3 Affected Environment, Environmental Consequences, and Mitigation Measures

3.5 Electromagnetic Fields and Electromagnetic Interference

3.5.1 Introduction

Section 3.5, Electromagnetic Fields and Electromagnetic Interference, of the *Merced to Fresno Section: Central Valley Wye Draft Supplemental Environmental Impact Report (EIR)/ Environmental Impact Statement (EIS)* (Draft Supplemental EIR/EIS) updates the *Merced to Fresno Section California High-Speed Train Final Project Environmental Impact Report/Environmental Impact Statement* (Merced to Fresno Final EIR/EIS) (Authority and FRA 2012) with new and revised information relevant to electromagnetic fields (EMF) and electromagnetic interference (EMI), analyzes the potential impacts of the No Project Alternative and the Central Valley Wye alternatives, and describes impact avoidance and minimization features (IAMF) that would avoid, minimize, or reduce impacts. Where applicable, mitigation measures are proposed to further reduce, compensate for, or offset impacts of the Central Valley Wye alternatives. This section also defines EMF and EMI and describes the affected environment in the resource study area (RSA).

The analysis herein is consistent with the analysis of impacts on EMF and EMI conducted for the Merced to Fresno Final EIR/EIS. Both analyses examine the potential impacts on EMF- and EMI-sensitive receptors from local sources of EMF and EMI and the impact of high speed rail (HSR)-generated EMF/EMI, and they use the same methods for evaluating impacts within the RSA. The analyses use similar information sources, including aerial imagery, surveys, photographs, and Federal Communications Commission (FCC) databases. Where information has changed or new information has become available since the Merced to Fresno Final EIR/EIS was prepared in 2012, the analysis in this Draft Supplemental EIR/EIS uses the updated versions of these sources or data sets. Relevant portions of the Merced to Fresno Final EIR/EIS (Authority and FRA 2012) that remain unchanged are summarized and referenced in this section, but are not repeated in their entirety.

Additional details on EMF and EMI are provided in the following appendix in Volume II of this Draft Supplemental EIR/EIS:

- Appendix 2-C, Applicable Design Standards, provides the list of relevant design standards for the Central Valley Wye alternatives.

EMF and EMI conditions in the Central Valley Wye alternatives RSA and surrounding San Joaquin Valley are important because of the potential impacts on the operation of electrical, magnetic, and electromagnetic devices. Three other resource sections in this Draft Supplemental EIR/EIS provide additional information related to EMF and EMI:

- **Section 3.12, Socioeconomics and Communities**—Impacts of the Central Valley Wye alternatives on the growth of populations and locations of sensitive receptors within the RSA.
- **Section 3.13, Land Use and Development**—Impacts of the Central Valley Wye alternatives on the growth of populations and locations of sensitive receptors within the RSA.
- **Section 3.18, Regional Growth**—Impacts of the Central Valley Wye alternatives on the growth of populations.

3.5.1.1 Definition of Resources

The following definitions of EMF and EMI are used in this Draft Supplemental EIR/EIS. These definitions are the same as those used in the Merced to Fresno Final EIR/EIS (Authority and FRA 2012).

- **EMF**—EMF consists of electric and magnetic fields. EMF occurs throughout the electromagnetic spectrum, is found in nature, and is generated both naturally and by human activity. Naturally occurring EMF includes the Earth's magnetic field, static electricity, and lightning. EMF is also created by the generation, transmission, and distribution of electricity;

the use of everyday household electric appliances and communication systems; industrial processes; and scientific research.

- **Electric fields**—Electric fields are forces that electric charges exert on other electric charges.
- **Magnetic fields**—Magnetic fields are forces that a magnetic object or moving electric charge exerts on other magnetic materials and on electric charges.
- **EMI**—EMI is the interference that occurs when the EMF produced by a source adversely affects the operation of an electrical, magnetic, or electromagnetic device. EMI may be caused by a source that intentionally radiates EMF (such as a television broadcast station), or one that does so incidentally (such as an electric motor).

The information presented in this section primarily concerns EMF at the 60-Hertz (Hz) power frequency and at radio frequencies produced intentionally by communications or unintentionally by electric discharges. EMF from the HSR operations would consist of the following:

- **Power-frequency electric and magnetic fields from the traction power system and electrical infrastructure**—Traction power substations (TPSS), switching stations, substations, transmission/power lines, emergency generators that provide backup power to the stations in case of a power outage, and utility feeder lines—60-Hz electric fields would be produced by the 25-kilovolts (kV) operating voltage of the HSR traction power system and network upgrade components, and 60-Hz magnetic fields would be produced by the flow of currents providing power to the HSR vehicles. Along the tracks, magnetic fields would be produced by the flow of propulsion currents to the trains in the overhead contact system (OCS) and rails.
- **Harmonic magnetic fields from vehicles**—Depending on the design of power equipment in the HSR trains, power electronics would produce currents with frequencies in the kilohertz (kHz) range. Potential sources include power conversion units, switching power supplies, motor drives, and auxiliary power systems. Unlike the traction power system, these sources are highly localized in the trains and move along the track as the trains move.
- **Radio Frequency (RF) fields**—RF fields are any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 billion hertz (GHz), which include those frequencies used for communications or radar signals. They include a variety of communications, data transmission, and monitoring systems—both on and off vehicles. These wireless systems would meet the FCC regulatory requirements for intentional emitters (47 Code of Federal Regulations [C.F.R.] Part 15 and FCC Office of Engineering Technology Bulletin No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields)*.

These concepts are discussed in more detail in the following sections.

Definitions: Electromagnetic Spectrum and Electromagnetic Waves

The electromagnetic spectrum is the range of waves of electromagnetic energy. It includes static fields such as the Earth's magnetic field, radio waves, microwaves, X-rays, and light. Electro-magnetic waves have frequencies and wavelengths that are directly related to each other–as frequencies increase, wavelengths get shorter.

Unit Definitions and Conversions

- Hertz (Hz) – Unit of frequency equal to one cycle per second
- 1 kilohertz (kHz) = 1,000 Hz
- 1 gigahertz (GHz) = 1 billion Hz
- Gauss (G) – Unit of magnetic flux density (intensity) (English units)
- 1 G = 1,000 milligauss (mG)
- Tesla (T) – Unit of magnetic flux density (intensity) (International units)
- 1 T = 1 million microtesla (µT)
- 1 G = 100 µT
- 1 mG = 0.1 µT

3.5.1.2 Characteristics of Electromagnetic Radiation

The electromagnetic (EM) spectrum consists of two types of radiation, ionizing and non-ionizing radiation. A wave's position on the EM spectrum depends on its wavelength. Ionizing radiation—capable of removing electrons from atoms and of thus damaging biological tissues—consists of short wave or high frequency radiation, including ultraviolet, X-ray, and gamma ray radiation. Non-ionizing radiation consists of long-wave radiation, including radio waves, microwaves, and infrared radiation. Visible light is the portion of the EM spectrum that lies between the infrared (non-ionizing) and ultraviolet (ionizing) portions of the EM spectrum. This section addresses the potential impacts of non-ionizing, long-wave electromagnetic radiation (EMR) at wavelengths below those of visible light on human health and on sensitive electric and electronic equipment and facilities along the Central Valley Wye alternatives.

Non-ionizing EMR consists of waves characterized by variations in electric fields (measured in volts [V] per meter [m], or V/m) and magnetic fields (measured in Tesla [T] or Gauss [G]). These periodic waves move through a medium, such as air, transferring energy from place to place as they go. The waves move at the speed of light and have dimensions of height, or amplitude; wavelength, or the distance between two adjacent peaks of the wave; and number of cycles per second (Hz), or frequency. Table 3.5-1 shows wavelengths for a range of different frequencies. Table 3.5-2 shows the magnetic field strengths of electrical devices and facilities commonly found in urban areas.

Table 3.5-1 Relationship between Typical Frequencies and Their Wavelengths

Frequency	Wavelength
1 Hz	186,280 miles
60 Hz	3,100 miles
10 kHz	18.6 miles
10 MHz	98.4 feet
100 MHz	9.8 feet

Source: Authority and FRA, 2018
Hz = Hertz
kHz = kilohertz
MHz = megahertz.

Table 3.5-2 Typical Magnetic Field Strengths

Electrical Source	Magnetic Field Strength at 1 Foot (mG)
Dishwasher	30
Hair Dryer	70
Electric Shaver	100
Vacuum Cleaner	200
High-Voltage Power/Transmission Line (115kV–500kV)	30 – 87
Power Distribution Line (4kV–24kV)	10 – 70

Source: Authority and FRA, 2018
mG = milligauss
kV = kilovolts

EMF consists of both an electric field and a magnetic field. These fields are generated by natural sources such as the sun, lightning, biological processes, and currents within the Earth's molten metallic core. Artificial EMF are intentionally generated by electrical devices, such as television and radio broadcasting towers, hand-held radios, X-ray machines, microwave links, and cellular phones. EMF of human origin are also unintentionally generated by such devices as electric power transmission and distribution lines, televisions, computers, appliances, ignition systems, and electrical wiring and switches.

Both direct current (DC) and alternating current (AC) electrical devices generate EMF. The magnetic flux density[1] is much higher for DC, however, than for AC current. The strength of an electric field is proportional to the strength of its electric charge (voltage), while the strength of a magnetic field is proportional to the motion of the charge (current); when no current is flowing in an electrical circuit, only the electrical field is present. The power of an electric field (i.e., the rate at which energy is transferred) is measured in Watts (W), and the power density (power distributed over a given cross-sectional area perpendicular to the direction of its flow) of the electric field's flux is measured in W/m^2.

Electrical devices generate both near-field and far-field EMF. Non-radiative near-field behaviors of EMF dominate close to the device (e.g., within 1 to 2 wavelengths of their source) while far-field behaviors dominate at greater distances. Near-field EM strength decreases in proportion to increasing distance from the source, while far-field EM strength decreases in proportion to the square of increasing distance from the source (the so-called inverse-square law). Far-field EMF are completely independent of their sources and constitute what is typically referred to as EMR.

EMF Frequencies

EMF are described in terms of their frequency, which is the number of times the EMF increases and decreases in intensity each second. The U.S. commercial electric power system operates at a frequency of 60 Hz, or 60 cycles per second, meaning that the field increases and decreases in intensity 60 times per second. Electric power system components are typical sources of electric and magnetic fields. These components include generating stations and power plants, substations, high-voltage transmission lines, and electric distribution lines. Even in areas not adjacent to transmission lines, 60-Hz EMF are generated by electric power systems and building wiring, electrical equipment, and appliances.

Natural and human-generated EMF cover a broad frequency spectrum. EMF that are nearly constant in time are called *direct current* (DC) EMF. EMF that vary in time are called *alternating current* (AC) EMF. AC EMF are further characterized by their frequency range. Extremely low frequency (ELF) magnetic fields typically are defined as having a lower limit of 3 to 30 Hz and an upper limit of 30 to 3,000 Hz. The HSR OCS and electrical transmission, power, and distribution system primarily would generate ELF fields at 60 Hz and at harmonics (multiples) of 60 Hz.

Radio and other communications operate at much higher frequencies, often in the range of 500,000 Hz (500 kHz) to 3 GHz. Typical RF sources of EMF include antennas on cellular telephone towers; radio and television broadcast towers; airport radar, navigation, and communication systems; high-frequency (HF) and very high-frequency (VHF) communication systems used by police, fire, emergency medical technicians, utilities, and governments; and local wireless systems, such as wireless fidelity (WiFi) or cordless telephone systems. The equipment used as part of the Central Valley Wye alternatives would employ active radio-frequency EMF sources.

The strength of magnetic fields is measured in milligauss (mG), G, T, or microtesla (µT). For comparison, Earth's ambient magnetic field ranges from 500 to 700 mG DC (0.5 to 0.7 G) (50 to 70 µT) at its surface. Average AC magnetic field levels within homes are approximately 1 mG (0.001 G) (0.1 µT), and measured AC values range from 9 to 20 mG (0.009 to 0.020 G) (0.9 to 2 µT) near appliances (Severson et al. 1988). The strength of an EMF rapidly decreases with distance away from its source; thus, EMF higher than background levels are usually found close to EMF sources. For overhead transmission and power lines, the strength of an EMF is typically the highest directly under the overhead line and decreases dramatically with increasing distance from the line. Table 3.5-3 shows the typical EMF levels from overhead electrical lines at varying

[1] The amount of magnetic flux (the number of magnetic field lines passing through a closed surface, such as a conducting coil) through a unit area taken perpendicular to the direction of the magnetic flux.

distances. EMF levels at a distance of 200 feet from a 230 kV transmission line and a 115 kV power line are reduced by approximately 97 and 99 percent, respectively.

Table 3.5-3 Typical EMF Levels for Transmission/Power Lines

Voltage of Source	Field Strength at Specified Distances from Source				
	At Source	50 feet (edge of ROW)	100 feet	200 feet	300 feet
230 kV Transmission Line Electric Field Strength (kV/m)	2.0	1.5	0.3	0.05	0.01
230 kV Transmission Line Mean Magnetic Field (mG)	57.5	19.5	7.1	1.8	0.8
115 kV Power Line Electric Field Strength (kV/m)	1.0	0.5	0.07	0.01	0.003
115 kV Power Line Mean Magnetic Field (mG)	29.7	6.5	1.7	0.4	0.2

Source: NIEHS, 2016
kV = kilovolt
kV/m = kilovolts per meter
mG = milligauss
ROW = right-of-way

3.5.1.3 EMF Exposure and Health Effects

EMF can cause EMI, which can disrupt sensitive equipment (e.g., pacemakers), possibly triggering a malfunction. At sufficiently high exposure levels, EMF also directly affect human health. Extensive research on EMF has led the majority of scientists and health officials to conclude, however, that low-frequency EMF has no adverse health effects at typical exposure levels. Objective scientific reviews of animal studies, from which some human health risks have been extrapolated, have also concluded that existing data are inadequate to indicate a potential risk of cancer, which is the primary human health concern associated with EMF exposure (WHO 2007, IARC 2002). However, EMF remains a human health concern (WHO 2007).

3.5.1.4 Electromagnetic Interference

General Considerations

EMI is an electromagnetic disturbance from an external source that interrupts or degrades the performance of an electrical device, circuit, or signal. Ambient EMI occurs when EMR intentionally or unintentionally jams, or blocks, another EM signal in free space. Hardware EMI occurs when EMR induces an unintended current in an electrical circuit. To interfere with a radio or microwave signal, the EMI must be at or near its frequency. Radio and other communications systems typically operate in the range of 500 kHz to 3 GHz.

Commercial standards developed for electromagnetic compatibility (EMC) both limit EMI generated by electrical devices and reduce susceptibility of electrical devices to external EMI. For example, the Federal Aviation Administration's (FAA) interim EMC commercial standards require aircraft systems to withstand EMF of up to 200 V/m (FAA 2014).

EMI and Radio Communications

Intentional radio signals exist in a sea of unwanted radio-frequency noise, so radio communications systems and devices are designed to operate in this environment. General frequency ranges are assigned for various types of radio signals, and specific radio frequencies and power output levels are assigned to individual users to minimize the potential for disruptions. Radio equipment is designed to separate the frequency of interest from background noise and to reject transient or unfocussed signals.

EMI and Sensitive Equipment

Research equipment is generally designed to operate within the Earth's natural magnetic field and to compensate for fluctuations in that field of up to 10 mG (University of Michigan 2009). Industries associated with the use, assembly, calibration, or testing of sensitive or unshielded RF equipment, however, are still sensitive to EMI. In particular, fluctuations in the magnetic field can interfere with nuclear magnetic resonance (NMR), nuclear magnetic imaging (NMI), and other imaging equipment, such as electron microscopes. Computed tomography (CT) and computed axial tomography (CAT) scanning devices also are sensitive to EMI, as are some semiconductor, nanotechnology, and biotechnology operations. NMR spectrometers are sensitive to time-varying DC magnetic fields of fewer than 2 mG (University of Michigan 2009). For unshielded equipment that is sensitive to magnetic fields in the range of 1 to 3 mG, such as magnetic resonance imaging (MRI) systems, electromagnetic interference is possible at distances of up to 200 feet. An installation guide for NMR equipment recommends a separation distance of 100 meters from electric trains (Field Management Services 2009).

3.5.2 Laws, Regulations, and Orders

The California Environmental Quality Act (CEQA) and the Council on Environmental Quality regulations require a discussion of inconsistencies or conflicts between a proposed undertaking and federal, state, regional, or local plans and laws. This section identifies laws, regulations, and orders that are relevant to the analysis of EMF and EMI in this Draft Supplemental EIR/EIS. Also provided are summaries of new or updated laws, regulations, and orders that have occurred since publication of the Merced to Fresno Final EIR/EIS.

The Central Valley Wye alternatives have been designed to comply with federal and state plans and policies, and would secure all applicable federal and state permits and approvals prior to initiating construction on the selected alternative. Therefore, there are no known inconsistencies between the Central Valley Wye alternatives and the objectives of the following federal and state acts, plans, policies, and controls.

3.5.2.1 Federal

The following laws, regulations, orders, and plans are the same as those described in Section 3.5.2, Laws, Regulations, and Orders, of the Merced to Fresno Final EIR/EIS (Authority and FRA 2012: pages 3.5-2 through 3.5-3):

- U.S. Department of Transportation, Federal Railroad Administration, Procedures for Considering Environmental Impacts (64 Fed. Reg. 28545)
- U.S. Department of Commerce, Federal Communications Commission (47 C.F.R. Part 15)
- U.S. Department of Commerce, Federal Communications Commission, Office of Engineering and Technology Bulletin 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields* (FCC 1997).

New, additional, or updated federal laws, regulations, and orders follow.

U.S. Department of Transportation, Federal Railroad Administration (49 C.F.R. § 236.8, 238.225, 229 Appendix F, and 236 Appendix C)

Other than 49 C.F.R. Part 229 Appendix F, these codes were included in the Merced to Fresno Final EIR/EIS. 49 C.F.R. Part 229 Appendix F (April 9, 2012) provides rules, standards, and instructions for operating characteristics of electromagnetic, electronic, or electrical apparatus, and safety standards for passenger equipment.

U.S. Department of Commerce, FCC (47 C.F.R § 1.1310, Radiofrequency Radiation Exposure Limits)

The FCC regulations at 47 C.F.R. section 1.1310 are based on the 1992 version of the American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) C95.1 safety standard. Table 3.5-4 shows the maximum permissible exposures (MPE) contained in the ANSI/IEEE C95.1 and FCC standards at frequencies of 450, 900, and 5,000 megahertz (MHz), which cover the range of frequencies that may be used by HSR radio systems. FCC MPEs are based on an averaging period of 30 minutes for exposure of the public and 30 minutes for occupational exposure. As shown in Table 3.5-4, the differences between the ANSI/IEEE C95.1 and FCC MPEs are minor.

Table 3.5-4 Radio Frequency Emissions Safety Levels Expressed as Maximum Permissible Exposure

	ANSI/IEEE C95.1 MPE (mW/cm^2)		FCC MPE (mW/cm^2)		OSHA MPE (mW/cm^2)
Frequency	Occupational	General Public	Occupational	General Public	Occupational
450 MHz	1.5	0.225	1.5	0.3	10
900 MHz	3.0	0.45	3.0	0.6	10
5,000 MHz	10	1.0	5.0	1.0	10

Sources: ANSI/IEEE, 2006; 47 C.F.R. §1.1310, Table 1 (FCC); 29 C.F.R. § 1910.97 (OSHA).
ANSI/IEEE = American National Standards Institute/Institute of Electrical and Electronics Engineers
cm = centimeter
FCC = Federal Communications Commission
MHz = megahertz
MPE = maximum permissible exposure
mW = milliwatt
OSHA = Occupational Safety and Health Administration

U.S. Department of Labor, OSHA (29 C.F.R. § 1910.97, Nonionizing Radiation)

29 C.F.R. Part 1910.97 provides safety standards for occupational exposure to RF emissions in the 10- MHz to 100-GHz range. Table 3.5-4 shows MPEs contained in the Occupational Health and Safety Administration (OSHA) standards. The OSHA safety levels do not vary with frequency and are less stringent than the equivalent ANSI/IEEE and FCC MPEs, except for occupational exposure to fields with frequencies above 5,000 MHz, where the OSHA MPE is equal to the C95.1 MPE and is two times higher than the FCC MPE. The OSHA MPEs are based on averaging over 6-minute intervals.

3.5.2.2 State

The following State of California laws, regulations, orders, and plans are the same as those described in Section 3.5.2, of the Merced to Fresno Final EIR/EIS (Authority and FRA 2012: page 3.5-3):

- California High-Speed Rail Authority—Electromagnetic Compatibility Program Plan
- California Department of Education, California Code of Regulations, Title 5, §14010(c)
- California Public Utilities Commission Decision D.93-11-013

New, additional, or updated laws, regulations, and orders follow:

California Public Utilities Commission Decision D.06-01-042

The August 2004 California Public Utilities Commission (CPUC) decision updates the EMF policy originally defined in D.93.11.013. D.06-01-042 re-affirmed D.93-11-013 in that health hazards from exposures to EMF have not been established and that state and federal public health regulatory agencies have determined that setting numeric exposure limits is not appropriate. The CPUC also reaffirmed the existing no-cost and low-cost precautionary-based EMF policy to be continued. D.06-01-042 ordered the utilities to convene a utility workshop, to develop standard approaches for design guidelines, including the development of a standard table showing EMF mitigation measures and costs.

California Public Utilities Commission EMF Guidelines for Electrical Facilities

These CPUC guidelines, based on D.93-11-013 and D.06-01-042, establish priorities among land use classes for EMF mitigation. While the CPUC decisions, general orders, and guidelines do not directly apply to the HSR, they are listed because:

- The Central Valley Wye alternatives would cause potential environmental impacts of the HSR TPSS and associated electric power substations, station switches, and high-voltage transmission lines consistent with CPUC D.93-11-013, D.06-01-042.
- Decision D.06-01-042 reaffirms the key elements of the updated EMF policy.

3.5.2.3 Regional and Local

Table 3.5-5 lists county and city general plan goals and policies relevant to the Central Valley Wye alternatives. Specific regional plans or policies pertaining to EMF and EMI were not identified in the Merced to Fresno Final EIR/EIS.

Table 3.5-5 Regional and Local Plans and Policies

Policy Title	Summary
Merced County	
2030 Merced County General Plan (2013)	Merced County adopted the *2030 Merced County General Plan* on December 10, 2013. The general plan includes the following policies: ▪ Policy PFS-5.1: Encourage the provision of adequate gas and electric, communications, and telecommunications service and facilities to serve the needs of existing and future residents and businesses. ▪ Policy PFS-5.3: Encourage new transmission and distribution lines within existing utility easements and rights-of-way, joint-use of easements among different utilities. ▪ Policy PFS-5.4: Require mitigation of electrical interference to adjacent land uses in the placement of electrical and other transmission facilities. ▪ Policy PFS-5.6: Require power transmission and distribution facilities to be located underground within urban communities and residential centers. ▪ Policy PFS-5.7: Coordinate with local gas and electric utility companies in the design and location, and appropriate expansion, of gas and electric systems, while minimizing impacts to agriculture and minimizing noise, electromagnetic, visual, and other impacts on residents.
Madera County	
Madera County General Plan (1995)	The *Madera County General Plan* was adopted in October 1995 and provides the framework for the protection of the county's residents from electromagnetic fields. The general plan includes the following policy: ▪ Policy 3.J.1: The County shall facilitate the provision of adequate gas and electric, communications, and telecommunications service and facilities to serve existing and future needs while minimizing noise, electromagnetic, and visual impacts on existing and future residents.

Policy Title	Summary
Madera County Code of Ordinances	The Madera County Code of Ordinances includes regulations for electrical or electronic inference which includes the following: ▪ Chapter 18.78.010 A.1 (a) Airport/Airspace Overlay District – Adopted. Permitted Uses. 1. Any use permitted in the underlying zoning district except: a. Uses creating electrical or electronic interference with communication or guidance devices used by aircraft or ground control.
City of Chowchilla	
City of Chowchilla 2040 General Plan (2011)	The City of Chowchilla adopted the *2040 General Plan* on May 2, 2011, and it includes the following policies: ▪ Policy PF 13.1: To the extent feasible and practical, all new residential, commercial, industrial, and public facilities and services shall be wired for new communication/ information technology. ▪ Policy PF 14.1: The City of Chowchilla shall expand the use of cable television as a public access communications tool.
City of Chowchilla Code of Ordinances	The City of Chowchilla Code of Ordinances includes regulations related to electrical interference that include the following: ▪ Chapter 14.08.060 Airport/Airspace Zoning – Adopted. Notwithstanding any other provisions of this chapter, no use may be made of land within any zone established by this chapter in such a manner as to create electrical interference with radio communication between the airport and aircraft, make it difficult for flyers to distinguish between airport lights and others, result in glare in the eyes of flyers using the airport, impair visibility in the vicinity of the airport, or otherwise endanger the landing, taking-off or maneuvering of aircraft.

Sources: Merced County, 2013; Madera County, 1995; City of Chowchilla, 2011

3.5.3 Compatibility with Plans and Laws

As indicated in Section 3.1.3.3, Compatibility with Plans and Laws, CEQA and National Environmental Policy Act (NEPA) regulations[2] require a discussion of inconsistencies or conflicts between a proposed undertaking and federal, state, regional, or local plans and laws. As such, this Draft Supplemental EIR/EIS describes the inconsistency of the Central Valley Wye alternatives with federal, state, regional, and local plans and laws to provide planning context.

Several federal and state laws and implementing regulations listed in Section 3.5.2.1, Federal, and Section 3.5.2.2, State, govern compliance with EMF limits for construction projects and for transportation facilities. EMF assessment is highly technical, and several published federal and state guidance documents address how to assess potential impacts. A summary of the federal and state requirements considered in this analysis follows:

- FRA rules, standards, and instructions for operating characteristics of electric and electronic equipment.
- FRA safety standards for passengers.
- OSHA standards for permissible worker exposure to non-ionizing radiation.
- FCC guidelines for safe EMF exposure.
- FCC rules for licensed and unlicensed radio-frequency transmissions.
- The Authority's Electromagnetic Compatibility Program Plan.
- California regulations on minimum siting distances of power lines from schools.

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[2] NEPA regulations refer to the regulations issued by the Council for Environmental Quality located at 40 CFR Part 1500.

- CPUC decisions that set EMF policies.
- Federal and state permit processes that require an applicant to demonstrate compliance with these acts, laws, and plans prior to, during, and after construction.

The Authority, as the lead state agency proposing to construct and operate the HSR system, is required to comply with all federal and state laws and regulations and to secure all applicable federal and state permits prior to initiating construction on the selected alternative. Similarly, FRA, as federal lead agency, is required to comply with all federal laws and regulations. Therefore, there would be no inconsistencies between the Central Valley Wye alternatives and these federal and state laws and regulations.

The Authority is a state agency and therefore is not required to comply with local land use and zoning regulations; however, it has endeavored to design and construct the HSR project so that it is compatible with land use and zoning regulations. For example, the Central Valley Wye alternatives would coordinate design and routing of power transmission and distribution lines and facilities with public utility companies, and would take local land use into consideration in the routing of these facilities.

Three plans with eight relevant policies and two ordinances were reviewed (Table 3.5-5). The Central Valley Wye alternatives are consistent with all eight policies and both ordinances because they would provide adequate electricity, communications, and telecommunications facilities to serve existing and future needs of the system, and these facilities would not create EMI that would interfere with air traffic. In addition, design characteristics of the Central Valley Wye alternatives would protect people vulnerable to EMF, such as those with implanted medical devices, and would include posting signs at the TPSSs, at switching stations, and on tie-line structures warning persons with an implanted medical device of the potential for high levels of EMF so they could avoid the possibility of interference.

3.5.4 Methods for Evaluating Impacts

The evaluation of impacts from EMF and EMI sources is a requirement of NEPA and CEQA. The following sections summarize the RSA and the methods used to analyze impacts from EMF and EMI generated by the Central Valley Wye alternatives.

3.5.4.1 Definition of Resource Study Area

As defined in Section 3.1, Introduction, RSAs are the geographic boundaries in which the environmental investigations specific to each resource topic were conducted. The RSA for impacts of EMF and EMI includes the project footprint for each of the Central Valley Wye alternatives and 500 feet on both sides of the proposed HSR right-of-way centerline (a 1,000-foot-wide corridor) plus 500 feet from the proposed TPSS (direct impact) and new/modified electrical infrastructure and associated work areas. The RSA encompasses the 200-foot distance from the centerline (a 400-foot-wide corridor) studied in the Merced to Fresno Final EIR/EIS for EMF effects, which was established because modeling demonstrated that 200 feet is the distance from the source where EMF has decayed to below 2 mG; this is the level below which no EMF-related human health effects have been observed. The RSA also encompasses the 500-foot distance from the centerline (1,000-foot-wide corridor) studied in the Merced to Fresno Final EIR/EIS for RF interference, which was established because modeling demonstrated that 500 feet is the distance from the source where EMI has decayed to a level of no concern.

This RSA has been defined based on typical screening distances identified in the *EIR/EIS Assessment of CHST Alignment EMF Footprint* (Footprint Report) (Authority 2012), the Central Valley Wye alternatives' footprints and track centerlines, and factors such as the rural setting of the RSA and the potential for EMF- and EMI-sensitive receptors. Screening distances indicate whether any EMF- or EMI-sensitive receptors are near enough to the Central Valley Wye alternatives' alignments for EMF or EMI impacts to be possible. If sensitive receptors are located farther from the alignment than these screening distances, the Footprint Report (Authority 2012) has determined that EMF and EMI impacts would be very unlikely.

3.5.4.2 Impact Avoidance and Minimization Features

As noted in Section 2.2.3.7, Impact Avoidance and Minimization Features, the Central Valley Wye alternatives would incorporate standard IAMFs to avoid or minimize potential environmental impacts of the HSR project. The Authority would incorporate IAMFs during design and construction of the Central Valley Wye alternatives, so the analysis of the impacts of the Central Valley Wye alternatives in this section takes into account all applicable IAMFs. Appendix 2-B, California High-Speed Rail: Impact Avoidance and Minimization Features, provides a detailed description of IAMFs that are part of the Central Valley Wye alternatives design. IAMFs applicable to EMF and EMI resources include:

- EMF/EMI -IAMF#1: Preventing Interference with Adjacent Railroads
- EMF/EMI-IAMF#2: Controlling Electromagnetic Fields/Electromagnetic Interference

3.5.4.3 Methods for NEPA and CEQA Impact Analysis

This section describes the sources and methods the Authority and FRA used to analyze the potential impacts from implementing the Central Valley Wye alternatives on EMF/EMI-sensitive receptors in the RSA. These methods apply to both NEPA and CEQA unless otherwise indicated. Refer to Section 3.1.3.4, Methods for Evaluating Impacts, for a description of the general framework for evaluating impacts under NEPA and CEQA. As described in Section 3.5.1, Introduction, and in the following discussions, the Authority and the FRA have applied the same methods and many of the same data sources used for the Merced to Fresno Final EIR/EIS to this Draft Supplemental EIR/EIS. Laws, regulations, and orders that regulate EMF and EMI (see Section 3.5.2, Laws, Regulations, and Orders) were also considered in the evaluation of impacts from EMF and EMI.

Regional and Local Sources of EMF and EMI

In addition to the references described in the Merced to Fresno Final EIR/EIS, analysts used information from several published reports to evaluate existing conditions within the EMF and EMI RSA. To identify regional and local sources of EMF and EMI, analysts relied upon aerial imagery, surveys, photographs, and FCC databases.

Local Conditions

Analysts evaluated local conditions by measuring EMF at selected locations in accordance with technical guidance developed by the Authority and FRA to establish EMF levels representative of existing conditions in the vicinity of the Central Valley Wye alternatives (Authority and FRA 2010b). Three baseline measurements evaluated in the Merced to Fresno Final EIR/EIS are also relevant to the Central Valley Wye alternatives and are reported in this analysis. These baseline measurements include Sites 2 through 4, identified subsequently in this section. In addition, analysts added one new baseline measurement (Site 1) at Henry Miller Road for this analysis. These measurement sites were selected because they represent a cross-section of typical local emitters such as power lines and antenna towers, potentially sensitive facilities such as medical and high-tech facilities, and areas that are relatively free of EMF point sources for comparison. Because Sites 2 through 4 were deemed to be representative of the Central Valley Wye alternative alignments, only one additional baseline measurement site was needed to fully characterize the conditions along the alternatives. The analysis at the sites was conducted for two different purposes: (a) to obtain measurements for a range of EMF levels, including both high-EMF sites such as those near power lines and antenna towers, and those in relatively quiet areas for comparison, and (b) to document existing EMF levels at sensitive facilities along the alignment such as medical and high-tech facilities.

Sensitive Receptors

The impact analysis focused on the potential impacts on sensitive receptors, which consist of land uses and facilities susceptible to EMF and EMI produced by the HSR. These receptors include schools, universities, hospitals and other medical facilities, high-tech businesses, research facilities, railroads, rail transit systems, and airports. These land uses have communications systems, sensitive equipment, or other electronic devices that could be disrupted by EMF. Residences are considered to be EMF-sensitive for their exposure of people to EMF. Agricultural operations are also considered to be EMF-sensitive for their exposure of poultry or other farm animals to EMF. Analysts identified sensitive receptors through a review of aerial imagery, county parcel data, and local planning documents.

EMF and EMI Levels

To predict EMF levels from HSR operations, the following assessment was performed. This assessment included sites that would not typically be affected by HSR operations, which served as “control” sites. First, EMF-sensitive land uses were identified through a review of aerial imagery, county parcel data, and local planning documents, and baseline EMF levels were measured. EMF-sensitive land uses are described in the preceding paragraph, Sensitive Receptors.

The Magnetic Field Calculation Model, a mathematical model of the HSR traction electrical system, was then used to calculate the anticipated maximum 60-Hz magnetic fields that a single HSR train would produce (Authority and FRA 2011). The model incorporates conservative assumptions for the potential EMF impacts of the HSR. For example, the projected maximum magnetic fields would exist only for a short period and only in certain locations as the train moves along the track or changes its speed and acceleration. The magnetic field levels would decline rapidly as the lateral distance from the tracks increases. For most locations and most times, exposure to EMF would not be as high as predicted by the model, which predicts peak EMF levels. The EMF model assumes a train speed of 220 miles per hour.

The model also identifies how the projected maximum EMF levels would vary with the lateral distance from the centerline of the tracks. For the sensitive land uses identified, the maximum EMF levels that would be emitted by the HSR system were predicted and compared to the measured, existing ambient conditions. Because magnetic fields are expected to be the dominant EMF impact from the HSR operations,[3] these results are the basis for the EMF impact analysis.

The predicted EMF levels on sensitive receptors associated with the new/modified electrical infrastructure (as distinguished from the OCS, TPSS, and other improvements within the HSR right-of-way) are based on the distance of the nearest sensitive receptor from the source, as shown in Table 3.5-3. EMFs are also produced within electric substations but, because of the spacing of electrical equipment, measured field strengths are low outside the fence line of the substation. EMF close to a substation are mainly produced by the electric power lines supplying the facility (WAPA n.d.).

EMF impacts on sensitive land uses were identified based on the differences between predicted EMF levels and existing conditions. The data from the four site measurement locations was generalized to represent the entire RSA. Where the predicted magnetic fields would be comparable to or lower than the typical existing levels, no significant impact would occur, and these locations were screened out. Where the predicted magnetic fields would be higher than typical existing levels, then the potential for EMI was used to evaluate whether significant impacts could be expected.

3.5.4.4 Determining Significance under CEQA

CEQA requires that an EIR identify the significant environmental impacts of a project (CEQA Guidelines § 15126). One of the primary differences between NEPA and CEQA is that CEQA requires a significance determination for each impact, using a threshold-based analysis (see Section 3.1.3.4, Methods for Evaluating Impacts, for further information). By contrast, under NEPA, significance is used to determine whether an EIS will be required; NEPA requires that an EIS is prepared when the proposed federal action (project) as a whole has the potential to

[3] The HSR OCS and distribution systems primarily would have 60-Hz magnetic fields, which are significantly lower than the frequency levels presented in Table 3.5-4.

"significantly affect the quality of the human environment." Accordingly, Section 3.5.9, CEQA Significance Conclusions, summarizes the significance of the environmental impacts from EMF and EMI for each Central Valley Wye alternative. The Authority is using the following thresholds to determine if a significant impact from EMF or EMI would occur as a result of the Central Valley Wye alternatives. The significance thresholds are based on relevant research and documentation on potential EMF and EMI safety levels, such as the ANSI/IEEE, FCC, and OSHA safety levels presented in Table 3.5-4. The thresholds are similar to those described in the Merced to Fresno Final EIR/EIS but have been updated to reflect revised standards (e.g., change in the recommended exposure limit for the general public) and to include additional thresholds that address refined analysis in this Draft Supplemental EIR/EIS (e.g., addition of threshold to address impacts on livestock). A significant impact is one that would result in project-generated EMF:

a) exposing a person to a documented EMF health risk, including a field intensity over the limit of an applicable standard;

The MPE limit (International Commission on Non-Ionizing Radiation Protection [ICNIRP] Guidelines 2010) for 60-Hz magnetic fields for the instantaneous exposure of the general public is 2,000 mG (200 µT), and the MPE for controlled environments where only employees work is 4.2 G (420 µT). The IEEE Standard 95.6 MPE limit, however, is 9,040 mG (904 µT) for the public. The MPE limit (ICNIRP Guidelines 2010; Tables 6 and 7) for 60-Hz electric fields for the public is 4.2 kilovolts per meter (kV/m). The MPE is 8.3 kV/m for controlled environments in which only employees work. These MPEs are used as threshold values to determine whether 60-Hz electric or magnetic fields posed a human health risk. The 60-Hz standards apply primarily to fixed facilities (TPSS, substations, distribution lines).

The MPE limit for 450 MHz magnetic fields for exposure to the public is 0.225 milliwatt per square centimeter (mW/cm^2) (which equals approximately 1 mG) and the MPE for occupational exposure is 1.5 mW/cm^2 (which equals approximately 2.5 mG) under ANSI/IEEE standards. Under FCC standards, the MPE limit for 450 MHz magnetic fields for exposure to the public is 0.3 mW/cm^2 and the MPE for occupational exposure is 1.5 mW/cm^2. See Table 3.5-4 for safety exposure levels for higher frequencies. These MPEs are used as threshold values to determine whether electric or magnetic fields in the MHz or GHz ranges posed a human health risk. The 450-MHz standards apply primarily to radio communications.

b) adversely affecting the productivity of livestock or poultry; or

c) interfering with implanted medical devices or unshielded sensitive equipment:

For impacts on nearby sensitive equipment, including at hospitals, industrial and commercial facilities, railroads, rail transit systems, or airports, the Footprint Report (Authority 2012) provides typical interference levels for common types of sensitive equipment. These reported levels are used as the significance criteria for this impact analysis. For this Draft Supplemental EIR/EIS analysis, 2 mG is used as a screening level for potential disturbance to unshielded sensitive equipment. In addition, early epidemiological studies showed 2 mG to be the lowest level of chronic long-term magnetic field exposure with no statistical association with a disease outcome (Savitz et al. 1988; Severson et al. 1988). The value of 2 mG also is a typical EMF level emitted by household appliances (Authority and FRA 2010b).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends magnetic and electric field exposure limits of 1,000 mG and 1 kV/m, respectively, for people with pacemakers (ACGIH 1996).

3.5.5 Affected Environment

This section describes the affected environment related to EMF and EMI in the Central Valley Wye alternatives RSA, including sources of EMF and EMI; local conditions; receivers susceptible to EMF or EMI impacts; and railroad and transportation equipment susceptible to EMF and EMI impacts along the project footprint for each Central Valley Wye alternative. It also discusses changes related to EMF and EMI in the San Joaquin Valley since publication of the Merced to

Fresno Final EIR/EIS. This information provides the context for the environmental analysis and evaluation of impacts.

3.5.5.1 Regional and Local Sources of EMF and EMI

Regional and local sources of EMF and EMI (including RF interference, which is a subset of EMI) in the EMF and EMI RSA are shown on Figure 3.5-1. Regional sources of EMF and EMI, such as television and radio transmissions, are present over a broad region and are captured in the baseline levels measured at representative sites in the RSA, which are shown on Figure 3.5-2 and discussed in the next section. Regional sources of EMF and EMI may be located outside the RSA. These sources include AM and FM radio stations, time signal transmitters, maritime and land mobile radio transmitters, air-to-ground transceivers, cellular telephone antennas, and television station transmission antennas.

Local sources of EMF and EMI can be captured only in baseline measurements near the source. Local sources and facilities that typically contain highly sensitive RF equipment include police and fire department and FM radio transmitters. One local source of interference from RF equipment within the RSA is Madera County Fire Station #4 on Avenue 21 in unincorporated Madera County, located within 150 feet of the track centerline for the Avenue 21 to Road 13 Wye Alternative.

Local sources of EMI also would include radio communication systems operated by schools within the RSA (e.g., wireless local area networks and internet connections). Three schools are located within the EMF and EMI RSAs. Chowchilla Seventh-day Adventist School, a private school and church, is located approximately 120 feet from the nearest track centerline of the Avenue 21 to Road 13 Wye Alternative. Washington Elementary School and El Capitan High School are located approximately 300 feet from the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line that would be reconductored under the SR 152 (North) to Road 19 Wye Alternative. Alview Elementary School, Fairmead Head Start, and Fairmead Elementary School are all outside the EMF and EMI RSAs (farther than 500 feet from the alignment centerline). FCC spectrum frequency allocations allow WiFi systems to operate in their frequency blocks at 2.4, 3.6, and 4.9/5.0 GHz, each divided into channels to allow multiple systems to operate without interference. Wireless networks used by schools operate at relatively low power levels and have a range of only 100 to 300 feet (FCC 2008).[4]

Construction equipment, such as trucks and light vehicles, also generate EMF. Additionally, many types of construction equipment contain electric motors that generate EMF. Communication equipment, which includes mobile telephones and radios, would generate RF fields as well.

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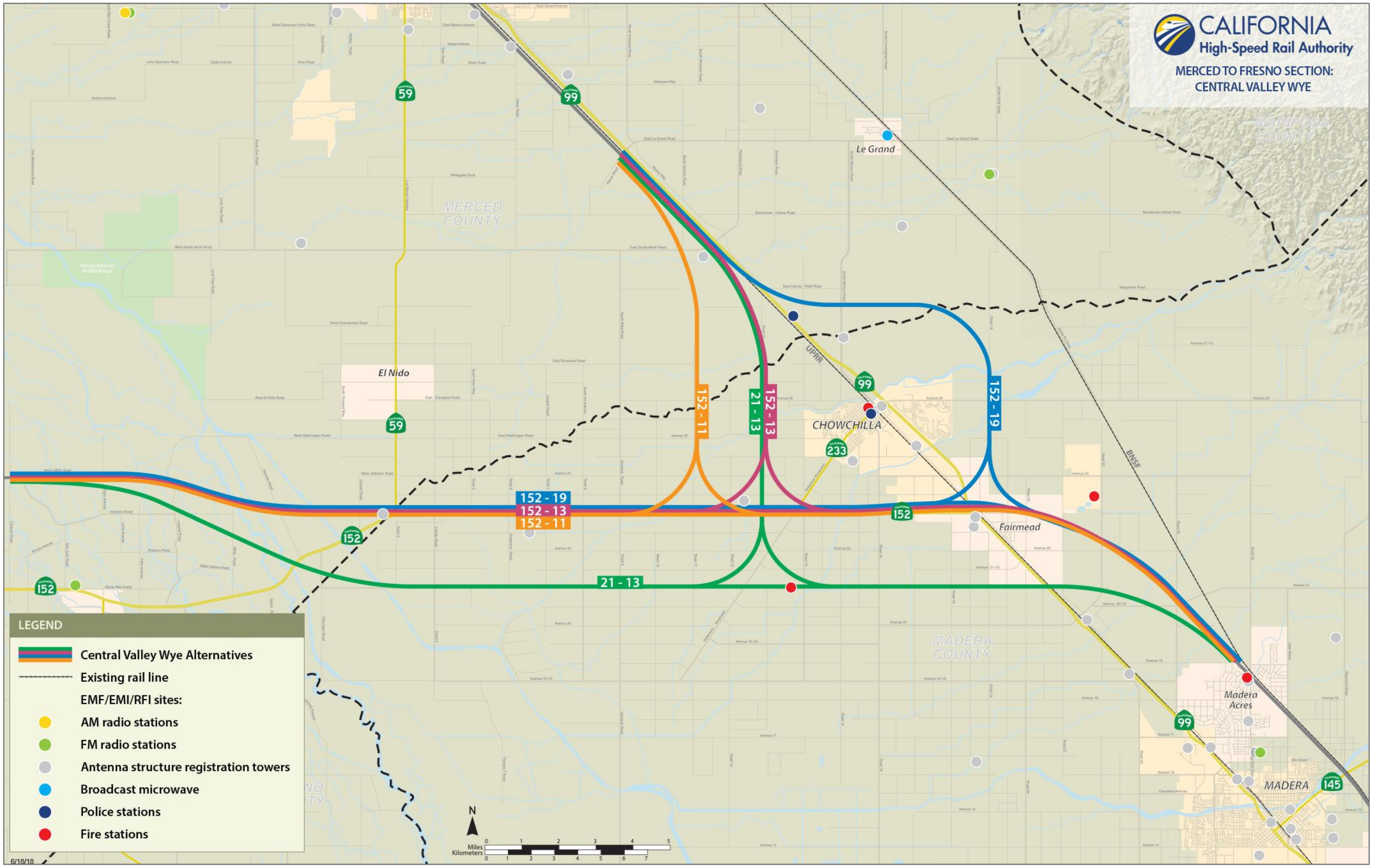
[4] The FCC has not updated this webpage since 2008.



Sources: Cavell, Mertz & Associates, 2015; Madera County, 2015; City of Chowchilla, 2015; California Highway Patrol, 2015

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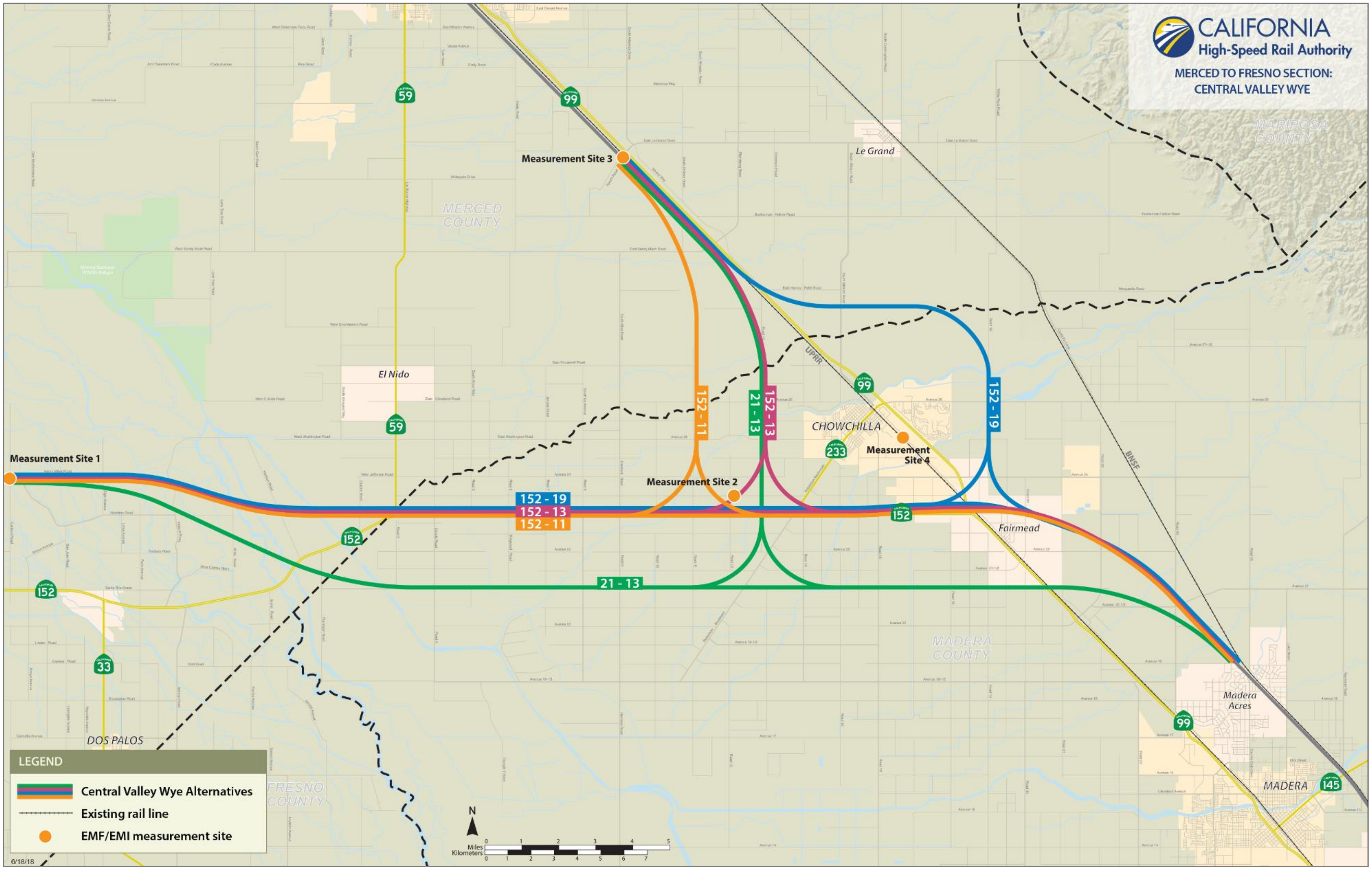
Figure 3.5-1 Regional and Local Sources of EMF and EMI



Sources: Authority and FRA, 2010a; Authority and FRA, 2011

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Figure 3.5-2 EMF and EMI Measurement Sites

3.5.5.2 Local Conditions

Existing local conditions were partially determined by measuring EMF levels at representative locations within the RSA. Figure 3.5-2 shows the EMF and EMI field measurement sites. Three of the baseline measurements (Sites 2–4) were taken from Section 3.5.4.2, EMF and EMI, of the Merced to Fresno Final EIR/EIS (Authority and FRA 2012: pages 3.5-6 to 3.5-12). One new baseline measurement (Site 1) at Henry Miller Road was added for this analysis.

Three of the measurement sites are located in rural areas with sparsely distributed residences. These areas may have underground pipelines, underground cables, or fencing associated with agricultural operations, including irrigation systems. One measurement site is near Chowchilla Municipal Airport, an area characterized by light-industrial land uses, high-voltage overhead power lines, and associated suburban infrastructure. The four measurement sites are representative of all Central Valley Wye alternatives under consideration because the four alternative alignments share the same land use types near the measurement sites. In general, RF electric field levels between 10 kHz and 6 GHz are relatively low throughout the RSA, with the highest RF electric field level occurring near Chowchilla Municipal Airport. The maximum or peak 60-Hz magnetic fields recorded in the survey ranged from 0.04 mG to 0.96 mG, depending on the measurement locations relative to local distribution and transmission power lines. Table 3.5-6 provides a comparison of the measured and calculated magnetic fields at the distances of each of the four measurement sites from the centerline of the closest proposed HSR ROW. There are no substantive differences in distances between the measurement sites and the centerlines of the alternative alignments. The calculated magnetic fields include those for the single-train HSR modeled in the Footprint Report (Authority 2012). The calculated magnetic fields consider the magnetic fields emanating from the active rails. They also consider the negative feeder, which partially cancels the magnetic fields from the supply current in the overhead contact system.

Table 3.5-6 Summary Comparison of Measured and Calculated 60-Hertz Magnetic Fields for Central Valley Wye Alternatives

Measurement Location	Distance from Centerline of Closest HSR Right-of-Way (feet)[1]	Measured AC Magnetic Field Levels[2] (mG)	Calculated 60-Hz Fields at Distance from HSR Right-of-Way Centerline (Single Train) (mG)[3,4]
1. Intersection of Carlucci Road and Henry Miller Road	185	0.65	2.8
2. Intersection of Avenue 23 1/2 and Road 12	245	0.04	1.1
3. Intersection of SR 99 and Ranch Road	940	0.12	<0.01
4. Chowchilla Airport	9,440	0.96	<0.001

Source: Authority, 2012

[1] Approximate distance of measurement location from centerline of the Central Valley Wye alternative right-of-way that is closest to each measurement site.

[2] Maximum measured AC magnetic field for spatial profile measured at each site (Authority and FRA 2010a, 2011).

[3] The calculated magnetic fields for HSR (Footprint Report (Authority 2012)) are for a single train passing at its closest point to the measurement location.

[4] Estimated from Figure E-1b of the Footprint Report (Authority 2012).

AC = alternating current
mG = milligauss
Hz = hertz
HSR = high-speed rail
SR = state route

3.5.5.3 Sensitive Receptors and Facilities

Land uses in the RSA for the Central Valley Wye alternatives are predominantly agricultural. In rural areas, receivers susceptible to EMF and EMI include linear aboveground structures, such as railroads, ungrounded metal irrigation systems, and ungrounded metal fences. The RSA includes the rural residential community of Fairmead, where sensitive human receptors are concentrated in residences and schools. Other sensitive receptors within the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line RSA associated with the SR 152 (North) to Road 19 Wye Alternative include the BNSF Railway (BNSF), Washington Elementary School (4402 Oakdale Road, Winton, CA), and El Capitan High School (100 Farmland Avenue, Merced, CA). No other potentially sensitive facilities (e.g., hospitals, airports, military facilities, telecommunications, or research facilities) are located in the RSA.

Nearby railroad tracks, underground pipelines, and cables susceptible to corrosion because of EMF emissions also parallel each of the Central Valley Wye alternatives. As described in Section 3.5.6, Environmental Consequences, the Central Valley Wye alternatives are adjacent to portions of the Union Pacific Railroad (UPRR) corridor. The northern portions of each of the Central Valley Wye alternative alignments are parallel to the UPRR tracks (Figure 3.5-1). Trains use the UPRR rail line to transport passengers and haul freight.

3.5.6 Environmental Consequences

3.5.6.1 Overview

This section evaluates how the No Project Alternative and the Central Valley Wye alternatives could affect EMF/EMI levels. The impacts of the Central Valley Wye alternatives are described and organized as follows:

Construction Impacts

- Impact EMF/EMI#1: Temporary Impacts from Use of Construction Equipment

Operations Impacts

- Impact EMF/EMI#2: Permanent Human Exposure to EMF
- Impact EMF/EMI#3: Permanent Livestock and Poultry Exposure to EMF
- Impact EMF/EMI#4: Permanent Interference with Sensitive Equipment
- Impact EMF/EMI#5: Permanent Interference with Signal Systems of Adjacent Railroads
- Impact EMF/EMI#6: Permanent Corrosion of Underground Pipelines and Cables

3.5.6.2 No Project Alternative

The population in the San Joaquin Valley is expected to grow through 2040 (see Section 2.2.2.2, Planned Land Use). Growth and development in the San Joaquin Valley would continue under the No Project Alternative, including planned residential, commercial, industrial, recreational, transportation, and agricultural projects. This development would likely result in associated direct and indirect impacts of EMF and EMI on human health, agricultural uses, and use of electrical and electronic devices. EMF associated with these future development activities would continue a historical trend of increasing intentional use of the EM spectrum and unintentional generation of EMI in the region.

As described in Section 3.5.5, Affected Environment, past development has led to conditions affecting EMF levels. Agricultural operations have become increasingly mechanized, with powered farm equipment replacing farm animals and manual methods, and increasingly automated, with the introduction of radio communications, weather and crop data collection systems, and automated control systems. Railroads traversing the San Joaquin Valley also have installed electrical and electronic data collection, monitoring, and control systems that both are sources of EMF and are vulnerable to EMI. Electric power transmission lines have been constructed through the San Joaquin Valley, emitting extremely low levels of EMF that are a source of EMI. Urban areas such as Chowchilla have expanded, increasing EMF from radio and microwave communications systems, electric motors, appliances, and other sources. Overall, however, the RSA has low levels of EMF and EMI relative to those found in large urban areas.

Future development in Merced and Madera Counties includes dairy farm expansions, airport development, and implementation of general and specific plans throughout both counties. Planned projects under the No Project Alternative also include residential, commercial, and industrial developments; the expansion of SR 99; and other transportation projects, such as reconstruction of interchanges, overcrossing construction, road widenings and lane additions, road realignment and extensions, and recreational bike and pedestrian trail construction. A full list of anticipated future development projects is provided in Appendix 3.19-A, Cumulative Plans and Non-Transportation Projects List, and Appendix 3.19-B, Cumulative Transportation Projects List. The residential and commercial growth expected in and around the City of Chowchilla, as described in the Introduction and Land Use sections of the *City of Chowchilla 2040 General Plan* (pages I-1 through L-69) (City of Chowchilla 2011), is anticipated to affect EMF levels in the RSA.

Under the No Project Alternative, recent development trends are anticipated to continue, leading to increasing levels of EMF and more occurrences of EMI. Existing land would be converted for residential, commercial, and industrial development, as well as for transportation infrastructure, to accommodate future growth, increasing the use of and potential conflicts with EMF. In addition, demand for EM spectrum would increase as a result of increased population from newly planned development. Electricity and RF communication equipment, including high-voltage electric power lines and directional and non-directional (cellular and broadcast) antennas that emit EMF and EMI, would continue to be used in the RSA. Under the No Project Alternative, future conditions would likely result in additional use of electricity and RF communications, consistent with the types of uses found today. By 2040, the use of electricity and RF communications would likely increase because of increased development, increased use of electrical devices, and technological advances in wireless transmission (such as wireless data communication). As a result, generation of EMF and EMI that might affect people and sensitive receptors would continue and would be expected to increase in the area under the No Project Alternative. Planned developments and transportation projects that would occur under the No Project Alternative would likely include building and equipment design features intended to address increased levels of EMF and EMI.

3.5.6.3 Central Valley Wye Alternatives

Construction Impacts

Impact EMF/EMI#1: Temporary Impacts from Use of Construction Equipment

Construction of the Central Valley Wye alternatives at any location would require the temporary use of heavy equipment, trucks, and light vehicles, which, like all motor vehicles, generate EMF. Additionally, many types of construction equipment contain electric motors that generate EMF. However, these weak sources of EMF would not generate noticeable EMI beyond the project footprints. The list of equipment used by construction, the communications equipment, and the construction activities would be effectively the same for any of the Central Valley Wye alternatives; only the locations of construction activities would differ among the alternatives.

Communication equipment used by construction crews would include mobile telephones and radios that would generate RF fields and temporarily increase the volume of radio transmissions during construction. Communication equipment would include off-the-shelf products that comply with FCC regulations designed to prevent EMI with other equipment or hazards to persons. No noticeable off-site EMI would be generated during construction. Communication equipment would comply with FCC regulations, so its effects would not be considerably different from the radio transmissions that occur under existing conditions, and would not affect nearby land uses or expose people to health risks or nuisance shocks.

EMF from electric motors and other uses of electric power on the construction sites would be generated; however, radio communications systems used on construction sites would comply with FCC regulations. Therefore, construction of the Central Valley Wye alternatives would not be a source of EMI that would expose a person to a documented health risk, interfere with implanted medical devices, or interfere with unshielded sensitive equipment.

CEQA Conclusion

The impacts of construction-phase EMF would be less than significant under CEQA for all Central Valley Wye alternatives because people would not be exposed to a EMF health risk. The impacts of construction-phase EMI would be less than significant under CEQA because sensitive equipment would not be affected by project-related EMI. EMF from powered construction vehicles would be limited to the project footprints, and off-site radio communications systems would comply with FCC regulations designed to prevent EMI. Therefore, CEQA does not require any mitigation.

Operations Impacts

Operations of the Central Valley Wye alternatives would involve the movement of electric trains as well as the operations and maintenance of the rail, associated structures and utilities, fencing, power system, train control, and communications. All of these activities could generate EMF and could interfere with the operation of electrical, magnetic, or electromagnetic devices. Additionally, HSR operations could affect adjacent rail signal systems or corrode underground pipelines or cables.

Impact EMF/EMI#2: Permanent Human Exposure to EMF

Human exposure to EMF during operation of any of the Central Valley Wye alternatives would be permanent but intermittent. The different alternatives would use the same technology and would operate at the same intensity, so EMF emissions would be largely the same for any of the Central Valley Wye alternatives. The alternative alignments would traverse the same terrain and would lie adjacent to the same land uses, so exposed individuals, facilities, and other resources would be generally the same for any of the Central Valley Wye alternatives. Given these similarities, the differences in potential EMF/EMI impacts among the alternatives would be indistinguishable.

Operations of the Central Valley Wye alternatives would generate 60-Hz and radio frequency electric and magnetic fields on and adjacent to trains (Authority 2012). The predicted HSR-generated EMF and EMI levels to which members of the public would be exposed would be far less than 1 percent of the relevant MPE limit of 9,040 mG. Even within the Central Valley Wye alternatives rights-of-way, health-based safety standards would not be exceeded during train operations (Authority 2012).

Passengers on HSRs also would be exposed to EMF. Measured EMF exposure levels inside existing HSRs are below the IEEE Standard 95.6 MPE limit of 9,040 mG for the public. Magnetic fields have been measured in the passenger compartments on board other HSR systems such as the Acela Express (119 mG) and French TGV A (165 mG), and in the operator's cabs of the Acela Express (58 mG) and French TGV A (367 mG) (FRA 2006). Permanent EMF impacts on people in nearby businesses and residences would be below the MPE limit of 9,040 mG for the public because measurements of existing systems indicate that, even within the mainline right-of-way, these levels would not be reached.

Passengers and members of the public with implanted medical devices are especially sensitive to EMF. Magnetic fields of 1,000 to 12,000 mG (1 to 12 G) may interfere with implanted medical devices (EPRI 2004). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends magnetic and electric field exposure limits of 1,000 mG and 1 kV/m, respectively, for people with pacemakers (ACGIH 1996). These levels would occur inside the TPSSs and switching stations, which are unmanned and inaccessible to the public, as well as at the source of the Site 7—Le Grand Junction/Sandy Mush Road, 115 kV Tie-Line and at the source and edge of right-of-way (50 feet) of the Site 7—Wilson, 230 kV Tie-Line. A provision in the Implementation Stage EMC Program Plan (ISEP) (EMF/EMI-IAMF#2) is to post signs at the TPSSs, switching stations, and on tie-line structures warning persons with an implanted medical device of the potential for high levels of EMF to avoid the potential for interference. There would be no change in baseline conditions for the transmission/power lines proposed to be reconductored as the voltage would remain the same.

Authority employees and utility workers also would be exposed to EMF from HSR trains, power distribution lines, TPSSs, switching stations, and other facilities. Given the nature of the work in which these individuals would be engaged, they could be exposed to higher levels of EMF than those to which passengers and members of the general public would be exposed. Individuals working within or adjacent to HSR facilities would be exposed to EMF of various frequencies at varying distances from the sources for irregular periods. Unlike the general public, however, Authority employees and utility workers are covered by OSHA regulations. Their work activities are conditioned by appropriate health and safety plans, training programs, and safety equipment and protocols that limit their EMF exposure to levels that are safe, with an adequate margin of safety.

For the Central Valley Wye alternatives, EMF would also occur because of electrical devices, such as transformers and electrical substations, electrical lines entering and exiting the TPSSs, switching stations, and substations. EMF levels provided in Table 3.5-3 indicate that EMF exposures in publicly accessible areas outside of 60-Hz power transmission and distribution facilities would be well below the thresholds for 60-Hz fields (4.2 kV/m for electric fields and 9,040 mG for magnetic fields). EMF levels above the thresholds would occur primarily in the secure work areas associated with the TPSSs, switching stations, and substations, except where electrical lines enter and exit the facilities. Beyond the fence line, EMF from substation equipment would typically be indistinguishable from background levels (Federal Transit Administration n.d.). EMF levels from TPSSs, switching stations, and substations would rapidly decrease with increasing distance from the source within the EMF and EMI RSAs (Table 3.5-3). The approximate distance between the fence line of an existing 115-kV electrical facility proposed to be expanded (i.e., Site 6—El Nido, El Nido Substation, common to all Central Valley Wye alternatives) and the closest sensitive receptor (i.e., a rural residence) is approximately 100 feet. As discussed earlier, measured field strengths are low outside the fence lines of substations.

EMF near substations are mainly being produced by the entering and exiting electrical distribution lines, in this case 115-kV power lines. At a distance of 100 feet, EMF exposure from the power lines would be reduced by approximately 94 percent. The approximate distance between the fence line of an existing 230/115 kV electrical facility proposed to be reconfigured (i.e., Site 7—Wilson, Wilson Substation, common to SR 152 (North) to Road 13, Avenue 21 to Road 13, and SR 152 (North) to Road 11 Wye Alternatives) and the closest sensitive receptor (i.e., a rural residence) is approximately 400 feet to the southeast where a new 230 kV Tie-Line is proposed to enter the Wilson Substation. At a distance of 400 feet from the facility, EMF levels would be reduced by over 99 percent. Given the distance between the sensitive receptors and the existing El Nido Substation, the change in EMF levels would be imperceptible. At the Wilson Substations, the distance to sensitive receptors would avoid any exceedances of human health standards.

Washington Elementary School and El Capitan High School are located in the RSA of the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville –Wilson 230 kV Transmission Line, of the SR 152 (North) to Road 19 Wye Alternative. The closest sensitive receptor is the Washington Elementary School classroom facilities, approximately 300 feet west of the existing transmission line. There are also rural residences in the RSA for the transmission/power lines proposed to be reconductored. As has been previously discussed, there would be no change in baseline EMF conditions for the transmission/power lines proposed to be reconductored because the voltages would remain the same as the existing voltage; therefore, no impact would occur. At the Chowchilla Seventh-day Adventist School, which is 120 feet from the centerline of the Avenue 21 to Road 13 Wye Alternative, human health would not be affected because EMF levels would be below the threshold for human health effects. Alview Elementary School, Fairmead Head Start, and Fairmead Elementary School are outside the EMF and EMI RSAs (i.e., beyond 500 feet from the alignment centerline) and no impact would occur.

Additionally, human health can be affected by nuisance shocks, which can occur when electrical currents induce voltages in ungrounded linear metal structures that are capable of conducting electric current. This phenomenon is more likely where long (>1 mile) conductors run parallel to the source of the current, and where electrical currents are continuous throughout that distance. Such voltages could give a nuisance shock to an individual who touches the ungrounded metal structure. An example of an ungrounded linear metal conductor would be a center-pivot irrigation system on rubber tires. Long, ungrounded metal fences and irrigation systems are common in rural areas because they are used to divide or irrigate agricultural fields.

A number of metal underground pipelines, cables, and facilities are present in the RSA, as well as metal fences and irrigation systems. Most metal structures adjacent to the HSR are relatively short, limiting the potential electric current that could be induced in them, and they typically are properly grounded in accordance with National Electrical Code guidelines (Article 250) for building and electrical system safety and lightning protection. In addition, the design of the Central Valley Wye alternatives (EMF/EMI-IAMF#2) would include grounding HSR fences, along with non-HSR parallel metal fences and parallel metal irrigation systems (with the cooperation of the affected owner or utility) to avoid possible nuisance shocks.

In addition, insulating sections would be installed in fences to prevent potential current flow. Specific insulation design measures would be implemented for the electrified fences used by ranchers to control livestock or wildlife. Furthermore, the electrical interconnection and network upgrades would be implemented pursuant to the CPUC General Order 95 (Rules for Overhead Electric Line Construction) and General Order 174 (Rules for Electric Utility Substations). Thus, the potential for the Central Valley Wye alternatives to cause nuisance shocks to individuals would be minimized. The impacts of EMF on humans from the operations of the Central Valley Wye alternatives would generally be the same for all alternatives.

CEQA Conclusion

The impact under CEQA would be less than significant under any of the Central Valley Wye alternatives because people would not be exposed to an EMF health risk. The design characteristics of the Central Valley Wye alternatives would limit and closely control EMF, and include warning signs to be posted in areas where EMF could affect individuals with implanted medical devices. Thus, the Central Valley Wye alternatives would not expose individuals to a documented EMF health risk or interfere with implanted medical devices. Therefore, CEQA does not require any mitigation.

Impact EMF/EMI#3: Permanent Livestock and Poultry Exposure to EMF

Studies conducted in response to concerns about impacts on farm animals and wildlife show little effect from EMF or EMI. With regard to dairy production, McGill University conducted a study (2008) with cows in pens exposed to controlled EMF levels of 300 mG and 10 kV/m, the projected magnetic and electric fields that occur at ground level under a 735-kV electric power line at full load. The researchers measured the following factors: milk production, milk fat content, dry matter intake by cows, blood hormone levels (e.g., melatonin and prolactin levels) of the cows, and reproductive outcomes. While a few statistically significant changes in these factors were found in individual studies, no change was consistently reported between studies, and no change was outside the normal range for dairy cows (McGill University 2008). The study concluded that the EMF exposure did not harm the cows or reduce milk production.

Various studies cited by other researchers about EMF and wildlife suggest a range of impacts similar to those found in livestock, from nonexistent to relatively small to beneficial (WHO 2005). One study suggests a beneficial application for extremely low frequency EMF in broiler chickens to fight a common parasitic infection called Coccidiosis (Golder Associates 2009). Because studies concluded that EMF exposure does not harm farm animals or reduce their productivity (McGill University 2008; Golder Associates 2009), there would be no impacts on livestock and poultry from permanent exposure to EMF. The different Central Valley Wye alternatives would use the same technology and would operate at the same intensity, so EMF emissions would be the same for any of the alternatives. The alternative alignments would be adjacent to similar land uses, so the exposures of livestock and poultry to HSR-generated EMF and EMI would be generally the same for any of the Central Valley Wye alternatives. Given these similarities, the differences in potential EMF/EMI impacts among the alternatives would be indistinguishable, for the most part, at the level of analysis appropriate for environmental review. Finally, studies have shown that EMF does not affect livestock or poultry productivity. Thus, the impacts of EMF exposure on livestock and poultry productivity from the operation of the Central Valley Wye alternatives would be effectively the same for all alternatives.

CEQA Conclusion

There would be no impact under CEQA under any of the Central Valley Wye alternatives because studies have shown that EMF does not affect livestock or poultry productivity. Therefore, CEQA does not require any mitigation.

Impact EMF/EMI#4: Permanent Interference with Sensitive Equipment

The small number of commercial and light industrial businesses located along SR 152 within the RSA do not include any facilities with sensitive equipment (e.g., hospitals, airports, military facilities, telecommunications facilities, or research facilities) with which operations of the HSR could permanently interfere. Sensitive receptors, including BNSF, Washington Elementary School, and El Capitan High School are located within the RSA of the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line associated with the SR 152 (North) to Road 19 Wye Alternative; however, there would be no change from existing EMF levels because the voltage of the existing transmission line would remain unchanged. Therefore, the SR 152 (North) to Road 13 Wye Alternative, SR 152 (North) to Road 19 Wye Alternative, and SR 152 (North) to Road 11 Wye Alternative would not interfere with unshielded sensitive equipment.

The Avenue 21 to Road 13 Wye Alternative would have one additional EMI concern, interference with equipment at Chowchilla Seventh-day Adventist School. The HSR system would use radio systems for enhanced automatic train control, data transfer, and communications, raising the concern that EMI from HSR operations could permanently affect the radio system in use at Chowchilla Seventh-day Adventist School (located approximately 120 feet from the centerline of the Avenue 21 to Road 13 Wye Alternative).

The Authority has acquired two dedicated frequency blocks, one block each for Northern and Southern California and each with a width of 4 MHz, for use by automatic train control systems. These blocks are in the 700 MHz spectrum and are dedicated for HSR use and, therefore, not subject to interference from or with other users. Communications systems at stations may operate at WiFi frequencies to connect to stationary trains; channels would be selected to avoid EMI with other users (Authority 2011, Authority 2014, Authority 2016).

In acquiring dedicated frequencies, the radio systems that would be installed as part of the Central Valley Wye alternatives would have EMC with radio systems operated by neighboring uses, including schools (EMF/EMI-IAMF#2). The HSR frequencies would be compatible with the other radio systems including the system operated by the Chowchilla Seventh-day Adventist School, and thus would avoid potential EMI with other radio systems. During the planning stage through system design, the Authority would continue to identify existing nearby radio systems, design systems to prevent EMI with identified neighboring uses, and incorporate these design requirements into bid specifications used to procure radio systems.

Most radio systems procured for HSR use are expected to be commercial off-the-shelf systems conforming to FCC regulations (47 C.F.R. Part 15), which contain requirements designed to confirm EMC among users and systems. The Authority would require all non-commercial off-the-shelf systems procured for HSR use to be certified in conformity with FCC regulations for 47 C.F.R. Part 15, Subpart B, Class A devices. HSR radio systems would also meet emissions and immunity requirements designed to establish EMC with other radio users that are contained in the European Committee for Electrotechnical Standardization EN 50121-4 Standard for railway signaling and telecommunications operations (CENELEC 2006). With these standards in place, the HSR radio system would use the dedicated Upper 700 MHz frequency Block A, and all HSR equipment would meet FCC regulations (47 C.F.R Part 15) for EMI, reducing the potential for impacts during operations of the Central Valley Wye alternatives.

CEQA Conclusion

There would be no impact under CEQA for the SR 152 (North) to Road 13 Wye Alternative because no MRI equipment or other specialized scientific equipment has been identified in the RSA, and the design of the Central Valley Wye alternatives includes use of dedicated frequency blocks and procurement of communications equipment meeting FCC regulations. Therefore, CEQA does not require any mitigation.

There would be no impact under CEQA for the SR 152 (North) to Road 19 Wye Alternative because no MRI equipment or other specialized scientific equipment has been identified in the RSA, the design of the Central Valley Wye alternatives includes use of dedicated frequency blocks and procurement of communications equipment meeting FCC regulations, and there would be no change from existing EMF levels as a result of reconductoring the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line. Therefore, CEQA does not require any mitigation.

There would be no impact under CEQA for the Avenue 21 to Road 13 Wye Alternative because interference with sensitive equipment would not occur. The design of the Central Valley Wye alternatives includes use of dedicated frequency blocks and procurement of communications equipment meeting FCC regulations. Thus, the Avenue 21 to Road 13 Wye Alternative would not interfere with sensitive communications systems such that nearby radio systems would be affected. Therefore, CEQA does not require any mitigation.

There would be no impact under CEQA for the SR 152 (North) to Road 11 Wye Alternative because no MRI equipment or other specialized scientific equipment has been identified in the RSA and the design of the Central Valley Wye alternatives includes use of dedicated frequency blocks and procurement of communications equipment meeting FCC regulations. Therefore, CEQA does not require any mitigation.

Impact EMF/EMI#5: Permanent Interference with Signal Systems of Adjacent Railroads

EMI-sensitive equipment in the RSA includes signal system controls for adjacent rail lines. Signal systems control the movement of trains on the existing UPRR that the Central Valley Wye alternatives would cross or parallel. These signal systems serve three general purposes:

- To warn drivers of street vehicles that a train is approaching. The rail signal system turns on flashing lights and warning bells; some crossings lower barricades to stop traffic.
- To warn train engineers of other train activity on the same track a short distance ahead, and advise the engineer that the train should either slow or stop. This is done by using changing, colored (green, yellow, or red) trackside signals.
- To show railroad dispatchers in a central control center where trains are located on the railway so that train movements can be controlled centrally for safety and efficiency.

Railroad signal systems operate in several ways but, generally, they are based on the principle that the railcar metal wheels and axles electrically connect the two running rails. An AC or DC voltage applied between the rails by a signal system would be shorted out; that is, reduced to a low voltage, by the rail-to-rail connection of the metal wheel-axle sets of a train. The low-voltage condition is detected and interpreted by the signal system to indicate the presence of a train on that portion of track.

The HSR OCS would carry 60-Hz AC per HSR train. Interference between the HSR 60-Hz currents and a nearby freight railroad signal system, which would be avoided with incorporation of agreements with railroads (EMF/EMI-IAMF#1), could occur under the following conditions:

- The strong electrical currents flowing in the OCS and the return currents in the overhead negative feeder, HSR rails, and ground could induce 60-Hz voltages and currents in existing parallel railroad tracks. If an adjoining railroad track parallels the HSR tracks for a long enough distance (i.e., several miles), the induced voltage and current could interfere with the normal operations of its signal system. This interference could cause the system to indicate that there is no train present when there is one present, or it could indicate the presence of a train when in fact one is not there.
- Higher-frequency EMI from several HSR sources (electrical noise from the overhead contact system, from electrical equipment onboard the HSR, or from the cab radio communication

system) could cause electrical interaction with the adjoining freight railroad signal or communication systems.

All four Central Valley Wye alternatives would operate trains at-grade adjacent to the existing UPRR tracks. Operations of the Central Valley Wye alternatives could affect the signaling systems along these existing track lengths. Among the four development alternatives, on the basis of the extent of adjacent UPRR facilities, the SR 152 (North) to Road 19 Wye Alternative would have the most potential for impact (4 miles), and the SR 152 (North) to Road 11 Wye Alternative would have the least potential for impact (1.3 miles). The SR 152 (North) to Road 13 Alternative and the Avenue 21 to Road 13 Wye Alternative (3 miles) would have an intermediate potential for impacts.

To avoid the possibility of interfering with the signaling system of adjacent railroads, the design requirements of the Central Valley Wye alternatives would include provisions to work with the engineering departments of passenger and freight railroads that parallel the HSR line to apply the standard design practices that a nonelectric railroad must use when electric power lines or an electric railroad are installed adjacent to its tracks (EMF/EMI-IAMF#1). These standard design practices include assessing the specific track signal and communication equipment in use on nearby sections of existing rail lines, evaluating potential impacts of HSR EMF and RF interference on adjoining railroad equipment, and applying suitable design provisions on the adjoining rail lines to prevent interference.

Physical modifications of the electrical circuitry in adjacent railroad right-of-way could be accomplished as routine maintenance or upgrades, and are not expected to require additional environmental clearances or approvals. From an EMI perspective, the effect of HSR on the signal system of adjacent railroads would be similar to the effect of transmission or distribution lines. Railroads routinely interact with electrical utilities to protect their signal systems. Similarly, the Authority would require its contractor to coordinate with adjacent railroads to establish agreements according to which the contractor would incorporate effective measures avoiding interference (EMF/EMI-IAMF#2); such measures could include retrofitting existing electrical circuits on adjacent railroad tracks.

Design provisions could also include replacing specific track circuit types on adjoining rail lines with other circuit types developed for operations on or near electric railways or adjacent to parallel utility power lines, providing filters for sensitive communication equipment, and potentially relocating or reorienting radio antennas. Additional design provisions could include HSR using new frequencies that would not interfere with existing frequencies and existing equipment, or positioning grounded static wires at their optimal distances from the OCS pole, the feeder wire, and OCS, which would reduce the HSR electrostatic voltage interference, magnetically induced current interference, and electrical noise interference. These design provisions would be in place prior to the activation of potentially interfering systems of the HSR. These provisions would be incorporated during the final design phase of the Central Valley Wye alternatives (EMF/EMI-IAMF#1). Because standard design and operational practices and coordination with the engineering departments of freight railroads that parallel the HSR would be incorporated, potential impacts on adjacent existing rail lines would be avoided.

CEQA Conclusion

The impact under CEQA would be less than significant under any of the Central Valley Wye alternatives because the IAMFs incorporated as part of the Central Valley Wye alternatives would require working with the engineering departments of adjacent parallel railroads to modify or upgrade their signal systems as needed to avoid interference from HSR operations. Therefore, CEQA does not require any mitigation.

Impact EMF/EMI#6: Permanent Corrosion of Underground Pipelines and Cables

TPSSs located every 30 miles would deliver AC to the HSR rails through the OCS, with return current flowing from the trains back to the TPSSs through the steel rails and static wires. At paralleling stations, which would be positioned approximately every 5 miles along the right-of-way, some of the current returning to the TPSS would be transferred from the rails to the static wires. Most return current would be carried by the HSR rails and the static wire back to the TPSS, but some return current would find a path through rail connections to the ground and through leakage into the ground from the rails via the track ballast.

The potential for corrosion of underground pipelines and cables during operations of the Central Valley Wye alternatives would be intermittent and permanent. Soils in the EMF and EMI RSA tend to be sandy and dry (except where irrigated), so they have higher electrical resistivity and lower ability to carry electrical current than soils with more clay and moisture content. Nevertheless, other linear metallic objects, such as buried pipelines or cables, could carry AC ground current. AC ground currents have a much lower propensity to cause corrosion in parallel conductors than the DC used by transit rail lines such as Bay Area Rapid Transit or the Los Angeles County Metropolitan Transportation Authority (Barlo and Zdunek 1995). Nonetheless, stray AC could cause corrosion by galvanic action.

Provisions in the ISEP (EMF/EMI-IAMF#2) would help avoid and minimize the potential for impacts on underground pipelines and cables, including the grounding of pipelines. If adjacent pipelines and other linear metallic structures are not sufficiently grounded through direct contact with earth, the Authority would arrange for additional grounding of pipelines and other linear metallic objects in coordination with the affected owner or utility. Alternatively, insulating joints or couplings may be installed in continuous metallic pipes to prevent current flow. Thus, the potential for corrosion from ground currents resulting from operations of the Central Valley Wye alternatives would be avoided.

The different Central Valley Wye alternatives would use the same technology and would operate at the same intensity, so EMF emissions would be the same for any of the alternatives. The alternative alignments would be adjacent to similar land uses, so the potential exposures of linear metallic structures to HSR-generated EMF and EMI would be generally the same for any of the Central Valley Wye alternatives. Given these similarities, the differences in potential EMF/EMI impacts among the alternatives would be indistinguishable. The potential impacts of the operations of the Central Valley Wye alternatives on corrosion of underground pipelines and cables thus would be approximately the same for all alternatives.

CEQA Conclusion

The impact under CEQA under any of the Central Valley Wye alternatives would be less than significant because interference with sensitive equipment in the form of corrosion of underground pipelines and cables would be avoided through design characteristics of the Central Valley Wye alternatives. These design requirements include arranging for the grounding of nearby ungrounded linear metal structures to prevent inducement of currents in these structures that could cause additional corrosion. Therefore, CEQA does not require any mitigation.

3.5.7 Mitigation Measures

All construction and operations impacts would be minimized or avoided. No mitigation measures are required.

3.5.8 Impacts Summary for NEPA Comparison of Alternatives

This section summarizes the impacts of the Central Valley Wye alternatives and compares them to the anticipated impacts of the No Project Alternative. Table 3.5-7 provides a comparison of the potential impacts of each of the Central Valley Wye alternatives, summarizing the more detailed information provided in Section 3.5.6. A comparison of the impacts on EMF and EMI of the different Central Valley Wye alternatives follows Table 3.5-7.

Table 3.5-7 Comparison of Central Valley Wye Alternative Impacts

Impacts	SR-152 (North) to Road 13	SR-152 (North) to Road 19	Avenue 21 to Road 13	SR-152 (North) to Road 11
Construction				
Impact EMF/EMI#1: Temporary Impacts from Use of Construction Equipment				
EMF effects related to construction equipment	No individuals would be exposed to EMF levels that exceed human health standards under any of the Central Valley Wye alternatives.			
EMI effects related to construction equipment	Sensitive equipment would not be affected by EMI generated by any of the Central Valley Wye alternatives.			
Operations				
Impact EMF/EMI#2: Permanent Human Exposure to EMF				
EMF impacts on people from operations of the Central Valley Wye alternatives	No individuals would be exposed to an EMF-related health risk under any of the Central Valley Wye alternatives.			
EMI impacts on people from operations of the Central Valley Wye alternatives	No alternative would interfere with an implanted medical device under any of the Central Valley Wye alternatives.			
Impact EMF/EMI#3: Permanent Livestock and Poultry Exposure to EMF				
EMF impacts on livestock and poultry	No impacts because there is no documented evidence that EMF has adverse impacts on livestock or poultry.			
Impact EMF/EMI#4: Permanent Interference with Sensitive Equipment				
EMI impacts on sensitive equipment	No impacts on sensitive medical or scientific equipment because no such equipment is located within the RSA under any of the Central Valley Wye alternatives.			
EMI impacts on school communications systems	NA	NA	NA	NA
Impact EMF/EMI #5: Permanent Interference with Signal Systems of Adjacent Railroads				
EMF/EMI effects related to length of HSR tracks paralleling existing UPRR tracks	3 miles of adjacent track	4 miles of adjacent track	3 miles of adjacent track	1.3 miles of adjacent track
Impact EMF/EMI#6: Permanent Corrosion of Underground Pipelines and Cables				
EMF impacts on corrosion of underground pipes or cables	Interference with sensitive equipment in the form of corrosion of underground pipelines and cables would be avoided through the design characteristics of the Central Valley Wye alternatives, which include grounding of nearby ungrounded linear metal structures, preventing inducement of currents in these structures that could result in corrosion.			

Source: Authority and FRA, 2018
EMF = electromagnetic field
EMI = electromagnetic interference
HSR = high-speed rail
NA = not applicable
UPRR = Union Pacific Railroad

Under the No Project Alternative, growth and development would continue, with associated EMF and EMI impacts. Development activities and ongoing infrastructure, such as continued operations of existing roads, highways, utilities, airports, and railways, would occur and could affect EMF and EMI resources. Electrical devices and RF communication equipment, including high-voltage electric power lines and directional and non-directional (cellular and broadcast) antennas that emit EMF and EMI, would continue to be used in the Central Valley Wye alternative RSAs. Under the No Project Alternative, future conditions would likely result in additional use of electricity and RF communications, similar to the types of uses found today. By 2040, the use of electricity and RF communications would likely increase because of increased development, increased use of electrical devices, and technological advances in wireless transmission (such as wireless data communication). As a result, emissions of EMF and EMI that might affect people and sensitive receptors would continue and could increase in the area under the No Project Alternative.

The Merced to Fresno Final EIR/EIS concluded that EMF and EMI from the HSR system would not affect human health, agricultural productivity, and use of the EM spectrum. EMF and EMI from the Central Valley Wye alternatives would also not affect human health, agricultural productivity, or use of the EM spectrum based on compliance with regulations, the low levels of public exposure, and design characteristics of the Central Valley Wye alternatives. The Central Valley Wye alternatives incorporate IAMFs to avoid potential EMF and EMI impacts on human health, agricultural productivity, and use of the EM spectrum. These IAMFs would include working with the engineering departments of railroads that operate parallel to the HSR to apply standard design practices to prevent interference with the electronic equipment operated by these railroads and preparing an EMF and EMI technical memorandum to guide design of the HSR system to avoid EMI.

Construction activities would generate EMF through the use of powered construction equipment and radio communications. These emissions would be temporary, occurring only during construction, and would not exceed relevant exposure thresholds or present a public health risk. Occasional licensed radio transmissions between construction vehicles would not generate off-site EMI because the radio equipment would operate on licensed frequencies and would be compliant with FCC regulations. Construction impacts would be the same for all Central Valley Wye alternatives.

Operational and maintenance activities of the Central Valley Wye alternatives also could affect local EMF and EMI levels, increasing EMF exposure of sensitive receptors or causing nuisance shocks. The Central Valley Wye alternatives could expose humans to EMF and EMI during operation of the trains and electrical infrastructure. Implementing any of the Central Valley Wye alternatives would have a low potential for EMF and EMI impacts. These impacts would be either temporary, occurring intermittently during operations of the Central Valley Wye alternatives, or permanent, occurring continuously during operations.

The Central Valley Wye alternatives would minimize or avoid EMF emissions through various design measures and their proposed routes would avoid sensitive receptors. The design characteristics of the Central Valley Wye alternatives would limit and closely control EMF. The Central Valley Wye alternatives would incorporate IAMFs to avoid impacts from EMF and EMI exposure. These IAMFs would include adhering to international guidelines and complying with applicable federal and state laws and regulations that address related EMF and EMI topics.

Under any of the Central Valley Wye alternatives, permanent EMF impacts on people in nearby businesses and residences would be below the IEEE Standard 95.6 MPE limit of 9,040 mG for the public because, even within the mainline right-of-way, these levels would not be reached. In addition, magnetic fields of 1,000 to 12,000 mG (1 to 12 G) could interfere with implanted medical devices, particularly within or near TPSSs. However, persons with an implanted medical device would not be permitted near the TPSSs.

Livestock and poultry could be exposed to EMF and EMI during operations of the Central Valley Wye alternatives as well. However, studies concluded that EMF exposure does not harm farm animals or reduce their productivity (McGill University 2008; Golder Associates 2009). Sensitive equipment, including magnetic resonance imaging equipment or specialized scientific equipment, school radio communications, and signal systems for adjacent rail lines, could be affected by operations of the Central Valley Wye alternatives. For all Central Valley Wye alternatives, no impacts would result on magnetic resonance imaging equipment or specialized scientific equipment because no such equipment is present within the EMF and EMI RSA. HSR 60-Hz electrical currents could interfere with a nearby railroad signal system under certain circumstances under all Central Valley Wye alternatives.

The Central Valley Wye alternatives would avoid potential EMI with the radio equipment operated by neighboring users, including the Chowchilla Seventh-day Adventist School, because the Authority has acquired dedicated frequencies for use on the HSR system, and the radio systems that would be installed as part of the Central Valley Wye alternatives would be compliant with FCC regulations for EMI. Operations of the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line under the SR 152 (North) to Road 19 Wye Alternative could result in EMI at two schools located within the RSA: Washington Elementary and El Capitan High School. However, risks associated with EMF exposure and EMI would remain unchanged because the voltage would remain unchanged. Moreover, EMF levels produced by the transmission line would continue to be reduced by over 99 percent at a distance of 300 feet (i.e., the distance of the nearest school facility to the Site 7—Le Grand Junction/Sandy Mush Road, Warnerville–Wilson 230 kV Transmission Line).

Underground pipelines and cables could corrode through stray ground currents during operations of the Central Valley Wye alternatives. In addition, the voltages on and currents flowing through the OCS could induce voltages and currents in nearby conductors such as ungrounded metal fences or irrigation systems near the Central Valley Wye alternatives project footprints. This impact would be more likely to occur where long (1 mile or more) ungrounded fences or irrigation systems run parallel to the HSR, and electricity is continuous throughout that distance. Such voltages could cause a nuisance shock to anyone who touches such a fence or irrigation system.

3.5.9 CEQA Significance Conclusions

Table 3.5-8 summarizes the CEQA determination of significance for all construction and operations impacts discussed in Section 3.5.6. The CEQA level of significance before and after mitigation for each impact in this table is the same for all Central Valley Wye alternatives.

Table 3.5-8 CEQA Significance Conclusions for Electromagnetic Fields and Electromagnetic Interference for the Central Valley Wye Alternatives

Impact	CEQA Level of Significance before Mitigation	Mitigation Measures	CEQA Level of Significance after Mitigation
Construction			
Impact EMF/EMI #1: Temporary Impacts from Use of Construction Equipment	Less than significant for all alternatives	No mitigation measures are required	Not applicable
Operations			
Impact EMF/EMI #2: Permanent Human Exposure to EMF	Less than significant for all alternatives	No mitigation measures are required	Not applicable
Impact EMF/EMI #3: Permanent Livestock and Poultry Exposure to EMF	No impact under any alternative	No mitigation measures are required	Not applicable
Impact EMF/EMI #4: Permanent Interference with Sensitive Equipment	No impact under any alternative	No mitigation measures are required	Not applicable
Impact EMF/EMI #5: Permanent Interference with Signal Systems of Adjacent Railroads	Less than significant for all alternatives	No mitigation measures are required	Not applicable
Impact EMF/EMI#6: Permanent Corrosion of Underground Pipelines and Cables	Less than significant for all alternatives	No mitigation measures are required	Not applicable

Source: Authority and FRA, 2018
CEQA = California Environmental Quality Act
EMF = electromagnetic field
EMI = electromagnetic interference