Air Quality Assessment for Columbia Containers New Grain Transloading Facility and Silos ("Rebuild") Project

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February 10, 2015

Internal Ref: 621893

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TABLE OF ABBREVIATIONS

AR5	(IPCC) Fifth Assessment Report
ASL	Above sea level
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria air contaminants
CHE	Cargo handling equipment
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CPR	Canadian Pacific Rail
CWS	Canada Wide Standards
DPM	Diesel particulate matter
EF	Emission factor
EI	Emissions inventory
EPA	Environmental Protection Agency (US)
GHG	Greenhouse gas
GWP	Global warming potential
IAQGGMP	Integrated Air Quality and Greenhouse Gas Management Plan (Metro Vancouver)
IPCC	Intergovernmental Panel on Climate Change
LEI	(Port Metro Vancouver) Landside Emissions Inventory
LSA	Local study area
MOVES	(US EPA) Motor Vehicle Emission Simulator
MV	Metro Vancouver
NAAQOs	National Ambient Air Quality Objectives
NH_3	Ammonia
NO_X	Nitrogen oxides
N_2O	Nitrous oxide
PM	Particulate matter
PMV	Port Metro Vancouver
RH	Relative humidity

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TABLE OF ABBREVIATIONS (Cont'd)

RSA	Regional study area
SO_X	Sulphur oxides
TPA	Tonnes per annum
VOCs	Volatile organic compounds
WD	Wind direction
WS	Wind speed

EXECUTIVE SUMMARY

An air quality assessment was completed for Columbia Containers (Columbia) in advance of the proposed construction of a new grain elevator and new grain storage silos on their existing facility at 2775 Commissioner Street in Vancouver (the proposed Rebuild Project). The existing grain transload facility is being modernized with the replacement of the existing aging elevator and the reinstatement of 9 silos. A new rail line parallel to the existing one will increase the number of rail cars that can be moved on site thereby reducing the amount of locomotive switching.

This air quality assessment includes a review of available ambient monitoring data in the area as well as an emission inventory; the following air contaminants are included in the inventory:

- Criteria air contaminants (CACs):

  Volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NO_X), sulphur oxides (SO_X), total suspended particulate (TSP), particulate matter of 10 microns in aerodynamic diameter or less (PM_{10}), particulate matter of 2.5 microns in aerodynamic diameter or less ($PM_{2.5}$), diesel particulate matter (DPM) and ammonia (NH_3);

- Greenhouse gases (GHGs):

  Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), black carbon (BC) and equivalent carbon dioxide (CO_2e).

The ambient monitoring data review is based on two Metro Vancouver (MV) ambient air quality stations in Burnaby and North Vancouver. The 2013 ambient air quality data are compliant with all relevant regional, provincial and federal standards and objectives. The 2013 annual mean for $PM_{2.5}$ at the North Vancouver monitoring station was slightly above the BC "planning goal" of 6 $\mu g/m^3$. For this reason $PM_{2.5}$ emissions were considered a priority for the assessment. Other pollutants of interest to MV, BC and Canada include diesel particulate matter (DPM) and ozone pre-cursors such as nitrogen oxides (NO_X) and volatile organic compounds (VOCs).

The assessment includes emission inventories for three scenarios:

1. A "2013 Baseline" scenario of the existing facility at 555,155 tonnes per annum (TPA) of grain throughput;
2. A "2017 without Project" scenario of the existing facility at 750,000 TPA; and
3. A "2017 with Project" scenario of the new facilities at 750,000 TPA.

The baseline was set to 2013 because it was the most recent typical operations year. The forecast scenarios were set to 2017 since the facility is expected to reach its maximum throughput of 750,000

TPA by that time, provided global supply and demand of grain remains. The same maximum throughput was used for both forecast scenarios since the proposed Project is not expected to expand the storage capacity of the facility but rather make the existing facility more efficient because grain will now be stored in silos instead of containers.

The estimated emission inventories include both exhaust and fugitive (dust) emissions for each year at the terminal itself (the local study area, or LSA) and within a broader region where the rail and truck traffic constitute a significant portion of the total traffic (the regional study area, or RSA). Columbia was estimated to contribute approximately 3% of the South Shore Trade Area (SSTA) truck and rail traffic so the RSA was defined to match the LSA since Columbia contributes less than 10% of the total port-related activity in the SSTA.

The baseline and future emission inventories are shown in Table ES-1, including the differences in emissions between the 2013 baseline and the two 2017 future scenarios (increase is positive, decrease is negative).

Table ES-1: Summary of baseline (2013) and future (2017) scenario emissions (kg).

Scenario	VOC	CO	NO_x	SO_x	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3	CO_2e
1. 2013 baseline	232	924	2,504	6	37,927	13,139	2,292	87	11	549,784
2. 2017 without Project	314	1,249	3,382	8	51,238	17,751	3,749	118	15	742,744
3. 2017 with Project	248	1,075	2,532	6	12,897	4,697	1,103	92	11	596,251
% change between 1 and 2	**35%**	**35%**	**35%**	**35%**	**35%**	**35%**	**64%**	**35%**	**35%**	**35%**
% change between 1 and 3	**7%**	**16%**	**1%**	**0%**	**-66%**	**-64%**	**-52%**	**5%**	**1%**	**8%**
% change between 2 and 3	**-21%**	**-14%**	**-25%**	**-26%**	**-75%**	**-74%**	**-71%**	**-22%**	**-25%**	**-20%**

Without the proposed Project, the projected 2017 emission estimates for the key CACs of interest (VOCs NO_X, $PM_{2.5}$ and DPM) are expected to increase due to increased throughput at the facility, as a result of increased global demand for grain. However, with the proposed Project, all CAC and GHG emissions are expected to be lower than the “2017 without Project” scenario, due to improved grain handling and facility efficiency improvements. In particular, the new fugitive dust control system installed as part of the proposed Project is expected to reduce $PM_{2.5}$ (a key CAC of interest) below the 2013 baseline level. Emission intensity levels (emissions per tonne of grain handled) for both CACs and GHGs are expected to decrease by 2017 with the proposed Project. For VOCs NO_X, $PM_{2.5}$ and DPM, the emissions intensity of the 2017 “Future with Project” scenario are expected to decrease by 21%, 25%, 64% and 22%, respectively, relative to the 2013 baseline.

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1.0 INTRODUCTION

Columbia Containers (Columbia) has applied to the Vancouver Fraser Port Authority (operating as Port Metro Vancouver, or PMV) to upgrade its grain handling facility as part of the proposed Rebuild Project (the proposed Project).

Currently, grain arrives at the facility by rail and is unloaded through a hopper into the elevator. The elevator drops the grain through a bin, a scale and then into a container, which is shipped out by truck. Canadian Pacific Rail (CPR) provides rail delivery and switching at the terminal, several times per work day; additional switching is provided by a facility-owned Shuttle Wagon. The existing facility has some controls for capturing fugitive grain dust between the rail car hopper and the slide gate before container loading but the controls are reaching the end of their service life.

The new grain handling process would be similar but after the elevator, most grain would be fed by conveyors to silos for storage prior to containers loading. The new dust management system will be installed as part of the proposed Project, including a baffle at the railcar dumper and a movable shroud at the container loading area. Between these points, the conveyors and silos are fully sealed and fugitive dust is suctioned to a baghouse. A new dual rail line will be built parallel to the existing single rail line, increasing storage capacity and reducing switching time. An aerial overview of Columbia Containers is shown in Figure 1-1, circa 2007 showing the silos that have since been removed.

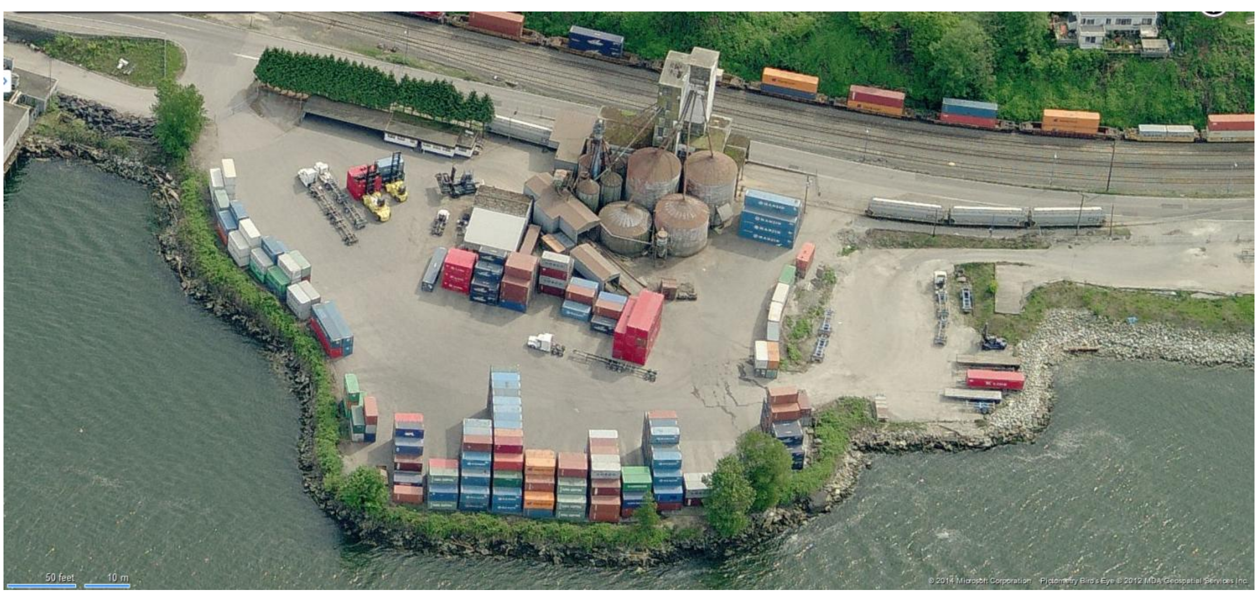


Figure 1-1: Columbia Containers, circa 2007 (credit: Bing Maps)

In 2013 (the last full year), grain throughput at Columbia was 435,479 tonnes. The previous AQ baseline year of 2011 (see Appendix A) was a poor crop year, with a throughput of 262,733 tonnes. The maximum capacity at Columbia is 750,000 tonnes per annum (TPA). The proposed replacement elevator and silos, and reconfigured site are designed to make the facility more cost-effective in the existing grain market by introducing efficiencies into Columbia's operation, not to increase throughput. The Phase II expansion is expected to reduce locomotive switching, yard truck activity and fugitive dust emissions. The replacement elevator, silos, and reconfigured site will enable more railcars to be stored during the unloading process and reduce the need to move individual railcars. When combined with the greater and more-efficient grain storage program (silos instead of containers) Columbia will be able to efficiently schedule container stuffing and transport activities independent of railway delivery timetables.

1.1 Scope of work

The scope of work for this air quality assessment includes calculation of a 2013 air emissions inventory (EI) baseline for the operations at Columbia Containers. The 2013 calendar year was defined as the inventory baseline year since it was the last typical year for which complete data was available. Forecast EIs to 2017 are included, incorporating the activity and infrastructure changes (as indicated) as well as the higher potential grain throughput. These forecasts are labeled “2017 with Project”, which includes the proposed facility replacement and an assumed maximum terminal throughput of 750,000 TPA and “2017 without Project”, which maintains the current grain handling equipment with the same maximum terminal capacity.

The EI includes criteria air contaminants (CACs), greenhouse gases (GHGs) and fugitive dust, based on best practice methods. Diesel particulate matter (DPM) is also accounted for, by attributing the fine particulate emissions ($PM_{2.5}$) to the various fuel sources. CACs and GHGs include the following specific compounds:

- Criteria air contaminants (CACs): Nitrogen oxides (NO_x), sulphur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOCs), total suspended particulate (TSP), particulate matter of 10 microns in aerodynamic diameter or less (PM_{10}), particulate matter of 2.5 microns in aerodynamic diameter or less ($PM_{2.5}$), diesel particulate matter (DPM) and ammonia (NH_3); and
- Greenhouse gases (GHGs): Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), black carbon (BC) and equivalent carbon dioxide (CO_2e).

Black carbon is included as a greenhouse gas due to the increasing awareness of its impact as a factor driving climate change. CO_2e amounts are developed using global warming potential (GWP) values from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) for both 20- and 100-year time horizons[1] (Table 1-1).

Table 1-1: Global warming potentials for 20- and 100-year time horizons.

Greenhouse gas	20-year GWP	100-year GWP
Methane	86	34
Nitrous oxide	268	298
Black carbon*	3,200	900

* Table 8.A.6, AR5, for "black carbon total, global".

In addition to the operational emission inventory, an evaluation was also conducted of the expected emissions due to the construction phase of the Project, which is expected to last approximately 10 months. Characterization of the existing air quality in and near the Columbia Containers facility is also addressed, based on historical monitoring data.

1.2 Columbia Containers environmental management program

Columbia's environmental management program includes the following:

- No truck idling on site;
- Frequent site cleaning with mobile sweeper (for dust suppression, and rat and bird control); and
- New equipment purchases to meet highest emission standards economically feasible.

1.3 Air quality assessment area

In accordance with the Preliminary Air Quality Requirements provided by PMV as well as discussions with PMV staff, a local study area (LSA) and a regional study area (RSA) were defined and used throughout this report. The LSA constitutes the terminal itself. Determination of the RSA depends on the volume of truck and rail traffic attributable to Columbia in the PMV South Shore Trade Area (SSTA) relative to all operations in the SSTA. The 2010 PMV Landside Emission Inventory (LEI)[2] lists the 2010 gate counts at all PMV facilities as approximately 2 million. Given a conservative assumption that the SSTA accounted for 25% of all 2010 PMV gate counts (i.e., 500,000), the 15,000 gate counts from Columbia in 2010 contributed approximately 3% of the SSTA truck traffic. Similarly, the LEI listed total 2010 fuel consumption from rail activity within the PMV administered areas (the Port Model Boundary) as 2.4 million litres of diesel. With the same assumption for trucking applied to rail (i.e., rail activity in

[1] IPCC. 2013. Fifth Assessment Report, Chapter 8 - Anthropogenic and Natural Radiative Forcing.

[2] SNC-Lavalin. 2012. Port Metro Vancouver 2010 Landside Emissions Inventory. Available from http://www.portmetrovancouver.com/environment/initiatives/air.aspx

the SSTA accounted for 25%, or 600,000L of the port total), the approximately 20,000L of rail diesel consumption due to Columbia contributed approximately 3% of the SSTA rail traffic. As such, the RSA is defined as equal to the LSA since Columbia contributes less than 10% of the activity to the SSTA.

Figure 1-2 shows Columbia Containers and the surrounding area. Key community concerns related to air quality are around PM and fugitive dust, due to the proximity of RS-1 zoned residential housing. The nearest sensitive receptor is a residence approximately 100m from Columbia's fence line. Other sensitive receptors in the area include parks (Burrard View Park is approximately 200m from the fence line) and schools (Tillicum Annex is approximately 1,000m from the fence line). These receptors were considered in the assessment.

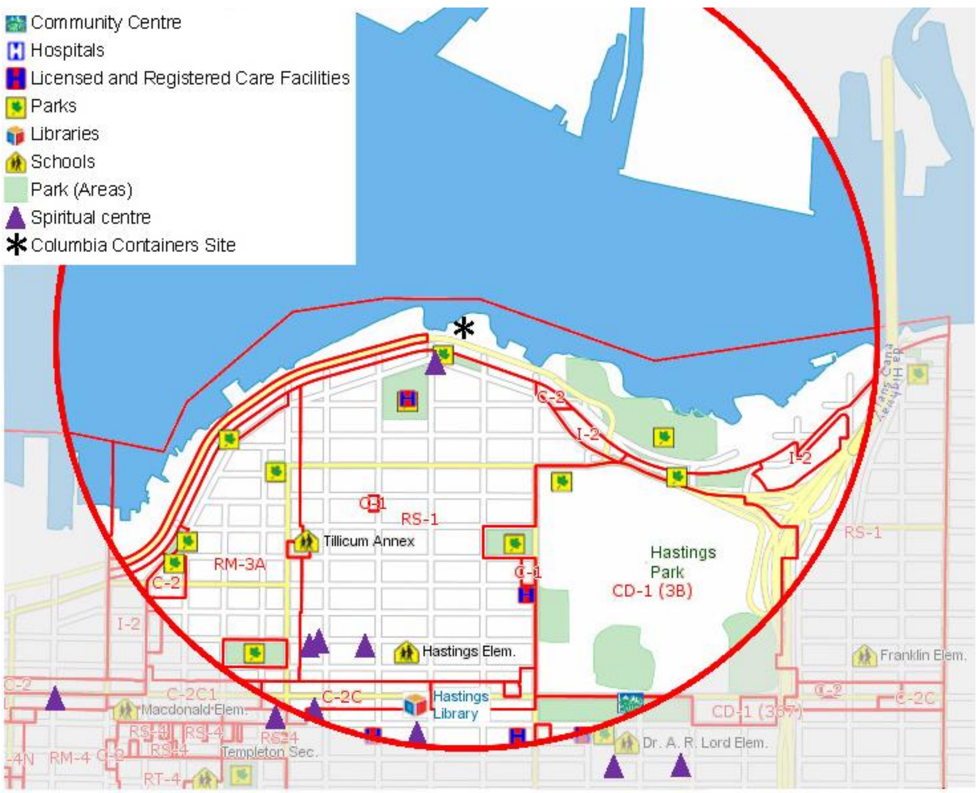


Figure 1-2: Columbia Containers and surrounding area.

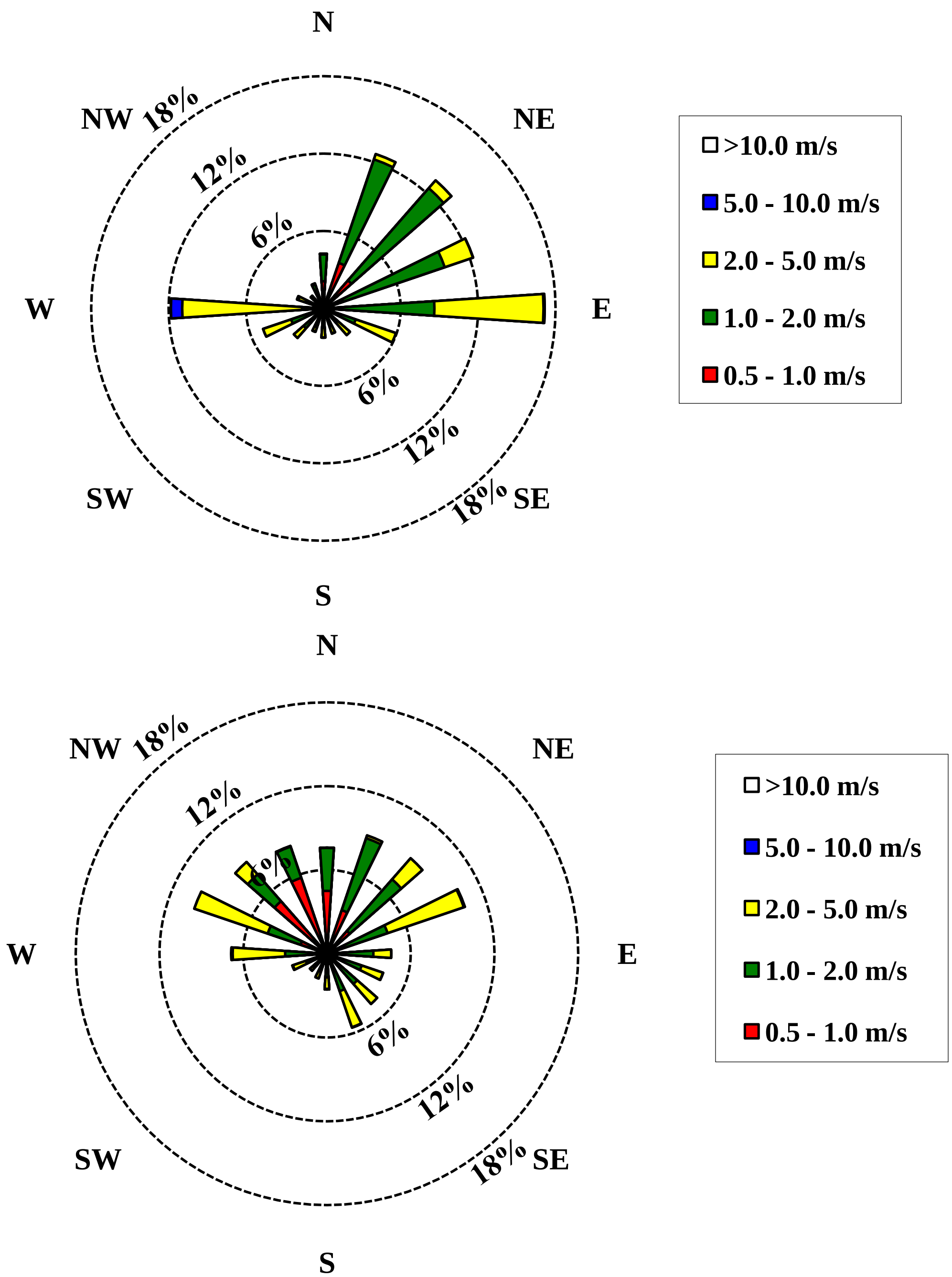
2.0 AMBIENT CONDITIONS AND AIR QUALITY OBJECTIVES

2.1 Meteorological conditions

Table 2–1 provides location information and wind speed summary statistics for the Burnaby North (2.9 km east of the facility) and the Second Narrows (2.2 km northeast of the facility) monitoring stations. One year (2013) of data is considered representative of the seasonal variability for the area. Wind speed and direction are of interest since they correlate with the direction that airborne pollutants disperse. Figure 2-1 provides wind rose diagrams of the station data for 2013, showing the annual frequency distributions for both wind speed (WS) and wind direction (WD); Figure 2-2 shows the locations of the monitoring stations relative to Columbia.

Table 2-1: Identification of monitoring stations and wind speed statistics

Parameter	Burnaby North MV AQ station	Second Narrows MV AQ station
Station information		
Location (latitude, longitude)	49.287480° N, 123.008314°W	49.301246°N, 123.020436°W
Elevation (m ASL)	69.0	5.0
Station owner	Metro Vancouver	Metro Vancouver
Meteorological data		
Data period	January 1 to December 31, 2013	January 1 to December 31, 2013
Parameters measured	WS, WD, temperature, relative humidity, precipitation	WS, WD
Data capture rate	99.8% (WS), 99.8% (WD)	98.9% (WS), 98.9% (WD)
Calms hours in 2013 (WS<0.5 m/s)	150 (0.017%)	18 (0.002%)
Annual mean WS (m/s)	1.6	1.8
Ambient air quality data		
Data period	January 1 to December 31, 2013	January 1 to December 31, 2013
Parameters measured	PM_{10}, SO_2	CO, NO_2, O_3, $PM_{2.5}$, SO_2



*Wind direction as shown is from which the wind is coming

Figure 2-1: 2013 Windrose diagrams for the Second Narrows (top) and Burnaby North (bottom) stations*

Figure 2-2: Map of monitoring station locations nearest to Columbia.

2.2 Air quality objectives and standards

Standards, Objectives and Guidelines are expressed by different levels of Canadian government to ensure the protection of human health and the environment. The Metro Vancouver ambient air quality objectives are shown in Table 2-2, noting the applicable averaging periods for each objective. Table 2-3 identifies the national criteria: Canada Wide Standards (CWS) as well as the National Ambient Air Quality Objectives (NAAQOs). The Provincial criteria are also included. The most stringent objectives or standards are considered applicable for a particular air contaminant and averaging period. At this time, there are no GHG objectives in effect at the regional, provincial or national level.

Table 2-2: Metro Vancouver ambient air quality objectives

Pollutant	Averaging period	MV objective ($\mu g/m^3$)
Carbon monoxide	1 hour	30,000
	8 hour	10,000
Nitrogen dioxide	1 hour	200
	Annual	40
Sulphur dioxide	1 hour	450
	24 hour	125
	Annual	30
Ozone	8 hour	156
PM_{10}	24 hour	50
	Annual	20
$PM_{2.5}$	24 hour	25

Table 2-3: National and provincial air quality criteria (all values in µg/m³)

Pollutant and Averaging Period	BC objective [(a)]			National objective [(b)]			CWS
	Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable	
CO							
1hr max	14,300	28,000	35,000	15,000	35,000	-	-
8hr max	5,500	11,000	14,300	6,000	15,000	20,000	-
NO_2							
1hr max	-	-	-	-	400	1,000	-
24hr max	-	-	-	-	200	300	-
Annual mean	-	-	-	60	100	-	-
PM_{10}							
24hr max	-	50	-	-	-	-	-
$PM_{2.5}$							
24hr mean			25[(d)]	-	-	-	30[(c)]
Annual mean			8	-	-	-	-
Annual mean			6[(e)]	-	-	-	-
Ozone							
1hr max	100	160	300	-	-	-	-
8hr mean							127[(f)]
24hr max	30	50	-	-	-	-	-
Annual mean	-	30	-	-	-	-	-
SO_2							
1hr max	450	900	-	450	900	900-1300	-
3hr max	-	-	-	-	375	665	-
24hr max	150	300	800	160	260	360	-
Annual mean	30	60	-	25	50	80	-
TSP							
24hr mean	150	200	260	-	120	400	-

Table 2-3 (Cont'd): National and provincial air quality criteria (all values in µg/m³)

Pollutant and Averaging Period	BC objective [a]			National objective [b]			CWS
	Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable	
TSP (cont'd)							
Annual mean (geom.)	60	70	75	60	70	-	-

[a] Concentrations at 20°C, 760 mm Hg, dry basis
[b] Concentrations at 25°C, 101 kPa, dry basis
[c] 98th percentile of 24 hour means averaged over three years
[d] 98th percentile of 24 hour means
[e] Planning goal
[f] 4th highest value over the year, averaged over 3 years

The CWS will be replaced with the Canadian Ambient Air Quality Standards (CAAQS) in 2015. At this time, the CAC-related CAAQS have been expressed for $PM_{2.5}$ and ground-level ozone only. For $PM_{2.5}$, these are 10 µg/m^3 (annual average) and 28 µg/m^3 (24-hour average), and for ground-level ozone, these are 123 µg/m^3 (8-hour average). The Metro Vancouver Integrated Air Quality and Greenhouse Gas Management Plan (IAQGGMP) also lists ozone and ozone pre-cursors (primarily NO_X and VOCs) as pollutants of concern for the region, as well as DPM.

Additional national and provincial ambient standards or objectives exist for specific compounds that may be released to the air (e.g., non criteria contaminants). For example, the provincial objectives include levels for formaldehyde and total reduced sulphur. However, the Columbia operations release insignificant quantities of these contaminants and therefore compliance to the additional standards/objectives is not considered in this study.

2.3 Ambient air quality baseline

Table 2-4 provides a summary of the ambient air quality data collected at the MV Second Narrows and Burnaby North ambient air quality monitoring stations (2013 data), by averaging period of interest. These two stations are co-located with the meteorological stations identified in Section 3.1.

Data capture in all cases was above 97% over the year or better, with the exception of $PM_{2.5}$ data at Second Narrows (91% data capture). The concentrations at these two monitoring stations are considered representative of the ambient air quality at the sensitive receptors near the Columbia facility.

Table 2-4: Concentrations of criteria air contaminants at the Second Narrows and Burnaby North station for 2013.

Ambient parameter	Concentration (µg/m³)						
	Second Narrows					Burnaby North	
	CO	NO_2	O_3	$PM_{2.5}$	SO_2	PM_{10}	SO_2
1-hour maximum	1,225.8	94.5	99.3	-	86.5	-	81.5
3-hour maximum	-	-	-	-	53.9	-	48.1
8-hour maximum	763.3	-	85.7	-	-	-	-
24-hour maximum	-	53.6	72.4	18.0	18.0	25.5	23.2
98th percentile of 24-hour mean	-	-	-	5.7	-	-	-
Annual mean	-	-	24.8	6.2*	3.2	10.6	4.5

* Above the BC planning goal.

There are no exceedences of the relevant ambient objectives and standards at the regional, provincial and national level. The 2013 $PM_{2.5}$ annual mean of 6.2 µg/m³ at the Second Narrows station is above the 6 µg/m³ planning goal. Planning goals are not regulatory requirements (and not subject to formal compliance) but this outcome highlights $PM_{2.5}$ as a contaminant of greater relative concern for the assessment.

The key CACs of interest for the assessment include:

- $PM_{2.5}$ (explanation stated above);
- NO_X and VOCs (due to the regional, provincial and federal focus on ozone pre-cursors); and
- DPM (due to the Metro Vancouver IAQGGMP focus on particulate matter from diesel engines).

3.0 AIR EMISSIONS

Section 3.1 describes the sources and activities associated with the three emission scenarios. Section 3.2 describes the resulting emissions for the three scenarios. Section 3.3 describes the emissions associated with the construction phase.

3.1 Operations emission sources and activities

The operational emissions included in this study are due to two primary source categories: exhaust (e.g., combustion of fuels) and fugitive emissions from grain handling operations. Fugitive emissions were calculated using US Environmental Protection Agency (EPA) methodologies, and are described in Section 3.1.5. The exhaust emissions were generated using the Transport Canada (TC) Port Emissions Inventory Tool (PEIT).

PEIT was recently updated to Version 3.1.6 as part of the TC National Ports Emissions Inventory project. PEIT is consistent with the EPA emissions models MOVES 2010b (onroad vehicles) and NONROAD 2008 (offroad equipment). PEIT consists of a Microsoft Access database and Excel data questionnaires. The database is programmed to import terminal questionnaires, calculate emissions and provide activity and emission summaries in a pivot table format (Appendix A includes the user guide for PEIT). Five source groups are included in PEIT:

- Admin (building heating and electricity consumption);
- Cargo-handling equipment (CHE) (forklifts, cranes, etc.);
- Marine vessels (harbour vessels and commercial ocean-going vessels);
- Onroad vehicles (facility trucks and highway vehicles); and
- Rail (facility locomotives and national rail providers).

Some of the sources that can be calculated using PEIT include activities not under the direct control of a terminal such as commercial ocean-going vessels, highway vehicles and national rail locomotives. In the case of Columbia, commercial ocean-going vessels are not included since no dock exists at the terminal. Indirect emissions associated with electricity were also evaluated since electricity accounts for more than 10% of the total energy usage at Columbia.

The PEIT model generates emissions for all the CACs and GHGs noted in Section 1.2. The model defines DPM as all $PM_{2.5}$ emissions from diesel-powered engines. Black carbon is defined as elemental carbon in PEIT, using average Mobile 6.2C speciation fractions for the gas- and diesel-powered engines, and EPA SPECIATE profile 92048 for propane-powered vehicles. Air toxics were not included in the emission inventory, as previously noted. There are no industrial processes at the facility that produce air toxics. The primary source of air toxics at Columbia is engine exhaust from mobile sources and the level of mobile activity is not high enough to expect significant quantities of air toxics. Furthermore, the facility does not report its emissions to the federal National Pollutant Release Inventory due to their overall low level.

As described in the scope of work, three emissions scenarios were considered for the air quality assessment of operations:

- 2013 baseline with throughput of 555,155 tonnes of grain;
- 2017 forecast with existing facilities and throughput of 750,000 tonnes of grain;
- 2017 forecast with new facilities and throughput of 750,000 tonnes of grain.

The baseline case was calculated using data provided by Columbia for the 2013 calendar year, which was the most recent typical year. The future EIs were calculated for the 2017 activity levels. To the degree possible, the expected (newer) equipment was accounted for in the future EIs. However, the 2017 emission estimates are likely conservative due to a lack of defined parameters for this future year. Limitations and approximations in the future EIs are identified in the following sections.

Figures 3-1 and 3-2 are maps showing the locations of emission sources for the three scenarios: Figure 3-1 shows the emission sources for “2013 baseline” and “2017 without Project” scenarios, and Figure 3-2 shows the emission sources for the “2013 with Project” scenario.

Figure 3-1: Site map showing the emission sources for the “2013 baseline” and “2017 without Project” scenarios at Columbia Containers.

Figure 3-2: Site map showing the emission sources for the "2017 with Project" scenario at Columbia Containers.

3.1.1 Rail Activity

Rail activity at Columbia includes switching from a single CPR locomotive as well as a Columbia owned Shuttle Wagon facility locomotive (a 300-hp Tier 3 locomotive) that transfers rail cars from the CPR drop area to the facility. Table 3-1 summarizes the rail activity for the 3 scenarios. Under current operations, CPR makes 3 deliveries a day, each lasting approximately 23 minutes. The number of deliveries was scaled linearly with throughput for the "2017 without Project" scenario, as a result of increased global demand for grain. Columbia indicated that only 2 CPR visits per day would be required in the "2017 with Project" scenario because of the increased rail car storage capacity at Columbia. Columbia indicated these "2017 with Project" CPR visits would each last approximately 28 minutes.

In 2013, diesel consumption at Columbia was 162,700 L. Based on reported operation of approximately 2 hours per day, the 2013 baseline Shuttle Wagon fuel consumption was estimated at 10% of the total, or 16,300 L. The fuel consumption for the Shuttle Wagon was linearly scaled based on throughput for the "2017 without Project" scenario. For the "2017 with Project" case, Shuttle Wagon use is expected to be more efficient because the increased rail capacity means 34 rail cars can be switched at a time instead of 28 cars. This 21% capacity increase per switch was estimated as a 20% reduction in fuel consumption relative to the "2017 without Project" scenario.

Table 3-1: Rail activity for 3 emission inventory scenarios at Columbia Containers.

Rail activity	2013 baseline	2017 without Project	2017 with Project
Annual trains	750	1,013	500
Average CPR switching per train (min)	23	23	28
Shuttle Wagon fuel consumption (L)	16,300	22,000	17,600

3.1.2 On-road vehicle activity

All onroad activity at Columbia is due to highway trucks picking up and dropping off grain containers. There is one company truck but it is not used on site so was not included in the analysis. Emissions associated with the Columbia-owned yard trucks (used to move containers within the facility) are captured under CHE in the following section. The age distribution of the highway trucks was based on the relative age distribution reported in the 2010 PMV LEI report[3]. It was adjusted such that all vehicles older than 10 years old were set to 10 years old, a conservative assumption to align with the requirements of PMV's Truck Licensing System.

Table 3-2 summarizes the onroad activity levels for the 3 scenarios. Columbia has indicated that gate counts (1 gate count corresponds to 1 vehicle entering and exiting the facility) are expected to reach 27,000 by 2017, due to the increased throughput resulting from increased global demand for grain. The baseline 2013 gate counts were unavailable and therefore were determined through linear scaling based on throughput and the expected 2017 gate counts. The proposed Project is not expected to change the vehicle activity levels of trucks while on site so all three scenarios use the same drive and idle times per vehicle.

Table 3-2: On-road vehicle activity at Columbia Containers

On-road activity	2013 baseline	2017 without Project	2017 with Project
Annual gate counts	20,000	27,000	27,000
Drive time on site (min)	1	1	1
Idle time on site (min)	2	2	2

3.1.3 Cargo handling equipment activity

Columbia has 13 individual pieces of cargo-handling equipment used on site. The primary fuel used is diesel and the major fuel consumers are container handlers and terminal tractors. Columbia recently replaced older container handlers and terminal trucks with newer models with higher emission standards. Table 3-3 summarizes the equipment used on site.

As indicated in Section 3.1.1, the 2013 diesel consumption was 162,700 L, and 90% was estimated to be used by CHE. For the "2017 without Project" scenario, the fuel consumption was scaled based on throughput, to a value of 197,800L. The total diesel fuel consumption for the "2017 with Project" scenario was reduced by 20% (to 158,300 L) since terminal tractor and container handler activity is expected to drop. This drop is caused because grain storage in silos and grain movement by conveyors requires less CHE trips than grain storage in containers.

[3] SNC-Lavalin. 2012. Port Metro Vancouver 2010 Landside Emissions Inventory. Available from http://www.portmetrovancouver.com/environment/initiatives/air.aspx

Table 3-3: Cargo-handling equipment at Columbia Containers

Fuel type	Cargo-handling equipment	Equipment count	Engine technology	Engine age	Engine size (hp)	Estimated annual operation (hrs)
Diesel	Container handler 1	1	Tier 3	2010	230	3900
	Container handler 2	1	Tier 3	2011	230	3900
	Container handler 3	1	Tier 3	2011	365	3900
	Container handler 4	1	Tier 3	2013	365	3900
	Terminal tractor 1	1	Tier 4	2012	500	3900
	Terminal tractor 2	1	Tier 4	2012	500	3900
	Skid steer loader 1*	1	Tier 2	2005	75	75
Propane	Forklift 1	1	Tier 2	2008	60	520
	Forklift 2	1	Pre-Tier	1976	60	250
	Aerial Lift	1	Pre-Tier	1999	50	75
Gasoline	Pressure washers 1-3	3	Phase 2	2006	5	50

* Skid steer loader also used as mobile sweeper.

3.1.4 Fugitive dust activity and emission estimates

Fugitive grain dust is caused by several activities at Columbia, including rail car grain receiving, grain handling (conveyors, belts, scales, etc.) and container loading. Fugitive grain dust generates suspended particulate matter, including TSP, PM_{10} and $PM_{2.5}$. The proposed Project will introduce new dust controls throughout the grain handling process.

The methodology used to assess fugitive emissions from grain handling at the terminal is consistent with the US EPA AP 42 approach, which requires an estimate of the material handling rates. The methods scale linearly with grain throughput and therefore can be scaled to determine future dust emissions in addition to the baseline. The fugitive dust generation equation is as follows:

$$E = TP * EF, \qquad \textit{(Equation 1)}$$

Where: E = fugitive dust emissions of TSP, PM_{10} or $PM_{2.5}$ (in grams);

TP = annual throughput (in tonnes of grain); and

EF = TSP, PM_{10} or $PM_{2.5}$ emission factor (in grams per tonne of grain handled)[4].

[4] US EPA, AP-42. 9.9.1 Grain Elevators and Processes.

The emission factor depends on the emission source; Table 3-4 summarizes the fugitive dust emission factors for uncontrolled grain handling for sources present at Columbia. Each emission factor represents emissions generated at a single transfer point, such as a drop off of a conveyor or a railcar emptying into a hopper.

Table 3-4: Fugitive dust emission factors for uncontrolled grain handling (in grams per tonne)*.

Emission source	TSP	PM_{10}	$PM_{2.5}$
Grain receiving – rail car	16.0	3.9	0.7
Grain shipping – truck	43.0	14.5	2.5
Headhouse and grain handling	30.5	17.0	2.9
Storage bin (vent)	12.5	3.2	0.6

* Source: US EPA. AP-42. Table 9.9.1-1.

The most common fugitive grain dust control is an enclosed building with sealed components where fugitive dust is drawn through a central baghouse that filters out the dust; other controls include baffles and shrouds. The existing and new grain handling systems at Columbia have different dust controls at each transfer point. Table 3-5 summarizes the most common grain path in the two systems, indicating the emissions source type and control measure at each transfer point.

Table 3-5: Description of existing and new grain handling systems at Columbia Containers.

Transfer point	Fugitive emission type	Fugitive dust control measure
Existing grain handling system		
Rail car dumper to hopper	Grain receiving – rail car	None
Hopper to elevator	Headhouse and grain handling	Existing baghouse
Elevator to garner bin	Headhouse and grain handling	Existing baghouse
Garner bin to scale	Headhouse and grain handling	Existing baghouse
Scale to container loading	Grain shipping – truck	None
New grain handling system		
Rail car dumper to conveyor	Grain receiving – rail car	Baffle
Two (2) conveyors to elevator	Headhouse and grain handling	Sealed conveyors and new baghouse
Elevator to diverter	Headhouse and grain handling	Sealed conveyors and new baghouse
Two (2) conveyors to silos	Headhouse and grain handling	Sealed conveyors and new baghouse
Silo storage	Storage bin (vent)	Sealed conveyors and new baghouse
Two (2) conveyors to elevator	Headhouse and grain handling	Sealed conveyors and new baghouse

Table 3-5 (Cont'd): Description of existing and new grain handling systems at Columbia Containers.

Transfer point	Fugitive emission type	Fugitive dust control measure
New grain handling system (Cont'd)		
Weigh scale into containers	Grain shipping – truck	Shroud

Schematics of the fugitive dust management system are included in Appendix D. Drawing "14024-GA-102A TRANSFER POINTS" indicates the key areas where dust is generated and collected. This drawing notes grain transfer points within the facility with numbers between 1 and 11. The numbers correspond to dust management elements at Columbia shown in the other drawings of Appendix D.

Each dust control measure has a characteristic fractional efficiency which corresponds to the ratio of particles collected to particles entering the system. Table 3-6 summarizes the efficiencies of the fugitive dust control measures in use or proposed at Columbia. As can be seen some dust control systems are designed to capture larger grains so have a lower efficiency for $PM_{2.5}$. The efficiency of the existing baghouse was based on data reported in the 2011 Columbia emission inventory (see Appendix A); the 90% efficiency reported is within the range published in literature[5]. The efficiency of the new baghouse was based on specifications (assuming a partially loaded filter bag) for the system under consideration at Columbia: a Donaldson Torit "Cyclone Dust Collectors" (see Appendix E). The efficiencies for the baffles and shrouds are based on literature[6] and discussions with Columbia's engineering contractor.

Table 3-6: Efficiencies of fugitive dust control measures in use or proposed for Columbia Containers.

Fugitive dust control measure	TSP	PM_{10}	$PM_{2.5}$
Baffle	0.9	0.9	0.8
Baghouse – existing	0.9	0.9	0.8
Baghouse – new	0.99	0.99	0.99
Shroud	0.7	0.7	0.6

Using Equation 1 and Table 3-4 to 3-6, we can show the difference between fugitive grain emissions at the rail car dumper between the new and old systems for PM_{10} (where the zero in the last term for the existing system represents the null fractional efficiency associated with no controls):

- "2013 baseline": (3.9 g/t) * (555,155 t) * (1 – 0) * (1 kg / 1000 g) = 2,165 kg
- "2017 with Project": (3.9 g/t) * (750,000 t) * (1 – 0.9) * (1 kg / 1000 g) = 292 kg

[5] Air and Waste Management Association. 2000. Air Pollution Engineering Manual, Second Edition. Wiley Inter-science, Table 4 of Chapter 13.
[6] Ibid.

3.1.5 Administration activity

Administration emissions result from the use of propane for space heating, as well as electricity consumption. In 2013, Columbia consumed approximately 600 L of propane. Columbia stated that space heating requirements were not expected to change by 2017. Given the low fuel consumption relative to other sources, propane heating emissions were not included in the scenario analysis. The electricity consumption for the facility in 2013 was 429,500 kWh. The "2017 without Project" electricity consumption was scaled with throughput; it is expected that electricity consumption for the "2017 with Project" scenario would be approximately 20% larger since more grain handling would be conducted with electric drive conveyors.

Electricity consumption does not release CAC emissions locally but is responsible for greenhouse gas emissions. The aggregate emission factor (using 100-year GWPs) for BC is 23.5 g CO_2e/kWh (see Appendix A).

3.1.6 Significant assumptions and limitations

The operations activity and emissions levels were modeled as follows:

- General:
  - Columbia will not replace any of their facility-owned mobile equipment (rail, CHE, trucks) between 2013 and 2017;
  - Renewable and sulphur content of fuel are not expected to change between 2013 and 2017;
  - Columbia operations are 5 days a week, 50 weeks a year;
  - Emission rates in grams per second from exhaust sources were assumed to remain constant between 2013 and 2017; this assumption is conservative since newer CPR locomotives and highway trucks will likely have lower emission rates in the future (see below);
- Rail:
  - The emissions model conservatively assumes the same locomotive models and emission rates are used in 2017 future scenarios as were used in 2013 baseline even though CPR is gradually replacing their active locomotives with newer units that have lower emission rates for some contaminants;
  - The Shuttle Wagon fuel consumption was reduced to 80% of the baseline value in the "2017 with Project" scenario, relative to the "2017 without Project" scenario to account for increased railcar storage capacity (see Section 3.1.1);

- Cargo-handling equipment:
  - 2017 CHE activity levels (hours of use) were estimated by linearly scaling the ratio of expected maximum throughput (750,000 TPA) and actual 2013 throughput (555,155 TPA);
  - Columbia's 2013 equipment population was considered representative of the 2017 equipment population;
- Fugitive dust:
  - Fugitive grain dust emission rates are expected to decrease with the new grain handling systems due to improved controls (see Section 3.1.4 for more details);
  - Fugitive road dust from paved surfaces was considered negligible, given Columbia's routine grounds sweeping program; and
  - Fugitive grain dust does not contain black carbon.

3.2 Operations emissions estimates

Emission estimates of CACs for the 3 scenarios are provided in Table 3-7 for the LSA/RSA, including the percent difference for the two 2017 scenarios (increase as positive, decrease as negative) from the 2013 baseline. Additionally, the "2017 with Project" scenario is compared to the "2017 without Project" scenario. It is important to note that the TSP emissions estimates relate to the larger particulate grains that tend to fall near the source. In contrast, $PM_{2.5}$ tends to disperse more like a gas. As such, much of the TSP generated by Columbia would not leave the compound. The emissions estimates for the "2017 without Project" are higher than the 2013 baseline due to the projected facility throughput increasing by almost 50% as a result of increased global demand for grain. With the proposed Project, the CAC emissions are expected to be lower than they would have been without the Project. Major reductions are predicted in PM due to improved fugitive dust controls; more efficient operations will also reduce CAC emissions.

Emission estimates of GHGs for the 3 scenarios are provided in Table 3-8 for the LSA/RSA. The carbon dioxide equivalent values were calculated using the values in Table 1-1. GHG emissions are expected to increase with increasing throughput. Facility improvements due to the proposed Project will reduce the potential increase by 20%.

The impact of the Project was also evaluated in terms of emissions intensity in grams of pollutant per tonne of grain handled. Tables 3-9 and 3-10 summarize the emission intensities for CACs and GHGs. The assessment indicates that the emission intensity for "2017 without Project" is the same as the baseline since all activities were scaled by throughput. However, in the "2017 with Project" scenario, the emission intensities associated with all pollutants (CACs and GHGs) are expected to decrease. The significant decrease in TSP, PM_{10} and $PM_{2.5}$ intensities is due to improved fugitive dust controls; other pollutant intensities decrease due to the operational efficiencies of the proposed Project.

Assessment of the emissions by fuel type was not considered relevant for Columbia Containers since diesel accounts for approximately 80% of energy usage in the Columbia LSA/RSA, with the remainder being electricity (and insignificant amounts of gasoline and propane).

Table 3-7: Operational CAC emissions estimates in the Columbia local/regional study area (kg).

Source group	VOC	CO	NO_X	SO_X	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3
2013 baseline									
Admin	0	0	0	0	0	0	0	0	0
CHE	141	672	1,476	3	45	45	44	43	7
Trucking	14	35	77	0	8	8	6	6	0
Rail	77	217	951	3	40	40	38	38	4
Fugitive dust	-	-	-	-	37,834	13,046	2,204	-	-
TOTAL	**232**	**924**	**2,504**	**6**	**37,927**	**13,139**	**2,292**	**87**	**11**
2017 without Project									
Admin	0	0	0	0	0	0	0	0	0
CHE	191	908	1,994	5	61	61	59	58	9
Trucking	18	47	104	0	11	11	9	9	1
Rail	104	294	1,285	4	54	54	51	51	5
Fugitive dust	-	-	-	-	51,113	17,625	3,630	-	-
TOTAL	**314**	**1,249**	**3,382**	**8**	**51,238**	**17,751**	**3,749**	**118**	**15**
% change from 2013 baseline	**35%**	**35%**	**35%**	**35%**	**35%**	**35%**	**64%**	**35%**	**35%**
2017 with Project									
Admin	0	0	0	0	0	0	0	0	0
CHE	159	815	1,609	4	49	49	48	47	7
Trucking	18	47	104	0	11	11	9	9	1
Rail	71	213	819	2	38	38	37	37	3
Fugitive dust	-	-	-	-	12,799	4,599	1,011	-	-
TOTAL	**248**	**1,075**	**2,532**	**6**	**12,897**	**4,697**	**1,103**	**92**	**11**
% change from 2013 baseline	**7%**	**16%**	**1%**	**0%**	**-66%**	**-64%**	**-52%**	**5%**	**1%**
% change from 2017 without Project	**-21%**	**-14%**	**-25%**	**-26%**	**-75%**	**-74%**	**-71%**	**-22%**	**-25%**

Table 3-8: Operational GHG emissions estimates in the Columbia local/regional study area (kg).

Source group	CO_2	CH_4	N_2O	BC	CO_2e - 20yr	CO_2e - 100yr
2013 baseline						
Admin	9,921	3	0	0	10,224	10,099
CHE	394,489	25	161	1	442,955	444,248
Trucking	14,424	1	0	0	14,940	14,672
Rail	71,270	4	30	1	81,516	80,766
Fugitive dust	-	-	-	-	-	-
TOTAL	**490,105**	**32**	**191**	**2**	**549,635**	**549,784**
2017 without Project						
Admin	13,404	3	0	0	13,812	13,643
CHE	532,945	33	218	1	598,420	600,167
Trucking	19,486	1	1	0	20,184	19,821
Rail	96,284	5	40	1	110,125	109,113
Fugitive dust	-	-	-	-	-	-
TOTAL	**662,119**	**43**	**259**	**2**	**742,542**	**742,744**
% change from 2013 baseline	**35%**	**35%**	**35%**	**35%**	**35%**	**35%**
2017 with Project						
Admin	16,084	4	0	0	16,574	16,372
CHE	427,916	27	174	1	480,606	481,795
Trucking	19,486	1	1	0	20,184	19,821
Rail	69,062	4	29	1	78,988	78,263
Fugitive dust	-	-	-	-	-	-
TOTAL	**532,548**	**36**	**204**	**2**	**596,353**	**596,251**
% change from 2013 baseline	**9%**	**14%**	**7%**	**10%**	**8%**	**8%**
% change from 2017 without Project	**-20%**	**-16%**	**-21%**	**-19%**	**-20%**	**-20%**

Table 3-9: Operational CAC emission intensity estimates in the Columbia LSA/RSA (grams / tonne).

Scenario	VOC	CO	NO_x	SO_x	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3
2013 baseline	0.42	1.67	4.51	0.01	68.32	23.67	4.13	0.16	0.02
2017 without Project	0.42	1.67	4.51	0.01	68.32	23.67	5.00	0.16	0.02
2017 with Project	0.33	1.43	3.38	0.01	17.20	6.26	1.47	0.12	0.01
% change without Project	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**21%**	**0%**	**0%**
% change with Project	**-21%**	**-14%**	**-25%**	**-26%**	**-75%**	**-74%**	**-64%**	**-22%**	**-25%**

Table 3-10: Operational GHG emission intensity estimates in the Columbia LSA/RSA (grams / tonne).

Scenario	CO_2	CH_4	N_2O	BC	CO_2e - 20yr	CO_2e - 100yr
2013 baseline	882.83	0.06	0.34	0.00	990.06	990.33
2017 without Project	882.83	0.06	0.34	0.00	990.06	990.33
2017 with Project	710.06	0.05	0.27	0.00	795.14	795.00
% change without Project	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
% change with Project	**-20%**	**-16%**	**-21%**	**-19%**	**-20%**	**-20%**

3.3 Construction activity and emissions

According to Columbia, the construction stage of the proposed Rebuild Project is expected to last 44 weeks, starting in 2015. Available data states that construction activities will be conducted for 10 hours a day, 6 days a week for the duration of construction.

3.3.1 Construction activity

Table 3-10 summarizes the equipment expected to be used for construction; all construction equipment is diesel powered. No engine age was available for the expected equipment and therefore a conservative assumption of 10 years old was applied (i.e., 2005 model year assuming a 2015 construction year), which corresponds to engine Tier 1 or 2, depending on engine size.

Table 3-11: Construction equipment for the proposed Rebuild Project at Columbia Containers.

Equipment	Count	Engine size (hp)
Crane	2	271
Skid steer loader	2	57
Excavator	3	463 / 1,343 / 1,944
Plate compactor	4	4
Roller compactor	1	33
Asphalt placer	1	55
Concrete pump truck	1	400*
Concrete delivery trucks	200	340
Dump trucks	500	426

* Engine size estimated.

Emissions were estimated using the PEIT model; the concrete delivery and dump trucks were represented by the Onroad source group (e.g., EPA MOVES emission rates) while all other vehicles were represented using the cargo-handling equipment source group, with EPA NONROAD emission rates.

In addition to the combustion emissions, the new structures of the proposed Project will be painted following construction. Paint releases VOCs during drying so these emissions were estimated following the EPA Paints and Coatings Resource Center VOC Calculator[7]. It was assumed that the paint used is "low VOC", which corresponds to 250 g VOC per litre of paint[8]. Table 3-11 summarizes the surface areas of structures expected to be painted.

Table 3-12: Surface areas of structure expected to be painted.

Structure	Count	Surface area (m^2)
Rail car dumper building	1	290
Dust collection cyclone	1	13
Tower 1	1	40
Tower 2	1	32
Container loading facility	1	395
330t malt bin	3	70
1200t malt bin	1	165
1400t malt bin	2	235
2900t malt bin	3	490

3.3.2 Significant assumptions and limitations

The construction emissions were modeled as follows:

- Concrete delivery and dump trucks will drive on site for 2 minutes per visit;
- Concrete delivery trucks will idle on site for 30 minutes per visit (the engines stay on to keep the concrete liquid);
- Dump trucks will idle on site for 1 minute per visit;
- All other equipment operates for half of the day (i.e., 5 hours), assuming the default load factors by equipment type included in NONROAD; and
- The thickness of paint applied was estimated at 1mm (0.001m).

[7] http://www.paintcenter.org/newvoccalc.cfm
[8] http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailreg.cfm?intReg=117

3.3.3 Emissions estimates

Tables 3-11 and 3-12 summarize the CAC and GHG emission estimates for the construction component of the proposed Rebuild Project at Columbia. As can be seen, the onsite equipment is the dominant source of emissions for all pollutants, with the excavators generating the most emissions.

Table 3-13: Construction CAC emission estimates for the proposed Rebuild Project at Columbia (kg).

Source group	VOC	CO	NO_x	SO_x	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3
Concrete and dump trucks	2	5	13	0	1	1	1	1	0
Onsite equipment	1,434	6,279	24,735	22	1,119	1,119	1,086	1,086	39
Painting	541	0	0	0	0	0	0	0	0
TOTAL	**1,977**	**6,284**	**24,748**	**22**	**1,120**	**1,120**	**1,087**	**1,087**	**39**

Table 3-14: Construction GHG emissions estimates for the proposed Rebuild Project at Columbia (kg).

Source group	CO_2	CH_4	N_2O	BC	CO_2e - 20yr	CO_2e - 100yr
Concrete and dump trucks	1,687	0	0	0	1,751	1,717
Onsite equipment	2,388,996	135	990	18	2,722,909	2,704,633
Painting	0	0	0	0	0	0
TOTAL	**2,390,683**	**135**	**990**	**18**	**2,724,660**	**2,706,349**

3.3.4 Construction mitigation measures

The following mitigation measures should be considered for the construction phase:

- Use well-maintained equipment to reduce air pollution;
- Limit idling;
- Limit construction activities during very warm and dry conditions when practical, and use water to control and limit dust;
- Employ use best available technology on all engines and emission sources; and
- Use “Low VOC” paint on structures to reduce VOC emissions.

4.0 RESULTS AND ASSESSMENT CRITERIA

An air quality assessment was completed for Columbia Containers in advance of a proposed upgrade of the facility to a tandem rail line and upgraded grain storage and handling facilities. The assessment includes development of an emissions inventory of both exhaust emissions as well as fugitive dust emissions for the baseline year (2013) and the future year of 2017 when the replacement facility would be fully implemented. Following PMV Preliminary Air Quality Requirements, the assessment considered:

- CAC emissions for the 2013 baseline and 2017 operations under maximum capacity; and
- GHG emissions, as indicated by CO_2e, including the indirect emissions associated with electricity use.

A review of available ambient monitoring data in the general area was also completed as part of the study. The ambient air quality data are compliant with all relevant regional, provincial and federal standards and objectives. The 2013 annual mean $PM_{2.5}$ level at one monitoring station was above the BC planning goal (6 µg/m^3). Planning goals are not objectives so this is not considered problematic. However, as a result, $PM_{2.5}$ was considered a priority contaminant for this assessment. Other contaminants of interest include DPM and ozone pre-cursors such as NO_X and VOCs, due to their inclusion in the relevant management plans of MV, BC and Canada.

Table 4-1 provides a summary of the emission estimates, including the difference in emissions from the 2013 baseline and the 2017 scenarios. Without the proposed Project, the projected 2017 emission estimates for all CACs and GHGs are expected to increase due to increased throughput at the facility, as a result of increased global demand for grain. However, with the proposed Project, all CAC and GHG emissions are expected to decrease relative to the scenario without the proposed Project, due to technological and efficiency improvements. In particular, the improved fugitive dust control system installed as part of the proposed Project is expected to reduce $PM_{2.5}$ (a key CAC of interest) below the 2013 baseline level.

Table 4-1: Summary of baseline (2013) and future (2017) scenario emissions (kg).

Scenario	VOC	CO	NO_x	SO_x	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3	CO_2e
1. 2013 baseline	232	924	2,504	6	37,927	13,139	2,292	87	11	549,784
2. 2017 without Project	314	1,249	3,382	8	51,238	17,751	3,749	118	15	742,744
3. 2017 with Project	248	1,075	2,532	6	12,897	4,697	1,103	92	11	596,251
% change between 1 and 2	**35%**	**35%**	**35%**	**35%**	**35%**	**35%**	**64%**	**35%**	**35%**	**35%**
% change between 1 and 3	**7%**	**16%**	**1%**	**0%**	**-66%**	**-64%**	**-52%**	**5%**	**1%**	**8%**
% change between 2 and 3	**-21%**	**-14%**	**-25%**	**-26%**	**-75%**	**-74%**	**-71%**	**-22%**	**-25%**	**-20%**

Emission intensity levels for both CACs and GHGs are expected to decrease by 2017 with the proposed Project. Table 4-2 and 4-3 shows the operational emission intensities.

Table 4-2: Operational CAC emission intensity estimates in the Columbia LSA/RSA (grams / tonne).

Scenario	VOC	CO	NO_x	SO_x	TSP	PM_{10}	$PM_{2.5}$	DPM	NH_3
2013 baseline	0.42	1.67	4.51	0.01	68.32	23.67	4.13	0.16	0.02
2017 without Project	0.42	1.67	4.51	0.01	68.32	23.67	5.00	0.16	0.02
2017 with Project	0.33	1.43	3.38	0.01	17.20	6.26	1.47	0.12	0.01
% change without Project	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**21%**	**0%**	**0%**
% change with Project	**-21%**	**-14%**	**-25%**	**-26%**	**-75%**	**-74%**	**-64%**	**-22%**	**-25%**

Table 4-3: Operational GHG emission intensity estimates in the Columbia LSA/RSA (grams / tonne).

Scenario	CO_2	CH_4	N_2O	BC	CO_2e - 20yr	CO_2e - 100yr
2013 baseline	882.83	0.06	0.34	0.00	990.06	990.33
2017 without Project	882.83	0.06	0.34	0.00	990.06	990.33
2017 with Project	710.06	0.05	0.27	0.00	795.14	795.00
% change without Project	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
% change with Project	**-20%**	**-16%**	**-21%**	**-19%**	**-20%**	**-20%**

APPENDIX A

Columbia Containers 2011 air quality report

SNC•LAVALIN Environment

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MEMORANDUM

TO:	Susan Ewing (Hemmera)	**Date:**	September 22, 2011
C.C.:	Cory Wellicome (Columbia); Randy Ferrario (Columbia); Bryan McEwen (SLE)		
FROM:	John Lindner (SLE)	**Ref.:**	507540
Subject:	Baseline Air Quality Assessment for Phase I Terminal Dock expansion of Columbia Containers (Columbia)		

This report summarizes the baseline air quality assessment conducted by SNC-Lavalin Inc., Environment Division (SLE) under contract from Hemmera Envirochem Inc. (Hemmera) on behalf of Columbia Containers (Columbia). The assessment was conducted as part of Port Metro Vancouver's (PMV's) environmental assessment for the Terminal Dock Expansion project commencing at Columbia in late 2011. The air quality assessment included several elements: summary of ambient air quality, an emission inventory and dustfall monitoring.

PROJECT OVERVIEW

Columbia Containers is a grain trans-loading facility located at 2775 Commissioner Street on the PMV South Shore Properties in Vancouver, BC. Grain arrives at the facility primarily by railcar, gets loaded into containers and is then trucked driven off site for eventual shipment overseas. The East Vancouver Ports Lands (EVPL) are immediately south of the Columbia facility (see Figure 1 later in memorandum).

The Terminal Dock Expansion project involves consolidating Columbia's existing facility with the Terminal Dock Lands site (vacated by Marco Marine in January 2011) to the west at 2695 Commissioner Street[1]. Phase I of the project (the focus of this report) covers several components:

- levelling of grade for the western portion of Columbia Container's current lease (the west yard);
- adding rail tracks at the site by extending the rail line from the existing lease across the west yard; and
- relocating the existing Commissioner Street rail crossing to the west.

This assessment focuses on the potential air quality impacts of construction by drawing on the following information:

1. ambient air quality monitoring in the area;
2. an emission inventory (EI) developed to provide Criteria Air Contaminant (CAC) and Greenhouse Gas (GHG) emission estimates for the baseline, construction and future operations stages; and
3. dustfall monitoring undertaken specifically for this assessment.

[1] Hemmera Envirochem Inc., "Draft Project Description for CEAA Process, Columbia Containers Terminal Dock Expansion Project". File 1165-002.1, June 2011.

EXISTING AMBIENT AIR QUALITY

Metro Vancouver (MV) operates numerous long-term air quality monitoring stations across the region; the two continuous monitoring sites nearest to the Columbia Containers facility are Burnaby North (just west of Confederation Park) and Second Narrows (on the north shore of the Ironworkers Memorial Bridge). The contaminants measured at each station are as follows:

- Burnaby North: Sulphur dioxide (SO_2) and total reduced sulphur (TRS); and
- Second Narrows: Nitrogen dioxide (NO_2,), carbon monoxide (CO), SO_2 and fine particulate matter ($PM_{2.5}$).

Air quality objectives and standards are set by provincial, federal and regional authorities. The relevant criteria are listed in Table 1.

TABLE 1: Relevant Canadian, British Columbia and Metro Vancouver Ambient Air Quality Objectives and Standards (in µg/m^3)

Pollutant and Averaging Period	BC Objectives			National Objectives			Canada-wide Standards	Metro Vancouver Objectives
	Level A	Level B	Level C	Maximum Desirable	Maximum Acceptable	Maximum Tolerable		
CO								
1-hr max	14,300	28,000	35,000	15,000	35,000	-	-	30,000
8-hr max	5,500	11,000	14,300	6,000	15,000	20,000	-	10,000
NO_2								
1-hr max	-	-	-	-	400	1,000	-	200
24-hr max	-	-	-	-	200	300	-	-
Annual mean	-	-	-	60	100	-	-	40
$PM_{2.5}$								
24-hr mean	<--------------25*--------------->			-	-	-	30**	25
Annual mean	<---------------8----------------->			-	-	-	-	12
Annual mean	<--------------6***-------------->			-	-	-	-	-
SO_2								
1-hr max	450	900	-	450	900	900-1300	-	450
3-hr max	-	-	-	-	375	665	-	-
24-hr max	150	300	800	160	260	360	-	125
Annual mean	30	60	-	25	50	80	-	30
TRS								
1-hr max	-	-	-	7	28	-	-	-
24-hr max	-	-	-	3	6	-	-	-

* Value at annual 98th percentile.
** Value at 98th percentile of 24-hour, averaged over 3 consecutive years.
*** Planning goal.

TABLE 2: Local Ambient Air Quality Monitoring Data for 2010 (in µg/m^3)

Contaminant	Averaging Period	Burnaby North Concentration	Second Narrows Concentration	Most Stringent Criteria
CO	1-hr max	-	1,019	14,300
	8-hr max	-	618	5,500
NO_2	1-hr max	-	118	200
	24-hr max	-	61	200
	Annual mean	-	26	40
$PM_{2.5}$	24-hr, 98th percentile	-	14	25
	Annual mean	-	4	6
SO_2	1-hr max	132	129	450
	3-hr max	85	90	375
	24-hr max	33	34	125
	Annual mean	8	6	25
TRS	1-hr max	2	-	7
	24-hr max	0.4	-	3

Table 2 lists the contaminant concentrations from the Burnaby North and Second Narrows stations in 2010. The data capture rate for all readings was above 95% except for the $PM_{2.5}$ readings at Second Narrows, which was only 87%. As can be seen in Table 2, no values exceeded even the most stringent air quality criteria during 2010.

EMISSION INVENTORY

Introduction

The EI provides a baseline of the emissions associated with normal operation at Columbia as well as characterizes the additional emissions generated by Phase I construction. The following air contaminants are included in the inventory:

- Criteria Air Contaminants (CACs):
  - Ammonia (NH_3);
  - Carbon monoxide (CO);
  - Nitrogen oxides (NO_x);
  - Particulate matter at diameters below 10 micrometres (PM_{10});
  - Particulate matter at diameters below 2.5 micrometres ($PM_{2.5}$);
  - Sulphur dioxide (SO_2); and
  - Volatile organic compounds (VOCs).

- Greenhouse Gases (GHGs):
  - Carbon dioxide (CO_2);
  - Methane (CH_4); and
  - Nitrous oxide (N_2O).

The emission inventory was compiled using an activity-based approach with the following general equation:

$$E = A \; x \; EF$$

Where:

E = Emissions of contaminant (in kg);

A = Activity (in hours used, kilometres driven or litres of fuel consumed); and

EF = Emission factor (in kg per unit activity).

Only those activities associated with the facility operations were included (i.e., employee commuting is ignored). The boundary for the EI is the PMV South Shore Property. Emissions will be reported on a monthly basis, which was deemed appropriate because Phase I construction is anticipated to take months not years.

The majority of the activity data used for this assessment was collected as part of the PMV 2010 Landside Emission Inventory (LEI) conducted by SLE under contract from the port authority. Columbia Containers provided permission to use this data as part of the Terminal Docks Expansion project. Furthermore, Columbia indicated that the 2010 activity is representative of activities at Columbia in 2011. Supplemental activity data was provided by Cory Wellicome (Plant Manager, Columbia) and Bruce Larson (Project Manager for the Terminal Docks Expansion project, Ausenco Sandwell).

Scenarios

Three scenarios have been included in the EI: baseline, construction and future operations. The baseline sources included in the EI were:

1. Fugitive grain dust (from handling);
2. Fugitive road dust;
3. Cargo-handling equipment (CACs and GHGs);
4. Highway trucks (CACs and GHGs); and
5. Rail (CACs and GHGs).

During Phase I construction, additional emissions from equipment and fugitive dust were generated and are also modelled here.

Electrical sources are not included in any of the scenarios since the associated emissions are not local to the site and are expected to be insignificant in terms of GHG emissions due to the low carbon intensive electricity in BC. Office heating by propane was not included because only 600 L of propane were consumed in 2010 and this was considered insignificant relative to the other sources.

Methodology

The emission factors were primarily sourced from models developed by the US Environmental Protection Agency (EPA), supported by relevant Canadian agencies for use in Canada. Each model is described in more detail below, along with their respective source group. A summary of the baseline and construction phase emissions is provided after a discussion of each source group.

When running the models, BC-specific fuel characteristics were applied, following the federal sulphur level regulations[2] and the recent BC renewable and low carbon fuels legislation[3]. For modelled hydrocarbons (THCs) a conversion factor was applied to generate VOC estimates from the EPA report "Conversion Factors for Hydrocarbon Emission Components"[4].

Cargo-handling equipment

Twelve different pieces of fuel-burning cargo-handling equipment (CHE) are currently in use at the Columbia site. Each piece of equipment generates different proportions of CACs and GHGs depending on their operating characteristics, which are listed in Table 3 below.

TABLE 3: Cargo-handling Equipment in use at Columbia Containers

Equipment Type	Model Year	Number of Units	Fuel Type	Engine Size (hp)	Annual Hours of Use
Top Pick	2005	1	Diesel	330	2000
Top Pick	2006	1	Diesel	215	1000
Top Pick	1988	1	Diesel	215	500
Tractor	2001	1	Diesel	475	2000
Tractor	2002	1	Diesel	475	2000
Forklift	2008	1	Propane	60	520
Forklift	1976	1	Propane	60	250
Skid steer loader	2005	1	Diesel	74.9	75
Pressure washer	2006	3	Gasoline	5	50
Aerial lift	1999	1	Propane	50	75

2 http://canadagazette.gc.ca/archives/p2/2002/2002-07-31/pdf/g2-13616.pdf#page=4 and http://canadagazette.gc.ca/archives/p2/1999/1999-06-23/pdf/g2-13313.pdf#page=7
3 http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/1231636805
4 EPA, "Conversion Factors for Hydrocarbon Emission Components", File 420r05015, December 2005.

The emission factors for CHE were extracted from the EPA NONROAD model (2008 version). NONROAD predicts emissions and fuel consumption for all non-road equipment categories with the exception of commercial marine, locomotive and aircraft. Therefore the model encompasses all CHE categories used at North American ports. The model handles all commonly-used fuels, including gasoline, diesel, compressed natural gas, and propane. The NONROAD model was run using default settings with the BC-specific fuel properties, as noted above. The emission factors extracted from NONROAD used for each piece of equipment are given in Table 4.

TABLE 4: NONROAD Emission Factors for Cargo-handling Equipment at Columbia Containers (in g/hp-hr)

Equipment Type	Model Year	THC	CO	NO_x	CO_2	SO_2	PM	NH_3
Top pick	2005	0.3	0.8	5.6	530	0.005	0.22	0.009
Top pick	2006	0.3	0.9	4.3	530	0.005	0.21	0.009
Top pick	1988	0.7	3.2	8.6	529	0.005	0.50	0.009
Tractor	2001	0.7	2.0	6.2	624	0.006	0.52	0.010
Tractor	2002	0.7	2.0	6.2	624	0.006	0.51	0.010
Forklift	1994	2.7	55.3	12.3	681	0.013	0.06	0.017
Forklift	2008	0.1	4.4	0.9	551	0.011	0.05	0.014
Skid steer loader	2005	0.6	4.1	5.2	694	0.006	0.79	0.011
Pressure washer	2006	57.5	805.2	4.2	1100	0.020	0.45	0.022
Aerial lift	1999	2.7	55.3	12.3	681	0.013	0.06	0.017

NONROAD does not support emission factors for CH_4 and N_20. Instead, fuel-based emission factors from the BC GHG Reporting Manual[5] were employed. These emission factors are given for different fuels in Table 5.

TABLE 5: Fuel-based Emission Factors for Different Fuel Types (in kg/L)

Fuel Type	CH_4	N_2O
Diesel	0.0001	0.0004
Propane	0.0000	0.0001
Gasoline	0.2571	0.0001

Highway Trucks

The highway truck activities were previously characterized in the LEI project. According to the LEI activity questionnaire, 14,696 gate counts[6] were recorded at the facility in 2010. Each truck spent an estimated 6 minutes idling and another 1 minute driving. In addition to the on-site activity, the trucks drive between Columbia and major container terminals such as Centerm and Vanterm. The distance between Columbia and Centerm, approximately 3.5 km, was taken as the average distance driven by highway trucks for each trip. Furthermore, the average speed of the highway trucks was set at 20 mph (32 km/h).

[5] http://www.env.gov.bc.ca/cas/mitigation/ggrcta/pdf/Final-Essential-Requirements-of-Mandatory-Reporting--Dec-17-2010.pdf

[6] One gate count equals a truck entering then leaving the facility.

Highway truck emissions were calculated using the EPA MOBILE model (version 6.2.3C), which is an on-road emission factor estimation model. It was originally developed by the EPA and was then modified by Environment Canada to incorporate Canadian fleet testing data. The model produces g/mi emission factors of VOC, CO, NO_x, PM, and CO_2 from cars, trucks, and motorcycles under various conditions.

Previous studies demonstrated that the slow speed emission estimates generated by MOBILE were too low. As such, SLE replaced the idle emission rates derived from MOBILE with data from the Coordinating Research Council (CRC) E-55/59 report[7]. The CRC emissions databank has improved the understanding of heavy-duty vehicle emissions by performing measurements on 75 heavy-duty trucks in California.

The emission factors for a heavy-duty diesel tractor/trailer (MOBILE class HDDV8b) are listed in Table 6 (transit emission factors from MOBILE and idle emission factors from CRC data).

TABLE 6: MOBILE and CRC Emission Factors for Class HDDV8b Tractor/Trailer

Vehicle Mode	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O
Drive (g/mi)	3.0	28.9	3.6	0.02	0.06	0.05	0.05	1,321	0.09	0.07
Idle (g/hr)	3.91	37.89	4.68	0.03	0.07	0.06	0.06	1,735	0.12	0.09

Rail

The majority of grain arrives at Columbia by railcar, with switching provided by Canadian Pacific (CP). A single rail track crosses Commissioner Street and can store 8 railcars. Columbia unloads up to 24 cars in a day so CP delivers and removes cars two to three times a day. A winch cable haul system is used to shift the railcars on site.

As part of Phase I, a new longer rail track capable of storing 24 railcars will be constructed on the Terminal Docks Lands and the west yard. With the new rail track, Columbia will purchase a railcar pusher or a modified front-end loader for on-site railcar movement. However, no decisions on model or type have yet been made so it has been assumed that the pusher is a 2010 diesel front-end loader with a 300-hp Tier 3 engine.

Based on information provided by Columbia and Ausenco, switching takes approximately 25 minutes per day with the current rail line but will require only half as much time with the new rail line. Columbia estimated that the new pusher will move cars for approximately two hours per day.

The emission factor for the front end loader was extracted from the EPA NONROAD model, as per CHE. For the switch engine, SLE sourced emission factors from the 1998 EPA Locomotive Regulatory Support Document[8]. The time in notch information is from the 2008 Locomotive Emissions Monitoring (LEM) Program conducted by the Rail Association of Canada (RAC)[9]. No information was available on the CP switch engine model in use so the conservative assumption of a pre-Tier EMD SP/40 locomotive was applied. Emission factors for a pre-Tier EMD SP/40 in each notch are shown in Table 7 as well as aggregate emission factors based on RAC's switch duty cycle.

7 Coordinating Research Council, "Heavy-Duty Vehicle Chassis Dynamometer Testing for Emissions Inventory, Air Quality Modeling, Source Apportionment and Air Toxics Emissions Inventory", File: E-55/59. August 2007.
8 EPA, "Locomotive Emission Standards, Regulatory Support Document", Appendix B, April 1998.
9 http://www.railcan.ca/assets/images/emissions/2010_06_03_LEM2008_en.pdf

TABLE 7: Rail Emission Factors for Pre-Tier EMD SP/40 (in g/hr)

Notch	Time in Notch	THC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O
DB	2.4%	295	660	4,134	0.10	66	64	19	157,378	9	65
Idle	77.6%	185	564	1,635	0.03	40	39	7	55,220	3	23
N1	4.3%	156	267	2,807	0.05	30	29	10	88,353	5	37
N2	4.4%	201	292	6,040	0.15	110	107	27	230,545	13	95
N3	2.8%	247	329	10,180	0.25	188	182	45	379,640	21	157
N4	2.2%	321	434	15,407	0.37	214	208	66	557,725	31	230
N5	1.4%	424	760	20,892	0.50	279	271	91	767,562	43	317
N6	1.1%	611	1,912	25,564	0.67	452	438	121	1,021,576	58	422
N7	0.6%	878	5,029	31,187	0.90	538	522	162	1,372,225	77	567
N8	3.2%	1,169	5,907	36,929	1.07	695	674	192	1,624,858	92	671
Aggregate		235	748	4,321	0.10	83	80	20	165,683	9	68

Fugitive Grain Dust

During grain handling, fugitive dust is released into the air. The activity measure is the 262,733 tonnes of grain handled by Columbia in 2010. All grain was shipped out (in containers) by truck but only 6% arrived by truck; the majority arrives by rail.

The grain handling emission factors were sourced from AP-42: Compilation of Air Pollutant Emission Factors. AP-42 is an online resource, published and updated regularly by the EPA since 1972, where field test measurements are used to generate representative industry emission factors. It is the primary compilation of the EPA's emission factor information and covers datasets from over 200 separate industries. Table 8 lists the PM emission factors for uncontrolled grain dust from AP-42[10].

TABLE 8: AP-42 Emission Factors for Uncontrolled Fugitive Grain Dust (in g/t handled)

Emission Source	PM_{10}	$PM_{2.5}$
Grain receiving – hopper truck	3.9	0.65
Grain receiving – railcar	3.9	0.65
Grain handling	17	2.9
Grain shipping – truck	14.5	2.45

The Columbia facility employs a grain control system to capture most of the fugitive dust. Grain is offloaded from the railcar, pulled up to the top of the elevator and then loaded by spout into containers. There are three pickup points at Columbia: one at the leg (bottom) of the elevator, one at the top of the elevator and one at the spout. Columbia indicated that at least 90% of the grain is captured at the pickup points. This is likely a conservative estimate since grain capture systems generally perform at

[10] http://www.epa.gov/ttn/chief/ap42/ch09/final/c9s0909-1.pdf

95-97% efficiency[11]. However, at the time of writing, this was the best estimate available so it was assumed that 10% of fugitive grain dust is released to air from the capture system.

Fugitive Dust from Roads

There are two entrances to the Columbia site: the west and east gates. Between the west gate and the paved container yard is the west yard containing an unpaved section of road approximately 130m long (see red line in Figure 1).

Figure 1: Air photograph of Columbia Containers property. The red line denotes the location of the unpaved road section on the west yard; the pin points denote the locations of the two dust fall monitors. [Source: Bing Maps and MapPoint Web Service. Copyright 2010 Microsoft Corporation.]

This gravel road will be graded and paved during Phase I of the Terminal Dock Lands expansion. Until then, when a vehicle drives over this surface, the force of the wheels liberates surface material

11 http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf

and some of this particulate becomes airborne. AP-42 provides an equation for the generation of fugitive dust from unpaved industrial roads[12]:

$$EF = k\left(\frac{s}{12}\right)^{0.9}\left(\frac{W}{3}\right)^{0.45}$$

Where:

EF = Emission factor (in pounds per vehicle mile travelled);

s = Surface material silt content (%);

W = Mean vehicle weight (in tons); and

k = Constant (for PM_{10}, k = 1.5; for $PM_{2.5}$, k = 0.15).

As can be seen, the emission factors are sensitive to the input parameters in the equation. Silt content can vary by several orders of magnitude; since no silt content data is currently available for the west yard the median EPA value of 11.7% was used. The mean vehicle weight was set at 30 tons, the gross vehicle weight of a heavy-duty tractor/trailer (MOBILE class HDDV8b). Using these values in the equation yields an emission factor of 1164 grams per vehicle kilometre travelled for PM_{10} and 116.4 for $PM_{2.5}$.

According to Columbia, only five owner-operated tractors drive on the west yard to access the site. Together these five tractors account for approximately 25% of the tractor/trailers coming through the site. Given the 2010 gate counts of 14,696 reported above, this corresponds to approximately 28.3 traverses per day on the unpaved road.

On days with more than 0.254mm of rain, no fugitive dust is generated. Assuming 260 annual operating days (i.e., five days a week) and 161 days of rain per year in Vancouver[13], the monthly PM_{10} dust generated from the road was estimated at 50.8 kg.

During Phase I construction, it is assumed that all tractor/trailers will enter and exit through the east gate and that the west yard will only be driven on by the construction equipment. Furthermore, after the west yard has been paved it is assumed that the fugitive road dust emissions will be zero.

Construction-related Emissions

In-filling and grading of the west yard is a major component of Phase I of the Terminal Docks Expansion project. It is important to the validity of the EI to characterize the impact of this additional activity. Ausenco Sandwell estimated that construction would last approximately three months; SLE assumed 10-hour work days and 22 work days per month. All equipment units were assumed to be five years old and running continuously during the work hours.

[12] http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf
[13] http://www.climate.weatheroffice.gc.ca/climate_normals/index_e.html

Estimates of the equipment to be used during construction were provided by Ausenco Sandwell and are summarized in Table 9. The single tractor/trailer represents the dump trucks bringing gravel and asphalt (300 loads and 40 loads, respectively) to and from the construction site. Emission factors for the construction equipment were sourced from the EPA NONROAD and MOBILE models, as described in the previous sections.

TABLE 9: Equipment Used during Phase I Construction

Equipment Type	Number of Units	Engine Size (hp)	Total Hours of Use
Track-mounted backhoe	2	200	660
Grader	1	200	660
Large compactor	1	200	660
Small compactor	1	120	660
Tractor-trailer	1	120	660

Fugitive dust emissions are also generated during construction and vary with the size of the land being disturbed (in this case, the extended west yard), the quantity of infill and the duration on activity. The construction emission factors employed are from the Western Regional Air Partnership (WRAP) 2006 Fugitive Dust Handbook[14]. The WRAP handbook is a set of data and tools used to calculate the fugitive dust emissions associated with a variety of agricultural and industrial sectors. The construction-related emissions are more current in the handbook than those included in AP-42.

The two PM_{10} emission factors sourced from the handbook were:

- 0.011 ton/acre-month (for general construction activities); and
- 0.059 ton per 1000 cubic yards (for on-site fill).

According to Hemmera, the area to be filled is 5,227 m^2. Ausenco indicated that approximately 6,300 m^3 of fill (mostly gravel) would be deposited on the west yard. As before, natural mitigation by rain will reduce the amount of fugitive dust released into the air.

Emission Inventory Results

The results of the emission inventory are presented in Table 10 for baseline, construction and future operations stages.

The primary source of air contaminants at the Columbia facility is the CHE used on site. Fugitive dust from grain and the unpaved road are higher sources of contaminants, but only for suspended matter. During construction, the emissions of all contaminants except methane are expected to increase by 80% or more because of the additional activity. Following construction, the emissions will largely return to the same levels, except for particulate matter, which will drop significantly because the west yard is now paved. The rail source emissions will increase slightly because of the new activity and emissions from the railcar pusher.

[14] http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf

TABLE 10: Estimated Monthly Emissions (in kg)

Emission source	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O
Baseline										
Grain dust	-	-	-	-	77.5	13.1	-	-	-	-
Road dust	-	-	-	-	51.8	5.2	-	-	-	-
Operations equipment	44	201	419	0.4	26.0	25.3	0.7	40,373	9.5	5.8
Trucking	10	93	12	0.1	0.2	0.2	0.1	4,270	0.3	0.2
Rail	2	7	40	0.0	0.8	0.7	0.2	1,519	0.1	0.6
MONTHLY TOTAL	**56**	**301**	**470**	**0.4**	**156.3**	**44.5**	**1.0**	**46,162**	**9.9**	**6.6**
Construction										
Grain dust	-	-	-	-	77.5	13.1	-	-	-	-
Road dust	-	-	-	-	51.8	5.2	-	-	-	-
Operations equipment	44	201	419	0.4	26.0	25.3	0.7	40,373	9.5	5.8
Trucking	10	93	12	0.1	0.2	0.2	0.1	4,270	0.3	0.2
Rail	2	7	40	0.0	0.8	0.7	0.2	1,519	0.1	0.2
Construction equipment	59	335	510	0.7	37.5	36.4	1.0	70,703	3.5	10.3
Construction dust	-	-	-	-	89.4	-	-	-	-	-
MONTHLY TOTAL	**115.4**	**635.9**	**979.8**	**1.1**	**283.2**	**80.9**	**2.0**	**116,865**	**13.4**	**16.5**
% DIFF. FROM BASELINE	**105%**	**111%**	**108%**	**153%**	**81%**	**82%**	**106%**	**153%**	**35%**	**150%**
Future Operations										
Grain dust	-	-	-	-	77.5	13.1	-	-	-	-
Operations equipment	44	201	419	0.4	26.0	25.3	0.7	40,373	9.5	5.8
Trucking	10	93	12	0.1	0.2	0.2	0.1	4,270	0.3	0.2
Rail	3	12	40	0.0	1.8	1.7	0.2	4,935	0.2	0.7
MONTHLY TOTAL	**57**	**306**	**471**	**0.5**	**105.5**	**40.3**	**1.0**	**49,579**	**10.0**	**6.7**
% DIFF. FROM BASELINE	**1%**	**2%**	**0%**	**8%**	**-33%**	**-9%**	**-2%**	**7%**	**2%**	**1%**

TABLE 11: Total Annual Emissions from Port Metro Vancouver 2005 Inventory, Metro Vancouver 2005 Inventory and 2010 Columbia Containers Baseline Inventory (in tonnes)

Emission Inventory	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O
MV 2005	54,325	321,526	44,156	5,381	7,757	4,699	963	6,691,995	1,494	918
PMV 2005	80.8	891	872.2	27.4	43.8	42.1	1.2	69,113	5.7	10.2
Columbia 2010 baseline	0.7	3.6	5.6	0.01	1.9	0.5	0.01	553	0.12	0.08

For comparison, Table 11 lists the results from the Metro Vancouver 2005 Emission Inventory[15] and Port Metro Vancouver 2005 Landside Emission Inventory for the port facilities along the Burrard Inlet and Roberts Bank[16]. As can be seen the baseline Columbia emissions (scaled by twelve for an annual measure) are approximately 1.2% of the PMV emissions and 0.01% of the MV emissions.

DUSTFALL MONITORING PROGRAM

As indicated at the beginning of the report, monitoring dustfall that may be generated during Phase I construction is a component of this assessment. SLE initiated a dustfall monitoring program at the Columbia facility in July 2011. Since Phase I construction has not yet started, the dustfall values presented here provide baseline dustfall conditions.

FIGURE 2: Dustfall monitor at Location A.

[15] http://www.metrovancouver.org/about/publications/Publications/2005_LFV_Emissions.pdf
[16] http://www.portmetrovancouver.com/Libraries/ENVIRONMENT/38146_Port_EI_Final_Report_26Aug09.sflb.ashx

Dustfall monitors were set up at two sites on the Columbia property: Location A on the eastern edge and Location B on the western edge (see Figure 1). For reference, Figure 2 shows the dustfall monitor at Location A. These locations were selected because previous studies in the area indicated that the prevailing wind patterns are primarily from the east with some westerlies.

The results of the monitoring program were compared to the dustfall standard applicable in the province, the 1977 British Columbia Dustfall Pollution Control Objectives (PCOs):

- For residential areas, 15 tons of dustfall per square mile per month (52.2 mg per square centimetre per month); and
- In other areas, 25 tons of dustfall per square mile per month (87.6 mg per square centimetre per month).

Two periods of monitoring have been completed as of September 2011, one in July and one in August. Each period lasted a minimum of two weeks. For each sample, a plastic container was filled with approximately 500 mL of 0.1% ammonium chloride (to prevent algae growth) and then placed in the stand. The containers were checked on by Columbia staff and/or SLE at least once a week. After two weeks, the containers were collected, sealed and sent to Maxxam Analytics in Burnaby (Maxxam) for analysis. Values were returned as total dustfall in milligrams per litre. Table 12 summarizes the results from the baseline monitoring.

TABLE 12: Summary of Baseline Dustfall Monitoring at Columbia Containers

Sample ID	Start Date	Start Time	End Date	End Time	Dustfall (mg/cm^2/month)
Blank	July 7/11	2:30pm	July 7/11	2:30pm	null*
A1	July 7/11	2:15pm	July 25/11	11:00am	0.55
B1	July 12/11	4:30pm	July 25/11	11:15am	0.87
A2	August 16/11	11:45am	Aug 31/11	11:30am	0.58
B2	August 16/11	11:45am	Aug 31/11	11:30am	0.58

* Below detectable limits.

To ensure consistent results, a single batch of ammonium chloride solution was prepared and then used for every sample. A 500 mL sample not exposed to dust was sent to Maxxam at the beginning of the monitoring program and yielded a reading below detectable limits (listed as “Blank” in Table 1).

As can be seen in the table, all the baseline dustfall readings were well below the PCO value of 52.2 milligrams per square centimetre per month. The average reading was 0.65 milligrams per square centimetre per month. Monitoring will continue during and after the Phase I construction to ensure a complete characterization of the airborne dust on site. During the sampling periods only two days of rain were recorded so the baseline results are considered to be conservative when compared to damper months.

CONCLUSION

Available ambient air quality monitoring around the Columbia site indicates that the relevant air quality objectives and standards were met in 2010. The results of the emission inventory indicate that emissions will effectively double during construction but that this increase is small compared to the emissions from other regional sources.

Baseline dustfall monitoring indicates that current dustfall levels are well below acceptable limits. This is in agreement with the fact there have been no dust complaints associated with Columbia's activities in the past. Baseline monitoring is complete; further monitoring will be undertaken when the Phase I construction commences again. Mitigation measures shall be provided by SLE should monitored exceedances occur.

APPENDIX B

PEIT User Guide

Transport Canada Transports Canada

TP 15192E

TRANSPORT CANADA
PORT EMISSIONS INVENTORY TOOL (PEIT) USER GUIDE
VERSION 3.1

Prepared For:

Transport Canada

March 31, 2014

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Canada

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Table 1: Index of Acronyms

CACs	common air contaminants
CH_4	methane
CNG	Compressed Natural Gas
CO	carbon monoxide
CO_2	carbon dioxide
DPM	diesel particulate matter
CO_2e	carbon dioxide equivalent
EF	emission factor
EI	Emissions Inventory
EPA	US Environmental Protection Agency
E&W	SNC-Lavalin Inc., Environment & Water
GHG	greenhouse gases
GWP	Global Warming Potential
HC	hydrocarbons
HFO	Heavy Fuel Oil, also called residual oil
hp	horsepower
IMO	International Maritime Organization
INNAV	Information System on Marine Navigation (Canadian Coast Guard)
IPCC	Intergovernmental Panel on Climate Change
kW	kilowatt
MDO	marine diesel oil, also called marine distillate
N_2O	dinitrogen monoxide, also referred to as nitrous oxide
NO_x	oxides of nitrogen
PM	suspended particulate matter
PM_{10}, $PM_{2.5}$	suspended particulate matter of diameter 10 (2.5) microns or less
ppm	parts per million (used to identify sulphur level in diesel fuel)
Protocol	Transport Canada Port Emissions Inventory Protocol
RAC	Railway Association of Canada
SO_2	sulfur dioxide
SO_x	oxides of sulfur
TEU	twenty foot equivalent unit
tonne	Metric tonne = 1,000 kg

1. INTRODUCTION

This User Guide is designed to provide instructions on the use of the Transport Canada Ports Emissions Inventory Tool (PEIT) developed by SNC-Lavalin Inc., Environment & Water (E&W). The tool was developed for Transport Canada during 2009 and updated in 2012 and 2013. The initial version of the User Guide included instruction on its application, whereas the recent update includes information on emission rates and use of defaults. The changes made in 2013 were in support of an emissions assessment for all 18 of Canada's official ports, for the 2010 calendar year, for the eastern ports[1] and the western ports[2]. The theoretical basis for PEIT is the Transport Canada Port Emissions Inventory Protocol (Protocol), which defines the sources, activities, boundaries and calculation methods. While the User Guide now provides information on the emission sources and calculations (Chapter 4), it primarily focuses on activity data sources, how to enter the data into the PEIT questionnaire and default fields that should be used if port data are not available. The Protocol can be consulted for further information on emissions data.

PEIT requires information on five distinct source groups:

- Marine Vessels – commercial Marine Vessels (CMVs) and harbour craft (tugs, ferries)
- Cargo Handling Equipment (CHE)
- Rail – port based locomotives and those from a national or regional rail line
- Onroad Vehicles – highway trucks (and other vehicles) and facility-operated vehicles
- Admin – administrative sources, including buildings and compound lighting

The five emission source groups constitute almost all of the total emissions that could be attributed to a port. Emissions include all common air contaminants (CACs), Greenhouse Gases (GHGs) and select air toxics. CACs include all 'criteria air contaminants' which is the preferred term in the US. In most cases, the majority of emissions are generated by port tenants and not the port directly. For this reason, a port requires the co-operation of its tenants to collect the necessary data required for PEIT.

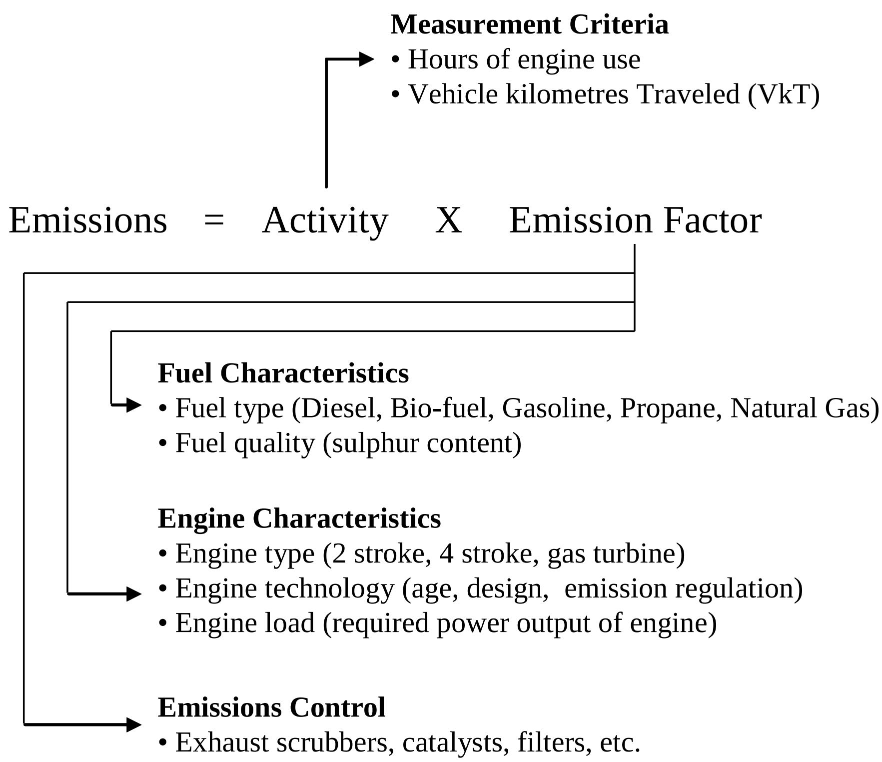
A port emission inventory (EI) traditionally has focused on engine emissions from mobile sources. However, PEIT now accounts for direct emissions from stationary sources (e.g., space heating, boilers, and generators) and indirect emissions from purchased electricity. Fugitive hydrocarbon emissions from ship fuels transport and loading/unloading are also now included. These sources may be considered optional for a port EI.

[1] E&W, 2013. East Coast/Great Lakes Ports 2010 Emissions Inventory Study (DRAFT). Prepared for Transport Canada, contract no. T8125-110138/002/XSB. June 6, 2013

[2] E&W, 2013. West Coast Ports 2010 Emissions Inventory Study (DRAFT). Prepared for Transport Canada, contract no. T8125-101004/001/XSB. July 24, 2013

Emissions are calculated in PEIT from the generalized equation shown in Figure 1. The tool requires 'Activity' data and contains all 'Emission Factors' necessary to support the EI calculations. Depending on the source, PEIT also requires identification of fuel and engine characteristics and emissions control technology (if an engine retrofit was completed).

Figure 1 – General Form of Emission Calculation



PEIT also requires commodity data – amount of goods loaded or unloaded – to spatially allocate emissions and to support EI forecasts. Temporal information is additionally required to establish emission summaries by hour of day and day of week. The temporal information is optional and is used by the tool to allow determination of relative emission levels by hour of day and day of week. In many cases, temporal information is simply work shift schedules; this establishes the times of day and days of week when emissions would be minimal (or zero).

A graphical representation of PEIT is provided in Figure 2. The PEIT questionnaire form (lower left of Figure 2) has specific MS Excel data tables for each of the five source groups identified. Although PEIT is representative of current best practices for port EI development, the EI quality will ultimately depend on the quality of activity data that are entered to the questionnaire tables. For example, errors or omissions in ship berthing records will result in inaccurate emission estimates from the tool. A port representative should complete a number of logical checks to ensure that the activity data summaries (such as number of ship movements or number of rail movements) are accurate for the port as a whole.

The tool user interface is built upon an MS Access database, which provides the supporting structure for the three main functions of PEIT. These functions are:

1) Import questionnaire activity information for a port or individual marine terminal/facility, perform quality checks on required data fields and expected value ranges.
2) Perform emission calculations based upon the activity data entered on the questionnaire sheets.
3) Report and aggregate the emissions to the following resolution:
    a) Inventory Boundary, Source Group, Equipment Type, Activity Type, Commodity Group, Fuel Type and Air Contaminant.
    b) Annual Total Emissions.

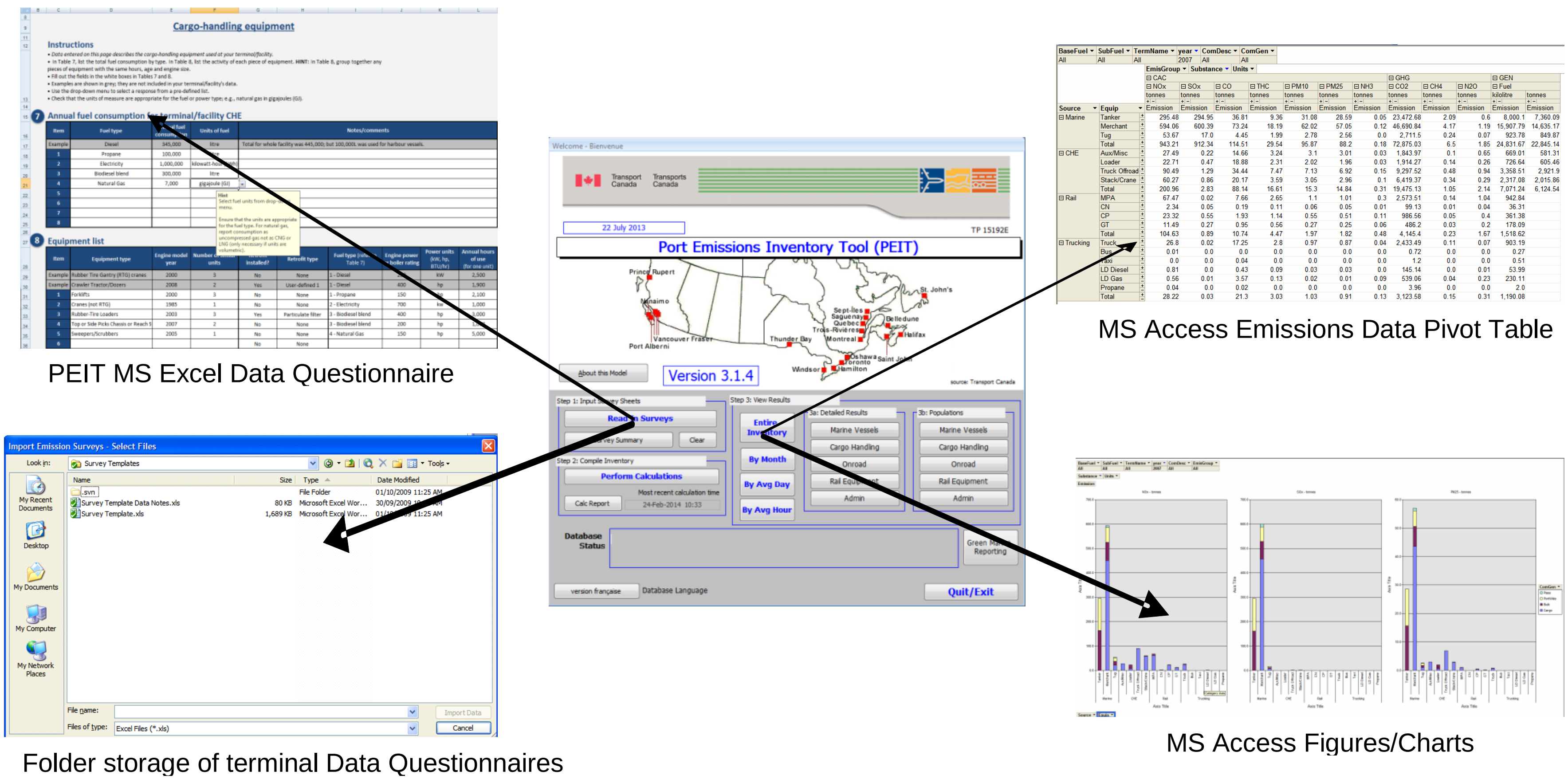
PEIT is fully operational within Access 2007 and 2010 (both runtime and full versions). The runtime version of Access 2007 can be downloaded from Microsoft's website. Another requirement to use PEIT is Microsoft Excel version 2003 or newer.

In most cases, a port will require each of its tenants to complete one PEIT questionnaire. Once all tenant questionnaires are imported to the database (potentially with additional information for the port itself) and quality checks have been successful, the port EI will be generated. The questionnaire data tables are described in detail in Chapter 3.

A brief description of the PEIT error checking process is provided in Chapter 5. Once a port authority receives a completed questionnaire from one of its tenants, the database should immediately be used to complete its internal data quality control. This process marks problematic fields (and missing entries) that must be addressed before any emission calculations. The tenant's marked up questionnaire (if errors are present) can then be sent back to the tenant for timely feedback.

In most if not all cases, an EI report should be prepared by the port or the port's contractor to accompany the PEIT emission summaries, to describe some of the important inventory decisions and assumptions that were made. References to such an EI report are made in Chapter 3, when describing the required data fields.

Figure 2 – Schematic of Port Emission Inventory Tool



1.1. Inventory Year and Forecasts

The current version of PEIT supports port EI generation for the 2010, 2011, 2012 and 2013[3] calendar years. To begin the port EI process, a port representative must first decide which inventory year will be used, and communicate this to its tenants before any data collection activities commence. The activity data collected, including identification of equipment fleets, must relate to the inventory year chosen.

A port may decide to complete an EI forecast. Although PEIT can be used to facilitate generation of EI forecasts, generation of EI forecasts was not a primary design consideration. This is because there is no commonly accepted method for achieving detailed port EI forecasts and the potential methods for completing a port (or terminal) forecast require assumptions that can dramatically influence the future estimates. However, there are some common features that were used to generate the Port Metro Vancouver and Port of Montreal EI forecasts[4]. A summary of port EI forecast issues is provided here:

- A simplistic forecast can be generated by linearly scaling the EI estimates (allocated by commodity type) by expected changes to throughput values (tonnage of goods for bulk goods and TEUs for containers) to reflect the expected future port activity. All emission estimates in the tool are linked to commodity levels and therefore a quick, simple forecast can be achieved this way. This type of forecast does not include the effects of fleet replacement and lower engine emission rates for some of the air contaminants. As such, the EI forecast should be labelled appropriately, if used.
- A more detailed, and representative forecast can be achieved by linearly scaling the EI activity estimates (such as hours of engine use or kms of travel) by expected changes to commodity throughput values and re-establishing the equipment populations by age, based on expected fleet turnover for ships, locomotives, trucks and CHE. This can be completed by 1) projecting the current age distribution of engines into the future, keeping the same relative ages, or 2) entering specific engine details based on a careful consideration of what equipment is expected to be purchased and when (e.g., if a new terminal is expected to come on line in a future year).

3 An Emission Control Area (ECA) was established for the east and west coasts of North America in late 2013, which limits the sulphur content of marine fuels allowed in North American waters. PEIT assumes the (higher) average fuel sulphur contents from earlier analysis work for all years 2010 – 2013. Therefore PEIT may over-estimate the marine SO_x and PM emissions for the last few months of the 2013 year.

4 The Port Metro Vancouver report is available at http://www.portmetrovancouver.com/environment/initiatives/air.aspx and provides further details on forecasting methods.

Detailed forecasts that account for expected changes to equipment fleets (including ships) were completed for Port Metro Vancouver and the Port of Montreal. In each case, a unique approach was used to establish the expected equipment fleets in the future. These steps require a considerable level of attention and experience and should likely be left to a qualified expert to complete.

1.2. Green Marine Reporting Requirements

Green Marine is a voluntary environmental program developed by the marine industry. Green Marine currently addresses six environmental issues, including air contaminant emissions and GHG emissions. PEIT facilitates completion of the Green Marine requirements for recognition of effective air quality and GHG management at the port or terminal level. In order to achieve level 3 on the air emissions performance indicator, a port must complete an inventory of air emissions and GHG emissions[5]. An individual marine terminal can also achieve the same level with use of PEIT. The inclusion of electricity consumption for the Green Marine Admin group is optional[6].

[5] See the Green Marine website at http://www.green-marine.org
[6] Based on information provided by D. Bolduc of the St. Lawrence Economic Development Council (SODES).

2. EI SCOPE

2.1. Air Contaminants

PEIT develops summaries of common air contaminants (CACs) and greenhouse gases (GHGs), including:

- CACs – NO_x, VOC, CO, SO_x, PM_{10}, $PM_{2.5}$
- GHGs – CO_2, CH_4, N_2O

Equivalent carbon dioxide (CO_2e) emissions are estimated in the tool, based on the Intergovernmental Panel on Climate Change (IPCC) global warming potential (GWP) values as reported in the Second Assessment Report[7], as follows:

- CO_2 – 1
- CH_4 – 21
- N_2O – 310

The tool can additionally address air toxics. At this time, the following air toxics are supported: 2,2,4-trimethylpentane, acenaphthene, acenaphthylene, acetaldehyde, acrolein, ammonia, anthracene, arsenic (and related compounds), benz(*a*)anthracene, benzene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g*,*h*,*i*)perylene, benzo(*k*)fluoranthene, chromium (Cr^{3+} and Cr^{6+}), chrysene,, ethyl Benzene, fluoranthene, fluorene, formaldehyde, hexane, indeno(1,2,3,*c*,*d*)pyrene, lead, manganese, mercury (divalent gaseous, elemental gaseous, particulate), naphthalene, nickel, phenanthrene, pyrene, styrene, toluene, and the xylenes.

Additional allocation of PM to elemental carbon, organic carbon and sulphates is supported.

2.2. EI Boundaries

Figure 3 provides a representation of the port emission sources and where they are situated in relation to defined EI boundaries. PEIT refers to two boundaries:

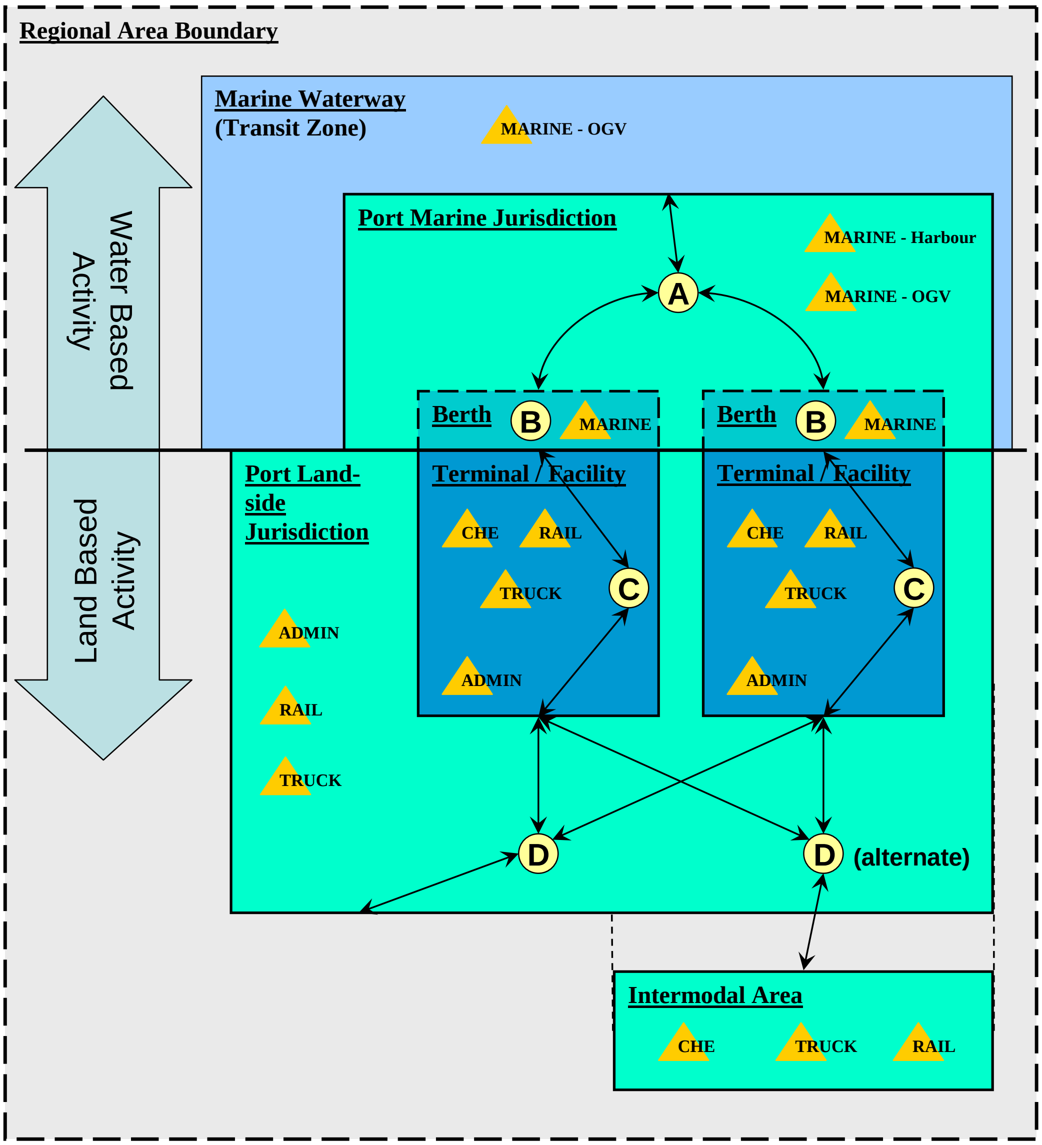
a) Terminal/Facility Boundary – a port terminal or facility property that is directly managed by a port or port tenant. This boundary is usually defined by clear features, including the facility gate. Any marine berths that are part of the terminal/facility are included.

---

[7] GWP values are based on a 100 year time horizon. See the IPCC second assessment report at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

b) Port Boundary – all land side and water side areas managed by the port where port related marine, CHE, rail or truck activity may occur. This boundary includes the port marine jurisdiction and all port landside property, some of which may be privately held.

Figure 3 – Port EI Boundary Schematic



Four Activity Zones are used in PEIT to define modes of activity for the data questionnaire form. As shown in Figure 3, the expected activity in these zones can be identified as follows:

- A: Marine transit, anchor and manoeuvring within the port marine jurisdiction.
- B: Marine berthing while at a terminal/facility.
- C: CHE, Rail and Truck activity on the terminal/facility grounds.
- D: Rail and Truck activity that occurs off of terminal/facility grounds, but within the port land-side jurisdiction. A port may utilize an off-site intermodal facility (e.g., container handling facility) and in that case Activity Zone D would include Rail and Truck activity from the terminal/facility boundary to the furthest extent of the Intermodal Area, even if the affected area includes public or private property.

It is expected that port tenants (e.g., terminal operators) can identify their terminal/facility boundaries without difficulty. In most cases, the port boundaries on the water side and the land side for a particular port will need to be identified by the port authority and communicated to the port's tenants before the PEIT questionnaire can be completed.

2.3. Port Tenants Included in the EI

Historically, port EIs have included activities that are directly related to the marine transport of goods. This general framework can be used to determine which port tenants should be included in a port EI assessment to be consistent with assessments that have been done in North America during the last several years. In some cases, a port may have tenants that do not engage in commercial marine activities in any way and these tenants may be excluded from the EI process. The following criteria are suggested to establish port tenant participation in the EI process:

- Does the facility handle traditional port commodities (e.g., bulk goods, containers, general cargo and passengers)?
- Does the facility provide service to the port or its tenants?

If the answer to either of the questions presented above is 'yes', then the facility should likely be included in the port EI.

3. DATA QUESTIONNAIRE FORMS

PEIT imports port and terminal data by way of MS Excel questionnaire worksheets. Each of the PEIT Questionnaire worksheets is structured with the colour coding shown in Figure 4. Fields highlighted in grey are example values. Yellow is used to identify missing or problematic fields that must be addressed before PEIT will complete emissions calculations. This colour will only appear after the questionnaire form has been input to the database (see Chapter 4). Following this step, the user can find the problematic cells, read the associated comments and make adjustments accordingly.

In two cases (for Onroad Vehicles and Rail) values in grey are also used for defaults if data are not available. This is further identified in the Onroad Vehicle and Rail descriptions that follow.

Figure 4 – Colour Coding Scheme in Questionnaire Forms

LEGEND:		**Example or Default Value**
		Missing/Check Entry (see cell comment)

3.1. Basic Terminal Information ('Introduction' Worksheet)

The first Questionnaire worksheet, 'Introduction', contains basic information about the inventory. Most of the required fields can be filled in by the port authority before the questionnaires are sent to the tenants. An important field that must be entered identically for each tenant is the 'Inventory Year'.

It is important to note that one field is hidden in the table. The field 'Terminal Unique KEY' on row 19 is hidden from the tenant since it is used by the port (or contractor) for identification of the tenant information in the PEIT outputs. Any label can be used for this field and a port may use its own classification scheme so that tenant activity and emissions in the output pivot tables cannot easily be traced to the operator (e.g., if the tool were to be shared with outside groups). Each Terminal key must be unique and not match any other questionnaire being entered otherwise the older data will be automatically replaced. This feature is included in the tool for the purposes of tenant confidentiality, which may or may not be important in the port EI analysis.

The Terminal Unique KEY field can be filled in before or after the tenant completes the questionnaire. To expose this field, the user must first unlock the worksheet ('Unprotect Sheet' function in Excel) and unhide row 19. Once this field is entered, the row should be hidden and the worksheet protected again. The Excel password for all worksheets is 'sncPort'.

All other fields are self-explanatory.

3.2. Terminal/Facility Operations Data

Questionnaire Table 1 (Figure 5) is used to enter terminal/facility operations data in the 'Terminal' worksheet for the inventory year. The fields for annual commodity throughput and units of measure are required, but only for those commodities handled at the terminal/facility.

Figure 5 – Questionnaire Table 1

Item	Commodity type	Annual throughput	Units of measure	Notes / comments
Example	Bulk Solid - Fish	120,000	tonne	30,000t mackerel, 90,000t salmon
1				
2				
3				
4				
5				
6				

3.3. Administrative Activities

Terminal/Facility (or port) administrative energy consumption is entered in the 'Admin' worksheet, to **Questionnaire Table 2** (Figure 6)**.** Consumption data are entered for any fuel source, allocated to 'Boiler', General admin electricity' and 'Generator' (for the infrequent cases where a terminal may generate electricity before it is consumed).

Figure 6 – Questionnaire Table 2

Item	Fuel type	Energy / equipment type	Total annual consumption	Units of fuel	Description of energy usage
Example	Electricity	Electric grid	125,000	kilowatt-hour (kWh)	80% building usage, 20% compound lighting
Example	Natural Gas	Boiler	40,000	gigajoule (GJ)	Total of 2,000,000 GJ. Only 2% used for admin, rest for process.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

3.4. Marine

3.4.1. Maritime 1 (Harbour Vessels)

Harbour Vessels are distinguished from Ocean Going Vessels (OGVs) as vessels that are operated by a local company (which could be the port). In most cases, this source group will include tugboats that are used to assist OGVs in manoeuvring activities but may also include ferry services, pilot boats and even commercial tour operators. Total annual fuel consumption must be available for each vessel group that is entered. If a vessel group has a portion of its operations that extend outside of the Port Boundary (in most cases, the Port Marine Jurisdiction) an estimate must be made for the fuel consumed within the Port Boundary. If such an estimate is necessary, any assumptions should be expressed clearly in the EI report.

Questionnaire Table 3 (Figure 7) is used to enter annual fuel consumption data for Harbour Vessel groups. The required fields include identification of fuel type (drop list), annual fuel consumption and units for the fuel consumption (drop list). Sulphur level for all fuels is handled automatically in PEIT (see Appendix A). Each vessel group to be included in the *Maritime 1* category will have one (or more) annual fuel consumption entry.

Questionnaire Table 4 (Figure 7) is used to enter vessel annual activity information for each vessel. The 'Fuel type' field in **Questionnaire Table 4** is used to identify the particular fuel (which must be identified in Table 3) is used for the vessel. Each field in **Questionnaire Table 4** is described in Table 2 below.

Table 2: Field Definitions for Questionnaire Table 4

Vessel Name	Identify harbour vessel
Vessel Type	Identify vessel from drop list
Relative intensity of use	Amount of time the vessel is used relative to the other vessels in the group (low, high etc)
Installed rated engine power - Main engine	Vessel main engine power rating (total power if more than 1 propulsion engine)
Installed rated engine power - Aux engine	Vessel auxiliary engine power rating (total power if more than 1 auxiliary engine)
Installed rated engine power - Power units	Units used for the power rating values (kW, hp)
Engine type and age - Main engine	Vessel main engine type and main engine age (choose from drop list)
Engine type and age – Auxiliary engine	Vessel auxiliary engine type and auxiliary engine age (choose from drop list)
Fuel type	Identification of fuel type, from those described in Table 3 (choose from drop list)

Figure 7 – Questionnaire Tables 3 and 4

Fuel consumption of marine harbour vessels by group

Item	Fuel type	Annual fuel consumption	Units of fuel
Example	Marine diesel oil (MDO)	100,000	litre
1			
2			
3			
4			
5			
6			

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Notes / comments:

Individual activity information of each marine harbour vessel

Item	Vessel name	Vessel type	Relative intensity of use	Installed rated engine power			Engine type and age		Fuel type (refer to Table 3)
				Main engine	Auxiliary engine	Power units	Main engine	Auxiliary engine	
Example	Coastal Jumper	Barge	1 - Low	1,000		kW	4-stroke, pre 2000	No aux engine	1 - Marine diesel oil (MDO)
Example	Titanic 2	Tug boat / Boom boat	4 - Medium/high	200	30	hp	2-stroke, post 2000	2-stroke, post 2000	1 - Marine diesel oil (MDO)
1									
2									
3									
4									
5									
6									

3.4.2. Maritime 2 (Ocean Going Vessel) Activity

Questionnaire Tables 5 and 6 (Figure 8) are used to capture the necessary data to estimate OGV emissions in Activity Zones A and B.

Questionnaire Table 5 (Figure 8) has three required fields to set port-wide parameters. The first two fields provide distance (nautical miles) and speed (knots) values for each vessel that arrives to berth. This sets the time required for each vessel to traverse the harbour area. It is suggested that these values be determined by the port authority and potentially be pre-entered for a tenant questionnaire. The third field represents total electrical consumption over the year for shoreside power provision ('cold ironing' for ships). At this time, most terminals will not have shoreside power available and this field would remain blank.

Figure 8 – Questionnaire Tables 5 and 6

Port marine characteristics

Distance from terminal to port marine jurisdiction boundary		nautical miles
Average vessel speed while in port marine jurisdiction		knots
Total electric power consumption for shore power (ships at berth)		megawatt-hours (MWh)

Vessel calls to port

Port Call	Vessel information				Vessel Activity				Commodity data			Notes/comments
	IMO Ship Number (Lloyd's ID)	Vessel name (OPTIONAL)	Vessel type (OPTIONAL)	Deadweight tonnage (OPTIONAL)	Arrival date (yyyy-mm-dd)	Time at berth (hours)	Total time at anchor (OPTIONAL, hours)	Shore power used?	Commodity type (OPTIONAL)	Amount transferred (OPTIONAL)	Units of measure (OPTIONAL)	
Example	7052363				2008-03-01	15.5	0.0	Yes	Autos	9,456	units	Loading 9,456 autos.
Example		Southern Intrepid	Merchant-Container	100,000	2008-04-31	47.3	85.5	No	Grain, special crop	15,262	tonne	Unloading grain
1								No				
2								No				
3								No				
4								No				
5								No				
6								No				
7								No				
8								No				

Questionnaire Table 6 (Figure 8) has a number of required and optional fields. For the great majority of vessels that visit a port, the vessel can be identified by its IMO Number. PEIT has a lookup table to select vessel characteristics (e.g., engine power rating) from the IMO number. If the IMO number for a particular vessel cannot be identified, the Vessel name, Vessel type and deadweight tonnage (DWT) fields must be entered. These fields are described in Table 3.

Table 3: Field Definitions for Questionnaire Table 6

IMO Number	Vessel identification, available from port records
Vessel name	Optional – must be entered if the IMO number is not available
Vessel type	Optional – must be entered if the IMO number is not available. Choose the vessel INNAV type, (available from port records drop list)
DWT	Optional – must be entered if the IMO number is not available. Vessel DWT is available from port records
Arrival date	Vessel arrival date to port
Time at berth	Total time spent at berth (hours)
Total time at anchor	Total time spent by the vessel anchoring within the Port Boundary (optional and does not have to be used). Leave blank if no anchoring occurs
Shore power used?	If shore power was used for the vessel, choose 'yes'. This links with the total electric power consumption value in Table 5
Commodity type	Optional – may be entered, data permitting
Amount transferred	Optional, may be entered, data permitting
Units of measure	Optional, but required if commodity data is entered.

Based on previous port assessments, service/drydock calls do not have associated emissions; therefore these calls should be removed from the ship call record before entry to **Questionnaire Table 6**. In past Canadian port assessments, Service/drydock periods have mistakenly been associated with ongoing vessel emissions. Given that a vessel drydock stay may continue for several weeks or more, it is very important that these activities are identified properly in the data.

3.5. Cargo Handling (CHE)

Questionnaire Tables 7 and 8 in the 'CHE' worksheet are used for entering activity data for cargo handling equipment (CHE).

Annual fuel consumption for each of the fuels used by CHE on the terminal/facility is entered in **Questionnaire Table 7** (Figure 9). These fields are required and therefore if direct fuel purchase data are not available, estimates must be completed (and these should be described in the EI report). Estimates can include surrogate methods such as throughput or a combination of total hours and average engine size.

Questionnaire Table 8 (Figure 9) is used to identify each piece of CHE used at the terminal/facility. Each unique piece of equipment must be identified separately; if several pieces of the same CHE exist (same equipment type, model year, fuel type, etc) then the 'Number of similar units' field can be used to indicate more than one identical CHE. Otherwise, this field will always be equal to one. Field definitions for **Questionnaire Table 8** are provided in Table 4.

Table 4: Field Definitions for Questionnaire Table 8

Equipment Type	Equipment identification, from drop list
Engine model year	Engine year, may or may not be the same as chassis year
Number of similar units	Number of identical units. All other fields in row must apply to each unit, including Annual Hours of Use (for one unit).
Retrofit installed?	yes or no
Retrofit type	Identify from drop list (if retrofits apply). This field will not be used in most cases
Fuel type	Type of fuel consumed in equipment, chosen from the entries to Table 7
Engine power or boiler rating	Engine power rating (no units) or boiler power rating (no units)
Power units	Units used for Engine Power or Boiler Rating entry, choose from drop list
Annual hours of use (one unit)	Number of hours CHE was used for the year (if more than 1 identical unit, this per-unit value must apply to all. Do not sum total hours for all pieces

In some cases, 'Annual hours of use' may be difficult to accurately determine. However, this value must be entered to Table 8. When the questionnaire is entered to the tool, a comparison of total estimated CHE fuel consumption (based on reported hours in **Questionnaire Table 8**) to total annual fuel consumption (from **Questionnaire Table 7**) is made. This is a first level quality check that may indicate the Annual Hours of Use fields should be reconsidered by the terminal/facility operator. Subsequent PEIT runs can be used to complete the quality check again (as described in greater detail in Chapter 4).

Figure 9 – Questionnaire Tables 7 and 8

Annual fuel consumption for terminal/facility CHE

Item	Fuel type	Annual fuel consumption	Units of fuel	Notes/comments
Example	Diesel	345,000	litre	Total for whole facility was 445,000; but 100,000L was used for harbour vessels.
1				
2				
3				
4				
5				
6				
7				
8				

(The example entry shown in grey is only for dem

Equipment list

Item	Equipment type	Engine model year	Number of similar units	Retrofit installed?	Retrofit type	Fuel type (refer to Table 7)	Engine power or boiler rating	Power units (kW, hp, BTU/hr)	Annual hours of use (for one unit)	Notes/comments
Example	Rubber Tire Gantry (RTG) cranes	2000	3	No	None	1 - Diesel	250	kW	2,500	
Example	Crawler Tractor/Dozers	2008	2	Yes	User-defined 1	1 - Diesel	400	hp	1,900	Retrofit is a Douglas 99203 DOC.
1				No	None					
2				No	None					
3				No	None					
4				No	None					
5				No	None					

3.6. Onroad Vehicle

Questionnaire Tables 9, 10 and 11 (Figure 10) are used to enter Onroad Vehicle activity information. The source group Onroad Vehicle is dominated by heavy duty (diesel) truck activity, but may also include smaller trucks, buses and even cars. A new entry is required for each unique route of travel through the port land-side jurisdiction (even if the same vehicle group is used).

Questionnaire Table 9 (Figure 10) is used to enter required information for 'Highway Vehicles' that are not owned or managed by the terminal/facility. These are vehicles that are involved in the transfer of goods or people to and from the terminal/facility. Since the vehicles are operated by a different contractor, no fuel consumption information is expected. Identification of vehicles, number of annual trips and vehicle activity per trip (distance, time) are entered to this table. Field definitions for **Questionnaire Table 9** are provided in Table 5 below.

Table 5: Field Definitions for Questionnaire Table 9

Vehicle Type	Type of vehicle that serves the terminal/facility. Choose from drop list
Annual Gate Count	Number of round-trip visits to the terminal/facility
Average time spent on terminal/facility grounds	Amount of time (min) on average that each vehicle spends on terminal/facility grounds during each trip for loading or unloading
Average time driving on terminal/facility grounds	Amount of time (min) on average that each vehicle spends driving on terminal/facility grounds
Average time idling on terminal/facility grounds	Amount of time (min) on average that each vehicle spends idling on terminal/facility grounds (e.g., at an entrance gate or loading/unloading)
Vehicle age profile	Optional entry, only can be used if information is entered to Questionnaire Table 12. Otherwise, enter "Average / not known"
Distance from terminal to port entry/intermodal point	Optional, only used if the Port Boundary extends beyond the Terminal/Facility Boundary
Distance from terminal to port exit/intermodal point	Optional, only used if the Port Boundary extends beyond the Terminal/Facility Boundary
Average time idling on port grounds	Optional, only used if the Port Boundary extends beyond the Terminal/Facility Boundary
Average speed driven on port grounds	Optional, only used if the Port Boundary extends beyond the Terminal/Facility Boundary

Figure 10 – Questionnaire Tables 9, 10 and 11

Highway vehicles (not operated by terminal/facility)

Item	Vehicle type	Annual gate counts	Zone C			Vehicle age profile (OPTIONAL, refer to Table 12)	Zone D (OPTIONAL)				Notes / comments
			Average time spent on terminal/facility grounds (min)	Average time driving on terminal/facility grounds (min)	Average time idling on terminal/facility grounds (min)		Distance from terminal to port entry/intermodal point (km)	Distance from terminal to port exit/intermodal point (km)	Average time idling on port grounds (min)	Average speed driven on port grounds (km/h)	
Example	Heavy Commercial Truck	2,500	15	2	3	Average / not known	10	15	10	35	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Terminal/facility vehicle fuel consumption

Item	Fuel type	Annual fuel consumption	Units of fuel
Example	Gasoline	10,000	litre
1			
2			
3			
4			
5			
6			
7			
8			

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Notes / comments

List of terminal / facility vehicles

Item	Vehicle type	Fleet age	Number of similar vehicles	Relative intensity of use	Fuel type (refer to Table 10)
Example	Van / Pickup - small utility	2005 - 2009	5	3 - Medium (average)	1 - Gasoline
1					
2					
3					
4					
5					
6					
7					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Gate Count data for **Questionnaire Table 9** should be based on terminal/facility records. If such records do not exist, the EI report should clearly document any assumptions made (e.g., one truck trip for each 50 tonnes of commodity moved, etc.).

In many cases, a terminal/facility operator should choose 'Average / not known' for the 'Vehicle age profile' choices from the drop menu. Especially for container terminals, trucking companies serving the terminal likely comprise a large fleet that can be difficult to characterize without a detailed investigation. The default distribution is defined (in grey entries) in **Questionnaire Table 12** and represents the tool default for heavy duty tractor trailer trucks in the US EPA MOVES model; percent of total activity attributable to each model year (which includes truck population by year as well as relative intensity of use). Age '0' is equal to the inventory year. This default distribution is shown in **Questionnaire Table 12** as an example; if a different 'Vehicle type' is chosen PEIT will automatically identify the appropriate MOVES age distribution once the 'Average / not known' entry is chosen in the 'Vehicle age profile' column.

If fleet data are available, a 25-year age distribution (percent of total trips attributable to each model age) must be entered in **Questionnaire Table 12** before it can be chosen for the 'Vehicle age profile' field in **Questionnaire Table 9. Questionnaire Tables 10 and 11** (Figure 10) are used to enter activity information on terminal/facility owned or leased vehicles. **Questionnaire Table 10** is used for annual fuel consumption, which must be entered, even if an estimate is necessary. **Questionnaire Table 11** is used to identify the vehicle type, general age range and number of vehicles for each vehicle group. The 'Relative intensity of use' and 'Fuel type' fields are used to allocate the amount of fuel that is consumed by each group (if there is more than 1 group that uses a particular fuel type noted in **Questionnaire Table 10**).

3.7. Rail

Rail activity information is entered to **Questionnaire Table 13** for train movements by the national and regional rail lines and **Questionnaire Table 14** for port or terminal owned or leased locomotives (Figure 11). **Questionnaire Table 15** (Figure 11) is used for optional information, only if specific data exist for locomotive models used at the port. In most cases, a terminal/facility will not have specific data unless it owns or leases one or more locomotive. Custom locomotive duty cycles are developed from assessment of locomotive event recorder data.

Field definitions for **Questionnaire Table 13** are provided in Table 6.

Table 6: Field Definitions for Questionnaire Table 13

Rail line service provider	Choose from drop list for type of operator
Duty cycle	Choose from drop list. In some cases 'Average / not known' will be chosen, unless information is available (and entered in Table 15)
Annual train visits to terminal	Number of trains arriving to the terminal/facility in the year
Average number of locomotives per Train	Number of locomotives for each train on average. A non-integer number (e.g., 1.5) can be used if necessary
Average time spent on terminal grounds	Amount of time (in hours) each train spends on terminal/facility grounds each visit on average. A non-integer number (e.g., '0.7') can be used
Average time spent on port grounds each visit	Optional - amount of time each train spends on port grounds each visit on average. A non-integer number (e.g., '0.7') can be used

The 'Average movement details per visit' fields in **Questionnaire Table 13** include the average amount of time each train or locomotive spends on terminal/facility grounds and, potentially, on port grounds. A terminal/facility operator may have to consult with the port authority to determine the average amount of time each train spends on port grounds before and after arriving to the terminal/facility gate. Should trains service more than 1 terminal/facility during visits, attention will be required to ensure double counting does not occur for the 'Average time spent on port grounds' column. This is an important data quality check the port authority should make. In general, the port authority should always carefully check this field for its tenant questionnaire submissions.

Field definitions for **Questionnaire Table 14** are provided in Table 7.

Table 7: Field Definitions for Questionnaire Table 14

Ownership	Choose from drop list for type of ownership
Model	Locomotive model used by the operator. Choose from drop list. A general type can be chosen in the locomotive is leased from a provider (e.g., 'CN/CP Switch' is an average for switch locomotives in Canada)
Duty cycle	Choose from drop list. In some cases 'Average / not known' will be chosen, unless information is available (and entered in Table 15). The average switch duty cycle is shown in grey in the Questionnaire Table 15
Engine year	Choose from drop list. This field is used to identify age of locomotive if possible
Fuel Type	Choose from drop list
Annual fuel consumption	Data or an estimate is required
Units of fuel	Choose from drop list

Figure 11 – Questionnaire Tables 13, 14 and 15

National/regional rail on terminal/facility grounds

Item	Rail line service provider	Duty Cycle	Annual train visits to terminal/facility	Average movement details per visit			Notes/comments	
				Average number of locomotives per train	Average time spent on terminal/facility grounds (hours)	Average time spent on port grounds		
Example	Regional line	Average / not known	100	1	0.25	0.5	Ontario Southern Rail	*(The exampl*
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Facility locomotives

Item	Locomotive details				Fuel details			Notes/comments
	Ownership	Model	Duty cycle	Engine year	Fuel Type	Annual fuel consumption	Units of fuel	
Example	Terminal owned or leased	MP15DC	Average / not known	2002 and older	Diesel	11,000	litre	Leased from Falcon Rail.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Custom locomotive duty cycle (OPTIONAL)

Notch	Duty cycle (percent time in notch)			
	National average for switch locomotives	User-defined A	User-defined B	User-defined C
Idle	84.90%			
N1	5.40%			
N2	4.20%			
N3	2.20%			
N4	1.40%			
N5	0.60%			
N6	0.30%			
N7	0.20%			
N8	0.60%			
Dynamic braking	0.20%			
Total check	100%	0%	0%	0%

Notes / comments

4. EMISSION CALCULATIONS

This chapter is included to the User's Guide to identify the methods used in PEIT to achieve the emission estimates. This information is not required to effectively use PEIT, although it should be considered if a port has a previous emissions assessment and wishes to understand how the methods used in the past assessment may differ from those used in PEIT. The tool utilizes current best-practices and the most recent emissions data available. The reader may wish to consult additional literature that is referenced, such as formal emissions models that have been supported by the US EPA.

For combustion sources, calculations are identified for each of the formal emission source groups and sub-groups identified in the Protocol. These are:

- Marine
    - Harbour Vessels
    - Ocean Going Vessels (OGVs)
- CHE
- Onroad Vehicle
    - Highway Vehicles
    - Facility Vehicles
- Rail
    - National/Regional Rail
    - Facility Rail
- Admin

Use of the sub-groups for Marine, Onroad Vehicle and Rail are to distinguish the emission sources that are supported by annual fuel consumption data (operated by the port or a tenant) and those that are not.

PEIT automatically completes emission calculations based on the activity data entered on the questionnaires. The general form of the emission equations is provided here for each source group, with additional criteria of importance. In each case, the reader will be able to identify how the activity metrics entered into the questionnaire forms are used in the calculations.

4.1. GHG Emissions

All emissions associated with GHG (CO_2, CH_4 and N_2O) are reported using emission factors from the Environment Canada National Inventory Report (NIR) 2010. In particular, Tables A8-1, A8-2, A8-3 and A8-11 of the NIR were employed for any combustion source with available fuel consumption data.

Table 8 summarizes the GHG emission factors for diesel and gasoline, where the CH_4 and N_2O rates vary by equipment type and age. The renewable content of diesel and gasoline varies across the country and is summarized in PEIT table GEN_Link_Biofuel_RegionFactors.

Table 8: GHG Emission Factors for Diesel and Gasoline from NIR (g/L)

Fuel type	Source Group	Equipment Type	CO_2 (0% renewable)	CO_2 (100% renewable)	CH_4	N_2O
Diesel	Admin	All	2,663	2,449	0.150	1.100
	CHE	All	2,663	2,449	0.150	1.100
	Onroad	Passenger car, <2004	2,663	2,449	0.100	0.160
		Passenger car, 2004-2006	2,663	2,449	0.068	0.210
		Passenger car, >2006	2,663	2,449	0.051	0.220
		Passenger truck, <2004	2,663	2,449	0.068	0.160
		Passenger truck, 2004-2006	2,663	2,449	0.068	0.160
		Passenger truck, >2006	2,663	2,449	0.068	0.160
		Commercial trucks and buses, <2004	2,663	2,449	0.150	0.075
		Commercial trucks and buses, 2004-2006	2,663	2,449	0.140	0.082
		Commercial trucks and buses, >2006	2,663	2,449	0.120	0.082
	Rail	All	2,663	2,449	0.150	1.100
Gasoline	Admin	All	2,289	1,494	2.700	0.050
	CHE	All	2,289	1,494	2.700	0.050
	Onroad	Passenger car, <1996	2,289	1,494	0.320	0.660
		Passenger car, >1996	2,289	1,494	0.120	0.160
		Passenger truck <1996	2,289	1,494	0.210	0.660
		Passenger truck, >1996	2,289	1,494	0.130	0.250
		Commercial trucks and buses	2,289	1,494	0.490	0.084

The renewable CO_2 emission rates are used to determine a blended, effective rate for any fuels with bio content (e.g., biodiesel or ethanol). Table 9 summarizes the GHG emission factors for the other fuels used in PEIT. The emission rates for natural gas vary by province and that is captured in the table.

Table 9: GHG Emission Factors for Marine Fuels, Natural Gas and Propane from NIR (g/L)

Fuel type	Source Group	Region	CO_2	CH_4	N_2O
Heavy fuel oil	Marine	All	3,124	0.280	0.079
Marine distillate oil	Marine	All	2,725	0.260	0.073
Natural gas*	Admin	Alberta	1.92	0.000037	0.000035
		British Columbia	1.92	0.000037	0.000035
		Manitoba	1.88	0.000037	0.000035
		Northwest Territories	2.45	0.000037	0.000035
		Ontario	1.88	0.000037	0.000035
		Quebec	1.88	0.000037	0.000035
		Saskatchewan	1.82	0.000037	0.000035
		Rest of Canada	1.96	0.000037	0.000035
	CHE	All	1.89	0.009000	0.000060
	Marine	All	1.89	0.009000	0.000060
	Onroad	All	1.89	0.009000	0.000060
Propane	Admin	All	1,510	0.024	0.108
	CHE	All	1,510	0.640	0.028
	Onroad	All	1,510	0.640	0.028

* Natural gas rates are for standard temperature and pressure.

The emissions intensity values for electricity are established by province, based upon annual utility generation over a year. Tables A13-2 to A13-13 from the NIR[8] were employed for each of the provinces and territories. These values can be viewed in the PEIT data table GEN_Link_Egrid.

4.2. Marine Vessel Emissions

Marine Vessel emission estimates in PEIT leverage Canada's Marine Emissions Inventory Tool (MEIT), Version 4.0. MEIT is a database emissions tool that uses ship movement data (e.g., Coast Guard data) and previous ship survey data (for engine and fuel criteria) to develop emission estimates for ship engines and boilers within a defined geographical region. MEIT has been used to develop several

[8] http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

Canadian marine vessel emission inventories since 2005[9],[10]. The emission equations and data tables provided here were sourced from the Environment Canada 2010 National Marine Emissions Inventory[11].

Emission Calculation:

Engines: $E = P \times LF \times T \times EF_{energy}$ (1)

Boilers: $E = F \times T \times EF_{fuel}$ (2)

Where E = Emissions

F = Fuel consumption in tonnes/hour

P = Power Rating of Engine (Maximum Continuous Rating)

LF = Load Factor (fraction of rated power for an engine)

T = Time in mode

EF_{energy} = Emission Factors in g/kWh

EF_{fuel} = Emission Factors in kg/tonne

The total emissions for a marine vessel are the sum of emissions from engines (mains and auxilliaries) and boilers in each activity mode. Emission factors for engines (EF_{energy}) relate to engine type (2-stroke, 4-stroke) engine build year and fuel consumed on a vessel by vessel basis. These characteristics are automatically identified from internal data tables once the required ship information is entered onto the questionnaires. Boiler emission factors (EF_{fuel}) are more generic, but relate to the expected fuels consumed. The current set of PEIT engine and boiler fuel consumption and CAC emission factors is identified in Tables 10, 11 and 12. GHG emissions are calculated from the estimated fuel consumption and NIR rates, as previously identified.

Both SO_x and PM emissions are known to vary with fuel sulphur content. As such, MEIT has accounted for SO_x and PM emissions in a dynamic manner since V2.2. These equations are also used in PEIT. Each equation assumes a linear relationship with fuel sulphur content as follows:

SO_x:

Engines: EF (g/kWh) = 4.2(S) (3)

Boilers: EF (kg/tonne) = 20.0(S) (4)

PM:

[9] Levelton Consultants, Maritime Innovation and J. Corbett, 2006. Marine Emission Inventory Study: Eastern Canada and Great Lakes. Prepared for Transport Canada.

[10] Weir Marine Engineering, 2008. 2007 Marine Emissions Inventory and Forecast Study. Prepared for Transport Canada.

[11] E&W, 2012. 2010 National Marine Emissions Inventory for Canada. Final Report. Prepared for Environment Canada, November 5, 2012.

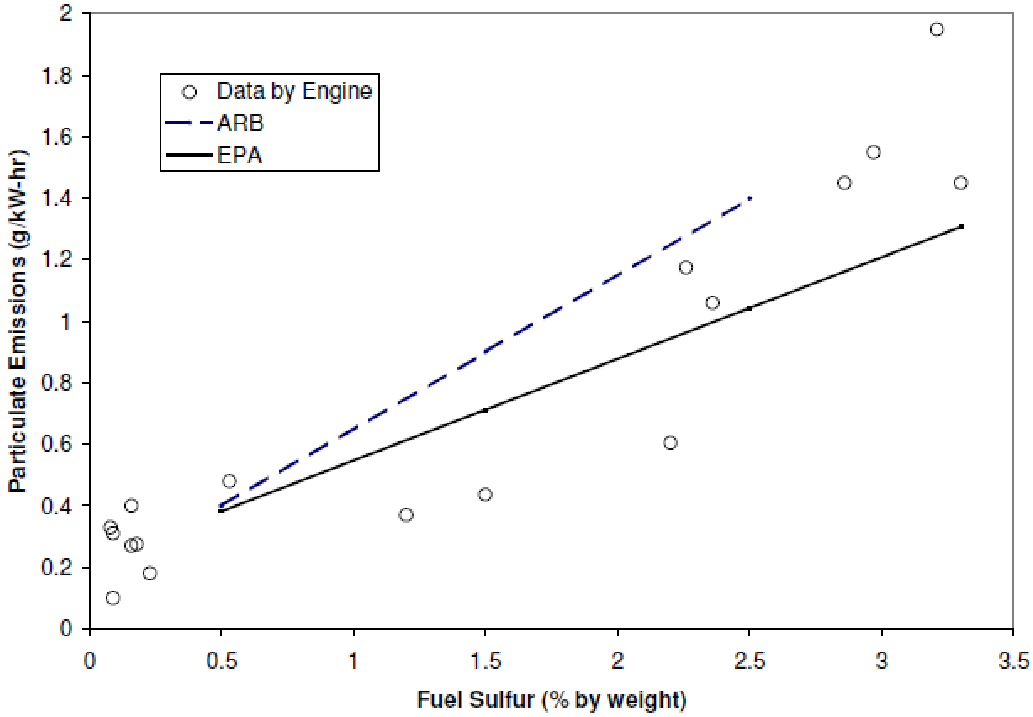
Engines: (g/kWh) = 0.4653(S) + 0.25 (5)

Boilers: (kg/tonne) = 1.17(S) + 0.41 (6)

where S = sulphur content of fuel in %.

Ratios of 0.96 and 0.92 are applied for PM_{10} to total PM and $PM_{2.5}$ to $PM_{10,}$ respectively. While the SO_x expressions are based on an assumption of total oxidation of the fuel sulphur to SO_2 in the atmosphere, the PM expressions are based on previous PM emissions tests at different sulphur levels. The boiler PM equation originates from the EPA[12] and the engine PM equation is a result of the California Air Resources Board (CARB) analysis of past emissions data as shown in Figure 12.

Figure 12 – Engine PM Emission Rates (g/kWh) by Fuel Sulphur Content*



* The CARB analysis ('ARB' in the figure above) is a re-analysis of the data, rejecting several data points that were included in the prior EPA regression analysis[13].

[12] EPA AP-42 Compilation of Emission Factors, Chapter 1. See http://www.epa.gov/ttnchie1/ap42/

[13] T. Sax and A. Alexis, California Air Resources Board, 2007. A Critical Review of Ocean-going Vessel Particular Matter Emission Factors. Available from arb.ca.gov

Table 10: Marine Engine Specific Fuel Oil Consumption (SFOC) in g/kWh by Engine Classification (kW) and Age (from IMO 2009)

Engine	Age of Build	SFOC (>15,500 kW)	SFOC (5,000 – 15,000 kW)	SFOC (<5,000 kW)
Main 2-stroke	1970-1983	205	205	205
	1984-2000	185	185	185
	2001-2007	175	175	175
	2008+	175	175	175
Main 4-stroke	1970-1983	215	225	225
	1984-2000	195	205	205
	2001-2007	185	195	195
	2008+	185	195	195
Auxiliary 4-stroke	1970-1983	220	220	220
	1984-2000	220	220	220
	2001-2007	220	220	220
	2008+	220	220	220

The fuel consumption rates shown in

Table 10 were developed by the International Marine Organization (IMO) in their most recent GHG emissions study[14]. Table 13: Current MEIT Low Load (main engine load 0.1) Scale Factors for All Emission Factors (unitless)

provides the current 'Low Load' scale factors that are used to adjust the base emission rates in Tables 11 and 12 for slow speed movements when the engine emissions on a g/kWh basis are expected to be higher.

Table 11: Current Activity Based Emission Factors (g/kWh) by Engine Classification*

Engine	Cat.	Fuel	NO_x (dom/int)	CO	HC	NH_3
Main 2-stroke	C3	HFO	17/18.1	1.4	0.6	0.021
		MDO	17	1.1	0.6	0.020
Main 4-stroke		HFO	13.2/14.0	1.1	0.5	0.023
		MDO	13.2	1.1	0.5	0.022
Auxiliary 4-stroke	C2	HFO	13.9/14.7	1.1	0.4	0.001
		MDO	13.9	1.1	0.4	0.001

*Note: HFO – heavy fuel oil, MDO – marine distillate oil
NO_x values are shown for domestic (dom) and international (int) fuel by purchase location. Domestic HFO fuel is lower in sulphur content on average.

[14] IMO, 2009. Second IMO GHG Study. Available at http://www.imo.org

Table 12: Current MEIT Boiler Emission Factors (kg/tonne fuel)

Fuel	NO_x	CO	HC	NH_3
HFO,MDO	12.3	4.6	0.38	0.006

Table 13: Current MEIT Low Load (main engine load 0.1) Scale Factors for All Emission Factors (unitless)

Fuel	NO_x	CO	HC	PM	NH_3
1.22	1.22	2.00	2.83	1.38	1.22

The engine NO_x emission rates are subject to the IMO regulations, which limits emissions based on the build year of vessel. The IMO emission limits, shown in Appendix A, are applied to each ship as indicated by the vessel build year.

For the OGVs, emissions result from the main engines (MEs), auxilliary engines (AEs) and boilers during transit and berthing. Several necessary assumptions are applied to achieve the emissions estimates. These assumptions are consistent with MEIT V4.0 as follows:

- All harbour movements occur under an ME load factor of 0.1 (meaning the 'Low Load' scale rates apply).
- An ME load factor of 0.0 is used for berthing (MEs are 'off').
- AEs and boilers are considered 'on' at all times.
- While ME power rating is identified for each vessel directly, AE power rating and load factor, and boiler fuel consumption is identified from MEIT lookup tables generated from previous vessel survey programs conducted in Canada.
- Fuel sulphur content is estimated for each vessel and engine/boiler based on previous vessel survey programs conducted in Canada.

Canada's 2010 National Marine Emissions Inventory can be consulted for these lookup tables. It's important to note that the fuel sulphur content data tables will not be applicable in late 2013 and beyond, due to an Emissions Control Area (ECA) for the west and east coasts of North America.

For Harbour Vessels, the engine emission estimates directly relate to the fuel consumption data entered. For example, for a ship that consumed a reported 1,000 litres of diesel in a year, the activity estimate required in equation (1) (time in mode) is completed in PEIT, based on a fuel consumption rate for the particular engine model and size (the appropriate SFOC values in Table 8). This approach allows use of the best available data (fuel consumption), while additionally accounting for CAC emission rates that strongly depend on the type and age of engine. Harbour Vessels are assumed to have no boilers and zero emissions while at berth.

4.2.1. Fugitive Cargo Emissions (OGVs)

Estimates of fugitive VOC emissions were adopted in PEIT from a new module included to MEIT V4.0. VOC emissions escape from the tanks of fuel carrying ships during transit and also during loading and unloading activities. As transit is relatively brief for the port inventories (through the harbour areas only), the loading/unloading activities are most significant.

The fugitive emission calculations require an estimate of the type and amount of fuel carried in the ships that visit Canadian ports. The current form of the module does not use cargo tonnage directly (since this information is not included in the Coast Guard movement records utilized by MEIT), and estimates for the cargo are achieved by assuming most of a vessel DWT is comprised of fuel cargo, for the appropriate ship classes. The equations used to estimate the fugitive emissions are defined below.

Transit:

$$E\ (mg) = DWT/D * LF * T * TF * EF_{transit} \quad (5)$$

Load/Unload:

$$E\ (mg) = DWT/D * LF * EF_{load} \quad (6)$$

Where:

E = emissions

DWT = deadweight tonnage

D = density of fuel (see Appendix A: Default Values)

LF = load factor (assumed to be 0.9 currently)

T = Time in transit mode

TF = transit factor (assumed to be 0.5 currently)

$EF_{transit}$ = transit emission rate

EF_{load} = loading/unloading emission rate

The emission rates for fugitive VOC emissions were taken from the US EPA, as defined in Table 14[15].

[15] These rates are published in the US EPA AP-42 Compilation of emission factors, Chapter 5.2

Table 14: Fugitive VOC Emission Rates

Vessel Class	Transit Emission Rate (mg/week/litre)	Load/Unload Emission Rate (mg/litre)
Crude Oil Tanker	150	73
Distillate Oil Tanker	0.54	0.55
Gasoline Tanker	320	215
LNG Tanker	0.0	0.0

Currently, MEIT assumes LNG vapours are captured and used as fuel for the vessel engines. As noted above, the load factor (LF) is less than 1.0 since DWT accounts for the mass of engine fuel as well as crew and supplies on board, in addition to cargo. The transit factor (TF) assumes that the cargo is carried one way only (e.g., the return leg of a voyage is done under ballast).

The fugitive emissions module should be considered preliminary and improvements to the module are recommended in the future. The module is currently considered appropriate for long term average emission estimates for a fleet of vessels (e.g., an annual emissions inventory) but not for application to a single vessel or a short-term period with multiple vessels.

4.3. CHE Emissions

Emission Calculation:

$$E = P \times LF \times T \times EF_{duty\text{-}cycle} \qquad (7)$$

Where E = Emissions

P = Power rating of engine

LF = Load Factor (fraction of rated power)

T = Time (elapsed) of engine use

$EF_{duty\text{-}cycle}$ = Emission Factors in g/hp-hr, based on a defined usage cycle

The equation shown above is used on an engine model by engine model basis, to account for important differences in engine emission characteristics by engine type, engine age and fuel quality. These emission rates were developed for the PEIT from the US EPA NONROAD 2008 emissions model. The emission rates for each specific piece of equipment by size (kW) and age were developed assuming the average annual hours of operation from the U.S. fleet statistics data in the tool. This allows for estimation of engine deterioration.

Engine retrofits and alternative fuels are represented in the PEIT. In addition, a linear load factor correction is used, based on the reported total facility fuel consumption for CHE. Incorporation of these elements can be represented with an extended version of the equation presented above:

Modified Emission Calculation for retrofits and alternative fuels:

$$E = P \times LF \times T \times EF_{duty\text{-}cycle} \times FA \times RF \times LM \qquad (8)$$

Where FA = Fuel Adjustment (ratio)

RF = Retrofit Adjustment (ratio)

LM = Load Modification (actual fuel consumed / predicted fuel consumed)

Retrofit Adjustment ratios are typically sourced from the US EPA 'Verified Technologies List'[16]. Fuel Adjustment ratios are needed in some cases (e.g., hybrid equipment) and these may be sourced from a reputable publication. Assistance with this issue may be required from a consultant. As previously indicated, retrofit labels will be identified by individual terminals; the port authority will enter the individual retrofit characteristics from the Verified Technologies List (or other source) into the tool retrofit data table. The tool data tables should be consulted as the primary source for identification of all retrofit or fuel adjustments used in the emission calculations (for all source groups).

4.4. Rail Emissions

Emission Calculation:

$$E = EF_{duty\text{-}cycle} \times T \qquad (9)$$

Where E = Emissions

$EF_{duty\text{-}cycle}$ = Emission Factors in g/hr, based on a defined usage cycle

T = Time (elapsed) of engine use

The total emissions for a locomotive are the sum of emissions in each activity mode.

The duty cycle emission factors are determined dynamically in PEIT from base emissions data specific to locomotive type and age, and engine throttle notch. Determination of duty cycle depends on data entered to the questionnaires, which allows development of a duty cycle average engine power level (kW or hp) and a duty cycle average activity based emission factor (g/kWh or g/hp-hr). The combination of these values provides emission factors in g/hr. The default duty cycle is shown on the questionnaire Rail worksheet, Table 15. This duty cycle, which is the national average duty cycle for switch locomotives, is automatically selected if the user selects 'Average/not known' for duty cycle. PEIT is populated with a large dataset of rail emission rates generated from emissions tests completed by the US EPA[17] for older model locomotives and additional studies for the newer (gen set) locomotives[18].

[16] http://epa.gov/cleandiesel/verification/verif-list.htm

[17] 1998, US EPA Office of Mobile Sources. Locomotive Emission Standards Regulatory Support Document (Appendix B)

As it is difficult to characterize the specific national or regional rail locomotives that serve a particular port, the National/Regional Locomotives were represented from national fleet information. For national or regional locomotives, emissions data were sourced from the Railway Association of Canada (RAC) on a per-litre basis (g/litre)[19]. The fuel-based rates, combined with duty cycle averaged fuel consumption rates (litres/hour), allow determination of emission factors in g/hr. However, it should be recognized that these rates may not be entirely representative of a particular region in Canada, if locomotive models and/or fuel qualities significantly differ from the national averages.

The RAC fuel-based emission rates for line haul and switch locomotives and the fuel consumption rates for a GE AC4400 and an EMD SD40 locomotive (the most common line haul and switch locomotives in the national fleet, respectively) are shown in Tables 15 and 16.

Table 15: Fuel-based Emission Rates (g/L) for Line Haul and Switch Activity

Source	Rail Emission Factor					
	NO_x	SO_x*	CO	VOCs	PM	NH_3
Line haul	44.0	0.187	4.7	1.7	1.5	0.3
Switch	77.9	0.187	4.7	1.7	2.3	0.3

* Assumes sulphur level of 129 ppm.

Table 16: Notch-specific Fuel Consumption Rates (L/hr) for Line Haul and Switch Locomotives

Notch	Idle	N1	N2	N3	N4	N5	N6	N7	N8	DB
Line	13.5	42.0	98.0	204.6	298.6	414.7	527.2	646.6	796.4	22.3
Switch	20.7	33.2	86.6	142.6	209.4	288.2	383.6	515.3	610.2	59.1

To make estimates of the smaller size fractions of PM, all of the PM mass is considered to be PM_{10} and 97% of the PM mass is considered to be $PM_{2.5}$.

For port or terminal operated locomotives ('Facility Locomotives'), fuel consumption records exist. The annual fuel consumption records are used in PEIT to automatically adjust the activity metric ('T') so that the emission estimates are consistent with the fuel consumption data. In all cases, the user is expected to identify the specific locomotive model used on the terminal grounds.

[18] PEIT identifies references for the emissions data in its 'Rail_Link_Emisfactors' table
[19] See the 2010 Locomotive Emissions Monitoring Program (LEM), http://www.railcan.ca/publications/emissions

4.5. Onroad Vehicle Emissions

Highway Truck emission estimates are determined in PEIT separately for transit activities and idle or 'creep' activities. Distance estimates are used for transit emission calculations and time estimates are used for idle/creep calculations.

Emission Calculation:

Transit: $E = D \times EF_{distance}$ (10)

Idle/creep: $E = T \times EF_{time}$ (11)

Where E = Emissions

T = Time

D = Distance travelled

$EF_{distance}$ = Emission Factors in g/km

EF_{time} = Emission Factors in g/hr

All vehicle emission factors were sourced from the US EPA MOVES 2010b model[20]. The vehicle emission rates were generated from the model assuming the national U.S. vehicle populations and annual accumulated mileage values by age and vehicle class, due to lack of similar Canadian data.

Engine retrofits and alternative fuels are represented in PEIT. Incorporation of these elements are addressed with a modified version of the equations presented above:

Modified Emission Calculation:

Transit: $E = D \times EF_{distance} \times FA \times RF$ (12)

Idle/creep: $E = T \times EF_{time} \times FA \times RF$ (13)

Where FA = Fuel Adjustment (ratio)

RF = Retrofit Adjustment (ratio)

These ratios are determined from the particular supplier of the emissions device, and entered to PEIT directly.

For port or terminal operated vehicles ('Facility Vehicles'), fuel consumption records exist. For these vehicles, only equation (12) is used, with the activity metric ('D') automatically adjusted so that the emission estimates are consistent with the fuel consumption data. Due to lack of information, transit and idle emission cannot be distinguished for Facility Vehicles and an average duty cycle is assumed.

[20] http://www.epa.gov/otaq/models/moves/index.htm

4.6. Admin

Admin sources amount to electricity use for buildings as well as compound lighting and boilers for space heating. Most boilers use natural gas, although PEIT accepts propane and heating oil (diesel) as well. The emission rates for boilers are shown in Table 17. These rates originate from the US EPA AP-42 Compilation of Emission Factors[21]. As noted in Chapter 4.1, the GHG rates from AP-42 were not used, in favour of the Environment Canada NIR values.

Table 17: Boiler Emission Factors (g/hp-hr)

Fuel type	NO_x	SO_x	CO	VOCs	PM_{10}	$PM_{2.5}$	NH_3
Diesel / Heating Oil	0.168	0.002	0.042	0.005	0.017	0.016	0.009
Natural Gas	0.113	0.002	0.095	0.000	0.009	0.009	0.008
Propane	0.159	0.000	0.092	0.012	0.009	0.009	0.014

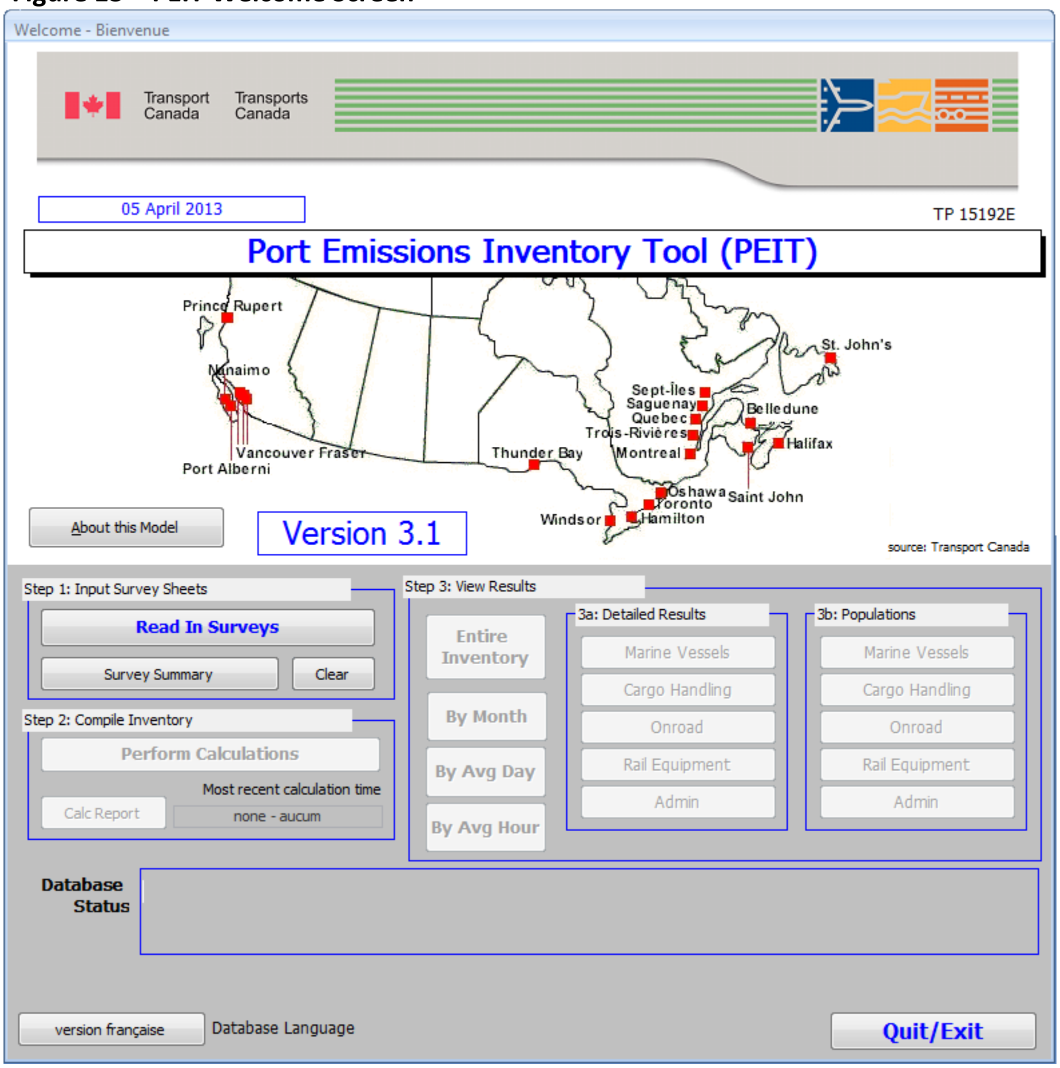
The type and age of Admin boilers is not currently a field in the PEIT questionnaire. It was expected that this information would be difficult to acquire for many of the port tenants (although this has not been investigated). As such, an assumption applied in PEIT for boilers is that all units are 15 years old. In effect, this simulates uncontrolled boilers, since units with low NO_x burners and flue gas recirculation did not become widely available until 2000. For this reason, the NO_x emissions associated with natural gas boilers may be overestimated in PEIT.

[21] See http://www.epa.gov/ttnchie1/ap42/, Chapter 1

5. PEIT FUNCTIONALITY AND QUALITY CONTROL

A graphic of the PEIT welcome screen is provided in Figure 13. The 'Step 1' selections constitute the data import and additionally facilitate internal activity data checks. The 'Survey Summary' should always be consulted to ensure that there are no errors or missing fields in the tenant questionnaires. PEIT will not complete its emission calculations with outstanding errors present in the questionnaire forms.

Figure 13 – PEIT Welcome Screen



5.1. Quality Control

In Step 1, importing the survey sheets, the user indicates which questionnaire(s) are to be imported into the database tool. This simply involves identifying the folder in which the questionnaires are located. One questionnaire or a group of questionnaires can be selected. The database will conduct a quality check on each MS Excel questionnaire sheet, assessing each field and its expected value range. The database reports missing data or irregularities directly on each questionnaire form with yellow highlighting. The Excel 'notes' mechanism is also used to provide a text description of the problem. This process is shown in Figure 14.

Figure 14 – Sample Survey Sheet for CHE (problematic data flagged in yellow)

Annual fuel consumption for terminal/facility CHE

Item	Fuel type	Annual fuel consumption	Units of fuel	Notes/comments
Example	Diesel	345,000	litre	Total for whole facility was 445,000; but 100,000L was used for harbour vessels.
1	Diesel	200,000		
2				
3				
4				
5				
6				
7				
8				

(The example entry shown in grey is only for dem

Equipment list

Item	Equipment type	Engine model year	Number of similar units	Retrofit installed?	Retrofit type	Fuel type (refer to Table 7)	Engine power or boiler rating	Power units (kW, hp, BTU/hr)	Annual hours of use (for one unit)	Notes/comments
Example	Rubber Tire Gantry (RTG) cranes	2000	3	No	None	1 - Diesel	250	kW	2,500	
Example	Crawler Tractor/Dozers	2008	2	Yes	User-defined 1	1 - Diesel	400	hp	1,900	Retrofit is a Douglas 99203 DOC.
1	Cranes (not RTG)		2	No	None	1 - Diesel	800		2,400	
2				No	None					
3				No	None					
4				No	None					
5				No	None					
6				No	None					

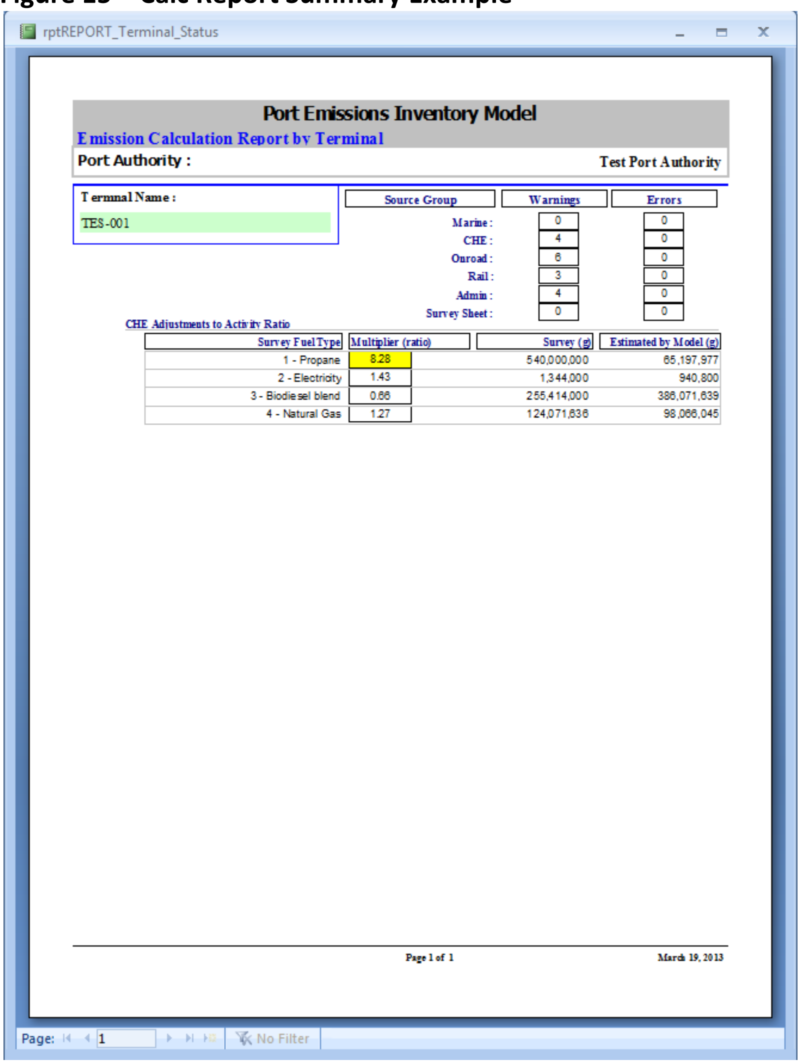
Hint
Select the power unit for the engine size of the equipment from the drop-down menu.

Once the flagged questionnaire cells are properly adjusted, the user can re-import the questionnaire to complete the data check process again. The final questionnaire must be error free (on all of its sheets) before any calculations will be performed in 'Step 2' of PEIT.

As indicated in Figure 13, the database also prepares a 'Survey Summary'. This summary can be viewed as a standard Access report with a line by line statement of errors or warnings.

Once 'Perform Calculations' is selected, PEIT will calculate the emissions for the data entered and complete additional checks on the information. The 'Calc Report' opens automatically upon completion of the emission calculations and a summary includes a comparison of modelled versus reported CHE fuel consumption for each questionnaire (as noted in Section 3.5). If the difference between the modelled and actual fuel consumption is less than 0.5 or greater than 2.0 (shown in the 'Multiplier (ratio)' field), Questionnaire Table 8 should be carefully re-assessed, in particular the 'Annual hours of use (for one unit)' column. Some difference is always expected between actual and estimated fuel consumption due to differences in the actual engine duty cycles used to perform work at the different terminals. Use of the 0.5/2.0 ratios as a quality control measure is based on professional judgment and is suggested system checks only (i.e., the user may apply different ratios in practice). PEIT will proceed with its calculations if the criteria noted above are not addressed. Therefore this comparison constitutes a warning that should be considered by the port and its tenant. In some cases a port will proceed with the PEIT calculations without addressing such a warning (e.g., if the emissions are judged relatively insignificant or better activity data simply cannot be acquired). Example CalcReport output is shown in Figure 15.

Figure 15 – Calc Report Summary Example



The 'Step 2' function (Perform Calculations) does not require any direct interaction from the user. Depending on the amount of data processed (in particular marine OGV activity) the time required to complete the calculations may span several minutes or more.

5.2. Reporting

The 'Step 3' function (View Results) provides the user the ability to examine emission totals by different source and fuel categories through Excel pivot tables. These features can be dynamically filtered and adjusted. In most cases, the user should focus on the 'Entire Inventory' pivot table since it is easiest to interpret. The 'Monthly', 'Daily' and 'Hourly' features simply provide an allocation of the annual emissions over shorter time periods based on the work schedules entered for each terminal (daily and hourly only). The 'Monthly' allocation is based on the distribution of ship calls to the port over the year. Table 18 provides a description of the field selection lists in the 'Entire Inventory' pivot table.

Table 18: Reporting Field Selection Key Descriptions

Selection Key	Definition	Notes (links to Questionnaire worksheet data)
Inventory Year	Year of inventory	Should only be 1 choice if all tenants select the same year
portAuthority	Name of port authority	Defined in 'Introduction' worksheet
Activity	General activity types	Defined in all activity worksheets
Terminal UKey	Allows for selection of terminals to be included	Based on terminal identification scheme chosen by the port and set in the worksheet 'Introduction'
CommodityClass	General commodity classes can be selected	Links with available general commodity classes in the 'Terminal' worksheet
Commodity	Specific commodity classes can be selected	Links with available specific commodity classes in the 'Terminal' worksheet
Boundary	EI boundary choice	Terminal/Facility Boundary or Port Boundary. Port Boundary includes all emissions in the Terminal/Facility Boundary
EquipmentGroup	Specific equipment groups can be selected	Associated with the 'Source Group' key which contains the parent groups
Tech	Technology type of engine (e.g., Tier 1, Tier 2, etc.)	Defined in all activity worksheets
Retrofit	Engine and emission retrofits	Emissions associated with specific retrofits can be selected

Table 18 (Cont'd): Reporting Field Selection Key Descriptions

Selection Key	Definition	Notes (links to Questionnaire worksheet data)
Substance	Specific air contaminants can be selected	CACs, GHGs and air toxics are included. Associated with the 'SubstanceGroup' key which contains the parent groups
SubstanceGroup	Air contaminant groups can be selected	Associated with the 'Substance' key which allows further selection
Units	Shows all units used in the EI data	Relates to the Questionnaire choices by the tenants
SourceGroup	General source groups can be selected	Associated with the 'EquipmentType' key which allows further selection
EquipmentType	Specific equipment pieces can be selected	Associated with the 'SourceGroup' key which contains the parent groups
Fuel	Emissions associated with specific fuels can be selected	Associated with the 'SourceGroup' and other keys

5.3. Test Questionnaire

A test questionnaire is included with the tool. This test questionnaire can be loaded into the tool and the emission results compared against a fixed standard, to ensure that the tool calculates as expected. The test questionnaires are labelled "TC Port EI Questionnaire – EN – test.xls" and "TC Port EI Questionnaire – FR – test.xls". The English and French versions contain the same activity data. The emission results from these test questionnaires are stored in a file labelled "TC Port EI Test Questionnaire – Emission results.xls". The emissions results from the file must match the results generated by the tool. If the results do not match then a previous user has modified one of the tables in the tool.

Appendix A: Supplemental Data Tables

Tables 19 – 24 list supplemental data utilized in the PEIT model. Table 19 lists volumetric and energy densities, global warming potentials, electricity carbon intensities by region, and sulphur content of fuels. Tables 20 – 22 list the age distributions of onroad vehicles for 2010 – 2012, and Table 23 lists renewable fuel (biodiesel and ethanol) content by region. Table 24 lists the IMO NO_X and SO_X fuel regulations. These data are accessed by the tool in its calculations, through the equations described in the main body of this user guide.

Table 19: Parameter Values by Type and Region of Canada

Parameter	Field	Value	Units	Source
Physical Density	Lumber	600	kg/m^3	EPA AP-42, Appendix A (Miscellaneous Data & Conversion Factors)
	Diesel	851	g/L	
	Gasoline	741		
	Heavy fuel oil	944		
	Marine diesel oil	845		
	Propane	540		
Energy density	Diesel	39	MJ/L	
	Gasoline	34		
	Heavy fuel oil	42		
	Marine diesel oil	39		
	Propane	26		
Global warming potentials	CO_2	1	CO_2e	IPCC Second Assessment Report
	CH_4	21		
	N_2O	310		

Parameter	Field	Value	Units	Source
Electricity carbon intensities	Alberta	863	g CO_2e/kWh	EC 2011 National Inventory Report (for 2010 inventory year; also used for 2011 – 2013 years)
	British Columbia	24		
	Manitoba	3		
	New Brunswick	503		
	Newfoundland and Labrador	18		
	Nova Scotia	760		
	Nunavut/NWT	380		
	Ontario	133		
	Prince Edward Island	3		
	Quebec	3		
	Saskatchewan	801		
	Yukon	47		
Sulphur content of fuel	Diesel – non-rail	15	ppm	EC Sulphur in Diesel Regulations
	Diesel – facility rail	15		EC Sulphur in Diesel Regulations
	Diesel – National/Regional rail	129		RAC Locomotive Emission Model 2010
	Gasoline	30		EC Sulphur in Gasoline Regulations
	Natural Gas	3		Fortis BC MSDS
	Propane	75		Fortis BC MSDS
	HFO - domestic	1.5	Percent (%)	MEIT 4.0 / 2010 EC National

Parameter	Field	Value	Units	Source
	HFO – international	2.6		Marine Inventory
	MDO – Domestic	0.05		
	MDO – International	1		
	MGO - Domestic	0.0015		

Table 20: Onroad Vehicle Age Distributions (% of fleet) for Inventory Year 2010*

Vehicle age	Gas		Diesel				
	Car	Pickup/ Van	Light Comm.	Medium Comm.	Heavy Comm.**	Bus	Pickup/ Van
0	0.062	0.056	0.052	0.065	0.053	0.061	0.056
1	0.052	0.039	0.036	0.062	0.049	0.058	0.039
2	0.058	0.049	0.045	0.068	0.112	0.064	0.049
3	0.065	0.072	0.055	0.071	0.081	0.066	0.063
4	0.066	0.073	0.051	0.073	0.078	0.066	0.060
5	0.064	0.076	0.070	0.071	0.052	0.066	0.067
6	0.061	0.074	0.112	0.057	0.046	0.052	0.100
7	0.060	0.069	0.076	0.044	0.032	0.041	0.071
8	0.062	0.064	0.084	0.038	0.044	0.035	0.076
9	0.063	0.061	0.087	0.043	0.059	0.040	0.078
10	0.063	0.055	0.058	0.046	0.052	0.043	0.061
11	0.057	0.047	0.068	0.045	0.048	0.040	0.066
12	0.049	0.041	0.014	0.035	0.032	0.039	0.015
13	0.043	0.035	0.040	0.026	0.030	0.034	0.040
14	0.036	0.031	0.024	0.027	0.038	0.032	0.026
15	0.030	0.026	0.026	0.031	0.027	0.030	0.025
16	0.025	0.023	0.020	0.029	0.017	0.026	0.021
17	0.019	0.019	0.014	0.021	0.013	0.022	0.015
18	0.014	0.014	0.009	0.016	0.014	0.018	0.011
19	0.011	0.011	0.007	0.015	0.021	0.020	0.008
20	0.009	0.011	0.008	0.017	0.020	0.027	0.008
21	0.008	0.010	0.008	0.021	0.020	0.023	0.007
22	0.006	0.009	0.006	0.017	0.016	0.019	0.005
23	0.005	0.008	0.004	0.014	0.013	0.018	0.004
24+	0.012	0.026	0.027	0.049	0.030	0.061	0.028

* Based on "EPA, MOVES2010 Highway Vehicle – Population and Activity Data, November 2010, EPA-420-R-10-026"
** Age distribution (%) from the Transport Canada Comprehensive Onroad Vehicles Database

Table 21: Onroad Vehicle Age Distributions (% of fleet) for Inventory Year 2011*

Vehicle age	Gas		Diesel				
	Car	Pickup/ Van	Light Comm.	Medium Comm.	Heavy Comm.**	Bus	Pickup/ Van
0	0.071	0.061	0.056	0.068	0.053	0.064	0.061
1	0.062	0.055	0.051	0.063	0.049	0.059	0.055
2	0.052	0.039	0.036	0.060	0.112	0.057	0.039
3	0.058	0.048	0.044	0.066	0.081	0.063	0.048
4	0.064	0.070	0.054	0.068	0.078	0.064	0.062
5	0.065	0.070	0.049	0.069	0.052	0.064	0.058
6	0.063	0.073	0.067	0.068	0.046	0.063	0.064
7	0.060	0.071	0.107	0.053	0.032	0.049	0.095
8	0.059	0.065	0.073	0.042	0.044	0.039	0.067
9	0.060	0.060	0.079	0.036	0.059	0.033	0.071
10	0.060	0.057	0.082	0.040	0.052	0.038	0.073
11	0.060	0.051	0.055	0.043	0.048	0.040	0.057
12	0.052	0.044	0.063	0.041	0.032	0.038	0.061
13	0.042	0.038	0.013	0.032	0.030	0.036	0.014
14	0.035	0.032	0.037	0.024	0.038	0.031	0.036
15	0.030	0.028	0.021	0.025	0.027	0.030	0.023
16	0.024	0.023	0.023	0.028	0.017	0.027	0.022
17	0.020	0.021	0.018	0.026	0.013	0.024	0.019
18	0.015	0.016	0.012	0.019	0.014	0.020	0.014
19	0.011	0.013	0.008	0.014	0.021	0.017	0.009
20	0.008	0.010	0.006	0.013	0.020	0.018	0.007
21	0.007	0.010	0.007	0.016	0.020	0.024	0.007
22	0.006	0.009	0.007	0.018	0.016	0.020	0.006
23	0.005	0.008	0.005	0.015	0.013	0.017	0.005
24+	0.012	0.028	0.026	0.052	0.030	0.066	0.026

* Based on "EPA, MOVES2010 Highway Vehicle – Population and Activity Data, November 2010, EPA-420-R-10-026"
** Age distribution (%) from the Transport Canada Comprehensive Onroad Vehicles Database

Table 22: Onroad Vehicle Age Distributions (% of fleet) for Inventory Year 2012*

Vehicle age	Gas		Diesel				
	Car	Pickup/ Van	Light Comm.	Medium Comm.	Heavy Comm.**	Bus	Pickup/ Van
0	0.077	0.062	0.057	0.070	0.053	0.067	0.061
1	0.070	0.060	0.055	0.066	0.049	0.063	0.059
2	0.062	0.054	0.050	0.061	0.112	0.058	0.054
3	0.051	0.038	0.035	0.058	0.081	0.056	0.038
4	0.057	0.047	0.043	0.064	0.078	0.061	0.047
5	0.063	0.068	0.052	0.065	0.052	0.061	0.060
6	0.063	0.068	0.048	0.066	0.046	0.061	0.056
7	0.061	0.070	0.065	0.064	0.032	0.059	0.061
8	0.058	0.067	0.102	0.050	0.044	0.046	0.090
9	0.056	0.062	0.069	0.039	0.059	0.037	0.063
10	0.057	0.057	0.074	0.033	0.052	0.031	0.067
11	0.057	0.053	0.077	0.037	0.048	0.035	0.068
12	0.055	0.048	0.051	0.039	0.032	0.037	0.053
13	0.045	0.040	0.058	0.038	0.030	0.035	0.056
14	0.035	0.034	0.011	0.030	0.038	0.034	0.013
15	0.029	0.028	0.033	0.022	0.027	0.029	0.032
16	0.024	0.025	0.019	0.023	0.017	0.027	0.021
17	0.019	0.021	0.021	0.025	0.013	0.025	0.020
18	0.015	0.018	0.016	0.024	0.014	0.022	0.017
19	0.011	0.015	0.011	0.017	0.021	0.018	0.012
20	0.008	0.011	0.007	0.012	0.020	0.015	0.008
21	0.006	0.009	0.005	0.012	0.020	0.016	0.006
22	0.005	0.009	0.006	0.014	0.016	0.022	0.006
23	0.004	0.008	0.006	0.016	0.013	0.018	0.005
24+	0.012	0.030	0.027	0.056	0.030	0.070	0.027

* Based on "EPA, MOVES2010 Highway Vehicle – Population and Activity Data, November 2010, EPA-420-R-10-026"
** Age distribution (%) from the Transport Canada Comprehensive Onroad Vehicles Database

Table 23: Renewable Fuel Content by Region of Canada*

Fuel Type	Year	Region (fraction)					
		AB	BC	MB	ON	SK	Rest of Canada
Diesel	2010	0	0.03	0.02	0	0	0
	2011	0.02	0.04	0.02	0	0	0
	2012	0.02	0.05	0.02	0.02	0.015	0
	2013	0.02	0.05	0.02	0.02	0.015	0.02
Gasoline	2010	0	0.05	0.085	0.05	0.075	0
	2011	0.05	0.05	0.085	0.05	0.075	0.05
	2012	0.05	0.1	0.085	0.05	0.075	0.05
	2013	0.05	0.1	0.085	0.05	0.075	0.05

* http://www.greenfuels.org/en/public-policy/federal-programs.aspx

Table 24: IMO NO_X and SO_X/Fuel Regulations*

Standard	Engine RPM 'n'	NOx Emission Limit (g/kWh)	Fuel Standard (max. sulphur content)	Year	Relevance
Tier 1	n < 130	17.0	n/a	2000	Applies to all vessels constructed during or after this year.
	n = 130-2000	$45*n^{-0.2}$			
	n > 2000	9.8			
SO_x /FUEL	n/a	n/a	1.00%	2010	Only applies to ECA areas.
Tier 2	n < 130	14.4	n/a	2011	Applies to all vessels constructed during or after this year.
	n = 130-2000	$44*n^{-0.23}$			
	n > 2000	7.7			
SO_x /FUEL	n/a	n/a	0.10%	2015	Only applies to ECA areas.
Tier 3	n < 130	3.4	n/a	2021	Applies to all vessels constructed during or after this year. Only applies to vessels operating in ECA areas.
	n = 130-2000	$9*n^{-0.2}$			
	n > 2000	1.96			
SO_x /FUEL	n/a	n/a	0.50%	2020	Applies to all areas, pending a 2018 fuel availability review.

*
http://www.imo.org/KnowledgeCentre/InformationResourcesOnCurrentTopics/AirPollutionandGreenhouseGasEmissionsfromInternationalShippping/Pages/default.aspx

APPENDIX C

PEIT activity questionnaires

See attached files

Administrative energy consumption

Baseline 2013

Instructions

- *This page relates to administrative energy consumption of a terminal/facility from electrical consumption, boilers and generators.*
- *If your terminal/facility is a manufacturing operation, only include energy consumption for administration (i.e., building and lights). Do not include the energy consumption associated with the facility processing (i.e., cement manufacturing, saw for lumber mills, etc.)*
- Fill out the fields in the white boxes in Table 2.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the fuel units are appropriate for the activity type (e.g., kWh for electricity).

2 Administrative energy consumption

Item	Fuel type	Energy / equipment type	Total annual consumption	Units of fuel	Description of energy usage	
Example	Electricity	Electric grid	125,000	kilowatt-hour (kWh)	80% building usage, 20% compound lighting	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
Example	Natural Gas	Boiler	40,000	gigajoule (GJ)	Total of 2,000,000 GJ. Only 2% used for admin, rest for process.	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
1	Electricity	General admin electricity	429,500	kilowatt-hour (kWh)		
2						
3						
4						
5						
6						
7						
8						
9						
10						

Notes / comments:

Cargo-handling equipment

Instructions

- *Data entered on this page describes the cargo-handling equipment used at your terminal/facility.*
- In Table 7, list the total fuel consumption by type. In Table 8, list the activity of each piece of equipment. **HINT:** In Table 8, group together any pieces of equipment with the same hours, age and engine size.
- Fill out the fields in the white boxes in Tables 7 and 8.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type; e.g., natural gas in gigajoules (GJ).

7 Annual fuel consumption for terminal/facility CHE

Item	Fuel type	Annual fuel consumption	Units of fuel	Notes/comments
Example	Diesel	345,000	litre	Total for whole facility was 445,000; but 100,000L was used for harbour vessels.
1	Diesel	146,440	litre	
2	Propane	3,600	litre	
3	Gasoline	150	Litre	
4	Diesel	16,271	litre	RAIL Shuttle Wagon (rail car pusher - included under CHE since rail RCP does not work for Tier 3)
5				
6				
7				
8				

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

8 Equipment list

Item	Equipment type	Engine model year	Number of similar units	Retrofit installed?	Retrofit type	Fuel type (refer to Table 7)	Engine power or boiler rating	Power units (kW, hp, BTU/hr)	Annual hours of use (for one unit)	Notes/comments
Example	Rubber Tire Gantry (RTG) cranes	2000	3	No	None	1 - Diesel	250	kW	2,500	
Example	Crawler Tractor/Dozers	2008	2	Yes	User-defined 1	1 - Diesel	400	hp	1,900	Retrofit is a Douglas 99203 DOC.
1	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3
2	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2013, entered as 2010 to force Tier 3
3	Top or Side Picks Chassis or Reach St	2010	1	No	none	1 - Diesel	230	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3
4	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3
5	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3
6	Forklifts	2008	1	No	None	2 - Propane	60	hp	520	
7	Forklifts	1976	1	No	None	2 - Propane	60	hp	250	
8	Skid Steer Loaders (small loaders)	2005	1	No	None	1 - Diesel	75	hp	75	
9	Pressure Washers	2006	3	No	None	3 - gasoline	5	hp	50	
10	Aerial Lifts	1999	1	No	None	2 - Propane	50	hp	75	
11	Tractors/Loaders/Backhoes	2010	1	No	None	4 - Diesel	300	hp	650	Shuttle Wagon equivalent; 2011 but reported as 2010 to force Tier 3
12	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	230	hp	3,900	
13				No	None					
14				No	None					
15				No	None					
16				No	None					
17				No	None					
18				No	None					
19				No	None					
20				No	None					
21				No	None					
22				No	None					
23				No	None					
24				No	None					
25				No	None					
26				No	None					
27				No	None					
28				No	None					
29				No	None					
30				No	None					
31				No	None					
32				No	None					
33				No	None					
34				No	None					
35				No	None					
36				No	None					
37				No	None					
38				No	None					
39				No	None					
40				No	None					
41				No	None					
42				No	None					
43				No	None					
44				No	None					
45				No	None					
46				No	None					
47				No	None					
48				No	None					
49				No	None					
50				No	None					
51				No	None					
52				No	None					
53				No	None					
54				No	None					
55				No	None					
56				No	None					
57				No	None					
58				No	None					
59				No	None					
60				No	None					
61				No	None					
62				No	None					
63				No	None					
64				No	None					
65				No	None					
66				No	None					
67				No	None					
68				No	None					
69				No	None					
70				No	None					
71				No	None					
72				No	None					
73				No	None					
74				No	None					
75				No	None					
76				No	None					
77				No	None					
78				No	None					
79				No	None					
80				No	None					
81				No	None					
82				No	None					
83				No	None					
84				No	None					
85				No	None					
86				No	None					
87				No	None					
88				No	None					
89				No	None					
90				No	None					
91				No	None					
92				No	None					
93				No	None					
94				No	None					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)
(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

95				No	None					
96				No	None					
97				No	None					
98				No	None					
99				No	None					

Onroad Vehicles

Instructions

• *Data entered on this page describes onroad vehicles that operate on your terminal/facility.*
• *Vehicles reported here must be licensed for onroad use (i.e., unlicensed trucks such as yard trucks or hostlers are accounted for under the "CHE-EMF" page).*
• Fill out the fields in the white boxes in Tables 9, 10 and 11. Complete Table 9 for all highway vehicles that pick up or drop off major commodities at your terminal/facility. Complete Tables 10 and 11 for the facility trucks used on your site.
• Table 12 should be used only if highway truck fleet data is available. Typically, this would be filled out by a consultant.
• Examples are shown in grey; they are not included in your terminal/facility's data.
• Use the drop-down menu to select a response from a pre-defined list.
• Check that the units of measure are appropriate for the fuel or power type (e.g., natural gas in GJ).

9 Highway vehicles (not operated by terminal/facility)

Item	Vehicle type	Annual gate counts	Zone C: Average time spent on terminal/facility grounds (min)	Zone C: Average time driving on terminal/facility grounds (min)	Zone C: Average time idling on terminal/facility grounds (min)	Vehicle age profile (refer to Table 12)	Zone D (OPTIONAL): Distance from terminal to port entry/intermodal point (km)	Zone D (OPTIONAL): Distance from terminal to port exit/intermodal point (km)	Zone D (OPTIONAL): Average time idling on port grounds (min)	Zone D (OPTIONAL): Average speed driven on port grounds (km/h)	Notes / comments
Example	Heavy Commercial Truck	2,500	15	2	3	Average / not known	10	15	10	35	
1	Heavy commercial truck	19,986	20	1	2	User-defined A					27000 for full capacity case scaled down by 2013 throughput
2											
3											
4											
5											
6											
7											
8											
9											
10											

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

10 Terminal/facility vehicle fuel consumption

Item	Fuel type	Annual fuel consumption	Units of fuel
Example	Gasoline	10,000	litre
1			
2			
3			
4			
5			
6			
7			
8			

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Notes / comments

Age profile based on PMV LEI age profile

11 List of terminal / facility vehicles

Item	Vehicle type	Fleet age	Number of similar vehicles	Relative intensity of use	Fuel type (refer to Table 10)
Example	Van / Pickup - small utility	2005 - 2009	5	3 - Medium (average)	1 - Gasoline
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

12 Custom highway vehicle fleet age profile (OPTIONAL)

Age	Average / not known (default)		User-defined A		User-defined B		User-defined C	
	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage
0	23,655	8.4%	1	0.5%		#DIV/0!		#DIV/0!
1	35,541	12.7%	2	1.7%		#DIV/0!		#DIV/0!
2	29,319	10.5%	2	2.0%		#DIV/0!		#DIV/0!
3	26,627	9.5%	10	10.1%		#DIV/0!		#DIV/0!
4	23,115	8.3%	4	4.0%		#DIV/0!		#DIV/0!
5	20,070	7.2%	8	7.5%		#DIV/0!		#DIV/0!
6	17,436	6.2%	8	7.5%		#DIV/0!		#DIV/0!
7	15,142	5.4%	7	7.3%		#DIV/0!		#DIV/0!
8	13,142	4.7%	3	3.0%		#DIV/0!		#DIV/0!
9	11,383	4.1%	8	8.0%		#DIV/0!		#DIV/0!
10	9,837	3.5%	48	48.2%		#DIV/0!		#DIV/0!
11	8,777	3.1%	0	0.0%		#DIV/0!		#DIV/0!
12	7,192	2.6%	0	0.0%		#DIV/0!		#DIV/0!
13	6,109	2.2%	0	0.0%		#DIV/0!		#DIV/0!
14	5,076	1.8%	0	0.0%		#DIV/0!		#DIV/0!
15	4,343	1.6%	0	0.0%		#DIV/0!		#DIV/0!
16	3,600	1.3%	0	0.0%		#DIV/0!		#DIV/0!
17	2,990	1.1%	0	0.0%		#DIV/0!		#DIV/0!
18	2,562	0.9%	0	0.0%		#DIV/0!		#DIV/0!
19	2,214	0.8%	0	0.0%		#DIV/0!		#DIV/0!
20	1,919	0.7%	0	0.0%		#DIV/0!		#DIV/0!
21	1,668	0.6%	0	0.0%		#DIV/0!		#DIV/0!
22	1,451	0.5%	0	0.0%		#DIV/0!		#DIV/0!
23	1,266	0.5%	0	0.0%		#DIV/0!		#DIV/0!
>24	5,567	2.0%	0	0.0%		#DIV/0!		#DIV/0!

National/regional and facility rail

Instructions

• *Data entered on this page describes rail locomotives that operate on your terminal/facility.*
• Fill out the fields in the white boxes in Tables 13, 14 and potentially 15. Complete Table 13 for locomotives on your terminal/facility that are operated by CN/CP or a regional line. Complete Table 14 for all locomotives that are operated by your terminal/facility. If you have specific notch data for your locomotives enter this in Table 15.
• Examples are shown in grey; they are not included in your terminal's data.
• Use the drop-down menu to select a response from a pre-defined list.
• Check that the units of measure are appropriate for the fuel or power type (e.g., diesel in litres).

13 National/regional rail on terminal/facility grounds

Item	Rail line service provider	Duty Cycle	Annual train visits to terminal/facility	Average movement details per visit			Notes/comments
				Average number of locomotives per train	Average time spent on terminal/facility grounds (hours)	Average time spent on port grounds	
Example	Regional line	Average / not known	100	1	0.25	0.5	Ontario Southern Rail
1	CN/CP Switch	Average / not known	750	1	0.38		3 23-min deliveries per day
2							
3							
4							
5							
6							
7							
8							
9							
10							

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

14 Facility locomotives

Item	Locomotive details				Fuel details			Notes/comments
	Ownership	Model	Duty cycle	Engine year	Fuel Type	Annual fuel consumption	Units of fuel	
Example	Terminal owned or leased	MP15DC	Average / not known	2002 and older	Diesel	11,000	litre	Leased from Falcon Rail.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

15 Custom locomotive duty cycle (OPTIONAL)

Notch	Duty cycle (percent time in notch)			
	National average for switch locomotives	User-defined A	User-defined B	User-defined C
Idle	84.90%			82.00%
N1	5.40%			6.00%
N2	4.20%			5.00%
N3	2.20%			3.00%
N4	1.40%			1.00%
N5	0.60%			1.00%
N6	0.30%			0.50%
N7	0.20%			0.50%
N8	0.60%			0.60%
Dynamic braking	0.20%			0.40%
Total check	100%	0%	0%	100%

Notes / comments

Administrative energy consumption

2017 No Project Case

Instructions

- *This page relates to administrative energy consumption of a terminal/facility from electrical consumption, boilers and generators.*
- *If your terminal/facility is a manufacturing operation, only include energy consumption for administration (i.e., building and lights). Do not include the energy consumption associated with the facility processing (i.e., cement manufacturing, saw for lumber mills, etc.)*
- Fill out the fields in the white boxes in Table 2.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the fuel units are appropriate for the activity type (e.g., kWh for electricity).

2 Administrative energy consumption

Item	Fuel type	Energy / equipment type	Total annual consumption	Units of fuel	Description of energy usage	
Example	Electricity	Electric grid	125,000	kilowatt-hour (kWh)	80% building usage, 20% compound lighting	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
Example	Natural Gas	Boiler	40,000	gigajoule (GJ)	Total of 2,000,000 GJ. Only 2% used for admin, rest for process.	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
1	Electricity	General admin electricity	580,243	kilowatt-hour (kWh)	2013 electricity scaled by ratio of throughputs	
2						
3						
4						
5						
6						
7						
8						
9						
10						

Notes / comments:

END-FIN

Cargo-handling equipment

Instructions

- *Data entered on this page describes the cargo-handling equipment used at your terminal/facility.*
- In Table 7, list the total fuel consumption by type. In Table 8, list the activity of each piece of equipment. **HINT:** In Table 8, group together any pieces of equipment with the same hours, age and engine size.
- Fill out the fields in the white boxes in Tables 7 and 8.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type; e.g., natural gas in gigajoules (GJ).

7 Annual fuel consumption for terminal/facility CHE

Item	Fuel type	Annual fuel consumption	Units of fuel	Notes/comments	
Example	Diesel	345,000	litre	Total for whole facility was 445,000; but 100,000L was used for harbour vessels.	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
1	Diesel	197,837	litre	2013 scaled by ratio of 2017/2013 throughputs	
2	Propane	4,864	litre	2013 scaled by ratio of 2017/2013 throughputs	
3	Gasoline	203	litre	2013 scaled by ratio of 2017/2013 throughputs	
4	Diesel	21,982	litre	Shuttle Wagon (rail car pusher - included under CHE since rail RCP does not work for Tier 3) - scaled relative to ratio of	
5					
6					
7					
8					

8 Equipment list

Item	Equipment type	Engine model year	Number of similar units	Retrofit installed?	Retrofit type	Fuel type (refer to Table 7)	Engine power or boiler rating	Power units (kW, hp, BTU/hr)	Annual hours of use (for one unit)	Notes/comments	
Example	Rubber Tire Gantry (RTG) cranes	2000	3	No	None	1 - Diesel	250	kW	2,500		*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
Example	Crawler Tractor/Dozers	2008	2	Yes	User-defined 1	1 - Diesel	400	hp	1,900	Retrofit is a Douglas 99203 DOC.	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
1	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3	
2	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2013, entered as 2010 to force Tier 3	
3	Top or Side Picks Chassis or Reach St	2010	1	No	none	1 - Diesel	230	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3	
4	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3	
5	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3	
6	Forklifts	2008	1	No	None	2 - Propane	60	hp	520		
7	Forklifts	1976	1	No	None	2 - Propane	60	hp	250		
8	Skid Steer Loaders (small loaders)	2005	1	No	None	1 - Diesel	75	hp	75		
9	Pressure Washers	2006	3	No	None	3 - gasoline	5	hp	50		
10	Aerial Lifts	1999	1	No	None	2 - Propane	50	hp	75		
11	Tractors/Loaders/Backhoes	2010	1	No	None	4 - Diesel	300	hp	650	Shuttle Wagon equivalent; 2011 but reported as 2010 to force Tier 3	
12	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	230	hp	3,900		
13				No	None						
14				No	None						
15				No	None						
16				No	None						
17				No	None						
18				No	None						
19				No	None						
20				No	None						
21				No	None						
22				No	None						
23				No	None						
24				No	None						
25				No	None						
26				No	None						
27				No	None						
28				No	None						
29				No	None						
30				No	None						
31				No	None						
32				No	None						
33				No	None						
34				No	None						
35				No	None						
36				No	None						
37				No	None						
38				No	None						
39				No	None						
40				No	None						
41				No	None						
42				No	None						
43				No	None						
44				No	None						
45				No	None						
46				No	None						
47				No	None						
48				No	None						
49				No	None						
50				No	None						
51				No	None						
52				No	None						
53				No	None						
54				No	None						
55				No	None						
56				No	None						
57				No	None						
58				No	None						
59				No	None						
60				No	None						
61				No	None						
62				No	None						
63				No	None						
64				No	None						
65				No	None						
66				No	None						
67				No	None						
68				No	None						
69				No	None						
70				No	None						
71				No	None						
72				No	None						
73				No	None						
74				No	None						
75				No	None						
76				No	None						
77				No	None						
78				No	None						
79				No	None						
80				No	None						
81				No	None						
82				No	None						
83				No	None						
84				No	None						
85				No	None						
86				No	None						
87				No	None						
88				No	None						
89				No	None						
90				No	None						
91				No	None						
92				No	None						
93				No	None						
94				No	None						

95				No	None					
96				No	None					
97				No	None					
98				No	None					
99				No	None					

Onroad Vehicles

Instructions

- *Data entered on this page describes onroad vehicles that operate on your terminal/facility.*
- *Vehicles reported here must be licensed for onroad use (i.e., unlicensed trucks such as yard trucks or hostlers are accounted for under the "CHE-EMF" page).*
- Fill out the fields in the white boxes in Tables 9, 10 and 11. Complete Table 9 for all highway vehicles that pick up or drop off major commodities at your terminal/facility. Complete Tables 10 and 11 for the facility trucks used on your site.
- Table 12 should be used only if highway truck fleet data is available. Typically, this would be filled out by a consultant.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type (e.g., natural gas in GJ).

9 Highway vehicles (not operated by terminal/facility)

Item	Vehicle type	Annual gate counts	Zone C			Vehicle age profile (refer to Table 12)	Zone D (OPTIONAL)				Notes / comments
			Average time spent on terminal/facility grounds (min)	Average time driving on terminal/facility grounds (min)	Average time idling on terminal/facility grounds (min)		Distance from terminal to port entry/intermodal point (km)	Distance from terminal to port exit/intermodal point (km)	Average time idling on port grounds (min)	Average speed driven on port grounds (km/h)	
Example	Heavy Commercial Truck	2,500	15	2	3	Average / not known	10	15	10	35	
1	Heavy commercial truck	27,000	20	1	2	User-defined A					27000 for full capacity case
2											
3											
4											
5											
6											
7											
8											
9											
10											

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

10 Terminal/facility vehicle fuel consumption

Item	Fuel type	Annual fuel consumption	Units of fuel
Example	Gasoline	10,000	litre
1			
2			
3			
4			
5			
6			
7			
8			

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Notes / comments

Age profile based on PMV LEI age profile

11 List of terminal / facility vehicles

Item	Vehicle type	Fleet age	Number of similar vehicles	Relative intensity of use	Fuel type (refer to Table 10)
Example	Van / Pickup - small utility	2005 - 2009	5	3 - Medium (average)	1 - Gasoline
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

12 Custom highway vehicle fleet age profile (OPTIONAL)

Age	Average / not known (default)		User-defined A		User-defined B		User-defined C	
	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage
0	23,655	8.4%	1	0.5%		#DIV/0!		#DIV/0!
1	35,541	12.7%	2	1.7%		#DIV/0!		#DIV/0!
2	29,319	10.5%	2	2.0%		#DIV/0!		#DIV/0!
3	26,627	9.5%	10	10.1%		#DIV/0!		#DIV/0!
4	23,115	8.3%	4	4.0%		#DIV/0!		#DIV/0!
5	20,070	7.2%	8	7.5%		#DIV/0!		#DIV/0!
6	17,436	6.2%	8	7.5%		#DIV/0!		#DIV/0!
7	15,142	5.4%	7	7.3%		#DIV/0!		#DIV/0!
8	13,142	4.7%	3	3.0%		#DIV/0!		#DIV/0!
9	11,383	4.1%	8	8.0%		#DIV/0!		#DIV/0!
10	9,837	3.5%	48	48.2%		#DIV/0!		#DIV/0!
11	8,777	3.1%	0	0.0%		#DIV/0!		#DIV/0!
12	7,192	2.6%	0	0.0%		#DIV/0!		#DIV/0!
13	6,109	2.2%	0	0.0%		#DIV/0!		#DIV/0!
14	5,076	1.8%	0	0.0%		#DIV/0!		#DIV/0!
15	4,343	1.6%	0	0.0%		#DIV/0!		#DIV/0!
16	3,600	1.3%	0	0.0%		#DIV/0!		#DIV/0!
17	2,990	1.1%	0	0.0%		#DIV/0!		#DIV/0!
18	2,562	0.9%	0	0.0%		#DIV/0!		#DIV/0!
19	2,214	0.8%	0	0.0%		#DIV/0!		#DIV/0!
20	1,919	0.7%	0	0.0%		#DIV/0!		#DIV/0!
21	1,668	0.6%	0	0.0%		#DIV/0!		#DIV/0!
22	1,451	0.5%	0	0.0%		#DIV/0!		#DIV/0!
23	1,266	0.5%	0	0.0%		#DIV/0!		#DIV/0!
>24	5,567	2.0%	0	0.0%		#DIV/0!		#DIV/0!

National/regional and facility rail

Instructions

- *Data entered on this page describes rail locomotives that operate on your terminal/facility.*
- Fill out the fields in the white boxes in Tables 13, 14 and potentially 15. Complete Table 13 for locomotives on your terminal/facility that are operated by CN/CP or a regional line. Complete Table 14 for all locomotives that are operated by your terminal/facility. If you have specific notch data for your locomotives enter this in Table 15.
- Examples are shown in grey; they are not included in your terminal's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type (e.g., diesel in litres).

13 National/regional rail on terminal/facility grounds

Item	Rail line service provider	Duty Cycle	Annual train visits to terminal/facility	Average movement details per visit			Notes/comments
				Average number of locomotives per train	Average time spent on terminal/facility grounds (hours)	Average time spent on port grounds	
Example	Regional line	Average / not known	100	1	0.25	0.5	Ontario Southern Rail
1	CN/CP Switch	Average / not known	1,013	1	0.38		3 23-min deliveries per day, scaled by throughput
2							
3							
4							
5							
6							
7							
8							
9							
10							

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

14 Facility locomotives

Item	Locomotive details				Fuel details			Notes/comments
	Ownership	Model	Duty cycle	Engine year	Fuel Type	Annual fuel consumption	Units of fuel	
Example	Terminal owned or leased	MP15DC	Average / not known	2002 and older	Diesel	11,000	litre	Leased from Falcon Rail.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

15 Custom locomotive duty cycle (OPTIONAL)

Notch	Duty cycle (percent time in notch)			
	National average for switch locomotives	User-defined A	User-defined B	User-defined C
Idle	84.90%			82.00%
N1	5.40%			6.00%
N2	4.20%			5.00%
N3	2.20%			3.00%
N4	1.40%			1.00%
N5	0.60%			1.00%
N6	0.30%			0.50%
N7	0.20%			0.50%
N8	0.60%			0.60%
Dynamic braking	0.20%			0.40%
Total check	100%	0%	0%	100%

Notes / comments

Administrative energy consumption

2017 Project Case

Instructions

- *This page relates to administrative energy consumption of a terminal/facility from electrical consumption, boilers and generators.*
- *If your terminal/facility is a manufacturing operation, only include energy consumption for administration (i.e., building and lights). Do not include the energy consumption associated with the facility processing (i.e., cement manufacturing, saw for lumber mills, etc.)*
- Fill out the fields in the white boxes in Table 2.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the fuel units are appropriate for the activity type (e.g., kWh for electricity).

2 Administrative energy consumption

Item	Fuel type	Energy / equipment type	Total annual consumption	Units of fuel	Description of energy usage	
Example	Electricity	Electric grid	125,000	kilowatt-hour (kWh)	80% building usage, 20% compound lighting	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
Example	Natural Gas	Boiler	40,000	gigajoule (GJ)	Total of 2,000,000 GJ. Only 2% used for admin, rest for process.	*(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)*
1	Electricity	General admin electricity	696,292	kilowatt-hour (kWh)	2013 electricity sscaled by ratio of througputs; increased to account for additiona	
2						
3						
4						
5						
6						
7						
8						
9						
10						

Notes / comments:

END-FIN

Cargo-handling equipment

Instructions

- *Data entered on this page describes the cargo-handling equipment used at your terminal/facility.*
- In Table 7, list the total fuel consumption by type. In Table 8, list the activity of each piece of equipment. **HINT:** In Table 8, group together any pieces of equipment with the same hours, age and engine size.
- Fill out the fields in the white boxes in Tables 7 and 8.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type; e.g., natural gas in gigajoules (GJ).

7 Annual fuel consumption for terminal/facility CHE

Item	Fuel type	Annual fuel consumption	Units of fuel	Notes/comments
Example	Diesel	345,000	litre	Total for whole facility was 445,000; but 100,000L was used for harbour vessels.
1	Diesel	158,269	litre	2013 scaled by ratio of 2017/2013 throughputs; CHE activity reduced by 80%
2	Propane	4,864	litre	2013 scaled by ratio of 2017/2013 throughputs
3	Gasoline	203	litre	2013 scaled by ratio of 2017/2013 throughputs
4	Diesel	17,585	litre	Shuttle Wagon (rail car pusher - included under CHE since rail RCP does not work for Tier 3) - reduced by 80% based or
5				
6				
7				
8				

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

8 Equipment list

Item	Equipment type	Engine model year	Number of similar units	Retrofit installed?	Retrofit type	Fuel type (refer to Table 7)	Engine power or boiler rating	Power units (kW, hp, BTU/hr)	Annual hours of use (for one unit)	Notes/comments
Example	Rubber Tire Gantry (RTG) cranes	2000	3	No	None	1 - Diesel	250	kW	2,500	
Example	Crawler Tractor/Dozers	2008	2	Yes	User-defined 1	1 - Diesel	400	hp	1,900	Retrofit is a Douglas 99203 DOC.
1	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3
2	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	365	hp	3,900	Age reported as 2013, entered as 2010 to force Tier 3
3	Top or Side Picks Chassis or Reach St	2010	1	No	none	1 - Diesel	230	hp	3,900	Age reported as 2011, entered as 2010 to force Tier 3
4	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3
5	Yard trucks (Hostler, Goats, Terminal	2012	1	No	None	1 - Diesel	500	hp	3,900	Age reported as 2012, entered as 2010 to force Tier 3
6	Forklifts	2008	1	No	None	2 - Propane	60	hp	520	
7	Forklifts	1976	1	No	None	2 - Propane	60	hp	250	
8	Skid Steer Loaders (small loaders)	2005	1	No	None	1 - Diesel	75	hp	75	
9	Pressure Washers	2006	3	No	None	3 - gasoline	5	hp	50	
10	Aerial Lifts	1999	1	No	None	2 - Propane	50	hp	75	
11	Tractors/Loaders/Backhoes	2010	1	No	None	4 - Diesel	300	hp	650	Shuttle Wagon equivalent; 2011 but reported as 2010 to force Tier 3
12	Top or Side Picks Chassis or Reach St	2010	1	No	None	1 - Diesel	230	hp	3,900	
13				No	None					
14				No	None					
15				No	None					
16				No	None					
17				No	None					
18				No	None					
19				No	None					
20				No	None					
21				No	None					
22				No	None					
23				No	None					
24				No	None					
25				No	None					
26				No	None					
27				No	None					
28				No	None					
29				No	None					
30				No	None					
31				No	None					
32				No	None					
33				No	None					
34				No	None					
35				No	None					
36				No	None					
37				No	None					
38				No	None					
39				No	None					
40				No	None					
41				No	None					
42				No	None					
43				No	None					
44				No	None					
45				No	None					
46				No	None					
47				No	None					
48				No	None					
49				No	None					
50				No	None					
51				No	None					
52				No	None					
53				No	None					
54				No	None					
55				No	None					
56				No	None					
57				No	None					
58				No	None					
59				No	None					
60				No	None					
61				No	None					
62				No	None					
63				No	None					
64				No	None					
65				No	None					
66				No	None					
67				No	None					
68				No	None					
69				No	None					
70				No	None					
71				No	None					
72				No	None					
73				No	None					
74				No	None					
75				No	None					
76				No	None					
77				No	None					
78				No	None					
79				No	None					
80				No	None					
81				No	None					
82				No	None					
83				No	None					
84				No	None					
85				No	None					
86				No	None					
87				No	None					
88				No	None					
89				No	None					
90				No	None					
91				No	None					
92				No	None					
93				No	None					
94				No	None					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

95				No	None					
96				No	None					
97				No	None					
98				No	None					
99				No	None					

Onroad Vehicles

Instructions

- *Data entered on this page describes onroad vehicles that operate on your terminal/facility.*
- *Vehicles reported here must be licensed for onroad use (i.e., unlicensed trucks such as yard trucks or hostlers are accounted for under the "CHE-EMF" page).*
- Fill out the fields in the white boxes in Tables 9, 10 and 11. Complete Table 9 for all highway vehicles that pick up or drop off major commodities at your terminal/facility. Complete Tables 10 and 11 for the facility trucks used on your site.
- Table 12 should be used only if highway truck fleet data is available. Typically, this would be filled out by a consultant.
- Examples are shown in grey; they are not included in your terminal/facility's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type (e.g., natural gas in GJ).

9 Highway vehicles (not operated by terminal/facility)

Item	Vehicle type	Annual gate counts	Zone C			Vehicle age profile (refer to Table 12)	Zone D (OPTIONAL)				Notes / comments
			Average time spent on terminal/facility grounds (min)	Average time driving on terminal/facility grounds (min)	Average time idling on terminal/facility grounds (min)		Distance from terminal to port entry/intermodal point (km)	Distance from terminal to port exit/intermodal point (km)	Average time idling on port grounds (min)	Average speed driven on port grounds (km/h)	
Example	Heavy Commercial Truck	2,500	15	2	3	Average / not known	10	15	10	35	
1	Heavy commercial truck	27,000	20	1	2	User-defined A					27000 for full capacity case
2											
3											
4											
5											
6											
7											
8											
9											
10											

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

10 Terminal/facility vehicle fuel consumption

Item	Fuel type	Annual fuel consumption	Units of fuel
Example	Gasoline	10,000	litre
1			
2			
3			
4			
5			
6			
7			
8			

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

Notes / comments

Age profile based on PMV LEI age profile

11 List of terminal / facility vehicles

Item	Vehicle type	Fleet age	Number of similar vehicles	Relative intensity of use	Fuel type (refer to Table 10)
Example	Van / Pickup - small utility	2005 - 2009	5	3 - Medium (average)	1 - Gasoline
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

12 Custom highway vehicle fleet age profile (OPTIONAL)

Age	Average / not known (default)		User-defined A		User-defined B		User-defined C	
	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage	Number of vehicles	Percentage
0	23,655	8.4%	1	0.5%		#DIV/0!		#DIV/0!
1	35,541	12.7%	2	1.7%		#DIV/0!		#DIV/0!
2	29,319	10.5%	2	2.0%		#DIV/0!		#DIV/0!
3	26,627	9.5%	10	10.1%		#DIV/0!		#DIV/0!
4	23,115	8.3%	4	4.0%		#DIV/0!		#DIV/0!
5	20,070	7.2%	8	7.5%		#DIV/0!		#DIV/0!
6	17,436	6.2%	8	7.5%		#DIV/0!		#DIV/0!
7	15,142	5.4%	7	7.3%		#DIV/0!		#DIV/0!
8	13,142	4.7%	3	3.0%		#DIV/0!		#DIV/0!
9	11,383	4.1%	8	8.0%		#DIV/0!		#DIV/0!
10	9,837	3.5%	48	48.2%		#DIV/0!		#DIV/0!
11	8,777	3.1%	0	0.0%		#DIV/0!		#DIV/0!
12	7,192	2.6%	0	0.0%		#DIV/0!		#DIV/0!
13	6,109	2.2%	0	0.0%		#DIV/0!		#DIV/0!
14	5,076	1.8%	0	0.0%		#DIV/0!		#DIV/0!
15	4,343	1.6%	0	0.0%		#DIV/0!		#DIV/0!
16	3,600	1.3%	0	0.0%		#DIV/0!		#DIV/0!
17	2,990	1.1%	0	0.0%		#DIV/0!		#DIV/0!
18	2,562	0.9%	0	0.0%		#DIV/0!		#DIV/0!
19	2,214	0.8%	0	0.0%		#DIV/0!		#DIV/0!
20	1,919	0.7%	0	0.0%		#DIV/0!		#DIV/0!
21	1,668	0.6%	0	0.0%		#DIV/0!		#DIV/0!
22	1,451	0.5%	0	0.0%		#DIV/0!		#DIV/0!
23	1,266	0.5%	0	0.0%		#DIV/0!		#DIV/0!
>24	5,567	2.0%	0	0.0%		#DIV/0!		#DIV/0!

National/regional and facility rail

Instructions

- *Data entered on this page describes rail locomotives that operate on your terminal/facility.*
- Fill out the fields in the white boxes in Tables 13, 14 and potentially 15. Complete Table 13 for locomotives on your terminal/facility that are operated by CN/CP or a regional line. Complete Table 14 for all locomotives that are operated by your terminal/facility. If you have specific notch data for your locomotives enter this in Table 15.
- Examples are shown in grey; they are not included in your terminal's data.
- Use the drop-down menu to select a response from a pre-defined list.
- Check that the units of measure are appropriate for the fuel or power type (e.g., diesel in litres).

13 National/regional rail on terminal/facility grounds

Item	Rail line service provider	Duty Cycle	Annual train visits to terminal/facility	Average movement details per visit			Notes/comments
				Average number of locomotives per train	Average time spent on terminal/facility grounds (hours)	Average time spent on port grounds	
Example	Regional line	Average / not known	100	1	0.25	0.5	Ontario Southern Rail
1	CN/CP Switch	Average / not known	500	1	0.46		1 30-min delivery, 1 25-min collection per day
2							
3							
4							
5							
6							
7							
8							
9							
10							

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

14 Facility locomotives

Item	Locomotive details				Fuel details			Notes/comments
	Ownership	Model	Duty cycle	Engine year	Fuel Type	Annual fuel consumption	Units of fuel	
Example	Terminal owned or leased	MP15DC	Average / not known	2002 and older	Diesel	11,000	litre	Leased from Falcon Rail.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

(The example entry shown in grey is only for demonstration; it will not be included in your facility's data.)

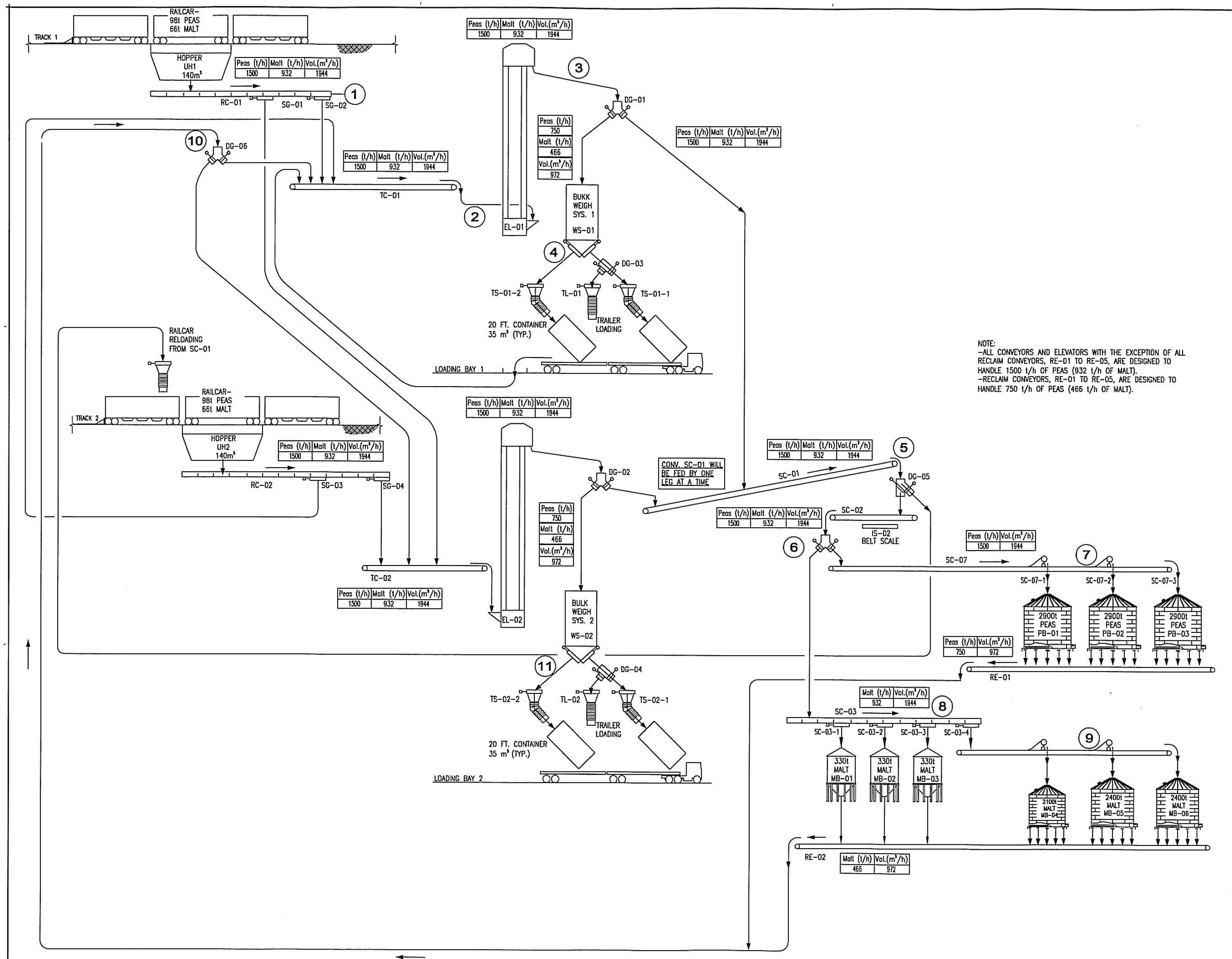
15 Custom locomotive duty cycle (OPTIONAL)

Notch	Duty cycle (percent time in notch)			
	National average for switch locomotives	User-defined A	User-defined B	User-defined C
Idle	84.90%			82.00%
N1	5.40%			6.00%
N2	4.20%			5.00%
N3	2.20%			3.00%
N4	1.40%			1.00%
N5	0.60%			1.00%
N6	0.30%			0.50%
N7	0.20%			0.50%
N8	0.60%			0.60%
Dynamic braking	0.20%			0.40%
Total check	100%	0%	0%	100%

Notes / comments

APPENDIX D

Fugitive dust collection transfer points



PROJECT TRUE

ISSUED FOR PERMIT
October 1, 2014

CONSULTANT

REV	DESCRIPTION	DATE (YYYY/MM/DD)	BY	CHECKED
E	ISSUED FOR PERMIT	2014/10/01	AAS	CF
D	ISSUED FOR PERMIT	2014/08/27	AN	-
C	ISSUED FOR AGI QUOTE	2014/08/01	AN	-
B	ISSUED FOR FROZEN LAYOUT	2014/07/16	AN	RC
A	PRELIMINARY		AN	RC

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DATE AUG 2014

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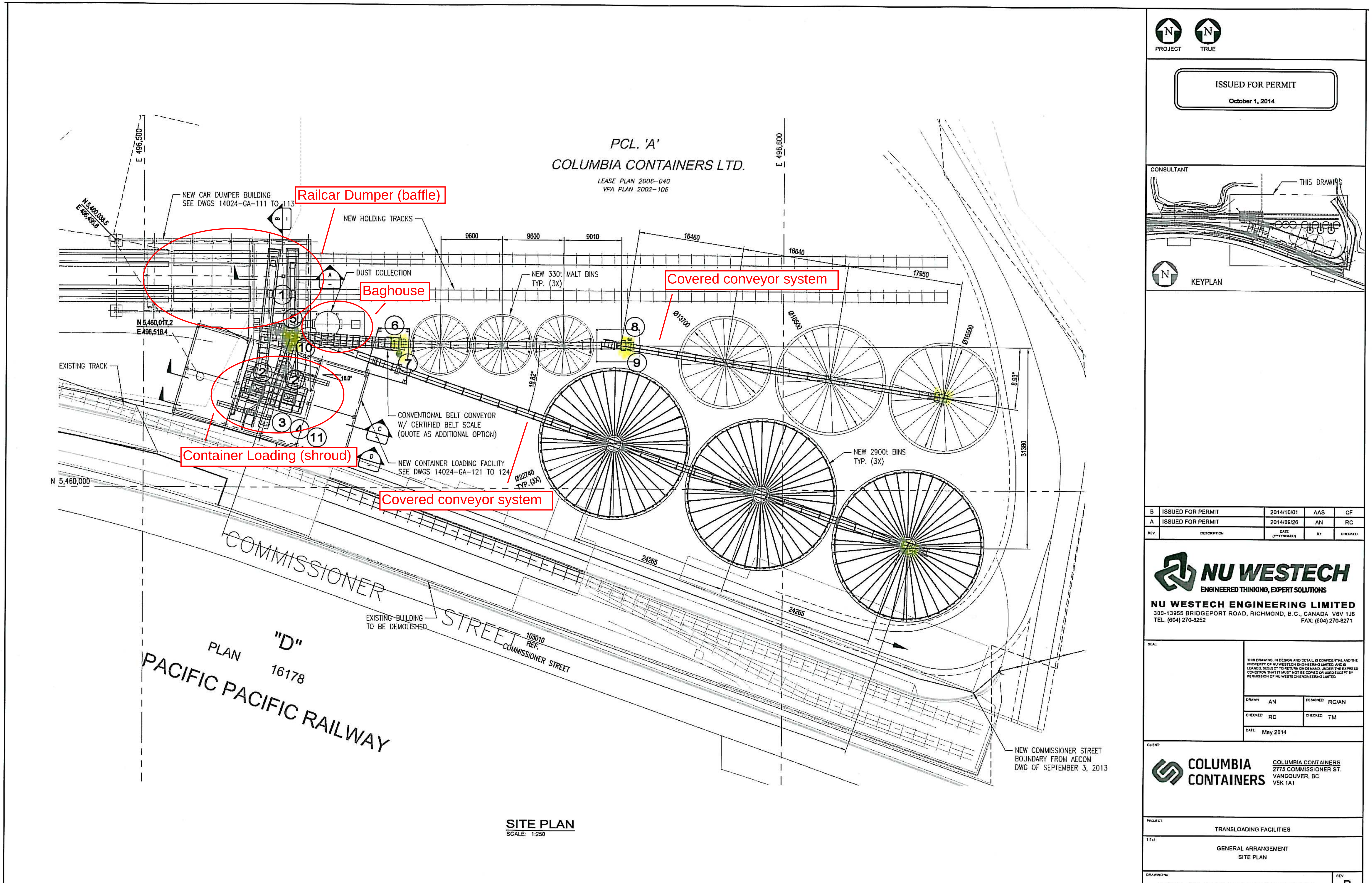
VANCOUVER, BC
V5K 1A1

PROJECT
TRANSLOADING FACILITIES

TITLE
PROCESS FLOWSHEET

DRAWING No. 14024-PF-100 TRANSFER POINTS
REV E



PCL. 'A'
COLUMBIA CONTAINERS LTD.
LEASE PLAN 2006-040
VPA PLAN 2002-106
E 496,500
E 496,600
N 5,460,038.5
E 496,495.6
NEW CAR DUMPER BUILDING
SEE DWGS 14024-GA-111 TO 113
Railcar Dumper (baffle)
NEW HOLDING TRACKS
9600
9600
9010
16460
16640
17950
DUST COLLECTION
Baghouse
NEW 330t MALT BINS
TYP. (3X)
Covered conveyor system
Ø13700
Ø16500
Ø16500
N 5,460,017.2
E 496,516.4
EXISTING TRACK
16.0°
18.82°
8.93°
31380
CONVENTIONAL BELT CONVEYOR
W/ CERTIFIED BELT SCALE
(QUOTE AS ADDITIONAL OPTION)
NEW CONTAINER LOADING FACILITY
SEE DWGS 14024-GA-121 TO 124
Container Loading (shroud)
Ø22740
TYP. (3X)
Covered conveyor system
NEW 2900t BINS
TYP. (3X)
N 5,460,000
24265
24265
COMMISSIONER
STREET
EXISTING BUILDING
TO BE DEMOLISHED
103010
REF.
COMMISSIONER STREET
"D"
PLAN
16178
PACIFIC PACIFIC RAILWAY
NEW COMMISSIONER STREET
BOUNDARY FROM AECOM
DWG OF SEPTEMBER 3, 2013
1
2
2
3
4
5
6
7
8
9
10
11
SITE PLAN
SCALE: 1:250
PROJECT
TRUE
ISSUED FOR PERMIT
October 1, 2014
CONSULTANT
THIS DRAWING
KEYPLAN
B | ISSUED FOR PERMIT | 2014/10/01 | AAS | CF
A | ISSUED FOR PERMIT | 2014/09/26 | AN | RC
REV | DESCRIPTION | DATE (YYYY/MM/DD) | BY | CHECKED
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CHECKED TM
DATE May 2014
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VANCOUVER, BC
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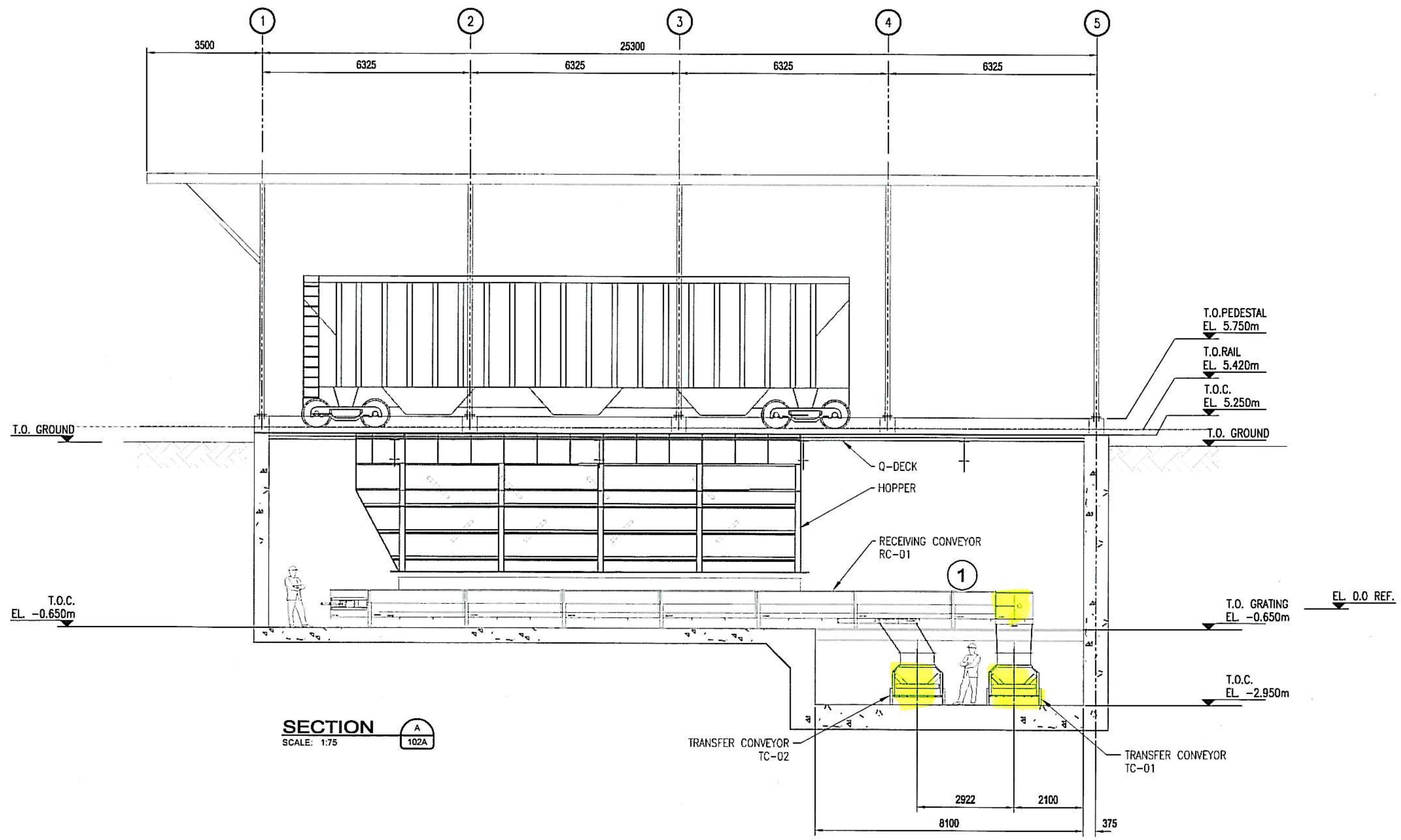
PROJECT
TRANSLOADING FACILITIES
TITLE
GENERAL ARRANGEMENT
SITE PLAN
DRAWING No
14024-GA-102A TRANSFER POINTS
REV
B



SECTION A / 102A
SCALE: 1:75

ISSUED FOR PERMIT
October 1, 2014

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REV	DESCRIPTION	DATE (YYYY/MM/DD)	BY	CHECKED
D	ISSUED FOR PERMIT	2014/10/01	AAS	CF
C	ISSUED FOR PERMIT	2014/08/27	AN	-
B	ISSUED AS FROZEN LAYOUT	2014/07/16	AN	RC
A	PRELIMINARY	2014/05/02	AN	RC

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CHECKED RC | CHECKED TM
DATE June 2014

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VANCOUVER, BC
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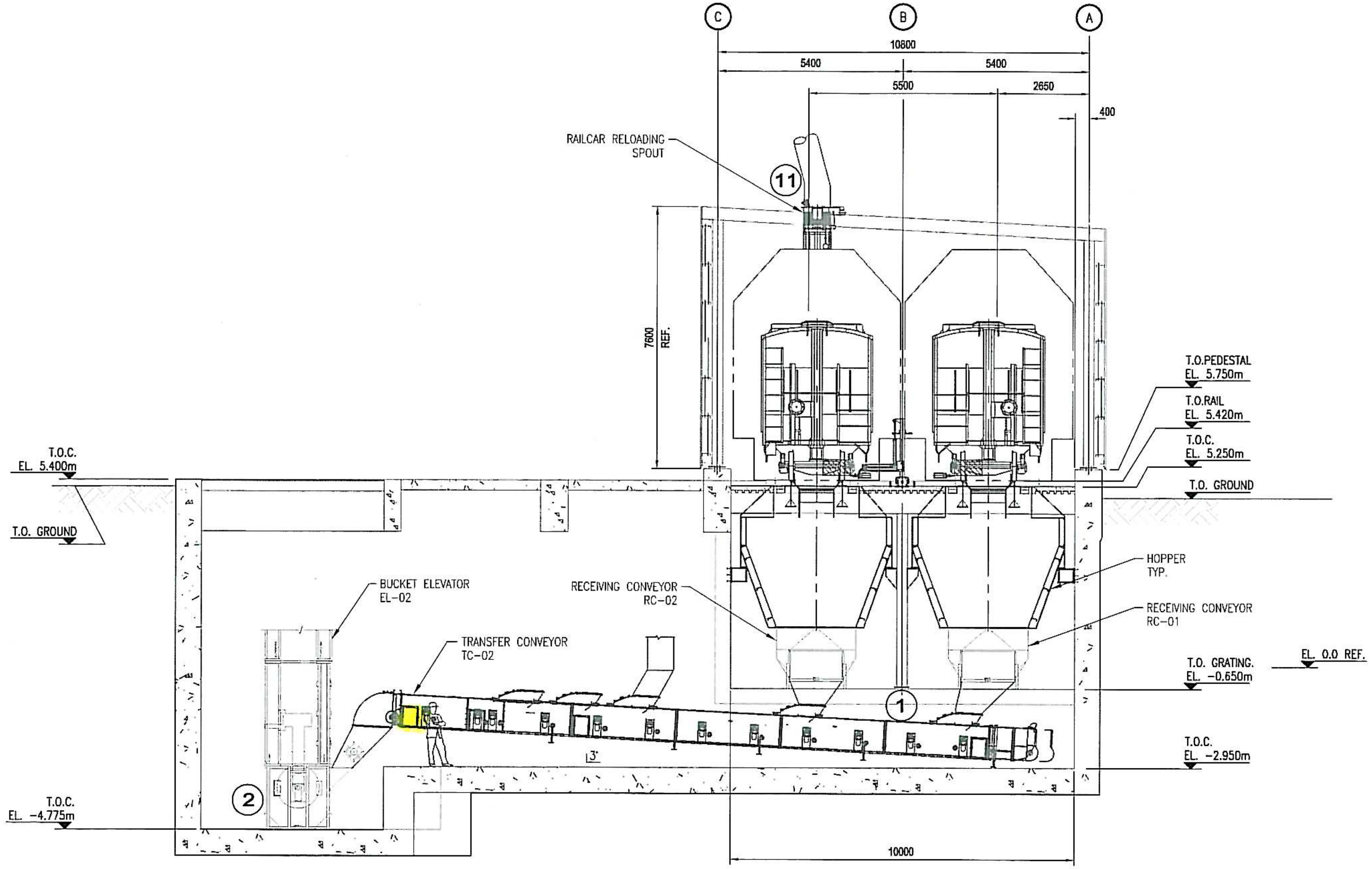
PROJECT
TRANSLOADING FACILITIES

TITLE
GENERAL ARRANGEMENT
RAILCAR UNLOADING FACILITY
SECTIONS - SHEET 1

DRAWING No.
14024-GA-115 TRANSFER POINTS

REV
D



SECTION B / 102A
SCALE: 1:75

NOTE:
TRANSFER CONVEYOR AND ELEVATOR SHOWN ROTATED FOR CLARITY

ISSUED FOR PERMIT
October 1, 2014

CONSULTANT

REV	DESCRIPTION	DATE (YYYY/MM/DD)	BY	CHECKED
E	ISSUED FOR PERMIT	2014/10/01	AAS	CF
D	-	-	AN	-
C	ISSUED FOR PERMIT	2014/08/27	AN	-
B	ISSUED AS FROZEN LAYOUT	2014/07/16	AN	RC
A	PRELIMINARY	2014/05/02	AN	RC

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CHECKED RC | CHECKED TM
DATE May 2014

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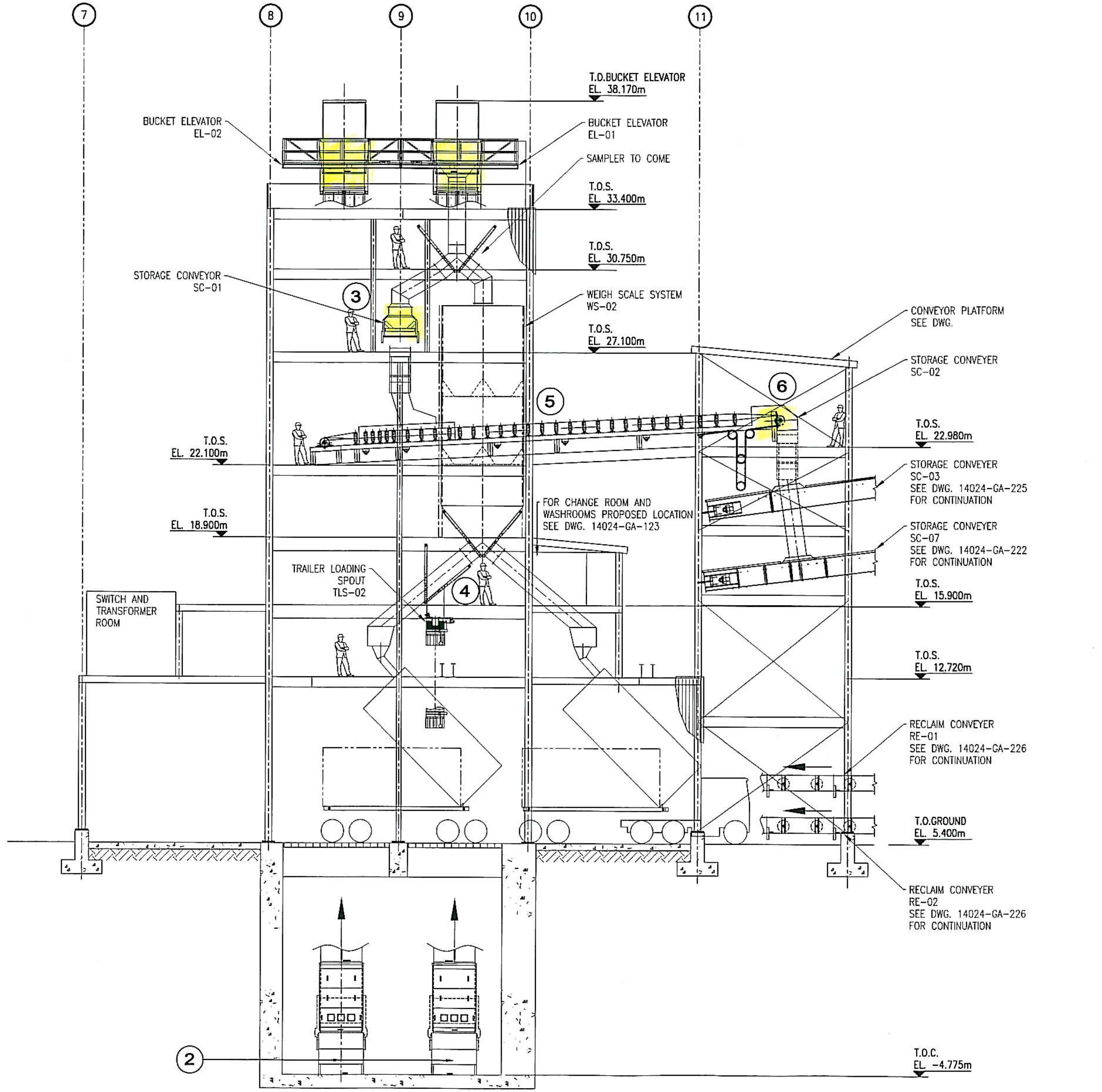
PROJECT
TRANSLOADING FACILITIES

TITLE
GENERAL ARRANGEMENT
RAILCAR UNLOADING FACILITY
SECTIONS - SHEET 3

DRAWING No.
14024-GA-117 TRANSFER POINTS
REV.
E



SECTION C 102A
SCALE: 1:100

NOTES:

STRUCTURAL IS FULLY CLAD.
TOWER CLADDING NOT SHOWN FOR CLARITY

ISSUED FOR PERMIT
October 1, 2014

CONSULTANT

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F	ISSUED FOR PERMIT	2014/10/01	AAS	CF
E	ISSUED FOR CLIENT REVIEW	2014/09/04	AN	-
D	ISSUED FOR PERMIT	2014/08/27	AN	-
C	ISSUED FOR PERMIT	2014/08/19	AN	-
B	ISSUED FOR FROZEN LAYOUT	2014/07/16	AN	RC
A	PRELIMINARY		AN	RC

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CHECKED	RC	CHECKED	TM
DATE	July 2014		

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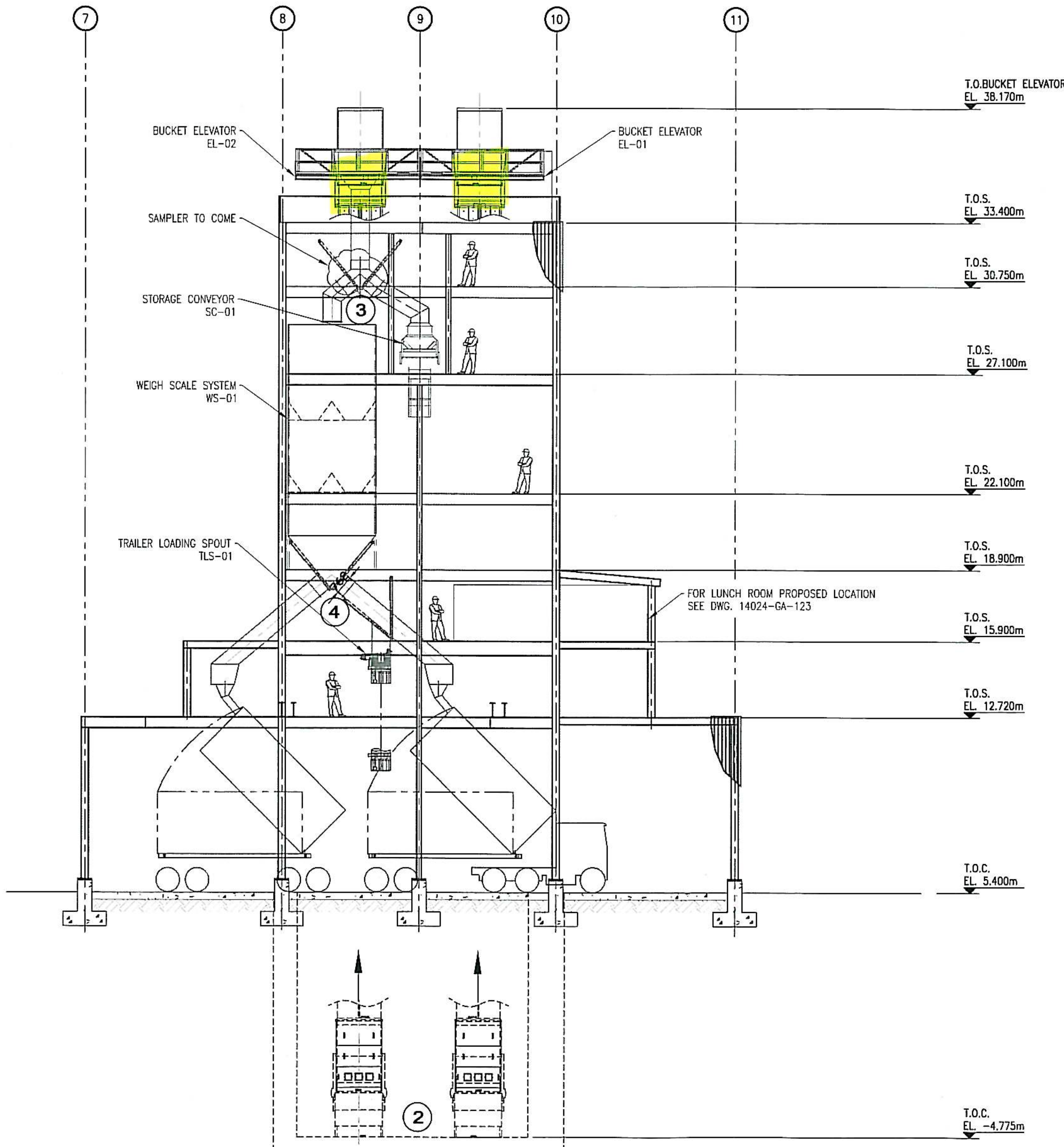
PROJECT
TRANSLOADING FACILITIES

TITLE
GENERAL ARRANGEMENT
CONTAINER LOADING FACILITY
SECTIONS - SHEET 1

DRAWING No
14024-GA-130 TRANSFER POINTS

REV
F



SECTION D/102A
SCALE: 1:100

NOTES:

STRUCTURAL IS FULLY CLAD.
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A	PRELIMINARY		AN	RC

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CHECKED	RC	CHECKED	TM
DATE	July 2014		

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PROJECT

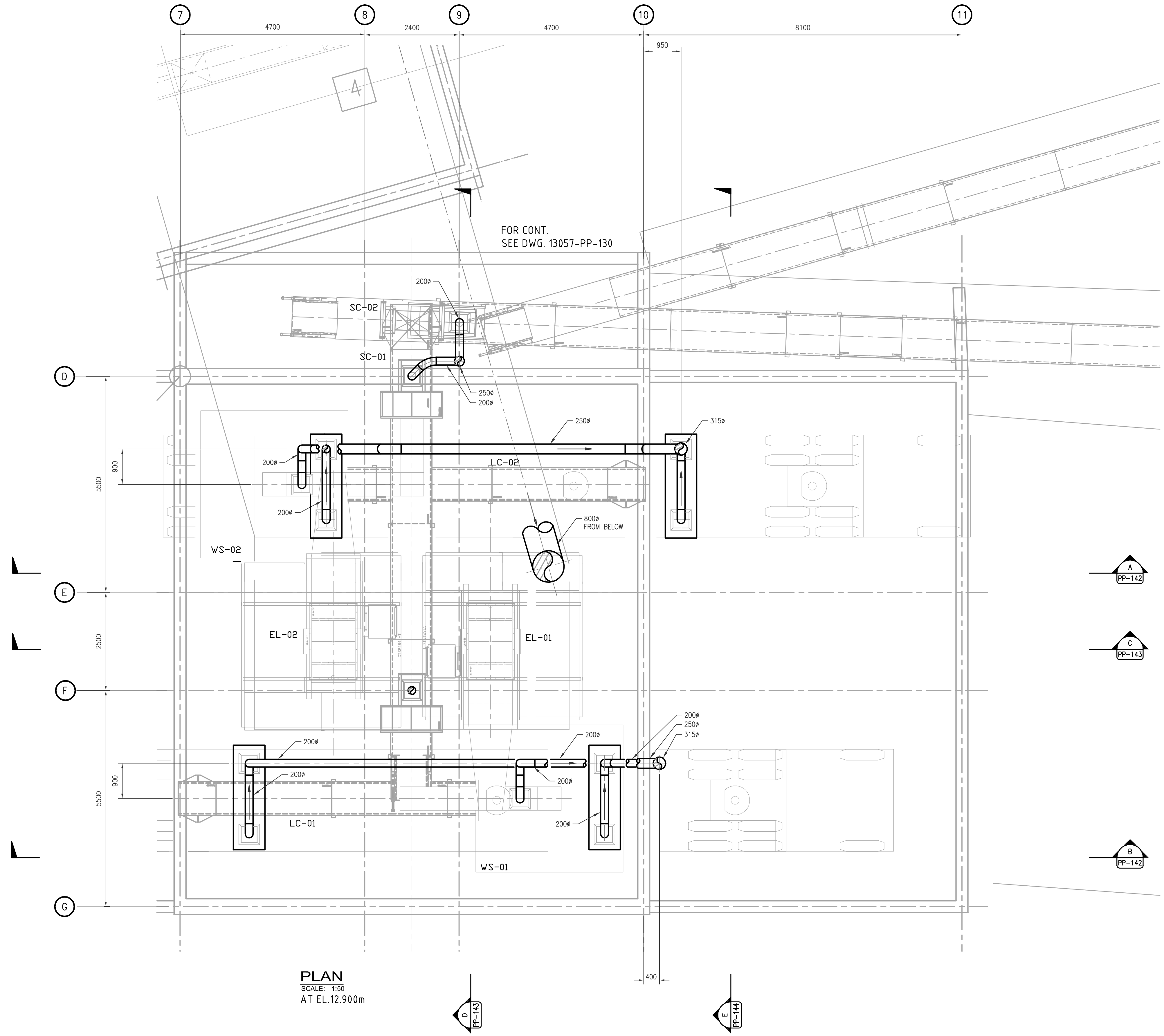
TRANSLOADING FACILITIES

TITLE

GENERAL ARRANGEMENT
CONTAINER LOADING FACILITY
SECTIONS - SHEET 2

DRAWING No.
14024-GA-131 TRANSFER POINTS

REV.
A



PLAN
SCALE: 1:50
AT EL.12.900m

PROJECT
TRUE

— PRELIMINARY —
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February 14, 2014

CONSULTANT

NOTES:

1. DUST COLLECTION SYSTEM IS BASE ON 18 M/S AIR FLOW AND 0.6 M/S

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A	ISSUE FOR REVIEW	2013/01/28	-	-

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DRAWN: FC
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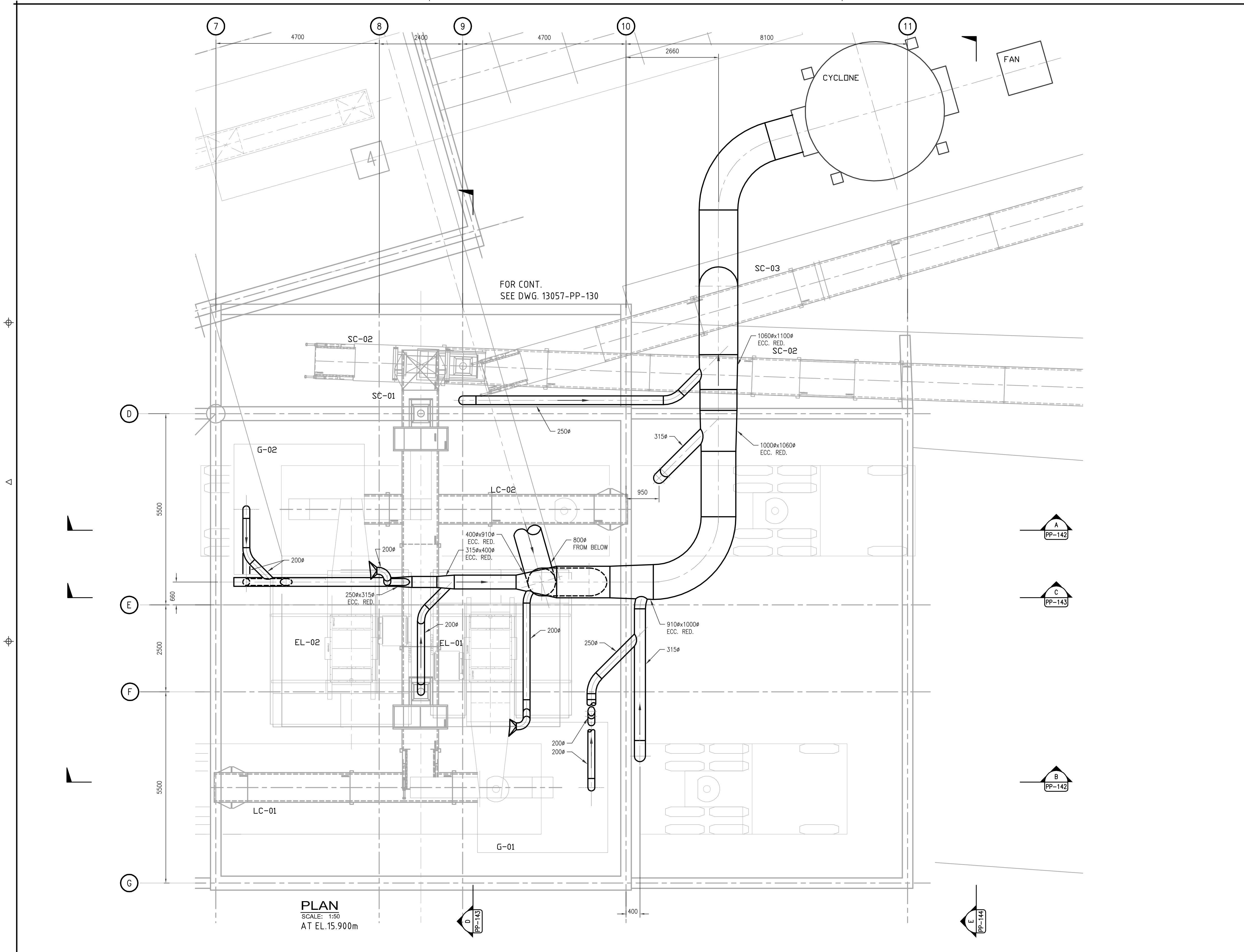
PROJECT: TRANSLOADING FACILITIES

TITLE: CAR DUMPER AREA
DUST COLLECTION PLAN
SHEET - 2

DRAWING No. 13057-PP-131
REV. A



N PROJECT
N TRUE

— PRELIMINARY —
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February 14, 2014

CONSULTANT

NOTES:

1. DUST COLLECTION SYSTEM IS BASE ON 18 M/S AIR FLOW AND 0.6 M/S

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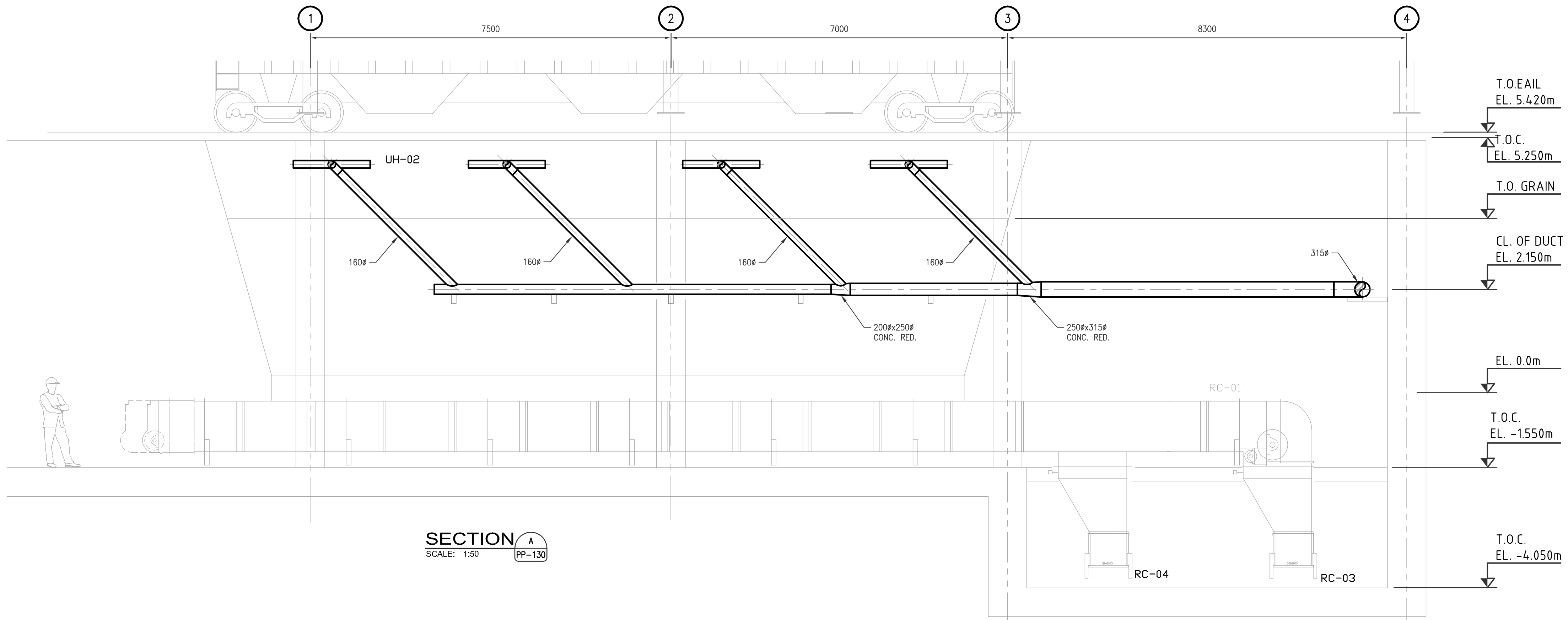
PROJECT: TRANSLOADING FACILITIES

TITLE: CAR DUMPER AREA
DUST COLLECTION PLAN
SHEET - 3

DRAWING No. 13057-PP-132

REV. A



SECTION A PP-130
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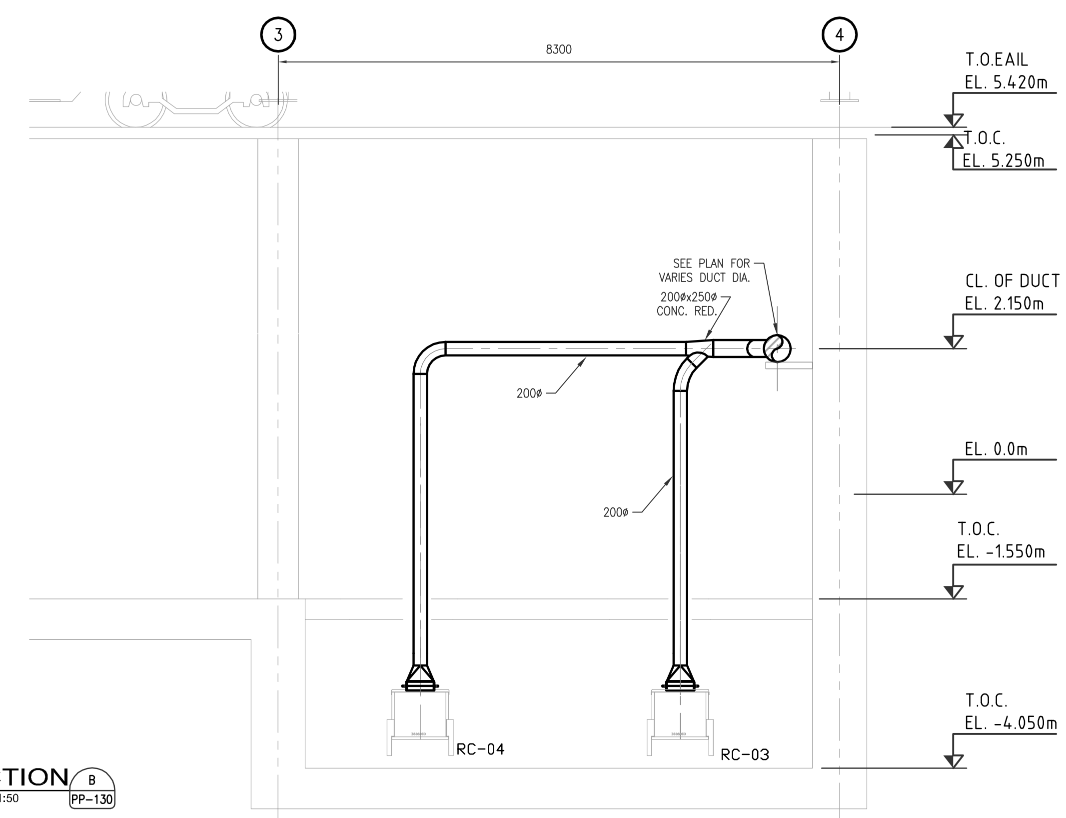

SECTION B PP-130
SCALE: 1:50

PROJECT N
TRUE N

— PRELIMINARY —
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NOTES:

1. DUST COLLECTION SYSTEM IS BASE ON 18 M/S AIR FLOW AND 0.6 M/S

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DATE: Feb. 2014	

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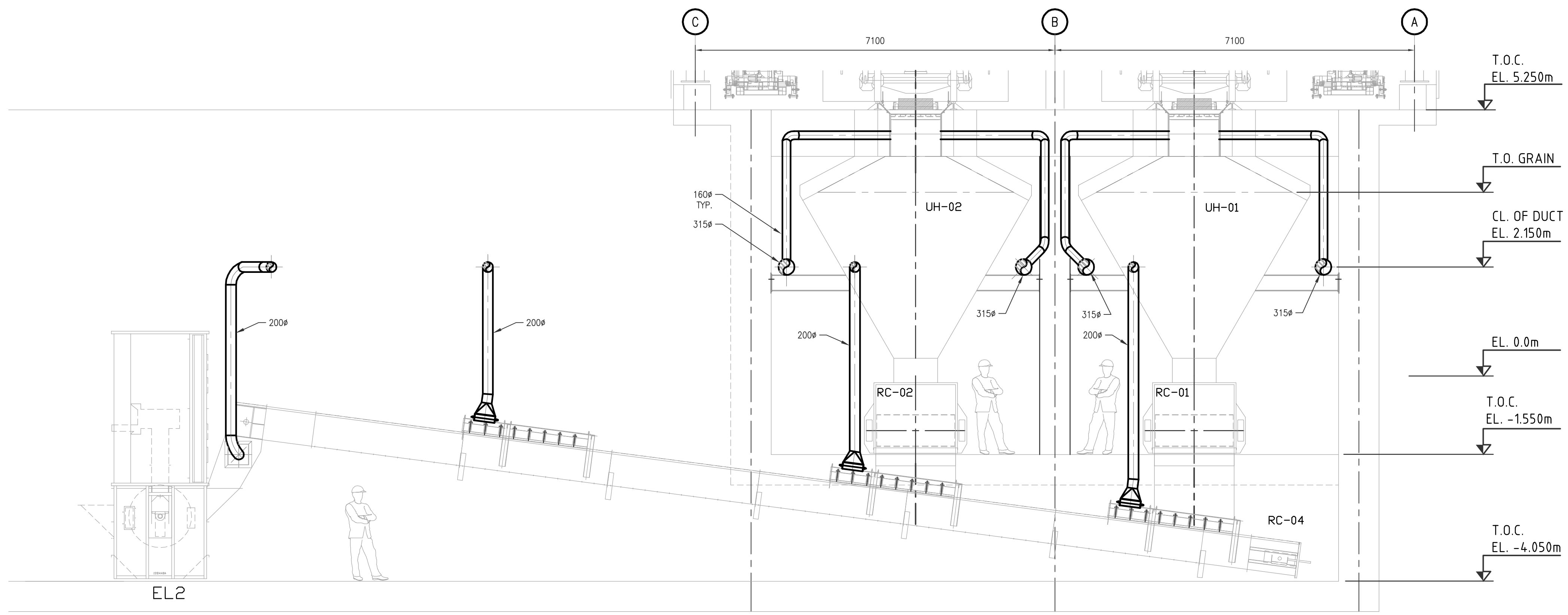
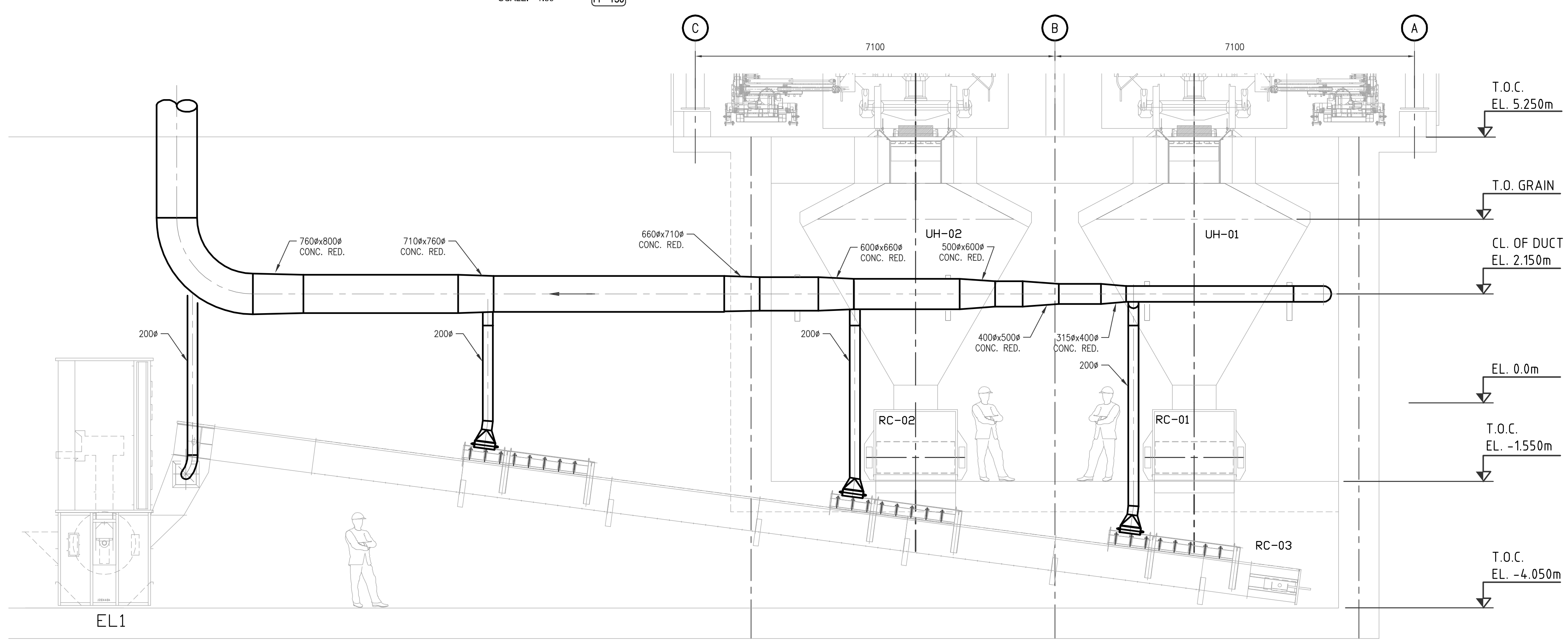
PROJECT: TRANSLOADING FACILITIES

TITLE: CAR DUMPER AREA
DUST COLLECTION SECTIONS
SHEET - 1

DRAWING No. 13057-PP-140 REV. A



SECTION C
SCALE: 1:50 PP-130



SECTION D
SCALE: 1:50 PP-130

PROJECT N — TRUE N

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NOTES:

1. DUST COLLECTION SYSTEM IS BASE ON 18 M/S AIR FLOW AND 0.6 M/S

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A	ISSUE FOR REVIEW	2013/01/28	-	-

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CHECKED:	RC	CHECKED:	-
DATE:	Feb. 2014		

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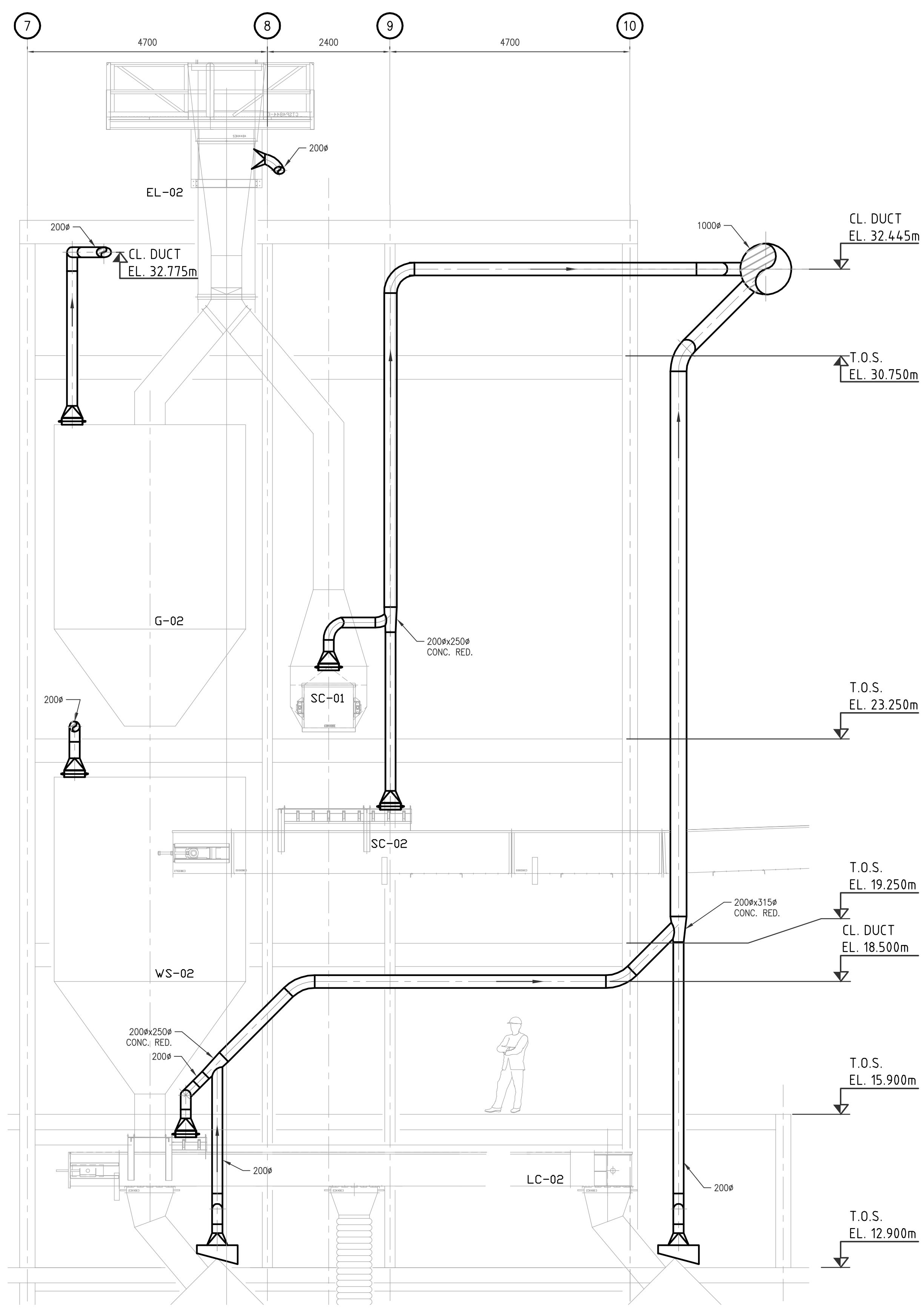
PROJECT: TRANSLOADING FACILITIES

TITLE:
CAR DUMPER AREA
DUST COLLECTION SECTIONS
SHEET - 2

DRAWING No. 13057-PP-141 REV. A



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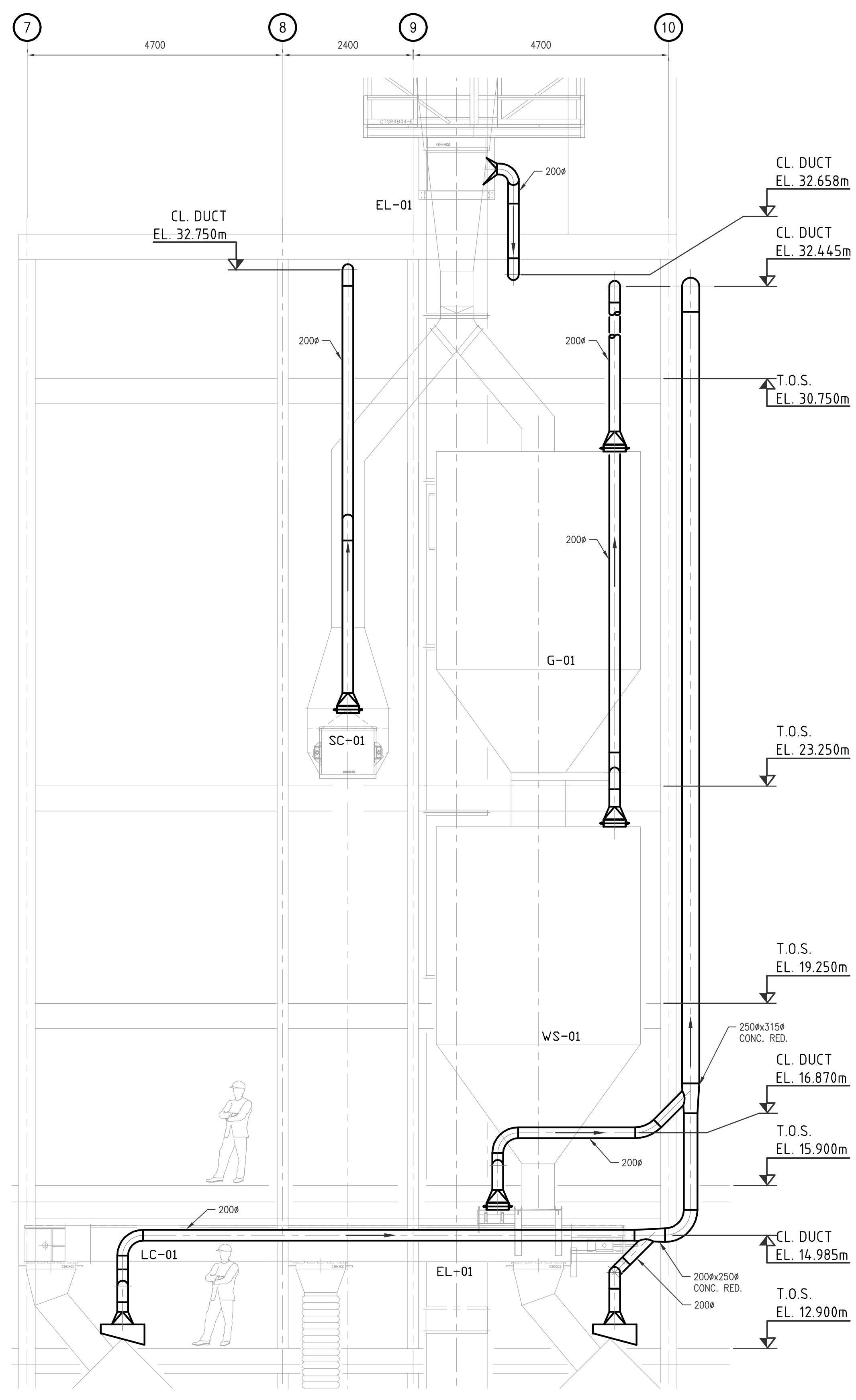

SECTION B/PP-131 B/PP-132
SCALE: 1:50

PROJECT N TRUE N

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NOTES:

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DATE:	Feb. 2014		

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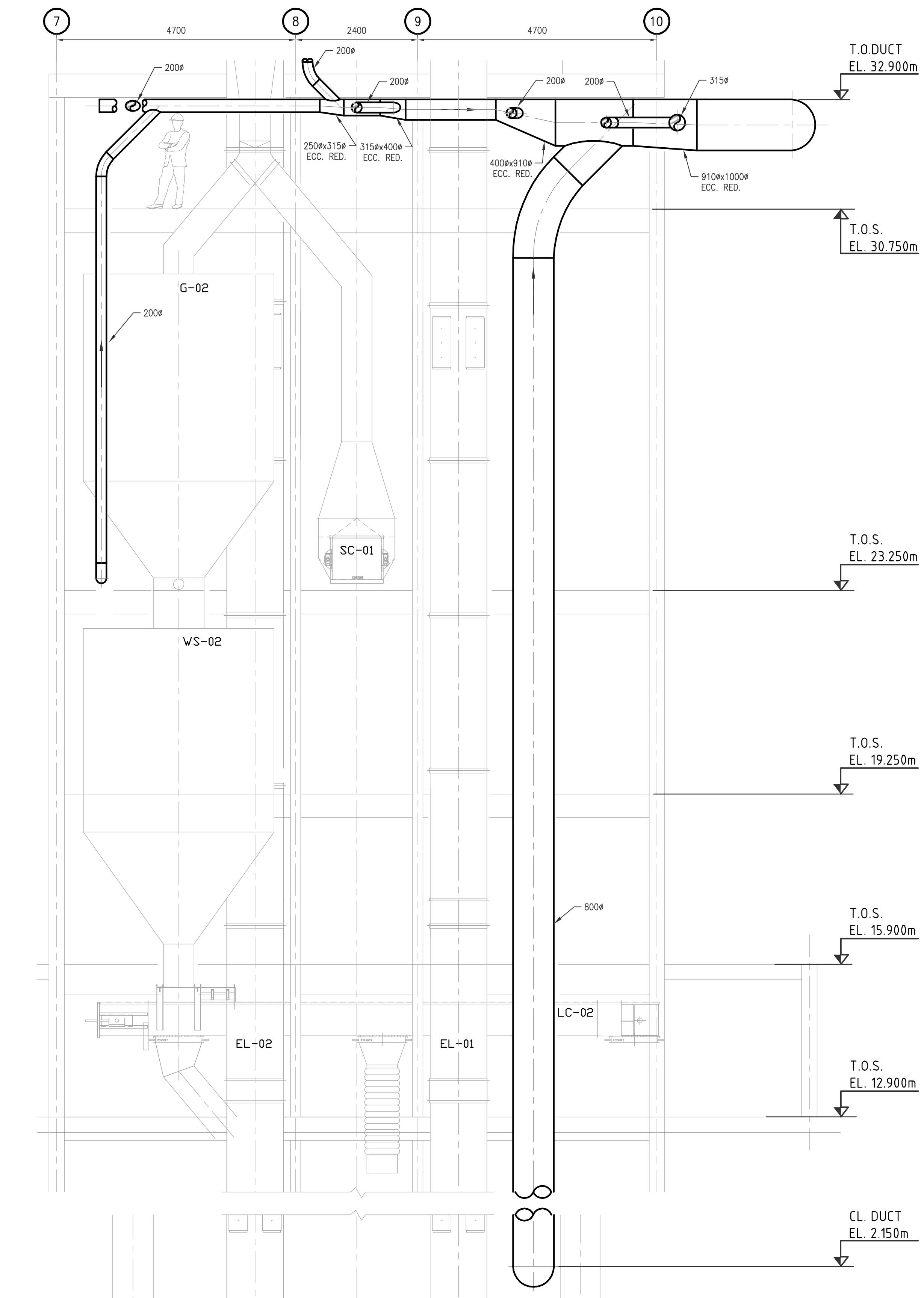
PROJECT: TRANSLOADING FACILITIES

TITLE: CAR DUMPER AREA
DUST COLLECTION SECTIONS
SHEET - 3

DRAWING No. 13057-PP-142 REV. A



SECTION C/PP-131 C/PP-132
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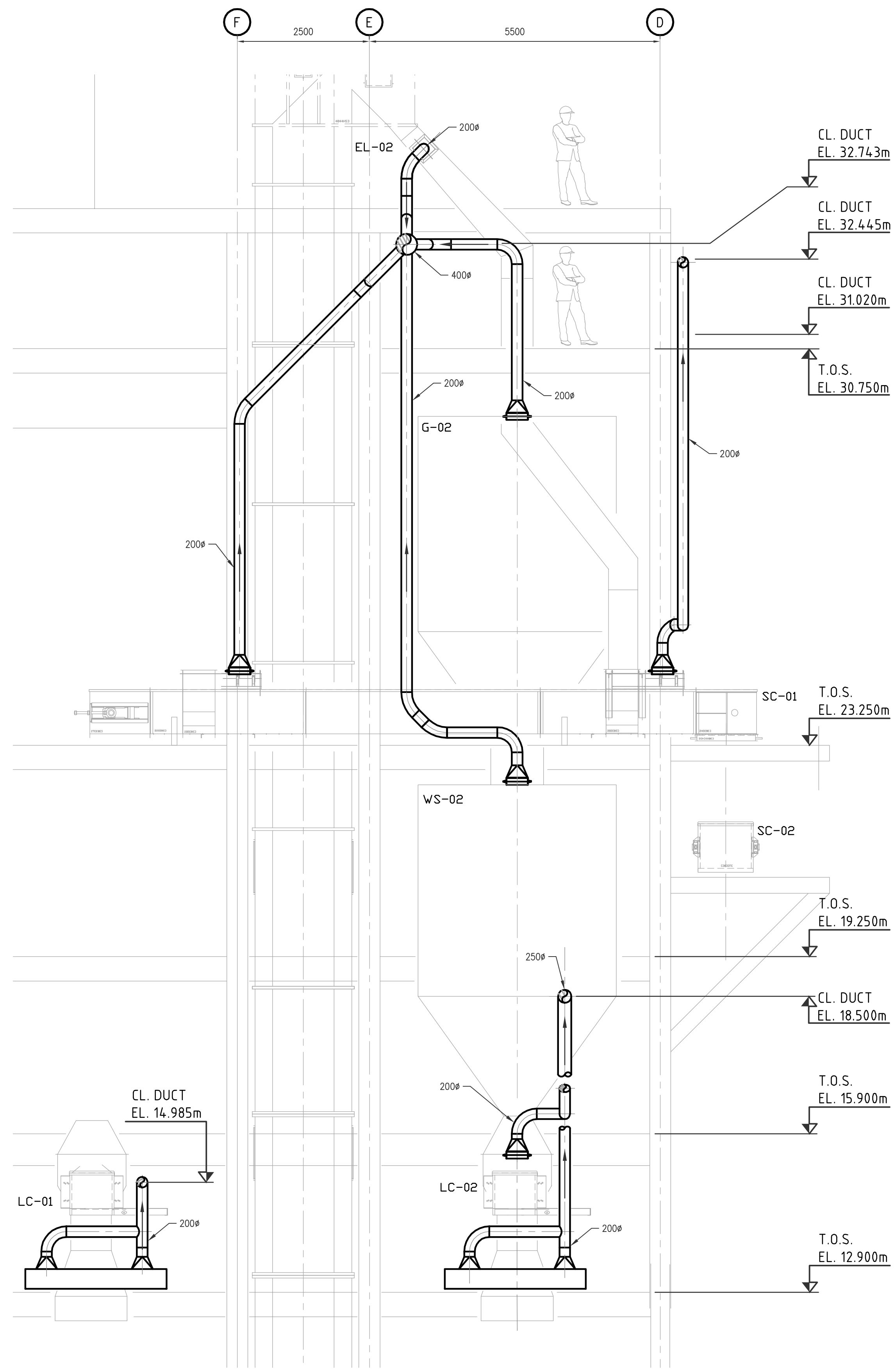

SECTION D/PP-131 D/PP-132
SCALE: 1:50

PROJECT N TRUE N

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NOTES:

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CHECKED:	RC	CHECKED:	-
DATE:	Feb. 2014		

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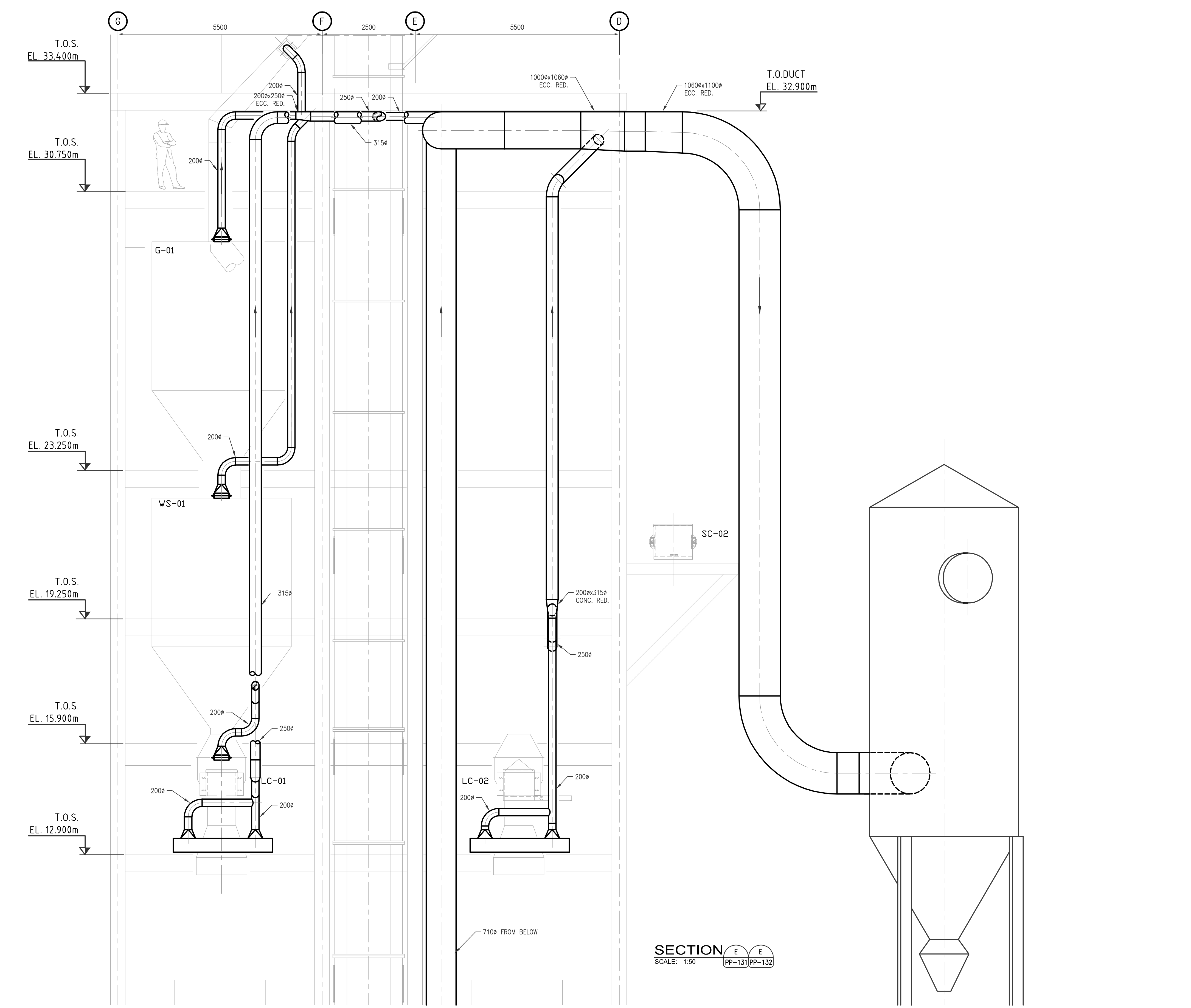
PROJECT:
TRANSLOADING FACILITIES

TITLE:
CAR DUMPER AREA
DUST COLLECTION SECTIONS
SHEET - 4

DRAWING No.: 13057-PP-143
REV.: A



— PRELIMINARY —
NOT FOR CONSTRUCTION
February 14, 2014

PROJECT
TRUE

CONSULTANT

NOTES:

1. DUST COLLECTION SYSTEM IS BASE ON 18 M/S AIR FLOW AND 0.6 M/S

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A	ISSUE FOR REVIEW	2014/02/25	-	-

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CHECKED: RC CHECKED: -
DATE: Feb. 2014

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VANCOUVER, BC
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PROJECT: TRANSLOADING FACILITIES

TITLE: CAR DUMPER AREA
DUST COLLECTION SECTION
SHEET - 5

DRAWING No. 13057-PP-144
REV. A

APPENDIX E

Donaldson cyclone dust collector specifications

Cyclone Dust Collectors

Models 12, 16, 20, 24, 30, 36, and 44

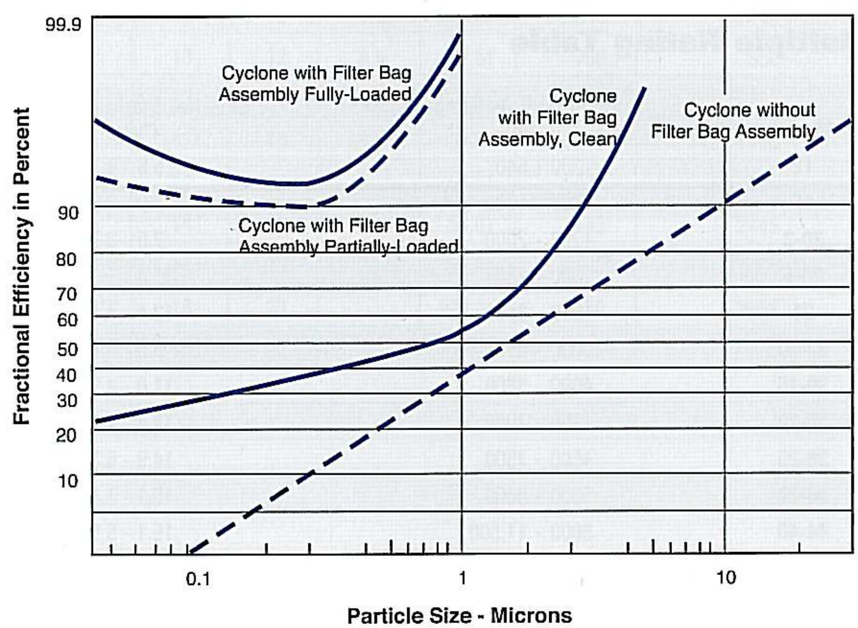
Mechanical separator using centrifugal force to remove large and high-volume dust from industrial applications.

- An economical solution to a wide range of dust collection problems.
- Excellent for high dust load, high temperature, and product recovery applications.
- Can be used alone, with optional filter bag assembly, or as a pre-cleaner.
- Applications from 300 to 13,000 cfm.
- Heavy-duty construction for long life and low maintenance.
- Meets seismic zone 4 and 100 mph wind load ratings.
- Removable cone section for easy replacement.

Cyclone Dust Collector with Optional Filter Bag Assembly

Fractional Efficiency is the ratio of particles collected to particles entering the cyclone.

- This chart illustrates the efficiency* of a Cyclone collector with and without an optional filter bag assembly under clean, partially-loaded, and fully-loaded filter bag conditions.



* Actual efficiency may vary depending on the application. Dust concentration, airflow, particle shape, and density affect filtration efficiency.