

DRAFT

**APPENDIX B**

Baseline Concentrations

---

## 1.0 BASELINE SOIL AND BIOTA

---

### 1.1 Introduction

Jacques Whitford Limited was retained by the Regions of Durham and York to complete a sampling program to establish baseline concentrations of selected chemicals in soil and biota. The physical sampling locations were in the vicinity of the preferred development area for a Municipal Energy-from-Waste facility in the Municipality of Clarington, Ontario (Jacques Whitford, 2009a).

The USEPA (2005) has provided guidance on evaluating human health environmental effects caused by air emissions from proposed facilities at the design stage. The guidance identifies a number of media that are to be included in the assessment. These same media were targeted as media of interest for the baseline sampling program. The following lists the media of interest and the rationale for inclusion in the baseline sampling program:

- **Soil:** Soil is one of the most important of the media considered. Both human (persons that reside in or visit the area surrounding the proposed facility, including members of the general public) and ecological receptors (living organisms other than humans, the habitat which supports such organisms, or natural resources which could be adversely affected by environmental contaminations resulting by a release at or migration from a site) are exposed directly to soil. Also the models used during the risk assessment (chemical fate and transport models, human and ecological risk evaluation models) rely heavily on the soil concentrations to predict concentrations in various other media. In addition, existing soil concentrations represent the current conditions associated with any historical deposition.
- **Forage:** Forage is considered to be green herbaceous vegetation, this year's growth, from nonwoody plants such as grasses and wildflowers. Forage ingestion is a direct pathway for many ecological receptors.
- **Browse:** Browse is considered to be this year's woody growth from shrubs and trees, such as willows, alders, birches, poplars, and conifers. Browse ingestion is a direct pathway for many ecological receptors.
- **Small Mammals:** Small mammals such as mice, voles, and shrews, are exposed directly to soil and forage/browse media as well as forming an exposure pathway for other ecological receptors.
- **Water:** Water quality is considered one of the primary indicators of the quality of aquatic habitats. In addition, water ingestion is a direct exposure pathway for all ecological receptors.
- **Sediment:** Sediment ingestion is an exposure pathway for ecological receptors.
- **Fish:** Fish ingestion is an exposure pathway for both human and ecological receptors.
- **Produce:** Produce ingestion is an exposure pathway for human receptors, and is broadly classified as above ground exposed, above ground protected, below ground, fruit and agricultural product (meat, dairy).

Several environmental media – soil, terrestrial vegetation (forage, browse, and crops), small mammals, surface water, sediment and fish – were sampled within a 1 km radius of the proposed site. However, in the case of agricultural products and local produce samples were collected from farms and markets located outside a 1 km radius of the proposed site due to limited availability. Every effort was made to ensure that the farms were as close as possible to the proposed facility site. Sampling garden produce from the backyards of residents within the area surrounding the proposed facility site was limited to one location; however, garden produce was obtained from local farmers' fields and markets. General inquiries were made to confirm that the produce acquired had been grown locally. The produce collected is considered to be sufficient to represent baseline conditions of the area surrounding the proposed facility site.

The sampling locations are shown on Figure 5-1 and the coordinates and media sampled at each location provided in Table 2.1 in the Environmental Baseline Report (Jacques Whitford, 2009a). The locations of produce and other agricultural products samples from outside the 1 km site radius are shown in Figure 2.2 (Jacques Whitford, 2009a) with the coordinates and media sampled at each location provided in Table 2.2 (Jacques Whitford, 2009a).

A summary of the sampling program, including number of samples collected and the chemical analysis required is provided in the Environmental Baseline Report (Jacques Whitford, 2009a). As indicated in the table, not all media were analyzed for all possible COPC. In some instances, this was due to limitations of the methods of analysis.

In addition, Jacques Whitford conducted ambient air quality monitoring in the vicinity of the Site from September 2007 to December 2008 (Jacques Whitford, 2009e). The monitoring station was located on the west side of Courtice Road, approximately 1.5 km south of Highway 401, and within the fenced area of the project office for the water pollution control plant. The location was approximately 2 km southwest from the Site.

Continuous monitoring of Criteria Air Contaminants (CACs) was conducted at the Courtice Road station for Sulphur Dioxide (SO<sub>2</sub>), Nitrogen Oxides (NO<sub>x</sub>), Carbon Monoxide (CO), Ozone (O<sub>3</sub>), and Particulate Matter smaller than 2.5 microns (PM<sub>2.5</sub>). Hi-volume air samplers were installed to collect 24-hour average samples of Total Suspended Particulate (TSP) and metals, Polycyclic Aromatic Hydrocarbons (PAHs), and Dioxins and Furans. Ambient monitoring data from the Courtice Road station were compared with monitoring data collected at available monitoring stations operated by the Ontario Ministry of the Environment (MOE) to compare the levels in the vicinity of the Facility to other locations in Ontario.

In addition to the ambient monitoring data collected at the Courtice Road station, data from monitoring stations operated under the National Air Pollution Surveillance (NAPS) Network by Environment Canada were used to characterize regional air quality and to develop background concentration levels for volatile organic compounds (VOCs), chlorinated monocyclic aromatics (CMAs), and Polychlorinated Biphenyls (PCB).

---

## 1.2 Baseline Concentrations

The baseline exposure point concentrations (EPCs) established in the Environmental Baseline Report (Jacques Whitford 2009a) represent the maximum concentration, the 95<sup>th</sup> percentile, or the 95<sup>th</sup> upper confidence limit of the arithmetic or geometric mean of the concentrations of each chemical within each media type. These are generally considered as conservative approaches for estimating potential exposures for the purposes of completing human health or ecological risk assessments (Health Canada 2004a).

A review of the results of the data quality (*i.e.*, method blanks, surrogate recoveries, matrix spikes, laboratory duplicates, and field duplicates) was completed. The results indicate that the data are acceptable for the purposes of establishing the baseline EPC.

Laboratory data results were used to determine the baseline EPC of the chemical parameters analyzed in the various media. Data not included in the establishment of the baseline EPC consisted of quality control (QC) samples, such as field duplicates and laboratory duplicates. Non-detectable values were carried forward in the statistical analysis at the laboratory estimate of quantification (EQL) value, sometimes referred to as the method detection limit (MDL), according to standard practice.

---

### 1.2.1 Statistical Analysis

Laboratory results were used to determine the baseline concentrations of the chemical parameters analyzed in the various media. Data not included in the reporting of the baseline concentrations consisted of quality control samples such as laboratory duplicates. Non-detectable values were carried forward in the statistical analysis at the method detection limit (MDL) value according to standard practice.

Baseline concentrations were established using statistical evaluation, provided that the chemical was detected in at least one of the samples from that medium. The statistical tests were based on the assumptions of a normal or log-normal distribution (*i.e.*, the log-normal distribution is skewed to the right but has a normal distribution once log-transformed). However, because of the uncertainty associated with estimating the true average concentration for the study area, the following procedure was used to report baseline values:

- If a chemical was not detected in any of the samples, the baseline concentration was presented based on the method detection limit (MDL).
- If the total number of samples analyzed was less than five, no statistical tests were applied to the collected data, and the maximum concentration was considered as the baseline concentration.
- If the number of samples equalled or exceeded five then the mean, standard deviation, minimum, maximum, the upper concentration limit of the mean (UCLM, at the 95<sup>th</sup> percentile) and the 95<sup>th</sup> percentile of the sample distribution was calculated and presented.

The distribution of chemical data sets as assessed for each medium was evaluated to identify if data conforms to either a normal or a log-normal distribution using the SAS<sup>TM</sup> statistical software package program. If the p-value of the Shapiro-Wilk normality test was greater than 0.05, then the measure was deemed to be from a normal distribution. If the measures were identified as not normal, then the data were log transformed using the natural log. If the Shapiro-Wilk test still indicated the data to be not normal, then histograms of the un-transformed data were created and visual observation was conducted for identifying the outliers. Where applicable, outliers were removed and the same procedure described above was applied on the new set of data. If the data set continued not to conform to a normal or log-normal distribution, no statistical tests were further applied.

If the means were calculated using the log-transformed data, the resulting UCLM or 95<sup>th</sup> percentile was back-transformed using the EXP function in Excel for communication purposes.

As indicated above, the baseline values used in this risk assessment represent the maximum concentration, UCLM or method detection limit of each detected chemical within each media type. These are generally considered as conservative approaches for estimating potential exposures for the purposes of completing human health or ecological risk assessments (Health Canada 2004a).

---

## 2.0 SUMMARY OF RESULTS USED IN THE HHERA

A summary of the results of the baseline sampling programs is provided in Tables B.1 and B.2. This data represents the baseline concentrations values used in the Human Health and Ecological Risk Assessment. Baseline concentrations represent either the maximum concentration, UCLM or method detection limit of each detected chemical within each media type

DRAFT

Table B.1 - Baseline Air Concentrations

COPC	1-hour ( $\mu\text{g}/\text{m}^3$ )	24-hour ( $\mu\text{g}/\text{m}^3$ )	Annual ( $\mu\text{g}/\text{m}^3$ )
<b>Combustion Gases</b>			
Ammonia (Slip at stack)	-	-	-
Carbon Monoxide (CO)	1040	1030	620
Hydrogen Chloride (HCl)	-	-	-
Hydrogen Fluoride (HF)	-	-	-
Nitrogen Oxides (NOx)	65	58	37
Organic Matter (as CH <sub>4</sub> )	-	-	-
Particulate Matter PM <sub>10</sub>	-	-	-
Particulate Matter PM <sub>2.5</sub>	23	20	9.8
Particulate Matter - Total	86	35	21
Sulfur Dioxide (SO <sub>2</sub> )	20	20	6.0
<b>Chlorinated Polycyclic Aromatics</b>			
Dioxins and Furans (as TEQ Toxic Equivalents)	4.71E-08	1.93E-08	1.66E-08
Polychlorinated Biphenyls (PCB)	1.02E-04	4.20E-05	1.85E-05
<b>Metals</b>			
Antimony	0.0073	0.0030	0.0029
Arsenic	0.0044	0.0018	0.0018
Barium	0.020	0.0082	0.0049
Beryllium	7.35E-04	3.02E-04	2.98E-04
Boron	0.19	0.076	0.015
Cadmium (Cd)	0.0015	6.04E-04	6.01E-04
Chromium (hexavalent)	-	-	-
Total Chromium (and compounds)	0.0067	0.0028	0.0017
Cobalt	0.0015	6.04E-04	5.96E-04
Lead	0.012	0.0050	0.0033
Mercury - Inorganic	-	-	-
Nickel	0.011	0.0045	0.0022
Phosphorus	0.18	0.072	0.047
Silver	8.33E-04	3.42E-04	3.43E-04
Selenium	0.0073	0.0030	0.0029
Thallium	-	-	-
Tin	0.0073	0.0030	0.0029
Vanadium	0.0038	0.0015	7.70E-04
Zinc	0.10	0.042	0.025
<b>Chlorinated Monocyclic Aromatics</b>			
1,2-Dichlorobenzene	0.0047	0.011	0.026
1,2,4,5-Tetrachlorobenzene	-	-	-
1,2,4 - Trichlorobenzene	0.017	0.046	0.11
2,3,4,6-Tetrachlorophenol	-	-	-
2,4,6-Trichlorophenol	-	-	-
2,4-Dichlorophenol	-	-	-
Pentachlorophenol	4.10E-04	8.76E-04	0.0021
Hexachlorobenzene	5.27E-05	6.25E-05	1.52E-04
Pentachlorobenzene	-	-	-

Table B.1 - Baseline Air Concentrations

COPC	1-hour ( $\mu\text{g}/\text{m}^3$ )	24-hour ( $\mu\text{g}/\text{m}^3$ )	Annual ( $\mu\text{g}/\text{m}^3$ )
<b>Polycyclic Organic Matter</b>			
Acenaphthylene	7.53E-04	3.09E-04	1.58E-04
Acenaphthene	0.0030	0.0012	5.48E-04
Anthracene	3.97E-04	1.63E-04	8.00E-05
Benzo(a)anthracene	1.65E-04	6.77E-05	5.63E-05
Benzo(b)fluoranthene	3.45E-04	1.42E-04	7.56E-05
Benzo(k)fluoranthene	1.65E-04	6.77E-05	5.63E-05
Benzo(a)fluorene	3.30E-04	1.35E-04	1.13E-04
Benzo(b)fluorene	3.30E-04	1.35E-04	1.13E-04
Benzo(ghi)perylene	1.72E-04	7.07E-05	5.85E-05
Benzo(a)pyrene	1.65E-04	6.77E-05	5.63E-05
Benzo(e)pyrene	3.30E-04	1.35E-04	1.13E-04
Biphenyl	0.0033	0.0014	5.21E-04
Chrysene	2.35E-04	9.64E-05	6.47E-05
Dibenzo(a,c)anthracene	-	-	-
Dibenzo(a,h)anthracene	1.65E-04	6.77E-05	5.63E-05
Fluoranthene	0.0015	6.01E-04	3.93E-04
Fluorene	-	-	-
Indeno(1,2,3 - cd)pyrene	1.65E-04	6.77E-05	5.63E-05
1 - methylnaphthalene	0.0032	0.0013	4.43E-04
2 - methylnaphthalene	0.0053	0.0022	7.56E-04
Naphthalene	0.0059	0.0024	8.59E-04
Perylene	3.30E-04	1.35E-04	1.13E-04
Phenanthrene	0.0063	0.0026	0.0017
Pyrene	6.88E-04	2.83E-04	1.83E-04
<b>Volatile Organic Chemicals (VOC)</b>			
Acetaldehyde	4.3	1.8	1.0
Benzene	29	12	3.9
Bromodichloromethane	0.045	0.017	0.011
Bromoform	0.29	0.029	0.023
Bromomethane	0.24	0.088	0.098
Carbon tetrachloride	1.8	0.74	0.61
Chloroform	0.55	0.23	0.16
Dichlorodifluoromethane	7.9	3.2	2.8
Dichloroethene, 1,1 -	0.0061	0.0025	5.76E-04
Dichloromethane	3.1	1.3	0.76
Ethylbenzene	3.0	1.2	0.69
Ethylene Dibromide	0.013	0.0052	0.0018
Formaldehyde	8.2	3.4	1.7
O-terphenyl	3.30E-04	1.35E-04	1.13E-04
Tetrachloroethene	1.2	0.49	0.26
Tetralin	3.30E-04	1.35E-04	1.13E-04
Toluene	23	9.5	4.4
Trichloroethane, 1,1,1 -	0.28	0.11	0.098
Trichloroethylene, 1,1,2 -	1.3	0.54	0.27
Trichlorofluoromethane	5.2	2.1	1.9
Vinyl chloride	0.014	0.0059	0.0036
Xylenes, m-, p- and o-	12	4.8	2.8

Table B.2 - Baseline Multi-Pathway Concentrations

COPC	Surface Water mg/L	Sediment mg/kg	Soil mg/kg	Fish mg/kg	Small Mammal mg/kg	Forage mg/kg	Browse mg/kg	Crops mg/kg	Aboveground Protected Produce mg/kg
<b>Metals</b>									
Antimony	0.005	1	1	0.01	0.01	0.025	0.0222	0.01	0.01
Arsenic	0.002	2	8	0.131	0.072	0.024	0.0247	0.01	0.01
Barium	0.0893	78.59	89.07	2.31	5.2	11.51	10.39	0.034	0.134
Beryllium	0.001	0.5	0.7	0.1	0.1	0.1	0.1	0.1	0.1
Boron	0.06	14.31	13.22	6	6	11.39	14.18	2	3.1
Cadmium	0.0001	0.5	0.5	0.022	0.225	0.039	0.11	0.005	0.0063
Chromium (Total)	0.006	14	22.17	0.28	0.172	0.53	0.389	0.1	0.1
Chromium VI	0.01	2	-	-	-	-	-	-	-
Cobalt	0.0005	5.15	7	0.028	0.05	0.095	0.044	0.02	0.02
Lead	0.001	6	16.91	0.06	0.044	0.209	0.268	0.02	0.02
Mercury - Inorganic	0.0001	0.05	0.07	0.0944	0.002	0.0087	0.0155	0.001	0.001
Nickel	0.006	8.77	12.25	0.19	0.311	0.6	0.291	0.11	0.1
Phosphorus	0.16	680	753	5999	8756.43	1215.96	834	1050	1018
Selenium	0.005	1	1	1.26	0.34	0.0854	0.1	0.075	0.054
Silver	0.0001	0.2	0.2	0.01	0.01	0.01	0.01	0.01	0.011
Thallium	0.0003	1	1	0.01	0.01	0.01	0.01	0.01	0.01
Tin	0.001	5	10	0.05	0.096	0.18	0.05	0.1	0.062
Vanadium	0.008	23.33	27.89	0.21	0.11	0.29	0.2	0.1	0.1
Zinc	0.0329	62.99	79	34.6	29.78	19.96	24.25	14.5	6.8
<b>Chlorinated Polycyclic Aromatics</b>									
Aroclor 1254 (Total PCBs)	0.00002	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dioxins and Furans (as TEQ Toxic Equivalents)	1.15E-09	9.54E-07	1.76E-06	6.93E-07	3.48E-07	1.93E-07	1.78E-07	6.66E-08	9.46E-08
<b>Chlorinated Monocyclic Aromatics</b>									
Hexachlorobenzene	0.00005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Pentachlorobenzene	0.00005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4,5-Tetrachlorobenzene	0.00005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4-Trichlorobenzene	0.0005	0.1	0.1	-	-	0.5	-	-	-
1,2-Dichlorobenzene	0.0005	0.02	0.02	-	-	0.1	-	-	-
Pentachlorophenol	0.00001	0.0006	0.0005	-	-	-	-	-	-
<b>Polycyclic Aromatic Hydrocarbons<sup>a</sup></b>									
Anthracene	0.00001	0.05	0.01	0.0003	0.0004	0.00274	0.00075	0.0002	0.0002
Benzo(a)pyrene TEQ	3.44E-05	1.42E-01	6.12E-02	1.04E-03	1.38E-03	1.61E-01	2.25E-03	6.89E-04	6.89E-04
Fluorene	0.00001	0.05	0.01	0.00115	0.0004	0.0002	0.0017	0.0002	0.0002
<b>VOCs<sup>b</sup></b>									
1,1,1-Trichloroethane	0.0005	0.003	0.003	-	-	0.02	-	-	-
Bromoform	0.0005	0.02	0.02	-	-	0.1	-	-	-
Carbon tetrachloride	0.0005	0.01	0.01	-	-	0.05	-	-	-
Chloroform	0.0005	0.01	0.01	-	-	0.05	-	-	-
Dichloromethane	1.54	0.1	0.2	-	-	0.5	-	-	-
Trichlorofluoromethane (FREON 11)	0.001	0.02	0.02	-	-	0.1	-	-	-

<sup>a</sup> Benzo(a)fluorene and benzo(b)fluorene were not assessed in the Environmental Baseline program.

<sup>b</sup> O-Terphenyl was not assessed in the Environmental Baseline program.

Table B.2 - Baseline Multi-Pathway Concentrations

COPC	Aboveground Exposed Produce mg/kg	Belowground Produce mg/kg	Fruit mg/kg	Chicken mg/kg	Beef mg/kg	Pork mg/kg	Dairy mg/kg	Eggs mg/kg
<b>Metals</b>								
Antimony	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Arsenic	0.01	0.011	0.01	0.011	0.01	0.01	0.01	0.01
Barium	0.388	0.35	0.74	0.402	0.065	0.061	0.05	0.398
Beryllium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Boron	4.7	3.7	5.85	2	4	4	2	2
Cadmium	0.0105	0.037	0.005	0.005	0.005	0.005	0.005	0.005
Chromium (Total)	0.1	0.1	0.1	2.54	0.1	0.1	0.1	0.1
Chromium VI	-	-	-	-	-	-	-	-
Cobalt	0.02	0.02	0.02	0.02	0.02	0.051	0.02	0.02
Lead	0.02	0.026	0.02	0.02	0.02	0.02	0.02	0.02
Mercury - Inorganic	0.0016	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.1	0.1	0.17	0.12	0.1	0.1	0.1	0.1
Phosphorus	565.99	498.87	478.35	4170	1160	1310	814	1740
Selenium	0.04	0.05	0.04	0.28	0.2	0.2	0.04	0.21
Silver	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thallium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Tin	0.122	0.258	0.07	0.05	0.05	0.05	0.05	0.05
Vanadium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	3.95	3.33	0.07	15.3	20.3	13.4	3.49	12.6
<b>Chlorinated Polycyclic Aromatics</b>								
Aroclor 1254 (Total PCBs)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dioxins and Furans (as TEQ Toxic Equivalents)	1.06E-07	1.29E-07	9.82E-08	1.47E-07	8.95E-08	8.67E-08	1.22E-07	1.29E-07
<b>Chlorinated Monocyclic Aromatics</b>								
Hexachlorobenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Pentachlorobenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4,5-Tetrachlorobenzene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4-Trichlorobenzene	0.5	-	-	10	0.5	10	5	5
1,2-Dichlorobenzene	0.1	-	0.1	2	0.1	2	1	1
Pentachlorophenol	-	-	-	-	-	-	-	-
<b>Polycyclic Aromatic Hydrocarbons<sup>a</sup></b>								
Anthracene	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Benzo(a)pyrene TEQ	6.89E-04	6.89E-04	6.90E-04	6.89E-04	6.89E-04	6.90E-04	6.89E-04	6.89E-04
Fluorene	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0002
<b>VOCs<sup>b</sup></b>								
1,1,1-Trichloroethane	0.02	-	0.02	0.3	0.02	0.3	0.2	0.2
Bromoform	0.1	-	0.1	2	0.1	2	1	1
Carbon tetrachloride	0.05	-	0.05	1	0.05	1	0.5	0.5
Chloroform	0.05	-	0.06	1	0.05	1	0.5	0.5
Dichloromethane	0.5	-	0.5	10	0.5	10	5	5
Trichlorofluoromethane (FREON 11)	0.1	-	0.1	2	0.1	2	1	1

<sup>a</sup> Benzo(a)fluorene and benzo(b)fluorene were not assessed in the Environmental Baseline program.

<sup>b</sup> O-Terphenyl was not assessed in the Environmental Baseline program.