

Annual Environmental Report
for
ConocoPhillips Bantry Bay Terminal Ltd

Licence Register No. P0419-01

Reporting Period: January – December 2009

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Table of Contents

1	INTRODUCTION	1
2	SUMMARY INFORMATION.....	2
2.1	MONITORING DATA	2
2.1.1	<i>Emissions to Waters.....</i>	2
2.1.2	<i>Groundwater Monitoring.....</i>	6
2.1.3	<i>Noise Monitoring.....</i>	14
2.1.4	<i>Emissions to Air.....</i>	15
2.1.5	<i>Waste Management.....</i>	15
2.1.6	<i>Site Inspections</i>	19
2.2	AGENCY MONITORING & ENFORCEMENT	19
2.2.1	<i>Emissions Sampling & Analysis</i>	19
2.3	ENERGY & WATER CONSUMPTION	19
2.3.1	<i>Energy Consumption.....</i>	19
2.3.2	<i>Water Consumption</i>	21
2.4	ENVIRONMENTAL INCIDENTS & COMPLAINTS	21
2.4.1	<i>Environmental Incidents.....</i>	21
2.4.2	<i>Environmental Complaints</i>	21
2.5	REVIEW OF RESIDUALS MANAGEMENT PLAN & ENVIRONMENTAL LIABILITIES RISK ASSESSMENT	21
3	MANAGEMENT OF THE ACTIVITY	22
3.1	INTRODUCTION	22
3.2	ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR 2009	22
3.2.1	<i>Introduction.....</i>	22
3.2.2	<i>Report on EMP for 2009.....</i>	22
3.3	ENVIRONMENTAL MANAGEMENT PROGRAMME 2010-2014.....	27
3.3.1	<i>Introduction.....</i>	27
3.3.2	<i>Environmental Management Programme 2010-2014.....</i>	27
3.4	POLLUTANT RELEASE AND TRANSFER REGISTER (PRTR)	35
3.4.1	<i>Introduction.....</i>	35
3.4.2	<i>Releases to Air and Water</i>	35
4	IPC LICENCE CHECKLIST	36

ANNEXES

Annex 1	ConocoPhillips Health, Safety and Environment Policy
Annex 2	Site Plan
Annex 3	Organisation Chart
Annex 4	Site Inspection Logs
Annex 5	Effluent Monitoring Results
Annex 6	Results of Groundwater Monitoring
Annex 7	Waste Management Record
Annex 8	Pollutant Release and Transfer Register
Annex 9	Fugitive Emissions Report
Annex 10	Register of Significant Environmental Impacts
Annex 11	Report on Bantry Bay Environmental Monitoring Programme
Annex 12	Landfill Status Report
Annex 13	Report on Agency Inspection
Annex 14	Report on Testing of Tanks and Pipelines

1 Introduction

This Annual Environmental Report (AER) is submitted to the Environmental Protection Agency (EPA) in compliance with Condition 2.9.2 of the Integrated Pollution Control (IPC) Licence, Register No. P0419-01.

The AER contains summary information on the environmental performance of ConocoPhillips Bantry Bay Terminal Ltd (formerly Bantry Terminals Ltd) from January to December 2009.

ConocoPhillips Bantry Bay Terminal Ltd (CPBBT) operates an oil storage terminal on Whiddy Island, Bantry, Co. Cork. The Terminal was constructed in the 1960s by Gulf Oil. It has fourteen floating roof tanks capable of storing a nominal capacity of 1,279,000 m³ of petroleum products and four fixed roof tanks capable of storing a nominal capacity of 38,083 m³ of petroleum products. In 1986, ownership of the Terminal was transferred from Gulf Oil to the Irish Government. In 1990, at the time of the first Gulf War, an emergency project was undertaken to import 205,000 tonnes of crude oil and store them on site to be held as a national strategic oil reserve.

In 1995, the then Minister for Transport, Energy & Communications sanctioned the construction of a Single Point Mooring (SPM) with associated sub-sea pipelines to provide:

- a facility for the storage of national strategic reserves;
- a facility for the storage of off-shore oil;
- a facility for the commercial storage of oil.

This was installed approximately 1,600 metres offshore from the Terminal. Two shipments of crude oil were imported to the Terminal in April 1998 to commission the SPM.

A bunkering service for vessels is also provided from the Terminal. The Terminal also stores and trades other petroleum products. The products stored at the Terminal during 2009 were:

- Crude Oil;
- Ultra Low Sulphur Gasoline;
- Finished Gas Oil;
- Ultra Low Sulphur Diesel;
- Marked Gas Oil;
- Dual Purpose Kerosene (Previously listed as Jet A1);
- Premium Blendstock for Oxygenate Blending;
- Reformulated Blendstock for Oxygenate Blending.

A copy of ConocoPhillips' Health, Safety and Environmental Policy is included in Annex 1. A site plan of the Terminal is contained in Annex 2 and a copy of CPBBT's Organisation Chart as of the end of 2009 is included in Annex 3.

2 Summary Information

2.1 Monitoring Data

2.1.1 Emissions to Waters

The mean monitoring results for the emissions to water at SWEP-01 during 2009 are presented in *Table 2.1*. The results from 2008 are included for comparison purposes.

Table 2.1: Summary of Emissions to Waters (Concentrations): January-December 2009

Parameter	Test Method & Limit of Detection	Mean Concentration (2008)	Mean Concentration (2009)	Emission Limit Values
Visual Inspection	Subjective Assessment (N/A)			
pH (pH units)	-	5.99	4.57	4 - 9
48 hour LC ₅₀ , 5 and 15 minute EC ₅₀ Toxicity Assays (Toxicity Units)	Acute toxicity testing for Tisbe battaglia & Skeletonema costatum Enterprise Ireland Methods 6.2 & 6.3 for Vibrio fischeri test species	Tisbe battaglia: 48 hour LC ₅₀ = < 3.1 Vibrio fischeri 5 min EC ₅₀ = < 2.2 Vibrio fischeri 15 min EC ₅₀ = < 2.2	Tisbe battaglia: 48 hour LC ₅₀ = < 3.1 Vibrio fischeri 5 min EC ₅₀ = < 2.2 Vibrio fischeri 15 min EC ₅₀ = < 2.2	5
BOD (mg/l)	UKSCA (1 mg/l)	5.19	5.83	25
Total Suspended Solids (mg/l)	UKSCA (1 mg/l)	27.58	13.75	30
Total Phenols (mg/l)	HPLC (1 µg/l)	0.12	0.38	1
Mineral Oil	<i>As outlined below as (i), (ii), (iii) and (iv)</i>			
(i) Total Hydrocarbons	UKSCA (0.5 mg/l)	15.67	25.50	-
(ii) Total Dissolved and Emulsified Hydrocarbons (mg/l)	UKSCA (0.5 mg/l)	15.67	24.67	-
(iii) Total Petroleum Hydrocarbons (mg/l)	UKSCA (0.5 mg/l)	1.2	1.44	10
(iv) Total Dissolved and Emulsified Petroleum Hydrocarbons (mg/l)	UKSCA (0.5 mg/l)	1.24	1.44	-

Notes: Visual Inspection Log of SWEP-01 Emission to water is presented in Annex 4.

UKSCA – UK Standing Committee of Analysis Methods for the analysis of Water and Associated Materials.

Full details of the effluent monitoring results are included in Annex 5.

The effluent samples were collected by CPBBT and the analysis was undertaken by En-Force Laboratories, Cork. The monitoring results from the extracted waste water samples are also expressed as mass emission values in *Table 2.2*. There is no Emission Limit Value (ELV) for the volumetric discharge at the SWEP-01 emission point. The effluent discharge consists almost entirely of stormwater run-off from the Terminal and the occasional release of water from the tank bottoms into the treatment system. The mass emissions have been calculated using average rainfall data for 2009 from the nearest Met Éireann climatological weather station (Valentia) and using a value for the area of land on site from which stormwater is directed to SWEP-01.

Table 2.2: Summary of Mass Emissions to Waters

Parameter	Mean Daily Mass Emissions (kg/day)* 2008	Mean Daily Mass Emissions (kg/day)* 2009
Mean Volumetric Discharge	1,392,907	2,078,370
pH	N/A	N/A
Toxicity	N/A	N/A
BOD	7.23	12.12
Suspended Solids	38.42	28.58
Mineral Oil**	1.73	2.99
Total Phenols	0.17	0.79

Notes:

- * Mean Volumetric Discharge is calculated using rainfall data from the nearest climatological station (Valentia) in conjunction with the total site area which undergoes surface water run-off collection (348,800 m²)
- ** Mass emission result for mineral oils is based on Total Petroleum Hydrocarbons assay results
- N/A Not Applicable

All non-compliant emissions recorded during the reporting period are listed in *Table 2.3*.

Table 2.3: Summary of Emissions to Water Non-compliances

Date	Non-compliance	Cause	Corrective Action
12/05/2009	Suspended solids Emission Limit Value exceeded (60 mg/l vs. 30 mg/l)	Location of sampler intake at stagnation point in effluent outflow pipe.	Sampler intake relocated and effluent outflow pipe cleaned.

The amount of waste water discharge from the site varies with the level of rainfall. The highest volumetric water discharge in 2009 occurred in November (4,189 m³/day on average) and the lowest occurred during February (680 m³/day on average). The total estimated rainfall for the site in 2009 was 30% greater than the total received in 2008.

Over the years that the monitoring programme has been in place, CPBBT have implemented a number of measures to ensure that the results of the effluent monitoring were representative of the actual effluent discharge. In 2005, the results showed some exceedances of the licence limit values. CPBBT carried out an audit of this sampling procedure as part of an investigation into these exceedances. As a result, the following items were identified:

- The automatic sampler required servicing and/or replacement;
- The hose connecting the outlet to the sampler requires regular replacing;
- Glass jars needed to be replaced and washed regularly;
- Latex gloves should be worn when handling the sample;
- A funnel should be used when preparing the composite sample;
- Proper training should be provided to the staff collecting the sample

In 2009 CPBBT continued to address all of the above concerns with the use of the new automatic sampler for collecting effluent samples. The new installation consists of a new refrigerated Auto-Sampler at SWEP-01 and includes a constant pH sensor. Also a number of operators are trained up in the use of the auto sampler and the procedure for collecting samples.

In addition, in 2007 CPBBT purchased a phenols test kit. This is used to conduct occasional cross checks before sending the effluent samples to En-Force Laboratories. It is also used to check the concentration of any large volumes of tank water before being released into the system. It is also occasionally used to check for phenols in local water draw offs.

The lagoon is not lined and it is possible that some areas of permeability may exist, and that some water could permeate the lagoon wall and escape to the bay at Trá na Seasca. However, as has already highlighted to the Agency, this quantity would be insignificant when compared to the licensed discharge point (SWEP-01) from this lagoon, also to Trá na Seasca.

It should be noted that the lagoon water is continuously in contact with this sediment and the results at the outfall show that the petroleum hydrocarbons content of the effluent is well within the licence conditions. If any water did manage to permeate the floor of the lagoon and enter the sea, it would not be bypassing any treatment steps as the purpose of the lagoon is simply to allow settlement of any solids in the effluent stream. In addition,

there is no indication that any contamination of the sediment can leech and dissolve into the water, as shown by the results of the ongoing effluent monitoring programme.

It is important to remember that the lagoon is only intended to allow settling of any solids contained in the effluent. The main effluent treatment step takes place at the oil-water separators, which are located before the effluent enters the lagoon.

One exceedance for Suspended Solids (SS) occurred in May 2009. This is a considerable improvement on 2008, where six exceedances were observed. On investigation, it was found that this (2009) exceedance was attributable to the location of the sampler intake in the effluent discharge line. The sampler intake was located in a region in the outflow pipe where there was stagnation of the flow and settlement of solids was occurring. As a consequence, the sampler was given a reading that was not truly representative of the effluent flow. CPBBT moved the sampler to a more suitable location and cleaned the area where solid build up was occurring. In 2009 the lagoon was dredged to remove the settled solids that had accumulated in it since it was commissioned. This should further enhance the removal of SS from the effluent before discharging to the bay.

Enterprise Ireland (EI) has conducted all toxicity testing in previous years with cross testing being carried out by Brixham Environmental Laboratory (BEL) (in 2006). The three tests carried out in 2009 included– *Tisbe battagliai* 48-hour LC₅₀, *Vibrio fischeri* 5 minute EC₅₀ and *Vibrio fischeri* 15 minute EC₅₀. The samples were collected and tested in November 2009. The results obtained from the tests showed no exceedance of the ELV for the test species.

The LC₅₀ (Concentration at which 50 % mortality of the species occurs) for *Tisbe battagliai* was calculated as > 32 % V/V, which corresponds to a toxicity level of < 3.1 Toxic Units. Tests carried out for *Vibrio fischeri* (5 and 15 minute Median Effect Concentration) to light inhibition showed that for 5 min EC₅₀ the concentration was > 45 % V/V, giving a toxicity level of < 2.2 and for the 15 min EC₅₀ the concentration was > 45 % V/V also giving a toxicity level of < 2.2. These results show that the toxicity of the effluent is low and is well below the emission limit value of 5 Toxic Units.

Two exceedances of the ELV for Phenols occurred in 2009. It is believed these exceedances resulted from the release of tank water bottoms through the oil-water interceptors to SWEP-01 while there was low natural runoff in the system. CPBBT have undertaken to continue local monitoring on-site using their own Phenol test kit in order to better manage the release of tank water bottoms.

All other parameters remained below their respective ELVs for the site. Values for “Total Hydrocarbons” are not compared to the ELV for “Mineral Oil” given in the licence. The test for total hydrocarbons is a measure of the number of C-H bonds in the sample. This is not an accurate indication of the amount of a petroleum compound present. Hence, the values for “Total Petroleum Hydrocarbons” are compared to the ELVs for mineral oil. No exceedances of the ELV were recorded in 2009.

2.1.2 Groundwater Monitoring

The results of the biannual analysis of groundwater for 2009 are given in *Table 2.4* and *Table 2.5*. *Table 2.4* shows the parameters measured in the field at the time of sampling, the corresponding results for 2008 are included in italics for comparison. The results of the laboratory analysis are presented in *Table 2.5*. The complete results of the groundwater monitoring undertaken in 2009 are contained in Annex 6. A slightly different set of parameters is examined at the landfill location when compared with the tank farm and the area adjacent to the oil pits. The monitoring at these particular wells is conducted as part of the Landfill Operational Plan. The results of the analysis of groundwater at the landfill site are contained in *Table 2.6*.

The groundwater sampling was conducted according to standard field methodologies. The monitoring wells were developed prior to sample extraction utilising a submersible pump. Sample extraction was performed into appropriate glass and plastic sample containers. Field observations and measurements were performed in a clean beaker subsequent to sample extraction. As there are no licensed concentration limits for groundwater, the results of the analysis are compared to the Drinking Water Parametric Values (PV) (see S.I. 278 of 2007).

Table 2.4: Field Results at Groundwater Monitoring Wells

Parameter	Test Method	PV	MW-1	MW-2	MW-3	BH-109	BH-110	BH-103	BH-102	BH-104	BH-105	BH-108	BH-106	BH-107
			Tank Farm					Landfill				Oil Pits		
			Up-gradient	Down-gradient	Down-gradient	Down-gradient	Down-gradient	Up-gradient	Down-gradient	Down-gradient	Down-gradient	Up-gradient	Down-gradient	Down-gradient
Monitoring Dates	N/A	N/A	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009	31/3/2009 6/10/2009
			27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08	27/03/08; 6/11/08
Visual Inspection of Extracted Groundwater	Subjective determination over two sampling events	-	Cloudy grey; Very slightly cloudy.	Cloudy light brown; Brown & Silty	Red orange cloudy brown; Orange red	Brown/grey cloudy; Very slightly cloudy, white	Slightly cloudy; Brown; Silty	Grey/ssd; Grey silty	Cloudy brown/grey; Brownish grey, silty	Slight iridescence; Cloudy, grey sheen	Cloudy grey/black ssd; Cloudy, grey	Grey, cloudy; Grey, slightly silty	Cloudy; Some ssd, cloudy	Cloudy; Slightly silty
			<i>Slight silty grey tint; Cloudy</i>	<i>Grey tint & silty; Cloudy & some ssd</i>	<i>Orange; Red orange cloudy red ssd</i>	<i>Brown tint; Some ssd black</i>	<i>Grey tint; Grey with ssd</i>	<i>Grey and very silty; Grey/ssd</i>	<i>Grey & silty; Slight red ssd</i>	<i>Silty grey; Cloudy grey ssd</i>	<i>Grey/brown tint; Cloudy grey ssd</i>	<i>Very silty, orange tint; Cloudy</i>	<i>Slightly grey and silty; Clear few ssd</i>	<i>Greyish tint & silty; Brown tinted</i>
Odour of Extracted Groundwater	Subjective determination over two sampling events	-	No odour; No odour	No odour; No odour	Metallic; Slight odour	No odour; No odour	No odour; No odour	Organic odour; No odour	No odour; No odour	Slight organic odour; Slight odour	No odour; No odour	Slight organic; No odour	No odour; No odour	No odour; No odour
			<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; Very slight metallic</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>	<i>No odour; No odour</i>
Temperature (°C)	Temperature probe	-	11.7; 12.4	12.6; 13	11.4; 14.5	13.2; 13.2	10.3; 13.1	11.7; 12.4	10.3; 12.8	12.1; 13.3	12.2; 12.7	11.3; 12.7	10.7; 13.1	10.6; 12.4
			12.7; 12	11.1; 13.3	11.3; 11.5	12.9; 13	12.3; 12.4	12.2; 11.4	12; 11.5	12.1; 13.1	10.4; 11.9	22; 12.8	14; 12.8	14.2; 12.8
Conductivity (µS/cm)	Conductivity meter	2,500	250; 212	640; 610	779; 342	712; 638	499; 470	391; 430	327; 250	2130; 1849	548; 510	299; 440	640; 581	489; 550
			399; 276	713; 577	2430; 640	935; 664	628; 602	962; 662	297; 168.5	2150; 1690	753; 554	778; 299	746; 829	339; 595
pH	pH meter	6.5-9.5	7.36; 5.86	4.65 ; 4.18	6.41; 6.47	6.97; 6.66	7.36; 6.58	7.37; 6.72	5.96 ; 6.22	7.36; 6.7	6.83; 6.83	6.15 ; 5.86	7.33; 6.83	7.36; 6.33
			6.15; 7.23	4.47 ; 4.12	6.68; 5.98	6.83; 7.39	7.03; 7.27	7.76; 8.15	6.12; 5.71	6.74; 7.23	7.52; 6.94	7.1; 6.95	6.24 ; 7.31	6; 7.5

Notes: Field monitoring results from the 2008 monitoring events presented in italicised format below the recorded values for 2009.

N/A Values in **bold** type exceed the Drinking Water PV

Not applicable

Suspended Solids

Hydrocarbon

ANC Analysis not conducted

The conductivity readings were less than the PV at all of the monitoring wells. Low pH levels were recorded at a number of wells in 2009, of these the majority were only slightly below the PV level for pH. One reading was considerably lower than the PV and this was the reading for MW-2. This is in line with previous results from this location. Previous investigations have revealed the presence of naturally-occurring iron pyrites and sulphides in the soil and groundrock on Whiddy Island. These minerals are acidic in nature, which would explain the low pH levels obtained in many of the wells. CPBBT will continue to review these readings to establish any trends in the pH levels on the site.

Table 2.5 presents the results of the chemical testing carried out on the groundwater samples at the tank farm and oil pits. The samples were transported off-site to a laboratory for chemical analysis.

Several metals were observed to be in excess of their respective PVs. The concentration of iron and nickel exceeded the PV at one site each. Similar results were recorded in 2008 and previous years. As mentioned above, there are naturally occurring iron pyrites and sulphides in the soil which may contribute to these elevated readings of iron.

Recorded concentrations of manganese exceeded the European Drinking water Standard at all monitoring wells with the exception of BH-102. Similar levels have been recorded in the past across the site. These elevated concentrations of manganese in the groundwater are likely to be a result of the high level of manganese in the soil and bedrock at the site which is naturally occurring.

MW-3 and BH-104 showed exceedances of the PV limit for Chloride (250mg/l) in 2009. Similar levels of Chloride have been recorded at these locations in the past and are likely to be a consequence of naturally occurring minerals in the groundrock.

The average Cadmium level was below the PV limits at all wells in 2009.

The organics analyses conducted indicate that the various organic compounds covered by the groundwater monitoring programme are all less than the limit of detection except at BH-102 and BH-105, located beside the inert landfill.

Table 2.5: Mean Chemical Analysis Results from Groundwater Monitoring

Parameter	Test Method & Limit of Detection	PV	MW-1	MW-2	MW-3	BH-109	BH-110	BH-108	BH-106	BH-107
			Tank Farm					Oil Pits		
			Up-gradient	Down-gradient	Down-gradient	Down-gradient	Down-gradient	Up-gradient	Down-gradient	Down-gradient
Quality Indicators										
Ammonium (mg/l)	UKAS (Kane analyser) (0.3 mg/l)	0.3	< 0.29	0.29	0.29	< 0.16	< 0.1	< 0.15	0.13	< 0.14
			< 0.25	0.2	< 0.87	< 0.23	< 0.2	< 0.3	0.29	< 0.4
Chloride (mg/l)	UKAS (Kane analyser) (1 mg/l)	250	29.6	56.9	448.1	96.9	64.1	40.8	93.5	57.3
			42.5	77	365.5	92	76.5	59	98	52.5
Sulphate (Soluble) (mg/l)	UKAS (Kone analyser) (3 mg/l)	250	29	194	116	75	131	11.68	25.2	32.7
			45	217	150	47	169	8.35	25.5	25
Nitrate (mg/l)	UKAS (Kone analyser) (0.3 mg/l)	50	0.9	0.35	1.75	< 0.35	< 0.3	0.25	0.35	8.8
			0.3	0.4	2.95	< 0.3	< 0.3	0.3	0.5	3.3
Sodium (mg/l)	UKAS (Flame Photometer) (0.2 mg/l)	200	17.93	33.58	218.95	76.29	43.69	21.93	32.00	36.93
			24.35	41.35	155.7	93.25	63.85	30.86	37.50	35.70
Potassium (mg/l)	UKAS (Flame Photometer) (0.2 mg/l)	12	0.88	1.9	7.96	1.3	1.7	1.8	1.19	4.25
			1	2.3	5.6	1.8	2.1	1.85	1.60	2.90
Calcium (mg/l)	ICP (0.05 mg/l)	200	15.07	28.195	40.625	52.8	51.695	13.70	71.94	65.72
			18.97	31.045	43.095	53.46	55.34	42.56	71.46	38.86
Magnesium (mg/l)	ICP (0.05 mg/l)	50	4.14	18.82	28.395	9.535	16.82	6.80	10.90	8.66
			5.27	21.105	16.855	10.411	17.17	9.42	10.86	8.34

Table 2.5 (cont'd): Mean Chemical Analysis Results from Groundwater Monitoring

Parameter	Test Method & Limit of Detection	PV	MW-1	MW-2	MW-3	BH-109	BH-110	BH-108	BH-106	BH-107
			Tank Farm					Oil Pits		
			Up-gradient	Down-gradient	Down-gradient	Down-gradient	Down-gradient	Up-gradient	Down-gradient	Down-gradient
Metals Analysis										
Arsenic (mg/l)	ICP (0.005 mg/l)	0.01	< 0.00255	< 0.0031	< 0.0031	< 0.00365	< 0.0029	< 0.0031	< 0.00315	< 0.00285
			< 0.001	< 0.001	< 0.0015	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Boron (mg/l)	ICP (0.05 mg/l)	1	0.012	0.0106	0.0755	0.0545	0.022	0.021	0.012	0.016
			0.061	0.0295	0.065	0.0325	0.02	0.0085	0.0095	0.013
Cadmium (mg/l)	ICP (0.0004 mg/l)	0.005	< 0.0005	< 0.00075	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
			0.0004	0.001	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Chromium (mg/l)	ICP (0.001 mg/l)	0.05	< 0.0015	< 0.00175	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
			< 0.001	< 0.001	< 0.0015	< 0.004	< 0.0025	< 0.001	< 0.0055	< 0.0035
Copper (mg/l)	ICP (0.01 mg/l)	2	0.007	0.047	0.007	0.007	0.007	0.007	0.007	0.007
			0.001	0.088	0.0045	0.003	0.0025	0.002	0.002	0.0035
Iron (mg/l)	ICP (0.001 mg/l)	0.2	0.02	1.7095	0.0505	0.02	0.02	0.02	0.0485	0.02
			0.022	1.1755	0.079	0.143	0.067	0.0385	0.0385	0.125
Manganese (mg/l)	ICP (0.001 mg/l)	0.05	0.689	2.7215	0.6805	0.512	0.2115	1.158	0.246	0.1985
			0.819	2.584	0.532	0.802	0.143	1.641	0.984	0.933
Mercury (mg/l)	CVAA (0.00005 mg/l)	0.001	< 0.0015	< 0.0008	< 0.0008	< 0.0006	< 0.0006	< 0.0008	< 0.0008	< 0.0008
			< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Nickel (mg/l)	ICP (0.01 mg/l)	0.02	0.005	0.0855	0.0105	0.0025	0.002	0.0025	0.002	0.002
			0.006	0.0985	0.0165	0.0045	0.0035	0.003	0.002	0.0025
Lead (mg/l)	ICP (0.005 mg/l)	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
			<0.001	<0.0015	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (mg/l)	ICP (0.005 mg/l)	0.01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
			<0.001	0.001	0.002	< 0.001	0.001	<0.001	0.001	0.001

Table 2.5 (cont'd): Mean Chemical Analysis Results from Groundwater Monitoring

Parameter	Test Method & Limit of Detection	PV	MW-1	MW-2	MW-3	BH-109	BH-110	BH-108	BH-106	BH-107
			Tank Farm					Oil Pits		
			Up-gradient	Down-gradient	Down-gradient	Down-gradient	Down-gradient	Up-gradient	Down-gradient	Down-gradient
Zinc (mg/l)	ICP (0.05 mg/l)	-	0.0075	0.241	0.0245	0.005	0.0105	0.0065	0.011	0.0145
			<i>0.002</i>	<i>0.311</i>	<i>0.037</i>	<i>0.0025</i>	<i>0.055</i>	<i>0.0025</i>	<i>0.001</i>	<i>0.0105</i>
Barium (mg/l)	ICP (0.05 mg/l)	-	< 0.003	< 0.0098	< 0.0145	< 0.008	< 0.0095	< 0.003	< 0.0055	< 0.009
			< 0.001	< 0.009	< 0.0095	< 0.009	< 0.0105	< 0.008	< 0.0065	< 0.0055
Organics Analysis										
Diesel Range Organics (mg/l)	GC-FID (0.01 mg/l)	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oil (mg/l)	GC-FID (0.01 mg/l)	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics (mg/l)	GC-FID (0.01 mg/l)	-	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene (mg/l)	GC-FID (0.01 mg/l)	0.001	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
			< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Notes: Mean monitoring results from the 2008 monitoring events are presented in italicised format below the recorded levels for the current monitoring period
Values in **bold** type are detected at levels greater than the Drinking Water PV.
ANC Analysis not conducted

Table 2.6: Groundwater Monitoring Results at Landfill

Parameter	Test Method & Limit of Detection	PV	BH-103	BH-102	BH-104	BH-105
			Up-gradient	Down-gradient	Down-gradient	Down-gradient
Quality Indicators						
pH (units)	pH meter	6.5-9.5	7.57 8.05	7.245 6.85	7.395 7.25	7.835 7.31
Conductivity (µS/cm)	Conductivity Probe	2,500	437.5 533	342 286	2510 1781.5	665.5 600.5
Dissolved Oxygen (mg/l)	D.O. Probe	No abnormal change	ANC 3.3	ANC 3.4	ANC 3.5	ANC 4.7
Ammonium (mg/l)	UKAS (Kone analyser) (0.3 mg/l)	0.3	< 0.165 < 0.229	0.126 0.2	0.206 0.229	<0.132 < 0.2
Total Oxidised Nitrogen (mg/l)	UKAS (Kone analyser) (0.3 mg/l)	-	< 0.275 < 0.3	< 0.395 < 0.25	< 0.275 < 0.3	< 0.275 < 0.3
Chloride (mg/l)	UKAS (Kone analyser) (1mg/l)	250	33.8 37	55.8 57	425 355	19.41 57.5
Sulphate (Soluble) (mg/l)	UKAS (Kone analyser) (3 mg/l)	250	16.38 16.5	9.69 11	312.94 322.5	99.96 120
Sodium (mg/l)	UKAS (Flame Photometer) (0.2 mg/l)	200	33.36 41.4	23.375 35.6	84.855 82.45	22.2 31.35
Potassium (mg/l)	UKAS (Flame Photometer) (0.2 mg/l)	12	0.785 0.45	0.84 0.75	3.97 3.9	1.935 2.75
Calcium (mg/l)	ICP (0.05 mg/l)	200	31.905 36.165	17.905 30.56	255.9 242.1	66.27 76.53
Magnesium (mg/l)	ICP (0.05 mg/l)	50	5.26 5.90	2.61 4.68	57.665 51.4	6.105 11.42
Phosphorus (mg/l)	ICP (0.05 mg/l)	-	0.01 0.065	< 0.012 < 0.08	< 0.028 < 0.05	< 0.005 < 0.04
Fluoride (mg/l)	UKAS (Kone analyser) (0.01 mg/l)	1	< 0.3 0.35	< 0.3 0.25	< 0.3 0.2	< 0.3 0.45
Total Alkalinity as CaCO ₃ (mg/l)	UKAS Titration Method (0.4 mg/l)	-	74.5 170	22 105	250.5 305	105 165
Component Alkalinity as CaCO ₃ (mg/l)	UKAS Titration Method (0.4 mg/l)	-	ANC ANC	ANC ANC	ANC ANC	ANC ANC
Total Organic Carbon (mg/l)	UKAS (Infra-red) (0.01 mg/l)	No abnormal change	< 3 2	< 6.5 2	< 1.5 2	< 3.5 2
Total Cyanide (mg/l)	UKAS (Alliance Distillation Instrument) (0.05 mg/l)	-	< 0.045 0.05	< 0.045 0.05	< 0.045 0.05	< 0.045 0.05

Table 2.6 (cont'd): Groundwater Monitoring Results at Landfill

Parameter	Test Method & Limit of Detection	PV	BH-103	BH-102	BH-104	BH-105
			Up-gradient	Down-gradient	Down-gradient	Down-gradient
Metals Analysis						
Arsenic (mg/l)	ICP (0.002 mg/l)	0.01	< 0.00455 <i>< 0.0015</i>	0.00275 <i>0.0015</i>	0.0064 <i>0.006</i>	< 0.0033 <i>< 0.001</i>
Boron (mg/l)	ICP (0.05 mg/l)	1	0.012 <i>0.0145</i>	0.0205 <i>0.013</i>	0.012 <i>0.012</i>	0.012 <i>0.0135</i>
Cadmium (mg/l)	ICP (0.0004 mg/l)	0.005	< 0.0005 <i>0.0004</i>	< 0.0005 <i>0.0004</i>	< 0.0005 <i>0.0004</i>	< 0.0006 <i>0.00075</i>
Chromium (mg/l)	ICP (0.001 mg/l)	0.05	0.0015 <i>0.0065</i>	0.0015 <i>0.0035</i>	0.0015 <i>0.001</i>	0.0015 <i>0.0015</i>
Copper (mg/l)	ICP (0.005 mg/l)	2	0.007 <i>0.004</i>	0.007 <i>0.002</i>	0.007 <i>0.0015</i>	0.007 <i>0.002</i>
Iron (mg/l)	ICP (0.001 mg/l)	0.2	0.02 <i>0.051</i>	0.0275 <i>0.053</i>	0.02 <i>0.037</i>	0.02 <i>0.055</i>
Manganese (mg/l)	ICP (0.001 mg/l)	0.05	0.13 <i>0.093</i>	0.012 <i>0.05</i>	4.23 <i>3.66</i>	2.79 <i>1.87</i>
Mercury (mg/l)	CVAA (0.00005 mg/l)	0.001	< 0.0008 <i>< 0.00005</i>	< 0.0035 <i>< 0.00005</i>	< 0.0008 <i>< 0.00005</i>	< 0.0008 <i>< 0.00005</i>
Nickel (mg/l)	ICP (0.01 mg/l)	0.02	0.002 <i>0.001</i>	0.002 <i>0.001</i>	0.005 <i>0.009</i>	0.008 <i>0.003</i>
Lead (mg/l)	ICP (0.05 mg/l)	0.01	<0.005 <i><0.001</i>	<0.005 <i><0.001</i>	<0.005 <i><0.001</i>	0.005 <i>0.0015</i>
Selenium (mg/l)	ICP (0.005 mg/l)	0.01	<0.003 <i><0.001</i>	0.003 <i>0.001</i>	0.003 <i>0.004</i>	0.003 <i>0.001</i>
Silver (mg/l)	ICP (0.01 mg/l)	-	ANC <i><0.002</i>	ANC <i><0.002</i>	ANC <i><0.002</i>	ANC <i><0.002</i>
Zinc (mg/l)	ICP (0.005 mg/l)	-	0.0035 <i>0.001</i>	0.0185 <i>0.01</i>	0.008 <i>0.003</i>	0.007 <i>0.001</i>
Barium (mg/l)	ICP (0.05 mg/l)	-	0.0035 <i>0.0045</i>	0.003 <i>0.0035</i>	0.057 <i>0.0525</i>	0.0075 <i>0.0065</i>
Diesel Range Organics (mg/l)	CG-FID (0.01 mg/l)	-	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>
Mineral Oil (mg/l)	CG-FID (0.01 mg/l)	-	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>	< 0.01 <i>< 0.01</i>
Petrol Range Organics (mg/l)	GC-FID (0.01 mg/l)	-	< 0.055 <i>< 0.01</i>	< 0.055 <i>< 0.01</i>	< 0.055 <i>< 0.01</i>	< 0.055 <i>< 0.01</i>
Benzene (mg/l)	GC-FID (0.01 mg/l)	0.001	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>
Toluene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>
Ethylbenzene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>	< 0.0075 <i>< 0.01</i>
Xylene (mg/l)	GC-FID (0.01 mg/l)	-	< 0.015 <i>< 0.01</i>	< 0.015 <i>< 0.01</i>	< 0.015 <i>< 0.01</i>	< 0.015 <i>< 0.01</i>

Notes: Mean monitoring results from 2008 are presented in italicised format below the recorded levels for the current monitoring period. Values in **Bold** Type are greater than the Drinking Water PV
 ANC: Analysis not conducted

The landfill monitoring programme, the results of which are presented in *Table 2.6*, uses a slightly different set of parameters within the same broad categories. The parameters covered by the landfill monitoring programme were selected based on the EPA's guidance for landfill management.

The average annual concentration of sulphate at BH-104 was in excess of the PV in 2009, which is similar to previous years' results. Analysis of soil in 2002 revealed high levels of naturally occurring sulphates (iron pyrites) in the vicinity of Tank 205 which is adjacent to BH-104. This may explain why sulphate concentrations are significantly higher at this location than those recorded at other locations.

There has been a gradual trend upwards in the level of calcium found in the groundwater at BH-104. According to the EPA report "Towards setting guideline values for the protection of groundwater in Ireland" limestone bedrock and limestone dominated subsoils, commonly found in Ireland (such as on Whiddy Island), can lead to groundwater that is often hard, containing high concentrations of calcium. This parameter will continue to be monitored as part of the biannual groundwater monitoring for the site.

A high average manganese concentration was recorded in BH-103, BH-104 and BH-105. Similar levels have often been recorded in the past and are likely to be a consequence of naturally occurring manganese and iron in the groundrock as previously described. The average manganese level found in BH-102 decreased below the drinking water PV in 2009.

The levels of Mineral Oils, Petrol Range Organics, Diesel Range Organics, Benzene, Toluene, Ethylbenzene and Xylene in all the monitoring wells at the landfill were below the laboratory limit of detection. The laboratory limit of detection changed in 2009 for PRO (0.1 mg/l), Benzene (0.005 mg/l), Toluene (0.005 mg/l) and Ethylbenzene (0.005 mg/l) due to changes in the laboratory testing techniques.

In general, there is no evidence of hydrocarbon contamination from the tank farm or the oil pits. The groundwater sampled in the vicinity of the landfill site did not indicate any significant leaching of contaminants into the groundwater.

2.1.3 Noise Monitoring

The most recent Noise Survey carried out at the Terminal took place in 2001. The results are reported in the AER for that year.

Noise levels measured at the boundary closest to the nearest noise-sensitive location were 31 dB L_{Aeq} during the daytime and 29 dB L_{Aeq} during the night-time period. These readings are very much lower than the limits specified in the IPC licence of 55 dB during daytime hours and 45 dB at night. There were no audible tonal or impulsive components at the noise sensitive locations under consideration.

2.1.4 Emissions to Air

There are no licensed emission points to air at the Terminal. The main emissions to air arising from operations on site are from electrical generators and pumps, and fugitive emissions from the tank farm. A report on fugitive emissions during 2009 is included in Annex 9.

Carbon dioxide emissions from the combustion of Light Fuel Oil for 2009 are estimated (using SEAI CO₂ emission factors) and presented in *Table 2.7* below. Emissions during 2008 are included for comparison purposes. There was a reduction in calculated CO₂ emissions as a result primarily of the use of less fuel oil on site in 2009.

Table 2.7: Mass Emissions to Atmosphere

Parameter	Mass Emission (kg) 2008	Mass Emission (kg) 2009
CO ₂	785,970*	457,184*

* From combustion of Light Fuel Oil only

2.1.5 Waste Management

A copy of CPBBT's Waste Management Records for 2009 is included in Annex 7.

There has been no on-site waste disposal for the past number of years. CPBBT are to keep the on-site inert waste landfill but do not envisage it being used under normal circumstances. Off-site waste disposal is conducted using approved waste contractors in accordance with Condition 7.4 of the sites IPC licence.

Table 2.8 provides the details of the Waste Collection Permits of all companies who remove waste from the Terminal during 2009. *Table 2.9* provides details of the Waste Treatment Facility Permits of all companies that treat the waste. A breakdown of each individual waste stream and the corresponding recycling/disposal information is shown in *Table 2.9* also.

Table 2.8: Waste Collection Permit Details

Waste Collection Contractor	Waste Collection Permit No	Issuing Authority
Bantry Skip Hire Ltd.	WCP-CK-09-0613-01	Cork County Council
Cork Metal Ltd.	WCP-LK-08-0589-01	Limerick County Council
Greenstar Recycling (Munster) Ltd	CK WMC/323/05	Cork County Council
RILTA Environmental Ltd.	WCP- DC-09-1192-01	Dublin City Council
Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd.)	WCP-CK-08-0578-01	Environmental Protection Agency

Table 2.9: Summary of Waste Arisings for 2009

Description of Waste	Waste Treatment Operation	M/C/E	Method Used	Location of Treatment	Name and Licence / Permit No. of Recoverer / Disposer / Broker	Address of Recoverer / Disposer / Broker	Name and Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)	Licence / Permit No. of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
Batteries (Lead)	R4	M	Weighted	Abroad	Rilta Environmental Ltd. W0192-02	Block 402 ,Greenogue Business Park,Rathcoole,County Dublin,Ireland	Darley Dale, Matlock, DE4 2LP, Derbyshire, UK.	BL5598
Batteries (Cadmium)	R4	M	Weighted	Abroad	Rilta Environmental Ltd. W0192-02	Block 402 ,Greenogue Business Park,Rathcoole,County Dublin,Ireland	Wiehage 12-14, Mulheim an der Ruhr, Germany.	E11715338
Domestic Waste	D1	M	Weighted	Ireland	Cork County Council. W089-02	Derryconnell Landfill Site, Schull, Co. Cork	N/A	N/A
Metals	R4	M	Weighted	Abroad	Cork Metal Ltd. CK(S) 204/05	Dublin Hill, Co. Cork	N/A	N/A
Oils	R9	C	Volume Calculation	Onsite in Ireland	ConocoPhillips Bantry Bay Terminal Ltd IPC Licence P0419-01 Schedule 2 (i)	Whiddy Island, Bantry, Co. Cork	Whiddy Island, Bantry, Co. Cork	IPC Licence P0419-01 Schedule 2 (i)
Oil Contaminated Soil	D10	M	Weighted	Abroad	Veolia Environmental Services Ltd. W0050-02	Corrin,Fermoy,..County Cork,Ireland	Brunsbüttel, Germany	A51 G00508

Table 2.9: Summary of Waste Arisings for 2009(cont/d)

Description of Waste	Waste Treatment Operation	M/C/E	Method Used	Location of Treatment	Name and Licence / Permit No. of Recoverer / Disposer / Broker	Address of Recoverer / Disposer / Broker	Name and Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)	Licence / Permit No. of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
Oils (Tank Scale Contaminated with Oil)	D10	M	Weighted	Abroad	Veolia Environmental Services Ltd. W0050-02	Corrin, Fermoy, County Cork, Ireland	Brunsbüttel, Germany	A51 G00508
Oil Filters	D9	M	Weighted	Abroad	Veolia Environmental Services Ltd. W0050-02	Corrin, Fermoy, Co. Cork, Ireland	Brunsbüttel, Germany	A51 G00508
Waste Timber	R3	M	Weighted	Ireland	CTO Environmental Ltd. WFP-CK-09-0018-02	Rostellan, Midleton, Co. Cork.	N/A	N/A
Wipes and rags	D9,D10	M	Weighted	Abroad	Veolia Environmental Services Ltd. W0050-02	Corrin, Fermoy, Co. Cork, Ireland	Brunsbüttel, Germany	A51 G00508

N/A Not applicable

2.1.6 Site Inspections

Copies of the following logs are included in Annex 4:

- Onshore emergency checklist;
- Lagoon sampler log;
- Tank Inspector Checklists.

2.2 Agency Monitoring & Enforcement

The Agency visited the Terminal in December 2009. In December, effluent grab and composite samples were taken for testing and the results are given in Section 2.2.1. No official on-site inspection of the facility was conducted in 2009.

2.2.1 Emissions Sampling & Analysis

The Agency visited the Terminal in March and November and collected samples of effluent from SWEP-01. A grab sample and a composite sample of the effluent were collected and sent for analysis to an ISO 17025 certified laboratory. The results of the chemical analysis of both samples are shown in *Table 2.10*. The ELVs from the licence are included for comparison purposes.

Table 2.10: Results of Chemical Analysis undertaken by Agency December 2009

Sample	pH (units)	BOD (mg/l)	COD (mg/l O ₂)	SS (mg/l)	Total Phenols (mg/l)	Mineral Oil (mg/l)	TPH (mg/l)
ELV	4-9	25	N/A	30	1	10	-
Composite	5.3	< 1.0	13	8	0.16	0.30	1.779
Grab	5.23	< 1.0	< 10	16	0.07	0.13	1.621

There were no exceedances of the ELV in the December EPA conducted effluent composite and grab samples.

2.3 Energy & Water Consumption

2.3.1 Energy Consumption

Energy consumption at CPBBT during 2009 is given in *Table 2.11* (overleaf). Energy consumption during 2008 is included for comparison.

Table 2.11: Energy Consumption Summary

Substance	Energy Consumption 2008 (MWh)	Energy Consumption 2009 (MWh)
Heavy Fuel Oil	N/A	N/A
Light Fuel Oil	2,978	1,732
Natural Gas	N/A	N/A
Electricity (National grid)	772.36	721.48
Electricity (on-site generation)	0.3	4.0
Electricity (on-site generation, renewable)	1.05	1.05
Coal and Other Fuels	N/A	N/A

N/A Not applicable

The consumption of light fuel oil in 2009 decreased compared to 2008. Light fuel oil is consumed by land vehicles and marine craft used by CPBBT personnel and by some of CPBBT's mobile plant.

In addition to the electricity drawn from the national grid, a small amount of electricity is generated on site. The on-site generators are run occasionally on test and when ESB supply is unavailable due to maintenance / failures or during periods of high demand where it is more cost effective to use own generated power.

During 2009, approximately 1,050 kWh of electrical energy was estimated to be generated on site from wind generators and solar panels on the SPM.

2.3.2 Water Consumption

Water consumption at CPBBT for the reporting period is summarised in *Table 2.12*. Consumption in 2008 is included for comparison purposes. All values are expressed in m³/year.

Table 2.12: Water Consumption

Substance	Quantity Used 2008 (m ³ /yr)	Quantity Used 2009 (m ³ /yr)
On-site groundwater	N/A	N/A
On-site surface water	N/A	N/A
Municipal Supply	550*	550*

N/A Not applicable

* The total supply is not metered to the site. The figure quoted is a combination of the metered figures available for the site and estimated figures for unmetered supplies. The estimate is based on 2007 levels.

2.4 Environmental Incidents & Complaints

2.4.1 Environmental Incidents

There was one minor environmental incident at CPBBT in 2009. On Wednesday the 8th of July 2009 there was a loss of less than 5 litres of gas oil to Bantry Bay when refuelling the “Maid of the Isles” ferry. On spillage, an absorbent disposable boom was deployed and the spill was quickly contained and the boom recovered.

This incident was reported as a Category 3 incident to the EPA and the Bantry Bay Harbour Master was also notified. Following this, CPBBT conducted a review of the refuelling procedure for the passenger ferry.

2.4.2 Environmental Complaints

No complaints of an environmental nature were received by CPBBT during 2009.

2.5 Review of Residuals Management Plan & Environmental Liabilities Risk Assessment

The Closure, Restoration & Aftercare Management Plan (formerly the Residual Management Plan) and the Environmental Liabilities Risk Assessment have been reviewed for 2009. No changes have been made to either document.

3 Management of the Activity

3.1 Introduction

The Environmental Management Programme for the site was established in 2000. It sets out CPBBT's Environmental Objectives and Targets and details the projects to be undertaken in order to achieve these Objectives and Targets.

3.2 Environmental Management Programme Report for 2009

3.2.1 Introduction

CPBBT's Proposal for an Environmental Management Programme (EMP) was submitted to the Agency in February 2000. The EMP is a 5-year rolling programme designed to ensure that CPBBT's environmental objectives and targets are met. The EMP was reviewed and updated in late 2008 and an updated version for the 5 year period 2009-2013 was submitted to the EPA.

The EMP is broken down into the following subheadings

- Environmental Management and Protection
- Legislation Compliance
- Training and Awareness
- Waste Management and Minimisation
- Water Management

3.2.2 Report on EMP for 2009

Progress on implementation of the Environmental Management Programme for 2009 is detailed in *Table 3.1* below

Table 3.1: Report on EMP for 2009**1 Environmental Management & Protection**

	Task	Achievement/Status
1.1.1	Review of any changes to BREF Note on storage	Ongoing
1.1.2	In event of significant changes at the site, review the gap analysis to compare CPBBT with BAT (& emission control measures), based on BREF Note on Storage	Ongoing
1.1.3	Maintain watching brief on best industry standards for tank storage (current editions of IP, NFPA codes and standards, EPA guidance etc)	Ongoing
1.1.4	Ensure permeability testing is carried out as appropriate on all bunding according to best practise.	Ongoing. The diesel generator tank was replaced with a bunded tank in 2009. Maintenance and testing of the bunding for TK-101 also took place.
1.1.5	Ensure all new bunding is appropriately assessed for retention capability.	Ongoing (see above)
1.1.6	Inspect tanks and pipes as per ConocoPhillips tank inspection protocol.	Extensive refurbishment was carried out on TK-205 in 2009.
		Replacement of underground pipelines P202/P201/P203 was undertaken in 2009.
		Tank 405 was gas freed, inspected and then returned to service during 2009.
		Tank 207 was gas freed, inspected and repaired as required, then restored to service.
		The subsea 42" crude line and the 30" product line were both inspected using mechanical pigging.
		A Biocide Injection Program was initiated in 2009 to reduce the effects of corrosion on the subsea piping.
		Approx 1.7km of water draw-off lines were replaced from TK-205 and TK-208.
		Roof drains were replaced on TK-201 and TK-205.
		The fire hydrant upgrade was completed.

	Task	Achievement/Status
1.1.7	Review and where appropriate, update maintenance programme for WWTP system - separators, lagoon, and outlet point.	Ongoing; separator maintenance (including the replacement of pipework) and lagoon dredging began in 2009.
1.2.1	Annual review of Environmental Management System	Ongoing, see 1.3.3 regarding Buncefield review.
1.2.2	Monthly review and where appropriate update of the Environmental Management Programme	Ongoing.
1.3.1	Maintain a register of significant environmental impacts and review annually	Ongoing.
1.3.2	Ensure that Procedure for Management of Change is consulted whenever alterations are made at the Terminal	Ongoing.
1.3.3	Review of Buncefield reports (to date) and the implications for Bantry Bay Terminal	Ongoing as further reviews published.
1.3.4	Review the results of the Environmental Monitoring Programme for Bantry Bay	Ongoing, 2009 review contained in Annex 12 of the 2009 AER.
1.3.5	Conduct trend analysis of environmental monitoring in Bantry Bay	Ongoing, trend analysis for 2009 contained in the 2009 AER
1.3.6	Ensure Emergency Response Plan is in place and review periodically in accordance with Emergency Response Procedure	Ongoing.
1.3.7	Hold one Oil Spill exercise each year involving contracted outside agency (OSRL)	Ongoing.
1.3.8	Inspect and record equipment as per Emergency Response Plan	Ongoing, formal documented SOP system commenced in 2009, a "critical equipment list" has also been developed and incorporated with quarterly maintenance checks.
1.4.1	Record the following environmental performance indicators: Total energy consumption; Total number of non-compliances in water discharge licence; Total quantity of water consumed; Total number of environmental incidents; Total number of environmental complaints received; Total quantity of fugitive emissions from tank farm; Total quantity of waste generated.	Ongoing, summary contained in 2009 AER.

	Task	Achievement/Status
1.5.1	Regular documented inspections and maintenance of monitoring and control equipment.	Ongoing, formal documented SOP system commenced in 2009, inspection and maintenance included in this.

2 Legislation Compliance

	Task	Achievement/Status
2.1.1	<ul style="list-style-type: none"> • Maintain a record of exceedances in ELVs of IPPC Licence; • Inform EPA in writing of all exceedances in ELV; • Continue submitting AER as required under Licence. 	Ongoing, record of exceedances contained in AER.
2.1.2	Regular update of Register of all environmental legislation that applies to CPBBT.	Ongoing, site legislation database contained online.
2.1.3	Annual Update of PRTR in accordance with EPA guidance.	Ongoing, copy of submitted version of PRTR available in AER.
2.2.2	Hazard identification and risk assessment Maintain Major Accident Prevention Policy.	Ongoing, Safety Report Review for the site commenced in late 2009.
2.2.3	Review fire fighting and spill response plans.	Ongoing

3 Training & Awareness

	Task	Achievement/Status
3.1.1	<ul style="list-style-type: none"> • All new staff given induction to EMS and sign for record; • All staff given update training to EMS and sign for record; • All ship operators given verbal EMS induction on arrival. 	Ongoing
3.1.2	Review induction material and update if required.	Ongoing
3.1.3	Ensure all personnel have basic training in energy response and know their roles and duties, as set out in the Oil Spill Response and Fire Fighting Response Plans.	Ongoing
3.1.4	CPBBT to conduct annual review of environmental monitoring (groundwater & effluent) and examine any trends.	Ongoing

4 Waste Management & Minimisation

	Task	Achievement/Status
4.1.1	Conduct annual fugitive emissions study.	Ongoing, the fugitive emissions study for 2009 has been completed and the results are contained in Annex 9 of the AER
4.1.2	Continue rim seal upgrade programme.	Ongoing. TK-205 upgraded during 2009.
4.2.1	Identify all recyclable waste streams and provide segregated collection facilities them including for plastics and other mixed dry recyclables.	Ongoing
4.2.2	Maintain register of waste contractors and up to date copies of their waste permits.	Ongoing, up to date register contained in AER
4.3.1	Maintain register of waste contractors and up to date copies of their waste permits. Annual review of permit validity.	Ongoing, up to date register contained in AER
4.4.1	Incorporate waste management training into environmental induction to include reducing and segregation of waste.	Ongoing

5 Water Management

	Task	Achievement/Status
5.1.1	Testing of water pre-treatment and post treatment to characterise the solids levels.	Completed 2008. Separator cleaning programme embarked on in 2009.
5.1.2	Testing of water pre-treatment and post treatment to determine the efficiency of the separators.	Completed 2008. Separator cleaning programme embarked on in 2009.
5.1.3	Examine remediation measures to clean up / remove solids accumulation within the separators and the lagoon.	Separator cleaning programme embarked on in 2009.
5.2.1	A monthly visual inspection will be carried out of the API separators and settlement lagoon.	Ongoing
5.3.1	Weekly visual inspection of shoreline.	Ongoing

3.3 Environmental Management Programme 2010-2014

3.3.1 Introduction

CPBBT's proposal for an Environmental Management Programme (EMP) was submitted to the Agency in February 2000. The EMP is a 5-year rolling programme designed to ensure that CPBBT's environmental objectives and targets are met. The EMP was reviewed and updated in late 2008 and an updated version for the 5 year period 2009-2013 was submitted to the EPA.

The EMP is broken down into the following subheadings

- Environmental Management and Protection
- Legislation Compliance
- Training and Awareness
- Waste Management and Minimisation
- Water Management

3.3.2 Environmental Management Programme 2010-2014

Table 3.2 contains a list of the environmental tasks that are scheduled for implementation under the Environmental Management Programme over the period 2010-2014. The scheduled tasks for 2010 are highlighted separately within this table.

Table 3.2 Environmental Management Programme 20010-2014**1 Environmental Management & Protection**

	Objective	Target		Task	Start date	Completion Date
1.1	Prevent releases of product to the environment	Identify and adhere to Best Practice for the storage and handling of petroleum products	1.1.1	Review of any changes to BREF Note on storage	Ongoing	Ongoing
			1.1.2	In event of significant changes to the site review the inputs to the gap analysis to compare CPBBT with BAT (& emission control measures), based on BREF Note on Storage	Ongoing	Ongoing
			1.1.3	Maintain watching brief on best industry standards for tank storage (current editions of IP, NFPA codes and standards, EPA guidance etc)	Ongoing	Ongoing
		Ensure all bunding is fit for service.	1.1.4	Ensure permeability testing is carried out as appropriate on all bunding according to best practise.	Ongoing	Ongoing
			1.1.5	Ensure all new bunding is appropriately assessed for retention capability.	Ongoing	Ongoing
		Ensure all tankage and associated pipework is fit for service.	1.1.6	Inspect tanks and pipes as per ConocoPhillips tank inspection protocol. Works scheduled for 2010 includes: <ul style="list-style-type: none"> • Completion of the P201/P203 piping and valve upgrade; • Inspection of TK-406; • Cleaning of TK-202; • Completion of the Separator maintenance programme; • Expand hydrant installation site wide. 	Ongoing	Ongoing

	Objective	Target		Task	Start date	Completion Date
		Minimise exceedances on emission limit values in effluent	1.1.7	Review and where appropriate, update maintenance programme for WWTP system - separators, lagoon, and outlet point.	2009	2010
1.2	Operate Environmental Management System for the site	Ensure a comprehensive Environmental Management System is maintained and reviewed regularly	1.2.1	Annual review of Environmental Management System	Ongoing	Ongoing
			1.2.2	Monthly review and where appropriate update of the Environmental Management Programme	Ongoing	Ongoing
1.3	Prevent incidents which could give rise to negative environmental consequences and minimise any environmental impact should an incident occur	Ensure all potential environmental impacts from CPBBT's activities are identified and appropriate mitigation measures are in place	1.3.1	Maintain a register of significant environmental impacts and review annually	Ongoing	Ongoing
			1.3.2	Ensure that Procedure for Management of Change is consulted whenever alterations are made at the Terminal	Ongoing	Ongoing
			1.3.3	Review of Buncefield reports (to date) and its implications for Bantry Bay Terminal	Ongoing	Ongoing reviews when further reports issued
		Monitor environmental indicators for Bantry Bay	1.3.4	Review the results of the Environmental Monitoring Programme for Bantry Bay	Ongoing	Ongoing
			1.3.5	Conduct trend analysis of environmental monitoring in Bantry Bay	Ongoing	Ongoing
		Oil Spill Emergency Response Plan	1.3.6	Ensure Emergency Response Plan is in place and review periodically in accordance with Emergency Response Procedure	Ongoing	Ongoing

	Objective	Target		Task	Start date	Completion Date
		Oil Spill Emergency Response Training	1.3.7	Hold one Oil Spill exercise each year involving contracted outside agency (OSRL)	Ongoing	Ongoing
		Ensure appropriate remediation equipment is available at key locations	1.3.8	Inspect and record equipment as per Emergency Response Plan Scheduled work for 2010 include: <ul style="list-style-type: none"> • Installation of hydrants site wide • Carry out service of firepump P430 • Replacement of foam lines on site 	Ongoing	Ongoing
1.4	Devise and implement practical methods of measuring environmental performance within CPBBT so that improvements and trends can be monitored	Maintain and record representative environmental performance indicators for Environmental Management, Environmental Impact and Waste Management	1.4.1	Record the following environmental performance indicators: Total energy consumption; Total number of non-compliances in water discharge licence; Total quantity of water consumed; Total number of environmental incidents; Total number of environmental complaints received; Total quantity of fugitive emissions from tank farm; Total quantity of waste generated.	Ongoing	Ongoing
1.5	Ensure maximum availability of all monitoring & control equipment / instrumentation	Control and minimise down time of all continuous monitoring and control equipment	1.5.1	Regular documented inspections and maintenance of monitoring and control equipment.	Ongoing	Ongoing

2 Legislation Compliance

		Objective	Target		Task	Start Date	Completion Date
2.1		Comply with all relevant environmental legislation and conditions of the IPPC licence	Achieve and maintain ongoing compliance with the conditions of the IPPC Licence	2.1.1	<ul style="list-style-type: none"> • Maintain a record of exceedances in ELVs of IPPC Licence; • Inform EPA in writing of all exceedances in ELV; • Continue submitting AER as required under Licence. 	Ongoing	Ongoing
			Maintain a record of all legislation relevant to CPBBT's operations.	2.1.2	Regular update of Register of all environmental legislation that applies to CPBBT.	Ongoing	Ongoing
			Comply with new PRTR requirements	2.1.3	Annual Update of PRTR in accordance with EPA guidance.	Ongoing	Ongoing
2.2		Ensure compliance with the Control of Major Accident Hazards involving Dangerous Substances Regulations (SI 74 of 2006)	Establish and implement the MAPP and SMS in accordance with the data in the Regulations	2.2.1	Procedures to be reviewed on a three year basis, or as required under Management of Change.	Ongoing	Reviewed every 3 years
			Identify the significant environmental risks from CPBBT's activities and the actions required to eliminate or reduce these risks	2.2.2	Hazard identification and risk assessment Maintain Major Accident Prevention Plan.	Ongoing	Ongoing
			Conduct periodic reviews of emergency response procedures	2.2.3	Review fire fighting and spill response plans.	Ongoing	Ongoing

3 Training & Awareness

		Objective	Target		Task	Start Date	Completion Date
3.1		Promote environmental awareness and good environmental practice within CPBBT and among ship operators using the Terminal	Induct all staff into the Environmental Management System (EMS). Verbal induction on EMS given to all ship operators.	3.1.1	<ul style="list-style-type: none"> • All new staff given induction to EMS and sign for record; • All staff given update training to EMS and sign for record; • All ship operators given verbal EMS induction on arrival. 	Ongoing	Ongoing
			Annual review of induction material.	3.1.2	Review induction material and update if required.	Ongoing	Ongoing
			Train all personnel in emergency response procedures.	3.1.3	Ensure all personnel have basic training in emergency response and know their roles and duties, as set out in the Oil Spill Response and Fire Fighting Response Plans.	Ongoing	Ongoing
			CPBBT environmental staff to understand trends in onsite environmental monitoring.	3.1.4	CPBBT to conduct annual review of environmental monitoring (groundwater & effluent) and examine any trends.	Ongoing	Ongoing

4 Waste Management & Minimisation

		Objective	Target		Task	Start Date	Completion Date
4.1		Minimise the release of fugitive emissions from the Terminal	Identify and quantify fugitive emissions arising from all operations	4.1.1	Conduct annual fugitive emissions study.	Ongoing	Ongoing
			Estimate the potential for reducing fugitive emissions from the Terminal following completion of the fugitive emissions study	4.1.2	Continue rim seal upgrade programme.	Ongoing	Ongoing
						Ongoing	Ongoing
4.2		Maximise the recovery, re-use and recycling of waste	Recycle all recyclable waste streams	4.2.1	Identify all recyclable waste streams and provide segregated collection facilities them including for plastics and other mixed dry recyclables.	Ongoing	Ongoing
			Ensure that all waste for recovery/disposal off site is conducted by licensed waste contractors as agreed by the Agency	4.2.2	Maintain register of waste contractors and up to date copies of their waste permits.	Ongoing	Ongoing
						Ongoing	Ongoing
4.3		Dispose of all hazardous waste appropriately	Identify hazardous waste and dispose of using licensed contractors.	4.3.1	Maintain register of waste contractors and up to date copies of their waste permits. Annual review of permit validity.	Ongoing	Ongoing
						Ongoing	Ongoing
4.4		Reduce waste generation on site.	Devise and implement procedures to reduce the quantities of waste generated on site	4.4.1	Incorporate waste management training into environmental induction to include reducing and segregation of waste.	Ongoing	Ongoing

5 Water Management

	Objective	Target		Task	Start Date	Completion Date
5.1	Improve effluent treatment plant performance	Assess the potential for improving the efficiency of the separators following completion of the oil/water separator investigation	5.1.3	Examine remediation measures to clean up / remove solids accumulation within the separators and the lagoon. Planned work for 2010 include: <ul style="list-style-type: none"> Completion of the refurbishment of the oil-water separators. 	Ongoing	Ongoing
5.2	Ensure effluent is below EPA ELVs	Operate and maintain water treatment system.	5.2.1	A monthly visual inspection will be carried out of the API separators and settlement lagoon.	Ongoing	Ongoing
5.3	Maintain shoreline quality	To identify any product pathways or releases to marine environment	5.3.1	Weekly visual inspection of shoreline.	Ongoing	Ongoing

3.4 *Pollutant Release and Transfer Register (PRTR)*

3.4.1 Introduction

CPBBT submitted their Pollution Emissions Register (PER) proposal to the Agency in 1999. The proposal listed eleven substances that comprised a Pollution Emission Register List (PERL). The materials listed in the PERL were mainly components of paints, anti-foulants, corrosion inhibitors and other coating materials. The usage and composition of these materials was used to calculate the quantities of the various components used.

Starting with the 2007 AER, CPBBT have changed their reporting to the PRTR format advised by the Agency. This format allows sites to report on pollutant emissions and waste transfers to the Agency in a format that can be uploaded to an Agency database. Reporting under PRTR is now an annual process since 2008. The data provided in the PRTR for releases to air and water is included in Annex 8.

3.4.2 Releases to Air and Water

The PRTR spreadsheet is used to record details of pollutant emission to air and water. Details of this are shown in Annex 8 as submitted to the Agency. Further details of the calculations for the fugitive emissions from the site can be found in Annex 9 of this report.

4 IPC Licence Checklist

The following items were called up in Schedule 4(i) of the IPC Licence, *Recording and Reporting to the Agency*.

Table 4.1 Report on EMP for 2009 Annual Environmental Report Content Requirements from IPC Licence

Emissions to Water Summary	§ 2.1.1
Waste Management Report	Annex 7
Resource Consumption Summary	§ 2.3
Complaints Summary	§ 2.4.2
Environmental Management Programme 2010-2014	§ 3.3
Environmental Management Programme – Report	§ 3.2
Landfill Status Report	Annex 13
Noise Monitoring Report	Noise survey conducted in February 2001
Pollutant Emissions Register - Report	Annex 8
Groundwater Monitoring Summary	§ 2.1.2
Bantry Bay Environmental Monitoring Report	Annex 11
Reported Incidents Summary	§ 2.5
Review of Residuals Management Plan	§ 2.5
Review of Environmental Liabilities Risk Assessment	§ 2.5
Tank and Pipeline Maintenance and Inspection Report	Annex 14

Annex 1 : ConocoPhillips Safety and Environment Policy

HEALTH, SAFETY & ENVIRONMENT POLICY

Our Commitment...

ConocoPhillips is committed to protecting the health and safety of everybody who plays a part in our operations, lives in the communities in which we operate or uses our products. Wherever we operate, we will conduct our business with respect and care for both the local and global environment and systematically manage risks to drive sustainable business growth. We will not be satisfied until we succeed in eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from our activities.

Our Plan...

To meet our commitment, ConocoPhillips will:

- Demonstrate visible and active leadership that engages employees and service providers and manage health, safety and environmental (HSE) performance as a line responsibility with clear authorities and accountabilities.
- Ensure that all employees and contractors understand that working safely is a condition of employment, and that they are each responsible for their own safety and the safety of those around them.
- Manage all projects, products and processes through their life-cycles in a way that protects safety and health and minimizes impacts on the environment.
- Provide employees with the capabilities, knowledge and resources necessary to instill personal ownership and motivation to achieve HSE excellence.
- Provide relevant safety and health information to contractors and require them to provide proper training for the safe, environmentally sound performance of their work.
- Measure, audit and publicly report HSE performance and maintain open dialogue with stakeholder groups and with communities where we operate.
- Work with both governments and stakeholders where we operate to develop regulations and standards that improve the safety and health of people and the environment.
- Maintain a secure work environment to protect ourselves, our contractors and the company's assets from risks of injury, property loss or damage resulting from hostile acts.
- Communicate our commitment to this policy to our subsidiaries, affiliates, contractors and governments worldwide and seek their support.

Our Expectations...

Through implementation of this policy, ConocoPhillips seeks to earn the public's trust and to be recognized as the leader in HSE performance.



A handwritten signature in black ink, appearing to read "J. J. Mulva".

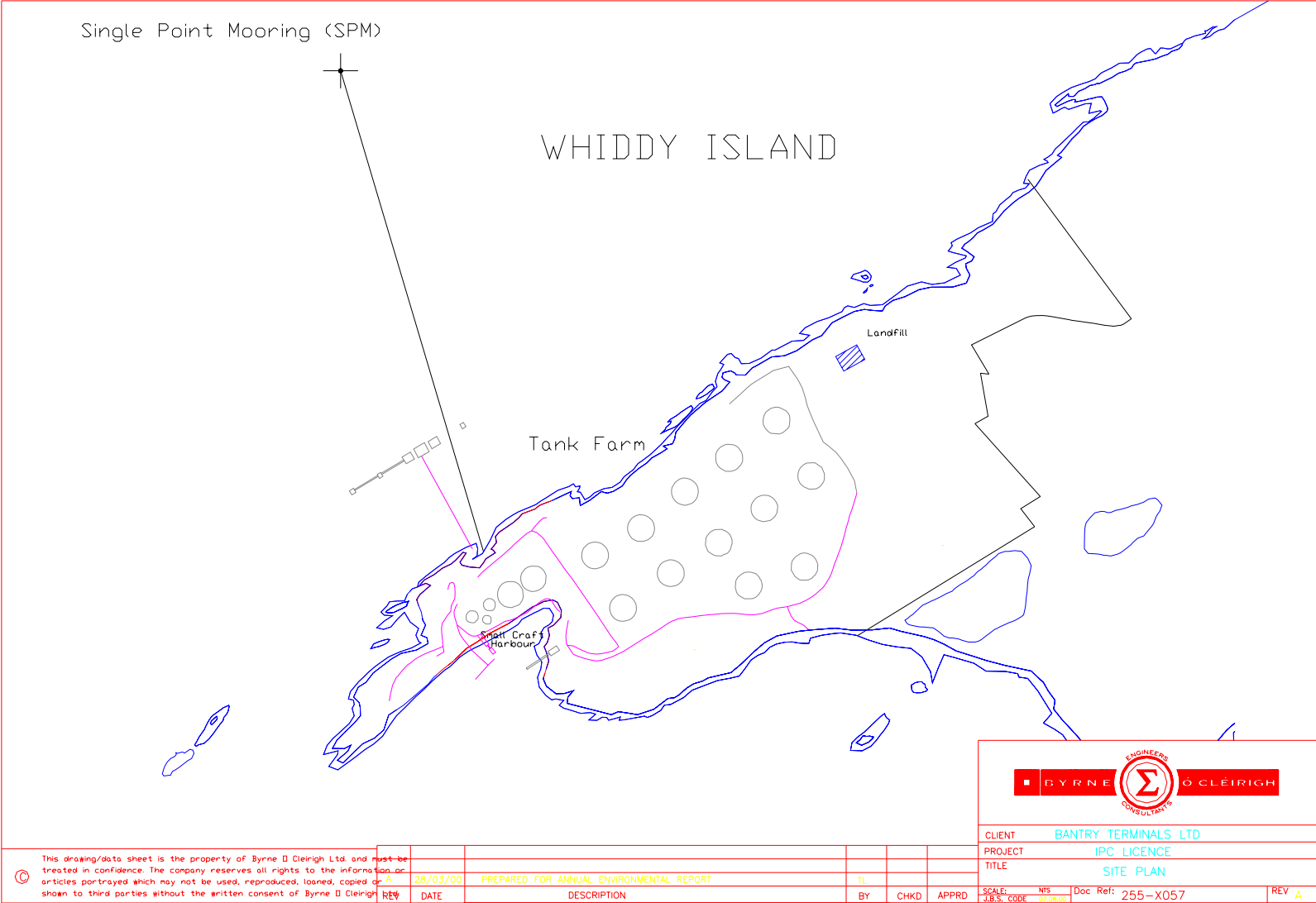
J. J. Mulva
President and Chief Executive Officer



A handwritten signature in black ink, appearing to read "Neil O'Carroll".

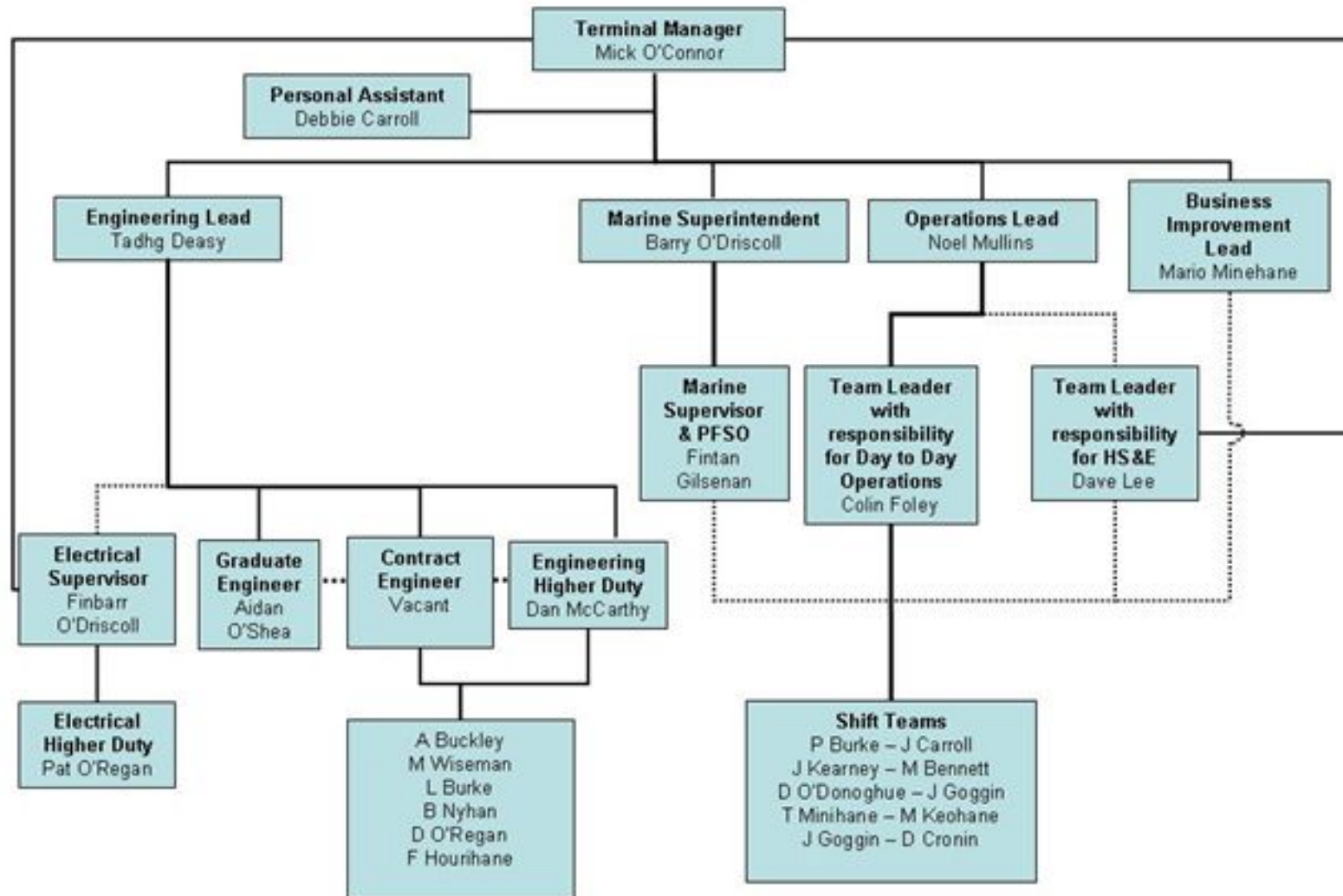
Neil O'Carroll
Lead Executive

Annex 2 : Site Plan



Annex 3 : CPBBT Organisation Chart

Current Bantry Bay Terminal Structure



Annex 4 : CPBBT Site Inspection Logs

ONSHORE EMERGENCY CHECKLIST

DATE: _____

Instructions for each check are listed on key to year planner

ITEM	REMARKS	INITIALS
P406 (JOCKEY)	Hours = Week's usage =	
P407 (ELECTRICAL)		
P408 (ELECTRICAL)		
P409 (DIESEL)		
P430 (DIESEL)		
FOAM TENDER		
FOAM TRANSFER PUMP		
FIRE SIRENS		
EMERGENCY LIGHTING		
GENERATOR USED / Fin Fan		
TRANSFORMER OIL LEVELS		
POWERHOUSE DRAIN TRAPS		
POWERHOUSE SUMP PUMP		
PUMPHOUSE DRAIN TRAPS		
P423 GREASING		
PORTABLE PUMPS*	No.	
FRESH WATER	Reading: Weeks Usage:	
ACCIDENT FREE DAYS		
Valve / flange check as per IPC Licence condition 9.2.3		

*Portable pumps - Numbers 1 - 4. Test one pump per week in rotation with fresh water at clariflocculator

[illegible]

D=Dark
H=Hazy
C=Clear

Bantry TerminalsTank Inspection

Tank No. _____

Date _____

Roof and Seal and Foam Dam: _____

Shell: _____

Position of Legs: _____

Varec Gauge / Radar: _____ Local: _____ Remote: _____

Pontoon Leaks: _____

Roof Ladder & wheels: _____

Bonding Cables: _____

Valves / MOV's: _____

Faulty Lights: _____

Ladder: _____

Top Platform: _____

Velve Platform: _____

Mixers: _____

Mixer 'A' Condition & Position: _____

Mixer 'C' Condition & Position: _____

Shell Relief Valve sealed open	Yes	No	Checked By
--------------------------------	-----	----	------------

	Operated Locally by:	Acknowledged in Control:
Alarms HI		
Alarms HI HI		

Remarks: _____

Inspected by: _____

TANK INSPECTION

NOTE: THIS SHEET IS TEMPORARILY MODIFIED FOR TANKS OUT OF SERVICE

Tank No. _____ Date _____

Roof and Seal and Foam Dam : _____

Shell : _____

Position of Legs : _____

How many deck plugs removed? : _____

Pontoons covers closed and fastened? : _____

Roof ladder and wheels are wheel on track? : _____

Bonding Cables : _____

Is perforated cover in position over centre roof drain? : _____

Are roof drains and plugholes free and clean of debris? : _____

Where possible all checks
should be made by walking
around the top platform
using binoculars if required

Remarks: _____

Inspected by: _____

Annex 5 : Results of Effluent Monitoring 2009

1.0 Results of Chemical Analysis of Effluent Samples

Table 1 Results of Monthly Effluent Analysis

Date	pH	BOD	SS	THC	TPH	Diss HC	Diss PH	Total Phenols	Cresols
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
09/01/2009	7.27	< 5	20	12	3.20	< 12	< 3.2	1.087*	0.44
09/02/2009	6.64	< 5	10	9	2.00	< 9	< 2	0.4483	0.21
09/03/2009	5.26	< 5	< 2	17	0.48	< 17	< 0.48	0.014	0.001
14/04/2009	6.17	< 5	7	37	2.30	< 37	< 2.3	0.663	0.34
12/05/2009	6.46	< 5	60	98	0.14	< 98	< 0.14	0.1128	0.061
03/06/2009	6.61	< 15	15	15	1.50	< 5	< 1.5	1.243*	0.56
27/07/2009	6.96	< 5	16	23	1.50	< 23	< 1.5	0.3887	0.0047
04/08/2009	6.5	< 5	< 9	47	1.80	< 47	< 1.8	0.545	0.11
04/09/2009	6.13	< 5	8	6	1.30	< 6	< 1.3	0.0243	0.0038
07/10/2009	6.61	< 5	< 6	13	1.80	< 13	< 1.8	0.0247	0.0063
04/11/2009	5.76	< 5	8	16	0.51	< 16	< 0.51	0.00922	0.0039
03/12/2009	4.57	< 5	4	13	0.76	< 13	< 0.76	0.012	0.0096
Min	4.57	< 5	< 2	6	0.14	< 5	< 0.14	0.00922	0.001
Max	7.27	< 15	60	98	3.20	< 98	< 3.2	1.243	0.56
Mean	6.25	5.83	13.75	25.50	1.44	24.67	1.44	0.38	0.15
ELV	4 – 9	25	30	N/A	10	N/A	N/A	1	N/A

BOD Biochemical Oxygen Demand
 SS Suspended Solids
 THC Total Hydrocarbons
 TPH Total Petroleum Hydrocarbons
 Diss HC Dissolved Hydrocarbons
 Diss PH Dissolved Petroleum Hydrocarbons

* Under condition 3.1.2 of CPBBT's IPC licence, no individual result for non-continuous composite sampling may exceed 1.2 times the ELV. As these results did not exceed 1.2 times the ELV, they have not been reported as exceedances of the licence ELV.

Shading indicates non-compliance with Emission Limit Value (ELV)

2.0 Results of Toxicity Testing of Effluent Samples

Table 2 Results Enterprise Ireland January 09

Test Species	<i>Tisbe battagliai</i>	<i>Vibrio fischeri</i>	<i>Vibrio fischeri</i>
Description	N/A	N/A	N/A
Effect	Acute toxicity	Light inhibition (5 min)	Light inhibition (15 min)
Concentration	32 %	45 %	45 %
% Effect	45 %	< 33 %	< 33 %
Test Parameter	48hr LC ₅₀	5min EC ₅₀	15min EC ₅₀
Result	> 32 %	> 45 %	> 45 %
Toxic Units	< 3.1	< 2.2	< 2.2

Annex 6 : Results of Groundwater Monitoring

Annex 6 – Results of Groundwater Monitoring 2009

Results of Groundwater monitoring at Tank Farm

Date	Drinking Water PV	Dutch Values		31/03/2009	31/03/2009	31/03/2009	31/03/2009	31/03/2009
Sample Location		S	I	MW-1	MW-2	MW-3	BH-109	BH-110
pH	6.5-9.5	-	-	7.36	4.65	6.41	8.42	8.75
Conductivity (µS/cm)	2,500	-	-	250	640	779	764	917
Dissolved Oxygen	-	-	-	-	-	-	-	-
Quality Indicators								
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	0.37	0.31	0.323	0.1161	0.0774
Chloride	250	-	-	31.1	60.7	114.5	96.1	95.3
Sulphate (soluble)	250	-	-	30.35	211.93	101.58	78.21	187.45
Nitrate	50	-	-	0.5	0.5	2	0.3	0.3
Sodium	200	-	-	18	35	77	74	57
Potassium	12	-	-	1	2	3	1	2
Calcium	200	-	-	15	30	39	53	72
Magnesium	50	-	-	4	20	16	10	24
Metals								
Arsenic	0.01	0.01	0.06	0.0026	0.0037	0.0037	0.0048	0.0033
Boron	1	-	-	< 0.012	0.02	0.041	0.049	0.03
Cadmium	0.005	0.0004	0.006	< 0.0005	<u>0.001</u>	< 0.0005	< 0.0005	< 0.0005
Chromium	0.05	0.001	0.03	< 0.0015	<u>0.002</u>	< 0.0015	< 0.0015	< 0.0015
Copper	2	0.015	0.075	< 0.007	<u>0.055</u>	< 0.007	< 0.007	< 0.007
Iron	0.2	-	-	< 0.02	2.638	0.081	< 0.02	< 0.02
Manganese	0.05	-	-	0.735	3.098	1.093	0.756	0.421
Mercury	0.001	0.00005	0.0003	< 0.002	< 0.0006	< 0.0006	< 0.0006	< 0.0006
Nickel	0.02	0.015	0.075	0.006	0.094	0.01	0.003	< 0.002
Lead	0.01	0.015	0.075	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	0.01	-	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Silver	0.01*	-	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Zinc	-	0.065	0.8	-	-	-	-	-
Barium	0.5*	0.05	0.625	< 0.003	0.018	0.006	0.008	0.012
Petroleum Indicators								
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	0.001	0.0002	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	-	0.007	1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethyl Benzene	-	0.004	0.15	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	-	0.0002	0.07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

See notes on following page

Results of Groundwater monitoring at Tank Farm (cont'd)

Date	Drinking Water PV	Dutch Values		06/10/2009	06/10/2009	06/10/2009	06/10/2009	06/10/2009
Sample Location		S	I	MW-1	MW-2	MW-3	BH-109	BH-110
pH	6.5-9.5	-	-	6.76	3.44	6.28	7.29	7.61
Conductivity (µS/cm)	2500	-	-	315	605	2900	744	448
Dissolved Oxygen	-	-	-	-	-	-	-	-
Quality Indicators								
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	0.2	0.26	0.258	< 0.2	< 0.2
Chloride	250	-	-	28	53	781.6	97.6	32.8
Sulphate (soluble)	250	-	-	26.65	175.72	129.76	71.27	74.13
Nitrate	50	-	-	< 1.3	< 0.20	1.5	< 0.4	< 0.2
Sodium	200	-	-	17.85	32.15	360.9	78.57	30.37
Potassium	12	-	-	0.76	1.79	12.91	1.59	1.44
Calcium	200	-	-	15.14	26.39	42.25	52.6	31.39
Magnesium	50	-	-	4.27	17.64	40.79	9.07	9.63
Metals								
Arsenic	<i>0.01</i>	<i>0.01</i>	0.06	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
Boron	1	-	-	< 0.012	0.0012	0.11	0.06	0.014
Cadmium	0.005	<i>0.0004</i>	0.006	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chromium	0.05	<i>0.001</i>	0.03	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
Copper	2	<i>0.015</i>	0.075	< 0.007	<u>0.039</u>	< 0.007	< 0.007	< 0.007
Iron	0.2	-	-	< 0.02	0.781	0.02	< 0.020	< 0.020
Manganese	0.05	-	-	0.643	2.345	0.268	0.268	< 0.002
Mercury	<i>0.001</i>	<i>0.00005</i>	0.0003	< 0.001	< 0.001	< 0.001	< 0.0006	< 0.0006
Nickel	<i>0.02</i>	<i>0.015</i>	0.075	0.004	0.077	0.011	0.002	0.002
Lead	<i>0.01</i>	<i>0.015</i>	0.075	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	0.01	-	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Silver	0.01*	-	-	-	-	-	-	-
Zinc	-	0.065	0.8	0.006	<u>0.214</u>	0.029	< 0.003	0.004
Barium	0.5*	0.05	0.625	< 0.003	0.0016	0.023	0.008	0.007
Petroleum Indicators								
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzene	<i>0.001</i>	<i>0.0002</i>	0.03	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Toluene	-	<i>0.007</i>	1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ethyl Benzene	-	<i>0.004</i>	0.15	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Xylene	-	<i>0.0002</i>	0.07	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Notes: all values in mg/l unless stated otherwise
 Values in **bold** type are greater than Drinking Water PV/EU Drinking Water Standard
 Values in *italics* indicate that Dutch value/PV is less than the laboratory detection limit
 * indicates EU drinking water standards (not included in SI 439 of 2000)
 Values underlined exceed Dutch S-Value
 Values shaded exceed Dutch I-Value
 ANC Analysis not conducted

Results of Groundwater monitoring at Oil Pits

Date	Drinking Water PV	Dutch Values		31/03/2009	31/03/2009	31/03/2009	06/10/2009	06/10/2009	06/10/2009
Sample Location		S	I	BH - 108	BH - 106	BH - 107	BH - 108	BH - 106	BH - 107
pH	6.5-9.5	-	-	8.53	8.4	8.41	6.66	7.37	7.26
Conductivity (µS/cm)	2,500	-	-	3.1	687	917	297	704	605
Dissolved Oxygen	-	-	-						
Quality Indicators									
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	0.0903	< 0.052	0.0774	< 0.20	< 0.20	< 0.20
Chloride	250	-	-	40.2	89.2	62.5	41.4	97.8	52
Sulphate (soluble)	250	-	-	11.59	24.91	35.23	11.76	25.39	30.1
Nitrate	50	-	-	0.3	<0.5	16.6	< 0.2	< 0.2	1
Sodium	200	-	-	22	32	38	21.85	32	35.85
Potassium	12	-	-	2	1	5	1.6	1.38	3.5
Calcium	200	-	-	14	73	72	13.39	70.88	59.44
Magnesium	50	-	-	7	11	8	6.6	10.8	9.31
Metals									
Arsenic	<i>0.01</i>	<i>0.01</i>	0.06	0.0031	< 0.0038	0.0032	0.0031	< 0.0025	< 0.0025
Boron	1	-	-	<0.03	<0.012	0.014	< 0.012	0.012	0.018
Cadmium	0.005	<i>0.0004</i>	0.006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.05	<i>0.001</i>	0.03	<0.0015	0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
Copper	2	<i>0.015</i>	0.075	< 0.007	0.007	< 0.007	< 0.007	< 0.007	< 0.007
Iron	0.2	-	-	< 0.02	0.02	< 0.02	< 0.020	0.077	< 0.02
Manganese	0.05	-	-	1.342	0.084	0.166	0.974	0.408	0.231
Mercury	<i>0.001</i>	<i>0.00005</i>	0.0003	< 0.0006	< 0.0006	< 0.0006	< 0.001	< 0.001	< 0.001
Nickel	<i>0.02</i>	<i>0.015</i>	0.075	0.003	<0.002	<0.002	< 0.002	< 0.002	< 0.002
Lead	<i>0.01</i>	<i>0.015</i>	0.075	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.01	-	-	<0.003	0.003	<0.003	<0.003	<0.003	<0.003
Silver	0.01*	-	-	-	-	-	-	-	-
Zinc	-	0.065	0.8	0.007	0.008	0.014	0.006	0.014	0.015
Barium	0.5*	0.05	0.625	< 0.003	0.006	0.009	< 0.003	0.005	0.009
Petroleum Indicators									
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.1	< 0.1	< 0.1
Benzene	<i>0.001</i>	<i>0.0002</i>	0.03	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005
Toluene	-	<i>0.007</i>	1	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005
Ethyl Benzene	-	<i>0.004</i>	0.15	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005
Xylene	-	<i>0.0002</i>	0.07	< 0.02	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01

Notes: all values in mg/l unless stated otherwise
Values in **bold** type are greater than Drinking Water PV/EU Drinking Water Standards
Values in *italics* indicate that Dutch value/PV is less than the laboratory detection limit
*indicates EU drinking water standards (not included in SI 439 of 2000)
Values underlined exceed Dutch S-Value
Values shaded exceed Dutch I-Value
ANC Analysis not conducted

Results of Landfill Monitoring Programme

Date	Drinking Water PV	Dutch Values		31/03/2009	31/03/2009	31/03/2009	31/03/2009	06/10/2009	06/10/2009	06/10/2009	06/10/2009
Sample Location		S	I	BH - 103	BH - 102	BH - 104	BH - 105	BH - 103	BH - 102	BH - 104	BH - 105
pH	6.5-9.5	-	-	7.43	8.01	7.81	8.38	7.71	6.48	6.98	7.29
Conductivity (µS/cm)	2500	-	-	451	330	2400	617	424	354	2620	714
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-
Nutrients etc											
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	<0.129	0.0516	0.1548	0.0645	< 0.2	< 0.2	0.258	< 0.2
Total Oxidised Nitrogen	11.3*	-	-	<0.5	< 0.5	< 0.5	<0.5	< 0.05	0.29	< 0.05	< 0.05
Chloride	250	-	-	33	65.3	392.4	4.02	34.6	46.3	457.6	34.8
Sulphate (soluble)	250	-	-	16.92	6.53	293.85	103.29	15.84	12.84	332.02	96.62
Nitrate	50	-	-	0.9	4.4	0.2	0.3	< 0.2	1.3	<0.2	<0.2
Sodium	200	-	-	32	26	78	23	34.72	20.75	91.71	21.4
Potassium	12	-	-	1	1	4	2	0.57	0.68	3.94	1.87
Calcium	200	-	-	30	21	238	65	33.81	14.81	273.8	67.54
Magnesium	50	-	-	5	3	55	2.34	5.52	2.22	60.33	9.87
Phosphorus	-	-	-	< 0.005	< 0.005	0.051	<0.005	0.015	0.018	< 0.005	< 0.005
Fluoride	1.5	-	-	< 0.3	< 0.3	<0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Total Alkalinity as CaCO ₃	30*	-	-	128	38	169	50	21	6	332	160
Component Alkalinity as CaCO ₃	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	12	-	-	<3	<3	<3	<3	3	10	<0.002	4
Total Cyanide	50	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.04	< 0.04	< 0.04	< 0.04
Metals											
Arsenic	0.01	0.01	0.06	0.0036	0.003	0.009	0.0041	0.0055	< 0.0025	0.0038	< 0.0025
Boron	1	-	-	<0.012	<0.012	<0.012	<0.012	< 0.012	0.029	< 0.012	< 0.012
Cadmium	0.005	0.0004	0.006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<u>0.0007</u>
Chromium	0.05	0.001	0.03	< 0.0015	< 0.0015	<0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
Copper	2	0.015	0.075	< 0.007	< 0.007	<0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Iron	0.2	-	-	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.035	< 0.020	< 0.020
Manganese	0.05	-	-	0.26	0.019	4.199	2.34	< 0.002	0.005	4.261	3.245
Mercury	0.001	0.00005	0.0003	< 0.0006	< 0.006	< 0.0006	< 0.0006	< 0.001	< 0.001	< 0.001	< 0.001
Nickel	0.02	0.015	0.075	<0.002	<0.002	0.005	0.01	<0.002	<0.002	0.005	0.006
Lead	0.01	0.015	0.075	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	0.01	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	0.01*	-	-	-	-	-	-	-	-	-	-
Zinc	-	0.065	0.8	0.004	0.004	0.011	0.011	<0.003	0.033	0.005	< 0.003
Barium	0.5*	0.05	0.625	0.004	0.003	<u>0.056</u>	0.006	< 0.003	< 0.003	<u>0.058</u>	0.009
Petroleum Indicators											
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1
Benzene	0.001	0.0002	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Toluene	-	0.007	1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Ethyl Benzene	-	0.004	0.15	< 0.01	< 0.01	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Xylene	-	0.0002	0.07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01

Notes as per previous page

Annex 7 : Waste Management Record 2009

Batteries (Lead)	Waste Disposal Arrangements
Agent and Transporter of Waste	RILTA Environmental Limited, Block 402, Greenogue Business Park, Rathcoole, Co. Dublin
Waste Collection Permit Number	WCP- DC-09-1192-01
Persons responsible for ultimate disposal/recovery of Waste	HJ Enthoven Ltd, UK Darley Dale, Matlock, DE4 2LP Derbyshire UK
Ultimate destination of Waste	Lead acid batteries – recycled by HJ Enthoven
Written confirmation for off-site disposal of any hazardous Waste	Certificate of Disposal.
Results of any Analyses	None
Tonnage	1.054
EWC Code	16 06 01*
Details of Rejected Consignments	None

Batteries (Ni-Cd)	Waste Disposal Arrangements
Agent and Transporter of Waste	RILTA Environmental Limited, Block 402, Greenogue Business Park, Rathcoole, Co. Dublin
Waste Collection Permit Number	WCP- DC-09-1192-01
Persons responsible for ultimate disposal/recovery of Waste	Accurec Recycling GMBH Wiehage 12-14 Mulheim an der Ruhr Germany
Ultimate destination of Waste	Recycled by Accurec
Written confirmation for off -site disposal of any hazardous Waste	Certificate of Disposal.
Results of any Analyses	None
Tonnage	3.421
EWC Code	16 06 02*
Details of Rejected Consignments	None

Domestic Waste	Waste Disposal Arrangements
Agent and Transporter of Waste	Bantry Skip Hire
Waste Collection Permit Number	WCP-CK-09-0613-01
Persons responsible for ultimate disposal/recovery of Waste	Cork County Council County Hall, Co. Cork
Ultimate destination of Waste	Derryconnell Landfill Site, Schull, Co. Cork
Written confirmation for off -site disposal of any hazardous Waste	n.a
Results of any Analyses	None
Tonnage	39.6
EW Code	20 03 01
Details of Rejected Consignments	None

Metals	Waste Disposal Arrangements
Agent and Transporter of Waste	Cork Metal Ltd.
Waste Collection Permit Number	WCP-LK-08-0589-01
Persons responsible for ultimate disposal/recovery of Waste	Aceralia Redondos Commercial SA
Ultimate destination of Waste	Metal recovery in various plants in Spain
Written confirmation for off -site disposal of any hazardous Waste	n.a
Results of any Analyses	None
Tonnage	96.1
EW Code	20 01 40
Details of Rejected Consignments	None

Oils	Waste Disposal Arrangements
Agent and Transporter of Waste	ConocoPhillips Bantry Bay Terminal Ltd
Waste Collection Permit Number	N/A
Persons responsible for ultimate disposal/recovery of Waste	ConocoPhillips Bantry Bay Terminal Ltd, Whiddy Island, Bantry, Co. Cork
Ultimate destination of Waste	Recovered and recycled to crude oil tanks
Written confirmation for off -site disposal of any hazardous Waste	n.a.
Results of any Analyses	None
Tonnage	180
EWC Code	13 07 03*
Details of Rejected Consignments	None

Oil Contaminated Soil	Waste Disposal Arrangements
Agent and Transporter of Waste	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
Waste Collection Permit Number	WCP-CK-08-0578-01
Persons responsible for ultimate disposal/recovery of Waste	Sonderabfall Verbrennungsanlage (SAVA), Osterweute 1, 25541 Brunsbüttel, Germany
Ultimate destination of Waste	Incinerated in Germany
Written confirmation for off-site disposal of any hazardous Waste	Waste Acceptance Cert
Results of any Analyses	None
Tonnage	0.257
EWC Code	17 05 03*
Details of Rejected Consignments	None

Oil Filters	Waste Disposal Arrangements
Agent and Transporter of Waste	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
Waste Collection Permit Number	WCP-CK-08-0578-01
Persons responsible for ultimate disposal/recovery of Waste	Sonderabfall Verbrennungsanlage (SAVA), Osterweute 1, 25541 Brunsbüttel, Germany.
Ultimate destination of Waste	Pyrolysis Treatment
Written confirmation for off-site disposal of any hazardous Waste	Waste Acceptance Cert
Results of any Analyses	None
Tonnage	0.315
EWC Code	15 02 02*
Details of Rejected Consignments	None

Oils (Tank Scale Contaminated with Oil)	Waste Disposal Arrangements
Agent and Transporter of Waste	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
Waste Collection Permit Number	WCP-CK-08-0578-01
Persons responsible for ultimate disposal/recovery of Waste	Sonderabfall Verbrennungsanlage (SAVA), Osterweute 1, 25541 Brunsbüttel, Germany
Ultimate destination of Waste	Incinerated in Germany
Written confirmation for off -site disposal of any hazardous Waste	Waste Acceptance Certificate
Results of any Analyses	None
Tonnage	60.384
EWC Code	06 03 15*
Details of Rejected Consignments	None

Waste Timber	Waste Disposal Arrangements
Agent and Transporter of Waste	Bantry Skip Hire
Waste Collection Permit Number	CK WMC 126/02
Persons responsible for ultimate disposal/recovery of Waste	CTO Environmental
Ultimate destination of Waste	Rostellan, Midleton, Co Cork
Written confirmation for off -site disposal of any hazardous Waste	n.a
Results of any Analyses	None
Tonnage	11.78
EWC Code	17 02 01
Details of Rejected Consignments	None

Wipes and Rags	Waste Disposal Arrangements
Agent and Transporter of Waste	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
Waste Collection Permit Number	WCP-CK-08-0578-01
Persons responsible for ultimate disposal/recovery of Waste	Sonderabfall Verbrennungsanlage (SAVA), Osterweute 1, 25541 Brunsbüttel, Germany
Ultimate destination of Waste	Incinerated in Germany
Written confirmation for off -site disposal of any hazardous Waste	Waste Acceptance Certificate
Results of any Analyses	None
Tonnage	0.614
EWC Code	15 02 02
Details of Rejected Consignments	None

	Hazardous (Yes/No)	Description of Waste	Quantity (t)	Disposal/ Recovery Code	Location of Disposal/Recovery	Name of Waste Disposal/Recovery Contractor	Name of Waste Collection Contractor
16 06 01*	Yes	Batteries (Lead)	1.054	R4	Darley Dale, Matlock, DE4 2LP, Derbyshire, UK.	HJ Enthoven Ltd.	Rilta Environmental Ltd.
16 06 02*	Yes	Batteries (Cadmium)	3.421	R4	Wiehage 12-14, Mulheim an der Ruhr, Germany.	Accurec Rcycling GMBH	Rilta Environmental Ltd.
20 03 01	No	Domestic Waste	39.6	D1	Derryconnell Landfill Site, Schull, Co. Cork	Cork County Council	Bantry Skip Hire Ltd.
20 01 40	No	Metals	96.1	R4	Guipúzcoa, Spain	Aceralia Redondos Commercial SA	Cork Metal Ltd.
13 07 03*	Yes	Oils	180	R9	Whiddy Island, Bantry, Co. Cork	ConocoPhillips Bantry Bay Terminal Ltd	N/A
17 05 03*	Yes	Oil Contaminated Soil	0.257	D10	Brunsbüttel, Germany	Sonderabfall Verbrennungsanlage (SAVA)	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
06 03 15*	Yes	Oils (Tank Scale Contaminated with Oil)	60.384	D10	Brunsbüttel, Germany	Sonderabfall Verbrennungsanlage (SAVA)	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
15 02 02*	Yes	Oil Filters	0.315	D9	Brunsbüttel, Germany	Sonderabfall Verbrennungsanlage (SAVA)	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)
17 02 01	No	Waste Timber	11.78	R3	Rostellan, Midleton, Co. Cork	CTO Environmental	Bantry Skip Hire Ltd.
15 02 02*	Yes	Wipes and rags	0.614	D9,D10	Brunsbüttel, Germany	Sonderabfall Verbrennungsanlage (SAVA)	Veolia Environmental Services Ltd. (collected by South Coast Transport Ltd)

Annex 8 : Pollutant Release and Transfer Register (PRTR) 2009



| PRTR# : P0419 | Facility Name : Conoco Phillips Bantry Bay Terminals Limited |
 Filename : P0419_2009(1).xism | Return Year : 2009 |

26/03/2010 19:56

AER Returns Worksheet

Version 1.1.10

REFERENCE YEAR	2009
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1. FACILITY IDENTIFICATION

Parent Company Name	Conoco Phillips Bantry Bay Terminals Limited
Facility Name	Conoco Phillips Bantry Bay Terminals Limited
PRTR Identification Number	P0419
Licence Number	P0419-01

Waste or IPPC Classes of Activity

No.	class_name
9.2	The handling or storage of crude petroleum, not included in paragraph 9.3.1 or 9.3.2.

Address 1	Reenrour
Address 2	Bantry
Address 3	Co. Cork
Address 4	
Country	Ireland
Coordinates of Location	-9.50631 51.6889
River Basin District	IESW
NACE Code	1920
Main Economic Activity	Manufacture of refined petroleum products
AER Returns Contact Name	David Lee
AER Returns Contact Email Address	David.Lee2@conocophillips.com
AER Returns Contact Position	Team Leader HSE
AER Returns Contact Telephone Number	027 - 50380
AER Returns Contact Mobile Phone Number	
AER Returns Contact Fax Number	027 - 50282
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
50.1	General

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

4.1 RELEASES TO AIR

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR							
POLLUTANT		METHOD			QUANTITY		
No. Annex II	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Yea
			Method Code	Designation or Description			F (Fugitive) KG/Yea
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR							
POLLUTANT		METHOD			QUANTITY		
No. Annex II	Name	M/C/E	Method Used		Vehicles	Plant	F (Fugitive) KG/Year
			Method Code	Designation or Description	Emission Point 1	Emission Point 2	
07	Non-methane volatile organic compounds (NMVOC)	C	API	Calculation of Fugitive emissions from fixed and floating roof tanks using API methodology	0.0	0.0	100334.0
03	Carbon dioxide (CO2)	C	OTH	Calculation of CO2 emissions using site fuel consumption data and SEI emission factor data	193798.0	263387.0	457185.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)

RELEASES TO AIR							
POLLUTANT		METHOD			QUANTITY		
Pollutant No.	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Yea
			Method Code	Designation or Description			F (Fugitive) KG/Yea
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Conoco Phillips Bantry Bay Terminals Limite

Please enter summary data on the quantities of methane flared and / or utilised

T (Total) kg/Year	M/C/E	Method Used		Facility Total Capacity m3 per hour
		Method Code	Designation or Description	
Total estimated methane generation (as per site model)	0.0			N/A
Methane flared	0.0			0.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0			0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	0.0			N/A

4.2 RELEASES TO WATERS

| PRTR# : P0419 | Facility Name : Conoco Phillips Bantry Bay Terminals Limited | Filename : P0419_2009(1).xslm | Return Year : 2009 |

26/03/2010 19:58

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR Reporting as th

RELEASES TO WATERS								
POLLUTANT					QUANTITY			
No. Annex II	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description				
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO WATERS								
POLLUTANT					QUANTITY			
No. Annex II	Name	M/C/E	Method Code	Method Used	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
				Designation or Description				
				Third party Laboratory Method: Aqueous injection into HPLC system with electrochemical detection to measure Total Phenols (439 kg pa). Conservatively estimate that Carbon content is 80% by weight				
71	Phenols (as total C)	M	OTH		289.0	289.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO WATERS								
POLLUTANT					QUANTITY			
Pollutant No.	Name	M/C/E	Method Code	Method Used	SWEP-01			
				Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
303	BOD	M	OTH	Third party Laboratory Method: Sample is placed in filled air-tight bottle and incubated for 5 days at 20C in the dark	4425.197	4425.197	0.0	0.0
240	Suspended Solids	M	OTH	Third party Laboratory Method: Filtration using glass fibre filter paper	10430.82	10430.82	0.0	0.0
324	Mineral oils	M	OTH	Third party Laboratory Method: Extraction using hexane followed by GC-FRID analysis	1093.024	1093.024	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER								
POLLUTANT		METHOD			QUANTITY			
No. Annex II	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description				
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER								
POLLUTANT		METHOD			QUANTITY			
Pollutant No.	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description				
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

4.4 RELEASES TO LAND

| PRTR# : P0419 | Facility Name : Conoco Phillips Bantry Bay Terminals Limited | Filename : P0419_2009(1).xlsm | Return Year : 2009 |

26/03/2010 19:59

SECTION A : PRTR POLLUTANTS

RELEASES TO LAND							
POLLUTANT		METHOD			QUANTITY		
No. Annex II	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
			Method Code	Designation or Description			
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO LAND							
POLLUTANT		METHOD			QUANTITY		
Pollutant No.	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
			Method Code	Designation or Description			
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR# : P0419 | Facility Name : Conoco Phillips Bantry Bay Terminals Limited | Filename : P0419_2009(1).xslm | Return Year : 2009 |

26/03/2010 20:01

14

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	13 07 03	Yes	180.0	Oils	R9	C	Volume Calculation	Onsite in Ireland	Conoco Phillips Bantry Bay Terminal Ltd,IPC Licence P0419-01 Schedule 2(i)	Whiddy Island,Bantry,County Cork,,Ireland	ConocoPhillips Bantry Bay Terminal Ltd.,IPC Licence P0419-01 Schedule 2(i),Whiddy Island,Bantry ,County Cork,,.,Ireland	Whiddy Island,Bantry ,County Cork,,.,Ireland
To Other Countries	06 03 15	Yes	60.384	Oils (Tank Scale Contaminated with Oil)	D10	M	Weighed	Abroad	Veolia Environmental Services Ltd.,W0050-02	Corrin,Fermoy,,.,County Cork,Ireland	,25541 Brunsbuttel ,,,,Germany	Osterweute 1 ,25541 Brunsbuttel ,,,,Germany
To Other Countries	15 02 02	Yes	0.614	Wipes and Rags	D10	M	Weighed	Abroad	Veolia Environmental Services Ltd.,W0050-02	Corrin,Fermoy,,.,County Cork,Ireland	,25541 Brunsbuttel ,,,,Germany	Osterweute 1 ,25541 Brunsbuttel ,,,,Germany
To Other Countries	15 02 02	Yes	0.315	Oil Filters	D9	M	Weighed	Abroad	Veolia Environmental Services Ltd.,W0050-02	Corrin,Fermoy,,.,County Cork,Ireland	,25541 Brunsbuttel ,,,,Germany	Osterweute 1 ,25541 Brunsbuttel ,,,,Germany
To Other Countries	17 05 03	Yes	0.257	Oil Contaminated Soil	D9	M	Weighed	Abroad	Veolia Environmental Services Ltd.,W0050-02	Corrin,Fermoy,,.,County Cork,Ireland	,25541 Brunsbuttel ,,,,Germany	Osterweute 1 ,25541 Brunsbuttel ,,,,Germany
To Other Countries	20 01 40	No	96.1	Metals	R4	M	Weighed	Abroad	Cork Metal Ltd.,CK(S) 204/05	Dublin Hill,Cork,County Cork,,.,Ireland		
Within the Country	20 03 01	No	39.6	Domestic Waste	D1	M	Weighed	Onsite in Ireland	Cork County Council,W089-02	Derryconnell Landfill site ,Schull ,Co. Cork,,.,Ireland		
Within the Country	17 02 01	No	11.78	Waste Timber	R3	M	Weighed	Onsite in Ireland	CTO Environmental Solutions Ltd,WFP-CK-09-0018-02	Rostellan ,Midleton ,Co. Cork,,.,Ireland		
To Other Countries	16 06 01	Yes	1.054	Batteries (Lead)	R4	M	Weighed	Abroad	Riita Environmental Ltd.,W0192-02	Block 402 ,Greenogue Business Park,Rathcoole,County Dublin,Ireland	HJ Enthoven Ltd ,BL5598,Darley Dale ,Matlock,DE4 2LP,Derbyshire,United Kingdom	Darley Dale ,Matlock,DE4 2LP,Derbyshire,United Kingdom
To Other Countries	16 06 02	Yes	3.421	Batteries (Ni-Cd)	R4	M	Weighed	Abroad	Riita Environmental Ltd.,W0192-02	Block 402 ,Greenogue Business Park,Rathcoole,County Dublin,Ireland	Accurec Recycling GMBH ,E11715338,Wiehage 12-14 ,Mulheim an der Ruhr,,.,Germany	Wiehage 12-14 ,Mulheim an der Ruhr,,.,Germany

* Select a row by double-clicking the Description of Waste then click the delete button

**Annex 9 : Fugitive Emissions Study at ConocoPhillips Bantry Bay
Terminal Ltd 2009**



Client: ConocoPhillips Bantry Bay Terminal Ltd

Fugitive Emissions Study at
ConocoPhillips Bantry Bay Terminal Ltd
2009

Certified Final

Document No 255-X151

March 2009

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TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	METHODOLOGY.....	2
2.1	DESCRIPTION	2
2.2	FLOATING ROOF TANKS.....	2
2.3	FIXED ROOF TANKS	3
3	PRODUCT HANDLING DATA.....	4
4	RESULTS	4
4.1	STANDING STORAGE LOSSES	4
4.2	PRODUCT HANDLING LOSSES.....	6
4.3	TOTAL FUGITIVE EMISSIONS FROM THE SITE	9
5	CONCLUSIONS	10

ANNEX 1 – DATA USED FOR CALCULATING FUGITIVE EMISSIONS

ANNEX 2 – SAMPLE CALCULATION FOR ONE MONTH (JUNE 2009)

ANNEX 3 – INVENTORIES AND PRODUCT MOVEMENTS FOR EACH MONTH



1 INTRODUCTION

This report by Byrne Ó Cléirigh (BÓC) provides information on the fugitive emissions of petroleum product vapours from the storage tanks at ConocoPhillips Bantry Bay Terminal (CPBBT), Whiddy Island, Bantry, Co. Cork in 2009. It is a continuation of fugitive emissions studies carried out in previous years, which have been submitted to the Environmental Protection Agency (EPA) with each Annual Environmental Report (AER). The first such report (Doc. Ref. 255-X058) was submitted in 2001 and covered the fugitive emissions calculated for the previous year (2000).

This report covers the standing storage losses and the product handling losses to atmosphere from floating and fixed roof tanks for the following products:

- Crude Oil (Including Oseberg and Harding);
- Gas Oil (Automotive Diesel Oil, Finished Gas Oil and Marked Gas Oil);
- Jet Fuel (Dual Purpose Kerosene);
- Gasoline.

Details of the storage tanks at the Terminal and their capacities are shown in Table 1.

Table 1: Storage Tanks at CPBBT as of beginning of 2009

Tank Number	Diameter (m)	Volume (barrels)	Volume (m ³)	Roof Type	Rim Seals
201	80	580,000	92,200	Floating	Secondary
202	80	580,000	92,200	Floating	Primary
203	80	580,000	92,200	Floating	Secondary
204	80	580,000	92,200	Floating	Secondary
205	80	580,000	92,200	Floating	Secondary
206	80	580,000	92,200	Floating	Secondary
207	80	580,000	92,200	Floating	Secondary
208	80	580,000	92,200	Floating	Secondary
209	80	580,000	92,200	Floating	Secondary
210	80	580,000	92,200	Floating	Primary
211	80	580,000	92,200	Floating	Secondary
212	80	580,000	92,200	Floating	Secondary
401	77	542,000	86,200	Floating	Secondary
402	77	542,000	86,200	Floating	Secondary
403	6.5	1,515	240	Fixed	n.a.
405	37	97,500	15,100	Fixed	n.a.
406	37	97,500	15,100	Fixed	n.a.
407	25	48,000	7,630	Fixed	n.a.

When carrying out the fugitive emissions calculations, we have reported all volumes in barrels (bbls) as these are the units used by the American Petroleum Institute (API) when developing the methodology for calculating fugitive emissions. One barrel is approximately equivalent to 0.159 m³.



2 METHODOLOGY

2.1 Description

Fugitive emissions of vapours from the storage tanks were calculated in two parts:

- Standing Storage Loss
- Product Handling Loss

The standing storage loss occurs as a result of storing petroleum products in tanks and is mainly dependent on the volatility of the product and on the type of tank used for storage. The product handling loss occurs as a result of product movements at the Terminal. These are described in greater detail in the sections below. The data used to perform the fugitive emission calculations is included in Annex 1. A sample calculation for one month (June 2009) is included in Annex 2. Annex 3 lists the inventories and product movements for each month over the course of 2009.

2.2 Floating Roof Tanks

Losses from floating roof tanks have been estimated using the methodology in “*Manual of Petroleum Measurement Standards; Chapter 19 – Evaporative Loss Measurement; Section 2 – Evaporative Loss from Floating Roof Tanks*”, by the American Petroleum Institute (API), 1997.

Standing storage losses arise due to emissions of volatile petroleum vapours through the rim seals and deck fittings of tanks. Standing storage losses from floating roof tanks are calculated by the following equation:

$$L_S = \left[F_R + F_F + F_D \right] \times P^* \times M_V \times K_C$$

F_R	Rim Seal Loss Factor of the tank (lb-mol per year)
F_F	Deck Fitting Loss Factor of the tank (lb-mol per year)
F_D	Deck Seam Loss Factor of the tank (lb-mol per year)
P^*	Vapour Pressure Function of the product stored as defined by API (-)
M_V	Average Molecular Weight of the product stored (lb/lb-mol)
K_C	Product Factor as defined by API (-)

Withdrawal losses occur as a result of the roof being lowered as product is removed from the tank. As the roof is lowered, some product that has adhered to the tank wall is exposed to the atmosphere. This residual product then evaporates to atmosphere as a fugitive emission.



The API methodology states that, apart from normal standing storage losses, there are no losses associated with the delivery of material to a floating roof tank.

Withdrawal losses for each tank are calculated using the following equation:

$$L_w = \left[\frac{0.943 \times Q \times C \times W_L}{D} \right] \times \left[\frac{N_{FC} \times F_C}{D} + 1 \right]$$

Q	Net Withdrawal per tank (bbl)
C	Clingage Factor (bbl per 1000 ft ²)
W _L	Average Liquid Stock Density (lb/gal)
D	Diameter of tank (ft)
N _{FC}	No. of Fixed Roof Support Columns (-)
F _C	Effective Column Diameter (ft)

2.3 Fixed Roof Tanks

Standing storage losses in fixed roof tanks are caused by an increase in the temperature of the tank contents. An increase in temperature causes the vapours in the tank to expand. These vapours are then emitted to atmosphere through the tank vents.

The average daily temperature change for each month was calculated and applied to the contents of the tank¹. This diurnal variation in temperature gives rise to a variation in volume in the air space of the tank. The displaced air was assumed to contain saturation levels of petroleum products. The storage loss from a fixed roof tank was calculated using the following equation:

$$\text{Standing Storage Fixed Roof Loss} = A_D \times \left(\frac{P_{vap}}{P_a} \right) \times \left(\frac{M_v}{22.4136} \right) \times \left(\frac{273}{273 + T_{ambient}} \right)$$

A _D	Air Displaced (m ³)
P _{vap}	Vapour Pressure (psi)
P _a	Atmospheric Pressure (psi)
M _v	Molecular weight (lb/lb-mol)
T _{ambient}	Ambient Temperature (°C)

Product handling losses occur due to the fact that material being loaded into the tank displaces an equal volume of air containing petroleum vapour. This air is assumed to contain saturation levels of petroleum products. There are no product handling losses associated with unloading material from fixed roof tanks.

¹ Data on diurnal changes in ambient temperature taken from “*The Climate of Ireland*” by P.K. Rohan, 1986



3 PRODUCT HANDLING DATA

The average levels of product in each tank and the total product movements to and from each tank for each month in 2009 are given in Annex 3. All quantities are expressed in barrels (bbls) as these are the units used in the API Methodology. Note that some variations arise in the quantities quoted for each tank from month to month due to measurement inaccuracies. One millimetre in liquid level in a tank is equivalent to as much as 5 m³ of product. The values given in the “Quantity Stored” column of the Tables in Annex 3 are the quantities present in each tank at the end of every month.

4 RESULTS

4.1 Standing Storage Losses

The fugitive emissions from each tank have been calculated on a monthly basis. These results were then grouped together for tanks with the same product to give total emissions for each product type.

The ratio of standing storage losses to the amount of product stored at the Terminal was then calculated. This allows the significance of the standing storage losses to be assessed for the purpose of comparing the results with those of previous years. Similarly, the ratio of product handling losses to quantity of product handled has also been calculated.

The monthly standing storage losses are summarised in

Table 2. The total standing storage loss from gas oil was insignificant compared with the other products, at approximately 36 g over the course of the year. This is similar to losses calculated for previous years.

Table 2: Summary of Standing Storage Losses (tonnes)

Product	Crude	Gas Oil	Jet	Gasoline
January	2.244	1.863 x 10 ⁻⁶	0.119	8.282
February	1.964	1.766 x 10 ⁻⁶	0.106	9.871
March	1.958	2.707 x 10 ⁻⁶	0.110	9.976
April	1.635	2.085 x 10 ⁻⁶	0.099	8.689
May	1.826	3.779 x 10 ⁻⁶	0.115	9.730
June	1.597	3.009 x 10 ⁻⁶	0.220	2.219
July	0.496	3.112 x 10 ⁻⁶	0.212	2.083
August	0.532	3.393 x 10 ⁻⁶	0.228	2.239
September	0.634	3.591 x 10 ⁻⁶	0.265	2.654
October	0.680	3.265 x 10 ⁻⁶	0.271	2.824
November	1.443	2.403 x 10 ⁻⁶	0.241	2.662
December	0.664	2.223 x 10 ⁻⁶	0.200	2.715
Total	15.673	3.320 x 10⁻⁵	2.185	63.944



The total amount of material stored on site is expressed as tonne-days. This is the quantity of each material stored and the amount of time for which it is stored. The quantities are shown in Table 3.

Table 3: Total Quantities Stored on Site (tonne-days)

Product	Crude	Gas Oil	Jet	Gasoline
January	3,538,845	9,591,983	6,509,025	5,462,254
February	3,200,671	8,663,114	5,877,201	6,819,538
March	3,516,963	9,591,227	6,511,084	6,414,528
April	3,427,235	9,283,851	6,297,000	5,060,140
May	3,558,274	8,269,109	6,498,379	3,281,518
June	985,713	9,274,428	9,957,684	1,907,330
July	80,056	11,564,575	11,588,616	1,969,829
August	98,558	9,593,861	11,584,244	1,969,184
September	94,790	9,119,917	10,256,598	1,904,740
October	102,050	9,429,670	10,605,436	1,968,298
November	96,721	9,127,871	8,579,145	1,901,970
December	100,071	9,433,008	6,449,314	1,968,176
Total	18,799,947	112,942,615	100,713,725	40,627,506

The ratios of the total standing losses (tonnes) to the total quantity stored (tonne-days) were then calculated. These indices were calculated for 2009 and are compared to those from previous years in Table 4.

Table 4: Indices for Emissions to Atmosphere for Standing Storage Losses

Year	Crude	Gas Oil	Jet	Gasoline	Alkylate
2000	1.210×10^{-6}	2.838×10^{-13}	2.109×10^{-7}	1.687×10^{-6}	0
2001	2.004×10^{-6}	2.801×10^{-13}	2.054×10^{-8}	1.227×10^{-6}	0
2002	4.648×10^{-6}	6.615×10^{-13}	1.941×10^{-8}	1.227×10^{-6}	0
2003	1.845×10^{-5}	3.004×10^{-13}	2.637×10^{-8}	1.231×10^{-6}	0
2004	1.196×10^{-5}	3.122×10^{-13}	3.15×10^{-8}	2.146×10^{-6}	4.043×10^{-6}
2005	1.224×10^{-6}	3.205×10^{-13}	1.932×10^{-8}	1.63×10^{-6}	0
2006	1.169×10^{-6}	3.546×10^{-13}	1.821×10^{-8}	1.004×10^{-6}	0
2007	1.251×10^{-6}	2.789×10^{-13}	2.0893×10^{-8}	1.446×10^{-6}	0
2008	9.77×10^{-7}	3.252×10^{-13}	1.772×10^{-8}	1.685×10^{-6}	0
2009	8.337×10^{-7}	3.014×10^{-13}	2.133×10^{-8}	1.574×10^{-6}	0



4.2 Product Handling Losses

The product handling losses are summarised in Table 5. All figures are expressed in tonnes.

Table 5: Summary of Product Handling Losses (tonnes)

Product	Crude	Gas Oil	Jet	Gasoline
January	0	0	0	0
February	0	0	0	4.821×10^{-3}
March	0	3.319×10^{-7}	0	4.687×10^{-3}
April	0	0	0	4.893×10^{-3}
May	0	5.389×10^{-3}	0	1.311×10^{-2}
June	6.688×10^{-2}	4.004×10^{-3}	8.956×10^{-3}	0
July	1.578×10^{-2}	0	0	0
August	0	1.926×10^{-8}	0	0
September	0	6.516×10^{-4}	4.044×10^{-3}	0
October	0	0	0	0
November	0	0	7.296×10^{-3}	0
December	0	0	1.003×10^{-2}	0
Total	8.266×10^{-2}	1.004×10^{-2}	3.033×10^{-2}	2.751×10^{-2}

Product movements, shown in Table 6, are expressed as the total of the amount imported and the amount exported to the Terminal during 2009. Transfers of product within the facility are not included.

Table 6: Total Product Movements (In + Out) of site (tonnes)

Product	Crude	Gas Oil	Jet	Gasoline
January	33,542	0	0	44,065
February	0	0	0	104,949
March	0	4,116	0	37,287
April	0	0	0	39,074
May	0	42,263	0	104,334
June	129,648	0	0	263,336
July	30,586	0	41,705	0
August	0	54	0	0
September	0	5,109	31,873	0
October	0	717	0	0
November	0	0	56,884	0
December	0	0	79,214	0
Total	193,776	52,259	209,676	593,046

The indices for each of these products are the ratios of the losses due to product handling divided by the total movements of each product.

Table 7 shows the indices for product handling losses calculated in 2009 and includes the indices from previous years for comparison.



Table 7: Indices for emissions to atmosphere for product handling losses

Year	Crude	Gas Oil	Jet	Gasoline
2000	4.318×10^{-7}	1.248×10^{-8}	1.253×10^{-7}	0
2001	2.458×10^{-7}	6.158×10^{-8}	0	0
2002	1.815×10^{-7}	2.821×10^{-10}	0	0
2003	4.869×10^{-7}	5.691×10^{-8}	1.08×10^{-6}	0
2004	3.72×10^{-7}	7.63×10^{-8}	1.84×10^{-6}	3.353×10^{-8}
2005	2.42×10^{-7}	6.50×10^{-8}	0	7.152×10^{-8}
2006	2.43×10^{-8}	5.74×10^{-9}	2.04×10^{-9}	5.72×10^{-9}
2007	3.784×10^{-8}	7.223×10^{-9}	1.327×10^{-8}	6.689×10^{-9}
2008	1.489×10^{-7}	1.005×10^{-7}	0	6.264×10^{-8}
2009	4.27×10^{-7}	1.92×10^{-7}	1.45×10^{-7}	4.64×10^{-8}

In addition to the normal product handling losses arising from transfers of material to and from the tanks, there is another source of fugitive emissions which occurs when a floating roof storage tank is emptied. When a floating roof is “landed”, a vacuum breaker fitted to the tank automatically opens in order to equalise the pressure in the vapour space between the roof and the tank floor. Petroleum vapours in the vapour space are then emitted to atmosphere through the open vacuum breaker. The indices for Gasoline show an increase in product handling losses. This is to be expected, given there were over twice as many Gasoline product movements in 2009 as 2008.

There were 8 occasions in 2009 where a floating tank was emptied. These are listed in Table 8.

Table 8: Maximum losses from instances where a floating roof was landed by emptying a tank

Month	Tank	Vapour space (m ³)	Product	Fugitive Emissions (tonnes)
April	212	5883	Gasoline	5.374
May	206	5883	Gasoline	5.742
May	211	5883	Gasoline	5.742
June	202	5883	Crude	1.526
June	207	5883	Gas Oil	2.13×10^{-6}
November	207	5883	Kerosene	0.012
December	206	5883	Kerosene	0.011
December	212	5883	Kerosene	0.011
			Total:	18.420

In order to calculate the fugitive emissions, the total volume of air enclosed between the landed roof and the tank floor was calculated. It was assumed that the vapour space between the floor and the roof was saturated with petroleum vapour. The vapour pressure was calculated for each product based on the maximum ambient temperature for the month in which the tank was emptied (See Annex 1 for meteorological data).

As can be seen, the fugitive emissions from the roof landing of a tank containing Gas Oil are negligible compared to those for the other products such as Gasoline. These losses increase the overall product movement losses on each of the occasions that a floating roof was landed. Combining these results with those in Table 5 gives the total product handling losses.



Table 9: Total Product Handling Losses from Product Movements & from Landing of Floating Roofs (tonnes)

Product	Crude	Gas Oil	Jet	Gasoline
January	0	0	0	0
February	0	0	0	4.821×10^{-3}
March	0	3.319×10^{-7}	0	4.687×10^{-3}
April	0	0	0	5.379
May	0	5.389×10^{-3}	0	11.503
June	1.593	4.006×10^{-3}	8.956×10^{-3}	0
July	1.578×10^{-2}	0	0	0
August	0	1.926×10^{-8}	0	0
September	0	6.516×10^{-4}	4.044×10^{-3}	0
October	0	0	0	0
November	0	0	1.957×10^{-2}	0
December	0	0	3.243×10^{-2}	0
Total	1.609	1.005×10^{-2}	6.500×10^{-2}	16.886

Including these terms to calculate overall indices for product handling losses gives the values set out in Table 10. The overall indices for 2009 are compared to those for previous years in Table 11.

Table 10: Overall Indices for Emissions to Atmosphere for Product Handling Losses for 2009

Description	Crude	Gas Oil	Jet	Gasoline
Fugitive Emissions, product movement losses only (from Table 7)	4.27×10^{-7}	1.92×10^{-7}	1.45×10^{-7}	4.64×10^{-8}
Fugitive Emissions including the contribution from Landing of Roofs	8.304×10^{-6}	1.923×10^{-7}	3.100×10^{-7}	2.847×10^{-5}

A comparison of the two sets of indices in Table 10 shows that the effect of landing a roof on a gasoline or crude oil tank is much more significant than landing a roof on a gas oil tank. The product handling indices for crude oil and gasoline are at least two orders of magnitude greater after the losses associated with emptying the tank are included, whereas the index for gas oil is unaffected. These materials all have similar clingage factors, meaning that the fugitive emissions associated with lowering a roof are similar in each case. However, the vapour pressures of crude oil and gasoline are much higher than that of gas oil or jet fuel and consequently there is a higher concentration of those materials present in the vapour space, thereby leading to significantly greater fugitive emissions when the roof is landed.



Table 11: Indices for Emissions to Atmosphere for Overall Product Handling Losses

Year	Crude	Gas Oil	Jet	Gasoline
2001	7.604×10^{-6}	6.610×10^{-8}	0	0
2002	1.192×10^{-5}	4.958×10^{-10}	0	0
2003	1.325×10^{-5}	5.69×10^{-8}	1.08×10^{-6}	0
2004	1.19×10^{-4}	7.63×10^{-8}	3.45×10^{-6}	2.16×10^{-5}
2005	1.11×10^{-5}	1.30×10^{-7}	0	4.57×10^{-5}
2006	6.02×10^{-6}	1.15×10^{-8}	4.08×10^{-9}	4.28×10^{-5}
2007	1.173×10^{-5}	7.228×10^{-9}	1.105×10^{-6}	5.506×10^{-5}
2008	8.738×10^{-6}	1.006×10^{-7}	0	5.710×10^{-5}
2009	8.304×10^{-6}	1.923×10^{-7}	3.100×10^{-7}	2.847×10^{-5}

4.3 Total Fugitive Emissions from the Site

The overall fugitive emissions from the tank farm are shown in Table 12.

Table 12: Summary of Fugitive Emissions from Tank Farm (2009)

Month	Total Stored (bbl)	Material in (bbl)	Material out (bbl)	Storage Loss (kg)	Withdrawal Loss (kg)	Total Loss (kg)
January	6,315,980	655,304	0	10,644	0	10,644
February	6,885,162	886,176	323,884	11,940	5	11,945
March	6,570,382	30,336	345,185	12,043	5	12,048
April	6,252,817	11,017	328,688	10,423	5,379	15,802
May	5,404,043	318,786	1,197,896	11,672	11,503	23,174
June	6,252,817	2,107,755	1,771,422	3,999	1,606	5,606
July	5,814,914	328,763	230,858	2,790	16	2,806
August	5,817,914	403	403	2,999	0	2,999
September	5,525,740	0	289,566	3,553	5	3,558
October	5,529,908	5,285	5,285	3,775	0	3,775
November	5,086,639	21,501	454,108	4,346	20	4,365
December	4,473,343	0	624,439	3,579	10	3,612
Total	69,929,659	4,365,326	5,571,734	81,764	18,570	100,334

We calculate that a total of 100.3 tonnes of petroleum vapour was emitted to the atmosphere in 2009. This is an increase from the figure of 94.4 tonnes of petroleum vapour that was calculated for 2008.



5 CONCLUSIONS

There has been an increase in standing storage losses in 2009 compared to 2008 and a slight reduction in withdrawal losses compared to 2008. The losses from the tank farm are highly dependent on the type of material stored and the movement of products between the tanks. The slight decrease in withdrawal losses can primarily be attributed to the nature of the landings incurred during 2009. There was a total of 8 roof landings in 2009 (one more than 2008), however there was one less crude tank roof landing in 2009 compared to 2008 (with the total number of landings for gasoline in 2009 equal with 2008). Crude and gasoline landings make up the bulk of roof landing losses and this would explain the slight decrease in landing losses. Standing storage losses have increased by approximately 7.5 tonnes in 2009, this can be attributed to the increase in crude oil stored on site which has almost doubled when compared to 2008. Therefore the overall effect was an increase in overall fugitive emissions for the site in 2009 compared to 2008.

The quantity of crude oil stored on site has increased considerably since 2008 with gasoline storage on site increasing marginally. Jet fuel and gas oil storage has decreased on site compared with 2008. No alkylate was stored on site in 2009.

Storage of gasoline and crude oil accounted for just less than 98 % of the total storage loss for all materials while storage of gas oil and jet fuel accounted for just over 2 % of the total storage losses. Overall there was an increase of around 36% in the volume of product movements in and out of the facility in 2009. This led to an increase of the amount of handling losses in 2009.

Total product handling losses from product movements and roof landings decreased from 19.9 tonnes in 2008 to 18.4 tonnes in 2009. Of the 2009 loss, 16.9 tonnes were directly associated with the three gasoline roof landings that took place in April and May respectively. The majority of the remaining total product handling losses came from the roof landing of tank 202 in June which contained crude, which accounted for 1.5 tonnes of losses. These large roof landing losses occur because when a floating roof tank is out of service, the vacuum breaker vents automatically open thus causing emissions to atmosphere. Roof landings are necessary when there is a change in the product stored or in the grade of the product stored. In fact, the total site losses associated with roof landings were 18.4 tonnes or over 99 % of the total handling losses. The total crude landing losses decreased by around 42% from 2008 and was due primarily a 50% decrease in crude tank roof landings during 2009 compared 2008.

Of the four products stored in 2009, gasoline and crude oil have the highest vapour pressures, so landing losses associated with these products will be higher than those associated with other products. The number of occasions when a roof was landed in 2009 increased compared to 2008. Gas oil and kerosene which have a lower vapour pressures, accounted for two of the eight roof landings in 2009 with crude and gasoline accounting for the remaining six landings (three each). By comparison, crude and gasoline accounted for only five roof landings in 2008.



When considering the factors contributing to fugitive emissions, it is better to use fewer tanks and fill them with product than to store small amounts of product in a larger number of tanks. However, from an operational point of view, it is better to keep more tanks in service as the wetted surface protects the tank from rust and from weathering which could increase the risk of failure. When a tank is emptied or taken out of service and is exposed to the elements (i.e. when the roof is landed), corrosion can occur on the floors and under-roof areas. In addition, allowing pipelines to lay idle can permit corrosion along the bottom of the line.

The indices calculated for standing storage and for product handling losses show how much the losses vary for each product. Crude and gasoline are the most volatile of the materials stored and hence have the greatest indices.

The indices quantify the emissions per unit stored or handled and depend on the quantity stored or handled as much as on any other factors. The standing storage loss index for a tank that contains a low liquid level will be higher than for the same tank with a high liquid level. This is because the quantity of fugitive emissions by standing storage losses will be the same but the relative loss is greater in the case where there is little product in a tank.

Similarly, the product handling loss index will increase in cases where floating roof tanks are being emptied (due to clingage) and fixed roof tanks are being filled (due to air displacement), and will decrease in cases where floating roof tanks are being filled and fixed roof tanks are being emptied (in these cases there would be no contribution to the emission associated with the additional product movements).

CPBBT do not propose to concentrate their stock into fewer tanks to reduce fugitive emissions. The actual emissions are low when compared to the inventory on site (total losses for the year were equivalent to approximately 0.011 % of the average inventory held on site during the year).

Overall fugitive emissions from the Tank Farm are dominated by the standing storage loss. In 2009, the standing storage loss formed over 81% of total emissions. According to the API Methodology, this is to be expected, even for facilities operating at full commercial activity. Should CPBBT increase the level of activity (product movements), the fugitive emissions to atmosphere would not be significantly increased; in fact, the product handling losses are mostly dependent on the number of roof landings that occur during the year (over 99% of the product handling losses occur from roof landings).

It is CPBBT's policy that all floating roof tanks will be fitted with double containment rim seals in accordance with Best Environmental Practice. CPBBT are currently engaged in a programme of tank refurbishment as part of their Environmental Management Programme. This is described in more detail in the Annual Environment Report itself.



Annex 1 : Data used for Calculating Fugitive Emissions



Meteorological Data

Meteorological data for Valentia Observatory has been used for this study.

	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Temperature (°C)	Average Wind Speed (m/s)	Average Pressure (hPa)
January	3.9	9.2	6.6	6.8	1,011.5
February	3.6	9.3	6.5	6.3	1,012.2
March	4.8	10.7	7.8	6.1	1,012.6
April	5.9	12.4	9.2	5.3	1,016.2
May	7.9	14.5	11.2	5.4	1,015.0
June	10.3	16.6	13.5	4.7	1,016.8
July	11.9	17.7	14.8	4.3	1,017.3
August	12.0	18.0	15.0	4.5	1,015.1
September	10.8	16.7	13.8	5.3	1,014.6
October	9.0	14.5	11.8	5.9	1,014.1
November	6.2	11.4	8.8	6.2	1,013.0
December	5.2	10.1	7.7	6.5	1,012.0

Product Data

	Crude	Gas Oil	Jet	Gasoline
Vapour Molecular Weight (lb/lb-mol)	50	254	128	64
Product Factor	0.4	1	1	1
Liquid Stock Density (lb/gal)	6.99	6.957	6.573	6.089
Vapour Pressure Equation Constant A	11.0051	19.85	14.83	11.724
Vapour Pressure Equation Constant B (°R)	4979.29	18022	9232	5237.27
True Vapour Pressure (psi) ²	4.09302	3.4×10^{-7}	0.05174	5.10875
Vapour Pressure Function ²	0.08112	5.8×10^{-9}	0.00088	0.10596

² Calculated using the Vapour Pressure Equation Constants A and B, and the Meteorological Data for June



Tank Data

Tank Number	Diameter (m)	Volume (barrels)	Volume (m³)	Roof Type	Rim Seals
201	80	580,000	92.213	Floating	Secondary
202	80	580,000	92.213	Floating	Primary
203	80	580,000	92.213	Floating	Secondary
204	80	580,000	92.213	Floating	Secondary
205	80	580,000	92.213	Floating	Secondary
206	80	580,000	92.213	Floating	Secondary
207	80	580,000	92.213	Floating	Secondary
208	80	580,000	92.213	Floating	Secondary
209	80	580,000	92.213	Floating	Secondary
210	80	580,000	92.213	Floating	Primary
211	80	580,000	92.213	Floating	Secondary
212	80	580,000	92.213	Floating	Secondary
401	77	542,000	86.171	Floating	Secondary
402	77	542,000	86.171	Floating	Secondary
403	6.5	1,515	241	Fixed	n.a.
405	37	95,000	15,104	Fixed	n.a.
406	37	95,000	15,104	Fixed	n.a.
407	25	48,000	7,631	Fixed	n.a.

For Floating Roof Tanks, the following Deck Fittings are in place.

<i>Tank</i>	<i>Deck Legs</i>	<i>Access Hatches</i>	<i>Gauge Floats</i>	<i>Vacuum Break</i>	<i>Rim Vents</i>	<i>Guide Poles</i>	<i>Drain Plugs</i>
201	190	2	1	5	4	1	4
202	190	2	1	5	4	1	4
203	190	2	1	5	4	1	4
204	190	2	1	5	4	1	4
205	190	2	1	5	4	1	4
206	190	2	1	5	4	1	4
207	190	2	1	5	4	1	4
208	190	2	1	5	4	1	4
209	190	2	1	5	4	1	4
210	190	2	1	5	4	1	4
211	190	2	1	5	4	1	4
212	190	2	1	5	4	1	4
401	176	2	1	5	4	1	4
402	176	2	1	5	4	1	4



Annex 2 : Sample Calculation for one Month (June 2009)



Month	June
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Data	Total
Minimum Temperature (C)	10.3
Maximum Temperature (C)	16.6
Average Temperature (C)	13.5
Average Wind Speed (m/s)	4.7
Average Atmospheric Pressure (HPa)	1016.8

Atmospheric Conditions			
Ambient Temperature	Ta	F	56.3
Ambient Pressure	Pa	psi	14.7
Wind Speed	V	mph	10.5

Product Data			Crude	Gas Oil	Kerosene	Jet	Gasoline
Vapour Molecular Weight	M _v	lb/lb-mol	50	254	156	128	64
Product Factor	K _c		0.4	1	1	1	1
		tonnes/m ³	0.838	0.834	0.794	0.788	0.730

Tank Data

Tank No.	Diameter (m)	Volume (bbl)	Roof	Rim Seals	Shell Condition	Product	Quantity (bbl)	Material in (bbl)	Material Out (bbl)
201	80	580,000	Floating	Secondary	Light Rust	Gasoline	538,997	0	0
202	80	580,000	Floating	Primary	Light Rust	Crude	365,092	0	365,355
203	80	580,000	Floating	Secondary	Light Rust	Crude	497,189	365,355	613,219
204	80	580,000	Floating	Secondary	Light Rust	Jet	577,918	0	0
205	80	580,000	Floating	Secondary	Light Rust	None	0	0	0
206	80	580,000	Floating	Secondary	Light Rust	Jet	493,342	565,579	557,420
207	80	580,000	Floating	Secondary	Light Rust	Jet	540,867	379,512	235,428
208	80	580,000	Floating	Secondary	Light Rust	Gas Oil	576,778	0	0
209	80	580,000	Floating	Secondary	Light Rust	Jet	573,384	0	0
210	80	580,000	Floating	Primary	Light Rust	Gas Oil	564,357	0	0
211	80	580,000	Floating	Secondary	Light Rust	Gas Oil	393,919	223,949	0
212	80	580,000	Floating	Secondary	Light Rust	Jet	0	573,360	0
401	77	542,000	Floating	Secondary	Light Rust	Gas Oil	526,359	0	0
402	77	542,000	Floating	Secondary	Light Rust	Jet	503,330	0	0
403	6.5	1,515	Fixed	n/a	Light Rust	Gas Oil	739	0	0
405	37	97,500	Fixed	n/a	Light Rust	None	0	0	0
406	37	97,500	Fixed	n/a	Light Rust	Gas Oil	96,897	0	0
407	25	48,000	Fixed	n/a	Light Rust	Gas Oil	3,648	0	0



Deck Fittings

Deck Legs	Adjustable (2 levels), No Seals/Gaskets
Access Hatches (Acc Hatch)	24", Bolted & Gasketed
Gauge Floats (Gge Flts)	"Varec", Bolted & Gasketed
Sample Hatch	8", part of guide pole
Vacuum Breakers (Vac Break)	Gasketed
Rim Vents	6" Diameter, Gasketed
Guide Poles (Gde Poles)	Perforated, no well gasket, pole wiper, or pole sleeve
Deck Drain Plugs (Drn Plugs)	3" Diam. Threaded. 10% open area

<i>Tank</i>	<i>Deck Legs</i>	<i>Acc Hatch</i>	<i>Gge Flts</i>	<i>Vac Break</i>	<i>Rim Vents</i>	<i>Gde Poles</i>	<i>Drn Plugs</i>
201	190	2	1	5	4	1	4
202	190	2	1	5	4	1	4
203	190	2	1	5	4	1	4
204	190	2	1	5	4	1	4
205	190	2	1	5	4	1	4
206	190	2	1	5	4	1	4
207	190	2	1	5	4	1	4
208	190	2	1	5	4	1	4
209	190	2	1	5	4	1	4
210	190	2	1	5	4	1	4
211	190	2	1	5	4	1	4
212	190	2	1	5	4	1	4
401	176	2	1	5	4	1	4
402	176	2	1	5	4	1	4
403	0	0	0	0	0	0	0
405	0	0	0	0	0	0	0
406	0	0	0	0	0	0	0
407	0	0	0	0	0	0	0



LOSSES FROM FLOATING ROOF TANKS

I – RIM SEAL LOSS FACTOR

$$F_r = K_r \cdot D$$

$$\text{Where } K_r = K_{ra} + K_{rb} \cdot V^n$$

<i>Rim Seal Type</i>			Primary	Secondary
K_{ra}	Factor @ Zero Wind	lb-mol/ft-yr	5.8	1.6
K_{rb}	Wind Dependent Factor	lb-mol/(min/hr) ⁿ ft-yr	0.3	0.3
n	Wind Dependent Exponent		2.1	1.6
V	Wind Speed	Mph	10.513599	10.5136
D	Tank Diameter	Ft		
K_r	Rim Seal Loss Factor	lb-mole/ft-yr	47.76	14.54

For each tank, the total rim seal loss factor (F_r) is calculated. It is the product of the rim seal loss factor and the tank diameter, as shown above.

<i>Tank</i>	<i>Roof</i>	<i>Rim Seals</i>	<i>K_r</i>	<i>D</i>	<i>F_r</i>
201	Floating	Secondary	14.54	262	3,816
202	Floating	Primary	47.76	262	12,535
203	Floating	Secondary	14.54	262	3,816
204	Floating	Secondary	14.54	262	3,816
205	Floating	Secondary	14.54	262	3,816
206	Floating	Secondary	14.54	262	3,816
207	Floating	Secondary	14.54	262	3,816
208	Floating	Secondary	14.54	262	3,816
209	Floating	Secondary	14.54	262	3,816
210	Floating	Primary	47.76	262	12,535
211	Floating	Secondary	14.54	262	3,816
212	Floating	Secondary	14.54	262	3,816
401	Floating	Secondary	14.54	253	3,673
402	Floating	Secondary	14.54	253	3,673
403	Fixed	n/a	0.00	21	0
405	Fixed	n/a	0.00	121	0
406	Fixed	n/a	0.00	121	0
407	Fixed	n/a	0.00	82	0



II - DECK FITTING LOSS FACTOR $F_f = [(N_{fi} \cdot K_{fi}) + (N_{f2} \cdot K_{f2}) + \dots + (N_{fk} \cdot K_{fk})]$ $K_f = K_{fa} + K_{fb}(K_v V)^m$

<i>Deck Fitting</i>	<i>Factor @</i>	<i>Wind</i>	<i>Wind</i>	<i>Wind</i>		<i>Loss</i>
	<i>No Wind</i>	<i>Factor</i>	<i>Correction</i>	<i>Exponent</i>		<i>Factor</i>
	K_{fa}	K_{fb}	K_v	m		K_{fi}
Deck Legs	0.82	0.53	0.7	0.14		1.520866
Access Hatches	1.6	0	0.7	0		1.6
Gauge Floats	2.8	0	0.7	0		2.8
Sample Hatch	<i>Loss Factor included in Guide Pole Loss Factor</i>					
Vacuum Breakers	6.2	1.2	0.7	0.94		14.03465
Rim Vents	0.71	0.1	0.7	1		1.445952
Guide Poles	43	270	0.7	1.4		4458.227
Deck Drain Plugs	1.8	0.14	0.7	1.1		3.057947

Tank No	Deck Legs	Acc Hatch	Gge Flts	Vac Break	Rim Vents	Gde Poles	Drn Plugs
201	190	2	1	5	4	1	4
202	190	2	1	5	4	1	4
203	190	2	1	5	4	1	4
204	190	2	1	5	4	1	4
205	190	2	1	5	4	1	4
206	190	2	1	5	4	1	4
207	190	2	1	5	4	1	4
208	190	2	1	5	4	1	4
209	190	2	1	5	4	1	4
210	190	2	1	5	4	1	4
211	190	2	1	5	4	1	4
212	190	2	1	5	4	1	4
401	176	2	1	5	4	1	4
402	176	2	1	5	4	1	4
403	0	0	0	0	0	0	0
405	0	0	0	0	0	0	0
406	0	0	0	0	0	0	0
407	0	0	0	0	0	0	0

The deck fitting loss factor (F_f) for each tank is calculated, using the equation above. F_f depends on the number and type of fittings present on each tank. The losses associated with each fitting are then summed to give the total deck fitting loss factor. The deck fitting loss factors for each of the tanks at CPBBT are shown overleaf.



Tank		Total Loss Factor							
	Roof	Deck Legs	Acc Hatch	Gge Flts	Vac Break	Rim Vents	Gde Poles	Drn Plugs	Ff
201	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
202	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
203	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
204	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
205	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
206	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
207	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
208	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
209	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
210	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
211	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
212	Floating	288.964479	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,841
401	Floating	267.67236	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,820
402	Floating	267.67236	3.2	2.8	70.1732622	5.7838078	4458.227	12.231789	4,820
403	Fixed	0	0	0	0	0	0	0	0
405	Fixed	0	0	0	0	0	0	0	0
406	Fixed	0	0	0	0	0	0	0	0
407	Fixed	0	0	0	0	0	0	0	0

III – DECK SEAM LOSS FACTOR

$$F_d = K_d S_d D^2$$

F_d Zero for Welded Decks

Tank	Fd
201	0
202	0
203	0
204	0
205	0
206	0
207	0
208	0
209	0
210	0
211	0
212	0
401	0
402	0
403	0
405	0
406	0
407	0

Similarly, the deck seam loss factor (F_d) can be calculated for each tank, but this value is equal to zero for welded tanks and hence is zero for each of the tanks at CPBBT.



IV - VAPOUR PRESSURE FUNCTION $P^* = (P/P_a) / \{1 + [1 - (P/P_a)]^{0.5}\}^2$
 $P = \exp[A - (B / (T_s + 459.6))]$
 $T_s = T_a + 3$
 $CrudeA = 12.82 - 0.9672 * \ln(RVP)$
 $B = 7261 - 1216 * \ln(RVP)$
Other
 $sA = 15.64 - 1.854.S^{0.5} - (0.8742 - 0.3280.S^{0.5}).\ln(RVP)$
 $B = 8742 - 1042.S^{0.5} - (1049 - 179.4.S^{0.5}).\ln(RVP)$
 $S = (T_{15} - T_5)/10$

A vapour pressure function, P* is calculated for each of the products, based on their properties and the temperature of the stock, as shown in the equations above.

			Crude	Gas Oil	Kerosene	Jet	Gasoline
R V P	Reid Vapour Pressure	psi	6.53				10
S	ASTM-D86 Distillation Slope	°F/vol%					3
A	Vapour Pressure Eq'n Constant		11.005	19.85	15.64	14.83	11.724
B	Vapour Pressure Eq'n Constant	°R	4979.28	18022	10830	9232	5237.273
T _s	Stock Temperature	°F	59.3	59.3	59.3	59.3	59.3
P	True Vapour Pressure	psi	4.093	3.445 x 10 ⁻⁷	0.005348	0.0517	5.109
P *	Vapour Pressure Function		0.0811	5.842 x 10 ⁻⁹	9.07 x 10 ⁻⁵	8 x 10 ⁻⁴	0.106

The vapour pressure functions for the products in each of the tanks are shown in the table overleaf.



<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>	<i>P*</i>
201	Gasoline					0.105956	0.10596
202	Crude	0.08112					0.08112
203	Crude	0.08112					0.08112
204	Jet				0.000879		0.00088
205	None						0
206	Jet				0.000879		0.00088
207	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
208	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
209	Jet				0.000879		0.00088
210	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
211	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
212	Jet				0.000879		0.00088
401	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
402	Jet				0.000879		0.00088
403	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
405	None						0
406	Gas Oil		5.84×10^{-9}				5.8×10^{-9}
407	Gas Oil		5.84×10^{-9}				5.8×10^{-9}



V – Vapour Molecular Weight

			<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>
M_v	Molecular Weight	lb/lb-mol	50	254	156	128	64

The molecular weights of the products in each of the tanks is shown in the table below.

<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>	M_v
201	Gasoline					64	64
202	Crude	50					50
203	Crude	50					50
204	Jet				128		128
205	None						0
206	Jet				128		128
207	Gas Oil		254				254
208	Gas Oil		254				254
209	Jet				128		128
210	Gas Oil		254				254
211	Gas Oil		254				254
212	Jet				128		128
401	Gas Oil		254				254
402	Jet				128		128
403	Gas Oil		254				254
405	None						0
406	Gas Oil		254				254
407	Gas Oil		254				254

VI - PRODUCT FACTOR

			<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>
K_c	Product Factor		0.4	1	1	1	1

A product factor, K_c , for each of the products is shown above. The figures are taken directly from the API methodology. The product factors for the products in each of the tanks are shown in the table overleaf.



<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>	<i>None</i>	<i>Kc</i>
201	Gasoline					1		1
202	Crude	0.4						0.4
203	Crude	0.4						0.4
204	Jet				1			1
205	None						0	0
206	Jet				1			1
207	Gas Oil		1					1
208	Gas Oil		1					1
209	Jet				1			1
210	Gas Oil		1					1
211	Gas Oil		1					1
212	Jet				1			1
401	Gas Oil		1					1
402	Jet				1			1
403	Gas Oil		1					1
405	None						0	0
406	Gas Oil		1					1
407	Gas Oil		1					1



TOTAL STANDING LOSSES FROM FLOATING ROOF TANKS

$$L_s = [F_r + F_f + F_d] \cdot P^* \cdot M_v \cdot K_c$$

F_r	Total Rim Seal Loss Factor	lb/mol/yr
F_f	Total Deck Fittings Loss Factor	lb/mol/yr
F_d	Total Deck Seam Loss Factor	lb/mol/yr
P^*	Vapour Pressure Function	
M_v	Molecular Weight of Stock	lb/mol/yr
K_c	Product Factor	

The standing loss from the each of the floating roof tanks is calculated using the product factor, molecular weight and loss factors calculated earlier, as shown in the equation above. The total standing loss is the sum of the losses from the individual tanks.

<i>Tank</i>	<i>Fr</i>	<i>Ff</i>	<i>Fd</i>	<i>P*</i>	<i>Mv</i>	<i>Kc</i>	<i>Ls (lb pa)</i>	<i>Ls (kg pa)</i>	<i>Ls (per month)</i>
201	3,816	4,841	0	0.105956476	64	1	58,710	26,631	2,219
202	12,535	4,841	0	0.081120151	50	0.4	28,192	12,788	1,066
203	3,816	4,841	0	0.081120151	50	0.4	14,046	6,371	531
204	3,816	4,841	0	0.00087891	128	1	974	442	37
205	3,816	4,841	0	0	0	0	0	0	0
206	3,816	4,841	0	0.00087891	128	1	974	442	37
207	3,816	4,841	0	5.84157E-09	254	1	0	0	0
208	3,816	4,841	0	5.84157E-09	254	1	0	0	0
209	3,816	4,841	0	0.00087891	128	1	974	442	37
210	12,535	4,841	0	5.84157E-09	254	1	0	0	0
211	3,816	4,841	0	5.84157E-09	254	1	0	0	0
212	3,816	4,841	0	0.00087891	128	1	974	442	37
401	3,673	4,820	0	5.84157E-09	254	1	0	0	0
402	3,673	4,820	0	0.00087891	128	1	956	433	36
403	0	0	0	5.84157E-09	254	1	0	0	0
405	0	0	0	0	0	0	0	0	0
406	0	0	0	5.84157E-09	254	1	0	0	0
407	0	0	0	5.84157E-09	254	1	0	0	0
								48,433	4,036

Total Standing Storage Losses

L_s 4,036 kg/month



WITHDRAWAL LOSSES FROM FLOATING ROOF TANKS

$$L_w = [0.943.Q.C.W_L/d]*[1+(N_{FC}.F_C)/D]$$

In this section, the withdrawal losses from the floating roof tanks are calculated. These depend on the amount of product withdrawn and a clingage factor, which is dependant on the product stored and on the condition of the tank itself. Clingage factors associated with each of the products and with various shell conditions are set out below.

Q	Net Withdrawal per Tank	bbls/month
C	Clingage Factor	bbls/1000sqf
W _L	Average Liquid Stock Density	lbs/gal
D	Tank Diameter	feet
N _{FC}	No of Fixed Roof Support Columns	n/a
F _C	Effective column diameter	n/a

CLINGAGE						
	<i>Shell Condition</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>
	Light Rust	0.006	0.0015	0.0015	0.0015	0.0015
	Dense Rust	0.03	0.0075	0.0075	0.0075	0.0075
	Guniting Lining	0.6	0.15	0.15	0.15	0.15
W _L		6.99018957	6.9568235	6.62316291	6.5731138	6.089306

The clingage factors for the products in each of the tanks are shown in the table below.

<i>Tank</i>	<i>Product</i>	<i>Shell Cond</i>	<i>Roof</i>	<i>Crude Oil</i>	<i>Other</i>	<i>None</i>	<i>Crude</i>	<i>Others</i>	<i>Clingage</i>
201	Gasoline	Light Rust	Floating		1			0.0015	0.0015
202	Crude	Light Rust	Floating	1			0.006		0.006
203	Crude	Light Rust	Floating	1			0.006		0.006
204	Jet	Light Rust	Floating		1			0.0015	0.0015
205	None	Light Rust	Floating			1			0
206	Jet	Light Rust	Floating		1			0.0015	0.0015
207	Gas Oil	Light Rust	Floating		1			0.0015	0.0015
208	Gas Oil	Light Rust	Floating		1			0.0015	0.0015
209	Jet	Light Rust	Floating		1			0.0015	0.0015
210	Gas Oil	Light Rust	Floating		1			0.0015	0.0015
211	Gas Oil	Light Rust	Floating		1			0.0015	0.0015
212	Jet	Light Rust	Floating		1			0.0015	0.0015
401	Gas Oil	Light Rust	Floating		1			0.0015	0.0015
402	Jet	Light Rust	Floating		1			0.0015	0.0015
403	Gas Oil	Light Rust	Fixed		1			0.0015	0
405	None	Light Rust	Fixed			1			0
406	Gas Oil	Light Rust	Fixed		1			0.0015	0
407	Gas Oil	Light Rust	Fixed		1			0.0015	0

The average liquid stock density of the products in each of the tanks is shown in the table overleaf.



<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>	<i>Density</i>
201	Gasoline					6.08931	6.08931
202	Crude	6.99018957					6.99019
203	Crude	6.99018957					6.99019
204	Jet				6.57311		6.57311
205	None						0
206	Jet				6.57311		6.57311
207	Gas Oil		6.95682		6.57311		6.57311
208	Gas Oil		6.95682				6.95682
209	Jet				6.57311		6.57311
210	Gas Oil		6.95682				6.95682
211	Gas Oil		6.95682				6.95682
212	Jet				6.57311		6.57311
401	Gas Oil		6.95682				6.95682
402	Jet				6.57311		6.57311
403	Gas Oil		6.95682				6.95682
405	None						0
406	Gas Oil		6.95682				6.95682
407	Gas Oil		6.95682				6.95682

The loss from each floating roof tank is calculated, based on the amount withdrawn, the product stored in the tank and on the condition of the tank shell. The individual losses are summed to give the overall withdrawal loss.

<i>Tank</i>	<i>Q</i>	<i>Product</i>	<i>C</i>	<i>WL</i>	<i>D</i>	<i>Lw (lb)</i>	<i>Lw (kg)</i>
201	0	Gasoline	0.0015	6.08931	262	0	0.0
202	365,355	Crude	0.006	6.99019	262	55	25.0
203	613,219	Crude	0.006	6.99019	262	92	41.9
204	0	Jet	0.0015	6.57311	262	0	0.0
205	0	None	0	0	262	0	0.0
206	557,420	Jet	0.0015	6.57311	262	20	9.0
207	235,428	Gas Oil	0.0015	6.95682	262	9	4.0
208	0	Gas Oil	0.0015	6.95682	262	0	0.0
209	0	Jet	0.0015	6.57311	262	0	0.0
210	0	Gas Oil	0.0015	6.95682	262	0	0.0
211	0	Gas Oil	0.0015	6.95682	262	0	0.0
212	0	Jet	0.0015	6.57311	262	0	0.0
401	0	Gas Oil	0.0015	6.95682	253	0	0.0
402	0	Jet	0.0015	6.57311	253	0	0.0
403	0	Gas Oil	0	6.95682	21	0	0.0
405	0	None	0	0	121	0	0.0
406	0	Gas Oil	0	6.95682	121	0	0.0
407	0	Gas Oil	0	6.95682	82	0	0.0

Total Withdrawal Losses

L_w 79.9kg/month

Total losses from Floating Roof Tanks

$L_s + L_w$ 4,079 kg/month



LOSSES FROM FIXED ROOF TANKS

I – LOSSES ARISING FROM DELIVERIES

Temperature 13.5 C

<i>Tank</i>	<i>Product</i>	<i>Fixed Roof</i>	<i>Deliveries per month</i>	<i>Displaced Air(m³)</i>
201	Gasoline	0	0	0
202	Crude	0	0	0
203	Crude	0	365,355	0
204	Jet	0	0	0
205	None	0	0	0
206	Jet	0	565,579	0
207	Gas Oil	0	379,512	0
208	Gas Oil	0	0	0
209	Jet	0	0	0
210	Gas Oil	0	0	0
211	Gas Oil	0	223,949	0
212	Jet	0	573,360	0
401	Gas Oil	0	0	0
402	Jet	0	0	0
403	Gas Oil	1	0	0
405	None	1	0	0
406	Gas Oil	1	0	0
407	Gas Oil	1	0	0

In order to calculate the losses arising from deliveries to fixed roof tanks, the vapour pressure of the product in each tank is calculated. This is then divided by the atmospheric pressure. The loss is calculated using the following equation.

$$\text{Fixed Roof Loss} = A_D \times \left(\frac{P_{vap}}{P_a} \right) \times \left(\frac{M_v}{22.4136} \right) \times \left(\frac{273}{273 + T_{ambient}} \right)$$



<i>Tank</i>	<i>Product</i>	<i>Vapour Pressures</i>			<i>Jet</i>	<i>Gasoline</i>	<i>Pvap</i>	<i>Pvap/Pa</i>
		<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>				
201	Gasoline					5.10875		5.10875
202	Crude	4.093						4.09302
203	Crude	4.093						4.09302
204	Jet				0.05174			0.05174
205	None						0	0
206	Jet				0.05174			0.05174
207	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
208	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
209	Jet				0.05174			0.05174
210	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
211	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
212	Jet				0.05174			0.05174
401	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
402	Jet				0.05174			0.05174
403	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
405	None						0	0
406	Gas Oil		3.445×10^{-7}					3.445×10^{-7}
407	Gas Oil		3.445×10^{-7}					3.445×10^{-7}

<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Kerosene</i>	<i>Jet</i>	<i>Gasoline</i>	<i>M_v</i>	<i>Loss (kg)</i>
201	Gasoline					64	64	0
202	Crude	50					50	0
203	Crude	50					50	0
204	Jet				128		128	0
205	None						0	0
206	Jet				128		128	0
207	Gas Oil		254				254	0
208	Gas Oil		254				254	0
209	Jet				128		128	0
210	Gas Oil		254				254	0
211	Gas Oil		254				254	0
212	Jet				128		128	0
401	Gas Oil		254				254	0
402	Jet				128		128	0
403	Gas Oil		254				254	0
405	None						0	0
406	Gas Oil		254				254	0
407	Gas Oil		254				254	0
Total Delivery Loss			0 kg/yr					

Note: There were no delivery losses from the fixed roof tanks as there were no deliveries made to any of the fixed roof storage tanks during the period.



II – STANDING STORAGE LOSSES FROM FIXED ROOF TANKS

T min	10.3
T max	16.6
T ave	13.5
% Temperature Change	2.2%
% Volume Displaced	2.2%

Standing storage losses from fixed roof tanks arise due to diurnal variations in the ambient temperature. These temperature changes cause the vapours in the tank to expand resulting in a fugitive emission to atmosphere. The volume change is proportional to the diurnal temperature change. For each of the fixed roof tanks, the volume of the vapour space (the total tank capacity less the volume of product in the tank) is multiplied by the percentage volume change to calculate the expanded volume of air. The excess volume is displaced to atmosphere. The loss of product is then calculated by assuming that the volume of displaced air is saturated with product at its vapour pressure.

<i>Tank</i>	<i>Fixed</i>	<i>Product</i>	<i>Av.</i>	<i>Displaced</i>	<i>Displaced</i>			<i>Loss</i>
	<i>Roof</i>	<i>in Tank</i>	<i>Space</i>	<i>Air</i>	<i>Air</i>			<i>(kg)</i>
			<i>m3</i>	<i>m3/day</i>	<i>m3</i>			
201	0	1	0	0	0			0
202	0	1	0	0	0			0
203	0	1	0	0	0			0
204	0	1	0	0	0			0
205	0	0	0	0	0			0
206	0	1	0	0	0			0
207	0	1	0	0	0			0
208	0	1	0	0	0			0
209	0	1	0	0	0			0
210	0	1	0	0	0			0
211	0	1	0	0	0			0
212	0	1	0	0	0			0
401	0	1	0	0	0			0
402	0	1	0	0	0			0
403	1	1	62	1	42			1.1 x 10 ⁻⁵
405	1	0	0	0	0			0
406	1	1	48	1	32			8.2 x 10 ⁻⁶
407	1	1	3,526	78	2,385			0.0006
						Total		0.00062

Total Losses from Diurnal Variations 0.00062 kg/month

III - LOSSES ARISING FROM SOLAR GAIN

Negligible



SUMMARY OF PRODUCT LOSSES

June

<i>Tank</i>	<i>Volume (bbl)</i>	<i>Product</i>	<i>Roof</i>	<i>Rim Seals</i>	<i>Quantity bbl</i>	<i>Material in bbl</i>	<i>Material out bbl</i>
201	580,000	Gasoline	Floating	Secondary	538,997	0	0
202	580,000	Crude	Floating	Primary	365,092	0	365,355
203	580,000	Crude	Floating	Secondary	497,189	365,355	613,219
204	580,000	Jet	Floating	Secondary	577,918	0	0
205	580,000	None	Floating	Secondary	0	0	0
206	580,000	Jet	Floating	Secondary	493,342	565,579	557,420
207	580,000	Gas Oil	Floating	Secondary	493,342	379,512	235,428
208	580,000	Gas Oil	Floating	Secondary	576,778	0	0
209	580,000	Jet	Floating	Secondary	573,384	0	0
210	580,000	Gas Oil	Floating	Primary	564,357	0	0
211	580,000	Gas Oil	Floating	Secondary	393,919	223,949	0
212	580,000	Jet	Floating	Secondary	0	573,360	0
401	542,000	Gas Oil	Floating	Secondary	526,359	0	0
402	542,000	Jet	Floating	Secondary	503,330	0	0
403	1,515	Gas Oil	Fixed	n/a	739	0	0
405	97,500	None	Fixed	n/a	0	0	0
406	97,500	Gas Oil	Fixed	n/a	96,897	0	0
407	48,000	Gas Oil	Fixed	n/a	3,648	0	0

LOSSES FROM EACH STORAGE TANK

<i>Tank</i>	<i>Floating Roof Tanks</i>			<i>Fixed Roof Tanks</i>			<i>Overall Losses</i>	
<i>Loss</i>	<i>Storage</i>	<i>Withdrawal</i>	<i>Total</i>	<i>Delivery</i>	<i>Diurnal</i>	<i>Total</i>	<i>kg</i>	<i>tonnes</i>
201	2,219	0	2219.242	0	0	0	2,219	2.219242
202	1,066	24.97243968	1090.618	0	0	0	1,091	1.090618
203	531	41.91256853	572.8653	0	0	0	573	0.572865
204	37	0	36.81725	0	0	0	37	0.036817
205	0	0	0	0	0	0	0	0
206	37	8.956406912	45.77366	0	0	0	46	0.045774
207	0	4.003586965	4.004073	0	0	0	4	0.004004
208	0	0	0.000486	0	0	0	0	4.86×10^{-7}
209	37	0	36.81725	0	0	0	37	0.036817
210	0	0	0.000975	0	0	0	0	9.75×10^{-7}
211	0	0	0.000486	0	0	0	0	4.86×10^{-7}
212	37	0.00000	36.81725	0	0	0	37	0.036817
401	0	0	0.000476	0	0	0	0	4.76×10^{-7}
402	36	0	36.11811	0	0	0	36	0.036118
403	0	0	0	0	1.053×10^{-5}	1.05×10^{-5}	0	1.05×10^{-8}
405	0	0	0	0	0	0	0	0
406	0	0	0	0	8.187×10^{-6}	8.19×10^{-6}	0	8.19×10^{-9}
407	0	0	0	0	0.00060177	0.000602	0	6.02×10^{-7}



TOTAL FUGITIVE EMISSIONS

Total Losses kg/month	Floating	Fixed	Total
Standing Storage Loss	3,999	0.00062	3,999
Withdrawal Loss	80	0	80
Total	4,079	0.00062	4,079

Breakdown

<i>Storage Losses</i>					
<i>Tank</i>	<i>Product</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Jet</i>	<i>Gasoline</i>
201	Gasoline				2219.2416
202	Crude	1065.64607			
203	Crude	530.9527086			
204	Jet			36.817248	
205	None				
206	Jet			36.817248	
207	Gas Oil		0.00048558		
208	Gas Oil		0.00048558		
209	Jet			36.817248	
210	Gas Oil		0.00097458		
211	Gas Oil		0.00048558		
212	Jet			36.817248	
401	Gas Oil		0.00047636		
402	Jet			36.118108	
403	Gas Oil		1.0529E-05		
405	None				
406	Gas Oil		8.1868E-06		
407	Gas Oil		0.00060177		
Totals	kg	1,596.599	0.00353	183.387	2,219.242
	Tonnes	1.597	3.5282×10^{-6}	0.183	2.219



<i>Delivery Losses</i>				
<i>Tank</i>	<i>Crude</i>	<i>Gas Oil</i>	<i>Jet</i>	<i>Gasoline</i>
201				
202				0
203	24.97144			
204	41.912569			
205			0	
206				
207			8.956407	
208		4.003587		
209		0		
210			0	
211		0		
212		0		
401			0	
402		0		
403			0	
405		0		
406				
407		0		
Totals	66.884008	4.003587	8.956407	0
(tonnes)	0.066884	0.004004	0.008956	0



Annex 3 : Inventories & Product Movements by Month



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for January 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	537,581	0	0
202	580,000	Crude	359,911	0	0
203	580,000	Crude	501,730	0	0
204	580,000	Jet	578,026	0	0
205	580,000	None	0	0	0
206	580,000	Gasoline	583,407	283,225	0
207	580,000	Gas Oil	540,510	0	0
208	580,000	Gas Oil	576,697	0	0
209	580,000	Jet	573,726	0	0
210	580,000	Gas Oil	564,599	0	0
211	580,000	Gasoline	368,850	372,079	0
212	580,000	None	0	0	0
401	542,000	Gas Oil	512,734	0	0
402	542,000	Jet	503,421	0	0
403	1,515	Gas Oil	971	0	0
405	97,500	Gas Oil	29,527	0	0
406	97,500	Gas Oil	80,622	0	0
407	48,000	Gas Oil	3,668	0	0
Totals			6,315,980	655,304	0

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for February 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,506	0	0
202	580,000	Crude	359,710	0	0
203	580,000	Crude	503,089	0	0
204	580,000	Jet	577,756	0	0
205	580,000	None	0	0	0
206	580,000	Gasoline	493,003	164,663	251,376
207	580,000	Gas Oil	541,091	0	0
208	580,000	Gas Oil	576,684	0	0
209	580,000	Jet	573,545	0	0
210	580,000	Gas Oil	564,332	0	0
211	580,000	Gasoline	528,006	231,694	72,508
212	580,000	Gasoline	499,046	489,818	0
401	542,000	Gas Oil	512,414	0	0
402	542,000	Jet	503,333	0	0
403	1,515	Gas Oil	867	0	0
405	97,500	Gas Oil	29,540	0	0
406	97,500	Gas Oil	80,593	0	0
407	48,000	Gas Oil	3,650	0	0
Totals			6,885,162	886,176	323,884



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for March 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,997	0	0
202	580,000	Crude	358,602	0	0
203	580,000	Crude	497,711	0	0
204	580,000	Jet	578,731	0	0
205	580,000	None	0	0	0
206	580,000	Gasoline	493,115	0	0
207	580,000	Gas Oil	541,047	0	0
208	580,000	Gas Oil	576,973	0	0
209	580,000	Jet	573,442	0	0
210	580,000	Gas Oil	563,825	0	0
211	580,000	Gasoline	528,549	0	0
212	580,000	Gasoline	188,564	0	314,849
401	542,000	Gas Oil	526,006	14,067	0
402	542,000	Jet	503,524	0	0
403	1,515	Gas Oil	808	0	0
405	97,500	Gas Oil	0	0	30,336
406	97,500	Gas Oil	96,849	16,269	0
407	48,000	Gas Oil	3,639	0	0
Totals			6,570,382	30,336	345,185

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for April 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,997	0	0
202	580,000	Crude	365,092	0	0
203	580,000	Crude	497,189	0	0
204	580,000	Jet	577,918	0	0
205	580,000	None	0	0	0
206	580,000	Gasoline	493,342	1,245	0
207	580,000	Gas Oil	540,867	0	0
208	580,000	Gas Oil	576,778	0	0
209	580,000	Jet	573,384	0	0
210	580,000	Gas Oil	564,357	0	0
211	580,000	Gasoline	393,919	9,771	140,550
212	580,000	Gasoline	0	0	188,138
401	542,000	Gas Oil	526,359	0	0
402	542,000	Jet	503,330	0	0
403	1,515	Gas Oil	739	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	96,897	0	0
407	48,000	Gas Oil	3,648	0	0
Totals			6,252,817	11,017	328,688



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for May 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	539,093	0	0
202	580,000	Crude	364,457	0	0
203	580,000	Crude	501,914	0	0
204	580,000	Jet	577,073	0	0
205	580,000	None	0	0	0
206	580,000	Gasoline	0	16,681	503,740
207	580,000	Gas Oil	223,949	0	316,918
208	580,000	Gas Oil	575,914	0	0
209	580,000	Jet	573,004	0	0
210	580,000	Gas Oil	563,093	0	0
211	580,000	Gasoline	356,759	302,105	377,238
212	580,000	Gasoline	0	0	0
401	542,000	Gas Oil	525,357	0	0
402	542,000	Jet	502,389	0	0
403	1,515	Gas Oil	652	0	0
405	97,500	Gas Oil	0	0	0
406	97,500	Gas Oil	96,747	0	0
407	48,000	Gas Oil	3,644	0	0
Totals			5,404,043	318,786	1,197,896

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for June 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,997	0	0
202	580,000	Crude	365,092	0	365,355
203	580,000	Crude	497,189	365,355	613,219
204	580,000	Jet	577,918	0	0
205	580,000	None	0	0	0
206	580,000	Jet	493,342	565,579	557,420
207	580,000	Gas Oil	493,342	379,512	235,428
208	580,000	Gas Oil	576,778	0	0
209	580,000	Jet	573,384	0	0
210	580,000	Gas Oil	564,357	0	0
211	580,000	Gas Oil	393,919	223,949	0
212	580,000	Jet	0	573,360	0
401	542,000	Gas Oil	526,359	0	0
402	542,000	Jet	503,330	0	0
403	1,515	Gas Oil	739	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	96,897	0	0
407	48,000	Gas Oil	3,648	0	0
Totals			6,205,291	2,107,755	1,771,422



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for July 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,570	0	0
202	580,000	None	0	0	0
203	580,000	Crude	19,492	0	230,858
204	580,000	Jet	577,703	0	0
205	580,000	None	0	0	0
206	580,000	Jet	341,171	328,763	0
207	580,000	Jet	388,803	0	0
208	580,000	Gas Oil	576,426	0	0
209	580,000	Jet	569,981	0	0
210	580,000	Gas Oil	564,331	0	0
211	580,000	Gas Oil	542,032	0	0
212	580,000	Jet	565,986	0	0
401	542,000	Gas Oil	526,281	0	0
402	542,000	Jet	503,212	0	0
403	1,515	Gas Oil	420	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	96,883	0	0
407	48,000	Gas Oil	3,622	0	0
Totals			5,814,914	328,763	230,858

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for August 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,393	0	0
202	580,000	None	0	0	0
203	580,000	Crude	23,997	0	0
204	580,000	Jet	577,729	0	0
205	580,000	None	0	0	0
206	580,000	Jet	340,718	0	0
207	580,000	Jet	388,601	0	0
208	580,000	Gas Oil	576,553	0	0
209	580,000	Jet	569,121	0	0
210	580,000	Gas Oil	563,905	0	0
211	580,000	Gas Oil	542,072	0	0
212	580,000	Jet	565,952	0	0
401	542,000	Gas Oil	526,442	0	0
402	542,000	Jet	503,624	0	0
403	1,515	Gas Oil	725	403	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	96,869	0	0
407	48,000	Gas Oil	3,213	0	403
Totals			5,817,914	403	403



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for September 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,133	0	0
202	580,000	None	0	0	0
203	580,000	Crude	23,849	0	0
204	580,000	Jet	577,251	0	0
205	580,000	None	0	0	0
206	580,000	Jet	99,390	0	239,373
207	580,000	Jet	388,523	0	0
208	580,000	Gas Oil	536,619	0	38,316
209	580,000	Jet	573,809	0	0
210	580,000	Gas Oil	563,704	0	0
211	580,000	Gas Oil	541,711	0	0
212	580,000	Jet	565,731	0	0
401	542,000	Gas Oil	525,887	0	0
402	542,000	Jet	490,374	0	11,878
403	1,515	Gas Oil	685	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	96,858	0	0
407	48,000	Gas Oil	3,217	0	0
Totals			5,525,740	0	289,566

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for October 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,151	0	0
202	580,000	None	0	0	0
203	580,000	Crude	24,847	0	0
204	580,000	Jet	577,599	0	0
205	580,000	None	0	0	0
206	580,000	Jet	101,303	0	0
207	580,000	Jet	388,813	0	0
208	580,000	Gas Oil	536,817	0	0
209	580,000	Jet	572,357	0	0
210	580,000	Gas Oil	564,140	0	0
211	580,000	Gas Oil	542,030	0	0
212	580,000	Jet	566,190	0	0
401	542,000	Gas Oil	530,875	5,285	0
402	542,000	Jet	490,582	0	0
403	1,515	Gas Oil	635	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	92,360	0	5,285
407	48,000	Gas Oil	3,207	0	0
Totals			5,529,908	5,285	5,285



Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for November 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	537,350	0	0
202	580,000	None	0	0	0
203	580,000	Crude	24,335	0	0
204	580,000	Jet	577,560	0	0
205	580,000	None	0	0	0
206	580,000	Jet	57,352	21,501	68,801
207	580,000	Jet	0	0	379,216
208	580,000	Gas Oil	536,808	0	0
209	580,000	Jet	571,756	0	0
210	580,000	Gas Oil	564,086	0	0
211	580,000	Gas Oil	542,294	0	0
212	580,000	Jet	557,086	0	6,091
401	542,000	Gas Oil	531,320	0	0
402	542,000	Jet	490,547	0	0
403	1,515	Gas Oil	546	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	92,375	0	0
407	48,000	Gas Oil	3,224	0	0
Totals			5,086,639	21,501	454,108

Average Stock Levels (barrels) and Material Throughput (barrels) at CPBBT for December 2009

Tank	Capacity	Product	Quantity Stored	Material in	Material out
201	580,000	Gasoline	538,118	0	0
202	580,000	None	0	0	0
203	580,000	Crude	24,365	0	0
204	580,000	Jet	577,547	0	0
205	580,000	None	0	0	0
206	580,000	Jet	0	0	66,855
207	580,000	None	0	0	0
208	580,000	Gas Oil	536,949	0	0
209	580,000	Jet	571,464	0	0
210	580,000	Gas Oil	564,665	0	0
211	580,000	Gas Oil	542,174	0	0
212	580,000	Jet	0	0	557,584
401	542,000	Gas Oil	531,066	0	0
402	542,000	Jet	490,977	0	0
403	1,515	Gas Oil	433	0	0
405	97,500	None	0	0	0
406	97,500	Gas Oil	92,369	0	0
407	48,000	Gas Oil	3,214	0	0
Totals			4,473,343	0	624,439

Annex 10 : Register of Significant Environmental Effects

PURPOSE

The purpose of this register is to compile a list of the *significant* environmental effects arising from the activities of ConocoPhillips Bantry Bay Terminals Ltd (CPBBT).

RESPONSIBILITY

It is the responsibility of the Environmental Lead to maintain an up-to-date register of the significant environmental effects

APPROVAL

This register and any revisions must be approved by the Terminal Manager.

SCOPE

The following guidance is used within CPBBT to determine if an environmental effect is identified as significant *in the context of the Company's operations*.

An environmental effect is identified as significant if the activity giving rise to the effect:

- causes or has the potential to cause nuisance to the local community, or
- does not comply with limit values or guidance values under existing and proposed Irish or EU environmental legislation. (The corollary of this is that emissions and discharges that are in compliance with existing or proposed legislative limits may be identified as *not significant*), or

Prepared by:

Date: _____

Approved by:

Date: _____

SCOPE Contd:

- has to be reported to a statutory or regulatory body, e.g. Local Authority, HSA, EPA, or
- uses scarce natural resources where more abundant alternatives are readily available, or
- uses natural resources wastefully.
- In addition to the above considerations, each effect is to be subjectively assessed for its potential to cause harm or, conversely, to be beneficial to health and to the local and global environment.

In the context of the guidance given above, an activity may be: an operation, release, incident, product or service.

A table of the environmental effects of CPBBT's activities which are judged to be *significant* is given on the following pages.

ConocoPhillips Bantry Bay Terminals	Register of Significant Environmental Effects	Doc. No: 255-X146 Page No: 4 of 6	Rev. No: 3 Effective Date
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Activity	Operating Conditions	Significant Environmental Effects	Remarks
1. Rim Seal Fire	Emergency	Release of products of combustion to atmosphere. Thermal radiation. May escalate into full tank fire.	Fixed foam systems on the floating roof tanks, designed to deal with rim seal fires.
2. Full Tank Fire	Emergency	Release of products of combustion to atmosphere. Thermal radiation. May escalate into full bund fire (boil over).	Insufficient fire fighting capability to put out a full tank fire, policy would be to protect adjacent tanks, contain fire to incident tank, reduce inventory of fire by pumping out tank and then allow fire to burn itself out.
3. Full Bund Fire	Emergency	Release of products of combustion to atmosphere. Thermal radiation.	Insufficient fire fighting capability to put out a full bund fire, policy would be to protect adjacent tanks, contain fire to incident bund, reduce inventory of fire by pumping out of the bund and then allow the fire to burn itself out. .
4. Fire	Emergency	Potential fire water discharge to surface water	Capacity of bunds is sufficient to contain water generated in any of the fire scenarios identified in the Firewater Retention Study.
5. Explosion on board crude oil tanker	Emergency	Confined Vapour Cloud Explosion on board tanker.	All tankers operating at the Terminal must pass a strict vetting procedure imposed by CPBBT and cleared by the Harbour Master.
6. Overfilling of Tank	Emergency	Release of material classed as toxic to aquatic environment to bund, risk to groundwater and surface water. Risk of pool fire.	Saab radar level control system. Operator on tank roof for top off. Level alarms. Bunds generally of very low permeability and the one area of high permeability has been replaced with low permeability clay.
7. Leak from pipeline (at sea)	Emergency	Release of material classed as toxic to aquatic environment to surface water.	Effect dependent on scale of incident. May need to involve Local Authority or EPA.

ConocoPhillips Bantry Bay Terminals	Register of Significant Environmental Effects	Doc. No: 255-X146 Page No: 5 of 6	Rev. No: 3 Effective Date
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Activity	Operating Conditions	Significant Environmental Effects	Remarks
8. Leak from pipeline (at terminal)	Emergency	Release of material classed as toxic to aquatic environment to bund, risk to groundwater and surface water. Risk of pool fire.	Effect dependent on scale of incident. May need to involve Local Authority or EPA. Bunds generally of very low permeability. The majority of pipelines at the Terminal are above ground meaning that any leaks are likely to be identified almost immediately.
9. Leak from tank	Emergency	Release of material classed as toxic to aquatic environment to groundwater, risk to surface water. Risk of pool fire.	Bund capacity sufficient to hold 110% of tank contents. Bunds generally of very low permeability. A tight inventory control system is operated ensuring that a leak would be identified very quickly. A water bottom procedure would be used in the event of a leak to prevent groundwater contamination.
10. Holing of tanker due to collision/grounding	Emergency	Release of material classed as toxic to aquatic environment to surface water.	Oil Spill Contingency Plan in place.
11. Accidental valve opening	Emergency	Release of material classed as toxic to aquatic environment to bund, risk to groundwater and surface water. Risk of pool fire.	Bund capacity sufficient to hold 110% of tank contents. Bunds generally of very low permeability. There are a full set of procedures in place at the Terminal for all transfer operations etc. Full risk assessments have been carried out.
12. Catastrophic tank failure	Emergency	Release of material classed as toxic to aquatic environment to groundwater, risk to surface water. Risk of pool fire.	Bund capacity sufficient to hold 110% of tank contents, however the rapid release of material associated with catastrophic tank failure could give rise to some material overtopping the bund wall. Bunds generally of very low permeability. There are a full set of procedures in place at the Terminal for all transfer operations etc. Full risk assessments have been carried out.

ConocoPhillips Bantry Bay Terminals	Register of Significant Environmental Effects	Doc. No: 255-X146 Page No: 6 of 6	Rev. No: 3 Effective Date
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Activity	Operating Conditions	Significant Environmental Effects	Remarks
13. High petroleum concentration in effluent discharge	Abnormal	Potential discharge of contaminated effluent to surface water	Breach of IPC Licence conditions. EPA would need to be informed immediately.
14. Storage of petroleum products in Floating Roof Tanks and Fixed Roof Tanks	Normal	Release of volatile organic compounds to atmosphere through fugitive emissions.	Double rim seals have been installed on many tanks. This represents the Best Available Technique for limitation of fugitive emissions. It is planned, in time, to install these seals on all tanks at the Terminal.
15. Loading/Unloading of products at the Small Craft Harbour	Normal	Waste water to separators. Unloading results in emissions to atmosphere due to clingage of product to walls as floating roof is lowered. Loading results in fugitive emissions to atmosphere from fixed roof tanks due to displacement of vapour.	
16. Loading/Unloading of products at the Single Point Mooring	Normal	Waste water to separators. Unloading results in emissions to atmosphere due to clingage of product to walls as floating roof is lowered. Loading results in fugitive emissions to atmosphere from fixed roof tanks due to displacement of vapour.	
17. Treatment of stormwater run-off at effluent treatment plant	Normal	Licensed emission	Occasional breaches of Emission Limit Values in Licence for pH and Suspended Solids. These are being investigated.
18. End use of products stored at CPBBT	Normal	Combustion of fuels. Emission of products of combustion to atmosphere.	Off site environmental impacts.

**Annex 11 : Summary of Environmental Monitoring Results in
Bantry Bay 2009**



Client: ConocoPhillips Bantry Bay Terminal Ltd

Summary of Environmental Monitoring Results in Bantry Bay 2009

Certified Final

**Document No.
255-X152 Rev 0**

March 2010

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TABLE OF CONTENTS

1	INTRODUCTION	1
2	RESULTS OF ENVIRONMENTAL MONITORING PROGRAMME 2009	2
2.1	GRAB SAMPLING OF WATER COLUMN	2
2.1.1	<i>Introduction</i>	<i>2</i>
2.1.2	<i>Methodology</i>	<i>2</i>
2.1.3	<i>Results</i>	<i>2</i>
2.1.4	<i>Comment</i>	<i>3</i>
2.2	CHEMICAL ANALYSIS OF MUSSEL SAMPLES	4
2.2.1	<i>Introduction</i>	<i>4</i>
2.2.2	<i>Methodology</i>	<i>4</i>
2.2.3	<i>Results</i>	<i>5</i>
2.2.4	<i>Comment</i>	<i>9</i>
2.3	TASTE TESTING OF MUSSEL SAMPLES	12
2.4	SEED MUSSEL DISTRIBUTION SURVEY	12
2.4.1	<i>Introduction</i>	<i>12</i>
2.4.2	<i>Methodology</i>	<i>12</i>
2.4.3	<i>Results</i>	<i>13</i>
2.5	CHEMICAL ANALYSIS OF SEDIMENT SAMPLES	14
2.5.1	<i>Introduction</i>	<i>14</i>
2.5.2	<i>Methodology</i>	<i>14</i>
2.5.3	<i>Results</i>	<i>14</i>
2.5.4	<i>Comment</i>	<i>19</i>
2.6	STORMWATER MONITORING	20
2.6.1	<i>Introduction</i>	<i>20</i>
2.6.2	<i>Methodology</i>	<i>20</i>
2.6.3	<i>Results</i>	<i>20</i>
2.6.4	<i>Comment</i>	<i>21</i>
2.7	GROUNDWATER MONITORING	22
2.7.1	<i>Introduction</i>	<i>22</i>
2.7.2	<i>Methodology</i>	<i>22</i>
2.7.3	<i>Results</i>	<i>23</i>
2.7.4	<i>Comment</i>	<i>27</i>
3	COMPARISON WITH RESULTS OF PREVIOUS SURVEYS	29
3.1	INTRODUCTION	29
3.2	GRAB SAMPLING OF WATER COLUMN	29
3.3	CHEMICAL ANALYSIS OF MUSSEL SAMPLES	30
3.4	TASTE TESTING OF MUSSEL SAMPLES	37
3.5	SEED MUSSEL DISTRIBUTION SURVEY	37
3.6	CHEMICAL ANALYSIS OF SEDIMENT	40
3.7	EFFLUENT MONITORING	48
3.8	GROUNDWATER MONITORING	51

APPENDIX 1 - MAPS SHOWING LOCATION OF MONITORING POINTS



1 Introduction

Bantry Terminals Ltd (BTL), now ConocoPhillips Bantry Bay Terminal Ltd, (CPBBT) constructed a Single Point Mooring (SPM) at its Whiddy Island Oil Terminal (“the Terminal”) as a means of importing and exporting crude oil and other petroleum products. The SPM was commissioned in April 1998.

As part of the re-commissioning process for the Terminal during the mid-1990s, BTL applied for, and received, a series of permissions and licences from the regulatory authorities. Under the terms of these licences, CPBBT were required to conduct an Environmental Monitoring Programme (EMP). The aim of the EMP was to establish background levels of various parameters in Bantry Bay prior to re-commissioning and to continue monitoring those parameters after re-commissioning. The EMP was set up in 1996 and has been ongoing since then. It is administered by an Environmental Monitoring Group (EMG) which consists of representatives from CPBBT, Bantry Bay Fishfarming Co-operative Society, the Environmental Protection Agency, Cork Co. Council, Bord Iascaigh Mhara and the Marine Institute.

Section 2 of the report contains the results of the 2009 monitoring programme. Section 3 compares the 2009 results with those from previous years and comments on the significance of any changes.

Maps of Bantry Bay and Whiddy Island showing the locations of the monitoring points under the various elements of the monitoring programme are included in Appendix 1.



2 Results of Environmental Monitoring Programme 2009

2.1 Grab Sampling of Water Column

2.1.1 Introduction

The analysis of grab samples of water gives a snap-shot of the level of pollutants in the water column. CPBBT have contracted Enterprise Ireland to collect and analyse the water column in Bantry Bay on a quarterly basis. Samples were collected in March, June, October and December 2009. This is in line with the sampling methodology from previous years.

2.1.2 Methodology

Grab samples of water were collected at depths of 3 m from seven locations in Bantry Bay and from one location in Kenmare Bay, as shown in Table 2.1. The water depths at the sampling locations ranged from 5 to 30 m. These samples were then tested for four parameters.

Table 2.1: Location of Water Column Sampling Sites

Site No.	Sampling Site
1	Bantry Pier
2	Lousy Castle Island
3	Whiddy Point West
4	CPBBT Jetty West
5	CPBBT Jetty East
6	Four Heads Point
7	Whiddy Point East
8	Control Site (Kenmare Bay)

2.1.3 Results

The results of the analysis of grab samples of water column from Bantry Bay are summarised in Table 2.2. The results for the control site at Kenmare Bay are given in Table 2.3.

Table 2.2: 2009 Results of Chemical Analysis of Water Column - Bantry Bay

Parameter	Units	No. of Tests	No. of Detections	Min	Max	Mean
Salinity	%	28	28	34	35	34.5
Suspended Solids	mg/l	8	2	< 1	3	< 1.57
Total Petroleum Hydrocarbons	mg/l	28	0	< 0.002	< 0.002	< 0.002
Tributyl Tin	µg/l	20	0	< 1.83	< 19.97	< 5.21



Table 2.3: 2009 Results of Chemical Analysis of Water Column - Control Site (Kenmare Bay)

Parameter	Units	No. of Tests	No. of Detections	Min	Max	Mean
Salinity	%	4	4	34	35	34.75
Suspended Solids	mg/l	4	2	< 1	3	< 2.67
Total Petroleum Hydrocarbons	mg/l	4	0	< 0.002	< 0.002	< 0.002
Tributyl Tin	mg/l	4	4	< 1.44	< 4.19	< 2.69

The purpose of the grab sampling of water column is to monitor the impact of CPBBT's activities on water quality in the Bay. The levels of total petroleum hydrocarbons (TPH) in the water column across all test sites were below the laboratory detection limits for 2009. Previously, samples were tested for total hydrocarbons (i.e. including those not of petroleum origin) and the TPH analysis was carried out only in those samples where there were detections of total hydrocarbons. However, since 2003 the analysis has been carried out for TPH on all samples.

2.1.4 Comment

The results show that the water quality is very similar between Bantry Bay and Kenmare Bay. This indicates that CPBBT's activities have little or no impact on the water quality in the Bay. However, grab sampling of water is of limited use in determining the environmental quality of a bay as it only gives a once off snap-shot of water quality at a particular point and at a particular instant in time. The chemical analysis of mussels and sediments described in § 2.2 and § 2.5 can be a better indicator as they can accumulate water-borne pollutants over a period of time.

It should also be noted that when analysing samples from bodies of uncontaminated water, the concentrations of interest can often be lower than the laboratory detection limits. In addition, if any contamination occurs when collecting or analysing the sample, as has happened in the past, this would dominate the measured values.



2.2 Chemical Analysis of Mussel Samples

2.2.1 Introduction

Mussels are filter feeders, meaning that higher concentrations of pollutants are generally found in mussel flesh than in the surrounding water. Analysis of adult mussels gives a reliable indication of the presence of pollution in the water and can be used as a method of analysing trends in water quality, even at concentrations where the pollution cannot be directly measured in water.

Two sets of mussel samples are collected each year for chemical analysis. The first set of samples is collected during the annual mussel and sediment monitoring round, which has taken place every year since 1996. These samples are collected from commercial mussel lines at ten locations in Bantry Bay. A second smaller set of mussels has been taken from the Dolphin No. 1 jetty on Whiddy Island each year since 2001.

The chemical analysis of both sets of mussels was conducted by the National Laboratory Service, Llanelli, Wales.

2.2.2 Methodology

When the EMP commenced in 1996, an agreement was reached with the Bantry Bay Fishfarming Co-Operative Society allowing mussels to be collected from commercial mussel lines in Bantry Bay. The locations of these sample sites are shown in Table 2.4. The mussels are tested on an annual basis for polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons, Organotins and heavy metals. The results of the 2009 analysis are given in § 2.2.3.

In 2009, due to an accreditation problem with the laboratory used for the mussel and sediment testing, it is currently not possible to report the PAH test results for the commercial mussel and jetty mussel tests. These results are expected mid-2010 and will be reported directly to the EPA when the results are available. These results will also be included in the 2010 AER.

The mussels at each site are examined during the sampling to ensure their suitability for testing. Mussels must be from 40 mm to 60 mm in length. It is not always possible to collect samples of these sizes from each of the sites as they are regularly cultivated and restocked by the mussel farmers. Adverse weather can also prevent sampling at some sites. In these cases, additional samples are taken from other sites in order to make up the required number of samples. A map of Bantry Bay showing the locations of the sampling sites is contained in Appendix 1.



Table 2.4: Location of Mussel Sampling Sites

Site No.	Location
1	Lousy Castle Island
2	League Point
3	Four Heads Point*
4	Glengarriff
5	Snave
6	Whiddy Point East
7	North Chapel East
8	South Chapel
9	North Chapel West
10	Dannemark

* Due to no mussels being available for collection at Four Heads Point, additional samples were taken at Glengarriff during the 2009 sample collection.

2.2.3 Results

The results of the chemical analysis of mussel samples collected in Bantry Bay in June 2009 are given in Table 2.5. These results are compared with the OSPAR Background/Reference Concentration Ranges and Ecotoxicological Assessment Criteria (EAC) in Table 2.6.

Where necessary, the results have been converted from wet weight (WW) to dry weight (DW) to allow direct comparison with the OSPAR values.



Table 2.5: Results of Chemical Analysis of Mussel Samples (2009)

Parameter	Units	No. Samples	Min	Max	Mean
Solids	%	-	-	-	-
Copper	mg/kg WW	6	0.722	0.985	0.864
Zinc	mg/kg WW	6	15.100	21.200	18.700
Cadmium	mg/kg WW	6	0.081	0.120	0.101
Mercury	mg/kg WW	6	0.007	0.019	0.011
Lead	mg/kg WW	6	0.069	0.132	0.102
Vanadium	mg/kg WW	6	0.290	0.366	0.324
Arsenic	mg/kg WW	6	1.860	2.200	1.991
Chromium	mg/kg WW	6	0.250	0.376	0.300
Nickel	mg/kg WW	6	0.300	0.314	0.305
Tributyl Tin Cation	µg/kg DW	16	< 32	< 32	< 32
Indeno[123-cd] Pyrene	µg/kg WW	16	*	*	*
Benzo[b] Fluoranthene	µg/kg WW	16	*	*	*
Benzo[ghi] Perylene	µg/kg WW	16	*	*	*
Fluoranthene	µg/kg WW	16	*	*	*
Total Hydrocarbons	mg/kg DW	16	*	*	*
C1 Naphthalenes	µg/kg WW	16	*	*	*
C2 Naphthalenes	µg/kg WW	16	*	*	*
C3 Naphthalenes	µg/kg WW	16	*	*	*
Acenaphthalene	µg/kg WW	16	*	*	*
Phenanthrene	µg/kg WW	16	*	*	*
Naphthalene	µg/kg WW	16	*	*	*
Anthracene	µg/kg WW	16	*	*	*
Pyrene	µg/kg WW	16	*	*	*
Fluorene	µg/kg WW	16	*	*	*
Acenaphthene	µg/kg WW	16	*	*	*
2,3-Benzanthracene	µg/kg WW	16	*	*	*
Benzo(e)pyrene	µg/kg WW	16	*	*	*
Perylene	µg/kg WW	16	*	*	*
Dibenzo(ah)anthracene	µg/kg WW	16	*	*	*
Benzo(a)pyrene	µg/kg WW	16	*	*	*
Chrysene	µg/kg WW	16	*	*	*
Benz(a)anthracene	µg/kg WW	16	*	*	*
Benzo(k)fluoranthene	µg/kg WW	16	*	*	*

* values to be reported in 2010 AER due to laboratory accreditation problem



Table 2.6: Comparison of Results of 2009 Chemical Analysis of Bantry Bay Mussels with OSPAR Background/Reference Concentrations and EAC

Parameter	Min	Max	Mean	OSPAR Low Concentration (LC)/Background Assessment Concentration (BAC)	OSPAR Ecotoxicological Assessment Criteria
Arsenic (mg/kg WW)	1.86	2.21	2.07		n.r
Cadmium (µg/kg DW)	405	600	507	600 / 1,940	280
Chromium (mg/kg WW)	0.250	0.376	0.300		n.r
Copper (mg/kg WW)	0.722	0.985	0.864	0.76 / 1.10	f.c
Lead (µg/kg DW)	345	660	510	800 / 1,520	8,500
Mercury (µg/kg DW)	32.6	92.5	53.49	50 / 140	10
Nickel (mg/kg WW)	0.300	0.314	0.305		f.c
Vanadium (mg/kg WW)	0.268	0.339	0.300		
Zinc (mg/kg WW)	15.10	21.20	18.70	11.6 / 30	n.r
Tributyl Tin (µg/kg DW)	< 32	< 32	< 32		1-10
Benzo[a] Anthracene (µg/kg DW)	*	*	*	1.0 / 3.6	80
Benzo[ghi] Perylene (µg/kg DW)	*	*	*	1.5 / 7.2	110
Fluoranthene (µg/kg DW)	*	*	*	5.5 / 11.2	110
Indeno[123-cd] Pyrene (µg/kg DW)	*	*	*	1 / 5.5	n.d
Benzo[k] Fluoranthene (µg/kg DW)	*	*	*	1 / -	n.d
Chrysene (µg/kg DW)	*	*	*	4 / 21.8	n.d
Anthracene (µg/kg DW)	*	*	*	- / 2.7	290
Pyrene (µg/kg DW)	*	*	*	5.5 / 10.1	1,000-10,000
Naphthalene (µg/kg DW)	*	*	*	- / 81.2	340
Phenanthrene (µg/kg DW)	*	*	*	4 / 12.6	1,700
Benzo[a] Pyrene(µg/kg DW)	*	*	*	0.5 / 2.1	5,000-50,000

n.r not considered relevant by OSPAR in relation to their monitoring programme
f.c for future consideration
n.d no data available or no sufficient data available for OSPAR to establish EAC values
* values to be reported in the 2010 AER due to laboratory accreditation problem



The results of the PAH and Total Hydrocarbons analyses carried out on the mussels collected from the Dolphin No. 1 jetty are given in Table 2.7. Samples have been taken from this location since 2001, usually towards the end of each year. The average weight and length of the mussels collected are shown in Table 2.8.

Table 2.7: Results of Chemical Analysis of Mussels taken from Jetty

Parameter	Units	Min	Max	Mean
Hydrocarbon Total (Ekofisk)	mg/kg WW	5.84	12.06	8.46
Acenaphthene	µg/kg WW	*	*	*
Acenaphthylene	µg/kg WW	*	*	*
Anthracene	µg/kg WW	*	*	*
Flouranthene	µg/kg WW	*	*	*
Fluorene	µg/kg WW	*	*	*
Naphthalene	µg/kg WW	*	*	*
Naphthalene - C1s	µg/kg WW	*	*	*
Naphthalene - C2s	µg/kg WW	*	*	*
Naphthalene - C3s	µg/kg WW	*	*	*
Phenanthrene	µg/kg WW	*	*	*
Pyrene	µg/kg WW	*	*	*
2,3-Benzanthracene	µg/kg WW	*	*	*
Benz(a)anthracene	µg/kg WW	*	*	*
Benzo(b)fluoranthene	µg/kg WW	*	*	*
Benzo(a)pyrene	µg/kg WW	*	*	*
Benzo(e)pyrene	µg/kg WW	*	*	*
Benzo(ghi)perylene	µg/kg WW	*	*	*
Benzo(k)fluoranthene	µg/kg WW	*	*	*
Chrysene	µg/kg WW	*	*	*
Dibenzo(a,h)anthracene	µg/kg WW	*	*	*
Indeno(1,2,3-cd) pyrene	µg/kg WW	*	*	*
Perylene	µg/kg WW	*	*	*

* values to be reported in the 2010 AER due to laboratory accreditation problem

The concentrations of PAHs in the mussel samples collected at the jetty are compared to the OSPAR EAC Values in Table 2.9. The values in Table 2.9 are expressed as dry weight rather than wet weight. When converting the concentrations from WW to DW, a solids content of 20 % was assumed based on the solids content measured in previous years. The concentrations are compared with the OSPAR Background Concentrations in Table 2.10.

Table 2.8: Average Length and Weight of Mussels taken from jetty

	Length	Weight of Shellfish	Weight of Tissue
Units	mm	g	g
Averages	49.4	9.8	4.4



Table 2.9: Comparison of results of chemical analysis of mussels taken from jetty with OSPAR EAC

Parameter	Min	Max	Mean	OSPAR Ecotoxicological Assessment Criteria
Benzo [a] anthracene (µg/kg DW)	*	*	*	80
Benzo [ghi] perylene (µg/kg DW)	*	*	*	110
Fluoranthene (µg/kg DW)	*	*	*	110
Indeno [123-cd] pyrene (µg/kg DW)	*	*	*	n.d
Benzo [k] fluoranthene (µg/kg DW)	*	*	*	260
Chrysene (µg/kg DW)	*	*	*	n.d
Anthracene (µg/kg DW)	*	*	*	290
Pyrene (µg/kg DW)	*	*	*	100
Naphthalene (µg/kg DW)	*	*	*	340
Phenanthrene (µg/kg DW)	*	*	*	1,700
Benzo [a] pyrene (µg/kg DW)	*	*	*	600

n.d no data available or no sufficient data available

* values to be reported in the 2010 AER due to laboratory accreditation problem

Table 2.10: Comparison of results of chemical analysis of mussels taken from jetty with OSPAR Background Concentrations

Parameter	Min	Max	Mean	Low Concentration (LC) / OSPAR Background Assessment Concentration (BAC)
Benzo [a] anthracene(µg/kg DW)	*	*	*	1.0 / 3.6
Benzo [ghi] perylene (µg/kg DW)	*	*	*	1.5 / 7.2
Fluoranthene (µg/kg DW)	*	*	*	5.5 / 11.2
Indeno [123-cd] pyrene (µg/kg DW)	*	*	*	1.0 / 5.5
Benzo [k] fluoranthene (µg/kg DW)	*	*	*	1.0 / -
Chrysene (µg/kg DW)	*	*	*	4.0 / 21.8
Anthracene (µg/kg DW)	*	*	*	- / 2.7
Pyrene (µg/kg DW)	*	*	*	4.0 / 10.1
Naphthalene (µg/kg DW)	*	*	*	- / 81.2
Phenanthrene (µg/kg DW)	*	*	*	4.0 / 12.6
Benzo [a] pyrene (µg/kg DW)	*	*	*	0.5 / 2.1

* values to be reported in the 2010 AER due to laboratory accreditation problem

2.2.4 Comment

Table 2.6 shows how the results compare with standards established by the Oslo and Paris Conventions from the Prevention of Marine Pollution (OSPAR).

It should be noted that OSPAR issued a new document in 2009 entitled “Background Document on CEMP¹ Assessment Criteria for QSR 2010²”. This replaces the earlier documents 2005 “*Agreement on Background Concentrations for Contaminants in Seawater, Biota and Sediment*” and Agreements 1997-14, although many of the values have remained unchanged.

¹ CEMP denotes Co-ordinated Environmental Monitoring Programme

² QSR denotes quality status report



This new document proposes the use of two different traffic light systems (one for PAHs and metals in sediment, one for metals in biota) with the transition points as follows

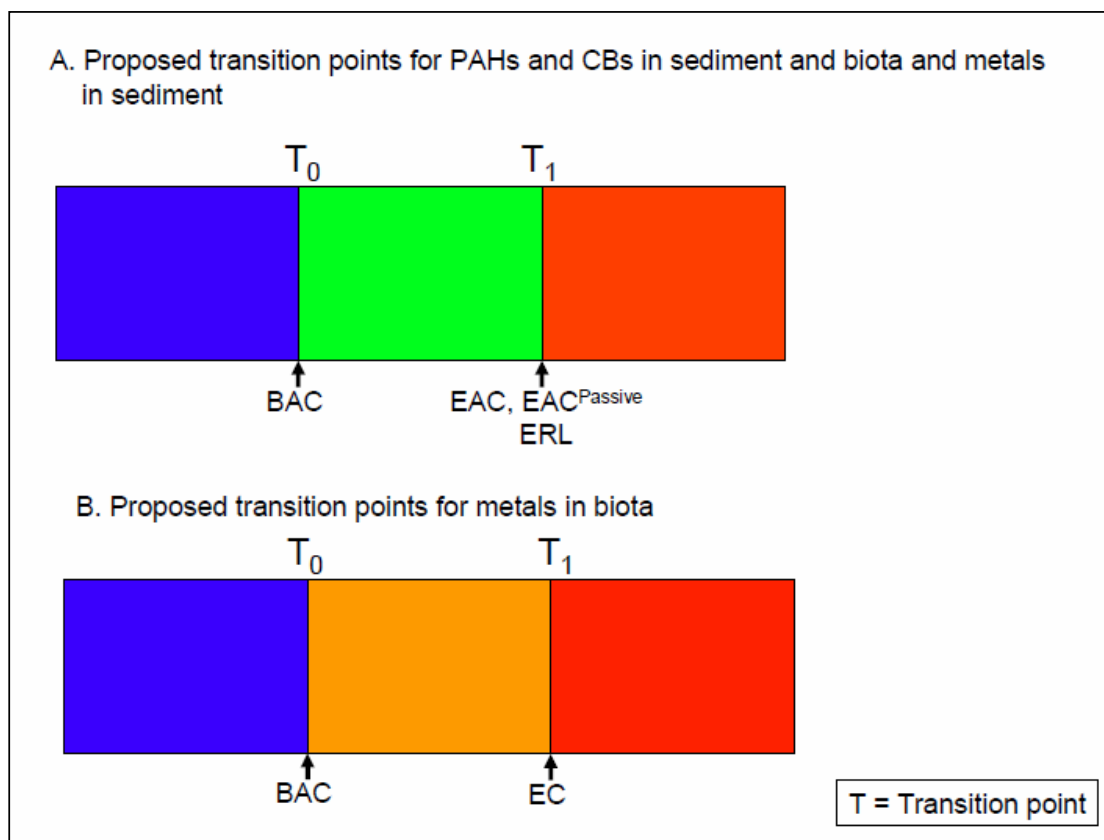


Figure 2.1: Summary of Transition Points from OSPAR CEMP Assessment

Background concentrations (BC) have been established by OSPAR to represent the concentrations of certain hazardous substances that would be expected in the North-East Atlantic if certain industrial developments had not happened. They represent the concentrations at 'remote' or 'pristine' locations.

It should be noted that due to the significant geological variability that can be expected between different environments in the OSPAR maritime area, the natural background levels should be regarded as having substantial inherent variability. Background concentrations do not represent target values and should not be used as such.

In order to facilitate precautionary assessments of data collected under the OSPAR CEMP against BCs, OSPAR has developed Background Assessment Concentrations (BACs). Observed concentrations are said to be 'near background' if the mean concentration is statistically significantly below the corresponding BAC.

In 2008, the ICES Marine Chemistry Working Group (MCWG) proposed low concentrations (LCs) for PAHs in shellfish (mussels and oysters). The MCWG used the limited available dataset from areas identified as pristine (mussel data from Spain and Scotland, and mussels and oysters from France) to estimate LCs as the 10th percentile of



the data. LCs were initially derived as µg/kg wet weight, but were converted to a dry weight basis by multiplying by five. LCs could not be proposed for naphthalene, anthracene, dibenzothiophene and alkylated naphthalenes due to the limited dataset and because the concentrations of some PAHs were commonly below limits of quantification.

EACs represent the contaminant concentration in the environment below which no chronic effects are expected to occur in marine species, including the most sensitive species. EACs for a range of contaminants were proposed in 2004 and updated EACs for PAHs were proposed in 2008. Some EACs have not been used in OSPAR assessments, mainly because the proposed EACs are less than the OSPAR Background Assessment Concentrations (BACs).

For example, EACs for three of the parent PAHs (benz[a]anthracene, benzo[ghi]perylene and indeno[1,2,3-cd]pyrene) in sediment are below the BACs. It has been concluded that EACs for PAHs or trace metals in sediment and for metals or chlorobiphenyls (CBs) in biota cannot be used to describe the green/red transition. Therefore, in cases where the EACs have not been recommended, alternative approaches to appropriate criteria for the assessment of data on contaminant concentrations in sediment and biota need to be considered.

EACs were calculated by OSPAR based on the results of toxicology tests. The EAC for any substance can only be calculated if ecotoxicological data showing the effect of that substance on three species is available. Factors were then applied to these results in order to determine safe concentrations.

The U.S Environmental Protection Agency (US EPA) have developed Effects Range (ER) values to be used to assess the quality of coastal and estuarine environments and the ecological significance of the concentrations of hazardous substances found in sediment (USEPA, 2002; Long et al, 1998). ER values were established as sediment quality guidelines to be used to predict adverse biological effects on organisms.

In summary, the derivation of ER values involved the collation of a large amount of information on the concentrations of contaminants in sediments in which biological effects (for example on the benthic infauna) were found to be occurring. Two main assessment criteria are then calculated from this data collation. The ER-Low (ERL) value is defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects, and the ER-Median (ERM) as the median of the concentrations associated with biological effects. Adverse effects on organisms are rarely observed when concentrations fall below the ERL value, and the ERL therefore has some parallels with the philosophy underlying the OSPAR EACs and Water Framework Directive (WFD) Environmental Quality Standards (EQS).

Comparing the results of the heavy metals analyses with the Background Concentrations, the levels detected in the mussel samples from Bantry Bay are broadly comparable with the values published by OSPAR. The concentrations of lead and zinc are within the background concentration ranges while the concentration of mercury is on the outer boundary of the range



It was noted in the 2008 Annual Environmental Report that two samples collected in 2008 showed high levels of chromium and nickel that were well in excess of the other samples collected or in any previously analysed samples. The 2009 results for chromium and nickel compare favourably with results of years previous to 2008's results.

2.3 Taste Testing of Mussel Samples

Due to consultation with the Marine Institute on a warning issued by the Food Safety Authority of Ireland (FSAI), in the month leading up to the scheduled time for the mussel sampling, that some mussels from Bantry Bay could contain Azaspiracid shellfish poisoning toxins (AZP), a naturally occurring marine biotoxins, the taste testing for 2009 was not carried out. Members of the environmental monitoring group were informed of this and it was agreed that the testing would recommence in 2010 as per previous years.

2.4 Seed Mussel Distribution Survey

2.4.1 Introduction

The assessment of quantity and quality of seed mussel (spatfall) distribution in Bantry Bay was first carried out in 1996. The seed mussel population is of great commercial importance as it is the main source of seed supply for the mussel farming industry in Bantry Bay. The aims of setting up this study were as follows:

1. To establish a sound, scientific protocol for a long term monitoring programme of spatfall in Bantry Bay;
2. To establish baseline data for spat against which future changes can be assessed;
3. To assess the inter-tidal rocky shore community, detailing the variety of species to be found;
4. To assess the population structure of mussels, using shell size as an estimate.

The survey has been conducted on an annual basis since 1996 by the Aquatic Services Unit (ASU) at University College Cork (UCC).

2.4.2 Methodology

Ten sites in Bantry Bay and a control site at Crookhaven in Roaringwater Bay were selected for the seed mussel distribution survey, as shown in Table 2.12. Transects were established at each of these locations. Samples are taken from three stations at each site.



Table 2.11: Location of Transects of Seed Mussel Distribution Survey

Site No.	Location
1	Coosard
2	Derrylough
3	Muccurragh
4	South of Illauncreveen
5	Ardaturrish Point
6	Gerane East
7	Gerahies
8	Toreen
9	Collack
10	Glanrooncoosh
11	Control Site (Crookhaven)

2.4.3 Results

The 2009 Seed Mussel Distribution Survey was conducted in December 2009, the results of which are given in Table 2.13. Only one of the thirty-three stations could not be located as the pin used to mark the sample location was absent.

Table 2.12: Mussel Density and Mean Shell Length – 2009

Site	No. of Mussels per 0.01 m ²	Mean Length (mm)
Coosard	1553.5	3.9
Derrylough	1065.0	4.2
Muccurragh	217.0	5.9
South of Illanuncreveen	91.3	4.6
Ardaturrish Point	431.5	5.9
Gerane East	142.0	6.9
Gerahies	1028.5	3.8
Toreen	598.0	4.9
Collack	90.0	6.3
Glanrooncoosh	108.5	9.3
Control Site (Crookhaven)	77.7	5.1

The densities of spatfall recorded in 2009 have increased on 2008 levels and are among the highest on record to date for the bay. The results also exhibit a high degree of variation in mean shell length between the sites. The average results per site results are compared to those from previous years (1996-2008) in § 3.5.



2.5 Chemical Analysis of Sediment Samples

2.5.1 Introduction

The analysis of sediments from the seabed is a useful method in determining any long term trend in marine pollution. Each year, samples of sediment are collected from eight locations around the SPM and Whiddy Island and are analysed for metals, hydrocarbons, organotins and PAHs. The chemical analysis of sediment samples is carried out by the Environment Agency in Llanelli.

In Table 2.16, background assessment criteria (BAC) are used to determine if mean observed concentrations can be considered to be near to the actual background concentrations. These values were established by OSPAR on the basis that there is a 90 % probability that the observed mean concentration will be below the BAC when the true concentration is at the BC, based on what is known about variability in observations. Where this is the case, the true concentration can be regarded as ‘near background’ (for naturally occurring substances) so “close to zero” (for artificial, man-made substances).

2.5.2 Methodology

Sediment samples were collected from eight locations around Whiddy Island in June 2009, as shown in Table 2.13. One of these sites is in the vicinity of the SPM. The samples were collected using a Van Veen sampler. A map showing the location of the sampling sites is included in Appendix 1.

Table 2.13: Location of Sediment Sampling Sites

Site Ref	Latitude	Longitude
1	51°42.37’	09°29.19’
2	51°42.38’	09°28.00’
3	51°43.00’	09°32.00’
4	51°42.00’	09°33.50’
5	51°40.80’	09°33.50’
6	51°41.78’	09°32.25’
7	51°40.30’	09°32.00’
8	51°41.40’	09°28.00’

2.5.3 Results

The results of the chemical analysis of sediments collected in 2009 are shown in Table 2.14.

For the purposes of comparison with the various values published by OSPAR, the Background Concentrations and the Ecotoxicological Assessment Criteria (EAC) are shown on two separate tables (Table 2.15 and Table 2.16). This is due to some of the Background Concentrations published by OSPAR being normalised to account for naturally



occurring background levels of certain parameters. For example, the metals content of sediment has to be adjusted for aluminium content and the PAH content has to be adjusted for organic carbon content.

In other words, the metals concentrations published by OSPAR have been normalised to 5% aluminium and the PAH values have been normalised to 2.5% organic carbon. This means that if a sample collected from Bantry contained only 2.5 % aluminium, the other metals concentrations would need to be doubled before they could be compared with the Background Concentrations. Other parameters (Cd, Pb and Hg) must be normalised to 1% TOC, with the remaining parameters expressed as absolute values. Monitoring of sediment samples usually includes an assessment of total organic carbon (TOC) so that the PAH results may be compared with the Background Concentrations established by OSPAR. This year, due to a laboratory error, there was no TOC analysis conducted. However based on the results obtained over the previous years' of the monitoring programme, an average value of 2.7% for the total organic carbon content has been assumed when assessing the 2009 samples.



Table 2.14: Results of Chemical Analysis of Sediment Samples – June 2009

Parameter	Units	No. of Samples	Min	Max	Mean
Solids Content	%	-	-	-	-
Aluminium	mg/kg DW	6	51,800	69,100	60,900
Arsenic	mg/kg DW	6	9.90	14.90	12.12
Cadmium	mg/kg DW	6	0.072	0.115	0.100
Chromium	mg/kg DW	6	69.10	83.60	77.78
Copper	mg/kg DW	6	22.30	33.30	28.50
Lead	mg/kg DW	6	22.80	31.00	26.95
Lithium	mg/kg DW	6	37.30	55.00	46.70
Mercury	mg/kg DW	6	0.034	0.054	0.047
Nickel	mg/kg DW	6	33.30	39.30	36.68
Vanadium	mg/kg DW	6	67.00	101.00	86.57
Zinc	mg/kg DW	6	78.30	186.00	108.90
Total Organotins	µg/kg DW	16	-	-	-
Tributyl Tin	µg/kg DW	16	< 4	< 7	< 6
Triphenyl Tin	µg/kg DW	16	< 3	< 5	< 4
Total HCs (Ekofisk)	mg/kg DW	16	2	29	13
Benzo[a] Anthracene	µg/kg DW	16	2.73	43.60	15.74
Benzo[ghi] Perylene	µg/kg DW	16	11.80	62.10	27.20
Fluoranthene	µg/kg DW	16	10.20	102.00	43.14
Indeno[123-cd] Pyrene	µg/kg DW	16	14.00	60.40	29.98
Benzo[b] Fluoranthene	µg/kg DW	16	< 10.00	74.30	32.22
Benzo[k] Fluoranthene	µg/kg DW	16	< 10.00	37.80	16.05
Chrysene	µg/kg DW	16	6.08	52.20	22.18
Acenaphthene	µg/kg DW	16	< 2.1	< 22.8	< 8.2
Anthracene	µg/kg DW	16	< 2.0	< 14.7	< 4.9
Benzo[e] Pyrene	µg/kg DW	16	11.20	133.00	39.08
Pyrene	µg/kg DW	16	6.70	71.10	29.63
Naphthalene	µg/kg DW	16	30.00	394.00	138.03
Fluorene	µg/kg DW	16	< 10.0	< 31.2	< 17.6
Phenanthrene	µg/kg DW	16	< 14.10	74.70	36.33
Perylene	µg/kg DW	16	< 10	147.0	56.3
C1- Naphthalenes	µg/kg DW	16	< 10.00	161.00	78.56
C2- Naphthalenes	µg/kg DW	16	12.20	194.00	102.19
C3- Naphthalenes	µg/kg DW	16	11.30	222.00	108.20
2,3- Benzanthracene	µg/kg DW	16	< 10.0	< 42.4	< 12.1
Benzo[a] Pyrene	µg/kg DW	16	< 2.0	< 42.7	< 11.4
Total Organic Carbon	%	-	2.7 (est)	2.7 (est)	2.7 (est)



Table 2.15: Comparison of Results of Chemical Analysis of Sediments with OSPAR Background Concentrations

Parameter	Min	Max	Mean	BC	BAC	Old BC (1997)	Effects Range –Low (ERL)
Arsenic (mg/kg DW) *	8.61	11.66	9.95	15	25		
Cadmium(mg/kg DW) *	0.07	0.09	0.08	0.2	0.31		1.2
Chromium (mg/kg DW) *	59.32	71.87	64.26	60	81		
Copper (mg/kg DW) *	20.88	27.57	23.52	20	27		
Lead (mg/kg DW) *	21.27	23.03	22.12	25	38		47
Lithium (mg/kg DW) *	36.00	39.80	38.26			22 – 44	
Mercury (mg/kg DW) *	0.03	0.04	0.04	0.05	0.07		0.15
Nickel (mg/kg DW) *	25.62	35.51	30.40	30	36		
Vanadium (mg/kg DW) *	64.67	74.92	70.74			60 – 110	
Zinc (mg/kg DW) *	75.58	134.59	88.02	90	122		
Tributyl Tin (µg/kg DW)	< 4	< 7	< 6				
Total Hydrocarbons (mg/kg DW)	1.6	28.7	12.9				
Benz [a] anthracene (µg/kg DW) ~	< 2.5	40.4	14.6	9	16	7.7 – 69	
Benzo [ghi] perylene (µg/kg DW) ~	< 10.9	57.5	25.2	45	80	30.7 – 189.5	
Fluoranthene (µg/kg DW) ~	9.4	94.4	39.9	20	39	13.8 – 159.6	250
Indeno [123-cd] pyrene (µg/kg DW) ~	13.0	55.9	27.8	50	103	43.4 – 211.6	240
Benzo [b+k] fluoranthene (µg/kg DW) +	< 20	104.3	48.3			46.3 – 433.8	
Chrysene (µg/kg DW) ~	5.6	48.3	20.5	11	20	12.8 – 91.3	
Acenaphthene (µg/kg DW) +	< 2.1	22.8	8.2			0.5 – 5.8	
Anthracene (µg/kg DW) ~	< 1.9	13.6	4.6	3	5	1.5 – 13.8	85
Pyrene (µg/kg DW) ~	6.2	65.8	27.4	13	24	11.3 – 128.4	
Naphthalene (µg/kg DW) ~	27.8	364.8	127.8	5	8	7.7 – 62.2	160
Fluorene (µg/kg DW) +	10	31.2	17.6			1.8 – 16.1	
Phenanthrene (µg/kg DW) ~	< 13.1	69.2	33.6	17	32	12.9 – 109.9	240
Benzo [a] pyrene (µg/kg DW) ~	< 1.9	39.5	10.5	15	30	8.8 – 111.6	

* The heavy metals results have been normalised to 5% Aluminium to allow comparison with the Background Concentrations

~ The PAH results have been normalised to 2.5% Organic Carbon to allow comparison with the Background Concentrations

+ The BC and BAC values for these PAH compounds have not been established. In these cases, it is appropriate to compare them with the values that had been established for the Northern North Sea / Skaggeak region back in 1997, as per the previous reports. These values are reported in this table without normalising them for TOC, so they can be compared directly with the older background concentrations established by OSPAR.



Table 2.16: Comparison of Results of Chemical Analysis of Sediments with OSPAR Reference Criteria

Parameter	Min	Max	Mean	Ecotoxicological Assessment Criteria
Arsenic (mg/kg DW)	9.90	14.90	12.12	1-10
Cadmium (mg/kg DW) ~	0.03	0.04	0.03	0.6
Chromium (mg/kg DW)	69.10	83.60	77.78	10-100
Copper (mg/kg DW)	22.30	33.30	28.50	5-50
Lead (mg/kg DW) ~	8.51	9.21	8.85	2.2
Lithium (mg/kg DW)	37.30	55.00	46.70	-
Mercury (mg/kg DW) ~	0.01	0.02	0.02	0.22
Nickel (mg/kg DW)	33.30	39.30	36.68	5-50
Vanadium (mg/kg DW)	67.00	101.00	86.57	-
Zinc (mg/kg DW)	78.30	186.00	108.90	50-500
Tributyl Tin (µg/kg DW)	< 4	< 7	< 6	0.005-0.05
Total Hydrocarbons (mg/kg DW)	1.71	31.00	13.90	-
Benzo [a] anthracene (µg/kg DW)	2.73	43.60	15.74	261
Benzo [ghi] perylene (µg/kg DW)	11.80	62.10	27.20	85
Fluoranthene (µg/kg DW)	10.20	102.00	43.14	250
Indeno [123-cd] pyrene (µg/kg DW)	14.00	60.40	29.98	1.5
Benzo [b+k] fluoranthene (µg/kg DW)	20.00	112.10	48.27	-
Chrysene (µg/kg DW)	6.08	52.20	22.18	384
Acenaphthene (µg/kg DW)	< 2.10	22.80	8.16	-
Anthracene (µg/kg DW)	< 2.00	< 14.70	< 4.92	78
Pyrene (µg/kg DW)	6.70	71.10	29.63	350
Naphthalene (µg/kg DW)	30.00	394.00	138.03	43
Fluorene (µg/kg DW)	< 10.0	< 31.2	< 17.6	-
Phenanthrene (µg/kg DW)	14.1	74.7	36.3	1,250
Benzo [a] pyrene (mg/kg DW)	< 2	42.70	11.39	0.625

n.d No data available or no sufficient data available for OSPAR to establish EAC values

~ Metals values normalised to 1% organic carbon to allow comparison with EAC



2.5.4 Comment

The results of the chemical analysis of sediments were compared with the Background Concentrations and EAC values for sediments. These concepts for sediments are similar to those for mussels, as described in § 2.2.4.

Table 2.15 shows how the results compare with the various background concentrations established by OSPAR. The BC, BAC and ERL values are taken from Background document on CEMP Assessment Criteria for QSR 2010 and Agreement 2005-6, where OSPAR have normalised the PAH values to 2.5% organic carbon.

Table 2.15 shows how the average concentrations of chrysene, pyrene and phenanthrene were marginally greater than the BAC values for sediment. In addition, although a BAC value has not been established for lithium or vanadium, the average concentration of these parameters were within the old BC values that had previously been established.

Comparing the PAH results with the background concentrations (normalised to 2.5% organic carbon), the average concentrations of chrysene, flouranthene and pyrene were greater than background levels. There are no BAC values given by OSPAR for acenaphthene and fluorene, but fluorene was found to be above the BC value that had previously been established.

Table 2.16 shows how the results compare with the various Ecotoxicological Assessment Criteria established by OSPAR. The values for cadmium, mercury and lead have been normalised to 1% organic carbon to allow comparison with the EAC values. Comparing the heavy metal results with the EAC values, the average levels detected in sediment samples from Bantry for all except Lead and Arsenic are less than the EAC values. However, it is worth noting here that both of the lead and arsenic results are below their respective BC and BAC values.

The limit of detection for TBT is greater than the values in the EAC range. As no detections were made of TBT in any of the sediment samples, it cannot be determined how the TBT levels compare with the EAC range.

Comparing the PAH results with the EAC values, the levels detected in all but two of the sediment samples from Bantry are less than, and in many cases significantly less than, the values published by OSPAR. This would indicate that there should be no risk of harm arising from these concentrations.

An analysis of this year's results and those from previous years is contained in Section 3.6.



2.6 Stormwater Monitoring

2.6.1 Introduction

Samples of stormwater from the Terminal have been collected since 1998, initially under the Terminal's Trade Effluent Licence and subsequently under its IPC Licence. En-Force Laboratories carry out chemical analysis of the stormwater on a monthly basis. The contract for annual toxicity testing of the effluent is currently with Enterprise Ireland.

2.6.2 Methodology

Samples are collected inside the discharge line from the lagoon to Trá na Seasca (emission point reference SWEP-01). The sampler is programmed to collect a composite sample over a 24-hour period. Samples are available for inspection by the EPA.

2.6.3 Results

The results of the effluent monitoring are given below. Table 2.17 lists the results of the chemical testing of the effluent. Table 2.18 shows the results of the toxicity testing of the effluent.

Table 2.17: Results of Chemical Testing of Effluent, 2009

Parameter	Units	No. of Samples	ELV	Min	Max	Mean
pH	-	12	4-9	4.6	7.3	6.2
BOD	mg/l	12	25	5	15	5.8
Suspended Solids	mg/l	12	30	2	60	13.8
Total Hydrocarbons	mg/l	12	-	6	98	25.5
Total Petroleum Hydrocarbons	mg/l	12	10	0.1	3.2	1.4
Dissolved Hydrocarbons	mg/l	12	-	5	98	24.7
Dissolved Petroleum Hydrocarbons	mg/l	12	-	0.1	3.2	1.4
Total Phenols	mg/l	12	1	0.38	1.2*	0.4
Cresols	mg/l	12	-	0.146	0.6	0.1

ELV: Emission Limit Values from the IPC Licence

Shaded cells indicate non-compliances

* Under condition 3.1.2 of CPBBT's IPC licence no individual result for non-continuous composite sampling may exceed 1.2 times the ELV. As this result did not exceed 1.2 times the ELV it was not deemed an exceedance.



Table 2.18: Results of Toxicity Testing of Effluent, 2009

Species	Test	Effect	ELV	EI (November 2009)
<i>Tisbe battagliai</i>	48 hour LC 50	Acute Toxicity	5 TU	< 3.1
<i>Vibrio fischeri</i>	5 min EC 50	Growth Inhibition	5 TU	< 2.2
<i>Vibrio fischeri</i>	15 min EC 50	Growth Inhibition	5 TU	< 2.2

TU: Number of Toxicity Units

EI: Enterprise Ireland

2.6.4 Comment

In 2009, an exceedance of the suspended solid Emission Limit Value was recorded in May. The location point of the sampler intake was thought to be partly responsible for this as it was in a stagnation point, with little flow and where solids tended to accumulate over time. Following cleaning of the outflow pipe and relocation of the sampler intake to a point more representative of the effluent flow, no exceedance of the ELV for suspended solids has been recorded. Work to assess and improve the effectiveness of the settling lagoon and separators in removing suspended solids was also undertaken during 2009 and will continue in 2010 (see also the site Environmental Management Programme report for 2009 in the Annual Environmental Report).

Comparing concentrations of total hydrocarbons in the effluent to the limit value for mineral oil is considered overly conservative. The total hydrocarbons test identifies any substance containing a C-H bond, including decaying organic matter, and as such is not an accurate indicator of levels of mineral oil in the sample. Therefore, concentrations of total petroleum hydrocarbons are compared to the emission limit value for mineral oil from the licence. The normal levels of total petroleum hydrocarbons in the effluent are generally of the order of 1 mg/l, with the maximum 2009 result recorded of 3.2 mg/l in January. Overall, the total petroleum hydrocarbon concentration remained low throughout the year and the average concentration was significantly lower than the ELV of 10 mg/l.

The effluent sample for the 2009 toxicity testing was collected by Enterprise Ireland in November 2009. The results were generally lower than those of the previous years and the same as 2008. They showed no exceedances of the ELV for the acute toxicity of the sample to *Tisbe battagliai* or *Vibrio fischeri*.

The LC₅₀ (Concentration at which 50 % mortality of the species occurs) for *Tisbe battagliai* was calculated as > 32 % V/V, which corresponds to a toxicity level of < 3.1 Toxic Units. Tests carried out for *Vibrio fischeri* (5 and 15 minute Median Effect Concentration) to light inhibition showed that for 5 min EC₅₀ the concentration was > 45 % V/V, giving a toxicity level of > 2.2 and for the 15 min EC₅₀ the concentration was > 45 % V/V also giving a toxicity level of > 2.2. These results show that the toxicity of the effluent is low and is well within the emission limit value of 5 Toxic Units.



2.7 Groundwater Monitoring

2.7.1 Introduction

Bi-annual groundwater monitoring at the Terminal is required by the IPC licence. A list and brief description of the groundwater monitoring wells is given in Table 2.19. A map showing the location of all the monitoring wells is included in Appendix 1. Groundwater monitoring on Whiddy Island commenced in 1998 at MW-1, MW-2 and MW-3. A more detailed programme incorporating a series of additional boreholes commenced October 2001. Groundwater samples were collected and analysed by WYG in 2009 on behalf of CPBBT.

The Landfill Monitoring Programme commenced in October 2001. Under this programme, a slightly different set of parameters is assayed at BH-102, BH-103, BH-104 and BH-105, when compared with the monitoring conducted at the tank farm.

Table 2.19: Location of Groundwater Monitoring Wells

Well No.	Description
Wells located at Terminal	
MW-1	Located up-gradient of the Terminal, Southeast of Tank 210
MW-2	Located down-gradient of the Terminal, Northwest of Tank 201
MW-3	Located down-gradient of the Terminal, South of Tank 401
BH-109	Located down-gradient of tank farm
BH-110	Located within bunded area adjacent to Tank 208
Wells located at Landfill	
BH-103	Located up-gradient of the Landfill Site
BH-102	Located down-gradient of the Landfill Site
BH-104	Located down-gradient of the Landfill Site
BH-105	Located down-gradient of the Landfill Site
Wells located at Oil Pits	
BH-108	Located up-gradient of Oil Pits
BH-106	Located down-gradient of Oil Pits
BH-107	Located down-gradient of Oil Pits

2.7.2 Methodology

Each monitoring well is developed prior to sampling by using a small submersible pump to evacuate the water from the well for one hour or three times the volume of water in the well. This ensures that the water sampled is representative of the groundwater from the surrounding aquifer material.

Samples are tested in situ for pH and conductivity and sent to the laboratory for further analysis. The groundwater monitoring is currently conducted on a biannual basis.



2.7.3 Results

The results of the groundwater monitoring at the Terminal are shown in Table 2.20 to Table 2.22. Table 2.20 and Table 2.21 present the results of the main survey at the tank farm and oil pits while Table 2.22 shows those of the inert landfill area. The values presented in the tables are averages of the two monitoring events.

The results are compared to the Drinking Water Parametric Values (PV)³. These are recommended concentrations of various parameters in drinking water and are included for comparison purposes only. No groundwater is extracted as drinking water at the site.

The results are also compared to the Dutch Intervention Values (I-Values) and Target Values (S-Values) for groundwater. The Target Values are baseline concentrations below which compounds or elements are known or assumed not to affect the natural properties of the soil. The Intervention Values are the maximum tolerable concentrations above which some form of remediation is generally required.

³S.I. 278 of 2007



Table 2.20: Results of Groundwater Monitoring, 2009 (area adjacent to Tank Farm)

	Drinking Water PV	Dutch Values		Average Annual Concentration (mg/l unless stated)				
		S	I	MW-1	MW-2	MW-3	BH-109	BH-110
pH (units)	6.5-9.5	-	-	7.06	4.045	6.345	7.855	8.18
Conductivity (µS/cm)	2,500	-	-	282.5	622.5	1839.5	754	682.5
Nutrients etc.								
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	< 0.285	0.285	< 0.291	< 0.158	< 0.1
Chloride	250	-	-	29.55	56.85	448.05	96.85	64.05
Sulphate (soluble)	250	-	-	28.5	193.83	115.67	74.74	130.79
Nitrate	50	-	-	0.9	0.35	1.75	< 0.35	< 0.3
Sodium	200	-	-	17.93	33.58	218.95	76.29	43.69
Potassium	12	-	-	0.88	1.895	7.955	1.295	1.72
Calcium	200	-	-	15.07	28.2	40.63	52.8	51.7
Magnesium	50	-	-	4.14	18.82	28.4	9.54	16.82
Metals								
Arsenic	0.01	0.01	0.06	< 0.00255	< 0.0031	< 0.0031	< 0.00365	< 0.0029
Boron	1	-	-	0.012	0.0106	0.0755	0.0545	0.022
Cadmium	0.005	0.0004	0.006	<u>0.0005</u>	<u>0.00075</u>	<u>0.0005</u>	<u>0.0005</u>	<u>0.0005</u>
Chromium	0.05	0.001	0.03	<u>< 0.0015</u>	<u>< 0.00175</u>	<u>< 0.0015</u>	<u>< 0.0015</u>	<u>< 0.0015</u>
Copper	0.002	0.015	0.075	0.007	0.047	0.007	0.007	0.007
Iron	0.2	-	-	0.02	1.7095	0.0505	0.02	0.02
Manganese	0.05	-	-	0.689	2.7215	0.6805	0.512	0.2115
Mercury	0.001	0.00005	0.0003	< 0.0015	< 0.0008	< 0.0008	< 0.0006	< 0.0006
Nickel	0.02	0.015	0.075	0.005	0.0855	0.0105	0.0025	0.002
Lead	0.01	0.015	0.075	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Selenium	0.01	-	-	< 0.003	0.003	0.003	< 0.003	0.003
Silver	0.01*	-	-					
Zinc	-	0.065	0.8	0.0075	0.241	0.0245	0.005	0.0105
Barium	0.5*	0.05	0.625	< 0.003	< 0.0098	< 0.0145	< 0.008	< 0.0095
Petroleum Indicators								
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
Benzene	0.001	0.0002	0.03	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Toluene	-	0.007	1	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Ethylbenzene	-	0.004	0.15	< 0.0075	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Xylene	-	0.0002	0.07	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015

See notes at the end of Table 2.22



Table 2.21: Results of Groundwater Monitoring at Oil Pits, 2009

	Drinking Water PV	Dutch Values		Average Annual Concentration (mg/l unless stated)		
		S	I	BH-108	BH-106	BH-107
pH (units)	6.5-9.5	-	-	7.595	7.885	7.835
Conductivity (µS/cm)	2,500	-	-	150.05	695.5	761
Nutrients etc.						
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	< 0.14515	0.126	< 0.1387
Chloride	250	-	-	40.8	93.5	57.25
Sulphate (soluble)	250	-	-	11.675	25.15	32.665
Nitrate	50	-	-	0.25	0.35	8.8
Sodium	200	-	-	21.93	32.00	36.93
Potassium	12	-	-	1.80	1.19	4.25
Calcium	200	-	-	13.70	71.94	65.72
Magnesium	50	-	-	6.80	10.90	8.66
Metals						
Arsenic	0.01	0.01	0.06	< 0.0031	< 0.00315	< 0.00285
Boron	1	-	-	0.021	0.012	0.016
Cadmium	0.005	0.0004	0.006	0.0005	0.0005	0.0005
Chromium	0.05	0.001	0.03	< 0.0015	< 0.0015	< 0.0015
Copper	0.002	0.015	0.075	0.007	0.007	0.007
Iron	0.2	-	-	0.02	0.0485	0.02
Manganese	0.05	-	-	1.158	0.246	0.1985
Mercury	0.001	0.00005	0.0003	< 0.0008	< 0.0008	< 0.0008
Nickel	0.02	0.015	0.075	0.0025	0.002	0.002
Lead	0.01	0.015	0.075	< 0.005	< 0.005	< 0.005
Selenium	0.01	-	-	< 0.003	0.003	0.003
Silver	0.01*	-	-			
Zinc	-	0.065	0.8	0.0065	0.011	0.0145
Barium	0.5*	0.05	0.625	< 0.003	< 0.0055	< 0.009
Petroleum Indicators						
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.055	< 0.055	< 0.055
Benzene	0.001	0.0002	0.03	< 0.0075	< 0.0075	< 0.0075
Toluene	-	0.007	1	< 0.0075	< 0.0075	< 0.0075
Ethylbenzene	-	0.004	0.15	< 0.0075	< 0.0075	< 0.0075
Xylene	-	0.0002	0.07	< 0.0015	< 0.0015	< 0.0015

See notes at the end of Table 2.22



Table 2.22: Results of Groundwater Monitoring, 2009 (Landfill Monitoring Programme)

	Drinking Water PV	Dutch Values		BH-103	BH-102	BH-104	BH-105
		S	I				
pH (units)	6.5-9.5	-	-	7.57	7.245	7.395	7.835
Conductivity (μS/cm)	2500	-	-	437.5	342	2510	665.5
Dissolved Oxygen	-	-	-				
Nutrients etc							
Ammoniacal Nitrogen as NH ₄ -N	0.3	-	-	< 0.165	0.126	0.206	< 0.132
Total Oxidised Nitrogen	11.3*	-	-	< 0.275	< 0.395	< 0.275	< 0.275
Chloride	250	-	-	33.8	55.8	425	19.41
Sulphate (Soluble)	250	-	-	16.38	9.685	312.9	99.955
Nitrate	50	-	-	0.55	2.85	0.2	0.25
Sodium	200	-	-	33.36	23.375	84.855	22.2
Potassium	12	-	-	0.785	0.84	3.97	1.935
Calcium	200	-	-	31.905	17.905	255.9	66.27
Magnesium	50	-	-	5.26	2.61	57.665	6.105
Phosphorus	-	-	-	0.01	< 0.0115	< 0.028	< 0.005
Fluoride	1.5	-	-	0.3	0.3	0.3	0.3
Total Alkalinity as CaCO ₃	30*	-	-	74.5	22	250.5	105
Component Alkalinity as CaCO ₃							
Total Organic Carbon	-	-	-	3	6.5	1.501	3.5
Total Cyanide	0.05*	-	-	0.045	0.045	0.045	0.045
Metals							
Arsenic	0.01	0.01	0.06	< 0.00455	0.00275	0.0064	< 0.0033
Boron	1	-	-	0.012	0.0205	0.012	0.012
Cadmium	0.005	0.0004	0.006	<u>0.0005</u>	<u>0.0005</u>	<u>0.0005</u>	<u>0.0006</u>
Chromium	0.05	0.001	0.03	<u>0.0015</u>	<u>0.0015</u>	<u>0.0015</u>	<u>0.0015</u>
Copper	0.002	0.015	0.075	0.007	0.007	0.007	0.007
Iron	0.2*	-	-	0.02	0.0275	0.02	0.02
Manganese	0.05	-	-	0.131	0.012	4.23	2.7925
Mercury	0.001	0.00005	0.0003	< 0.0008	< 0.0035	< 0.0008	< 0.0008
Nickel	0.02	0.015	0.075	0.002	0.002	0.005	0.008
Lead	0.01	0.015	0.075	< 0.005	< 0.005	< 0.005	0.005
Selenium	0.01	-	-	< 0.003	0.003	0.003	0.003
Silver	0.01*	-	-	-	-	-	-
Zinc	-	0.065	0.8	0.0035	0.0185	0.008	0.007
Barium	0.5*	0.05	0.625	0.0035	0.003	<u>0.057</u>	0.0075
Petroleum Indicators							
Diesel Range Organics	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01
Mineral Oils	-	0.05	0.6	< 0.01	< 0.01	< 0.01	< 0.01
Petrol Range Organics	-	-	-	< 0.055	< 0.055	< 0.055	< 0.055
Benzene	0.001	0.0002	0.03	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Toluene	-	0.007	1	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Ethyl Benzene	-	0.004	0.15	< 0.0075	< 0.0075	< 0.0075	< 0.0075
Xylene	-	0.0002	0.07	< 0.015	< 0.015	< 0.015	< 0.015

Notes: Values in **bold** type are greater Drinking water PV
 Values in *italics* indicates that Dutch value/PV is less than the laboratory detection limit
 * indicates EU drinking water standards (not included in SI 439 of 2000)
 Values underlined exceed Dutch S-Value
 Values shaded exceed Dutch I-Value
 ANC Analysis not conducted
 PV Parametric Value for drinking water as per S.I. 430 of 2000
 S-Values Target values. Typical of normal or background concentrations
 I-Values Intervention values. Further investigation may be required to determine whether remediation is necessary.



2.7.4 Comment

The groundwater monitoring survey has two parts: the main survey covering the site as a whole (the tank farm and the oil pits) and a survey of the groundwater in and adjacent to the on-site landfill. The range of parameters analysed varies slightly between the two parts.

Low average pH levels were recorded in two wells during 2009 (MW-2 & MW-3). In the past, low pH levels have often been recorded in CPBBT's groundwater and indeed low pH levels have been recorded at well MW-2 previously. This was found to have been caused principally by the presence of naturally occurring metal sulphides in the soil and ground rock on Whiddy Island. It is likely that this was a contributing cause of the low pH level recorded in the groundwater in 2009.

Several metals were observed to be in excess of their respective drinking water PVs. The concentration of iron exceeded the PV at one well (MW-2) while the concentration of nickel exceeded the PV at one well in the tank farm area (MW-2). This is an improvement on the 2008 monitoring results. As mentioned previously, there are naturally occurring iron pyrites and sulphides in the soil which contribute to the elevated readings of iron.

Recorded concentrations of manganese exceeded the European Drinking water Standard in all wells at one or both stages of testing during 2009. This is in line with similar levels recorded over the past monitoring periods. These elevated concentrations of manganese in the groundwater are likely to be a result of naturally occurring high levels of manganese in the soil and ground rock on site.

Concentrations of copper at MW-2 exceeded the PV limit. This result is lower than the 2008 reading but is consistent with readings at this borehole from previous years and is likely to be naturally occurring.

The average ammoniacal nitrogen concentrations did not exceed the Drinking Water PV at any wells during the 2009 testing. Ammoniacal nitrogen was detected in excess for the first time in 2004 at BH-107 (0.5mg/l) and has been noted on several occasions since. This parameter will continue to be monitored in future analyses to determine whether these readings are indicative of a trend. To date, no sign of a trend is apparent as the wells with higher concentrations vary from year to year across the site.

MW-3 showed an exceedance of the PV limit for Chloride (448.05 mg/l) in 2009. Similar levels have often been recorded in the past at this location and are likely to be a consequence of naturally occurring minerals in the ground rock of the area.

It should be noted that none of the petroleum indicators were detected in any of the samples at either the tank farm or the oil pits, which is in line with the results from previous years.



The monitoring conducted at the landfill also indicated a good overall standard, although there were some exceedances. The average annual concentration of sulphate at BH-104 (312.9 mg/l) was slightly in excess of the PV in 2009. Analysis of soil at the Terminal conducted in 2002 revealed high levels of naturally occurring sulphates in the vicinity of Tank 205 which is adjacent to BH-104. This may explain why sulphate concentrations are significantly higher at this location than those recorded at other locations around the site.

Slight exceedances in the average annual concentration of calcium (255.9 mg/l) and magnesium (57.67 mg/l) were recorded at BH-104. These limits were also exceeded at this well in 2008. There has been a gradual trend upwards in the levels of calcium and magnesium found in the groundwater at BH-104. According to the EPA report “Towards setting guideline values for the protection of groundwater in Ireland” limestone bedrock and limestone dominated subsoils, commonly found in Ireland and on Whiddy Island, can lead to groundwater that is often hard, containing high concentrations of calcium. Any further trends in this parameter will continue to be monitored as part of the biannual groundwater monitoring for the site.

High manganese concentrations were recorded across all the monitoring wells (except BH-102) in 2009. Similar levels have regularly been recorded in the past and are likely to be a consequence of naturally occurring manganese and iron in the ground rock as previously described. The alkalinity readings exceeded the PV (for EU drinking water standards) at all these wells as per previous years.

No hydrocarbons were detected in any of the monitoring wells at the site in 2009 indicating there is no significant contamination of the groundwater from the tank farm.



3 Comparison with Results of Previous Surveys

3.1 Introduction

Previously, the results of the monitoring programmes were compared to those from previous years using the analysis of variance (ANOVA) methodology. This methodology does not give any indications of a trend, it simply determines whether the results for each year are equivalent to each other. At this stage, the monitoring programme has been ongoing for enough years that it is inevitable that the analysis will show that there are differences between the various years as it only takes one year of significantly high or low figures for an ANOVA to show that there are significant differences. Due to the varying nature of such results from year to year it was decided to cease this analysis, as it was not possible to gain any useful insight from it. Instead, plots are now produced showing how the results have varied over the course of the monitoring programme and can be used to clearly identify any trends in the monitoring results.

3.2 Grab Sampling of Water Column

In previous years, testing was carried out for total hydrocarbons and tests for total petroleum hydrocarbons were undertaken only where total hydrocarbons were detected. However, since 2003 a new laboratory technique was introduced (the Ekofisk technique) which tests the samples for total petroleum hydrocarbons rather than simply for total hydrocarbons. This reduced the limit of detection by a factor of 1,000 and correspondingly increased the number of detections. The results of the analysis for the period 2003 to 2009 are given in Table 3.1.

Table 3.1: Results of Water Column Analysis for Total Petroleum Hydrocarbons (mg/l, Bantry Bay sites only)

	2003	2004	2005	2006	2007	2008	2009
Min	0.0004	0.0002	0.0001	0.0004	0.0002	0.0002	0.0020
Max	0.0028	0.0062	0.0099	0.0092	0.0015	0.0002	0.0020
Mean	0.0015	0.0012	0.0014	0.0020	0.0005	0.0002	0.0020

We have not examined how the concentrations of Tributyl tin (TBT) have varied over time, as detections of this parameter have not been very common due to the low concentrations in the water column. Instead, we have expressed the number of detections each year as a percentage of the samples taken.



Table 3.2: Number of Grab Samples of Water in which Tributyl Tin was detected

Year	No. of Samples	No. of Detections	% Detections
1996	25	7	28
1997	44	11	25
1998	21	4	19
1999	20	0	0
2000	13	0	0
2001	18	4	22
2002	0	0	0
2003	20	1	5
2004	20	0	0
2005	24	2	8
2006	20	2	10
2007	20	0	0
2008	20	0	0
2009	20	0	0

Table 3.2 shows the number of analyses made and the number of samples in which TBT was detected for each year of the monitoring programme. The average level of Tributyl Tin found in the control water of Kenmare was comparable to that of Bantry Bay.

3.3 Chemical Analysis of Mussel Samples

Table 3.3 and Table 3.4 illustrate the variation in the concentrations of each parameter over the course of the monitoring programme. Table 3.4 shows how the concentrations have varied from year to year. Table 3.4 shows how the concentrations vary between mussel sites. The plots from Figure 3.1 to Figure 3.9 show the variation each year in the chemical analyses at each of the different sample locations.



Table 3.3: Average Concentrations in Mussel Samples for each year since 1996

(Values are in mg/kg WW unless stated)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Solids (%)	20.78	17.61	17.9	21.59	22.55	18.36	20.3	20.5	15.32	19.54	18.18	18.9	18.0	20 (est)
Arsenic	-	-	-	2.85	2.58	1.58	1.98	2.25	1.6	1.74	1.81	1.81	1.68	2.13
Cadmium	0.1	0.08	0.08	0.12	0.13	0.09	0.09	0.1	0.08	0.13	0.09	0.08	0.07	0.09
Chromium	0.26	0.31	0.18	0.41	0.4	0.26	0.18	0.36	0.19	0.12	0.22	0.28	1.58	0.30
Copper	1.24	1.00	0.97	1.43	1.48	1.16	1.26	0.99	0.99	1.33	1.04	1.2	0.90	1.00
Lead	0.25	0.21	0.17	0.28	0.17	< 0.2	0.09	0.17	0.14	0.08	0.14	0.11	0.12	0.15
Mercury	0.014	0.013	0.01	0.011	0.011	0.008	0.009	0.014	0.009	0.012	0.014	0.076	0.010	0.01
Nickel	0.36	0.28	0.24	0.38	0.36	0.3	0.41	0.2	0.15	0.14	0.23	0.17	2.03	0.32
Vanadium	0.43	0.37	1.01	0.57	0.52	2.00	0.4	2.75	0.3	0.21	0.37	-	0.39	0.52
Zinc	21.03	17.5	15.96	19.27	21.67	26.93	16.07	19.41	17.24	15.01	15.99	13.07	14.12	15.61
TPH (mg/kg DW)	35.61	34.89	4.84	11.59	16.10	15.26	19.32	8.92	30.05	17.43	48.09	14.31	24.3	8.37
Sum PAH (mg/kg DW)	0.61	0.27	0.14	1.09	1.54	2.04	2.48	1.16	1.38	0.69	0.622	0.603	0.387	*

Table 3.4: Average Results of Mussel Analyses for Each Sampling Site (all years)

(Values are in mg/kg WW unless stated)

	Dannemark	Four Heads Point	Glengarriff Harbour	League Point	Lousy Castle Island	North Chapel East	North Chapel West	Snave	South Chapel	Whiddy Point East
Total Solids (%)	20.2%	19.8%	19.2%	18.8%	18.9%	18.2%	18.4%	19.4%	19.8%	19.1%
Arsenic	2.16	1.82	2.14	1.78		2.27	2.60	2.54	1.98	2.03
Cadmium	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.09	0.09	0.09
Chromium	0.45	0.26	0.25	0.33	0.14	0.28	0.32	0.31	0.48	0.33
Copper	1.22	1.16	0.99	1.08	0.74	1.01	0.97	0.97	1.14	1.12
Lead	0.19	0.12	0.15	0.17	0.17	0.19	0.16	0.15	0.17	0.13
Mercury	0.012	0.012	0.011	0.008	0.008	0.009	0.010	0.009	0.010	0.010
Nickel	0.50	0.33	0.27	0.44	0.20	0.25	0.24	0.27	0.49	0.36
Vanadium	0.48	0.45	0.85	0.49	0.44	0.44	0.39	0.64	0.64	0.65
Zinc	20.55	17.01	16.27	15.97	11.97	14.96	15.45	13.57	17.20	20.05
TPH (mg/kg DW)	10.4	5.84	4.18	3.73	9.45	16.9	5.05	5.6	11.3	11.2
Sum PAH (mg/kg DW)	*	*	*	*	*	*	*	*	*	*

* values to be reported in the 2010 AER due to laboratory accreditation problem

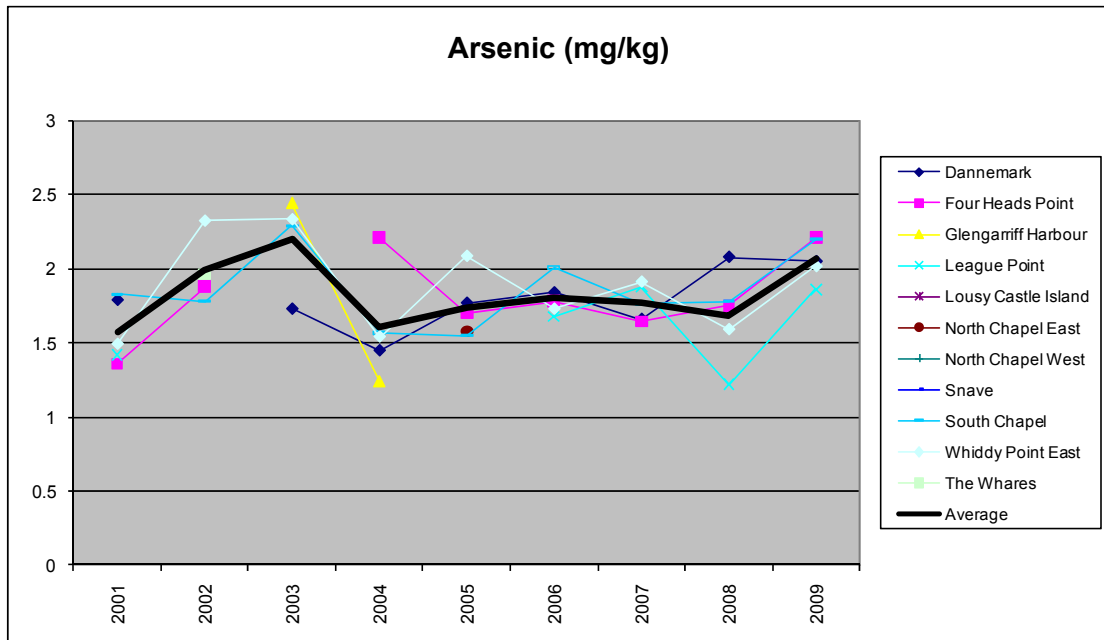


Figure 3.1: Arsenic Wet Weight Results from Chemical Analysis of Mussels

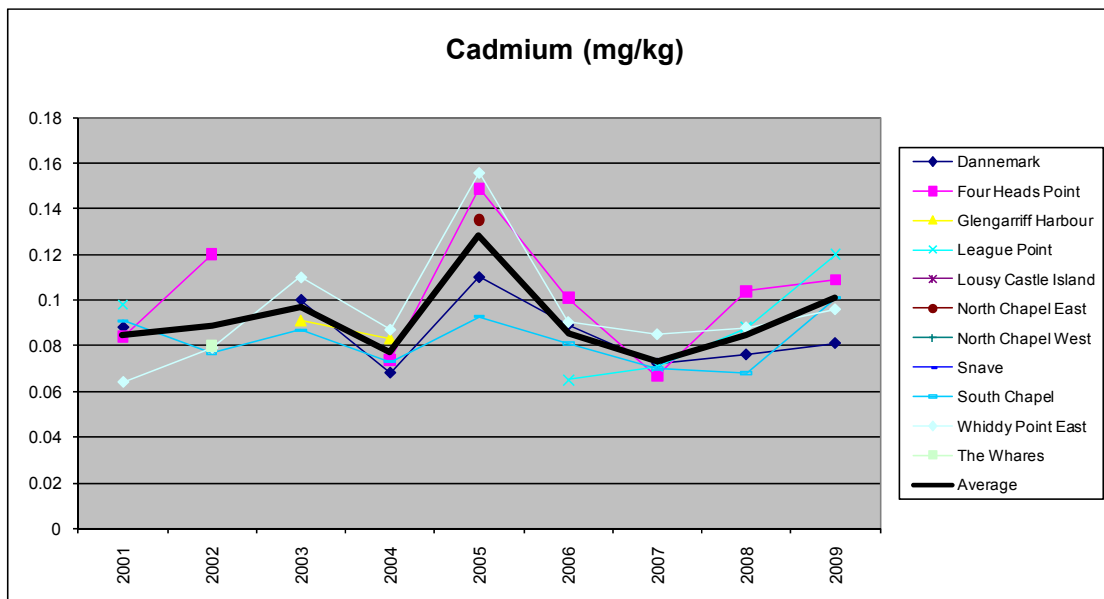


Figure 3.2: Cadmium Wet Weight Results from Chemical Analysis of Mussels

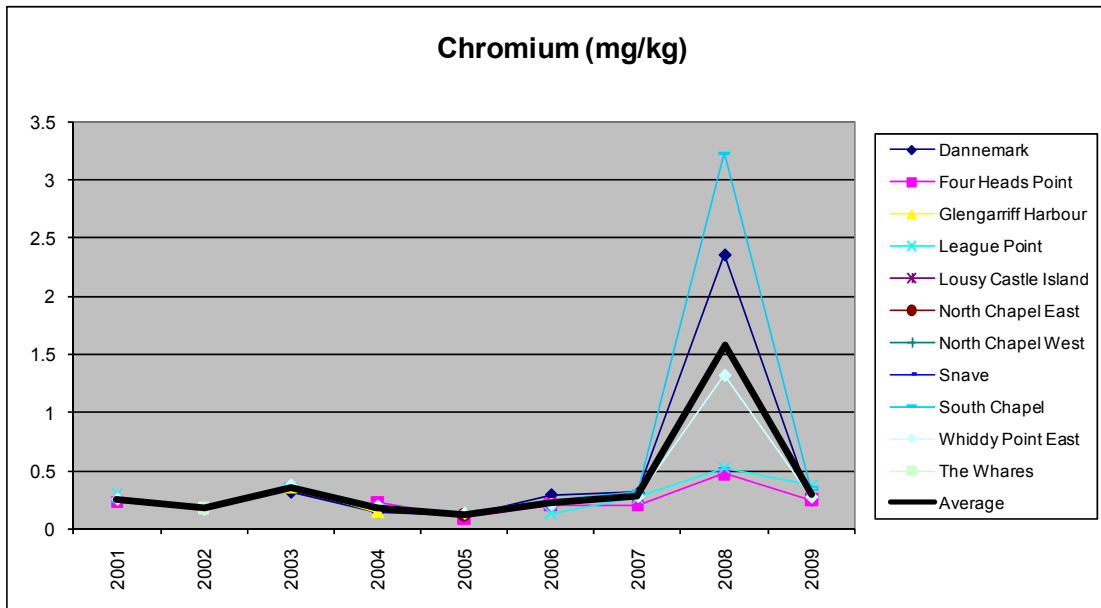


Figure 3.3: Chromium Wet Weight Results from Chemical Analysis of Mussels

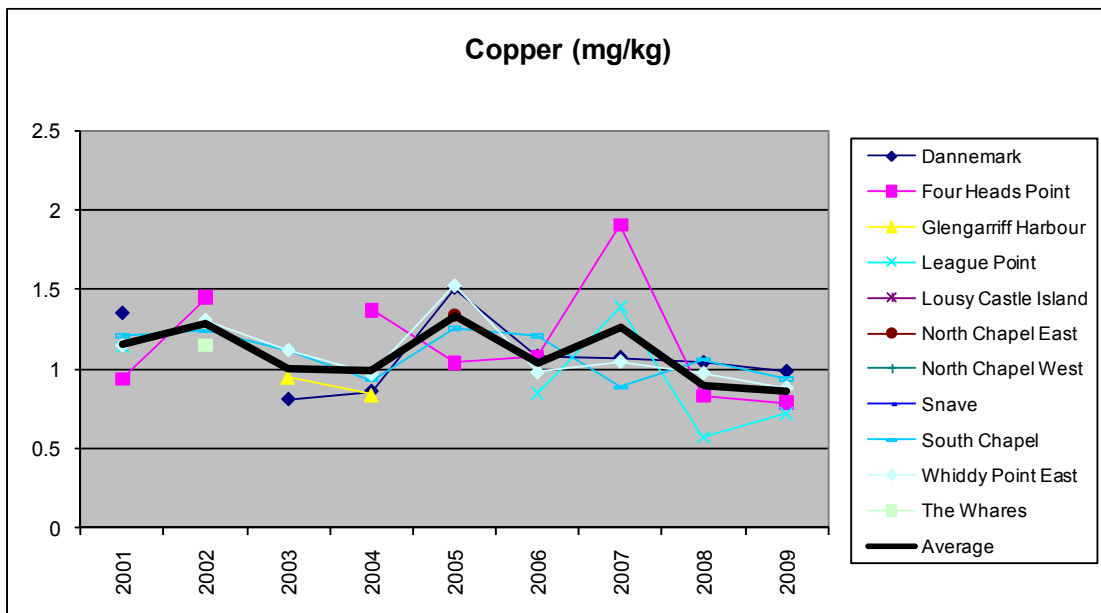


Figure 3.4: Copper Wet Weight Results from Chemical Analysis of Mussels

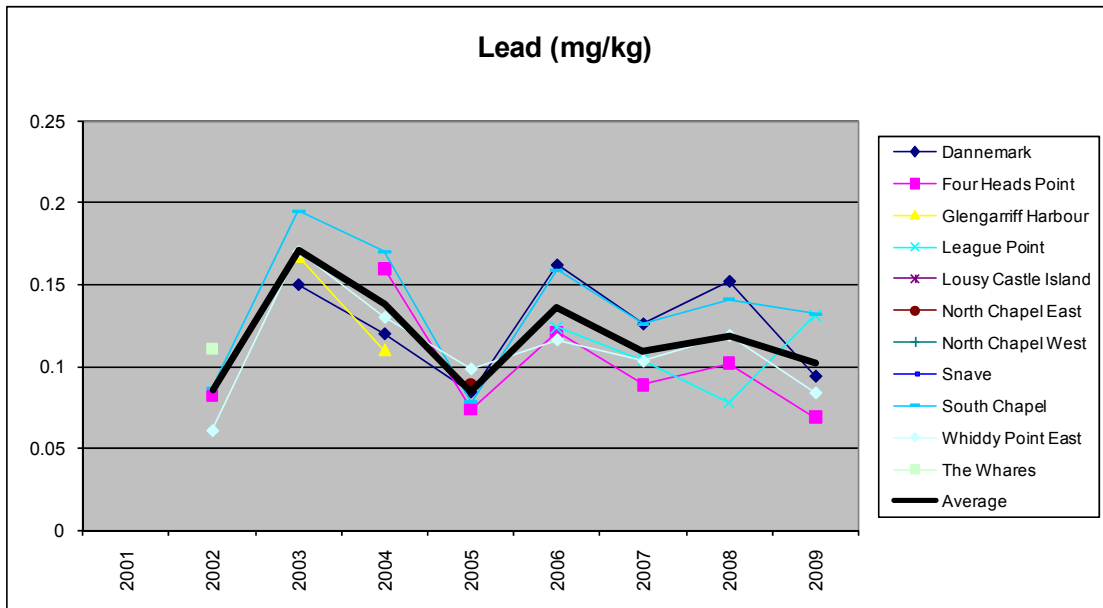


Figure 3.5: Lead Wet Weight Results from Chemical Analysis of Mussels

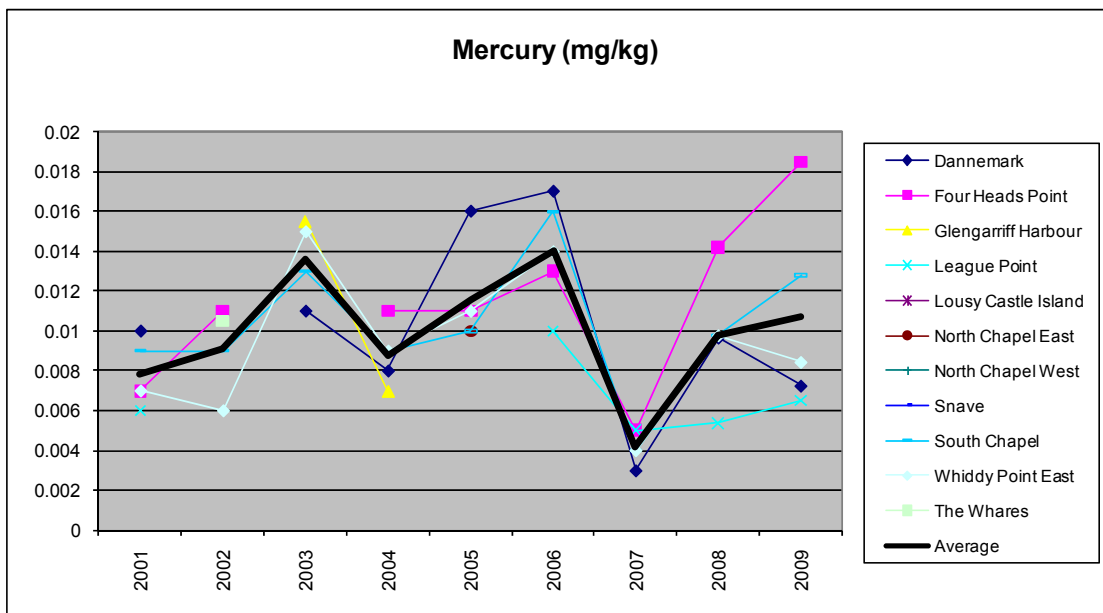


Figure 3.6: Mercury Wet Weight Results from Chemical Analysis of Mussels

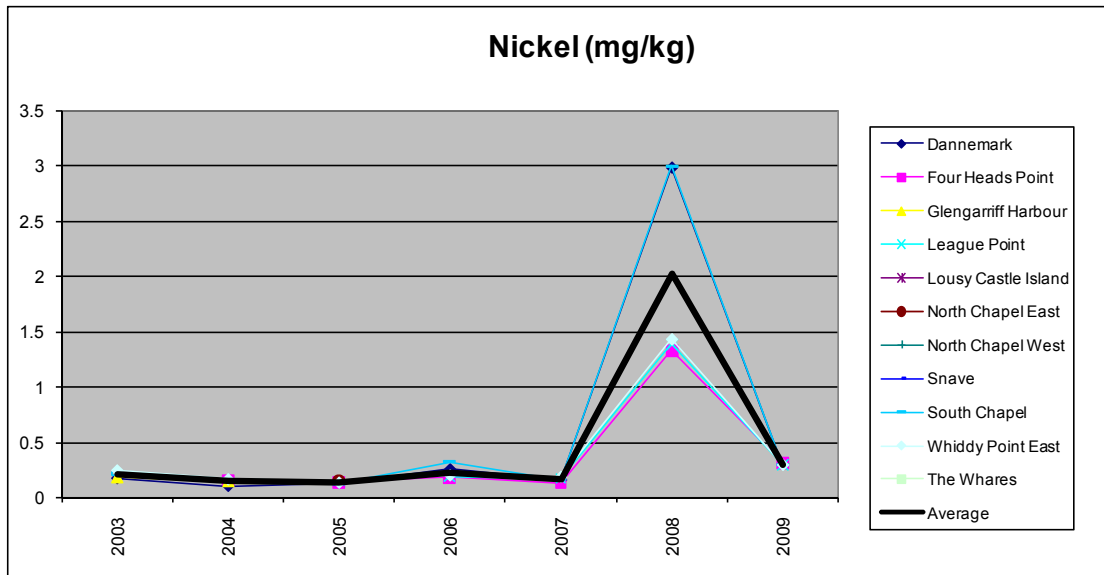


Figure 3.7: Nickel Wet Weight Results from Chemical Analysis of Mussels

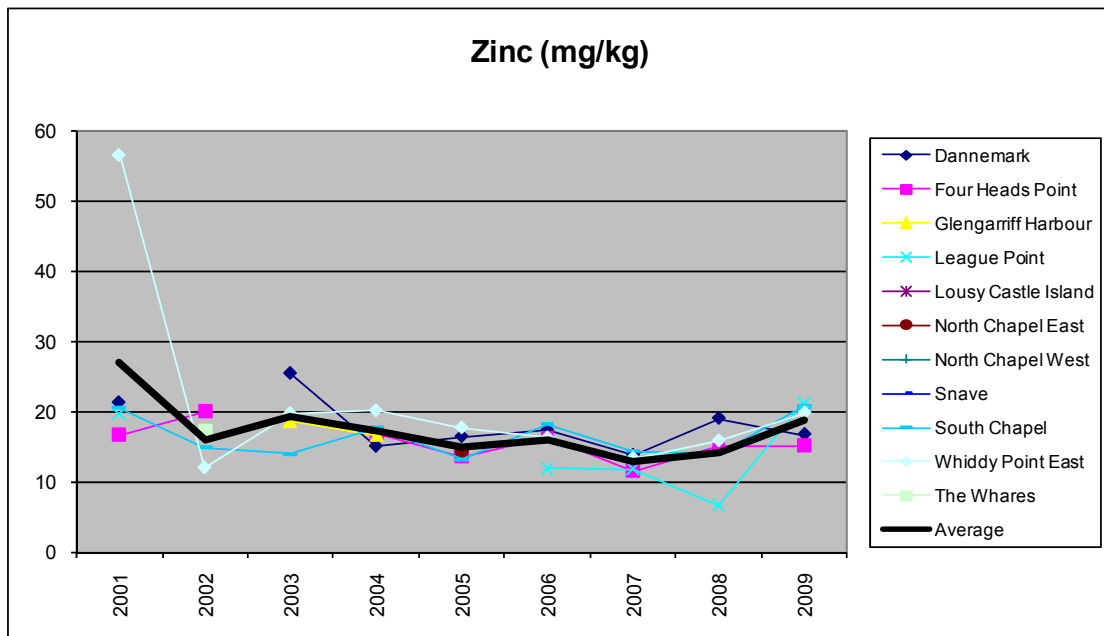


Figure 3.8: Zinc Wet Weight Results from Chemical Analysis of Mussels

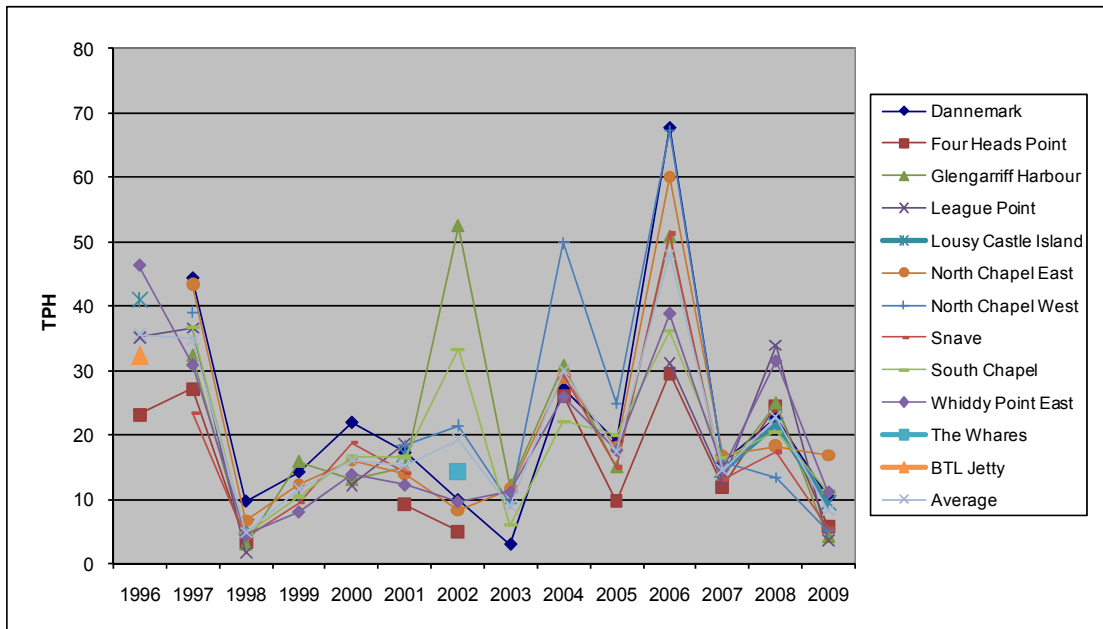


Figure 3.9: TPH Results from Chemical Analysis of Mussels (mg/kg DW)

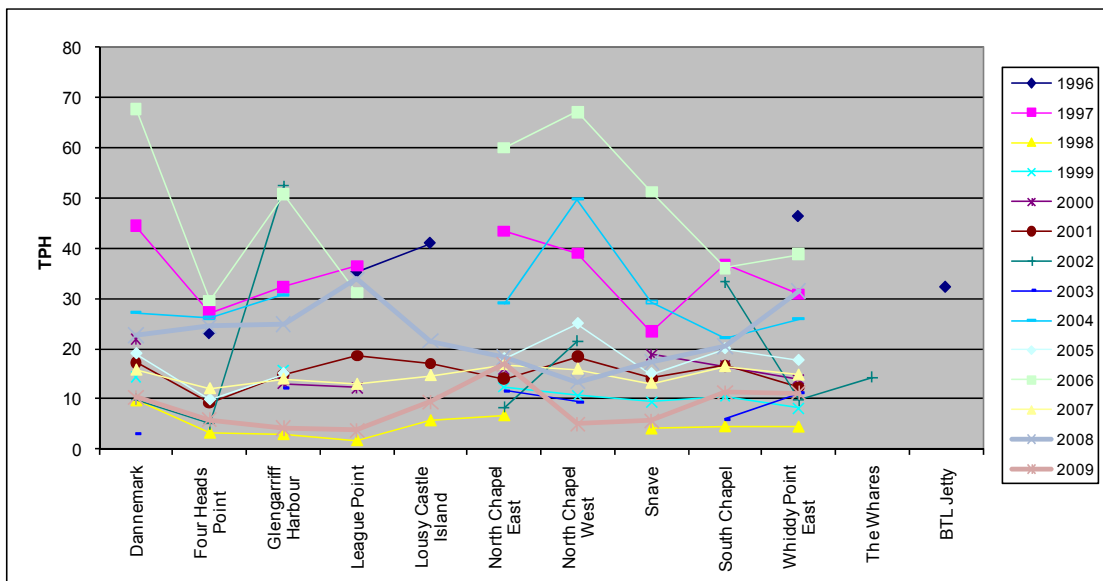


Figure 3.10: PAH Results from Chemical Analysis of Mussels (mg/kg DW)

The results for 2001 to 2009 have been shown in graph form in Figure 3.1 to Figure 3.8. These give a clear indication of the scatter of results for each year as well as the variation by location. The results for TPH and total PAHs are given in Figure 3.9 and Figure 3.10. The TPH graph shows the results from 1996 until 2009, with the PAH graph showing the results from 1996 to 2008. As explained earlier the results for the Mussel TPH are due in mid-2010 and will be included in the 2010 AER.



From Figure 3.9 and Figure 3.10, it can be seen that the 2009 results for Arsenic, Cadmium, Lead, Mercury and Zinc are all broadly similar to previous years. The recorded levels of Lead and Chromium have varied widely from year to year over the course of the programme. In 2008 Nickel and Chromium showed a wide deviation in results compared to previous years. At the time it was suspected that the readings were anomalous due to their magnitude. The 2009 results for Nickel and Chromium returned to the typical levels seen prior to 2008. This indicates that the 2008 values were a spike in the data, rather than an indication of an upward trend.

None of the results indicate any significant trend upwards or downwards in levels of any of the parameters tested for and this will continue to be monitored to ensure no significant trends become apparent. There is no trend showing increased concentrations of metals in mussels collected from locations close to the Terminal when compared with the results from more distant locations.

The TPH results given in Figure 3.9 illustrate there is no significant trend in results but that there is a high degree of scatter from year to year. Since 2001, mussels have been collected annually from the Dolphin No.1 jetty and analysed for PAHs and Total Hydrocarbons. The results from samples collected here show that over the period since testing began there is no trend in the levels of Hydrocarbon found in the test samples from the jetty. There was no detections of TBT in the mussels sampled at the jetty.

As mentioned earlier due to a laboratory accreditation problem the PAH results for both the commercial and jetty mussels have not yet been received. The results are expected in the coming months and will be reported in the 2010 Annual Environmental Report

3.4 Taste Testing of Mussel Samples

No preference testing was carried out in 2009 due to the occurrence of Azaspiracid shellfish poisoning toxins (AZP), during the sampling events.

3.5 Seed Mussel Distribution Survey

The results of all Seed Mussel Surveys between 1996 and 2009 are summarised in Table 3.5 and Table 3.6.

From the average line shown in the Figure 3.11 and Figure 3.12 it is clear that there is a wide variation in results for both location and year-to-year.



Table 3.5: Results of Seed Mussel Distribution Survey (Average Spatfall Abundance per site – no. of mussels per 0.01m²)

	Coosard	Derrylough	Maccurragh	South of Illuancreveen	Ardaturrish	Gerane East	Gerahies	Toreen	Collack	Glanrooncosh	Crookhaven (Control)
1996	372	224	7	85	136	40	46	254	56	193	270
1997	191	31	31	47	110	34	39	68	48	69	79
1998	301	70	35	255	37	54	249	33	65	-	69
1999	167	630	10	237	-	3	425	335	76	-	45
2000	214	460	212	13	200	17	189	153	33	157	40
2001	572	502	42	324	260	201	414	126	6	439	138
2002	1,907	1,217	742	718	1,310	1,171	1,295	1,458	94	522	372
2003	266	60	15	78	252	49	314	77	55	156	168
2004	1,000	1,366	107	146	242	46	726	352	192	252	-
2005	737	633	109	369	552	106	436	255	67	280	5
2006	713	905	265	310	368	129	351	422	131	498	61
2007	503	269	131	15	240	94	288	173	55	351	-
2008	1553	1065	217	91	431	142	1028	598	90	108	77
2009	1391	448	351	779	665	865	612	547	406	545	123

Note: Dashes indicate that no transects were available at that sample site

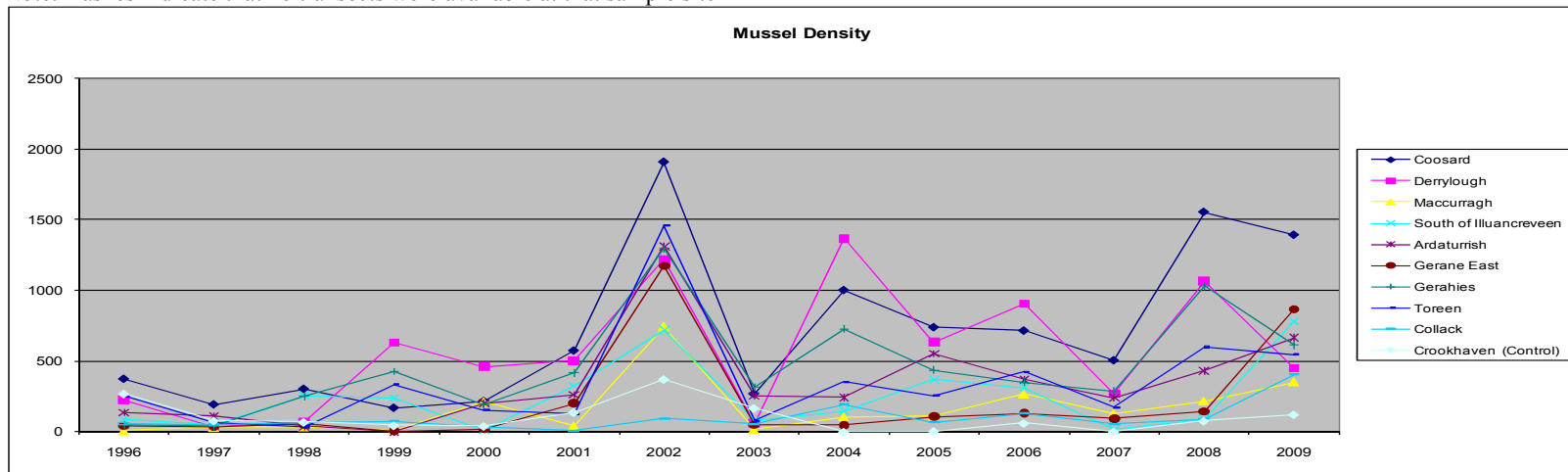


Figure 3.11: Mussel Density by Year



Table 3.6: Results of Seed Mussel Distribution Survey (Mean Shell Length in mm)

	Coosard	Derrylough	Maccurragh	South of Illuancreveen	Ardaturrish	Gerane East	Gerahies	Toreen	Collack	Glanrooncosh	Crookhaven (Control)
1996	8.24	8.02	9.34	8.41	8.43	10.62	6.52	8.39	13.18	11.23	10.43
1997	5.99	3.76	5.88	6.42	5.26	5.49	4.37	4.54	4.24	5.17	6.2
1998	5.77	3.23	2.72	5.42	2.60	3.34	6.62	1.95	2.51	-	2.17
1999	5.16	4.27	2.57	11.05	-	1.3	5.35	3.56	8.24	-	1.4
2000	6.64	4.77	6.41	7.74	6.58	6.78	7.55	6.03	7.69	7.15	1.78
2001	5.05	4.83	3.21	2.00	5.79	5.31	5.44	5.63	3.83	5.72	5.33
2002	3.16	3.97	5.16	3.05	4.19	2.7	3.04	3.65	4.07	3.28	4.19
2003	4.31	3.95	4.2	3.94	4.14	6.77	4.09	3.47	5.34	8.9	7.34
2004	4.8	4.19	3.34	5.12	5.48	5.73	5.47	7.22	6.87	9.42	-
2005	4.47	3.63	3.76	6.12	5.44	4.26	4.70	3.80	7.90	4.65	2.40
2006	6.32	8.03	5.22	8.28	5.34	5.64	5.51	6.27	8.34	6.18	7.18
2007	2.28	5.22	4.6	7.5	7.21	10.01	4.83	6.05	11.07	5.05	-
2008	4.2	5.9	4.6	5.9	6.9	3.8	4.9	6.3	9.3	5.1	4.2
2009	3.9	4.2	5.9	4.6	5.9	6.9	3.8	4.9	6.3	9.3	5.1

Note: Dashes indicate that no transects were available at that sample site

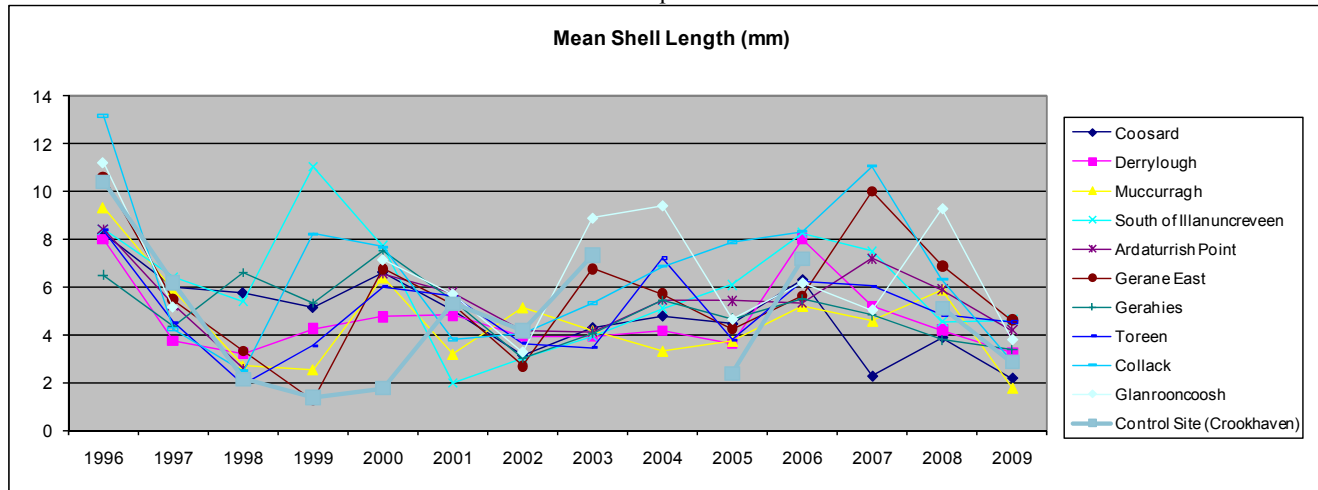


Figure 3.12: Mean Mussel Shell Length by Year



3.6 *Chemical Analysis of Sediment*

The following tables illustrate the variation in the concentrations of each of the parameters since the commencement of the monitoring programme in 1996. Table 3.7 shows how the concentrations have varied from year to year. Table 3.8 shows how the concentrations have varied between sampling sites.



Table 3.7: Average results for each year in Sediment Samples (mg/kg DW unless stated)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Solids	59%	50%	46%	48%	48%	52%	51%	59%	55%	54%	50%	51%	48%	54.8%
Al	-	-	-	-	-	53,522	17,467	-	22,039	23,166	11,806	53,883	60,167	60,900
As	-	-	-	-	8.68	10.64	9.29	8.69	9.18	8.56	6.92	12.24	12.34	12
Cd	0.204	0.109	0.128	0.132	0.093	0.146	0.107	0.083	0.100	0.064	0.087	0.18	0.259	0.1
Cr	42.32	36.67	40.75	44.84	43.71	78.63	33.30	32.90	45.10	38.90	27.27	103.4	74.22	78
Cu	7.91	12	10.36	10.45	10.89	36.32	10.98	25.63	12.89	10.28	9.63	19.17	74.33	29
Pb	17.22	21.02	25.38	24.24	21.83	29.27	25.40	20.02	22.30	22.85	22.70	32.13	26.45	27
Li	-	-	-	-	-	53.61	33.08	-	45.75	34.08	31.62	66.93	43.75	47
Hg	0.030	0.040	0.042	0.948	0.045	0.071	0.056	0.045	0.044	0.043	0.044	0.05	0.037	0.047
Ni	19.62	25.32	19.56	21.79	23.03	29.94	25.28	21.30	24.11	21.74	19.84	42.45	32.78	37
Va	34.47	3.95	48.61	48.83	47.13	88.76	31.35	37.10	53.93	45.82	28.00	-	71.89	87
Zn	66.31	85.33	81.06	88.92	83.54	97.53	77.67	74.75	78.79	74.37	66.38	91.17	89.6	109
TPH	11.14	45.50	34.44	35.66	39.60	5.05	33.11	31.34	56.22	42.13	41.82	30.22	44.44	25.7
PAHs	0.581	0.344	0.309	0.489	0.747	1.167	1.014	0.774	0.746	1.201	0.552	0.757	0.453	0.447

Al *Aluminium*

As *Arsenic*

Cd *Cadmium*

Cr *Chromium*

Cu *Copper*

Pb *Lead*

Li *Lithium*

Hg *Mercury*

Ni *Nickel*

Va *Vanadium*

Zn *Zinc*

TPH *Total Petroleum Hydrocarbons*

PAH *Polycyclic Aromatic Hydrocarbons*



Table 3.8: Results of Analysis of Sediment Samples at each site (all years) (mg/kg DW unless stated)

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Total Solids	51.5%	46.4%	42.4%	55.3%	59.6%	52.8%	67.0%	42.9%
Aluminium	33,591	39,640	41,538	33,590	28,543	30,569	-	-
Arsenic	11.09	12.30	10.11	9.30	6.61	8.27	-	-
Cadmium	0.15	0.17	0.14	0.10	0.11	0.11	-	-
Chromium	46.55	54.26	57.27	50.19	45.68	43.40	-	-
Copper	21.61	24.45	17.12	15.24	20.91	16.49	-	-
Lead	24.10	30.74	28.35	21.23	18.60	20.44	-	-
Lithium	41.08	47.82	56.19	43.32	36.12	37.58	-	-
Mercury	0.11	0.21	0.16	0.07	0.06	0.07	-	-
Nickel	25.99	29.87	30.46	22.43	20.38	21.67	-	-
Vanadium	47.54	54.33	50.04	37.92	33.05	37.54	-	-
Zinc	85.36	96.49	94.52	69.51	65.71	63.81	-	-
TPH	3.065	26.2	20.8	10.145	11.65	10.33	7.625	21.35
PAHs	1.169	2.348	0.722	0.656	0.489	0.620	0.236	0.844

The results of sediment analysis have been grouped together by year and by location in Table 3.7 and Table 3.8, these tables display both the current and historical results for the PAHs in the mussel sediments across all sites since the sampling began.

Since 2001, PAH and TPH have been assayed at an additional two sites (Site 7 and Site 8). In 2008 there was an elevated reading for PAHs at site 2; at the time it was suspected that this result was an error. The 2009 results show a return to PAH levels seen prior to 2008 at site 2. This indicates that there may have been an anomaly in the PAH testing for this site in 2008 and confirms that there is no rising trend evident for PAHs at site 2.

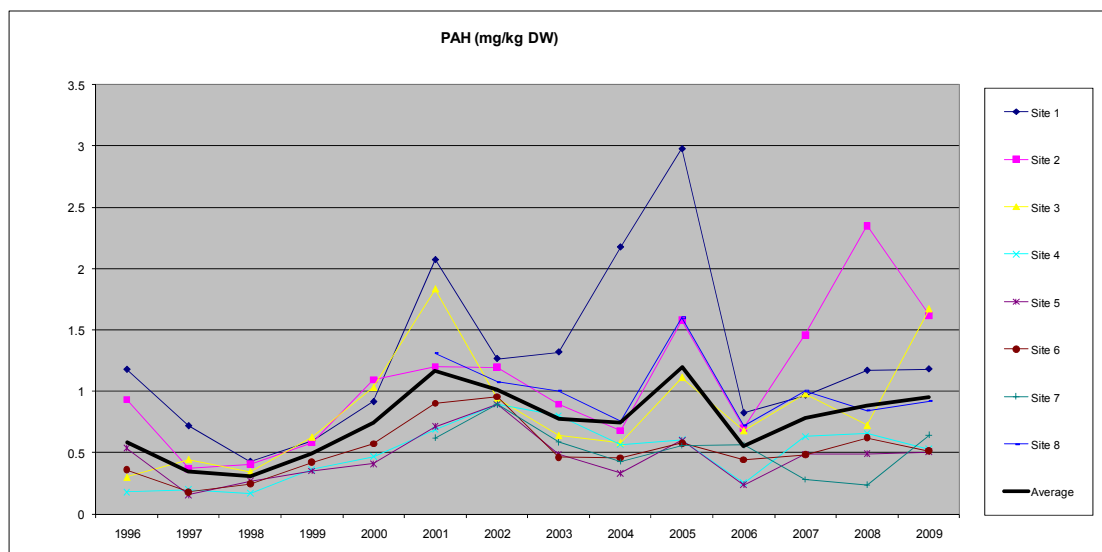


Figure 3.13: PAH levels in Sediment samples

In Figure 3.14 the variation in TPH levels from samples since the commencement of the monitoring programme clearly illustrates a similar variation in levels across all sites for each year, with the exception of the results for 2001. The results for 2008 were within the levels previously found in the Bay at all of the sample sites except site 2. The 2009 results



show a TPH reading similar to those previously recorded at site 2. This indicates that the elevated reading observed at this site in 2008 may have been due to errors in testing or due to sample contamination, and confirms that there is no rising trend evident for TPH.

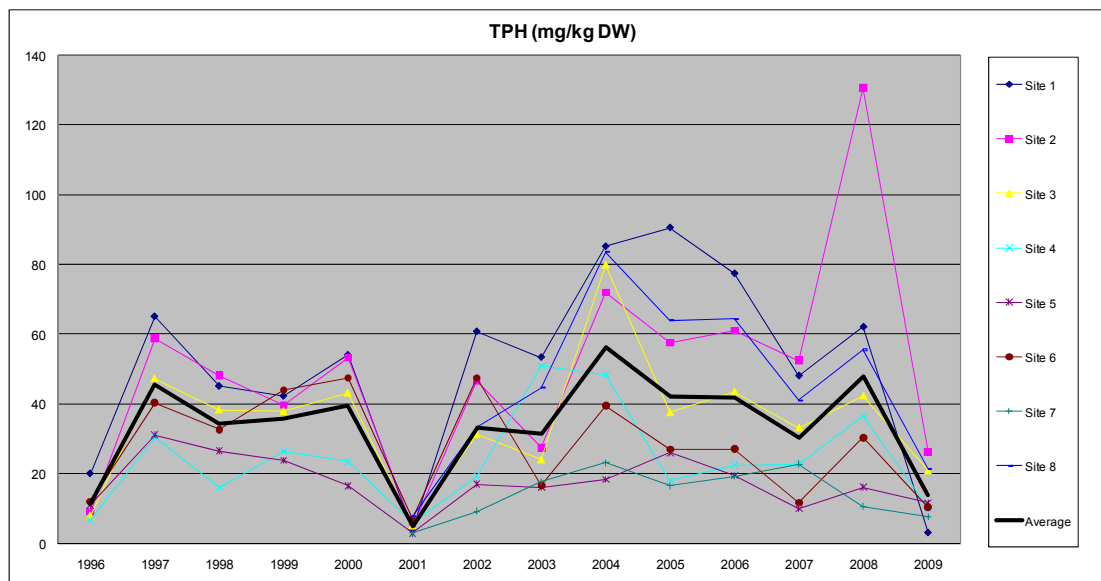


Figure 3.14: TPH in sediment samples

Figure 3.15 to Figure 3.24 in the following pages show the results for the chemical parameters tested in the sediment samples between 2000 and 2009, with the exception of aluminium and lithium which commenced in 2001 and have no results in 2003, there were no results recorded for vanadium in 2001. All parameters observed were broadly in line with previous years testing and no parameters increased significantly during the 2009 monitoring round.

Due to the wide variation in results from year-to-year, there does not appear to be a significant increase in the levels of the parameters analysed over the period since testing began. These parameters will continue to be monitored to see if any significant trend upwards or downwards becomes apparent in any of the test parameters. As in previous years, there is no trend showing increased concentrations of any of the parameters in sediment samples collected in locations close to the terminal.

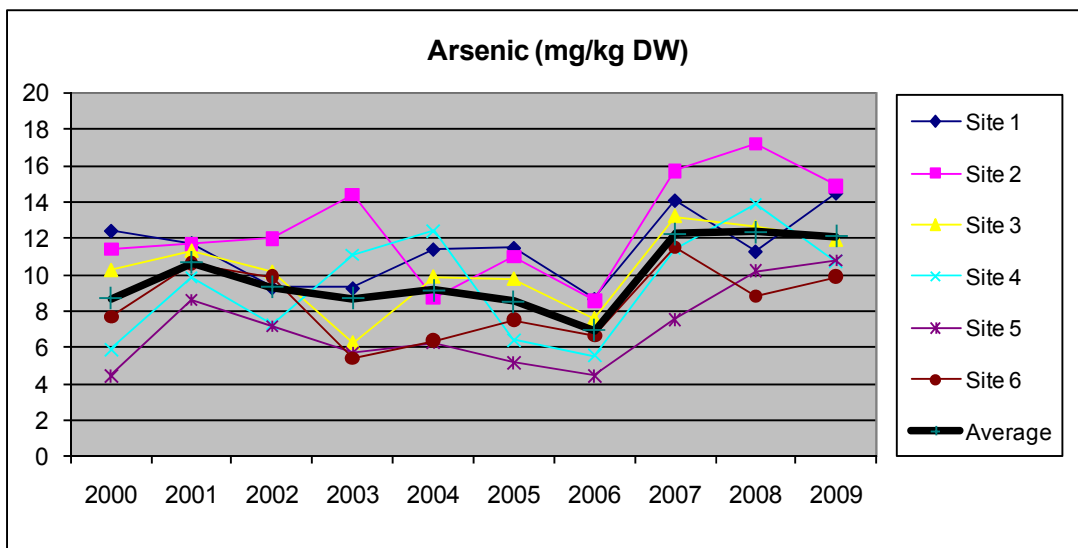


Figure 3.15: Arsenic Levels in Sediment Samples

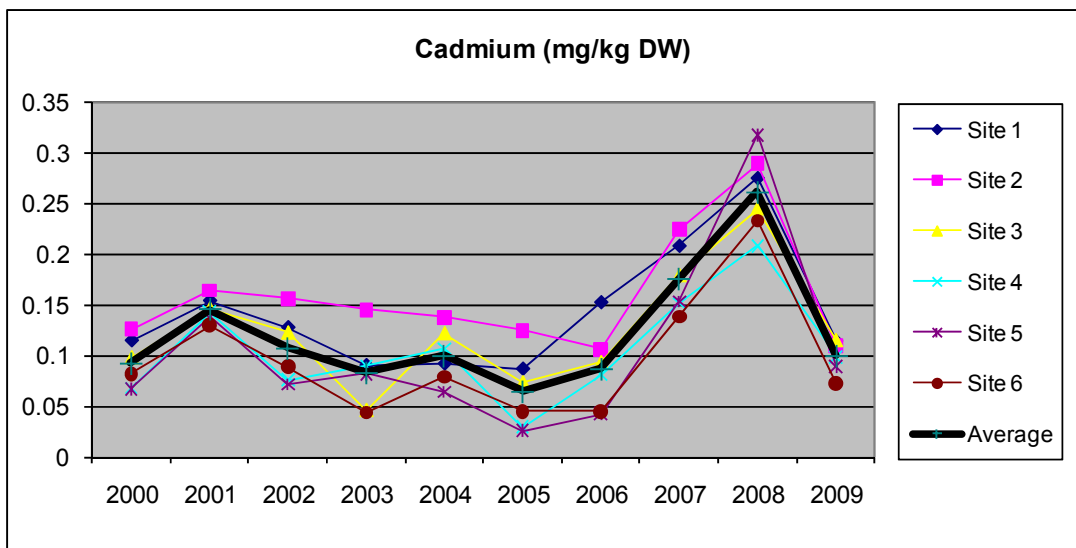


Figure 3.16: Cadmium Levels in Sediment Samples

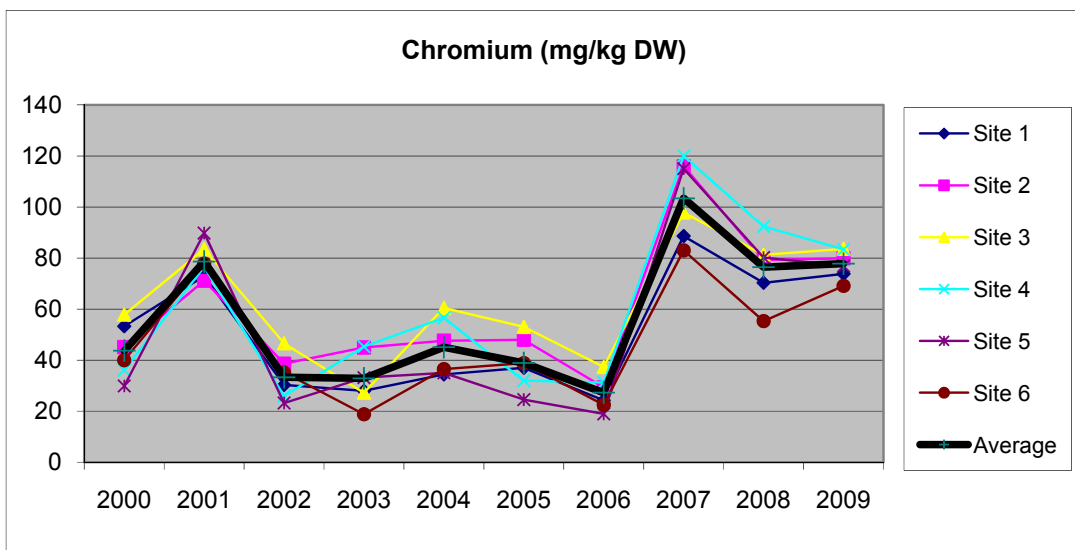


Figure 3.17: Chromium Levels in Sediment Samples

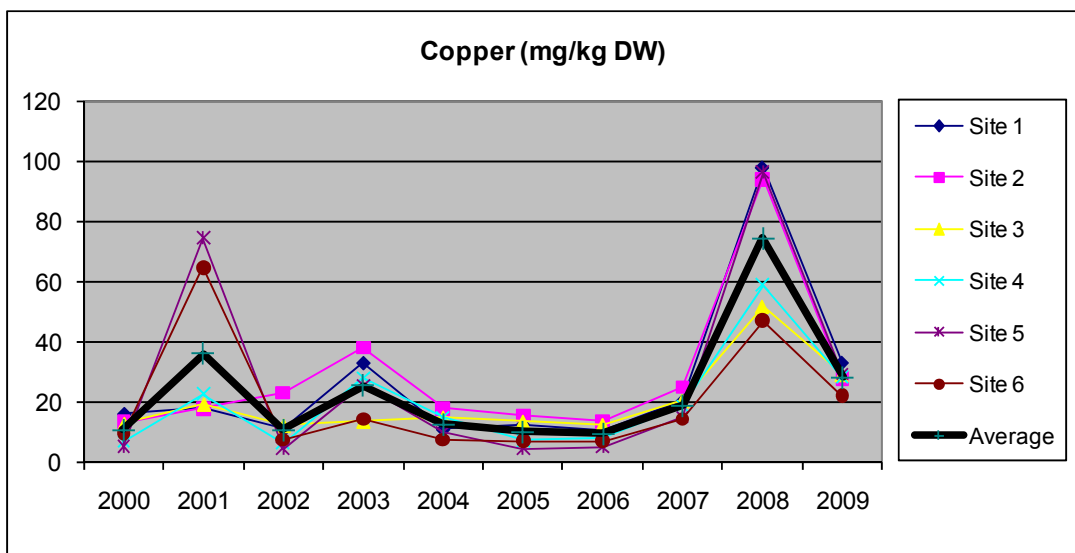


Figure 3.18: Copper Levels in Sediment Samples

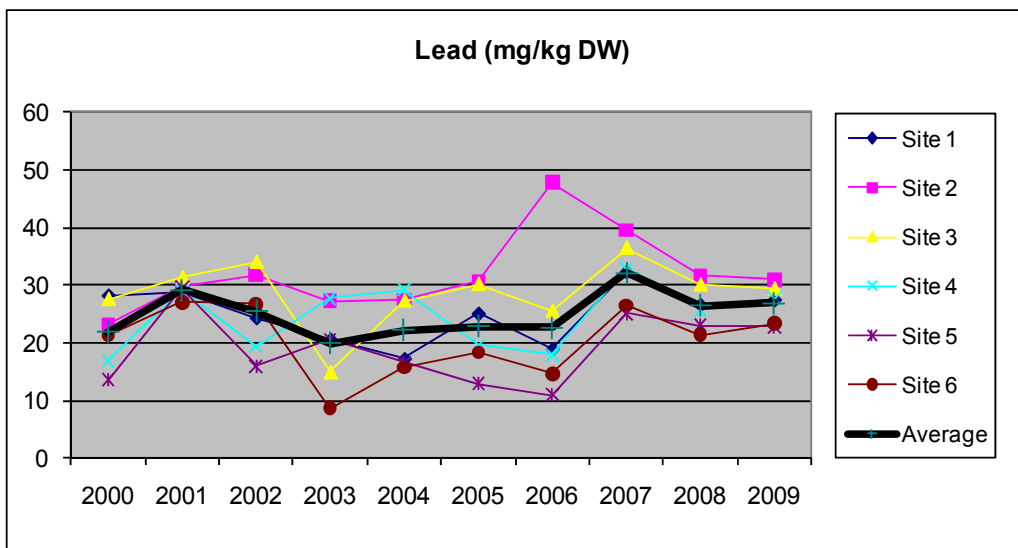


Figure 3.19: Lead Levels in Sediment Samples

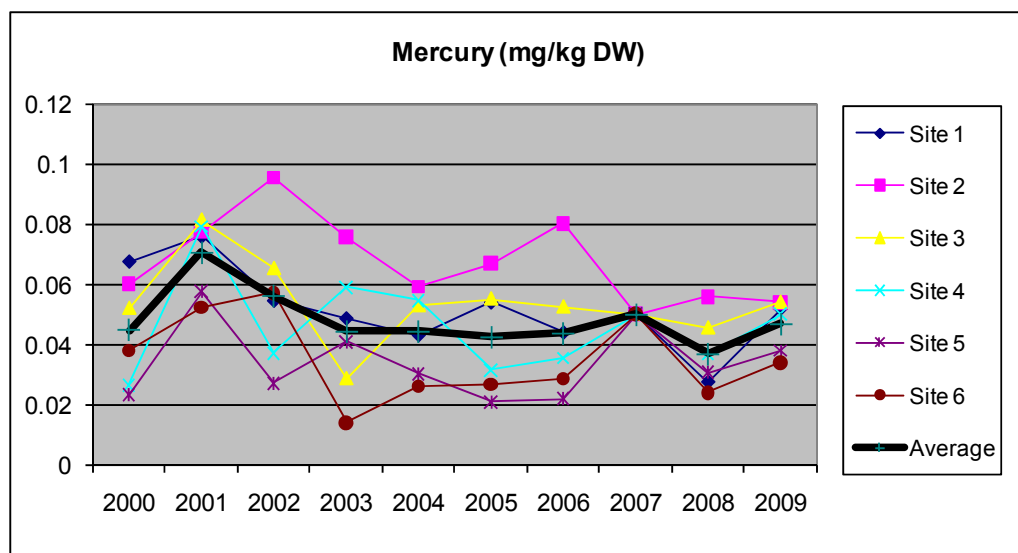


Figure 3.20: Mercury Levels in Sediment Samples

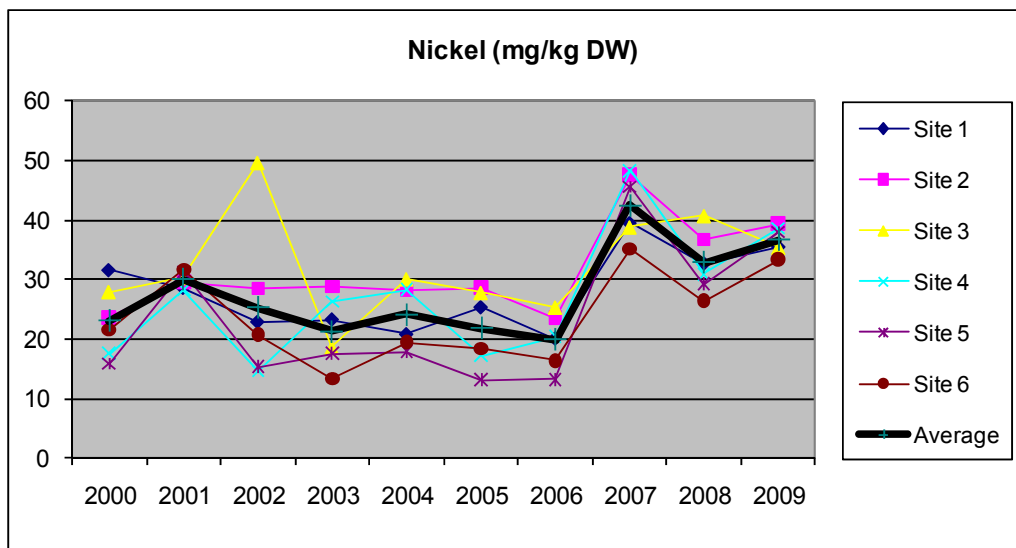


Figure 3.21: Nickel Levels in Sediment Samples

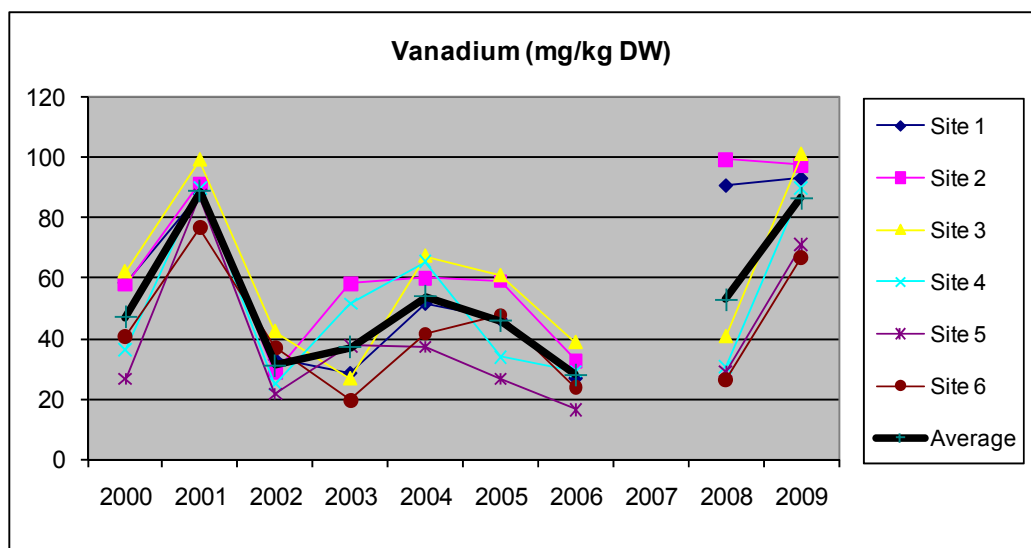


Figure 3.22: Vanadium Levels in Sediment Samples

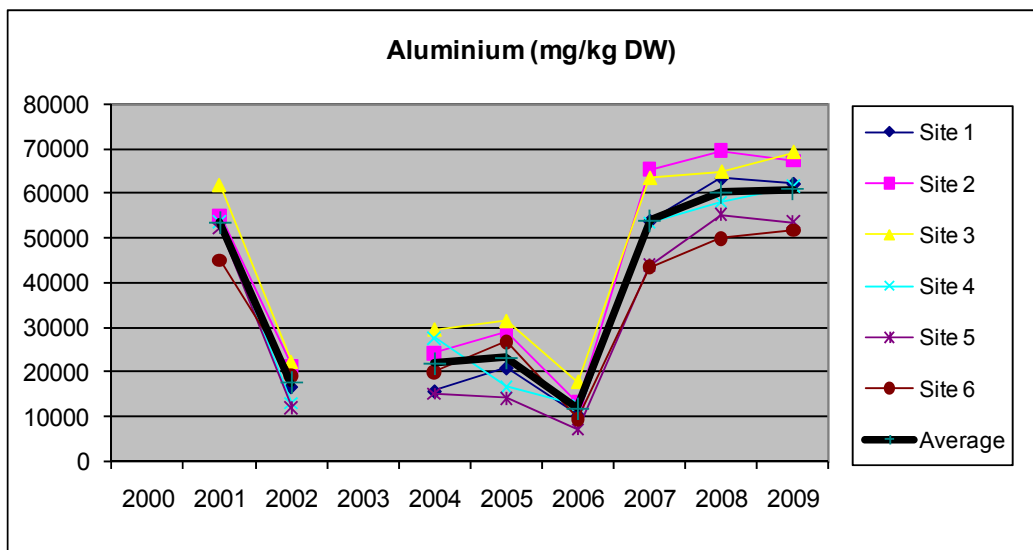


Figure 3.23: Aluminium Levels in Sediment Samples

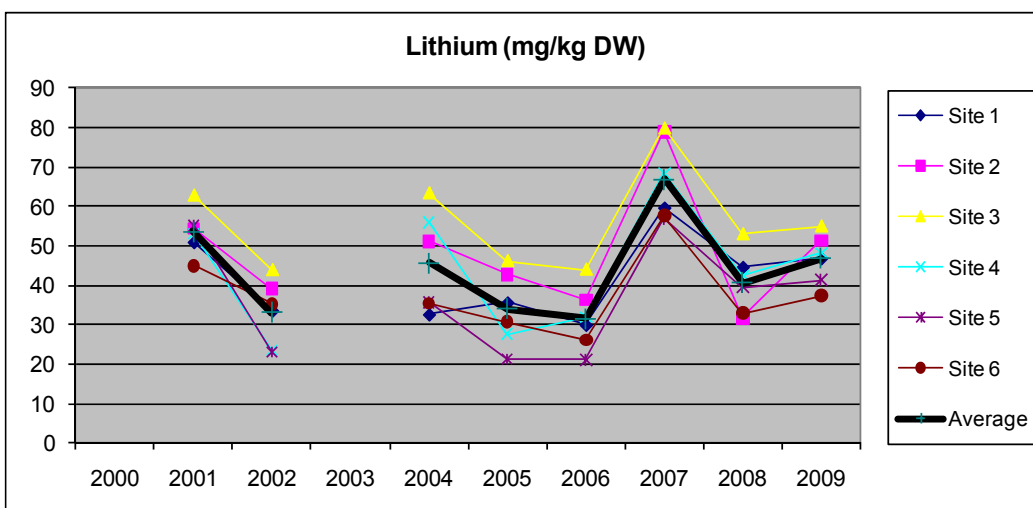


Figure 3.24: Lithium Levels in Sediment Samples

3.7 Effluent Monitoring

The effluent monitoring results for 2009 are compared with those from previous years in the following tables.



Table 3.9: Average Results of Chemical Testing of Effluent (units are mg/l except for pH)

	pH	BOD	Susp Solids	THC	TPH	Diss THC	Diss TPH	Phenols	Cresols
1998	5.52	2.41	18.79	1.56	0.99	1.07	0.74	0.03	0.05
1999	5.54	4.75	26.00	2.53	2.03	1.98	1.62	0.02	0.04
2000	4.30	3.97	26.71	1.46	0.98	1.13	0.83	0.19	0.08
2001	4.61	7.25	20.92	5.63	1.45	5.58	1.45	0.02	0.01
2002	4.75	19.18	13.27	10.36	1.09	5.91	1.09	0.03	0.01
2003	5.17	7.33	11.00	13.42	0.99	4.33	0.99	0.03	0.01
2004	4.90	4.50	12.50	13.50	0.51	13.50	0.51	0.12	0.03
2005	6.54	15.33	24.33	13.69	2.59	13.69	2.59	1.48	0.56
2006	5.81	5.18	18.22	9.00	2.69	8.18	2.64	0.05	0.02
2007	6.36	4.90	14.08	8.16	1.04	7.33	0.99	1.60	0.75
2008	5.99	5.2	27.58	15.67	1.2	< 15.67	1.24	0.11	0.048
2009	6.25	5.83	13.75	25.50	1.44	< 24.67	< 1.44	0.38	0.15

THC Total Hydrocarbons
 TPH Total Petroleum Hydrocarbons
 Diss Dissolved

The results in Table 3.9 show an increase in total hydrocarbons since 1998 with the highest reading to date recorded in 2009. The total hydrocarbons analysis detects the presence of a C-H bond in the sample. This covers a wide range of parameters, some of which may naturally occur, such as decaying organic matter. Therefore, the increase in the concentration of total hydrocarbons is not necessarily an indication of petroleum contamination in the sample. The concentration of Total Petroleum Hydrocarbons is a better indicator and this stayed well below the ELV and shows no indication of any particular trend.

The concentrations of other parameters show fluctuations by year but in most cases there is no clear upward or downward trend. There appears to be a slight increase in BOD over the course of the monitoring programme, but there is also a large degree of scatter from year to year.

In early 2005 there was a significant increase in phenols. CPBBT conducted an investigation into the cause of the increase in phenol concentration and discovered that several factors have been contributing to the elevated level of phenols. There was a release of tank water bottoms through SWEP-01 during the year which may have given rise to high readings in the period thereafter. In addition, an analysis at the site has found some contamination of the lagoon sediment. In 2006 CPBBT used this information to devise a programme to ensure tank water bottoms no longer pass directly through SWEP-01 and this has seen a large decrease in the levels of phenols found in the effluent. There was an increase in the levels of Phenols observed in the effluent in 2009. These increases were slight but CPBBT are monitoring them closely and will take corrective action if necessary in the future.



Toxicity testing of effluent commenced in 1998. Since then, a total of thirty-six toxicity tests have been carried out. The testing of the effluent for 2009 was carried out in December. Since 1998 there have been six exceedances of the ELV of 5 Toxic Units (TU) out of a total of thirty-six tests. There were no exceedances of the ELV in 2009, the previous exceedances are listed in Table 3.10, for reference.

Table 3.10: Exceedances of Toxicity Licensed Limit Value

Date	Test	Species	Licensed Limit Value (TU)	Result (TU)
16/11/2001	Growth Inhibition 72 hr LC 50	<i>Skeletonema Costatum</i>	5	11.4
14/09/2002	Acute Toxicity 48 hr LC 50	<i>Tisbe Battagliai</i>	5	< 5.2
04/12/2003	Acute Toxicity 48 hr LC 50	<i>Tisbe Battagliai</i>	5	5.2
10/12/2004	Acute Toxicity 48 hr LC 50	<i>Tisbe Battagliai</i>	5	6
03/04/2005	Acute Toxicity 48 hr LC 50	<i>Tisbe Battagliai</i>	5	7.3
02/11/2005	Acute Toxicity 48 hr LC 50	<i>Tisbe Battagliai</i>	5	10

An exceedance of the licensed limit value is not necessarily an indication of adverse environmental impact. Most exceedances in previous years were generally only slightly above the licensed limits. In 2006 a cross-testing of samples was conducted to substantiate previous results and to see the effects of the remedial measures carried out in response to the audit carried out by the EPA in 2005. This included replacing of the automatic sampler, regular replacement of the hose connecting the outlet to the sampler, a new sample collection routine and additional training to the staff who carry out the sampling.

Since this new test regime has been in force no exceedances in toxicity levels have been reported.



3.8 Groundwater Monitoring

Table 3.11 shows the average results for the boreholes located at the Tank Farm and near the oil pits for each year since 2000. The results are compared to the Drinking Water PV.

The only parameter which has consistently exceeded the drinking water PV since testing began is manganese with iron, copper and nickel occasionally exceeding the drinking water PV. The high manganese concentrations are likely to be as a result of the high level of manganese naturally present in the soil and ground rock throughout the site. The levels of copper and iron found in 2009 also slightly exceeded the relevant drinking water PVs. This is consistent with results from previous years.

Table 3.12 shows the average results for the Landfill Monitoring programme. The parameters classified as “Quality Indicators” that are now included in the survey were not measured prior to 2002. The results quoted for metals and petroleum indicators for the period 2003 to 2009 represent averages over a larger number of sites than were examined prior to 2003.

For some parameters (chloride, calcium, magnesium), most of the down-gradient concentrations are slightly higher than the up-gradient concentrations. The only parameter detected which was consistently in excess of the PV across the site was manganese. High readings of manganese are found in soils where there are also high iron concentrations. Previous studies at the terminal have shown that there are high levels of iron pyrites naturally present in the soil and so it is not unexpected that high manganese concentrations are also present.



Table 3.11: Results of Groundwater Monitoring (Average Values for MW1, MW2, MW3, BH106, BH107, BH 108, BH109 and BH110)

Parameter	Units	PV	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
pH (Field)	units	6.5-9.5	5.4	7.3	6.5	6.9	6.9	6.3	6.3		6.7	7.1
Conductivity	μS/cm	2,500	1,527	4,644	1,377	978	799	670	720.4	861.3	819.4	723.4
Quality Indicators												
Ammoniacal Nitrogen as NH ₄ -N	mg/l	0.3	-	-	0.275	< 0.306	0.24	0.2	0.3	0.6	0.4	0.2
Chloride	mg/l	250	-	-	147.1	132.7	109.6	75.6	131.1	114.3	107.9	110.9
Sulphate (soluble)	mg/l	250	-	-	112	131.6	122.6	111.3	120.9	92.3	78.6	68.1
Nitrate	mg/l	50	-	-	< 0.34	< 1.55	4.27	0.5	0.6	0.4	1.0	1.6
Sodium	mg/l	200	-	-	97.4	96	68.1	58	72.4	54.7	51.2	48.8
Potassium	mg/l	12	-	-	3.2	3.03	2.7	2.9	2.5	2.8	2.4	2.6
Calcium	mg/l	200	-	-	59.3	74.5	69.7	41	66.0	60.5	44.3	42.5
Magnesium	mg/l	50	-	-	19.6	22.9	19.1	6.3	21.2	14.8	12.4	13.0
Metals												
Arsenic		0.01	< 0.05	< 0.05	0.04	< 0.32	< 0.002	0.007	0.002	0.001	0.001	0.003
Boron		1	0.07	0.13	0.146	< 0.055	0.059	0.053	0.073	0.077	0.030	0.028
Cadmium	mg/l	0.005	< 0.05	< 0.05	0.15	< 0.063	0.0008	0.001	0.002	0.004	0.0005	0.0005
Chromium	mg/l	0.05	< 0.05	0.053	0.026	< 0.001	0.0018	0.004	0.002	0.002	0.003	0.0015
Copper	mg/l	0.002	< 0.05	-	0.044	< 0.02	0.018	0.012	0.021	0.011	0.013	0.012
Iron	mg/l	0.2	6.64	5.88	0.058	0.029	0.12	0.32	0.124	0.209	0.211	0.239
Lead	mg/l	0.01	< 0.05	0.08	0.028	< 0.005	0.0052	0.001	0.001	0.005	0.001	0.0050
Manganese	mg/l	0.05	2.3	2	ANC	ANC	1.65	1.922	1.550	1.105	1.062	0.8021
Mercury	mg/l	0.001	< 0.05	< 0.05	0.025	< 0.003	0.0001	0.003	0.000	<0.00005	0.00005	<0.00084
Nickel	mg/l	0.02	< 0.1	< 0.005	< 0.005	< 0.005	0.022	0.034	0.022	0.020	0.017	0.0140
Selenium	mg/l	0.01	< 0.1	< 0.005	< 0.005	< 0.005	< 0.002	0.008	0.002	0.002	0.001	0.0030
Zinc	mg/l	-	0.15	0.26	0.09	< 0.072	0.064	0.12	0.084	0.074	0.053	0.0401
Petroleum Indicators												
Diesel Range Organics		-	51	170	68	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Mineral Oil		-	< 10	87	47	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Petrol Range Organics	μg/l	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 55
Toluene	μg/l	1	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Benzene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Ethylbenzene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Xylene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 15

Notes Values in **bold** type indicate levels in excess of the PV



Table 3.12: Results of Landfill Groundwater Monitoring (Average values BH102, BH103, BH104 and BH105)

Parameter	Units	PV	2003	2004	2005	2006	2007	2008	2009
pH (field)	Units	6.5-9.5	7.18	7.05	6.9	6.8	6.8	7.4	7.5
Conductivity	μS/cm	2,500	695	668	674	822.5	755.1	800.3	988.8
Dissolved Oxygen	mg/l	-	6.95	5.36	6.4	5.7	6.5	3.7	-
Quality Indicators									
Ammoniacal Nitrogen as NH ₄ -N	mg/l	0.3	< 0.29	0.24	0.2	0.2	< 0.26	0.2	< 0.2
Total Oxidised Nitrogen	mg/l	-	< 0.3	1.6	0.2	0.3	< 0.3	0.3	< 0.3
Chloride	mg/l	250	41.63	51.9	61.5	73.5	84	126.6	133.5
Sulphate (soluble)	mg/l	250	93	126.9	112.3	131.8	141.4	117.5	109.7
Sodium	mg/l	200	47.1	39.6	44.5	39.6	41.25	47.7	40.9
Potassium	mg/l	12	2.9	2.7	2.2	2.6	2.575	2.0	1.9
Calcium	mg/l	200	85.8	74.3	72.2	95.7	102.7	96.3	93.0
Magnesium	mg/l	50	16.9	14.4	0.8	18.8	16.2	18.4	17.9
Phosphorus	mg/l	-	< 0.073	< 0.05	0.1	0.0	< 0.08	0.1	< 0.01
Fluoride	mg/l	1.5	< 0.35	0.25	0.5	0.3	< 0.15	0.3	< 0.3
Total Alkalinity as CaCO ₃	mg/l	-	183.8	202.5	187.5	190.0	190.5	186.3	113.0
Component Alkalinity as CaCO ₃	mg/l	-	-	-	-	0.0	-	-	-
Total Organic Carbon	mg/l	-	< 7	3.75	5.3	6.5	< 3.63	2.0	< 3.6
Total Cyanide	mg/l	-	< 0.05	< 0.05	0.05	0.050	0.05	0.05	< 0.045
Metals									
Arsenic	mg/l	0.01	< 0.004	< 0.002	0.01	0.001	< 0.002	0.003	< 0.004
Boron	mg/l	1	< 0.13	0.053	0.05	0.069	< 0.066	0.013	< 0.014
Cadmium	mg/l	0.005	< 0.0004	0.0006	0.001	0.001	< 0.0014	0.0005	< 0.0005
Chromium	mg/l	0.05	< 0.001	0.0012	0.005	0.004	< 0.00375	0.0031	< 0.0015
Copper	mg/l	0.002	< 0.005	< 0.005	0.001	0.002	< 0.0013	0.0024	< 0.0070
Iron	mg/l	0.2	0.015	0.0098	0.288	0.015	< 0.045	0.0490	< 0.0219
Manganese	mg/l	0.05	1	1.23	0.802	1.437	1.176	1.420	< 1.7914
Mercury	mg/l	0.001	< 0.00005	0.00006	0.00005	0.00005	< 0.00005	0.00005	< 0.00005
Nickel	mg/l	0.02	< 0.01	< 0.01	0.015	0.003	< 0.0028	0.0035	< 0.0043
Lead	mg/l	0.01	< 0.025	< 0.005	0.001	0.001	< 0.0034	0.0011	< 0.0050
Selenium	mg/l	0.01	< 0.004	< 0.002	0.011	0.002	< 0.003	0.002	< 0.0030
Silver	mg/l	-	< 0.01	< 0.01	< 0.01	0.002	< 0.002	< 0.002	-
Zinc	mg/l	-	< 0.02	0.015	0.003	0.027	< 0.045	0.004	< 0.0093
Barium	mg/l	-	< 0.05	< 0.05	0.011	0.016	< 0.025	0.017	< 0.0178
Petroleum Indicators									
Diesel Range Organics	μg/l	-	< 10	15.8	< 10	< 10	< 0.046	< 10	< 10
Mineral Oil	μg/l	-	< 10	< 10	< 10	< 10	< 0.022	< 10	< 10
Petrol Range Organics	μg/l	-	< 10	< 10	< 10	< 10	< 1.16	< 10	< 55
Benzene	μg/l	1	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Toluene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Ethylbenzene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 7.5
Xylene	μg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 15



As part of the AER 2009, the levels recorded of the 14 metals tested for as part of the biannual groundwater sampling have been included in Figure 3.25 to Figure 3.38. No significant trends upwards have been identified for any of the metals in the groundwater over the course of the monitoring programme. Each of the parameters monitored will continue to be analysed to ensure no significant upwards trends become apparent.

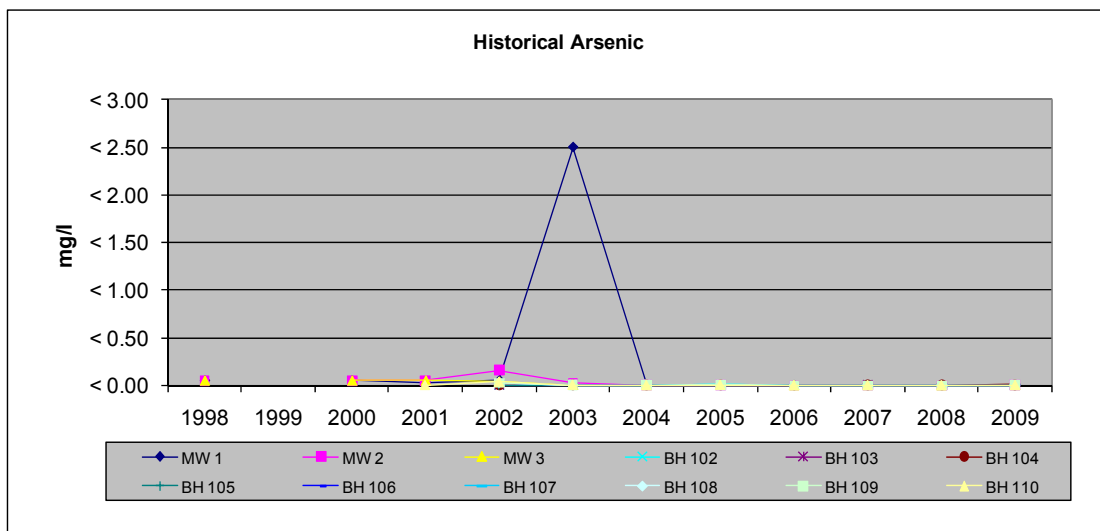


Figure 3.25: Groundwater monitoring Arsenic

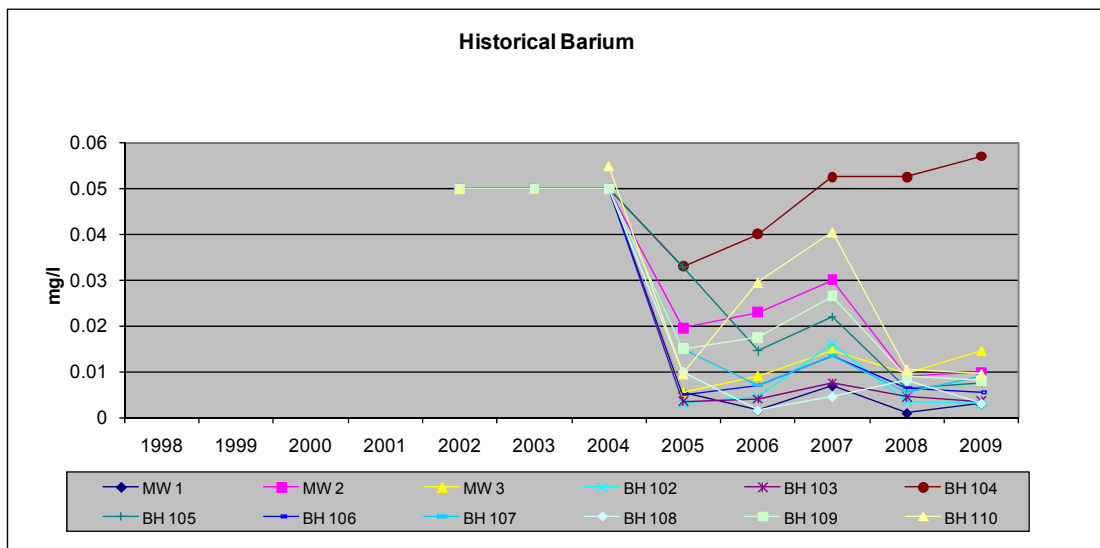


Figure 3.26: Groundwater monitoring Barium

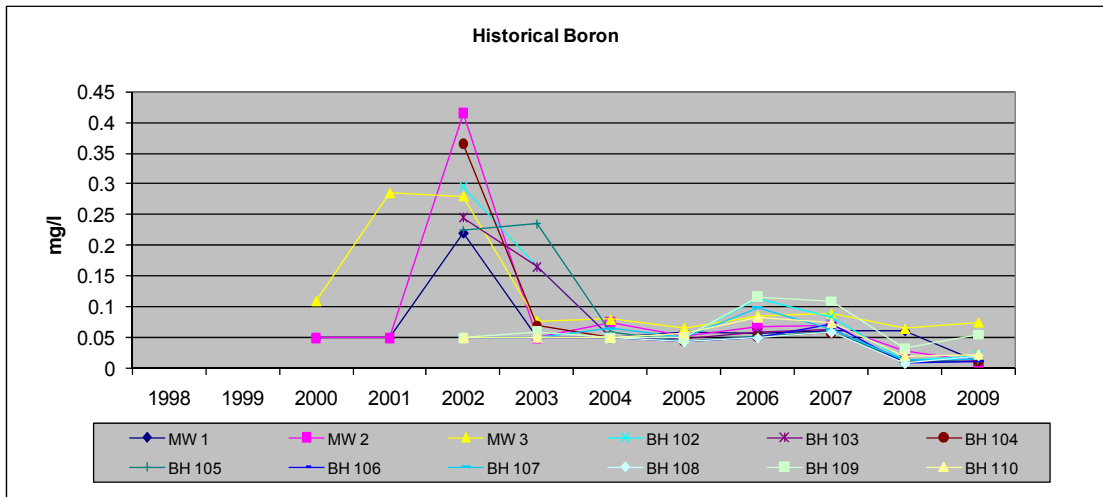


Figure 3.27: Groundwater monitoring Boron

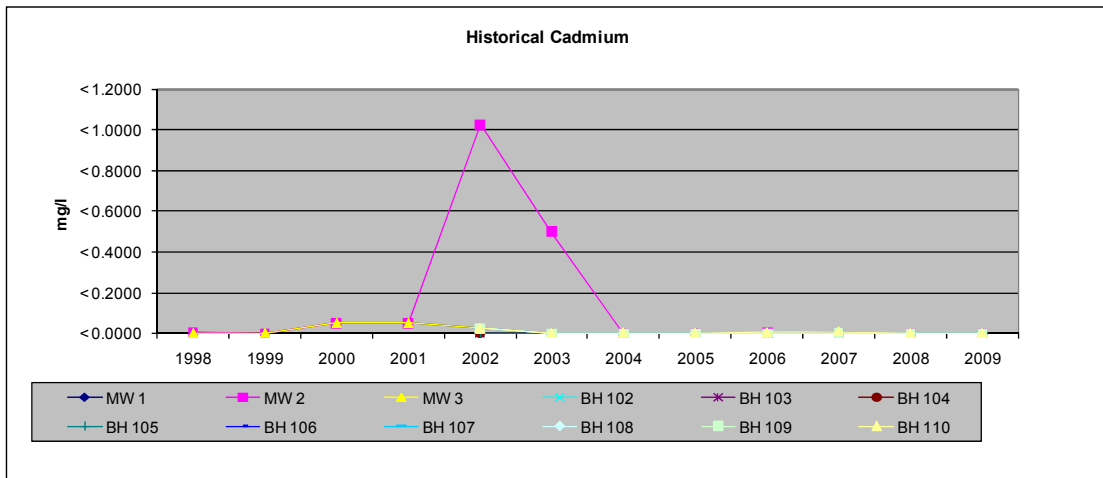


Figure 3.28: Groundwater monitoring Cadmium

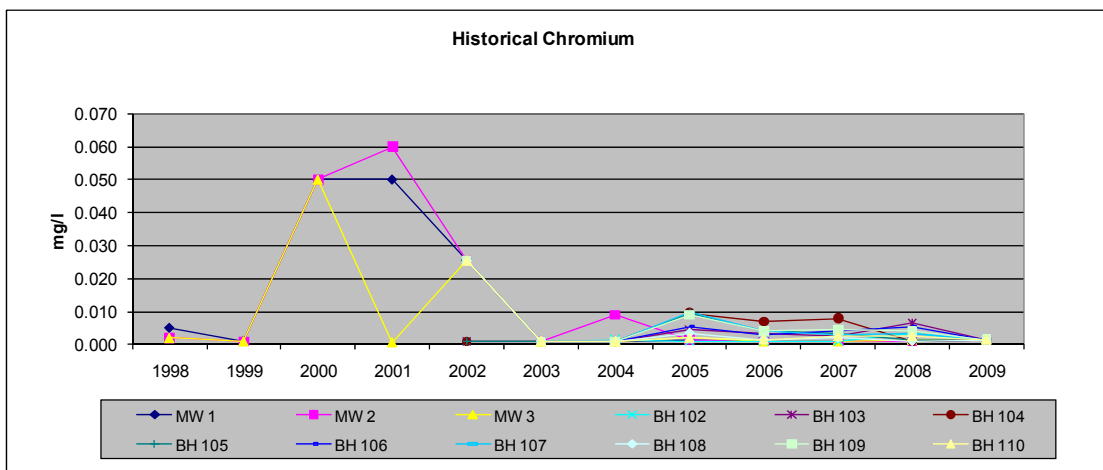


Figure 3.29: Groundwater monitoring Chromium

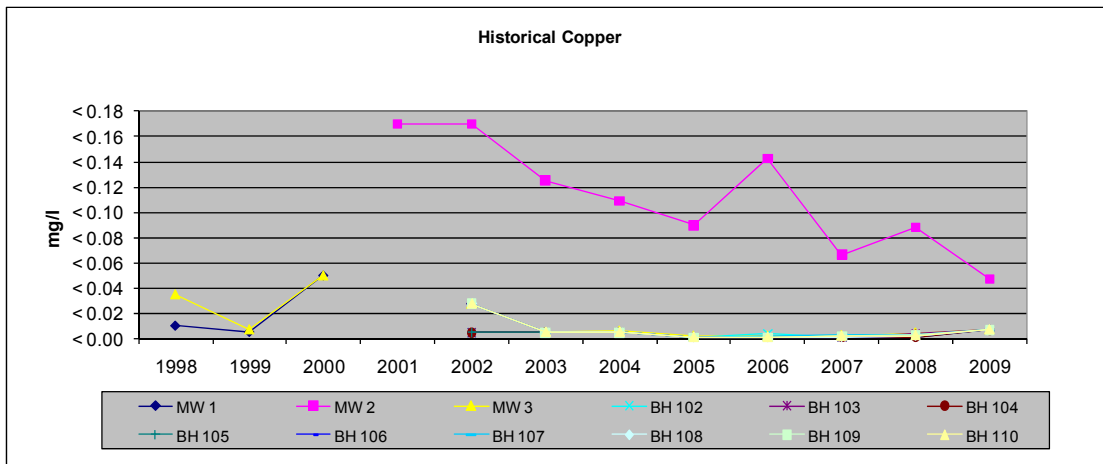


Figure 3.30: Groundwater monitoring Copper

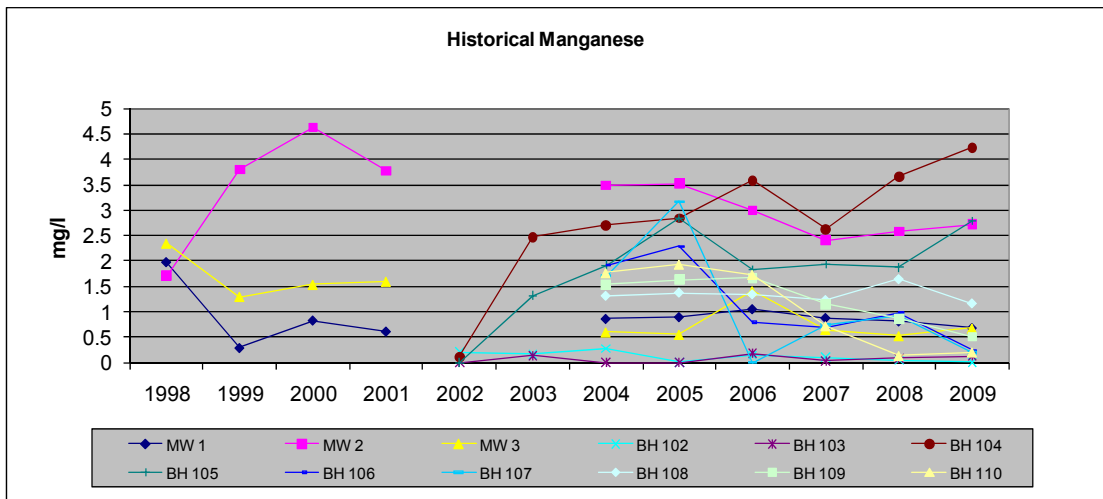


Figure 3.31: Groundwater monitoring Manganese

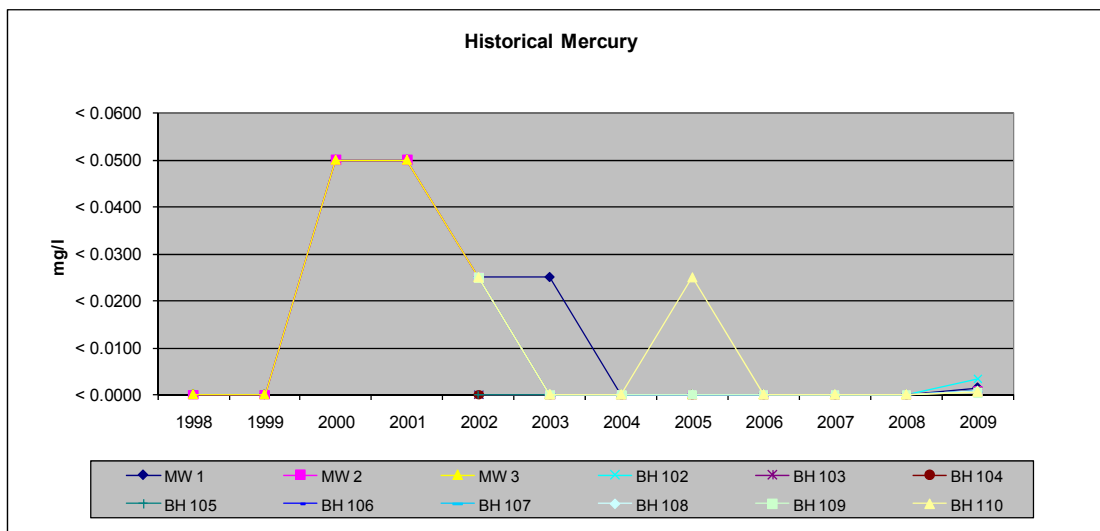


Figure 3.32: Groundwater monitoring Mercury

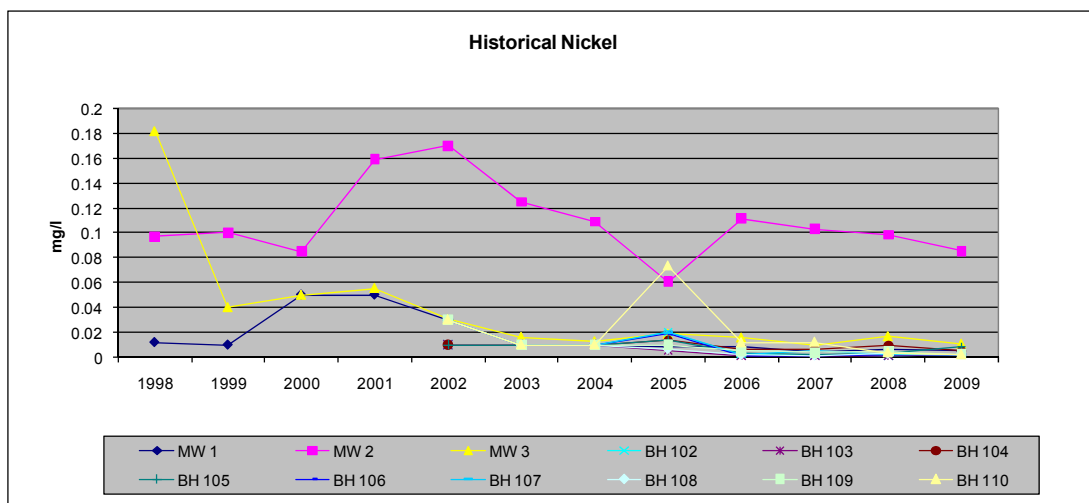


Figure 3.33: Groundwater monitoring Nickel

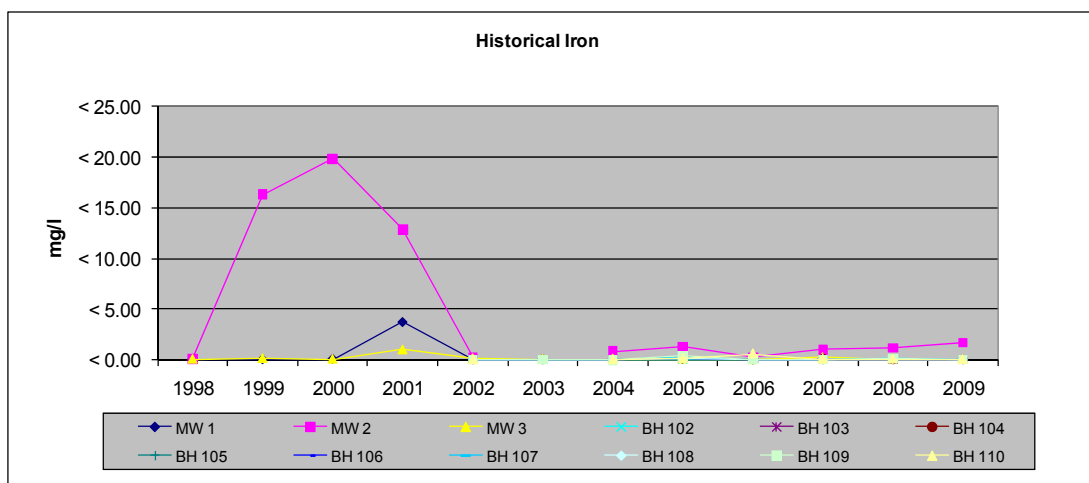


Figure 3.34: Groundwater monitoring Iron

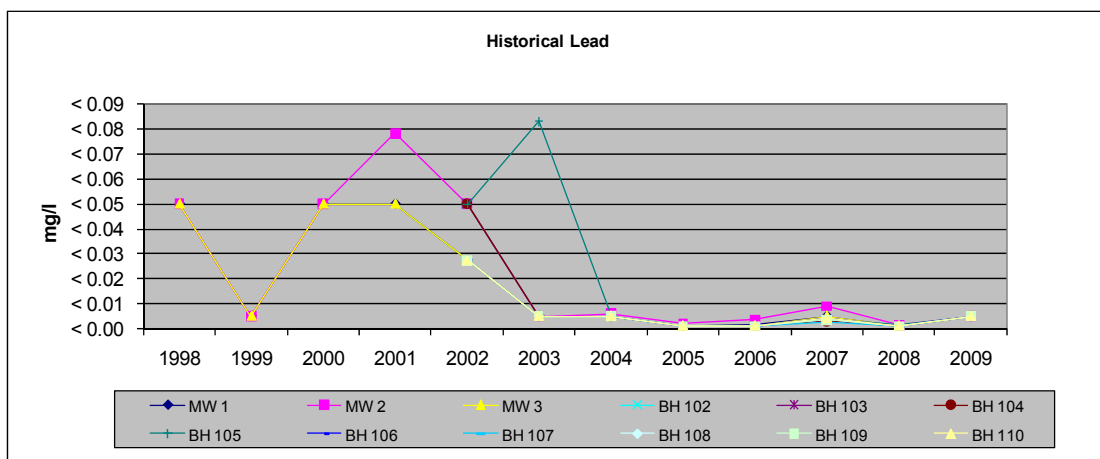


Figure 3.35: Groundwater monitoring Lead

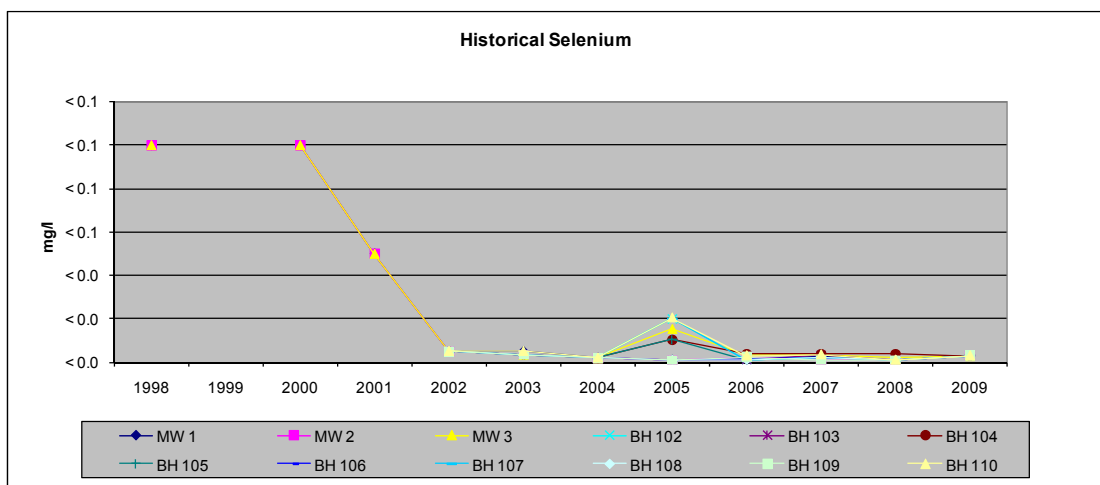


Figure 3.36: Groundwater monitoring Selenium

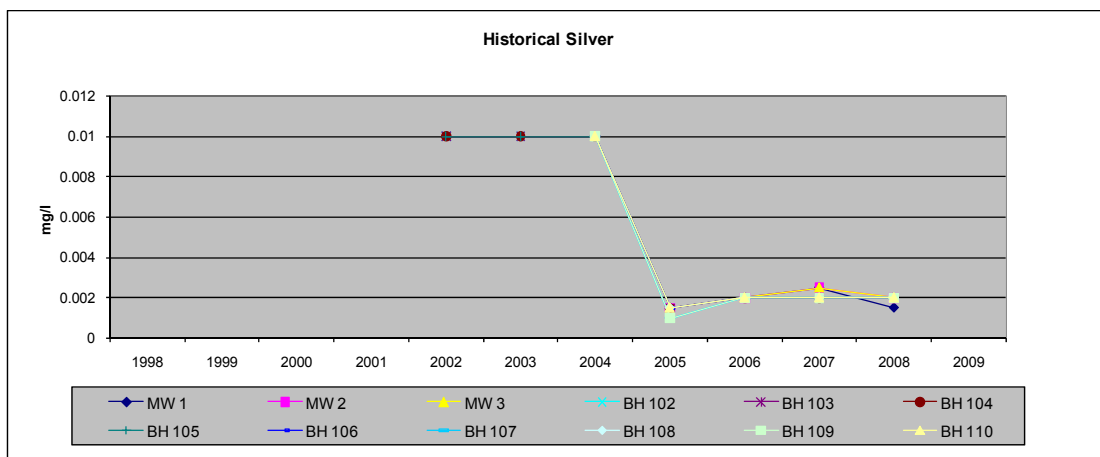


Figure 3.37: Groundwater monitoring Silver

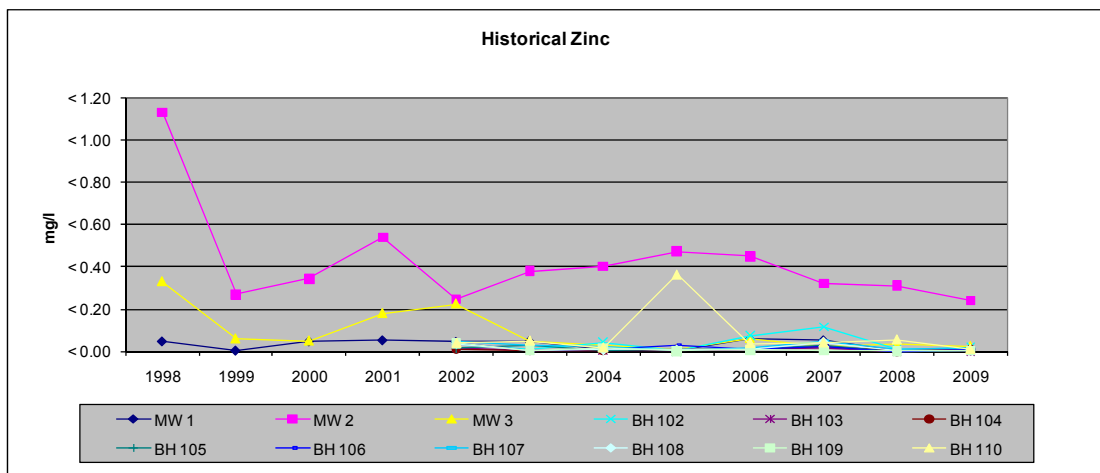


Figure 3.38: Groundwater monitoring Zinc

The pH values (Figure 3.39) recorded vary across the site and are typically found in the 6 – 8 range. The EPA IGVS standard range is between 6.5 and 9.5. The trend for each of the monitoring wells remains largely flat with no significant changes in pH recorded over the monitoring period. MW 2 has experienced greater pH fluctuations than the other wells covered by this programme, with a number of readings outside of the EPA standard range. The water samples from this well have historically also shown high concentrations of iron and of sulphur-containing compounds, which are most likely due to the presence of naturally occurring metal pyrites in the soil in the surrounding area.

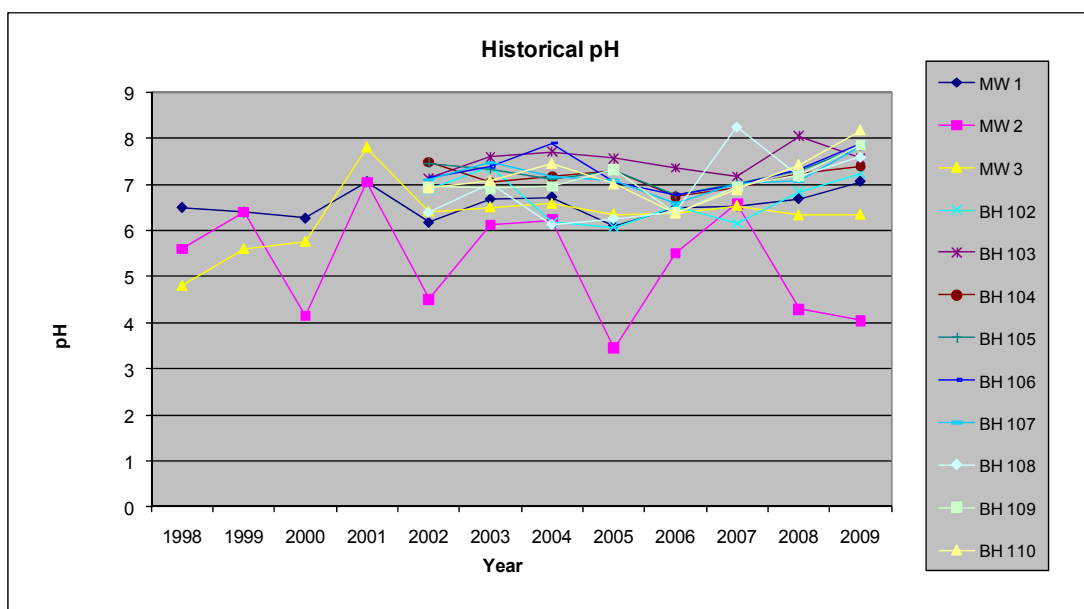


Figure 3.39: pH levels recorded in Groundwater Monitoring Programme

The electrical conductivity (EC) readings across the wells are shown in Figure 3.40, it can be seen that the majority of the values remain below the EPA IGVS of 1,000 $\mu\text{S}/\text{cm}$. MW 3 showed very high levels of conductivity during the early stages of the monitoring



programme, but these values have dropped in recent years and are now comparable to those measured at the other wells. In 2009 there was a slight increase in the conductivity found in BH 104. This will continue to be monitored to establish if there is any underlying trend in the groundwater conductivity in the area.

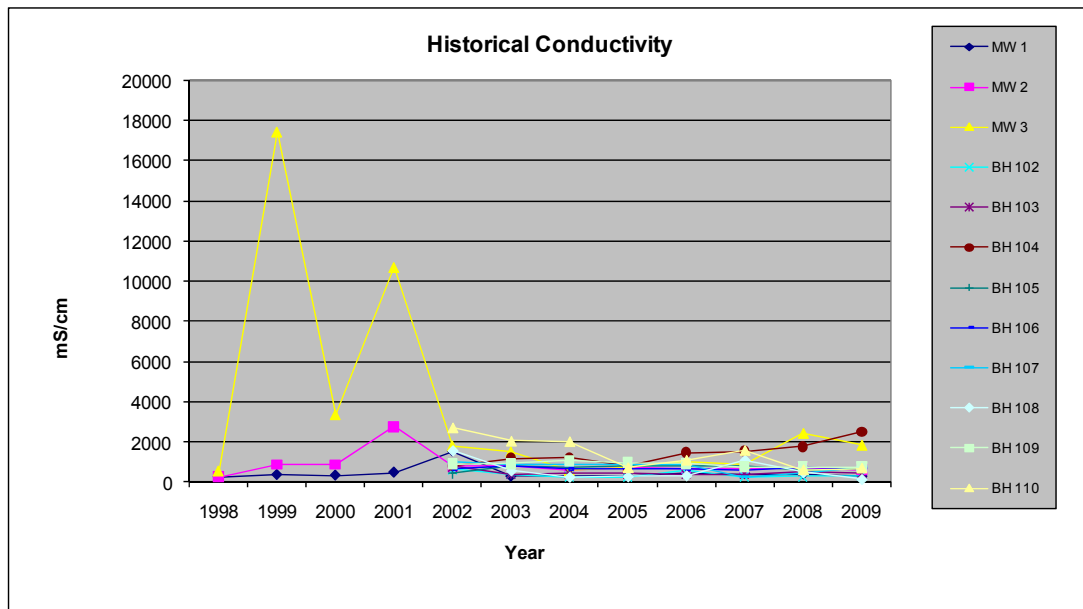


Figure 3.40: Conductivity levels recorded in Groundwater Monitoring Programme

Chemical Oxygen Demand (COD) is normally used to indirectly measure the amount of organic compounds in water and determine the approximate amount of organic matter in a water sample. COD is only measured in the three wells that were established when the initial monitoring programme was drawn up. There are no published standards or guidance values for COD in groundwater with which to compare these figures. The levels of COD detected in MW 3 fluctuates widely across the monitoring programme with the average levels detected in 2009 below those detected the previous year.

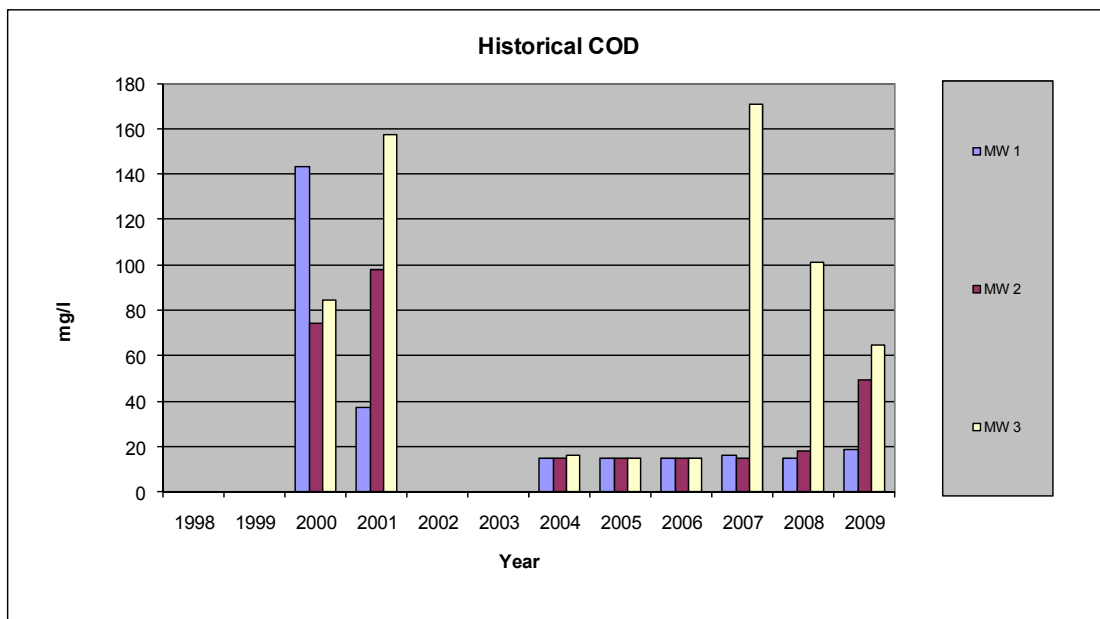


Figure 3.41: COD levels recorded in Groundwater Monitoring Programme

The testing for Mineral Oils normally finds that the levels in each well are below the limit of detection, as shown in Figure 3.42. This plot shows that, over the 11 years in which the programme is in place and the 12 wells that are now covered by this programme, there have been only nine samples in which mineral oil was detected. There is no EPA IGV for mineral oil in groundwater. However, the Dutch Guidelines for groundwater (RIVM 2000) provide target values for mineral oil in groundwater of 0.05 mg/l for the Dutch S-value (background) and 0.6 mg/l for the Dutch I-value (intervention). No detections have been made to date for any BTEX compounds at any of the monitoring wells.

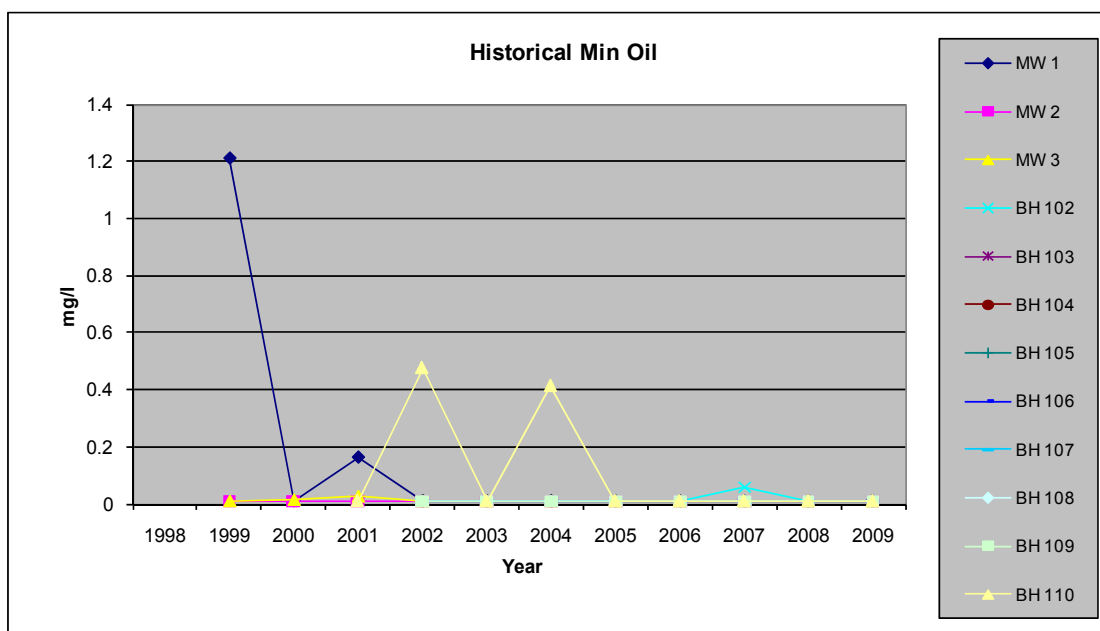
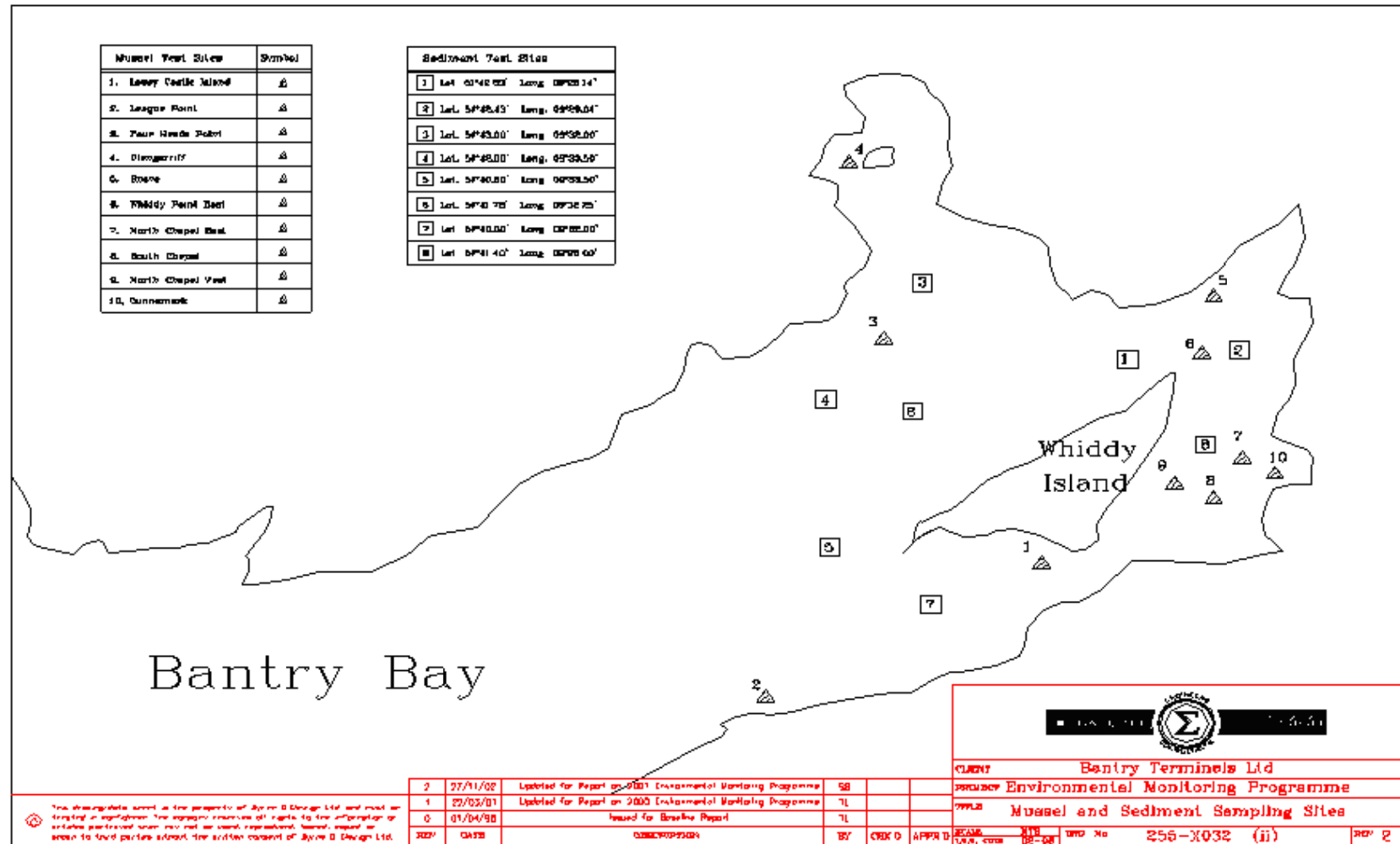
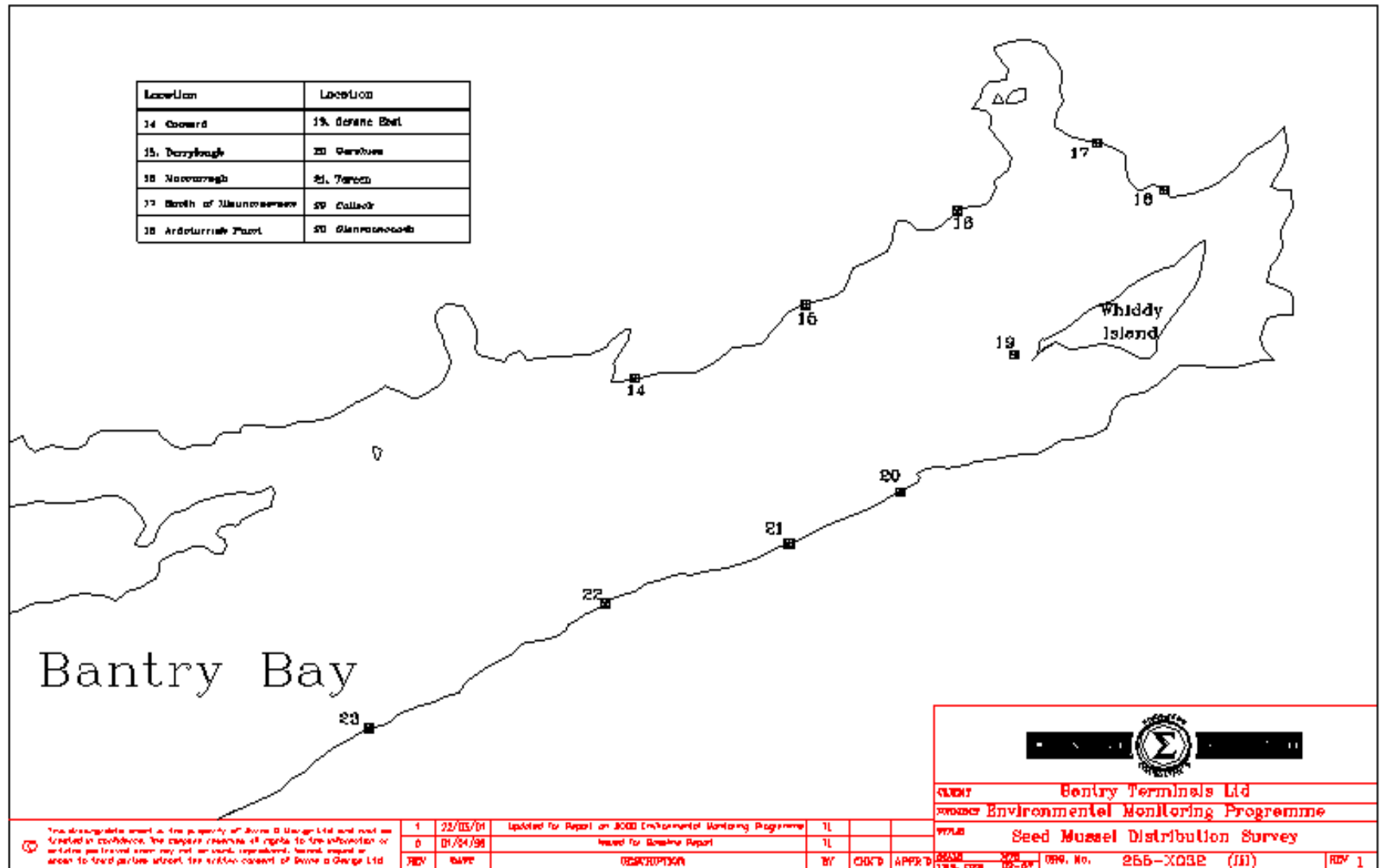
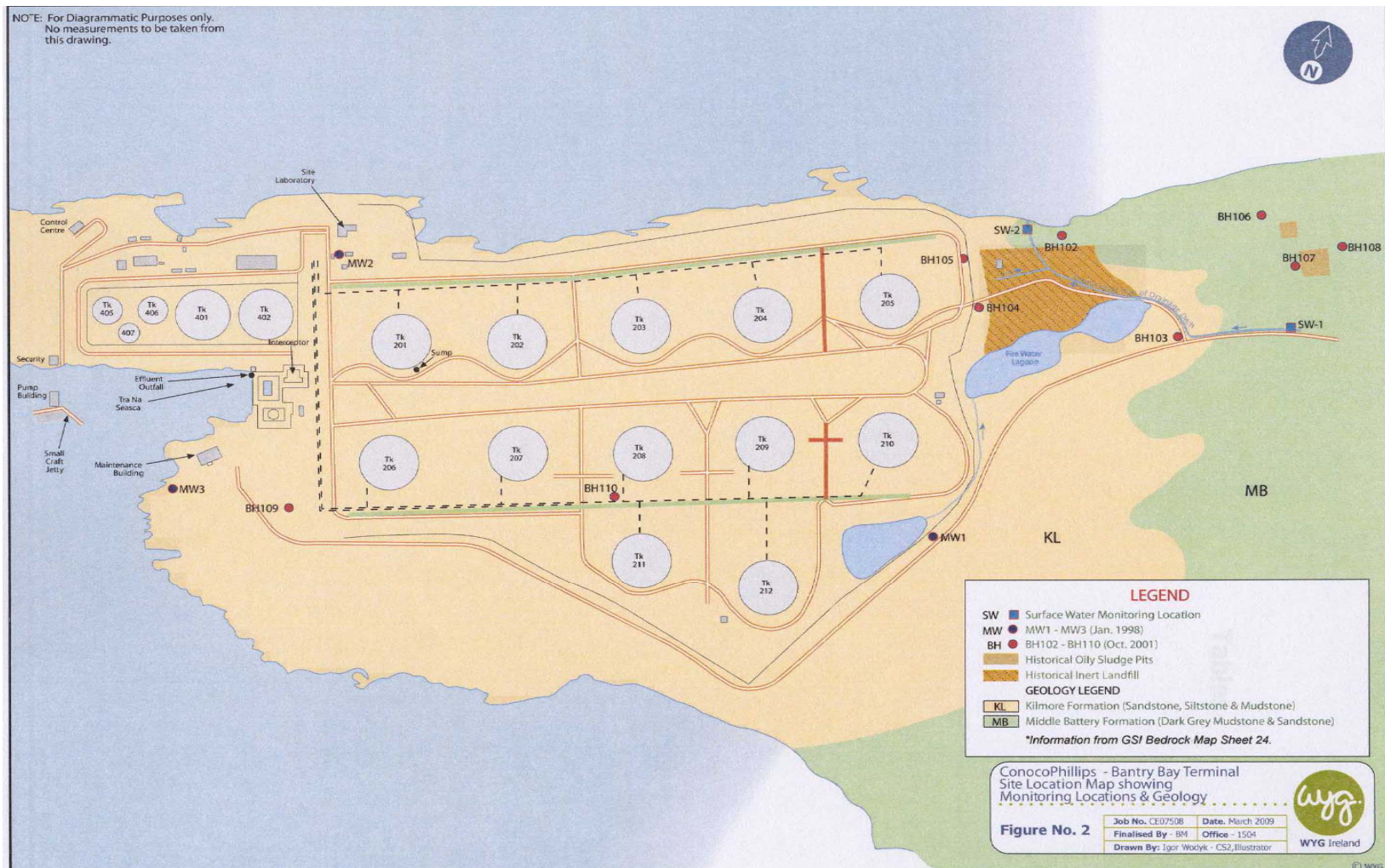


Figure 3.42: Mineral Oil levels recorded in Groundwater Monitoring Programme

Appendix 1 : Maps Showing Locations of Monitoring Points







Map of locations of groundwater monitoring wells. Extracted from "Biannual IPPC Groundwater Monitoring – October 2009", White Young Green (2009)

Annex 12: Landfill Status Report

Annex 12: Landfill Status Report

The onsite inert landfill area to the east of ConocoPhillips Bantry Bay Terminal Ltd (CPBBT) has been previously used for the disposal of grit, dust and dirt. Under the conditions of the IPC Licence, CPBBT are permitted to dispose of other inert waste streams to the landfill area. However, due to the limited capacity of the landfill, other inert waste streams are disposed of off- site as described in Annex 7. The landfill is operated in accordance with the current Landfill Operational Plan (Document No. 255X045).

The monitoring of groundwater in the vicinity of the inert landfill continued during 2009 as per previous years. No significant changes were found in the parameters for groundwater quality tested for in this round of testing. Samples were collected from boreholes located both upgradient and downgradient of the landfill. These samples were then chemically analysed in order to determine whether the landfill had any effect on the groundwater quality. The results of this year's analyses are presented in Annex 6 and are discussed in § 2.1.2 of the Main Report.

No materials were disposed of to the on-site landfill in the course of 2009. If any future changes to the landfill are to be made, CPBBT will contact the EPA to discuss the impacts of any of these proposals on the existing licence.

**Annex 13 : Report on Environmental Protection Agency Site
Inspection of ConocoPhillips Bantry Bay Terminals Ltd 2009**

**Annex 13 : Report on Environmental Protection Agency Site Inspection of
ConocoPhillips Bantry Bay Terminals Ltd 2009**

The EPA visited the site on the 15th of December 2009 and took a grab sample and a composite sample of the effluent at SWEP-01.

The results of this analysis were duly received and all parameters measured were below their respective Emission Limit Values.

The EPA conducted a 'site transfer' visit on the 29th September 2009 to facilitate the hand-over of the site to a new inspector. No report was issued from the Agency for this visit.

There were no other official visits to the site by the EPA in 2009.

Annex 14 : Report on Maintenance of Tanks and Pipelines 2009

Annex 14: Report on Maintenance of Tanks and Pipelines 2009

Introduction

Maintenance and repair of tanks and pipelines on the Terminal is ongoing. Refurbishment of tanks to American Petroleum Institute (API) Standards has been carried out since the mid-1990s. This report describes the refurbishment work carried out during 2009 and outlines the planned activities for 2010.

Refurbishment of Tank 205

During 2009, the refurbishment work on Tank 205 continued and was completed to API Standards 650 and 653¹. A new steel floor was installed and built on a gravel bed with tracer pipes running through it. These pipes will enable any leaks in the tank floor to be detected and ensure that any leaked product can be collected and prevented from entering the water table. A new centrepan, pontoons, roof and double roof seal have also been fitted. This is in line with Best Environmental Practice guidelines.

A new oil inlet/outlet valve (36" diameter) has been fitted to the tank and a new roof drain, the "Coflexip" roof drain, has been installed. The old roof drain system consisted of several moving parts, each with a potential for leakage. However, the new system will have no moving parts and thus the potential for leakages will be reduced.

The foam injection system, which is needed in the event of a roof or rim seal fire to apply foam safely to the rim seal areas of the tanks, has also be replaced along with a new spiral stairs.

The American Petroleum Institute Standard API 650 describes material, design, fabrication, erection and testing requirements for tanks used in the petroleum industry. Standard API 653 covers the maintenance, inspection, repair, alteration, relocation and reconstruction of these tanks.

Biocide Injection Skid

Due to MIC (Microbial Induced Corrosion) in the subsea pipeline, a Biocide Injection Program was set up to decrease/stop this type of corrosion. A new self contained skid was manufactured to store and inject the treatment solution directly into the line. This biocide injection will be done from the Thrax (Tug) after shipping activities using the skid.

¹ API 650 is the American Petroleum Institute Standard, *Welded Steel Tanks for Oil Storage*. API 653 is the American Petroleum Institute Standard, *Tank Inspection, Repair, Alteration and Reconstruction*.

Replacement and Upgrading of Product Lines

The aim of this project is to eliminate all underground pipe work on the crude system. This has been done in stages with P202 suction and discharge lines removed and replaced with new 36" pipe work supported on a newly erected steel rack and P201/203 suction / discharge lines removed and replaced with 24"/30"/36" pipe work. When this project is completed all the crude system pipe work and valves will have been replaced in the last 2 years from battery limit to the 3 crude tanks.

Tank Inspections

Tank 405 was taken out of service (as per API inspection requirements) and was gas freed, inspected and found to be in good condition and returned to service. It is not due for inspection again until 2013. Tank 207 was gas freed, inspected and had pontoon repairs carried out. This tank has also been returned to service.

Waste Water Treatment Upgrade

A number of tasks were carried out in 2009 to reduce the suspended solid levels in the wastewater from the site. These actions included draining and desludging the settlement lagoon and removing the API separator plates from separator no.1, cleaning the plates and the separator bay, and then returning it to service.

Other projects

A number of other maintenance projects were also carried out on the site in 2009 including:

- The upgrade of foam ring mains on Tank 207/211;
- Tank 402 replacement ladder and track;
- Replacement & re-routing of 10" WDO pipe work (10" to 8" line Tank 205 down and Tank -208 down) 1.7km approximately;
- Removal and replacement of pumphouse exhaust stacks;
- Replacing 4" roof drains externally on Tanks 201 and 205;
- Replacing of diesel tank for generator with bunded tank as per EPA standards;
- Change out of Single Point Moor seals;
- Pigging of subsea lines. Both the 30" product line and 42" crude line were inspected by pigging method in 2009;
- Repairing Tank 101 bund and hydro testing of the bund.

Maintenance Programme in 2010

Major works due to be carried out in 2010 include the completion of the upgrade of the SPM. Tank 206 is due to be inspected, Tank 202 is due to be cleaned and be gas freed and Tank 207 is due to have its ladder and track replaced. Further repair and maintenance of the wastewater treatment plant is also due to be implemented in 2010. This includes the removal of tilted plates in the separator and the cleaning/desludging of the separator bay. The contractors' compound is to be relocated and the site wide fire hydrant installation is to be completed. The upgrade of roads site wide and the removal of sections of redundant pipe work at the pumphouse manifold are also scheduled.