State of Washington
Department of Ecology
Technical Support Document (TSD)

Source Background and Description

Source Name:	**Pasco Sanitary Landfill**
	1901 Dietrich Road, Pasco, WA
Source Location:	**SW ¼ of the NW1/4 of Section 22, Range 30, Township 9, WM**
County:	**Franklin**
SIC Code:	
Approval Order No.:	**14AQ-E571**
Permit Engineer:	**Robert Koster**

Introduction

The Washington State Clean Air Act and its supporting regulation, the General Regulation for Air Pollution Sources requires all new or modified sources of air pollution to submit notice before constructing and operating any new source of air pollution except single family and duplex dwellings or de minimis sources. This process is referred to as NSR. NSR includes a verification that the new or modified source will not cause or contribute to a violation of any ambient air quality standard, employ Best Available Control Technology (BACT), and comply with all federal and state rules. After the analysis, an order of approval is issued that sets forth requirements and conditions to ensure those requirements are met.

History

On August 18, 2014, the Industrial Waste Area Generators Group (IWAG) responsible for the clean-up of Zone A (the 40,000 drum hazardous waste deposit at the Pasco Sanitary Landfill) submitted a Notice of Construction (NOC) application for the rerouting of Zone A gas from the flare combusting both municipal waste generated gas and the Zone A gas to a regenerative thermal oxidizer (RTO) dedicated to the Zone A soil vapor extraction (SVE) system. The SVE system is currently operated as part of an interim compliance strategy for the IWAG to prevent the spread of subsurface contaminants from Zone A under Agreed Order No. 9240. Historically the Ecology Air Quality Program did not require NOC approval for a Model Toxics Control ACT (MTCA) project such as this. In late 2013 it was determined that this could jeopardize Ecology's ability to implement federal air quality permitting requirements in Washington. As per guidance on the application of the permit exemption for MTCA projects, Ecology's air quality program agreed to issue approval for criteria pollutant emissions from this SVE/RTO project. Following that agreement, it was determined that the toxic air contaminant health impact evaluation would be most efficiently performed by Ecology's AQP toxicologists and that

the determinations resulting should be incorporated into the criteria air pollutant approval.

Permitted Emission Units and Pollution Control Equipment

The AQP has not issued a permit for the Zone A clean up. It was the program's historic belief that the MCTA permit exemption applied and that AQP interests were served by TCP implementing substantive and mandatory AQ requirements. So, rather than issuing separate AQ approval, the AQP assisted the Toxics Clean-up Program (TCP) to implement necessary AQ requirements. In accordance with Ecology guidance issued in late 2013, the AQP will now issue an approval for this RTO project. The approval will include any specific air toxics limitations as an efficient way to use the AQ toxicology and modeling expertise.

Unpermitted Emission Units and Pollution Control Equipment

There are no unpermitted facilities operated by this source during this review process.

New Emission Units and Pollution Control Equipment

The proposed RTO will replace the use of the flare to dispose of the gases drawn from the area (Zone A) with drums of hazardous waste. The RTO is designed to combust 1000 scfm of the contaminated soil vapor extracted from Zone A with 1300 scfm of dilution air. In addition, seven gallons per hour of condensate will be introduced to the RTO for disposal. The application indicates that the overall VOC destruction and removal efficiency will be greater than 98%.

The source consists of the following new facility/unit:

(a) One two-canister RTO, Gulf Coast Environmental (GCE) Model 20-92-RTO,

Existing Approval Orders

None

Stack Summary

There is one stack for the RTO which has been evaluated for this project. In the past, the SVE gases were cofired in the flare that combusted gases generated in the municipal solid waste part of the landfill. The municipal solid waste gases will be isolated from the SVE gases and will continue to be combusted in the flare.

Enforcement Issue(s)

There are no air quality enforcement actions pending for this source.

Recommendation

Staff recommends that the construction and operation of the RTO facility be approved. This recommendation is based on the following facts and conditions:

Information used in this review was derived from the revised application and Second Tier Health Impact Assessment (received October 24, 2014).

A complete application for the purposes of this review was received on October 24, 2014.

Emission Calculations

See appendix A for detailed emission calculations.

Actual Emissions

No previous emission data has been received by the air quality program from the source.

Limited Potential to Emit

The source shall limit total VOC emissions to a maximum of 3.3 lb/hr at the outlet of the RTO. The source must also demonstrate and continue to demonstrate that the RTO will result in a 98% destruction/removal efficiency for the contaminants being removed from the contaminated vadose zone by the SVE system.

County Attainment Status

Pollutant	Status
PM10	attainment
SO2	attainment
NO2	attainment
Ozone	attainment
CO	attainment
Lead	attainment

Part 70 Permit Determination

The landfill SVE facility is not subject to the Part 70 Permit requirements because the potential to emit (PTE) of:

(a) each criteria pollutant is less than one hundred (100) tons per year;
(b) a single hazardous air pollutant (HAP) is less than ten (10) tons per year, and;
(c) any combination of HAPs is less than twenty-five (25) tons per year.

State and Federal Rule Applicability

The proposed facility is subject to the requirements of WAC 173-400-110, New Source Review (NSR), and WAC 173-455-120, NSR Fees.

1.1. WAC 173-400-113, Requirements for new sources in attainment or unclassifiable areas, is the State regulation that defines the evaluations of the air quality project at this landfill. The subsections of WAC 173-400-113 require the following:

1.1.1. WAC 173-400-113(1): "The proposed new source will comply with all applicable new source performance standards (NSPS), national emission standards for hazardous air pollutants (NESHAP)...".

1.1.1.1. Ecology is not aware of any NSPS or NESHAP that apply to the Pasco Landfill operations.

1.1.2. WAC 173-400-113(2): "The proposed new source or modification will employ BACT for all pollutants not previously emitted or whose emissions would increase as a result of the new source or modification".

1.1.2.1. Pasco Landfill proposes that the RTO, resulting in 98% control of the VOC removed from the vadose zone by the SVE system, and its exhaust containing a maximum of 3.3 pounds per hour VOC represents BACT and t-BACT. Ecology agrees although we note that there is no economic analyses provided supporting this determination. The control proposed requires that the active oxidation bed in the RTO be maintained at a temperature at or higher than 1600 degrees Fahrenheit, and that the flow of SVE gas and condensate and dilution air are accurately and precisely monitored.

1.1.3. WAC 173-400-113(5): "If the proposed new source or the proposed modification will emit any toxic air pollutants regulated under chapter 173-460 WAC, the source meets all applicable requirements of that program. The RTO will reduce and emit several pollutants regulated under WAC 173-460. Because this project is being done under an agreed clean up order under MTCA, normal air quality program jurisdiction does not apply. However, Ecology's Toxic Cleanup Program does not have the toxicology or air pollution engineering expertise required for this project so AQ and TCP agreed that AQ would process the RTO application in accordance with AQ NSR rules.

1.2. WAC 173-460, Controls for New Sources of Toxic Air Pollutants, is the State regulation that addresses the risk to the public from routine releases of toxic air contaminants from new and modified sources.

1.2.1. WAC 173-460-050: The applicant must quantify the facility's emissions of toxic air contaminants. The applicant has done this in its application. The toxics emission point will be the exhaust stack of the RTO.

1.2.2. WAC 173-460-060: The applicant must install and operate t-BACT on each emission point for which there is an increase in a toxic air pollutant. The Approval Order based on the analyses described in this technical support document contains emission limitations that reflect t-BACT for a hazardous waste clean-up project like this one.

1.2.3. WAC 173-460-070: This section of the regulation requires that impacts of emissions of toxic air pollutants be demonstrated to be sufficiently low to protect human health and safety. This was accomplished by modeling the dispersion of any TAP emitted at a rate greater than the WAC 173-460 small quantity emission rates to determine the concentration of that pollutant at the property boundary. The RTO while reducing the halogenated organics in the SVE stream, produces acid gases as a result. HF and HCl are the two acid gases of greatest concern and HCl

will be emitted at a rate sufficient to exceed the acceptable source impact level (ASIL) at the property boundary. This impact triggers a Health Impact Assessment (HIA), referred to as a Tier II toxics review, to determine if the impacts can be approved at concentrations determined to be higher than the ASIL. The applicant provided a HIA to the Ecology modelers and toxicologists for this Tier II review. The toxicologists have provided the Tier II recommendation in Appendix B to this technical support document. As part of the Tier I review, Ecology questioned whether dioxins might also be formed by this control device. After review of documents referenced by the applicant, Ecology found no evidence that dioxins are a concern great enough to establish permit limits or require emission testing. The important features of this control device that support that determination are the requirement that the unit be maintained at 1600 degrees Fahrenheit and the fact that the heat recovery bed quenches the exhaust stream to below favorable temperatures almost immediately. The unit will emit very low levels of particulate matter to serve as necessary nucleation sites for the formation process.

1.2.4. There are no National Emission Standards for Hazardous Air Pollutants (NESHAPs) applicable to this source.

Conclusion

Ecology has determined the applicant, Environmental Partners, Inc., has satisfied all of the requirements of New Source Review for its proposal to establish an air pollution control device on the soil vapor extraction system at the Pasco Landfill MTCA clean up site. The construction and operation of this pollution control device (the RTO) shall be subject to the conditions of the attached proposed Approval Order no. 14AQ-E571.

Appendix A

Pasco Sanitary Landfill RTO Project
Applicant's Emission Estimates

SVE Vapor Analytical Data		RTO Outlet (98% DRE)	
VOC Compounds	Average Concentration (ug/L)	Emissions Rate (lbs/day)	Emissions Rate (lbs/year)
1,1,1-Trichloroethane	47	0.36	131.36
1,1-Dichloroethane	32	0.08	30.22
1,1-Dichloroethene	1.6	0.03	11.82
1,2,4-Trimethylbenzene	65	0.20	72.25
1,2-Dichlorobenzene	3.3	0.03	11.17
1,2-Dichloroethane	31	0.10	36.14
1,2-Dichloropropane	1.1	0.002	0.72
1,3,5-Trimethylbenzene	39	0.10	35.48
1,4-Dichlorobenzene	0.4	0.004	1.31
2-butanone (MEK)	3,458	16.76	6,120.96
2-Hexanone (MBK)	22	0.05	18.71
4-Methyl-2-pentanone (MIBK)	758	1.99	725.12
Acetone	2,539	17.48	6,383.68
Benzene	4.1	0.04	14.45
Carbon disulfide	0.30	0.001	0.26
Chlorobenzene	0.7	0.007	2.69
Chloroethane	2.6	0.03	9.85
Chloroform	2.1	0.02	5.85
Chloromethane	2.2	0.02	7.88
cis-1,2-Dichloroethene	7.0	0.06	23.65
Dichlorodifluoromethane (CFC-12)	2.2	0.01	5.06
Ethanol	1,046.2	12.75	4,655.60
Ethylbenzene	396	0.99	361.29
Isopropylbenzene	13	0.14	50.58
m,p-Xylene	1,221	3.06	1,116.74
Methylene chloride	535	1.47	538.58
Naphthalene	1.1	0.01	4.88
n-butylBenzene	2.0	0.01	4.86
n-propylbenzene	24	0.18	64.37
o-Xylene	340	0.83	302.20
p-Isopropyltoluene	1.2	0.009	3.22
Tetrachloroethene	31	0.07	25.62
Toluene	5,796	17.26	6,305.73
Total Xylenes	1,561	3.88	1,418.94
trans-1,2-Dichloroethene	0.2	0.001	0.21
Trichloroethene	327	0.90	329.88
Trichlorofluoromethane (CFC-11)	23	0.12	45.32
Vinyl chloride	1.0	0.009	3.35
Acid Gas (HCl)	-	118.05	43,116.85
Acid Gas (HF)	-	2.940	1,073.84
Total VOC Emissions		79	28,875

Appendix B

Health Impact Assesssment (Tier 2) Review and Recommendation Document

DEPARTMENT OF
ECOLOGY
State of Washington

Second Tier Review Recommendation Document for

Pasco Landfill Regenerative Thermal Oxidizer Project Pasco, Washington

Prepared by

Air Quality Program
Washington State Department of Ecology
Olympia, Washington

February 19, 2015

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1. Summary and Purpose

The Industrial Waste Area Generators Group III proposes to install a regenerative thermal oxidizer (RTO) at the Pasco Sanitary Landfill Site in Pasco, Washington (the project). One of several waste repositories at the site (Zone A) contains an estimated 35,000 drums of hazardous waste. Deterioration of the buried drums has resulted in the release of volatile organic compounds (VOCs) to the vadose soil layer beneath the drums. The vadose layer is soil that lies between the soil surface and the water table. This release of VOCs is expected to continue throughout the current phase of Interim Action cleanup.

The proposed RTO will reduce emissions of VOCs from the soil vapor extraction system in Zone A. This oxidation of VOCs, which include both chlorinated and fluorinated compounds, will produce some toxic air pollutants (TAPs). The Industrial Waste Area Generators Group III estimated these emissions could cause the ambient air concentration of hydrogen chloride (HCl) to exceed a regulatory trigger level called the acceptable source impact level (ASIL); therefore, the Washington State Department of Ecology (Ecology) required them to submit a Second Tier petition under the authority of Washington Administrative Code (WAC) 173-460-090. A Second Tier petition requires a health impact assessment (HIA) to quantify possible toxic hazards. The Industrial Waste Area Generators Group III hired Landau Associates (Landau) to prepare the HIA. Landau estimated toxicity hazards to people near the landfill who might be exposed to HCl from the project and from other sources.

The project will produce HCl emissions intermittently. But, evidently even the worst-case maximum emission will not cause injury to offsite workers or the general population living or visiting areas near the project. The complete HIA included workers and visitors to the Basin Disposal Incorporated facility next to the Pasco Sanitary Landfill. On-site occupational exposure to Pasco Sanitary Landfill workers is not assessed since that is not required in Second Tier petitions. The project will add to existing air pollutant exposures, but it is not likely to add to long-term respiratory health hazards. The highest hazard is estimated to occur at a point along Dietrich Road approximately 246 ft (75 m) northeast of the proposed RTO. But even if someone stayed at this one point continuously for their entire life, their exposure to TAPs from the RTO will evidently not reach levels that could cause adverse health effects. When people are exposed to significantly higher levels of HCl, the effects are minor irritation of the eyes and upper respiratory tract.

Because increased TAP exposures attributable to the project are unlikely to harm people around the landfill, it may be approved. This document presents Ecology's review of the HIA and other requirements under WAC Code 173-460.

2. Second Tier Petition Review Processing and Approval Criteria

2.1. Second Tier Review Processing Requirements

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

(a) The permitting authority has determined that other conditions for processing the Notice of Construction Order of Approval (NOC) have been met, and has issued a preliminary approval order. The permitting authority, the Ecology Air Quality Program Eastern Regional Office has completed a draft Preliminary Determination approval order and Technical Support Document (TSD) for the project.[1]

(b) Emission controls contained in the preliminary NOC approval order represent at least "toxics Best Available Control Technology (tBACT)." The permitting authority has determined that the project meets the tBACT condition.[2] Ecology's Second Tier Review engineer verified item (b).[3]

(c) The applicant has developed an HIA protocol that has been approved by Ecology. On July 2, 2014, Landau submitted an HIA protocol for the project.[4] Ecology verified it promised to provide most of the information necessary to assess health impacts from the project. On July 7, 2014, in a teleconference between Ecology and Landau concerning the protocol, Landau agreed to provide some other details requested by Ecology. Contingent on the agreements reached during the discussion, Ecology approved the protocol.

(d) The ambient impact of the emissions increase of each TAP that exceed ASILs has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol. Ecology's air toxics dispersion modeler found the refined modeling conducted by Landau to be acceptable.[5]

(e) The Second Tier Review petition contains an HIA conducted in accordance with the approved HIA protocol. An HIA was received by Ecology on October 23, 2014, and supplemental information received January 27, 2015.[6]

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[1] Robert Koster to Matthew Kadlec, cc: Charles Gruenenfelder [Ecology TCP-ERO], "Pasco Landfill Preliminary Determination and TSD," e-mail message, November 12, 2014.
[2] Ibid.
[3] Marc Crooks, AQP engineer, personal communication with Matthew Kadlec, "regarding the Pasco Landfill Preliminary Determination and TSD," December 22, 2014.
[4] Mark Brunner [Landau] to Matthew Kadlec, cc: Ranil Dhammapala, Robert Koster, and Jim Wilder [Landau], "Pasco Landfill RTO - Health Impact Assessment Protocol," e-mail message, July 2, 2014.
[5] Ranil Dhammapala to Matthew Kadlec, "File Transfer: Pasco Landfill RTO Revised NOC and HIA Submittal - 1295001.010 - EPI-Pasco Landfill Off Gas Treatment," e-mail message, November 3, 2014.
[6] Mark Brunner to Matthew Kadlec, "File Transfer: Pasco Landfill RTO Revised NOC and HIA Submittal - 1295001.010 - EPI-Pasco Landfill Off Gas Treatment," e-mail message, October 23, 2014, linking to "Landau associates. Revised Report Second-Tier Risk Analysis for Hydrogen Chloride Emissions, Pasco Sanitary Landfill, Pasco, Washington, October 23, 2014;" and Mark Brunner to Matthew Kadlec and Robert Koster, cc: Charles Gruenenfelder, Jeremy Schmidt, Michael Riley, Adam Morine, Jeremy Davis, and Jim Wilder, "Pasco RTO HIA Addendum," e-mail message, January 27, 2015.

In summary, the parties satisfied the Second Tier Review processing requirements.

3. HIA Review

As described above, the applicant was responsible for preparing the HIA under WAC 173-460-090. The HIA focused on health hazards of HCl because its modeled ambient air concentrations exceeded its ASIL. Landau also assessed the hydrogen fluoride (HF) exposure since it was the only other emitted TAP with a corrosive mechanism of action. Ecology's project review team—consisting of an engineer, a toxicologist, and a modeler—reviewed the HIA and related information to determine if the methods and assumptions were appropriate for assessing the surrounding community's potential health risks from the project.

3.1. HC1

Short-term exposure to sufficient concentrations can cause corrosion of exposed tissues: prolonged or repeated exposures over longer durations can cause hyperplasia of nasal mucosa larynx and trachea. HCl is primarily an eye and respiratory tract irritant. Some chronic exposure studies report bleeding of nose and gums, ulcerations of mucous membranes, and etching or erosion of the front teeth by repeated exposure in occupational settings. HCl is not suspected to be carcinogenic.

3.2. HF

Inhalation or skin absorption can result in chemical burns, irritation to the eyes, nose and throat, and systemic fluoride poisoning. Sufficient acute exposure can result in coughing and choking, and may cause life-threatening pulmonary edema. HF is not suspected to be carcinogenic. Exposure to sufficient concentrations of HCl and HF together is likely to be additively corrosive. Although HF is corrosive and potentially harmful at any portal of entry, no studies regarding chronic irritant or respiratory effects of exposure in humans are available at this time.

3.3. HCI and HF Toxicological Reference Values

The Agency for Toxic Substances and Disease Registry (ATSDR), United States Environmental Protection Agency (USEPA), U.S. Occupational Safety and Health Administration (OSHA) and California Office of Environmental Health Hazard Assessment (OEHHA) have developed Risk-Based Concentrations (RBCs) for HCl and/or HF based on data from studies of occupationally exposed humans and from animal bioassays. The resulting Minimal Risk Level (MRL), Reference Concentration (RfC), Permissible Exposure Level (PEL), Short-Term Exposure Limit (STEL) and Reference Exposure Levels (RELs) are intended to assess acute, chronic repeated-, and chronic-continuous HCl and HF exposures. These values are intended to indicate HCl and HF exposure concentrations below which adverse noncancer health effects would be unlikely. Values are expressed in the units in which they were promulgated. If the units were not originally microgram per cubic meter ($\mu g/m^3$), the conversion is shown in parenthesis herein.

3.3.1. HC1

- Acute REL 2100 $\mu g/m^3$, 1-hr TWA, mild irritation of the respiratory tract and eyes.
- OSHA Permissible Exposure Limit (PEL) 5 ppm (~7000 $\mu g/m^3$) 8-hr TWA as a ceiling limit. It is outdated and the California Occupational Safety and Health Standards Board recently proposed replacing it with 0.3 ppm (~455 $\mu g/m^3$ at 20°C).[7]
- RfC 20 $\mu g/m^3$, hyperplasia of nasal mucosa larynx and trachea.
- Chronic REL, 9 $\mu g/m^3$, respiratory tract irritation.

3.3.2. HF

- Acute REL, 240 $\mu g/m^3$, 1-hr TWA, mild irritation of the respiratory tract and eyes.
- PEL (California), 0.33 mg/m^3 (330 $\mu g/m^3$), 8-hr TWA, for repeated daily occupational exposures lasting eight hours.
- STEL, 0.83 mg/m^3 (830 $\mu g/m^3$), 15-minute TWA, to prevent severe injuries that could result from a single excessive occupational exposure lasting 15 minutes or less.
- Acute MRL, 0.02 ppm (~16.6 $\mu g/m^3$ at 20°C) 1-day to 2-week TWA, irritation of the skin, eyes, and respiratory tract. Exposure to higher concentrations can cause musculoskeletal system damage.
- Chronic REL, 14 $\mu g/m^3$, bone and teeth, respiratory system.

There is no evidence HCl and HF are carcinogenic. Consequently, none of these authorities (or others) has published cancer unit risk factors for either chemical.

4. Ambient Air Quality Analysis

Landau modeled emissions of HCl and HF and other TAPs from the RTO. The proposed location of the RTO is shown in HIA Figure 1-2, which also shows the soil vapor extraction (SVE) system features.[8] The geographic domain of the modeled area is shown in HIA Figure 1-1, which provides visual reference of the project location.[9] HIA Figure 4-1 (copied below) provides a labeled satellite photo showing the project boundary, its vicinity, and the locations of the MIBR, MIRR, MICR, and MIIR (Ochoa Middle School).[10] The concentrations match ones given in HIA Table 4-2.[11] HIA Figure 4-2: Pasco Sanitary Landfill Pasco, Washington Annual Average HCl

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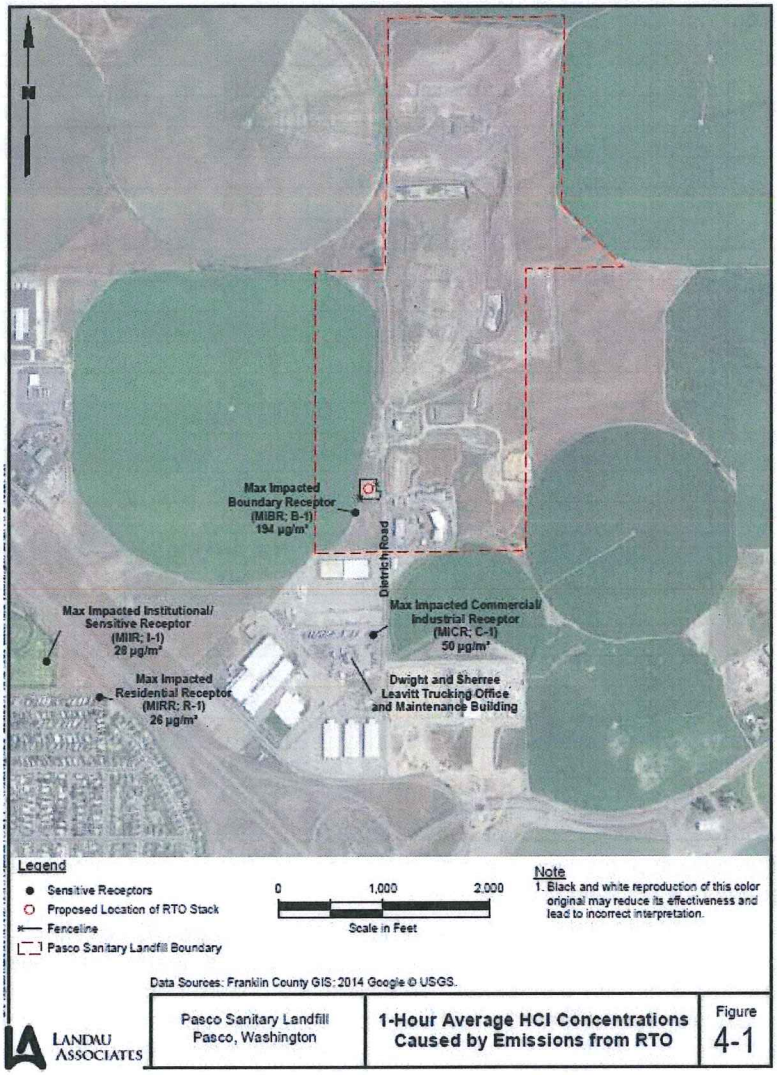
[7] <http://www.dir.ca.gov/oshsb/Airborne_contaminants_Hydrogen_Chloride_ISOR.pdf>, accessed on December 22, 2014.
[8] HIA *Figure 1-2: Pasco Sanitary Landfill Pasco, Washington* Soil Vapor Extraction System.
[9] HIA *Figure 1-1: Pasco Sanitary Landfill Pasco, Washington Vicinity Map.*
[10] HIA *Figure 4-1: Pasco Sanitary Landfill Pasco, Washington 1-Hour Average HCI Concentrations Caused by Emissions from RTO*
[11] HIA *Table 4-2: Maximally Exposed Receptors (1-Hour Time-Weighted Average) Hydrogen Chloride Impacts Attributable to Project Pasco Sanitary Landfill Pasco, Washington.*

Concentrations Caused by Emissions from RTO provides a labeled satellite photo showing each receptor.[12]



Ecology reviewed the AERMOD modeling input and output files and found them to represent an adequate ambient air quality analysis.[13] Modeling results are summarized in Tables A and B.

[12] HIA *Figure 4-2: Pasco Sanitary Landfill Pasco, Washington Annual Average HCl Concentrations Caused by Emissions from RTO.*

[13] Ranil Dhammapala to Matt Kadlec, cc: Robert Koster, "File Transfer: Pasco Landfill RTO Revised NOC and HIA Submittal - 1295001.010 - EPI-Pasco Landfill Off Gas Treatment," e-mail message, November 3, 2014.

Table A. Acute Hazards Attributable to Emissions and Background Levels				
	Pollutant	Concentration ($\mu g/m^3$)	Reference Value ($\mu g/m^3$)	Hazard Quotient
1-hr duration				
MIIR*	HC1	28	2100	0.01
	HF	0.70	240	0.003
			Hazard Index	0.02
MIRR*	HC1	26	2100	0.01
	HF	0.65	240	0.003
			Hazard Index	0.02
MIBR*	HC1	194	2100	0.1
	HF	4.86	240	0.02
			Hazard Index	0.1
MICR*	HC1	50	2100	0.02
	HF	1.25	240	0.01
			Hazard Index	0.03
8-hr duration†				
MIIR	HC1	19.6	7000	0.003
	HF	0.49	330	0.001
			Hazard Index	0.004
MIRR	HC1	18.2	7000	0.003
	HF	0.455	330	0.001
			Hazard Index	0.004
MIBR	HC1	135.8	7000	0.02
	HF	3.402	330	0.01
			Hazard Index	0.03
MICR	HC1	35	7000	0.005
	HF	0.875	330	0.003
			Hazard Index	0.008

* Maximally impacted institutional, residential, boundary, and commercial receptors described in Section 5.1.

† The revised HIA did not report a series of 8-hr average HC1 or HF concentrations; however, people who work at places nearby may receive repeated 8-hr daily exposures. To assess the hazard potential of such exposures, the estimated worst-case concentrations are required. In this table, Ecology estimated the likely concentration averages by applying the 1- to 8-hr factor in AERSCREEN, which is 0.7, to the maximum 1-hr concentrations reported in the HIA. This 0.7 factor is the average ratio of 1- to 8-hr concentrations given in AERSCREEN, a screening-level air quality model based on AERMOD.[14] Landau subsequently submitted the missing maximum 8-hr averaged HC1 and HF concentration data.[15] Ecology evaluated these data as shown in the Appendix.

[14] USEPA, 2004, User's Guide for the AMS/EPA Regulatory Model – AERMOD, EPA-454/B-03-001, USEPA, Research Triangle Park, NC 27711. AERSCREEN includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr, and annual averages.

[15] Mark Brunner to Matthew Kadlec and Robert Koster, cc: Charles Gruenenfelder, Jeremy Schmidt, Michael Riley, Adam Morine, Jeremy Davis, and Jim Wilder, "Pasco RTO HIA Addendum," e-mail message, January 27, 2015.

Table B. Chronic Hazards Attributable to Emissions and Background Levels						
	Pollutant	Concentration ($\mu g/m^3$)	Lower Reference Value ($\mu g/m^3$)	Higher Reference Value ($\mu g/m^3$)	Higher HQ	Lower HQ
MIIR	HC1	0.12	9	20	0.013	0.006
	HF	0.006*	14	N/A	0.0004	N/A
				Hazard Index	0.014	0.006
MIRR	HC1	0.11	9	20	0.012	0.01
	HF	0.0055*	14	N/A	0.0004	N/A
				Hazard Index	0.013	0.01
MIBR	HC1	8.7	9	20	0.97	0.4
	HF	0.435*	14	N/A	0.03	N/A
				Hazard Index	0.998	0.5
MICR	HC1	0.83	9	20	0.092	0.042
	HF	0.042*	14	N/A	0.003	N/A
				Hazard Index	0.095	0.044
Background Concentration†	HC1	0.070	9	20	0.01	0.004

* The HIA did not present estimates of long-term average HF. Ecology estimated them by applying the ratio of maximum HF/HC1 emissions rates reported by the applicant to the reported annual average HC1 concentration at each receptor. The maximum HF/HC1 emissions rates ratio was ~0.05. Note that Landau derived HF concentrations as a fixed fraction factor of HC1 concentrations.

† Landau obtained the background concentration of HC1 in Franklin County census tract 020100 from the 2005 USEPA National Air Toxics Assessment: the only information available on background HC1 concentrations in the Tri-Cities area.

On January 27, 2015, Landau submitted a *Supplement to the Pasco Landfill RTO Health Impact Assessment* and modeling files compact disk (CD), which provided the 8-hr averaged HCl and HF concentrations in the Basin Disposal Incorporated (BDI) waste transfer station area adjacent to the landfill and its proposed RTO. Ecology's evaluation of that information is described in the Appendix.

5. Maximally Exposed Receptors

Ecology's review of the HIA found that Landau identified appropriate receptors to capture the highest exposures for residential, commercial, fence line, and potentially sensitive population place receptors. Landau also identified other potential sensitive receptor areas, but these areas were outside the area impacted by HCl concentrations greater than the ASIL, so Ecology did not require hazards at these locations to be quantified.

HIA Figure 2-1 provides a labeled satellite photo of the project location and structures on neighboring properties.[16] HIA Figure 2-2 provides a labeled satellite photo of the project location and structures on neighboring property.[17] The landfill borders lands zoned for agricultural, industrial, or light industrial use. Ag-use (center pivot irrigation field) occurs in industrial zone land west of the RTO. Placement of the MIBR location takes account of this allowance for multiple land-use designations. HIA Figure 2-3 provides a labeled satellite photo of the project boundary, its vicinity, and the locations of the MIBR, MIRR, MICR, MIIR, and a few public places.[18]

5.1. HIA Description of Each Maximally Exposed Receptor-Type's Location

MIBR	The location identified where a person could be exposed to the highest modeled 1-hr average HCl concentration is at an edge of an agricultural field adjacent to the west of the proposed RTO. HIA Figure 4-1 shows this location.[19]
MIRR	The nearest single-family residences, which are located on residentially-zoned land approximately 0.6 miles southwest of the proposed RTO.
MICR	A commercial building owned by Dwight & Sherree Lovitt Trucking, which is located on industrially-zoned land approximately 0.25 miles to the south of the proposed RTO.
$MICR_{alt}$	The BDI waste transfer station bordering the Pasco Sanitary Landfill to the southeast of the RTO (see Appendix).
MIIR	Ochoa Middle School, which is located approximately 0.6 miles southwest of the proposed RTO.

5.2. Land Use – Exposed Receptors

The project is located in Franklin County about 2 km (~1.2 mi) southeast of the Tri-Cities Airport in Pasco, Washington. The proposed location of the RTO will be within a fenced area of the site to the west of Dietrich Road area.

Current land-uses of the areas around the landfill are shown in HIA Figure 2-4. Current and expected land-uses in the area surrounding the landfill are primarily agricultural or industrial/commercial.[20]

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[16] HIA *Figure 2-1: Pasco Sanitary Landfill Pasco, Washington Site Map and Nearby Properties.*
[17] HIA *Figure 2-2: Pasco Sanitary Landfill Pasco, Washington Zoning Map.*
[18] HIA *Figure 2-3: Pasco Sanitary Landfill Pasco, Washington Sensitive Receptors.*
[19] HIA *Figure 4-1: Pasco Sanitary Landfill Pasco, Washington 1-Hour Average HCI Concentrations Caused by Emissions from RTO.*
[20] HIA *Figure 2-4: Future Land Use and Zoning of the Areas around the Project Facility.*

6. Risk Characterization

6.1. Noncancer Health Hazards

In order to evaluate the potential for noncancer adverse health effects that may result from exposure to air pollutants, exposure concentrations at each receptor location are compared to relevant noncancer RBCs. If a concentration exceeds the RBC, an adverse health effect is possible. The magnitude of this possibility can be inferred from the degree to which the RBC is exceeded. This comparison is known as a hazard quotient (HQ) and is given by the equation below:

$$HQ = \frac{\text{time weighted average concentration of toxicant in air } (\mu g/m^3)}{\text{time interval specific toxicant RBC } (\mu g/m^3)}$$

An HQ of less than one indicates that the exposure to a toxicant is not likely to result in adverse noncancer health effects. As the HQ increases above one, the probability of an adverse health effect increases by an undefined amount. However, it should be noted that due to uncertainty in deriving RBCs, an HQ above one does not necessarily mean health impacts will occur.

HQs are time-interval specific. Shorter term intervals are usually associated with acute health hazards, whereas repeated or continuous long-term exposures are usually associated with chronic health hazards.

Landau calculated HQs for project-attributable HCl and HF exposures and background exposure attributable to other regional sources near the landfill. These are summarized in Tables A and B.

The HIAs did not list the average of 8-hr, time-weighted average HCl and HF concentrations at any offsite commercial location (and these data were not located on the compact disks provided with the original or revised HIAs); however, Ecology initially evaluated commercial location hazards using concentration estimates and 1-hr maxima data. The resulting HQs at offsite commercial receptors are likely to be less than one. In fact, the highest 8-hr hazard index (HI, the sum of HQs) for combined effects of HCl and HF at the current MICR is less than 0.008. Landau subsequently submitted the missing maximum 8-hr averaged HCl and HF concentration data[21] and Ecology evaluated the data as shown in the Appendix.

If someone were to remain outdoors at the MIBR location for an entire year or longer, their combined exposure to HF and HCl from the proposed project (HI ~ 0.998) along with background levels of HCl (HQ ~ 0.001) could reach a sum HI of 1.006, indicating potential risk of mild eye and respiratory tract irritation. However, this exposure scenario is extremely improbable. For the record, Ecology determined a gate was needed to limit casual trespass onto the site. The HIA states:

[21] Mark Brunner to Matthew Kadlec, cc: Charles Gruenenfelder, Jeremy Schmidt, Michael Riley, Adam Morine, Jeremy Davis, and Jim Wilder, "Pasco RTO HIA Addendum," e-mail message, January 27, 2015.

> *"Note, after air modeling was completed, it was determined that a fence with a gate will be installed across Dietrich Road to the east-southeast of the RTO, which will restrict public access to the north of the gate. The modeled receptor grid currently extends to the north of the gate where a member of the public would have no access to the Site."*

The HIs of the other exposure scenarios (MIRR, MICR, $MICR_{alt}$, and MIIR) at all assessed durations (1-hr, 8-hr, and annual) were all less than one, therefore of no concern to health. All known and reasonably anticipated HCl and HF HQs were lower than one. This indicates that receptors living or working near the landfill RTO are not likely to experience adverse noncancer effects from chronic exposure to emitted HCl and HF, either alone or in combination with other local and regional HCl and HF sources.

6.2. Increased Cancer Risks

Increased cancer risks were not formally estimated because emissions rates of potentially carcinogenic TAPs emitted by the RTO were less than Small Quantity Emission Rates (requirement: WAC 173-460-50; values: WAC 173-460-150). As noted, there is no evidence HCl and HF are carcinogenic. Ecology did not require the applicant to assess cancer risks of the proposed emissions.

As relating to cancer risk, HIA Table 3-2 provides project-attributable offsite maximum annual average concentrations of HCl and HF as well as benzene, 1,2-dichloroethane , ethylbenzene, methylene chloride, trichloroethene, and vinyl chloride—the emitted carcinogenic TAPs.[22] The same table shows corresponding ASILs. These data and their risk products are presented in the right-hand column of Table C. The sum of the risk products is at the bottom of that column. Exposure to any one of these RTO-emitted carcinogens at the reported maximum annual average does not exceed corresponding ASILs.

Table C. Maximum Annual Average Concentrations and Cancer Risks of RTO-Emitted Carcinogenic TAPs

	ASIL ($\mu g/m^3$)	Max. Conc. ($\mu g/m^3$)	Excess Risk/ $1.0E^{-6}$
Benzene	0.0345	0.0064	0.1855
1,2-Dichloroethane	0.0385	0.016	0.416
Ethylbenzene	0.4	0.16	0.4
Methylene chloride	1.0	0.24	0.2
Trichloroethene	0.5	0.15	0.3
Vinyl chloride	0.0128	0.0015	0.1172
		Sum	1.7*

* Life-long exposure to the combination of these could increase a person's cancer risk by about 1.7 in a million.

[22] HIA *Table 3-2 First-Tier Ambient Impact Assessment for Toxic Air Pollutants Pasco Sanitary Landfill Pasco, Washington*

Some polychlorinated dibenzo-dioxins and -furans (PCDDs/Fs) are carcinogenic. On November 4, 2014, Ecology examined the theory that RTO could emit PCDDs/Fs. Robert Koster stated the RTO minimum normal operation temperatures will be 1600°F (with a 60°F span), and that the injection rate of condensate oxidized will be steady. SVE pulses will be collected and fed steadily into the RTO. These nearly constant high temperature conditions should lead to complete destruction of any PCDD/Fs in the landfill gas, and should also prevent *de novo* formation them as combustion products. Temperatures between 392°F (200°C) and 842°F (450°C) are most conducive to forming PCDDs/Fs, with maximum formation occurring at around 662°F (350°C).[23] As long as the landfill operator is able to maintain 1400°F (760°C) or higher, there should be no significant emissions of PCDDs or PCDFs.

7. Uncertainties

Uncertainty may be defined as imperfect knowledge concerning present and future conditions of a system. In risk assessments undertaken in support of regulatory decisions, many uncertainties are encountered. Recognition of these uncertainties allows risk managers to assess the overall strength of information on which decisions must be based.

As in any health risk assessment, the Pasco Landfill RTO assessment involved incomplete scientific information: emission rate estimates, air dispersion and fate modeling, resulting environmental concentrations, exposures and dose estimates, also assumptions about dose-response relationships and resulting estimates of the possibilities of different types of health impacts. Landau evaluated uncertainties in the assessment.[24] Overall risk uncertainties are summarized in Table D. Following the table, uncertainties in specific aspects of the assessment are noted.

Table D. Summary of how Uncertainties may Affect the Estimate of Health Risk

Source of Uncertainty	Potential Effect
Hazard identification	Possibly leading to an underestimate of overall health risks.
Emissions estimates	Likely leading to overestimate of TAP concentrations.
Concentration estimates	Possibly leading to overestimated or underestimated exposures.
Environmental fates of the acid gases	Possibly overestimate or underestimate risk.
Background TAP concentrations	Possibly leading to overestimated or underestimated exposures.
Receptor locations and exposure durations	Likely leading to overestimated exposures.
Toxicity of emitted TAPs	Likely to overestimate effects among most or all humans.
Risk characterization	Likely to leading to overestimated risks.

[23] Environment Australia, "Incineration and Dioxins: Review of Formation Processes," consultancy report prepared by Environmental and Safety Services for Environment Australia, Commonwealth, Department of the Environment and Heritage, Canberra, 1999.
[24] Part 5 of Landau's revised "Report Second-Tier Risk Analysis for Hydrogen Chloride Emissions, Pasco Sanitary Landfill," Pasco, Washington, October 23, 2014, p. 5-1 and 2.

7.1. Hazard Identification

It is possible some substances in the RTO's emissions have not been identified, and that some of these could be harmful to health. Only the substances listed as TAPs in WAC 173-460 were assessed in this Second Tier permit process.

7.2. Emission Rates

Calculated HCl emission rates were based on results of tests done in 2010 for benzene from the old flare under different operation scenarios. Uncertainty in the applicability of these tests leads to uncertainty in the emission rates in the current review.

Vapor extraction is operationally controlled and believed to be relatively steady, but there is some variability in emissions rates. Nonetheless, Landau consciously overestimated the variation in maximum emissions rates to provide a margin of safety.

7.3. TAP Concentrations

Uncertainty and variability in concentration estimates arise from:

- Inaccuracy in the TAP dispersion model's source term parameters that describe the RTO emission point, exhaust velocity, etc.
- Uncertainty in the appropriate placement and spacing of the model receptor grid points.
- Measurement variability in recent meteorological data (of sequential hourly data of 2007 to 2011 from the Tri-Cities International Airport), as well as uncertainties in related model inputs such as the twice-daily upper air data from Spokane to define mixing heights. There is also uncertainty in the similarity of the recent meteorological data to the future meteorology.
- Inaccuracy of the digital topographical data in the form of "Shuttle Radar Topography," which describes local terrain with a resolution of about 30 meters.
- Inaccuracy of surface characteristics in the area digital land classification files used in the model.
- TAP concentration modeling uncertainty arises from uncertainty in the precision and accuracy of the air pollutant dispersion model used: USEPA's AERMOD and its associated pre- and post-processors.
- There are no available atmospheric HCl or HF monitoring data for the Pasco area.
- NATA is the only information we have. The NATA HCl concentration estimate used is the most recent one. NATA estimates of background HCl concentrations are likely to be imprecise. There is little data on existing nearby sources and the regional background HCl level. The existing concentration of HCl in the present assessment may be an

underestimate or overestimate, but as indicated, it is apparently negligible. If the concentration has increased since the latest NATA, it is probably still negligible.

- Existing background HF concentrations cannot be estimated for the Pasco area due to insufficient data.
- There are uncertainties about the persistence of emitted acid gases in the environment.
    - The half-life HCl has been calculated as 11 days.[25] HCl readily dissociates in atmospheric water (rain, clouds, fog, snow) into hydrated protons and chloride ions. HCl can react with hydroxyl radicals to form chloride free-radicals and water.
    - Gaseous HF is absorbed by water to form an aerosol or fog. It is removed from the atmosphere primarily by wet deposition.[26] No information was found on the reactions of HF with common atmospheric species or estimates of its overall atmospheric half-life.

7.4. Receptor Locations and Exposure Durations

Once Ecology received TAP concentration estimates for the BDI facility (noted in the Appendix) we concluded that all the receptor types (occasional bystander, commercial, residential, and potentially sensitive-population institutional) could be appropriately assessed. However, omissions or other errors in identifying receptors are possible. Moreover, it is impossible to know the lengths of time that people near the landfill will actually be exposed to RTO emissions. Further, individual human behavior is unpredictable. Potential, expected, and unexpected land-uses are uncertain. To address these uncertainties, Landau consciously chose worst-case scenario exposure durations. The calculations based on these conditional scenarios likely result in an overestimation of health risks attributable to RTO emission exposure.

7.5. TAP Potencies

There are large differences among people in terms of individual susceptibility to toxic effects of substance they are exposed to. This is reflected in the methods used to derive toxicity RBCs for air pollutants. For example, OEHHA has noted the possibility that RELs may not be protective of certain small, unusually sensitive human subpopulations, which can be difficult to identify.[27] The ways the USEPA calculates RfCs listed in the Integrated Risk Information System (IRIS) and ATSDR calculates MRLs are very similar to the way OEHHA calculated RELs. All of the RBCs used in this assessment may or may not be protective of certain small, unusually sensitive human subpopulations.

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[25] OECD SIDS UNEP, http://www.inchem.org/documents/sids/sids/7647010.pdf, accessed on December 24, 2014.
[26] Part 6 of ASTDR's ToxProfile on Fluorides, Hydrogen Fluoride, and Fluorine.
[27] Office of Environmental Health Hazard Assessment California Environmental Protection Agency, *Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*," August 2003.

7.6. Risk Characterizations

The overall health risk to people living or working nearby is estimated to be negligible. This estimated risk is probably an overestimate of actual exposure to site contaminants due to inherent conservatism built into the overall risk evaluation process.

8. Other Considerations

When Ecology reviewed the HIA protocol, the question of potential crop damage was raised by the extent of the area of elevated HCl concentrations in adjacent agricultural land. The revised HIA does not provide any findings on this topic. The maximum 1-hr TWA HCl concentration reported in the revised HIA is about eight-fold less than a level known to result in such damage.[28] Potential crop loss is unlikely given a sample of available HCl phytotoxicity literature. Some publications show a 'no observed effect level' (NOEC) of 1470 $\mu g/m^3$, 1-hr TWA, for a seedling of one plant species. In view of this preliminary literature screening, the Toxics Cleanup Program did not require further investigation of potential crop damage as part of the revised HIA. Investigation of TAP effects on non-human species (i.e., ecological receptors) is outside the scope of WAC 173-460.

9. Conclusions and Recommendation

9.1. Project Review Team's HIA Determination

The project review team has reviewed the HIA and determined that:

(a) The TAP emission estimates presented in the HIA represent reasonable estimates of the project's future emissions.

(b) Emission controls for the new and modified emission units will meet the tBACT emission requirements.

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

(d) The revised HIA submitted to Ecology adequately assesses project-related increased health hazards attributable to TAP emissions.

The project review team concludes that the revised HIA presents an appropriate estimate of potential increased health hazards posed by the RTO's TAP emissions. There is no evidence the proposed HCl and HF emissions—alone or in combination with other HCl and HF sources—could pose chronic noncancer hazards within the modeling domain around the facility, which is an area extending about 1.34 mi (~2.15 km) out from the RTO. Furthermore, cancer risk among people exposed to RTO emissions is unlikely to increase as a result.

[28] Based on a brief literature review of HCl phytotoxicity threshold concentrations done July 3, 2014.

The greatest health hazard may occur at a point along Dietrich Road approximately 246 ft (75 m) northeast of the proposed RTO, but even if a human population stayed at this one point continuously over a lifetime, their exposures to HCl and other TAPs from the RTO likely would not cause adverse health effects.

Based on the project team's review of the HIA, and with awareness that this review is based on HCl and HF emissions rates that will be limited to rates no greater than those used to model the impacts, the risk manager may recommend approval of the proposed project because project-related health hazards are permissible under WAC 173-460-090.

9.2. Second Tier Review Approval Criteria

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

(a) Determines that the emission controls for the new and modified emission units represent tBACT.

(b) The applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased chance of cancer of more than one in one hundred thousand.

(c) Ecology determines that the noncancer hazard is acceptable.

The recommendation to approve the project is contingent on the ultimate requirement that HCl emissions be limited to a rate no greater than what Landau used in refined modeling of TAP concentrations.

10. Glossary

$\mu g/m^3$	microgram per cubic meter
AQP	Air Quality Program of the Washington State Department of Ecology
AREL	Acute Reference Exposure Level
AERMOD	American Meteorological Society/USEPA Regulatory Model
ASIL	Acceptable Source Impact Level
ATSDR	Agency for Toxic Substances and Disease Registry
BDI	Basin Disposal Incorporated
CREL	Chronic Reference Exposure Level
Ecology	Washington State Department of Ecology
ft	feet
HCl	hydrogen chloride or hydrochloric acid
HF	hydrogen fluoride or hydrofluoric acid
HI	Hazard Index
HIA	Health Impact Assessment
HQ	hazard quotient
hr	hour(s)
IRIS	USEPA Integrated Risk Information System
m	meter
mg/Kg	milligrams per kilogram
MIBR	Maximally Impacted Boundary Receptor
MICR	Maximally Impacted Commercial/Industrial Receptor
$MICR_{alt}$	Alternative Maximally Impacted Commercial/Industrial Receptor
MIIR	Maximally Impacted Institutional Receptor
MIRR	Maximally Impacted Residential Receptor
NOC	Notice of Construction
NOEC	No Observed Effect Level
MRL	Minimal Risk Level

NATA	USEPA National Air Toxics Assessment
OEHHA	California Office of Environmental Health Hazard Assessment
OSHA	U.S. Occupational Safety and Health Administration
PCDDs/Fs	Polychlorinated dibenzo-dioxins and -furans
PEL	Permissible Exposure Level
RBC	Risk-Based Concentration
REL	Reference Exposure Level
RfC	Reference Concentration
RTO	Regenerative Thermal Oxidizer
Site	Pasco Sanitary Landfill Site
STEL	Short-Term Exposure Limit
SVE	Soil Vapor Extraction
TAP	toxic air pollutant
tBACT	Toxics Best Available Control Technology
TWA	time weighted average
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WAC	Washington Administrative Code

APPENDIX

After completing the preceding HIA review, Ecology received additional information, which required review in order to comply with WAC 173-460. This review is described in the following memorandum:

To: Robert Koster and Charles Gruenenfelder

From: Matt Kadlec

Subject: Pasco Landfill RTO Design Modification and Assessment of Health Risks at Basin Disposal Incorporated, Pasco, Washington

Date: February 11, 2015

Regarding Mark Brunner's design modification in the Pasco Sanitary Landfill RTO stack gas exit velocity,[29] Ranil Dhammapala agrees with his assertion the effect of the increase would be to non-linearly lower modeled Toxic Air Pollutant (TAP) concentrations slightly relative to those we reviewed before in the *December 30, 2014 Second Tier Review Recommendation Document for the Pasco Landfill Regenerative Thermal Oxidizer Project, Pasco, Washington*. Lower concentrations result in lower exposure and consequently less potential for harm to human health.

Despite the RTO proponent's assertions that Basin Disposal Incorporated (BDI) is "*Development Related to Landfill (owned by L. Dietrich),*" you recently confirmed it is not, and that the RTO emission health risks must therefore be evaluated at BDI in order to comply with Ch. 173-460 WAC. The following is our evaluation.

The *January 27, 2015 Supplement to the Pasco Landfill RTO Health Impact Assessment* (HIA) and modeling files compact disk (CD) provided the 8-hour averaged HCl and HF concentrations in the BDI area. These data and their corresponding hazard quotients are shown in Table A:

Table A.

	Maximum 8-hour averaged concentration ($\mu g/m^3$)	OSHA Permissible Exposure Limit ($\mu g/m^3$, 8-hr TWA)	Hazard Quotient
HCl	123	7000	0.018
HF	3.1	2500	0.001

[29] Mark Brunner to Robert Koster and Charles Gruenenfelder, cc: Matthew Kadlec, Jeremy Schmidt, Gregory S. Flibbert, Thom Morin, Adam Morine, Michael Riley, Jeremy Davis, Jim Wilder, "Pasco Landfill RTO - Minor Design Modification," e-mail message, February 03, 2015.

The maximum concentrations are far less than the Occupational Health and Safety Administration (OSHA) Permissible Exposure Limits (PELs) thus no adverse effects are likely from chronic exposure to either TAP. These TAPs are acid gases so together they might have additive effects if in sufficient concentrations. However, the sum of their hazard quotients, *i.e.,* the hazard index (HI), is only 0.019. Because this HI is less than one, it indicates there is low or no potential adverse health effects from chronic exposure to acid gases from the RTO to BDI workers even if they will be employed fulltime and long-term.

As noted in the Table B of the *December 30, 2014 Second Tier Review Recommendation Document for the Pasco Landfill Regenerative Thermal Oxidizer Project, Pasco, Washington*, the USEPA estimated the long-term average HCl concentration in Franklin County census tract (020100) in the 2005 National Air Toxics Assessment. The tract is where BDI is located. EPA's modeled concentration estimate was 0.070-ug/m^3 (We know of no HF background concentration information for the area). HQs given this level of exposure are 0.01 and 0.004. Adding either one to the RTO-attributable chronic HI (0.019) yields an overall HI of either 0.029 or 0.023. Because these HIs are less than one it is safe to conclude there is low or no potential health concern from chronic exposure to acid gases among people engaged in work at BDI.

You also confirmed that the general public has short-term access to BDI. This requires that occasional acute exposures to ordinary people – even those who may be unusually sensitive to such exposures – also be evaluated in order to comply with Ch. 173-460 WAC. We did this by comparing maximum 1-hour averaged HCl and HF concentrations in the BDI area to the California Office of Environmental Health Hazard Assessment (OEHHA) acute inhalation Reference Exposure Levels (RELs) for HCl and HF.

The *January 27, 2015 Supplement...* and modeling files CD do not report the 1-hour averaged outputs of HCl and HF concentrations on BDI property. Nonetheless, Ranil Dhammapala noted they may be reliably estimated beginning with the 1-hr and 8-hr averaged maximum concentrations at a receptor near BDI (at coordinates 341524, 5123808 UTM). These data are in the original HIA and modeling files CD. Maximum reported HCl concentrations at the receptor are 194-μg/m^3 (1-hr averaged) and 108-μg/m^3 (8-hr averaged). Their ratio (1:8 -hr ratio) is 1.8. Coincidentally, the modeled 1-hour maximum occurred during the maximum 8-hour concentration interval.

We calculated the 1-hr HCl concentration maximum on BDI property by multiplying the reported maximum modeled 8-hr average concentration at BDI by the 1:8 -hr ratio.

$$123\text{-}\mu g/m^3 \times 1.8 = 221\text{-}\mu g/m^3$$

To estimate the maximum 1-hr averaged HF concentration, we first calculated the HCl:HF concentration ratio based on the reported maximum 8-hour averaged concentrations on BDI property:

$$123\text{-}\mu g\ HCl/m^3 \div 3.1\text{-}\mu g\ HF/m^3 = 40$$

We then divided the calculated the 1-hr HCl maximum concentration by the HCl:HF ratio to obtain the maximum 1-hr averaged HF concentration on BDI property:

$$221\text{-}\mu g\ HCl/m^3 \div 40 = 6\text{-}\mu g\ HF/m^3$$

Lastly we compared calculated 1-hr averaged HCl and HF BDI property concentration maxima to the California OEHHA acute RELs as shown in Table B:

Table B.

	Maximum 1-hour averaged concentration ($\mu g/m^3$)	OEHHA REL ($\mu g/m^3$, 1-hr TWA)	Hazard Quotient
HCl	221	2,100	0.1
HF	6	240	0.03

These maxima are less than the OEHHA acute RELs thus no one is likely to experience adverse effects as a result of even the highest exposures to these acid gases. Exposure to both together might cause additive effects if they were present at higher concentrations; However, the HI is only 0.13. This indicates there is low or no potential health concern from acute exposure to acid gases from the RTO among people working at or briefly visiting the BDI facility.

We have no information on fluctuations in short-term average HCl or HF concentrations attributable to existing background sources near BDI. Therefore we cannot realistically estimate the acute HI for overall acid gas exposure there. Nonetheless, we have no reason to suspect that swings in these concentrations occur in sufficient magnitude to result in health risks among people there when in combination with the RTO emissions.

In summary the risks of the RTO's acid gas emissions to workers and other people in the BDI area are apparently *de minimis* and therefore permissible under Ch. 173-460 WAC.