona)





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November 3, 2026
Californians for Electric Rail

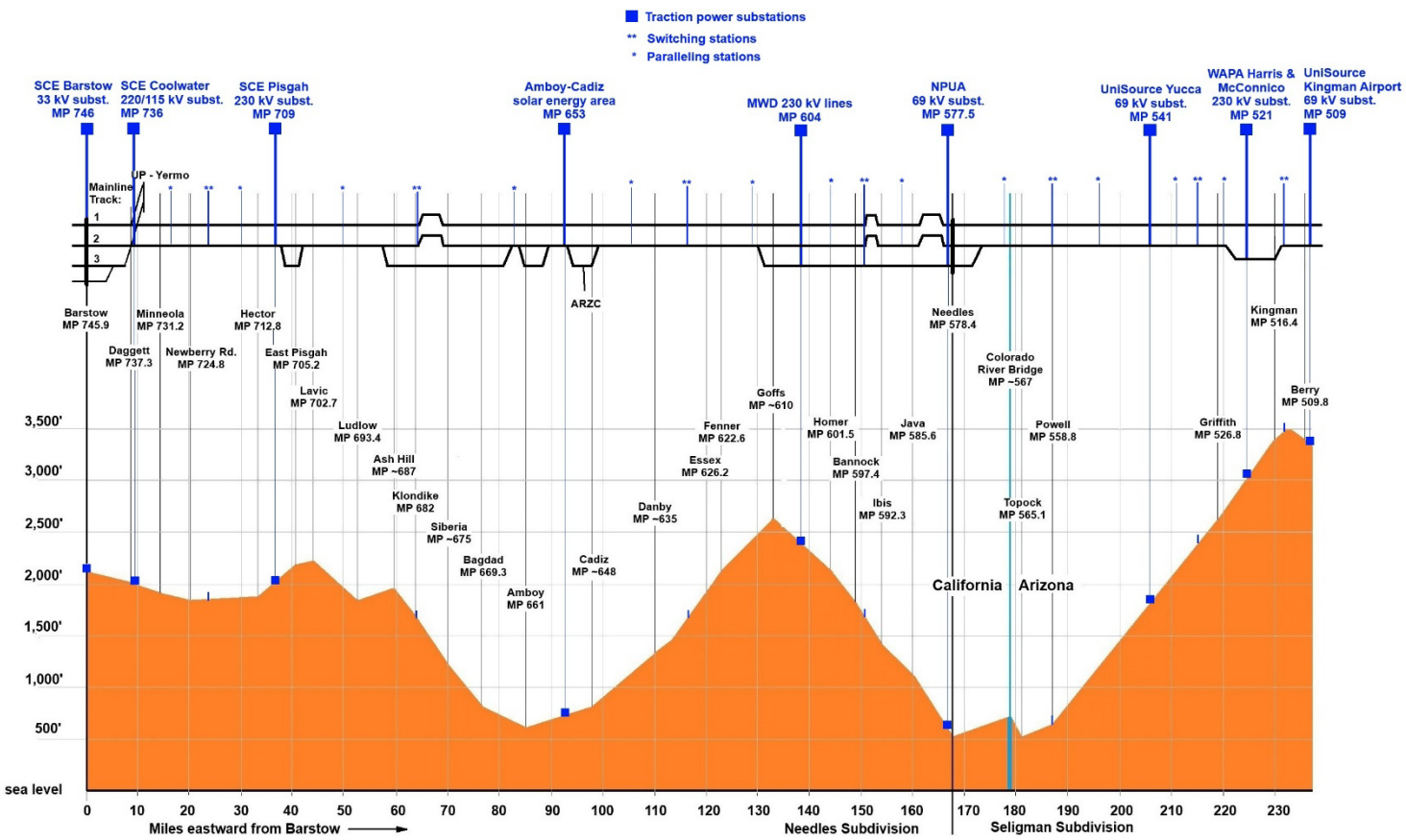
Top: BNSF intermodal train on Needles Subdivision passing under LADWP transmission lines, 3 miles east of Daggett Junction (November 13, 2023 photo)
Bottom: BNSF intermodal train on Needles Subdivision passing behind SCE Pisgah switching station (February 13, 2026 photo)

The BNSF Needles Subdivision, part of the 'Southern Transcon' between Los Angeles and Chicago, runs 167.5 miles from Barstow to Needles. It is one of the busiest segments of freight railroad in North America. The 2023 Anacostia/Pacific Harbor Lines short haul rail study[1] gave a 2022 estimate that the BNSF Cajon Subdivision had an average of 62 freight trains per day, and 2 passenger trains (the Amtrak *Southwest Chief*). The 'practical capacity' of 99 trains per day was estimated based on the segment's current infrastructure, which includes long sections of triple-track mainline.

This white paper proposes a conceptual electrification scheme for the ~168 route miles of the Needles Subdivision, and about an 80-mile portion of the Seligman Subdivision, or about 250 route miles total between Barstow, California and Kingman, Arizona. There is some overlap with a prior report on electrifying the BNSF Cajon Subdivision between San Bernardino and Barstow[2], which included electrifying east of Barstow to Newberry Springs (on the Needles subdivision) and to Yermo (on the Union Pacific Railroad's Los Angeles Subdivision).

The industrial park area around the Kingman Airport was chosen as a termination point for electrification due to ample space for new long siding tracks, existing trackside large capacity existing utility substations, and due to the fairly steep grade and 3,000' of elevation gain over the first 57 route miles in Arizona, between the Colorado River Bridge (MP 567) and Berry (MP 509.8). This large grade means electrification would have greater economic benefit to BNSF freight operations.

Concept for electrification of the BNSF Railway from Barstow, California to Kingman, Arizona



[1] https://www.anacostia.com/wp-content/uploads/2024/01/Anacostia-Feasibility-and-Benefits-of-Intermodal-Service-in-Short-Haul-Markets-Report-final-rev.pdf

[2] https://calelectricrail.org/wp-content/uploads/2025/04/Cajon-Sub-OCS-electrification-appendices-BYanity-2025.01.19.pdf

The Seligman Subdivision, going eastbound into Kingman, has grades up 1.8%. The westbound Goffs Hill 1.5% grade between Needles and Goffs climbs over 2,000' in elevation over a route length of less than 32 miles. Westbound trains climb grades of 1.4% between Amboy, Bagdad and Ash Hill (the older 2% grade track is primarily used for descending eastbound trains). Such steep grades are well-suited to an electric locomotive's many advantages in mountainous terrain, including better adhesion, greater power at low speeds, and regenerative braking downhill[3]. The grades are a prime opportunity for harnessing the economic and capacity benefits of freight rail electrification.

The current level of freight traffic on the BNSF Needles Subdivision is well above what rail industry experts have calculated as a minimum level of freight rail traffic that economically justifies electrification. As described in this 2015 blog post by Paul Druce[4]:

> "[with social, environmental and economic benefits] combined, we see that it takes 21-29 bidirectional frequencies for benefits to match the costs of railroad electrification [for passenger rail]. In California, this would indicate that it would be justified to electrify Caltrain between San Jose and San Francisco. With increased service, electrification would also be justified on Metrolink's San Bernardino Line as well as LOSSAN between Burbank and Irvine (Metrolink and Pacific Surfliner) and Oceanside and San Diego (Coaster and Pacific Surfliner).
>
> For freight trains, the decreased fuel costs play a much larger role, and more importantly, the only one that the board of directors actually care about, resulting in break even at fewer frequencies. From the 2014 STB R-1 reports, we see that, for the Class I railroads, there is an average consumption of 6.92 gallons per train-mile; a comparable figure for electric traction would be 86.5 kWh per train-mile. Because of the significantly greater fuel consumption, the pay off is much quicker: Only 9 trains per day are needed in each direction with social benefits included or 15.4 when only considering fuel costs. Of course, private companies aren't going to be using Federal discount rates and will likely be seeking money on the open market. While this will be more expensive, it won't be enormously so. Union Pacific recently sold 40 year bonds at 3.875%; if I've done the math correctly, this would come out to $212,374 per mile of track, pushing the break even points to 10 and 17.3 frequencies. In Southern California, this would justify the electrification of the Alameda Corridor, Sunset Corridor, and Southern Transcon."

A 1978 Federal Railroad Administration study on freight rail electrification, used a metric for route evaluation not based simply on trains per day, but gross tons of freight per year. The positive rate of return scenarios (18- 21%) modelled were on routes with 70 million and 97 million gross tons per year, which work out to an average of about 19 and 27 freight trains per day (10,000 short tons each), respectively. A 1983 study, "Cost/Benefit Evaluation of Electrification of a U.S. Rail Network", concluded the best single 'surrogate' for main economic factors of rail electrification was annual fuel consumption per route-mile, although variables uncorrelated with fuel consumption (e.g. bridge clearance and signal and communication compatibility) were still significant cost factors[5]. It should be remembered that the 1970s-80s era North American coal railroads justified electrification on at most three heavy trains per day. The economics and energy efficiency of overhead contact system (OCS) heavy/frequent freight rail electrification has proven in many applications around the world as having very positive return on investment, in large part due to a substantial reduction in operating and maintenance costs[6]. The operating and maintenance cost reduction is typically great enough long-term to

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[3] G.T. Fisher, "50 kV through the Rockies", *Railway Gazette International*, October 1971, pp. 380-383;
John G. Allen and Gregory L. Newmark, "The Life and Death of North American Rail Freight Electrification", *Transportation Research Record*, Vol. 2627, Issue 10, December 2018, pp 166-175: https://trid.trb.org/view/1493092 .

[4] https://reasonrail.blogspot.com/2015/09/a-cost-to-benefit-analysis-of-railroad.html

[5] C.H. Spenny and G.B. Mott, "Cost/Benefit Evaluation of Electrification of a U.S. Rail Network", Transportation Research Record 939, 1983.

[6] https://railtec.illinois.edu/wp/wp-content/uploads/2024_11_08-Hay-Seminar_Tyler-Dick_compressed.pdf

offset the cost of OCS electrification while also driving improved bottom line results for rail operators (public and private).

BNSF Railway intends to grow traffic on the Needles Subdivision and the rest of the Southern Transcon to Chicago, on which the railroad been making capacity investments[7]. BNSF's massive Barstow International Gateway (BIG) is under development on the west side of Barstow[8]. This proposed 'inland port' development is heavily tied to the Ports of LA/Long Beach container traffic, utilizing the concept of "short-haul freight shuttle" trains between the Barstow area and the ports. The business model depends on the contents of international 40' containers to/from the ports being transloaded to 53' containers going to the rest of the USA. Port of LA/Long Beach-BIG short-haul rail would be a prime pilot application for electric freight trains. Such container transloading activity, and short-haul trains, could be expanded to Kingman in the future. Kingman is already positioning itself as an inland port as part of the I40 TradePort Corridor[9].

It would be preferred to change locomotive power at the same location as a crew change- which now happens at Barstow, Needles and Winslow. So would make sense for OCS to be extended along the rest of the Seligman Subdivision from Kingman to Winslow, via Flagstaff. Electrifying the BNSF from Hobart-Berdoo-Kingman-Winslow would cover the Southern Transcon's heaviest grades, including the highest point on the transcon (Arizona Divide- 7,322').

Next steps:

In addition to engineering design and cost estimates, a technical study is needed on performance and economics of electric locomotive operations between Barstow and Kingman, and part of a larger study on Southern California electrified freight operation. Such a study needs to evaluate how electrification could increase throughput (trains per day) on the Needles and Seligman subdivisions while reducing operating and maintenance costs.

Working assumptions:

1. *50 kV overhead contact system (OCS) system*, with overhead catenary wire tall enough (about 23' above rail) to have sufficient vertical clearance for double-stack container trains.

1A. *An OCS voltage of 50 kV, 60 Hz would have lower overall cost, and greater energy efficiency and power capacity than 25 kV*.

Due to the heavy freight traffic of the line, steep grades and the high power requirements of the typical BNSF freight trains on this segment, the higher power capacity of a 50 kV OCS offers many advantages. 50 kV requires fewer traction power substations and switching stations than 25 kV and so supporting infrastructure cost is less for the same amount of overall power capacity. There is also better train performance due to less voltage drop and less energy loss. It is assumed that electric freight locomotives moving at speed will be able to transition between 50 kV and standard 25 kV 60 Hz AC electrification system, to be installed in future by CHSRA on the LA to Fullerton segment of the San Bernardino Subdivision, as part of the California High Speed Rail project.

50 kV requires half the current in the wire as on a 25 kV system for the same amount of power, and gives more margin of safety on very hot days (which is about half the year on the Needles Subdivision). Overheating is one of

[7] https://www.bnsf.com/news-media/railtalk/service/emporia-sub.html

[8] https://bnsfcalifornia.com/barstow-international-gateway-project/

[9] https://www.cityofkingman.gov/Home/Components/News/News/3102/
https://i40tradeportcorridor.com/i40-tradeport-corridor/

the most common cause of electrical equipment failures in general, and conductive properties of wire get worse with heat (which is quickly a vicious cycle as greater resistance creates more heat). So the less current in the wire needed to do the same job, the better.

1B. A contact wire (or conductor bar) height of about 23' (7 m) above top-of-rail, which is assumed to be sufficient clearance for 50 kV wire or conductor bar above the tallest double-stack (2 x 9' 6 1/2") 'high cube' double-well cars (20' 3"[10] or 6.2 m). It is assumed that a height of about 25' total overhead clearance, below an obstruction, is needed by 50 kV catenary wire in free air. This would allow up to 2' of vertical clearance between the energized wire and the overhead obstruction. However, the actual height above rail or the wire or conductor bar may vary, and even be less than 23' above top-of-rail, depending on total available overhead clearance and techniques to reduce electrical clearances needed from bridges and other structures. It is also assumed that no bridge structures or at-grade crossings will be significantly modified on the segment studied, as all appear by casual observation and public records to have a minimum total overhead clearance of 2' above double-stacked 'high cubes' (Appendix C). This needs to be verified with BNSF Railway or Caltrans records or field measurements.

This report does not examine any at-grade crossings, as it is assumed that 23' height of a 50 kV OCS is sufficient overhead clearance for road traffic.

2. *Substations-*

The maximum electric power demand of the ~260-mile Barstow-Needles-Kingman OCS electrification segment is assumed to be about 1,000 MW, about 1 GW[11]. This amount would be more than sufficient to power a worst-case scenario of thirty (30) 20,000 ton freight trains simultaneously going up the grades on this segment on a hot day (each pulling 30 MW off the OCS, plus some extra for continency and yard/switching operations). At least 1,000 MVA of electric substation capacity will be needed, spread across the nine or more proposed traction power substations. Each traction power substation could have one to three (3) transformers, each of 50-75 MVA capacity, to allow for redundancy and maintenance. The capacity of each traction power substation may vary based on capacity available at the particular power grid interconnection point/electric utility substation.

2A. New traction power substations will connect to existing utility substations, owned by the electric utilities Southern California Edison (SCE), the Metropolitan Water District (MWD), Needles Public Utility Authority (NPUA), UniSource and the Western Area Power Administration (WAPA). There are many existing electric utility substations adjacent the BNSF Needles and Seligman Subdivisions, so the existing electrical infrastructure should mostly be in place to handle the amount of power needed (up to roughly 1 GW total) to be delivered to an electrify BNSF operations between Barstow and Kingman. This report identifies the existing major electric utility substations along the track, which appear to be the most feasible locations for traction power substations. This report will provide a starting point for rail electrification discussions with the electric utilities.

2B. The substations shown in this report are located next to the tracks, but also appear to be surrounded by enough free space for a new, adjacent rail traction power substation to be built:

- A traction power substation up to 150 MVA in capacity has typically a 150' x 200' minimum footprint. It is worth exploring standardized 'modular' 50 kV traction power substations which could be installed on

[10] https://web.archive.org/web/20210224215901/https://my.aar.org/OTLR/Documents/Section%201/Section1AppendixA_20200826.pdf

[11] A megawatt (MW), equivalent to one million watts, is a unit of real electrical power. A megavolt-ampere (MVA), equivalent to one million volt-amperes, is unit of overall electrical 'apparent power', including both real and reactive power. Substations and transformers are typically rated in MVA.

the grounds of, or adjacent to, existing utility substations. Paralleling and switching stations, also needed along the line, each take up a smaller space than a traction power substation.

- Switching station compound dimensions are typically about 80' x 160'. Switching stations are typically located about midway between traction power stations, and serve as a phase break so that power supplies from each traction power substation are isolated from each other, to avoid a fault condition. In addition, switching stations provide operating flexibility during equipment outages. Exact locations are to be determined.However, there appears to be ample vacant land next to the BNSF mainline in the areas where switching stations would be needed.

- Paralleling station compound dimensions are typically about 40' x 80'. Paralleling stations are typically spaced between switching and traction stations, to maintain system voltages and the auto-transformer system.

3. *Locomotives-*

It is assumed that 50 kV-capable electric freight locomotives, with sufficient tractive effort and horsepower, will be provided by established manufacturers. Siemens and Alstom are mass producing heavy-duty 25 kV electric freight locomotive drivetrains in India that could be adapted to North American standards. Due to their mass production, it would be easier to find parts, maintenance/repair support from the manufacturers. Two-section Alstom WAG-12 with 12,000 hp (2 x 6,000 hp) or Siemens single-section 9000 hp (6.7 MW) electric locomotive drivetrains developed for Indian Railways should offer the equivalent performance needed by US freight railroads. Four of the 9000 hp units would translate to 26.8 MW total max draw per train (or assuming five rounded to an average max load of about 30 MW). European and Asian electric locomotive drivetrains will need to be converted to American frame/trucks. Frames or other components could be repurposed from existing diesel-electric freight locomotives[12].

4. *No cost estimate is given in this report-*

This document's purpose is to show a plausible physical electric rail infrastructure layout and system configuration along the BNSF Needles and Seligman subdivisions, which can serve as a basis for detailed engineering design and planning.

5. *Passenger trains-*

The only passenger trains currently using the BNSF Needles Subdivision are two Amtrak *Southwest Chief* trains per day, one in each direction. Even if Amtrak were to increase service frequency in the future, the combined electric energy demand of all passenger trains would be extremely small compared to that of freight trains.

6. *Signals and communication systems* used by the BNSF Railway, UPRR, and Amtrak will need to be evaluated in the context of electromagnetic interference from a 50 kV OCS system, and mitigation measures recommended.

[12] https://railtec.illinois.edu/wp/wp-content/uploads/UIUC-Hay-Seminar_Iden_20240927.pdf

OCS sections

The segments below do not necessarily correspond to proposed possible locations of traction power substations and switching stations, though provide a general guide to the scale of OCS sections between Barstow and Kingman. Google Earth images of each, with segment length measurements, are shown in Appendix B.

	Segment	**# of tracks**	**Length (miles)**	
			Route	Track
1	Barstow to Daggett Jct.	3	9	27
2	Daggett Jct. to Newberry Springs	2	15	30
3	Newberry Springs to Pisgah (I40 bridges)	2	15.3	30.6
4	Pisgah 3rd mainline segment	3	2	6
5	Pisgah to Ash Hill	2	16.8	33.6
6	Ash Hill to Klondike	3	4.9	14.7
7A	Klondike-Siberia single track segment	1	3.8	3.8
7B	Klondike-Siberia double track segment	2	5.8	11.6
8	Siberia to Pinto	3	11.9	35.7
9	Pinto to Saltus	3	7.1	21.3
10	Saltus to Cadiz	2	11.2	22.4
11	Cadiz to Essex	2	22.9	45.8
12	Essex to Goffs	2	12.1	24.2
13	Goffs to Arrowhead Jct.	3	16.6	49.8
14A	Arrowhead Jct. to Ibis double track segment	2	2.7	5.4
14B	Arrowhead Jct. to Ibis single track segment	1	2	2
15	Ibis-Needles	3	17.2	51.6
16	Needles-Franconia	2	21.5	43
17	Franconia-Yucca	2	13.6	27.2
18	Yucca-Griffith	2	12.5	25
19A	Griffith-Kingman - track 1	1	12.5	12.5
19B	Griffith-Kingman - track 2	1	13	13
21	Kingman-Kingman Airport	2	7	14
	TOTAL		**~256**	**~550**

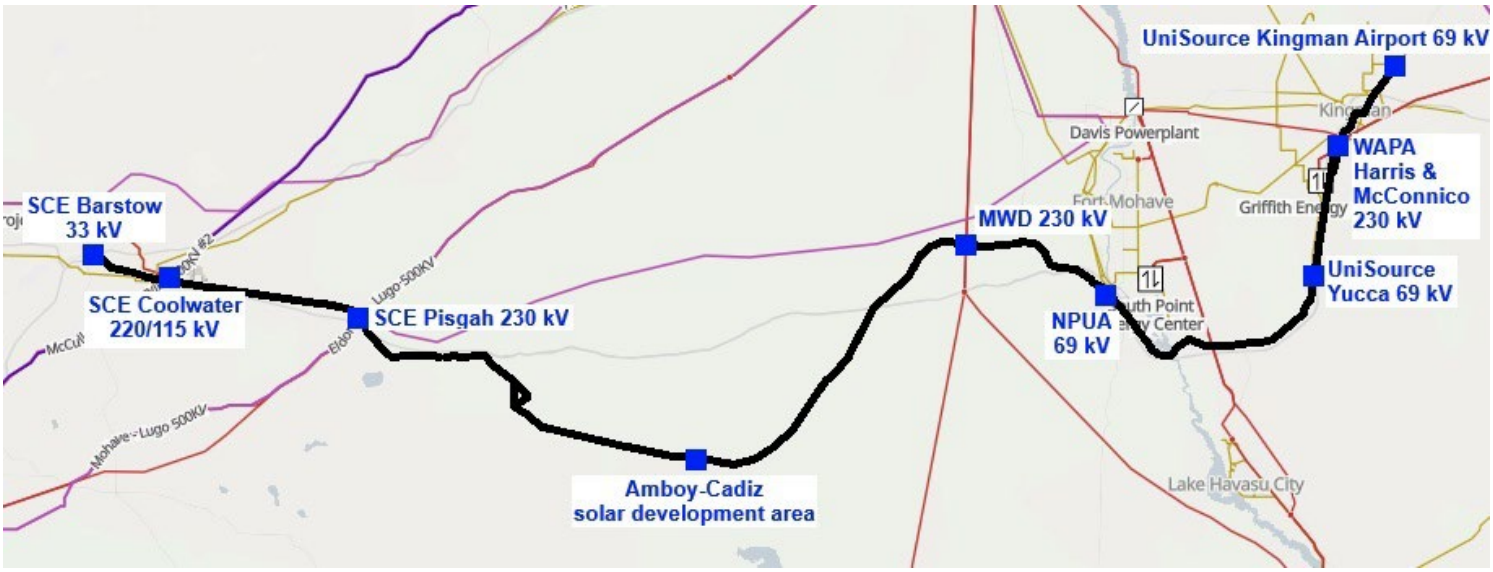
Route miles do not include yard sidings, which exist at these locations (which could add 50 track miles or more):

- Barstow
- Daggett
- Newberry Springs
- Ludlow
- Cadiz
- Goffs
- Needles
- Kingman

Power Sources

Efficient and cost-effective utilization of existing power grid infrastructure is key for economical rail electrification, so it is best for new traction power substations to be built as close as possible to existing major electric utility substations. Thankfully nine sites have been identified where electric utility substations exist in close proximity to the BNSF mainline between Barstow, Needles and Kingman. Three of the substations are owned and maintained by Southern California Edison (SCE), along with three by the Needles Public Utility Authority (NPUA) system, one by the Metropolitan Water District (MWD) and two each by Unisource and the Western Area Power Administration in Arizona[13].





Primary substations along Barstow-Needles-Kingman electrified track segment, annotated on transmission grid background map, by Open Infrastructure Map (https://openinframap.org/#7.54/34.816/-114.952).

Power grid interconnection and modelling studies will be needed. While the substations may require some upgrades, and new adjacent traction power substations built next to them, the basic power grid infrastructure 'backbone' is in

[13] For reference, see Southwest rail + electric rail infrastructure Google My Map: https://www.google.com/maps/d/viewer?mid=15AjsVJEgHQqvnQmprJYIpt7Auq_xmTw&ll=34.04910161961106%2C-111.91303875&z=6

place for powering an OCS electrification of the Needles Subdivision. Additional sites for traction power substations could be added if needed, possibly enabled by new power transmission lines routed in the BNSF right-of-way itself. See below example images of how overhead power transmission lines can be integrated with OCS structures.

Amboy-Cadiz (described below on pages 17-19) is an additional site midway in between a ~90 mile stretch of track where there are no large substations or power line crossings, is a possible large-scale solar energy development area. Power transmission, combined with OCS, along the BNSF right-of-way would unlock the economic development potential of this and other stranded solar energy resource areas.



Swiss mast with 66 kV overhead transmission line and 15 kV OCS (Photo: Ferrer + Frey)

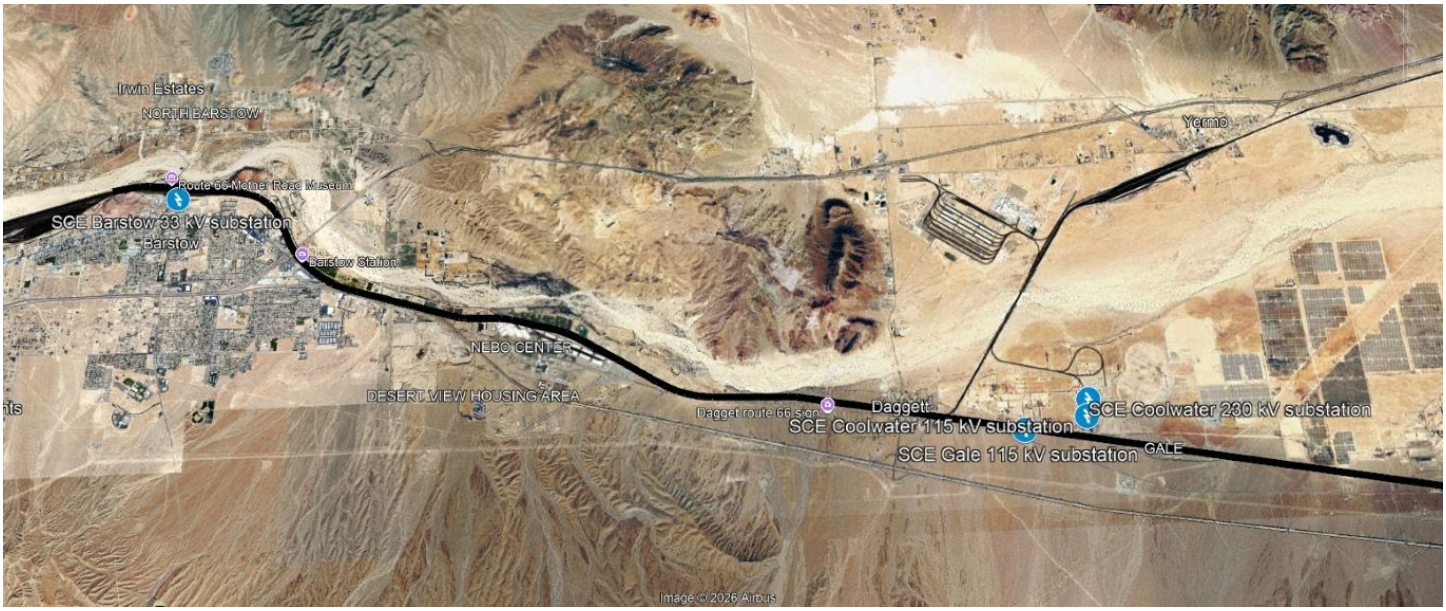


Rendering: OCS mast combined w/ 115 kV overhead power transmission masts (Ferrer + Frey)



SCE's Coolwater substation complex has several hundred MW each of both local large-scale solar generation and battery energy storage already feeding right into it (see right side of Google Earth map below).

Los Angeles Department of Water and Power (LADWP) 500 kV and 287 kV [part of Path 46], and ±500 kV HVDC [Path 27] lines pass over the Needles Subdivision, just over a mile east of Coolwater. However, these are high enough voltage that 150 MW load for a traction power station may not be a big enough load for the LADWP to allow connecting while keeping the transmission system stable.



The primary traction power substation sites, in an order of west to east between Barstow and Kingman [with distances from track given in feet], along with approximate BNSF milepost (MP numbers), are described below:

SCE Barstow [1,000'] connects to several 33 kV circuits. MP 746



SCE Barstow substation (November 5, 2024 photo)



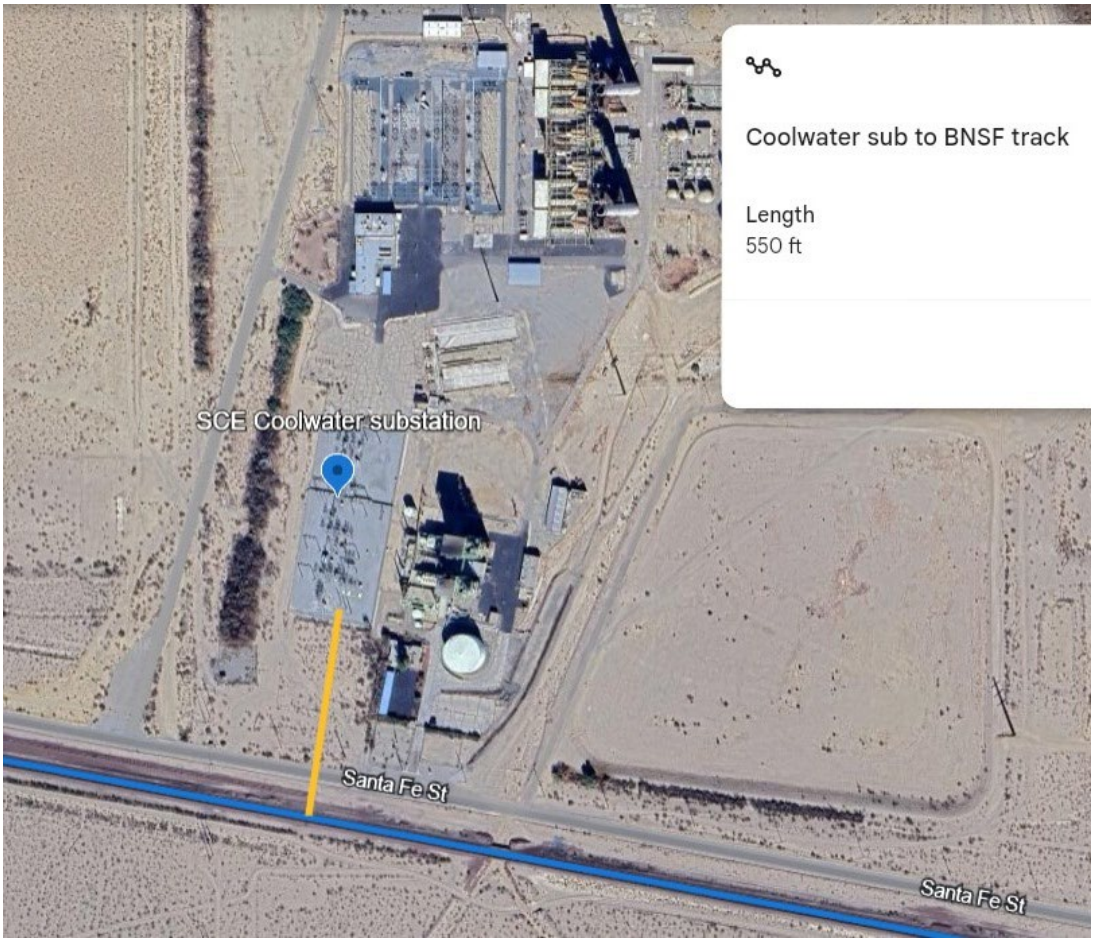
Even if Coolwater is the primary power feeder for OCS in the greater Barstow area, a feeder from SCE Barstow substation would still be beneficial for supporting yard operations at least since it is adjacent to the existing BNSF railyard. Even a small traction power substation at this location could power a pilot development focused on battery-electric yard switcher locomotives.

SCE Coolwater (Daggett) [550'] MP 736

connecting to (5) 115 kV and (2) 230 kV transmission (and 33 kV sub-transmission) circuits, including connections to local large-scale solar generation and battery storage.



SCE Coolwater complex, including substations, directly behind intermodal train on BNSF Needles Subdivision (November 5, 2024 photo)



Coolwater is actually two substations- 115 kV and 220 kV, both with much greater capacity than the 33 kV Barstow substation. These were originally built for now-decommissioned coal and gas-fired power plants on the property, and remain an important transmission hub for the regional power grid. SCE has plans for expansion of Coolwater's capacity.

Several hundred megawatts each from local solar generation and battery energy storage (the Daggett Solar+Storage and Sunray Solar projects) is already directly connected to Coolwater.

SCE's 115 kV Gale substation, directly connected to Coolwater and on the opposite side of the tracks, is also an alternative location, though appears to be of much lower capacity.

The existing 33 kV SCE substations listed below, while each less than ½ mile from the BNSF mainline tracks, are likely too small (or limited in spare capacity) to support a new, adjacent traction power substation. Listed west to east:

- East Barstow
- Daggett
- Yermo
- Minneola
- Cady

The SCE 12 kV Hector line goes about 40 miles east from Cady 33 kV substation on Newberry Road to serve Hector, Pisgah and Ludlow, shown on the Google Earth amp below. It is not considered in this study due to its low capacity[14].



[14] https://drpep.sce.com/drpep/?page=Page#data_s=id%3AdataSource_2-substations%3A763

SCE Pisgah 230 kV switching station [1,900’] MP 709



BNSF intermodal train on Needles Subdivision passing behind SCE Pisgah switching station (February 13, 2026 photo)

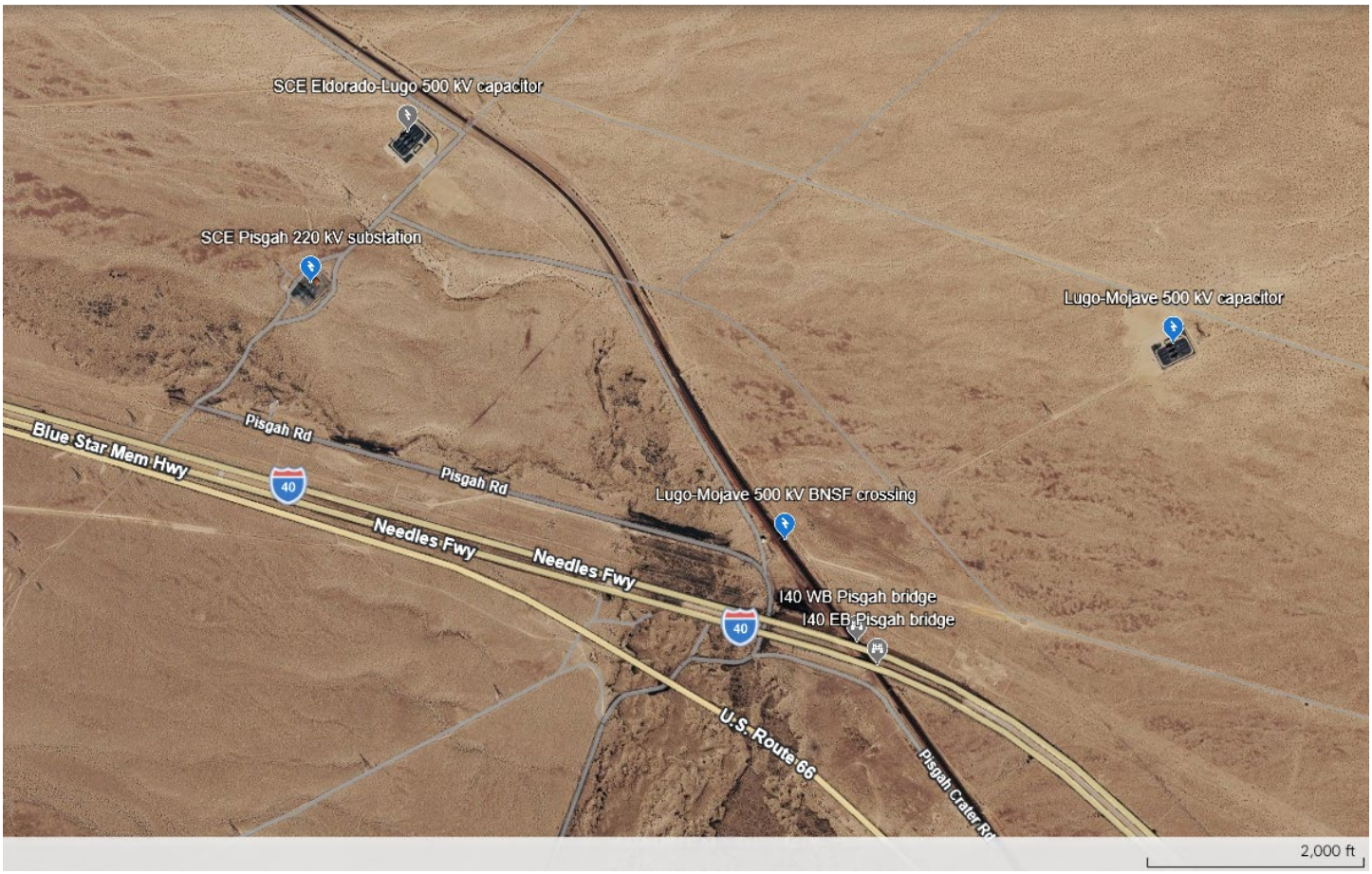


Pisgah substation-BNSF track

Length
1,900 ft

The SCE Pisgah switching station/ substation is located along the parallel circuits of the 230 kV Eldorado-Lugo transmission line connecting Southern California to Southern Nevada.

As can been seen on the Google Earth Map below, near the SCE Pisgah 230 kV switching station/ substation, there are also nearby capacitor stations for SCE's 500 kV Eldorado-Lugo and Mojave-Lugo lines. It is likely more practical for a traction power substation to connect to the 230 kV line and switching station, compared to the 500 kV transmission circuits. However, SCE should be consulted about the possibility.



Amboy-Cadiz solar development area

SCE's Sheephole 33 kV line goes about 50 miles east and north from the Twentynine Palms area to serve the mining operations around Amboy and Saltus. The SCE Amboy 33 kV substation could possibly power a traction substation, but it would be one of very limited power capacity (probably less than 10 MW of max capacity). It may be able to could a small rail traction power substation for trains idling/switch operations right around Amboy.



Google Earth map showing SCE 16 kV power line from existing SCE Camino substation to Cadiz, and SCE 33 kV Sheephole line to Amboy

Cadiz is where the BNSF interchanges with the Arizona & California Railroad, Class III short line railroad which connects to the Phoenix area via Parker, Arizona[15]. Cadiz, located about 11 track miles east of Amboy, is served by the SCE 16 kV Danby line from the SCE Camino substation described below, with no power line connecting between them. However, the area alongside the BNSF right-of-way in this area (roughly around MP 653), north of Bristol Lake, is relatively flat with good potential for large-scale solar energy development. Described in a prior white paper[16], large scale solar energy development locally, most likely combined with battery energy storage, is likely necessary to provide power for traction substation in this area. The Amboy-Cadiz area has some of the best solar energy potential in the United States, with over 6.5 kWh/m^2/day average[17]. A large landowner in the area, Cadiz, Inc., has large-scale solar energy development plans[18]. The existing electric utility infrastructure in the area has far too low a capacity for the ~150 MW load of a heavy freight rail traction power substation. Much of the potential land for solar and battery energy development, including former salt works and private land, does not have zoning/regulatory restrictions on such development. The main reason such

[15] https://www.gwrr.com/railroads/arizona-and-california-railroad

[16] https://calelectricrail.org/wp-content/uploads/2025/06/BNSFNeedles-UPCima-RE-electric-power-BYanity-2025.05.16.pdf

[17] https://databasin.org/datasets/2e4e5a80edee41afb1b25b0014e21117/

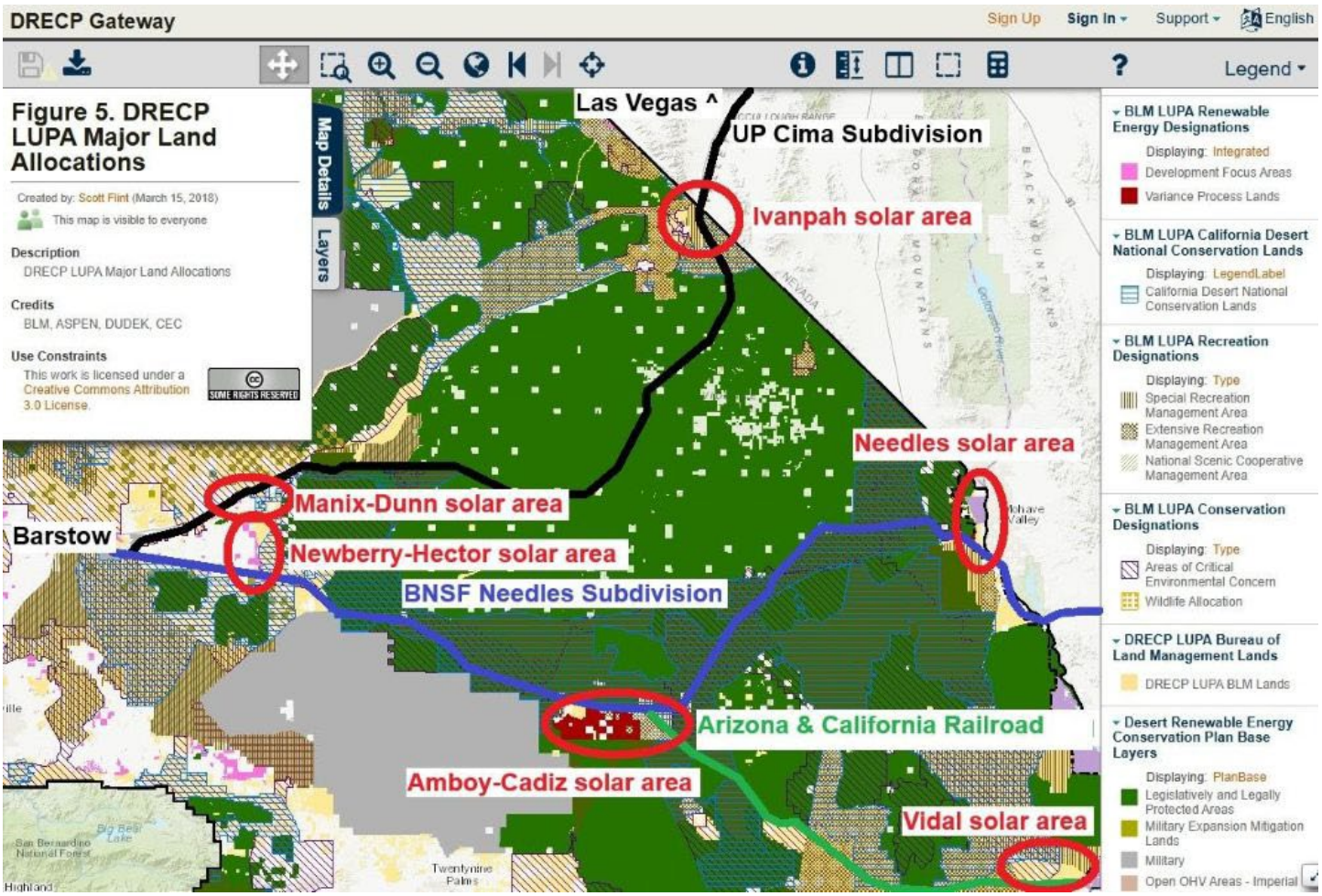
[18] https://www.prnewswire.com/news-releases/cadiz-and-ric-energy-sign-mou-to-advance-solar--hydrogen-development-at-cadiz-ranch-302832468.html https://cadizinc.com/cadiz-signs-second-mou-for-hydrogen-solar-development-at-cadiz-ranch/

large-scale solar energy development has not yet happened in this area is likely the lack of nearby existing transmission lines. The BNSF Railway right-of-way itself could be a future path for such utility-scale power transmission.



Solar development in this area would be outside of protected areas such as the Mojave National Preserve, Bureau of Land Management Wilderness areas, Mojave Trails National Monument etc. Rail lines and possible solar development areas (including Amboy-Cadiz) are annotated on below Desert Renewable Energy Conservation Plan online map[19].

[19] https://drecp.databasin.org/maps/


DRECP Gateway
Sign Up
Sign In
Support
English
Legend
Figure 5. DRECP LUPA Major Land Allocations
Created by: Scott Flint (March 15, 2018)
This map is visible to everyone
Description
DRECP LUPA Major Land Allocations
Credits
BLM, ASPEN, DUDEK, CEC
Use Constraints
This work is licensed under a Creative Commons Attribution 3.0 License.
SOME RIGHTS RESERVED
Map Details
Layers
Las Vegas ^
UP Cima Subdivision
Ivanpah solar area
Needles solar area
Manix-Dunn solar area
Barstow
Newberry-Hector solar area
BNSF Needles Subdivision
Arizona & California Railroad
Amboy-Cadiz solar area
Vidal solar area
BLM LUPA Renewable Energy Designations
Displaying: Integrated
Development Focus Areas
Variance Process Lands
BLM LUPA California Desert National Conservation Lands
Displaying: LegendLabel
California Desert National Conservation Lands
BLM LUPA Recreation Designations
Displaying: Type
Special Recreation Management Area
Extensive Recreation Management Area
National Scenic Cooperative Management Area
BLM LUPA Conservation Designations
Displaying: Type
Areas of Critical Environmental Concern
Wildlife Allocation
DRECP LUPA Bureau of Land Management Lands
DRECP LUPA BLM Lands
Desert Renewable Energy Conservation Plan Base Layers
Displaying: PlanBase
Legislatively and Legally Protected Areas
Military Expansion Mitigation Lands
Military
Open OHV Areas - Imperial



Potential solar energy development area between Amboy and Cadiz, looking from the BNSF track southwards towards Bristol Lake (June 10, 2025 photo taken from Amtrak *Southwest Chief*)

Goffs area Metropolitan Water District (MWD) 230 kV lines

Metropolitan Water District / SCE 230 kV Camino substation



230 kV MWD / SCE substation (February 13, 2026 photo)

Metropolitan Water District (MWD) 230 kV Camino substation, next to Interstate 40, has two 230 kV lines from Hoover Dam, and split here to Parker Dam and to Iron Mountain to the south. Camino substation is 5 miles south of where the two 230 kV lines cross the BNSF track, about 6 miles east of Goffs at about MP 606.

These 230 kV lines will likely be upgraded (or a new line built along the MWD right-of-way), as they date from the 1930s, providing power from Hoover and Parker dams to MWD's pumping plants along the Colorado Aqueduct.

As described above, the SCE Danby 16 kV distribution line goes west about 40 miles from SCE Camino substation to serve Essex, Fenner, Chambless and Cadiz.



230 kV MWD power lines crossing BNSF mainline, about 6 miles east of Goffs (February 13, 2026 photo)



SCE's 500 kV Mojave-Lugo transmission line passes as close as 2.6 miles from the BNSF track, north of Goffs. This is less likely to be tapped for a new substation in the Goffs area than the MWD 230 kV lines, though should be studied.

Needles Public Utility Authority (NPUA)[20] owns three 69 kV substations that are close to the BNSF tracks, as shown on the Google Earth map below, located at around track mile MP 577.5 less than one mile west of the Needles train station (and division point between Needles and Seligman subdivisions).

The Needles #1 (Eagle Pass Road) substation is located only about 800' from the BNSF mainline, while the Bill Yoney substation is about 1,500' away. The Murl Shaver substation is about a half mile away.





NPUA Needles #1 (Eagle Pass Road) substation (February 13, 2026 photo)

[20] https://cityofneedles.com/departments/utilities/electric/



810 Bush St
Needles, California



NPUA Bill Yoney 69 kV substation (Google Streetview)





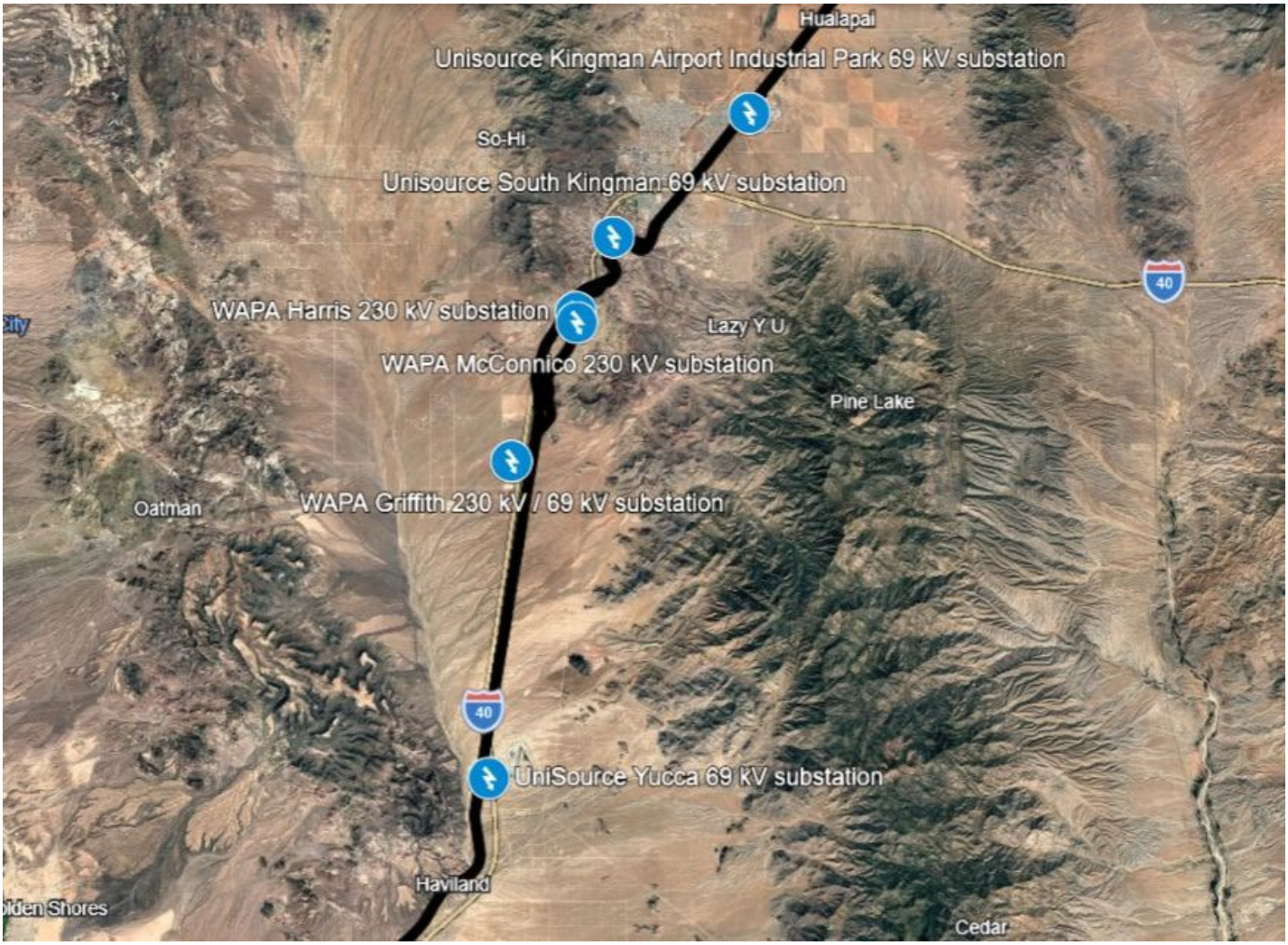
NPUA Murl Shaver 69 kV substation (February 13, 2026 photo)



NPUA Murl L Shaver substation to BNSF track: 0.5 mile

Length
2,863 ft

Arizona substations



Along about a 40 mile stretch of the BNSF Seligman subdivision, there are six large electric utility substations near the track- three each owned by the Western Power Are Administration (WAPA) and UniSource.

UniSource Yucca 69 kV substation [1,700’] MP 541



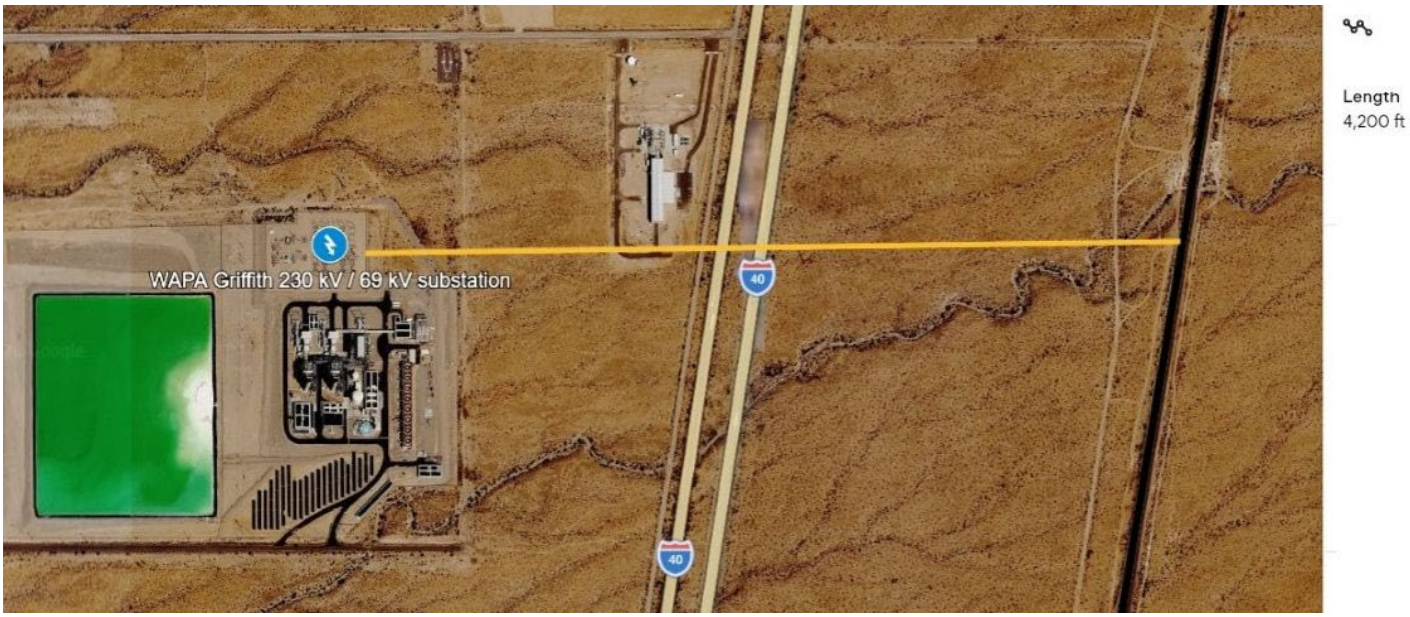
3870 Gandalf Wy
Yucca, Arizona



UniSource Yucca 69 kV substation (Google Streetview)

Western Area Power Administration (WAPA) Griffith 230 kV / 69 kV substation [4,200’] MP 527.7

Western Area Power Administration (WAPA) Griffith 230 kV / 69 kV substation connects the ~655 MW gas-fired Griffith Energy Facility (owned and operated by Onward Energy) to the WAPA transmission grid. Given that is further away from the tracks, and across I40, from the BNSF tracks, Griffith substation would not be a first choice site for a traction power substation compared to the other large WAPA McConnico and Harris substations located about 6 miles north.



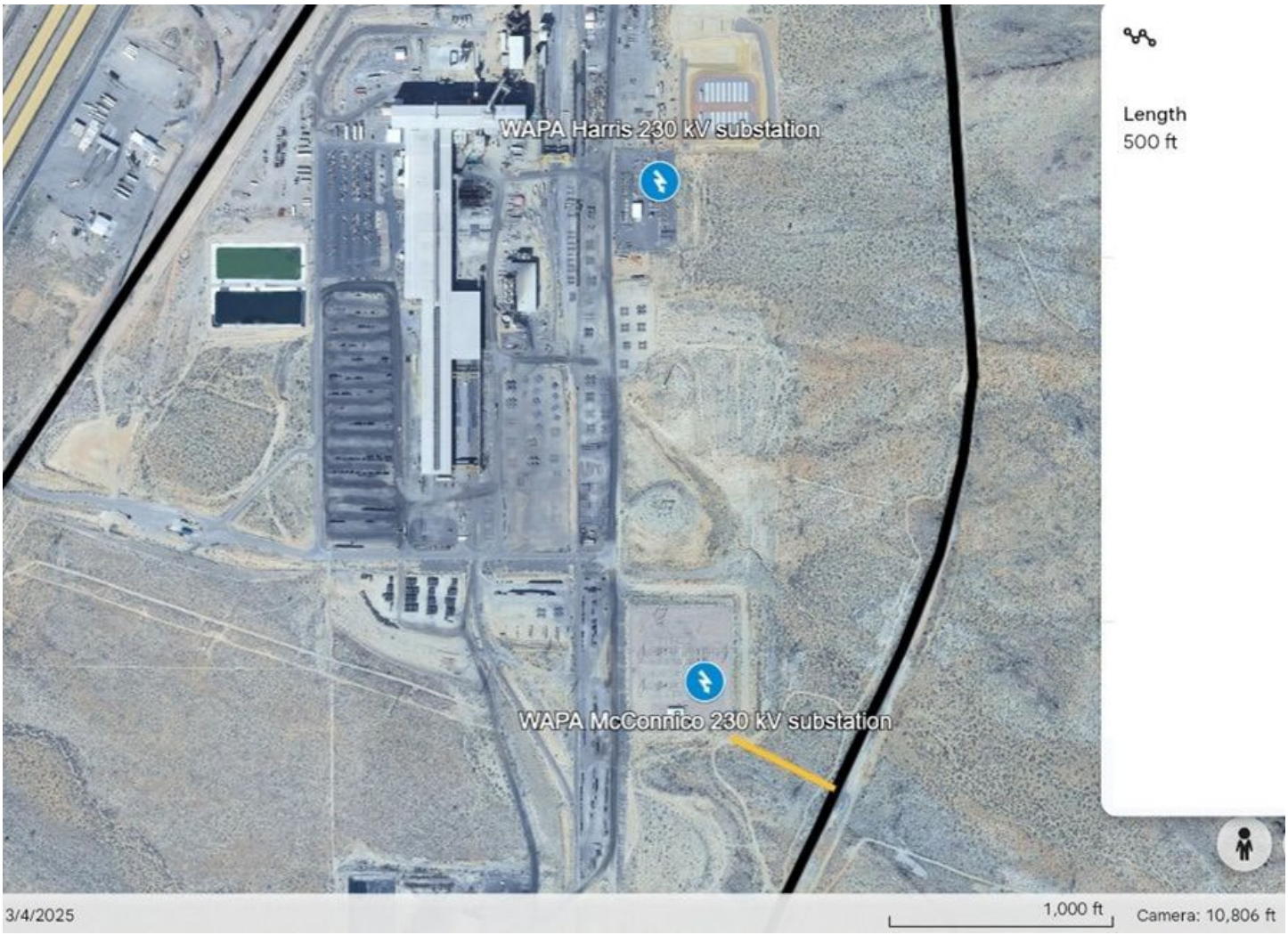
S Frontage Rd
Golden Valley, Arizona



Onward Energy gas-fired Griffith Energy Facility and WAPA Griffith 230 kV / 69 kV substation (Google Streetview)

WAPA McConnico and Harris 230 kV substations [500’ – 1,500’] MP 521

These two large WAPA 230 kV McConnico and Harris substations are hubs of the regional grid and adjacent to the Nucor Kingman steel mill. The facility recently installed a 50 MW / 200 MWh battery energy storage system. Given the large capacity of the two existing 230 kV WAPA substations and connecting transmission plans, the Nucor still mill area is the best site for a traction power substation in the Kingman area.



UniSource South Kingman 69 kV substation [100’] MP ~517

UniSource’s South Kingman 69 kV substation is directly adjacent to the BNSF tracks, but far smaller in capacity that the WAPA 230 kV substations to the south. It is located less than a half mile west of the Kingman Amtrak station, so could serve a small rail traction power substation for trains idling/switch operations right around the Kingston station.



Length
100 ft

UniSource Kingman Airport Industrial Park 69 kV substation [700’] MP ~509



There is ample space between the substation and the BNSF tracks for a new traction power substation. There is also space next to the BNSF tracks along the Kingman Airport Industrial Park for new sidings for switching and locomotive change outs.

Bridges

There are 18 road bridges over the BNSF mainline track between Barstow and Kingman.

Heights shown in brackets are from Federal Highway Administration's LTBP InfoBridge minimum vertical under clearance in the public database[21]. Google Earth maps and photos of the bridges are cataloged in Appendix C.

California

1. Yucca Rd. – Barstow [24.3']
2. I40 Westbound – Pisgah [23.9']
3. I40 Eastbound- Pisgah [24']
4. National Trails Highway – Essex [22.9']
5. I40 Westbound – Fenner [23.4']
6. I40 Eastbound- Fenner [23.4']
7. I40 Westbound – Java [23.8']
8. I40 Eastbound- Java [23.8']
9. I40 Westbound – Needles [25']
10. I40 Eastbound- Needles [25']
11. Route 66 / West Broadway- Needles [24.9']
12. Park Maobi Road [26.5']

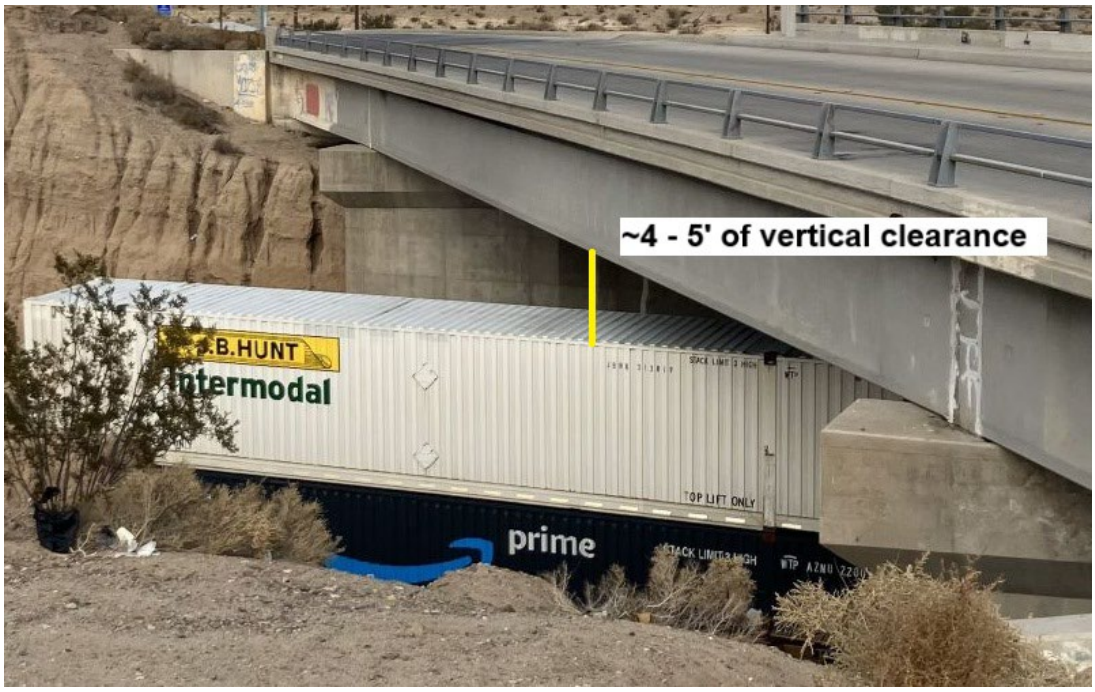
Arizona

13. I40 Westbound – Yucca [23.4']
14. I40 Eastbound- Yucca [23']
15. Hualapai Road, Track 1 – Kingman [29.9']
16. Hualapai Road, Track 2 – Kingman [29.9']
17. I40 Westbound – Kingman [23.5']
18. I40 Eastbound- Kingman [23.3']

Field measurements of the bridge heights above the rails would need to confirm the exact clearances, if BNSF Railway, Caltrans, or AzDOT do not already have these measurements. The good news is, like the Alameda Corridor and both the BNSF San Bernardino and Cajon Subdivisions, none of the clearances of all the existing bridges on the 250-mile Barstow-Kingman route appear to "dealbreakers". While the vast majority of the bridges appear to be high enough for conventional overhead catenary wire (50 kV at 23' above top-of-rail), above double stack of two "high cube" containers. There appear to be only couple 'tight spots': at two of the bridges, for which the 'minimum vertical under clearance' is reported to be 23' or less: I40 Eastbound- Yucca, AZ [23'] and the National Trails Highway – Essex [22.9']. If a significant interference issue were to be caused by the overhead catenary structures and wire at the locations of bridges or at-grade crossings (i.e. if 2' of overall vertical clearance is insufficient), that could not be mitigated with modern methods (conductor bars, special insulation structures, etc.), this would not be an insurmountable obstacle. It is common practice around the world for electric trains to coast through short unelectrified sections, unpowered on a 'dead' (permanently grounded or neutral)[22] section. Such a dead section could be strategically located at the lowest bridges, without significant modifications to the bridge or track.

[21] https://infobridge.fhwa.dot.gov/

[22] Short unelectrified sections, with pantograph-up – would typically be Permanently Earthed Sections (PES – using UK terminology) – rather than Neutral Sections. A PES would just be cabled from one electrified section to another, with an grounded section of



BNSF double-stacked 'high-cube' container train under Yucca Avenue bridge, Barstow (December 4, 2023 photo)



Interstate 40 bridges, Needles (February 13, 2026 photo)

In sum, several new technologies are allowing tighter clearances for electric wires going under bridges[23]:

- Under-cable support structures
- Conductor bars with top insulation
- Insulating covers/coatings (combined with surge arresters), incl. voltage-controlled clearances
- Permanently-grounded or neutral sections (some of which already required by AC OCS electrification systems)

conductor bar or catenary (contact wire run in parallel) in between. A neutral section would typically be fed separately on either side to separate different electrical phases/or power fed from different traction power substations.

[23] https://www.thepwi.org/wp-content/uploads/2021/10/Journal-2021-10-Vol139-Pt4_Voltage-controlled-clearances.pdf

https://www.railengineer.co.uk/overcoming-the-clearance-issue/

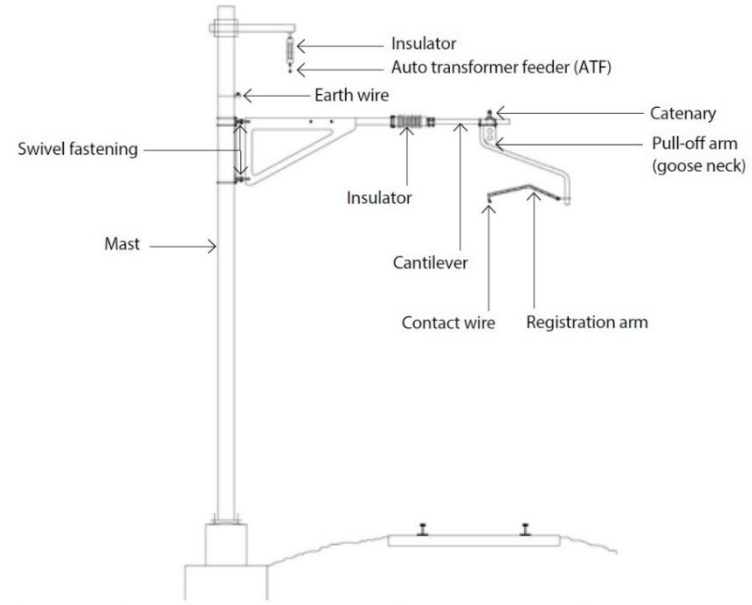


Conductor bar on a European OCS system passing under a low bridge (photo: Furrer+Frey)

Appendix A:

Examples of OCS Structures

Typical New single post assembly with single overhead wire:



OLE mast, cantilever and associated equipment (in this case Series One)

Source: Network Rail (UK)

Along the route studied, the supporting structures are assumed to be steel or composite masts (poles).

- Pole foundation options:
  - Poured concrete in holes augered or dug with a backhoe.
  - Precast concrete
  - Driven steel pile
- Pole structural components:
  - Cross arm
  - Pull-off arm
  - Misc. fittings

Mechanical -

- Cantilevers-swivel (one per pole)
- Tensioning spring mechanism (two per 1-mile section)

Electrical components-

- Parallel (autotransformer) feeder wire
- Ground return (static) wire- electrically connected to the track

- Messenger (catenary) wire- maintains the contact wire at the correct height above the rail (part of electrical circuitry)
- Contact wire- delivers power to the pantograph.
- Droppers that hold the contact wire from the catenary wire.
- Insulators

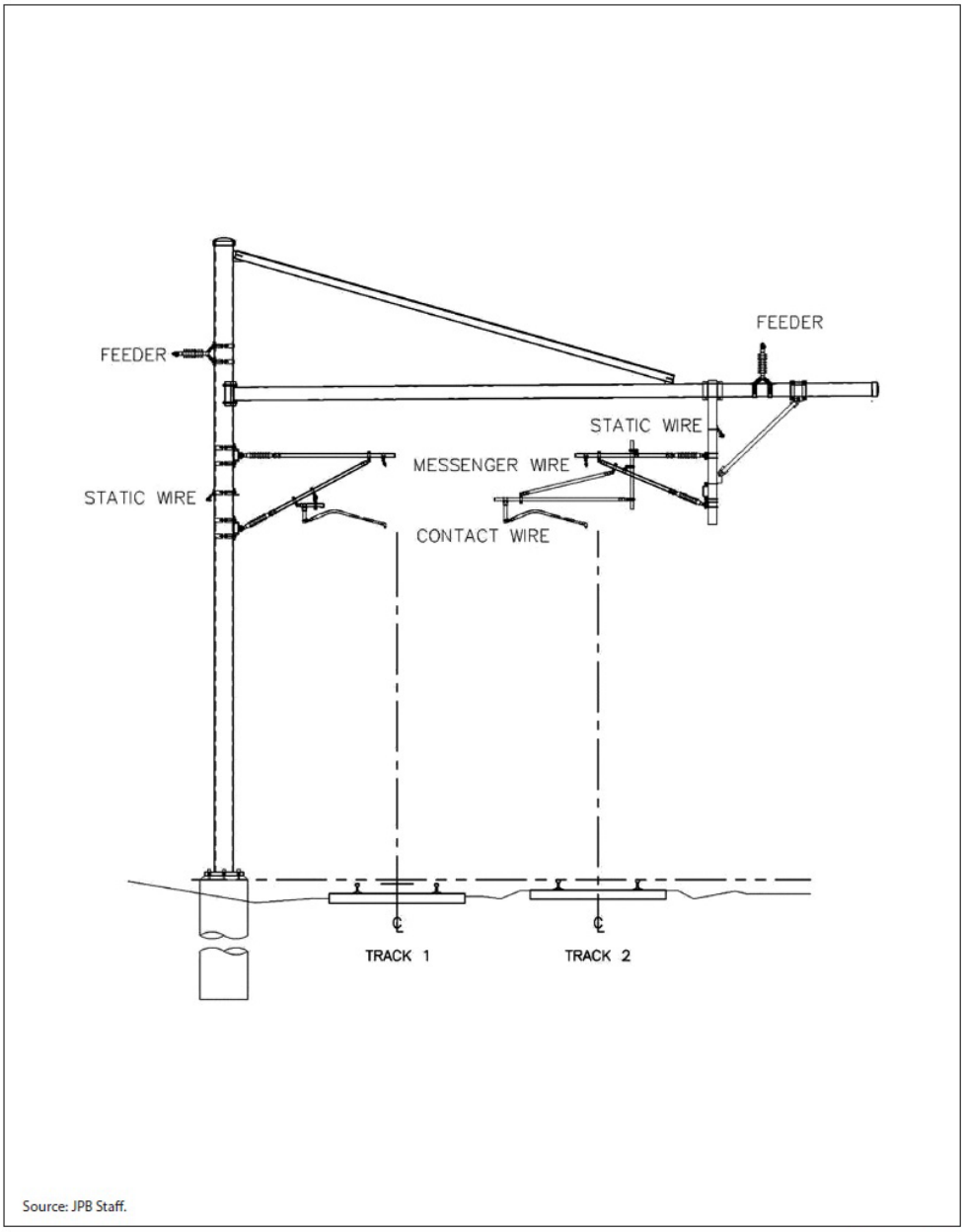
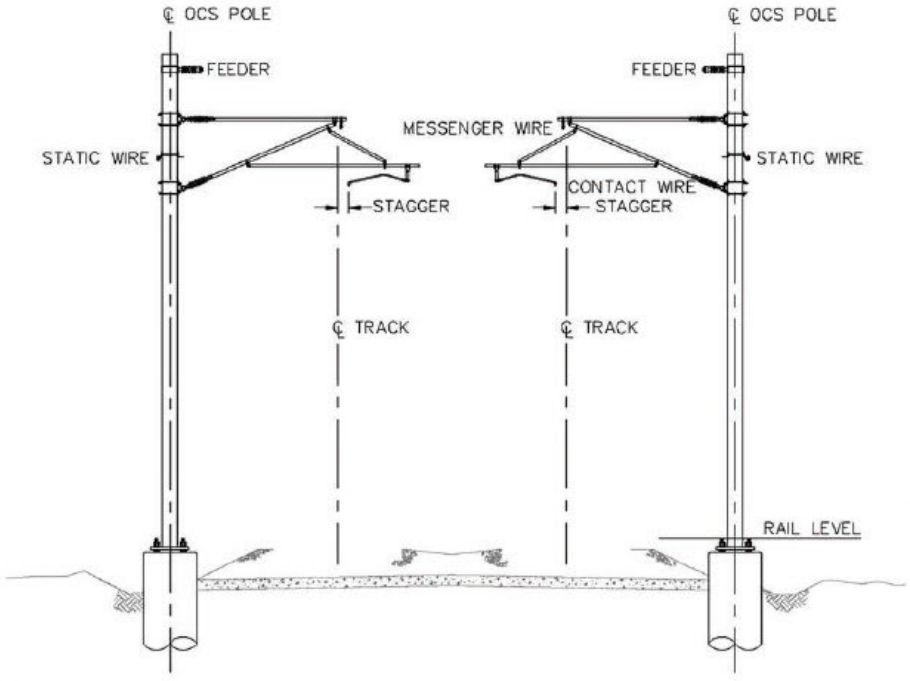


Figure 2-7
OCS Two Track Cantilever
Peninsula Corridor Electrification Project



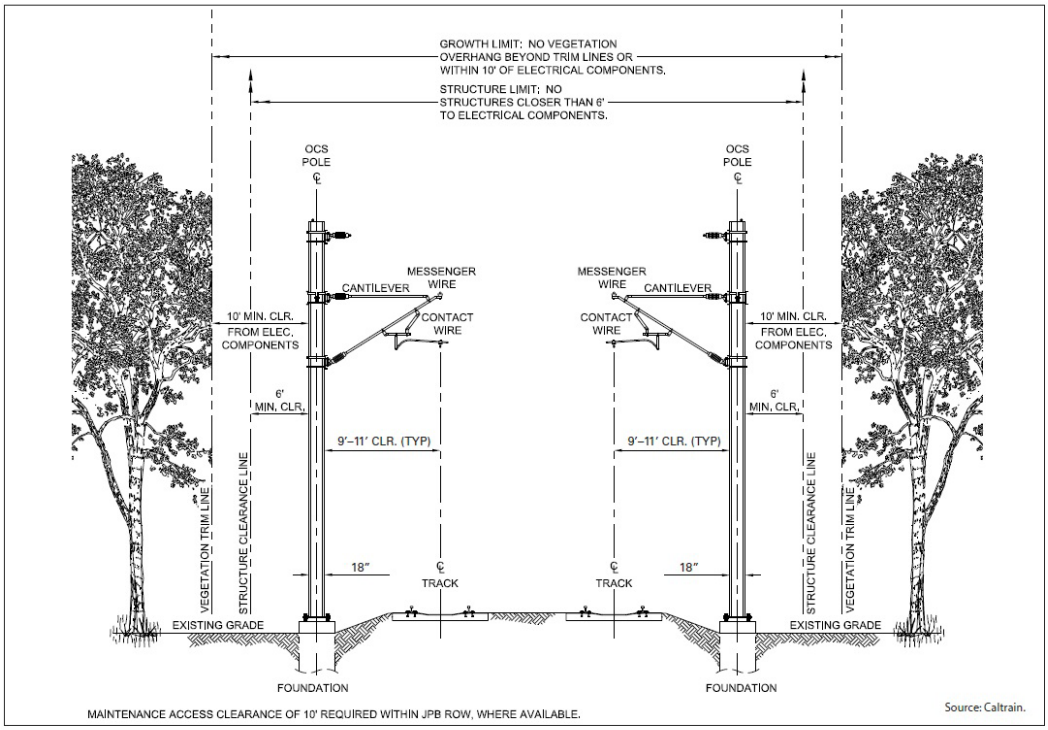
Amtrak's North End Electrification



Source: JPB Staff.

Graphics ... 0060.6.12 (12-10-13)

Figure 2-3
OCS Two Track Arrangement with Side Pole Construction
Peninsula Corridor Electrification Project



Note: This figure replaces Figure 2-8 from the Draft EIR.

Figure 2-8
Vegetation Clearance
Peninsula Corridor Electrification Project

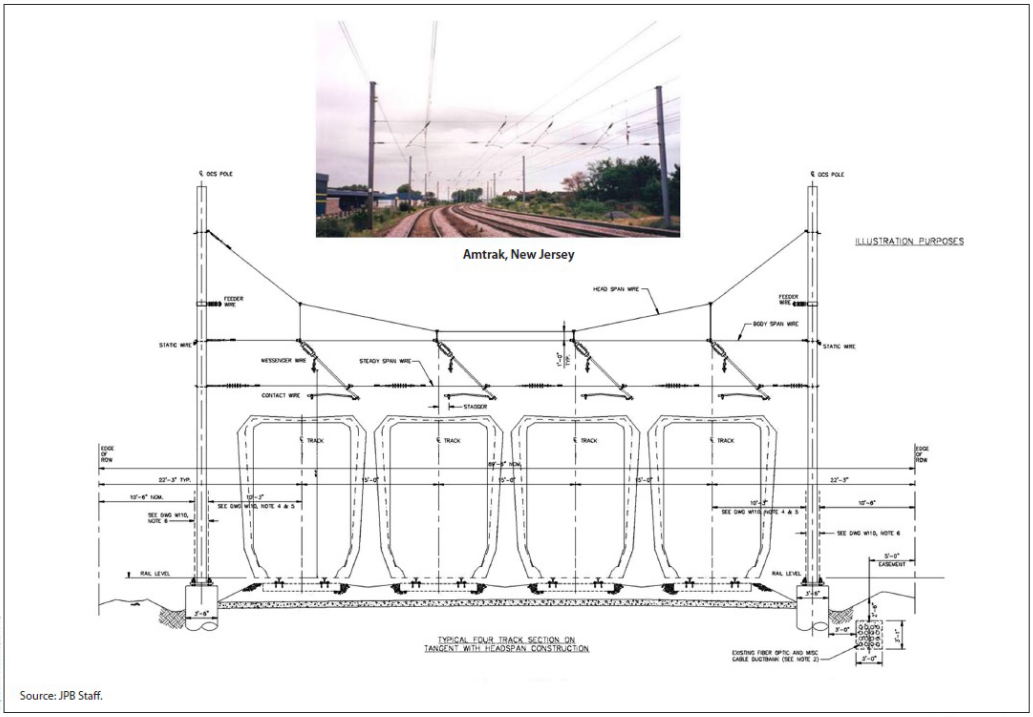
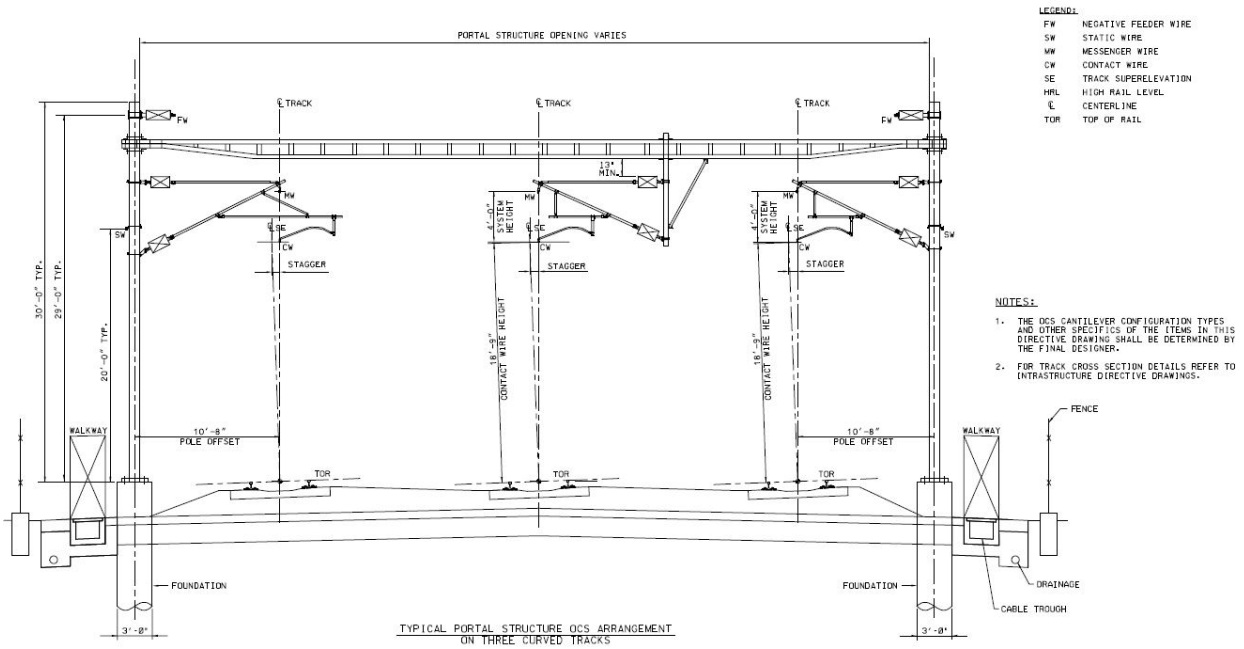


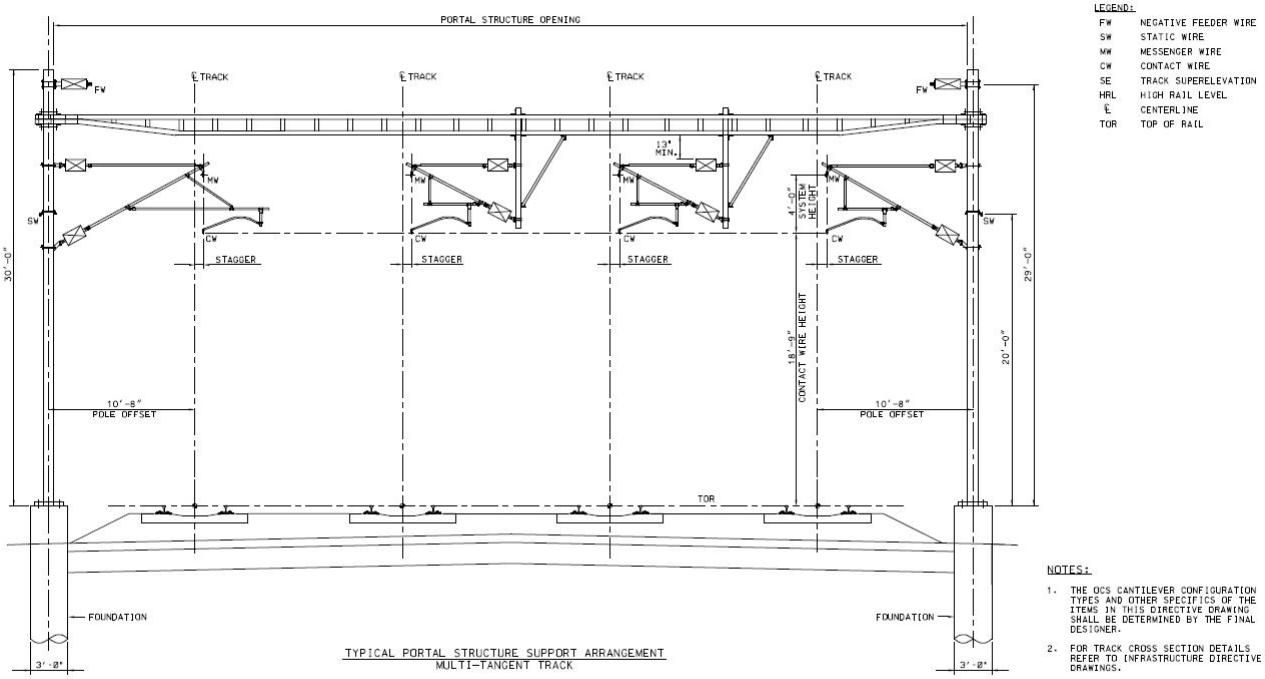
Figure 2-6
OCS Multi-Track Arrangement with Headspan Construction
Peninsula Corridor Electrification Project

Examples of OCS configuration of three-track mixed use, similar to Fullerton-Riverside-San Bernardino-

Note that the three reference 'directive drawings' shown below from the *Technical Memorandum (TM) 3.2.1 – OCS Requirements,* for California High Speed Rail Authority by Parsons Brinkerhoff, October 2010, are for 25 kV OCS with an overhead clearance of 16'9" above the top of rail, or lower than needed for double-stack container trains. The structure and wire heights would be higher (contact wire height of 23' above the top of rail) for a 50 kV San Bernardino-Barstow-Yermo/Newberry OCS, due to the need to accommodate double-stack container trains, and a higher voltage.

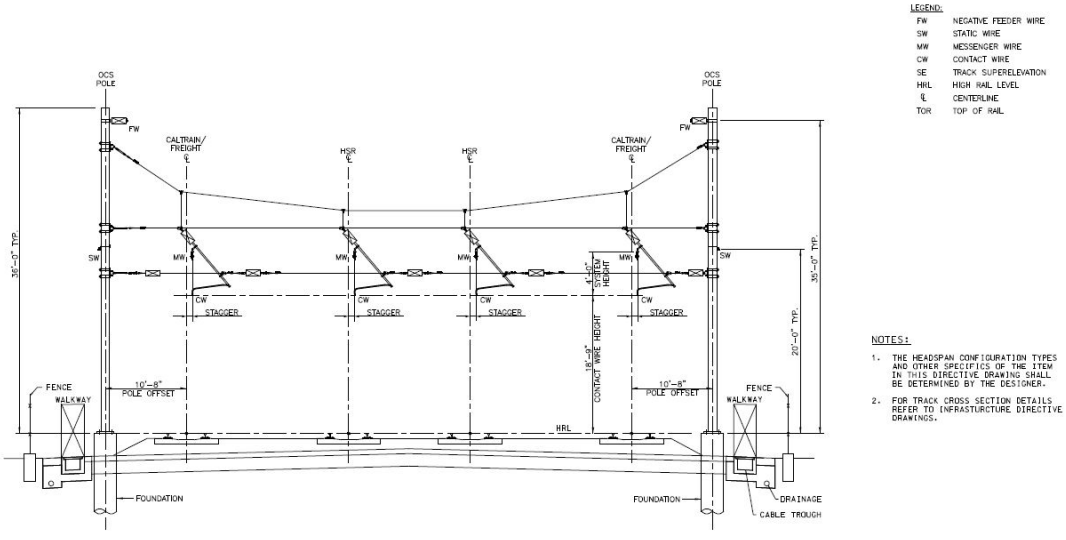


"Typical portal structure OCS arrangement on three curved tracks, speed up to 125 MPH", Drawing TM 3.2.1-F from *Technical Memorandum (TM) 3.2.1 – OCS Requirements,* for California High Speed Rail Authority by Parsons Brinkerhoff, October 2010



TYPICAL PORTAL STRUCTURE SUPPORT ARRANGEMENT
MULTI-TANGENT TRACK

"Typical portal structure arrangement, multi-tangent track, speed up to 125 MPH", Drawing TM 3.2.1-G from *Technical Memorandum (TM) 3.2.1 – OCS Requirements,* for California High Speed Rail Authority by Parsons Brinkerhoff, October 2010



TYPICAL OCS HEADSPAN ARRANGEMENT – FOUR TANGENT TRACKS
SHARED USE CORRIDOR AND SPEED UP TO 125 MPH
FOR CALTRAIN CORRIDOR ONLY

"Typical OCS headspan arrangement, four tangent tracks shared use corridor, speed up to 125 MPH", Drawing TM 3.2.1-M from *Technical Memorandum (TM) 3.2.1 – OCS Requirements,* for California High Speed Rail Authority by Parsons Brinkerhoff, October 2010

Appendix A: Examples of OCS Structures

Overhead power lines combined with OCS structures



Swiss mast with 66 kV and OCS (Photo: Ferrer + Frey)

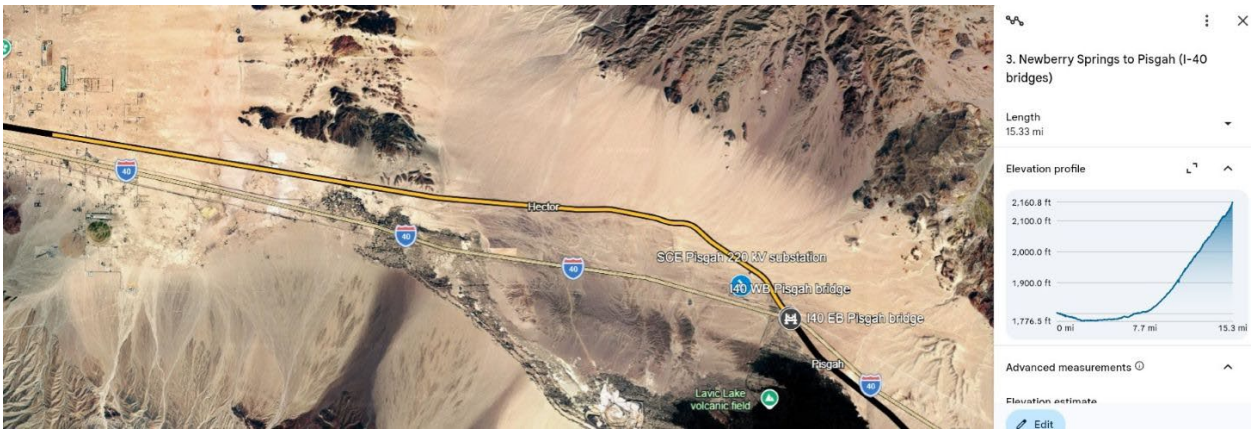


Rendering: OCS mast combined w/ 115 kV (Ferrer + Frey)

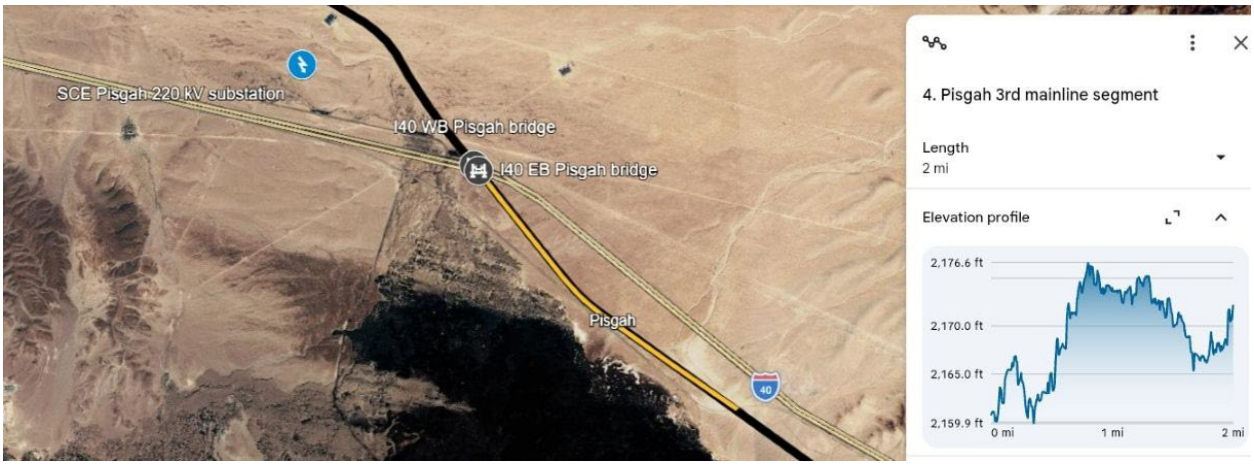


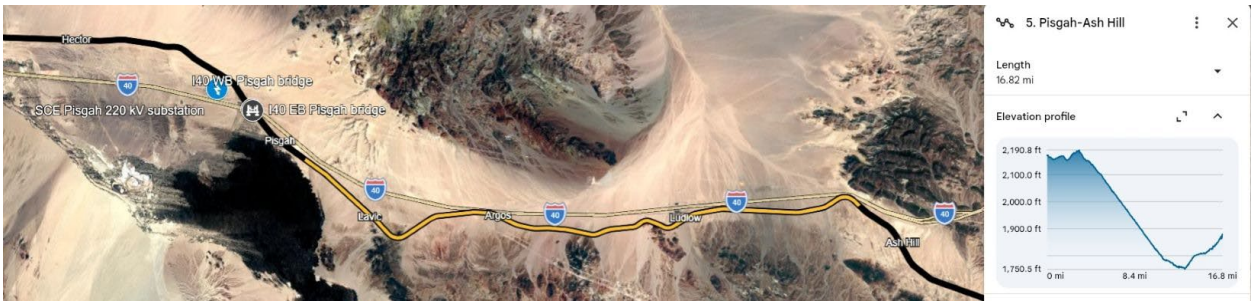
Appendix B: Potential OCS track segments on the BNSF mainline between Barstow and Kingman



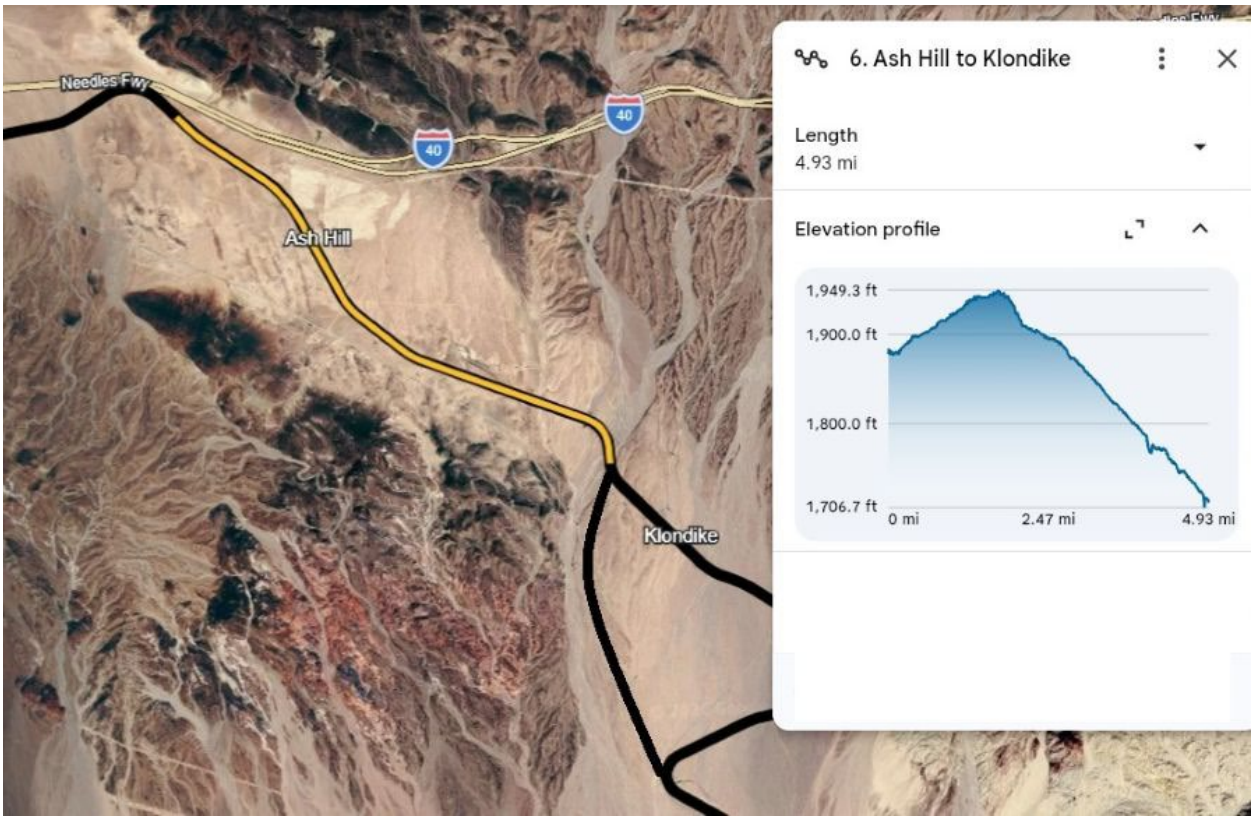


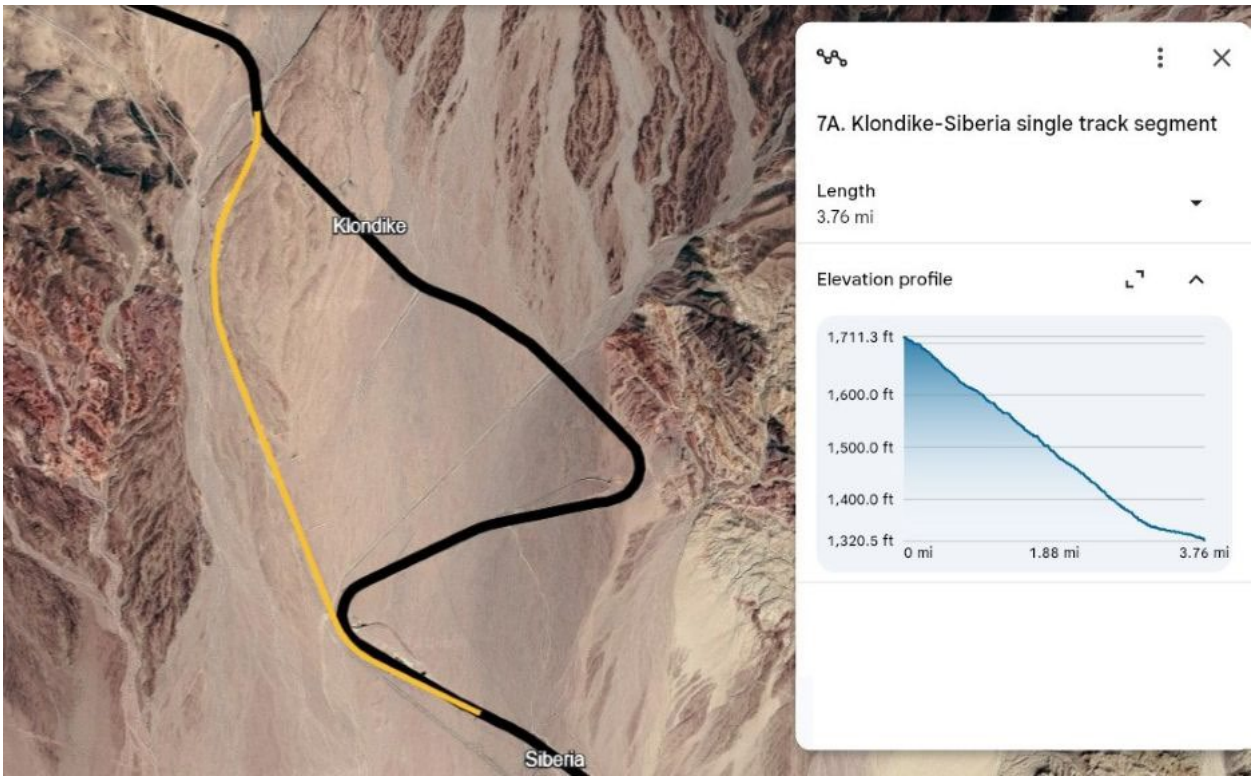
Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline





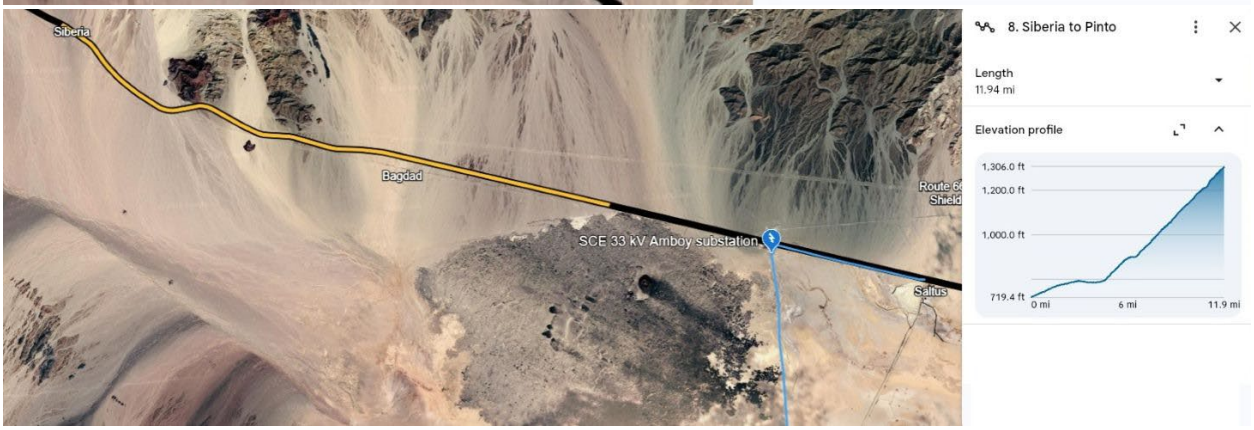
Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline

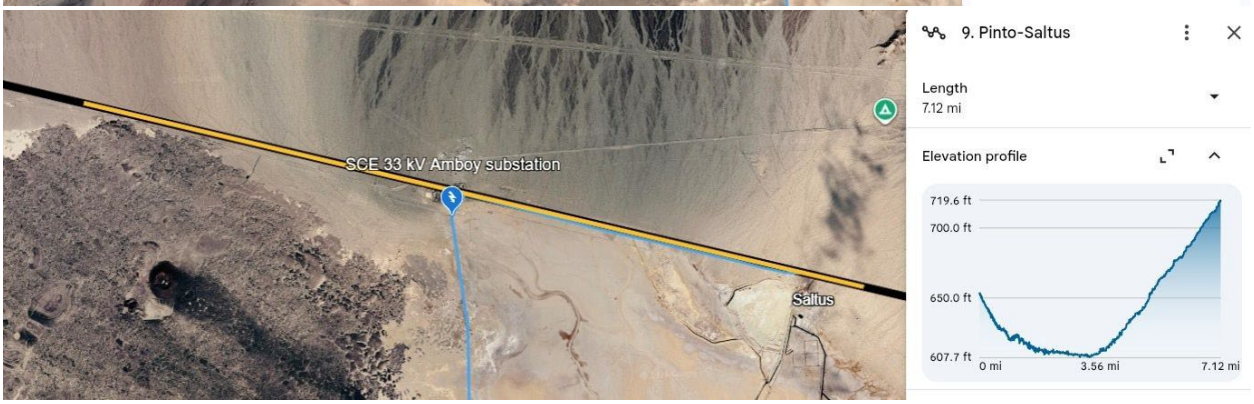




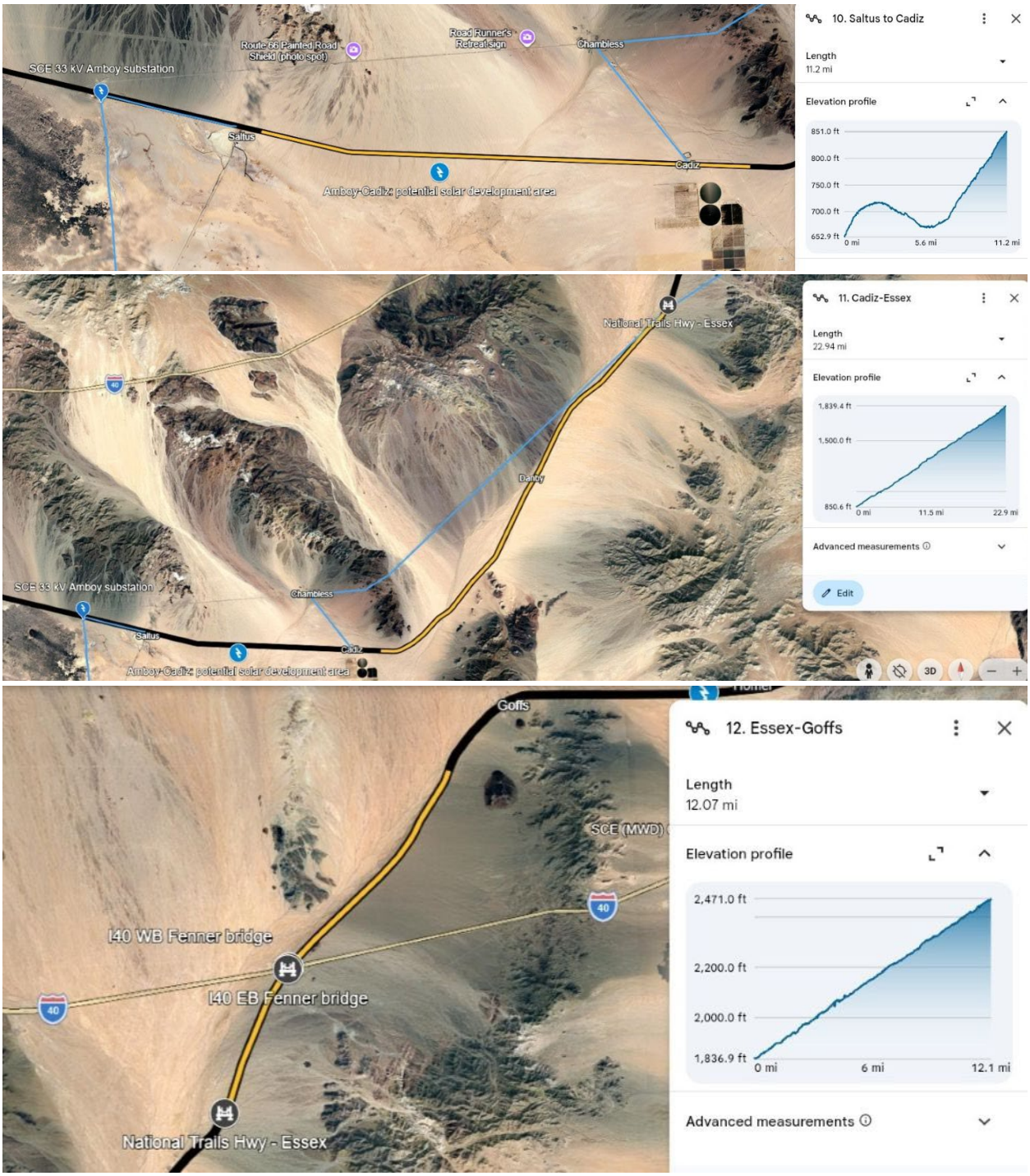
Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline



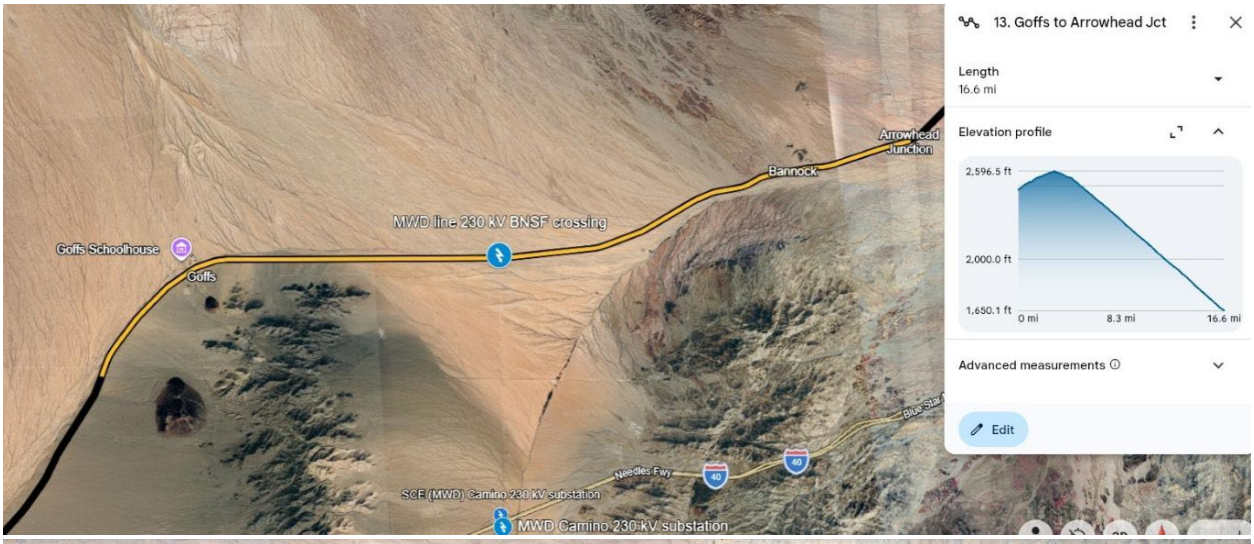




Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline



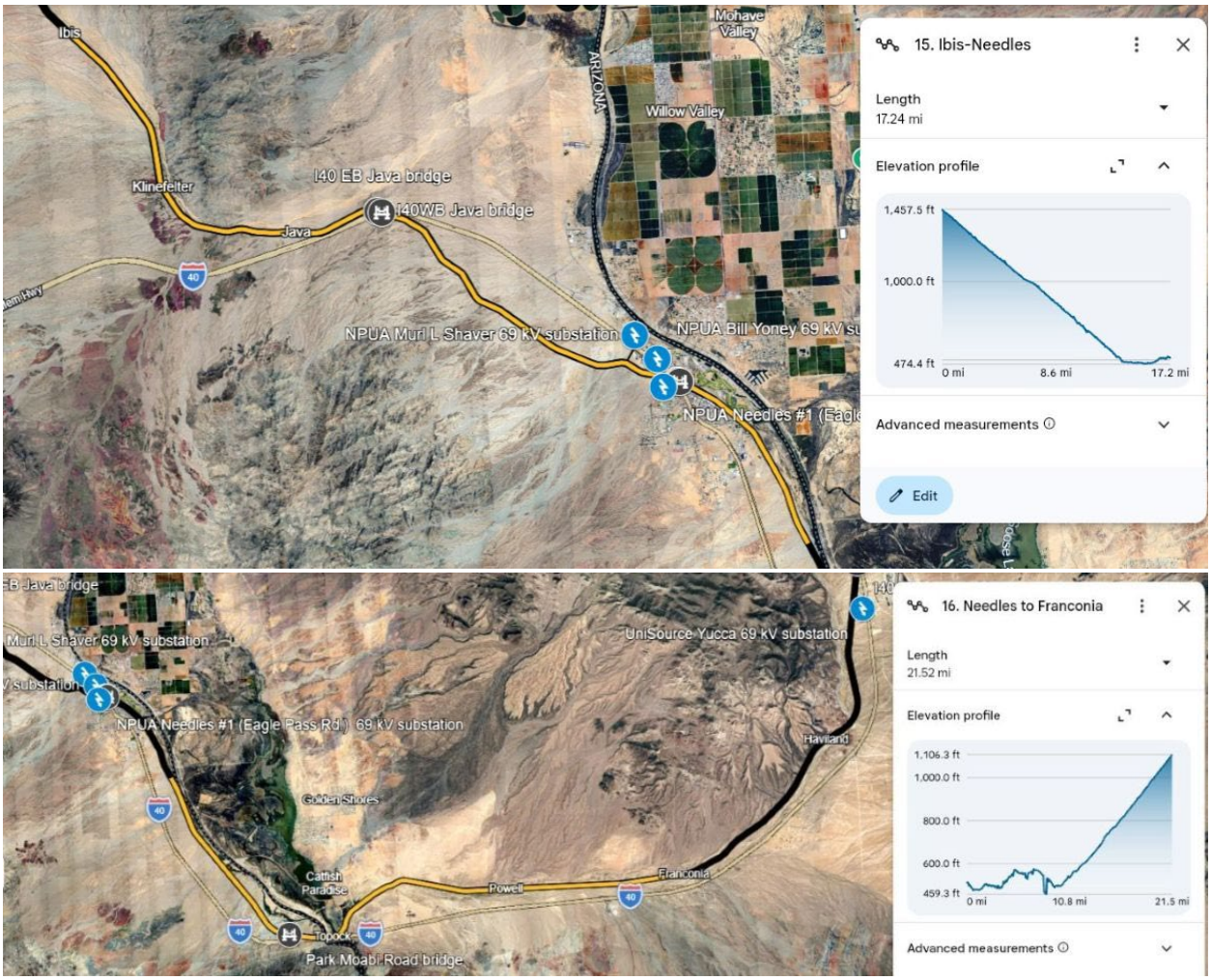
Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline



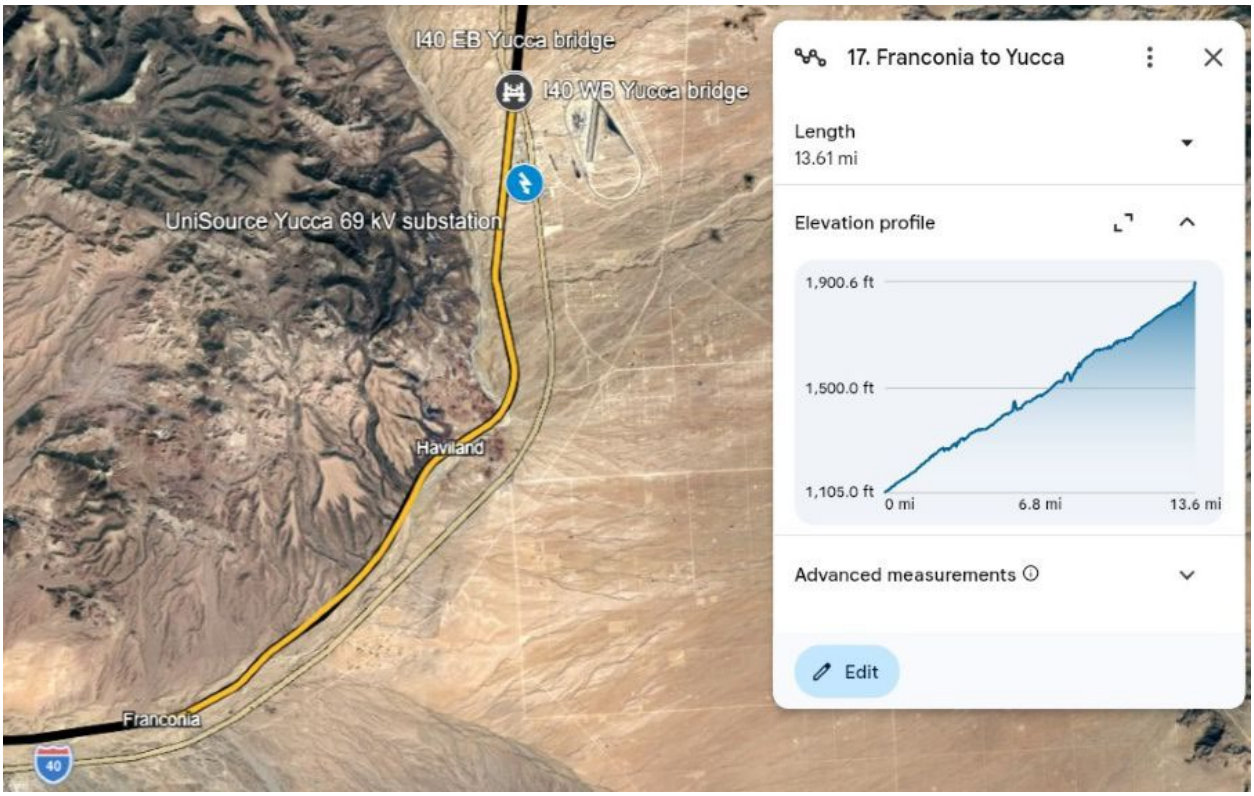


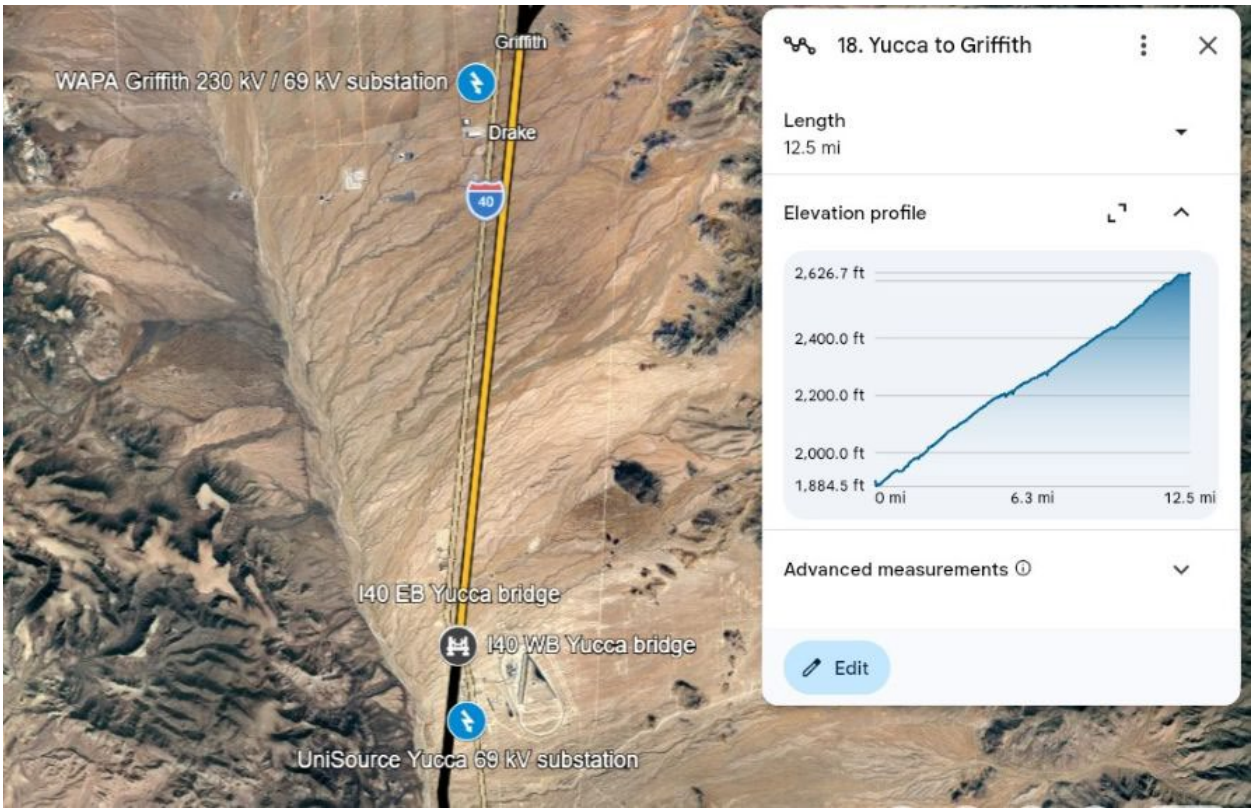


Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline

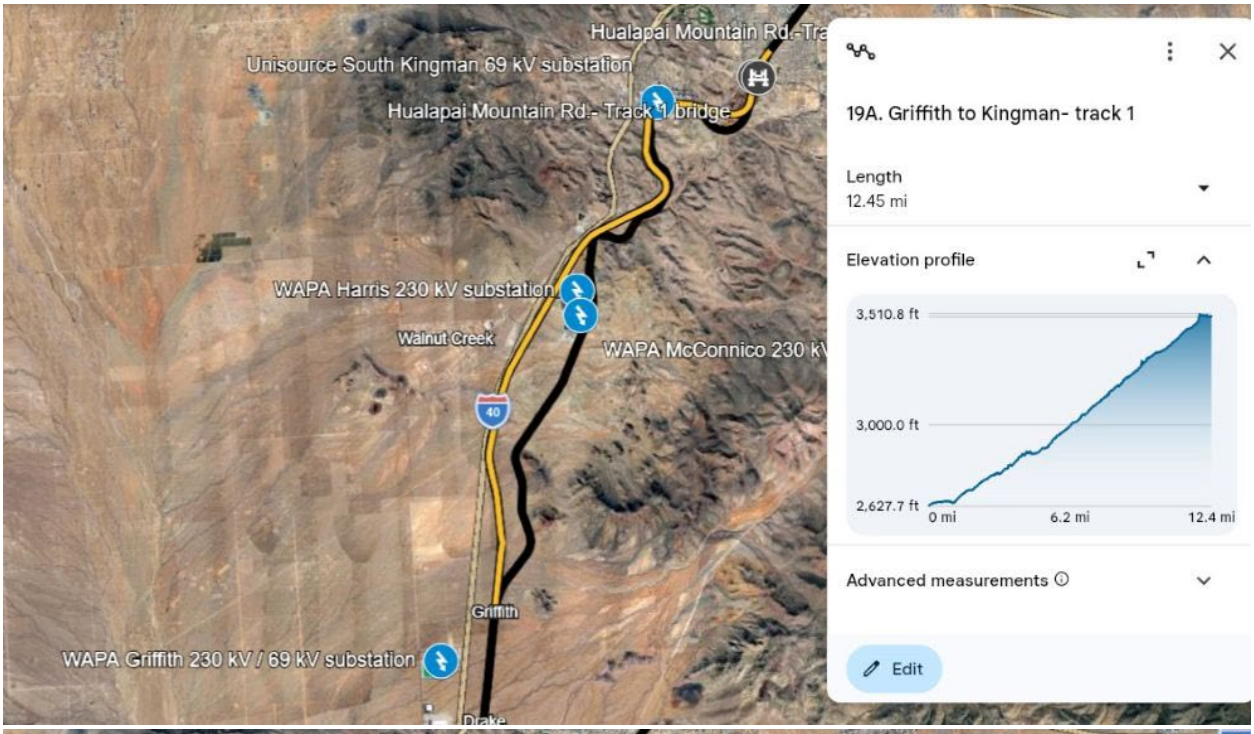


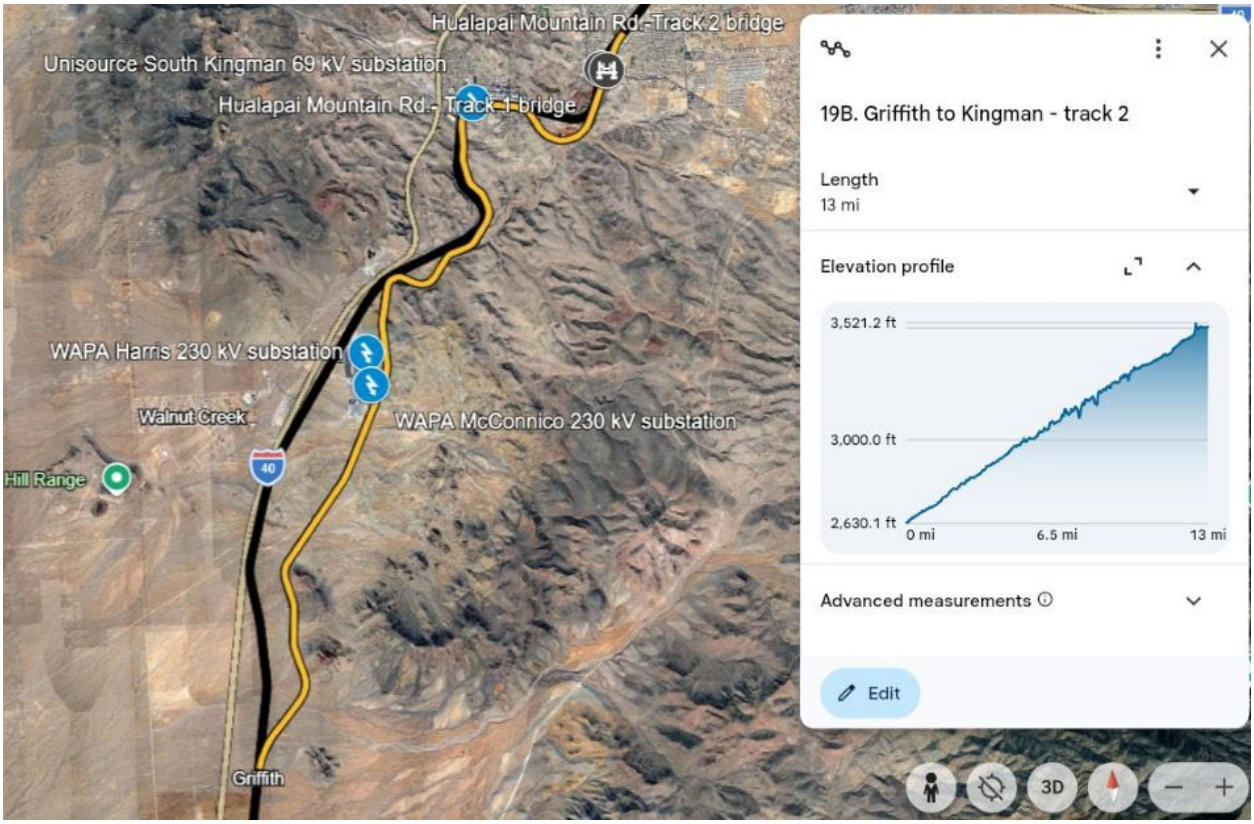
Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline



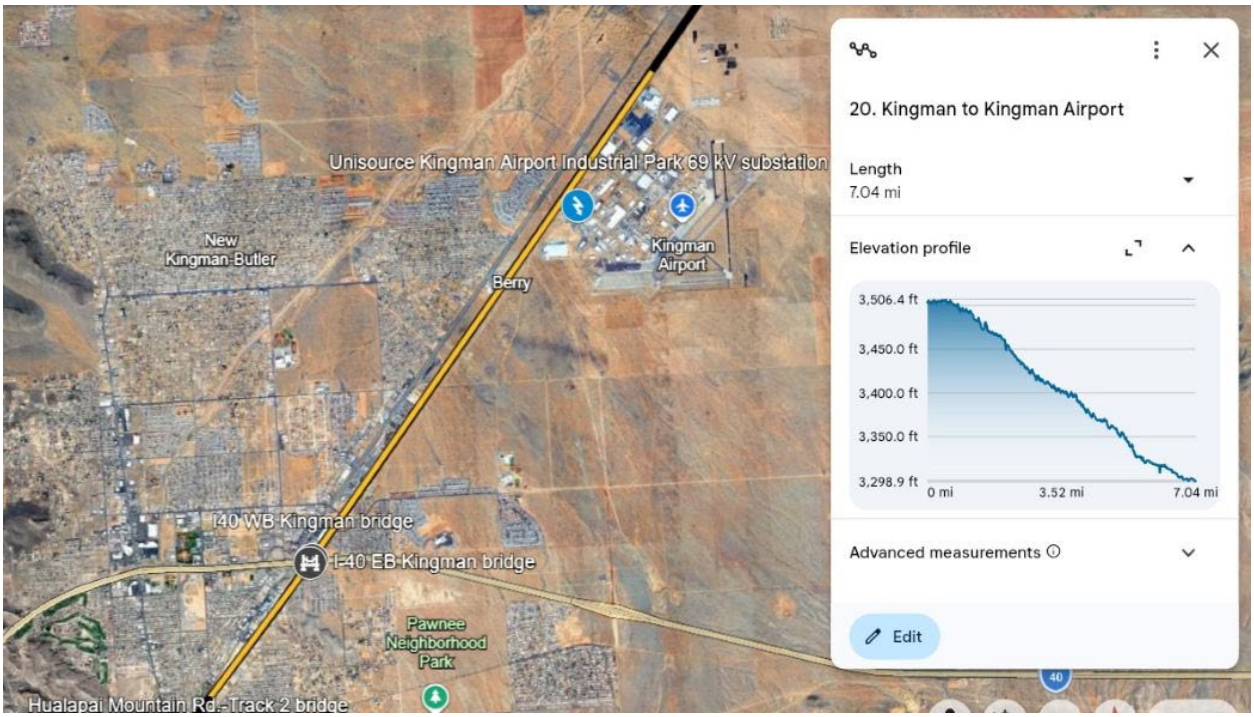


Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline





Appendix B: Barstow-Needles-Kingman OCS track segments BNSF mainline



Appendix C: Bridges over BNSF Mainline

Needles and Seligman Subdivisions (Barstow-Needles-Kingman)

There are 18 road bridges over the BNSF mainline between Barstow and Kingman.

All of them appear to be sufficiently high enough for 50 kV (with neutral sections, special insulators, etc at the lowest bridges) over double-stacked container train, without major modifications to the bridge or track.

[Heights shown in brackets are from Federal Highway Administration's LTBP InfoBridge minimum vertical under clearance in the public database[1]],

California

1. Yucca Avenue – Barstow [24.3']
2. I40 Westbound – Pisgah [23.9']
3. I40 Eastbound– Pisgah [24']
4. National Trails Highway – Essex [22.9']
5. I40 Westbound – Fenner [23.4']
6. I40 Eastbound- Fenner [23.4']
7. I40 Westbound – Java [23.8']
8. I40 Eastbound- Java [23.8']
9. I40 Westbound – Needles [25']
10. I40 Eastbound- Needles [25']
11. Route 66 / West Broadway- Needles [24.9']
12. Park Maobi Road [26.5']

Arizona

13. I40 Westbound – Yucca [23.4']
14. I40 Eastbound – Yucca [23']
15. Hualapai Road, Track 1 – Kingman [29.9']
16. Hualapai Road, Track 2 – Kingman [29.9']
17. I40 Westbound – Kingman [23.5']
18. I40 Eastbound– Kingman [23.3']

[1] https://infobridge.fhwa.dot.gov/

1. Yucca Avenue – Barstow [24.3']





(December 4, 2023 photo)

2. **I40 Westbound – Pisgah [23.9’]**
3. **I40 Eastbound – Pisgah [24’]**





(February 13, 2026 photo)

4. National Trails Highway – Essex [22.9']





(Google Streetview photo)

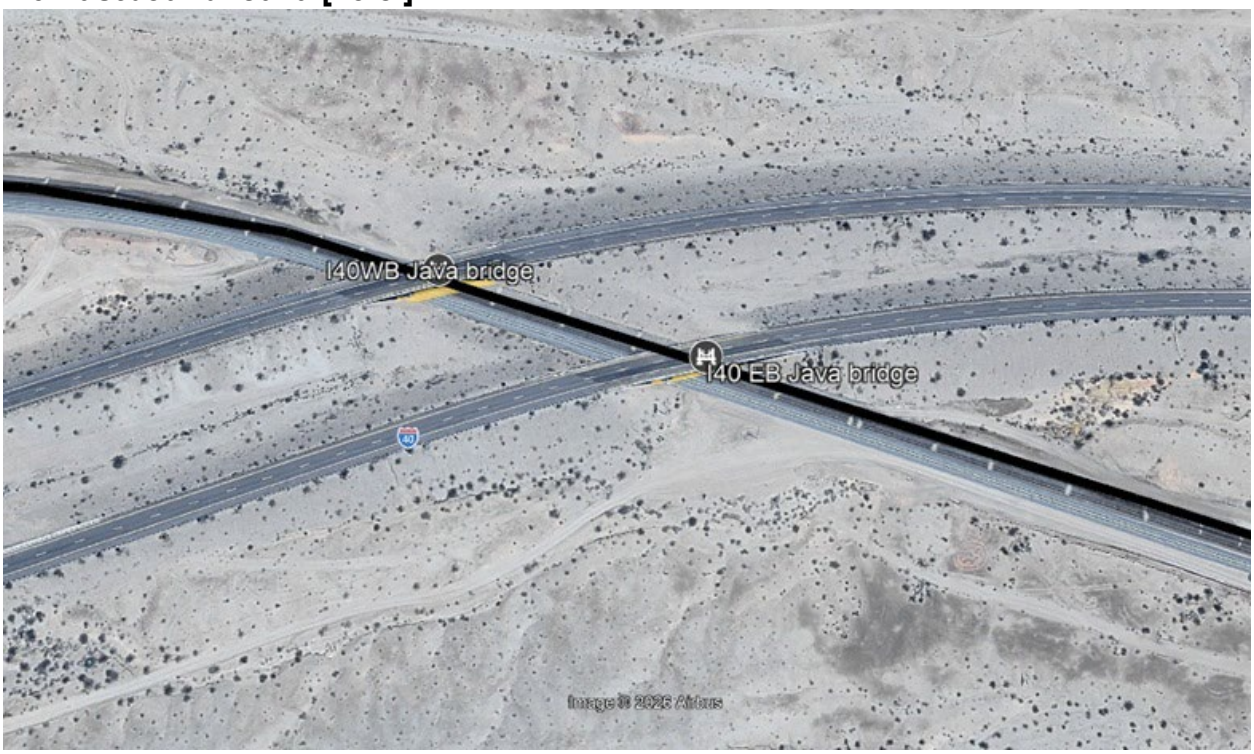
5. **I40 Westbound – Fenner [23.4']**
6. **I40 Eastbound- Fenner [23.4']**





(February 13, 2026 photo)

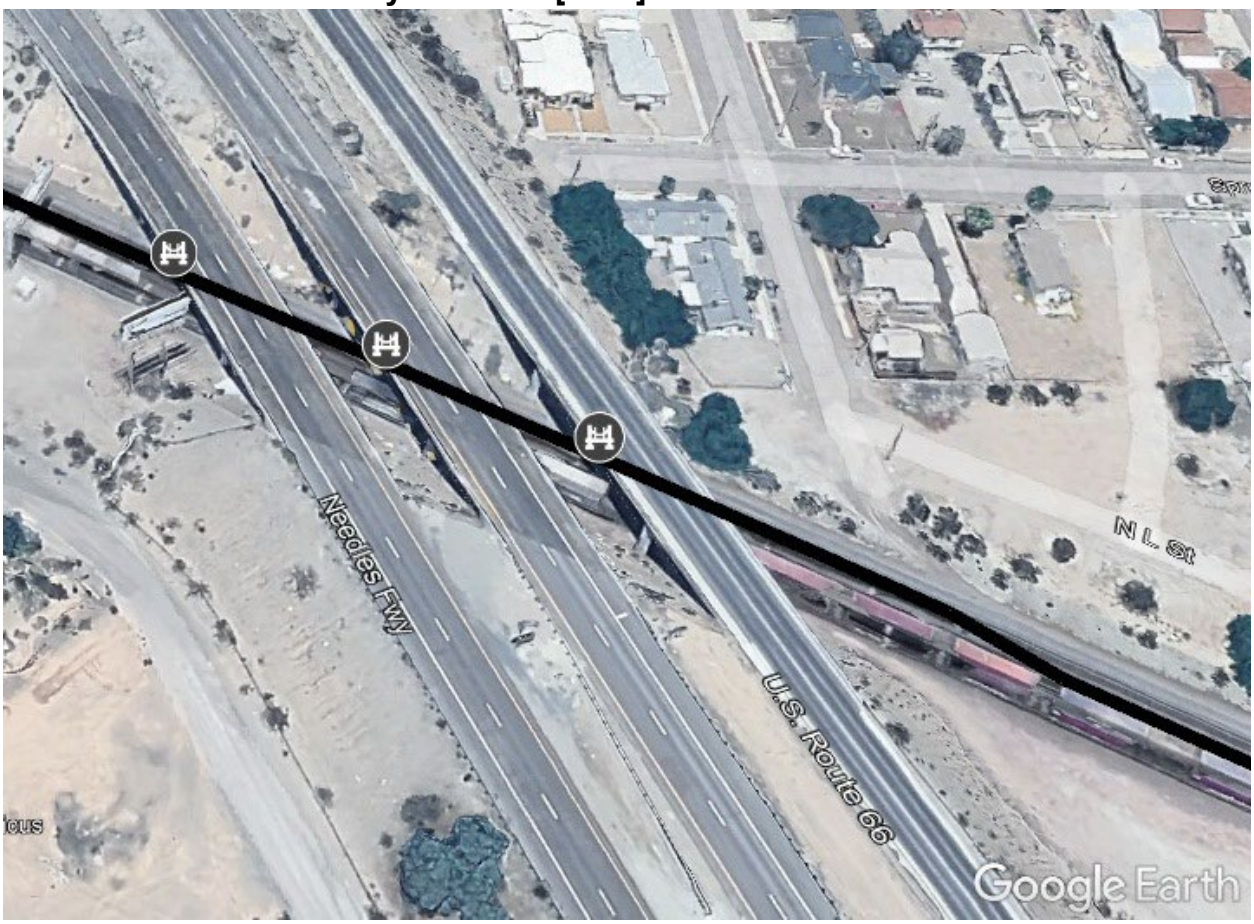
7. **I40 Westbound – Java [23.8’]**
8. **I40 Eastbound- Java [23.8’]**





(February 13, 2026 photo)

9. **I40 Westbound – Needles [25’]**
10. **I40 Eastbound- Needles [25’]**
11. **Route 66 / West Broadway- Needles [24.9’]**





(February 13, 2026 photo)

Appendix C: Barstow-Needles-Kingman bridges over the BNSF mainline



(February 13, 2026 photo)

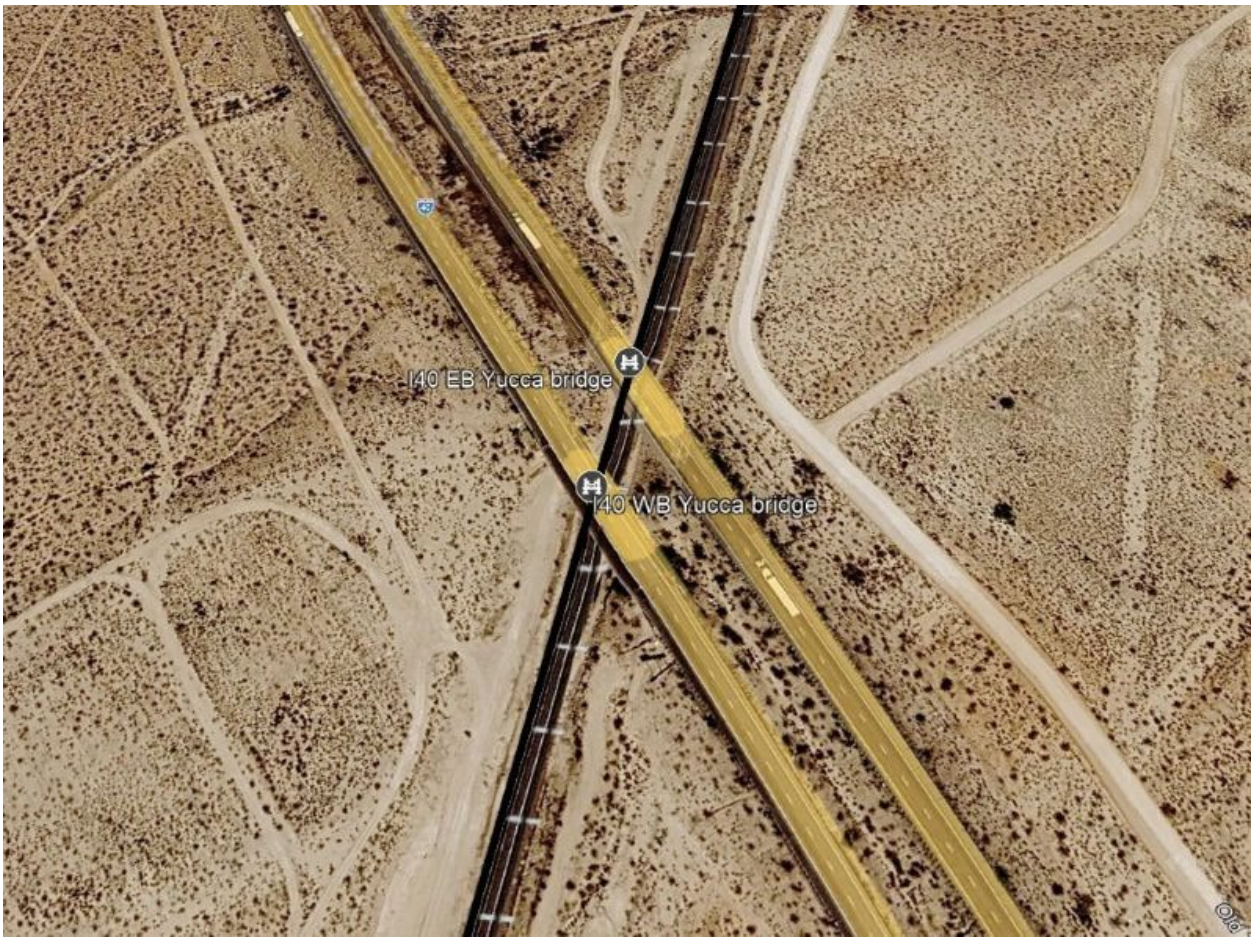
12. Park Maobi Road [26.5']





(Google Streetview photo)

13. **I40 Westbound – Yucca [23.4’]**
14. **I40 Eastbound – Yucca [23’]**



15. Hualapai Road, Track 1 – Kingman [29.9']
16. Hualapai Road, Track 2 – Kingman [29.9']



17. I40 Westbound – Kingman [23.5']
18. I40 Eastbound – Kingman [23.3']





(Google Streetview photo)