4.13 Electromagnetic Fields

4.13.1 Introduction to Resources and Regulatory Requirements

Electric and magnetic fields, known as electromagnetic fields (EMFs), are produced wherever electricity is used. Electric fields are produced by charges. Magnetic fields are produced by the flow of electric current. The greater the electric charge, the greater the electric field. Similarly, the greater the electric current, the greater the magnetic field. EMFs surround all electrical equipment and facilities, including the electrical conveyance lines and electrical devices as proposed in the East Link Project. Although there are no regulatory requirements for EMF, EMF results in electromagnetic interference (EMI), which can cause disruptions and possibly malfunctions in sensitive equipment. In certain situations, EMF can result in effects on human health. The EMF study area is dependent on the location of sensitive equipment in relation to the light rail line and the amount of electrical power that the East Link Project requires to accelerate or decelerate near sensitive facilities. However, rarely can a light rail vehicle adversely affect sensitive equipment from a distance greater than 100 feet.

Where there are electric currents, it is possible that stray currents would occur when a portion of the electrical current finds an alternative conducting path, such as metal, water, or a buried pipe or cable. Over time, a stray current can cause corrosion, which in turn can cause pipes to leak or wires to break.

4.13.2 Affected Environment

The affected environment of the East Link system is the area immediately adjacent to project alternatives and on board the train cars. EMI may temporarily interfere with the operation of sensitive electronics and electrical equipment near the right-of-way, so the concern is for facilities that may be sensitive to EMI, such as hospitals or laboratories that use sensitive electronic equipment. Also, the pipes and cable utilities commonly located under and along roadways, including the floating bridge on Interstate 90 (I-90), can be susceptible to stray currents, which can be conducted some distance away from the right-of-way.

Sound Transit contacted Overlake Hospital and Group Health, which both have facilities near I-405, to identify sensitive receptors. As a result of these discussions, Sound Transit identified two buildings—Overlake's Portable MRI Unit and the Overlake Outpatient Optical Surgery Unit—as possibly susceptible to EMI. The Portable MRI Unit is a parked, trailer-mounted magnetic resonance imaging (MRI) unit located at the west end of the North Parking Garage at a loading dock shipping and receiving area next to several trash dumpsters and an electrical transformer that provides power to buildings on the hospital campus. This Portable MRI Unit operates next to large, energized electrical equipment and near roadways and parking garages with moving cars and trucks that produce magnetic fields. The Overlake Outpatient Optical Surgery Unit is located just southeast of the NE 12th Street Overpass east of I-405 in the ground floor of Overlake's west garage.

A proposed Children's Hospital Ambulatory Surgery Center (ASC) may be located between the 116th Maintenance Facility (MF1) and approximately 100 feet north of where the 108th NE Tunnel (C3T), the Couplet (C4A), 112th Elevated (C7E) and 110th Elevated (C8E) alternatives would cross 116th Avenue NE at approximately NE 16th Street, east of I-405).

An earlier report (LTK Engineering Services, 2006) describes extensive measurements and magnetic field modeling performed for the Sound Transit North Link line near the University of Washington campus. In that report, LTK Engineering evaluated the magnetic fields that could be produced by operation of trains on the North Link line as well by as cars, large trucks, and buses that pass close to several of the campus buildings. Because the North Link and East Link light rail lines are similar and part of the Sound Transit light rail system, the model predictions and measurements described in the LTK Engineering report can also be used to predict the present and future magnetic field environment for the Portable MRI Unit and the Overlake Outpatient Optical Surgery Unit at Overlake Hospital as well as equipment at the proposed Children's Hospital ASC.

There are several different external periodic magnetic fields located near the Overlake Portable MRI Unit, as described in Table 4.13-1. These EMFs result from the perturbations of the earth's magnetic field that are caused by the movement of large metal objects such as cars, trucks, and buses. At present, the EMFs have not caused any malfunctions of the Portable MRI Unit.

It is likely that there are underground pipe and electrical and telephone cable utility lines along the segment alternatives, especially on I-90 and in downtown Bellevue, that could be subject to stray currents. Accordingly, these utility lines would need to be carefully evaluated for the possibility of effects from stray currents and the need for protection from stray currents.

TABLE 4.13-1
Estimated External Magnetic Fields Near Potable MRI Unit

Source of EMF	Distance from MRI Unit	Estimated Total Peak Magnetic Field [a]
Buses and large trucks moving in eastbound lanes of NE 12th Street	125 feet (38 meters)	0.1 milliGauss
Cars moving on driveway between West and North parking garages	16 feet (5 meters)	5 milliGauss
Large trucks on driveway between West and North parking garages	16 feet (5 meters)	10 milliGauss
Cars moving in North Parking Garage	33 feet (10 meters)	<1 milliGauss

[a] Estimates taken from measurements and modeling described in the LTK Engineering Services report (2006).

4.13.3 Environmental Impacts

4.13.3.1 No Build Alternative

The No Build Alternative would not introduce any new sources of EMI into the study area.

4.13.3.2 Impacts During Operation

The overhead catenary wires and the power transmission lines that provide power to the traction power substations along the route would produce EMFs. EMFs would also be produced by the train cars themselves, both within and outside the cars, especially when they are moving. The electricity needed to operate the train cars flows from the overhead catenary wires to the traction motors and other electronic equipment. The power flows through cables located either in the ceiling or under the floor of the cars. The amount of electricity flowing in these cables would vary depending on whether the train is accelerating, running at steady speed, decelerating, or is stopped. The electrical current would be highest when the train is accelerating. EMFs would be created whenever the train operates.

Cathodic Protection

Cathodic protection is an effective method of preventing stress corrosion cracking. It is a technique used to control the corrosion of a metal surface by making that surface the cathode or terminal that transports the current.

Only the 108th NE Tunnel (C3T), Couplet (C4A), 112th NE Elevated (C7E), and the 110th NE Elevated (C8E) alternatives approach the potentially EMF sensitive sites. During interviews with staff of Overlake Hospital, Group Health and Children's Hospital ASC and personal visits to the Overlake Portable MRI Unit and the Outpatient Optical Surgery Unit, the MRI units were the only current equipment found to be potentially sensitive to EMF. Other parts of Overlake Hospital are too distant to be affected and Children's Hospital is not presently planning other equipment that would be of concern.

The Overlake Portable MRI Unit trailer and the proposed MRI Unit in the Children's Hospital are located over 100 feet from proposed East Link routes and track in the maintenance facilities. The Children's Hospital site is also located just north of an existing Puget Sound Energy overhead electric transmission line and electrical substation.

The EMF level for the East Link light rail train operating in the C3T, C4A, C7E, C8E alternatives over I-405 is expected to be 6 milliGauss at a distance of 220 feet from the MRI unit at Overlake Hospital. The EMFs from the East Link Project routes would have a lower magnitude than those existing near the Overlake MRI Unit as shown in Table 4.13-1; therefore, the fields from these sources should not cause a problem for the continued successful operation of this unit.

The proposed Children's Hospital MRI unit is planned to be placed inside a shielded room on the second floor. The shielding may lower the EMF from the outside. This shielded room would be at a distance of approximately 100 feet from the south turn around loop track at the 116th Maintenance Facility (MF1) and over 100 feet from the operation of C3T, C4A, C7E, C8E alternatives south of the hospital. These conditions may result in an approximately 20 milliGauss transient magnetic field at the shielded MRI room whenever trains pass at full speed (up to 55 miles per hour). A slower train speed (such as the 8 mph speed in the maintenance facility) may reduce this estimate. Whether this will pose a problem for the operation of the MRI, depends on the design of the MRI room's shielding and the sensitivity of the MRI to outside interference none of which are presently known.

Without control measures, a portion of the electrical current flowing through the light rail trains could stray into a buried pipe or cable, then flow along conducting utility lines in the ground back to the traction power substation. To avoid this issue, however, Sound Transit would coordinate control measures with entities that own and operate the utility lines that could be affected. In addition, Sound Transit has conducted a study to verify the potential impacts of stray currents on the I-90 floating bridge. The concern would be that stray currents could cause corrosion in the bridge structure, thereby reducing the lifespan of the bridge.

Sound Transit would minimize or avoid the potential for stray current impacts by selecting best management practices (BMPs) for the circumstances. The BMPs may include one or a combination of the following:

- Installing cathodic protection systems in nearby utility lines to protect them from corrosion.
- Installing insulating unions to break the electrical conductivity of the pipe and thus force the stray current to take another path.
- Isolating the electrical rails from ground.
- Installing stray-current-control track-fastening systems where appropriate:
  - Tie-and-ballasted track using high-resistance track-fastening systems on concrete ties
  - Direct-fixation track using high-resistance, rubberized track-fastening systems
  - Embedded track using various methods of rail encapsulation such as rail coatings, polyurethane encasement, and rail boots

New natural gas and water lines routed below East Link tracks, and/or new piping systems close to the tracks, would require cathodic protection systems. Cathodic protection system components include the following:

- Galvanic anodes
- Electrical isolation with insulating unions at connections to existing piping
- Pipe coatings
- Bonded mechanical pipe joints
- Permanent test facilities to monitor stray currents and rates of corrosion

Where tracks are elevated on overhead structures, the return current cannot get to ground as easily as on structures that are not elevated; therefore, EMFs from overhead structures are less likely to affect underground utility lines. Absent planned mitigation measures, stray current may find its way into utilities and concrete reinforcing steel or structural steel on the I-90 Floating Bridge and cause corrosion.

Potential Health Effects from Light Rail Alternatives

EMFs can cause a variety of impacts to humans. Certain EMF combinations can cause shock and burn injuries through direct contact with energized components; others can interfere with the operation of electrical and magnetic devices, including heart pacemakers. Based on data available from similar rail systems, however, operation of the light rail is unlikely to generate health impacts for riders or people along the tracks. Anticipated EMF intensities at locations of human exposure within and adjacent to the light rail line are considerably below exposure guidelines established by the American Conference of Governmental Industrial Hygienists and the more recent guidelines established by the International Commission on Non-Ionizing Radiation Protection. These guidelines address known biological effects and do not address speculative concerns about cancer and other possible health effects. Given uncertainties in potential biological effects, these guidelines do incorporate safety factors. Among the various alternatives, no notable differences exist in potential health impacts related to EMFs.

4.13.3.3 Impacts During Construction

No impacts from EMF on nearby sensitive facilities are anticipated during construction.

4.13.3.3 Potential Mitigation Measures

No mitigation measures for EMI from the East Link Project are needed for sensitive equipment at Overlake Hospital because the projected EMF from East Link is lower than the existing EMF environment. Standard design measures are necessary for protection against stray currents. These measures would be developed and implemented in consultation with utility owners during final design.

Stray electrical current from light rail operation could corrode the steel components of the I-90 bridge. The project would include three layers of protection: isolating the rail by constructing special insulating systems, installing a stray current collector mat, and a cathodic protection system. Additionally, the project would place a monitoring system on the bridge to monitor stray current levels.