



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

**Technical Support Document for  
Second Tier Review**

**of**

**Blackrock and Sabey Data Centers  
East Wenatchee, Washington**

**October 5, 2010**

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## 1. EXECUTIVE SUMMARY

Washington Administrative Code (WAC) 173-400-113(5) requires a proposed new source or modification to comply with the toxic air pollutant (TAP) regulations in Chapter 173-460 WAC.

Sabey Corporation (Sabey) owns a multi-unit data server facility called the Intergate Columbia Data Center. It is located at 4405 Grant Road, East Wenatchee, (Douglas County) Washington. Sabey submitted a Notice of Construction (NOC) permit application to the Washington State Department of Ecology's Central Regional Office (CRO) on June 18, 2010, for the installation of six new back-up electrical generator diesel engines at the Intergate Columbia Data Center.

Sabey is proposing to install two new independent data centers inside the same building currently occupied in part by the VMware Data Center. The two independent data centers are herein referred to as "Sabey Data Center" and "Blackrock Data Center." VMware leases a part of the building in which Blackrock and Sabey data centers are housed, and T-Mobile leases an adjacent building within the barrier to public access and to access by Sabey's multi-unit data center.

Sabey retained ICF International Corporation (ICF) to complete second tier petitions for Sabey and its tenant, Blackrock. Sabey has requested a NOC permit for the new Blackrock Data Center's generators, and a separate NOC permit for the new Sabey Data Center. Blackrock and Sabey will use three generators a piece; each rated at 2,500 kWe. Each engine will use its own vertical exhaust stack.

At the conclusion of this construction project, there will be three independent data centers inside the existing Sabey/VMware building:

1. Blackrock Data Center (three diesel-fired generators, 2.5 MW)
2. Sabey Data Center (three diesel-fired generators, 2.5 MW)
3. VMware Data Center (10 diesel-fired generators already permitted (2.0 MW each), but only three generators currently installed).

An existing T-Mobile Data Center is located in the adjacent building on an adjacent parcel. The T-Mobile Data Center is already permitted to install and operate up to 20 diesel-fired generators (2.0 MW each).

Air dispersion modeling of Blackrock and Sabey's proposed emissions showed that diesel engine exhaust particulates (DEEP), a Washington regulated TAP could be emitted at a level that exceeds its regulatory trigger level in Chapter 173-460 WAC, called an Acceptable Source Impact Level (ASIL). Because the DEEP concentration could exceed its ASIL, a second tier petition, per WAC 173-460-090, is required to evaluate the potential health impacts of the project. This document describes the technical analysis performed by the Washington State Department of Ecology's Headquarters Office (Ecology).

Review of data included in the Health Impact Assessments (HIAs) conducted by ICF indicates that, at the maximally impacted residence, DEEP emissions from Blackrock could result in an increased risk of lung and bladder cancer of up to  $2.4 \times 10^{-6}$  (2.4 in one million) and of up to 1.5

$\times 10^{-6}$  (1.5 in one million) from Sabey. The combined DEEP emissions from Sabey and Blackrock could result in an increased lung and bladder cancer risk of up to  $3.9 \times 10^{-6}$  (3.9 in one million) at the maximally impacted residence. This maximally impacted residence is the location most likely to sustain the highest additional risk from data center emissions.

This risk level is less than Ecology's threshold of maximum acceptable increased risk level (one in one hundred thousand) as defined in Chapter 173-460 WAC. Additionally, acute and chronic exposure to TAP emissions from the proposed project is not likely to result in significant adverse non-cancer health effects. Therefore, based on the technical analysis described below, and the DEEP concentration, Ecology has determined the health risks are within the range that Ecology may approve for proposed new sources of TAPs under Chapter 173-460 WAC.

In accordance with WAC 173-460-090(5), Ecology considered background concentrations of DEEP as part of these second tier reviews. The background DEEP concentrations for Sabey and for Blackrock are from emissions by generators at VMware, T-Mobile, and other sources covered in the latest estimate of DEEP concentrations in the United States Environmental Protection Agency's (EPA's) National Ambient Toxics Assessment (NATA) in the census tract in which the Intergate Columbia Data Center is located. The overall cancer risk posed by combined exposure to DEEP from all four data centers and the sources covered in NATA is  $3.65E-05$  (36.5 in one million) at the maximally impacted residence.

Provided no new residences are built in more heavily impacted areas near the data centers, and if the generators are operated no more than permitted, the additional cancer risk attributable to their DEEP emissions will be permissible under Chapter 173-460 WAC.

## **2. PERMITTING PROCESS OVERVIEW**

### **2.1. The Regulatory Process**

The requirements for performing a toxics screening are established in Chapter 173-460 WAC. This regulatory code requires a review of any increase in toxic emissions for all new or modified stationary sources in the state of Washington.

#### **2.1.1. The Three Tiers of Permitting Toxic Air Pollutants**

The objectives of permitting TAPs are 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 as will protect human health and safety.

There are three levels of review when processing a new or modified emissions unit emitting TAPs: (1) first tier (toxic screening), (2) second tier (health impact assessment), and (3) third tier (risk management decision).

All projects are required to undergo a toxics screening (first tier review) as required by WAC 173-460-040. There are two ways to perform a first tier review. If proposed emissions are

below the Small Quantity Emission Rates (SQERs) found in WAC 173-460-150, no further analysis is required. If emissions are greater than the SQERs, those emissions must be modeled and the resultant ambient concentration compared against the appropriate ASIL. If the ambient concentration is below the ASIL, then no further analysis is required.

A second tier review, required by WAC 173-460-090, is a site-specific health impact assessment. The objective of a second tier review is to quantify the increase in lifetime cancer risk for persons exposed to the increased concentration of any carcinogenic TAP and to quantify other increased health hazards from any TAP in ambient air that would result from the proposed project. Once quantified, the cancer risk is compared to the maximum risk allowed under a second tier review, which is one in one hundred thousand, and the concentration of any TAP that would result from the proposed project is compared to non-cancer health risk-based concentration values (RBC).

If the emission of a TAP results in additional cancer risk greater than one in one hundred thousand or Ecology finds that other health hazards are not acceptable, an applicant may request Ecology perform a third tier review. A third tier review is a risk management decision made by the director of Ecology about whether or not the health risks posed by a project are acceptable. The decision is based on a determination that emissions will be maximally reduced through available preventive measures, assessment of environmental benefits, disclosure of risks at a public hearing, and related factors associated with the facility and the surrounding community.

As stated earlier, Sabey and Blackrock's proposed data centers trigger second tier review because the data centers' diesel engines at a level that exceeds its ASIL could emit DEEP.

### **2.1.2. Second Tier Review Processing Requirements**

Processing requirements for second tier petitions are found in WAC 173-460-090(2). Ecology shall evaluate a source's second tier petition only if:

- (i) The permitting authority submits to Ecology a preliminary order of approval that addresses all applicable new source review issues with the exception of the outcome of second tier review, State Environmental Policy Act review, public notification, and Prevention of Significant Deterioration review (if applicable);
- (ii) Emission controls contained in the preliminary approval order represent at least Best Available Control Technology for Toxics (tBACT);
- (iii) The applicant has developed a HIA protocol that has been approved by Ecology;
- (iv) The ambient impact of the emissions increase of each TAP that exceeds its ASIL has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol; and
- (v) The second tier petition contains a HIA conducted in accordance with the approved HIA protocol.



CRO submitted a preliminary order of approval to Ecology on September 1, 2010. Ecology considers the preliminary order of approval to satisfy items (i) and (ii) above.

Sabey and Blackrock did not submit HIA protocols for their projects. Lack of item (iii) above caused additional work for Ecology and delayed review of the HIAs.

On June 18, 2010, ICF submitted two draft HIAs to Ecology: one for the Sabey Data Center, the other for the Blackrock Data Center. These were titled “Second Tier Risk Assessment for Diesel Particulate Matter Sabey Data Center East Wenatchee, WA” and “Second Tier Risk Assessment for Diesel Particulate Matter Blackrock Data Center East Wenatchee, WA,” respectively. Ecology reviewed these assessments and requested the additional information necessary to review the health risks posed by the projects. ICF subsequently sent additional information in a series of e-mails and electronic files. The latest information was submitted on September 28, 2010.

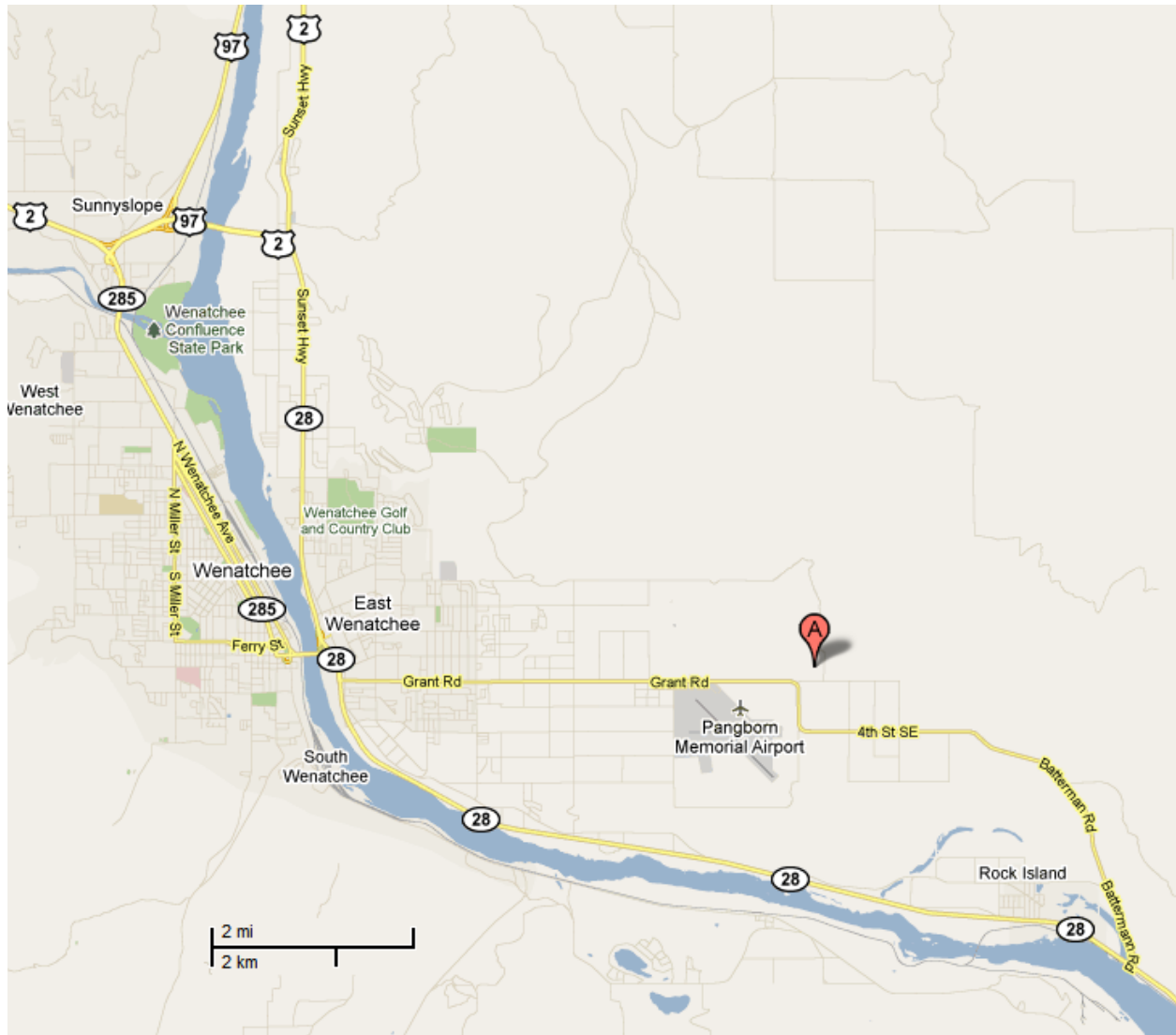
Together, the assessments and supporting files presented overviews of air dispersion modeling and health hazards assessments and predictions about subsequent health risks for the Sabey and Blackrock data centers. The documents and electronic files submitted by ICF contained sufficient information to perform health impacts analyses in accordance with standard risk assessment procedures. Accordingly, Ecology accepted the HIAs and related submittals on September 8, 2010, thereby satisfying item (v) above.

In summary, Sabey, Blackrock, and CRO satisfied four of the five requirements listed above. Although lack of item (iii) significantly affected the length of time Ecology spent reviewing Sabey and Blackrock’s projects, we do not believe that submission of that information would lead to different conclusions regarding health risks attributable to the proposed projects.

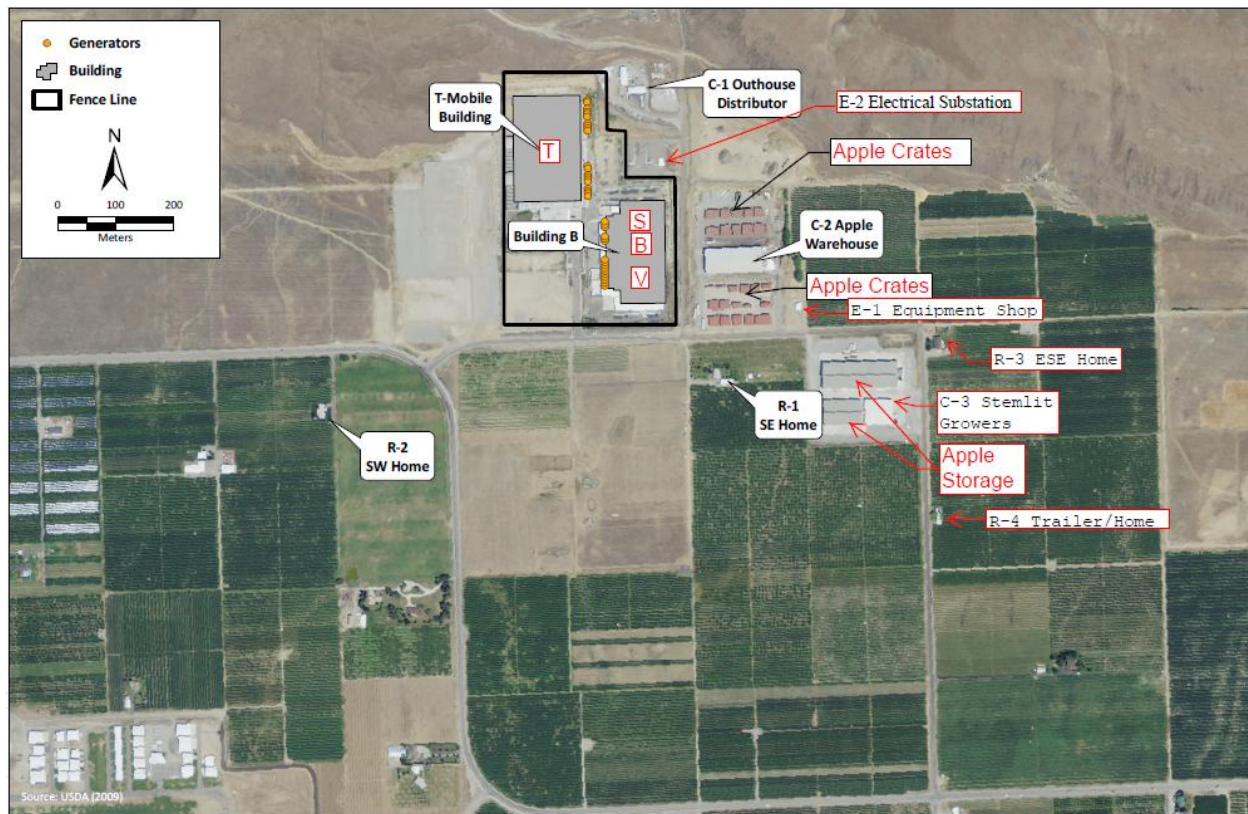
### **3. FACILITIES INFORMATION**

#### **3.1. Facilities Location**

Sabey’s Intergate Columbia Data Center, 4405 Grant Road, East Wenatchee, WA 98802, is located approximately five miles west of the center of East Wenatchee, two miles northwest of Rock Island, and one mile NE of Pangborn Airport, in Douglas County, Washington. Figures 1 and 2 shows the proposed data centers in relation to the surrounding area.



**Figure 1.** Map showing the location of the Intergate Columbia Data Center and surroundings. The data center is at marker “A.”



**Figure 2.** Satellite photo of Sabey's Intergate Columbia Data Center, its surroundings, and nearby buildings. Diagram of Sabey facility, buildings (grey shaded polygons), boundary line (black), and proposed emission points (orange circles).

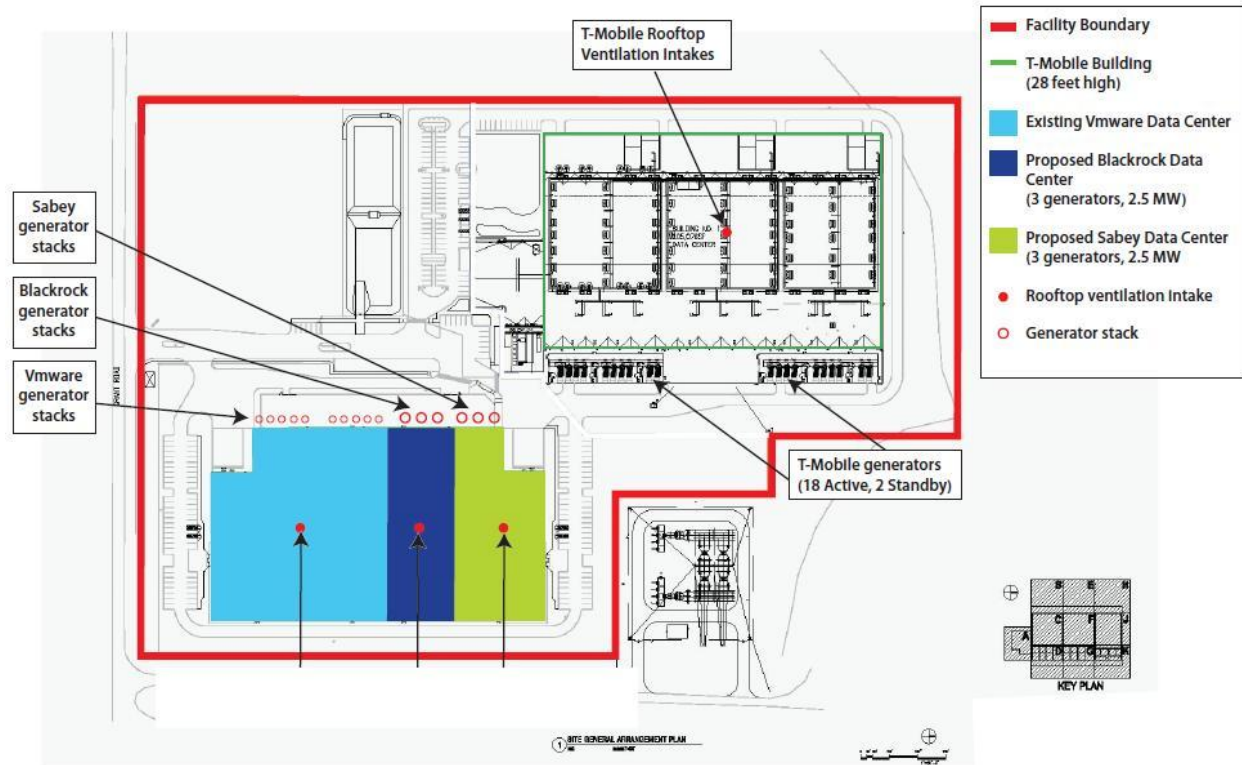
### 3.2. Permitting History

On September 19, 2008, CRO issued Notice of Construction Orders No. 08AQ-C075 and 08AQ-C078 to T-Mobile and VMware data centers, respectively, for installation of 2000 kWe diesel-fired generators at each facility in the Intergate Columbia Data Center area. T-Mobile was approved for twenty 2000 kWe diesel engines, while VMware was approved for sixteen 2000 kWe engines and one small 150 kWe maintenance engine. On July 9, 2010, WDOE-CRO issued Notice of Construction Order No. 08AQ-C078 First Revision, decreasing the number of generators approved to ten 2000 kWe engines.

### 3.3. The Proposed Projects

The NOC applications submitted to CRO on June 18, 2010, explain that the Sabey and Blackrock data centers projects consist of installation and operation of three 2500 kWe diesel generators at each facility (Sabey and Blackrock data centers): six new generators in the Intergate Columbia Data Center area. The Intergate Columbia Data Center, located at 4405 Grant Road, East Wenatchee, (Douglas County) Washington, is a multi-unit data server facility owned by Sabey Data Center Properties LLC (Sabey). The site plan of the center is shown in

Figure 3. VMware leases part of the building in which Sabey and Blackrock data centers are housed, and T-Mobile leases an adjacent building within the same barrier to public access.



**Figure 3.** Intergate Columbia Data Center site plan

According to ICF,<sup>1</sup> VMware Data Center leases a building from Sabey in East Wenatchee. VMware is currently permitted for 10 generators (each 2 MW), but they will only use half of the building and only 7 to 10 of those generators. Sabey will take over half the building, and install two new independent data centers (Blackrock Data Center and Sabey Data Center).

Sabey requested two independent NOC orders: one for Blackrock Data Center, one for Sabey Data Center. Each data center will use three generators (each 2.5 MW). In other words, Sabey is proposing to install two new independent data centers inside the same building currently occupied by VMware Data Center. There will be three independent data centers inside the existing Sabey Data Center Properties LLC Building B:

- Blackrock Data Center (three diesel-fired generators, 2.5 MW)
- Sabey Data Center (three diesel-fired generators, 2.5 MW)
- VMware Data Center (10 diesel-fired generators already permitted (2.0 MW each), but only three generators currently installed.

<sup>1</sup> KICKOFF - SABEY BLACKROCK DATA CENTERS.pdf sent by Jim Wilder of ICF to Ecology 5/28/2010.

In addition, the existing T-Mobile Data Center is in a building on an adjacent parcel. VMware and T-Mobile's data centers are already permitted.

The Blackrock and Sabey data centers will be inside the same building, adjacent to VMware and to each other, they are considered separate stationary air pollution sources because the two data centers (Sabey and Blackrock) are independently owned and operated. Blackrock and Sabey will use three generators a piece; each rated at 2,500 kWe. Each engine will use its own 44.2-foot high vertical exhaust stack.

ICF stated the engines would be operated in one of two modes at a given time:

1. All three engines of each facility will be run according to scheduled engine testing (monthly low-load testing, plus quarterly load-bank testing). Each monthly test will be done for 30 minutes at low load. Each quarterly load-bank test will be done for 30 minutes, one engine at a time. Blackrock, VMware, and Sabey will coordinate their testing so only one company does its testing on any given day.
2. During a power outage (assumed as 48 hours/year maximum), the two primary engines of each facility (Sabey and Blackrock) will activate at 80 percent load. Each facility's third "reserve" engine will activate at idle to confirm it is needed or not, and then if not, will shut down after 15 minutes.

ICF stated that Sabey and Blackrock would not run the engines for "storm avoidance" but they will be occasionally operated for "transformer maintenance" and "main switchgear maintenance". Therefore, the proposed engines will be primarily operated for "emergency" purposes. While this technical analysis assumes the proposed engines will primarily serve as "emergency generators", we are not making a determination that the proposed diesel engines qualify as "emergency engines" as defined in EPA regulations. This analysis is based on the estimated worst-case emissions from engine use.

ICF claims (5/28/2010 message to Ecology) that the "electrical substation at the Intergate Columbia Data Center has dual supply lines and dual facility feeds." They state that this power source is "exceptionally reliable."

The forecast engine usage at the Sabey Data Center is identical to that of the Blackrock Data Center. Table 1 describes the Intergate Columbia Data Center's generator usage (load and time) per year.

**Table 1. Intergate Columbia Data Center’s Generator Usage**

	<b>Engine Load (%)</b>	<b>Number of Engines</b>
S & B monthly engine testing, 8 am-5 pm (11 hr/yr)	50	6
S & B annual load testing, 8 am-5 pm, 1 engine/day for 4 hours	100	6
S & B main switchgear and transformer maintenance, 8 am-5pm (14-hr/yr per generator, every 3 years)	67	6
S & B full power outage (48 hr/yr for 2, 1 hr/yr for 1)	67	6
VMware full power outage	100	10
T-Mobile full power outage	83	20
All VMware and T-Mobile engines at annual loads	75	30

Sources: “Tier\_2\_App A Emissions Calcs Blackrock.pdf” and “Tier\_2\_App A Emissions Calcs Sabey.pdf”

#### 4. POLLUTANT SCREENING

##### 4.1. Emissions

Diesel engine exhaust contains thousands of gas, particle, and particle-bound constituents, including carbon dioxide, carbon monoxide, water vapor, oxides of nitrogen, saturated and unsaturated aldehydes and ketones, alkanes, alkenes, monocyclic aromatic hydrocarbons, carbon-core particles, metals, and gas- and particle-phase polycyclic aromatic hydrocarbons (PAH) and PAH-derivatives.<sup>2</sup>

Using emission factors for diesel-fueled engine electric generators, ICF estimated TAP emissions from the proposed Sabey and Blackrock data centers. The emission rates in Table 2 are consistent with the tBACT determination made by CRO in the preliminary Order of Approval, dated September 1, 2010. The emissions from each center are expected to be equal. Table 2 shows TAP emissions compared to SQERs.

Emissions of three TAPs (DEEP, nitrogen dioxide, and acrolein) exceed their SQERs. ICF reported the maximum NO<sub>2</sub> emission rate<sup>3</sup> as 7.42 lb/hour. This rate is more than 7-fold higher than the NO<sub>2</sub> SQER, which is 1.03 lb/hour. Presumably, Sabey’s NO<sub>2</sub> emission rate will be the same as Blackrock. The maximum emission rate of acrolein listed in the same reference is slightly more than its SQER.

<sup>2</sup> [http://www.arb.ca.gov/toxics/dieseltac/part\\_a.pdf](http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf)

<sup>3</sup> “NOC\_App B Emissions Calcs Blackrock.pdf”, table on page 9 of 11.

**Table 2. Comparison of Sabey or Blackrock's Forecast Maximum TAP Emission Rates to Small Quantity Emission Rates\***

TAP	CASRN	SQER			Maximum Emissions			Emission Rate > SQER?	
		Conc. Wtd. Avg. Time Period	lb/hr	lb/day	lb/yr	lb/hr	lb/day		lb/yr
1,3-Butadiene	106-99-0	1-yr			1.13			7.60E-02	No
Acetaldehyde	75-07-0	1-yr			71			9.80E-02	No
Acrolein	107-02-8	1-day		0.00789			9.53E-03		Yes
Benzene	71-43-2	1-yr			6.62			3.02E+00	No
Benzo(a)anthracene	56-55-3	1-yr			1.74			2.42E-03	No
Benzo(a)pyrene	50-32-8	1-yr			0.174			5.00E-04	No
Benzo(b)fluoranthene	205-99-2	1-yr			1.74			4.32E-03	No
Benzo(k)fluoranthene	207-08-9	1-yr			1.74			4.24E-04	No
Carbon monoxide	630-08-0	1-hr	50.4			42.5			No
Chrysene	218-01-9	1-yr			17.4			5.96E-03	No
Dibenz(a,h)anthracene	53-70-3	1-yr			0.16			6.74E-04	No
Diesel Particulate	---	1-yr			0.639			1.85E+02	Yes
Formaldehyde	50-00-0	1-yr			32			3.06E-01	No
Ideno(1,2,3-cd)pyrene	193-39-5	1-yr			1.74			8.06E-04	No
Nitrogen Dioxide	10102-44-0	1-hr	1.03			7.42			Yes
Sulfur Dioxide	7440-65-5	1-day		1.45			0.463		No
Toluene	108-88-3	1-day		657			0.340		No
Xylenes	---	1-day		29.0			0.233		No

\*Sabey's emission rates are identical to these.

## 4.2. tBACT

CRO is responsible for establishing BACT and tBACT for the new diesel generators. CRO has determined that tBACT for DEEP emissions from any of Sabey or Blackrock's engines consists of installation and operation of EPA Tier 2-certified engines and compliance with a DEEP emission limit of 0.20 g/kW-hour.

CRO has further limited annual DEEP emissions from either Blackrock or Sabey's data centers to 184.8 lb/year.

Ecology concurs with CRO's tBACT determination.

## 4.3. Air Dispersion Modeling

ICF conducted air dispersion modeling for each data center's generators and various combinations of Intergate Columbia Data Center's generators. The generators were modeled as multiple discharge points. ICF used AERMOD (Version 09292), with EPA's PRIME algorithm for building downwash, to determine the potential ambient impacts of DEEP and other TAPs that exceed SQERs.

Terrain elevations and hill height scales for receptors were prepared using EPA's terrain processor AERMAP (Version 06341) referencing 7.5-minute digital elevation models (DEMs)



developed by the United States Geological Survey (USGS) and ICF. Receptors were spaced 100 meters (m) apart covering a 10 kilometer (km) square simulation domain, with a 4-km by 4-km nested receptor grid at 50-m spacing, and a 1.6-km by 1.6-km nested receptor grid at 25-m spacing. As shown in Figure 4, all receptor grid points were centered on the facility. Receptors were also located at 10-m intervals along the boundary of the facility. Sensitive receptors were also incorporated into the receptor grid.



**Figure 4.** AERMOD receptor grid points (figure provided by ICF).

A representative meteorological modeling data set was prepared using surface data (e.g., temperature, wind direction and wind speed) collected between January 1, 2001 and December 31, 2005 at Pangborn Field in East Wenatchee. Upper air sounding data were obtained for the same time period from Spokane Geiger Field. Wind speed, wind direction, temperature, ceiling height, and cloud cover data were extracted from the University Corporation for Atmospheric Research's (UCAR's) ds472.0 hourly surface data archive. Radiosonde data collected by the upper air station in Spokane were obtained from the National Climatic Data Center (NCDC) and Forecast Systems Laboratory (FSL) website (<http://raob.fsl.noaa.gov>).

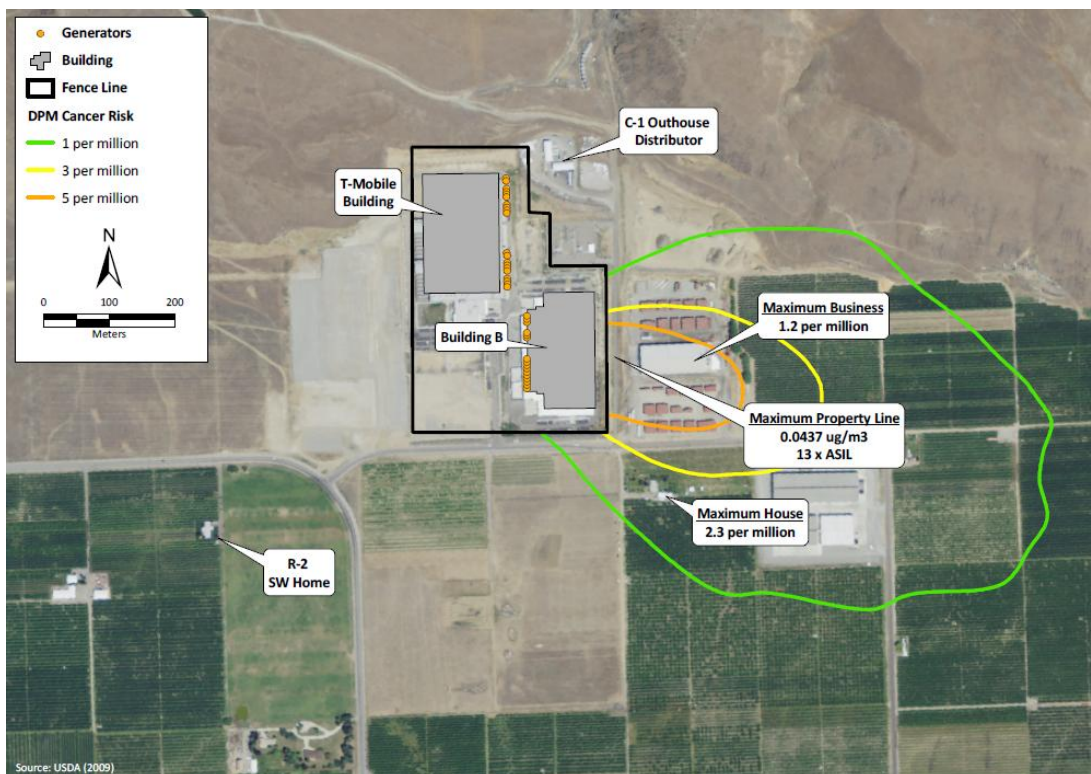
Annual average surface characteristics including surface roughness length, albedo, and Bowen ratio were characterized for the area surrounding the Spokane Airport, using EPA's guidance



with a combination of land use data (Baseline Thematic Mapping version 1 [BTM1]) and USGS 2001 National Land Cover (NLCD2001) land use data.

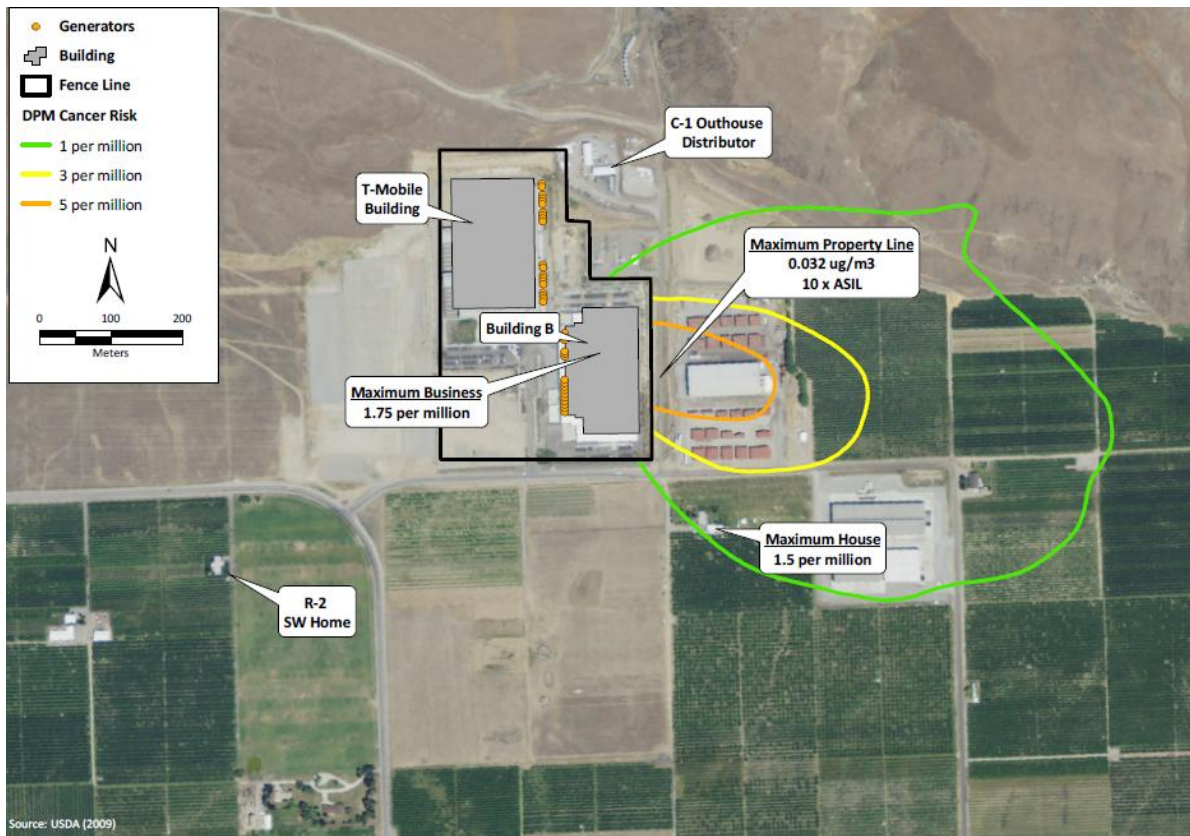
For this analysis, the T-Mobile building was considered to be outside of Sabey, Blackrock, and VMware's property boundary. As shown in Figure 4, a receptor grid was therefore placed over T-Mobile's property.

The forecast maximum emissions of DEEP, nitrogen dioxide, and acrolein from Blackrock and from Sabey exceed their SQERs. ICF reported the modeled the concentration maxima of these TAPs. These concentrations are given in Table 3.

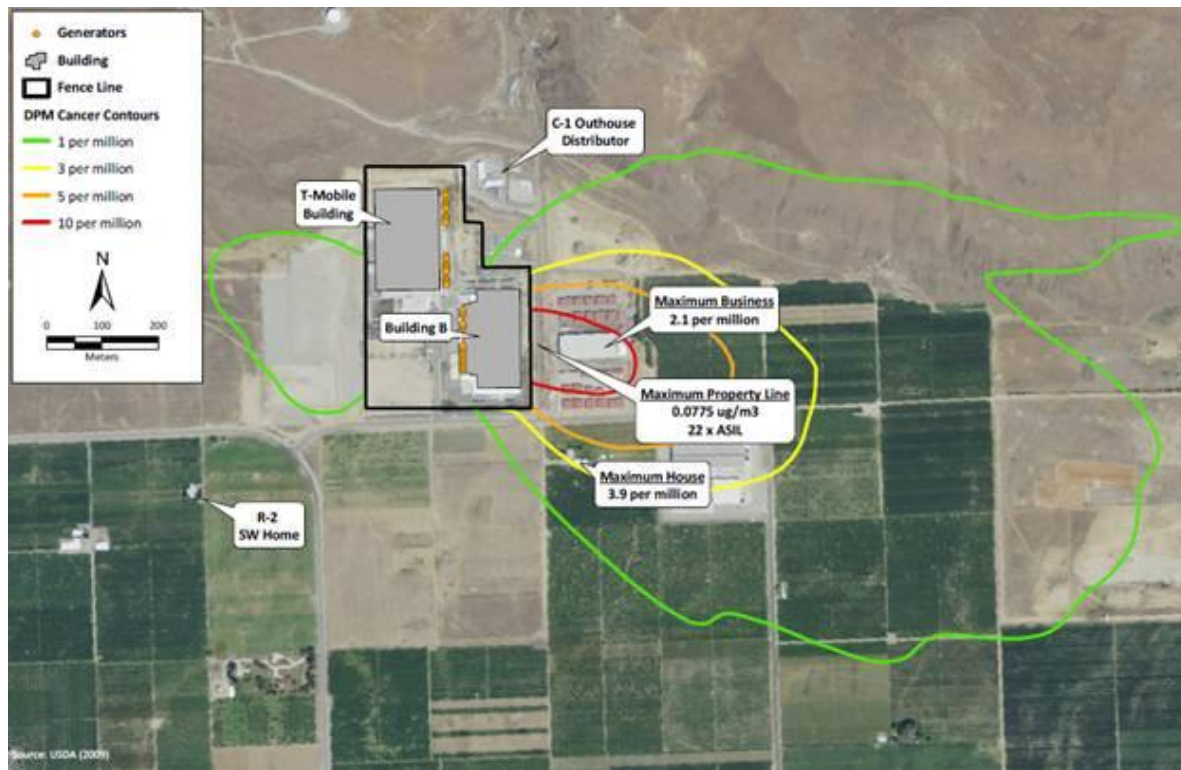


**Figure 5.** Blackrock-attributable DEEP 1-yr, time-weighted average concentration gradient as multiples of the ASIL.

Figure 5 shows the average DEEP concentration gradient as multiples of the ASIL attributable to Blackrock that could occur in the single worst year among five recent years and assuming one 48-hour long electricity transmission interruption and the normal testing and maintenance generators operations. Likewise, Figure 6 shows the single worst year DEEP concentration gradient as multiples of the ASIL attributable to Sabey. Figure 7 shows the combined 1-year, time-weighted average DEEP concentration gradient attributable to Blackrock and Sabey together.



**Figure 6.** Sabey-attributable 1-yr, time-weighted average DEEP concentration gradient as multiples of the ASIL.



**Figure 7.** One-year, time-weighted average DEEP concentration gradient as multiples of the ASIL attributable to Blackrock and Sabey together.

#### 4.4. Point of Compliance

The building air intakes for VMware, T-Mobile, and Sabey or Blackrock (depending on which data center was under consideration) were considered as points of compliance. As agreed in the initial meeting between ICF and Ecology about these projects, the air intakes, not the property fence barrier to public access, were designated as the assumed points of maximum public exposure (nearest point of ambient air) to the proposed emissions. Concentrations were also calculated at and beyond the Sabey, Blackrock, and VMware property boundary.

#### 4.5. Maximum TAP Concentrations

Maximum AERMOD simulation concentrations and respective ASILs are shown in Table 3. It shows the maximum-modeled results of TAP concentrations off site. These results were provided to Ecology by ICF. Only those TAPs that exceeded their SQERs are shown. The highest modeled off-site concentration of each TAP is compared to its respective ASIL.

The modeled 1st high NO<sub>2</sub> concentration attributable to Blackrock at the fence line and beyond is 273.59- $\mu\text{g}/\text{m}^3$ .<sup>4</sup> The 1st high NO<sub>2</sub> concentration attributable to Sabey at the fence line and

<sup>4</sup> Page 8 of 8 of file "NOC\_App F AERMOD Blackrock.pdf"

beyond is 275.52- $\mu\text{g}/\text{m}^3$ .<sup>5</sup> These are the highest concentrations listed for any receptor considered. Therefore, both facilities show that  $\text{NO}_2$  concentrations attributable to each proposed data center will be less than the  $\text{NO}_2$  ASIL (470- $\mu\text{g}/\text{m}^3$  1-hr TWA) beyond the public assess boundary and at adjacent buildings' breathing air intakes.

**Table 3. Comparison of Modeled Maximum Off-Site TAP Concentrations to ASILs**

TAP	ASIL ( $\mu\text{g}/\text{m}^3$ )	Conc. Averaging Time	Maximum Off-Site Conc. ( $\mu\text{g}/\text{m}^3$ ) Attributable to:		Maximum Conc. > ASIL?
			Blackrock	Sabey	
Acrolein	0.06	24-hr	0.0031 <sup>6</sup>	0.0035 <sup>7</sup>	No
Diesel Particulate Matter	0.00333	1-yr	0.04371 <sup>8,9</sup>	0.04198 <sup>10</sup>	Yes
Nitrogen Dioxide	470	1-hr	273.59 <sup>11,12</sup>	276 <sup>13</sup>	No

#### 4.6. Pollutants Subject to Second Tier Review

The air dispersion modeling analyses presented in the air permit applications predicted that in a one-year averaging period, the off-site concentrations of diesel particulate matter would exceed the DEEP ASIL, and that maximum off-site concentrations of acrolein and nitrogen dioxide would not exceed their ASILs in any 24-hour and 1-hour averaging period, respectively. Since Sabey and Blackrock are considered two separate stationary sources, each data center's modeled concentrations were compared with the ASIL independently.

### 5. HEALTH IMPACT ASSESSMENT

#### 5.1. Introduction

Health impact assessments were prepared by ICF on behalf of Blackrock and Sabey. These HIAs addressed the public health risk associated with exposure to DEEP emitted from the proposed back-up generators. An Ecology Air Quality Program engineer, toxicologist, and meteorologist then reviewed the assessments. Their reviews constitute the basis for the Ecology risk manager's permit decision.

<sup>5</sup> Table on the final page of "Notice of Construction Support Document, Sabey Data Center, East Wenatchee, WA"

<sup>6</sup> Tier\_2\_App A Emissions Calcs Blackrock (2).pdf

<sup>7</sup> Table on page 49 of 71 in "SecondTierAssess\_Sabey\_061710\_k.pdf"

<sup>8</sup> Tier\_2\_App C AERMOD Blackrock.pdf

<sup>9</sup> Tier\_2\_App A Emissions Calcs Blackrock (2).pdf

<sup>10</sup> README\_for\_Sabey\_AERMOD\_Files.xls

<sup>11</sup> Tier\_2\_App C AERMOD Blackrock.pdf

<sup>12</sup> Tier\_2\_App A Emissions Calcs Blackrock (2).pdf

<sup>13</sup> Table on page 49 of 71 in "SecondTierAssess\_Sabey\_061710\_k.pdf"

## 5.2. Hazard Identification

Hazard identification is the process of gathering information on potential adverse health effects associated with TAPs that exceed their SQERs. Hazard identification takes account of the knowledge of these TAPs toxic effects in human health and other organisms. Our principal sources of this information are the IRIS, ATSDR, OEHHA toxic air contaminants databases. Table 4 summarizes the potential effects of each TAP proposed to be emitted by Blackrock and Sabey in amounts greater than its respective SQER.

**Table 4. Potential Adverse Effects of TAPs to be Emitted in Amounts Above SQERs**

TAP	Potential Effects and Hazard Index Targets
Acrolein	Acrolein is a strong eye and respiratory tract irritant.
Diesel Engine Exhaust Particulates	<p>The following effects have been associated with exposure to various concentrations of DEEP for various duration:</p> <ul style="list-style-type: none"> <li>• Lung cancer or cancers originating in several other possible organs</li> <li>• Inflammation and irritation of the respiratory tract</li> <li>• Eye, nose, and throat irritation along with coughing, labored breathing, chest tightness, and wheezing</li> <li>• Decreased lung function</li> <li>• Worsening of allergic reactions to inhaled allergens</li> <li>• Asthma attacks and worsening of asthma symptoms</li> <li>• Heart attack and stroke in people with existing heart disease</li> <li>• Increased likelihood of respiratory infections</li> <li>• Male infertility</li> <li>• Birth defects</li> <li>• Impaired lung growth in children</li> </ul> <p>Exposure to DEEP in controlled laboratory animal studies has demonstrated its carcinogenicity. Further, epidemiological evidence among occupationally exposed people, although lacking in well-quantified exposure levels, suggests diesel exhaust may cause lung and bladder cancer.</p> <p>The International Agency for Research on Cancer (IARC) designated DEEP as a probable (Group 2A) carcinogen in humans based on sufficient evidence in experimental animals and limited evidence in humans (IARC, 1989).</p>



TAP	Potential Effects and Hazard Index Targets
	<p>In the <i>Health Assessment Document for Diesel Engine Exhaust</i>, EPA ORD states that diesel exhaust is a probable human carcinogen.<sup>14</sup></p> <p>At exposure levels significantly higher than those that may cause cancer, DEEP can cause a range of other toxic effects including respiratory illnesses, reproductive, developmental, and immune system impairments.</p>
Nitrogen dioxide	<p>NO<sub>2</sub> reacts with water in the respiratory tract to form nitric acid, which is a corrosive irritant. It impairs lung function and causes an array of respiratory problems including airway inflammation in healthy people, and increased symptoms in people with asthma. Children, elderly and asthmatic people are particularly sensitive. It probably also increases allergic responses to inhaled pollen.</p>

Emissions of DEEP are subject to second tier review based on DEEP’s critical effect: cancer. Acrolein and nitrogen dioxide will be emitted at rates that exceed their SQERs, but they are not known to be carcinogenic. Their toxic effects are summarized in Table 4.

Because Blackrock and Sabey’s acrolein and nitrogen dioxide emissions are not likely to result in concentrations that exceed their ASILs, and because they are unlikely to contribute additional cancer risks, Ecology did not evaluate their health risks further.

Diesel engines emit very small fine (<2.5 micrometers [ $\mu\text{m}$ ]) and ultrafine (<0.1  $\mu\text{m}$ ) particles. These particles can easily enter deep into the lung when inhaled. 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 report titled “Concerns about Adverse Health Effects of Diesel Engine Emissions” available at <http://www.ecy.wa.gov/pubs/0802032.pdf>.

It is noteworthy that the estimated airborne levels of DEEP that will be attributable to Blackrock and Sabey’s emissions are lower than levels linked with the health effects listed above. For determining whether Blackrock and Sabey’s DEEP emissions are tolerable in terms of potential public health impacts, Ecology presents estimates of exposure and risk in the remaining sections of this document.

<sup>14</sup> *Health Assessment Document for Diesel Engine Exhaust*, U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington, DC, EPA/600/8-90/057F, 2002, <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060>.

### 5.2.1. Environmental Fate

The World Health Organization International Programme on Chemical Safety report, Diesel Fuel and Exhaust Emissions,<sup>15</sup> cites information on the topics of environmental transport, distribution, and transformation of diesel exhaust:

“The compartment first affected by diesel exhaust emissions is the atmosphere. The hydrosphere and geosphere are contaminated indirectly by dry and wet deposition. The environmental fate of the individual constituents of diesel exhaust is generally well known: Particles behave like (non-reacting) gas molecules with regard to their mechanical transport in the atmosphere; they may be transported over long distances and even penetrate the stratosphere. The overall removal rate of diesel particles is estimated to be low, resulting in an atmospheric lifetime of several days. During aging, particles may coagulate, with higher fall-out rates, thus reducing the total airborne level. The elemental carbon of diesel particulates may act as a catalyst in the formation of sulfuric acid by oxidation of sulfuric dioxide. The organic components adsorbed on elemental carbon may undergo a number of physical and chemical reactions with other atmospheric compounds and during exposure to sunlight.”<sup>15</sup>

“The major fraction (50-80%) of the particulate emissions of diesel engines is in the submicron size, ranging from 0.02 to 0.5  $\mu\text{m}$  ... Once particles have been emitted, their mechanical transport in the atmosphere is like that of gas molecules (nonreactive). Together with carbon particles from other combustion processes, they may be transported over long distances and even penetrate the stratosphere (Muhlbaier Dasch & Cadle, 1989).”<sup>16</sup>

“The hydrosphere and geosphere may be affected indirectly by diesel exhaust emissions after dry or wet deposition of particulate matter or individual constituents.”<sup>16</sup>

“Atmospheric removal of airborne carbon particles consists mainly of dry deposition and scavenging by precipitation (wet deposition). The rate of wet removal is directly correlated to the ratio of organic to elemental carbon and is low for small ratios (Muhlbaier Dasch & Cadle, 1989).<sup>17</sup> As the overall removal rate of diesel particulates is estimated to be low, the atmospheric life-time is several days (Jaenicke, 1986).”<sup>18</sup>

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<sup>15</sup> United Nations Environment Programme, International Labour Organisation, World Health Organization, International Programme on Chemical Safety, “Environmental Health Criteria 171, Diesel Fuel and Exhaust Emissions,” World Health Organization, Geneva, 1996, <http://www.inchem.org/documents/ehc/ehc/ehc171.htm>.

<sup>16</sup> Muhlbaier Dasch J & Cadle SH (1989) Atmospheric carbon particle in the Detroit urban area: Wintertime sources and sinks, *Aerosol Sci Technol*, 10: 236-248 (as cited in 11).

<sup>17</sup> Muhlbaier Dasch J & Cadle SH (1989) Atmospheric carbon particle in the Detroit urban area: Wintertime sources and sinks, *Aerosol Sci Technol*, 10: 236-248 (as cited in 11).

<sup>18</sup> Jaenicke R (1986) Physical characterization of aerosols, In: Lee SD, Schneider T, Grant LD, & Verkerk PJ, eds, *Aerosols: Research, risk assessment and control strategies*, Chelsea, MI, Lewis Publishers, pp. 97-106 (as cited in 15).

The wide range of chemical constituents in diesel engine exhaust has an even wider range of atmospheric fates. Diesel exhaust's constituents can react with atmospheric radicals to form new species, combine with other substances to form more complex species, and be deposited onto surfaces.

The two most important processes affecting diesel exhaust particles in the atmosphere are: (1) dry and wet deposition (physical removal) of the particles, and (2) atmospheric transformations of species adsorbed to the particles.<sup>19</sup> A particle's atmospheric lifetime due to dry deposition is a function of its diameter.<sup>20</sup> Diesel exhaust particles, generally smaller than 1- $\mu\text{m}$ ,<sup>21</sup> are expected to remain in the atmosphere from five to 15 days. Rain results in almost complete washout of particles 0.1 to 10  $\mu\text{m}$  in diameter from the atmosphere.<sup>22,23,24</sup> Thus, some of the DEEP from Sabey and Blackrock will deposit on fruit stored at the apple warehouse, as well as at orchards, soils, etc.

Organic chemicals, notably PAHs/derivatives, in the particles in the exhaust stream may be protected from photolysis and/or chemical reactions. Organic chemicals coating the surface of the particles are expected to primarily react with sunlight (through photolysis), ozone ( $\text{O}_3$ ), gaseous nitric acid ( $\text{HNO}_3$ ), and nitrogen dioxide ( $\text{NO}_2$ ). Organic chemicals coating the surface of the particles also volatilize from the particle and become more susceptible to photolysis and chemical reactions. Five or more ringed PAHs and nitro-PAHs have low volatility and tend to remain bound to larger particles.<sup>25</sup> The 5+ ringed PAHs and PAH derivatives tend to be carcinogenic, whereas ones with fewer aromatic rings are not likely to be carcinogenic.

A literature search did not yield information about the fate of DEEP deposited in terrestrial and aquatic environmental compartments.

### 5.3. Exposure Assessment

In order for pollutants to cause harm, people must be exposed. The exposure assessment step of the HIA involves measuring or estimating concentrations, durations, and frequencies of exposures to agents present in the environment, and the estimation of hypothetical exposures that might arise from the release of TAPs into the ambient air. Ambient air is publicly accessible air in the vicinity of a proposed project (i.e., air outside of space controlled by the permit applicant).

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<sup>19</sup> [http://www.arb.ca.gov/toxics/dieseltac/part\\_a.pdf](http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf)

<sup>20</sup> Graedel, T. E., and C. J. Weschler, 1981, Chemistry within aqueous atmospheric aerosols and raindrops, *J. Geophys. Res.*, 19, 505-539.

<sup>21</sup> Pierson W.R., Gorse R.A., Jr., Szkariate A.C., Brachaczek W.W., Japar S.M., Lee F.S.C., Zweidinger R.B., and L.D. Claxton, 1983, Mutagenicity and chemical characteristics of carbonaceous particulate matter from vehicles on the road, *Environ. Sci. Technol.*, 17, 31-44.

<sup>22</sup> Leuenberger, C., Ligocki, M. P., and J. F. Pankow, 1985, Trace organic compounds in rain. 4. Identities, concentrations and scavenging mechanisms for phenols in urban air and rain, *Environ. Sci. Technol.*, 19, 1053-1058.

<sup>23</sup> Ligocki M. P., Leuenberger C., and J.F. Pankow, 1985a, Trace organic compounds in rain-III, Particle scavenging of neutral organic compounds, *Atmos. Environ.*, 19, 1619-1626.

<sup>24</sup> Ligocki M.P., Leuenberger C., and J.F. Pankow, 1985b, Trace organic compounds in rain-II, Gas scavenging of neutral organic compounds, *Atmos. Environ.*, 19, 1609-1617.

<sup>25</sup> [http://www.arb.ca.gov/toxics/dieseltac/part\\_a.pdf](http://www.arb.ca.gov/toxics/dieseltac/part_a.pdf)



To the practical extent possible, the current exposure assessment characterizes past, current, and expected TAP exposures. Inhalation will be the dominant exposure route to Blackrock and Sabey’s DEEP emissions. Small exposures by ingestion and skin contact will also occur.

### 5.3.1. Multi-Route Exposures

The following paragraph and table is from the California OEHHA’s Air Toxics Hotspots Risk Assessment Guidance.<sup>26</sup>

“Table [5] shows the multipathway substances that, based on available scientific data, can be considered for each non-inhalation exposure pathway. The exposure pathways that are evaluated for a substance depend on two factors: 1) whether the substance is considered a multipathway substance for the Hot Spots Program (Table 5.1), and 2) what the site-specific conditions are. A multipathway substance may be excluded from a particular exposure pathway because its physical-chemical properties can preclude significant exposure via the pathway. For example, some water-soluble chemicals do not appreciably bioaccumulate in fish; therefore, the fish pathway is not appropriate. In addition, if a particular exposure pathway is not impacted by the facility or is not present at the receptor site, then the pathway is not evaluated. For example, if surface waters are not impacted by the facility, or the water source is impacted but never used for drinking water, then the drinking water pathway is not evaluated.”

**Table 5. Specific Pathways to be Analyzed for Each Multi-Pathway Substance**

Substance	Ingestion Pathway									
	Soil	Dermal	Meat, Milk & Eggs	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

<sup>26</sup> The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, August 2003.

It is possible that levels of PAHs and the few other persistent chemicals in DEEP will build up in food crops, soil, and drinking water sources near Blackrock and Sabey. However, quantifying exposure to these chemicals from these media is impractical and very unlikely to yield significant concerns. Inhalation is the only route of exposure to DEEP that has received sufficient scientific study to be useful in human health risk assessment.

### 5.3.2. Identification of Exposed Populations

To assess exposure to DEEP and ultimately estimate potential health risks to people exposed to Blackrock and Sabey diesel engines emissions, ICF identified key locations where people might be exposed, including some of the buildings near the Intergate Columbia Data Center. ICF did not provide locations of buildings where sensitive populations are likely to be concentrated. However, Ecology queried bing.com maps and found no East Wenatchee schools, doctor offices, clinics, hospitals, or assisted living facilities listed inside the sum total of all of the Intergate Columbia Data Center's DEEP emissions  $>0.003\text{-}\mu\text{g}/\text{m}^3$  concentration isopleth. It appears Blackrock and Sabey will not affect locations where people who are likely to be extraordinarily sensitive to adverse effects of DEEP are most likely to be.

The data centers are in U.S. Census Bureau Tract 9503, block group 3, of Douglas County,<sup>27</sup> which in 2000 had 919 persons residing in 340 housing units (about 3 per unit) with a density of 73 persons per square mile. The estimated population increase between 2000 and September 2009 was 107 persons and 29 housing units.<sup>28</sup>

No other demographic characteristics specifically for Tract 9503, block group 3, are available; however, the U.S. Census Bureau's 2006-2008 American Community Survey 3-Year estimates for all of Douglas County are available, along with corresponding U.S. demographic characteristics for comparison. These are summarized in Table 6. Douglas County demographic characteristics are nearly average with respect to those of the entire U.S.

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<sup>27</sup> <http://www.ofm.wa.gov/pop/smallarea/maps/bg2000/pdf/northcentralbg.pdf>

<sup>28</sup> [http://factfinder.census.gov/servlet/ThematicMapFramesetServlet?\\_bm=y&\\_MapEvent=Pan&-errMsg=&\\_-useSS=N&\\_-dBy=140&-redoLog=false&\\_-zoomLevel=&-tm\\_name=DEC\\_2000\\_SF1\\_U\\_M00090&-tm\\_config=|b=50|l=en|t=4001|zf=0.0|ms=thm\\_def|dw=0.14742116997381507|dh=0.0756441033284385|dt=gov.census.aff.domain.map.EnglishMapExtent|if=gif|cx=-120.1731974110022|cy=47.426503703308214|zl=4|pz=4|bo=|bl=|ft=350:349:335:389:388:332:331|fl=403:381:204:380:369:379:368|g=16000US5320190|ds=DEC\\_2000\\_SF1\\_U|sb=50|tud=false|db=140|mn=73|mx=3942|cc=1|cm=1|cn=5|cb=|um=Persons/Sq%20Mile|pr=0|th=DEC\\_2000\\_SF1\\_U\\_M00090|sf=N|sg=&-PANEL\\_ID=tm\\_result&-\\_pageY=&-\\_lang=en&-geo\\_id=16000US5320190&-\\_pageX=&-\\_mapY=&-\\_mapX=&-\\_latitude=&-\\_pan=W&-ds\\_name=DEC\\_2000\\_SF1\\_U&-\\_longitude=&-\\_changeMap=Identify#?461,290](http://factfinder.census.gov/servlet/ThematicMapFramesetServlet?_bm=y&_MapEvent=Pan&-errMsg=&_-useSS=N&_-dBy=140&-redoLog=false&_-zoomLevel=&-tm_name=DEC_2000_SF1_U_M00090&-tm_config=|b=50|l=en|t=4001|zf=0.0|ms=thm_def|dw=0.14742116997381507|dh=0.0756441033284385|dt=gov.census.aff.domain.map.EnglishMapExtent|if=gif|cx=-120.1731974110022|cy=47.426503703308214|zl=4|pz=4|bo=|bl=|ft=350:349:335:389:388:332:331|fl=403:381:204:380:369:379:368|g=16000US5320190|ds=DEC_2000_SF1_U|sb=50|tud=false|db=140|mn=73|mx=3942|cc=1|cm=1|cn=5|cb=|um=Persons/Sq%20Mile|pr=0|th=DEC_2000_SF1_U_M00090|sf=N|sg=&-PANEL_ID=tm_result&-_pageY=&-_lang=en&-geo_id=16000US5320190&-_pageX=&-_mapY=&-_mapX=&-_latitude=&-_pan=W&-ds_name=DEC_2000_SF1_U&-_longitude=&-_changeMap=Identify#?461,290)

**Table 6. Demographic Estimates**

	Douglas County			U.S.
	%	Estimate	Margin of Error	
Total population		35,943		
Male	49.4	17,739	+/-143	49.3%
Female	50.6	18,204	+/-143	50.7%
Median age (years)		36.2	+/-0.4	36.7
Under 5 years	7.1	2,558	+/-68	6.9%
18 years and over	73.4	26,397	+/-59	75.5%
65 years and over	13.1	4,717	+/-124	12.6%

Source:

[http://factfinder.census.gov/servlet/ACSSAFFacts?\\_event=Search&geo\\_id=&\\_geoContext=&\\_street=&\\_county=douglas+county&\\_cityTown=douglas+county&\\_state=04000US53&\\_zip=&\\_lang=en&\\_sse=on&pctxt=fph&pgsl=010](http://factfinder.census.gov/servlet/ACSSAFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=douglas+county&_cityTown=douglas+county&_state=04000US53&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010) (accessed 8/20/2010)

In consideration of the possibility that new buildings will be constructed and occupied in the DEEP affected area, Ecology examined current land-use zoning. The area within the 1E-6 additional cancer risk isopleth of the combined Sabey and Blackrock emission is zoned for General Industrial and Commercial-Agriculture uses. The zoning boundaries are illustrated in the Douglas County zoning map (Figure 8). The oval red line, which loosely conforms to the 1E-6 additional cancer risk isopleth for the entire Intergate Columbia Data Center's DEEP emissions, was added to the map by ICF. The data centers are located inside this oval near the western edge.

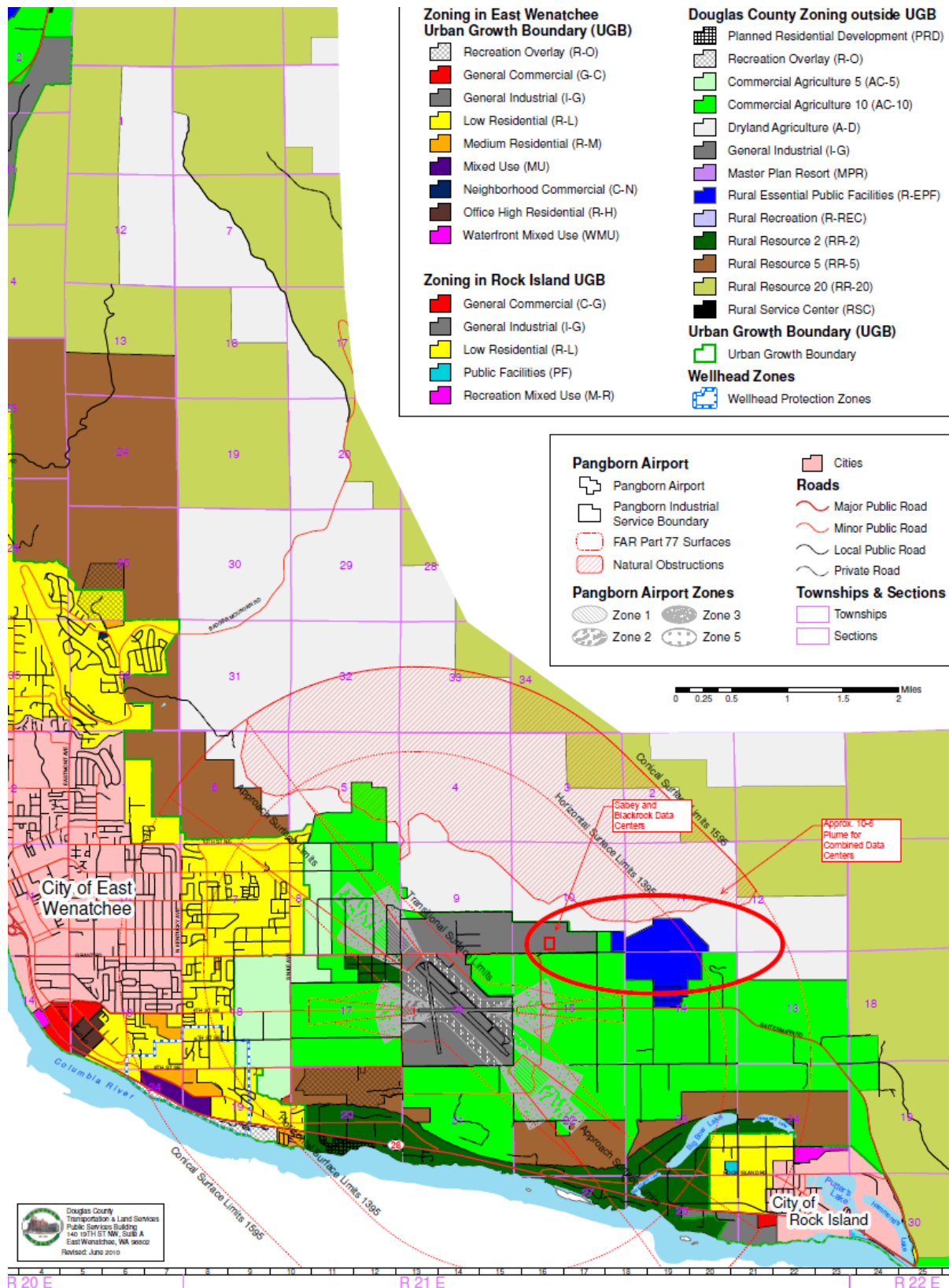


Figure 8. Douglas County land use zoning map

Based on these zonings, it is reasonable to assume there will be no immediate residential development near the data centers; however, several residences, businesses, and orchardists currently occupy the affected area. Future decisions about use and development of this area should consider potential impacts of data center emissions on human health.

ICF identified buildings in the area nearest to the data centers. These are shown in Figures 2 and 9 and described in Table 7.

**Table 7. Buildings in the DEEP Impact Area**

Receptor	Location Description	Use	Source
R-1	SE Home (4520 Grant Rd.)	Residence	a
R-2	SW Home	Residence	a
R-3	ESE Home (11 S. Ward Ave.)	Residence	a
R-4	Trailer	Residence	a
C-1	Outhouse Distributor	Apparent Residence	a
C-2	Northern Fruit Company (4577 Grant Rd.)	Cold storage for apples inside and bin storage outside	a
C-3 (x)	Stemilt Growers, LLC (88 S. Ward Ave.)	NW corner of apple storage building	b
C-3 (y)	Stemilt Growers, LLC (88 S. Ward Ave.)	Cold storage for apples inside and bin storage outside	b
E-1	Equipment Shop (east of Northern Fruit Co.)	Equipment/shop for orchards	a
E-2	Electrical Substation	Housing for equipment	a
B	Blackrock rooftop	Ventilation intake	c
S	Sabey rooftop	Ventilation intake	b
T	T-Mobile rooftop	Ventilation intake	b
V	VMware rooftop	Ventilation intake	b

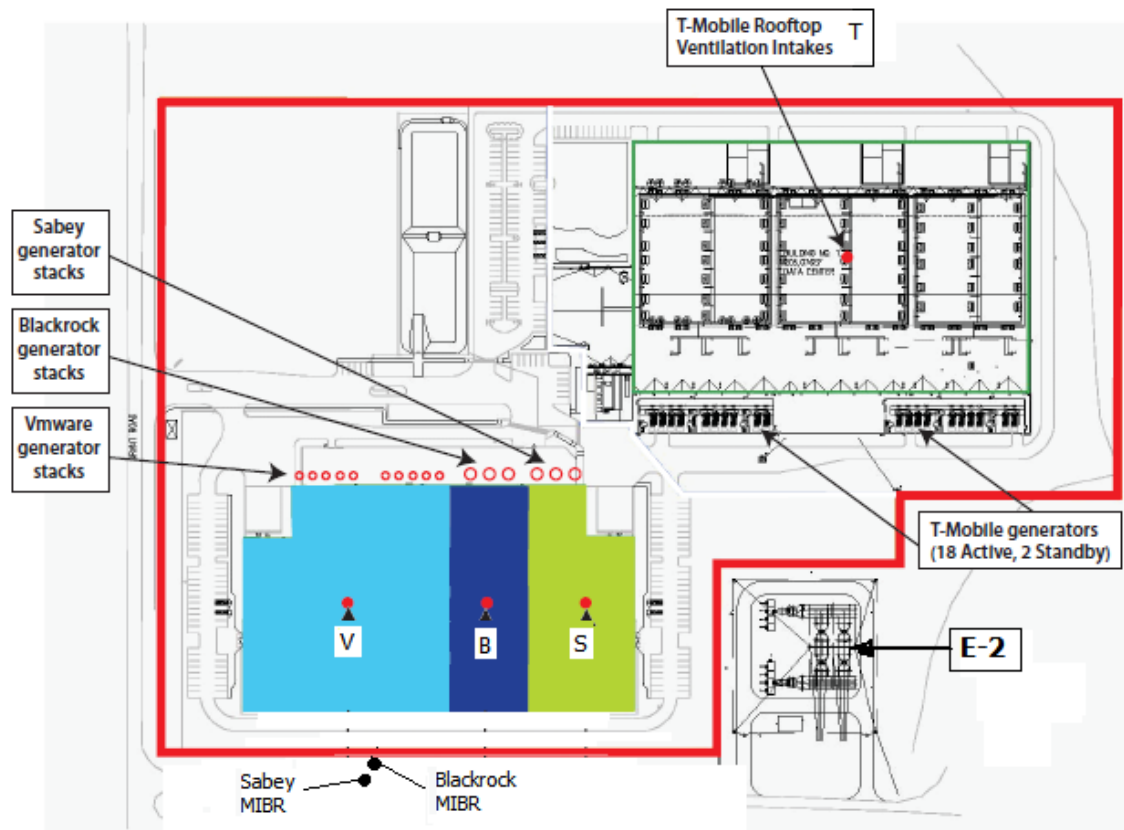
- a. Table 8-1 of "Response to Blackrock Questions\_final.docx"
- b. Table 10-1 of "Response to Blackrock Questions\_final.docx"
- c. Figure 1-2 of "Second-Tier Risk Assessment for Diesel Particulate Matter Sabey Data Center East Wenatchee, WA"

From among these buildings, ICF identified maximally impacted residential receptors (MIRR) and maximally impacted commercial receptors (MICR). These locations, as used for each activity, would experience highest average DEEP concentrations according to AERMOD results. The MIRR and MICRs attributable to the data centers' DEEP emissions are noted in Table 8.

**Table 8. DEEP MIRR and MICRs Attributable to Blackrock and Sabey’s Generators**

Location	Description	Blackrock	Sabey	Blackrock + Sabey
R-1	SE Home <sup>29</sup>	MIRR	MIRR	MIRR
C-2	Northern Fruit Company Apple Warehouse	MICR		MICR
B	Blackrock building ventilation air intake		MICR	

Likewise, ICF identified outdoor locations, beyond the access controlled by Blackrock or by Sabey that would have the highest modeled DEEP concentrations. These were designated as the maximally impacted boundary receptors (MIBRs). These locations are indicated in Figure 9.



**Figure 9.** Intergate Columbia Data Center rooftop ventilation intake points and MIBR locations

<sup>29</sup> The MIRR attributable to Blackrock is the same as for Sabey: A house located at 4520 Grant Rd. The Douglas County Assessor and Treasurer list the current owner of this property as Clifford Jones.

### **5.3.3. Estimates of Exposure Durations of Identified Populations**

Cancer risk from exposure to DEEP is estimated by determining the DEEP concentration at each receptor point. These concentrations are multiplied by the DEEP unit risk factor (URF). Because URFs are based on a continuous exposure over a 70-year lifetime, exposure duration and exposure frequency are considered.

People who work at commercial or industrial locations near Blackrock and Sabey are likely only to be exposed for up to the duration of their workday (e.g., eight hours per day). Residents living near the data centers have the potential to be exposed for a longer period (e.g., 24 hours per day). A person who lived at the MIRR, worked at either of the MICR locations and was frequently in either of the MIBR locations would have the highest conceivable exposure to Sabey and Blackrock DEEP emissions.

In order to estimate the exposure times of various populations to the TAPs of concern, standard values were used. These values are estimates of how much time people using the MIBR, MICR, and MIRR locations might be in those locations. In this assessment:

- A continuous exposure 24 hr/day for 365 days/yr for 70 years is assumed for people in the MIRR.
- Repeated exposures of 8 hr/day for 250 days/yr for 40 years are assumed for people in the MICR.
- Repeated exposures of 2 hr/day for 250 days/yr for 30 years are assumed for people in the MIBR.

### **5.3.4. TAP Concentration Estimates**

To assess human exposure to DEEP attributable to the data centers' diesel engine generators, ICF used AERMOD to calculate average annual concentrations in breathing zone air at each of the grid points shown in Figure 4. The model used emissions rate estimates combined with recent meteorological data. The results are estimates of average DEEP concentrations at grid points outside Blackrock or Sabey facility property boundaries. ICF examined the estimates of concentrations at grid points to locate the points of highest DEEP concentrations.

Table 9 shows the maximum off-site 1-year average DEEP concentrations attributable to Blackrock and to Sabey. Ecology verified that the DEEP concentrations at the maximally impacted extra-boundary, commercial buildings, and residential receptor locations reported by ICF were correct and that the locations of these receptors agree with AERMOD results.

Among these, the highest concentration is at the Blackrock Data Center's ventilation air intake on the building's rooftop (Receptor "B" in Table 8).

**Table 9. Maximum Off-Site 1-Year Average DEEP Concentrations Attributable to Blackrock and to Sabey**

Maximally Impacted	Maximum 1-Year TWA DEEP Conc. Attributable to:	
	Blackrock ( $\mu\text{g}/\text{m}^3$ )	Sabey ( $\mu\text{g}/\text{m}^3$ )
Extra-boundary location	0.04371 <sup>30,31</sup>	0.04198 <sup>32</sup>
Commercial building	0.0316 <sup>33</sup>	0.04644 <sup>34</sup>
Residence	0.0077 <sup>35</sup>	0.0078 <sup>36</sup>

### 5.3.4.1. TAP Concentration Estimates

DEEP is released into the atmosphere by various human activities. Blackrock and Sabey emissions will add to the existing levels of this TAP. Knowledge of currently existing levels is needed for predicting how much DEEP exposure there will be from both existing and proposed emissions.

Quantities of DEEP in ambient air can be measured by sampling and laboratory analyses (monitoring), or calculated by using information on process rates, emissions factors, emissions inventories, and meteorological conditions.

Ecology considered “background” DEEP concentrations in the current review. WAC 173-460-090(5), second tier review, states:

- “(5) Background concentrations of TAPs will be considered as part of a second tier review. Background concentrations can be estimated using:
- (a) The latest National Ambient Toxics Assessment data for the appropriate census tracts; or
  - (b) Ambient monitoring data for the project's location; or
  - (c) Modeling of emissions of the TAPs subject to second tier review from all stationary sources within 1.5 kilometers of the source location.”

The EPA’s National-Scale Air Toxics Assessment (NATA) contains calculated concentrations of DEEP and 177 Federal Clean Air Act-listed Hazardous Air Pollutants in most U.S. census tracts.

Ecology is unaware of any DEEP monitoring data collected anywhere in Douglas County.

<sup>30</sup> Tier\_2\_App C AERMOD Blackrock.pdf

<sup>31</sup> Tier\_2\_App A Emissions Calcs Blackrock (2).pdf

<sup>32</sup> README\_for\_Sabey\_AERMOD\_Files.xls

<sup>33</sup> Fig10-1\_DPM\_Concentrations\_Blackrock.pdf

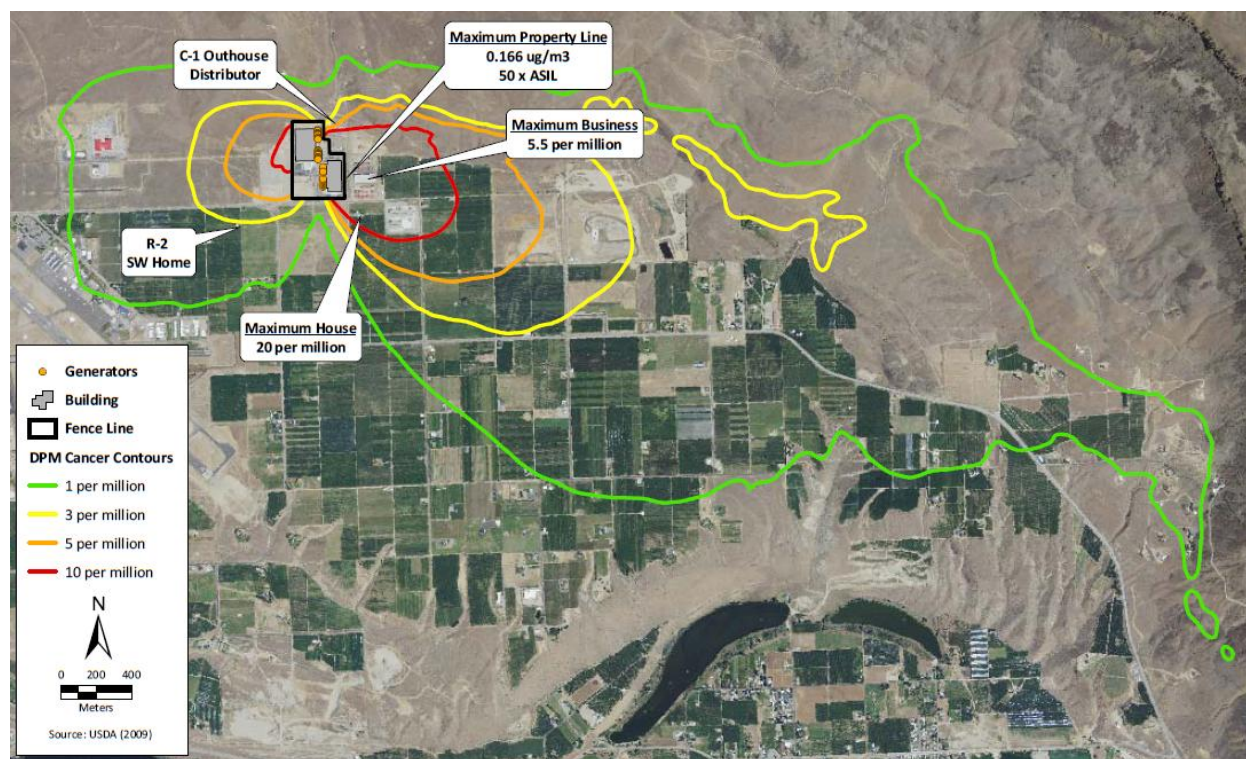
<sup>34</sup> ICF’s table “AERMOD Modeling Results for Sabey Data Center –Revised 5-28 Data”

<sup>35</sup> Fig10-1\_DPM\_Concentrations\_Blackrock.pdf

<sup>36</sup> Table 7-3 of ICF’s “Second-Tier Risk Assessment for Diesel Particulate Matter Sabey Data Center East Wenatchee, WA”



In the absence of monitoring data, the median concentrations reported in recent NATA reports and in AERMOD results from ICF for each of the tenants of the Intergate Columbia Data Center are the only available estimates of DEEP in the area.



**Figure 10.** DEEP concentration gradients from all the data centers' generators combined. Includes impacts from VMware and T-Mobile at their permitted levels.

**Table 10. NATA DEEP Concentration Estimates**

Region	Census Tract 9503 in Douglas County, WA		WA Statewide		US Nationwide		
	NATA Year	2005	2002	2005	2002	2005	2002
Onroad		0.011173	0.08829	0.1746523	0.35494796	0.115460032	0.25107
Nonroad		0.0433762	0.22672223	0.325233	0.60118156	0.290614428	0.55797
Total		0.0545493	0.31501223	0.4998853	0.95612952	0.40607446	0.80904
Onroad Exposure		0.0070724	0.05588631	0.1284669	0.25454442	0.133818149	0.24059
Nonroad Exposure		0.0202943	0.10607568	0.1615272	0.28953508	0.195616247	0.34175
Total Exposure		0.0273666	0.16196199	0.2899941	0.5440795	0.329434396	0.58234

(Concentration estimates are in  $\mu\text{g}/\text{m}^3$ )

The estimated DEEP concentration gradients from all the data centers' generators together are shown in Figure 10.

The EPA's NATA contains modeled concentration estimates in the census tract where the data centers are now located (Tract 9503, Douglas County) and in other census tracts. EPA's estimates were derived with emissions inventory information and EPA's Assessment System for Population Exposure Nationwide (ASPEN) model.<sup>37</sup> Their estimates of ambient concentrations of DEEP in 2002 and 2005 were 0.31501223- $\mu\text{g}/\text{m}^3$  and 0.0545493- $\mu\text{g}/\text{m}^3$ , respectively. The estimates were aggregates of DEEP from on-road vehicles and equipment and vehicles used for non-road purposes. These are shown in Table 10.

The Intergate Columbia Data Center was constructed after 2005. Therefore, DEEP originating from its existing generators was not included in either NATA estimate. The Blackrock, Sabey, VMware, and T-Mobile facility emission impacts were added to the most recent NATA estimate for the affected census tract in order to estimate the overall concentrations of DEEP that could exist at each receptor after the Blackrock and Sabey generators begin operating. The estimates are shown in Table 11. T-Mobile and VMware were modeled at their currently permitted levels.

**Table 11. Maximum Off-Site 1-Year Average DEEP Concentrations Attributable to the Data Centers and Other Sources**

Location	Blackrock	Sabey	Blackrock & Sabey	VMware & T-Mobile *	Blackrock & Sabey & VMware & T-Mobile	NATA 2005, Tract 9503
C-1	0.001 a	0.001 a	0.002 b	0.021 a	0.023 a	0.0545493
C-2	0.0313 k	0.025 k	0.055 b	0.090 k	0.145 a	0.0545493
C-3 (x)	0.01 d	0.006 k	0.018 b	0.054 k	0.073 a	0.0545493
C-3 (y)	0.006 d	0.004 k	0.01 b	0.036 k	0.047 a	0.0545493
E-1	0.016 d	0.013 k	0.029 b	0.074 a	0.103 a	0.0545493
E-2	0.0023 a	0.0047 a	0.007 k	0.1005 a	0.1075 a	0.0545493
Extra-boundary	0.04371 g	0.0322 k	0.0725 k	0.094 k	0.166 a	0.0545493
R-1	0.008 d	0.005 b	0.013 b	0.054 k	0.067 a	0.0545493
R-2	0.001 a	0.001 a	0.002 b	0.008 a	0.01 a	0.0545493
R-3	0.006 a	0.005 k	0.012 b	0.039 a	0.051 a	0.0545493
R-4	0.0027 a	0.0019 a	0.0046 f,i	0.0196 a	0.0242 a	0.0545493
B	0.07856 a	0.04603 k	f	f	f	0.0545493
S	0.011 a	0.01167 j	f	f	f	0.0545493
T	0.001 a	0.001 a	0.002 b	0.033 a	0.035 a	0.0545493
V	0.026 a	0.009 k	0.035 b	0.093 k	0.127 a	0.0545493

\*DEEP concentrations resulting from VMware U T-Mobile were not modeled; instead, they were estimated as: T & V = (B & S & T & V) - (B & S)

a Belle-response-Matt-Kadlec-DPM-Summary-Table\_09-27-10 (2).xls

b Table 10-1. Response to Blackrock Questions\_final.doc

c Fig10-1\_DPM\_Concentrations\_Blackrock.pdf

d Figure 10-1 Blackrock only

<sup>37</sup> ASPEN is the computer simulation model used to estimate toxic air pollutant concentrations for NATA. For details, see <http://www.epa.gov/ttn/atw/nata/aspn.html>.

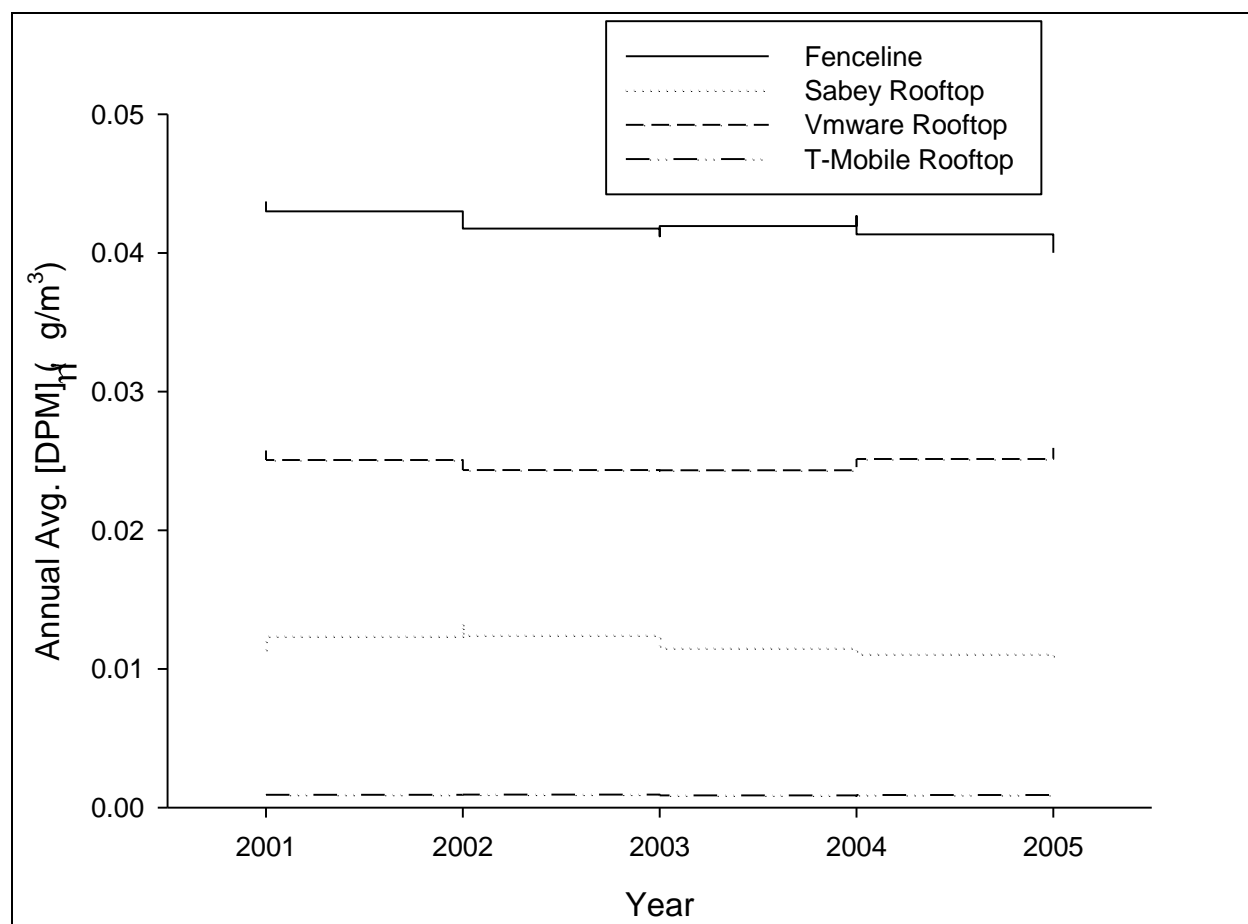
- f ICF did not provide these data
- g Tier\_2\_App C AERMOD Blackrock.pdf
- h Fig 7-2 Blackrock and Sabey
- i Concentration at this receptor is [Blackrock] + [Sabey], not modeled.
- j README\_for\_Sabey\_AERMOD\_Files.xls
- k Tier 2 TSD for Blackrock and Sabey\_CL100110\_LH+Sabey+ICF\_comments\_2.docx

Ecology summarized these estimates as Blackrock and Sabey percentages of total DEEP concentrations that could exist at off-site receptor locations following completion of the Blackrock and Sabey projects. The summary results are shown in Table 12.

**Table 12. Intergate Columbia Data Center + NATA DEEP Concentration Estimates With Blackrock and Sabey Percent Contributions to the Totals at Off-Site Receptor Locations**

Location	Blackrock & Sabey & VMware & T-Mobile & NATA ( $\mu\text{g}/\text{m}^3$ )	Blackrock % of total	Sabey % of total	Blackrock & Sabey % of total
E-2	0.1621	1%	3%	4%
C-2	0.1995	16%	13%	28%
Extra-boundary	0.2206	20%	15%	33%
V	0.1820	14%	5%	19%
E-1	0.1575	10%	8%	18%
C-3 (x)	0.1272	8%	5%	14%
R-1	0.1215	6%	4%	11%
R-3	0.1054	6%	5%	11%
C-3 (y)	0.1011	6%	4%	10%
T	0.0898	1%	1%	2%
C-1	0.0775	1%	1%	2%
R-4	0.0787	3%	2%	6%
R-2	0.0645	1%	2%	3%

Weather patterns over the 2002–2004 model data interval suggest that inter-year differences in weather could have a relatively small effect on DEEP concentrations at off-site locations. The results of this analysis for Blackrock emissions at extra-boundary and off-site rooftop air intake locations are shown in Figure 11.



**Figure 11.** Inter-year weather effects on DEEP concentrations resulting from Blackrock's emissions at four off-site locations.

#### 5.4. Exposure-Response Assessment

Exposure-response assessment is the process of characterizing the potential incidence of adverse health effects in humans resulting from exposure and uptake of toxicants. The process often involves establishing risk-based toxicity values or criteria to use in assessing potential health risk from each toxicant. Exposure-response assessment attempts to consider time-changing exposure magnitudes in whole populations and in theoretically maximally exposed individuals.

The EPA, the California's Office of Environmental Health Hazard Assessment (OEHHA), and the Agency for Toxic Substances and Diseases Registry (ATSDR) have developed toxicological values for the chemicals evaluated in this project. These values are derived from laboratory studies of animals and humans and from human epidemiological studies.

Some of the toxicological values concern adverse effects other than cancer. The inhalation reference concentration (RfC), OEHHA reference exposure levels (RELs) and ATSDR minimal risk level (MRLs) are derived by methods that are believed to yield exposure concentrations for

specified time frames below which non-cancer toxic effects are not expected to happen. The lack of such effects in all humans at these exposure concentrations cannot be confirmed. However, the closer a chemical concentration is to an RfC, REL, or MRL, the closer it may be to a toxic effect threshold level.

In addition to RfCs, RELs and MRLs, there are toxicological values derived for estimating toxicant-exposure-enhanced cancer risk. Nearly a third of all people develop some form of cancer at some point in life. The additional risk of cancer posed by exposure to TAPs to be emitted by the project is calculated using these cancer potency values, which are called unit risk factors (URFs).

The toxicological values for the chemicals of potential concern (identified in Section 5.2) are shown in Table 13.

#### 5.4.1. Risk-Based Concentrations for Exposed Populations

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

To evaluate the possibility of non-cancer effects arising from exposure to DEEP from the data centers, modeled concentrations at receptor locations were compared to its EPA inhalation RfC and OEHHA RELs.

**Table 13. Risk-Based Concentration Values for Comparison With the Modeled DEEP Concentrations**

Agency	Type	RBC
EPA <sup>a</sup>	RfC	5 µg/m <sup>3</sup>
	URF	1 x 10 <sup>-3</sup> to 1 x 10 <sup>-5</sup> per µg/m <sup>3</sup>
OEHHA <sup>b</sup>	Chronic REL	5 µg/m <sup>3</sup>
	URF	3.0 x 10 <sup>-4</sup> per µg/m <sup>3</sup>

- a. The EPA *Health Assessment Document for Diesel Engine Exhaust* (EPA ORD, 2002) gives a possible range of upper-bound risk of 1 x 10<sup>-3</sup> (µg/m<sup>3</sup>)<sup>-1</sup> to 1 x 10<sup>-5</sup> (µg/m<sup>3</sup>)<sup>-1</sup> for lifetime diesel exhaust exposure. However, to date, the EPA has not promulgated a specific point unit risk factor.
- b. Listed by ARB as “Particulate Matter from Diesel-Fueled Engines,” Scientific Review Panel unit risk “reasonable estimate” = 3.0 E-4 (µg/m<sup>3</sup>)<sup>-1</sup>. Range of unit risks in TAC document was 1.3 E-4 – 2.4 E-3 (µg/m<sup>3</sup>)<sup>-1</sup>. *California Environmental Protection Agency, Part B: Health Risk Assessment for Diesel Exhaust for the Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant*, California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section, Oakland, May 1998.

EPA and OEHHA developed non-cancer toxicity values for chronic exposure to DEEP. Because chronic toxicity values (RfCs and RELs) are based on a continuous exposure, an adjustment is sometimes necessary or appropriate to account for people working at commercial properties who

are exposed for only eight hours per day, five 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, Ecology determined the RfC or REL ( $5 \mu\text{g}/\text{m}^3$ ) will be used as the chronic risk-based concentration for all scenarios where receptors could be exposed frequently (e.g., residences, workplaces, or schools).

Reflecting uncertainty in their estimates, the DEEP cancer unit risk factor values published by EPA, California EPA and IARC, and individual researchers are not identical. The unit risk factors range from  $1.4 \times 10^{-2}$  to  $3.9 \times 10^{-4}$  per  $\mu\text{g}/\text{m}^3$ . However, the narrowness of this range shows there is consistency among the estimates relative to unit risk factor estimates for many other chemicals.

## 5.5. Risk Characterization

In risk characterization, conclusions about hazards and exposure responses are integrated with the exposure assessment conclusions. Non-cancer health hazards and cancer risks are quantified and attempts are made to estimate increased likelihoods of these effects in populations exposed to anticipated TAP emissions. In addition, confidence about these conclusions, including information about the uncertainties associated with each aspect of the assessment is highlighted.

### 5.5.1. Estimating Cancer Risks

DEEP may be emitted by Blackrock and Sabey in amounts that exceed its ASIL. With sufficient exposure, it may cause lung and other tumor types in humans. It is known to cause cancer in some experimental animal species after long-term inhalation exposure. Cancer may result from genotoxicity and or prolonged hyperplasia.

Additional cancer risk may be estimated by estimating the concentrations of a given carcinogen in a location (receptor point) multiplied by the carcinogen's unit risk factor (URF). A URF is expressed as the upper-bound probability of developing cancer assuming continuous lifetime exposure to an agent at a concentration of one microgram per cubic meter (i.e.,  $(\mu\text{g}/\text{m}^3)^{-1}$ ).

Some URFs are derived from epidemiological human population data. Others are derived from laboratory animal studies involving doses or concentrations higher than likely to be encountered in the environment. When certain assumptions are made, animal data may be used to derive a URF by extrapolation of the cancer potency obtained from a high-dose study to an expected exposure.

Because URFs are usually calculated as continuous lifelong exposure (70 years), it may be necessary to factor different exposure durations and exposure frequencies to estimate risk for people exposed primarily in occupational or other less than continuous lifelong exposure scenarios. In general, the formula for determining cancer risk is as follows:

$$\text{Additional Cancer Risk} = \frac{CAIR (\mu\text{g}/\text{m}^3) \times \sum \text{Exposure time}}{URF (\mu\text{g}/\text{m}^3)^{-1}}$$

Where:  $C_{Air}$  = Concentration in air at place(s) where people will be exposed to each carcinogen ( $\mu\text{g}/\text{m}^3$ );  $\sum$ Exposure time = (hours/24 hours) x (days/7 days) x (weeks/52 weeks) x (years/70 years); URF = Cancer Unit Risk Factor ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup> based on continuous life-long (70-year) exposure to  $1 \mu\text{g}/\text{m}^3$ .

### 5.5.2. Cancer Risk

Cancer risks are reported using scientific notation. The values quantify the increased cancer risk for hypothetically maximally exposed people. For example, a cancer risk of 1.0E-06 means that if 1,000,000 people were exposed to a carcinogen at the given concentration, one additional cancer case might occur in that population. Each person in an evenly exposed population would have their chance of getting cancer increase by 0.0001 percent. Note that these estimates are of cancer risks that might result in addition to those normally expected in an unexposed population. Cancer risks quantified in this document are an upper-bound theoretical estimate.

We did not estimate the number of additional cancers that might result in the exposed population because the population in the vicinity of the Intergate Columbia Data Center is too small. When small populations are exposed, population risk estimates tend to be very small. For example, if 100 people were exposed to a carcinogen at a level estimated to cause an additional individual lifetime cancer risk of  $10^{-4}$ , the expected number of additional cancer cases would be 0.01. In such situations, individual risk estimates, but not population risk estimates, are usually more meaningful for decision makers. The number of additional cancer cases in a given population is not an actuarial prediction of cases in the population. Actuarial predictions are statistical predictions based on a great deal of empirical data.

Table 14 shows the estimated worst-case residential and off-site worker cancer risks from exposure to DEEP near the Intergate Columbia Data Center. OEHHA's URF was used to estimate cancer risks to off-site residential receptors and to workers in commercial and Intergate Columbia Data Center property boundary maximum DEEP concentration points.

**Table 14. Ranges of Estimated Worst-Case Residential and Off-Site Worker Cancer Risks From Exposure to DEEP Near the Intergate Columbia Data Center**

	Location	$C_{Air}$ ( $\mu\text{g}/\text{m}^3$ )	Fraction of a 70- year continuous exposure	URF ( $(\mu\text{g}/\text{m}^3)^{-1}$ )	Additional Cancer Risk
Blackrock's MICR	C-2	0.0313	0.1308 <sup>a</sup>	0.0003	1.23E-06
Blackrock & Sabey MICR	C-2	0.055	0.1308 <sup>a</sup>	0.0003	2.16E-06
All four data centers + NATA	C-2	0.145	0.1308 <sup>a</sup>	0.0003	5.69E-06
Sabey's MICR	B	0.046	0.1308 <sup>a</sup>	0.0003	1.81E-06

	Location	C <sub>AIR</sub>	Fraction of a 70-year continuous	URF (( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup> )	Additional Cancer
All four data centers + NATA	B	Not reported	0.1308 <sup>a</sup>	0.0003	
Blackrock's MIBR	Extra-boundary	0.04371	0.0245 <sup>b</sup>	0.0003	3.21E-07
Sabey's MIBR	Extra-boundary	0.0322	0.0245 <sup>b</sup>	0.0003	2.37E-07
Blackrock & Sabey	Extra-boundary	0.0725	0.0245 <sup>b</sup>	0.0003	5.33E-07
All four data centers + NATA MIBR	Extra-boundary	0.2206	0.0245 <sup>b</sup>	0.0003	1.62E-06
Blackrock's MIRR	R-1	0.008	1 <sup>c</sup>	0.0003	2.40E-06
Sabey's MIRR	R-1	0.005	1 <sup>c</sup>	0.0003	1.50E-06
Blackrock & Sabey	R-1	0.013	1 <sup>c</sup>	0.0003	3.90E-06
All four data centers + NATA at R-1	R-1	0.1215	1 <sup>c</sup>	0.0003	3.65E-05

- Repeated exposures of 8 hr/day for 250 days/yr for 40 years are assumed for the MIBR. Based on this frequency, the additional cancer risk that would occur if the average concentration of DEEP occurred every time a maximally exposed person was in an MIBR location.
- Repeated exposures of 2 hr/day for 250 days/yr for 30 years are assumed for the MIBR. Based on this frequency, the additional cancer risk that would occur if the average concentration of DEEP occurred every time a maximally exposed person was in the MIBR location.
- A continuous exposure 24 hr/day for 365 days/yr for 70 years is assumed for the MIRR. Based on such an exposure, the additional cancer risk that would occur if the average concentration of DEEP continued to occur in the MIRR location.

Additional cancer risks of less than 1.0E-05 that result from exposure to regulated TAPs are considered acceptable in Chapter 173-460-090 WAC. At all receptor locations for which information is available, cancer risks attributable to Blackrock or to Sabey emissions alone are less than 10 per million. The concentration of DEEP derived from modeling the combination of emissions from Blackrock, Sabey, VMware, and T-Mobile, and adding of the NATA 2005 ambient concentration estimate for Census Tract 9503 at the R-1 receptor exceeds the 1.0E-05 limit by 3.65-fold, however.

In contrast to the ambient concentration estimate for Census Tract 9503, USEPA derived an actual exposure estimate using the ambient concentration estimate and a second model (ASPEN). The resulting exposure estimate was 0.0273666  $\mu\text{g}/\text{m}^3$ , which is 50 percent of the 2005 NATA ambient concentration estimate. Additional cancer risk resulting from this exposure could be 8.21E-06. Thus once Blackrock and Sabey emissions are added to the emissions from other generators at the Intergate Columbia Data Center (including T-Mobile) and to the background DEEP exposure level, the overall cancer risk attributable to DEEP exposure at R-1 is likely to be less than 16 per million.

Blackrock and Sabey emissions will increase the DEEP concentration in the air in the vicinity of the Intergate Columbia Data Center. Ecology finds the additional cancer risk attributable to a



70-year long continuous exposure to background DEEP sources in the census tract where the data centers are located will be 8.12E-06 at most. This estimate is crude and likely to change as the accuracy and magnitude of NATA estimates change over time.

Assuming the URF is accurate and that the most recent NATA estimate of the background DEEP concentration in the census tract where the data centers are is accurate and will continue to be so for 70 years, the cancer risk posed by Blackrock and Sabey emissions, together with the existing DEEP sources, will be highest at the MIRR. The highest reasonable additional cancer risk estimate is 2.37E-05. Approximately 80 percent of this risk will come from existing background DEEP sources (i.e., T-Mobile, VMware, and sources included in NATA).

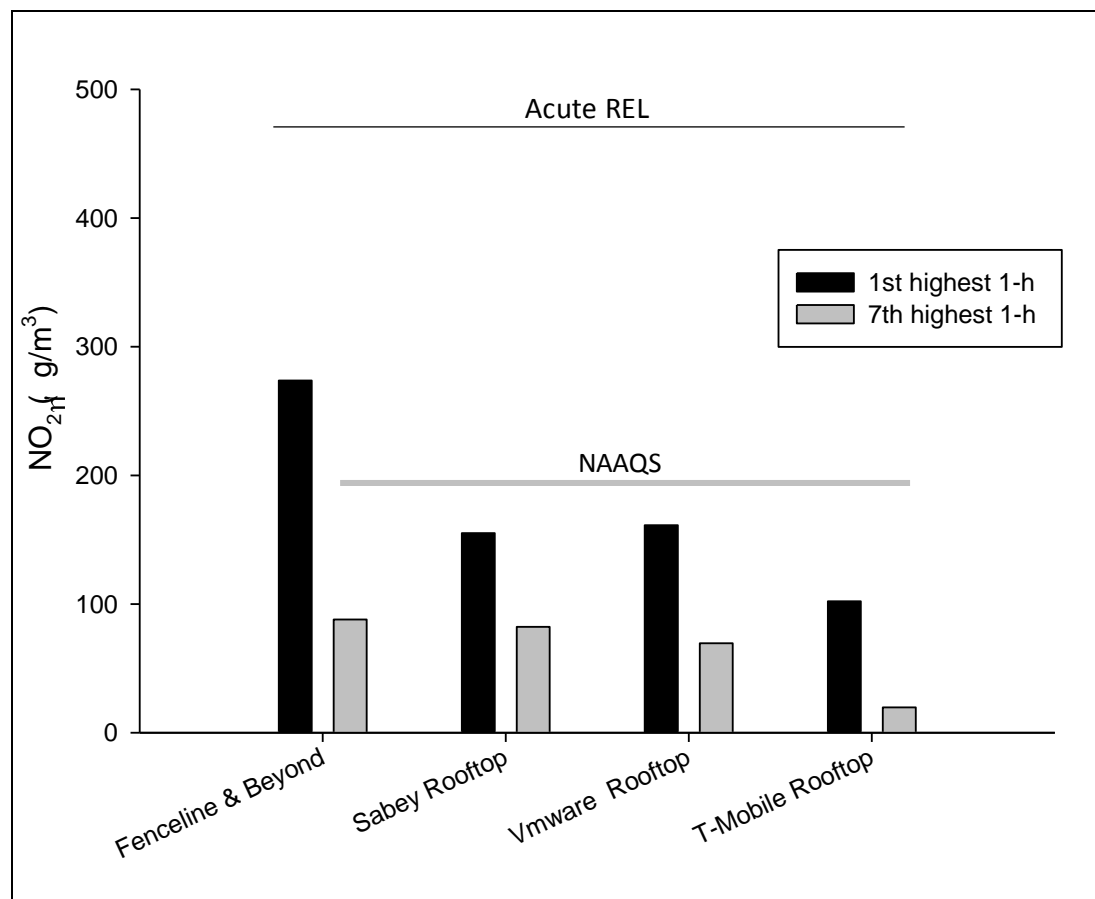
### **5.5.3. Hazard Quotients/Hazard Index**

Many air pollutants can harm health in ways other than by causing cancer. Common “non-cancer effects” include problems such as eye and throat irritation, cough, and headache. Effects less commonly include more severe problems such as bronchitis, shortness of breath, and heart arrhythmias, for example. In addition to these, some type of air pollutant can affect most other organs systems too.

To determine if Blackrock and Sabey emissions could pose any significant non-cancer effect risks, we calculated a hazard quotient (HQ) for DEEP at the highest expected ambient concentration likely to occur. We used the basic equation:

$$\text{Hazard Quotient} = \frac{\text{Time-weighted average concentration } (\mu\text{g}/\text{m}^3)}{\text{Risk-based concentration } (\mu\text{g}/\text{m}^3)}$$

Nitrogen dioxide HQs did not exceed unity at any receptor. Evaluation of the available model results suggests that acute adverse health effects are improbable even during concentrations extremes (Figure 12).



**Figure 12.** Blackrock-attributable nitrogen dioxide 1-hour concentration extremes

Table 15 shows the modeled DEEP concentration at the maximally impacted receptor point, the non-cancer RBCs, and resulting HQ.

**Table 15. Non-Cancer Adverse Health Effect Hazards of All Four Intergate Data Centers and NATA Modeled Background DEEP Emissions Together at the Maximally Exposed Extra-Boundary Receptor Locations**

Maximum 1-yr TWA	0.1215- $\mu\text{g}/\text{m}^3$	
RBC	RfC 5- $\mu\text{g}/\text{m}^3$	REL 5- $\mu\text{g}/\text{m}^3$
HQ	0.0243	0.0243

#### **5.5.4. Hazard Indexes Discussion**

DEEP may cause respiratory epithelium irritation and lesions like acrolein and nitrogen dioxide can. The sum of HQs for a given effect is the index of the potential adverse effect. Ecology screened the combined risk of respiratory irritation effects that may be posed by exposure to these TAPs at the highest maximally exposed receptor location. Like DEEP, the maximum possible concentrations of acrolein and nitrogen dioxide were also well below their non-cancer effect RBCs (Table 3). For this reason, Ecology did not conduct further respiratory irritation hazard index calculations.

#### **5.6. Uncertainty Characterization**

Uncertainty may be defined as imperfect knowledge concerning the present and future conditions of a system under consideration. In risk assessments undertaken in support of regulatory decisions, many uncertainties are encountered. Knowledge of these uncertainties allows us to assess the strength of decisions.

Evaluating potential impacts of the Blackrock and Sabey projects involves several key elements including emissions rate assumptions, air dispersion and fate modeling, estimates of resulting environmental concentrations, exposure modeling to estimate received doses, and exposure-response relationships to estimate the possibilities of different types of health impacts. Each of these elements is encumbered by uncertain science and measurement variability that prevents absolute confidence in predictions about adverse health impacts of this project.

To the extent that people may be exposed to emissions of TAPs from the proposed data centers, and despite the uncertainties in concentration estimates, exposure estimates, cancer potency estimates, and irritation hazards, the potential health risks appear to be acceptable. Quantitative assessments of the effects of data center diesel generators' emission impacts on human health cannot be made with greater confidence. As in any risk assessment, the current risk assessment involves circumstances of incomplete scientific information. Overall risk uncertainties are summarized in Table 16. The largest sources of uncertainty and variability are:

##### **5.6.1. Emissions Uncertainty**

Emissions uncertainty includes measurement uncertainty and process variability. The emissions factors used to estimate emission rates from the proposed new generators are estimates of central tendency of measured emissions from comparable diesel engines. EFs are just as likely to underestimate as to overestimate TAP emissions. No quantitative description of uncertainty and variability consistent with available data are available in this situation. The effects of emissions rates uncertainties may result in overestimates of TAP concentrations that will result from the data centers' emissions initially but these may change to underestimates over extended time.

Further uncertainty in the DEEP emissions estimates comes from uncertainty in the assumption that dispersion and power failure conditions are independent from each other in East Wenatchee.

It is possible that weather extremes will trigger power failures in the future. Weather and climatic conditions can damage equipment used for the generation, transmission, or utilization of electrical power. Distribution equipment and transmission lines sometimes fail due to severe weather, ice storms, lightning, as well as human-caused accidents. Various components such as transformers, fuses, switches, insulators, and other components that carry electricity, periodically fail.

Emergency operation of the data centers' diesel generators will be more likely to occur as increasing electricity demand<sup>38,39,40</sup> coincides with increasingly uncertain hydroelectric power generation capacity from diminishing stream flows resulting from climate-change,<sup>41</sup> and with diminishing reserves of fossil fuel. Consistent hydroelectric power production over the next century in eastern Washington is uncertain. According to a study by UW scientists:<sup>42</sup>

"...substantial changes in the amount and seasonality of energy supply and demand in the PNW are likely to occur over the next century in response to warming, precipitation changes, and population growth. For the 2020s, regional hydropower production increases by 0.5-4% in winter, decreases by 9-11% in summer, with annual reductions of 1-4%. Slightly larger increases in winter, and summer decreases, are projected for the 2040s and 2080s."

Some of these weather and climate change problems are directly related to DEEP dispersion conditions. Ecology does not have enough information to be able to characterize the risk of power failures, so cannot quantify the probability the diesel generators will be used for an emergency. In general, it appears that the overall risk of back-up generator operation will increase over time.

### **5.6.2. TAP Concentration Modeling Uncertainty**

TAP concentration modeling uncertainty results from uncertainties about future meteorology, and the measurement variability and applicability of past meteorological conditions of the air data used for the current analyses. Additionally, TAP concentrations uncertainty arises from uncertainty in the precision and accuracy of the air quality dispersion model used (EPA's AERMOD and associated pre- and post-processors). The results of TAP concentration modeling for the data centers are just as likely to be underestimates as to overestimates. The results are

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<sup>38</sup> In May of 2001, the Bonneville Power Administration asked ten aluminum smelters in the Pacific Northwest to close for two years, to reduce electricity consumption in the area. Reported in *The Outlook*, WALL ST. J ONLINE, May 21, 2001.

<sup>39</sup> <http://openjurist.org/126/f3d/1158/association-of-public-agency-customers-inc-v-bonneville-power-administration-and-utility-reform-proj>

<sup>40</sup> Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State, Hamlet, A.F., S.Y. Lee, K.E.B. Mickelson, and M.M. Elsner, 2009. Effects of projected climate change on energy supply and demand in the Pacific Northwest and Washington State, Chapter 4 in *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*, Climate Impacts Group, University of Washington, Seattle, Washington, <http://www.cses.washington.edu/db/pdf/wacciach4energy647.pdf>.

<sup>41</sup> Ibid

<sup>42</sup> Ibid

central estimates of long-term concentrations and of extreme short-term concentrations. No quantitative descriptions of uncertainty and variability consistent with available data are available. The effects of these uncertainties may be underestimates or overestimates of TAP concentrations that will result.

### **5.6.3. Background TAP Concentration Estimates Uncertainties**

Background TAP concentration estimates uncertainties result from the uncertainty about the validity of EPA's ASPEN model, and from the possibility that toxic air emissions have changed since 2005 (the most recent NATA year). Further uncertainty arises from the geographic scale of the NATA concentration model, which is too large to provide precise results at single census tract scale. NATA results are most reliable when analyzed on a national or state scale, and have increasing uncertainty at smaller county and census tract levels. Therefore, concentration estimates at the census tract level may be misleading. Another limitation is that, while EPA has issued Maximum Achievable Control Technology (MACT) standards that are expected to reduce emissions of air toxics from stationary sources, other source categories emissions are generally increasing. The NATA background concentrations estimates are unlikely to exist at steady levels, but are likely to generally increase or decrease in long-term trends. Other than EPA's analysis, we have no data about future background levels. The overall effect of these uncertainties is to reduce our confidence in estimates of existing and future air toxics concentrations in the vicinity of Blackrock and Sabey.

### **5.6.4. Exposure Uncertainty**

Exposure uncertainty results from potential inaccuracies of assumptions about the time people will spend in various locations. Concerning locations that will be affected by Blackrock and Sabey's emissions, we assume a defined intermittent exposure pattern for a hypothetical worker entering the MIBR locations routinely. We also assume a defined intermittent exposure pattern for workers entering the MICRs, and that a person occupying the MIRR will have continuous life-long exposure at that location. The need to ensure that uncertainty and variability are addressed is met by ensuring that the maximal exposures are not underestimated. However, each exposure pattern assumption is likely to overestimate what will actually occur.

### **5.6.5. Toxicity Uncertainty**

Toxicity uncertainty results from potential inaccuracies in the risk-based concentrations used in a risk assessment. RBCs are based on inherently variable experimental toxicology and epidemiological studies. In the process of developing RBCs, there are uncertainties in the assumptions used to extrapolate these data, especially for chemicals with little or no human exposure-response data. Many RBCs are based on animal studies at high levels of exposure.

DEEP is a probable human carcinogen based on evidence from controlled laboratory animal studies that demonstrated its carcinogenicity, and epidemiological evidence among occupationally exposed people that suggests it may cause lung and bladder cancer. The OEHHA

URF<sup>43</sup> used in the current analysis may be inaccurate. To avoid underestimating DEEP's true cancer potency, OEHHA based the URF on upper confidence limits of response data. In this way, they attempted to ensure that uncertainty and variability were addressed and to avoid underestimating actual risks. The cancer risk quantified in this technical analysis is an upper-bound theoretical estimate. Actual risks are likely to be lower. The estimate of increased cancer risk is the best possible estimate of the upper extreme. The estimate is of cancer cases that might result in addition to those normally expected in an unexposed population.

Other sources of uncertainty cited in EPA's health assessment document for diesel exhaust are the lack of knowledge about the underlying mechanisms of DEEP toxicity, and the question of whether toxicity studies of DEEP based on older engines are relevant to emissions from current technology diesel engines.

**Table 16. Summary of How the Uncertainty Affects the Quantitative Estimate of Risks or Hazards**

<b>Source of Uncertainty</b>	<b>How Does it Affect Estimated Risk From This Project?</b>
Emissions estimates	Likely to overestimate risk initially but to underestimate risk in coming decades
Concentration modeling	Possible underestimate of long-term risks and possible overestimate of acute risks
Exposure assumptions	Likely to overestimate risk slightly
Toxicity of DEEP at low concentrations	Possible overestimate of cancer risk, possible underestimate of non-cancer hazards for extremely sensitive people

Ecology's screening of potential non-cancer adverse health effects risks involved comparisons of possible exposures to RBCs, which are estimates of inhalation exposures for humans (including sensitive subgroups) likely to be without appreciable risks of adverse effects for defined durations. This assessment evaluated the possibility that non-cancer health risk could arise due to DEEP, NO<sub>2</sub>, and acrolein exposure. Despite the uncertainty in RBCs developed for these TAPs, it is unlikely that there will be a significant risk of respiratory irritation at any maximally exposed receptor.

## **6. OTHER CONSIDERATIONS**

### **6.1. Short-Term Exposures to DEEP**

As discussed previously, exposure to DEEP can cause both acute and chronic health effects. However, reference toxicological values specifically for DEEP exposure at short-term or intermediate intervals do not currently exist. Therefore, Ecology did not quantify short-term risks from DEEP exposure. By not quantifying short-term health risks in this document, Ecology

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<sup>43</sup> A URF is the upper bound of a confidence interval around, most typically, a mean of expected carcinogenic response at a given concentration. The 95 percent confidence interval of the mean is the range of values that will contain the true population mean 95 percent of the time.

does not imply that they have not been considered. Instead, we have assumed that compliance with the 24-hour  $PM_{2.5}$  National Ambient Air Quality Standard (NAAQS) is an indicator of acceptable short-term health effects from DEEP exposure. In our analysis, we assumed all DEEP emissions to be  $PM_{2.5}$ .

Relevant to the data centers' DEEP emissions, the 24-hr  $PM_{2.5}$  NAAQS was set by EPA to protect people from short-term exposure to small particles (which include DEEP). Ecology determined that Blackrock and Sabey adequately demonstrated compliance with the  $PM_{2.5}$  NAAQS. Therefore, short-term impacts from DEEP exposure were considered and found to be acceptable.

## **6.2. Other Possible Acute Non-Cancer Health Effects**

In the event of a system-wide power outage in East Wenatchee, dozens of backup diesel engines could run simultaneously resulting in higher short-term emission rates of nitrogen dioxide and other TAPs. The impacts of higher short-term  $NO_2$  emission rates from the existing unmodified engines have not been evaluated in this document because only DEEP emissions from the Blackrock and Sabey projects exceeded the ASIL. Because emissions of  $NO_2$  and other TAPs from these projects were below the ASIL, no further review was required for those pollutants. Emissions below the ASIL suggest that increased health risks from these pollutants are acceptable.

Although a total system-wide power outage in East Wenatchee is not common due to system reliability, we cannot completely rule out the possibility of having an increased number of outages in the future. If multiple outages were to occur, people with asthma, who might be cumulatively exposed to  $NO_2$  and DEEP from the data centers and other sources, may experience respiratory symptoms such as wheezing, shortness of breath, and reduced pulmonary function with airway constriction.

## **7. CONCLUSION**

Blackrock and Sabey's proposed emissions of DEEP could each increase lung and bladder cancer risk by less than  $2.5 \times 10^{-6}$  (< 2.5 in one million) for a person(s) living 70 years in the maximally impacted residential location. Combined DEEP emissions from Blackrock and Sabey could result in increased cancer risks of up to  $3.9 \times 10^{-6}$  (3.9 in one million) at the maximally impacted residence, which is the location most likely to sustain the highest additional risk from data center emissions. The increased cancer risks from Blackrock and Sabey for people frequently in maximally impacted boundary and commercial locations are less than two in one million. The addition of the data centers' DEEP emissions to existing emissions could result in overall DEEP-associated cancer risk of up to  $3.65 \times 10^{-5}$  (36.5 in one million).

Non-cancer adverse health effects among people near the data centers are unlikely to result solely from exposure to the new generators' emissions. For this reason, the non-cancer effect hazards of combined exposure to existing diesel exhaust sources and proposed Blackrock and Sabey emissions was not evaluated.

Based on the current zoning within the project area, it is reasonable to assume there will be no dense residential development near the data centers. However, several residences, businesses, and orchardists currently occupy the affected area. Future decisions about development and use of the land area around the data centers should consider potential impacts of data center air emissions on human health.

In summary, Blackrock and Sabey's emissions are unlikely to result in excessive cancer risk or in any significant adverse non-cancer health problems to people at nearby residences or commercial locations. The increased risks from the proposed projects appear to be permissible because they fall within the limits defined in WAC 173-460-090(7). Based on our analysis, the Washington State Department of Ecology finds that the applicants have satisfied all requirements for approval of their second tier petitions. The project review team recommends approval of the proposed projects in accordance with WAC 173-460-090(7).

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## 9. LIST OF ACRONYMS AND ABBREVIATIONS

AERMOD	Air dispersion model
ASIL	Acceptable Source Impact Level
ATSDR	Agency for Toxic Substances and Diseases Registry
B	Blackrock Data Center rooftop ventilation air intake
BACT	Best Available Control Technology
Blackrock	Blackrock Data Center, East Wenatchee, Washington
C	Celsius
C <sub>Air</sub>	Concentration in air
CRO	Washington State Department of Ecology, Central Regional Office
DEEP	Diesel Engine Exhaust Particulates
Ecology	Washington State Department of Ecology, Headquarters Office
EPA	United States Environmental Protection Agency
HIA	Health Impact Assessment
HQ	Hazard Quotient
h or hr	Hour
ICF	ICF International
Max.	Maximum
µg/m <sup>3</sup>	Micrograms per Cubic Meter
MIBR	Maximally Impacted Boundary Receptor
MICR	Maximally Impacted Commercial Receptor
MIRR	Maximally Impacted Residential Receptor
MRL	ATSDR Minimal Risk Level
NAD27	North American Data of 1927
NATA	National-Scale Air Toxics Assessment
NOC	Notice of Construction Order of Approval
NWS	National Weather Service
OEHHA	California's Office of Environmental Health Hazard
ORD	EPA Office of Research and Development
RBC	Risk-Based Concentration
REL	OEHHA Reference Exposure Level
RfC	Reference Concentration
S	Sabey Data Center rooftop ventilation air intake
Sabey	Sabey Data Center, East Wenatchee, Washington
SQER	Small Quaintly Emission Rate
T	T-Mobile Data Center rooftop ventilation air intake
TAP	Toxic Air Pollutant
tBACT	Best Available Control Technology for Toxics
UF	Uncertainty Factor
URF	Unit Risk Factor
V	VMware Data Center rooftop ventilation air intake
WAC	Washington Administrative Code
y or yr	Year