3.6 Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions adversely affect the environment by contributing to global climate change. The Washington State Department of Ecology has provided guidance for consideration of GHG in State Environmental Policy Act (SEPA) review. Consistent with this guidance, this section summarizes potential GHG impacts associated with the proposed alternatives. Please see the GHG Emissions Appendix E for the detailed calculation worksheets used in this analysis.

3.6.1 Affected Environment—Methodologies

The City of Seattle uses an origin-destination approach to estimate citywide GHG emissions. The methodology calculates VMT (Vehicle Miles Traveled) based on the forecasted number of trips as follows:

- All trips that begin and end within the City
- Half of trips that either begin or end within the City
- None of the trips that begin and end outside the City

This approach is most effective at the community scale since it results in a citywide average VMT. Since the U District has different travel characteristics from the City as a whole, a more detailed subarea evaluation was conducted. This analysis combined two methodologies: the King County SEPA Greenhouse Gas (GHG) spreadsheet and a VMT GHG Analysis tool geared toward a more detailed subarea evaluation. Both of these methodologies are discussed in more detail below.

King County SEPA GHG Spreadsheet

The SEPA GHG Emissions spreadsheet tool developed by King County[1] was used to calculate GHG emissions in the U District. The King County spreadsheet is a comprehensive tool that encompasses a variety of GHG emissions categories related to the building materials used to construct new development, energy consumed at the development, and transportation to and from the development. In accordance with findings regarding the primary sources of greenhouse gas emissions, this tabulation focused on three areas/sources of emissions as described below. The results of the GHG spreadsheet emissions calculations were then converted to an annual equivalent to facilitate a comparison between the different alternatives.

- Building materials and processes (embodied emissions). This portion of the calculation considered both the "upstream" (i.e., mining, harvest, manufacturing, and transport) and the "downstream" (i.e., subsequent, "in place" use and maintenance) of building materials. The embodied emissions are generated only once during the lifetime of the development, at the initial construction phase. The King County spreadsheet lifespan of the buildings is projected to be 80.5 years for multi-family buildings and 62.5 years for office and retail uses. These lifespans are used to annualize the embodied emissions results for new development.[2] Only the amount of new development was used to calculate embodied emissions.
- Post-development energy usage (energy). This element considered energy consumption such as heating and electrical usage. No consideration was made to whether or not the buildings would incorporate Built Green or Energy Star ratings, or LEED® ratings. Some studies suggest that these ratings could represent at least 20 percent reductions in overall energy usage. The complete inventory of U District land use (i.e., existing plus new development) was used to calculate energy-related emissions.
- Transportation (transport). This component considered GHG emissions related to vehicle travel of residences and employees. The King County default calculation was used to calculate existing conditions in Table 3.6–1, which includes annual miles traveled and mileage assumptions for King County residents.

$MTCO_2e$ is defined as Metric Tonne Dioxide Equivalent, equating to 2204.62 pounds of CO_2. This is a standard measure of amount of equivalent CO_2 emissions.

1 *your.kingcounty.gov/ddes/forms/SEPA-GHG-EmissionsWorksheet-Bulletin26.pdf*

2 *A building's lifespan acknowledges the finite useful life of a building; eventually buildings must be redeveloped or substantially renovated to maintain their value. This redevelopment/renovation cycle is captured in the building lifespan.*

To estimate the energy and transportation GHG emissions of the existing development within the U District, this analysis used data from the project travel demand model, consistent with the transportation analysis documented in Section 3.5 of this EIS. Embodied emissions are not calculated for existing conditions since the buildings are already in place and no additional embodied emissions are generated once a development is built. Data in the travel demand model is based on existing travel characteristics and is a reliable basis for measuring the incremental differences in GHG emissions resulting from the action alternatives.

Table 3.6–1 provides greenhouse gas emissions estimates from the existing development within the study area based upon the King County GHG Inventory Worksheets.

Based upon the calculations from the King County SEPA GHG Emissions worksheet, the existing development in the U District is estimated to generate roughly 183,000 $MTCO_2e$ GHG emissions per year.

Table 3.6–1: **Existing Annual Greenhouse Gas Emissions Based on King County SEPA GHG Emissions Inventory Worksheet**

Energy Emissions ($MTCO_2e$)	87,000
Transportation Emissions ($MTCO_2e$)	96,000
Total Estimated Existing GHG Emissions ($MTCO_2e$)*	183,000

*Total may differ from sum due to rounding during calculation.

Source: Fehr & Peers, 2013

VMT-GHG Analysis Tool

As described in the Transportation Chapter (3.5) of the EIS, the unique characteristics of the study area (high density, mix of land uses, demographics, robust pedestrian and bicycle network), will lead to less vehicle travel when compared to a typical area within King County. The King County SEPA GHG spreadsheet has no way to account for the travel characteristics of a dense urban area like the U District. As stated in the King County spreadsheet, the transportation GHG analysis is based on the average VMT estimate of Washington State residents. To prepare a more accurate transportation GHG analysis, an alternative approach based on the MXD trip generation model (described in Section 3.5) was used. The MXD trip generation model estimates account for the built environment within the U District.

The trip generation estimates were input into the project travel demand model to estimate the neighborhood's total VMT, stratified by speed. The VMT/speed data were processed using CO_2 emissions factors from the California Air Resources Board's EMFAC air quality model.[3] The emissions factor estimates from EMFAC were further factored to estimate CO_2 equivalent

3 *The more traditional US EPA MOBILE6 air quality model was not used since it does not consider variations in speed when estimating CO_2 emissions and therefore tends to produce inaccurate results.*

(which accounts for trace amounts of other GHGs like hydrocarbons and HFCs) using a factor from the US EPA.

The results of the EMFAC analysis indicate that the study area generates about 205 metric tons of transportation-related CO_2e per day, or 72,000 metric tons of transportation-related CO_2e per year.

Table 3.6–2: **Existing Annual Greenhouse Gas Emissions Based on King County SEPA GHG Emissions Inventory Worksheet with VMT GHG Tool**

Energy Emissions ($MTCO_2e$)	Transportation Emissions ($MTCO_2e$)	Total Estimated Existing GHG Emissions ($MTCO_2e$)*
87,000	72,000	159,000

*Total may differ from sum due to rounding during calculation.

Source: Fehr & Peers, 2013

Since the numbers above are large and difficult to put in perspective, the transportation GHG emissions can be summarized in another way, which compares the three-hour PM peak period CO_2e emissions in pounds per person (residents plus employees in the U District). As a point of comparison, driving an average car for one mile emits approximately one pound of CO_2e.

This result indicates that under existing conditions, each person who lives/works in the area generates about 2.95 pounds of CO_2e per person in the PM peak period. This result is higher than the 2035 CO_2e emissions estimates discussed under Impacts of the Alternatives later in this section (roughly 2.22 pounds per person), which is expected given the lower densities under existing conditions.

Based upon the calculations from the table above, the U District currently generates roughly 159,000 $MTCO_2e$ GHG per year.

3.6.2 Significant Impacts

Impacts Common to All Alternatives

The scale of global climate change is so large that a project's impacts can only be considered on a "cumulative" scale. It is not anticipated that a single development project or programmatic action, even one on the scale of the development alternatives in this Draft EIS, would have an individually discernible impact on global climate change. It is more appropriate to conclude that the greenhouse gas emissions from future development in the U District would combine with emissions across the state, country, and planet to cumulatively contribute to global climate change.

This section describes the assumed impacts of the development alternatives on climate change, and greenhouse gas emissions. This analysis does not quantify or take into consideration any potential efforts to reduce climate change impacts by incorporating sustainable features into future redevelopment. However, it is assumed that some sustainable features would be incorporated into future development to reduce the impacts quantified in this section.

Greenhouse Gas Emissions

As described in Chapter 2, the alternatives each assume a common growth estimate. (See Table 3.6–3 at right.) All alternatives have the same employment and housing growth estimates, but each alternative proposes a different distribution of growth to achieve these estimates.

Table 3.6–3: **Planning Estimates for Growth of Households and Jobs**

	Alternatives 1, 2 & 3
Households	3,900
Jobs	4,800

Source: Fehr & Peers and Studio 3MW, 2013

EMBODIED AND ENERGY EMISSIONS: KING COUNTY SEPA GHG SPREADSHEET

The growth in square footage and number of households was used to forecast 2035 embodied and energy GHG emissions totals using the King County GHG Emissions Inventory Worksheets. Embodied emissions were annualized based on the estimated building lifespans from the King County Worksheet.

TRANSPORTATION GHG EMISSIONS: VMT-GHG ANALYSIS TOOL

Similar to how the existing conditions GHG emissions were calculated, the MXD model and VMT-GHG spreadsheet were used to forecast 2035 annual transportation emissions. The results are shown below and an example calculation can be found in Appendix E.

Existing Conditions	72,000 $MMCO_2e$
No Action Alternative	86,000 $MMCO_2e$
Alternative 1	84,000 $MMCO_2e$
Alternative 2	85,000 $MMCO_2e$

Driving an average car for one mile emits approximately one pound of CO_2e.

Table 3.6–4 illustrates that under existing conditions, each person who lives or works in the area generates about 2.95 pounds of CO_2e during the PM peak period. This result is higher than the CO_2e emissions estimates for both of the action alternatives, which is expected given the lower densities under existing conditions. As is also shown in Table 3.6–4, the two action alternatives produce transportation GHG emissions per capita that is about two percent lower than the No Action Alternative.

The table also shows the result of the transportation GHG emissions rates for a more suburban employment center that is otherwise similar to the U District: Downtown Redmond. While Downtown Redmond is not located next to a major university, the overall level of employment and housing is similar to the U District. Downtown Redmond is also close to the major employment centers of Overlake and Downtown Bellevue, similar to the U District's proximity to Downtown Seattle. As shown, Downtown Redmond has about 85 percent higher CO_2e emissions per person because it is more isolated and less dense than the U District. Downtown Redmond also has substantially less transit service than the U District, even when assuming the extension of East Link and several major frequent bus lines to Seattle, Kirkland, and Bellevue.

Table 3.6–4: **Estimated Transportation GHG Emissions: VMT-GHG Analysis Tool**

	Pounds of CO_2e per Person* during 3 Hour PM Peak Period
Existing Conditions	2.95
No Action Alternative	2.26
Alternative 1	2.22
Alternative 2	2.22
Redmond Comparison Site	4.18

*U District residents and employees

Source: Fehr & Peers and Studio 3MW, 2013

Total GHG Emissions Results

Table 3.6–5 compares greenhouse gas emissions from the development alternatives based on the King County GHG Emissions Inventory Worksheets for embodied and energy emissions. Transportation

GHG emissions as described above were substituted for the transportation estimates included in the King County Worksheets. The completed SEPA GHG Emissions Worksheets for all alternatives, as well as an explanation of the methodology employed to create the formulas, are included in Appendix E of this Draft EIS.

Based on these calculations, all three 2035 alternatives generate roughly the same annual GHG emissions. The same embodied and energy emissions are expected under all three alternatives since the planning estimates are identical. The variation is within one percent and represents slightly different distribution patterns for the land uses and resulting differences in transportation-related GHG emissions:

- Alternatives 1 and 2 would generate roughly 216,000 $MTCO_2e$ GHG annual emissions
- Alternative 3 (No Action) would generate roughly 218,000 $MTCO_2e$ GHG annual emissions

Alternatives 1 and 2 have lower annual emissions than the No Action Alternative.

Table 3.6–5: **GHG Emissions Based on King County SEPA GHG Emissions Inventory Worksheets and VMT-GHG Analysis Tool**

	Estimated Annual GHG Emissions Associated by Alternative ($MTCO_2e$)
Existing Conditions	159,000
No Action Alternative	218,000
Alternative 1	216,000
Alternative 2	216,000

Source: Fehr & Peers and Studio 3MW, 2013

3.6.3 Mitigating Measures

The following potential mitigation strategies would reduce potential impacts to climate change, energy use and greenhouse gas emissions from future development in the U District.

TRANSIT, PEDESTRIAN, AND BICYCLE IMPROVEMENTS

Transit, pedestrian, and bicycle improvements would help encourage use of non-SOV modes, thereby reducing transportation-related GHG emissions. Refer to Section 3.5.4 for a complete discussion of transportation mitigation measures.

DISTRICT INFRASTRUCTURE SYSTEMS FOR ENERGY, WATER AND WASTE

District Infrastructure Systems aggregate enough service demands to make local neighborhood utility solutions feasible, and may reduce greenhouse gases by utilizing renewable sources of energy and increasing the use of local resources, materials and supplies. District parking solutions and car sharing

are designed to reduce vehicle trips and land devoted to parking. Water reuse and anaerobic digesters may reduce sewer flows. Rainwater capture may reduce stormwater flows. Water reuse and rainwater capture could also reduce potable water demands. The City could pursue a district energy system in the U District, which was identified as a major opportunity area for district energy in a 2011 study. The City could also pursue a partnership with private developers and UW to expand the University's existing district heat system to more areas within the U District.

WASTE MANAGEMENT AND DECONSTRUCTION

When existing buildings need to be demolished, there are often opportunities to reduce the amount of waste being sent to the landfill with sustainable waste management strategies. In the Seattle area, standard practice for building construction and demolition results in fairly high recycling rates of over 50 to 60 percent. However, these rates can be increased by implementing aggressive demolition recycling. The City could consider programs to require or encourage best practices to achieve higher recycling rates.

BUILDING DESIGN

Green building encompasses energy and water conservation, waste reduction, and good indoor environmental quality. Tools and standards that are used to measure green building performance, such as Built Green, LEED, the Living Building Challenge, and the Evergreen Sustainable Development Criteria, could be encouraged or required for development within the U District.

NATURAL DRAINAGE AND GREEN ROOFS

Green roofs can provide additional open space, opportunities for urban agriculture, and decreased energy demands by reducing the cooling load for the building. Green Stormwater Infrastructure (GSI), currently required for all redevelopment, also could reduce climate change impacts by adding landscaping and reducing energy requirements for stormwater treatment. Most areas north of NE 50th Street will be eligible for GSI funding through the Residential RainWise program, which is run as a partnership between Seattle Public Utilities and King County. Much of the U District is already required to meet a landscaping standard called Seattle Green Factor, which encourages incorporation of various landscaping features such trees, shrubs, groundcovers, green roofs, green walls, native plants, and food gardens. This program should be maintained, and potentially expanded to cover the entire study area.

TREE PROTECTION

The City of Seattle has aggressive urban forest goals in order to help restore tree cover which has been lost due to development. Trees can provide stormwater management, habitat value, noise buffering, air purification, carbon sequestration, and mitigation of the urban heat island effect. Trees also have a positive effect on property values and neighborhood quality. Protection of existing trees, as feasible, and careful attention to new tree planting could help meet the Seattle Comprehensive Urban Forest Management Plan Goals for multifamily residential and commercial office development by achieving 15–20 percent overall tree canopy within 30 years.

URBAN AGRICULTURE

New P-patch Community Gardens and rooftop gardens could be provided or encouraged within the neighborhood for residents to grow food. Balconies, decks, and right-of-way planting strips could also be utilized for individual residents' agriculture needs.

3.6.4 Significant Unavoidable Adverse Impacts

No impact is expected for Alternatives 1 or 2 since they would both have lower GHG emissions than the No Action Alternative. Moreover, the proposed development in the U District has lower GHG emissions than comparable development elsewhere in the Puget Sound region.

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