APPENDIX E: AIR QUALITY TECHNICAL MEMORANDUM

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I-405, Bellevue to Lynnwood Improvement Project

INTERSTATE 405 Corridor Program

Congestion Relief & Bus Rapid Transit Projects

AIR QUALITY TECHNICAL MEMORANDUM

April 2011

Washington State Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

Americans with Disabilities Act (ADA) Information

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ACRONYMS AND ABBREVIATIONS

µg/m3	micrograms per cubic meter
AADT	annual average daily traffic
CO	carbon monoxide
CO_2	carbon dioxide
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
IRIS	Integrated Risk Information System
MSATs	Mobile Source Air Toxics
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxide
NO	nitric oxide
NO_x	nitrogen oxides
PM	particulate matter
ppm	parts per million
PSCAA	Puget Sound Clean Air Agency
PSRC	Puget Sound Regional Council
SIP	State Implementation Plan
SO_2	sulfur dioxide
SR	State Route
VMT	vehicle miles traveled
WASIST	Washington State Intersection Screening Tool
WSDOT	Washington State Department of Transportation

GLOSSARY

Term	Meaning
air emissions	Pollutants emitted into the air, such as: carbon monoxide, nitrogen oxide, nitrogen dioxide, sulfur dioxide, particulates, and others.
air pollutant	Any substance in air that could, in high enough concentration, harm people, animals, vegetation, or materials. They may be in the form of solid particles, liquid droplets, gases, or a combination thereof. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric elements.
air quality standards	The level of pollutants prescribed by regulations that may not be exceeded during a given time in a defined area.
attainment area	An area considered to have air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) for the criteria pollutants designated in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.
carbon monoxide (CO)	A colorless, odorless, toxic gas produced by incomplete combustion.
criteria pollutants	The six pollutants for which the Environmental Protection Agency has identified and set standards to protect human health under the Clean Air Act: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide.
emission factor	A representative value that relates the quantity of a pollutant released to the atmosphere with the activity that is associated with the release.
emission standard	The maximum amount of air polluting discharge legally allowed from a single source, e.g., the amount of CO that may be released by an automobile per mile of travel.
emission	Pollution discharged into the atmosphere from smokestacks, other vents, surface, vehicles, and other sources.
express toll lane	A limited-access freeway lane that is actively managed through a variable toll system to regulate its use and thereby maintain express travel speeds and reliability. Toll prices rise or fall in real time as the lane approaches capacity or becomes less used. This ensures that traffic in the express toll lane remains flowing at express travel speeds of 45 to 60 miles per hour. Transit and carpools do not pay a toll. See also: “managed lane.”

Term	Meaning
fugitive emissions	Air pollutants released to the air other than those from stacks or vents; typically small releases from leaks in plant equipment such as valves, pump seals, flanges, sampling connections, etc.
hazardous air pollutants	Air pollutants which are not covered by ambient air quality standards but which, as defined in the Clean Air Act, may reasonably be expected to cause or contribute to irreversible illness or death.
maintenance area	Area that has recently attained compliance with the NAAQS and is being managed to continue to meet the NAAQS.
mobile source air toxics (MSATs)	Toxic pollutants released from mobile sources identified by EPA as priority pollutants. These include benzene, formaldehyde, naphthalene, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3 butadiene.
national ambient air quality standards (NAAQS)	Standards established by the Environmental Protection Agency under the Clean Air Act for pollutant concentrations in outside air throughout the country. See also: "criteria pollutants".
nitrogen oxides (NO_x)	A product of combustion from transportation and stationary sources resulting from nitric oxide combining with oxygen in the atmosphere; a contributor to the formation of ozone, which is a major component of photochemical smog. This includes NO and NO_2.
non-attainment area	An area that does not meet one or more of the National Ambient Air Quality Standards (NAAQS) for the criteria pollutants designated in the Clean Air Act.
ozone (O_3)	Ozone is a natural form of oxygen that provides a protective layer shielding the earth from ultraviolet radiation. It also is a chemical oxidant and major component of photochemical smog. Ozone can seriously impair the respiratory system and is one of the most widespread of all the criteria pollutants regulated under the Clean Air Act. Ozone in the troposphere is produced through complex chemical reactions of nitrogen oxides, which are among the primary pollutants emitted by combustion sources; hydrocarbons released into the atmosphere through the combustion, handling and processing of petroleum products; and sunlight.
particulate	Sources of particulate matter include sea salt, pollen, smoke from forest fires and wood stoves, road dust, industrial emissions, and agricultural dust. Fine particulate matter is also formed in the atmosphere through complex chemical reactions involving gaseous pollutants. Some particles may be small enough to be drawn deep into the respiratory system where they can contribute to infection and reduced resistance to disease.

Term	Meaning
parts per million (ppm)	A measure of concentration based on weight or volume.
$PM_{2.5}$	Particulate matter less than 2.5 micrometers in diameter.
PM_{10}	A standard for measuring the amount of solid or liquid matter suspended in the atmosphere, specifically, particulate matter less than 10 micrometers in diameter. Smaller PM_{10} particles can penetrate to the deeper portions of the lung, affecting sensitive population groups such as individuals with respiratory ailments and children.
smog	Dust, smoke, and/or chemical fumes that pollute the air and make hazy, unhealthy conditions. Contributing factors include vehicle exhausts and particulates that are trapped close to the ground, obscuring visibility and worsening a number of respiratory problems. See also: nitrogen oxides, ozone, and volatile organic compounds.
troposphere	The portion of the atmosphere closest to the Earth's surface.
volatile organic compound (VOC)	An organic (carbon-based) compound that readily forms vapors at normal temperature and pressure. The term is generally applied to organic solvents, certain paint additives, aerosol spray can propellants, fuels (such as gasoline and kerosene), petroleum distillates, dry cleaning products, and many other industrial and consumer products, ranging from office supplies to building materials.

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SUMMARY

The I-405, Bellevue to Lynnwood Improvement Project (Bellevue to Lynnwood Improvement Project) is part of the overall I-405 master plan designed to improve safety, reduce congestion, and add travel capacity. The project extends approximately 17 miles along I-405 from NE 6th Street in Bellevue at the southern limit, to I-5 in Lynnwood at the northern limit. The I-405 Team identified three signalized intersections in the study area that will be affected by the Bellevue to Lynnwood Improvement Project. Existing (year 2005), No Build (years 2014 and 2040) and Build (design years 2014 and 2040) one-hour and eight-hour average carbon monoxide (CO) concentrations were calculated at these three intersections using MOBILE 6.2 emission factors and Cal3QHC Version 2 software. The year 2014 was evaluated as the year of opening. The three intersections analyzed for CO effects are: 1) NE 128th Street and 116th Avenue NE, 2) NE 128th Street and the I-405 off/on ramps, and 3) NE 128th Street and Totem Lake Boulevard. The No Build and Build Alternatives 1 and 2 results were compared to National Ambient Air Quality Standards (NAAQS) in order to determine the project's effects on CO concentrations. No exceedances of either the one-hour or eight-hour NAAQS were predicted for CO for existing conditions (2005), the year of opening, or the No Build and Build Alternatives.

The conformity process (see the following *Background* section for an explanation) applies to the Bellevue to Lynnwood Improvement Project because it is located in a Clean Air Act (CAA) CO maintenance area. Projects may only be constructed if they demonstrate conformance to the revised State Implementation Plans (SIP). The Bellevue to Lynnwood Improvement Project conforms to these plans because it is not expected to cause air pollutant concentrations that exceed air quality standards.

In accordance with Federal Highway Administration (FHWA) guidelines, the Easy Mobile Inventory Tool (EMIT) was used to calculate annual Mobile Source Air Toxic (MSAT) pollutant burdens (in tons per year) for five of the priority pollutants (see the following *Background* section for discussion). The sixth MSAT, naphthalene, was evaluated using MOBILE6.2. To assess potential project effects, MSAT priority pollutant levels were compared to existing conditions and the No Build and Build Alternatives. Future MSAT levels are predicted to be lower than existing levels under the No Build and Build Alternatives, even with increased vehicle miles traveled (VMT). Conformity requirements for MSAT emissions do not yet exist, because the Environmental Protection Agency (EPA) has not established ambient standards for MSAT levels.

Air pollutant emissions that result from construction activities were qualitatively assessed for this project. During construction, avoidance and minimization measures will help reduce pollutant emissions. These methods could include spraying exposed soil with water, covering truck loads and materials as needed, washing truck wheels before leaving the site, removing particulate matter from roads, routing and scheduling

construction trucks to reduce delays, ensuring well-maintained equipment, and implementing other temporary mitigation measures as needed and considered appropriate.

PROJECT DESCRIPTION

What is the intent of the Bellevue to Lynnwood project and what are the improvements?

The Bellevue to Lynnwood Improvement Project is intended to improve safety and reduce congestion along I-405 between NE 6th Street in Bellevue and I-5 in Lynnwood. To accomplish this, WSDOT proposes the following improvements:

- Northbound lane from NE 124th Street to SR 522;
- Braided ramps between the I-405 northbound on-ramp from NE 160th Street and the northbound I-405 off-ramp to SR 522;
- Southbound transit shoulders between SR 522 and NE 160th Street and between SR 527 and NE 195th Street;
- New northbound and southbound structures over NE 132nd Street and a new northbound structure over the railroad for the I-405 northbound off-ramp to NE 124th Street;
- Small amounts of additional widening, between four and eight feet, at several locations for buffers, wider shoulders, tolling equipment, enforcement areas and maintenance pull-outs;
- Minor upgrades to pedestrian facilities in some areas.

Exhibit 1 shows the Bellevue to Lynnwood project vicinity. Exhibit 2, sheets 1 through 17, shows more detail of the project improvements in the 17-mile long corridor.

Are there related projects?

The Bellevue to Lynnwood Improvement Project is designed to compliment other projects along I-405 including:

Exhibit 1: Project vicinity

- Kirkland Nickel Stage 1 Project, which added one lane in each direction between NE 85th Street and NE 124th Street and opened to traffic in November 2007;
- NE 195th Street to SR 527 Auxiliary Lane Project, which added one northbound lane between NE 195th Street and SR 527 and opened to traffic in June 2010; and
- NE 8th Street to SR 520 Braided Ramps Project, which creates new multi-level "braided" ramps to separate vehicles entering and exiting northbound I-405 between NE 8th Street and SR 520 and is anticipated to be open to traffic during the summer of 2012.

The Kirkland Nickel Stage 2 Project will reconfigure the NE 116th Street interchange, and northbound and southbound lanes between NE 70th Street and NE 85th Street, and a southbound lane between SR 522 and NE 124th Street, and between NE 70th Street and SR 520. The Kirkland Nickel Stage 2 project has been environmentally cleared and permitted, and, along with the other projects mentioned in this section, is considered part of the baseline conditions for most analyses. The Bellevue to Lynnwood Improvement Project will be constructed at the same time.

What will the completed project provide?

The Bellevue to Lynnwood Improvement Project fills in the remaining gaps and allows WSDOT to provide an improved system on I-405 between NE 6th Street and I-5. WSDOT has designed this project to maximize the use of existing pavement and minimize the need for new pavement. In some areas, small amounts of widening of less than a lane width, together with narrower shoulders and lanes, will allow an additional lane. In other areas, narrowing the shoulders and lanes will allow an additional lane without any pavement widening.

Exhibit 3 shows the configuration in each of the project segments when this project and the related projects described above are complete.

How will this portion of I-405 be operated after the project is completed?

In this environmental document, WSDOT and FHWA are considering two operational alternatives: 1) Express Toll and General Purpose Lanes (ETL); and 2) High Occupancy Vehicle and General Purpose Lanes (HOV). Under both scenarios, the project footprint is the same. The occupancy requirement for HOVs in this portion of the I-405 corridor is the same. It is assumed the occupancy requirement, to maintain HOV performance standards under WSDOT's HOV policy, will be three or more people (HOV 3+). The difference is in how the roadway lanes would be managed.

Alternative 1: Express Toll and General Purpose Lanes (ETL)

This operational alternative will provide two express toll lanes in each direction between NE 6th Street in Bellevue and SR 522 in Bothell, and one express toll lane in each

direction between SR 522 and I-5 in Lynnwood. The express toll lane system will be open toll free to all HOV traffic with three or more occupants and all transit operations. The express toll lane system will also be open to single occupant vehicles (SOVs) and HOVs with two occupants through tolling.

The southern end of the express toll lane system will be at the existing direct access ramps at NE 6th Street in Bellevue where one of the two northbound express toll lanes will begin and one of the two southbound express toll lanes will end. South of the NE 6th Street, the other express toll lanes will connect with the existing single northbound and southbound HOV lanes. The northern end of the system would be much like it is today with I-405 becoming SR 525. Access points will be at various locations along the mainline as shown in Exhibit 4. The express toll lanes will be separated from the general purpose (GP) lanes by a two- to four-foot wide buffer. At an access point, the buffer will open and a section of transition lane may be provided between the express toll and general purpose lanes to ease ingress and egress to the system.

Alternative 2: High Occupancy Vehicle and General Purpose Lanes (HOV)

This operational alternative will allow HOV users with three or more occupants and transit vehicles to use the single HOV lane, similar to today's operation. Access between the HOV lane and GP lanes will be allowed throughout the project, except northbound between NE 6th Street and SR 520 where access is not allowed under today's operation. The new northbound lane between NE 124th Street and SR 522 will be operated as a GP lane.

What will conditions be like if the project is not built?

No Build Alternative

A No Build Alternative has been evaluated as the basis for comparing effects associated with the Build Alternatives. No new improvements would be made beyond those constructed as a part of the Kirkland Nickel Project Stage 2 and the NE 8th Street to SR 520 Braided Ramps Project.

The No Build Alternative does not include additional stormwater treatment or any roadway improvements that would increase roadway capacity, reduce congestion, or improve safety on I-405. Only routine activities such as road maintenance, repair, and minor safety improvements would occur. As with the two build alternatives, we assume that the occupancy requirement for HOVs in this portion of the I-405 corridor will be three or more people (HOV 3+).

Exhibit 2: Project improvements – sheet 1 of 17

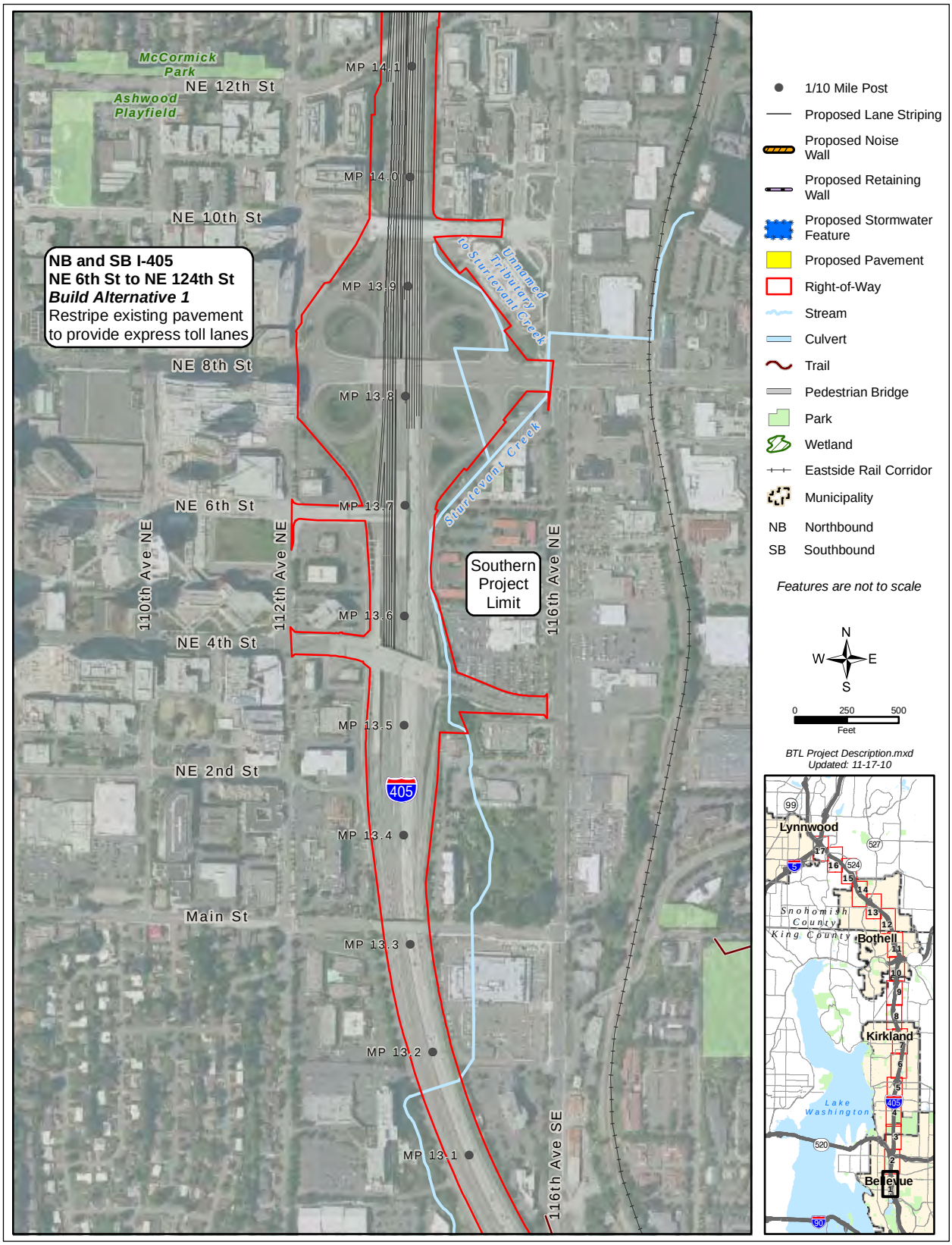


Exhibit 2: Project improvements – sheet 2 of 17

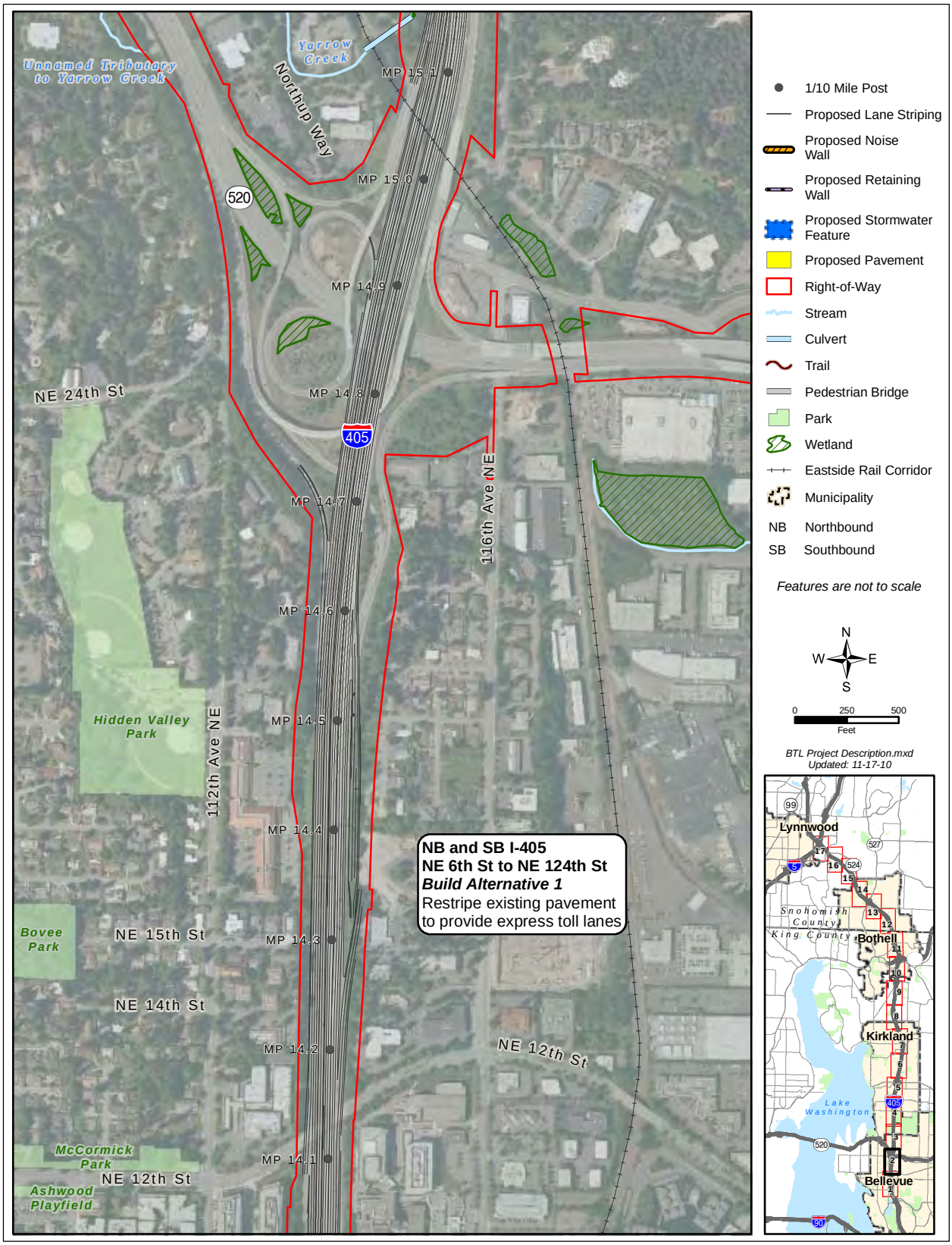
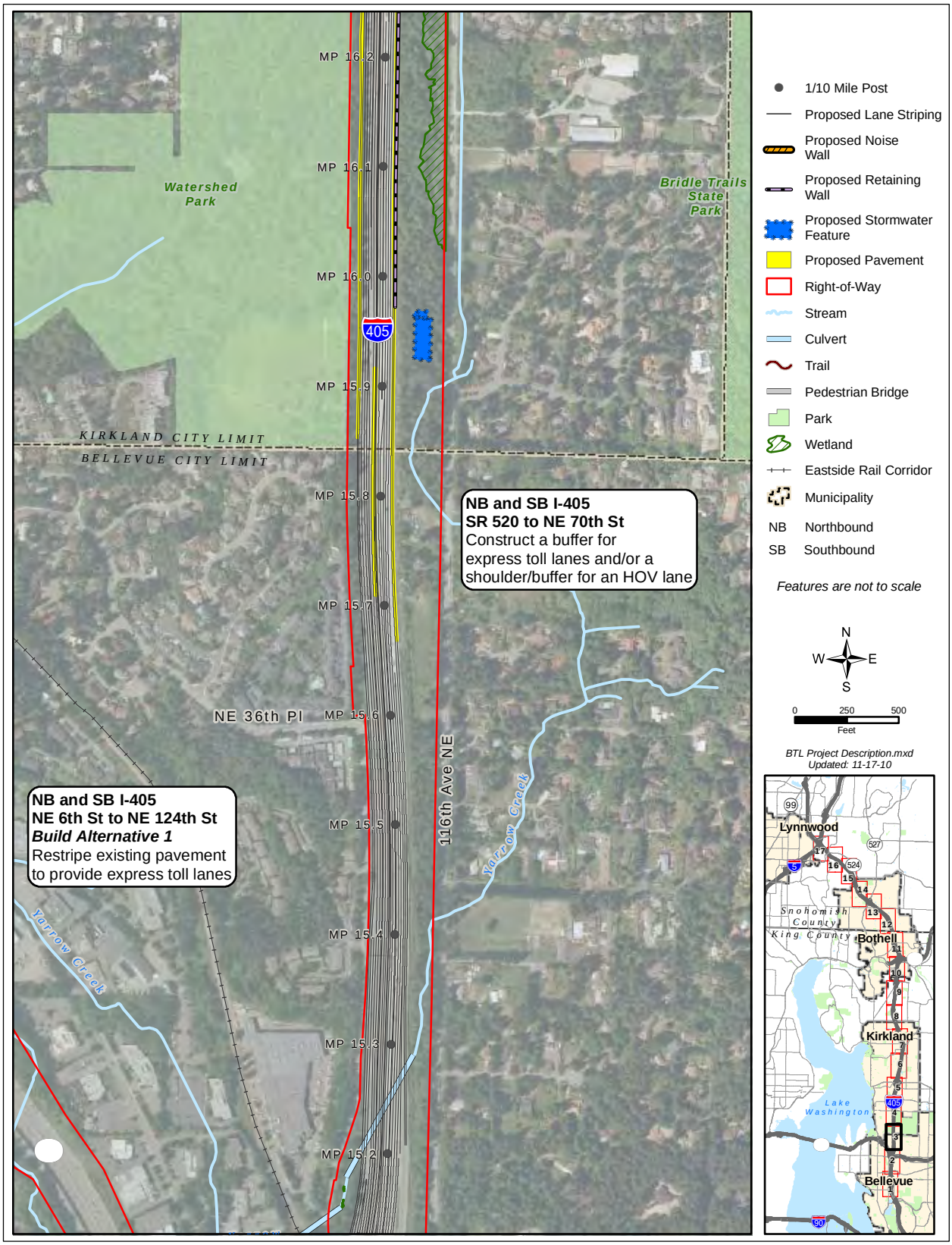


Exhibit 2: Project improvements – sheet 3 of 17



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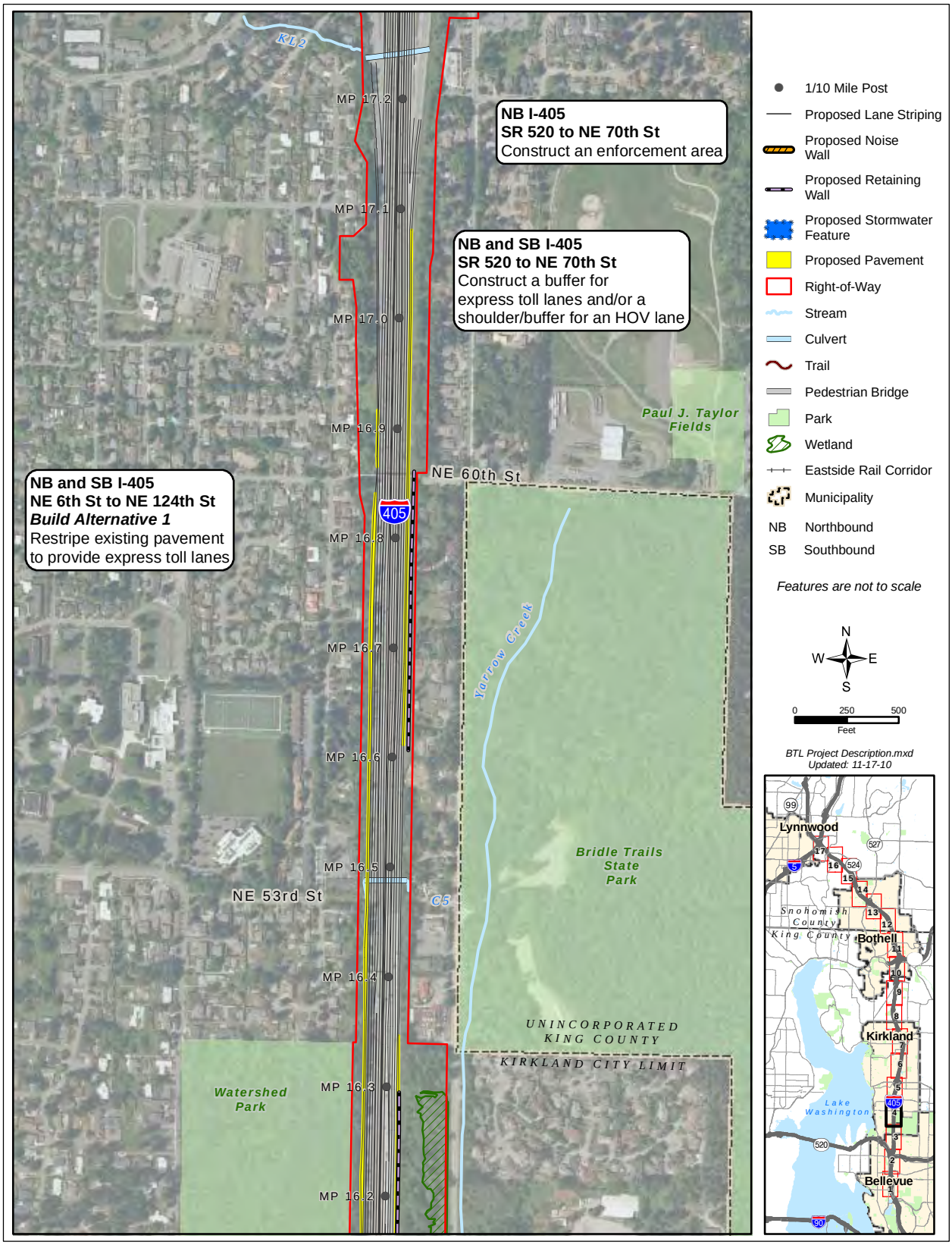

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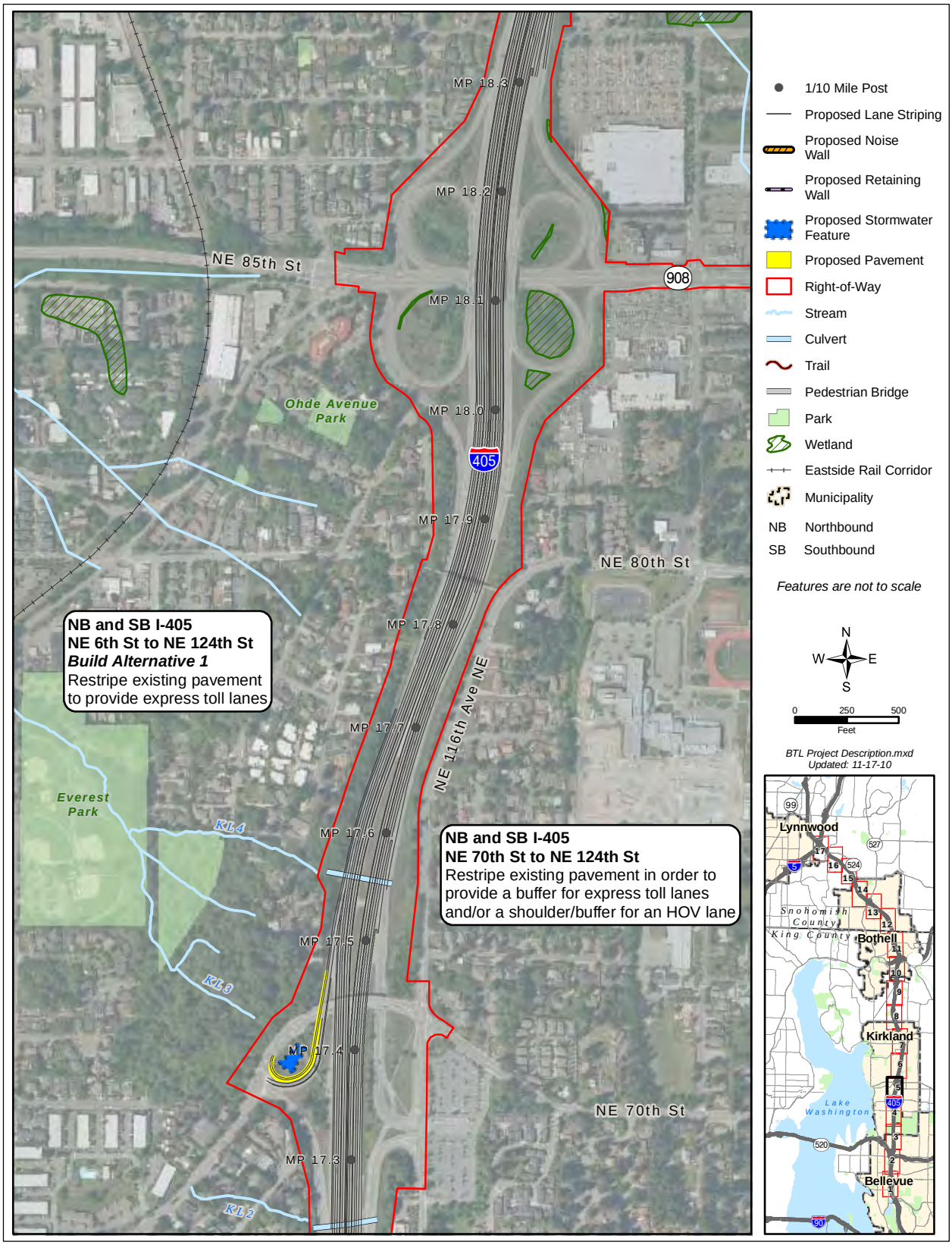

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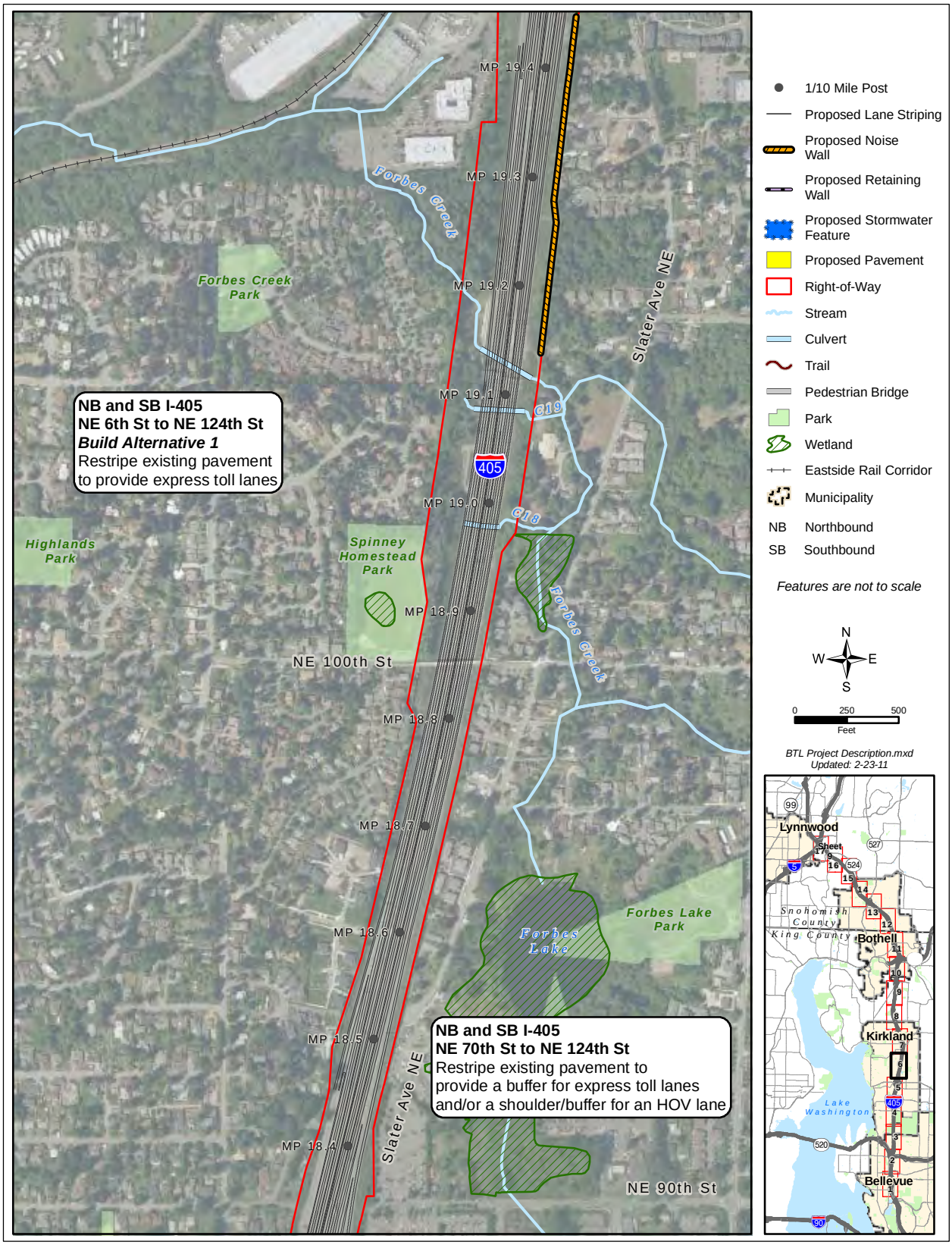

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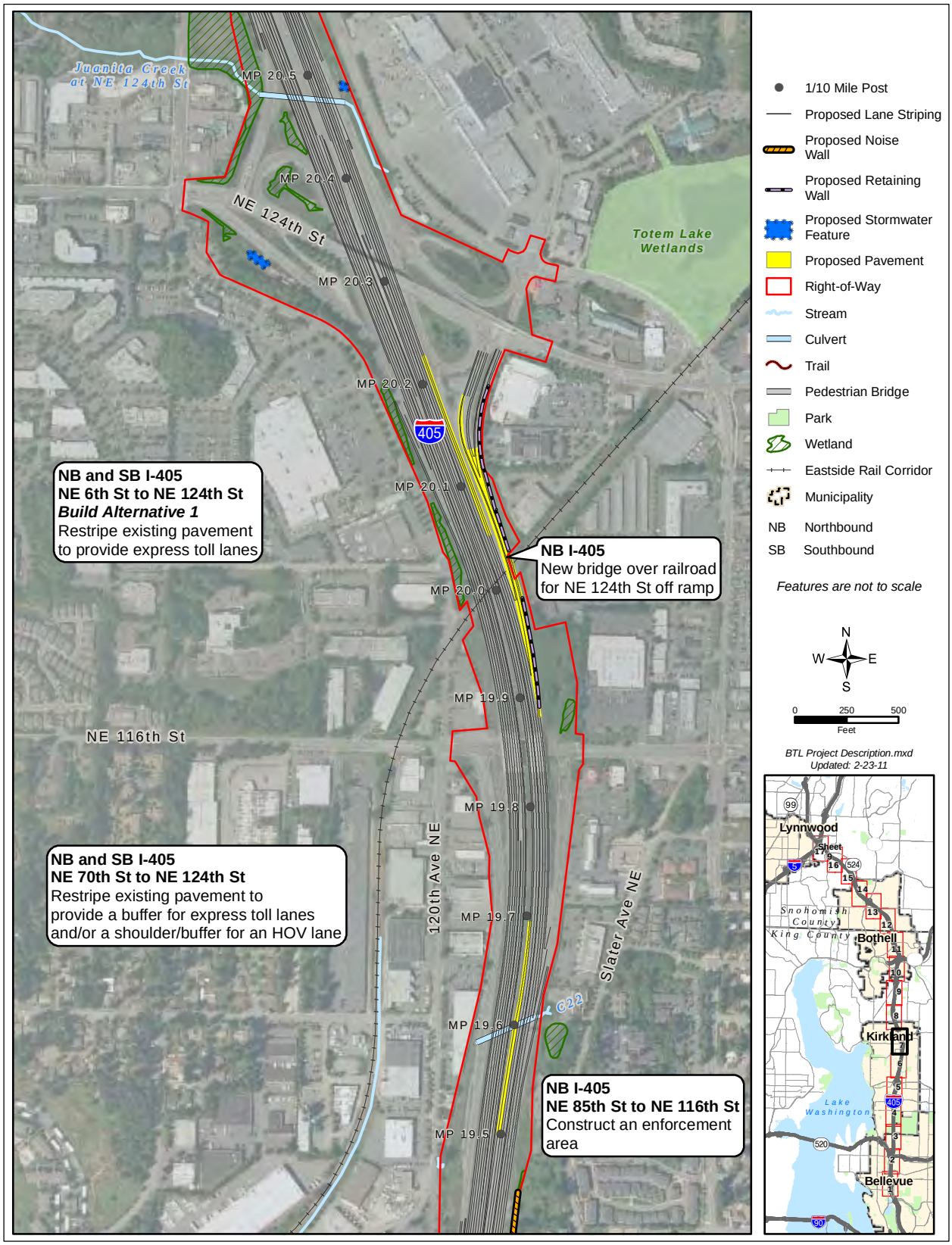

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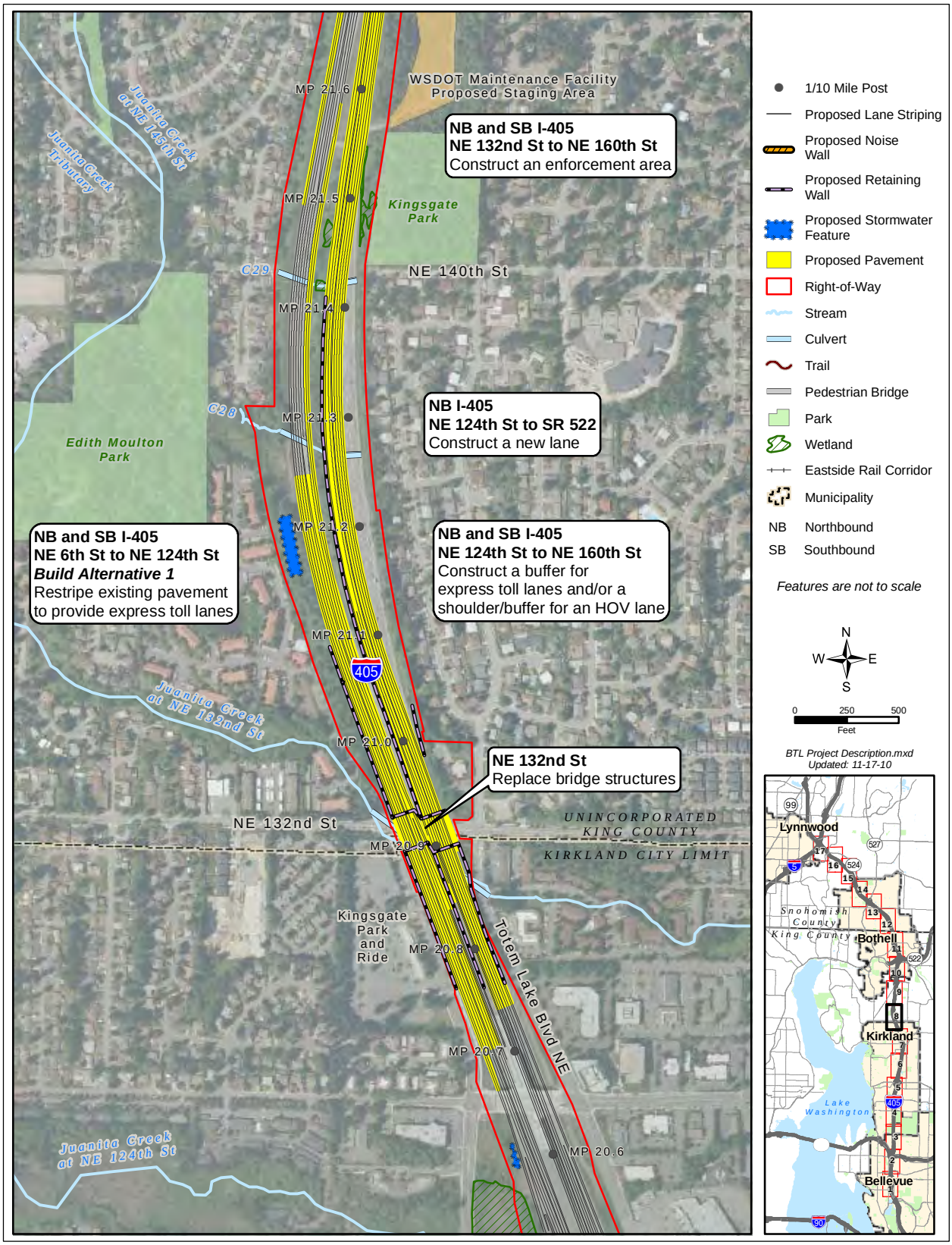

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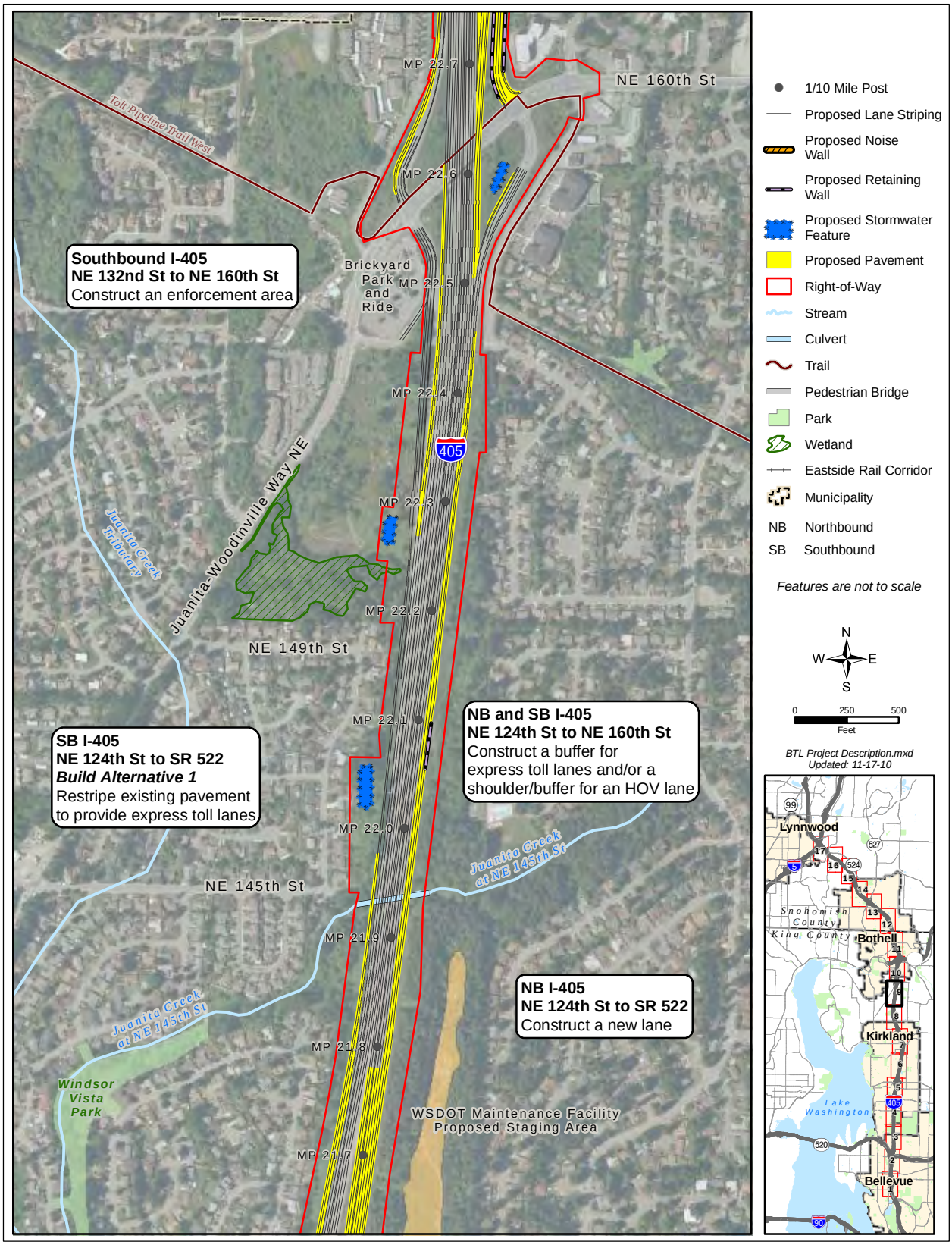

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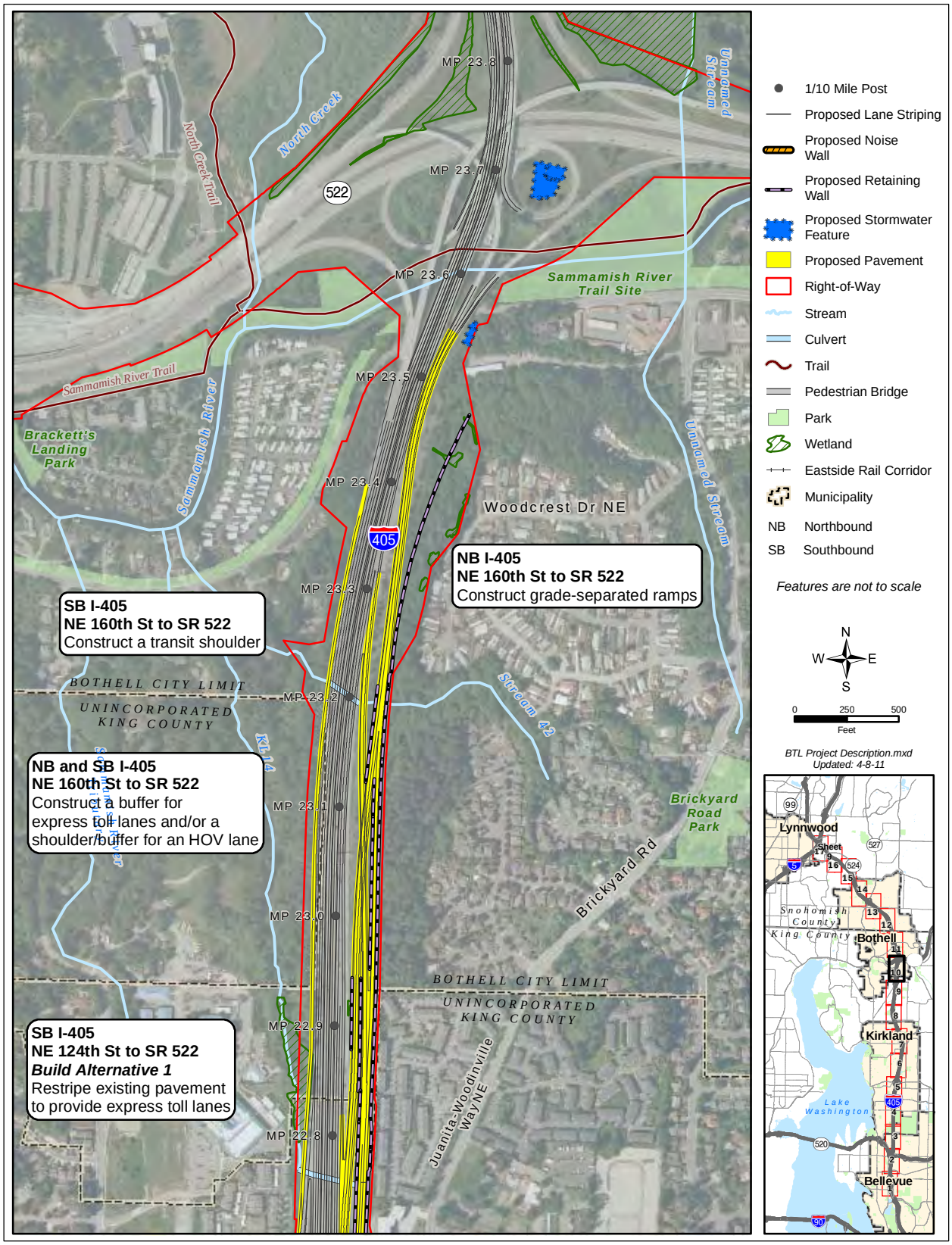

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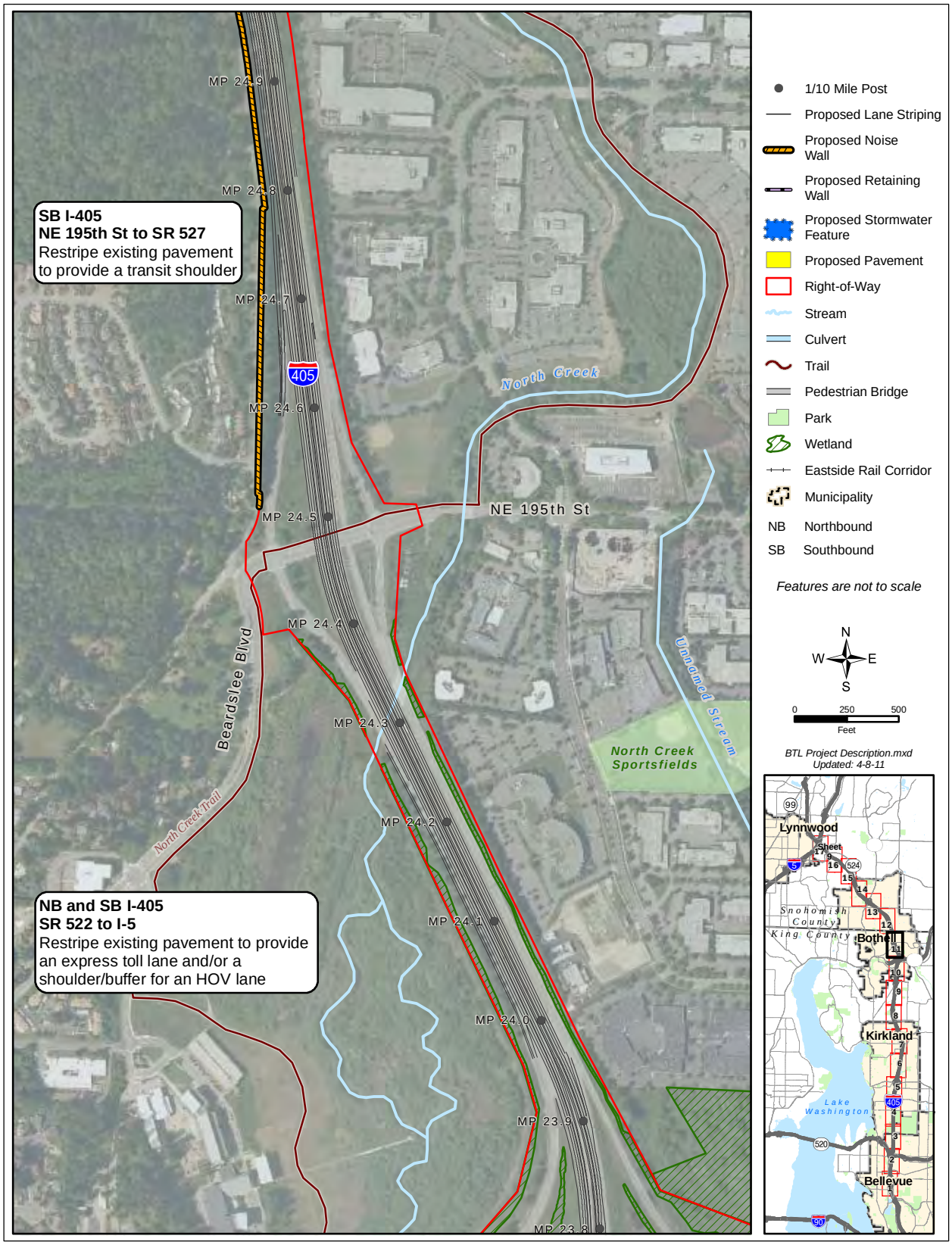

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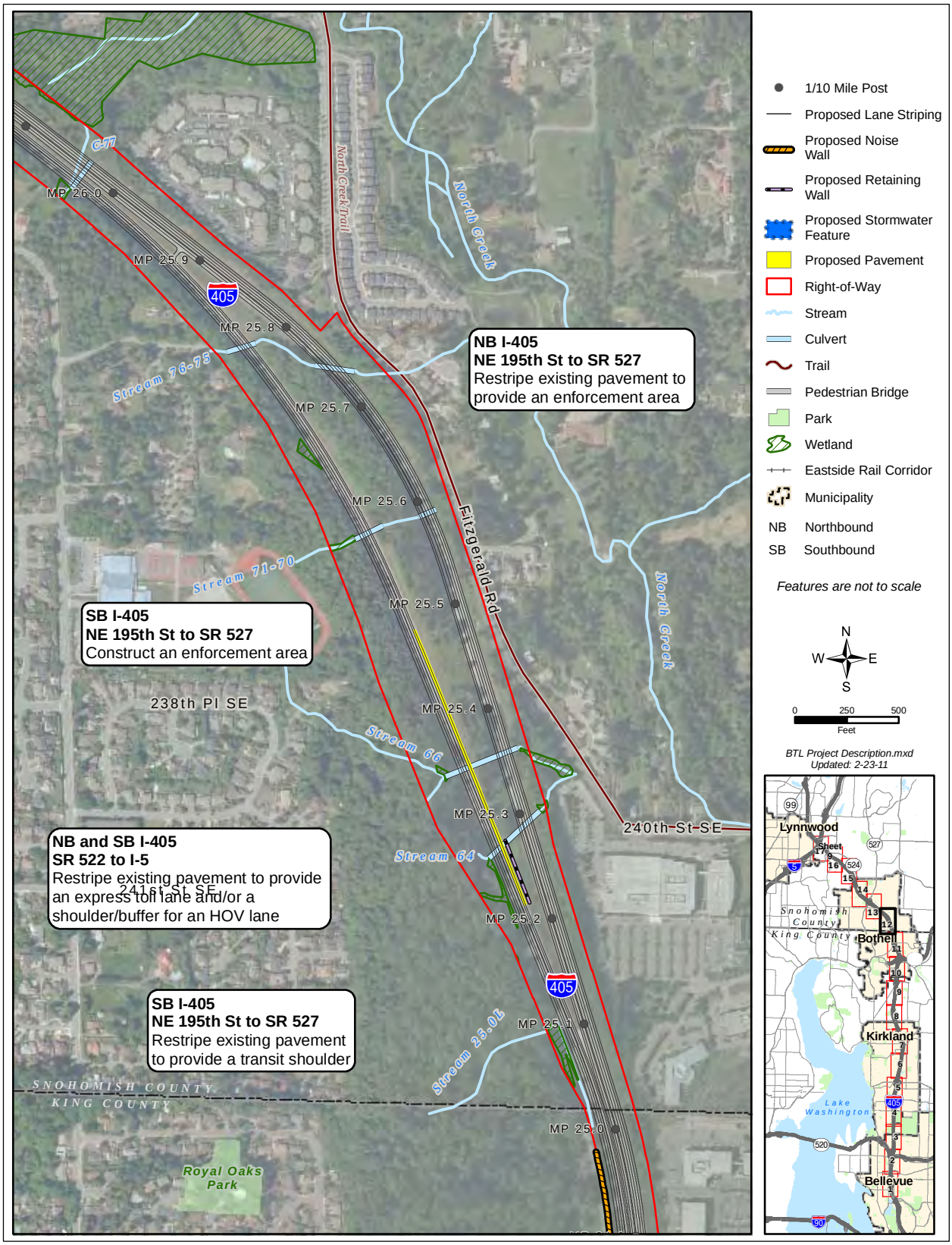

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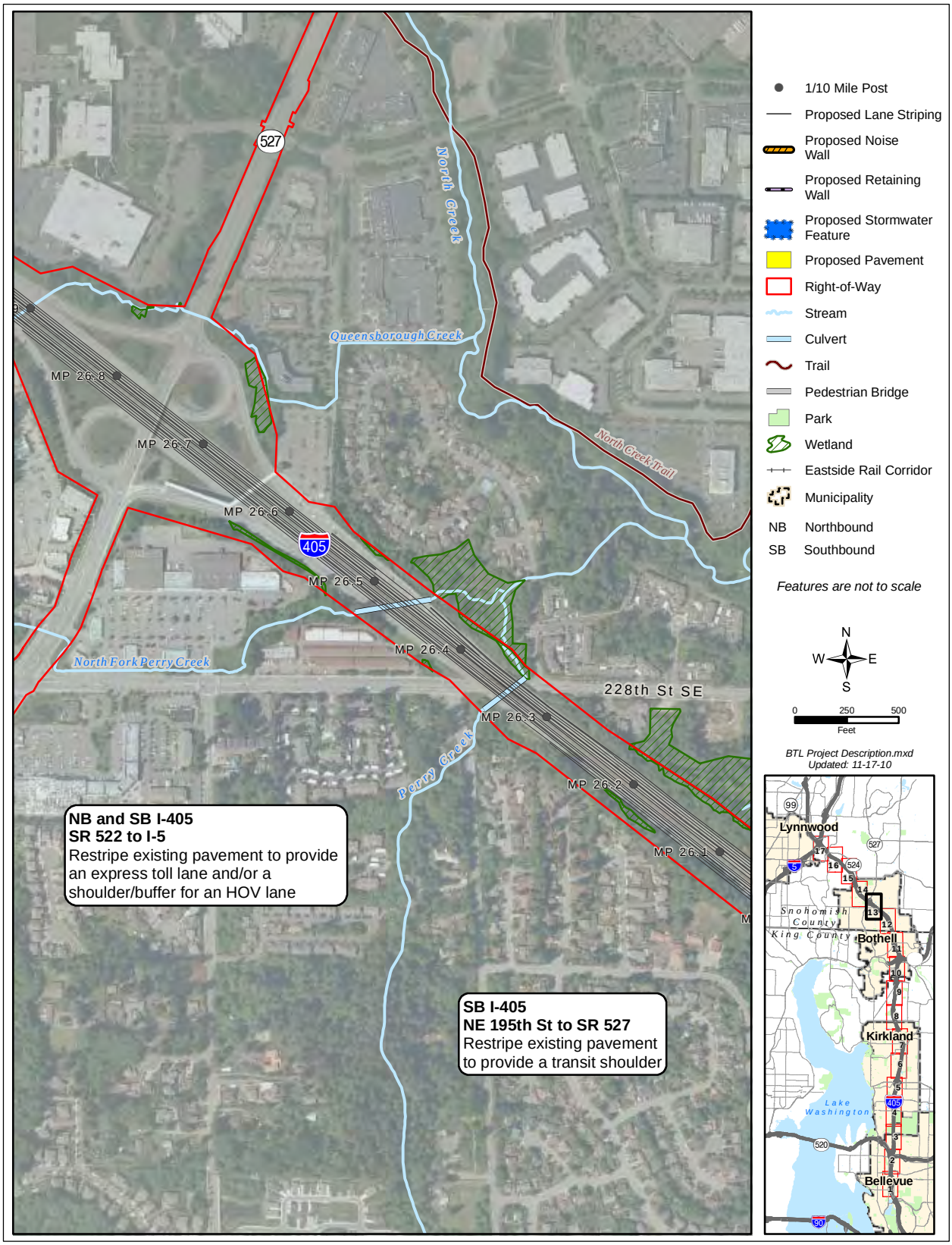

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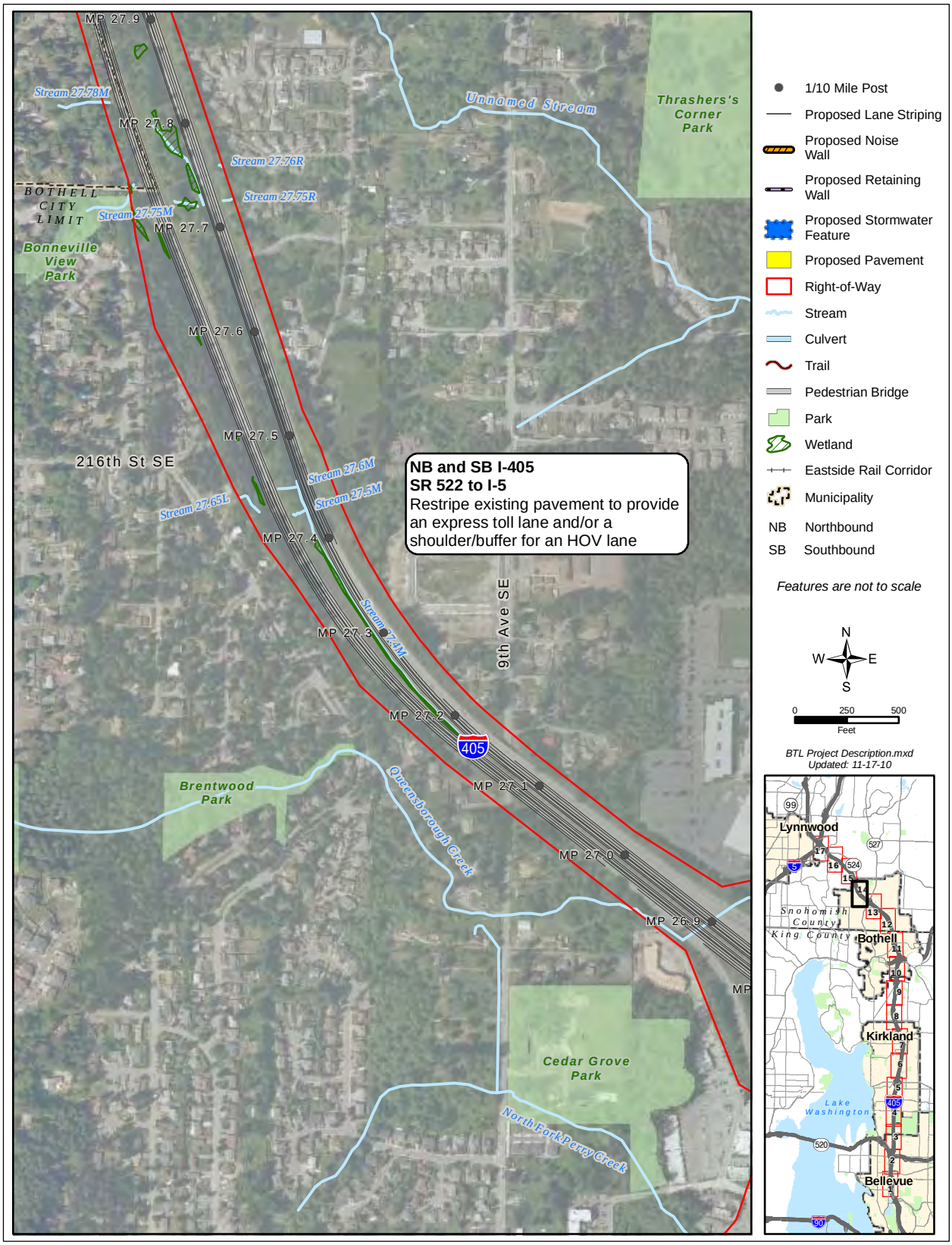
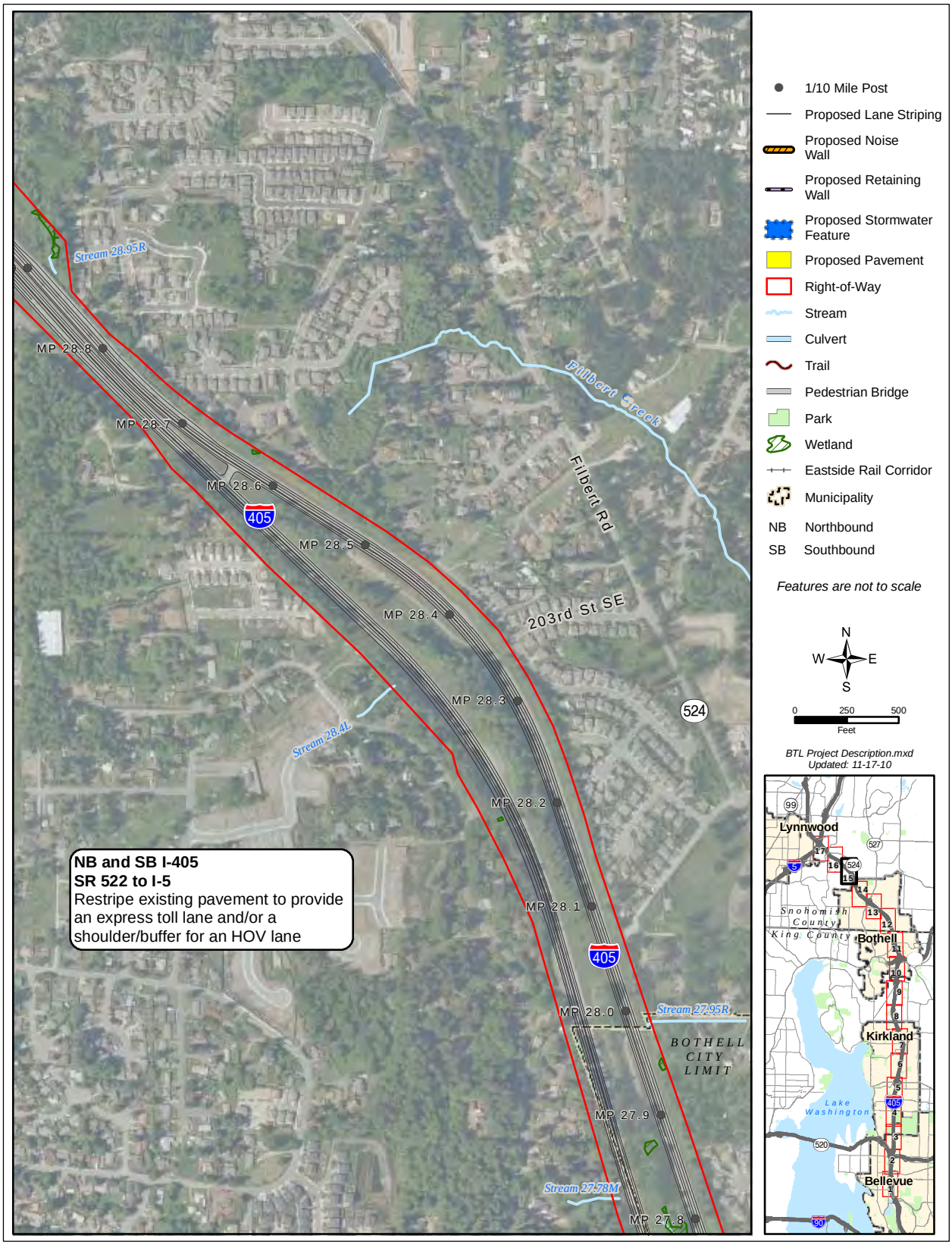


Exhibit 2: Project improvements – sheet 15 of 17



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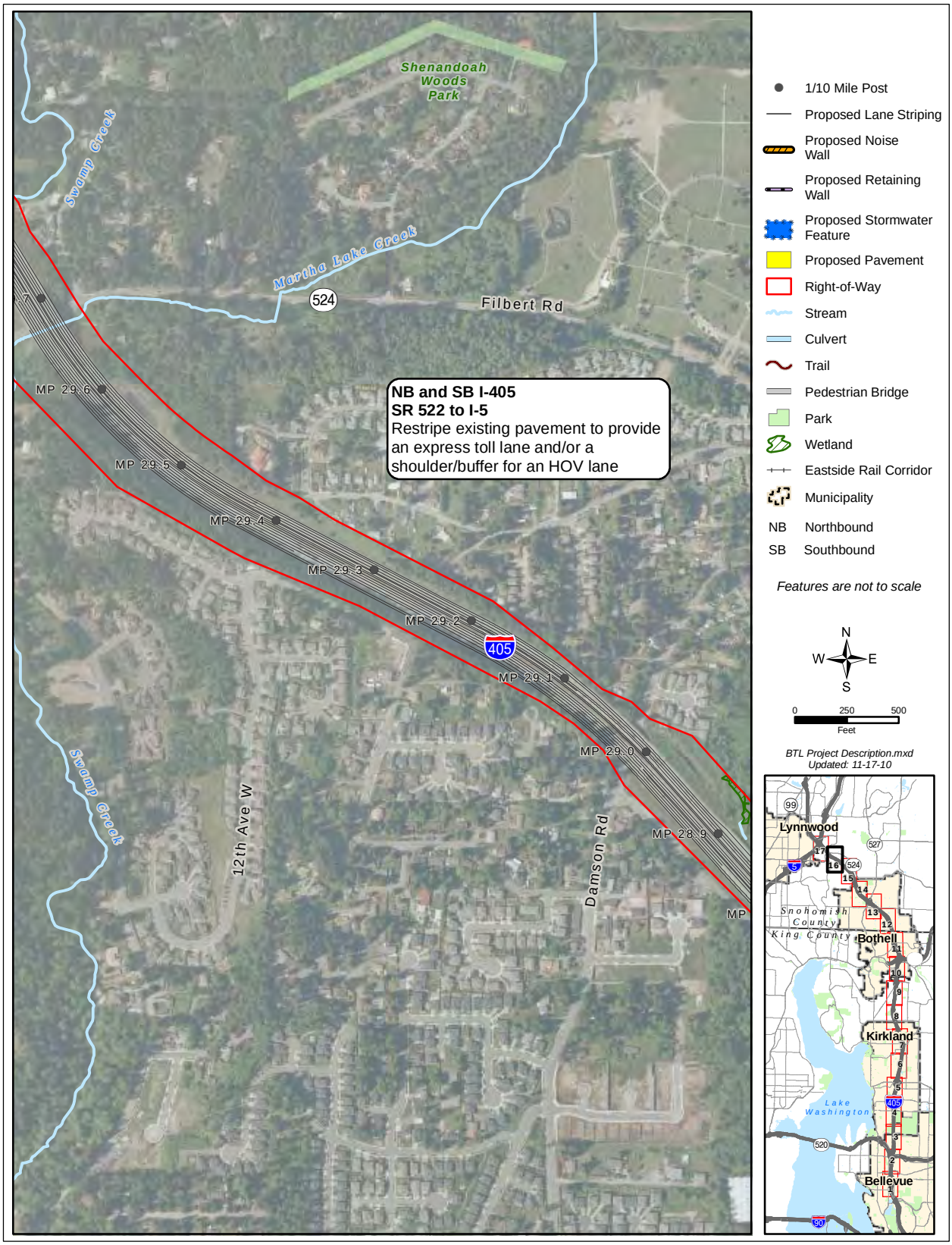

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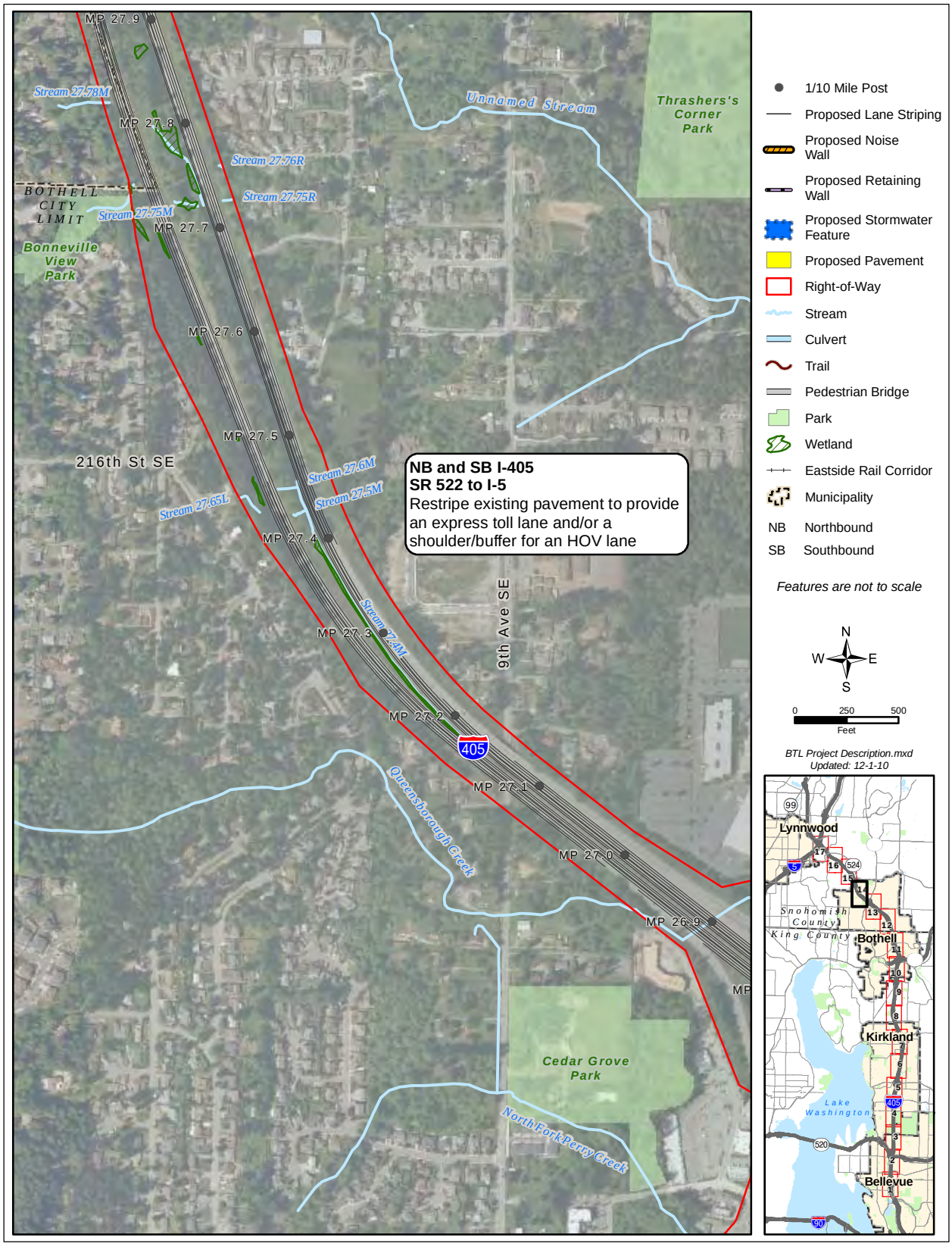

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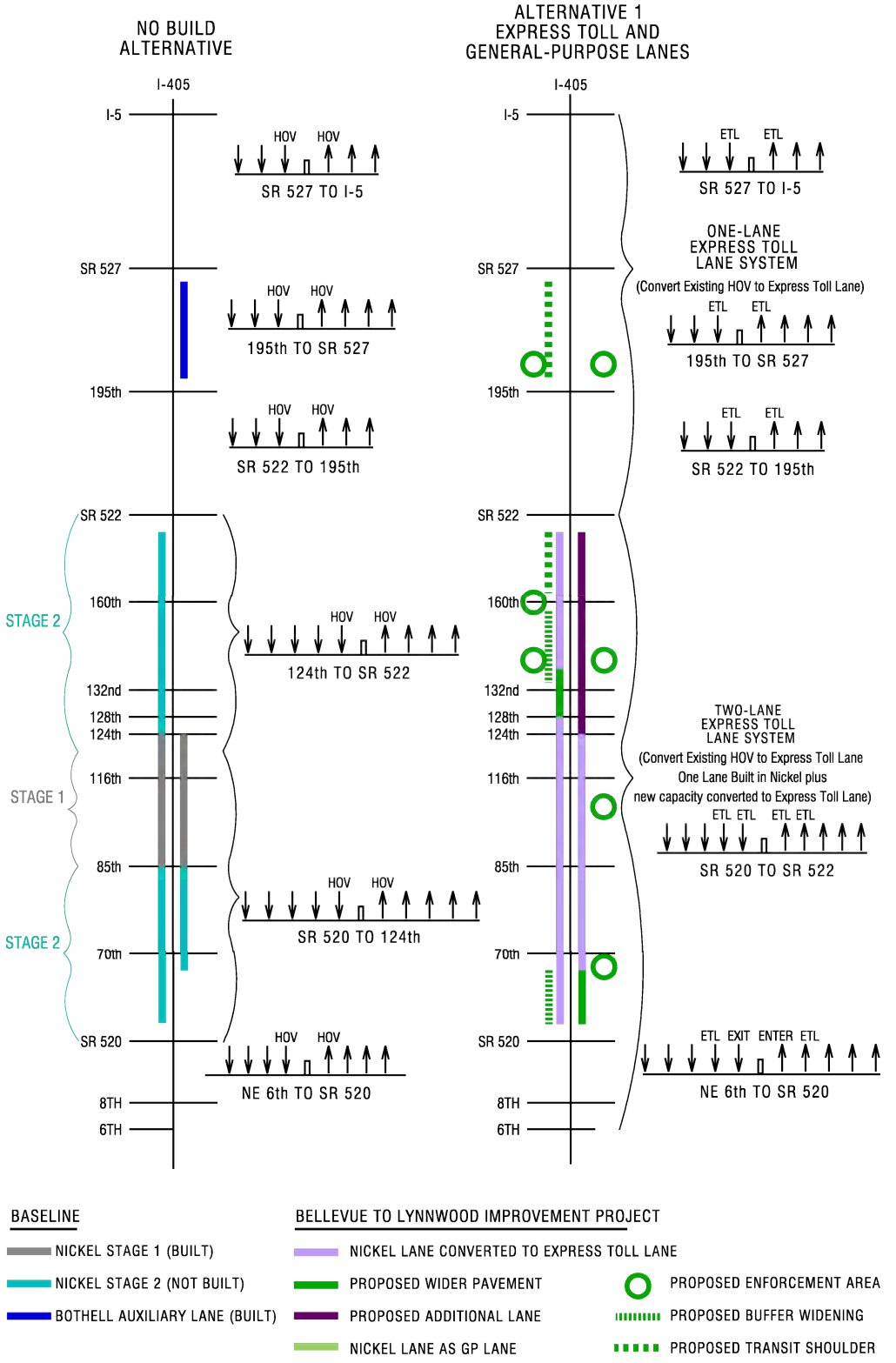

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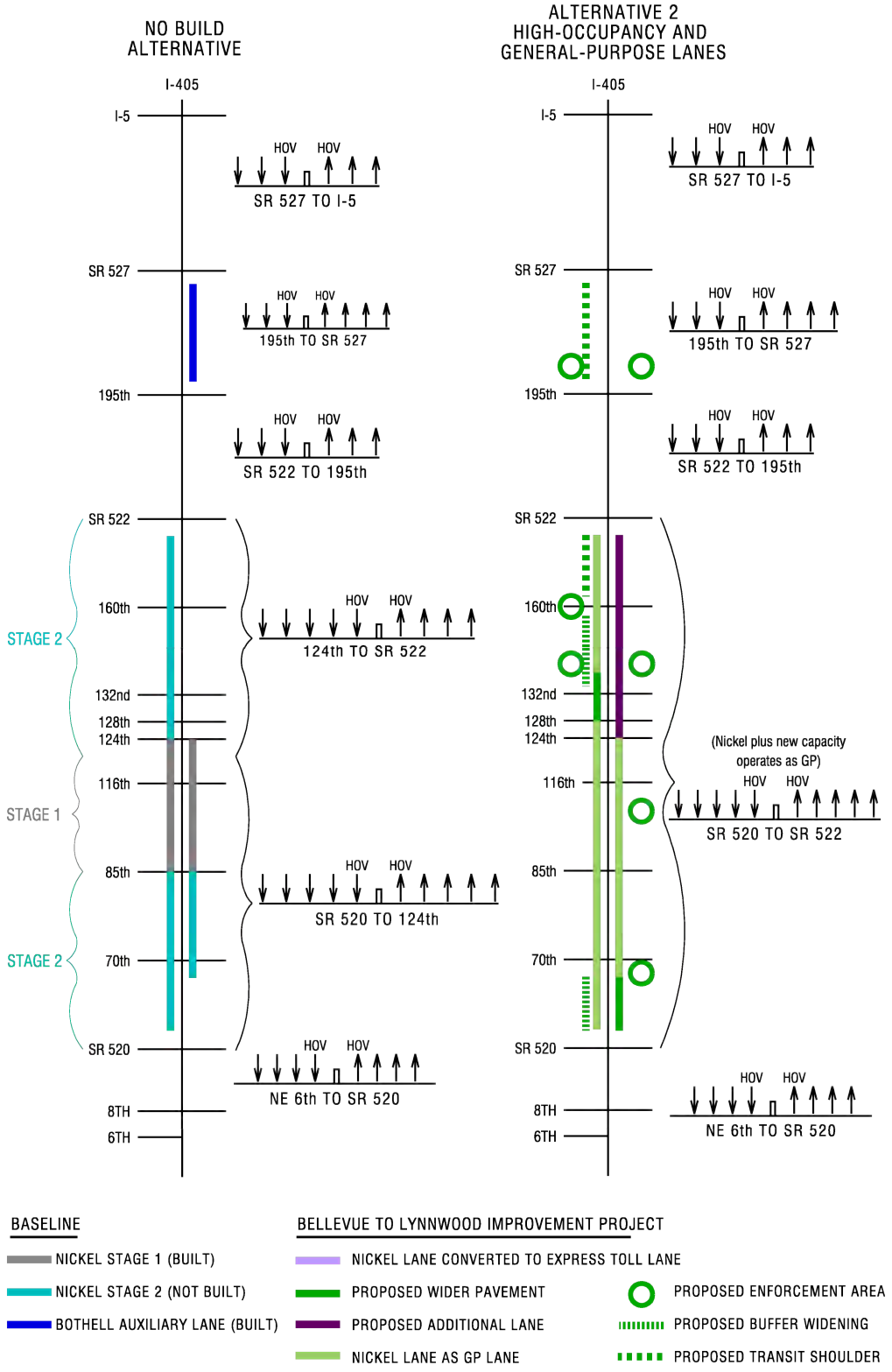
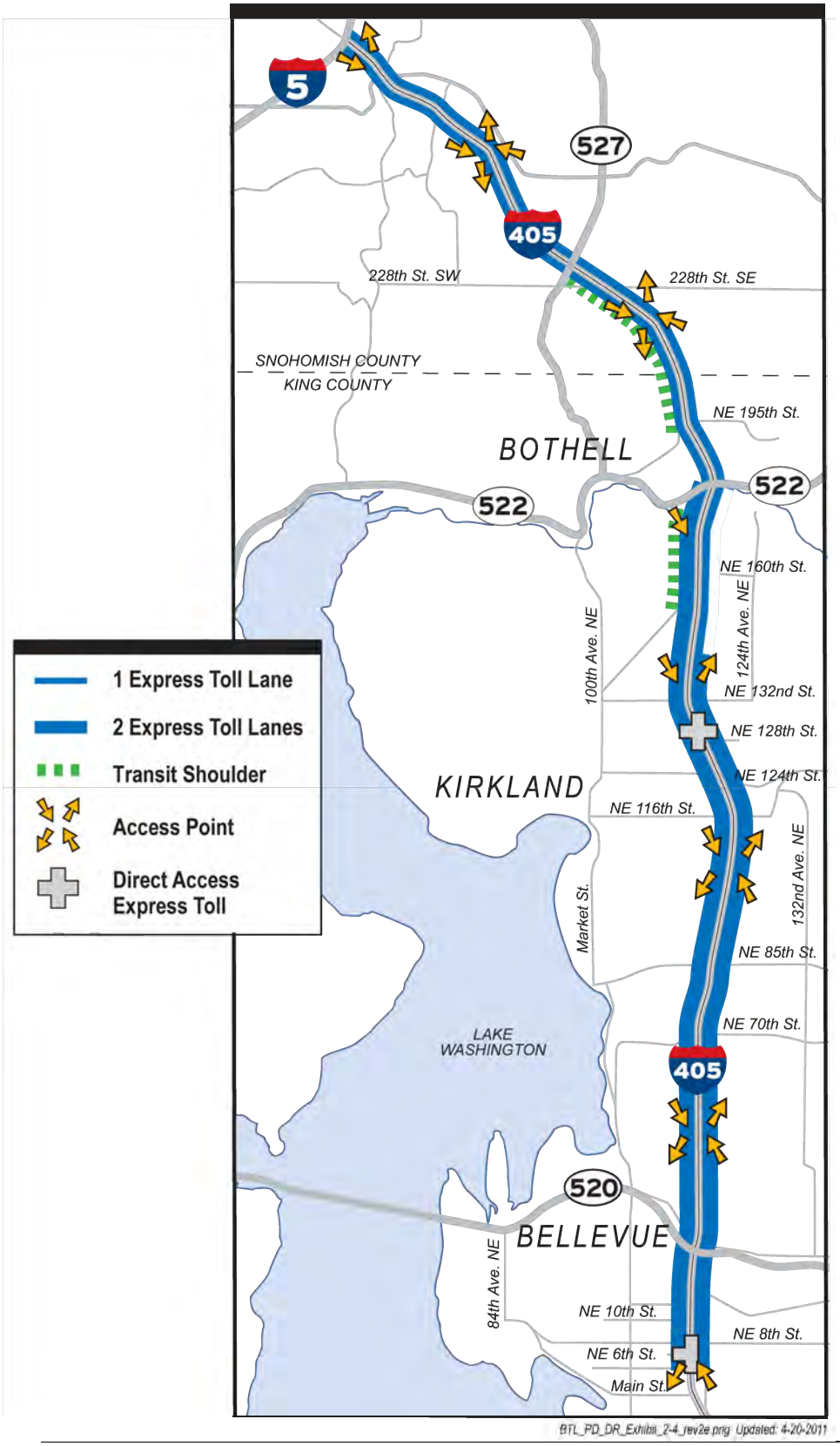


Exhibit 4: Express Toll Lanes access locations



BACKGROUND

Air Quality Standards

The EPA identified several air pollutants as being of concern nationwide. These pollutants, known as "criteria pollutants," are carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide (SO_2), lead, and nitrogen dioxide (NO_2). The sources of these pollutants, their effects on human health and the nation's welfare, and their final deposition in the atmosphere vary considerably. Under the Clean Air Act, EPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum allowable concentrations for these criteria pollutants. The standards applicable to transportation projects are summarized in Exhibit 5.

Exhibit 5: Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State and PSCAA Regional Standards
CARBON MONOXIDE (CO)		
One-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm
Eight-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm
PM_{10}		
Annual Arithmetic Mean	NS	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	150 µg/m^3	150 µg/m^3
$PM_{2.5}$		
Annual Arithmetic Mean	15 µg/m^3	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	35 µg/m^3	NS
TOTAL SUSPENDED PARTICULATES (TSP)		
Annual Arithmetic Mean	NS	60 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	NS	150 µg/m^3
OZONE		
Eight-Hour Average (the 3-year average of the fourth-highest daily maximum 8-hour average ozone must not exceed)	0.08 ppm	NS

Notes: PSCAA = Puget Sound Clean Air Agency
ppm = parts per million
µg/m^3 = micrograms per cubic meter
NS = No Standard
Sources: PSCAA Regulation 1 (1994), 40 CFR Part 50 (1997)
WAC chapters: 173-470, 173-474, 173-175 (1987)

The current $PM_{2.5}$ standards were published in the Federal Register on July 30, 2004 and became effective on that date. EPA adopted new $PM_{2.5}$ standards on October 17, 2006 and these went into effect on December 17, 2006. They consist of a stricter 24-hour standard for $PM_{2.5}$ (35 $\mu g/m^3$ versus the previous standard of 65 $\mu g/m^3$), but no change was made to the annual $PM_{2.5}$ standard. EPA has not yet developed a methodology for estimating annual $PM_{2.5}$ impacts, which should be evaluated on a neighborhood (not a discrete receptor) basis. For PM_{10}, the 24-hour standard remained the same, and the annual standard was dropped. EPA will redesignate nonattainment areas for $PM_{2.5}$ based on the new 24-hour $PM_{2.5}$ standard. Compliance with the recently-adopted 24-hour $PM_{2.5}$ standard is not yet required.

Regulatory Setting

WSDOT roadway projects that receive federal funds or approval must demonstrate compliance with EPA's Transportation Conformity Rule. If not, a violation of the NAAQs may threaten federal funding of transportation projects. Conformity is demonstrated by showing that a project would not cause or contribute to any new violation of any NAAQS, increase the frequency or severity of any existing NAAQS violations, or delay timely attainment of the NAAQS.

The conformity process only applies to Clean Air Act (CAA) nonattainment and maintenance areas, which are areas that the EPA has designated due to violation of a NAAQS for criteria pollutants. *Nonattainment areas* are geographical regions where air pollutant concentrations exceed the NAAQS. *Maintenance areas* are regions that were previously nonattainment areas but have attained compliance with the NAAQS. The Bellevue to Lynnwood Improvement Project lies within the Puget Sound CO air quality maintenance area.

The Washington State Department of Ecology (Ecology) and the Puget Sound Clean Air Agency (PSCAA) regulate air quality in the study area. Air quality emissions in the Puget Sound Region are currently being managed under the provisions of Air Quality Maintenance Plans (AQMP) for CO. PSCAA and Ecology developed the current plans and the EPA approved the plans in 1996.

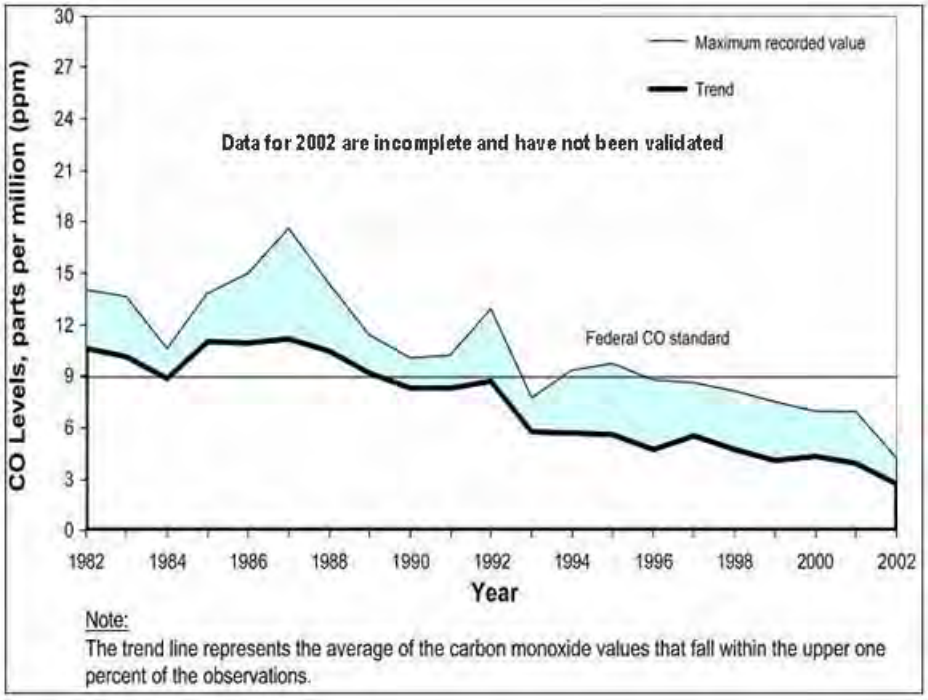
Transportation projects constructed on facilities that serve regional transportation needs (e.g., access to and from areas outside the region, or major activity centers in the region) are considered to be *regionally significant*. Any regionally significant transportation project in the Puget Sound Air Quality Maintenance areas must conform to the AQMPs. *Conformity* is demonstrated by showing that the project will not cause or contribute to any new violation of any NAAQS, will not increase the frequency or severity of any existing NAAQS violations, and will not delay timely attainment of the NAAQS around any intersection for the proposed year of opening and design year. Revised State Implementation Plans (SIPs) must comply with the project-level conformity criteria

described in the EPA Conformity Rule and with Washington Administrative Code (WAC) Chapter 173-420.

Regional air pollutant trends have generally followed national patterns over the last 20 years. Although the average weekday VMT in the central Puget Sound region have increased from 30 million miles in 1981 to 65 million in 1999 (PSRC, 2000), the pollutants associated with transportation sources have decreased. This is due to more stringent federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles.

Maximum CO concentrations measured regionally have decreased considerably over the past 20 years (see Exhibit 6).

Exhibit 6: Carbon monoxide (CO) trends in the Puget Sound Region



*Source: Ecology, 2003**
** Ecology has not updated this Exhibit since 2003*

Pollutants of Concern

Carbon Monoxide

CO is a colorless gas that interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections,

along heavily used roadways that carry slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions. Consequently, CO concentrations are predicted on a localized, or microscale, basis.

Particulate Matter

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. Of particular concern are particles that are smaller than or equal to 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$) in diameter.

PM_{10} consists of very small liquid and solid particles floating in the air and can include smoke, soot, dust, salts, acids, and metals. It also forms when gases emitted from motor vehicles or industrial sources undergo chemical reactions in the atmosphere. Major sources of PM_{10} include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

PM_{10} poses a greater health risk than larger-sized particles. When inhaled, these tiny particles can penetrate the human respiratory system's natural defenses and damage the respiratory tract. PM_{10} can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections.

$PM_{2.5}$ results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. $PM_{2.5}$ can also be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. The main health effects of airborne $PM_{2.5}$ are on the respiratory system. Like PM_{10}, $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Whereas particles 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system, particles 2.5 microns in diameter or less are so tiny that they can penetrate deeper into the lungs and damage lung tissues.

Because the proposed project is not anticipated to substantially affect diesel vehicle operations, analyses of particulate concentrations are not warranted.

Ozone

Ozone (O_3) is a colorless toxic gas that enters the blood stream and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. Ozone also damages plants by inhibiting their growth. Although ozone is not directly emitted, it forms in the atmosphere through a chemical reaction between reactive organic gases and nitrogen oxides (NOx) that are emitted from industrial sources and automobiles.