Final Report
Second-Tier Risk Analysis for
Diesel Engine Exhust Particulate Matter
Microsoft Project Oxford Data Center
Quincy, Washington

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Prepared for

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LIST OF ABBREVIATIONS AND ACRONYMS

$\mu g/m^3$	Microgram per Cubic Meter
µm	Micrometer
AERMOD	American Meteorological Society/EPA Regulatory Model
ASIL	Acceptable Source Impact Level
BACT	Best Available Control Technology
CO	Carbon Monoxide
DEEP	Diesel Engine Exhaust Particulate Matter
DPF	Diesel Particulate Filter
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ft	Feet
G-I	City of Quincy City Industrial
GCA	Grant County Agriculture
g/kWm-hr	Grams per Mechanical Kilowatt-Hour
HI	Hazard Index
HIA	Health Impact Assessment
HQ	Hazard Quotient
m	Meter
MIBR	Maximally Impacted Boundary Receptor
MICR	Maximally Impacted Commercial Receptor
Microsoft	The Microsoft Corporation
MIRR	Maximally Impacted Residential Receptor
MRL	Minimal Risk Level
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen Dioxide
NOC	Notice of Construction
NO_x	Nitrogen Oxides
OEHHA	California Office of Environmental Health Hazard Assessment
PAH	Polycyclic Aromatic Hydrocarbon
$PM_{2.5}$	Particulate Matter with an Aerodynamic Diameter Less Than or Equal to 2.5 Microns
RBC	Risk-Based Concentration
REL	Reference Exposure Level
RfC	Reference Concentration
SCR	Selective Catalytic Reduction
SO_2	Sulfur Dioxide
SQER	Small-Quantity Emission Rate
SR	State Route
TAP	Toxic Air Pollutant
tBACT	Toxics Best Available Control Technology
TWA	Time-Weighted Average
URF	Unit Risk Factor
VOC	Volatile Organic Compound
WAC	Washington Administrative Code

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1.0 EXECUTIVE SUMMARY

1.1 PROPOSED PROJECT

This final report updates the Second-Tier Risk Analysis for Diesel Engine Exhaust Particulate Matter that was submitted to the Washington State Department of Ecology (Ecology) on March 13, 2014 (Landau Associates 2014a), to address comments from Ecology and to incorporate the analyses from subsequent submittals to Ecology after that date.

The Microsoft Corporation (Microsoft) has proposed to develop the Project Oxford Data Center in Quincy, Washington. Construction of Phases 1 and 2 of the proposed data center will include the installation of 32 2.5-megawatt (MW) emergency diesel engine generators, four 2.0-MW generators, and one 0.75-MW emergency diesel engine generator, and the construction of 32 cooling towers. All of the engines will be U.S. Environmental Protection Agency (EPA) Tier 2 engines equipped with engine exhaust add-on air pollution control devices designed to achieve the stringent emission standards set by the EPA for Tier 4 (Final) certification. The add-on air pollution controls for each engine will include catalyzed diesel particulate filters (DPFs) and selective catalytic reduction (SCR) for the removal of nitrogen oxides (NO_x).

Construction of the Project Oxford Data Center will be conducted in four phases. Phases 1 and 2 are expected to begin construction before the end of 2015, while the construction of Phases 3 and 4 will be based on market demand and is unlikely to begin before 2016. Under state regulations, a Notice of Construction (NOC) approval becomes invalid if construction of the source is not commenced within 18 months of receipt of the NOC approval unless Ecology approves an extension of the NOC approval [WAC 173-400-111(7)]. Therefore, this NOC application addresses the air permitting requirements associated with the construction of Phases 1 and 2. Future phases of construction at the Project Oxford Data Center will be permitted, if appropriate, when actual plans and specifications are developed and when those phases are funded for construction.

Microsoft evaluated air quality impacts associated with the proposed project in an NOC application submitted to Ecology's Eastern Regional Office (Landau Associates 2014b). As documented in the NOC application, potential emissions of diesel engine exhaust particulate matter (DEEP) from the 37 emergency diesel engine generators may cause ambient air impacts that exceed the Washington State Acceptable Source Impact Level (ASIL). Based on that modeled exceedance, Microsoft is required to submit a second-tier petition per Chapter 173-460 of the Washington Administrative Code (WAC).

Ecology has implemented a cumulative approach to evaluating health impacts from Quincy data centers because the engines are within close proximity to other background sources of DEEP. As part of the cumulative approach, this second-tier health impact assessment (HIA) considers the cumulative impacts of DEEP from the proposed generators, nearby existing permitted sources, and other background sources including highways and the railroad.

1.2 HEALTH IMPACTS EVALUATION

The HIA demonstrates that the ambient cancer risks and non-cancer risks caused by emissions of DEEP from the proposed project are less than Ecology's approval limits. Under worst-case exposure assumptions involving residents standing outside their homes for 70 continuous years, the 37 proposed emergency diesel engine generators could cause an increased cancer risk of up to 4.1 in 1 million (4.1×10^{-6}) at the maximally impacted residence. Because the increase in cancer risk attributable to the proposed project alone would be less than the maximum risk allowed by a second-tier review, which is 10 in 1 million (10×10^{-6}), the project is approvable under WAC 173-460-090.

Based on the cumulative maximum DEEP concentration at a residential location near the Project Oxford Data Center, the estimated maximum potential cumulative cancer risk posed by DEEP emitted from the proposed project and background sources within the area would be approximately 33 in 1 million (33×10^{-6}) at the most impacted residential receptor. Most of the DEEP cancer risk at that location would be caused by on-road emissions from State Route (SR) 28.

1.3 CONCLUSIONS

Project-related health risks are less than the limits permissible under WAC 173-460-090. Therefore, the project is approvable under WAC 173-460-090.

2.0 PROJECT OXFORD DATA CENTER PROJECT

2.1 DESCRIPTION OF PROPOSED DEVELOPMENT OF PROJECT OXFORD DATA CENTER

Microsoft is proposing to develop the Project Oxford Data Center in Quincy, Washington (Figure 2-1). Construction of the proposed data center will occur in four phases; the current permit application covers the combined Phases 1 and 2. During Phase 1, stationary emission units that consist of 16 2.5-MW backup diesel engine generators, four 2.0-MW generators, one 0.75-MW backup diesel engine generator, and 16 cooling towers will be installed. During Phase 2, stationary emission units that consist of an additional 16 2.5-MW backup diesel engine generators and 16 additional cooling towers will be installed. Each backup diesel engine generator will be housed within its own acoustical enclosure. During a power outage, the 2.5-MW backup diesel engine generators will be used to provide electricity to the servers and the 0.75-MW backup diesel engine generator will be used for facility operations (i.e., lights and appliances). The ambient air impacts associated with installation of the proposed 32 cooling towers are discussed in the NOC air permit application submitted under separate cover and the cooling towers will not emit any toxic air pollutants (TAPs) at emission rates exceeding the Small-Quantity Emission Rate (SQER) thresholds; therefore, no further discussion of these emission units is provided.

The Project Oxford Data Center site layout and the proposed location of the backup diesel engine generators and cooling towers are shown on Figure 2-2. Each diesel engine generator will have its own 46.25-foot-tall vertical exhaust stack.

2.2 FORECAST EMISSION RATES

Air pollutant emission rates were calculated for the sources identified in Section 2.1 in accordance with WAC 173-460-050. Emission rates were quantified for criteria pollutants and toxic air pollutants (TAPs). Detailed emission calculation spreadsheets are provided in the NOC Supporting Information report (Landau Associates 2014b).

The emission estimates presented in this report are based on the operating modes for the proposed 37 emergency diesel engine generators summarized in Table 2-1.

The emission estimates presented in this report have been conservatively calculated for diesel engine generators that meet EPA Tier 4 (Final) emission limits. Table 2-2 summarizes the facility-wide calculated emission rates for the Project Oxford Data Center diesel engine generators. That table lists several different values for the DEEP emissions. One row in the table lists the conservatively high DEEP emissions assuming that DEEP consists of both the filterable "front-half" particulates and the condensable "back-half" particulates. That row lists two values for the annual DEEP emission rates (one value for the

70-year average, and a higher value for the theoretical maximum 12-month operating period). The 70-year average DEEP emission rate of 0.531 tons per year was used to estimate the 70-year average cancer impacts, while the theoretical maximum 12-month value of 0.536 tons per year was used to evaluate non-cancer chronic health impacts. A second row in the table lists the DEEP emissions assuming DEEP consists only of the filterable front-half particulates (0.126 tons per year).

Ammonia gas will be emitted from the SCR control system used to reduce NO_x emissions because a small fraction of the urea-nitrogen that is injected into the catalyst passes through without reacting, and is emitted through the exhaust stack as ammonia.

2.3 LAND USE AND ZONING

Land uses in the vicinity of the proposed Project Oxford Data Center are presented on Figure 2-3. The topography in the vicinity of the Project Oxford Data Center is relatively flat with elevations ranging between approximately 1,300 and 1,400 feet (ft) above sea level. The zoning designation for the site is City of Quincy City Industrial (G-I). Zoning designations on adjacent lands include G-I to the east and south, Grant County Agriculture (GCA) to the north and west, and Grant County Urban Residential to the northwest.

Detailed zoning information for the area surrounding the proposed Project Oxford Data Center is shown on Figure 2-4 (City of Quincy 2011; Grant County website 2013). From a health impacts standpoint, an existing single-family residence located to the north of the Project Oxford Data Center on land zoned GCA is of primary interest (see Figure 2-3). Zoning and land use developments for properties surrounding the Project Oxford Data Center are shown in Table 2-3.

2.4 SENSITIVE RECEPTORS

The following sensitive receptors are near the proposed Project Oxford Data Center:

- The nearest school is Monument Elementary School (I-1), approximately 1 mile southeast of the Project Oxford Data Center.
- The nearest daycare or pre-school is a private home-based facility, approximately 0.6 miles southeast of the Project Oxford Data Center.
- The nearest church is located approximately 0.7 miles southeast of the Project Oxford Data Center.
- The nearest medical facility is Quincy Valley Medical Center (I-2), approximately 0.7 miles southeast of the Project Oxford Data Center.
- The nearest convalescent home is Cambridge, approximately 1.0 mile southeast of the Project Oxford Data Center.

3.0 PERMITTING REQUIREMENTS FOR NEW SOURCES OF TOXIC AIR POLLUTANTS

3.1 OVERVIEW OF THE REGULATORY PROCESS

The requirements for performing a toxics screening are established in Chapter 173-460 WAC. This rule requires a review of any non-*de minimis*[1] increase in TAP emissions for all new or modified stationary sources in Washington State. Sources subject to review under this rule must apply best available control technology (BACT) for toxics (tBACT) to control emissions of all TAPs subject to review.

There are three levels of review when processing an NOC application for a new or modified emissions unit emitting TAPs in excess of the *de minimis* levels: 1) first-tier (toxic screening); 2) second-tier (health impacts assessment); and 3) third-tier (risk management decision).

All projects with emissions exceeding the *de minimis* levels are required to undergo a toxics screening (first-tier review) as required by WAC 173-460-080. The objective of the toxics screening is to establish the systematic control of new sources emitting TAPs in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality to protect human health and safety. If modeled emissions exceed the trigger levels called ASILs, a second-tier review is required.

As part of a second-tier petition, described in WAC 173-460-090, the applicant submits a site-specific HIA. The objective of an HIA is to quantify the increase in lifetime cancer risk for persons exposed to the increased concentration of any carcinogen, and to quantify the increased health hazard from any non-carcinogen that would result from the proposed project. Once quantified, the cancer risk is compared to the maximum risk allowed by a second-tier review, which is 10 in 1 million, and the concentration of any non-carcinogen that would result from the proposed project is compared to its effect threshold concentration.

In evaluating a second-tier petition, background concentrations of the applicable TAPs must be considered. If the emissions of a TAP result in an increased cancer risk of greater than 10 in 1 million (equivalent to 1 in 100,000), then an applicant may request that Ecology conduct a third-tier review. For non-carcinogens, a similar path exists, but there is no specified numerical criterion to indicate when a third-tier review is triggered.

[1] If the estimated increase of emissions of a TAP or TAPs from a new or modified project is below the *de minimis* emissions threshold(s) found in WAC 173-460-150, the project is exempt from review under Chapter 173-460 WAC.

3.2 BACT AND TBACT FOR THE PROJECT OXFORD DATA CENTER

Ecology is responsible for determining BACT and tBACT for controlling criteria pollutants and TAPs emitted from the proposed project. Microsoft has committed to equipping the proposed diesel engine generators with an integrated add-on control package designed to achieve the stringent emission standards set by the EPA for Tier 4 (Final) certification. The add-on controls for each diesel engine will include a catalyzed DPF for removal of particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), DEEP, and volatile organic compounds (VOCs), and SCR for NO_x removal.

Microsoft conducted a BACT and tBACT analysis as presented in the NOC Supporting Information report (Landau Associates 2014b). The BACT/tBACT analysis concluded that although all of the add-on control technology options (the SCR/catalyzed DPF Integrated Control Package proposed by Microsoft, Urea-SCR, Catalyzed DPF, and diesel oxidation catalyst-alone) are technically feasible, each of them failed the BACT cost-effectiveness evaluation. Therefore, none of the add-on controls should be considered BACT, regardless of Microsoft's voluntary proposal to install the Integrated Control Package on all of its diesel engine generators. Instead, the emission controls inherent to EPA Tier 2-certified diesel engines should be required as BACT. The proposed BACT for carbon monoxide (CO) and VOCs is based on compliance with EPA's Tier 2 emission limitations for non-road diesel engines: 0.20 grams per mechanical kilowatt-hour (g/kWm-hr) for $PM_{2.5}$, 3.5 g/kWm-hr for CO, and 6.4 g/kWm-hr for combined NO_x plus non-methane hydrocarbons. The proposed BACT and tBACT determinations are summarized in Tables 3-1 and 3-2, respectively.

Additional restrictions proposed in the NOC application include:

- Limits on the total number of hours that the emergency diesel engines operate
- Limits on the total number of hours the emergency diesel engines are allowed to operate during each category of testing and maintenance
- Use of ultra-low sulfur diesel fuel (15 parts per million sulfur content)
- Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII
- Use of high-efficiency drift eliminators on the cooling towers.

3.3 FIRST-TIER TOXICS SCREENING REVIEW FOR PROJECT OXFORD DATA CENTER

The first-tier TAP assessment compares the forecast emission rates to the SQERs and compares the maximum ambient air impacts at any sensitive receptor to the ASILs.

Table 3-3 shows the calculated emission rates for each TAP emitted from the proposed project, and compares the emission rates to the SQERs. The SQERs are emission thresholds, below which Ecology does not require an air quality impact assessment for the listed TAP. Table 3-3 lists the "SQER Ratio" of the emission rate for the proposed project compared to the SQER. The maximum emission rates for DEEP, nitrogen dioxide (NO_2), CO, ammonia, and acrolein exceed their respective SQERs, so an ambient air impact assessment based on atmospheric dispersion modeling was required for those TAPs.

Ecology requires facilities to conduct a first-tier screening analysis for each TAP whose emission exceeds its SQER by modeling the 1st-highest 1-hour, 1st-highest 24-hour, or annual impacts (based on the averaging period listed for each TAP in WAC 173-460-150) at or beyond the project boundary, then comparing the modeled values to the ASILs (WAC 173-460-080). For this analysis, annual-average impacts were modeled based on a worst-case operational scenario of 24 hours per day for 365 days per year for 5 years, with the American Meteorological Society/EPA Regulatory Model (AERMOD).

Table 3-4 presents the first-tier ambient air concentration screening analysis for each TAP whose emission rate exceeds its SQER. Details on the methodologies for the modeling are provided in the NOC Supporting Information report (Landau Associates 2014b). All of the modeled maximum impacts occur at the unoccupied facility boundary (i.e., locations where there are no current buildings). The maximum annual-average DEEP impact at the unoccupied facility boundary far exceeds its ASIL, while the impacts for all TAPs other than DEEP are less than their respective ASILs. Therefore, DEEP is the only TAP triggering a requirement for a second-tier HIA.

3.4 SECOND-TIER REVIEW PROCESSING REQUIREMENTS

In order for Ecology to review the second-tier petition, each of the following regulatory requirements under WAC 173-460-090 must be satisfied:

(a) The permitting authority has determined that other conditions for processing the NOC Order of Approval have been met, and has issued a preliminary approval order.

(b) Emission controls contained in the preliminary NOC approval order represent at least tBACT.

(c) The applicant has developed an HIA protocol that has been approved by Ecology.

(d) The ambient impact of the emissions increase of each TAP that exceeds ASILs has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol.

(e) The second-tier review petition contains an HIA conducted in accordance with the approved HIA protocol.

Ecology provided comments to Landau Associates' HIA protocol [item (c) above]. Ecology's comments were addressed as part of this HIA.

3.5 SECOND-TIER REVIEW APPROVAL CRITERIA

As specified in WAC 173-460-090(7), Ecology may recommend approval of a project that is likely to cause an exceedance of ASILs for one or more TAPs only if:

- Ecology determines that the emission controls for the new and modified emission units represent tBACT

- The applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than 1 in 100,000
- Ecology determines that the non-cancer hazard is acceptable.

The remainder of this document discusses the HIA conducted by Landau Associates.

4.0 HEALTH IMPACT ASSESSMENT

This HIA was conducted according to the requirements of WAC 173-460-090 and guidance provided by Ecology. The HIA addresses the public health risk associated with exposure to DEEP from Microsoft's proposed emergency diesel engine generators and existing sources of DEEP in the vicinity. While the HIA is not a complete risk assessment, it generally follows the four steps of the standard health risk assessment approach proposed by the National Academy of Sciences (NAS 1983, 1994). These four steps are: 1) hazard identification; 2) exposure assessment; 3) dose-response assessment; and 4) risk characterization. As described later in this document, the HIA did not consider exposure pathways other than inhalation.

4.1 HAZARD IDENTIFICATION

Hazard identification involves gathering and evaluating toxicity data on the types of health injury or disease that may be produced by a chemical, and on the conditions of exposure under which injury or disease is produced. It may also involve characterization of the behavior of a chemical within the body and the interactions it undergoes with organs, cells, or even parts of cells. This information may be of value in determining whether the forms of toxicity known to be produced by a chemical agent in one population group or in experimental settings are also likely to be produced in human population groups of interest. Note that risk is not assessed at this stage. Hazard identification is conducted to determine whether and to what degree it is scientifically correct to infer that toxic effects observed in one setting will occur in other settings (e.g., are chemicals found to be carcinogenic or teratogenic in experimental animals also likely to be so in adequately exposed humans?).

Although the second-tier HIA is triggered solely by potential ambient air impacts of DEEP, the toxicity of other TAPs with emission rates exceeding the SQERs was also reviewed to consider whether additive toxicological effects should be considered in the HIA.

4.1.1 OVERVIEW OF DEEP TOXICITY

Diesel engines emit very small, fine [smaller than 2.5 micrometers (µm)] and ultrafine (smaller than 0.1 µm) particles. These particles can easily enter deep into the lungs when inhaled. Mounting evidence indicates that inhaling fine particles can cause numerous adverse health effects.

Studies of humans and animals specifically exposed to DEEP show that diesel particles can cause both acute and chronic health effects including cancer. Ecology has summarized these health effects in a document titled *Concerns about Adverse Health Effects of Diesel Engine Emissions* (Ecology 2008).

The following health effects have been associated with exposure to very high concentrations of diesel particles, primarily in industrial workplace settings (e.g., underground mines that use diesel equipment) with concentrations much higher than the ambient levels that will be caused by the Project Oxford Data Center:

- Inflammation and irritation of the respiratory tract
- Eye, nose, and throat irritation along with coughing, labored breathing, chest tightness, and wheezing
- Decreased lung function
- Worsening of allergic reactions to inhaled allergens
- Asthma attacks and worsening of asthma symptoms
- Heart attack and stroke in people with existing heart disease
- Lung cancer and other forms of cancer
- Increased likelihood of respiratory infections
- Male infertility
- Birth defects
- Impaired lung growth in children.

It is important to note that the estimated levels of DEEP emissions from the proposed project that will potentially impact people will be much lower than levels associated with many of the health effects listed above. For the purpose of determining whether Microsoft's project-related and cumulative DEEP impacts are acceptable, non-cancer hazards and cancer risks are quantified and presented in the remaining sections of this document.

4.2 EXPOSURE ASSESSMENT

An exposure assessment involves estimating the extent that the public is exposed to a chemical substance emitted from a facility. This includes:

- Identifying routes of exposure
- Estimating long- and/or short-term offsite pollutant concentrations
- Identifying exposed receptors
- Estimating the duration and frequency of receptors' exposure.

4.2.1 IDENTIFYING ROUTES OF POTENTIAL EXPOSURE

Humans can be exposed to chemicals in the environment through inhalation, ingestion, or dermal contact. The primary route of exposure to most air pollutants is inhalation; however, some air pollutants may also be absorbed through ingestion or dermal contact. Ecology uses guidance provided in

California's *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (CalEPA 2003) to determine which routes and pathways of exposure to assess for chemicals emitted from a facility. Chemicals for which Ecology assesses multiple routes and pathways of exposure are presented in Table 4-1.

DEEP consists of ultra-fine particles (approximately 0.1 to 1 micron in size) that behave like a gas and do not settle out of the downwind plume by gravity. DEEP particles will eventually be removed from the atmosphere and can be slowly deposited onto the ground surface by either molecular diffusion or by being incorporated into rain droplets, but that deposition process is slow and will likely occur many miles downwind of the Project Oxford Data Center. At those far downwind distances, the resulting DEEP concentrations in the surface soil will likely be indistinguishable from regional background values.

It is possible that very low levels of polycyclic aromatic hydrocarbons (PAHs) and the few other persistent chemicals in DEEP will build up in food crops, soil, and drinking water sources downwind of the Project Oxford Data Center. However, given the very low levels of PAHs and other multi-exposure route-type TAPs that will be emitted from the proposed project, quantifying exposures via pathways other than inhalation is very unlikely to yield significant concerns. Further, inhalation is the only route of exposure to DEEP that has received sufficient scientific study to be useful in human health risk assessment. Therefore, in the case of Project Oxford Data Center emissions, only inhalation exposure to DEEP is evaluated.

4.2.2 Estimating Particulate Concentrations

To estimate where pollutants will disperse after they are emitted from the Project Oxford Data Center, Landau Associates conducted air dispersion modeling, which incorporates emissions, meteorological, geographical, and terrain information to estimate pollutant concentrations downwind from a source.

Each of the proposed Project Oxford Data Center emergency diesel engine generators was modeled as an individual discharge point. Additionally, local background DEEP contributions were modeled, including existing diesel engine generators at the Dell Data Center and Microsoft's existing Columbia Data Center, diesel truck exhaust along SR 28 and SR 281, and diesel locomotive emissions along the railroad. Diesel engine emission rates for the Dell Data Center and the existing Microsoft Columbia Data Center were calculated based on the maximum permitted emission rates provided in the Ecology Approval Orders for those facilities. Emission rates for the highways and the railroad were calculated based on DEEP emissions data provided by Ecology (Bowman 2013). Highway DEEP emissions data were developed by Ecology using the EPA model MOVES, which incorporates Grant County-wide on-road diesel emissions exhaust data and highway-specific vehicle miles traveled.

Additionally, Ecology determined DEEP emissions from locomotives using Grant County locomotive emissions data in conjunction with the ratio of active track feet in Quincy compared to Grant County. DEEP ambient air impacts from the proposed project and local background sources were modeled using the following air dispersion model inputs:

- AERMOD with Plume Rise Model Enhancements algorithm for building downwash (Version 12345).
- Five years of sequential hourly meteorological data from Grant County International Airport (2001 to 2005).
- Twice-daily upper air data from Spokane, Washington (2001 to 2005) to define mixing heights.
- Grant County area digital topographical data in the form of Digital Elevation Model files (which describe local topography and terrain).
- Grant County area digital land classification files (which describe surface characteristics).
- The emissions for each diesel engine were modeled with stack heights of 46 ft (Microsoft Project Oxford Data Center), 21 to 38 ft (Microsoft Columbia Data Center), and 58 ft (Dell Data Center) above ground level.
- The building dimensions for the multiple buildings at the Project Oxford Data Center, Dell Data Center, and the Microsoft Columbia Data Center were included to account for building downwash.
- The receptor grid for the AERMOD modeling domain at or beyond the facility boundary was established using a variable Cartesian grid:
  - 10-meter (m) spacing from emission source to 350 m
  - 25-m spacing from 350 m to 800 m
  - 50-m spacing from 500 m to 2000 m
  - 100-m spacing beyond 2,000 m.

4.2.3 IDENTIFYING POTENTIALLY EXPOSED RECEPTORS

There are several different land use types within the general vicinity of the Project Oxford Data Center. Residential, commercial, and institutional locations where people could be exposed to project-related emissions are identified on Figure 2-3. The residential, business, and institutional receptors are modeled for exposure to project-related emissions. Typically, Ecology considers exposures occurring at maximally exposed boundary, residential, and business/commercial areas to capture worst-case exposure scenarios.

4.2.3.1 Receptors Maximally Exposed to DEEP

Maximally exposed receptors of different use types and the direction and distance of those receptors from the Project Oxford Data Center are summarized in Table 4-2. This table also shows the estimated 70-year average exposure concentration at each maximally exposed receptor for emissions from the proposed Project Oxford Data Center.

Figure 4-1 shows a color-coded map of estimated 70-year annual-average DEEP concentrations attributable solely to DEEP emissions from the proposed Project Oxford Data Center. Figure 4-1 shows the ambient air impacts of Microsoft's project at each of the maximally exposed receptors representing different land uses. The concentrations at the Maximally Impacted Boundary Receptor (MIBR), Maximally Impacted Residential Receptor (MIRR), and Maximally Impacted Commercial Receptor (MICR) are highlighted. The modeling indicates that emissions from the proposed project will reach multiple existing residences to the north, west, and southeast at a level exceeding the ASIL. The blue contour line [0.0033 micrograms per cubic meter ($\mu g/m^3$)] represents the ASIL. Receptors at all locations outside the blue contour are forecast to be exposed to concentrations less than the ASIL.

Figure 4-2 shows a contour map of the 70-year annual average DEEP concentrations attributable to the proposed project and other local background sources of DEEP in the vicinity, including SR 28, SR 281, the railroad, the Dell Data Center, and the Columbia Data Center.

4.2.4 Exposure Frequency and Duration

The likelihood that someone would be exposed to DEEP from the Project Oxford Data Center depends on local wind patterns, the frequency of engine testing, and how much time people spend in the immediate area. As discussed previously, the air dispersion model uses emission and meteorological information (and other assumptions) to determine ambient DEEP concentrations in the vicinity of the Project Oxford Data Center.

This analysis considers the land use surrounding the proposed Project Oxford Data Center to estimate the amount of time a given receptor could be exposed. For example, people are more likely to be exposed frequently and for a longer duration if the source impacts residential locations because people spend much of their time at home. People working at industrial or commercial properties in the area are likely exposed to project-related emissions only during the hours that they spend working near the facility.

This analysis uses simplified assumptions about receptors' exposure frequency and duration and assumes that people located at residential receptors are potentially continuously exposed, meaning they never leave their property. These behaviors are not typical; however, these assumptions are intended to avoid underestimating exposure so that public health protection is ensured. Workplace and other non-residential exposures are also considered, but adjustments are often made because the amount of time that people spend at these locations is more predictable than time spent at their homes. These adjustments are described in Section 4.4.2 when quantifying cancer risk from intermittent exposure to DEEP.

4.2.5 BACKGROUND EXPOSURE TO POLLUTANTS OF CONCERN

WAC 173-460-090 states, "Background concentrations of TAPs will be considered as part of a second-tier review." The word "background" is often used to describe exposures to chemicals that come from existing sources, or sources other than those being assessed.

To estimate DEEP background concentrations, ambient air impacts from SR 28, SR 281, the railroad, the Dell Data Center, and the Columbia Data Center were modeled using the methodology described in Section 4.2.2. Regional background DEEP concentrations from the EPA's National Air Toxics Assessment database were not used because Ecology has concluded that site-specific modeling of the local highways and railroads provides a more realistic spatial determination of regional background concentrations.

4.2.6 CUMULATIVE EXPOSURE TO DEEP

Table 4-3 shows the calculated cumulative DEEP concentrations near the Project Oxford Data Center based on allowable emissions from the proposed project, other permitted sources of DEEP in the area, and nearby highways and the railroad. Two sets of analyses are shown in the table. The top part of the table shows the conservatively high results assuming the DEEP emissions from the Project Oxford generators consist of the total particulate matter (front-half plus back-half). The bottom part of the table shows the results assuming the DEEP emissions from the Project Oxford generators consist only of the filterable front-half particulates. Using the more conservative calculation method, the maximum 70-year cumulative concentration at a residence near the Project Oxford Data Center is estimated at 0.109 $\mu g/m^3$ (approximately 33 times greater than the DEEP ASIL). This is modeled to occur at R-2, which is southeast of the proposed Project Oxford Data Center. However, at that location, most of the DEEP exposure is due to emissions from trucks traveling on nearby SR 28, and only a fraction of the DEEP exposure is due to emissions from the Project Oxford facility. It is important to note that the estimated ambient levels of DEEP are based on allowable (permitted) emissions instead of actual emissions. Actual emissions are likely to be lower than what the facilities are permitted for, but worst-case emissions were used to avoid underestimating cumulative DEEP exposure concentrations.

4.3 DOSE-RESPONSE ASSESSMENT

Dose-response assessment describes the quantitative relationship between the amounts of exposure to a substance (the dose) and the incidence or occurrence of injury (the response). The process often involves establishing a toxicity value or criterion to use in assessing potential health risk.

4.3.1 DOSE-RESPONSE ASSESSMENT FOR DEEP

The EPA and California Office of Environmental Health Hazard Assessment (OEHHA) developed toxicological values for DEEP evaluated in this project (EPA 2002; EPA website 2013; CalEPA 1998). These toxicological values are derived from studies of animals that were exposed to a known amount (concentration) of DEEP, or from epidemiological studies of exposed humans, and are intended to represent a level at or below which non-cancer health effects are not expected, and a metric by which to quantify increased risk from exposure to emissions. Table 4-4 shows DEEP non-cancer and cancer toxicity values.

The EPA's reference concentration (RfC) and OEHHA's reference exposure level (REL) for diesel engine exhaust (measured as DEEP) was derived from dose-response data on inflammation and changes in the lung from rat inhalation studies. Each agency established a level of 5 $\mu g/m^3$ as the concentration of DEEP in air at which long-term exposure is not expected to cause non-cancer health effects.

National Ambient Air Quality Standards (NAAQS) and other regulatory toxicological values for short- and intermediate-term exposure to particulate matter have been promulgated, but values specifically for DEEP exposure at these intervals do not currently exist.

OEHHA derived a unit risk factor (URF) for estimating cancer risk from exposure to DEEP. The URF is based on a meta-analysis of several epidemiological studies of humans occupationally exposed to DEEP. URFs are expressed as the upper-bound probability of developing cancer, assuming continuous lifetime exposure to a substance at a concentration of 1 $\mu g/m^3$, and are expressed in units of inverse concentration [i.e., $(\mu g/m^3)^{-1}$]. OEHHA's URF for DEEP is 0.0003 $(\mu g/m^3)^{-1}$ meaning that a lifetime of exposure to 1 $\mu g/m^3$ of DEEP results in an increased individual cancer risk of 0.03 percent or a population risk of 300 excess cancer cases per million people exposed.

4.4 RISK CHARACTERIZATION

Risk characterization involves the integration of data analyses from each step of the HIA to determine the likelihood that the human population in question will experience any of the various health effects associated with a chemical under its known or anticipated conditions of exposure.

4.4.1 EVALUATING NON-CANCER HAZARDS

The non-cancer health impacts were evaluated based on the conservatively high emission rates during the maximum theoretical 12-month period. In order to evaluate the potential for non-cancer health effects that may result from exposure to TAPs, exposure concentrations at each receptor location are compared to relevant non-cancer toxicological values (i.e., RfC, REL). Table 4-4 lists the non-cancer toxicological values that were used for this assessment, including the federal minimal risk levels (MRLs) for ammonia exposure. If a concentration exceeds the RfC, MRL, or REL, this indicates only the potential for health effects. The magnitude of this potential can be inferred from the degree to which this value is exceeded. This comparison is known as a hazard quotient (HQ) and is given by the equation below:

$$HQ = \frac{\text{Concentration of pollutant in air } (\mu g/m^3)}{\text{RfC, MRL, or REL}}$$

An HQ of 1 or less indicates that the exposure to a substance is not likely to result in non-cancer health effects. As the HQ increases above 1, the potential of human health effects increases by an undefined amount. However, it should be noted that an HQ above 1 would not necessarily result in health impacts due to the application of uncertainty factors in deriving toxicological reference values (e.g., RfC and REL).

4.4.1.1 Hazard Quotient – DEEP

The chronic HQ for DEEP exposure is calculated using the following equation:

$$\text{Chronic HQ} = \frac{\text{Annual average DEEP concentration } (\mu g/m^3)}{5\ \mu g/m^3}$$

HQs were calculated for the maximally exposed residential, workplace, and sensitive receptors. Because chronic toxicity values (RfCs and RELs) are based on a continuous exposure, an adjustment is sometimes necessary or appropriate to account for shorter receptor exposure periods (i.e., people working at business/commercial properties who are exposed for only 8 hours per day, 5 days per week). While EPA risk assessment guidance recommends adjusting to account for periodic instead of continuous exposure, OEHHA does not employ this practice. For the purpose of this evaluation, an RfC or REL of 5 $\mu g/m^3$ was used as the chronic risk-based concentration for all scenarios where receptors could be exposed frequently (e.g., residences, work places, or schools).

Table 4-5 shows chronic HQs at the maximally exposed receptors near the Project Oxford Data Center attributable to DEEP exposure from all sources. HQs are more than 45 times lower than 1.0 for all receptors' cumulative exposure to DEEP. This indicates that non-cancer effects are not likely to result from chronic exposure to DEEP in the vicinity of the Project Oxford Data Center.

4.4.1.2 Combined Hazard Quotient for All Pollutants Whose Emission Rates Exceed SQER

The non-cancer health impacts were evaluated based on the conservatively high emission rates during the maximum theoretical 12-month period. Five TAPs (i.e., DEEP, NO_2, CO, ammonia, and acrolein) to be emitted by the Project Oxford Data Center have emission rates exceeding their respective SQERs and, therefore, are subject to further evaluation. The receptor locations of concern are the maximally impacted boundary receptor (MIBR), the maximally impacted commercial receptors (MICR), the maximally impacted residential receptor (MIRR), the nearest school and hospital, and the maximally impacted house in the modeling domain. Tables 4-6 through 4-10 show modeled concentrations, risk-based concentrations (RBCs), and HQs for each receptor point. All modeled concentrations and RBCs are reported in $\mu g/m^3$. The chronic HQ for each location is the annual time-weighted average (TWA) HQ for DEEP (the only TAP with an emission rate above the SQER with a chronic RBC). The acute hazard index (HI) for each location is the sum of the 1-hour TWA HQs for NO_2, CO, ammonia, and acrolein.

Table 4-6 shows the impacts at the MIBR for DEEP, NO_2, CO, ammonia, and acrolein. The acute HI of 0.81 and the chronic HQ of 0.018 for the combined pollutants are lower than 1.0. This indicates that the MIBR is not likely to experience either acute or chronic non-cancer health effects attributable to emissions from the Project Oxford Data Center.

Table 4-7 shows the impacts at the MICR for DEEP, NO_2, CO, ammonia, and acrolein. The acute HI of approximately 0.54 and the chronic HQ of approximately 0.0061 for the combined pollutants are lower than 1.0. This indicates that the MICR is not likely to experience either acute or chronic non-cancer health effects attributable to emissions from the Project Oxford Data Center.

Table 4-8 shows the impacts at the MIRR for DEEP, NO_2, CO, ammonia, and acrolein. The acute HI of approximately 0.47 and the chronic HQ of 0.0031 for the combined pollutants are lower than 1.0. This indicates that the MIRR is not likely to experience either acute or chronic non-cancer health effects attributable to emissions from the Project Oxford Data Center.

Table 4-9 shows the impacts at the nearest school for DEEP, NO_2, CO, ammonia, and acrolein. The acute HI of approximately0.31 and the chronic HQ of 0.0010 for the combined pollutants are lower than 1.0. This indicates that receptors attending the nearest school are not likely to experience either acute or chronic non-cancer health effects attributable to emissions from the Project Oxford Data Center.

Table 4-10 shows the impacts at the nearest hospital for DEEP, NO_2, CO, ammonia, and acrolein. The acute HI of approximately 0.42 and the chronic HQ of 0.0006 for the combined pollutants are lower than 1.0. This indicates that the receptors at the nearest hospital are not likely to experience either acute or chronic non-cancer health effects attributable to emissions from the Project Oxford Data Center.

The information in Table 4-6 through 4-10 suggests that both chronic and acute health effects are unlikely to occur even under worst-case conditions at the maximally impacted locations. At times when unfavorable air dispersion conditions occur coincident with a maximum operating scenario, the combined HQs (i.e., the hazard index) from DEEP, NO_2, CO, ammonia, and acrolein are modeled to be less than 1. If the HQ or HI is less than 1, then the risk is considered acceptable.

4.4.2 QUANTIFYING AN INDIVIDUAL'S INCREASED CANCER RISK

4.4.2.1 Cancer Risk from Exposure to DEEP

Cancer risk is estimated by determining the concentration of DEEP at each receptor point and multiplying it by its respective URF. Because URFs are based on a continuous exposure over a 70-year lifetime, exposure duration and exposure frequency are important considerations.

The formula used to determine cancer risk is as follows:

$$Risk = \frac{C_{Air} \times URF \times EF1 \times EF2 \times ED}{AT}$$

The exposure frequencies for each receptor type are shown below, based on Ecology's judgment from review of published risk evaluation guidelines.

EXPOSURE FREQUENCIES FOR EACH RECEPTOR TYPE

Parameter	Description	Value Based on Receptor Type						Units
		Residential	Worker	School-Staff	School-Student	Hospital	Boundary	
C_{Air}	Concentration in air at the receptor	See Table 4-3						µg/m^3
URF	Unit Risk Factor	0.0003						(µg/m^3)$^{-1}$
EF1	Exposure Frequency	365	250	200	180	365	250	Days/Year
EF2	Exposure Frequency	24	8	8	8	24	2	Hours/Day
ED	Exposure Duration	70	40	40	7 (Elem) 4 (HS & College)	1	30	Years
AT	Averaging Time	613,200						Hours

Based on the factors listed above, Table 4-11 shows the resulting unit risk factor for each exposure scenario.

Current regulatory practice assumes that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are, therefore, not yes or no answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the magnitude of a cancer threat because any level of a carcinogenic contaminant carries an associated risk. The validity of this approach for all cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered carcinogenic must exceed a threshold of tolerance before initiating cancer. For such chemicals, risk estimates are not appropriate. Guidelines on cancer risk from the EPA reflect the potential that thresholds for some carcinogenesis exist. However, the EPA still assumes no threshold unless sufficient data indicate otherwise.

In this document, cancer risks are reported using scientific notation to quantify the increased cancer risk of an exposed person, or the number of excess cancers that might result in an exposed population. For example, a cancer risk of 1 x 10^{-6} means that if 1 million people are exposed to a carcinogen, one excess cancer might occur, or a person's chance of getting cancer in their lifetime increases by 1 in 1 million or 0.0001 percent. Note that these estimates are for excess cancers that might result in addition to those normally expected in an unexposed population. Cancer risks quantified in this document are upper-bound theoretical estimates. In other words, each is the estimate of the plausible upper limit, or highest likely true value of the quantity of risk.

Table 4-12 shows ranges of estimated worst-case residential, business, school, hospital, and fenceline receptor increased cancer risks attributable to DEEP exposure near the Project Oxford Data Center. Two sets of analyses are shown in the table. The top part of the table shows the conservatively high results assuming that the DEEP emissions from the Project Oxford generators consist of the total particulate matter (front-half plus back-half). The bottom part of the table shows the results assuming the DEEP emissions from the Project Oxford generators consist of the filterable front-half particulates. Using the more conservative calculation method, the cancer risks attributable to the proposed project are less than 1 in 100,000 (1 x 10^{-5}). The highest risk caused solely by the Project Oxford emissions occurs at the residential home to the north of the Project Oxford Data Center (4.1 x 10^{-6}). Under Chapter 173-460 WAC, Ecology may recommend approval of a project if the applicant demonstrates that the increase in emissions of TAPs (caused solely by the Project Oxford emissions) is not likely to result in an increased cancer risk of more than 1 in 100,000 (1 x 10^{-5}).

As part of the second-tier risk evaluation, Ecology also considers the cumulative impacts of DEEP emissions in the project vicinity. Note that Chapter 173-460 WAC does not currently contain a numerical limit on allowable cumulative cancer risks. However, Ecology has indicated that new sources of DEEP may not be approved to locate in Quincy if the resulting cumulative cancer risk is above 100 in 1 million.

The results, as shown in Table 4-12, indicate that the cumulative cancer risk for the maximally impacted current residential receptor near the Project Oxford Data Center is approximately 33 in 1 million. This risk occurs at an existing residence to the southeast of the facility, adjacent to SR 28, in a location where about 86 percent of the cumulative risk is attributable to roadway emissions. The maximum cumulative cancer risk at an existing industrial business to the south of the Project Oxford Data Center is 4.3 in 1 million. The maximum cumulative cancer risk at an existing school to the southeast of the Project Oxford Data Center is approximately 0.32 in 1 million. The maximum cumulative cancer risk to patients at an existing hospital or medical facility to the southeast of the Project Oxford Data Center is 0.38 in 1 million.

4.4.2.2 Cancer Risk from Exposure to All Potential Substances

Based on the estimated emissions of all potentially carcinogenic compounds from the proposed project alone, the emission rates for all of the carcinogenic constituents are less than Ecology's SQERs except for DEEP. The SQERs are Ecology's screening threshold emission rates below which the WAC 173-460 regulation indicates there is negligible potential for ambient air quality impacts. The maximum permitted emission rates for most toxic pollutants to be emitted from the proposed project are less than their respective SQERs. Regardless of the SQER comparison, the emission rate for every carcinogenic constituent was considered in the cumulative cancer analysis, which is shown in Table 4-13.

As indicated in Table 4-13, the cancer risk associated with DEEP alone at the MIRR (R-1, the north residence) is 4.1 per million. The other recognized carcinogenic compounds contribute negligibly to the overall cancer risk (i.e., 0.003 per million). The combined cancer risk caused by all constituents is 4.1 per million.

5.0 UNCERTAINTY CHARACTERIZATION

Many factors of the HIA are prone to uncertainty. Uncertainty relates to the lack of exact knowledge regarding many of the assumptions used to estimate the human health impacts of DEEP emissions from the proposed project and “background” sources of DEEP. The assumptions used in the face of uncertainty may tend to overestimate or underestimate the health risks estimated in the HIA.

5.1 EMISSION FACTOR AND EXPOSURE UNCERTAINTY

One of the major uncertainties is the emission factors for TAPs emitted by diesel engines. The forecast emission rates for particulate matter used for this analysis were based on the upper range of vendor estimates for emission controls capable of achieving the emission standards set by the Tier 4 (Final) emission regulation. For this analysis, it was conservatively assumed that all of the particulate matter emitted from diesel engine generators (including both the filterable “front-half” and the condensable “back-half” fractions) is DEEP, with the highest level of cancer potency. The forecast emission rates for NO_2 were based on the conservatively high assumption that NO_2 comprised 10 percent of the emitted NO_x. The emission rates for the other TAPs were based on published emission factor data from the EPA, which are believed to be conservatively high because they were developed based on historical testing of older-technology engines. A 90 percent removal efficiency was assumed for organic compound emissions that were calculated based on emission factor data from the EPA.

It is difficult to characterize the amount of time that people will be exposed to DEEP emissions from the proposed Project Oxford Data Center. For simplicity, this analysis assumed that a residential receptor is at one location for 24 hours per day, 365 days per year for 70 years. These assumptions tend to overestimate exposure.

The duration and frequency of power outages is also uncertain. For this permit application, Microsoft conservatively estimated that it will use the diesel engine generators during emergency outages for no more than 24 hours per year. In reality, Microsoft staff have reported that there have been only a small number of unplanned power outages lasting a total of only several hours at the nearby Columbia Data Center since it began operations in 2007 (Fierbaugh, D., 2013, personal communication). While this high level of historical reliability provides some assurance that power service is relatively stable, Microsoft cannot predict future outages with any degree of certainty. Microsoft accepted a limit of 24 hours per year for emergency operations, and estimated that this limit should be more than sufficient to meet its emergency demands. It is expected that estimates of cancer risks will be significantly overestimated by assuming diesel engine generators will operate annually at the maximum permitted level (including 24 hours of power outages every year) for 70 consecutive years.

5.2 AIR DISPERSION MODELING UNCERTAINTY

The transport of pollutants through the air is a complex process. Regulatory air dispersion models have been developed to estimate the transport and dispersion of pollutants as they travel through the air. The models are frequently updated as techniques that are more accurate become known, but are developed to avoid underestimating the modeled impacts. Even if all of the numerous input parameters to an air dispersion model are known, random effects found in the real atmosphere will introduce uncertainty. Typical of the class of modern steady-state Gaussian dispersion models, the AERMOD model used for the Project Oxford Data Center analysis will likely slightly overestimate the short-term (24-hour average) impacts and somewhat underestimate the annual pollutant concentrations. The expected magnitude of the uncertainty is probably similar to the emissions uncertainty and much lower than the toxicity uncertainty.

5.3 TOXICITY UNCERTAINTY

One of the largest sources of uncertainty in any risk evaluation is associated with the scientific community's limited understanding of the toxicity of most chemicals in humans following exposure to the low concentrations generally encountered in the environment. To account for uncertainty when developing toxicity values (e.g., RfCs), the EPA and other agencies apply "uncertainty" factors to doses or concentrations that were observed to cause non-cancer effects in animals or humans. The EPA applies these uncertainty factors so that it derives a toxicity value that is considered protective of humans including susceptible populations. In the case of the DEEP RfC, the EPA acknowledges (EPA 2002):

> "… the actual spectrum of the population that may have a greater susceptibility to diesel exhaust (DE) is unknown and cannot be better characterized until more information is available regarding the adverse effects of diesel particulate matter (DPM) in humans."

Quantifying DEEP cancer risk is also uncertain. Although the EPA classifies DEEP as probably carcinogenic to humans, it has not established a URF for quantifying cancer risk. In its health assessment document, the EPA determined that "human exposure-response data are too uncertain to derive a confident quantitative estimate of cancer unit risk based on existing studies" (EPA 2002). However, the EPA suggested that a URF based on existing DEEP toxicity studies would range from 1×10^{-5} to 1×10^{-3} per $\mu g/m^3$. OEHHA's DEEP URF (3×10^{-4} per $\mu g/m^3$) falls within this range. Regarding the range of URFs, the EPA states in its health assessment document for diesel exhaust (EPA 2002):

> "Lower risks are possible and one cannot rule out zero risk. The risks could be zero because (a) some individuals within the population may have a high tolerance to exposure from [diesel exhaust] and therefore not be susceptible to the cancer risk from environmental exposure, and (b) although evidence of this has not been seen, there could be a threshold of exposure below which there is no cancer risk."

Other sources of uncertainty cited in the EPA's health assessment document for diesel exhaust are:

- Lack of knowledge about the underlying mechanisms of DEEP toxicity.
- The question of whether historical toxicity studies of DEEP based on older engines is relevant to current diesel engines. It is likely that the mixture of pollutants emitted by new-technology diesel engines (such as those proposed by Microsoft) is different from older technology engines.

Table 5-1 presents a summary of how the uncertainty affects the quantitative estimate of risks or hazards.

6.0 OTHER CONSIDERATIONS

6.1 SHORT-TERM EXPOSURE TO DEEP AND $PM_{2.5}$

As discussed previously, exposure to DEEP can cause both acute and chronic health effects. However, as discussed in Section 4.3.1, reference toxicological values specifically for DEEP exposure at short-term or intermediate intervals (e.g., 24-hour values) do not currently exist. Therefore, short-term risks from DEEP exposure are not quantified in this assessment. Regardless, not quantifying short-term health risks in this document does not imply that they have not been considered. Instead, it is assumed that compliance with the 24-hour NAAQS for particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$) is an indicator of acceptable short-term health effects from DEEP exposure. In our analysis, we assumed all DEEP emissions to be $PM_{2.5}$. The NOC Supporting Information report (Landau Associates 2014b) concludes that emissions from the proposed project are not expected to cause or contribute to an exceedance of any NAAQS.

6.2 SHORT-TERM EXPOSURE TO OTHER TOXIC AIR POLLUTANTS

The impacts of short-term emission rates of other TAPs from the Project Oxford Data Center have not been evaluated in detail in this document because only DEEP emissions from the project exceeded the ASIL. Because emissions of other TAPs from the project were below the ASIL, no further review was required for those pollutants. Emissions below the ASIL suggest that increased health risks from these project-related pollutants are acceptable.

7.0 DISCUSSION OF ACCEPTABILITY OF RISK WITH REGARD TO SECOND-TIER REVIEW GUIDELINES

7.1 PROJECT-ONLY CANCER RISKS ARE LOWER THAN 10-PER-MILLION

As noted above, the modeled worst-case TAP concentrations at the facility boundary caused solely by emissions from the proposed project are less than the ASIL values established by Ecology for all pollutants, with the exception of DEEP. The worst-case emission rates are less than the SQERs for most pollutants, with the exception of DEEP, NO_2, CO, ammonia, and acrolein. The long-term uncontrolled cancer risks at the nearby residences, businesses, and sensitive receptor locations range from 0.01 to 4.1 per million for DEEP and are much lower for the other TAPs considered in this analysis. The overall cancer risk at any of the maximally exposed residential, business, and sensitive receptors, caused solely by emissions from the proposed project, is estimated to be less than the 10-per-million threshold that has been established by Ecology under its second-tier review criteria.

7.2 CUMULATIVE CANCER RISK

The residences and businesses that will be exposed to the highest cumulative cancer risk are located south of the Project Oxford Data Center near the railroad and SR 28, in locations where most of the cancer risk is attributable to trucks and trains unrelated to the Project Oxford Data Center. The total 70-year average cumulative DEEP cancer risks for the maximally exposed home, business, and sensitive receptors are as follows:

Project Oxford-only cancer risk (R-2 SE residence):	1.3 per million
Background DEEP cancer risk:	31.3 per million
Cumulative DEEP cancer risk:	32.6 per million
Project Oxford-only cancer risk (C-1 S industrial building):	1.0 per million
Background DEEP cancer risk:	3.3 per million
Cumulative DEEP cancer risk:	4.3 per million

Note, as presented above, the increased cancer risk associated with DEEP emissions from the proposed Project Oxford Data Center is about 4 percent of the total cumulative DEEP cancer risk at receptor R-2.

7.3 NON-CANCER RISK HAZARD QUOTIENT <1.0

As described previously, based on using the theoretical maximum 12-month emission rates, the maximum HQ related to Project Oxford-only annual-average DEEP impacts at any maximally impacted receptor is 0.02. The maximum HI for cumulative impacts caused by emissions of DEEP, NO_2, CO, ammonia, and acrolein is only 0.81. This confirms that emissions from Microsoft's proposed project are unlikely to cause non-cancer impacts.

8.0 SIGNATURES

This document has been prepared under the supervision and direction of the following key staff.

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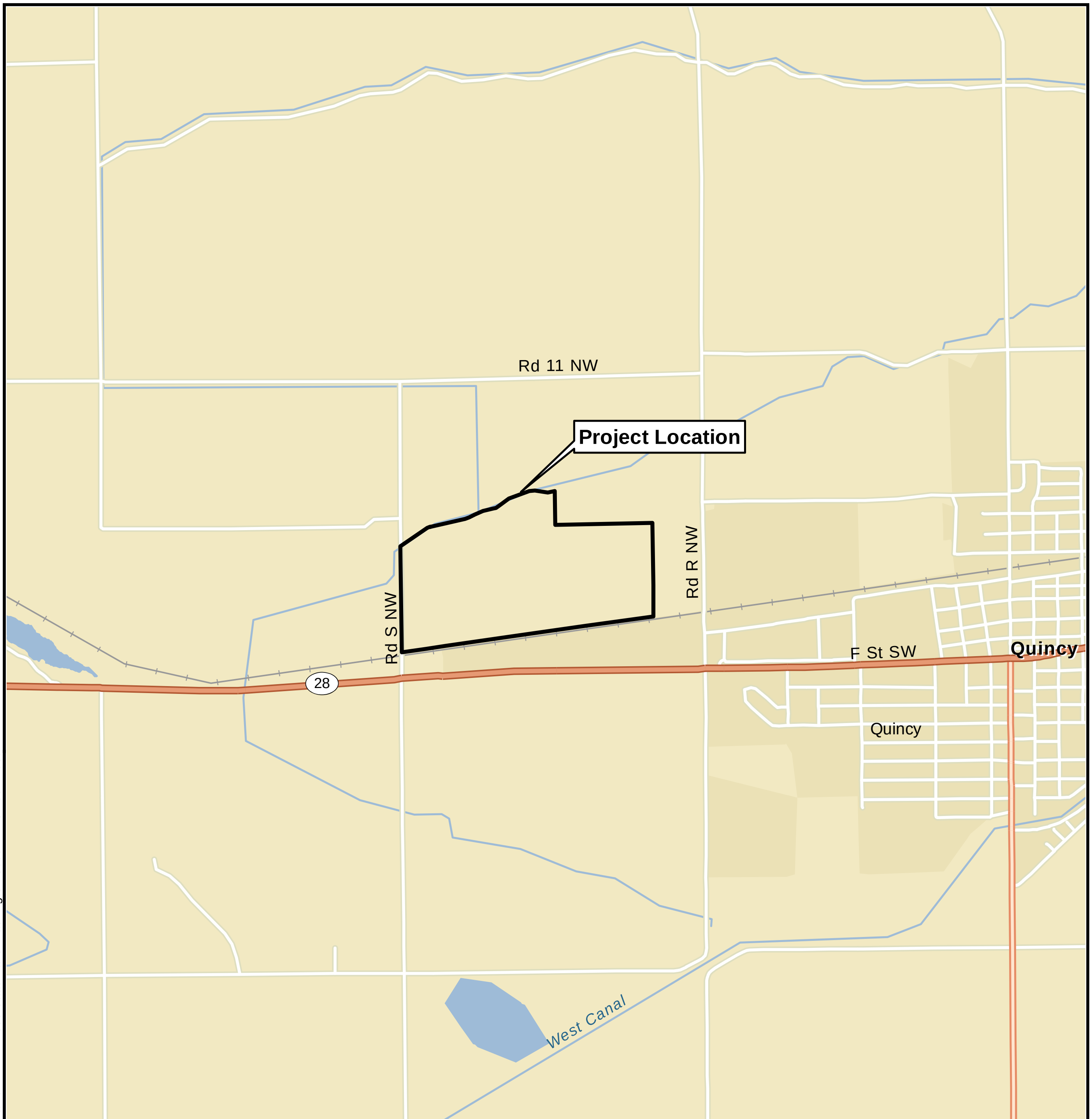

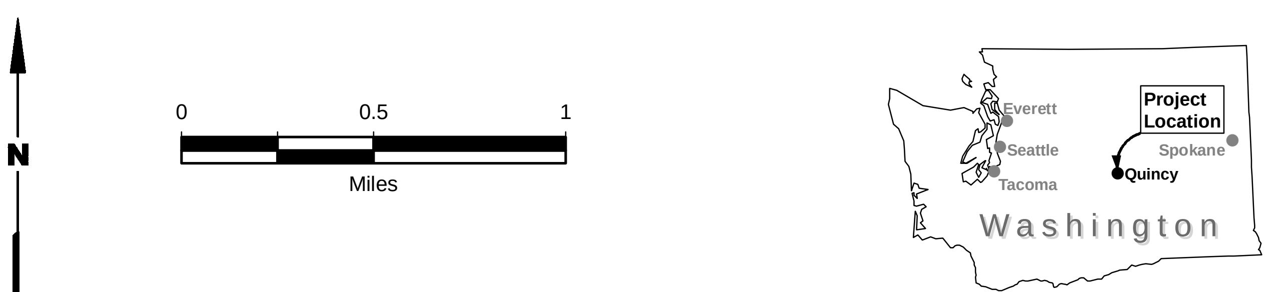

Data Source: Esri 2012.

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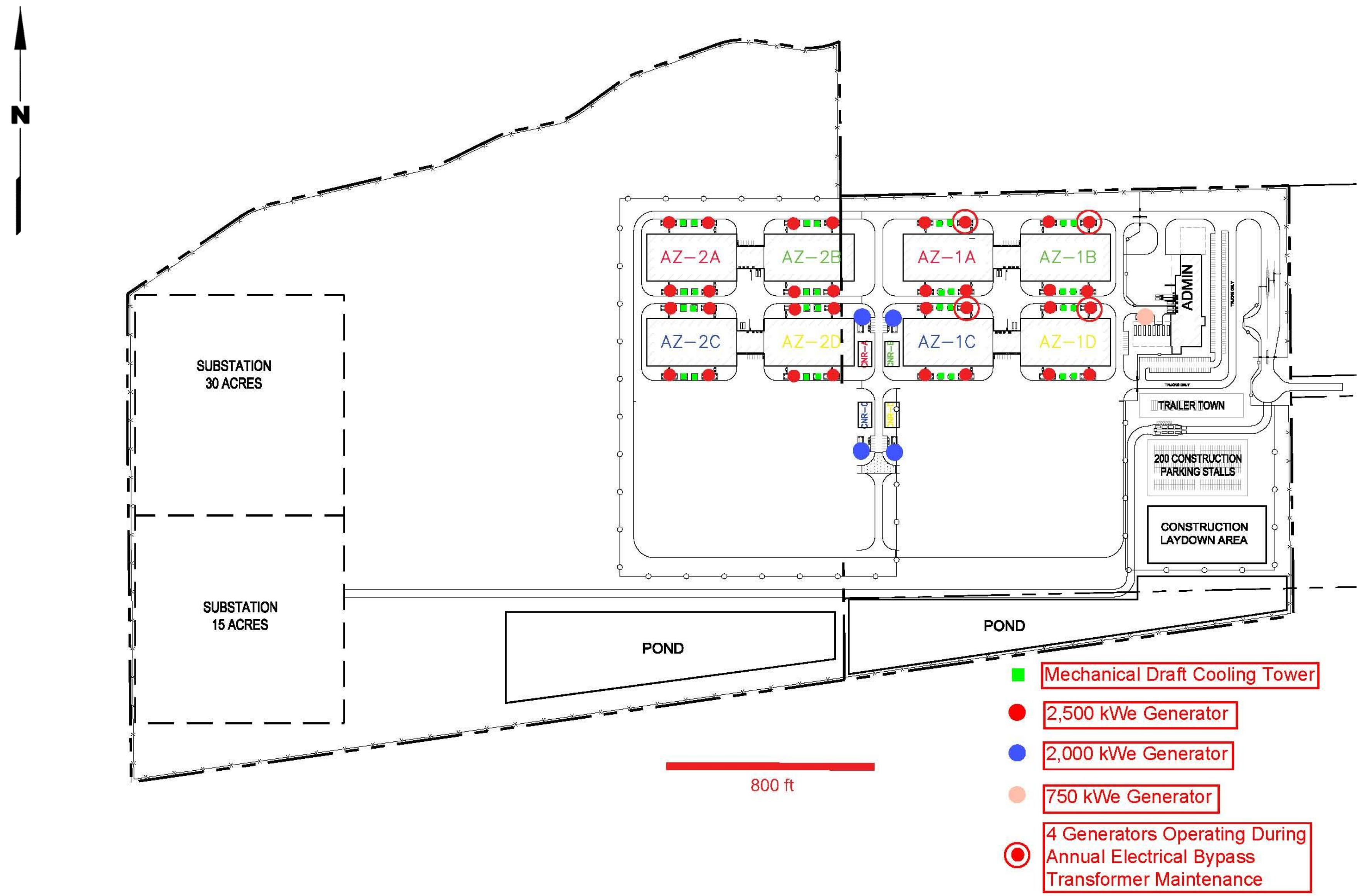
Project Oxford Data Center Quincy, Washington	**Vicinity Map**	Figure 2-1



Data Source: Microsoft

Project Oxford Data Center Quincy, Washington	**Site Plan**	Figure 2-2

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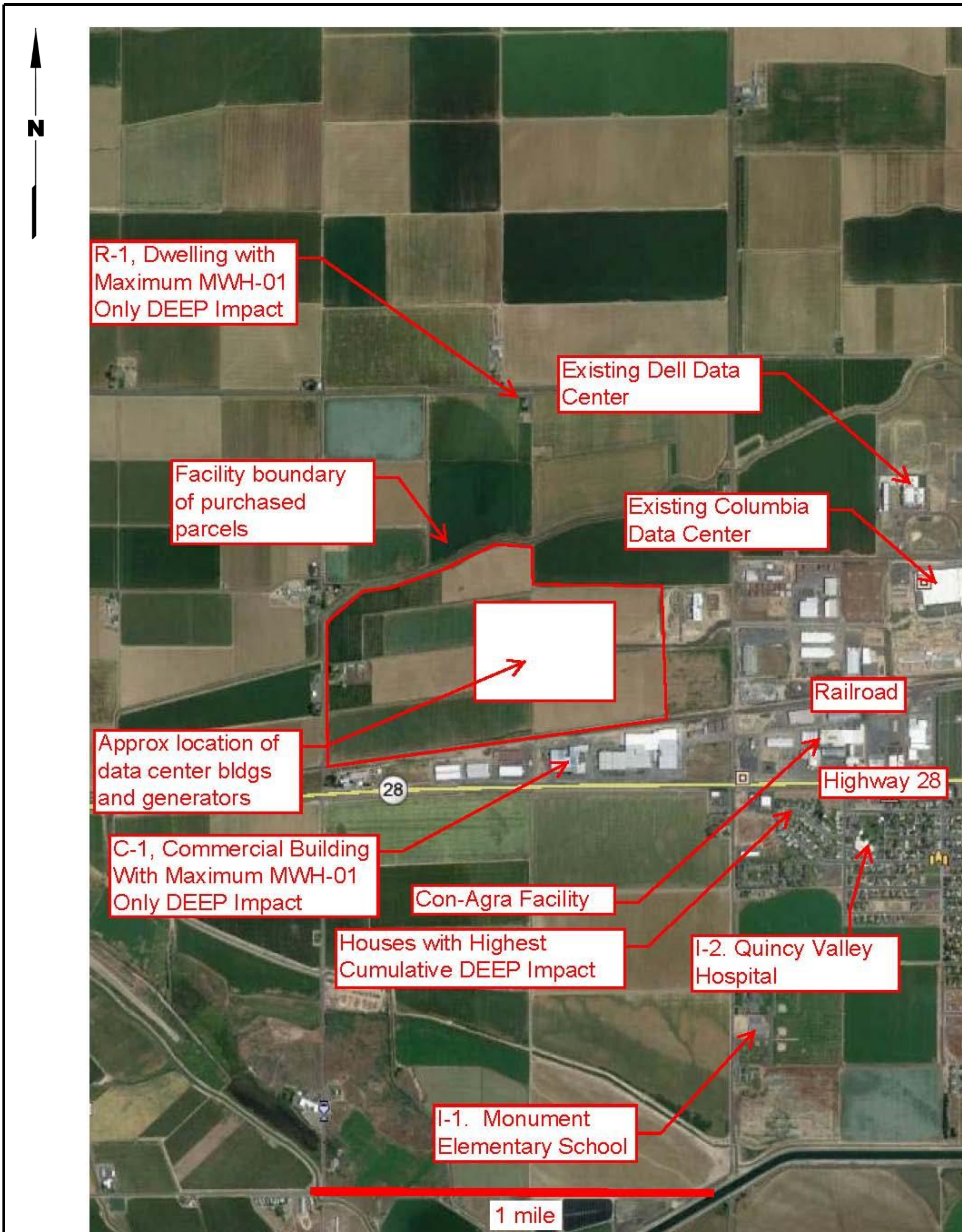

Data Source: Google Earth 2013

Project Oxford Data Center Quincy, Washington	**Land Use in the Vicinity of the Proposed Project Oxford Data Center**	Figure 2-3

Landau Associates

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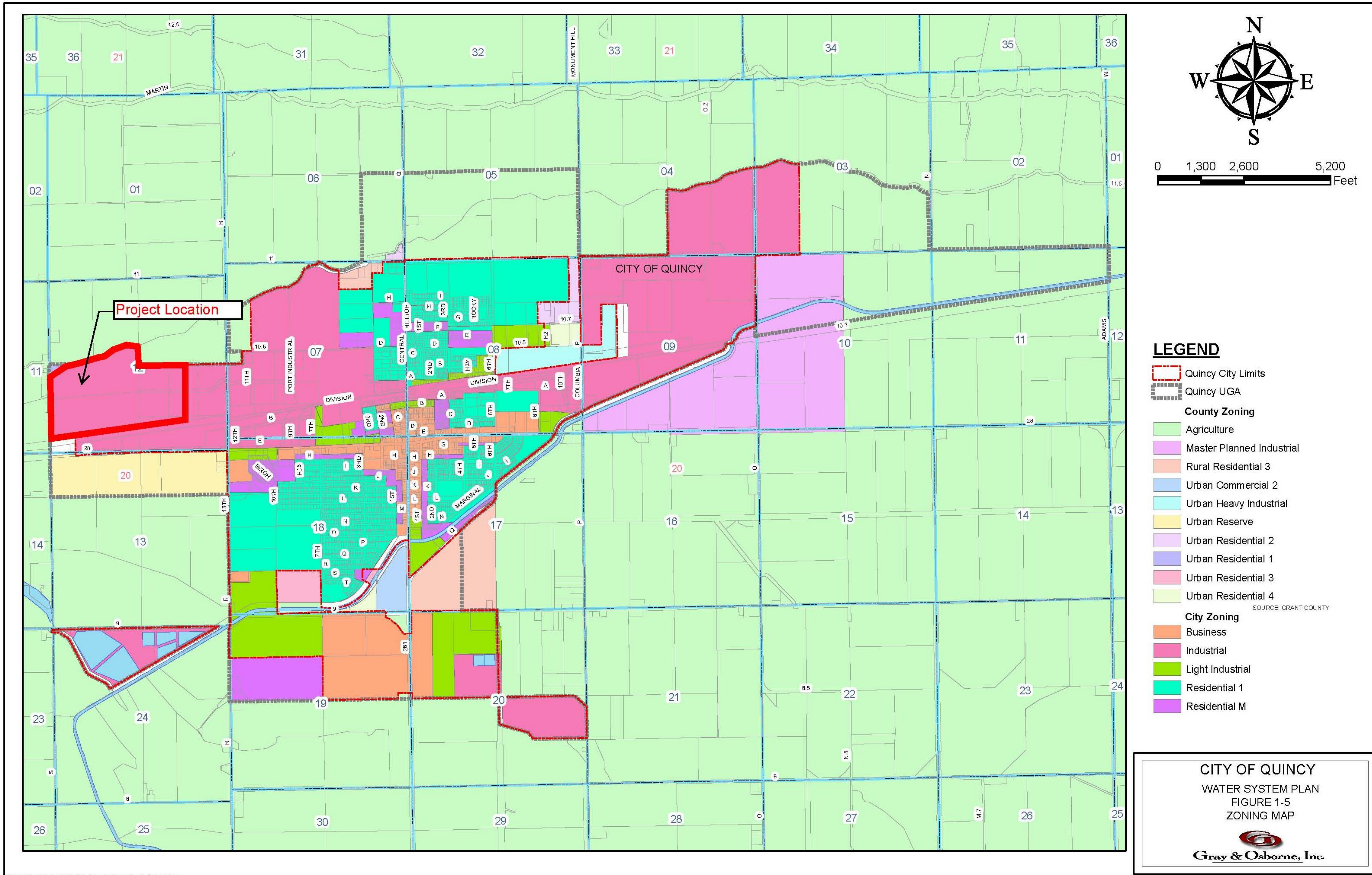

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Project Oxford Data Center
Quincy, Washington

Detailed Zoning Map for the Vicinity of the Proposed Project Oxford Data Center

Figure 2-4

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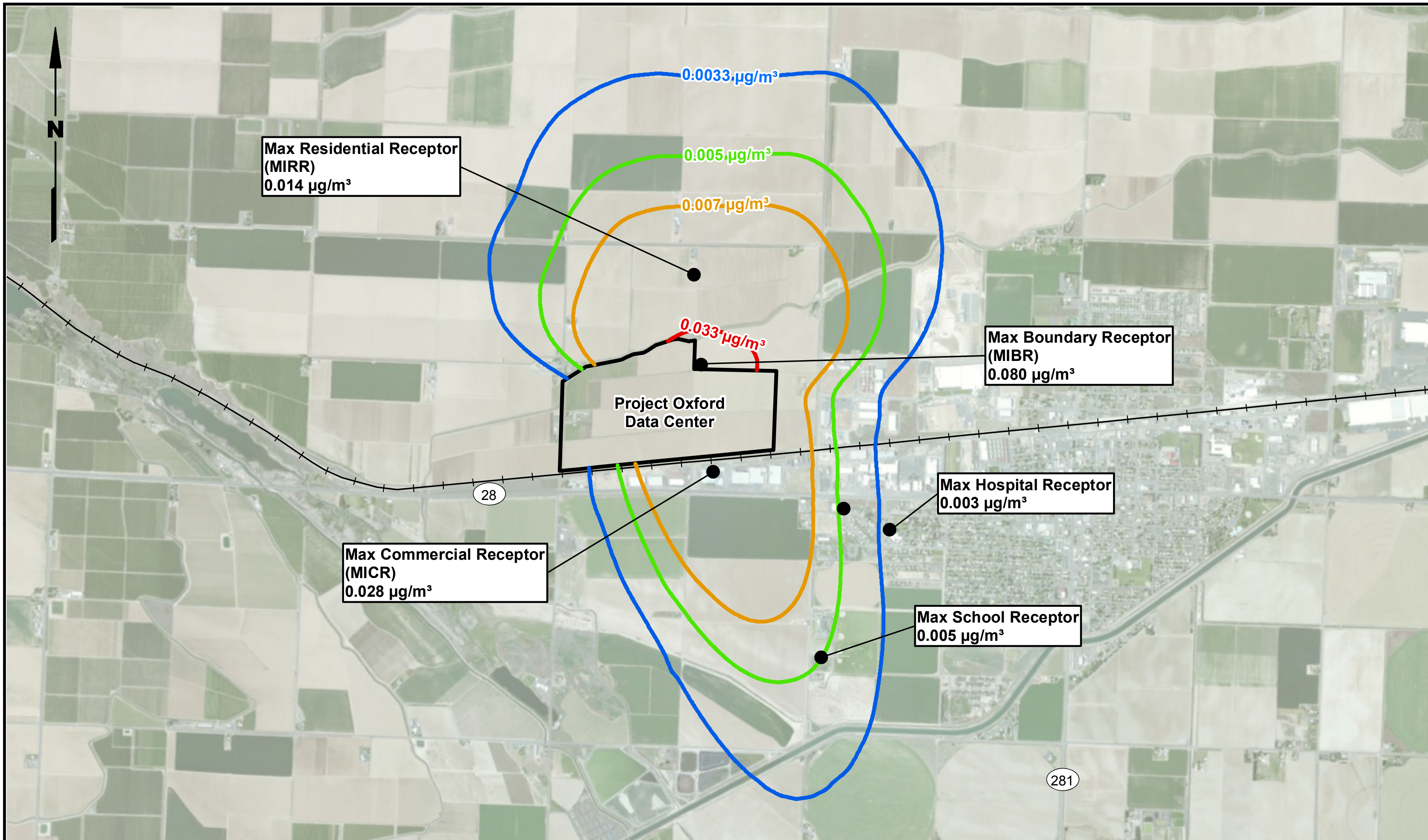

Legend

DEEP Concentrations
- 0.0033 µg/m³
- 0.005 µg/m³
- 0.007 µg/m³
- 0.033 µg/m³

Microsoft Project Oxford Data Center Fenceline

Railroads

0 3,000 6,000
Scale in Feet

Data Sources: Grant County GIS; Esri World Imagery.

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Project Oxford Data Center
Quincy, Washington

70-Year Average DEEP Concentrations Caused Solely by Emissions from Project Oxford

Figure
4-1

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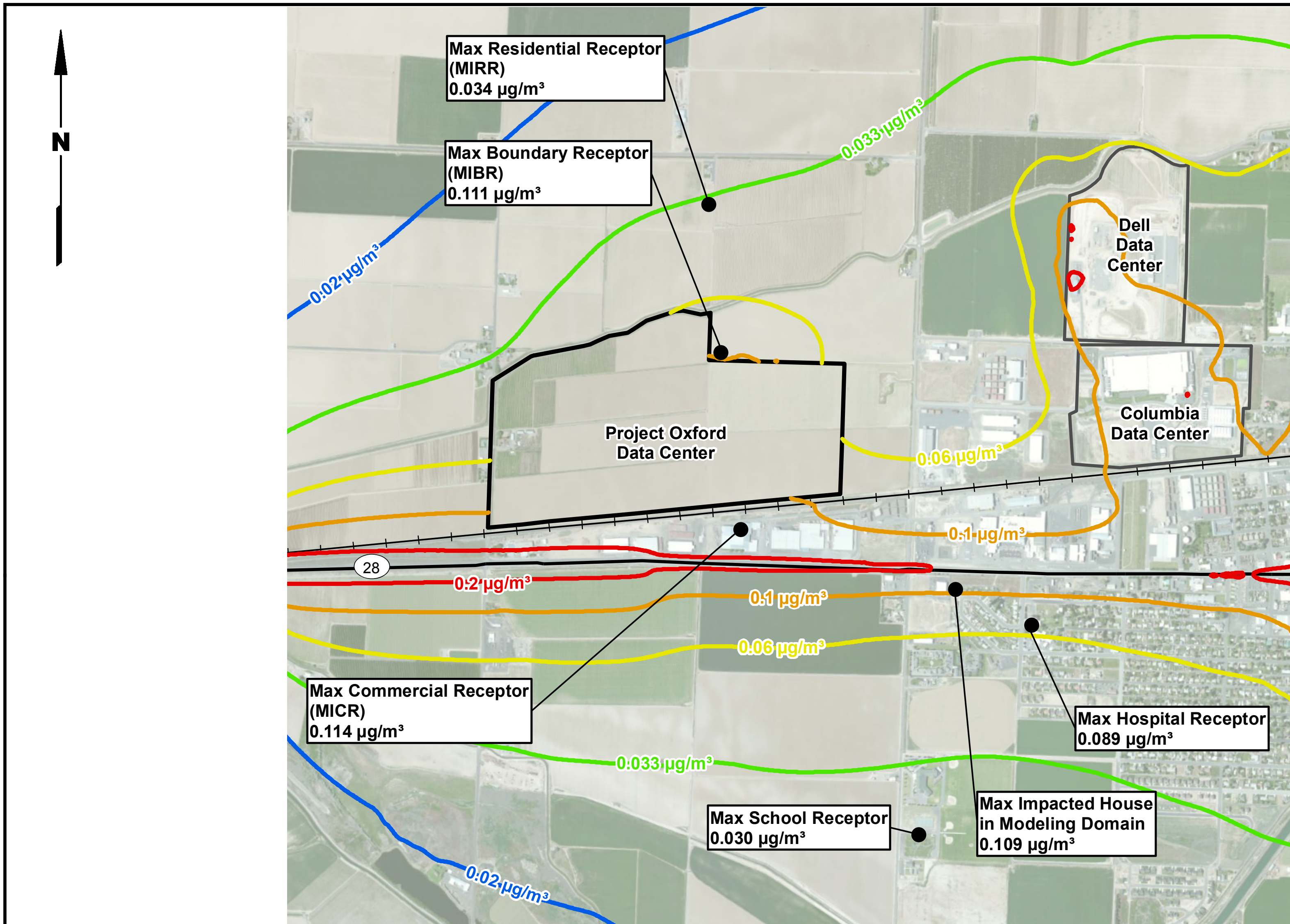

Legend

DEEP Concentrations
- 0.02 µg/m³
- 0.033 µg/m³
- 0.06 µg/m³
- 0.1 µg/m³
- 0.2 µg/m³

Microsoft Project Oxford Data Center Fenceline

Railroads

0 2,000 4,000

Scale in Feet

Data Sources: Grant County GIS; Esri World Imagery.

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Project Oxford Data Center
Quincy, Washington

70-Year Average Cumulative DEEP Concentrations Caused by Emissions from Project Oxford and Background Sources

Figure 4-2

TABLE 2-1
EMERGENCY GENERATOR RUNTIME SCENARIOS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Runtime Event	**Annual Hours/Year of Runtime at Indicated Load**		
	Idle (10% Load)	**80% Load**	**100% Load**
Annual Events			
Total Annual Runtime for Combined Runtime Scenarios	29 hrs/yr for combined weekly testing and generator cool down .	40 hrs/yr for combined emergency power outages and electrical bypass for transformer maintenance.	17.5 hrs/yr for combined monthly load bank testing, semiannual load bank testing, and as-needed generator corrective maintenance.
One-Time-Only or Infrequent Events Accounted for in 70-Year Average DEEP Risk Assessment			
Initial Generator Commissioning (30 hours per generator, conducted once during the 70-year averaging period)	Not applicable	Each generator is tested once for 40 hrs. Distributed over 70 years, this is equivalent to 40/70 or 0.6 hrs/yr.	Not applicable
Periodic Stack Emission Testing on 3-yr cycle (2 generators per year)	Not applicable	Each generator runs for 30 hrs/test. Distributed over 24 years this is equivalent to 30/24 or 1.25 hours/year for each generator.	Not applicable

Note: Detailed breakdown of the daily, weekly, monthly, and annual runtime hours for each operating scenario are provided in NOC application.

TABLE 2-2
MAXIMUM FACILITY-WIDE GENERATOR EMISSION RATES
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Pollutant	Uncontrolled Emission Factor			Removal Efficiency	Maximum Emission Rates (Total)		
	Factor	Units	Source		(lbs/hr)	(lbs/day)	(tons/year)
NO_X	Tier 4-Compliant Engine with Cold Start Factors			Incorporated	352	3,641	8.7
$PM_{2.5}$/DEEP (Total PM, Front-Half plus Back-Half)	Tier 4-Compliant Engine with Cold Start Factors			Incorporated	11	252	0.531 (70-yr average) 0.536 (Max 12-month)
$PM_{2.5}$/DEEP (Front-Half Only)	Tier 4-Compliant Engine with Cold Start Factors			Incorporated	2.6	60	0.126 (70-year average)
CO	Tier 4-Compliant Engine with Cold Start Factors			Incorporated	593	13,166	16.1
VOC	Tier 4-Compliant Engine with Cold Start Factors			Incorporated	30.3	699	0.81
Ammonia	Tier-4-Compliant Engine, No Cold Start Emissions			Incorporated	22.7	545	0.70
SO_2	Fuel sulfur mass balance			Incorporated	1.16	27.9	0.047
Primary Nitrogen Dioxide (NO_2)	10% of primary NO_X			Incorporated	35.2	363	0.87
Benzene	7.76E-04	lbs/MMBTU	AP-42 Sec 3.4	90%	5.88E-02	1.41E+00	2.24E-03
Toluene	2.81E-04	lbs/MMBTU	AP-42 Sec 3.4	90%	2.13E-02	5.11E-01	8.11E-04
Xylenes	1.93E-04	lbs/MMBTU	AP-42 Sec 3.4	90%	1.46E-02	3.51E-01	5.57E-04
1,3-Butadiene	3.91E-05	lbs/MMBTU	AP-42 Sec 3.3	90%	2.96E-03	7.11E-02	1.13E-04
Formaldehyde	7.89E-05	lbs/MMBTU	AP-42 Sec 3.4	90%	5.98E-03	1.43E-01	2.28E-04
Acetaldehyde	2.52E-05	lbs/MMBTU	AP-42 Sec 3.4	90%	1.91E-03	4.58E-02	7.27E-05
Acrolein	7.88E-06	lbs/MMBTU	AP-42 Sec 3.4	90%	5.97E-04	1.43E-02	2.27E-05
Benzo(a)Pyrene	2.57E-07	lbs/MMBTU	AP-42 Sec 3.4	90%	1.95E-05	4.67E-04	7.42E-07
Benzo(a)anthracene	6.22E-07	lbs/MMBTU	AP-42 Sec 3.4	90%	4.71E-05	1.13E-03	1.79E-06
Chrysene	1.53E-06	lbs/MMBTU	AP-42 Sec 3.4	90%	1.16E-04	2.78E-03	4.42E-06
Benzo(b)fluoranthene	1.11E-06	lbs/MMBTU	AP-42 Sec 3.4	90%	8.41E-05	2.02E-03	3.20E-06
Benzo(k)fluoranthene	2.18E-07	lbs/MMBTU	AP-42 Sec 3.4	90%	1.65E-05	3.96E-04	6.29E-07
Dibenz(a,h)anthracene	3.46E-07	lbs/MMBTU	AP-42 Sec 3.4	90%	2.62E-05	6.29E-04	9.98E-07
Ideno(1,2,3-cd)pyrene	4.14E-07	lbs/MMBTU	AP-42 Sec 3.4	90%	3.14E-05	7.53E-04	1.19E-06
Naphthalene	1.30E-04	lbs/MMBTU	AP-42 Sec 3.4	90%	9.85E-03	2.36E-01	3.75E-04
Propylene	2.79E-03	lbs/MMBTU	AP-42 Sec 3.4	90%	2.11E-01	5.07E+00	8.05E-03

TABLE 2-3
GENERAL LAND USE ZONES NEAR THE PROJECT OXFORD DATA CENTER
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Direction From Microsoft Project Oxford Data Center	Zoning (from Quincy and Grant County zoning maps)	Notable Development
North	Grant County Agriculture	Agricultural; single-family farm houses
East	City Industrial (G-I)	120 x 360 ft rectangular industrial building; Port of Quincy property
West	Grant County Agriculture	Agricultural; single-family farm houses
South	City Industrial (G-I), Grant County Commercial and Grant County Urban Reserve, followed by Grant County Agricultural	Industrial buildings

TABLE 3-1
SUMMARY OF BACT DETERMINATION FOR DIESEL ENGINE GENERATORS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Pollutant(s)	BACT Determination
Particulate matter (PM)	Use of good combustion practices; Use of EPA Tier 2-certified engines; and Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII
Nitrogen oxides (NO_x)	Use of good combustion practices; Use of EPA Tier 2-certified engines; and Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII
Carbon monoxide (CO) and volatile organic compounds (VOCs)	Use of good combustion practices; Use of EPA Tier 2-certified engines; and Compliance with the operation and maintenance restrictions of 40 CFR Part 60, Subpart IIII
Sulfur dioxide (SO_2)	Use of ultra-low sulfur diesel fuel containing no more than 15 parts per million by weight of sulfur

TABLE 3-2
SUMMARY OF TBACT DETERMINATION FOR AIR TOXICS FOR DIESEL ENGINE GENERATORS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Toxic Air Pollutant(s)	tBACT Determination
DEEP	Compliance with the PM BACT requirement
Acetaldehyde, carbon monoxide, acrolein, benzene, benzo(a)pyrene, 1,3-butadiene, formaldehyde, propylene, toluene, total PAHs, xylenes	Compliance with the VOC BACT requirement
Nitrogen dioxide	Compliance with the NO_x BACT requirement
Ammonia	Limit ammonia slip to 15 parts per million dry basis at an oxygen concentration of 15 percent
Sulfur dioxide	Compliance with the SO_2 BACT requirement

TABLE 3-3
SMALL-QUANTITY EMISSION RATES COMPARISON FOR TOXIC AIR POLLUTANTS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Pollutant	CAS Number	SQER		Facility Emissions		SQER Ratio	SQER Exceeded?
Generator TAPs							
DEEP (Maximum 12-month Period)	None	0.639	lbs/yr	1,072	lbs/yr	1,677	**Yes**
CO	630-08-0	50.2	lbs/hour	592.9	lbs/hour	12	**Yes**
SO_2		1.45	lbs/hour	1.2	lbs/hour	0.80	No
NO_2	10102-44-0	1.03	lbs/hour	35.2	lbs/hour	34	**Yes**
Ammonia	7664-41-7	9.3	lbs/day	545	lbs/day	59	**Yes**
Benzene	71-43-2	6.62	lbs/yr	4.48	lbs/yr	0.68	No
Toluene	108-88-3	657	lbs/yr	0.511	lbs/day	0.000778	No
Xylenes	95-47-6	58	lbs/yr	0.351	lbs/yr	0.006051	No
1,3-Butadiene	106-99-0	1.13	lbs/yr	0.226	lbs/yr	0.20	No
Formaldehyde	50-00-0	32	lbs/yr	0.455	lbs/yr	0.014	No
Acetaldehyde	75-07-0	71	lbs/yr	0.145	lbs/yr	0.0020	No
Acrolein	107-02-8	0.00789	lbs/day	0.015	lbs/day	1.82	**Yes**
Benzo(a)Pyrene	50-32-8	0.174	lbs/yr	0.0015	lbs/yr	0.0085	No
Benzo(a)anthracene	56-55-3	1.74	lbs/yr	0.0036	lbs/yr	0.0021	No
Chrysene	218-01-9	17.4	lbs/yr	0.0088	lbs/yr	0.00051	No
Benzo(b)fluoranthene	205-99-2	1.74	lbs/yr	0.0064	lbs/yr	0.0037	No
Benzo(k)fluoranthene	207-08-9	1.74	lbs/yr	0.0013	lbs/yr	0.00072	No
Dibenz(a,h)anthracene	53-70-3	0.16	lbs/yr	0.0020	lbs/yr	0.0125	No
Ideno(1,2,3-cd)pyrene	193-39-5	1.74	lbs/yr	0.0024	lbs/yr	0.0014	No
Naphthalene	91-20-3	5.64	lbs/yr	0.750	lbs/yr	0.133	No
Propylene	115-07-1	394	lbs/yr	5.07	lbs/yr	0.013	No

TABLE 3-4
FIRST-TIER AMBIENT IMPACT ASSESSMENT FOR TOXIC AIR POLLUTANTS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Toxic Air Pollutant	ASIL ($\mu g/m^3$)	Averaging Period	1^{st}-Highest Ambient Concentration ($\mu g/m^3$)
DEEP	0.00333	Annual average	0.0797
NO_2	470	1-hour average	388
CO	23,000	1-hour average	1,602
Ammonia	70.8	24-hour average	21.8
Acrolein	0.06	24-hour average	0.003

TABLE 4-1
CALIFORNIA'S AIR TOXICS HOTSPOTS RISK ASSESSMENT GUIDANCE ON SPECIFIC PATHWAYS TO BE ANALYZED FOR EACH MULTI-PATHWAY SUBSTANCE SOURCE IMPACT LEVEL COMPLIANCE AT FACILITY BOUNDARY
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

	Ingestion Pathway									
Substance	**Soil**	**Dermal**	**Meat, Milk & Egg**	**Fish**	**Exposed Vegetable**	**Leafy Vegetable**	**Protected Vegetable**	**Root Vegetable**	**Water**	**Breast Milk**
4,4'-Methylene dianiline	X	X		X	X	X	X	X	X	
Creosotes	X	X	X	X	X	X			X	
Diethylhexylphthalate	X	X		X	X	X	X	X	X	
Hexachlorocyclohexanes	X	X		X	X	X			X	
PAHs	X	X	X	X	X	X			X	
PCBs	X	X	X	X	X	X	X	X	X	X
Cadmium & compounds	X	X	X	X	X	X	X	X	X	
Chromium VI & compounds	X	X	X	X	X	X	X	X	X	
Inorganic arsenic & compounds	X	X	X	X	X	X	X	X	X	
Beryllium & compounds	X	X	X	X	X	X	X	X	X	
Lead & compounds	X	X	X	X	X	X	X	X	X	
Mercury & compounds	X	X		X	X	X	X	X	X	
Nickel	X	X	X		X	X	X	X	X	
Fluorides (including hydrogen fluoride)	To be determined									
Dioxins & furans	X	X	X	X	X	X	X		X	X

TABLE 4-2
MAXIMALLY EXPOSED RECEPTORS
70-YEAR AVERAGE DEEP, ATTRIBUTABLE TO PROJECT
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Receptor Type	Direction From Nearest Project-Specific DEEP Emission Source	Estimated Distance From Nearest Project-Specific DEEP Emission Source		Estimated Increase in 70-Year Average DEEP Concentration at Receptor Location from Project Only (µg/m³)
		Feet	Meters	
Point of Maximum Offsite Impact (MIBR)	North	130	40	0.0797
Maximally Impacted Residence (MIRR) – (Yard near residential building, R-1)	North	2,230	680	0.0138
Maximally Impacted Commercial Receptor (MICR) – (C-1)	South	1,120	340	0.0278
Maximally Impacted School (Monument Elementary School, I-1)	Southeast	5,400	1,640	0.005
Maximally Impacted Hospital (Quincy Valley Medical Center, I-2)	Southeast	4,150	1,260	0.00309
Maximally Impacted House in Modeling Domain (R-2)	Southeast	3,090	940	0.00444

TABLE 4-3
MAXIMALLY EXPOSED RECEPTORS
70-YEAR AVERAGE CUMULATIVE ANNUAL DEEP
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

	70-Year Average Annual DEEP Concentration (μg/m^3) at Various Receptor Locations					
Attributable To	**Maximally Impacted Boundary Receptor (MIBR)**	**R-1 North Residence (MIRR)**	**C-1 Industrial Building (MICR)**	**I-1 Monument Elementary School**	**I-2 Quincy Valley Medical Center**	**R-2 Maximally Impacted House in Modeling Domain**
Project Oxford Generators	0.0797	0.0138	0.0278	0.005	0.00309	0.00444
Railroad	0.00407	0.00188	0.0172	0.025	0.00451	0.00512
SR 28	0.0223	0.0119	0.0646		0.0679	0.0895
SR 281	0.00255	0.00272	0.00208		0.00440	0.00348
Columbia & Dell Data Centers	0.00283	0.00420	0.00237		0.00892	0.00621
Cumulative (post-project)	0.111	0.0344	0.114	0.030	0.0889	0.109

TABLE 4-4
TOXICITY VALUES USED TO ASSESS AND QUANTIFY NON-CANCER HAZARD AND CANCER RISK
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Pollutant	Agency	Non-Cancer	Cancer
DEEP	U.S. Environmental Protection Agency	RfC = 5 µg/m^3	NA (a)
	California EPA–Office of Environmental Health Hazard Assessment	Chronic REL = 5 µg/m^3	URF = 0.0003 per µg/m^3
NO_2	California OEHHA	Acute REL = 470 µg/m^3	NA
Ammonia	U.S. Agency for Toxic Substance and Disease Registry	Acute MRL = 1,184 µg/m^3 Chronic MRL = 70 µg/m^3	NA
Acrolein	California OEHHA	Acute REL = 2.5 µg/m^3	NA
CO	California OEHHA	Acute REL = 23,000 µg/m^3	NA

(a) The EPA considers DEEP to be a probable human carcinogen, but has not established a cancer slope factor or unit risk factor.

TABLE 4-5
DEEP CHRONIC NON-CANCER HAZARD QUOTIENTS FOR RESIDENTIAL, OCCUPATIONAL, AND SENSITIVE EXPOSURE SCENARIOS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

<table>
<tr><th rowspan="2">Attributable To</th><th colspan="6">DEEP Chronic Hazard Quotient at Various Receptor Locations</th></tr>
<tr><th>Maximally Impacted Boundary Receptor (MIBR)</th><th>R-1 North Residence (MIRR)</th><th>C-1 Industrial Building (MICR)</th><th>I-1 Monument Elementary School</th><th>I-2 Quincy Valley Medical Center</th><th>R-2 Maximally Impacted House in Modeling Domain</th></tr>
<tr><td>Project Oxford Generators</td><td>0.0159</td><td>0.0028</td><td>0.0055</td><td>0.0010</td><td>0.0006</td><td>0.0009</td></tr>
<tr><td>Railroad</td><td>0.0008</td><td>0.0004</td><td>0.0035</td><td rowspan="4">0.008</td><td>0.0009</td><td>0.0010</td></tr>
<tr><td>SR 28</td><td>0.0045</td><td>0.0024</td><td>0.0129</td><td>0.0136</td><td>0.0179</td></tr>
<tr><td>SR 281</td><td>0.0005</td><td>0.0005</td><td>0.0004</td><td>0.0009</td><td>0.0007</td></tr>
<tr><td>Columbia & Dell Data Centers</td><td>0.0006</td><td>0.0008</td><td>0.0005</td><td>0.0018</td><td>0.0012</td></tr>
<tr><td>Cumulative (post-project)</td><td>0.0223</td><td>0.0069</td><td>0.0228</td><td>0.009</td><td>0.0178</td><td>0.0218</td></tr>
</table>

TABLE 4-6
NON-CANCER HAZARDS OF PROJECT OXFORD EMISSIONS AT THE MAXIMALLY EXPOSED LOCATION AT OR BEYOND THE FACILITY BOUNDARY (MAXIMALLY IMPACTED BOUNDARY RECEPTOR)
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

NO_2			
NO_2 Concentration (µg/m^3)	345 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 470		
HQ	0.734		
DEEP			
DEEP Concentration (µg/m^3)		0.080 (Max annual TWA)	
RBC (µg/m^3)		RfC = 5	REL = 5
HQ		0.016	0.016
Ammonia			
Ammonia Concentration (µg/m^3)	38 (Max 1-hr TWA)	0.105 (Max annual TWA)	
RBC (µg/m^3)	MRL = 1,184	MRL = 70	
HQ	0.032	0.0015	
Acrolein			
Acrolein Concentration (µg/m^3)	0.001 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 2.5		
HQ	0.0004		
CO			
CO Concentration (µg/m^3)	963		
RBC (µg/m^3)	REL = 23,000		
HQ	0.042		
Combined Pollutants			
Combined Pollutant Hazard Index	Max 1-hr Acute Hazard	Max Chronic Hazard	
	0.81	0.018	

TABLE 4-7
NON-CANCER HAZARDS OF PROJECT OXFORD EMISSIONS AT THE MAXIMALLY IMPACTED COMMERCIAL RECEPTOR
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

NO_2			
NO_2 Concentration ($\mu g/m^3$)	232 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 470		
HQ	0.494		
DEEP			
DEEP Concentration ($\mu g/m^3$)		0.028 (Max annual TWA)	
RBC ($\mu g/m^3$)		RfC = 5	REL = 5
HQ		0.0056	0.0056
Ammonia			
Ammonia Concentration ($\mu g/m^3$)	22.8 (Max 1-hr TWA)	0.037 (Max annual TWA)	
RBC ($\mu g/m^3$)	MRL = 1,184	MRL = 70	
HQ	0.019	0.0005	
Acrolein			
Acrolein Concentration ($\mu g/m^3$)	0.0006 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 2.5		
HQ	0.0002		
CO			
CO Concentration ($\mu g/m^3$)	602 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 23,000		
HQ	0.026		
Combined Pollutants			
Combined Pollutant Hazard Index	Max 1-hr Acute Hazard	Max Chronic Hazard	
	0.54	0.0061	

TABLE 4-8
NON-CANCER HAZARDS OF PROJECT OXFORD EMISSIONS AT THE MAXIMALLY IMPACTED RESIDENTIAL RECEPTOR
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

NO_2			
NO_2 Concentration ($\mu g/m^3$)	195 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 470		
HQ	0.415		
DEEP			
DEEP Concentration ($\mu g/m^3$)		0.014 (Max annual TWA)	
RBC ($\mu g/m^3$)		RfC = 5	REL = 5
HQ		0.0028	0.0028
Ammonia			
Ammonia Concentration ($\mu g/m^3$)	27.4 (Max 1-hr TWA)	0.018 (Max annual TWA)	
RBC ($\mu g/m^3$)	MRL = 1,184	MRL = 70	
HQ	0.023	0.00026	
Acrolein			
Acrolein Concentration ($\mu g/m^3$)	0.00072 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 2.5		
HQ	0.00029		
CO			
CO Concentration ($\mu g/m^3$)	665 (Max 1-hr TWA)		
RBC ($\mu g/m^3$)	REL = 23,000		
HQ	0.029		
Combined Pollutants			
Combined Pollutant Hazard Index	Max 1-hr Acute Hazard	Max Chronic Hazard	
	0.47	0.0031	

TABLE 4-9
NON-CANCER HAZARDS OF PROJECT OXFORD EMISSIONS AT THE MAXIMALLY EXPOSED SCHOOL
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

NO_2			
NO_2 Concentration (µg/m^3)	128 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 470		
HQ	0.27		
DEEP			
DEEP Concentration (µg/m^3)		0.007 (Max annual TWA)	
RBC (µg/m^3)		RfC = 5	REL = 5
HQ		0.0013	0.0013
Ammonia			
Ammonia Concentration (µg/m^3)	26.3 (Max 1-hr TWA)	0.009 (Max annual TWA)	
RBC (µg/m^3)	MRL = 1,184	MRL = 70	
HQ	0.016	0.00009	
Acrolein			
Acrolein Concentration (µg/m^3)	0.00069 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 2.5		
HQ	0.00028		
CO			
CO Concentration (µg/m^3)	636		
RBC (µg/m^3)	REL = 23,000		
HQ	0.028		
Combined Pollutants			
Combined Pollutant Hazard Index	Max 1-hr Acute Hazard	Max Chronic Hazard	
	0.31	0.0010	

TABLE 4-10
NON-CANCER HAZARDS OF PROJECT OXFORD EMISSIONS AT THE MAXIMALLY EXPOSED HOSPITAL
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

NO_2			
NO_2 Concentration (µg/m^3)	173 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 470		
HQ	0.368		
DEEP			
DEEP Concentration (µg/m^3)		0.003 (Max annual TWA)	
RBC (µg/m^3)		RfC = 5	REL = 5
HQ		0.0006	0.0006
Ammonia			
Ammonia Concentration (µg/m^3)	26.6 (Max 1-hr TWA)	0.004 (Max annual TWA)	
RBC (µg/m^3)	MRL = 1,184	MRL = 70	
HQ	0.023	0.00006	
Acrolein			
Acrolein Concentration (µg/m^3)	0.0007 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 2.5		
HQ	0.0003		
CO			
CO Concentration (µg/m^3)	720 (Max 1-hr TWA)		
RBC (µg/m^3)	REL = 23,000		
HQ	0.031		
Combined Pollutants			
Combined Pollutant Hazard Index	Max 1-hr Acute Hazard	Max Chronic Hazard	
	0.42	0.0006	

TABLE 4-11
EXPOSURE ASSUMPTIONS AND UNIT RISK FACTORS FOR DEEP RISK ASSESSMENT
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Receptor Type	Annual Exposure	Exposure Duration	Diesel Particulate Matter Cancer Unit Risk Factor (risk per million, per annual µg/m^3 DEEP)
Unoccupied Land	2 hours/day 250 days/year	30 years	7.3-per-million cancer risk per µg/m^3 DEEP
Residences	24 hours/day 365 days/year	70 years	300-per-million cancer risk per µg/m^3 DEEP
Schools (College Students)	36 hours/week 40 weeks/year	4 years	2.8-per million risk per µg/m^3 DEEP
Schools (High School Students)	36 hours/week 40 weeks/year	4 years	2.8-per-million risk per µg/m^3 DEEP
Schools (Elementary School Students)	36 hours/week 40 weeks/year	7 years	4.9-per-million risk per µg/m^3 DEEP
Schools (All Teachers)	40 hours/week 40 weeks/year	40 years	31-per-million risk per µg/m^3 DEEP
Churches	2 hours/week 52 weeks/year	40 years	2-per-million risk per µg/m^3 DEEP
Business	8 hours/day 250 days/year	40 years	38-per-million risk per µg/m^3 DEEP
Hospital	24 hours/day 365 days/year	1	4.3-per-million risk per µg/m^3 DEEP

TABLE 4-12
ESTIMATED CUMULATIVE INCREASED CANCER RISK
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Attributable To	Total PM (Front half plus back half): 70-Year Average Risk Per Million From DEEP Exposure at Various Receptor Locations					
	Maximally Impacted Boundary Receptor (MIBR)	R-1 North Residence (MIRR)	C-1 Industrial Building (MICR)	I-1 Quincy Valley School	I-2 Quincy Valley Medical Center	R-2 Maximally Impacted House in Modeling Domain
Project Oxford Generators (Total PM, front half plus back half)	0.58	4.13	1.05	0.03	0.01	1.33
Railroad	0.03	0.56	0.66	0.02	0.02	1.54
SR 28	0.16	3.56	2.45	0.23	0.29	26.9
SR 281	0.02	0.82	0.08	0.01	0.02	1.04
Columbia & Dell Data Centers	0.02	1.26	0.09	0.02	0.04	1.86
Cumulative (post-project)	0.81	10.3	4.33	0.32	0.38	32.6

Attributable To	Front Half Only: 70-Year Average Risk Per Million From DEEP Exposure at Various Receptor Locations					
	Maximally Impacted Boundary Receptor (MIBR)	R-1 North Residence (MIRR)	C-1 Industrial Building (MICR)	I-1 Quincy Valley School	I-2 Quincy Valley Medical Center	R-2 Maximally Impacted House in Modeling Domain
Project Oxford Generators (Front half only)	0.14	0.98	0.25	0.007	0.002	0.32
Railroad	0.03	0.56	0.66	0.02	0.02	1.54
SR 28	0.16	3.56	2.45	0.23	0.29	26.9
SR 281	0.02	0.82	0.08	0.01	0.02	1.04
Columbia & Dell Data Centers	0.02	1.26	0.09	0.02	0.04	1.86
Cumulative (post-project)	0.37	7.1	3.5	0.30	0.37	31.5

TABLE 4-13
CANCER RISK CAUSED BY ALL EMITTED CARCINOGENS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Carcinogen	70-Year Average Emission Rate (Tons per Year)	ASIL ($\mu g/m^3$)	Cancer Risk at Key Receptors (per Million)		
			MIRR	MIBR	MICR
DEEP	0.53	0.0033	4.1	0.58	1.1
Naphthalene	3.8E-04	2.9E-02	3.3E-04	4.6E-05	8.4E-05
Benzene	2.2E-03	3.5E-02	1.7E-03	2.3E-04	4.2E-04
1,3-Butadiene	1.1E-04	5.9E-03	5.0E-04	7.0E-05	1.3E-04
Formaldehyde	2.3E-04	1.7E-01	3.5E-05	5.0E-06	9.0E-06
Acetaldehyde	7.3E-05	3.7E-01	5.1E-06	7.1E-07	1.3E-06
Benzo(a)pyrene	7.4E-07	9.1E-04	2.1E-05	3.0E-06	5.4E-06
Benzo(a)anthracene	1.8E-06	9.1E-03	5.1E-06	7.2E-07	1.3E-06
Chrysene	4.4E-06	9.1E-02	1.3E-06	1.8E-07	3.2E-07
Benzo(b)fluoranthene	3.2E-06	9.1E-03	9.1E-06	1.3E-06	2.3E-06
Benzo(k)fluoranthene	6.3E-07	9.1E-03	1.8E-06	2.5E-07	4.6E-07
Dibenz(a,h)anthracene	1.0E-06	9.1E-04	2.8E-05	4.0E-06	7.2E-06
Ideno(1,2,3-cd)pyrene	1.2E-06	9.1E-03	3.4E-06	4.8E-07	8.7E-07
Total Risk Per Million	--	--	4.1	0.58	1.1

TABLE 5-1
QUALITATIVE SUMMARY OF THE EFFECTS OF UNCERTAINTY ON QUANTITATIVE ESTIMATES OF RISKS OR HAZARDS
MICROSOFT PROJECT OXFORD DATA CENTER
QUINCY, WASHINGTON

Source of Uncertainty	How Does it Affect Estimated Risk From This Project?
Exposure assumptions	Likely overestimate of exposure
Emissions estimates	Possible overestimate of emissions
AERMOD air modeling methods	Possible underestimate of average long-term ambient air concentrations and overestimate of short-term ambient air concentration
Toxicity of DEEP at low concentrations	Possible overestimate of cancer risk, possible underestimate of non-cancer hazard for sensitive individuals