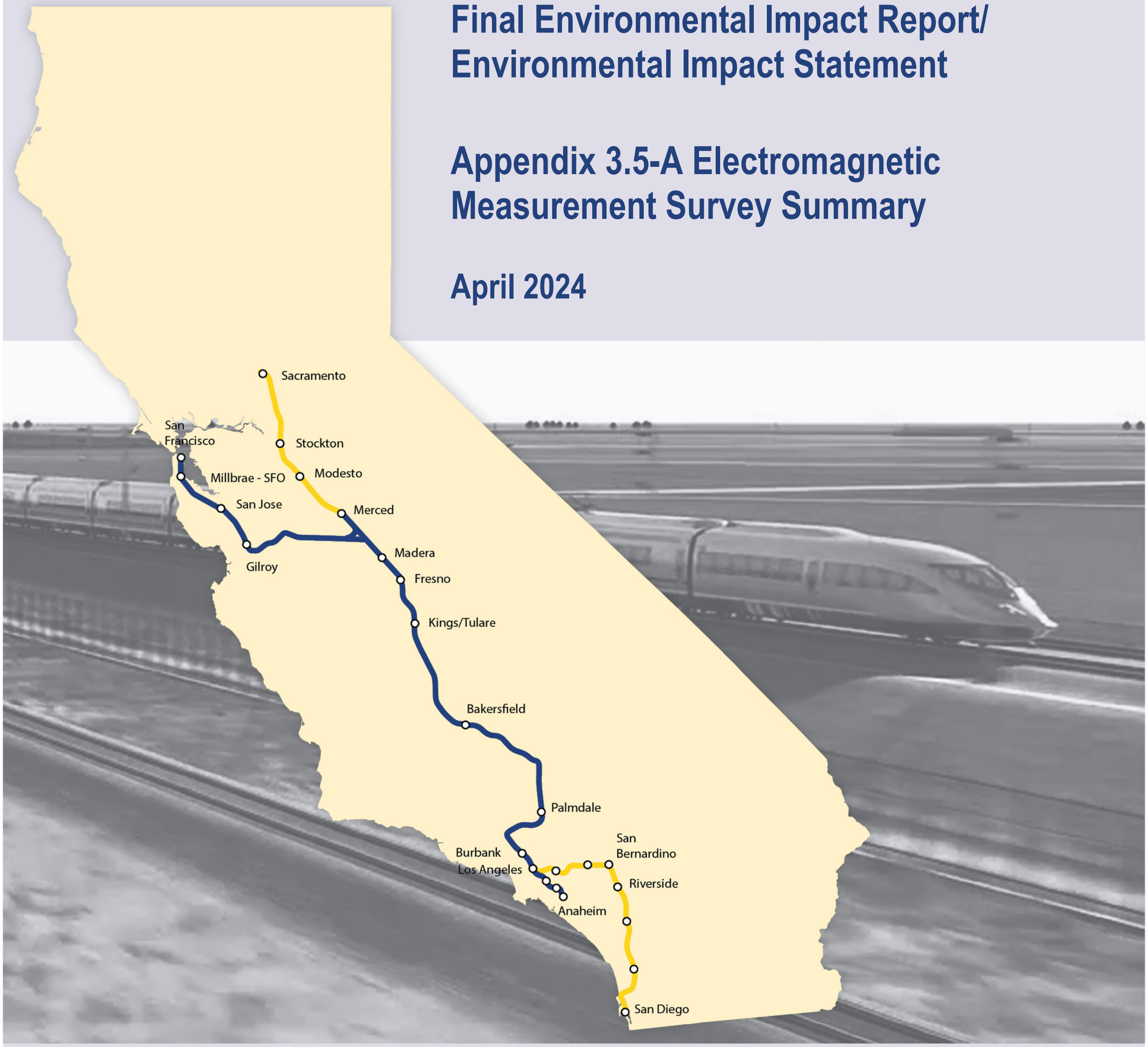
California High-Speed Rail Authority

Palmdale to Burbank Project Section

Final Environmental Impact Report/ Environmental Impact Statement

Appendix 3.5-A Electromagnetic Measurement Survey Summary

April 2024



CALIFORNIA High-Speed Rail Authority

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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APPENDIX 3.5-A: ELECTROMAGNETIC MEASUREMENT SURVEY SUMMARY

INTRODUCTION

This Appendix documents measurement results from a preconstruction electromagnetic survey of locations along the proposed High-Speed Rail (HSR) Project Section between Palmdale and Burbank. The purpose of the survey was to: (1) provide a baseline characterization of the existing electromagnetic environment, (2) permit comparisons with the expected electromagnetic footprint from the planned HSR system, and (3) provide guidance for electromagnetic compatibility (EMC) requirements by defining the typical electromagnetic environment that the HSR system must operate in without interference.

Land uses, existing facilities, and infrastructure along the alignment were reviewed, with a list of approximately 15 candidate sites evaluated. This review concentrated on identifying potentially electromagnetic interference (EMI)-sensitive facilities as well as existing electromagnetic field (EMF) sources such as power generation, power distribution, and communications facilities. The selection criteria, taken from Technical Memorandum 3.4.11, favored providing a balanced coverage of:

- The geographic extent of the segment,
- High-emission sites,
- Low-emission sites,
- Sites with high-sensitivity receptors.

A final group consisting of ten sites was selected based upon the above considerations and to provide representative coverage of land uses.

Two types of measurements were performed at each location. The first involved measurement of radiated electric fields from 10 kilohertz (kHz) to 6 gigahertz (GHz), meant to characterize the radio-frequency (RF) environment. These electric field strengths were measured using an RF spectrum analyzer and calibrated antennas. Expected sources of RF signals include:

- Cell towers (cellular telephone)
- Broadcast towers (radio and television broadcasts)
- Airport radars and aircraft communications equipment
- General high-frequency (HF) and very-high-frequency (VHF) fixed and mobile communications systems (police, fire, emergency medical technician, utilities, and government)
- Local wireless (wireless fidelity [WiFi] and Worldwide Interoperability for Microwave Access [WiMAX])

The second part of the test procedure involved measurements of background direct-current (DC) and power frequency magnetic fields along the alignment. These magnetic fields were recorded using a three-axis fluxgate sensor with a waveform recording data acquisition system. Expected sources of DC and low-frequency magnetic fields include:

- The geomagnetic field
- High-voltage transmission lines
- Electric distribution lines
- Substations/generation facilities
- Geomagnetic perturbations due to passing vehicles and trains

The facilities most sensitive to abrupt shifts in the DC (geomagnetic perturbations) and alternating-current (AC) magnetic fields are:

- High-tech semiconductor (e.g., electron microscopes [transmission electron microscopes/scanning electron microscopes], electron-beam lithography, ion-writing systems, focused ion-beam systems)
- High-tech biology (e.g., nuclear magnetic resonance, electron microscopes)
- Medical imaging (e.g., computed tomography [CT] scanners, MRI systems)
- University/research (instrumentation for chemistry, physics, electrical engineering, and similar systems to those mentioned for high-tech and medical facilities).

TEST PROCEDURES AND EQUIPMENT

Characterization of the radio-frequency (RF) environment along the proposed alignment was done by measuring the prevailing electric field strength at each of 7 test sites, over the frequency range from 10 kHz to 6 GHz.

Measurements were made using a vertical monopole antenna (AH Systems SAS-550-1) for the frequency range from 10 kHz to 30 megahertz (MHz), and a broadband biological[1] antenna (AH Systems SAS-521-7) for the frequency range from 25 MHz to 6 GHz, connected to an Anritsu MS2721B Spectrum Analyzer. Measurements were made in eight contiguous frequency bands and recorded per Section 6.4 of TM 3.4.11. Data were transferred to a laptop computer and backed up on USB flash drives for archiving and post-survey analysis. Where practical, the RF antennas were located approximately 50 feet from the proposed alignment.

Electric field measurement files from the spectrum analyzer included both min-hold and max-hold levels as a function of frequency across each of the measurement bands. Reported results include the low frequency measurements with the omni-directional vertical monopole, plus measurements with the biological antenna in both horizontal and vertical positions, first facing the proposed alignment, and then in the direction that exhibited the maximum signal strength in each measurement band.

The magnetic field measurements characterized the prevailing background magnetic field levels as well as the temporal variations caused by local vehicular traffic, and in some cases, the passing of trains on the existing right-of way. Measurements were made at two positions at each site, separated by approximately 30 feet.

The magnetic field measurements were performed using a pair of three-axis 5 gauss Bartington fluxgate sensors (bandwidth DC to 3 kHz), connected to a National Instruments data acquisition system. Magnetic field waveforms were recorded so that DC and full frequency information is available over the entire sensor bandwidth. Measurement data were downloaded to a laptop computer in the field, and backed up on USB flash drives.

The RF and magnetic field measurements for the Palmdale to Burbank Project Section were performed between 23 and 27 August 2016.

OVERVIEW OF THE MEASUREMENT RESULTS

Magnetic Fields

Figure 1 shows the average measured AC magnetic field strengths at three measurement sites: a largely rural location adjacent to Southern California Edison (SCE)'s Vincent Substation (Acton, Site 3), a commercial/industrial setting (Burbank, Site 10), and a rural/residential area (Acton, Site 5). These sites encompass the full range of observed 60 Hz magnetic field levels, with Site 5 the lowest, Site 3 the highest, and Site 10 representing the median level. Plotted are levels for the 60

[1] Antenna designed for making measurements over a wide frequency range. The name derives from its hybrid design combining elements of Biconical and Log-periodic antennas.

Hz fundamental and the next 6 harmonics. The AC magnetic field strengths across the ten sites varied by over two orders of magnitude, from 0.05 milligauss (mG) to 18.9 mG. This is a typical range for heterogeneous, highly-developed settings such as the one found along the Palmdale to Burbank Project Section. The AC ambient field is determined almost solely by the site's proximity to power (medium voltage distribution and high voltage transmission) lines and other electrical system infrastructure.

The DC magnetic fields also varied, but by much smaller amounts, and were comparable to the expected ambient geomagnetic field strength. The measured values, across the ten measurement sites ranged from a low of 362 mG to a high of 482 mG. At individual sites, the difference in DC field strength between the two sensors ranged from 1 to 30 mG. These differentials typically are the result of the differing influence from passing vehicles, or from the influence of nearby steel objects.

Measured transient shifts in the DC magnetic field were generally very small and attributable to nearby vehicular traffic, with some exceptions noted at sites 8 and 10. Site 8 (San Fernando Road in Sun Valley) showed variations of approximately 20 mG from a passing freight train. The DC fields strengths at Site 10 (Burbank Metrolink Station) showed shifts of 5-10 mG from Metrolink and Amtrak trains.

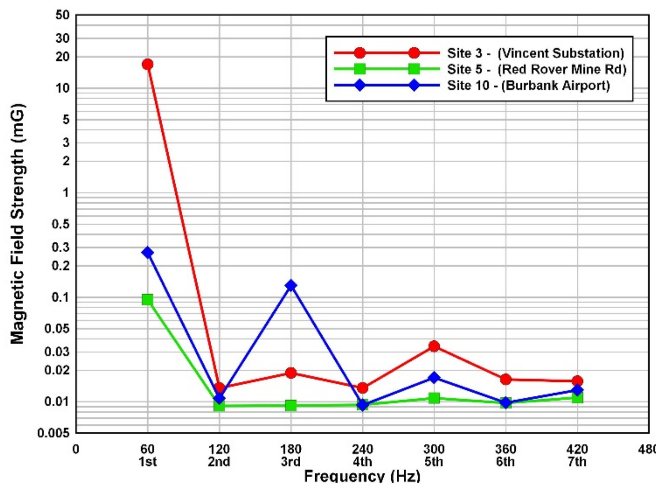

Figure 1: Average Measured AC Magnetic Field Strengths

Electric Fields

Because of the broad range of frequencies of interest, the electric field measurements at each site were divided into eight overlapping frequency bands, in order to provide the desired frequency resolution in each band (Authority 2010a). Table 1 summarizes the magnitude of the maximum measured electric field by frequency band, for each site. The maximum electric field strengths in bands B0 through B4 varied considerably across the measurement sites, with standard deviations of 10 decibels (dB) or greater in all bands. As can be seen in Figure 2, maximum measured levels in band B3 were particularly variable, reflecting the different usage of this portion of the radio spectrum across the region. Such variation in levels is not unusual in sections such as this which encompass both rural and highly-developed areas.

Table 1: Maximum Measured Electric Field Strengths by Band

Measurement Site	B0 10-50 kHz	B1 50-550 kHz	B2 0.5-3.0 MHz	B3 2.5-7.5 MHz	B4 5.0-30 MHz	B5 25-200 MHz	B6 0.2-2.2 GHz	B7 2.0-6.0 GHz
1 – Palmdale (Sixth St. / Transit Station)	142.9	114.5	131.7	96.4	79.9	118.0	115.8	105.1
2 – Palmdale (Sixth St / Palmdale Bl)	135.3	121.2	132.1	104.4	89.7	103.8	113.6	98.9
3 – Acton (Foreston Rd / Vincent Substation)	152.0	148.6	132.4	104.0	88.7	86.3	108.3	86.7
4 – Acton (Aliso Canyon Rd)	138.6	127.2	113.5	103.6	90.0	82.4	84.4	83.2
5 – Acton (Red Rover Mine Rd)	143.8	115.6	116.8	93.0	82.0	98.3	108.7	100.6
6 – Agua Dulce (Soledad Canyon Rd)	137.9	114.8	125.4	82.3	79.0	107.6	101.2	90.4
7 – Santa Clarita (Filmore St / Cometa Ave)	135.9	130.4	144.9	135.2	106.0	107.2	101.5	95.9
8 – Sun Valley (Sheldon / San Fernando Bl)	142.3	131.1	143.4	129.0	95.8	104.1	116.1	113.5
9 – Shadow Hills (Orcas Park trail)	136.6	128.2	144.3	122.8	92.4	97.5	101.4	96.3
10 – Burbank (Lockheed Dr / San Fernando Bl)	135.4	127.6	144.3	126.6	92.9	109.1	115.3	115.7

GHz = gigahertz
kHz = kilohertz
MHz = megahertz

The southern part of the project area is highly developed and includes a large number of RF sources. Approximately 100 television and radio (AM and FM broadcast) transmitters operate within the region. In addition, there are dozens of cellular communications towers and point-to-point microwave links operating in the region, as well as a significant number of intermittent fixed- and mobile RF sources. This activity results in significantly elevated – and somewhat more uniform - background levels over much of the RF spectrum.

Figure 2 graphically shows the maximum measured electric field strengths by frequency band for the ten measurement sites. Typical spectrum uses in each frequency band are also indicated. Increasing distance from the plot center indicates higher field strength. Figure 3 shows the variance in RF field strengths across the seven sites, by frequency band.

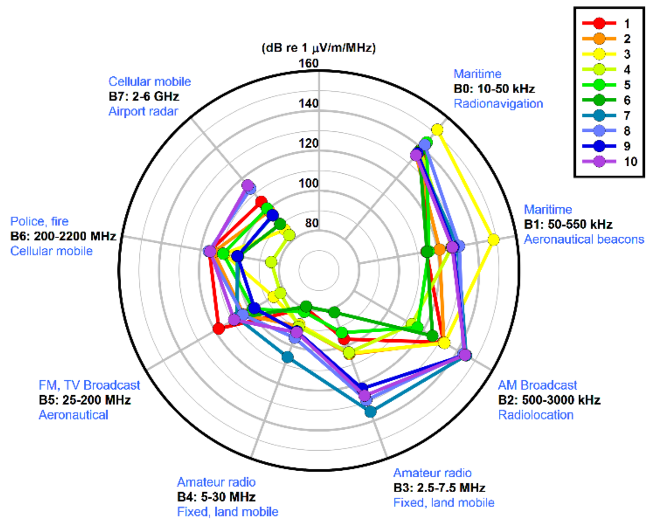

Figure 2: Maximum Electric Field Strengths by Spectral Band

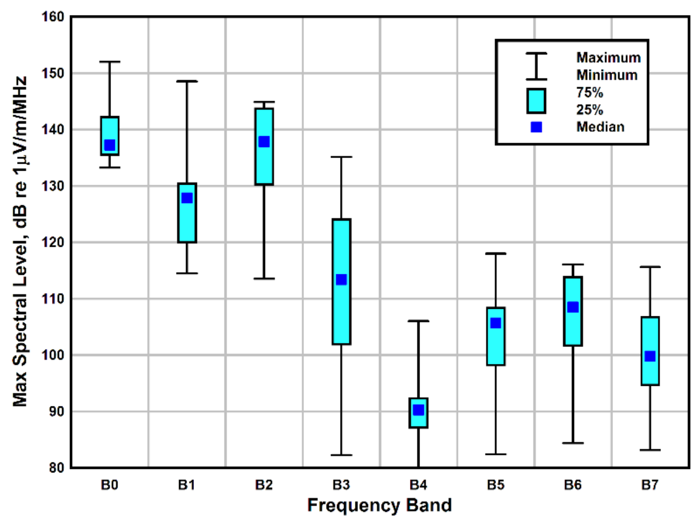

Figure 3: Range of Electric Field Strengths Across All Sites

The ten panels in Figure 4 separately illustrate the tabulated Electric field strength values in Table 1. As elsewhere, the field strength values are in dB re 1 microvolt/meter/MHz (µV/m/MHz).

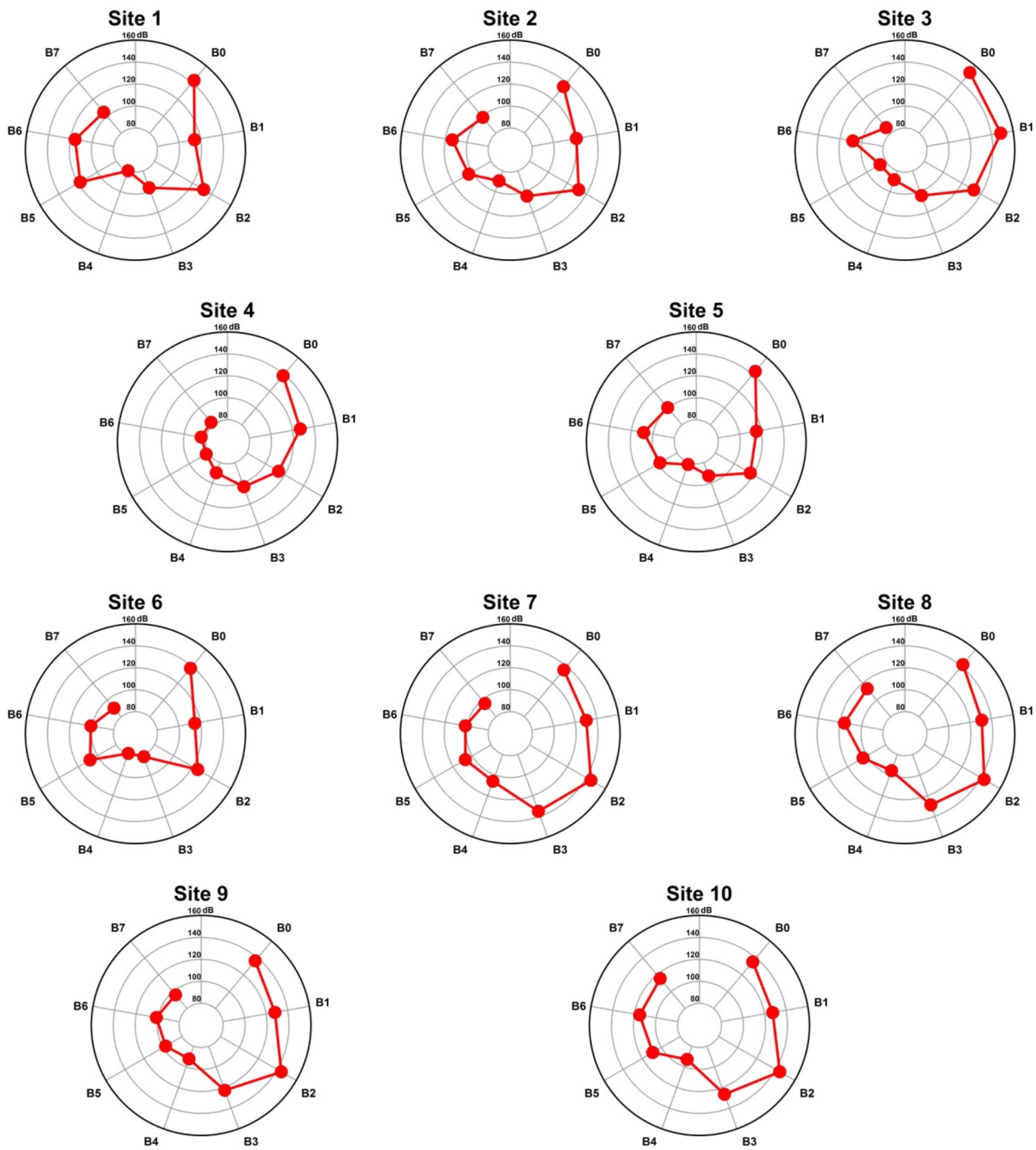

Figure 4: Maximum Measured Electric Field Strengths by Band, All Sites