BORD NA MÓNA

**BORD NA MÓNA ENERGY LIMITED**
Leabeg, Tullamore, Co Offaly

# Srahmore Waste Licence W199-2

# Annual Environmental Report

# 2011

29th March 2012

Bord na Móna today operates 5 main subsidiary companies in more than 20 locations throughout Ireland, the UK and USA. The principal businesses are in the Energy, Resource Recovery, Horticulture, Home Heating and Wastewater Treatment and Air Pollution Abatement markets. The company also engages in an extensive rehabilitation program to develop its peat lands in an environmentally sustainable manner.


Bord na Móna has long recognised the need to diversify its activities in order to secure a sustainable future. In this context we identified the energy and resource recovery sectors as appropriate areas of growth and development, given our assets, strengths and skills.
Significant challenges face Ireland in meeting the country's needs to provide secure sustainable energy and manage waste while minimising the impact on the environment. Bord na Móna is in a strong position to contribute to dealing with these challenges. We have a unique mixture of assets, experience and innovation which will enable us to cross-link our activities in energy, water and resource recovery to provide products and services which will meet Ireland's needs. We also have the capacity to become an exemplar for others to follow in these fields.
With this background we have scoped out a new vision for the future sustainable development of Bord na Móna.
Following on from our vision, we have developed a new mission for Bord na Móna which the Company is committed to achieving.
In 1934 the Turf Development Board was formed to ‘develop and improve the turf industry.' The experience of fuel shortages during the war re-enforced the Irish State's commitment to developing the country's bogs. In 1944 the TDB was asked to devise and submit a comprehensive programme, the outcome was the transformation in 1946 of the TDB into Bord na Móna. The Board was given a mandate to increase the use of peat as a fuel and in energy production. Markets for the use of moss peat in horticulture were also developed.
In 1990 Bord na Móna implemented a divisionalised and decentralised structure, designed to delegate responsibility downwards ensuring a sharper focus on each profit centre and a greater spirit of enterprise.

# Group Vision


The vision statement defines the Company's purpose, in terms of its values.
Values are guiding beliefs about how things should be done.
The vision statement communicates both the purpose and values of Bord na Móna.
For employees, it gives direction about how they are expected to behave and inspires them to give their best. Shared with customers, it shapes the customers' understanding of why they should work with Bord na Móna.
Bord na Móna will seek solutions that optimise the creative energy and potential of the organisation, driven by long term goals and the organisation's vision and mission.
In this context our devolved business units will align their vision and strategic planning with the global direction provided.
Consistent with our vision, innovation will once again return to the core of everything we do. We will capitalise on opportunities to cross fertilise our unique range of skills and technologies that add value and are socially and environmentally sustainable.
Greater focus will be placed on managing and developing our land assets in a responsible and sustainable manner. Our award winning initiatives at Lough Boora (Co. Offaly) and Oweninny (Co Mayo), provide shining examples of what can be achieved

# Group Mission

We conduct our affairs with openness, honesty and integrity.
We are Ireland's leading environmentally responsible integrated utility service provider encompassing electricity, heating solutions, resource recovery, water, horticulture and related services.
We capitalise on international opportunities where we have a competitive advantage.
We achieve continuing growth through superior customer service, outstanding quality and innovation delivered through the excellence and commitment of our people.
We engage in sustainable profitable business in the communities we serve, which is rewarding and challenging for employees and other stakeholders.

**Contents:**

## 1.0 Introduction

### 1.1. Report Period

This Annual Environmental Report covers the period of 01/01/11 to 31/12/11 for the Srahmore Peat Repository at Attavally, Bangor-Erris, Co Mayo.
This is the seventh Annual Environmental Report for Bord na Mona's Peat Repository at Srahmore, Attavally, Bangor-Erris, Co Mayo. The structure and contents of this report are based on the requirements of Schedule D Reports & AER Content.

### 1.2. Waste Licence Register Number - W199-02

### 1.3. Operator & Address of Facility.

Bord na Mona Energy Ltd
Srahmore,
Attavally
Bangor-Erris
Co Mayo

### 1.4. Environmental Policy (attached on next page)

**BORD NA MÓNA**

**BORD NA MÓNA ENERGY LIMITED**

## Environmental Policy Statement

Bord Na Mona Energy Limited is a commercial semi-state body with responsibility to develop Ireland's peat resources in the national interest.

Bord Na Mona Energy Limited is committed to gather and make available information on all aspects of its environmental impact and to help improve understanding among the public generally of its role and of the importance of Irish peatlands.

Bord Na Mona Energy Limited recognises the importance of peatland conservation.

Bord Na Mona Energy Limited will leave behind all areas it owns as either an economically or socially integrated resource of high environmental value.

Bord Na Mona Energy Limited seeks to conduct all aspects of its business in an environmentally sensitive manner.

Bord Na Mona Energy Limited operates an environmental management system specifically addressing the following impacts:

- Discharges to water
- Emissions to atmosphere
- Waste disposal
- Use of natural resources
- Noise, vibration, odour, dust and visual effects
- Natural environmental and eco-system

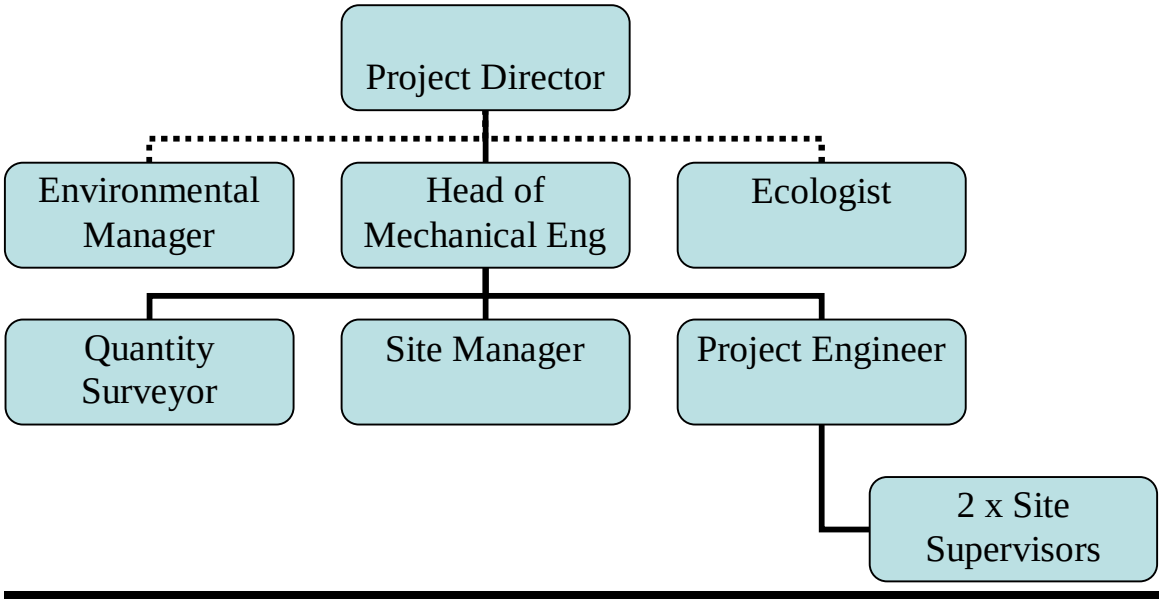
The environmental management system will be monitored, maintained and continually improved.

A system of regular environmental audits will be put in place.

Bord Na Mona Energy Limited will continue research and development (R&D) into all aspects of its environmental impact.

This statement is published and is available at all locations within the section and its contents are brought to the attention of all employees.

### 1.5. Current Management Structure



## 2.0 Waste Management Report

### 2.1 Site Description

The site is situated approximately 1km northwest of the village Bangor-Erris and comprises cutover peatland in the Oweninny bog complex. This consists of eight separate areas of cutover peatland, numbered 1 – 8, each of which was assessed for suitability for the development. Area 5 was selected as the peat reception area. Area 6 was selected for the actual deposition of peat and a section of Area 7 is utilised as a "controlled overflow area" in the event of exceedance of the design rainfall. The peat reception area is utilised for off-loading of the peat is the closest area to the public road.

The site is a peat disposal area for the placement of c. 450,000m³ of peat waste excavated from the development of the Shell Corrib Gas Field Terminal at the nearby Bellanaboy Bridge site. The peat, which is from a 3000 to 5000 year old Atlantic Blanket Bog, is transported by road in trucks to the Srahmore deposit area. It was originally anticipated that peat transport and deposit would take place over a 6 month period, spread out over two seasons. However, peat transport and deposit ceased on the 4th July 2005, and as of that date**,** 112,937tonnes were transported to and deposited at the site.

Peat deposition at the site did not resume during 2006. Peat deposition did recommence on the 2nd of April 2007 and completed the deposition of peat on the 29th June 2007.

As the volumes of peat deposited had reached the licensed limit in June 2007, no more peat was accepted in 2008 or 2009.

Since then, decommissioning of plant and equipment has taken place in accordance with Condition 9.1 of the Waste Licence.

During 2009, an application for a review of this licence was submitted to the Agency to allow acceptance of up to 75,000 tonnes of peat from the new gas pipeline route. In July 2010, a new waste licence (WL199-02) was issued and supersedes the WL199-01 licence.

During 2011, peat deposition re-commenced on the 15th November, with 16,185 tonnes accepted and deposited as of the 31st December 2011.

| Bay | Srahmore Storage Volume | Srahmore Deposited Volume | Srahmore Remaining Volume |
|---|---|---|---|
| | ($m^3$) | ($m^3$) | ($m^3$) |
| 1 | 15,000 | 0 | 15,000 |
| 2 | 80,190 | 47,054 | 33,136 |
| 3 | 106,974 | 132,764 | 0 |
| 4 | 135,802 | 175,048 | 0 |
| 5 | 84,856 | 109,368 | 0 |
| 6 | 28,806 | 0 | 28,806 |
| 7 | 13,372 | 0 | 13,372 |
| **Totals** | **465,000** | **464,234** | **90,314** |

As of this AER, the volume of peat deposited in Srahmore is 464,234 tonnes or m3.

## 3.0 Environmental Emissions of the Activity

### 3.1 Emissions to Atmosphere Summary

The only potential emissions to the atmosphere from the activities on site are dust. As required by Condition 8.8.1, locations for dust monitoring around the site were agreed with the Agency, and Bergerhoff Dust gauges were installed.

| Srahmore Waste Licence W199-2 | | | | | Dust Gauges | | |
|---|---|---|---|---|---|---|---|
| **Month** | **Date** | **Days** | **DM-01** mg/m²/day | **DM-02** mg/m²/day | **DM-03** mg/m²/day | **DM-04** mg/m²/day | **DM-05** mg/m²/day |
| Jan | no activities | | | | | | |
| Feb | no activities | | | | | | |
| March | no activities | | | | | | |
| April | no activities | | | | | | |
| May | no activities | | | | | | |
| June | no activities | | | | | | |
| July | no activities | | | | | | |
| Aug | no activities | | | | | | |
| Sept | no activities | | | | | | |
| Oct | no activities | | | | | | |
| Nov | no activities | | | | | | |
| Dec | 14/12/2011 | 30 | 277 | 377 | 306 | 246 | 267 |
| | | | | | | | |

**Non-compliances:**

| Monitoring Point | Emission (SS mg/l) | ELV (mg/l) | Corrective Action |
|---|---|---|---|
| DM-02 | **377mg/l** | 350mg/l | Submitted and applied |

### 3.2 Emissions to Water Summary

Emissions to water from the site takes place at 3 locations:

| Licence Emission Ref. No | SW No |
|---|---|
| S5-1 | SW100 |
| S5-2 | SW101 |
| Location 7 (combined from Area 5/6) | SW4 |

As required by Schedule C (2.2) the following parameters were monitored during peat deposition, from January to December 10

| | Continuous | Daily | Weekly | Monthly | Quarterly |
|---|---|---|---|---|---|
| Flow | **SW4** | | | | |
| pH | | | **SW4** | **SW 100 & 101** | |
| Conductivity | **SW4** | | **SW100 & 101** | | |
| COD | | | **SW4, 100 & 101** | | |
| BOD | | | | | **SW4** |
| Suspended Solids | | **SW4** | **SW 100 & 101** | | |
| TDS | | | **SW4** | | |
| Nitrite (as N) | | | | **SW4** | |
| Nitrate (as N) | | | | **SW4** | |
| Ammonia (as N) | | | **SW4, 100 & 101** | | |
| Total Phosphorus | | | | **SW4** | |
| Oils, fats & greases | | | | | **SW4** |

Emissions from SW4 are monitored using a flow proportional composite sampler, which operates on a continuous basis. Two x 2 litre sample bottles are filled over a 24 hour period, with 1 litre sent to Complete Laboratory Services for analysis and the remaining 3 litres retained on site for sampling by the EPA.

The compliance requirements at SW4 are as follows:

> [1]*8/10 consecutive results, calculated as daily mean concentration or mass emission values on the basis of flow proportional composite sampling, shall not exceed the emission limit value. No individual result similarly calculated shall exceed 1.2 times the emission limit value*

Emissions from SW100 & 101 are sampled by grab sample on a weekly basis and sent to the lab for analysis. The compliance requirements at SW100 & 101 are as follows:

> *No grab sample value shall exceed 1.2 times the emission limit value.*

The emission limit value (ELV) attached to emissions to water from the site is 35mg/l suspended solids.

Results for the 3 emission points are in Appendix 1.

**Non-compliances:**

| Monitoring Point | Emission (SS mg/l) | ELV (mg/l) | Corrective Action |
|---|---|---|---|
| SW4 (Location 7) | **None** | 42mg/l | n/a |
| SW100 | **None** | 42mg/l | n/a |
| SW101 | **None** | 42mg/l | n/a |

This represents an over compliance level of 100% at Sw4, Sw100 and 101
The 2007 - 2011 results for these three emission points are graphed in Appendix 2. These trends over the 5 year period show a gradual drop in the suspended solids from the site, from an average of 10.8 mg/l in 2007, to 4.2 mg/l in 2011 at the main emission point from the site, Location 7 (SW4).
This is also the case with SW100 where the SS reduced, while the SS increased at SW101 over the same period, but was still within the ELV of 35mg/l

| Year | SW4(Location 7) SS (mg/l) | SW100 SS (mg/l) | SW101 SS (mg/l) |
|---|---|---|---|
| **2007** | 10.8 | 4.08 | 4.18 |
| **2008** | 5.6 | 2.74 | 2.66 |
| **2009** | 4.4 | 1.9 | 2.36 |
| **2010** | 4.5 | 2.9 | 5.0 |
| **2011** | 4.2 | 2.9 | 4.4 |

### 3.3 Ambient Monitoring.

**River-water Monitoring:**

Schedule C (6) requires monthly monitoring for Suspended Solids and Ammonia at two locations on the Munhin River, upstream and down stream of the discharge from Location 7 (SW4). The average suspended solids upstream and downstream of the discharge from the site were 9.8mg/l and 5.7mg/l respectively.

The average ammonia levels upstream of the discharge are 0.016 mg/l and 0.018 mg/l downstream. These results would be typical of levels found in peatland catchments and are well below the Maximum Allowable Concentration (0.23 mg/l)

These results would indicate that the Srahmore Peat Repository activities had no negative effect on the suspended solids content of the river during 2011.

Results of the analysis are attached in Appendix 2.

**Biological monitoring:**

Biological Quality (Q) rating/Q index is required annually.
This was carried out, in agreement with the Agency, on the 29th June 2011, by Anua Ltd. Assessment was carried out upstream and downstream of the discharge from the site, to establish a Q index for both locations and identify any change in water quality.

The biological quality at the upstream location on the Munhin River was denoted a Q-value of Q3-4, which equates to “slightly polluted” waters. The downstream location on the Munhin River was denoted with a Q-value of Q4, which equates to “unpolluted” waters. No deterioration in biological quality was noted between the upstream and downstream monitoring location indicating that the main outfall from the Srahmore Facility is not having a deleterious effect on macroinvertebrate species and hence the river water quality. The upstream monitoring location recorded a lower Q-value than the downstream monitoring location. This is most likely due to the less favourable sampling conditions at the upstream location (i.e. increased river depth, lack of riffle sections and less suitable riverbed substrate).

**Groundwater Monitoring:**

Condition 8.10 required the installation of a groundwater monitoring network at the site, in accordance with Agency guidelines. This required one up-hydraulic gradient, one down gradient of the peat reception area, and two down gradient of the peat deposition area.
Groundwater sampling was conducted in June and November 2011.

Diesel Range Organics at low levels were detected at Bh’s 2A, 3A and 4A, in November, but following a review of the chromatograms by the subcontracted laboratory it was found likely that “the levels of elevated DRO can be attributed to naturally occurring compounds which would be characteristic of a peat like environment”.

COD concentrations exhibit normal levels for groundwater across the site ranging from <10mg/l at BH1-S to 90 mg/l at BH4-S.
Nitrate levels were found to be below the limit of detection (<0.2 mg/l) and therefore remain within the Guideline Threshold Value (GTV) for Nitrate as N (8.47mg/l –N) as set out in the *European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010*).
Ammonia levels, ($NH_3$-N) ranged from <0.02mg/l at BH-4S to 3.30 mg/l at BH-2D.

All ammonia results with the exception of BH-4S remain elevated and are above their GTV upper limit of (0.136mg/l as N). These elevations are in keeping with previous trends and are due to natural processes in the peatland.
The Srahmore Facility is located within a cut-away peat land. Groundwaters beneath peatland's have been found to be naturally high in nitrogen and due to the nature of the peatland's reducing conditions; the nitrogen is present in the form of ammonia. The ammonia levels remain elevated as it is not oxidised to nitrite or nitrate.
BH-4 is downgradient of the reception area and BH's 1 and 2 are downgradient of the deposition area. Results of all sampling during the period of investigation and the groundwater contour map are attached in appendix 3.

### 3.4 Noise Monitoring Report.

Condition 8.11 of the licence requires a noise survey to be carried out during weeks 2, 6 & 12 at the following locations:

NRA – At site entrance from the R313.
NRB – North/West of the site on the R313 at a dwelling.
NRC – West of the site, close to Bangor-Erris Village

Noise Monitoring was carried out on the 28th November 2011.

L(A)eq, L(A)10,, L(A)90 values and ~13 Octave band analysis were determined at the three, monitoring locations N1, N2 & N3. The noise emissions determined at the Noise Sensitive locations (N1, N2 & N3) during the Start-up period, (07:00hrs to 09:00hrs), ranged from 55dBA at N3 to 70dBA at N1.
As works on the site stops at 17:00hrs, the measurements for the evening noise monitoring period were taken earlier in the afternoon. The noise emissions determined at the Noise Sensitive locations (N1, N2 & N3) during the evening period was 68, 71 & 47 dB(A)respectively.
It is evident from onsite observations and recorded data that noise emanating from on-site activity at the Srahmore Peat Repository Facility does not have any significant impact on the existing neighbouring noise environment. The major contributory factor to the exceedance of respective noise limits at the Noise Sensitive Locations (N1 -

N3) is due to event noise arising from traffic movement on the R313 and adjoining secondary routes in close vicinity to the noise meter. This event noise was predominately unrelated to site activities.

In conclusion the results of this assessment indicate that the noise emanating from on-site activity at the Srahmore Peat Repository Facility does not have any significant impact on the existing noise environment.

A map of the Waste Licence Emission & Monitoring Points is included in Appendix 5.

### 3.5 Resource & Energy Consumption

Resource and Energy Consumption for the Facility was as follows:

| | | |
|---|---|---|
| Marked gas oil for all machine operations | - | 22739 litres |
| Electricity usage | - | 558 kWh |

## 4.0 Environmental Management System

### 4.1 Management & Reporting Structure

This is included in section 1.5 and details the current management & reporting structure.

### 4.2 Schedule of Environmental Objectives & Targets

This sets out the schedule of objectives as proposed by Condition 2.2.2.2.

| Objective | Target |
|---|---|
| 1. Minimisation of suspended solids | Assessment of suspended solids generation during peat deposition during the first two months and setting a programme for its reduction |
| 2. Reduction of fugitive dust | Establish the levels of dust generation during peat deposition during the first two months and setting a programme for its reduction. |
| 3. Protection of dust sensitive areas | Establish the levels of dust nuisance at the three dust sensitive locations during the first two months of monitoring and setting a programme for the protection of these areas |
| 4. Reuse of silt pond waste | Monitor the levels of silt pond waste cleanings at the 7 silt ponds and swale locations over the peat deposition period and establish a reuse option. |
| 5. Effective spill leak management of Mobile fuelling units | Comply with all of the condition of the licence in relation to operation and maintenance of all mobile fuelling operations, and assess its effectiveness after 3 months operation. |
| 6. Management of dangerous substances | Comply with the conditions of licence relating to oil and diesel storage, bunding and recycling and review after 2 months operation |
| 7. Management of silt pond flow discharges | Comply with the conditions of the licence in relation to the management of silt pond flow discharges during high rainfall events and assess its effectiveness after two months operation. |
| 8. Reuse of stone used in internal haul-road construction | Investigate any potential re-uses for the geotextile and stone used in the construction of the internal; haul-roads, either on site or in the locality. |

### 4.3 Environmental Management Programme Report.

Minimisation of Suspended Solids (EMP1)

| Activity/Emission | Objective | Target Date | Target | Persons Responsible |
|---|---|---|---|---|
| OT1<br>Emission of suspended Solids | Minimisation of suspended Solids | On-going programme during the life of the project and as part of aftercare & maintenance. | To comply with Conditions 8.9.1, 8.9.3 & 8.9.4. a programme of weekly inspections of all drainage and subsequent waste treatments systems, daily inspections of discharges to receiving waters and the regulation and monitoring of all silt generating activities will be put in-place. This will be used for establishing the cleaning roster.<br><br>These systems will be assessed on an ongoing basis for the first two months of peat deposition, to assess the degree of suspended solids generation, and this along with the daily results for SS from the Composite Sampler will be used to establish targets for the reduction of Suspended Solids<br><br>**Status: The inspections and monitoring of these emissions were continued during 2011 and are retained on site for inspection.** | Site Manager & Environmental Manager |

## Reduction of fugitive dust (EMP2)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT2<br>Fugitive dust emissions | Reduction of fugitive dust emissions during all operations | On-going programme during the life of the project. | This programme will establish the degree of dust generation during the first two months of peat deposition. Peat delivery, tipping on the peat reception area, loading into the trailers and deposition into the bays will be examined along with any dust suppression methods employed and the appropriate Dust Handling Procedure. This will include the first two months of dust monitoring.<br><br>The results of these assessments will be used to establish targets for reduction of fugitive dust emissions.<br><br>**Status: There were no dust complaints during 2011. The one dust non-compliance during the period was during Nov/Dec2011, the wettest period of the year, and was only slightly over the ELV of 350mg/m2/day.** | Site Manager & Environmental Manager |

## Protection of dust sensitive areas. (EMP3)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT3<br>Fugitive dust emissions | Protection of Dust sensitive areas. | On-going programme during the life of the project. | Based of the results of the initial two months dust monitoring at the five dust sensitive locations, a programme of protection of dust sensitive locations will be examined.<br><br>This will address any measures to be put in-place, such as the planting of trees, or any special measures to be put in place to protect any areas that exceed the ELV of 350 mg/m²/day.<br><br>**Status: There were no dust complaints during 2011. The one dust non-compliance during the period was during Nov/Dec2011, the wettest period of the year, and was only slightly over the ELV of 350mg/m2/day.** | Site Manager & Environmental Manager |

# Reuse of silt pond wastes (EMP4)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT4<br>Reuse of Silt Pond Waste | The reuse of all silt pond wastes. | On-going programme during the life of the project. | As the silt wastes generated form the cleaning and maintenance of silt ponds S5-1, S5-2, Area 5 & Area 6 silt ponds are directly as a result of peat deposition, they will either be used in the Bog & Peat Deposition Area rehabilitation & aftercare, or will be incorporated into the existing bays once deposition is complete.<br><br>**Status: As all peat wastes accepted and generated at the site are for landfilling purposes, there is no further use for the silt pond cleanings. These will be incorporated into the peat deposited or if of benefit will be used in the final rehabilitation.** | Site Manager & Environmental Manager<br><br>Site Manager & Environmental Manager |

## Management of mobile fuelling wagons (EMP5)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT5 Management of mobile Fuelling units | Effective spill/leak management of mobile fuelling units. | On-going programme during the life of the project. | To comply with conditions 3.17, 3.19 and 3.20, the two mobile fuelling units are stored in a bunded location, with an oil spill kit in-place. Fuelling nozzles will be fitted with overflow shut-off mechanisms and auto fill clips will be disabled. All personnel will be made aware through training, of the Oil/Diesel Loading Procedure & the Emergency Response Procedure. Shortened versions of the procedures are posted on the tanks and at the bunded storage location. All service wagons have been inspected before use and bi-annually there after. Leaks, flaws, necessary repair etc, will be reported to the Site Manager. All the above will be in-place before peat deposition re-commences, and will be re-assessed as to their effectiveness every 3 months. The out come of these assessments will determine any improvements to be made and target dates to achieve them.<br><br>**Status: There is one double-skinned tank retained on-site for re-fuelling excavators etc which is stored on the protected pad.** | Site Manager & Environmental Manager |

# Management of dangerous substances (EMP6)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT6<br>Management of dangerous substances List I & List II | To manage of any dangerous substances as listed in I & II of the Dangerous Substances Directive 80/68/EEC | On-going programme during the life of the project. | The only substances from Lists I & II of the Dangerous Substances Directive (76/464/EEC and 80/68/EEC and amendments) are List I (7) Mineral Oils and Hydrocarbons. The management of these will include:<br><br>(1). **Pollution Prevention** as required by Conditions 3.13 – 3.21. This includes the safe storage of diesels/oil/Filters and protection of ground and surface water during fuelling operations.<br><br>(2). **Pollution Control**: Maintenance of diesel/oil interceptors as required by Conditions 8.9.1 & 8.9.2<br><br>All of these measures will be in-place before peat deposition commences.<br><br>A review will be carried out after the first two months operation and every 3 months thereafter, to assess the effectiveness of programme OT6.<br><br>A programme of improvement will be implemented once the operational performance of the management of diesels & oils has been assessed. | Site Manager & Environmental Manager |

| | | | | |
|---|---|---|---|---|
| | | | **Status: The oil interceptors installed at the site include 3 Klargester units. These units are installed downstream of the grit trap and are operating successfully. They have also been fitted with alarms, which indicate when they require cleaning. The operation and maintenance of these units is on-going. They were cleaned in August and December 2011, with the filters replaced. Sampling for COD at SW2 during the year showed an average of 57 mg/l.** | |

# Management of silt pond flow discharges (EMP7)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT7<br>Effective management of<br>Silt pond flow discharges | Effective management of flow discharges during periods of high precipitation and flooding. | On-going programme during the life of the project. | As is required by Conditions 3.11 & 3.12, all silt ponds must achieve specific design criteria i.e. max flow velocity <10 $cm^{-1}$ and min. 75$m^3$/nett ha of bog. Flow regulators must also be fitted to ensure the design flow capacity is not exceeded.<br><br>The drainage system has been designed to a rainfall event of 31 mm, which equates to a 100 year storm event of 1 hours rainfall.<br><br>As the preferred option for the drainage management was the controlled discharge of water from the drains to the swale to the silt ponds, appropriate flow regulators will be in-place to ensure the design flow of each of the silt ponds is not exceeded during heavy rainfall and that any excess runoff generated is discharged to the overflow area (Area 7).<br><br>Condition 3.4 requires a construction quality assurance validation to be completed on the surface water drainage/control/treatment works. This will include an assessment of the performance of the silt ponds and will assess its compliance with the stated maximum flow velocity < 10 $cms^{-1}$ | Site Manager & Environmental Manager |

| | | | | |
|---|---|---|---|---|
| | | | **Status. The manual operation of the overflow valve continued in 2011 with flow directed to the controlled overflow area during predicted periods of heavy rain as advised by Met.ie. Flow meters were installed at the outlet of all active silt ponds, with the flow being monitored weekly to ensure compliance with the max flow velocity <10 $cm^{-1}$. These flow meters are calibrated daily and adjustments recorded.** | |

## Reuse of road building materials (EMP8)

| Activity/Emission | Objective | Target Date | Target | Person Responsible |
|---|---|---|---|---|
| OT8<br>Road materials re-use | Reuse of stone used in internal haul-road construction. | As stated in the EIS, the decommissioning plan for the internal haul road network would envisage it occurring at the end of the stabilisation period (5 yrs after deposition has been completed). There may also be a requirement to leave these roads in-place as part of the after use of the deposition area. | All materials used in the internal haul road construction will be either recycled or reused.<br><br>The Geotextile will be collected for reuse within BNM for under rail lines, or recycled through a licensed contractor.<br>The 300mm of crushed stone will be recycled through one of the following:<br><br>1. As internal service roads to a Proposed Wind Farm Development at Oweninny.<br>2. As construction material on an alternative site.<br>3. Through an appropriate recycling contractor. | Site Manager & Environmental Manager |

| | | | | |
|---|---|---|---|---|
| | | | 4. Placement at the base of the toe drains to assist in drainage.<br><br>**Status: The stone peat haulage roads will have to be retained on site for 3 – 5 years so that access can be maintained to the bays for maintenance of drainage, monitoring and assessment.**<br>**Given the current condition of the roads, it is not envisaged that recycling of the road material will be possible due to encroachment of the deposited peat, flooding and degradation of the road surface and weed growth. Excavation and cleaning/screening of the road materials for reuse would be time and energy intensive and the energy and material offset for another site reuse would be negative. This was still the case in 2011.** | |

### 4.4 Environmental Management Programme Proposal.

The proposal for 2012 is to continue with projects EMP 1 - 8 due to the continuation of peat deposition in 2012.

### 4.5 Silt Pond Inspection & Desilting Report.

Inspections of the silt ponds are carried out weekly. A full log of all inspections is maintained at the site office and this along with SS results obtained from the silt ponds form the basis for the cleaning roster.

The silt ponds servicing the Srahmore site were all cleaned during 2011 as follows:

| **Silt Pond** | **Date Cleaned** |
|---|---|
| S5-1 (SW100) | June 2011 |
| S5-2 (SW101) | June 2011 |
| SP1 (SW 1) | June 2011 |
| SP2a/b (SW2) | June 2011 |
| SP3a/b (SW3) | June 2011 |

## 5.0 Site Development Works.

### 5.1 Summary of main changes/developments/works carried out in 2011

- Lay Bog Mat Road across Bays 3 & 4. Construct stone ramps into each Bay. Create stone haul road in Bay 2 to facilitate peat deposition. Lay Bog Mat Road in Bay 2 if required.
- Supply & install wheelwash and water recycling tanks.
- Supply and install mobile weighbridge.
- Clean out existing grit trap and service petrol interceptor as required.
- Clean out silt ponds and clear drains as necessary.
- Upgrade and maintain existing haul roads.
- Remove old rail tracks at southern end of Bays 2 & 3.
- Install new wireless CCTV system on site.
- Supply and install new water monitoring & control equipment.
- Maintain and upgrade existing weirs, samplers etc.
- Carry out Integrity testing on existing drainage system.
- Grade and sort bog mats stored on Peat Reception Slab.
- Maintain line of sight at entrance. Cut back grass and bushes along entrance to site when necessary.
- Carry out repairs to roofs of portacabins on site.
- Monitor dust levels during deposition
- Carry out Bird and Fauna Surveys
- Maintain plant and equipment on site.
- Install new wind sock & entrance sign

- Installed temporary stone haul road in bay 2 to assist peat deposition.
- Installed temporary diversion road around peat reception slab.
- Deposited 16,186 tonne of peat.
- Installed additional site accommodation.
- Installed pedestrian access to sampling equipment.
- Installed 6000Lt Cesspool to collect foul water from site facilities.
- Erected new safety signage.

## 5.2 Summary of Planned Works for 2011 (Pre Peat Deposition 2012)

- Cleaning of settlement ponds as required
- Cleaning of grit trap and oil interceptor as required
- Maintenance/ Repair of gravel roads
- Install Bog Mat Road to upper section of Bay 2 to assist deposition.
- Repair fencing to settlement ponds
- Deposition of an expected 41,000 Tonne of Peat.
- Decommissioning of site facilities on completion of peat deposition. Facilities include: Weighbridge, Wheel Wash, Temporary Roads, Additional Site Accommodation, Bog Mat Roads Etc

## 6.0 Waste received and consigned from the Facility

### 6.1 Non-hazardous waste received by the facility.

| | | Non-Hazardous Waste Received | | | |
|---|---|---|---|---|---|
| Waste Description | EWC Code | On-site Disposal | | On-site Recovery | |
| | | Method | Tonnes | Method | Tonnes |
| Waste Peat Excavations | 17 05 04 | Deposit into landfill | 16185 | 0 | 0 |
| | | | | None | |

### 6.2 Hazardous waste received by the facility.

| | | Hazardous Waste Received | | | |
|---|---|---|---|---|---|
| Waste Description | EWC Code | On-site Disposal | | On-site Recovery | |
| | | Method | Tonnes | Method | Tonnes |
| | | None | | | |

## 6.3 Non-hazardous waste sent off-site for Recovery/Disposal.

| Waste Description | EWC Code | Tonnes | Details of Haulage Contractor | Recovery /Disposal | Name & Address of recovery/Disposal Site |
|---|---|---|---|---|---|
| Canteen/office Waste | 20 01 08 | 6.47 | G & T Loftus Recycling Ltd | Disposal | Rathroeen, Killala Rd, Ballina, Co. Mayo |
| Dry Mixed Recycling | 20 01 01 | 0.135 | G & T Loftus Recycling Ltd | Recycling | Rathroeen, Killala Rd, Ballina, Co. Mayo |

## 6.4 Hazardous waste sent off-site for Recovery/Disposal

| Consignment Note/TFS Note Number | Date of Dispatch | Description of Waste | EWC Code | Tonnes | Details of Haulage Contractor | Disposal/ Recovery | Name & Address of Recovery/ Disposal site |
|---|---|---|---|---|---|---|---|
| SDC 000667 | 15-04--11 | Oil Interceptor Cleanings | 13 05 08 | 8.1 | Enva Ltd | Disposal | Enva Ltd. Portlaoise, Co Laois |
| MO 000271 | 01-09-11 | Oil Interceptor Cleanings | 13 05 08 | 60.94 | Enva Ltd | Disposal | Enva Ltd. Portlaoise, Co Laois |
| MO 000272 | 17-08-11 | Contaminated oil booms | 15 02 02 | .181 | Enva Ltd | Disposal | KWA. Kamp-Limfort, Germany |
| MO 000235 | 16-09-11 | Contaminated soils | 19 13 01 | 26.18 | Enva Ltd | Disposal | Enva Ltd. Portlaoise, Co Laois |
| MO 000274 | 05-10-11 | Contaminated oil booms | 15 02 02 | .271 | Enva Ltd | Disposal | KWA. Kamp-Limfort, Germany |
| | 07-12-11 | Oil & Grit Trap Cleanings | 13 05 08 | 69.94 | Enva Ltd | Disposal | Enva Ltd. Portlaoise, Co Laois |
| | 15-12-11 | Septic Tank | 20 03 04 | 80 | Asthetic Services | Disposal | Ballina Wastewater Treatment Works, Belleek, Ballina, Co. Mayo |

## 7.0 Environmental Incidents & Complaints.

### 7.1 Reported Incidents Summary.

| Date | Nature of Incident | Cause | Corrective Action |
|---|---|---|---|
| 11-08-11 | Sludge Spillage | Human Error | SR-CA/2011.01 |

### 7.2 Reported Complaints Summary

| Date | Nature of Complaint | Cause | Corrective Action |
|---|---|---|---|
| | NONE | | |

## 8.0 Review of Nuisance Controls.

The nuisance controls at the site only include dust suppression and pest control.

Peat Guard have pest control on-site. For dust suppression, there is a tractor and water bowser on-site for wetting internal roads along with a mechanical brush.

## 9.0 Review of Rehabilitation Plan.

Rehabilitation at the Srahmore site is outlined in the Rehabilitation Plan for the Srahmore Peat Deposition Area and Associated Facilities (March 2011). Note: An updated rehabilitation plan was agreed and circulated to consultees in March 2011 as part of Condition 10 of Waste Licence W199-2. This supersedes the previous Rehabilitation Plan that was developed in February 2005. With reference to the 2011 rehabilitation plan for the Srahmore PDA, It should be noted that there are no significant changes proposed to the original 2005 rehabilitation plan other than those relating to the timeframe for ecological monitoring and final rehabilitation works.

The main criteria[1] defining successful rehabilitation of the Srahmore PDA and associated facility are:

(i) Stabilisation of the deposited peat[2]

(ii) Mitigation of silt run-off

Natural revegetation processes are outlined as the BAT for rehabilitation of the Srahmore site. Results show that vegetation establishes rapidly on the deposited peat; the plant roots bind the introduced peat layer, altering the peat structure to create a homogeneous peat mass thereby stabilising the peat.

### *Deposition Area*

The deposition area comprises access routes on high fields, peat deposition area and drainage channels. It can be split into two areas: inactive deposition areas that have already revegetated and areas where peat is currently being deposited.

*Inactive deposition areas that have already revegetated*: The greater part of the deposition area has been covered with peat between 2005 and 2007. The peat was deposited and levelled between high fields using long-reach

[1] These are the basic criteria as identified in the consultation process for development of *The Rehabilitation Plan* for the entire Oweninny Works.

[2] Stabilisation of these areas infers revegetation. Once stabilised there will be no potential peat run-off from the site, which will cover the second criterion for successful rehabilitation.

excavators. The final shaping allows for run-off into drainage channels with the peat remaining undisturbed to facilitate natural revegetation processes.

Within weeks the deposited peat was colonised by a flush of soft rush *Juncus effusus* seedlings. Other plants colonising included bulbous rush *Juncus bulbosus* and sorrel *Rumex acetosella*. The soft rush tussocks form the dominant character of the vegetation with inter-tussock spaces of patchy plant cover, with shrubs such as bramble *Rubus fruticosus* and some willow *Salix* spp. emerging. The cover of this pioneer vegetation is continuous over the entire area of deposited peat. The establishment of other species between the tussocks of soft rush will further bind the peat together and eventually lead to a complete cover and stabilisation of the introduced peat.

Areas where peat is currently being *deposited*: peat has been brought into Bay 6 between November 20122 and March 2012. The peat has been handled in the same manner as the inactive areas described above. There has been no establishment of vegetation to date. Vegetation is likely to begin with establishment of rush seedlings over the course of the spring and early summer 2012 and become extensive over the year.

Vegetation cover in the remaining uncovered area is low and comprises patchy growth of bog cotton *Eriophorum angustifolium* and soft rush *Juncus effusus*.

***Water over-spill area (Area 7)***

This area was rehabilitated in line with the rehabilitation plan for the Oweninny Works, Cutaway Bog Rehabilitation (2003). This involved field drain blocking and it is anticipated that natural revegetation processes will proceed in this area and over the duration of the peat deposition activity. The overflow facility will be maintained for the duration of the peat deposition and also for a number of years following the activity to ensure that there is no build-up of water on site. When the area is no longer required, the site will be re-surveyed

to determine the vegetative condition and whether further rehabilitation work is required (unlikely to be more than superficial).

***Off-loading facility (Area 5)***

Construction work was completed in April 2005 and the final activity on-site was in Autumn 2007. To date, there has been extensive colonisation of the surrounding bare peat, predominantly soft rush *Juncus effusus.*

**Srahmore Assessment November 2010**

Annual walkover surveys of the Srahmore PDA indicate that the vegetation that has established on the inactive deposited peat is developing further as outlined in previous annual assessments. Inter-tussock spaces of the soft rush are becoming further colonised by herbs, grasses and mosses with intermittent pools. The initial pioneer vegetation is maturing and developing a denser growth pattern. There are increasing signs of Willow shrubs *Salix* spp. throughout the PDA with a small area of emerging Gorse *Ulex europaeus* to the north west of the PDA.

A notable feature is the emergence of *Sphagnum cuspidatum* plants throughout the deposited peat area. The plants are by no means extensive in cover but do indicate Poor Fen conditions. The spontaneous regeneration of *Sphagnum* suggests that growth of the bog-mosses could be accelerated by creation of pools throughout the deposited peat complex. The potential to carry out this work was assessed in spring 2010 (outlined below).

The active peat deposition areas are currently devoid of vegetation and this will be monitored over the coming year. It is expected that these areas will colonise with rushes as before.

The vegetation will continue to develop over time and Bord na Móna will continue to monitor the changes in structure and composition: the site is still utilised by a number of bird species, particularly nesting Skylark (*Alauda arvensis*).

**Srahmore PDA: bog pools trials (*note circulated to consultees in June 2010*)**

As part of the Rehabilitation Plan that was developed for the Srahmore PDA site (*Rehabilitation Plan for the Srahmore Peat Deposition Area and Associated Facilities* February 2005) it was outlined that following stabilisation of the deposited peat, trials would be established to determine post-peat stabilisation management:

"There will also be an assessment in 5 years following the deposition of the peat to assess the scope for rewetting and/or other long-term rehabilitation measures proposed by the licensee and the consultees as detailed in Chapter 6 of the *Srahmore Peat Deposition Site Development* EIS (December 2003)".

An area of peat at the top of Bay 4 was selected as the peat was spread here in 2005 and has subsequently stabilised predominantly through natural colonisation by rushes. The work comprised digging of pools within the re-vegetated peat and inoculating with *Sphagnum* plants (bog mosses) to determine the ability of the plant to spread within the pools. This work has already been trialled at the Bellacorick site (Farrell 2001) with success.

**Aims**

- To determine the potential for regeneration of peat formation within the deposited peat at Srahmore
- To determine the best practical approach to accelerating re-establishment of peat-forming conditions within the Srahmore PDA.

**Method**

- The work was completed on May 31st 2010 following a particularly dry spell; ground conditions were excellent for operating machinery on the deposited peat.
- A long reach excavator was used to dig out pools within the Srahmore deposited peat.
- There were 10 pools marked out initially across the top of Bay 4, two rows of five and each approximately 2m*5m.
- One larger pool was created – approx. 5m*5m

- Each pool except for one was inoculated with *Sphagnum cuspidatum* taken from pools already within the Srahmore deposited peat.

**Monitoring *Sphagnum* growth**

- The water level in the pools will be monitored (depth measurement)
- Extent of *Sphagnum* growth within each pool will be measured at monthly intervals to determine rate of growth.

**February 2011 update**

- The trial plots have filled with water and an estimate of *Sphagnum* cover is less than 5%. The plots will be re-assessed in April 2011 and October 2011 and scope for further trials determined.
-

**March 2012 update**

- The trial plots have filled with water and all have been colonised with Sphagnum. The cover ranges from 20% to 100%, with Sphagnum continuing to cover the surface and fill the pools (see attached photos). The plots will be re-assessed in April 2012 and it is hoped to establish a more comprehensive network of pools in Bay 4 in summer 2012.

## 10.0 Review of Environmental Liabilities Insurance Cover.

In Accordance with the requirements of Schedule D, Annual Environmental Report Content, a review of the Environmental Liabilities Insurance Cover is required. The initial Environmental Liabilities Risk Assessment (ELRA) was carried out in March 2005. This assessment examined 8 Potential Hazards, including, peat combustion, dust blow, sediment laden run-off and fire etc.

The ELRA was again reviewed in 2011, to reflect the new Waste Licence 199-02 and the proposed resumption of peat deposition in 2011 and 2012. This was submitted to the EPA and agreed in 2011.

As stated in Condition 12.3.2 of the Current Waste Licence W0199-02 for the Srahmore Peat Deposition site, the ELRA shall be reviewed as necessary to reflect any significant change on site, and in any case every three years following initial agreement. The results of the review shall be notified as part of the AER.

In particular, these reviews should include:

- Update the Risk Identification Table, Assessment of Risks Table, Risk Register & Risk Matrix, through the addition of new risks of the omission of redundant risks;
- Verify the implementation of the 'Risk Prevention Mitigation Measures & Management' Plan;
- Ensure that the 'Financial Provision' continues to cover the environmental liabilities at the facility;
- Verify that the 'Financial Instruments' continue to effectively provide the adequate financial provision.

Activities on site have not changed in the 6 months since the ELRA was agreed with the Agency

## 11.0 Landfill Costs

Condition 12.2.1 requires the licence holder to submit a statement on the determination of charge for the disposal of waste in accordance with the requirements of S.I. No. 337 of 2002 European Communities Regulation 2002.
Following the consultation of this regulation, it is determined that as Srahmore Peat Deposition Site is only accepting waste peat from one permitted contractor, and that this charge has been agreed with the contractor prior to the commencement of the peat deposition and is applicable for the duration of the contract, the provision of this statement does not apply. The price agreed with the contractor is commercially sensitive.

## 12.0 Other Reports.

### 12.1 Fuel Bowser Testing.

Fuel bowers were supplied by Roadbridge and include a mobile double skinned tank and a fixed double skinned tank. Both of these bowers were certified and tested by the manufacturer and a copy of the conformity certificates are kept on file in Srahmore.

### 12.2 Placed Peat Stability Assessment.

Condition 8.7 requires a stability assessment of each bay once filled. This was carried out on the 1st of December 2007 by Tobin Consulting Engineers following the completion of the initial landfilling under WL0199-01
Based on the site walkover survey and previous assessments in 2003/2005/2006, all works were carried out in accordance with the rehabilitation plan.
There is no indication of instability in the internal high fields, perimeter high fields, deposited peat bays or drainage system.

The deposited peat is contained within each bay. In its current condition the risk of a mass deposited peat flowing out of bays 2, 3, 4 & 5 and entering the surrounding watercourse is very low.

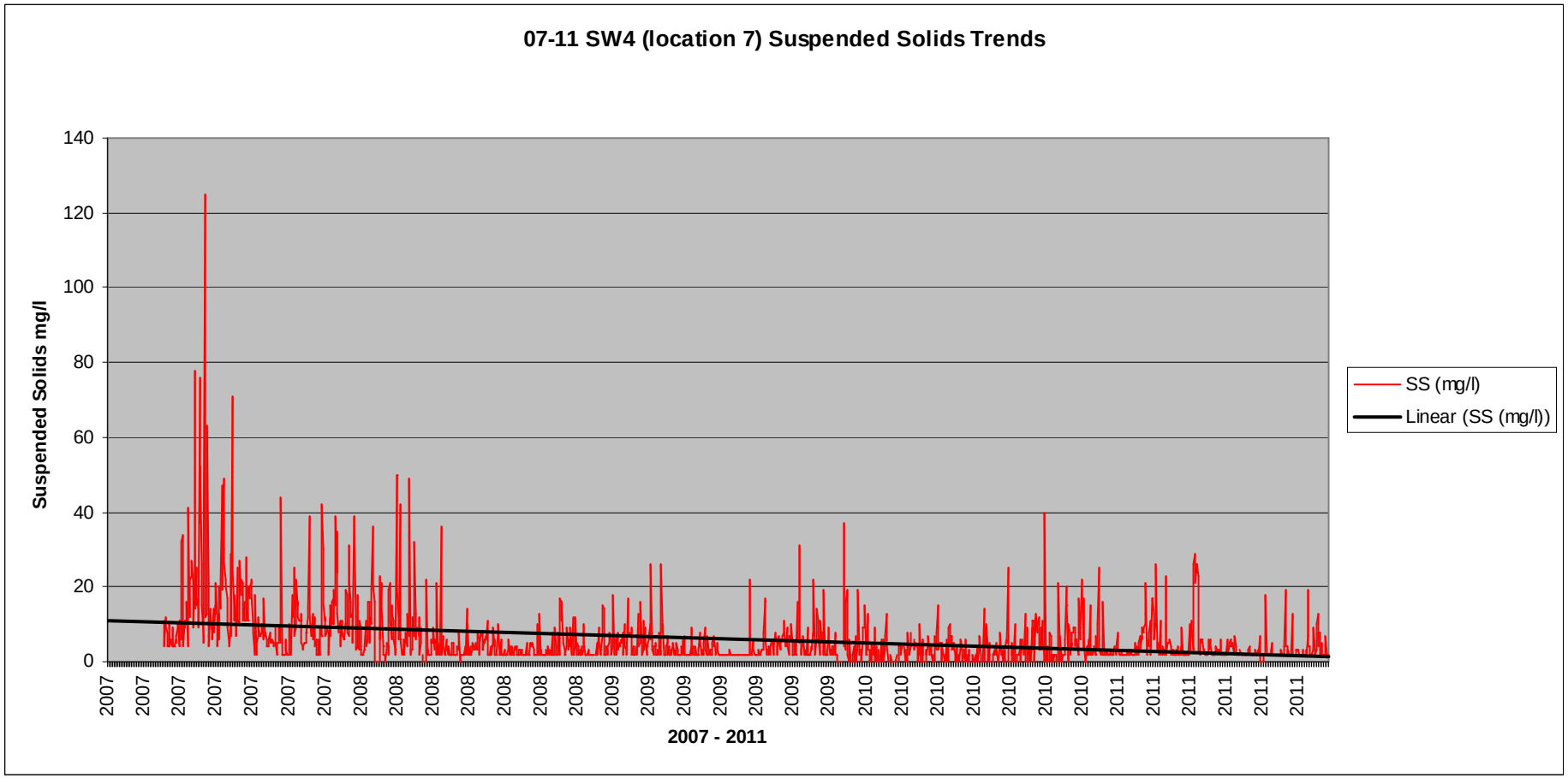
A copy of this Stability Assessment is retained on file at the site office.

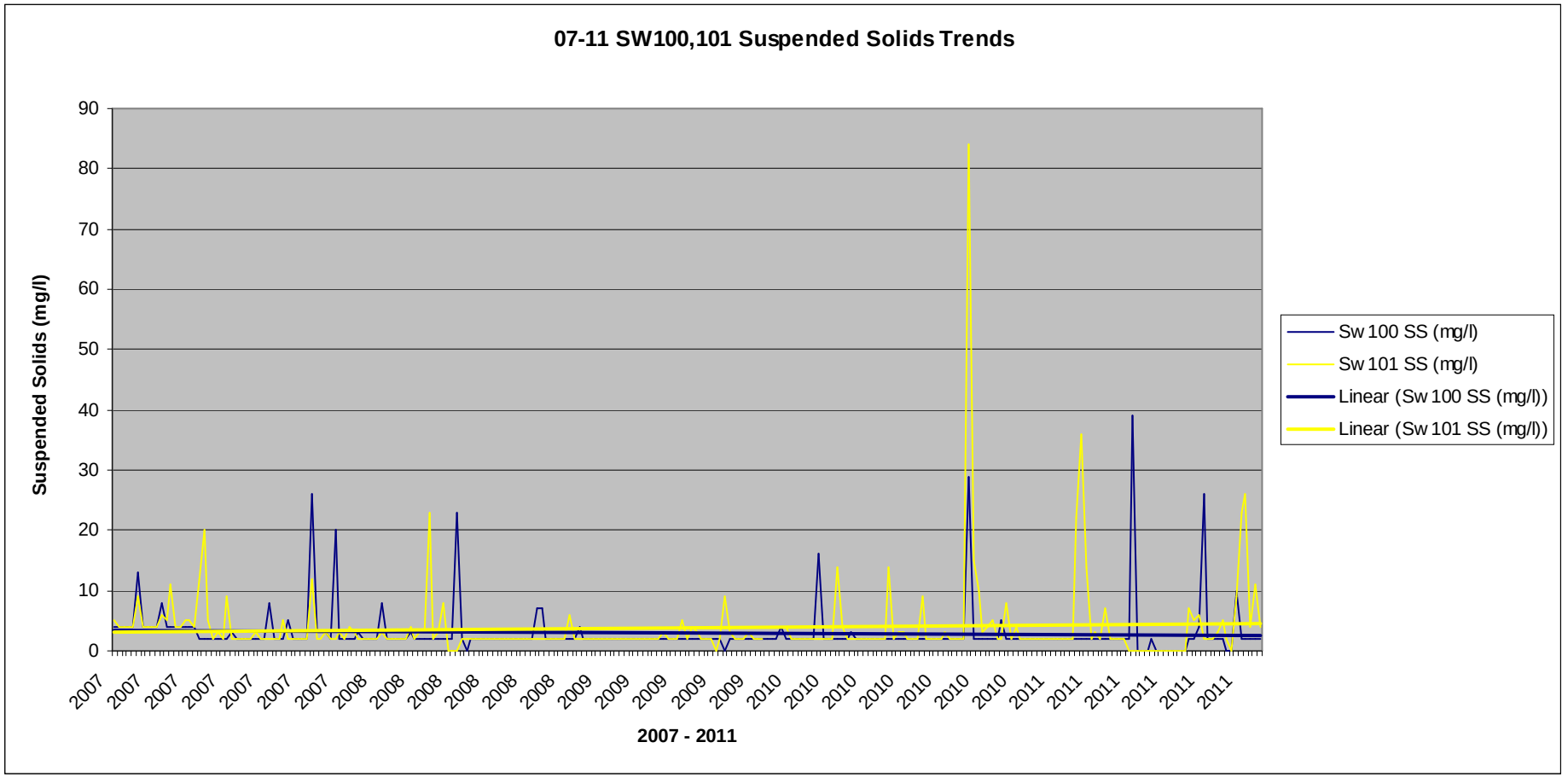
As there was no bay completed in 2011, a stability assessment was not required.

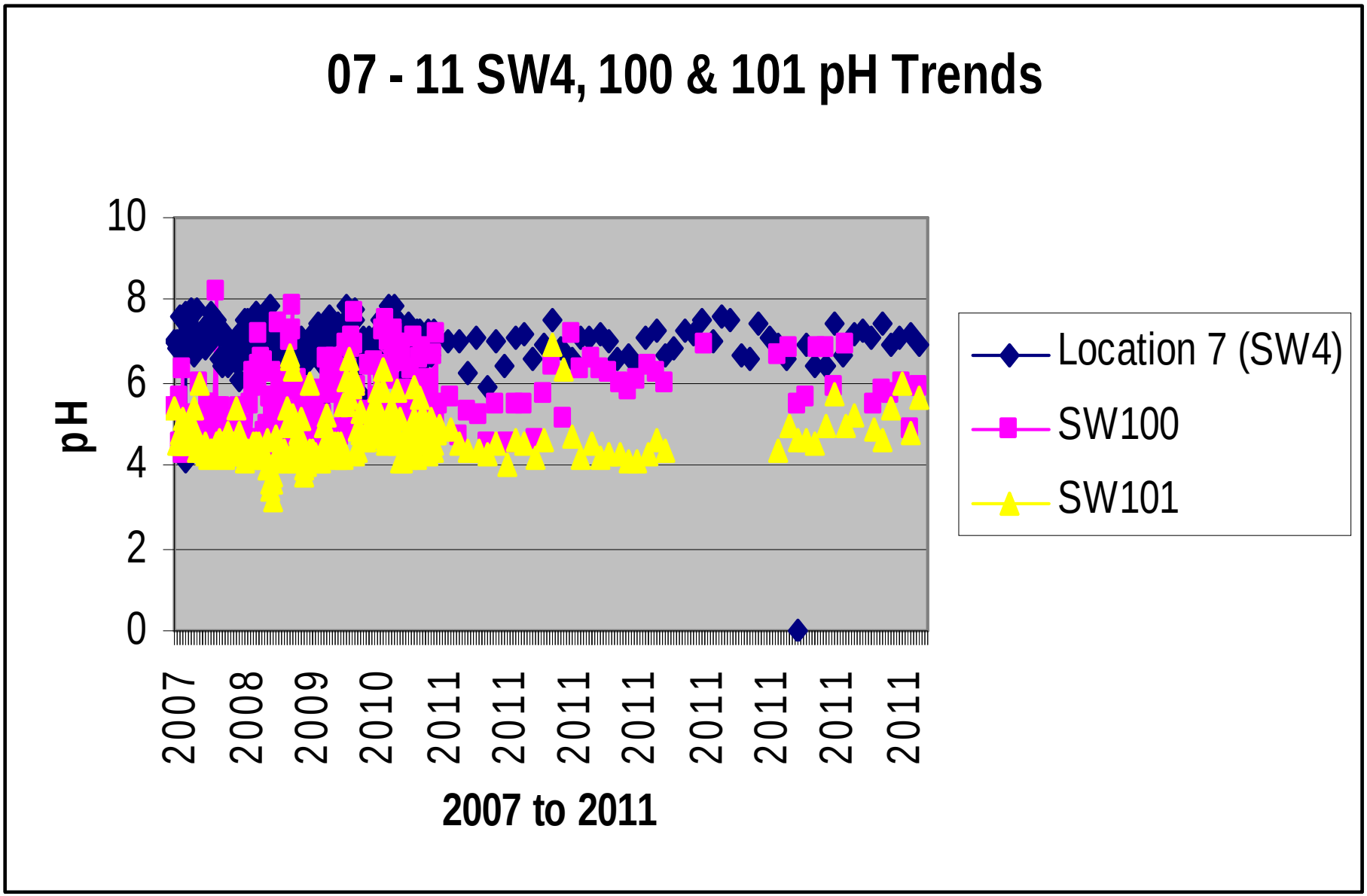
## 13.0 Summary.

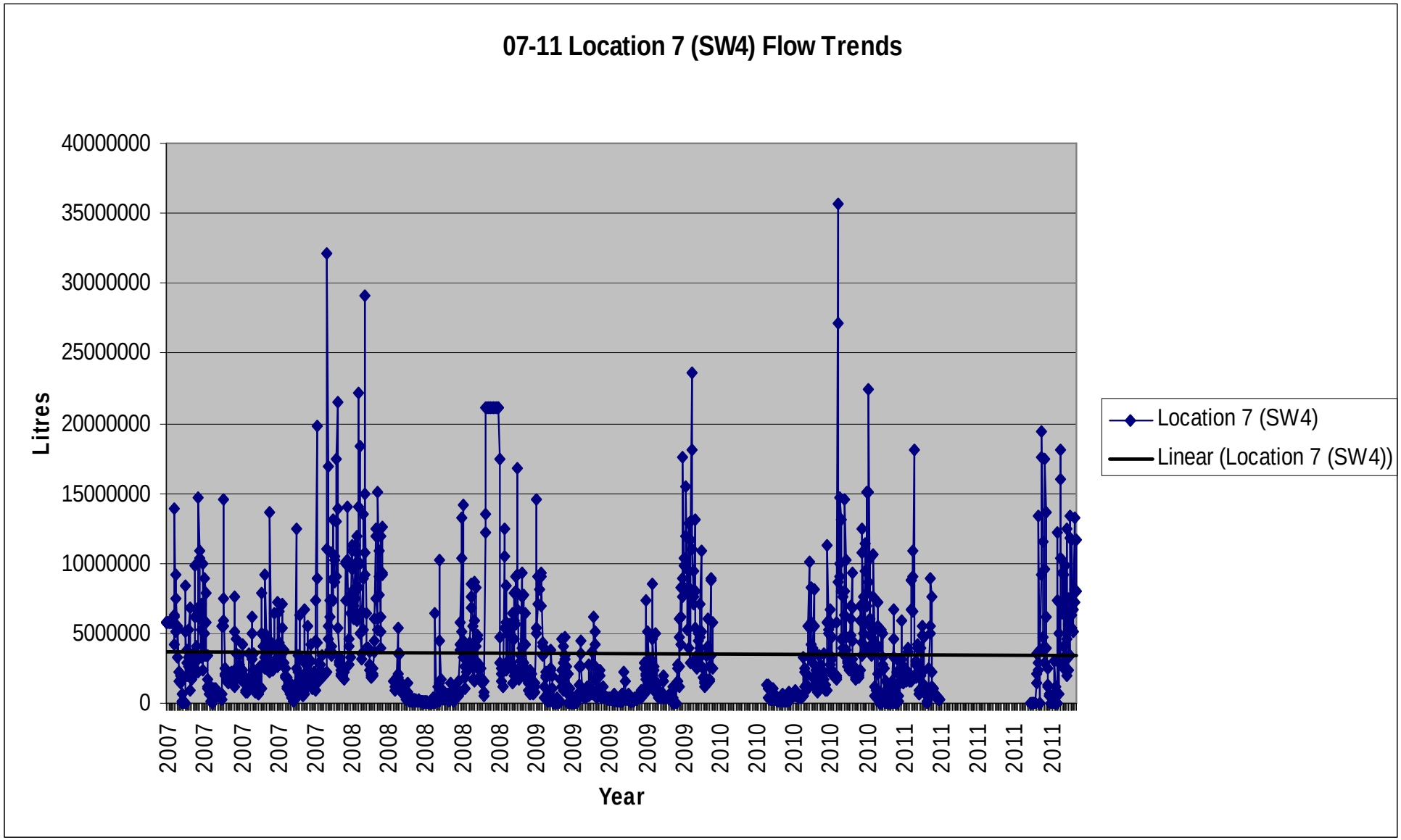
This site has been operational since 15th November 2011, after a long period over 3 yrs where there were no peat deposition activities. The peat deposited during 2005 and 2007 has integrated well into the bays, as reported in section 9 and would be classed as having been completely stabilised with natural rehabilitation on-going. It is expected that peat deposited during November and December and on into 2012, will stabilise and rehabilitate in much the same time frame.
Compliance with the main Emission Limit Value at the site, which is 35mg/l for Suspended Solids, was between 2.9 and 4.4mg/l during 2011, with no exceedances.

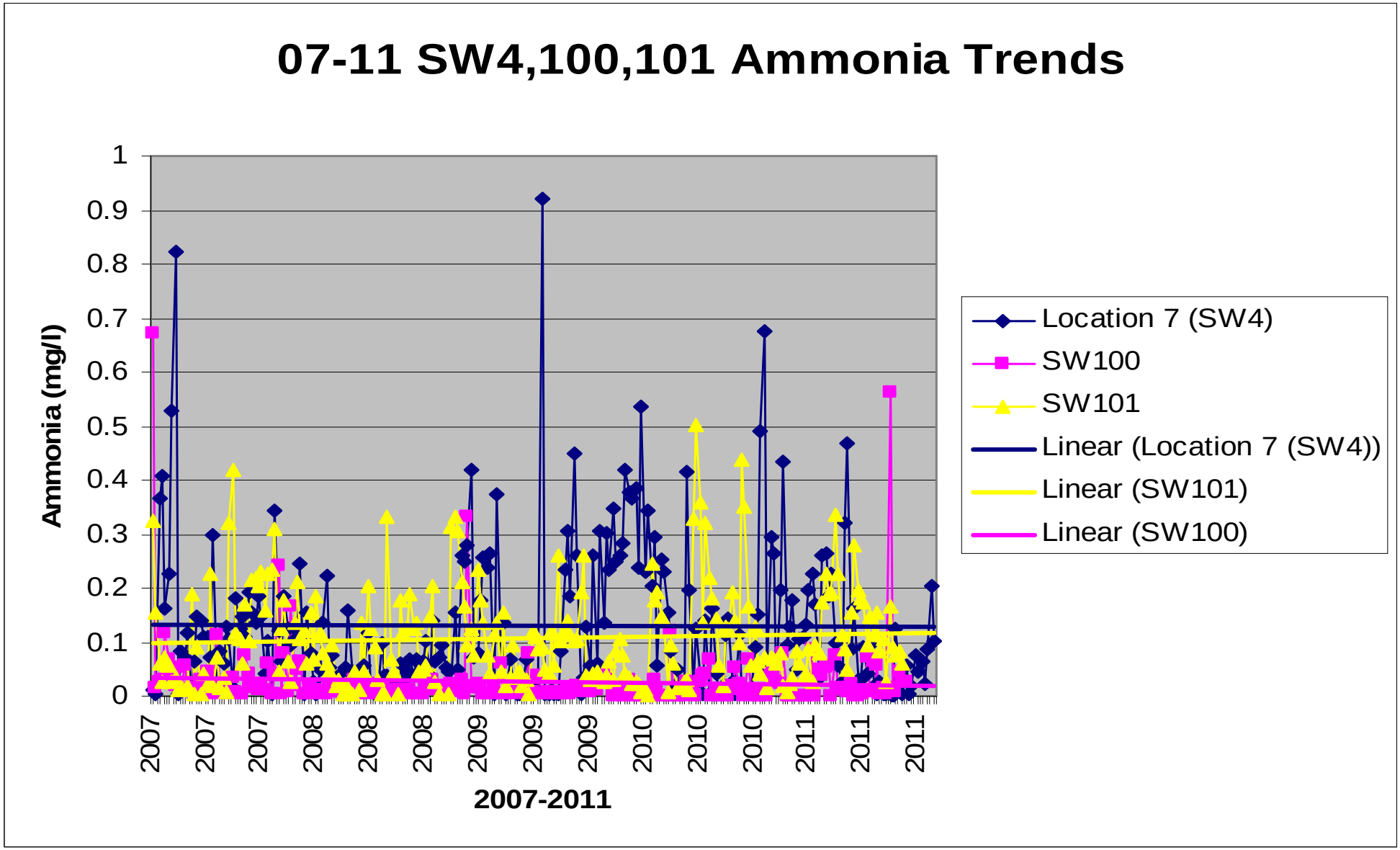
# Appendix 1

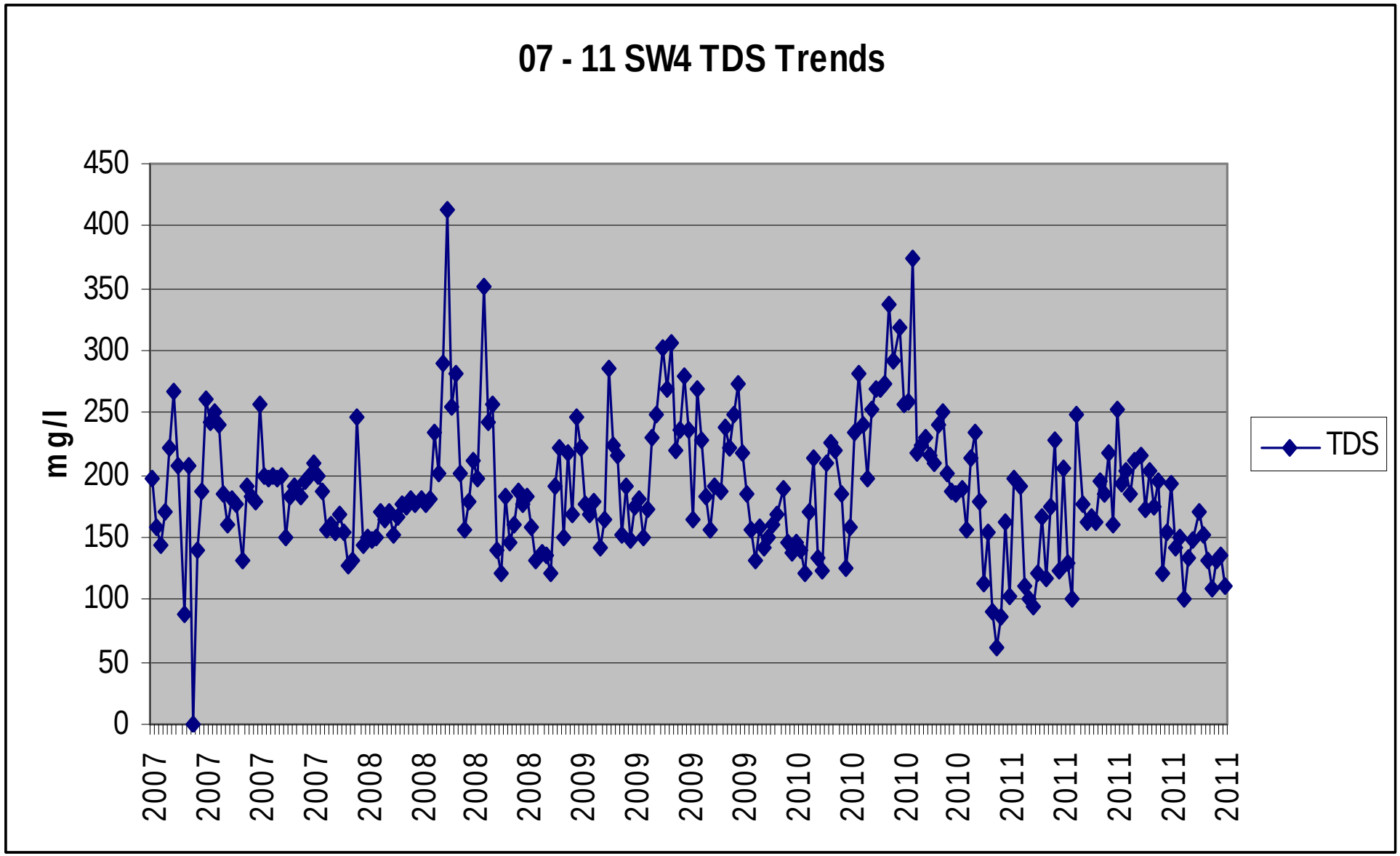

07-11 SW4 (location 7) Suspended Solids Trends
Suspended Solids mg/l
140
120
100
80
60
40
20
0
2007 2007 2007 2007 2007 2007 2007 2008 2008 2008 2008 2008 2008 2008 2009 2009 2009 2009 2009 2009 2009 2010 2010 2010 2010 2010 2010 2010 2011 2011 2011 2011 2011 2011
2007 - 2011
SS (mg/l)
Linear (SS (mg/l))


07-11 SW100,101 Suspended Solids Trends
Suspended Solids (mg/l)
90
80
70
60
50
40
30
20
10
0
2007 2007 2007 2007 2007 2007 2007 2008 2008 2008 2008 2008 2008 2009 2009 2009 2009 2009 2010 2010 2010 2010 2010 2010 2010 2011 2011 2011 2011 2011 2011
2007 - 2011
Sw 100 SS (mg/l)
Sw 101 SS (mg/l)
Linear (Sw 100 SS (mg/l))
Linear (Sw 101 SS (mg/l))

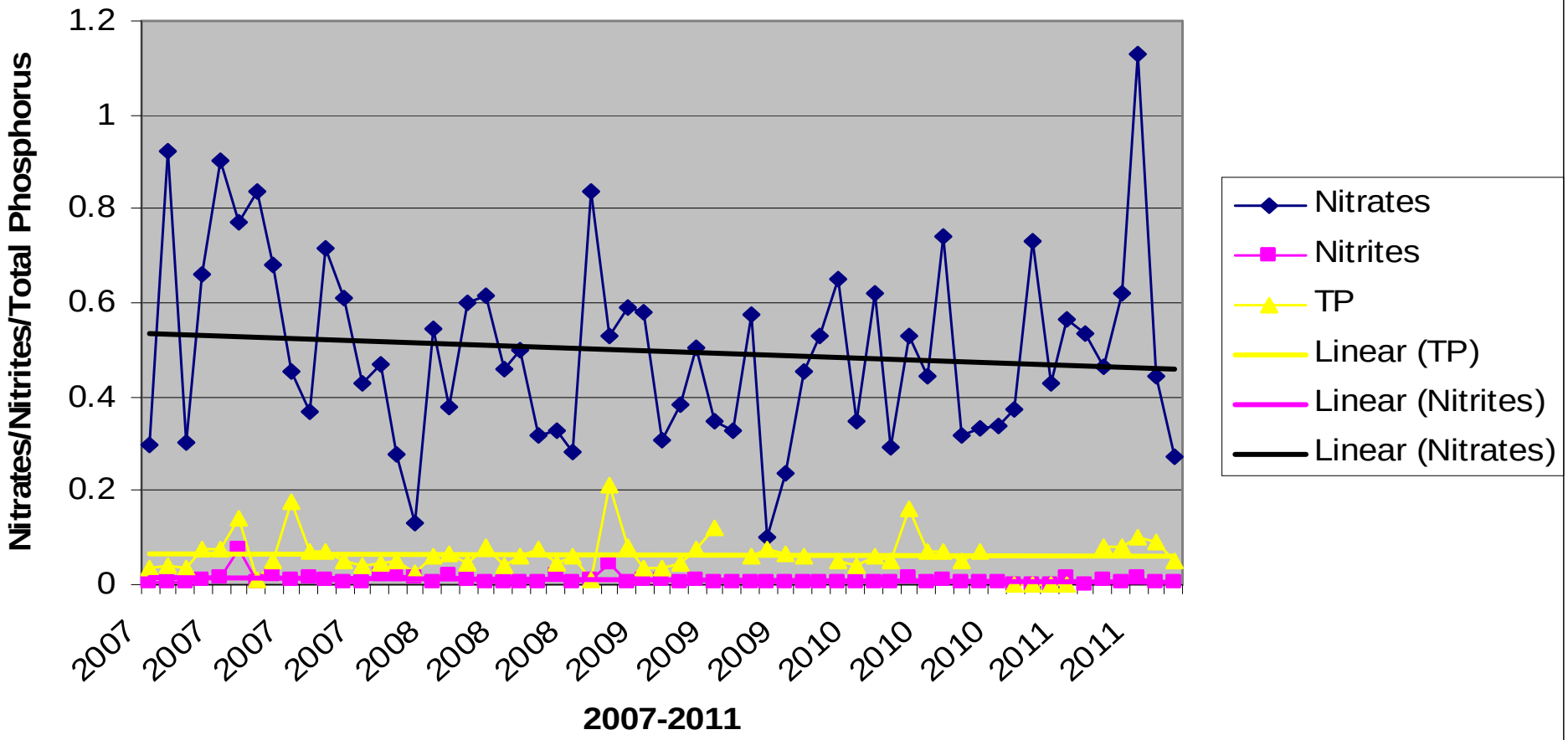

07 - 11 SW4, 100 & 101 pH Trends
10
8
6
4
2
0
pH
2007
2008
2009
2010
2011
2011
2011
2011
2011
2011
2011
2007 to 2011
Location 7 (SW4)
SW100
SW101

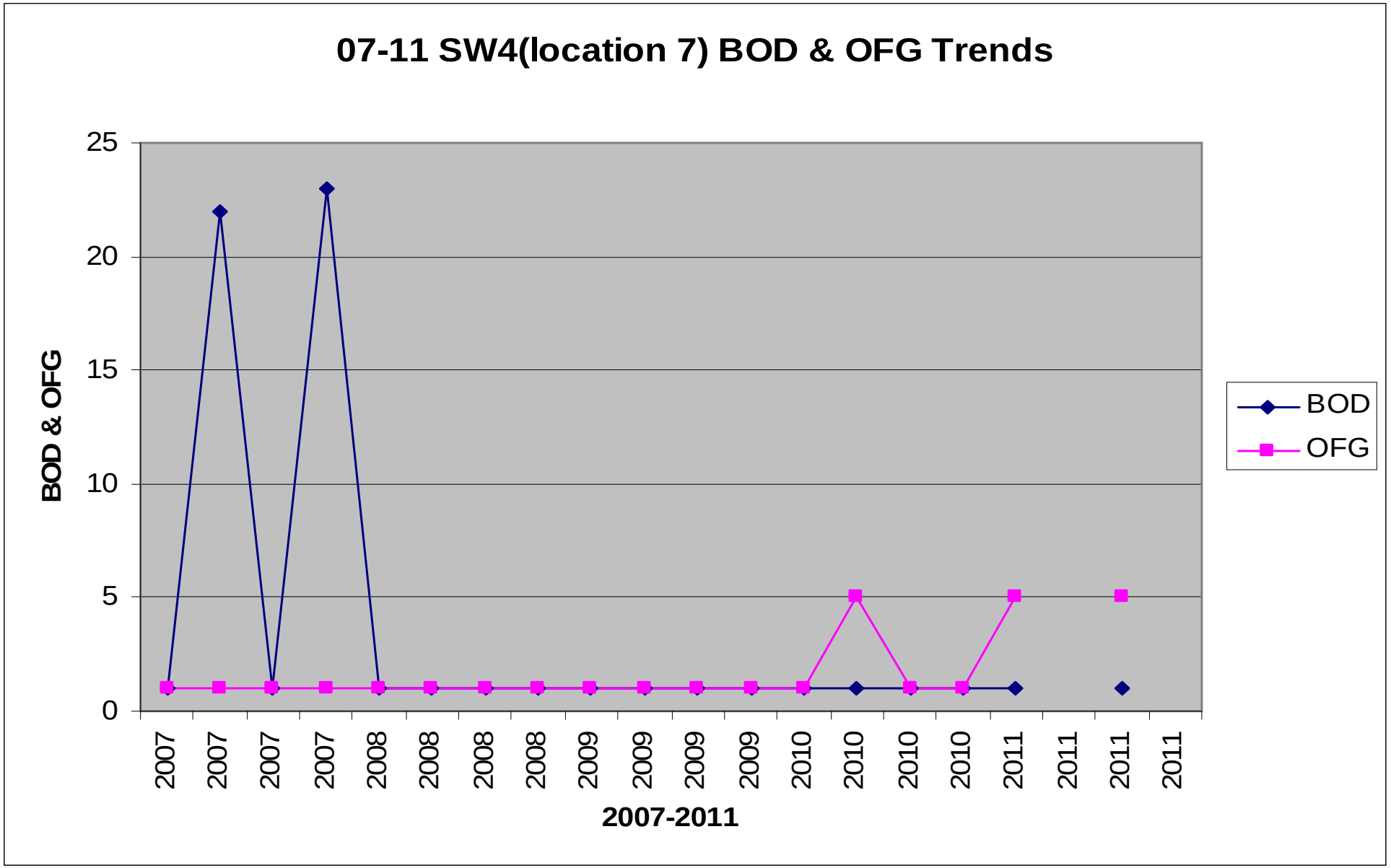

07-11 Location 7 (SW4) Flow Trends
Litres
40000000
35000000
30000000
25000000
20000000
15000000
10000000
5000000
0
2007
2007
2007
2007
2007
2008
2008
2008
2008
2008
2009
2009
2009
2009
2009
2010
2010
2010
2010
2010
2011
2011
2011
2011
2011
Year
Location 7 (SW4)
Linear (Location 7 (SW4))

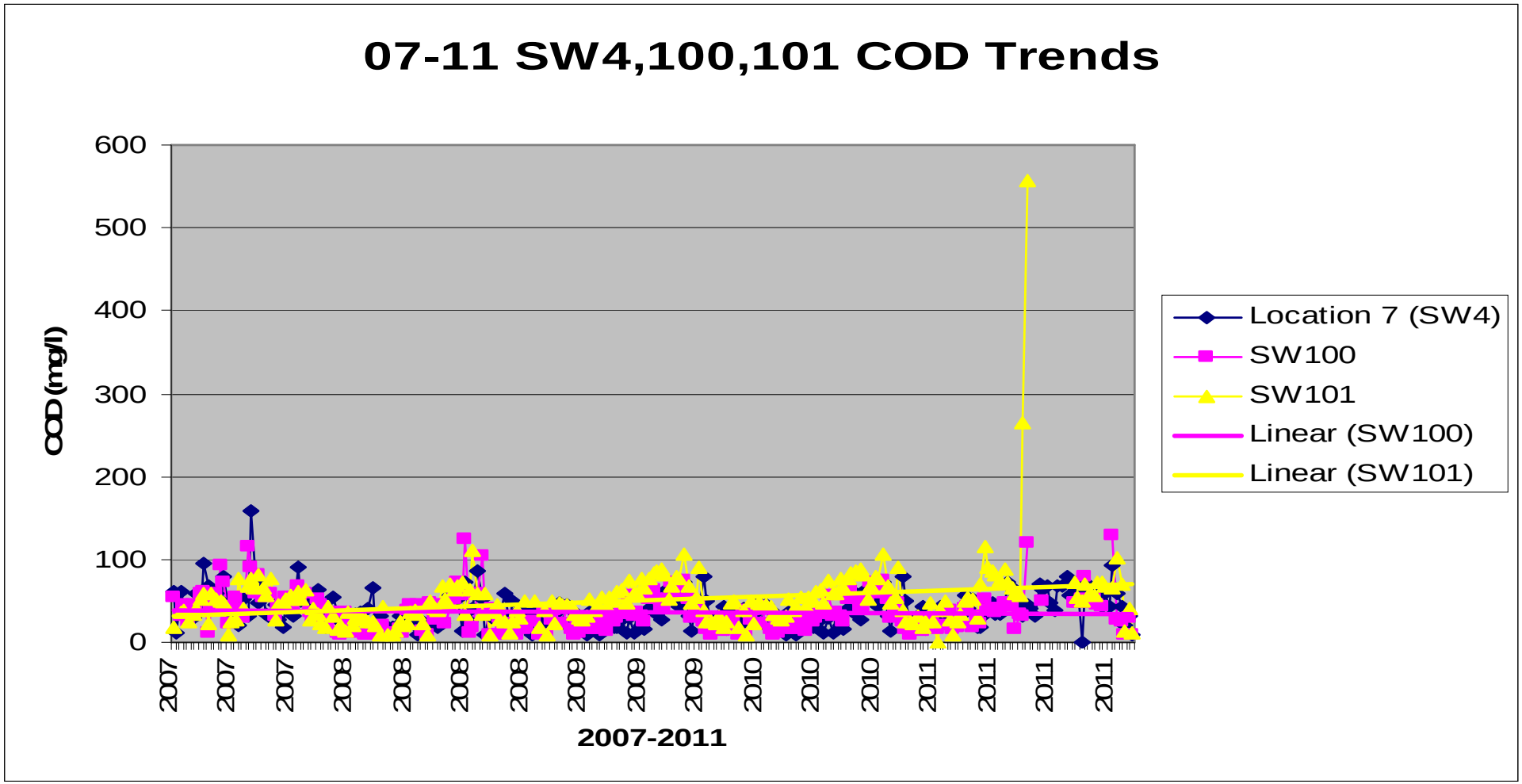

07-11 SW4,100,101 Ammonia Trends
Ammonia (mg/l)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007
2007
2007
2008
2008
2008
2009
2009
2009
2010
2010
2010
2011
2011
2011
2007-2011
Location 7 (SW4)
SW100
SW101
Linear (Location 7 (SW4))
Linear (SW101)
Linear (SW100)

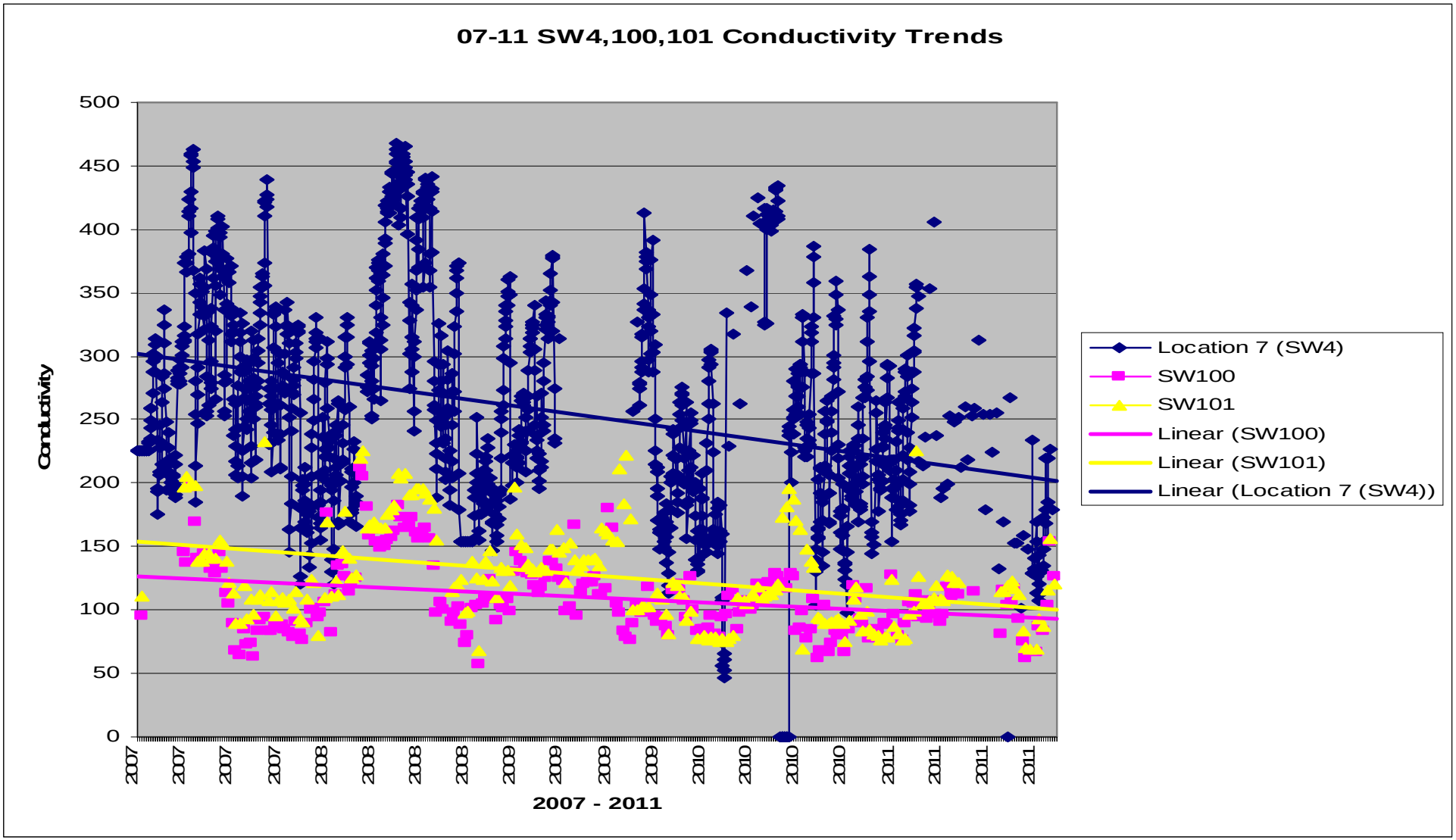

07 - 11 SW4 TDS Trends
mg/l
450
400
350
300
250
200
150
100
50
0
2007
2007
2007
2007
2008
2008
2008
2008
2009
2009
2009
2009
2010
2010
2010
2010
2011
2011
2011
2011
2011
TDS

# 07-11 SW4(location 7) Nitrates/Nitrites/Total Phosphorus Trends



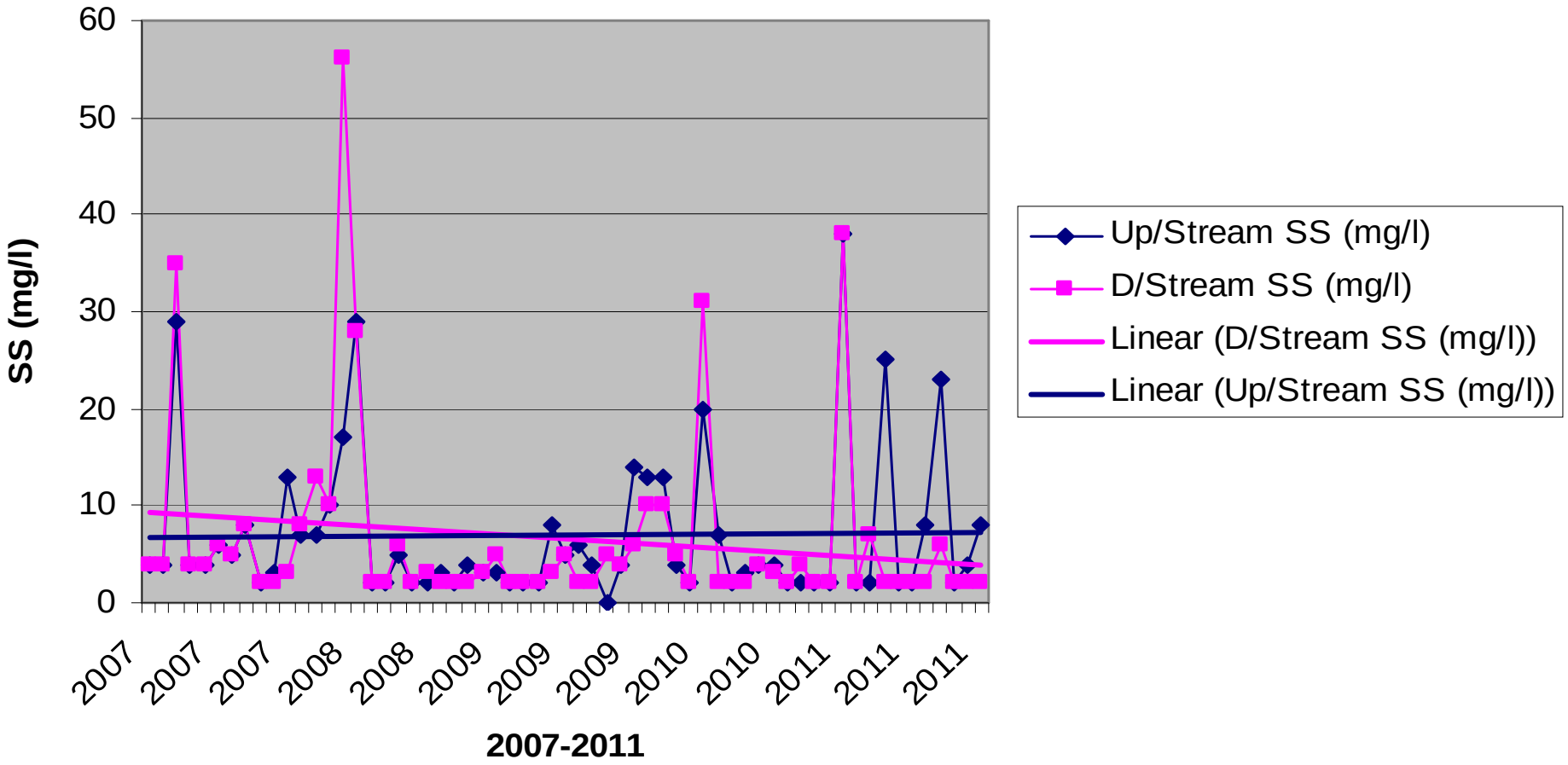

07-11 SW4(location 7) BOD & OFG Trends
BOD & OFG
25
20
15
10
5
0
2007
2007
2007
2007
2008
2008
2008
2008
2009
2009
2009
2009
2010
2010
2010
2010
2011
2011
2011
2011
2007-2011
BOD
OFG

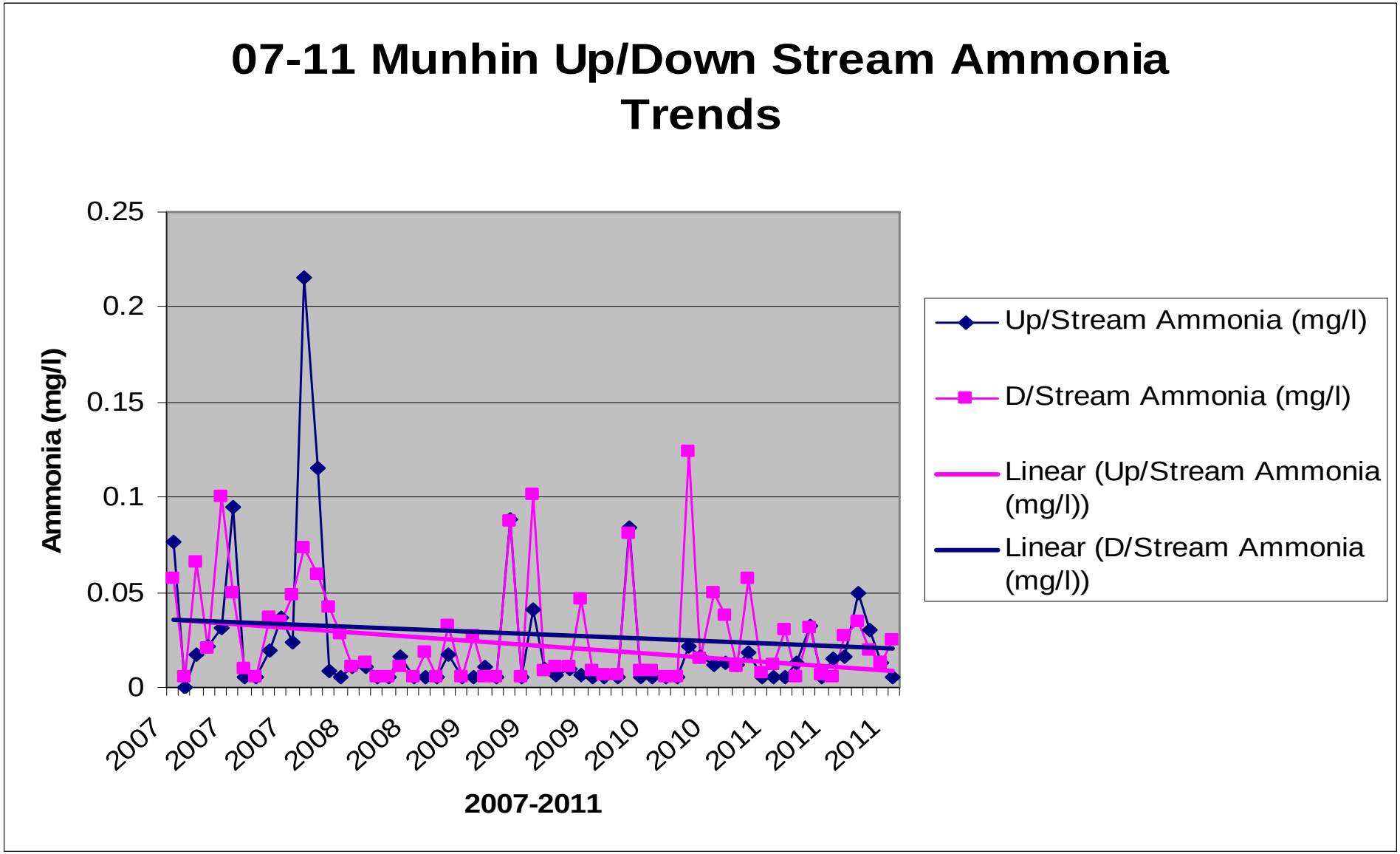

07-11 SW4,100,101 COD Trends
COD (mg/l)
600
500
400
300
200
100
0
2007
2007
2007
2008
2008
2008
2008
2009
2009
2009
2010
2010
2010
2011
2011
2011
2011
2007-2011
Location 7 (SW4)
SW100
SW101
Linear (SW100)
Linear (SW101)


07-11 SW4,100,101 Conductivity Trends
Conductivity
500
450
400
350
300
250
200
150
100
50
0
2007
2007
2007
2007
2008
2008
2008
2008
2009
2009
2009
2009
2010
2010
2010
2010
2011
2011
2011
2011
2007 - 2011
Location 7 (SW4)
SW100
SW101
Linear (SW100)
Linear (SW101)
Linear (Location 7 (SW4))

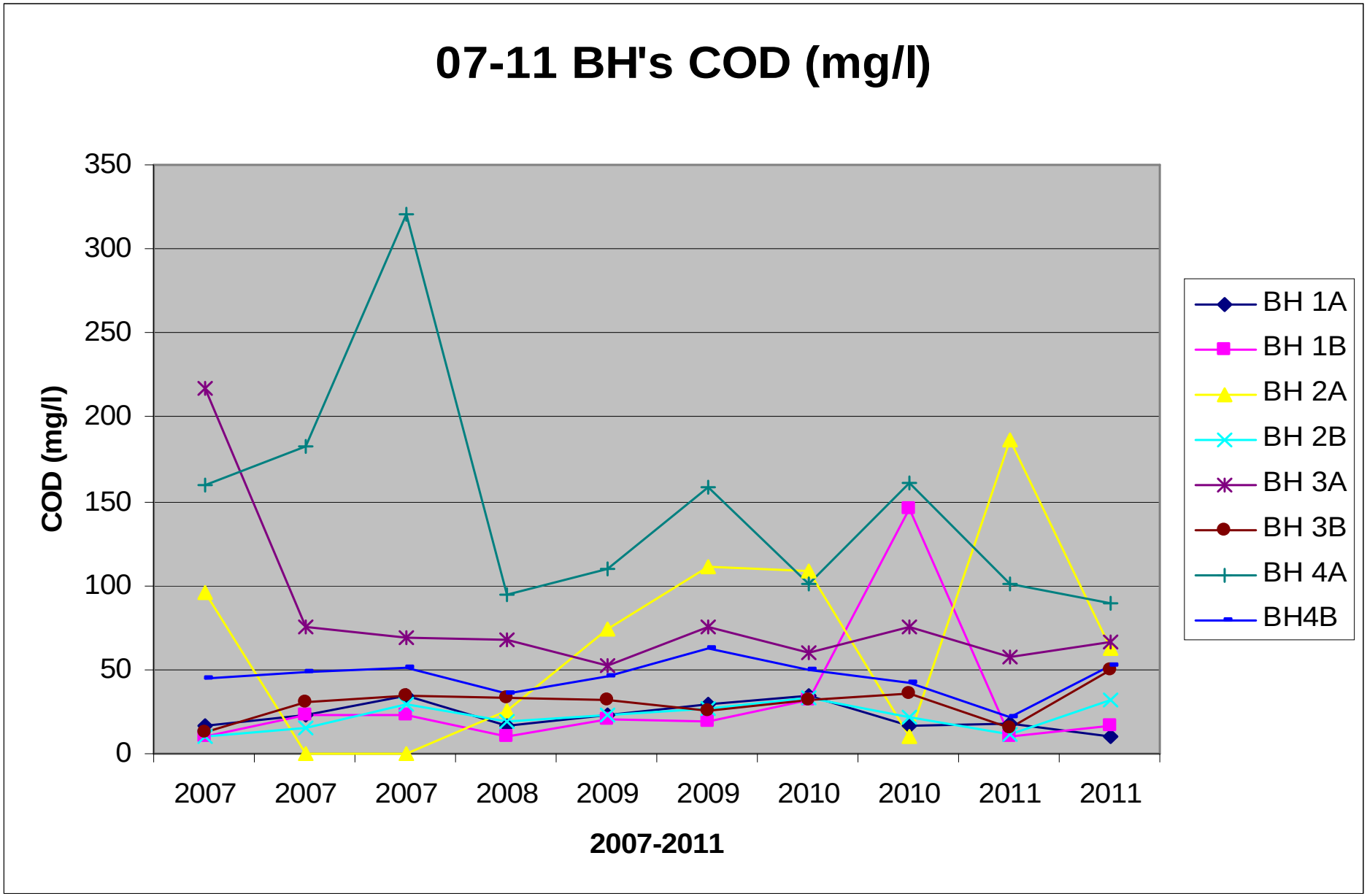
Appendix 2

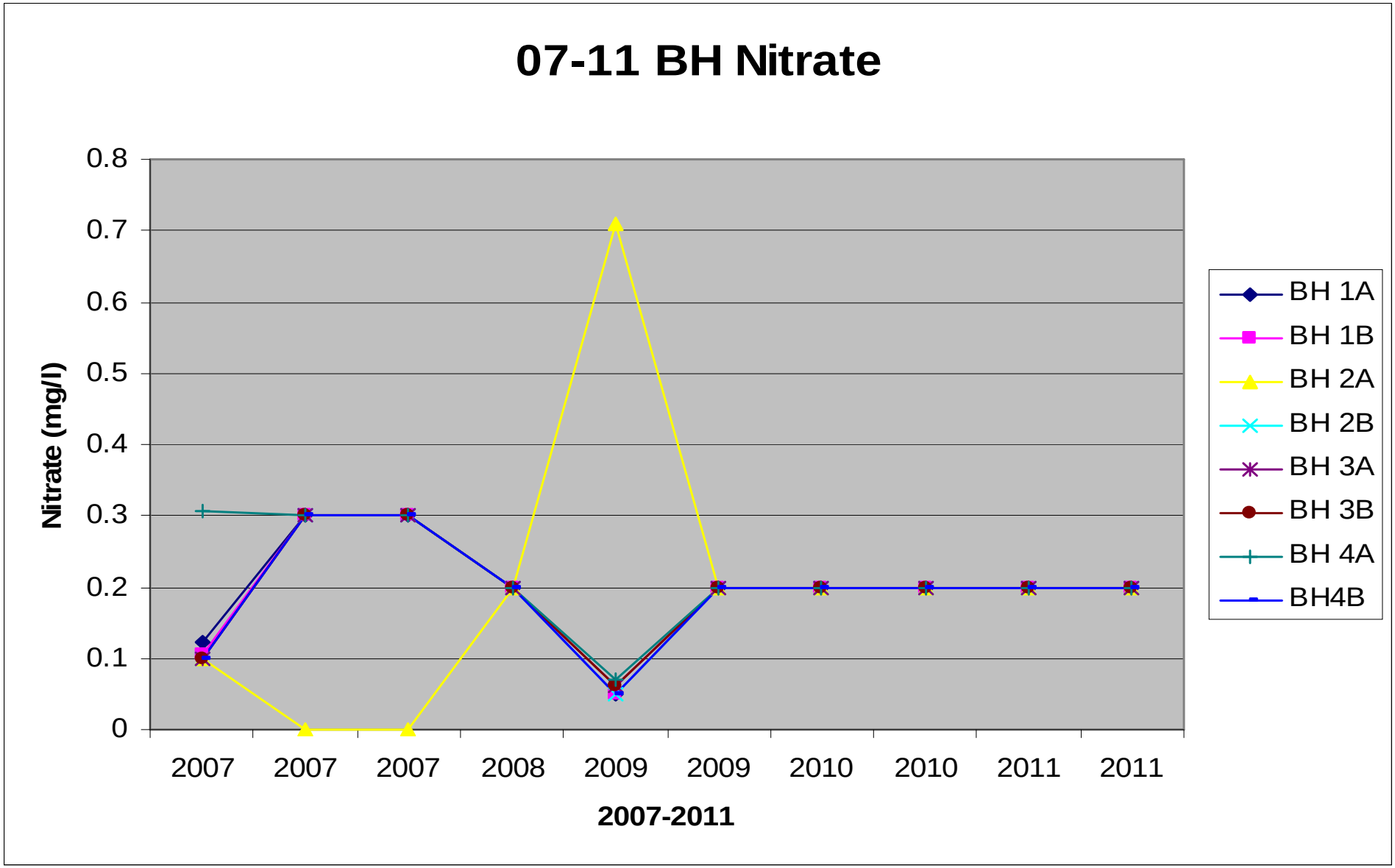
# 07-11 Munhin Up/Down Stream Suspended Solids Trends

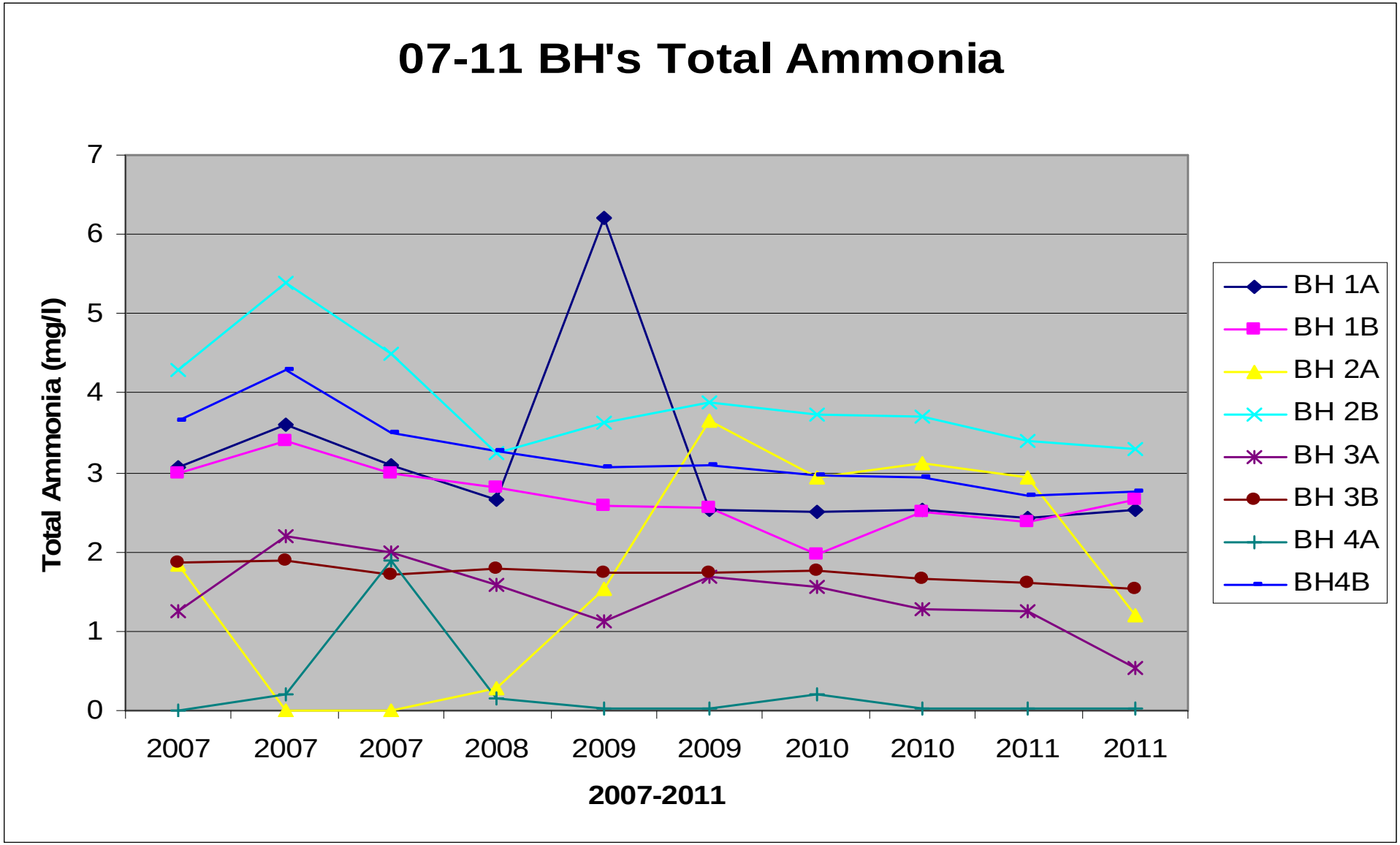


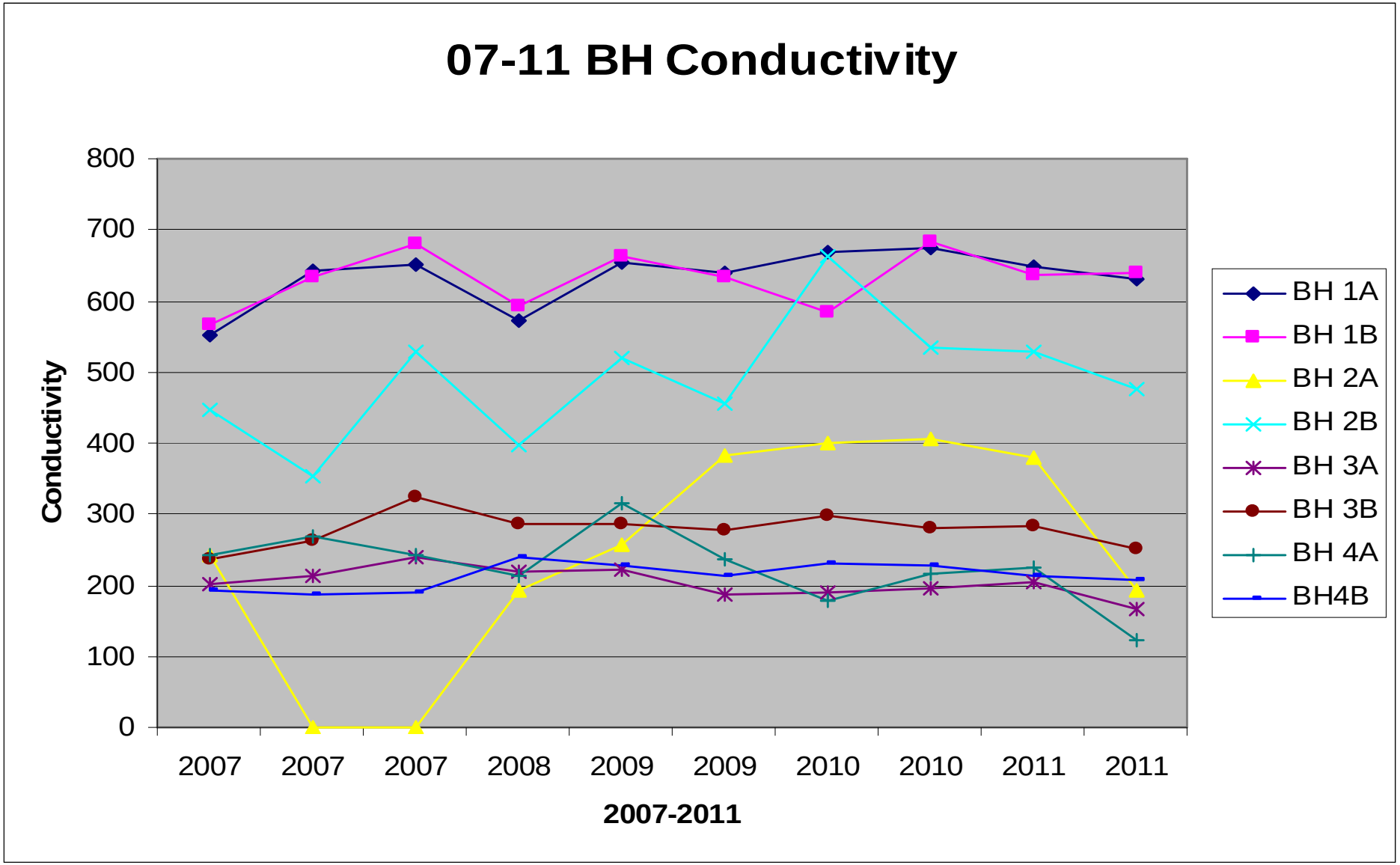

07-11 Munhin Up/Down Stream Ammonia Trends
Ammonia (mg/l)
0.25
0.2
0.15
0.1
0.05
0
2007
2007
2007
2008
2008
2009
2009
2009
2010
2010
2011
2011
2011
2007-2011
Up/Stream Ammonia (mg/l)
D/Stream Ammonia (mg/l)
Linear (Up/Stream Ammonia (mg/l))
Linear (D/Stream Ammonia (mg/l))

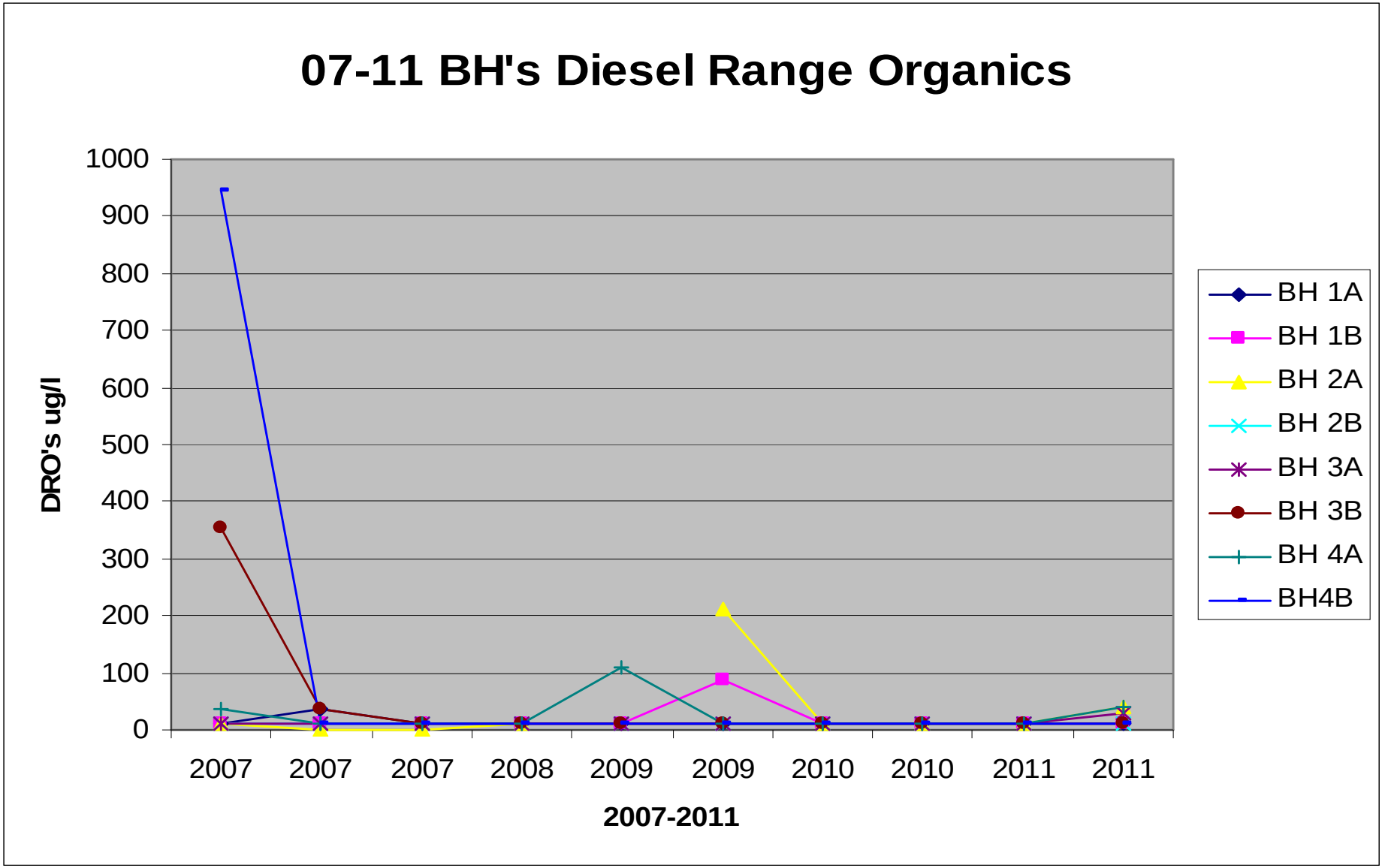
Appendix 3


07-11 BH's COD (mg/l)
COD (mg/l)
350
300
250
200
150
100
50
0
2007
2007
2007
2008
2009
2009
2010
2010
2011
2011
2007-2011
BH 1A
BH 1B
BH 2A
BH 2B
BH 3A
BH 3B
BH 4A
BH4B


07-11 BH Nitrate
Nitrate (mg/l)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007
2007
2007
2008
2009
2009
2010
2010
2011
2011
2007-2011
BH 1A
BH 1B
BH 2A
BH 2B
BH 3A
BH 3B
BH 4A
BH4B


07-11 BH's Total Ammonia
Total Ammonia (mg/l)
7
6
5
4
3
2
1
0
2007
2007
2007
2008
2009
2009
2010
2010
2011
2011
2007-2011
BH 1A
BH 1B
BH 2A
BH 2B
BH 3A
BH 3B
BH 4A
BH4B


07-11 BH Conductivity
Conductivity
800
700
600
500
400
300
200
100
0
2007
2007
2007
2008
2009
2009
2010
2010
2011
2011
2007-2011
BH 1A
BH 1B
BH 2A
BH 2B
BH 3A
BH 3B
BH 4A
BH4B


07-11 BH's Diesel Range Organics
DRO's ug/l
1000
900
800
700
600
500
400
300
200
100
0
2007
2007
2007
2008
2009
2009
2010
2010
2011
2011
2007-2011
BH 1A
BH 1B
BH 2A
BH 2B
BH 3A
BH 3B
BH 4A
BH4B

Appendix 4


MUNNIN RIVER
OWENMORE