

CAC Emission Inventory for the Province outside of the Lower Fraser Valley for 2010

Warren McCormick
Ministry of Environment
Victoria, BC

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Section A: Summary

Background

This report presents the inventory of Common Air Contaminants (CAC) for 2010 for the area of the Province outside of the Lower Fraser Valley (also referred to as the “Rest of BC”). MetroVancouver Air Quality staff compile and report on the inventory for the Lower Fraser Valley including the area of greater Vancouver and the Fraser Valley as far east as Hope¹. This report does not include any results for that area.

Common Air Contaminants

Common Air Contaminants are those pollutants emitted by human activity that are considered to be harmful or potentially harmful to human health. One pollutant not inventoried is Ozone since ozone is a secondary pollutant and is formed in the atmosphere due to the reactions of nitrogen oxides and organic compounds. The list of CACs reported on here is:

Particulate Matter

Particulate Matter (PM) refers to solid or liquid particles of various sizes that are suspended in the air and essentially act much like a gas. They are classified by their size ranges: Total Particulate Matter (TPM) refers to all particles up to about 50microns (1 micron is 1×10^{-6} of a metre), historically called Total Suspended Particles; Particulate Matter less than 10microns (PM10) is particles up to 10microns, also called respiratal particles or PMcoarse and Particulate Matter less than 2.5microns (PM25) is particles up to 2.5microns, also called inhalable particles or PMfine. Recent medical research has shown that the smaller sized particles (PM2.5) have the greater health effect which has driven the need to report on the selected size ranges of PM. Measurements of particulate matter are made on the basis of its mass, not composition. Thus, a tonne of PM from a source such as wind-blown dust or even road dust may not have the same health effect as a tonne of PM from a combustion source, however the cut-point of 2.5microns forms a generalized boundary between combustion produced particles (PM25) and those formed by mechanical forces (PM10 and TPM).

Nitrogen Oxides

Nitrogen Oxides (NOx) are formed during the combustion process when nitrogen gas (N₂) in the air reacts in the combustion process to form Nitrogen Oxide (NO) and Nitrogen Dioxide (NO₂), which are generally reported in emission inventories as NOx. Some liquid fuels, such as diesel and oil, can have a fuel based source of nitrogen which adds to the emission amounts.

Sulphur Oxides

Sulphur Oxides (SOx) are formed in the combustion process when the fuel contains sulphur, which is particularly true in heavier liquid fuels. The emission is usually in the form of Sulphur Dioxide (SO₂) but there can be trace amounts of other oxides. Some source sectors use sulphur based products in their processes (e.g. the making of pulp) or extract it from the product as a waste (e.g. the removal of sulphur

¹ See <http://www.metrovancouver.org/services/air/emissions/Pages/default.aspx>

from natural gas and oil refining). These facilities will emit SO_x due to that activity which is much greater than their fuel combustion amounts.

Volatile Organic Compounds

Volatile Organic Compounds (VOC) are a family of organic compounds (also called hydrocarbons) containing 100's of individual compounds that are important in the chemistry of ground level ozone formation. They are emitted from combustion sources as un-burnt fuel and products of in-complete combustion, through the use of paints, glues, solvents and cleaners and from wood processing activities such as cutting, sanding and drying.

Carbon Monoxide

Carbon Monoxide (CO) is a product of un-complete combustion that can have serious health effects at high concentrations, however given the improvements in vehicle engines over the decades there is little issues in the ambient environment currently. It remains part of the inventory reporting largely due to historical precedence.

Other Contaminants

Total Reduced Sulphur (TRS) is a group of odorous compounds that are usually associated with the kraft pulp mill process. This parameter is reported separately for pulp mills since this is an important industry in the province. Ammonia (NH₃) is associated with some activities mainly agriculture. Recent atmospheric research is indicating that it is a key player in visibility chemistry. Ammonia is reported separately for some activities.

Summary of Results

In this report, the anthropogenic sources will be divided into the source sectors: Point, Area and Mobile. The Point Source Sector refers to larger industrial facilities that either report emissions to Environment Canada or have BC Ministry of Environment permits. The Area Source Sector is all other stationary sources such as space heating. The Mobile Source Sector is all vehicles and other equipment powered by an internal combustion engine.

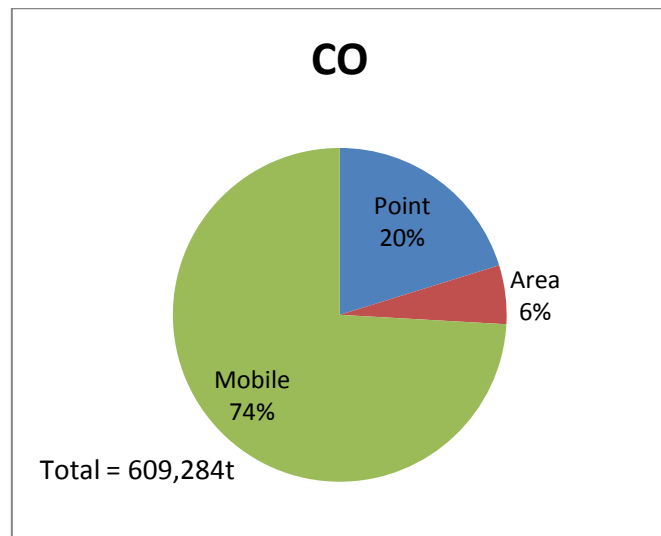
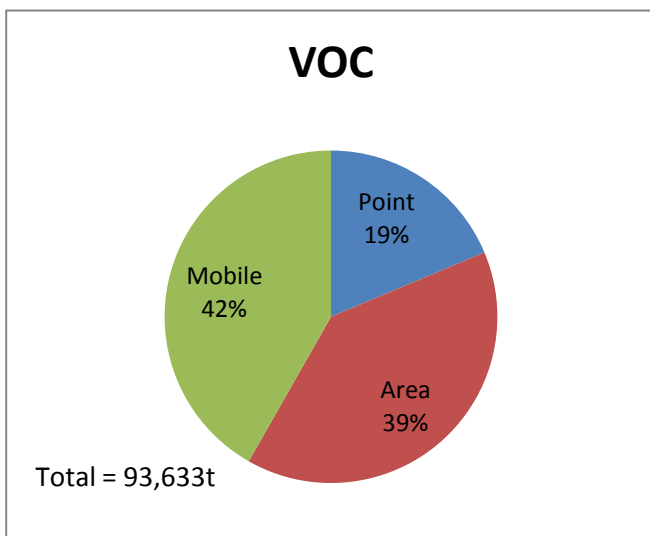
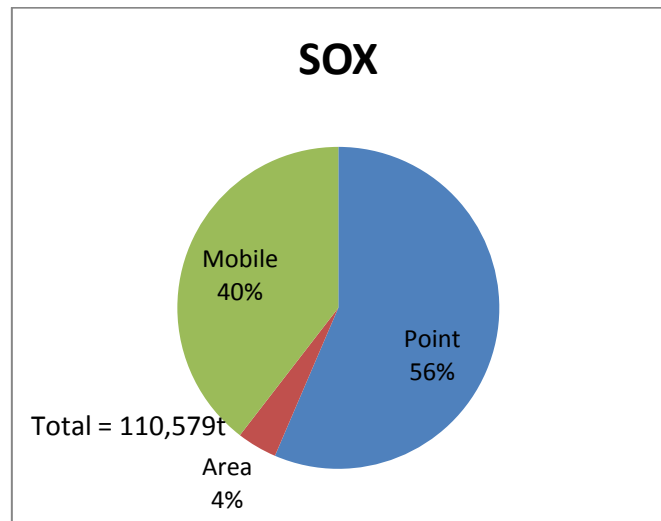
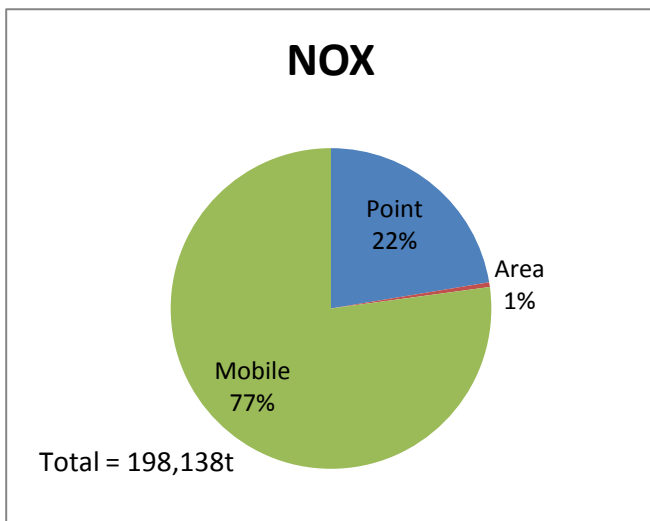
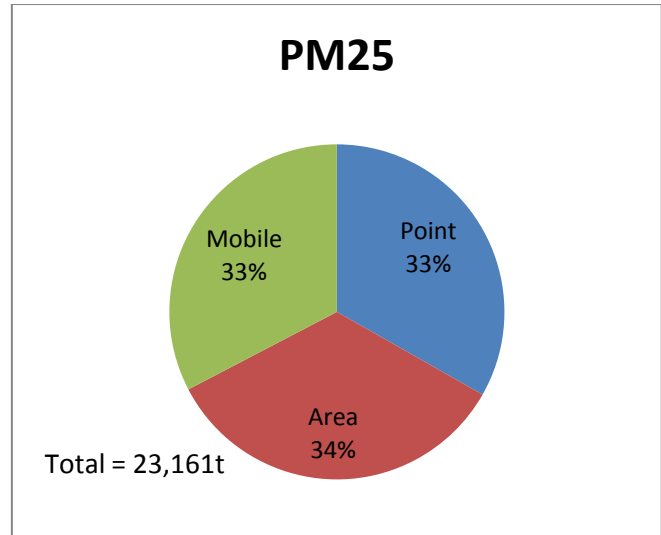
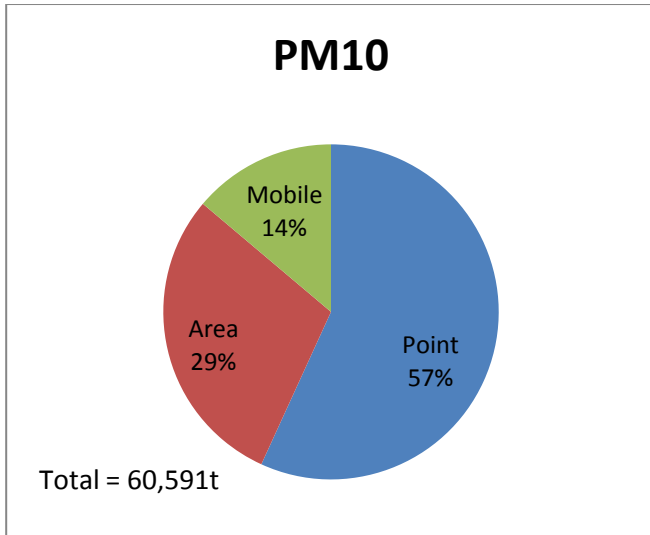
Table A.1 shows the provincial (outside of the Lower Fraser Valley) totals for the CACs and the distribution between Point, Area and Mobile sectors.

Table A.1: Rest of BC Anthropogenic CAC inventory for 2010 in tonnes

	TPM	PM10	PM25	NOX	SOX	VOC	CO	TRS	NH3
Point	87,116	34,429	7,694	44,357	62,414	17,488	123,101	1,092	
Area	33,524	17,772	7,903	931	4,454	37,040	34,688		9,416
Mobile	8,626	8,390	7,563	152,850	43,711	39,104	451,495		1,570
Total	129,266	60,591	23,161	198,138	110,579	93,633	609,284	1,092	10,986

Figure A.1 shows the distribution between the sectors graphically.

Figure A.1: Rest of BC Sector Distribution



Discussion

The above graphs show, for each pollutant, the relative contribution from each of the primary anthropogenic sectors. The Point Source sector overwhelms the PM10 distribution however the majority of this sector is the emissions of coarse material from open sources at mines. This distribution changes markedly in the PM25 distribution. Mobile sources form the majority of the NOx and CO distributions due to the number of on-road vehicles. Mobile sources also form a large part of the SOx emissions as well however, the majority of this contribution is from marine sources because the fuels have a higher sulphur content.

Other Specialized Inventory Results

Road Dust

Road dust is the material suspended in the atmosphere due to the motion of vehicles along the surface. While this is easy to see when a vehicle travels along a gravel road, road dust is still emitted from travel on paved roads. It does not include direct emissions from the vehicle or brake and tire wear. There is much discussion about the validity of the estimates since one of the controlling factors is the amount and distribution of silt on the surface, which is not normally known with any certainty. There is also much discussion about the impact and whether it should be included in anthropogenic inventories at all since as a non-buoyant source and emitted close to the ground, the area of influence may be small. However, in small interior communities where sand is used during the winter as a traction material on roads, road dust generated air quality events in the spring can be a serious problem. Table A.2 shows the estimation of road dust in the Rest of BC as generated by Environment Canada.

Table A.2: Road Dust Estimates in the Rest of BC for 2010 in tonnes

	TPM	PM10	PM25
Road Dust	613,185	153,840	30,323

Open Burning

In BC open burning refers to the disposal of vegetative debris by open fire from activities such as logging and land-clearing. The majority of the activity is in the logging sector. See a following section (Section C) regarding the procedure to estimate emissions from this sector. While the results are likely representative of most years, they are based on 2011 activity data (this year of raw data was available from another project). Table A.3 shows the estimation of CACs from Open Burning in the Rest of BC.

Table A.3: Inventory of CACs for Open Burning in the Rest of BC for 2011 in tonnes

	TPM	PM10	PM25	NOX	SOX	VOC	CO	NH3
Open Burning	58,614	41,565	36,176	10,623	212	9,853	145,801	3,346

Wildfires

An estimate of CACs from wildfires is included here for completeness as this is a major issue in BC. This has been reported elsewhere². Table A.4 shows the estimation of CACs from wildfires in BC for 2010. The area burned in 2010 was the highest over the last 10 years of record and was over 4 times the 10 year average. Over 50% of the area burned occurred in the Cariboo region, most of those fires were just west of Williams Lake and Quesnel.

Table A.4: Inventory of CACs from Wildfires for 2010 in tonnes

	TPM	PM10	PM25	NOX	SOX	VOC	CO
Wildfire	680,825	496,753	465,486	11,425	286	156,124	4,537,749

² See http://www.bcairquality.ca/reports/topic_Inventory.html

Section B: Sector Analysis

Point Source Sector

Data from the Environment Canada National Pollutant Release Inventory (NPRI)³ was obtained for 2010 for BC and facilities within the Lower Fraser Valley (LFV) were removed. Industrial facilities that meet NPRI reporting criteria are required to report their actual emissions to the best of their ability. The main reporting criteria is that the facility generated 20,000 person-hours of work in the calendar year, this amounts to approximately 8 Full Time Equivalent positions, or about 8 person working a standard ~40 hour work week. There are other sub-criteria for the various pollutant parameters and also for some selected industries. Pollutant parameters discussed in this report are: Total Particulate Matter (TPM), Particulate Matter less than 10microns (PM10), Particulate Matter less than 2.5microns (PM25 or PM2.5), Nitrogen Oxides (NOx), Sulphur Oxides (SOx), Volatile Organic Compounds (VOC) and Carbon Monoxide (CO). Total Reduced Sulphur (TRS) is also reported for specific sub-sectors.

Data from the Ministry of Environment Permit Fee system was also obtained and will be discussed in the next section.

Summary

The full NPRI list included over 550 facilities in BC outside of the LVF for 2010. These were grouped into sub-sectors of interest for BC: Pulp&Paper, Smelting (base metal and aluminum), Mining, Wood, Upstream Oil&Gas and Others. Table B.1 shows the sub-sector totals for BC for 2010.

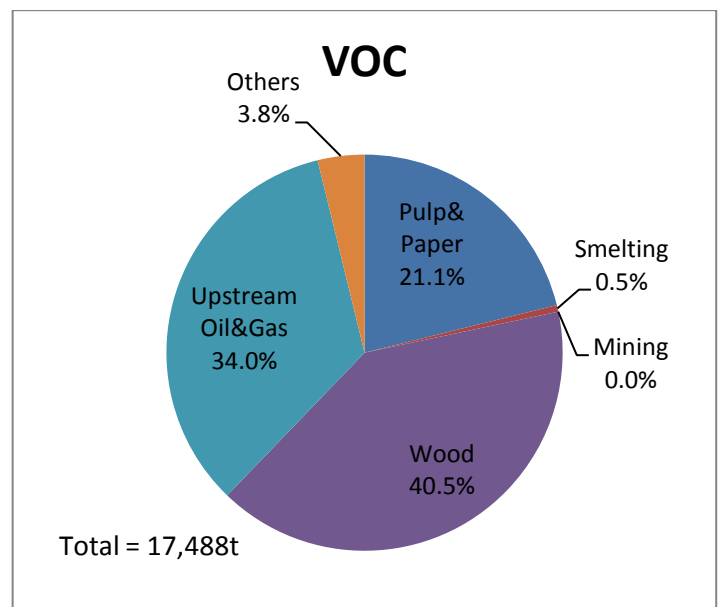
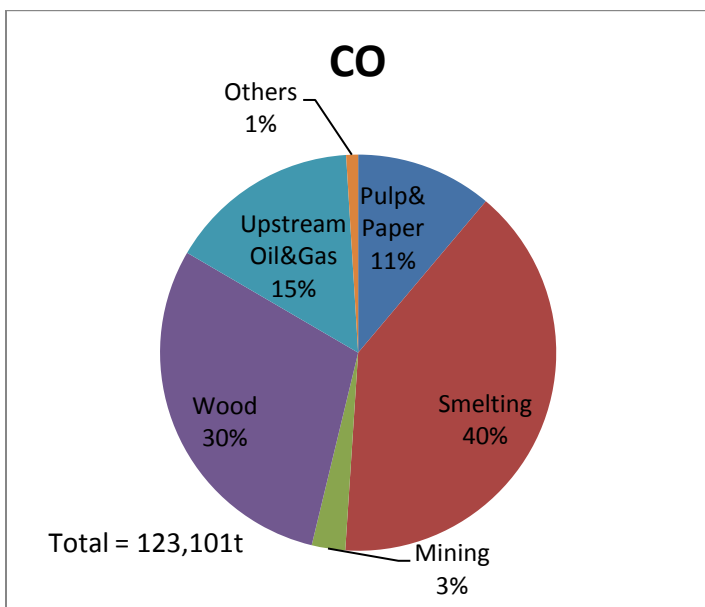
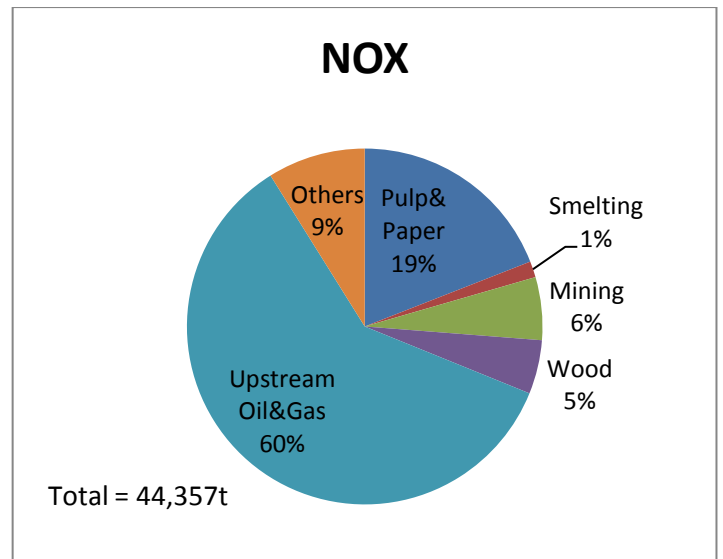
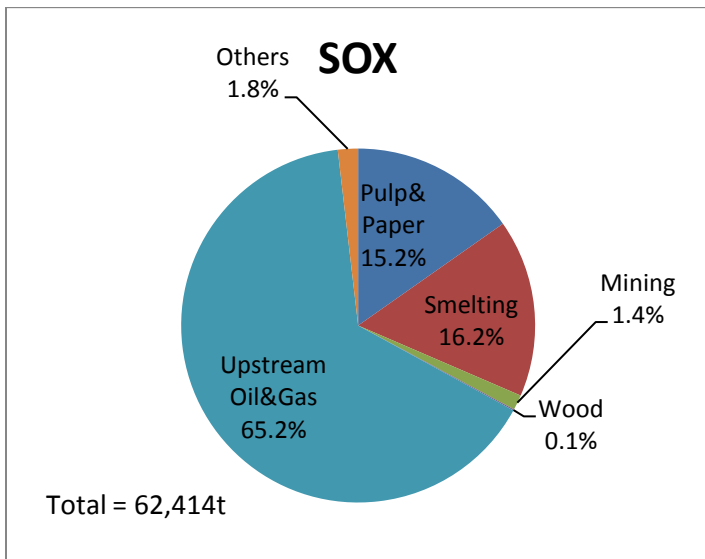
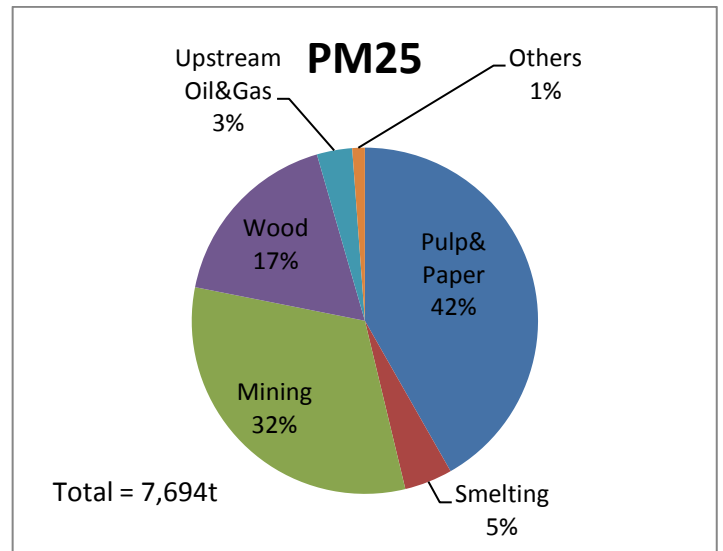
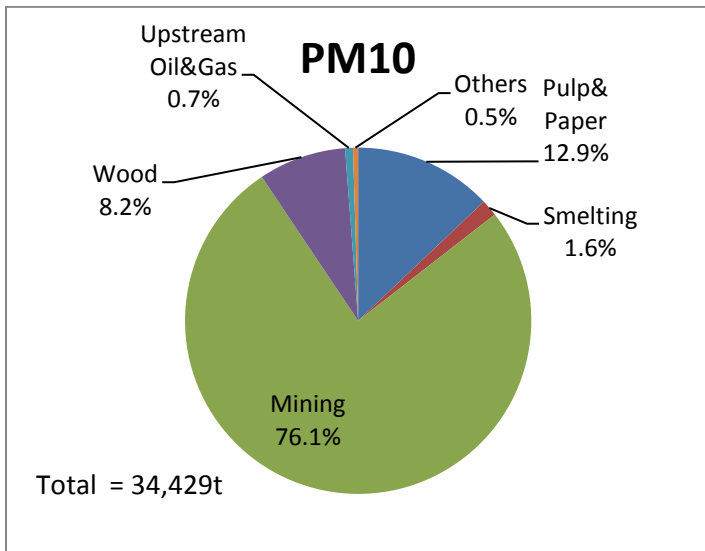
Table B.1: Summary of Reported Emissions in tonnes for 2010 for the Point Source Sector

	TPM	PM10	PM25	NOX	SOX	VOC	CO	TRS
Pulp&Paper	5,937	4,450	3,213	8,453	9,517	3,697	13,725	914
Smelting	1,280	537	345	649	10,129	95	49,104	178
Mining	72,820	26,208	2,452	2,535	866	0	3,366	
Wood	6,501	2,817	1,340	2,174	62	7,086	36,486	
Upstream Oil&Gas	261	254	254	26,604	40,689	5,944	19,223	
Others	318	164	90	3,941	1,150	667	1,197	
Total	87,116	34,429	7,694	44,357	62,414	17,488	123,101	1,092

Figure B.1 shows the allocation by sector for the major pollutant parameters.

³ See <http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=4A577BB9-1>

Figure B.1: Sub-Sector Allocation by Pollutant Parameter for 2010



Discussion

The Mining sub-sector has such a high proportion of the PM10 emissions since most of the particulate emissions are from mechanical sources such as road dust and open pit operations. The proportion drops significantly in the PM2.5 allocation since fine particulate is dominated by combustion sources as found in the Pulp&Paper and Wood sub-sectors.

The Upstream Oil&Gas sub-sector dominates the emissions of SOx and NOx due to the large number of facilities that process or pump product. These are facilities such as gas processing plants to remove sulphur and pipeline compressor station engines. Except for the few large gas processing plants, Oil&Gas facilities tend to be numerous and spread over a large geographical area.

The Smelting sub-sector dominates the emissions of Carbon Monoxide, almost entirely from the Rio Tinto Alcan works in Kitimat.

The Wood and Oil&Gas sub-sectors dominate the VOC emissions; however the types of VOC would be entirely different with VOCs from the Wood industry originating from the processing of wood and the VOCs from the Oil&Gas industry originating from hydrocarbon products.

Mobile Source Sector

The Mobile source sector estimates for 2010 were obtained from Environment Canada⁴ as part of their inventory for the entire province. In order to estimate the mobile inventory for the province outside of the Lower Fraser Valley (Rest of BC), a previously obtained 2006 inventory that had been spatially allocated to Census sub-divisions was used to generate ratios of “Rest of BC” to “All of BC” for each parameter. Using this ratio, the 2010 All of BC inventory could be pro-rated to produce a 2010 Rest of BC inventory. The Marine sub-sector in the Environment Canada inventory was replaced with the 2010 Chamber of Shipping/Environment Canada Marine Inventory⁵.

Summary

Mobile sources are all types of vehicles with internal combustion engines used for mobility (on-road and off-road vehicles) or for work (off-road construction equipment). HD Vehicles are heavy duty trucks, over 90% of these vehicles are using diesel fuel. LD Vehicles are light duty cars and trucks fuelled largely by gas and some diesel. Off-Road refers to mobile equipment such as construction and farm vehicles as well as logging equipment and private road haul trucks.

Table B.2 shows the 2010 emission of CACs for the mobile sector for the Rest of BC (outside of the Lower Fraser Valley) in tonnes.

Table B.2: Mobile Sector for 2010 for the Rest of BC (tonnes)

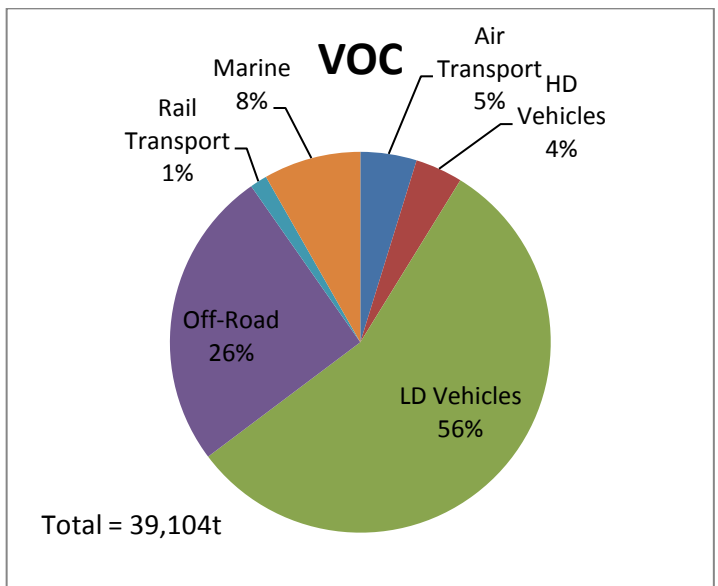
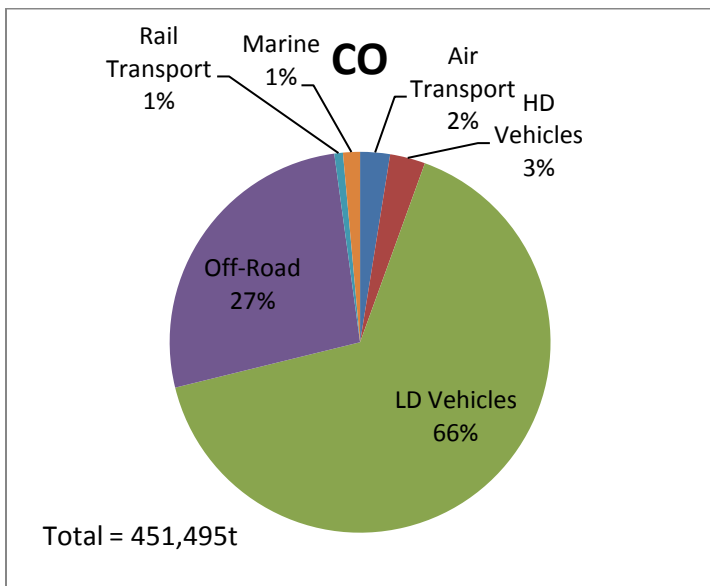
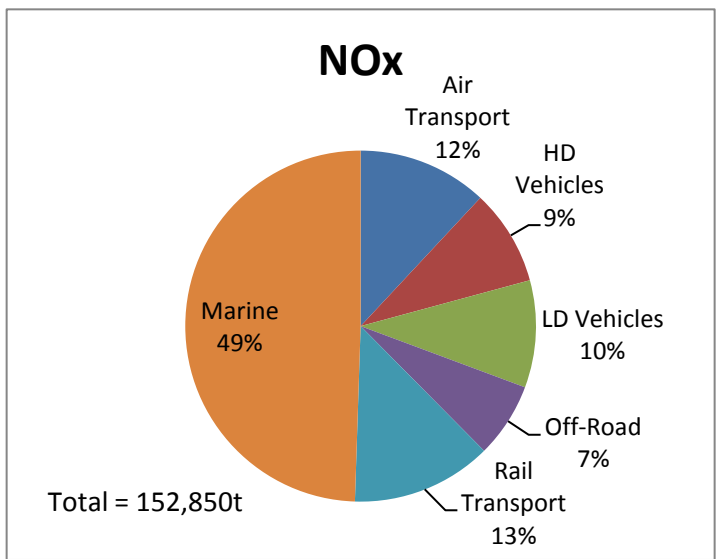
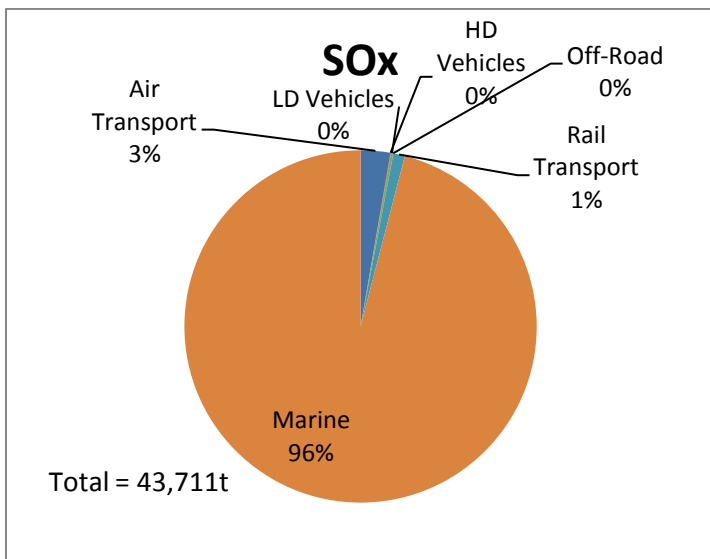
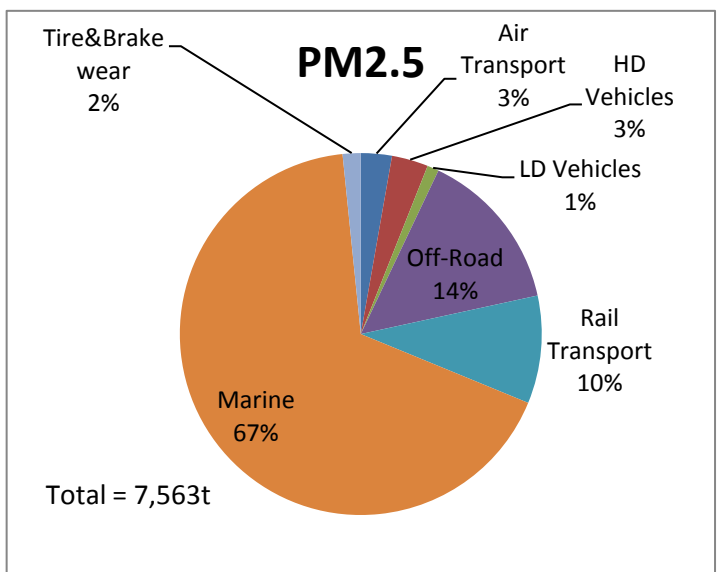
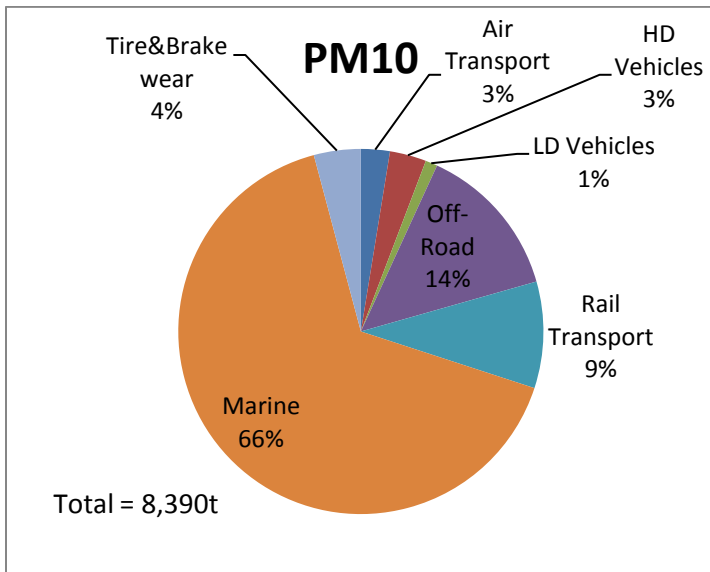
	TPM	PM10	PM2.5	NOx	SOx	VOC	CO	NH3
Air Transport	215	215	209	18,266	1,187	1,869	11,426	9
HD Vehicles	273	271	246	13,505	21	1,575	13,540	70
LD Vehicles	91	89	78	15,114	89	21,873	296,346	1,368
Off-Road	1,153	1,153	1,099	10,552	12	9,988	120,394	13
Rail Transport	791	791	728	19,785	461	571	3,299	20
Marine	5,752	5,523	5,081	75,629	41,941	3,228	6,489	90
Tire&Brake wear	352	348	122					
Total	8,626	8,390	7,563	152,850	43,711	39,104	451,495	1,570

Figure B.2 shows the allocation by sector for the major pollutant parameters.

⁴ Personal communication with Francois Lavallee

⁵ See http://www.chamber-of-shipping.com/index.php?option=com_docman&task=cat_view&gid=73&Itemid=72

Figure B.2: Sub-Sector Allocation by Pollutant Parameter for 2010 for the Mobile Sector in tonnes



Discussion

While the Marine sub-sector dominates the PM emission as well as the Sulphur and Nitrogen parameters, Light Duty Vehicles dominate the Carbon Monoxide and Volatile Organic Compound parameters. Considering the small number of marine vessels compared to on-road vehicles this seems unexpected. However, as of 2010 marine vessels (especially ocean going vessels) still used heavy marine diesel in their engines. Changes to allowable fuels in ocean going vessels travelling in coastal water were introduced in 2012 which should greatly reduce the Sulphur and Nitrogen emissions from this sub-sector in the future.

Road Dust

Estimates of road dust (that is particulate matter swept up from the road surface by the passage of vehicles) is a very difficult parameter to estimate on a provincial scale. Road dust estimates are similar to natural sources in that they are generally reported but not included in the analysis of sub-sectors, since on this scale they tend to overwhelm other emissions. Table B.3 shows the estimates for Road Dust provided by Environment Canada prorated for the Rest of BC for 2010.

Table B.3: Estimates of Road Dust in the Rest of BC for 2010 in tonnes.

	TPM	PM10	PM2.5
Paved Roads	377,253	72,761	18,141
Unpaved Roads	235,933	81,079	12,182
Total	613,185	153,840	30,323

Area Source Sector

The Area Source Sector refers to all other stationary sources that are not captured under the Point Source Sector. This includes smaller commercial activities such as bakeries, concrete batch plants, space heating, urban activities such as meat cooking, solvent and paint use, smoking, and agriculture activities such as livestock handling, tilling and plowing and fertilizer application.

As in the Mobile Sector, the 2010 All of BC inventory from Environment Canada was prorated using factors from the Census Division inventory previously obtained to generate a “Rest of BC” inventory for the area of the province outside of the Lower Fraser Valley.

Summary

The numerous Area Sector line items were combined into similar groups of interest: Commerce, Space Heating, Urban and Agriculture.

The Commerce group refers to small businesses such as bakeries, concrete batch, bulk petroleum products storage and printing.

The Space Heating group covers residential and institutional space heating.

The Urban group refers to activities such as cigarette smoking, dry cleaning, solvent and paint use, etc..

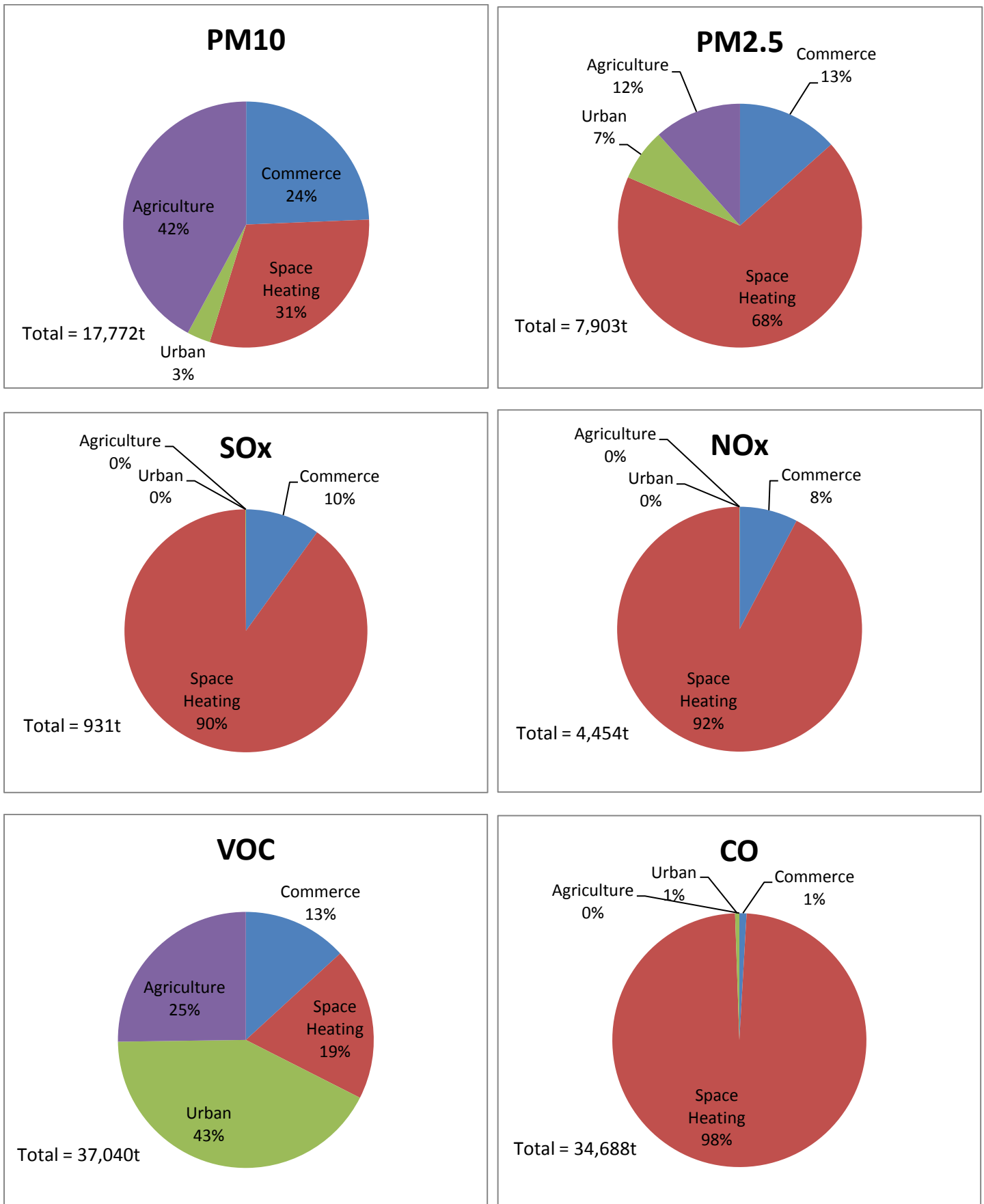
The Agriculture group covers livestock handling and plowing and tilling and fertilizer application. Table B.4 shows the estimates for the Area Source Sector for the Rest of BC for 2010

Table B.4: Area Source Sector for the Rest of BC for 2010 in tonnes

	TPM	PM10	PM2.5	SOx	NOx	VOC	CO	NH3
Commerce	14,546	4,329	1,061	93	343	4,886	317	1
Space Heating	5,719	5,408	5,379	837	4,109	7,141	34,183	61
Urban	547	547	546	1	1	15,672	189	98
Agriculture	12,712	7,488	918	0	0	9,342	0	9,256
Total	33,524	17,772	7,903	931	4,454	37,040	34,688	9,416

Figure B.3 shows the allocation by sector for the major pollutant parameters.

Figure B.3: Sub-Sector Allocation by Pollutant Parameter for 2010 for the Area Sector in tonnes



Discussion

The Space Heating group dominates many of the CAC parameters simply because there is so much of that activity in the province.

For Particulate, VOC and CO parameters residential wood fueled space heating accounts for over 90% of the Space Heating total.

For SO_x emissions the major activity is fuel use in commercial and institution buildings as they tend to use oil as a fuel (which has a higher level of sulphur than natural gas). There is no major activity for NO_x emissions since its emissions are due to combustion with air and is not dependent on the type of fuel.

The Urban group shows up a major part of VOC emissions due to paint and solvent use, which accounts for over 95% of the group total.

Section C: Open Burning of Vegetative Debris in BC

Background

Every year in BC thousands of piles of vegetative debris are open burned, mainly from the logging sector of the forest industry. With mechanized logging trees are cut, trimmed, topped and stacked all in one motion. If this debris, as well as un-merchantable logs, were left on the cutblocks it would present a hazard for catastrophic wildfire events. While some debris is left as nutrients for the soil, most logging companies will pile this debris and open burn. A majority of this open burning is done in the fall after the wildfire risk decreases and before the heavy rain and snow of winter. A minority of the burning occurs in the spring, mostly due to the risk that the burning will leave hotspots that could re-ignite if the weather unexpectedly turns hot and dry.

Open burning of vegetative debris occurs for other reasons such as Resource Management and land clearing for development and agricultural activities; however this activity is a small fraction of the number of piles consumed in the logging sector. Resource Management fires are set for activities such as wildlife habitat restoration and to mimic natural wildfire in many areas of the province⁶. A third and smaller sector still is the open burning of backyard waste in smaller communities and rural areas of BC. This debris is small piles of yard waste and trimmings from residential lots.

Activity Data

Tracking of Open Burning in BC

The Ministry of Forest, Lands and Natural Resource Operations (FLNRO) operates a tracking system, called the Open Fire Tracking System (OFTS)⁷, mainly to know where larger open burns are taking place (so they are not called in as a wildfire) and to provide education to the operators about fire safety and smoke management. Operators doing Category 4 (Resource Management) burning and Category 3 burning (larger piled debris) are required to obtain a Burning Reference Number (BRN). Category 2 (smaller piled debris) and backyard burning is not required to obtain a BRN. Operators supply location, expected window to conduct the burning and number of piles or area to be burned (among other “tombstone” information not relevant here).

Shortcomings of the data in the OFTS for emission inventory calculations are:

- BRNs were reused for the same client within their Timber Supply Area for different locations and burns (this practice has been decreasing due to FLRNO call centre policy)
- BRNs covered a large logging area (this practice has also decreased due to changes in call centre policy)
- For some major clients, BRNs were issued to cover a long time period; e.g. up to 4 or 5 months

⁶ See Prescribed Fire Council for more information at <http://bcwildfire.ca/Prevention/PrescribedFire/>

⁷ See link at http://bcwildfire.ca/Industry_Stakeholders/fire_departments/

- BRNs could be re-issued if the operator did not complete some or all of his burns
- No other information is recorded such as size and shape of piles, types of wood/debris and other practices used
- The land area covered by OFTS is restricted to forest Crown Land (and some private forest land) where FLNRO has responsibility for protecting the forest resources and values. Other land area that has its own fire protection services (such as municipal and some higher populated Regional District areas) may not be included in the OFTS database.
- The OFTS only records Category 4 and Category 3 fires, although many operators doing a large single pile (Category 2) will obtain a BRN.
- Open burning on Federal lands and parks does not usually obtain a BRN.

Despite the shortcomings of the OFTS, it is the only database of its kind for compiling any information on open burning for inventory purposes in BC. A computer readable file was requested from the FLRNO call center for all records with a start date of 2011. While this data is being included in the 2010 provincial inventory compilation, it is believed that it will be representative of this activity within this timeframe. (The actual year of 2011 was requested due to its use in a detailed inventory being done for the agricultural sub-sector).

Refinement of the 2011 OFTS Database

The raw file contained 7,274 records which was refined down to 3,953 records. A number of objectives were achieved in this refinement:

- Removable of duplicate records where it was clear the operator applied for a new BRN when he did not complete the burn.
- Combining BRNs at the same geographical location with the same operator.

The rationale for the latter point was to provide a better picture of the type of operator. A BRN must be attached to a legal land description and when a cutblock covers more than one legal land description the operator must obtain a BRN for each one. Combining these BRNs into one BRN gave a better picture of the type of burning.

Inventory Procedure

Analysis of BRNs

In the inventory procedure the number of piles per BRN was used as an indicator of the type of the burn. In a BRN with a small number of piles, it was assumed that the purpose was for land clearing and that there was a higher proportion of stumps and dirt in the pile leading to a higher emission factor for smoke emissions. In a BRN with a high number of piles it was assumed that this was logging debris which has a low number of stumps (since almost all stumps are left in the ground) and that the piles were generally very clean. A small group of in-between BRNs was also used.

Analysis of the frequency distribution of the number of piles within BRNs was used to determine the

class sizes. Figure C.1 shows the Frequency Distribution up to 50 piles per BRN.

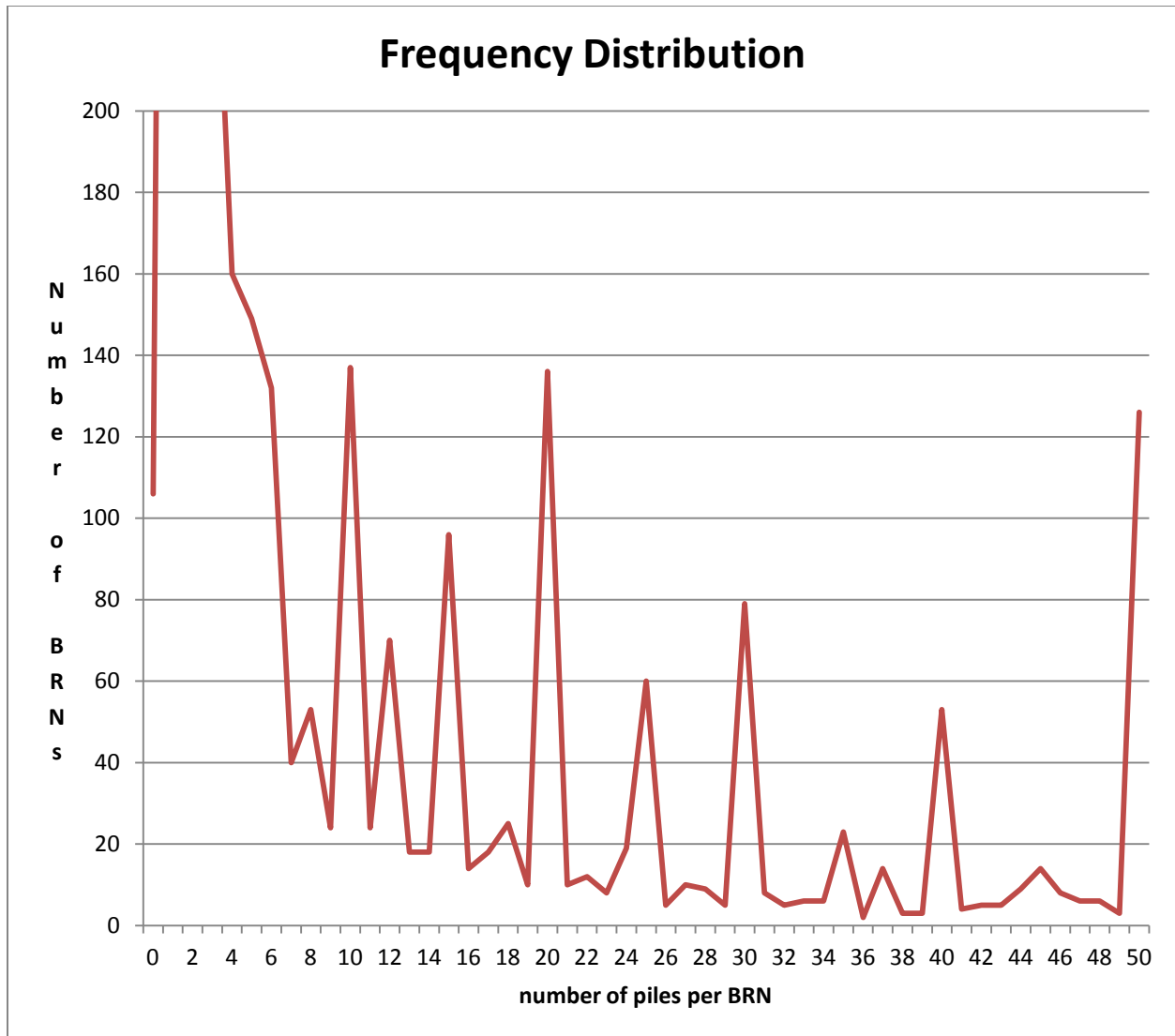


Figure C.1: Frequency Distribution

The reader will notice that above 10 piles per BRN human nature influences the person reporting to OFTS in that they tend to report the number of piles as ordinate numbers (i.e. in groups of 10's or 5's). The first minimum was used as the small BRN class and 9 piles/BRN was chosen as the cutpoint. 20 piles/BRN and above was chosen as the large BRN class as this was the point where the distribution started to tail-off. Table C.1 shows the statistics of the small BRNs (Class C) between 1 and 9 piles, medium BRNs (Class B) between 10 and 19 piles and large BRNs (Class A) 20 and more piles.

Table C.1: Pile Class Statistics

Class	# BRN	# piles	%BRNs	%piles
C	1918	5361	49	2
B	430	5570	11	2
A	1499	273052	38	96

Of note is that 96% of the piles open burned in the province are done by larger operators (which is good from an air quality point of view) who tend to have more experience at piling and burning debris, but represent only 38% of all the BRNs issued (in the refined OFTS list). Table C.2 shows the breakdown by season and shows that most of the large BRNs are burnt in the Fall while the small BRNs are nearly equally distributed between Fall and Spring.

Table C.2: Season Breakdown

	Fall	# BRN	# piles	Spring	# BRN	# piles
C		1051	3036		973	2325
B		336	4419		94	1151
A		1309	243874		190	29178

Selection of Emission Factors

Emission factors were taken from a few sources mostly since one source did not have factors for all the required pollutants. Table C.3 shows the emission factors used by MetroVancouver (MV) in their last inventory (2005) as detailed in Section B.1.2.⁸

Table C.3: MV Emission Factors

	TPM	PM10	PM2.5	CO	NOx	SOx	VOC	NH3
Prescribed burning kg/tonne (of fuel)	13.3	10.3	9.4	111.1	2	0.04	9	0.63

⁸ See <http://www.metrovancouver.org/services/air/emissions/Pages/default.aspx>

A report by Taylor (1996)⁹ on open burning in BC gave the following factors, shown in Table C.4.

Table C.4: Emission Factors from Taylor (1996)

	TPM	PM10	PM2.5	CO	NOx
Landing kg/tonne	6	4	4	101	1.5

The CONSUME model v3.0¹⁰ give average emission factors for piled open burning from tables 2a and 2b, shown here in Table C.5 in kg/tonne as well. The Particulate Matter (PM) factors are segregated by the amount of dirt expected in the piles (which is directly related to stumps and piling technique) and by the PM species: Total PM (TPM), PM less than 10microns (PM10) and PM less than 2.5 microns (PM2.5). The two factors for Carbon Monoxide (CO) and Non Methane HydroCarbons (NMHC) are given for the flaming phase and the smouldering phase of combustion.

Table C.5: Emission Factors from CONSUME

	TPM	PM10	PM2.5	CO	NMHC	
Clean	11.0	7.8	6.8	26.3	1.8	flaming
Dirty	13.5	10.0	8.5	65.2	3.4	smouldering
Very Dirty	18.0	14.0	11.9			

The factors for PM chosen by MetroVancouver represent the mid range of the CONSUME factors but higher than the data from Taylor. The Taylor report is for landing piles which are closer to the Clean category in the CONSUME model. These would represent log and debris only piles constructed with a grapple and thus have little dirt in the pile. The CONSUME PM factors were chosen for the work here.

Only the MetroVancouver data included a factor for Sulphur Dioxide (SO₂) so that factor was used for all classes, as well as for Ammonia (NH₃).

MetroVancouver and Taylor gave factors for Nitrogen Oxide (NO_x), which are quite close in value. The MetroVancouver value was chosen as it is more recent than the Taylor work and represents more average burning scenarios.

For Carbon Monoxide (CO) the factors had a wider range of values, while the MetroVancouver value seems too high for good burning, even though it is close to the Taylor value, it may represent more typical land clearing burning. All three factors were used: the MetroVancouver factor for Very Dirty

⁹ Taylor and Sherman (1996) Biomass Consumption and Smoke Emissions from contemporary and prehistoric wildland fires in BC, Canadian Forest Service

¹⁰ See <http://www.fs.fed.us/pnw/fera/research/smoke/consume/index.shtml>

piles, the CONSUME smouldering factor for Dirty piles and the CONSUME flaming factor for Clean piles. The same approach was used for the factors for NMHC / VOC.

Table C.6 shows all the final emission factors chosen for this work in kg/tonne (of mass consumed).

Table C.6: Final Emission Factors

	#piles	Class	TPM	PM10	PM2.5	CO	NOx	SOx	VOC	NH3
Clean	>19.5	A	11.0	7.8	6.8	26.3	2	0.04	1.8	0.63
Dirty	>9.5<19.5	B	13.5	10.0	8.5	65.2	2	0.04	3.4	0.63
Very Dirty	<9.5	C	18.0	14.0	11.9	111.1	2	0.04	9	0.63

Other Assumptions

An average gross pile size was estimated from the advice of the Regional Air Quality staff and was chosen as a parabolic shape of 6m high with a base diameter of 9m. This gives an average volume of 190.5 cubic metres. The CONSUME model recommends packing ratios ranging from 0.25 to 0.10 for different types of piles and the following was used in this work: 0.25 for the Class A BRNs, 0.15 for the Class B BRNs and 0.10 for the Class C BRNs. Packing ratio in this sense can be thought of as the volume of wood in the pile compared to the total volume of the pile. A consumption factor of 0.90 was also assumed as recommended by CONSUME.

To calculate the mass of debris a wood density must be assumed. Table C.7 was extracted from page 208 of the CONSUME Users Guide for typical wood species found in BC. The average was used in the calculation of wood mass.

Table C.7: Typical Wood Densities

	lb/ft ³
Balsam fir	23
Black spruce	32
Douglas fir	31
Engleman Spruce	23
Lodgepole pine	29
Ponderosa pine	28
Average	27.7

Results

Provincial Overview

The model used herein calculated the following results for the Common Air Contaminants: Total Particulate Matter (TPM), Particulate Matter less than 10microns (PM10), Particulate Matter less than 2.5microns (PM2.5), Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulphur Oxides (SOx), Volatile Organic Compounds (VOC) and Ammonia (NH3). The total mass of woody debris consumed was 5.3million tonnes and Table C.8 shows the annual emissions for the entire province in tonnes.

Table C.8: Annual CAC Emissions (tonnes)

TPM	PM10	PM2.5	CO	NOx	SOx	VOC	NH3
58,614	41,565	36,176	145,801	10,623	212	9,853	3,346

Overall 88% of the wood consumed and the annual emission occur in the Fall season and 97% of the annual emissions are from the larger operator (BRNs with more than 20 piles).

Regional Breakdown

A breakdown of emissions and mass of wood consumed is also presented here, Table C.9 shows the annual mass consumed and the emission estimates for the CACs by FLNRO Fire Zones (all units in tonnes). See Appendix A for description of the FLNRO Fire Zones.

Table C.9: Emissions by Fire Zone (tonnes)

	net mass	TPM	PM10	PM2.5	CO	NOx	SOx	VOC	NH3
Coast	645,194	7,127	5,055	4,400	17,795	1,290	26	1,205	406
NW	666,476	7,334	5,197	4,524	18,031	1,333	27	1,217	420
PG	1,211,132	13,390	9,499	8,267	33,565	2,422	48	2,270	763
Kamloops	712,210	7,886	5,597	4,870	19,916	1,424	28	1,344	449
SE	707,465	7,834	5,560	4,838	19,777	1,415	28	1,336	446
Cariboo	1,369,269	15,044	10,656	9,278	36,717	2,739	55	2,481	863

The Cariboo and Prince George (PG) zones each had the highest mass consumed with nearly twice as much as the average of the other zones, likely a product of the higher harvesting rate due to the pine beetle attack.

Figure C.2 shows some differences in the distribution of larger operators (Class A) and small operators (Class C) in each of the Fire Zones.

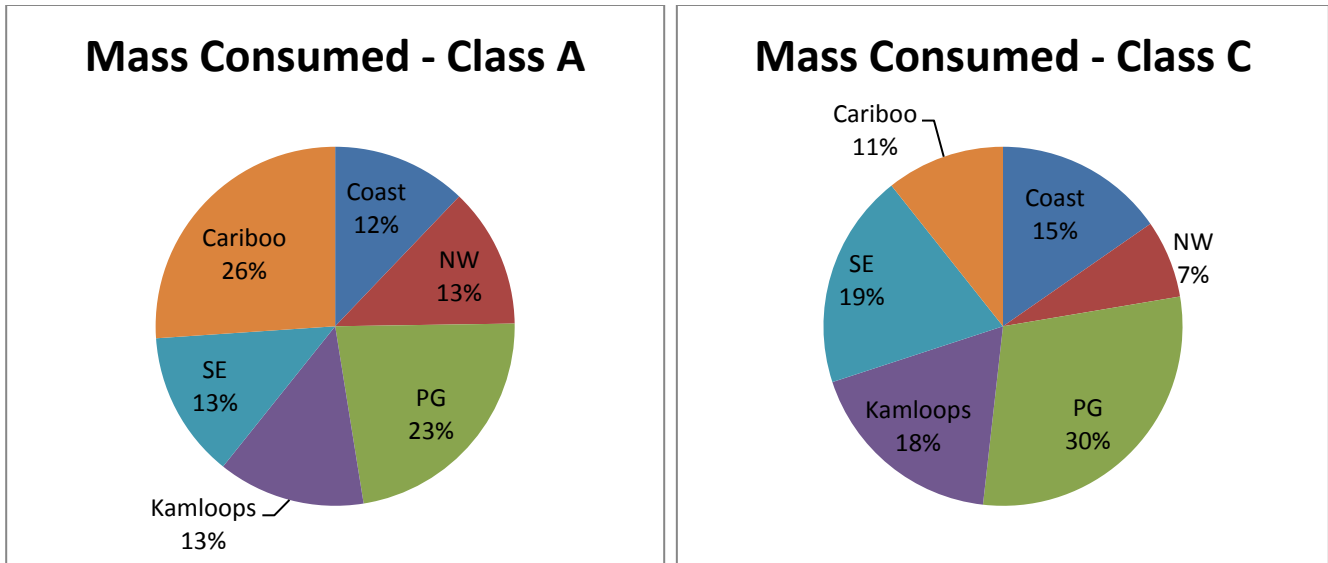


Figure C.2: Distribution of Large and Small BRNs by Fire Zone

Fire Zones with a small population base and lower levels of urbanization (Cariboo and NorthWest (NW)) show a decrease in the relative distribution of small BRNs compared to the other Zones, all which have a higher population base and areas of urbanization leading to more small open burning events.

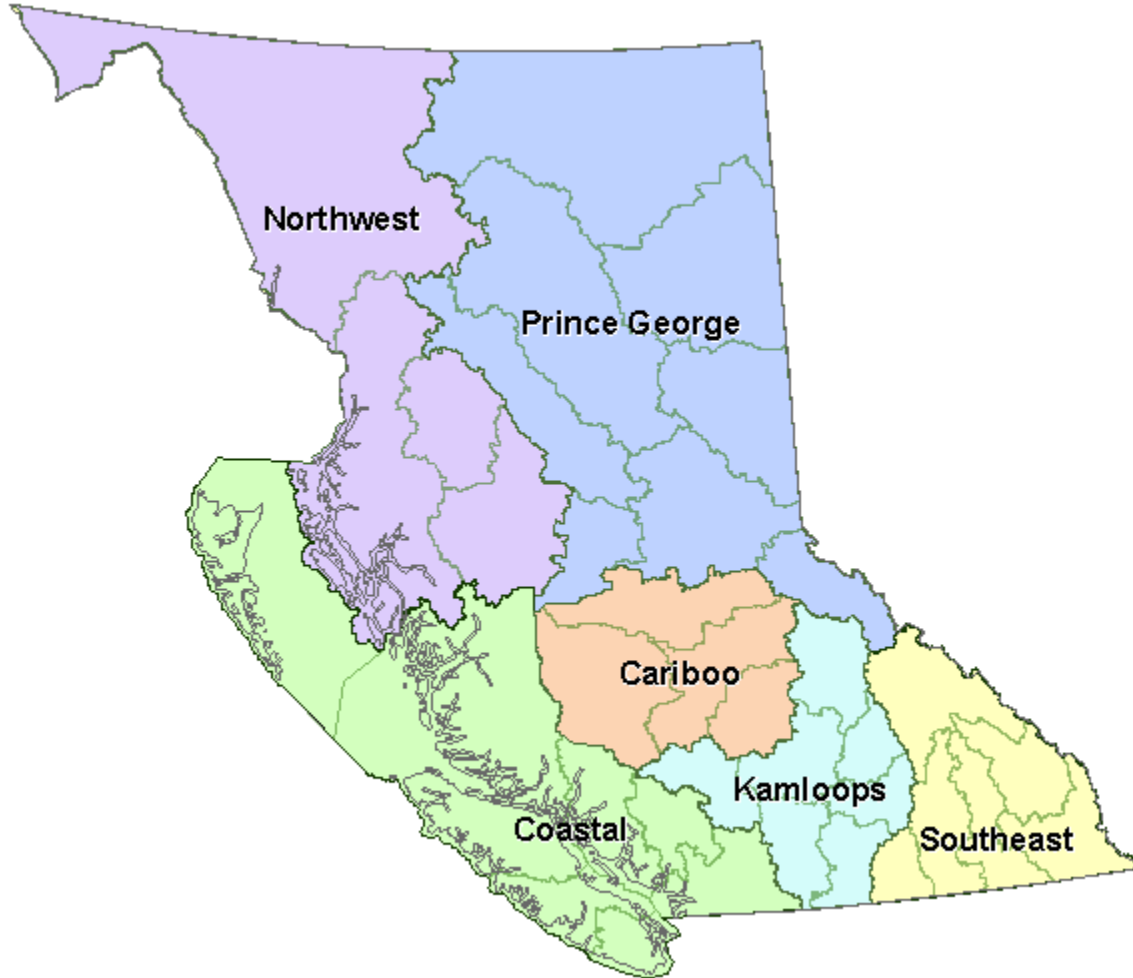
Conclusion

An emission inventory of Common Air Contaminants was calculated from a database of Category 4 and Category 3 piled open burning in BC on Provincial Crown and private forest lands. The database was extracted from the Open Fire Tracking System run by Ministry of Forests, Lands and Natural resource Operations. Emission factors were developed from several local and recent sources. Several assumptions based on good judgment were needed to calculate various base quantity data. The area of most uncertainty is likely with these assumptions, especially those surrounding the average pile size and shape.

It is estimated that over 285,000 piles of debris containing some 5million tonnes of wood are open burned annually. This activity generates over 228,000 tonnes of air pollutants.

Appendix A: FLNRO Fire Zones

Map of FLNRO Fire Zones:



Section D: Emission Inventory of CACs from Asphalt plants in BC

Background

A calculation of Common Air Contaminants (CACs) from asphalt plants outside of the MetroVancouver jurisdiction was conducted and presented herein. While asphalt plants are not a significant source compared to some of the traditional heavy industries in BC, they are one sector that has had significant attention from the public from time to time as they can be in relatively close proximity to the public. The odour associated with the product can be a source of complaints. This sector has been regulated under the Asphalt Plant Regulation¹¹ that sets typical emission standards but also sets out a unique way fees are calculated for plant operators. All other authorization holders in BC pay an annual fee based on their permitted emission loading. This is calculated from permitted stack parameters or specialized emission factors. Asphalt plant operator pay a fee based on their annual production and no emission loadings are calculated, thus the need to calculate an inventory for this sub-sector.

Further, only some plants report actual emissions to Environment Canada via the National Pollutant Reporting Inventory (NPRI) system, since most do not meet the reporting criteria. The result is that some asphalt plants are reported in the Point Source list and the rest estimated under the Area Source category. The results presented here will replace both entries in the national inventory with one point source list.

Inventory Procedure

Registration data

The registration data from 89 plants registered under the provincial regulation in 2010 were reviewed and following data was extracted for use in the inventory calculations: plant operator and location, type of plant (Batch, Continuous Drum, Hot In-place), Emission Controls (Uncontrolled, Wet Scrubber, Baghouse, Incinerator) and fuel used (Natural Gas/Propane, Diesel, Waste Oil). The 2010 production data was also retrieved from the BC Ministry of Environment permit management system.

To assist in the calculations, the full list was segregated into the main types of plants: Batch – 36 Plants, Continuous Drum – 48 plants and Hot In-Place Recyclers – 5 plants.

Emission Factors

Process and fugitive emission factors were taken from US EPA AP42, chapter 11.1, dated 3/04¹². Emission factors for Batch and Drum plants are provided in this document, however no factors were given for Hot In-Place Recyclers, and none could be found from other sources. The factors for Continuous Drum plants were applied to Hot In-Place Recyclers since they are similar in that they are

¹¹ See <http://www.env.gov.bc.ca/epd/codes/apr/index.htm>

¹² See <http://www.epa.gov/ttn/chief/ap42/index.html>

both continuous operations.

Table D.1 shows the Process Emission Factors used for Batch Plants.

Batch Plant Process EF			
	TPM (kg/tonne)	PM10 (% of TPM)	PM2.5 (% of TPM)
Un-controlled	16	14	0.83
Wet Scrubber	0.07	39	33
Baghouse	0.021	39	33

Batch Plant Process EF				
	CO (kg/tonne)	NOx (kg/tonne)	SOx (kg/tonne)	VOC (kg/tonne)
Natural Gas/Propane	0.2	0.0125	0.0023	0.0041
Diesel	0.2	0.06	0.044	0.0041
Waste Oil	0.2	0.06	0.044	0.018

Table D.2 shows the Process Emission Factors used for Continuous Drum Plants.

Drum Plant Process EF			
	TPM (kg/tonne)	PM10 (% of TPM)	PM2.5 (% of TPM)
Un-controlled	14	23	5.5
Wet Scrubber	0.0225	30	21
Baghouse	0.0165	30	21

Drum Plant Process EF				
	CO (kg/tonne)	NOx (kg/tonne)	SOx (kg/tonne)	VOC (kg/tonne)
Natural Gas/Propane	0.065	0.013	0.0017	0.016
Diesel	0.065	0.0275	0.0055	0.016
Waste Oil	0.065	0.0275	0.029	0.016

Fugitive emission factors represent emissions from the loading of trucks, filling of the silos with materials and product and a small amount of VOC emissions from the product trucks as they leave the facility but not from the product at the location where it is being applied to a road surface. Also not included in these factors are any emissions from the trucks themselves, or road dust from the truck

movements.

Table D.3 shows the Fugitive Emission Factors used in either type of asphalt plant.

	TPM (kg/tonne)	VOC (kg/tonne)
Loading and Filling		
	0.00015	0.0007
Trucking		
		0.00055

Results

The following tables show the results for the provincial CAC inventory for Asphalt plants (except those plants under MetroVancouver authority) for the production year of 2010.

Table D.4 shows production (tonnes of asphalt) and count by the type of plant.

Asphalt Plants		
	Production	Count
Batch	1,062,906	36
Drum	1,866,714	48
In-Place	194,059	5
Total	3,123,679	89

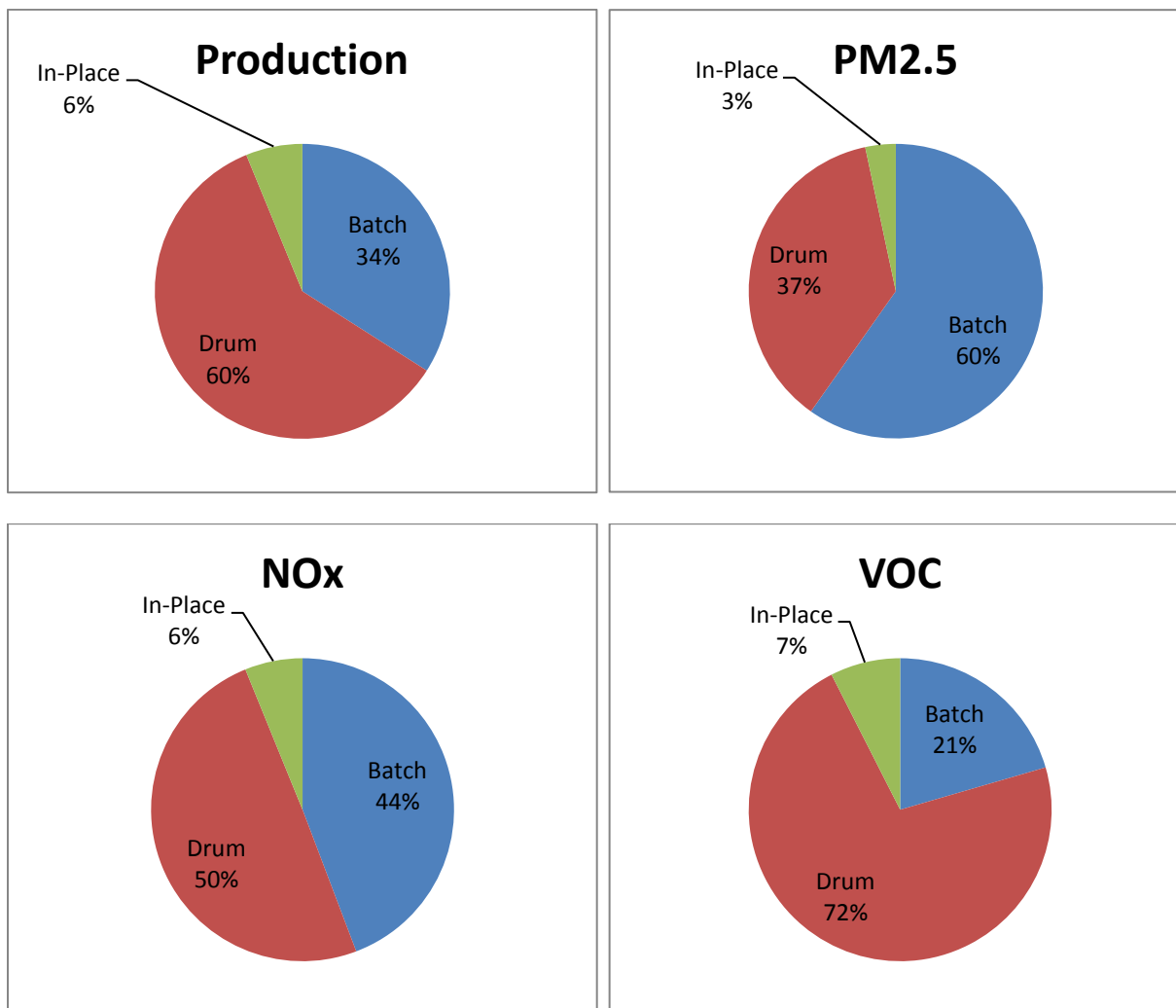
Table D.5 shows the CAC emissions (tonnes) for the Process emissions by each type of plant.

Asphalt Plants	Process Emissions						
	PM	PM10	PM2.5	CO	NOx	SOx	VOC
Batch	36.5	14.2	12.0	212.6	36.9	23.2	8.5
Drum	35.3	10.6	7.4	121.3	41.4	16.4	29.9
In-Place	3.2	1.0	0.7	12.6	5.1	1.4	3.1
Total	75.0	25.8	20.1	346.5	83.4	40.9	41.5

Table D.6 shows the CAC emissions (tonnes) for the Fugitive emissions.

Asphalt Plants	Fugitive Emissions	
	PM	VOC
Batch	0.2	1.3
Drum	0.3	2.3
In-Place	0.0	0.2
Total	0.5	3.9

Figure D.1 shows the percentage allocated to each type of plant.



It is interesting to note that the percentage of a pollutant emitted by Batch plants was disproportionately greater than their Production percentage for all CAC pollutants (PM2.5 and NOx shown here for example) except for VOC, in which case the reverse is true.

Figure D.2 shows the location of Batch plants (green circle) and Drum plants (blue squares) for Northern BC:

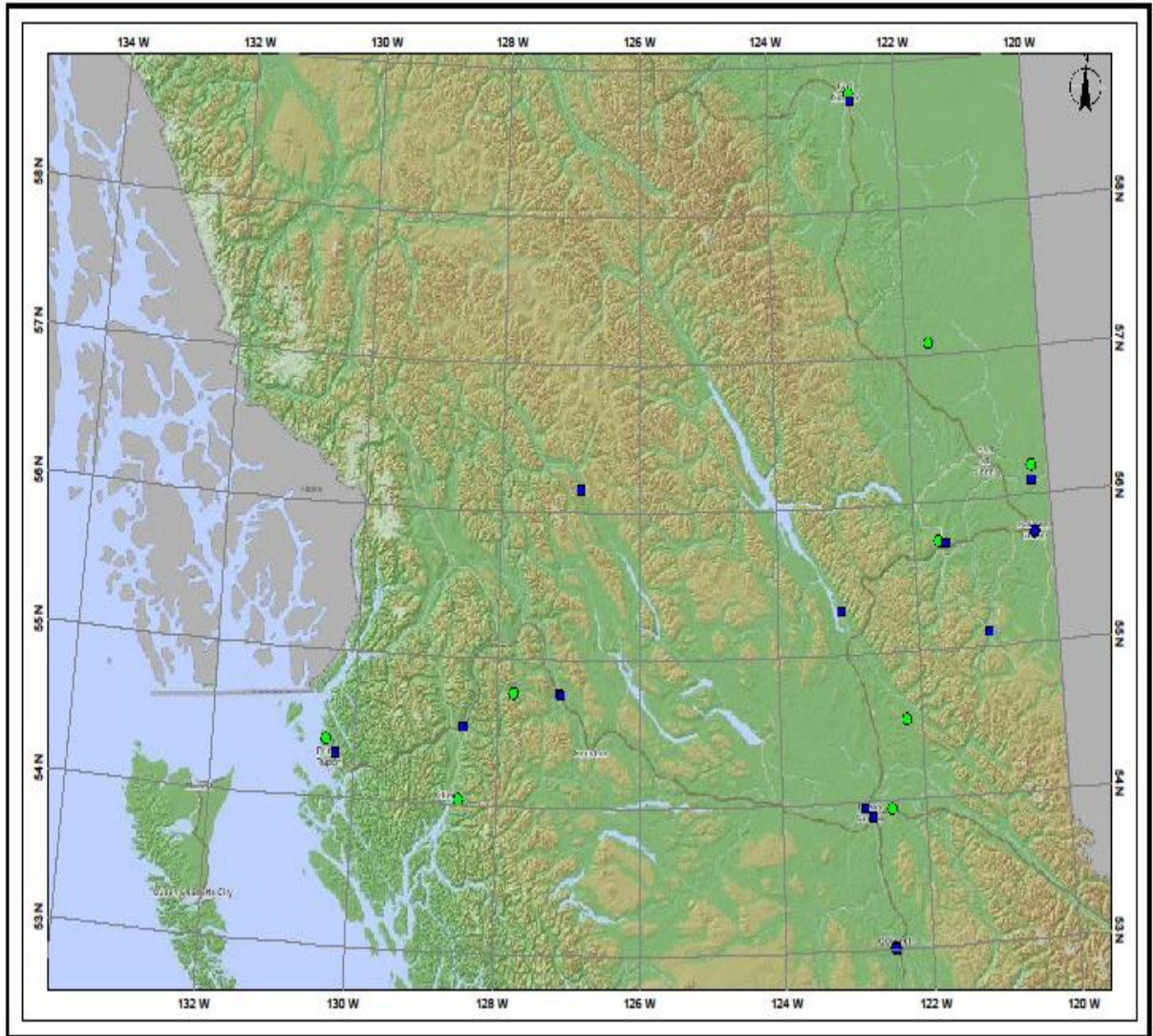
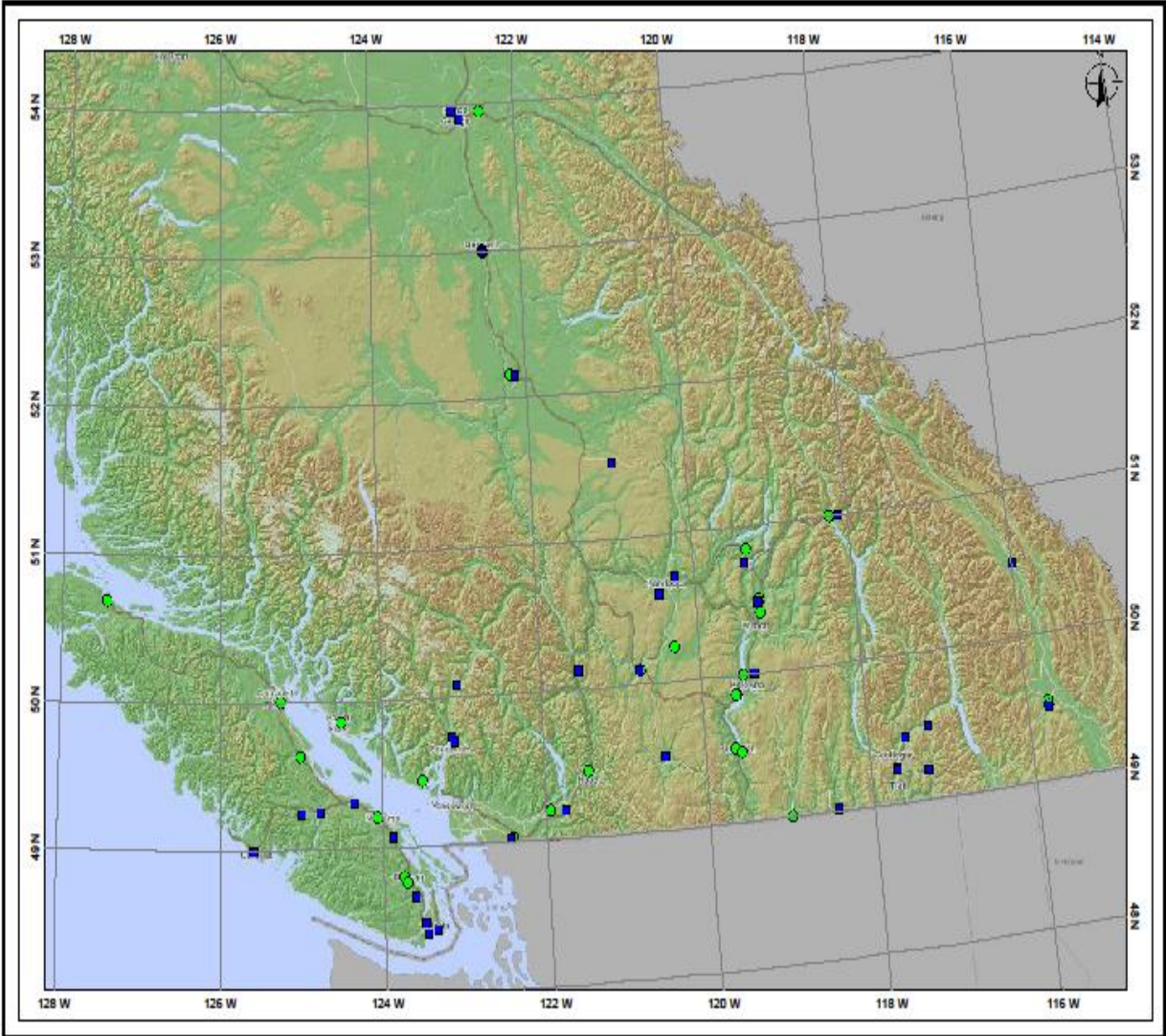


Figure D.3 shows the location of Batch plants (green circle) and Drum plants (blue squares) for Southern BC:



Section E: Analysis of Point Sources

The Point Source list from the 2010 National Pollutant Release Inventory (NPRI) list for BC was extracted and sorted into various categories of interest. The NPRI list of facilities was matched with BC authorization numbers (permits) and fee based emission loadings were generated. As required by federal law, facility reports to NPRI are the best estimate of actual emission loadings calculated for the reporting year, in this case 2010¹³. The BC fee based emission loadings are generated through the Permit Fee Regulation which sets out requirements that all authorization holders (permittees) are to pay an annual variable fee based on their emissions. The emission loadings and fees are calculated by the authorization system based on stack pollutant criteria (where specified in the permit), permitted maximum flow rates and continuous operation (unless otherwise specified in the permit). Where a pollutant parameter is not specified in the permit, a database of emission factors is specified in the regulation for use in calculating the loadings and the fees.

The fee based emission loadings will be the maximum permitted loadings (if based on a stack criteria) or maximum loading amount (if based on an emission factor). In either case, the actual emissions should be lower than either of the former. Most, if not all, permits will have Total Particulate Matter (TPM) specified as a stack criterion. Other pollutants specified in the permit will vary depending on the nature of the facility: pulp mill permits will likely specify criteria for sulphur (TRS and/or SO₂), NO_x and maybe others; smelter permits may specify only the element of interest (e.g. lead in a lead smelter); wood products facilities permits may specify TPM and NO_x criteria if they have a large combustion source.

NPRI reporting criteria varies by parameter which allows facilities to not report those parameters that do not meet that criteria, which leaves blanks or zeros in some fields that are not necessarily true zeros. Some facilities are required by NPRI regulations to report fugitive sources such as wind blown dust from open operations and storage piles and in-facility road dust. These types of sources are not usually specified in BC authorizations.

The list of facilities was sorted into the following categories of relevance to BC: Pulp and Paper, Smelting, Mining, Wood Products, Upstream Oil and Gas and Other.

Pulp and Paper Sector

There are 16 pulp and paper facilities in BC (the Canfor mills PG P&P and Intercon report as one facility). Missing in the 2010 report due to closures is the Catalyst mill in Campbell River (Elk Falls), the Skeena Cellulose mill in Prince Rupert and the Western FP mill near Squamish. There are 5 Mechanical mills and 11 Chemical mills. The chemical mills are all Kraft process except the Port Alice mill which is a Sulphide process. Tables E.1 and E.2 show the data for the Pulp&Paper sector in BC.

¹³ See <http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F6300E68-1>

Table E.1 shows the Reported emissions of CACs for the Pulp and Paper sector in tonnes for 2010.

Type	Permit	NPRI	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO	TRS
Mechanical	3149	0000000723	Catalyst Paper Corporation	Powell River Division	Powell River	16	16	12	440	48	232	130	
Mechanical	7779	0000001257	Canadian Forest Products Ltd	Canfor Taylor Pulp	Taylor	125	124		49		31	36	
Mechanical	1863	0000001593	Catalyst Paper Corporation	Port Alberni Division	Port Alberni	9	8	5	254	192	121	842	14
Mechanical	8998	0000005141	Tembec	Tembec	Chetwynd	38	1		114		70	467	
Mechanical	5804	0000009405	West Fraser Mills Ltd.	Quesnel River Pulp	Quesnel	46	17	7	50		37	34	
Chemical	1578	0000000479	Cariboo Pulp and Paper	Cariboo Pulp and Paper Company	Quesnel	680	609	547	801	104	122	1072	38
Chemical	3080	0000000672	Zellstoff Celgar Limited	Zellstoff Celgar Limited Partnership	Castlegar	121	94	63	424	240	60	757	2
Chemical	2149	0000001185	Tembec	Tembec Skookumchuck	Skookumchuck	69	58	44	310	50	148	898	29
Chemical	1902	0000001266	Catalyst Paper Corporation	Crofton Division	Crofton	473	406	287	958	1702	522	1518	159
Chemical	2708	0000001383	Nanaimo Forest Products Ltd.	Harmac Pacific Operations	Nanaimo	487	324	227	213	1420	403	1105	42
Chemical	3095	0000001419	Howe Sound Pulp & Paper	Howe Sound Pulp and Paper Mill	Port Mellon	211	195	151	1133	1000	197	821	22
Chemical	1644	0000001486	Mackenzie Pulp Mill	Mackenzie Pulp Mill	MacKenzie	310	246	171	193	184	103	218	14
Chemical	2559	0000001797	Canfor Pulp Limited	Northwood Pulp Mill	Prince George	1189	926	612	490	747	572	1432	151
Chemical	3760	0000002377	Neucel Specialty Cellulose	Port Alice Cellulose Operation	Port Alice	177	105	104	310	815	15	367	
Chemical	1517	0000002924	Domtar Inc.	Kamloops Mill (SFO)	Kamloops	1384	944	698	1316	171	310	1753	30
Chemical	2763	0000004063	Canfor Pulp Limited	PG Pulp and Paper and Intercontinental	Prince George	601	377	283	1397	2845	753	2274	414

Table E.2 shows the ratio of Reported emissions to Permitted emissions of selected CACs.

Permit	NPRI	COMP_NAME	FACI_NAME	CITY	TPM	SOx	TRS	NOx
3149	000000723	Catalyst Paper Corporation	Powell River Division	Powell River	0.05	1.20		0.13
7779	000001257	Canadian Forest Products Ltd	Canfor Taylor Pulp	Taylor	0.28	0.00		0.15
1863	000001593	Catalyst Paper Corporation	Port Alberni Division	Port Alberni	0.01	3.91	#	0.96
8998	000005141	Tembec	Tembec	Chetwynd	0.05	0.00	0.00	0.68
5804	000009405	West Fraser Mills Ltd.	Quesnel River Pulp	Quesnel	0.07	0.00	0.00	0.33
1578	000000479	Cariboo Pulp and Paper Company	Cariboo Pulp and Paper Company	Quesnel	0.22	0.31	0.24	1.45
3080	000000672	Zellstoff Celgar Limited Partnership	Zellstoff Celgar Limited Partnership	Castlegar	0.26	0.25	0.04	0.69
2149	000001185	Tembec	Tembec Skookumchuck Operation	Skookumchuck	0.16	0.09	0.86	0.76
1902	000001266	Catalyst Paper Corporation	Crofton Division	Crofton	0.28	1.02	1.18	0.56
2708	000001383	Nanaimo Forest Products Ltd.	Harmac Pacific Operations	Nanaimo	0.22	3.50	0.19	0.33
3095	000001419	Howe Sound Pulp & Paper	Howe Sound Pulp and Paper Mill	Port Mellon	0.17	0.71	0.22	0.38
1644	000001486	Mackenzie Pulp Mill Corporation	Mackenzie Pulp Mill	MacKenzie	0.16	0.06	0.11	0.17
2559	000001797	Canfor Pulp Limited Partnership	Northwood Pulp Mill	Prince George	0.40	0.58	0.94	0.49
3760	000002377	Neucel Specialty Cellulose	Port Alice Cellulose Operation	Port Alice	0.17	0.14		0.22
1517	000002924	Domtar Inc.	Kamloops Mill (SFO)	Kamloops	0.43	0.07	0.27	1.77
2763	000004063	Canfor Pulp Limited Partnership	PG Pulp and Paper and Intercontinental Pulp Mills	Prince George	0.27	0.82	3.00	1.52

NOTES: A value greater than 1.0 means the reported emissions are greater than the permitted emissions. A blank cell means there was no reported emissions and no permitted values. A zero in a cell means there was no reported emissions and a permitted value. The # sign indicates the facility reported emissions but there was no permitted value.

Summary

All facilities are accounted for in both the NPRI list and the permit list. Table E.3 gives a summary of reported emissions and permitted emissions for the Pulp & Paper sector.

Table E.3: Summary of Reported and Permitted Emissions (tonnes, 2010)

	TPM	PM10	PM25	NOx	SOx	VOC	CO	TRS
Reported	5,937	4,450	3,213	8,453	9,517	3,697	13,725	914
Permitted	23,525	17,271	12,633	16,315	22,154	4,877	100,218	1,218

Discussion

The ratios of Actual to Permitted emissions for TPM are generally below 0.40, with many below 0.20. This indicates that reported emissions are much lower than permitted values.

TRS ratios vary widely for the Kraft mills, from 0.04 to 3.00. This is somewhat surprising given that TRS is a highly regulated pollutant at Kraft pulp mills. This may indicate that some sources of TRS at the mills with high ratios are not captured in the permit conditions. Ratios of SOx also vary, to a high of 3.91, although this may reflect an issue with the fee database emission factor since SOx is not specified in many permits.

Values for the ratio of NOx also range up to 1.77 which also could reflect the emission factor issue as NOx is rarely specified in permit values.

Smelter Sector

There are 4 facilities listed in as primary metal smelters in the NPRI list. The top 2 by far are the Rio-Tinto Alcan aluminum facility in Kitimat and the Teck Cominco lead, zinc and copper metal works in Trail. The other 2 are small operations mostly involved in recycling.

Summary

All facilities are accounted for in both the NPRI list and the permit list. Although, KC Recycling did not meet the reporting criteria for CACs. Table E.6 gives a summary of reported emissions and permitted emissions for the Smelter sector.

Table E.6: Summary of Reported and Permitted Emissions (tonnes, 2010)

	TPM	PM10	PM25	NOx	SOx	VOC	CO	TRS
Reported	1,280	537	345	649	10,129	95	49,104	178
Permitted	4,237	2,439	1,728	297	18,242	34	330	

Table E.4 shows the Reported emissions of CACs for Smelter sector in tonnes for 2010.

NAICS_E	Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO	TRS
Primary Production of Alumina & Aluminum	100138	0000002788	Rio Tinto Alcan	Kitimat Works	Kitimat	1121	383	227	287	5489	81	49036	178
Non-Ferrous (except Al) Smelting & Refining	2693	0000003802	Teck Cominco	Trail Operations	Trail	155	150	117	362	4640	14	68	
Non-Ferrous (except Cu & Al) Secondary Proc.	6187	0000007752	Schnitzer Steel Pacific, Inc.	Steel Pacific Recycling Duncan	Duncan	4	4	1					
Non-Ferrous (except Cu & Al) Secondary Proc.	9019	0000007830	K.C. Recycling Ltd.	K.C. RECYCLING - TRAIL	Trail								

Table E.5 shows the ratio of Actual Emissions to Permitted Emissions.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	SOx	NOx
100138	0000002788	Rio Tinto Alcan	Kitimat Works	Kitimat	0.42	0.56	0.96
2693	0000003802	Teck Cominco	Trail Operations	Trail	0.10	0.55	

Discussion

Actual to Permitted ratios for the major smelters and the selected CACs were below 1.0 (meaning the facility reported emissions were less than the permitted or fee calculated emissions).

Mining Sector

There are 22 mining facilities reporting to NPRI for 2010. There are 9 coal mining operations, 2 gold and silver, 2 copper and zinc, 3 other speciality mines and 5 sand and gravel or limestone operations.

Summary

Seven facilities reported to NPRI but not have a BC air related permit or could not be identified with the information in AMS. Some of these are facilities that historically would not be required to hold a BC air permit such as quarries. Further there were 10 facilities with BC air related permits that did not report to NPRI. It is likely these facilities are not operating or did not meet the NPRI hours of work criteria for reporting.

Table E.7: Summary of Reported and Permitted Emissions for the Mining Sector (tonnes, 2010)

	TPM	PM10	PM2.5	NOx	SOx	VOC	CO
Reported	72,820	26,208	2,452	2,535	866	0	3,336
Permitted	5,824	1,746	208	2,479	4,456	1,062	242

Discussion

Table E.8 shows the Reported emissions and Table E.9 shows the ratio of Actual to Permit emission loadings. The reader will note that a number of facilities do not have air permits from Ministry of Environment. There could be a number of reasons; remoteness of the facility and the lack of specific point sources. The ministry has historically focussed permitting on stacks and point sources at facilities and not fugitive type sources, as typical concentration criteria cannot be applied to a fugitive type source. Another issue is that NPRI reporting criteria require the facility to estimate open source emissions such as in-facility road dust and emissions from storage piles. This is the reason that ratios for TPM can be much higher than 1.00.

Table E.8 shows the Reported emissions of CACs for Mining Sector in tonnes for 2010.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO
1501	000006669	Teck Coal Limited	Fording River Operations	Elkford	21356	7417	529	253	126	0	40
6249	000006671	Teck Coal Limited	Greenhills Operations	Elkford	7617	1942	169	46	0	0	0
4751	000006674	Teck Coal Limited	Coal Mountain Operations	Sparwood	1889	599	44	82	0	0	0
1807	000007838	Teck Coal Limited	Elkview Operations	Sparwood	16418	6476	358	192	26	0	46
5352	000007839	Teck Coal Limited	Line Creek Operations	Sparwood	3372	986	71	0	0	0	0
17680	0000020078	Western Coal Corp	Dillon / Brule Mine	Chetwynd	7120	3382	505	86	0	0	75
17759	0000020116	Western Coal Corp	Wolverine Group- Perry Creek Mine	Tumbler Ridge	3774	1227	183	186	332	0	35
999999	0000020129	Peace River Coal Inc.	Trend Mine (SFO)	Tumbler Ridge	925	227	23	1047	0	0	869
17043	0000020175	Western Coal Corp	Willow Creek Mine	Chetwynd	4224	1988	296	206	70	0	768
999999	000005134	BARRICK GOLD INC.	Eskay Creek Mine	Smithers	1	0	0	19	7	0	4
1595	000001303	Gibraltar Mines Ltd.	Gibraltar Mine (SFO)	McLeese Lake	1425	392	39	93	0	0	377
2408	000002372	NVI MINING LTD.	Myra Falls Operations	Campbell River	0	0	0	35	0	0	0
1557	000003356	Highland Valley Copper	Highland Valley Copper	Logan Lake	13	2	2	168	22	0	665
2399	000002794	THOMPSON CREEK MINING LTD.	Endako Mine	Endako	2728	930	123	40	284	0	159
999999	000005102	Imperial Metals Corporation	Mount Polley Mine	Likely	311	83	8	36	0	0	142
999999	0000020131	Northgate Minerals Corporation	Kemess South Mine	Smithers	1342	466	85	45	0	0	165
999999	0000019242	Lafarge North America	Texada Quarrying Ltd., Texada Quarry	Van Anda	223	64	12	0	0	0	22
999999	0000019247	Lafarge North America	Lafarge Canada, Inc., GVA Aggregates, Earle Creek Pit	Egremont	30	9	2	0	0	0	0
999999	0000020053	Lehigh Hanson Materials Ltd.	Sechelt Operation	Sechelt	3	1	0	0	0	0	0
999999	0000020156	Polaris Minerals Corporation	Orca Sand and Gravel	Port McNeil	34	11	1	0	0	0	0
999999	000000394	BARRICK GOLD INC.		Penticton	8	2	0	0	0	0	0
999999	0000020103	CERTAINTEED GYPSUM CANADA	Windermere Mining Operation	Windermere	6	4	1	0	0	0	0

NOTE: a permit number of 999999 indicates that no air permit is issued for this facility

Table E.9 shows the ratio of Actual Emissions to Permitted Emissions.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	SOx	NOx
1501	0000006669	Teck Coal Limited	Fording River Operations	Elkford	23.73	0.12	0.44
6249	0000006671	Teck Coal Limited	Greenhills Operations	Elkford	11.19	0.00	0.17
4751	0000006674	Teck Coal Limited	Coal Mountain Operations	Sparwood	5.44	0.00	0.59
1807	0000007838	Teck Coal Limited	Elkview Operations	Sparwood	18.07	0.03	0.42
5352	0000007839	Teck Coal Limited	Line Creek Operations	Sparwood	9.03	0.00	0.00
17680	0000020078	Western Coal Corp	Dillon / Brule Mine	Chetwynd	#	#	#
17759	0000020116	Western Coal Corp	Wolverine Group- Perry Creek Mine	Tumbler Ridge	14.39		
999999	0000020129	Peace River Coal Inc.	Trend Mine (SFO)	Tumbler Ridge			
17043	0000020175	Western Coal Corp	Willow Creek Mine	Chetwynd	659.95	#	#
999999	0000005134	BARRICK GOLD INC.	Eskay Creek Mine	Smithers			
1595	0000001303	Gibraltar Mines Ltd.	Gibraltar Mine (SFO)	McLeese Lake	2.13	0.00	4.11
2408	0000002372	NVI MINING LTD.	Myra Falls Operations	Campbell River	0.00	0.00	0.04
1557	0000003356	Highland Valley Copper	Highland Valley Copper	Logan Lake	0.03	0.69	1.49
2399	0000002794	THOMPSON CREEK MINING LTD.	Endako Mine	Endako	2.77	0.16	51.14
999999	0000005102	Imperial Metals Corporation	Mount Polley Mine	Likely			
999999	0000020131	Northgate Minerals Corporation	Kemess South Mine	Smithers			
999999	0000019242	Lafarge North America	Texada Quarrying Ltd., Texada Quarry	Van Anda			
999999	0000019247	Lafarge North America	Lafarge Canada, Inc., GVA Aggregates, Earle Creek Pit	Egremont			
999999	0000020053	Lehigh Hanson Materials Ltd.	Sechelt Operation	Sechelt			
999999	0000020156	Polaris Minerals Corporation	Orca Sand and Gravel	Port McNeil			
999999	0000000394	BARRICK GOLD INC.		Penticton			
999999	0000020103	CERTAINTEED GYPSUM CANADA	Windermere Mining Operation	Windermere			

NOTE: the # indicates there is no air emission criteria and thus no estimation of permit loadings for this pollutant.

Wood Industry Sector

Tables E.10 and E.11 (next page) show the data for the Wood Industry in BC. There are 83 facilities reporting; 55 general sawmills, 4 as wood preservation, 8 as softwood veneer and plywood, 3 as particle and waferboard and 11 others.

Summary

One facility on the NPRI list did not have a BC air related permit or one could not be assigned to it. In addition, there were 274 permitted wood processing facilities that did not report to NPRI. It is likely that a large majority of these facilities are closed or shuttered in 2010, but have not cancelled their permits. Unfortunately, due to the lack of reporting requirements for these facilities, it is difficult to determine the fate of these permits.

Table E.12: Summary of Reported and Permitted Emissions (tonnes, 2010)

	TPM	PM10	PM25	NO _x	SO _x	VOC	Co
Reported	6,501	2,817	1,340	2,174	62	7,086	36,486
Permitted	30,510	11,489	4,536	3,509	296	8,603	76,525
Unreported Permits	17,472			2,108	260	5,659	56,512

Discussion

The ratios of TPM for the wood product facilities show many facilities with very low ratios, under 0.20 and quite a few under 0.10. It is more likely that a majority of the mills operated at a reduced level of production throughout 2010.

There are a few facilities with very high ratios. These could be facilities with large outdoor storage piles or large unpaved lots.

Table E.10 shows the reported emissions of CACs for Wood Sector in tonnes for 2010.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO
2747	0000005186	Hauer Bros. Lumber Ltd.	HAUER BROS.	Valemount	1483	800	400	0	0	0	815
2574	0000005142	Tembec	Elko Sawmill	Elko	144	41	5	0	0	88	0
3403	0000005158	West Fraser Mills Ltd.	Chetwynd Forest Industries, a Division of West Fraser Mills	Chetwynd	144	19	7	101	0	998	10810
4215	0000005160	West Fraser Mills Ltd.	Chasm Sawmills	Clinton	363	110	35	99	0	97	226
5625	0000005161	West Fraser Mills Ltd.	Fraser Lake Sawmills	Fraser Lake	229	63	21	90	0	618	5748
1691	0000005162	Pacific Inland Resources	Smithers Sawmill	Smithers	12	8	4	53	0	111	113
3336	0000005167	Canadian Forest Products Ltd	Clear Lake	Prince George	40	12	3	0	0	52	36
2268	0000005168	Conifex Inc.	Conifex Inc.	Fort Saint James	335	134	67	0	0	45	0
3478	0000005169	Canadian Forest Products Ltd	Fort St. John	Fort St. John	66	18	4	38	0	72	102
2190	0000005173	Canadian Forest Products Ltd	Isle Pierre	Isle Pierre	72	23	8	23	0	78	62
3034	0000005174	Canadian Forest Products Ltd	POLAR DIVISION	Bear Lake	54	15	5	27	0	72	73
4122	0000005188	Babine Forest Products Ltd.	Babine Forest Products	Burns Lake	211	56	17	64	0	383	3444
3446	0000007703	International Forest Products Ltd.	Adams lake Division	Chase	29	8	1	0	0	44	0
1615	0000007704	West Fraser Mills Ltd.	100 Mile Lumber - A Division of West Fraser Mills Ltd.	100 Mile House	65	39	19	26	0	72	56
5339	0000007705	Houston Forest Products Ltd.	Houston Sawmill	Houston	96	31	8	0	0	75	0
3898	0000007709	Dunkley Lumber Ltd.	Dunkley Lumber Ltd.	Strathnaver	32	8	2	40	0	96	15
2684	0000007710	Canadian Forest Products Ltd	Plateau Division	Vanderhoof	184	37	14	97	0	966	9246
3283	0000007760	Tolko Industries Ltd.	Lakeview - Williams Lake	Williams Lake	252	217	184	93	0	125	255
1676	0000007770	Canadian Forest Products Ltd	MACKENZIE OPERATIONS	Mackenzie	5	3	1	0	0	70	40
1548	0000007788	West Fraser Mills Ltd.	WEST FRASER MILLS - WILLIAMS LAKE	Williams Lake	41	13	2	0	0	93	0
1945	0000007790	Tolko Industries Ltd.	Nicola Valley Division	Merritt	62	20	4	0	0	102	0
7841	0000007791	Tolko Industries Ltd.	Quest Wood Division	Quesnel	32	13	6	0	0	35	0
2001	0000007792	Tolko Industries Ltd.	Lavington Planer Mill	Lavington	29	8	1	0	0	55	0
3039	0000007811	Wynndel Box & Lumber Co. Ltd.	WYNNDEL BOX & LUMBER CO - WYNNDEL	Wynndel	1	1	0	0	0	0	0
2122	0000007826	Gorman Bros. Lumber Ltd.	Gorman Bros. Lumber	Westbank	50	32	18	25	0	66	30

1750	000007829	J.H. Huscroft Ltd.	J. H. Huscroft Ltd.	Creston	16	10	8	3	0	4	1
1869	000007832	Lakeland Mills Ltd.	Lakeland Mills Ltd.	Prince George	95	30	14	39	0	63	82
7512	000007840	West Fraser Mills Ltd.	WEST FRASER MILLS - QUESNEL SAWMILL	Quesnel	129	45	21	113	0	233	177
1842	000007872	Springer Creek Forest Products Ltd.	Springer Creek Forest Products Ltd.	Slocan	2	1	0	0	0	4	10
1596	000007907	Tembec	Cranbrook Planer and Finger Joint Plant	Cranbrook	15	9	6	0	0	26	32
3028	000007908	Tembec	Canal Flats Sawmill	Canal Flats	95	33	11	0	0	50	49
1955	000007909	Canadian Forest Products Ltd	Chetwynd	Chetwynd	36	10	1	0	0	27	0
1699	000007910	Canadian Forest Products Ltd	Prince George Sawmill Division	Prince George	66	18	3	0	0	104	0
7844	000007912	Canadian Forest Products Ltd	Quesnel Division	Quesnel	20	5	1	0	0	54	0
4680	000007914	Carrier Lumber Ltd.	Tabor Sawmill	Prince George	1	1	0	0	0	0	0
1846	000007920	Weyerhaeuser Company Limited	iLevel By Weyerhaeuser Princeton Sawmill	Princeton	77	23	4	0	0	108	0
2696	000007922	Western Forest Products Inc.	Alberni Pacific Sawmill	Port Alberni	9	6	2	0	0	0	0
7149	000007923	Western Forest Products Inc.	Chemainus Sawmill	Chemainus	3	2	1	0	0	0	0
3051	000007925	Western Forest Products Inc.	Somass Sawmill	Port Alberni	3	2	1	0	0	0	0
10837	000007928	Western Forest Products Inc.	South Island Reman	Chemainus	3	2	1	0	0	0	0
3679	000007938	Tolko Industries Ltd.	Williams Lake (Creekside)	Williams Lake	3	2	0	0	0	0	0
2484	000007939	Tolko Industries Ltd.	Soda Creek	Williams Lake	4	3	2	0	0	36	0
14322	000007988	Cheslatta Forest Products Ltd.	Ootsa Lake Mill	Burns Lake	3	2	0	0	0	0	0
3133	0000020016	Nechako Lumber Company Ltd.	NECHAKO LUMBER - VANDERHOOF	Vanderhoof	93	83	70	26	0	43	735
5490	0000020019	International Forest Products Ltd.	Castlegar Sawmill	Castlegar	7	6	1	0	0	0	0
1951	0000020021	International Forest Products Ltd.	Grand Forks Sawmill	Grand Forks	22	7	1	0	0	33	0
3877	0000020036	Western Forest Products Inc.	Saltair Division	Duncan	22	7	1	0	0	0	0
7605	0000020037	Western Forest Products Inc.	Ladysmith Sawmill	Ladysmith	2	1	0	0	0	0	0
4396	0000020038	Western Forest Products Inc.	Cowichan Bay Division	Duncan	40	12	2	0	0	0	0
1997	0000020039	Downie Timber Ltd.	Downie Timber	Revelstoke	32	10	3	0	0	0	0
2410	0000020075	Mill and Timber Products Ltd.	Aspen Planers Ltd.	Merritt	101	41	16	0	0	136	33

4166	0000020084	Western Forest Products Inc.	Value Added Division	Chemainus	4	3	1	0	0	0	0
8003	0000020086	Western Forest Products Inc.	Duke Point Sawmill	Nanaimo	3	2	0	0	0	0	0
1543	0000005172	Canadian Forest Products Ltd	Houston	Houston	262	129	87	208	0	227	453
5543	0000020100	Copper Mountain Cedar Products Ltd.	Copper Mountain Cedar Products	Terrace	1	0	0	0	0	0	14
1772	0000002912	Stella-Jones Inc.	Prince George Plant	Prince George	6	2	1	0	0	0	0
3019	0000005130	Decker Lake Forest Products Ltd.	DECKER LAKE FOREST PRODUCTS - BURNS LAKE	Burns Lake	64	19	3	25	0	45	379
2818	0000005156	Selkirk Forest Products	SELKIRK FOREST PRODUCTS - GALLOWAY	Galloway	74	21	3	0	0	0	0
7248	0000005184	Tolko Industries Ltd.	Ashcroft Treating Division	Ashcroft	2	1	1	0	0	0	0
11706	0000005191	Ainsworth Lumber Co. Ltd.	Ainsworth OSB Division	One Hundred Mile House	134	71	23	184	0	568	1061
2524	0000007843	Tolko Industries Ltd.	Heffley Creek Division	Kamloops	118	48	5	26	0	86	46
2573	0000007873	Federated Co-operatives Ltd.	Plywood Plant	Canoe	1	0	0	0	0	8	0
3725	0000007932	West Fraser Mills Ltd.	QUESNEL PLYWOOD, A Division of West Fraser Mills Ltd.	Quesnel	92	20	10	60	0	40	77
1764	0000007933	West Fraser Mills Ltd.	WILLIAMS LAKE PLYWOOD, A Division of West Fraser Mills Ltd.	Williams Lake	37	12	5	101	0	84	270
2082	0000007940	Tolko Industries Ltd.	Kelowna Division	Kelowna	60	25	10	58	0	78	214
2717	0000007941	Tolko Industries Ltd.	Armstrong Division	Armstrong	218	97	30	268	62	82	546
17945	0000020150	Thompson River Veneer Products LP	TRVP	Kamloops	7	4	3	0	0	0	0
2662	0000000618	Louisiana-Pacific Canada Ltd.	Golden EWP Division	Golden	47	19	7	44	0	46	272
1916	0000007707	Greenwood Forest Products (1983) Ltd.	GREENWOOD FOREST PRODUCTS (1983) - PENTICTON	Penticton	2	1	1	0	0	0	0
13444	0000005108	West Fraser Mills Ltd.	WestPine MDF	Quesnel	110	34	3	60	0	47	124
6099	0000005197	Northern Engineered Wood Products Inc.	Smithers	Smithers	31	14	5	46	0	42	72
7596	0000000718	Louisiana-Pacific Canada Ltd.	LP Dawson Creek OSB	Dawson Creek	9	6	3	0	0	54	91
2011	0000005199	Tolko Industries Ltd.	White Valley Division	Lumby	2	1	1	0	0	0	0
10606	0000007835	Vanderhoof Specialty Wood Products		Vanderhoof	66	40	20	5	0	14	159
4697	0000007851	North Enderby Timber Ltd.	NORTH ENDERBY TIMBER LTD - ENDERBY	Enderby	1	0	0	0	0	0	9
5051	0000020034	Brink Forest Products Co.	Brink Forest Products	Prince George	4	1	0	0	0	0	0
999999	0000020099	Tolko Industries Ltd.	Lake Country Division	Kelowna	3	2	0	0	0	0	0

17751	0000020104	Canfor Pulp Limited Partnership	Peace Valley OSB	Fort St. John	82	43	21	85	0	274	467
6159	0000020117	Pleasant Valley Remanufacturing Ltd.	PVR	Houston	2	1	0	0	0	0	0
18312	0000020133	Pacific BioEnergy Corp.	Pacific BioEnergy Corporation - Prince George Operations.	Prince George	53	34	28	0	0	0	0
100229	0000020163	Pinnacle Pellet Meadowbank Inc.	Meadowbank	Strathnaver	59	57	54	45	0	23	22
17557	0000020164	Pinnacle Pellet WL Inc.	Williams Lake	Williams Lake	5	4	4	0	0	23	22
13758	0000020165	Pinnacle Pellet Inc.	Quesnel	Quesnel	11	9	8	0	0	11	0

Table E.11 shows the ratio of Actual Emissions to Permitted Emissions.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	SOx	NOx
2747	0000005186	Hauer Bros. Lumber Ltd.	HAUER BROS.	Valemount	15.10	0.00	0.00
2574	0000005142	Tembec	Elko Sawmill	Elko	0.37	0.00	0.00
3403	0000005158	West Fraser Mills Ltd.	Chetwynd Forest Industries, a Division of West Fraser Mills	Chetwynd	0.08	0.00	1.05
4215	0000005160	West Fraser Mills Ltd.	Chasm Sawmills	Clinton	0.59	0.00	2.57
5625	0000005161	West Fraser Mills Ltd.	Fraser Lake Sawmills	Fraser Lake	0.11	0.00	0.82
1691	0000005162	Pacific Inland Resources	Smithers Sawmill	Smithers	0.03	0.00	2.70
3336	0000005167	Canadian Forest Products Ltd	Clear Lake	Prince George	0.07	0.00	0.00
2268	0000005168	Conifex Inc.	Conifex Inc.	Fort Saint James	0.36	0.00	0.00
3478	0000005169	Canadian Forest Products Ltd	Fort St. John	Fort St. John	0.16	0.00	0.99
2190	0000005173	Canadian Forest Products Ltd	Isle Pierre	Isle Pierre	0.09	0.00	0.69
3034	0000005174	Canadian Forest Products Ltd	POLAR DIVISION	Bear Lake	0.15	0.00	0.43
4122	0000005188	Babine Forest Products Ltd.	Babine Forest Products	Burns Lake	0.30	0.00	1.57
3446	0000007703	International Forest Products Ltd.	Adams lake Division	Chase	0.07	0.00	0.00
1615	0000007704	West Fraser Mills Ltd.	100 Mile Lumber - A Division of West Fraser Mills Ltd.	100 Mile House	0.12	0.00	0.77
5339	0000007705	Houston Forest Products Ltd.	Houston Sawmill	Houston	0.15	0.00	0.00
3898	0000007709	Dunkley Lumber Ltd.	Dunkley Lumber Ltd.	Strathnaver	0.06	0.00	1.37

2684	0000007710	Canadian Forest Products Ltd	Plateau Division	Vanderhoof	0.07	0.00	0.73
3283	0000007760	Tolko Industries Ltd.	Lakeview - Williams Lake	Williams Lake	0.95	0.00	5.62
1676	0000007770	Canadian Forest Products Ltd	MACKENZIE OPERATIONS	Mackenzie	0.01	0.00	0.00
1548	0000007788	West Fraser Mills Ltd.	WEST FRASER MILLS - WILLIAMS LAKE	Williams Lake	0.17	0.00	0.00
1945	0000007790	Tolko Industries Ltd.	Nicola Valley Division	Merritt	0.26	0.00	0.00
7841	0000007791	Tolko Industries Ltd.	Quest Wood Division	Quesnel	0.11	0.00	0.00
2001	0000007792	Tolko Industries Ltd.	Lavington Planer Mill	Lavington	0.15	0.00	0.00
3039	0000007811	Wynndel Box & Lumber Co. Ltd.	WYNNDEL BOX & LUMBER CO - WYNNDEL	Wynndel	0.04	0.00	0.00
2122	0000007826	Gorman Bros. Lumber Ltd.	Gorman Bros. Lumber	Westbank	0.67	0.00	4.81
1750	0000007829	J.H. Huscroft Ltd.	J. H. Huscroft Ltd.	Creston	1.00	0.00	1.00
1869	0000007832	Lakeland Mills Ltd.	Lakeland Mills Ltd.	Prince George	0.30	0.00	1.06
7512	0000007840	West Fraser Mills Ltd.	WEST FRASER MILLS - QUESNEL SAWMILL	Quesnel	0.20	0.00	1.64
1842	0000007872	Springer Creek Forest Products Ltd.	Springer Creek Forest Products Ltd.	Slocan	0.01	0.00	0.00
1596	0000007907	Tembec	Cranbrook Planer and Finger Joint Plant	Cranbrook	0.07	0.00	0.00
3028	0000007908	Tembec	Canal Flats Sawmill	Canal Flats	0.33	0.00	0.00
1955	0000007909	Canadian Forest Products Ltd	Chetwynd	Chetwynd	0.12	0.00	0.00
1699	0000007910	Canadian Forest Products Ltd	Prince George Sawmill Division	Prince George	0.07	0.00	0.00
7844	0000007912	Canadian Forest Products Ltd	Quesnel Division	Quesnel	0.05	0.00	0.00
4680	0000007914	Carrier Lumber Ltd.	Tabor Sawmill	Prince George	0.00	0.00	0.00
1846	0000007920	Weyerhaeuser Company Limited	iLevel By Weyerhaeuser Princeton Sawmill	Princeton	0.37	0.00	0.00
2696	0000007922	Western Forest Products Inc.	Alberni Pacific Sawmill	Port Alberni	0.03	0.00	0.00
7149	0000007923	Western Forest Products Inc.	Chemainus Sawmill	Chemainus	0.03	0.00	0.00
3051	0000007925	Western Forest Products Inc.	Somass Sawmill	Port Alberni	0.01	#	#
10837	0000007928	Western Forest Products Inc.	South Island Reman	Chemainus	0.12	0.00	0.00
3679	0000007938	Tolko Industries Ltd.	Williams Lake (Creekside)	Williams Lake	0.01	0.00	0.00
2484	0000007939	Tolko Industries Ltd.	Soda Creek	Williams Lake	0.02	0.00	0.00
14322	0000007988	Cheslatta Forest	Ootsa Lake Mill	Burns Lake	0.78	0.00	0.00

		Products Ltd.					
3133	0000020016	Nechako Lumber Company Ltd.	NECHAKO LUMBER - VANDERHOOF	Vanderhoof	0.22	0.00	0.45
5490	0000020019	International Forest Products Ltd.	Castlegar Sawmill	Castlegar	0.01	#	#
1951	0000020021	International Forest Products Ltd.	Grand Forks Sawmill	Grand Forks	0.08	0.00	0.00
3877	0000020036	Western Forest Products Inc.	Saltair Division	Duncan	0.26	0.00	0.00
7605	0000020037	Western Forest Products Inc.	Ladysmith Sawmill	Ladysmith	0.06	#	#
4396	0000020038	Western Forest Products Inc.	Cowichan Bay Division	Duncan	0.54	#	#
1997	0000020039	Downie Timber Ltd.	Downie Timber	Revelstoke	0.20	0.00	0.00
2410	0000020075	Mill and Timber Products Ltd.	Aspen Planers Ltd.	Merritt	1.78	0.00	0.00
4166	0000020084	Western Forest Products Inc.	Value Added Division	Chemainus			
8003	0000020086	Western Forest Products Inc.	Duke Point Sawmill	Nanaimo	0.02	#	#
1543	0000005172	Canadian Forest Products Ltd	Houston	Houston	0.17	0.00	2.71
5543	0000020100	Copper Mountain Cedar Products Ltd.	Copper Mountain Cedar Products	Terrace	0.06	0.00	0.00
1772	0000002912	Stella-Jones Inc.	Prince George Plant	Prince George	34.52	0.00	0.00
3019	0000005130	Decker Lake Forest Products Ltd.	DECKER LAKE FOREST PRODUCTS - BURNS LAKE	Burns Lake	0.24	0.00	1.17
2818	0000005156	Selkirk Forest Products	SELKIRK FOREST PRODUCTS - GALLOWAY	Galloway	8261.89	0.00	0.00
7248	0000005184	Tolko Industries Ltd.	Ashcroft Treating Division	Ashcroft	0.23	0.00	0.00
11706	0000005191	Ainsworth Lumber Co. Ltd.	Ainsworth OSB Division	One Hundred Mile House	0.89	#	#
2524	0000007843	Tolko Industries Ltd.	Heffley Creek Division	Kamloops	0.38	0.00	0.41
2573	0000007873	Federated Co-operatives Ltd.	Plywood Plant	Canoe	0.01	0.00	0.00
3725	0000007932	West Fraser Mills Ltd.	QUESNEL PLYWOOD, A Division of West Fraser Mills Ltd.	Quesnel	0.13	0.00	0.26
1764	0000007933	West Fraser Mills Ltd.	WILLIAMS LAKE PLYWOOD, A Division of West Fraser Mills Ltd.	Williams Lake	0.09	0.00	2.62
2082	0000007940	Tolko Industries Ltd.	Kelowna Division	Kelowna	0.07	0.00	1.23
2717	0000007941	Tolko Industries Ltd.	Armstrong Division	Armstrong	0.27	3.60	3.25
17945	0000020150	Thompson River Veneer Products LP	TRVP	Kamloops	0.23	0.00	0.00

2662	0000000618	Louisiana-Pacific Canada Ltd.	Golden EWP Division	Golden		0.00	2.31
1916	0000007707	Greenwood Forest Products (1983) Ltd.	GREENWOOD FOREST PRODUCTS (1983) - PENTICTON	Penticton	0.06	#	#
13444	0000005108	West Fraser Mills Ltd.	WestPine MDF	Quesnel	0.36	0.00	1.68
6099	0000005197	Northern Engineered Wood Products Inc.	Smithers	Smithers	0.08	0.00	0.36
7596	0000000718	Louisiana-Pacific Canada Ltd.	LP Dawson Creek OSB	Dawson Creek	0.02	0.00	0.00
2011	0000005199	Tolko Industries Ltd.	White Valley Division	Lumby	0.04	0.00	0.00
10606	0000007835	Vanderhoof Specialty Wood Products		Vanderhoof	1.00	0.00	1.00
4697	0000007851	North Enderby Timber Ltd.	NORTH ENDERBY TIMBER LTD - ENDERBY	Enderby		0.00	0.00
5051	0000020034	Brink Forest Products Co.	Brink Forest Products	Prince George			
999999	0000020099	Tolko Industries Ltd.	Lake Country Division	Kelowna			
17751	0000020104	Canfor Pulp Limited Partnership	Peace Valley OSB	Fort St. John	0.34	0.00	0.67
6159	0000020117	Pleasant Valley Remanufacturing Ltd.	PVR	Houston	1534.62	#	#
18312	0000020133	Pacific BioEnergy Corp.	Pacific BioEnergy Corporation - Prince George Operations.	Prince George	0.21	0.00	0.00
100229	0000020163	Pinnacle Pellet Meadowbank Inc.	Meadowbank	Strathnaver		0.00	2.09
17557	0000020164	Pinnacle Pellet WL Inc.	Williams Lake	Williams Lake		#	#
13758	0000020165	Pinnacle Pellet Inc.	Quesnel	Quesnel	0.30	#	#

Upstream Oil and Gas

The NPRI list of facilities for the Upstream Oil and Gas sector contains 359 facilities, of which a small fraction (only 98) have associated permits. These facilities are largely extraction facilities, with some service and pipeline operations. This list does not include exploration facilities. This discrepancy is in part due to NPRI reporting criteria that requires facility reporting for certain CACs or other toxics at fairly low levels and without regard to the location of the facility. A facility of this type may not be required to hold a permit if they are very remote from populations and/or do not emit significant amounts of pollutants such as fine particulate matter or SO₂. In addition, if there is no industrial process to regulate (for example a small compressor station) no permit may be required.

The other confounding issue in BC is that the Oil and Gas Commission (OGC) regulates some of this activity and thus, these facilities would be not require MoE permits. The data associated with these facilities is not available to BC Environment.

Summary

Table E.13 shows the total CACs from all facilities listed in the Oil and Gas sector for 2010. Some parameters show large discrepancies, especially NO_x and SO_x. This arises from the issues discussed above.

Table E.13: Summary of Reported and Permitted Emissions (tonnes, 2010)

	TPM	PM10	PM2.5	NO _x	SO _x	VOC	CO
Reported	261	254	254	26,604	40,689	5,944	19,223
Permitted	979	892	891	1,200	9,014	6,865	15,232

Discussion

Tables E.14 and E.15 show a selected list of facilities illustrating reported emissions and the ratio of reported to permitted loadings.

Table E.14: Selected Oil and Gas Facilities Reported emissions for 2010 (tonnes)

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO
1555	0000004304	Spectra Energy Transmission	Fort Nelson Gas Plant	Fort Nelson	7	6	6	5622	1087	372	287
1742	0000004305	Spectra Energy Transmission	McMahon Gas Plant	Taylor	2	2	2	3446	193	208	89
2737	0000007720	Spectra Energy Transmission	Station 1 - Taylor	Taylor	2	2	2		1405	37	726
3448	0000007961	Spectra Energy Transmission	Booster Station 6 - Bluehills	Peace River District				146	119		21
3449	0000007965	Spectra Energy Transmission	Booster Station 11 - Rigel	Peace River District					33	16	52
3457	0000007958	Spectra Energy Transmission	Booster Station 3 - Kobes Creek	Peace River District	1	1	1	382	630	17	478
5151	0000004306	Spectra Energy Transmission	Pine River Gas Plant	Peace River District	11	10	10	9929	872	2930	229
5365	0000018087	Talisman Energy	Talisman Bullmoose D-77-E/93-P-3	N/A	4	4	4	980			
8462	0000007744	Aitken Creek Gas Storage ULC	Aitken Creek Gas Storage ULC	Fort St John	4	4	4		105	146	71
8738	0000018082	Talisman Energy	Talisman West Sukunka a-64-J/93-P-4	n/a	0	0	0		924	26	130
9101	0000003935	ExxonMobil Canada Ltd	Sierra Gas Plant	Fort Nelson	3	3	3	237	101	52	79
10951	0000001080	Suncor Energy Inc.	Suncor Boundary Lake Gas Plant (11/14-24-084-15W6M)	Fort St John	0	0	0	287	58		
12448	0000015714	ConocoPhillips Canada Resources Corp.	Noel Sweet Gas Plant	n/a	3	3	3		817	14	1241
12449	0000015713	ConocoPhillips Canada Resources Corp.	Brassey Comp Station D-013-F	n/a	1	1	1		259		370
14268	0000007717	Spectra Energy Transmission	Booster Station 19 - Cabin Lake	Fort Nelson	1	1	1		47		24
14698	0000005125	Spectra Energy Midstream Corporation	Jedney I Gas Plant	Fort St. John	14	14	14	206	464	52	170
14929	0000005124	Spectra Energy Midstream Corporation	Highway Gas Plant	Peace River District	1	1	1	30	101	119	40
14980	0000020061	Keyera Corp	Caribou Gas Plant	Pink Mountain	8	8	8	477	1037	15	104
15309	0000017701	NuVista Energy Ltd.	Martin Creek Sour Gas Plant b-002-E	n/a	1	1	1	218	73	13	181
15377	0000018452	Canadian Natural Resources Limited	CNRL Fox D-47-D/94-A-16	n/a	0	0	0		88	17	
15379	0000016423	Devon Canada Corporation	Tommy Lakes C-019	na	2	2	2	248	61	20	79
15381	0000015725	ConocoPhillips Canada Resources Corp.	Bullmoose Comp Station D-083-G	N/A	0	0	0		73		110
15382	0000016667	EnCana Corporation	Gunnell Comp Stn b-023-F	n/a	1	1	1		1302	38	283
15383	0000017958	Suncor Energy Inc.	Mel D-008-I/94-P-04	Fort St. John				61	70		
15384	0000017959	Progress Energy Resources Corp.	BLUEBERRY c-29-K/94-A-12	Fort St. John					40		37
15389	0000018399	Canadian Natural Resources Limited	CNRL BEG B-13-B/94-G-1	n/a	1	1	1			14	42
15391	0000016057	Canadian Natural Resources Limited	CNRL BULRUSH B-38-K/94-A-16	n/a	0	0	0		204		

Table E.15: ratio of Reported to Permitted Emissions for 2010 for selected facilities in the Oil and Gas sector.

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	SOx	NOx	VOC	
1555	0000004304	Spectra Energy Transmission	Fort Nelson Gas Plant	Fort Nelson		0.19	0.08	3.34	1.00
1742	0000004305	Spectra Energy Transmission	McMahon Gas Plant	Taylor		0.33	0.03	11.78	2.48
2737	0000007720	Spectra Energy Transmission	Station 1 - Taylor	Taylor		0.08	451.00	0.00	0.19
3448	0000007961	Spectra Energy Transmission	Booster Station 6 - Bluehills			0.00	19.36	0.19	0.00
3449	0000007965	Spectra Energy Transmission	Booster Station 11 - Rigel			0.00	103.80	0.00	0.43
3457	0000007958	Spectra Energy Transmission	Booster Station 3 - Kobes Creek	Peace River District		0.37	13.39	0.34	0.62
5151	0000004306	Spectra Energy Transmission	Pine River Gas Plant	Peace River District		0.43	0.06	14.12	5.68
5365	0000018087	Talisman Energy	Talisman Bullmoose D-77-E/93-P-3	N/A					
8462	0000007744	Aitken Creek Gas Storage ULC	Aitken Creek Gas Storage ULC	Fort St John		0.18	104.52	0.00	2.45
8738	0000018082	Talisman Energy	Talisman West Sukunka a-64-J/93-P-4	n/a		0.03	1.32	0.00	0.26
9101	0000003935	ExxonMobil Canada Ltd	Sierra Gas Plant	Fort Nelson		0.09	0.05	0.36	3.26
10951	0000001080	Suncor Energy Inc.	Suncor Boundary Lake Gas Plant (11/14-24-084-15W6M)	Fort St John		1.76	0.10	34.32	0.00
12448	0000015714	ConocoPhillips Canada Resources Corp.	Noel Sweet Gas Plant	n/a					
12449	0000015713	ConocoPhillips Canada Resources Corp.	Brassey Comp Station D-013-F	n/a		0.29	0.43	0.00	0.00
14268	0000007717	Spectra Energy Transmission	Booster Station 19 - Cabin Lake	Fort Nelson		0.03	0.18	0.00	0.00
14698	0000005125	Spectra Energy Midstream Corporation	Jedney I Gas Plant	Fort St. John		2.32	0.51	0.29	1.29
14929	0000005124	Spectra Energy Midstream Corporation	Highway Gas Plant	Peace River District		0.03	2.99	0.14	11.76
14980	0000020061	Keyera Corp	Caribou Gas Plant	Pink Mountain					0.09
15309	0000017701	NuVista Energy Ltd.	Martin Creek Sour Gas Plant b-002-E	n/a					
15377	0000018452	Canadian Natural Resources Limited	CNRL Fox D-47-D/94-A-16	n/a					
15379	0000016423	Devon Canada Corporation	Tommy Lakes C-019	na			0.47	2.72	
15381	0000015725	ConocoPhillips Canada Resources Corp.	Bullmoose Comp Station D-083-G	N/A			1.06	0.00	
15382	0000016667	EnCana Corporation	Gunnell Comp Stn b-023-F	n/a					
15383	0000017958	Suncor Energy Inc.	Mel D-008-I/94-P-04				1.37	0.58	
15384	0000017959	Progress Energy Resources Corp.	BLUEBERRY c-29-K/94-A-12				3.38	0.00	
15389	0000018399	Canadian Natural Resources Limited	CNRL BEG B-13-B/94-G-1	n/a			0.00	0.00	
15391	0000016057	Canadian Natural Resources Limited	CNRL BULRUSH B-38-K/94-A-16	n/a					

For the SOx data, the larger facilities such as the major gas plants (Fort Nelson, McMahon, Pine River) have low ratios indicating that they emit much less SOx than permitted values, while smaller facilities (such as booster stations) have very high ratios. This may indicate that the permit fee emission factor may need to be reviewed. While for NOx emissions the opposite appears true; with the larger facilities having ratio values over 1.0.

Other Selected Facilities

The NPRI list of the remaining industrial facilities in BC numbered 50. Some of these facilities will not have permits due to the nature of the process; waste water treatment plants and non-point source facilities such as ship building and repair.

A short list of 28 facilities was compiled of selected facilities of interest that hold permits.

Summary

Table E.16 shows a summary of emissions from the list of Other Selected Facilities in tonnes for 2010:

	TPM	PM10	PM2.5	NOx	SOx	VOC	CO
Reported	318	164	90	3,941	1,150	667	1,197
Permitted	2,298	1,039	623	5,460	2,618	949	7,230

Discussion

Table E.17 lists all the facilities in this section with their Reported emissions for 2010. They are grouped by like sub-sectors such as power generation and chemical manufacturing, however many of the facilities are one-of-a-kind in BC such as the Husky Oil refinery in Prince George and the cement plant in Kamloops.

Table E.18 shows the ratio of Reported to Permitted emissions for TPM, NOx and SOx. While all facilities have a ratio of less than 1.0 for TPM, the ratios for NOx and SOx vary between 0.0 and as high as 12.0. The '#' in a cell indicates that there was a significant reported emission but that there was no permit value for that parameter.

Table E.17: Reported Emissions from list of Other Selected Facilities in tonnes for 2010:

Permit	NPRI	COMP_NAME	FACI_NAME	CITY	TPM	PM10	PM25	NOX	SOX	VOC	CO
6741	7751	Prince Rupert Grain Ltd.	Prince Rupert Grain Ltd	Prince Rupert	0	0	0	0	0	0	0
3106	7854	Sure Crop Feeds, Inc.	Grindrod	Grindrod	0	0	0	0	0	0	0
4641	7801	British Columbia Hydro and Power Authority	Masset Diesel Generating	Masset	7	6	6	391	0	10	90
11128	7959	Spectra Energy Transmission	McMahon Cogen Plant	Taylor	10	9	9	320	0	10	144
15854	7866	British Columbia Hydro and Power Authority	Fort Nelson Generating Stn	Fort Nelson	3	3	3	134	0	0	82
16080	6549	V.I. Power LP	Island Generation LP	Campbell R.	2	1	1	208	0	12	28
8808	6688	NW Energy (Williams Lake) Limited Partnership	Williams Lake Power Plant	Williams Lake	13	11	10	630	133	90	468
4628	7806	British Columbia Hydro and Power Authority		Telegraph Cr	1	1	1	36	0	0	0
4629	7805	British Columbia Hydro and Power Authority		Iskut	1	1	1	55	0	0	0
4644	7807	British Columbia Hydro and Power Authority		Sandspit	2	1	1	83	0	0	0
4710	7802	British Columbia Hydro and Power Authority		Anahim Lake	2	1	1	96	0	0	22
5890	7803	British Columbia Hydro and Power Authority		Bella Coola	2	2	2	110	0	0	25
	20120	British Columbia Hydro and Power Authority		Fort Ware	1	1	1	43	0	0	0
3822	7737	Top Shelf Feeds Inc.	TOP SHELF FEEDS -	Duncan	1	1	0	0	0	0	0
2825	7810	Labatt Breweries of Canada LP	Columbia Brewery	Creston	1	1	1	0	0	0	0
2065	405	Husky Oil Operations Limited	Prince George Refinery	Prince George	19	14	9	78	544	163	324
2110	3526	Canexus Chemicals Canada Limited Partnership	Nanaimo	Nanaimo	0	0	0	0	0	0	0
2119	2674	Marsulex Inc.	Prince George Plant	Prince George	0	0	0	0	83	0	0
9034	3272	FMC of Canada Ltd	FMC of Canada Ltd	Prince George	0	0	0	0	0	13	0
5612	5136	Kohler Canada Co.	Armstrong Plant	Armstrong	0	0	0	0	0	130	0
6578	5123	MAAX Bath Inc.	Armstrong Plant	Armstrong	0	0	0	0	0	101	0
15755	5179	Whitewater Composites Ltd.	N/A	Kelowna	0	0	0	0	0	29	0
1894	5153	Lafarge Canada Inc.	Kamloops Plant	Kamloops	94	34	13	1083	114	0	14
2280	6827	Graymont Western Canada Inc.	Pavilion Plant	Cache Creek	91	45	14	674	34	0	0
15832	5126	Roxul Inc.	ROXUL - GRAND FORKS	Grand Forks	58	28	20	0	243	0	0
16586	7794	I.G. Machine and Fibers	I.G. Ashcroft	Ashcroft	10	5	0	0	0	0	0
7610	7985	Campion Marine Inc.	CAMPION MARINE - KELOWNA	Kelowna	0	0	0	0	0	55	0
12975	5135	Toxco Waste Management Ltd.	Toxco Waste Management	Trail	0	0	0	0	0	53	0

Table E.18: Ratio of Reported to Permitted emissions for Other Selected Facilities for 2010:

Permit	NPRI_ID	COMP_NAME	FACI_NAME	CITY	TPM	SOx	NOx
6741	7751	Prince Rupert Grain Ltd.	Prince Rupert Grain Ltd	Prince Rupert	0.00		
3106	7854	Sure Crop Feeds, Inc.	Grindrod	Grindrod	0.00	0.00	0.00
4641	7801	British Columbia Hydro and Power Authority	Masset Diesel Generating Station	Masset	0.09	0.00	0.46
11128	7959	Spectra Energy Transmission	McMahon Cogen Plant	Taylor	0.06	0.00	0.77
15854	7866	British Columbia Hydro and Power Authority	Fort Nelson Generating Station	Fort Nelson	0.05	0.00	0.83
16080	6549	V.I. Power LP	Island Generation LP	Campbell River	0.01	0.00	0.22
8808	6688	NW Energy (Williams Lake) Limited Partnership	Williams Lake Power Plant	Williams Lake	0.22	12.06	1.70
4628	7806	British Columbia Hydro and Power Authority		Telegraph Creek	0.18	0.00	0.46
4629	7805	British Columbia Hydro and Power Authority		Iskut	0.15	0.00	0.60
4644	7807	British Columbia Hydro and Power Authority		Sandspit		#	
4710	7802	British Columbia Hydro and Power Authority		Anahim Lake	0.14	0.00	0.47
5890	7803	British Columbia Hydro and Power Authority		Bella Coola	0.09	0.00	0.24
	20120	British Columbia Hydro and Power Authority		Fort Ware		#	
3822	7737	Top Shelf Feeds Inc.	TOP SHELF FEEDS - DUNCAN	Duncan	0.04		0.00
2825	7810	Labatt Breweries of Canada LP	Columbia Brewery	Creston	0.11	0.00	0.00
2065	405	Husky Oil Operations Limited	Prince George Refinery	Prince George	0.40	0.33	0.88
2110	3526	Canexus Chemicals Canada Limited Partnership	Nanaimo	Nanaimo	0.03	0.19	0.05
2119	2674	Marsulex Inc.	Prince George Plant	Prince George	0.00	0.46	0.00
9034	3272	FMC of Canada Ltd	FMC of Canada Ltd	Prince George	0.00	0.00	0.00
5612	5136	Kohler Canada Co.	Armstrong Plant	Armstrong	0.00		
6578	5123	MAAX Bath Inc.	Armstrong Plant	Armstrong	0.00		
15755	5179	Whitewater Composites Ltd.	N/A	Kelowna	0.00		
1894	5153	Lafarge Canada Inc.	Kamloops Plant	Kamloops	0.40	0.25	0.90
2280	6827	Graymont Western Canada Inc.	Pavilion Plant	Cache Creek	0.61	38.08	4.60
15832	5126	Roxul Inc.	ROXUL - GRAND FORKS	Grand Forks	0.79	#	
16586	7794	I.G. Machine and Fibers	I.G. Ashcroft	Ashcroft	0.02	0.00	0.00
7610	7985	Campion Marine Inc.	CAMPION MARINE - KELOWNA	Kelowna	0.00		
12975	5135	Toxco Waste Management Ltd.	Toxco Waste Management Ltd.	Trail	0.00	0.00	

