3.13 Electric and Magnetic Fields

Electric and magnetic fields are produced both naturally—e.g., by lightning—and by human-made devices such as cell phones, electric appliances, and light rail transit systems. Although we experience them as separate phenomena, electric and magnetic fields are closely interrelated, and we refer to them collectively as electromagnetic fields or EMF.

There has been concern in the general public regarding the health effects of exposure to EMF. Although studies on the effects of EMF by the health and medical community have proven inconclusive, and there are no federal laws that limit exposure to EMF, the CRC project team considered it prudent to analyze the potential EMF exposure from the CRC project on users of the project and the general public.

A comparison of impacts from the LPA and the DEIS alternatives is summarized in section 3.13.3. A more detailed description of the impacts of the DEIS alternatives on EMF is in the DEIS starting on page 3-327.

This section assesses the potential for human health impacts from exposure to EMF during operation of the light rail component of the CRC project. Light rail uses an overhead electrical system powered by substations to power the trains, which creates EMF. Bus rapid transit and roadways generate only minor EMF emissions. Therefore, this section addresses impacts near light rail infrastructure within the main project area. No substantial changes in EMF exposure are anticipated to result from operations, maintenance, and construction activities in casting and staging areas, on the Steel Bridge, or at the Ruby Junction Maintenance Facility. The information in this section is based on the CRC Electromagnetic Fields Technical Report and cover letter, included as an electronic appendix to this FEIS.

3.13.1 New Information Developed Since the Draft EIS

Since publication of the DEIS, potential locations of electrical substations to serve the light rail system have been refined and land uses around the substation locations have been analyzed. The results of this analysis are discussed below.

In addition to new information developed since the DEIS, the FEIS includes refinements in design, impacts and mitigation measures. Where new information or design changes could potentially create new significant environmental impacts not previously evaluated in the DEIS, or could be meaningful to the decision-making process, this information and these changes were applied to all alternatives, as appropriate. However, most of the new information did not warrant updating analysis of the non-preferred alternatives because it would not meaningfully change the impacts, would not result in new significant impacts, and would not change other factors that led to the choice of the LPA. Therefore, most of the refinements were applied only to the LPA. As allowed under Section 6002 of SAFETEA-LU

[23 USC 139(f)(4)(D)], to facilitate development of mitigation measures and compliance with other environmental laws, the project has developed the LPA to a higher level of detail than the other alternatives. This detail has allowed the project to develop more specific mitigation measures and to facilitate compliance with other environmental laws and regulations, such as Section 4(f) of the DOT Act, Section 106 of the National Historic Preservation Act, Section 7 of the Endangered Species Act, and Section 404 of the Clean Water Act. FTA and FHWA prepared NEPA re-evaluations and a documented categorical exclusion (DCE) to analyze changes in the project and project impacts that have occurred since the DEIS. Both agencies concluded from these evaluations that these changes and new information would not result in any new significant environmental impacts that were not previously considered in the DEIS. These changes in impacts are described in the re-evaluations and DCE included in Appendix O of this FEIS. Relevant refinements in information, design, impacts and mitigation are described in the following text.

3.13.2 Existing Conditions

Current Guidelines and Regulations

There are no federal laws that limit exposure to electric or magnetic fields. Several agencies, including the U.S. Food and Drug Administration (FDA), Department of Defense (DOD), and EPA, have considered developing standards for EMF exposure. The Federal Communications Commission (FCC) has recently adopted and enforces limits for exposure in the workplace and public areas for AM and FM radio frequency radiation, television, and other wireless sources. Schools, daycare facilities, hospitals, senior living facilities, research facilities, and universities are considered sensitive receptors to EMF.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP), in association with the American Conference of Governmental Industrial Hygienists (ACGIH) and the World Health Organization (WHO), has developed voluntary occupational guidelines for EMF exposure. These guidelines are intended to prevent potential effects such as nerve stimulation or induced currents in human cells (these effects have been shown to occur from exposure to higher frequency EMF than typically occurs in residences or on job sites). Exhibit 3.13-1 shows exposure guidelines that have been developed by ICNIRP and ACGIH.

Exhibit 3.13-1
Exposure Guidelines for 60 Hz Electromagnetic Fields

Exposure at 60 Hz	Electric Field (kV/m)	Magnetic Field (mG)
International Commission on Non-Ionizing Radiation Protection		
Occupational	8.3	4,200
General Public	4.2	833
American Conference of Governmental Industrial Hygienists		
Occupational Exposure Should Not Exceed	25	10,000
Prudence Dictates Use of Protective Clothing Above this Level	15	–
Exposure of Workers with Cardiac Pacemakers Should Not Exceed this Level	1	1,000

Sources: ICNIRP 1998, ACGIH 2007.

Notes: Hz: Hertz, or cycles per second. Most alternating current in the U.S. is produced at 60 Hz.
kV/m: kilovolts per meter.
mG: milligauss.

Washington State has no standards relating to EMF exposure. In Oregon, the electrical field exposure standard is 9 kilovolts per meter (kV/m) within the right-of-way of an electric transmission line. The Oregon Energy Facilities Siting Council (Oregon Department of Energy) has a "prudent avoidance policy" safety standard. A prudent avoidance policy requires the exercise of sound judgment and caution in dealing with EMF. For example, it is considered prudent to limit or avoid exposure to EMF, particularly in the workplace.

EMF Generation and the Existing TriMet Light Rail System

TriMet's existing light rail lines use a 750-volt direct current (DC) system to deliver power to the cars from the overhead electrical lines (catenary wires). Other elements of the light rail system—such as lighting, signals, and switches—use either alternating current (AC) or DC electricity for power. Generally, strong electromagnetic fields are not associated with operation of light rail. Measurements taken of the TriMet system in Portland at distances of 10, 20, and 30 meters (about 32, 65, and 98 feet, respectively) from the light rail track gave the results shown in Exhibit 3.13-2.

Exhibit 3.13-2
Magnetic Field Strength at Distance from TriMet's Light Rail Tracks (mG)[a]

	10 Meters	20 Meters	30 Meters
Horizontal	167.0	44.6	13.3
Vertical	17.8	8.22	3.43

Source: Edelson and Holmstrom 1998.

a mG = milligauss.

The highest measured value (167 milligauss [mG]) is well below the ICNIRP standard of 833 mG for general public exposure to magnetic fields. The magnetic field strengths weaken with increasing distance from the track.

Magnetic fields measured on TriMet's light rail system in 2007 ranged from 107 to 601 mG at the perimeter of the substation buildings, and from 47 to 551 mG at light rail stations. These field intensities are also below the general public exposure standards. Measurements at other light rail systems have produced similar results.

The existing light rail system exposes the general public and train operators to electric and magnetic fields at stations and inside the light rail cars. Magnetic field measurements taken inside the cars fluctuated between approximately 0.38 and 8.13 mG at approximately seat height, indicating that EMF emissions are extremely low within the LRVs used in the existing light rail system.

3.13.3 Long-term Effects

The CRC alternatives with light rail (LPA Option A and Option B, and Alternatives 3 and 5) would be expected to have similar EMF levels to those measured on the existing light rail system. In those locations where people could be exposed (within and near the light rail right-of-way, near

Units for Electric and Magnetic Fields.

You can think of voltage as "electrical pressure" in an electrical line. It is measured in volts (V) or kilovolts (kV or 1,000 volts). This pressure produces an electrical field that extends out from the line and is measured in volts per meter (V/m). Current in an active electrical line also produces a magnetic field around the line. Magnetic fields are measured in units of gauss (G). Since most magnetic fields to which humans are exposed are weak, these fields are typically measured in milligauss (mG or 1/1,000th of a gauss).

Electrical systems can be either direct current (DC) or alternating current (AC). The electricity in wall sockets and power lines is alternating current. Direct current powers the MAX light rail system in Portland. The frequency of alternating current is measured in Hertz (Hz).

substations, or in the LRVs), EMF emissions would be below exposure guidelines.

Although EMF levels are below the exposure guidelines at the perimeter of the substation buildings, the expected future land uses around the substations were examined to determine if any sensitive uses are likely to locate nearby. Since health effects from EMF exposure are still unknown, it is prudent to limit extended exposure to children, the elderly, and the infirm.
Exhibit 3.13-3 illustrates the site locations of the three proposed substations, existing buildings, and the project footprint. These substation locations would not change if LPA Option A, Option B, or their respective highway phasing options are constructed, and therefore the impacts between these options would be the same.

No school, daycare, hospital, or senior housing facilities are located near the proposed project substations. The northernmost substation will be located between 17th Street and McLoughlin Boulevard in Vancouver, land currently in residential use. However, the five residential parcels closest to the substation will be acquired by the project, and the property will be kept clear of structures to provide adequate sightlines for LRV drivers. The LPA, including the LPA with highway phasing, may encourage and facilitate mixed-use development and redevelopment in downtown Vancouver and on Hayden Island. However, as shown in Exhibit 3.13-3, proposed substations in downtown Vancouver and on Hayden Island would be located within the project footprint. As such, any new TOD activity would be located a considerable distance from proposed substation locations, minimizing the likelihood of future indirect EMF impacts. Similarly, new sensitive uses, should they occur, would also be located far from proposed substations in these areas, reducing the likelihood of future direct impacts as well.

While light rail generates higher EMF intensities than bus rapid transit, none of the options or alternatives would pose substantial EMF exposure risks to human health.

3.13.4 Temporary Effects

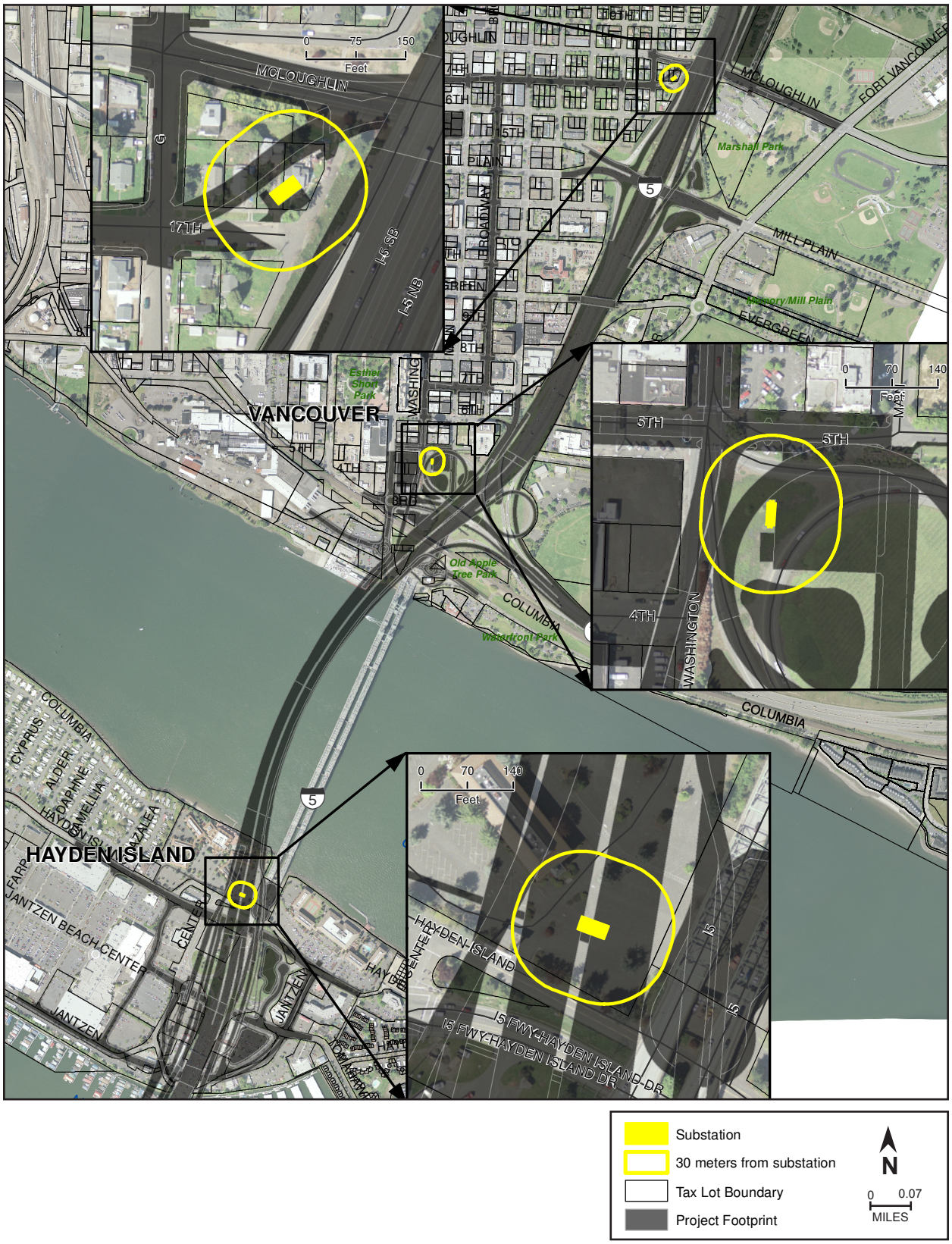
To the extent it is powered by electricity, equipment used in the construction of the LPA would produce EMF. However, the EMF intensities would be modest and would not pose substantial exposure risks to human health.

3.13.5 Mitigation or Compensation

The levels of anticipated EMF are below exposure standards for both the workplace and general public. Thus, mitigation would not be necessary. However, because light rail electric power substations tend to generate the highest EMF intensities in the field measurements, the substations have been designed and sited to minimize exposure to users of the system, the general public, and sensitive users.

Exhibit 3.13-3

Light Rail Substations and Existing Land Uses



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