Dow AgroSciences (NZ) Ltd Monitoring Programme Annual Report 2013-2014

Technical Report 2014–120

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Taranaki Regional Council
Private Bag 713
STRATFORD

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Executive summary

Dow AgroSciences (NZ) Ltd (Dow AgroSciences) operates an industrial agrichemical formulating and packaging facility located at Paritutu Road, New Plymouth, in the Herekawe catchment. The Company holds resource consents to allow it to discharge stormwater into the Herekawe Stream, and to discharge emissions into the air. This report for the period July 2013-June 2014 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and effects of the Company's activities.

The Company held 2 resource consents which included a total of 29 conditions setting out the requirements that the Company must satisfy. The Company held one consent to allow it to discharge stormwater into the Herekawe Stream, and one consent to discharge emissions into the air at the plant site. An application to replace the consent to emit to air was being processed at the end of the review period.

During the monitoring period, Dow AgroSciences demonstrated an overall high level of environmental performance.

The Council's monitoring programme included 4 inspections, 4 sets of water samples collected for pesticide analysis, 2 biological surveys of receiving waters, and a marine ecology inspection. The Company carried out air emission sampling and groundwater monitoring through independent consultants and further storm water sampling, and forwarded the results to the Council for audit and review.

Operating hours in some plant areas reduced during the period, due to dry conditions for agriculture and hence less demand for the Company's products.

The monitoring showed that the Company has had no significant impact on air quality in the vicinity of the plant or on water quality in the Herekawe Stream. No complaint in relation to the Company's activities was registered by the Council.

During the year, the Company demonstrated a high level of environmental and administrative performance.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2014-2015 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2013-June 2014 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by Dow AgroSciences (NZ) Ltd (Dow AgroSciences). The Company operates an industrial agrochemical formulation plant situated at Paritutu Road, New Plymouth, in the Herekawe catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Dow AgroSciences that relate to discharges of water within the Herekawe catchment, and the air discharge permit held by Dow AgroSciences to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Taranaki Regional Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of Dow AgroSciences' use of water and air, and is the twenty-second combined annual report by the Taranaki Regional Council for the Company.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Dow AgroSciences in the Herekawe catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at Dow AgroSciences' site.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretation, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2014-2015 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act 1991 and monitoring

The *Resource Management Act 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

(a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
(d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic);
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, and considered responsible resource utilisation to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the consent holder during the period under review, this report also assigns a rating as to the company's environmental and administrative performance.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. **Administrative performance** is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

- **High** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment .The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

- **Good** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

  For example:

  - High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
  - Strong odour beyond boundary but no residential properties or other recipient nearby.

- **Improvement required** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

- **Poor** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

- **High** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

- **Good** Perhaps some administrative requirements of the resource consents were not met at a particular time, however these were addressed without repeated interventions from the Council staff. Alternatively adequate reason

was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

- **Improvement required** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

- **Poor** Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process description

Figure 1 Aerial photograph of Dow AgroSciences site

Dow AgroSciences prepares a range of agricultural chemicals at its facility in New Plymouth. It both manufactures (reacting substances to form new ones) and formulates (blending active ingredients and other agents). The production is based

on 'batch' processes (i.e. not continuous) involving chemical reactions, blending or packaging. Various formulation types are produced/packed or repacked, including liquid concentrates, flowable suspensions, wettable powders, water dispersible granules and coated granules. There are approximately 36 different active ingredients handled on the site. Of these, 13 are contained in products that are only repacked or stored for further distribution. The remainder are used in the formulation of products in varying quantities. There are five production plants on the site, and in addition there are support activities such as laboratories and a high temperature waste incinerator.

1.2.1 History

Dow AgroSciences has been located at the present site since 1960. The manufacturing processes for phenoxy herbicide active ingredients (2,4-D, MCPA and MCPB) and triclopyr were discontinued in early 1998 and the Phenoxy Plant shut down. These active ingredients were then imported for formulation into herbicide products. As a result of the closure of the Phenoxy Plant a number of raw materials are no longer used on the site, including chlorophenols (2, 4- dichlorophenol and p-chloro-o-cresol) and monochloroacetic acid (MCAA). The cessation of these chemical syntheses reduced the number of chemicals stored on site and consequently has reduced the potential for odour to be emitted from the site.

Changes to the site over the past two decades have included:

- terminating the manufacture of dairy sanitisers and detergent bases;
- the high temperature solids incinerator has been upgraded to include a new control system, an extended secondary combustion chamber, and the installation of a liquids nozzle to allow liquids to be burnt;
- cessation of use of the 'liquids' incinerator in 1994, and demolition of the liquids incinerator in June 2000;
- diversion of stormwater from the roads in the vicinity of the incinerator to a new HDPE-lined stormwater pond (SV9200) in the 1995-1996 year;
- termination of the production of phenoxy herbicides (2,4-D, MCPA and MCPB) and triclopyr in 1998;
- introduction of the insecticide active ingredient spinosad, and start up of the Spinosad Plant in 1998;
- closure of the powders side of the Powders/Protectants Plant at the end of 1999;
- in accordance with the revised site Groundwater Management Plan, 18 groundwater bores were closed in 2001-2002; dedicated pumps were installed into remaining sampling wells in May 2002;
- formulation of solid herbicides ceased in June 2002 and the Solids Plant closed;
- the formulation of water-based glyphosate product was introduced during 2002-2003;

- from 2003-2004, there was reduced use of the high temperature incinerator, with the operation changed from continuous use to operation 5 days per week (24 hours) intermittently for a total of 6 months of the year;
- the esterification process of 2,4-D esters recommenced in October 2005, in the Commodities Plant;
- the neutralisation process of MCPA with amines recommenced in September 2006, in the Commodities Plant; and
- the neutralisation process of glyphosate with amines commenced and of 2,4-D with amines recommenced in August 2007, in the Commodities Plant.

1.2.2 Herbicides Plant

Formulations involving a wide range of active ingredients are prepared for sale. Both liquid (water and solvent based) and granular herbicides are produced. 2,4-D is the most common ingredient.

Air from liquid formulation preparation areas is passed through a coarse filter to capture dust, before treatment through a series of carbon beds before being discharged to atmosphere.

1.2.3 Commodities Plant

The esterification process of 2,4-D esters recommenced in October 2005. Imported 2,4-D flake is reacted with either butyl or ethylhexyl alcohol to convert the acid to the ester form.

The neutralisation of MCPA with amines recommenced in September 2006, using the same equipment that is used in 2,4-D esterification. Imported MCPA is mixed with dimethylamine (DMA) to convert the acid to the amine.

The neutralisation of glyphosate with amines recommenced in August 2007. Imported glyphosate acid is mixed with isopropylamine (IPA) to convert the acid to the amine.

The neutralisation of 2,4-D with amines recommenced in August 2007. Imported 2,4-D flake is mixed with either IPA or a dimethylamine/dimethylethanolamine (DMEA) mixture to convert the acid to amine form.

The process ventilation system is connected to a caustic scrubber followed by a carbon filter, to remove organic vapours before discharge to atmosphere.

1.2.4 Insecticides Plant

Liquid organophosphate insecticides, mostly based on chlorpyrifos, are blended and packaged for sale. The process ventilation system is connected to a sodium hypochlorite scrubber, in which chemical reactions between hypochlorite and compounds released from the process lead to the solubilisation of those compounds and their capture in the scrubber.

1.2.5 Granular Herbicides Plant

Granules, based on picloram, are formulated and packaged. Discharges are passed through a bag filter and absolute (high performance) filter before discharge.

1.2.6 Spinosad Plant

Liquid spinosad-based insecticides are formulated and packaged. The process ventilation system passes through a bag filter and absolute filter before discharge.

1.2.7 High temperature incinerator

A high temperature incinerator provides for the thermal destruction of Company wastes. Materials to be combusted include all chemically contaminated clothing and production plant wastes. The liquids nozzle allows the burning of liquids such as wash water.

Emissions are controlled primarily by optimising the conditions of combustion, together with the proper design of the combustion chamber and stack.

1.2.8 Laboratories

Fumes from the laboratories are extracted either as general building ventilation air or through fume cupboard hoods. The quantities of chemicals involved are minute by comparison either with the formulating processes or with the amounts that would be handled by an end user of the Company's products.

1.2.9 Maintenance workshops

Activities carried out in the workshops, and periodically on site, include welding, painting, abrasive blasting, and other typical operations. Ventilation systems extract air from around particular process areas.

1.2.10 Pilot plant

The building is used only infrequently, to trial process control or to produce small scale batches.

1.3 Resource consents

1.3.1 Water discharge permit

Section 15(1)(a) of the Resource Management Act stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or rule in a regional plan, or by national regulations.

Dow AgroSciences holds water discharge permit **4108-2** to cover the discharge of stormwater from its production site via retention dams, together with uncontaminated stormwater from landscape and non-manufacturing areas, into the Herekawe Stream. This permit was issued by the Taranaki Regional Council on 4 September 2008 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2026.

Condition 1 requires the adoption of the best practicable option for controlling effects of discharges on the environment.

Condition 2 sets a maximum stormwater catchment area.

Condition 3 requires a management plan to prevent and to deal with spillage and accidental discharges.

Condition 4 addresses record keeping.

Condition 5 prohibits significant adverse effect on the environment.

Condition 6 imposes limits upon the discharge's significant potential contaminants.

Condition 7 is a general review provision.

The permit is attached to this report in Appendix I.

1.3.2 Air discharge permit

Section 15(1)(c) of the Resource Management Act stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

Dow AgroSciences holds air discharge permit **4020** to cover the discharge of emissions from the manufacture of agrichemical products and associated processes. This permit was issued by the Taranaki Regional Council on 12 June 1996 under Section 87(e) of the Resource Management Act. It expired on 1 June 2014, but remained in force while application for a new consent was being processed.

Conditions 1 and 2 require the adoption of the best practicable option for controlling effects of discharges on the environment, and that processes be operated to minimise discharges.

Condition 3 requires Dow AgroSciences to provide a report every 2 years on technological advances in reduction or mitigation of discharges to air, particularly dioxin, together with an inventory of discharges.

Condition 4 requires consultation with Council before any significant changes on the site.

Conditions 5 and 6 address the keeping of records and information relevant to process control, and to formulations on the site.

Conditions 7 and 8 impose limits on significant potential contaminants in discharges.

Condition 9 relates to monitoring.

Conditions 10 to 18 relate to an incinerator, imposing limits on visual effects and significant potential contaminants, placing controls on operating conditions, and requiring provision of records.

Condition 19 prohibits direct significant adverse ecological effects.

Condition 20 is a review provision.

Conditions 21 and 22 involve submitters and the local community in liaison meetings and the monitoring of odour.

The permit is attached to this report in Appendix I.

1.4 Monitoring programme: water

1.4.1 Introduction

Section 35 of the Resource Management Act sets out an obligation upon the Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The monitoring programme for the Dow AgroSciences site consisted of six primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in on-going liaison with resource consent holders over consent conditions and their interpretation and application:

- in discussion over monitoring requirements
- preparation for any reviews
- renewals
- or new consents
- advice on the Council's environmental management strategies and content of regional plans, and
- consultation on associated matters.

1.4.3 Site inspections

The Dow AgroSciences site was visited four times during the monitoring period for scheduled visits. The main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

1.4.4 Stormwater sampling

Stormwater is sampled and analysed for chemical and physical parameters before it is released. If the collected stormwater does not meet the release criteria, an application for approval is sought from New Plymouth District Council before it is pumped to the trade waste system.

Results of monitoring are reported by Dow AgroSciences to the Regional Council, and samples of stormwater are taken by the Council for comparative laboratory analysis. The stormwater discharge was sampled by Council on four occasions, and the samples sent to an independent laboratory (AsureQuality) for acid herbicides analysis and a multi-residue pesticide scan on each occasion and for glyphosate analysis once.

1.4.5 Groundwater monitoring

Dow AgroSciences conducts an on-going groundwater monitoring and modelling program, prepared in consultation with the Council, to assess the quality of groundwater beneath the site. Results are forwarded to the Council annually, while relevant matters are discussed as they arise. Shallow groundwater under the site flows under natural gradients north and west towards the coastal marine area, including the Sugar Loaf Islands (Nga Motu) Marine Protected Area.

To address the low-level contamination found through a past investigation, Dow AgroSciences developed a Site Groundwater Management Plan, which was received and agreed to by the Council during the 1996-1997 period and (updated) in 2001. Contaminants (phenoxies and chlorophenols) were initially detected at low levels and groundwater flow suggested that the contamination evident would pose no environmental risk and would reduce to levels below detection.

Dow AgroSciences fully evaluated the site and recommended a monitoring approach to ensure that, as predicted by modelling, no adverse environmental effects occur. The current monitoring approach adopted through the Site Groundwater Management Plan requires the Council to remain fully informed of the results. The approach enables the risk of effects on the environment to be assessed fully on an on-going basis, and appropriate action to be taken. The information available at this time suggests that no adverse environmental effects are likely and that the contaminants will fully degrade before migration from the site occurs.

In July 2008, the Council agreed to a change in the date of annual sample collection, from October to June-August, to coincide with maximum groundwater levels. This was in response to most of the monitoring wells being found dry in October 2007.

1.4.6 Freshwater biological surveys

The Council has a bio-monitoring programme to assess biological diversity and richness of the Herekawe Stream. Two surveys were conducted during the monitoring year to assess whether discharges from the Dow AgroSciences Paritutu Road site were having any environmental impact on the stream.

1.4.7 Foreshore marine ecology inspection

The Council carries out an annual marine ecology inspection on the Back Beach foreshore by the DAS Paritutu Road site to look for any evidence of a discharge from the Dow AgroSciences site (including any groundwater seeps) and to assess any environmental impact.

1.5 Monitoring programme: air emissions

1.5.1 Introduction

Section 35 of the Resource Management Act sets out an obligation for the Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The air quality monitoring programme for the Dow AgroSciences site consisted of three primary components.

1.5.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of the air quality regional plan, and consultation on associated matters.

1.5.3 Site inspections

The Dow AgroSciences site was visited four times during the monitoring period. The main points of interest were plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

As far as was practicable, inspection in relation to air emissions were integrated with inspections undertaken for other purposes e.g. stormwater discharges.

1.5.4 Chemical emission sampling

Air emissions from process vents and the high temperature incinerator stack were monitored to check for compliance with consent conditions. Since 2006-2007, Dow AgroSciences has implemented a policy that all air emission monitoring be undertaken by independent specialist environmental consultants. In 2013-2014, Source Testing New Zealand Ltd carried out and reported on the sampling and analysis of vent and stack emissions.

Process vents in the Insecticides Plant, Granules Herbicides Plant, Herbicides Plant and Commodities Plant, and also the Spinosad Plant, were monitored under typical operating conditions.

The high temperature incinerator stack was monitored under typical operating conditions.

2. Results

2.1 Water

2.1.1 Inspections

Stormwater from the production plants, dangerous goods storage compound, despatch store, incinerator and roads in these areas is collected in two retention pond systems. It is sampled and analysed for checking against release criteria. If the stormwater meets the release criteria, it is discharged to the Herekawe Stream. Stormwater which fails to meet the release criteria may be pumped to the trade waste system with approval from the New Plymouth District Council.

Stormwater from the southern part of the site drains directly to a New Plymouth District Council stormwater drain and then to the Herekawe Stream. This part of the site is predominantly an open grassed area surrounding a parking area, two storage buildings, the closed pilot plant and the access road to the site.

There are four stormwater retention ponds at the Paritutu Road site: SV9000, SV9100, SV9200 and SV8000. Stormwater from building roofs and roading is collected in SV9100 after treatment in separators to remove silt. SV9000 is used as an overflow retention pond. Stormwater from around the incinerator building and roadway is collected in SV9200, while stormwater from around the despatch and dangerous goods storage areas is collected in SV8000.

If stormwater does not meet the release criteria, Dow AgroSciences seeks to identify the source of the contaminant so corrective actions can be implemented to prevent a recurrence.

Officers of the Council carried out regular inspections of the site during the 2013-2014 monitoring period. The inspections included the storage of raw materials and product, the maintenance and housekeeping of process areas and roadways, the stormwater collection and retention systems, stormwater sampling and release records and inspections of the discharge point and receiving waters in the Herekawe Stream. Scheduled inspections were carried out on 24 September and 10 December 2013 and 19 March and 19 May 2014.

Notes from these visits are listed below. Records of production and incinerator operation were inspected and found to be satisfactory.

24 September 2013
The weather was overcast, with a moderate SE wind. The storm ponds, which were fairly clear with a green tinge, were not discharging while a chemical test methodology issue was resolved. Pond samples were taken for inter-laboratory comparison. The high temperature incinerator was operating, burning solids, at satisfactory temperature and oxygen levels. The day's burn manifest was printed out. A marine-grade anemometer had been installed on the SW corner of the incinerator building. Air sampling around the site for the AEE for air consent replacement was completed last week and the equipment removed. Stack testing of the Insecticides Plant was carried out last week. The Commodities Plant was not operating, awaiting raw materials; 2,4-D flake was being loaded into the building. MCPA and DMA were manufactured earlier in the week, and 2,4-D ethyl hexyl ester recently. The air

scrubber record was satisfactory. Scaffolding for maintenance of the overhead pipe bridge was still in place. Odour survey: no odour from the DAS site was detected; fresh paint odour from the STOS site opposite DAS was at Paritutu/Centennial intersection; faint domestic fire smoke was smelled but not visible at the bottom of Paritutu Road; slight "preservative" odour from Carter Products was noticed on Paritutu Road; and freshly mown grass was smelled at several locations.

10 December 2013
The weather was fine and cloudy, with a light W wind. The storm ponds were not discharging, following low level detection of chlorpyrifos in SV9100, but later were authorised to be released together to Herekawe Stream. Samples for inter-laboratory comparison were taken. The incinerator was not operating, while undergoing routine maintenance. The Commodities Plant was operating, recently esterifying 2,4-D and aminating MCPA. The air scrubber record was satisfactory. The overhead pipebridge work was completed, except for one beam to be galvanized. Stack testing was delayed as the tester had injured himself at another site – incinerator testing would be completed in February. Odour survey: no odour from the DAS site was detected; mown grass, both new and old, was smelled along Paritutu Road; a very slight sweet smell, possibly from vegetation, was noticed at Paritutu/Centennial intersection. A new trade waste metering/sampling system, operated by NPDC, was observed while in use on Paritutu Road.

19 March 2014
The weather was overcast and misty, with a light W wind, after rain the previous day. The storm ponds, which had not been emptied for over six weeks and were soupy green, were released all together at slow rate to reduce discoloration of Herekawe Stream. There was some foaming within the mixing zone. The incinerator was operating, burning general waste. The temperature and oxygen records were satisfactory. The Commodities Plant was manufacturing 2,4-D ester at reduced rate, and had been aminating MCPA recently. The building door was open for loading raw material. The 20-litre container line was inspected while filling with Pasture Kleen and was satisfactory. The date for the annual meeting of interested parties was discussed. Odour survey: no odour was detected, except for salt air along Centennial Drive, and warm tarmacadam.

19 May 2014
The weather was fine and bright, with a light SW wind. The storm ponds and discharge to Herekawe Stream were sampled. The incinerator was down for repair of refractory damage at the liquids inlet: curing and warm-up was expected to take another week. The Commodities Plant was not operating. The annual turnaround was planned for next month. The lack of response to invitations to the annual liaison meeting was discussed. Odour survey: occasional light wafts of unidentified chemical odour from the DAS site were noticed at the top of Paritutu Road; the grass under the DAS fence along Paritutu was being sprayed; the characteristic preservative odour from Carter Products was noticed downwind of the factory on Port View Crescent.

2.1.2 Results of discharge monitoring

All stormwater collected in the four stormwater retention ponds is sampled and analysed by the Company prior to release. The samples are checked for the parameters controlled by consent 4108 - floatable and suspended materials, odour, colour and visual clarity, pH and the potential chemical contaminants phenoxy herbicides, organophosphates, triclopyr, picloram, glyphosate, and oxyfluorfen. During the 2013-2014 year, a total of 110 stormwater samples were collected and analysed by the Company. On all occasions, the release criteria were met.
The stormwater ponds are also sampled by the Regional Council for consent compliance checking and inter-laboratory comparison on four occasions each year. The Council's laboratory determines general water quality parameters, and an independent specialist laboratory (AsureQuality) is used to analyse for the organic constituents limited on the consent. In 2013-2014, sampling was undertaken by an officer from the Council with staff from Dow AgroSciences on 24 September and 10 December 2013, and 19 March and 19 May 2014.

The focus of monitoring continued to be on acid herbicides, in connection with the recommencement of esterification of 2,4-D and neutralisation of MCPA and 2,4-D with amines, rather than on organophosphorus pesticides, which had not been detected from monitoring over the previous decade.

The results of Council monitoring for 2013-2014 are presented in Table 1 and Table 2.

Table 1 Stormwater results for acid herbicides, glyphosate and pH in 2013-2014

Parameter	Maximum concentration detected (g/m^3 or mg/L)			
	SV8000 (n = 4)	SV9000* (n = 1)	SV9100 (n = 3)*	Maximum
2,4,5-T	0.00041	0.00028	0.00042	0.00042
2,4-D	<0.0001	<0.0001	<0.0001	<0.0001
2,4-DB	<0.0001	<0.0001	<0.0001	<0.0001
MCPA	<0.0001	<0.0001	0.00026	0.00026
MCPB	<0.0001	<0.0001	<0.0002	<0.0002
Picloram	0.0017	0.0011	0.0043	0.0043
Triclopyr	0.0049	0.00059	0.00085	0.00085
Glyphosate**	-	-	-	-
pH (range)	6.4 – 7.6	7.4	6.8 – 8.9	6.4 – 8.9

* SV9000 was sampled on 19 May 2014, as SV9100 was empty
** Glyphosate monitoring was not undertaken

Table 2 Stormwater results for pesticides in 2013-2014

Parameter	Maximum concentration detected (g/m^3 or mg/L)			
	SV8000 (n = 4)	SV9000 (n = 1)	SV9100 (n = 3)	Maximum
chlorpyrifos	<0.001	<0.001	<0.001	<0.001
chlorpyrifos-methyl	<0.001	<0.001	<0.001	<0.001
oxyfluorfen	<0.001	<0.001	<0.001	<0.001

A total of 255 pesticide residues were tested for (excluding acid herbicide compounds that were tested separately), at detection limits of 0.001 to 0.005 g/m^3. The list of residues determined is given in Appendix II.

One residue, simazine, was found in pond SV9000/SV9100 on three successive samplings, from 10 December 2013 onwards, at concentrations ranging from 0.0023 to 0.0066 mg/L. The source was attributed to residue attached to old sediment in the under/over stormwater settling compartments which may have been released when a trade waste system (containing chlorpyrifos) overflowed to the stormwater system late in 2013. Under the ANZECC guidelines, the freshwater moderate reliability trigger value for simazine is 0.0032 mg/L. Given the dilution of the stormwater that occurs in Herekawe Stream, and the relatively short duration and occasional frequency of discharge, no further action was taken, other than continued surveillance.

A summary of the Company's results from inter-laboratory comparison exercises is presented in Table 3. The results indicate good agreement, and compliance with the conditions of the Company's stormwater discharge consent 4108, after mixing.

Table 3 Company stormwater results from 2013-2014 inter-laboratory comparisons

Consent Item	Consent limit	SV8000	SV9000	SV9100
Oil, floatables, suspended solids	None present	Pass	Pass	Pass
Objectionable odour	None present	Pass	Pass	Pass
Colour and visual clarity	No change	Pass	Pass	Pass
pH	6.0 – 9.0	6.8 – 7.5	7.5	6.8 – 7.6
Total phenoxy herbicides	0.10 mg/L	0.075*	0.075*	0.075*
Total organophosphates	0.0005 mg/L	0.0004**	0.0004**	<0.0010
Triclopyr	0.10mg/L	<0.05	<0.05	<0.05
Pichloram	0.10mg/L	<0.05	<0.05	<0.05
Glyphosate	0.10mg/L	<0.00022	<0.00022	<0.00022
Oxyfluorfen	0.005mg/L	<0.0007	<0.0007	<0.0007

* none detected, assumes 2,4-D, MCPA and MCPB all present at half detection limit of 0.05 mg/L

** none detected, assumes chlorpyrifos and chlorpyrifos-methyl both present at half detection limit of 0.0004 mg/L

On 10 December 2013, the insecticide chlorpyrifos was found in pond SV9100 at 0.0006 mg/L, above the consent limit of 0.0005 mg/L for total organophosphates. After consultation with Council, the pond contents were diluted with stormwater from pond SV8000, which testing had shown contained <0.0004 mg/L total organophosphates, during discharge to Herekawe Stream.

In July 2014, the Council received a stormwater report from Dow AgroSciences covering the period between July 2013 and June 2014. The report is attached as Appendix III.

The stormwater report summarises the monitoring and discharge data for the Dow AgroSciences site during the 2013-2014 monitoring period. It also details process management of stormwater and its release from site. As noted in the report, there were no changes to the stormwater system during 2013-2014.

2.1.3 Freshwater biological monitoring

Freshwater biological surveys were undertaken in the Herekawe Stream on 9 November 2013 and 4 February 2014. The surveys were both undertaken under low flow conditions. Copies of the full reports are attached as Appendix IV.

The surveys were undertaken using standard Council procedures and indicated that the streambed communities had not been significantly affected by stormwater discharges from the Dow AgroSciences site or other industrial sites in the vicinity.

2.1.4 Foreshore marine ecology inspections

A marine ecological inspection was undertaken by a Council officer on 14 January 2014 at 0945 NZDT (low tide at 0950 NZDT at 1.0m) at the intertidal reef area at the base of Paritutu Rock to approximately 200 metres south of Paritutu. This inspection was made to ascertain the presence of any environmental effects on this area due to the adjacent Dow AgroSciences site or other industrial facilities in the vicinity, and the general state of the reef.

An intertidal reef area is present at the north eastern end of Back Beach at the base of Paritutu Rock. The outer landward edges of the reef appeared to be subject to fluctuating levels of sand and during this inspection there were moderate levels of sand present on the reef, with rocks and boulders exposed, but no cobbles present higher on the shore.

Two groundwater seeps were observed flowing down the cliffs to the south of Paritutu Rock. The seeps flowed across the beach and over the reef before reaching the sea. These flows did not appear to be deleteriously affecting the reefs, as abundant limpets and little back mussels were present close to the flows.

A diverse range of algae and animal species were present on the reef. *Scytothamnus* sp. was abundant and several other algae were common, including encrusting *Corralina* spp., *Endarachne binghamiae*, *Laurencia thryisifera, Ralfisa sp.*and *Ulva* sp. A variety of filter feeders (little black mussels, barnacles, anemones), grazers (limpets, chitons, top-shells), and crabs were present. From observations made during this inspection, the diversity of reef biota is typical to that seen at other local intertidal reefs in the Taranaki region.

A faint chemical-type odour was detected during the inspection on 24 January 2014. The wind direction was from the south. The source of the odour was not clear i.e. it was not obvious that these odours emanated from the groundwater seeps. Further investigations were conducted on 27 January 2014. Groundwater samples were collected at 0745 NZDT and in the afternoon of 27 January 2014. On both occasions there was no detectable 'chemical' odour from the samples and therefore no further chemical analyses were undertaken.

2.2 Air

2.2.1 Inspections

Officers of the Council carried out regular inspections of the Dow AgroSciences Paritutu Road site during the 2013-2014 monitoring period. Scheduled inspections were undertaken on 24 September and 10 December 2013, and 19 March and 19 May 2014.

During each inspection a record was made of weather conditions prevailing at the time. An odour survey was carried out on the site boundary and around the surrounding neighbourhood. Some slight odours were detected during the routine inspections. The incinerator and its operating records were found to be in compliance with consent conditions during inspections. The vents on site were all visually checked for emissions during each inspection. At no time were any emissions noticed. A high standard of housekeeping in all areas of the site was noted at each inspection.

2.2.2 Company air emissions report

In July 2014, Council received an air emissions report from Dow AgroSciences covering the period from July 2013 to June 2014. The main body of this report is attached as Appendix V – the appendices to the report are available from Council. The report addresses changes in plant processes, resource consent requirements, and emission monitoring. Process management of air emissions is described, and the results from monitoring of point source emissions (process vents and incinerator stack) produced. Vegetation monitoring, and general aspects of air quality management are covered. The results of monitoring are summarised in sections 2.2.3 to 2.2.5 below.

2.2.3 Process vents

Monitoring of process vent emissions from the Insecticides Plant, Spinosad Plant, Granule Herbicides Plant, Herbicides Plant and Commodities Plant was carried out by independent specialist Source Testing New Zealand Ltd (STNZ). Emissions were sampled by STNZ using international standard methods where applicable, and analysed by an IANZ accredited laboratory.

Samplings were timed and conducted to provide data representative of the various production and formulation processes. The emission components monitored were either active ingredients (chlorpyrifos, spinetoram, picloram, 2,4-D acid or ester) of products under formulation, or reactants (2-ethyl hexanol, 2,4-D acid/ester) in the 2,4-D esterification and neutralisation processes.

A summary of the emission test results and associated information is presented in Table 4.

Table 4 Summary of process vent emission monitoring results, 2013-2014

Plant	Vent	Emission component	No	Sampling period	Concentration *mg/m^3	Guideline mg/m^3
Insecticides	03-5	Chlorpyrifos	3	16-18 Sep 2013	<0.0016 - <0.0018	3.333
Spinosad	BB600	Spinetoram	3	11-13 Feb 2014	<0.004 - <0.005	5.0
Granule herbicides	03-14	Picloram	3	16-18 Sep 2013	<0.00007 - <0.00010	167
Herbicides	03-8	Total 2,4-D (acid and ester)	3	11-13 Feb 2014	0.00003 – 0.00015	167
Commodities	48-1	Total 2,4-D (acid and ester)	3	27-28 May 2014	0.0004 – 0.0009	167
		2-ethyl hexanol	3	27-28 May 2014	0.22 – 0.43	2500

* all data corrected to 0˚C, one atmosphere, dry gas basis

Guidelines are used to evaluate the process vent emissions, which are based on concentration limits applicable at the site boundary and on an assumed dilution with ambient air between the vent and ground level at the boundary. The boundary concentration limits are drawn from special condition 8 on consent 4020, which constrains any increase above background level to no more than 1/30th of the relevant NZ Workplace Exposure Standard. A dilution of 500 times is conservatively estimated between vent and boundary.

From Table 4 it can be seen that the maximum emission component concentrations are well below the relevant component guidelines, by factors of at least 1,000-fold.

It is noted that additional monitoring was carried out on the Commodities Plant vent in April 2006, to verify that dioxins were not being generated from the 2,4-D esterification process. The maximum reported value for dioxins and furans was 0.00399 ng(TEQ)/m^3, which is well within the range of field blank data from previous testing of the high temperature incinerator, that is, not measurably different from ambient air levels. As dioxins/furans are not created as part of the 2,4-D esterification or neutralisation processes, future monitoring is not required.
In comparison, the consent limit on average concentration for the high temperature incinerator stack is 0.1 ng(TEQ)/m^3 (see below).

2.2.4 High temperature incinerator

Conditions on Dow AgroSciences's air discharge permit 4020 place limits on the discharge of dioxins/furans and of hydrogen chloride from the high temperature incinerator. Monitoring for both types of emission component was carried out during the 2013-2014 period. In 2010-2011, the frequency of stack testing was increased, from annual to biannual, in response to an increase in incineration associated with greater herbicides and insecticides production. Poor weather interrupted the first scheduled stack test, in October 2013, and an off-site injury to the tester delayed a full test until February 2014. The second test was carried out in June 2014.

2.2.4.1 Dioxins and furans

Special condition 12 on Dow AgroSciences' air discharge consent 4020 limits the discharge of polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF) from any incinerator stack to an average concentration of 0.1 nanograms per cubic metre of gas (adjusted to 0 degrees Celsius, 101.3 kilopascals, 11% oxygen and calculated as dry gas) on the basis of at least three sampling runs within 12 months, and a maximum mass rate of 5.0 micrograms per hour. The

measure of PCDD/PCDF as reported is the equivalent amount of the most toxic cogener, 2, 3, 7, 8 tetrachlorodibenzo-p-dioxin, according to NATO toxic equivalency factors.

Monitoring of the incinerator for dioxin/furan emissions was carried out by independent specialist STNZ using the revised sampling method that was developed in 2007. (A modification was made to the USEPA Method 23 sampling train, in order to lower the detection limit for dioxins/furans). The sampling programme was carried out with separate monitoring of crushed drums, liquid waste and general waste incineration. The amount of crushed drums was double that normally processed to ensure suitable sample volume. The sampling periods were all four hours.

Testing during incineration of crushed drums occurred on 10 October 2013, and of all three waste types on 25 to 27 February and 4 to 6 June 2014. A summary of the results is presented in Table 5.

Table 5 High temperature incinerator PCDD/PCDF monitoring results, 2013-2014

Date	Waste type	Laboratory blank PCDD/PCDF Max. concentration ng/m³		PCDD/PCDF Max. concentration ng/m³ (not corrected for laboratory blank)		PCDD/PCDF Emission rate µg/h (not corrected for laboratory blank)	
		Total WHO-TEQ	Total I-TEQ	Total WHO-TEQ	Total I-TEQ	Total WHO-TEQ	Total I-TEQ
10 Oct 2013	Crushed drums	0.00333	0.00403	0.0629	0.0587	0.189	0.176
25 Feb 2014	Crushed drums	0.00217	0.00182	0.0107	0.0115	0.0318	0.0339
26 Feb 2014	General waste	0.00217	0.00182	0.00217	0.00218	0.0058	0.0057
27 Feb 2014	Liquid waste	0.00217	0.00182	0.00276	0.00245	0.0073	0.0064
Average				**0.00521**	**0.00538**		
4 Jun 2014	General waste	0.00373	0.00309	0.00365	0.00363	0.0092	0.0091
5 Jun 2014	Crushed drums	0.00373	0.00309	0.0355	0.0404	0.0902	0.103
6 Jun 2014	Liquid waste	0.00373	0.00309	0.00840	0.00878	0.0183	0.0191
Average				**0.0158**	**0.0176**		
Consent limit				**0.1**	**0.1**	**5.0**	**5.0**

Key

PCDD	polychlorinated dibenzodioxins
PCDF	polychlorinated dibenzofurans
ng/m³	nanogrammes per cubic metre, adjusted to 0 degrees Celsius, 101.3 kilopascals pressure, 11% oxygen, and calculated as a dry gas
µg/h	microgrammes per hour
WHO-TEQ	World Health Organisation – Total Toxic Equivalence
I-TEQ	International – Total Toxic Equivalence

Results are presented in terms of both the 'International' toxic equivalence measure (derived by NATO) that was in use when consent 4020 was granted, and the more recent WHO measure, which uses slightly higher toxic equivalency factors. Maximum upper bound values are reported, for PCDD/PCDF concentration and emission rate, together with the analytical laboratory blank value.

The average concentration value for the seven sampling runs, of 0.0182 ng/m^3 I-TEQ is less than the limit of 0.1 ng/m^3 on consent 4020, by a factor of about 5.5.

The maximum mass emission rate value for the seven sampling runs, of 0.176 µg/h I-TEQ, is less than the limit of 5.0 µg/h on consent 4020, by a factor of about 28.

These are highly conservative values, given that no correction is made for the laboratory blank, and that upper bound analytical values are used. The revised sampling method has lowered the detection limits for individual PCDD/PCDF cogeners to the extent that total toxic equivalence (TEQ) for the laboratory blank has become similar to that for the test samples.

2.2.4.2 Hydrogen chloride

Special condition 11 on consent 4020 limits the discharge of hydrogen chloride (HCl) from the high temperature incinerator to 1.5 kilograms/hour.

Testing for hydrogen chloride was done on 8 October 2013 and 3 June 2014. Two-hour samples were collected during a normal burn of crushed drums, liquid waste and general waste. The results are presented in Table 6.

Table 6 High temperature incinerator hydrogen chloride monitoring results, 2013-2014

Date	Waste type	Hydrogen Chloride Concentration mg/m^3	Hydrogen Chloride Emission rate kg/h
8 Oct 2013	Crushed drums	336	0.732
8 Oct 2013	General waste	92.7	0.213
8 Oct 2013	Liquid waste	5.7	0.011
3 Jun 2014	Crushed drums	317	0.574
3 Jun 2014	General waste	84.6	0.155
3 Jun 2014	Liquid waste	2.1	0.0037

Key mg/m^3 milligrammes per cubic metre, adjusted to 0 degrees Celsius, 101.3 kilopascals pressure, 11% oxygen, and calculated as a dry gas
kg/h kilogrammes per hour

The results of the hydrogen chloride monitoring performed showed that the mass emission rate complied with the maximum limit of 1.5 kg/h, and ranged from 0.0037 to 0.732 kg/h.

2.2.4.3 Particulate matter

Testing for particulate matter was done on 8 October 2013 and 3 June 2014. Two-hour samples were collected during a normal intermittent burn of crushed drums, general waste and liquid waste. The results are presented in Table 7.

Table 7 High temperature incinerator particulate matter monitoring results, 2013-2014

Date	Waste type	Particulate matter Concentration mg/m³	Particulate matter Emission rate kg/h
8 Oct 2013	Crushed drums	72.9	0.218
8 Oct 2013	General waste	16.9	0.0493
8 Oct 2013	Liquid waste	53.1	0.144
3 Jun 2014	Crushed drums	35.7	0.0923
3 Jun 2014	General waste	45.9	0.108
3 Jun 2014	Liquid waste	46.5	0.102

Key mg/m³ milligrammes per cubic metre, adjusted to 0 degrees Celsius, 101.3 kilopascals pressure, 11% oxygen, and calculated as a dry gas
kg/h kilogrammes per hour

The results for particulate matter monitoring performed showed that the mass emission rate ranged from 0.0493 to 0.218 kg/h. There is no limit within the consent on mass emission rate of particulate, or on particulate concentation.

2.2.5 Vegetation monitoring

During the year under review the Company monitored plantings of potato vine (Solanum jasminoides), jasmine (Jasmine officinale), rock rose (Cistus cyprius) and Norfolk Island Hibiscus (Lagunaria patersonii). These species were chosen for their resistance to wind and salt spray, and their susceptibility to the herbicides and ALS (acetolactate synthase) inhibitors handled on the site.

Visual monitoring of the plants showed no sign of the characteristic deformities that would be caused by exposure to herbicide products.

2.2.6 Community consultation

The Company is required by the conditions of its consent to hold a public meeting at least annually. In mid-April 2014, Dow AgroSciences invited the original submitters to the air discharge consent (where up-to-date contact addresses were available), along with interested local residents, the New Plymouth District Council trade waste officer and Regional Council officers, to a meeting to be held on 28 May 2014 to discuss general aspects of the site's operation. Due to poor RSVP attendance response, after consultation with Council, the Company cancelled this meeting. This was the first year where this meeting was cancelled due to low interest.

2.2.7 Groundwater monitoring

Field investigations into possible groundwater contamination at the site were commenced by Dow AgroSciences in 1993 and concluded in 1996. The site investigation identified two locations where soil and/or groundwater have been impacted by phenoxy herbicides and chlorophenols.

For a history of groundwater monitoring see 'Dow AgroSciences (NZ) Ltd, Monitoring Program Annual Report 2002-2003' Technical Report 2003-72.

In July 2014, the Council received a groundwater management report from Dow AgroSciences covering the period between July 2013 and June 2014 (Appendix VI). The report is based on the results of the groundwater sampling round undertaken in August 2013 by consultant ERM New Zealand Limited.

All 28 existing monitoring wells (five shallow and 23 deep) had been gauged on 6 May 2010 to assess groundwater levels, water column and silt build-up thickness. Groundwater sampling of the seven Groundwater Monitoring Plan wells was carried out on 14 and 15 August 2013 using in-well bladder pumps in accordance with "Low Flow Sampling Methodology".

The results of chlorophenol and phenoxy acid analysis are listed in Table 8.

Table 8 Groundwater monitoring results, August 2013

Well identification No	Phenoxy Herbicides concentration (µg/L)	Chlorophenol concentration (µg/L)
Shallow perimeter wells		
1	ND	ND
21	ND	ND
Deep Perimeter wells		
20	NS	ND
32	ND	ND
41	≤0.18	ND
42	≤0.27	≤0.25
47	ND	NS
Additional non-perimeter wells		
39J	47.9	≤6.71
46A	2.9	≤1.3
Trigger levels	50,000	10,000

Phenoxy herbicides [2,4-D; 2,4,5-T; MCPA; MCPB]

Chlorophenols [2,4-DCP; 2,4,5-TCP; 2,4,6-TCP; PCOC]

ND = below laboratory reporting limits (<0.16 µg/L for phenoxy acids and <0.2µg/L for chlorophenols)

NS = not sampled due to either being unsuitable for sampling or not meeting sampling requirements

No phenoxy acid or chlorophenol was detected in either of the shallow perimeter wells (1 and 21).

Of the five deep perimeter wells routinely monitored, one (47) was not sampled as there was insufficient water within the well. Phenoxy herbicides were detected at two of the deep perimeter wells, at wells 41 and 42 on the northern boundary, at ≤0.18 and ≤0.27 µg/L, significantly below the action level of 50,000 µg/L. Chlorophenols were detected at one deep perimeter well, at well 42 on the northern, at ≤0.25 µg/L, significantly below the action level of 10,000 µg/L.

Of the two non-perimeter wells normally monitored, well 39J showed low levels of phenoxy herbicides, at 47.9 µg/L, and chlorophenols, at ≤6.71 µg/L. Well 46A, drilled into the andesite south of the stormwater pond, showed low levels of phenoxy herbicides, at 2.9 µg/L, and of chlorophenols, at ≤1.3 µg/L.

Total phenoxy acid herbicide and total chlorophenol concentrations have not exceeded the Groundwater Management Plan trigger levels since sampling rounds began in 1993, and if detected, concentrations typically continue to show a decreasing trend.

Wells 20, 32, 39J, 41 and 47 were redeveloped on 14 and 15 August 2013 to provide more reliable groundwater levels for low flow sampling techniques, and to free up the dedicated sampling pump in well 20.

The five-yearly survey of all 28 monitoring wells is next due in 2015-2016.

2.2.8 Technical review report

Special condition 3 on consent 4020 requires Dow AgroSciences to provide to the Council, by 30 June 1998 and every two years thereafter, a written report:

(a) reviewing technological advances relevant to the reduction or mitigation of any discharge to air from the site, particularly but without limitation discharges of dioxin, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances;

(b) assessing any other issue relevant to the minimisation or mitigation of discharges to air from the site that the Chief Executive, Taranaki Regional Council, considers should be included; and

(c) detailing any inventory of discharges to air from the site of such contaminants as the Chief Executive, Taranaki Regional Council, may from time to time specify following consultation with the consent holder.

A report was received on 5 November 2012 (Appendix VII). The previous report was provided in April 2011.

The report covers the existing treatment and monitoring of emissions from plant vents and the high temperature incinerator. A technical review carried out on the incinerator is summarised. Measures completed since June 2011 to minimise or mitigate discharges to air are described, particularly the control of odour associated with storage of 2,4-D acid and formulation and storage of 2,4-D products.

For plant vents, it is noted that the concentrations of contaminants emitted are very low, levels at source being several orders of magnitude below maximum ground-level concentration limits set by the consent (condition 8) for the site boundary. Dow AgroSciences advises that no changes to abatement technology are considered necessary.

For the high temperature incinerator, it is noted that, since the previous report in 2011, measured levels of dioxins and furans have averaged one twenty-fifth of the permit limit.

The latest technical review of the incinerator, by an expert from Dow Chemical's Environmental Technology Centre in 2012, endorses the 2006 technical review, which broadly concluded:

The site incinerator is consistent with the technology of similar incinerators. The incinerator's combustion process is controlled by monitoring the temperature and ensuring excess oxygen is available and monitored. The continuous measurement of low carbon monoxide (less than 100 ppm) is considered reliable ongoing proof of complete combustion and minimized emissions. The site incinerator's carbon monoxide levels are typically measured at less than 1 ppm.

While hydrogen chloride is not continuously monitored it is controlled by adjusting the load size of the waste based on the chlorine content. As these levels are low there is not enough chlorine to warrant a quench or scrubber system. The low carbon monoxide emission level indicates a very high destruction efficiency of the introduced waste.

In view of these low historical emissions and conclusions from the technical review, no changes to technology are considered necessary.

The 2012 review adds:

The site incinerator has a proven track record of ultra low dioxin emissions at the edge of detection ability when using certified sampling and analytical methodology. The January 2012 test series results are hardly distinguishable from the laboratory method blank data and show emission levels between 0-3% of the widely international accepted dioxin emission standard of 0.1 ng I-TEQ/Sm³. When calculating the 'Medium Bound' emission concentrations by using 50% of the detection limits for all 17 dioxin and furan isomers which were not detected, these values increase to 2-5% of the 0.1 ng I-TEQ/Sm³ standard including the laboratory blank at 2% itself.

The technology of this incinerator provides all properties and conditions such as a high incineration and stack emission temperature for effective destruction of potential precursors to keep dioxin emission at an extreme minimum. The total absence of medium range temperatures (200-500 deg C) and short of residence times eliminate any potential for dioxin reformation in downstream equipment often found in other incineration devices.

There are no dioxin mitigation technologies that exist for this particular incinerator that would result in any significant reduction of already extremely low dioxin emissions.

It is noted that the assessment of environmental effects that was undertaken in support of the application lodged in November 2013 for replacement of air discharge permit 4020 included a comprehensive review of technological advances relevant to the reduction or mitigation of discharges to air from the Paritutu site, and an assessment of issues relevant to the minimisation or mitigation of discharges to air from the site. The consent application was being processed at the end of the compliance monitoring review period.

2.2.9 Other investigations

2.2.9.1 Soil analysis

The Council, the Ministry for the Environment, and the Ministry of Health have previously investigated levels of dioxin in soil in the vicinity of the site. The studies concluded that the low levels measured mean that any risk to human health is negligible. For further information see 'Dow AgroSciences (NZ) Ltd, Monitoring Program Annual Report 2002-2003', Technical Report 2003-71 by Taranaki Regional Council, and 'Dioxin concentrations in Residential Soil, Paritutu, New Plymouth', report prepared for the Ministry for the Environment and the Institute of Environmental Science and Research Ltd by Pattle Delamore Partners Ltd, September 2002.

2.2.9.2 Odour survey

In April and May 2007, an air quality scientist commissioned by Dow AgroSciences investigated possible sources of odours that had recently been noticed by contractors working on an adjacent site across Paritutu Road, and by the Council's inspecting officer. Samples were collected from three potential odour sources for analysis by dynamic dilution olfactometry (sniffing by an independent trained panel). The Bulk Storage Tank vent, and the Commodities Plant and Herbicides Plant stacks were tested.

The results of odour monitoring showed that odour emissions from these three sources were low.

2.3 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year matters may arise which require additional activity by the Council e.g. provision of advice and information, or investigation of potential or actual courses of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment.
The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2013-2014 year, no incident was recorded by the Council that was associated with Dow AgroSciences.

3. Discussion

3.1 Discussion of site performance

In general, from the inspections of Dow AgroSciences's site and from discussions held with Dow AgroSciences staff, Council officers have concluded that the Company has a comprehensive, carefully documented and well considered approach to all areas of environmental performance. This included written methods for process management and technical control, documentation of processes and emissions, a self monitoring programme implemented by the Company and regular provision of information to the Council. Staff are assigned particular areas of responsibility, so that familiarity and experience are gained. All major air emissions sources have appropriate treatment systems and in most cases general building ventilation is also extracted through similar treatment systems.

Some process changes were made in 2013-2014.

Two new products were introduced to the site: eNtrench™ Nitrogen Stabiliser, which contains Nitrapyrin, that falls under the HSNO Fertiliser Group Standard, is imported and repacked into smaller containers on site for the Australian market; Cobalt™ Advanced Insecticide, which contains Lambda-cyhalothrin and Chlorpyrifos, is imported as a packed finished product and is stored only on site for distribution throughout New Zealand

Two new products were manufactured in the Herbicides Plant using existing actives: FallowBoss TORDON™ Herbicide and TORDON™ RegrowthMaster Herbicide.

The annual report on air emission monitoring was produced as required under consent 4020-3. Compliance with the consent conditions was demonstrated.

In recent years, odour control has been the main performance issue. In the 2011-2012 reporting period, Dow AgroSciences made further operational and equipment changes to improve odour control, particularly in relation to the formulation of 2,4-D products. Two capital projects were completed, to install general building ventilation and extraction, with emission treatment systems, on the Commodities Plant and the raw material storage warehouse. No complaint about odour has since been received.

The annual report on stormwater discharge monitoring was produced as required under consent 4108-2. Compliance with the consent conditions was demonstrated.

The annual groundwater management report was produced as agreed in the Site Groundwater Management Plan. All groundwater samples from the perimeter wells were found to be significantly below the contaminant action levels.

3.2 Environmental effects of exercise of water permit

Environmental investigations, including biomonitoring of the Herekawe Stream, found no cause for concern over the effects of the discharge of stormwater from the site, or from groundwater from beneath the site.

3.3 Environmental effects of exercise of air discharge permit

The results of emission testing on various plant processes indicate that there is no potential health effect from the primary contaminants discharged from the site, according to recognised guidelines. Dioxin testing carried out in the 1995-1996 monitoring period showed that levels of dioxin in New Plymouth are low and that there was no increase in ambient dioxin levels in the vicinity of the Dow AgroSciences site. Further ambient testing was underway in 2013-2014 as background to the Company's applications for replacement of its air consent.

3.4 Environmental effects of groundwater movement

Monitoring of groundwater quality beneath the site has confirmed modelling that predicts that historical groundwater contamination at two points beneath the site would not result in any off-site effects, nor detection at the limits of detection used by the Company for its routine monitoring.

3.5 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Table 9 and Table 10.

Table 9 Summary of performance for Consent 4108-2 Discharge of stormwater, 2013-2014

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practicable option	Checking that standard operating procedures to achieve compliance with consent conditions are followed	Yes
2. Stormwater catchment area not to be exceeded	Inspections of plant site	Yes
3. Provision of stormwater management plan	Revised plan received 22 September 2008 and approved by Council	Yes
4. Keeping of discharge records	Inspection by Council and annual report by Dow AgroSciences	Yes
5. Controls on effect of discharge in receiving water	Inspections, chemical sampling and biomonitoring	Yes
6. Concentration limits upon potential contaminants in discharge	Chemical sampling by Dow AgroSciences with checking by Council	Yes
7. Optional review of consent	Next review date June 2020	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 10 Summary of performance for Consent 4020-3 Discharge emissions to air, 2013-2014

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practicable option	Checking that standard operating procedures to achieve compliance with consent conditions are followed	Yes

2. Minimise discharges	Checking that standard operating procedures to achieve compliance with consent conditions are followed	Yes
3. Biennial report on technological advances in emission reduction	Report received 5 November 2012. No further report required, while consent replacement investigations underway	Yes
4. Notification of plant changes	Liaison and plant inspection. No plant changes made, other than move to two-shift operation	Yes
5. Provision of process control records	Site inspection and provision of annual report by Dow AgroSciences	Yes
6. Provision of formulations details	Site inspection and provision of annual report by Dow AgroSciences	Yes
7. Limits on specific emission components	Continuous monitoring of high temperature incinerator by Dow AgroSciences	Yes
8. Limits on general emission components	Discrete sampling of process vents by independent agent	Yes
9. Monitoring exercise of consent	Inspection by Council, continuous monitoring and recording of processes, formulations and emissions by Dow AgroSciences, and independent testing of emissions and effects	Yes
10. Limit on visual effects	Inspection by Council	Yes
11. Limit on hydrogen chloride	Incinerator stack testing by independent agent	Yes
12. Limit on dioxins and furans	Incinerator stack testing by independent agent. More sensitive method developed	Yes
13. Incinerator monitoring records	Inspection by Council and annual report by Dow AgroSciences	Yes
14. Incinerator loading and weather records	Inspection by Council and annual report by Dow AgroSciences	Yes
15. Incinerator oxygen concentration	Continuous monitoring by Dow AgroSciences	Yes
16. Incinerator temperature	Continuous monitoring by Dow AgroSciences	Yes
17. Incinerated liquids halogen limit	Monitored by Dow AgroSciences	Yes
18. Incinerator exhaust temperature	Continuous monitoring by Dow AgroSciences	Yes
19. Ecological effects	Inspection by Council and observation of vegetation	Yes
20. Optional review of consent	Option not available	N/A
21. Liaison with submitters and local community	Liaison meeting arranged for28 May 2014 cancelled owing to lack of interest	Yes
22. Odour monitoring programme	Inspection by Council and liaison with local community	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

During the year, the Company demonstrated a high level of environmental and high level of administrative performance with the resource consents to discharge stormwater and to discharge emissions to air.

3.6 Recommendations from the 2012-2013 Annual Report

In the 2012-2013 Annual Report, it was recommended:

1. THAT monitoring of air emissions from Dow AgroSciences in the 2013-2014 year continue at the same level as in 2012-2013.
2. THAT monitoring of water discharges from Dow AgroSciences in the 2013-2014 year continue at the same level as in 2012-2013.
3. THAT the option of a review of resource consent **4108-2** (discharge stormwater), as set out in condition 7, not be exercised, on the grounds that current conditions are adequate to deal with any potential adverse effects

These recommendations were implemented in the 2013-2014 year in full.

3.7 Alterations to monitoring programmes for 2014-2015

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring emissions/discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

In the case of Dow AgroSciences, the programme for 2013-2014 was essentially unchanged from that for 2012-2013 by Dow AgroSciences, on the grounds that Dow AgroSciences has maintained a high level of environmental performance and the existing monitoring program was adequate to provide sufficient data to assess environmental performance. It is now proposed that for 2014-2015, the programme be maintained at the same level as the programme for 2013-2014.

Recommendations to this effect are attached to this report.

It should be noted that the Company commissioned and implemented a comprehensive suite of air emission and air quality studies in preparation for an application to the Council for replacement of the air discharge permit that expired in June 2014.

3.8 Exercise of optional review of consent

Neither of the consents held for operation of the Paritutu agrichemical plant provides for an optional review of the consent in June 2015

4. Recommendations

1. THAT monitoring of air emissions from Dow AgroSciences in the 2014-2015 year continue at the same level as in 2013-2014.
2. THAT monitoring of water discharges from Dow AgroSciences in the 2014-2015 year continue at the same level as in 2013-2014.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

2,4-D	2,4 di-chloro-phenoxy-acetic acid, a herbicide
2,4-DB	2,4 di-chloro-phenoxy-butanoic acid, a herbicide
2,4,5-T	2,4,5 tri-chloro-phenoxy-acetic acid, a herbicide
AEE	Assessment of environmental effects
biomonitoring	Assessing the health of the environment using aquatic organisms
bund	A wall around a tank to contain its contents in case of a leak
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20˚C and expressed in mS/m
DMA	Dimethylamine
DMEA	Dimethylethanolamine
Dioxins	See PCDD
g/m^3	Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
IPA	Isopropylamine
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident
l/s	Litres per second
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
MCPA	Methyl-chloro-phenoxy-acetic acid, a herbicide
MCPB	Methyl-chloro-phenoxy-butanoic acid, a herbicide
mS/m	MilliSiemens per metre
mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
ng/m^3	Nanogrammes per cubic metre
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water
PCDD	Polychlorinated dibenzo-para-dioxins, a contaminant of phenoxy herbicides
PCDF	Polychlorinated dibenzofurans, a contaminant of phenoxy herbicides
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than pH of 5.

physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections (9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and including all subsequent amendments
SQMCI	Semi-quantitative macroinvertebrate community index;
Temp	Temperature, measured in ˚C (degrees Celsius)
Turb	Turbidity, expressed in NTU
$\mu g/m^3$	Micrograms per cubic metre
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan

For further information on analytical methods, contact the Council's laboratory

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Appendix I

Resource consents held by Dow AgroSciences (NZ) Ltd

Consent 4020-3

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz

Please quote our file number on all correspondence

Discharge Permit

Pursuant to the Resource Management Act 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder:	Dow AgroSciences (NZ) Limited Private Bag 2017 NEW PLYMOUTH
Change To Conditions Date:	11 November 2005 [Granted: 12 June 1996]

Conditions of Consent

Consent Granted:	To discharge emissions into the air from the manufacture of agrichemical products and associated processes at an agrichemical manufacturing complex at or about GR: P19:987-374
Expiry Date:	1 June 2014
Review Date(s):	June 1998, June 2000, June 2002, June 2004, June 2006, June 2008, June 2010, June 2012
Site Location:	89 Paritutu Road, New Plymouth
Legal Description:	Lot 1 DP 10018 Lots 1 & 2 DP 9829 Lot 1 DP 9022 Lot 3 DP 8465 Blk IV Paritutu SD
Catchment:	Herekawe

For General, Standard and Special conditions pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

Conditions 1 to 11 – unchanged

1. The consent holder shall at all times adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment associated with the discharges into the air from the site. 'Best practicable option' shall be determined by the Taranaki Regional Council, taking into account the information supplied by the consent holder under condition 3 of this consent, and following review as set out under condition 20 of this consent.

2. The consent holder shall at all times operate, maintain, supervise, monitor and control all processes so that discharges authorised by this consent are maintained at a practicable minimum.

3. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, by 30 June 1998 and every two years thereafter, a written report:

(a) reviewing technological advances relevant to the reduction or mitigation of any discharge to air from the site, particularly but without limitation discharges of dioxin, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances;

(b) assessing any other issue relevant to the minimisation or mitigation of discharges to air from the site that the Chief Executive, Taranaki Regional Council, considers should be included; and

(c) detailing any inventory of discharges to air from the site of such contaminants as the Chief Executive, Taranaki Regional Council, may from time to time specify following consultation with the consent holder.

4. Prior to undertaking any alteration to the plant, process, or operations as they were specified in the application and supporting documentation lodged with the Taranaki Regional Council for this consent, which may significantly change the nature or quantity of contaminants discharged to air from the site, the consent holder shall consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

5. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, all process control records relevant to air quality, air monitoring data, and documentation of air monitoring programmes, for a period of six months.

6. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, details of all formulations received, prepared, stored, mixed or otherwise processed on the premises, including but not limited to material safety data sheets and toxicological information and environmental fate information as contained in the agrochemical registration information. The information specific to any formulation shall be retained for a period of six months after that formulation is last processed.

7. The consent holder shall control all discharges of sulphur dioxide, carbon monoxide and nitrogen dioxide, in order that the maximum ground level concentrations of each of these contaminants shall satisfy the guideline values set out in Table 1 of 'Ambient Air Quality Guidelines', July 1994, Ministry for the Environment, when measured as specified in that document. Should the ambient concentration of any contaminant be found to exceed its relevant guideline value, this consent may be reviewed under condition 20.

8. The consent holder shall control all discharges, other than of carbon dioxide or as in condition 7 and 12, so as to ensure that the maximum ground level concentration for any particular contaminant at or beyond the boundary of the site is not increased above background levels:

> by more than 1/30th of the relevant Occupational Threshold Value -- Time Weighted Average for any eight-hour period of measurement, or by any more than the Short Term Exposure Limit for any fifteen-minute period of measurement, or, if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average for any fifteen-minute period of measurement. [Workplace Exposure Standards and Biological Exposure Indices for New Zealand, 1992, Department of Labour].

9. The exercise and the effects of the exercise of this consent shall be monitored to the satisfaction of the Chief Executive, Taranaki Regional Council.

10. The opacity of discharges from the incinerator stacks shall not exceed 20%.

11. The discharge of hydrogen chloride from the incinerator stacks shall not exceed 1.5 kg/hour in aggregate.

Condition 12 – changed

12. The discharge of polychlorinated dibenzodioxins and polychlorinated dibenzofurans from any incinerator stack shall not exceed an average concentration of 0.1 ng/m^3 [adjusted to 0 degrees Celsius, dry gas basis, 101.3 kPa pressure, and 11% oxygen], nor a mass discharge rate of 5.0 µg/hour, when expressed as the equivalent amount of 2,3,7,8 tetrachloro dibenzo-p-dioxin according to NATO toxic equivalent factors. The average concentration shall be determined over not less than 3 sampling runs within any 12-month period, each of which shall be taken while the incinerator is fed on different waste types unless specifically approved otherwise by the Chief Executive, Taranaki Regional Council.

Conditions 13 to 22 – unchanged

13. Without restriction or limitation to conditions 5 or 9, the consent holder shall monitor and record, and make available to the Chief Executive, Taranaki Regional Council, upon request, the following operating parameters on the solid incinerator on a continuous basis:

    (a) oxygen concentration within or at the exit from the secondary combustion chamber;

    (b) carbon monoxide concentration within or at the exit from the secondary combustion chamber;

    (c) temperature within or at the exit of the primary combustion chamber; and

    (d) temperature within or at the exit of the secondary combustion chamber.

    Records shall be retained for a period of six months.

14. Without restriction or limitation to conditions 5 or 9, the consent holder shall record, and make available to the Chief Executive, Taranaki Regional Council, upon request, the feedstock type and loading rate, operating times and the prevailing weather conditions for each incinerator burn, and for the solids incinerator the loading time at which each batch is loaded into the incinerator. Records shall be retained for a period of six months.

15. The oxygen concentration within the secondary combustion chamber of the solids incinerator shall be maintained between 6% and 9% [by volume] as far as is practicable, and shall not be less than 4.5% [by volume], for more than 60 seconds at any time during the incineration of material during any 24-hour period.

16. The temperature in the secondary combustion chamber of the solids incinerator shall not be less than 1100 degrees Celsius, at any time during the incineration of material.

17. The temperature at the exit from the liquids incinerator chamber shall not be less than 1000 degrees Celsius and the total proportion of halogens within the feedstocks shall not exceed 0.8%.

18. The temperature of the exhaust gases from the solids incinerator stack shall not be less than 700 degrees Celsius immediately prior to discharge.

19. The discharges authorised by this consent shall not give rise to any direct significant adverse ecological effect on any off-site ecosystems, including but not limited to habitats, plants, animals, microflora and microfauna.

20. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 1998 and every two years thereafter for the purpose of:

    (a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered and which it is appropriate to deal with at the time of review; or

    (b) requiring the holder to adopt the best practicable option to remove or reduce any adverse effect on the environment caused by any discharge into the air; or

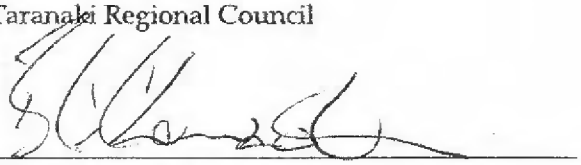
    (c) to alter, add, or delete limits on discharge or ambient concentrations of any contaminants or contaminant.

21. The consent holder and staff of the Taranaki Regional Council shall meet as appropriate and at least once per year, with submitters to the consent and interested members of the local community, in order to discuss any matter relating to the exercise of this resource consent.

22. The Taranaki Regional Council, in conjunction with the consent holder, submitters to the consent and other interested members of the local community shall establish a programme to monitor odours and odour sources.

Signed at Stratford on 11 November 2005

For and on behalf of
Taranaki Regional Council



Chief Executive

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Dow AgroSciences (NZ) Limited Private Bag 2017 NEW PLYMOUTH
Consent Granted Date:	4 September 2008

Conditions of Consent

Consent Granted:	To discharge stormwater from an industrial agrichemical manufacturing site via retention dams together with uncontaminated stormwater from landscape and non-manufacturing areas into the Herekawe Stream at or about (NZTM) 1688226E-5675009N
Expiry Date:	1 June 2026
Review Date(s):	June 2014, June 2020
Site Location:	89 Paritutu Road, New Plymouth
Site Legal Description:	Lot 3 DP 8465 Lot 1 DP 9022 Lots 1 & 2 DP 9829 Lot 1 DP 10018
Catchment:	Herekawe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The stormwater discharged shall be collected from a catchment area of no more than 16 hectares.

3. The consent holder shall maintain, and comply with at all times, a stormwater management plan, approved by the Chief Executive, Taranaki Regional Council, detailing measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent, and measures to avoid, remedy or mitigate the environmental effects of such a discharge.

4. The consent holder shall keep records of the date and time that the stormwater discharges begin and end, the volume of water discharged, and the results of all physicochemical testing carried out on water discharged to the Herekawe Stream. These records shall be made available to the Chief Executive, Taranaki Regional Council, upon request.

5. After allowing for a mixing zone of 25 metres from the point of discharge, the discharge shall not give rise to any of the following effects in the Herekawe Stream:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission of objectionable odour;
   d) any significant adverse effects on aquatic life.

6. Concentrations of the following components shall not be exceeded in the discharge:

Component	**Concentration**
Total phenoxy herbicides [2,4-D, MCPA and MCPB]	0.10 mg/L
Total organophosphates [chlorpyrifos and chlorpyrifos-methyl]	0.0005 mg/L
Triclopyr 0.10	mg/L
Picloram 0.10	mg/L
Glyphosate	0.10 mg/L
Oxyfluorfen	0.005 mg/L
pH [range]	6.0 – 9.0

This condition shall apply prior to the entry of the stormwater into the Herekawe Stream, at designated sampling points approved by the Chief Executive, Taranaki Regional Council.

7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2014 and/or June 2020, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 4 September 2008

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

List of 255 pesticide residues analysed for in Dow AgroSciences stormwater

GC/MS MULTI RESIDUE METHOD (FWA-02)

The sample is extracted and further purified using gel permeation chromatography. Measurement is performed using gas chromatography - mass spectrometry.

Specific Residues reportable and MDLs can be matrix dependent.

MDL = Method Detection Limit

№	COMPOUND	MDL (mg/kg)	№	COMPOUND	MDL (mg/kg)	№	COMPOUND	MDL (mg/kg)	№	COMPOUND	MDL (mg/kg)
1	acetochlor	0.001	65	DDE (o,p')	0.001	129	flumiclorac-pentyl	0.001	193	piperophos	0.001
2	alachlor	0.001	66	DDE (p,p')	0.001	130	flumioxazin	0.001	194	pirimicarb	0.001
3	aldrin	0.001	67	DDT (o,p')	0.001	131	fluquinconazole	0.001	195	pirimiphos-methyl	0.001
4	allidochlor	0.001	68	DDT (p,p')	0.005	132	flusilazole	0.001	196	pretilachlor	0.001
5	ametryn	0.001	69	deltamethrin	0.005	133	flutolanil	0.001	197	prochloraz	0.001
6	anilofos	0.001	70	demeton-S-methyl	0.001	134	flutriafol	0.001	198	procymidone	0.001
7	atrazine	0.001	71	diazinon	0.001	135	fluvalinate	0.001	199	profenofos	0.001
8	azaconazole	0.001	72	dichlobenil	0.001	136	fonofos	0.001	200	promecarb	0.001
9	azinphos-methyl	0.005	73	dichlofenthion	0.001	137	fosthiazate	0.001	201	prometryn	0.001
10	azoxystrobin	0.001	74	dichlofluanid	0.001	138	furalaxyl	0.001	202	propachlor	0.001
11	benalaxyl	0.001	75	dichloran	0.001	139	furathiocarb	0.001	203	propargite	0.001
12	bendiocarb	0.001	76	dicofol	0.001	140	haloxyfop-etotyl	0.001	204	propazine	0.001
13	benfluralin	0.001	77	dichlorvos	0.001	141	haloxyfop-methyl	0.001	205	propetamphos	0.001
14	benodanil	0.001	78	diclobutrazol	0.001	142	heptachlor	0.001	206	propham	0.001
15	benoxacor	0.001	79	diclofop-methyl	0.001	143	heptachlor-endo-epoxide	0.005	207	propiconazole	0.001
16	BHC-alpha	0.001	80	dieldrin	0.001	144	heptachlor-exo-epoxide	0.001	208	propoxur	0.001
17	BHC-beta	0.001	81	diethofencarb	0.001	145	heptenophos	0.005	209	propyzamide	0.005
18	BHC-delta	0.001	82	difenoconazole	0.001	146	hexachlorobenzene	0.001	210	prothiofos	0.001
19	BHC-gamma (lindane)	0.001	83	diflufenican	0.001	147	hexaconazole	0.001	211	pyraclostrobin	0.001
20	bifenox	0.005	84	dimepiperate	0.001	148	hexazinone	0.001	212	pyraflufen-ethyl	0.001
21	bifenthrin	0.001	85	dimethenamid	0.001	149	indoxacarb	0.001	213	pyrazophos	0.001
22	bioresmethrin	0.001	86	dimethoate	0.005	150	iodofenphos	0.001	214	pyributicarb	0.001
23	bitertanol	0.001	87	dimethomorph	0.001	151	iprobenfos	0.001	215	pyridaben	0.001
24	bromacil	0.005	88	dimethylvinphos	0.001	152	iprodione	0.001	216	pyridaphenthion	0.001
25	bromobutide	0.001	89	dioxabenzofos	0.001	153	iprovalicarb	0.001	217	pyrimethanil	0.001
26	bromophos-ethyl	0.001	90	diphenamid	0.001	154	isazofos	0.001	218	pyrimidifen	0.001
27	bromophos-methyl	0.001	91	diphenylamine	0.001	155	isofenphos	0.001	219	pyriminobac-methyl(E)	0.001
28	bromopropylate	0.001	92	disulfoton	0.001	156	isoprocarb	0.001	220	pyriminobac-methyl(Z)	0.001
29	bupirimate	0.001	93	dithiopyr	0.001	157	isoprothiolane	0.001	221	pyriproxyfen	0.001
30	buprofezin	0.001	94	edifenphos	0.001	158	kresoxim-methyl	0.001	222	quinalphos	0.005
31	butachlor	0.001	95	endosulfan sulphate	0.001	159	lactofen	0.001	223	quinoxyfen	0.001
32	butafenacil	0.001	96	endosulfan (alpha)	0.001	160	leptophos	0.001	224	quintozene	0.001
33	butamifos	0.001	97	endosulfan (beta)	0.005	161	malathion	0.001	225	quizalofop-ethyl	0.001
34	cadusafos	0.001	98	endrin	0.001	162	mepronil	0.001	226	simazine	0.001
35	carbaryl	0.005	99	EPN	0.005	163	metalaxyl	0.001	227	simeconazole	0.001
36	carbofuran	0.001	100	epoxiconazole	0.001	164	methacrifos	0.001	228	simetryn	0.001
37	carboxin	0.001	101	EPTC	0.001	165	methidathion	0.001	229	tebuconazole	0.001
38	carfentrazone-ethyl	0.001	102	esprocarb	0.001	166	methiocarb	0.001	230	tebufenpyrad	0.001
39	chlordane-cis	0.001	103	ethalfluralin	0.001	167	metolachlor	0.001	231	tecnazene	0.001
40	chlordane-trans	0.001	104	ethiofencarb	0.001	168	mevinphos	0.001	232	tefluthrin	0.001
41	chlorfenapyr	0.001	105	ethion	0.001	169	molinate	0.001	233	terbacil	0.001
42	chlorfenvinphos	0.001	106	ethoprophos	0.001	170	myclobutanil	0.005	234	terbufos	0.001
43	chlorobenzilate	0.001	107	etoxazole	0.001	171	napropamide	0.001	235	terbuthylazine	0.001
44	chlorothalonil	0.001	108	etridiazole	0.001	172	nitrofen	0.001	236	terbutryne	0.001
45	chlorpropham	0.001	109	etrimfos	0.001	173	nitrothal-isopropyl	0.001	237	tetrachlorvinphos	0.001
46	chlorpyrifos	0.001	110	famphur	0.001	174	norflurazon	0.005	238	tetraconazole	0.001
47	chlorpyrifos-methyl	0.001	111	fenamiphos	0.001	175	oxadiazon	0.001	239	tetradifon	0.001
48	chlorthal-dimethyl	0.001	112	fenarimol	0.001	176	oxadixyl	0.001	240	thenylchlor	0.001
49	chlozolinate	0.001	113	fenchlorphos	0.001	177	oxyfluorfen	0.001	241	thiobencarb	0.001
50	clodinafop-propargyl	0.001	114	fenitrothion	0.005	178	paclobutrazol	0.001	242	thiometon	0.001
51	clomazone	0.001	115	fenobucarb	0.001	179	parathion	0.001	243	tolclofos-methyl	0.001
52	cloquintocet-1-methylhexyl	0.001	116	fenoxanil	0.001	180	parathion-methyl	0.001	244	tolyfluanid	0.001
53	coumaphos	0.001	117	fenoxaprop-ethyl	0.001	181	penconazole	0.001	245	tralkoxydim	0.005
54	cyanazine	0.001	118	fenoxycarb	0.001	182	pendimethalin	0.001	246	triadimefon	0.001
55	cyanophos	0.001	119	fenpropathrin	0.001	183	permethrin	0.005	247	triadimenol	0.001
56	cyflufenamid	0.001	120	fenpropimorph	0.001	184	phenthoate	0.001	248	triallate	0.001
57	cyfluthrin	0.005	121	fensulfothion	0.001	185	phorate	0.001	249	triazophos	0.001
58	cyhalofop-butyl	0.001	122	fenthion	0.001	186	phorate-sulphone	0.001	250	tribufos	0.001
59	cyhalothrin	0.001	123	fenvalerate	0.001	187	phorate-sulphoxide	0.001	251	trifloxystrobin	0.001
60	cypermethrin	0.005	124	fipronil	0.001	188	phosalone	0.001	252	trifluralin	0.001
61	cyproconazole	0.001	125	flamprop-methyl	0.001	189	phosmet	0.001	253	uniconizole-P	0.001
62	cyprodinil	0.001	126	fluacrypyrim	0.001	190	phosphamidon	0.001	254	vinclozolin	0.001
63	DDD (o,p')	0.001	127	fluazifop-P-butyl	0.001	191	picolinafen	0.001	255	XMC	0.001
64	DDD (p,p')	0.001	128	fluazinam	0.005	192	piperonyl butoxide	0.001			

Appendix III

Dow AgroSciences Annual Stormwater Report 2013-2014

Dow AgroSciences

Stormwater Discharge Report

1 July 2013 – 30 June 2014

Consent No. 4108-2

15 July 2014

Table of Contents

Introduction

Discharge of stormwater from the Paritutu Site is subject to the conditions detailed in discharge permit 4108-2 issued by the Taranaki Regional Council.

In order to comply with these conditions, stormwater from the production plant, dangerous goods storage compound, despatch store, incinerator, and roads in these areas is directed to stormwater retention ponds. The water collected in these ponds is sampled and analysed before being released. The sampling, analysis and release procedures are outlined in standard operating procedures.

Drainage from process areas is segregated from non-process areas to reduce the potential for contamination of stormwater. Areas around storage tanks and process equipment, located outside buildings in the production area, are contained by bunding. This water is discharged to the site trade waste system.

Stormwater from the southern part of the site drains directly to the New Plymouth District Council stormwater drain and then to the Herekawe Stream. This part of the site is a predominantly open grassed area surrounding a parking area, two storage buildings, the closed Pilot Plant and the access road to the site. Specific controls for stormwater from the storage buildings and storage tank bunds are in place to direct stormwater to the trade waste system.

There are four stormwater retention ponds on the site:

i. **Concrete stormwater retention pond: SV9100**

Stormwater enters this system through a series of under/over separators and then discharges into SV9100. This pond collects water from the production plant and roads in this area.

ii. **Concrete stormwater retention pond: SV9000**

When SV9100 is full, the water overflows into SV9000. This pond collects water from the production plant and roads in this area.

iii. **HDPE stormwater retention pond: SV9200**

This pond collects stormwater from the incinerator and roads in this area. Stormwater in this pond is discharged through SV9100 when it is empty.

iv. **HDPE stormwater retention pond: SV8000**

This pond collects stormwater from the despatch and dangerous goods areas and roads in this area.

Changes Made During The Year

Stormwater System Changes

Other than carrying out routine maintenance, no physical changes were made to the stormwater system during the period.

Consent Changes

No consent changes occurred during the reported period.

Monitoring & Discharge

Conditions

Performance Criteria

1) *Adopting best practicable option to prevent or minimise any adverse effects on the environment.*

2) *Stormwater discharge from catchment area of no more than 16 hectares.*

3) *Compliance with the stormwater management plan (standard operating procedure) at all times.*

4) *Records of stormwater sampling, analysis and discharge shall be kept and made available for review by the Taranaki Regional Council.*

5) *After allowing for a mixing zone of 25 metres from the point of discharge, the discharge shall not give rise to any of the following effects on the Herekawe Stream:*

a) *the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;*
b) *any conspicuous change in the colour or visual clarity;*
c) *any emission of any objectionable odour;*
d) *any significant adverse effects on aquatic life.*

6) *Discharge shall not exceed the following limits prior to the entry of stormwater into the Herekawe Stream:*

Total phenoxy herbicides	*0.10*	*mg/L*
Total organophosphates	*0.0005*	*mg/L*
Triclopyr	*0.10*	*mg/L*
Picloram	*0.10*	*mg/L*
Glyphosate	*0.10*	*mg/L*
Oxyfluorfen	*0.005*	*mg/L*
pH	*6.0 – 9.0*	

7 *The consent may be reviewed in 2014 and 2020.*

Monitoring

Stormwater collected in the four stormwater retention ponds is sampled and analysed before release to the Herekawe Stream.

In the rare event that stormwater does not meet the release criteria, the Company will identify the source of the contamination so corrective actions can be implemented to prevent a reoccurance. Prompt attention is given to the containment and clean-up of any spills/leaks on site.

If an incident occurs and impacts the standard management of the stormwater system the Company will discuss the specific details and obtain the any necessary approvals from the Taranaki Regional Council, before any action is taken. Water may be treated, or an alternative method of disposal identified such as, seeking approval from the New Plymouth District Council to pump to the site trade waste system.

Results

There were a total of 110 discharges from the stormwater retention ponds to the Herekawe Stream, during the monitoring period of 1 July 2013 to 30 June 2014.

On all occasions (100%) the conditions of the discharge consent were met, that is, there were no breaches of the consent conditions. For details refer to Appendix 1 attached to this report.

Biological Monitoring

Conditions

Performance Criteria

Discharge shall not cause an adverse biological impact on the receiving water.

Monitoring

The Taranaki Regional Council has undertaken regular biomonitoring of the Herekawe Stream to assess the impact stormwater discharges from industrial sites in the area have on the stream bed fauna and microflora. The surveys have been carried out at six monthly intervals since April 1986.

Three sites are sampled during each survey period:

1. *Upstream of Centennial Drive culvert and stormwater discharges;*
2. *Downstream of stormwater discharges and approximately 75m above the coast; and*
3. *Downstream of stormwater discharges and approximately 50m above the coast.*

Results

Results from the biological monitoring studies are held by the Taranaki Regional Council.

General

Stormwater Quality Inspections

Regular stormwater quality inspections, including collection of stormwater samples for interlaboratory testing, were undertaken by officers of the Taranaki Regional Council during 1 July 2013 to 30 June 2014.

Incident Review

During the monitoring year (1 July 2013 to 30 June 2014) there were zero incidents resulting in breaches of the discharge resource consent conditions.

Appendices

Appendix 1: Stormwater discharged to the Herekawe Stream (2013-14)

APPENDIX 1: Stormwater discharged to the Herekawe Stream (2013-14)

Only stormwater from the Paritutu site which meets the consent conditions will be released to the Herekawe Stream, or with approval from the Taranaki Regional Council.

Year : **1 July 2013 - 30 June 2014**

"-" = Insufficient stormwater to test for release, or requires treatment
Y = Retention pond met the discharge criteria, approved and released
N = Retention pond did not meet the discharge criteria and was released

Date	Stormwater Retention Pond				Comments
	SV9000	SV9100	SV9200	SV8000	
	N. Conc.	S. Conc.	S. HDPE	W. HDPE	
10-Jul-13	Y	Y	-	Y	
12-Jul-13	-	-	Y	-	
25-Jul-13	Y	Y	-	Y	
12-Aug-13	-	-	-	Y	
13-Aug-13	Y	Y	Y	-	
20-Aug-13	Y	Y	-	-	
21-Aug-13	-	-	-	Y	
23-Aug-13	-	Y	-	-	
29-Aug-13	Y	Y	Y	Y	
12-Sep-13	Y	Y	-	Y	
22-Sep-13	Y	Y	-	Y	
24-Sep-13	-	Y	Y	Y	TRC Sampled
1-Oct-13	Y	Y	-	Y	
10-Oct-13	-	Y	-	Y	
14-Oct-13	Y	Y	-	Y	
16-Oct-13	Y	Y	Y	Y	
31-Oct-13	-	-	-	Y	
14-Nov-13	-	-	Y	Y	
28-Nov-13	-	-	-	Y	
3-Dec-13	-	-	Y	-	
3-Dec-13	-	-	-	-	
5-Dec-13	Y	Y	-	Y	
6-Dec-13	-	-	Y	-	
10-11-Dec-13	-	Y	-	Y	TRC Sampled
5-Jan-14	Y	Y	Y	Y	
22-Jan-14	Y	-	-	Y	
22-Jan-14	-	Y	Y	-	
27-Jan-14	-	Y	-	-	
19-Mar-14	Y	Y	Y	Y	TRC Sampled
10-Apr-14	-	Y	-	-	
11-Apr-14	-	Y	-	Y	
16-Apr-14	Y	Y	Y	Y	
17-Apr-14	Y	-	-	Y	
22-Apr-14	Y	Y	Y	Y	
24-Apr-14	Y	Y	-	Y	
28-Apr-14	Y	-	Y	Y	
1-May-14	-	Y	-	Y	
2-May-14	Y	-	Y	-	
8-May-14	Y	Y	-	Y	
14-May-14	-	Y	-	-	
19-May-14	Y	-	Y	Y	TRC Sampled
6-Jun-14	Y	Y	-	Y	
11-Jun-14	Y	Y	-	Y	
12-Jun-14	-	-	Y	-	
19-Jun-14	Y	Y	-	Y	
26-Jun-14	Y	Y	-	Y	
27-Jun-14	Y	Y	-	Y	
Total "Y"	27	32	17	34	
Total "N"	0	0	0	0	

Total number of discharges which met the permit criteria and released: **110**

Total number of discharges which did not meet the permit criteria and released: **0**

Appendix IV

Biomonitoring reports
2013-2014

To Job Managers, David Olsen & James Kitto
From Freshwater Biologist, CR Fowles
Doc No 1312404
Report No CF596
Date 18 February 2014

Biomonitoring of the Herekawe Stream in relation to the Omata Tank Farm and other stormwater discharges, surveyed in November 2013

Introduction

This biological survey was the first of two scheduled for the Herekawe Stream in the 2013-2014 monitoring year to assess whether there had been any detrimental effects on the Herekawe Stream from stormwater discharges originating from STOS, DowAgro Sciences, Chevron, Origen Energy and NPDC. The previous survey was performed in summer, 2013 as scheduled. The results from surveys performed since the 2001-02 monitoring year are discussed in reports referenced at the end of this report.

Methods

The standard '400 ml kick-net' and sweep-sampling' techniques were used to collect streambed macroinvertebrates at a 'control' site ('kick-net') and another downstream site (mainly 'kick-net' and limited 'sweep-sampling') in the Herekawe Stream (Table 1, Figure 1) on 19 November 2013. The 'sweep-sampling' technique is very similar to Protocol C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the same protocols.

Table 1 Biomonitoring sites in the Herekawe Stream in relation to stormwater discharges

Site No.	Site Code	GPS Reference	Location
1	HRK 000085	E1688283 N5674972	Upstream of Centennial Drive culvert and stormwater discharges
2	HRK 000094	E1688201 N5675010	Downstream of stormwater discharges, approx. 75 m above coast

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly `sensitive' taxa were assigned the highest scores of 9 or 10, while the most `tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By

averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' taxa inhabit less polluted waterways.

A semi-quantitative MCI value ($SQMCI_s$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 & 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower, ranging from 0 to 10 $SQMCI_s$ units.

Figure 1 Biomonitoring sites in the Herekawe Stream

Results

At the time of this early afternoon survey, the water temperature in the Herekawe Stream was 18.5˚C at the two sites. No stormwater discharges were occurring from the right bank or the left bank outfalls at the time of the survey. The channel at site 1 was narrow and constrained by gabion baskets on the banks and bed of the stream where the substrate comprised mainly gravels and cobbles with some silt, sand, wood, and boulders. The stream at this site had a moderate, clear, uncoloured, swift flow and there were thin periphyton mats and widespread filamentous algae on the bed. Some macrophytes were recorded at the edges of the stream at this partially shaded site.

The substrate at site 2 comprised mainly silt and sand with some wood and a small proportion of cobbles and boulders. The site can periodically be affected by salt water under extremely high tide and very low flow conditions. The clear, uncoloured, moderate flow at this site was slightly deeper and slower moving than at site 1 upstream. There were patchy filamentous algae and thin periphyton mats noted on the harder substrate components of the bed during the survey. Aquatic macrophytes were recorded at intervals along the stream margins. The small area of macrophytes was sweep-sampled at site 2 and the woody

substrate and the limited area of cobble-boulder substrate were kick-sampled for macroinvertebrates at this site.

The survey was performed 12 days after a fresh in excess of 3 times median flow and 18 days after a fresh in excess of 7 times median flow in the catchment in accordance with Taranaki Regional Council biomonitoring fieldwork protocols.

Macroinvertebrates

A number of surveys have been performed previously at these two sites. Results of the current and past surveys are summarised in Table 2 and the results of the current survey presented in Table 3.

Table 2 Results of the current and previous surveys (since April 1986) performed at sites 1 and 2 in the Herekawe Stream in relation to the Omata Tank Farm and other stormwater discharges

Site	Number of previous surveys	Numbers of taxa			MCI values		
		Median	Range	Current Survey	Median	Range	Current Survey
1	55	18	11-23	15	86	68-99	93
2	55	15	9-22	19	71	54-96	76

Table 3 Macroinvertebrate fauna of the Herekawe Stream in relation to Omata Tank Farm and other stormwater discharges sampled on 19 November 2013

Taxa List	Site Number	MCI score	1	2
	Site Code		HRK000085	HRK000094
	Sample Number		FWB13335	FWB13336
ANNELIDA (WORMS)	Oligochaeta	1	A	XA
	Lumbricidae	5	R	-
MOLLUSCA	Lymnaeidae	3	-	R
	Potamopyrgus	4	VA	XA
	Sphaeriidae	3	-	R
CRUSTACEA	Ostracoda	1	-	R
	Paracalliope	5	VA	VA
	Paranephrops	5	-	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R
	Coloburiscus	7	R	-
	Deleatidium	8	R	-
HEMIPTERA (BUGS)	*Anisops*	5	-	R
COLEOPTERA (BEETLES)	Elmidae	6	C	R
TRICHOPTERA (CADDISFLIES)	*Hydrobiosis*	5	C	-
	Hudsonema	6	-	R
	Oxyethira	2	-	R
	Triplectides	5	R	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	R
	Chironomus	1	-	A
	Orthocladiinae	2	A	A
	Polypedilum	3	R	A
	Austrosimulium	3	R	R
	Tanyderidae	4	R	-
ACARINA (MITES)	Acarina	5	-	R
		No of taxa	15	19
		MCI	93	76
		SQMCIs	4.1	2.7
		EPT (taxa)	5	3
		%EPT (taxa)	33	16

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 1 (upstream of stormwater discharges)

A moderate richness of fifteen taxa was recorded at this site, which was three taxa fewer than the median number of taxa from previous surveys at this site (Table 2), but relatively typical of richnesses found in the lower reaches of small coastal streams elsewhere in Taranaki.

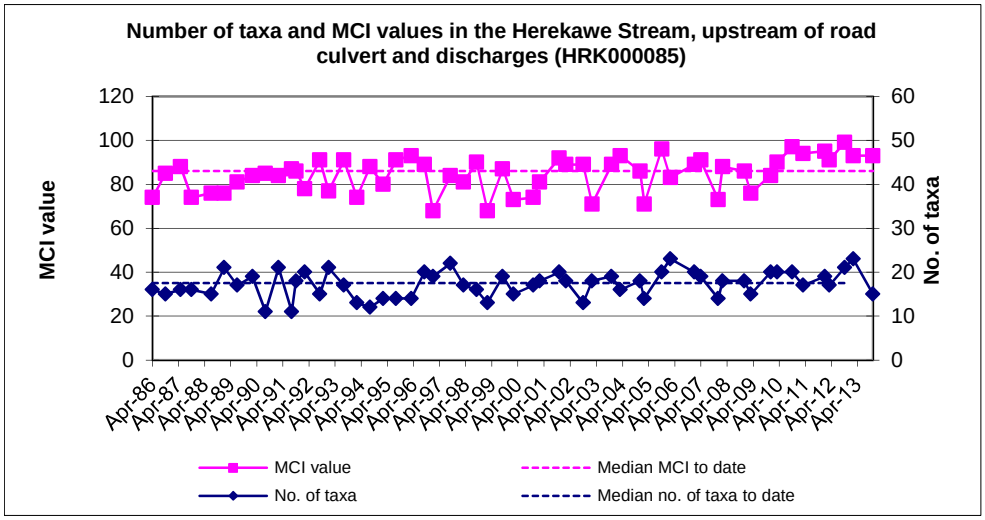


Figure 2 Number of taxa and MCI values in the Herekawe Stream upstream of the Centennial Road culvert since monitoring began in 1986

There were only four taxa dominant in the community (Table 3). These included one 'moderately sensitive' taxon [amphipod (*Paracalliope*)] and three 'tolerant' taxa [snail (*Potamopyrgus*), oligochaete worms, and orthoclad midges]. Most of these taxa are commonly found in habitats typical of the lower gradient reaches of small coastal streams, many of which are particularly abundant in association with periphyton and/or aquatic macrophytes. However, some of the more 'sensitive' taxa also present at this site (e.g. mayflies, beetles, and some caddisflies) are associated with swifter flowing, harder substrates, and also amongst aquatic vegetation (e.g. amphipods and some other caddisflies).

Characteristic macroinvertebrate taxa in the communities at this site prior to the spring 2013 survey are listed in Table 4.

Table 4 Characteristic taxa (abundant, very abundant, extremely abundant) recorded in the Herekawe Stream at Centennial Drive between April 1986 and February 2013 [55 surveys], and by the spring 2013 survey

Taxa List		MCI Score	Total abundances	% of Surveys	Survey Spring 2013
ANNELIDA	Oligochaeta	1	32	58	A
MOLLUSCA	*Potamopyrgus*	4	55	100	VA
CRUSTACEA	Ostracoda	1	2	4	
	Paracalliope	5	34	62	VA
EPHEMEROPTERA	*Austroclima*	7	4	7	
	Coloburiscus	7	11	20	
PLECOPTERA	*Acroperla*	5	1	2	
TRICHOPTERA	*Aoteapsyche*	4	1	2	
	Oxyethira	2	12	22	
	Triplectides	5	12	22	
DIPTERA	*Aphrophila*	5	4	7	
	Orthocladiinae	2	24	44	A
	Polypedilum	3	2	4	
	Austrosimulium	3	17	31	

Prior to the current survey, 14 taxa had characterised the community at this site on occasions. These have comprised six 'moderately sensitive' and eight 'tolerant' taxa i.e. an absence of 'highly sensitive' taxa and a relatively high proportion of 'tolerant' taxa as would be expected in the lower reaches of a small coastal stream. Predominant taxa have included only the one 'moderately sensitive' taxon [amphipod (*Paracalliope*)] and two 'tolerant' taxa [oligochaete worms and snail (*Potamopyrgus*)]. This snail taxon has characterised this site's community on every occasion.

Four of the historically characteristic taxa were dominant in the spring 2013 community and comprised all three of the predominant taxa (above) together with another one 'tolerant' taxon which previously had been characteristic of this site's communities (Table 4).The two taxa which were recorded as very abundant had characterised this site's communities on 62% to 100% of past surveys.

The MCI score (93 units) reflected the presence of a significant proportion of 'sensitive' taxa (60% of richness). The score was 7 units above the median of scores, but six units lower than the maximum, found by previous surveys (Table 2, Figure 2). It was also a very significant (Stark, 1998) 15 units higher than the median score found by 188 previous surveys of sites below 25 masl in similar lowland coastal streams (TRC, 1999 (updated, 2013)). The moderate $SQMCI_s$ value of 4.1 units (Table 3) reflected the numerical dominance of the 'tolerant' snail and 'sensitive' amphipod in particular at this site. The relatively high proportion of 'sensitive' taxa indicated reasonably good physicochemical water quality conditions preceding this survey.

Site 2 (downstream of stormwater discharges)

An above median richness of 19 taxa was found at this slower flowing site although it was noticeably more sandier and less of a cobble-boulder substrate habitat than usual. This richness was four taxa more than recorded upstream (Table 2, Figure 3) although it should be noted that 12 of these taxa (63% of richness) were recorded as rarities (less than 5 individuals per taxon). Although ten of these taxa were also present at the upstream site 1 and the two sites shared four of the dominant taxa (with two other ('tolerant') taxa characteristic at this site (2)), the two sites had only 42% in common of the total taxa (24) found over this short reach

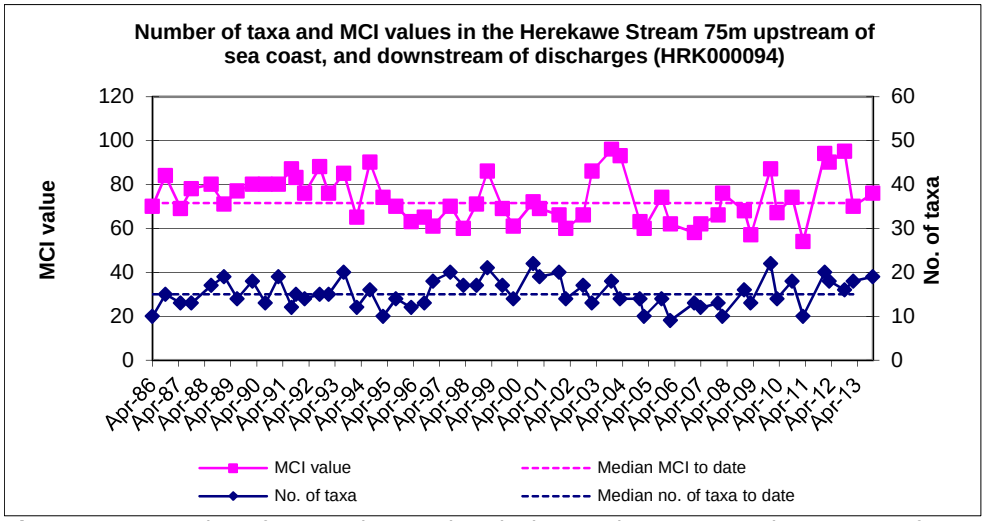


Figure 3 Number of taxa and MCI values in the Herekawe Stream downstream of industrial stormwater discharges since monitoring began in 1986

There was an increase (of 13%) in the proportion of 'tolerant' taxa in this community with 53% of the total taxa number. This was due mainly to the addition of five 'tolerant' taxa present (although mainly as rarities) at the downstream site. Taxa characteristic of this community included the one 'moderately sensitive' taxon and three 'tolerant' taxa dominant at the upstream site together with another two 'tolerant' taxa [midges *(Chironomus* and *Polypedilum*)].

Characteristic macroinvertebrate taxa in the communities at this site prior to the spring 2013 survey are listed in Table 5.

Table 5 Characteristic taxa (abundant, very abundant, extremely abundant) recorded in the Herekawe Stream downstream of Centennial Drive between April 1986 and February 2013 [55 surveys], and by the spring 2013 survey

Taxa List		MCI Score	Total abundances	% of Surveys	Survey
					Spring 2013
NEMERTEA	Nemertea	3	1	2	
ANNELIDA	Oligochaeta	1	30	55	XA
MOLLUSCA	*Physa*	3	1	2	
	Potamopyrgus	4	51	93	XA
	Sphaeriidae	3	2	4	
CRUSTACEA	Ostracoda	1	10	18	
	Paracalliope	5	26	47	VA
	Paratya	3	1	2	
EPHEMEROPTERA	*Coloburiscus*	7	5	9	
ODONATA	*Xanthocnemis*	4	1	2	
HEMIPTERA	*Sigara*	3	3	5	
TRICHOPTERA	*Hydrobiosis*	5	2	4	
	Oxyethira	2	15	27	
	Triplectides	5	7	13	
DIPTERA	*Aphrophila*	5	4	7	
	Chironomus	1	10	18	A
	Maoridiamesa	3	1	2	
	Orthocladiinae	2	34	62	A
	Polypedilum	3	3	5	A
	Empididae	3	1	2	
	Austrosimulium	3	8	15	
ACARINA	Acarina	5	2	4	

Prior to the current survey, 22 taxa had characterised the community at this site on occasions. These have comprised six 'moderately sensitive' and sixteen 'tolerant' taxa i.e. an absence of 'highly sensitive' taxa and a very high proportion of 'tolerant' taxa as would be expected in the lower reaches of a small coastal stream, particularly with a softer, more sedimented substrate. Predominant taxa have included only the three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and orthoclad midges].

Six of the historically characteristic taxa were dominant in the current survey community and comprised three of the predominant taxa (above) together with another two 'tolerant' and one 'moderately sensitive' taxa which previously had been characteristic of this site's communities (Table 5). The three taxa which were recorded as very or extremely abundant during spring had characterised this site's communities on 47% to 93 % of past surveys.

The MCI value of 76 units was an insignificant five units higher than the median of previous values (Table 2) but a significant (Stark 1998) 17 units less than the score recorded at site 1. This was due to the smaller proportion of 'sensitive' taxa in the community (particularly the absence of most mayflies which are more commonly associated with harder substrates and swifter flow conditions), as a result of the more ponded and slower flow of water and the higher proportion of fine-sedimented substrate at this site. This reflected the very different habitat to that at the upstream 'control' site 1, rather than the effects of stormwater discharges. Sand inundation and saltwater penetration have occurred at this site in the past as a result of very high tides coincident with low stream flow conditions. However, many of the differences between the communities at sites 1 and 2 related to the presence/absence of taxa rarities (less than five individuals per taxon), rather than significant differences in individual taxon abundances [Note: removing these rarities from the two communities' compositions enlarged the downstream decrease in MCI score to 26 units]. The three significant differences in numerically increased abundances of individual 'tolerant' taxa recorded between sites, resulted in a decrease of 1.4 units in $SQMCI_s$ value at the downstream site 2, despite the similarity in dominant (characteristic) taxa between sites.

Discussion

The MCI values recorded since monitoring of these sites began in 1986 are illustrated in Figure 4.

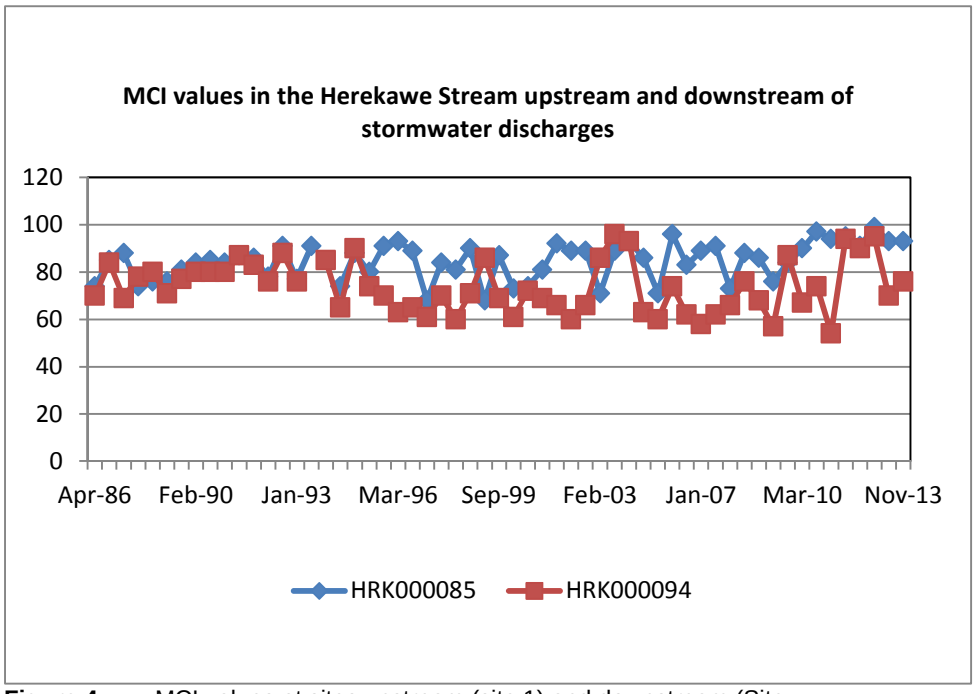


Figure 4 MCI values at sites upstream (site 1) and downstream (Site 2) of the stormwater discharges from the Omata tank farm area since monitoring began in 1986

There was a distinct change in the MCI values in 1995 when values at site 2 decreased markedly in comparison with those recorded at site 1, upstream of the culvert. Between March and September 1995 the habitat in the Herekawe Stream at site 2 changed significantly. Prior to the September 1995 survey, the stream at this site had a more riffle-like habitat. Although the water was slower flowing (compared to site 1), the stream had been shallower and contained a greater proportion of cobbles. A natural dam of debris and rocks appeared downstream between these two surveys, causing the stream to pond around site 2, becoming deeper and very slow flowing. The substrate became more dominated by silt and

macrophyte beds developed. This habitat generally supports fewer 'sensitive' taxa and therefore MCI values generally reflected a poorer community. The very low flow conditions surveyed at the time of post 2002 summer surveys however, indicated more similar conditions at site 2 to pre-1995 habitat, particularly the absence of aquatic macrophytes, reversing recent trends in MCI scores. Ponding at site 2 became more apparent again during many of the last fourteen (spring and summer) surveys, and at the time of the current survey, with the MCI value reflecting such a habitat.

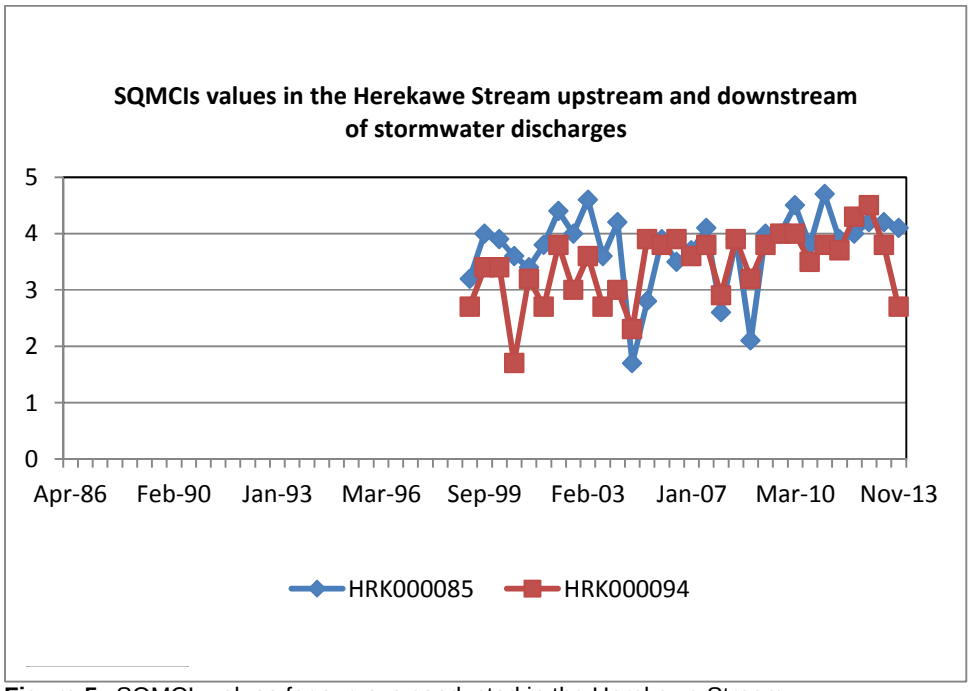


Figure 5 $SQMCI_s$ values for surveys conducted in the Herekawe Stream since 1999 (when $SQMCI_s$ was first implemented)

The $SQMCI_s$ values over the surveys conducted since 1999 suggest that while there have been differences in community composition, it is likely that the dominant taxa on many occasions were similar between sites, and $SQMCI_s$ values at both sites have followed a similar pattern (Figure 5). The exception has been certain post-2004 surveys when the $SQMCI_s$ highlighted some significant differences in community composition at site 2 in terms of increased abundances within several individual 'sensitive' taxa in a downstream direction. Since this date, with two exceptions (spring 2008, spring 2010, and on this occasion), the two sites have had relatively similar $SQMCI_s$ values. This had been the case at the time of the four previous surveys in particular.

It is unlikely that any differences in macroinvertebrate communities between site 1 and site 2 in recent years have been due to stormwater discharges from the Omata Tank Farm, NPDC or DowAgro Sciences. There have been no records of major changes to community compositions, i.e. significant loss of characteristic taxa, at the site (2) below these discharges, indicative of minimal impacts of stormwater discharges.

Conclusions

This spring 2013 survey of the Herekawe Stream performed under very low flow conditions indicated that the streambed communities had not been detrimentally affected by discharges of stormwater to the stream from the Omata Tank Farm, New Plymouth District Council, or other industrial sites. The macroinvertebrate communities at the sites both upstream and

downstream of the discharges contained quite different proportions of 'sensitive' macroinvertebrate taxa which were most probably related to variations in stream habitat with a lower proportion present at the slower flowing, more sedimented downstream site, but the two sites had very similar dominant (characteristic) taxa.

The numbers of taxa and MCI scores were insignificantly different and mainly higher than the respective medians of results found by previous surveys. The MCI value downstream was 17 units lower than that recorded upstream at the time of this spring survey due to marked physical habitat differences (softer substrate and slower flowing nature of the site) downstream of the discharges. This was a similar deterioration in MCI score to that found by several previous surveys principally since the mid 1990's when habitat changed markedly at the downstream site. There was a much lower proportion of 'sensitive' taxa in the community at this site, although there was minimal change in the number or composition of the dominant taxa.

Larger differences in the MCI value between sites 1 and 2 have been illustrated by historical data since 1995. Before 1995 both of these sites contained similar numbers of taxa and MCI values. A change in the habitat occurred at site 2 in 1995 when the faster flowing stream with substrate more characteristic of a riffle altered to a slow flowing, deeper, and ponded area with silt and from time to time macrophyte beds dominating the substrate. Saltwater penetration as far upstream as the road culvert (Figure 1), under extremely high tide and very low stream flow conditions, may have influenced community composition at site 2 on occasions. These changes in habitat are more likely to be the cause of lower MCI values at this downstream site since 1995 and at the time of the current survey rather than stormwater discharges from the Omata Tank Farm area. [However, under the low flow conditions of some of the more recent summer surveys, this trend in MCI scores was reversed (e.g. in 2009, 2010, and 2011) and in spring 2012].

Summary

The Council's standard 'kick-sampling' and 'sweep-sampling' techniques were used at two established sites, to collect streambed macroinvertebrates from the Herekawe Stream. Samples were sorted and identified to provide the number of taxa (richness) and MCI and $SQMCI_s$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may be the more appropriate index if non-organic impacts are occurring.

Significant differences in either the MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring macroinvertebrate survey indicated that the discharge of treated stormwater and discharges from the Omata Tank Farm or Dow Agro Sciences sites had not had any detrimental effect on the macroinvertebrate communities of the stream. Stormwater discharges had occurred on several of occasions in the three months preceding this survey. A significant change in the MCI scores between the upstream 'control' site and site downstream of the discharges was more attributable to habitat differences between these sites. There were minimal changes in the number and composition of dominant taxa in

communities in a downstream direction (as reflected in a moderate decrease in $SQMCI_s$ scores) and there were no significant changes in terms of historical community compositions at the downstream site.

The macroinvertebrate communities of the stream were generally dominated by more 'tolerant' than 'sensitive' taxa. Taxonomic richnesses (numbers of taxa) were lower at the time of this spring survey particularly at the upstream site, compared to the previous summer survey, but MCI scores were similar or slightly higher.

MCI and $SQMCI_s$ scores indicated that the stream communities deteriorated from 'fair' (upstream) to 'poor' health at the slower flowing, weedier downstream site, where the health was below the typical condition recorded in similar small Taranaki coastal streams. However, the relatively recent community initiatives to create the Herekawe walkway and extensive adjacent riparian planting in the 1.5 km reach immediately upstream of Centennial Drive (Report: CF485) should maintain or contribute towards a gradual improvement in stream health over future years, and it is noted that this spring MCI score at the upstream site was within 6 units of the maximum (recorded recently in spring, 2012) for the 28 year period of monitoring. This site has recently shown a more positive improvement in MCI scores which has become a statistically significant temporal trend for the 18 year period between 1995 and 2013 (TRC, 2014).

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To Job Managers, David Olsen & James Kitto
From Freshwater Biologist, CR Fowles
Doc No 1320017
Report No CF603
Date 6 March 2014

Biomonitoring of the Herekawe Stream in relation to the Omata Tank Farm and other stormwater discharges, surveyed in February 2014

Introduction

This biological survey was the second of two scheduled for the Herekawe Stream in the 2013-2014 monitoring year to assess whether there had been any detrimental effects on the Herekawe Stream from stormwater discharges originating from STOS, DowAgro Sciences, Chevron, Origen Energy and NPDC. The previous survey (CF596) was performed in spring, 2013 as scheduled. The results from surveys performed since the 2001-02 monitoring year are discussed in reports referenced at the end of this report.

Methods

The standard '400 ml kick-net' and sweep-sampling' techniques were used to collect streambed macroinvertebrates at a 'control' site ('kick-net') and another downstream site (mainly 'kick-net' and limited 'sweep-sampling') in the Herekawe Stream (Table 1, Figure 1) on 4 February 2014. The 'sweep-sampling' technique is very similar to Protocol C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001). The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the same protocols.

Table 1 Biomonitoring sites in the Herekawe Stream in relation to stormwater discharges

Site No.	Site Code	GPS Reference	Location
1	HRK 000085	E1688283 N5674972	Upstream of Centennial Drive culvert and stormwater discharges
2	HRK 000094	E1688201 N5675010	Downstream of stormwater discharges, approx. 75 m above coast

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare) = less than 5 individuals;
C (common) = 5-19 individuals;
A (abundant) = estimated 20-99 individuals;
VA (very abundant) = estimated 100-499 individuals;
XA (extremely abundant) = estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly `sensitive' taxa were assigned the highest scores of 9 or 10, while the most `tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By

averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' taxa inhabit less polluted waterways.

A semi-quantitative MCI value ($SQMCI_s$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 & 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower, ranging from 0 to 10 $SQMCI_s$ units.

Figure 1 Biomonitoring sites in the Herekawe Stream

Results

At the time of this late morning survey, the water temperature in the Herekawe Stream ranged from 17.0˚ C to 17.3˚ C at the two sites. No stormwater discharges were occurring from the right bank or the left bank outfalls at the time of the survey. The channel at site 1 was narrow and constrained by gabion baskets on the banks and bed of the stream where the substrate was comprised mainly of sand, gravels, and cobbles with some silt, wood, and boulders. The stream at this site had a low, clear, uncoloured, swift flow and there were patchy periphyton mats and widespread filamentous algae on the bed. No macrophytes were recorded at the edges of the stream at this partially shaded site.

The substrate at site 2 was comprised mainly of silt, sand, and wood with a small proportion of gravel and boulders. The site can periodically be affected by salt water under extremely high tide and very low flow conditions. The clear, uncoloured, low flow at this site was slightly deeper and much slower moving than at site 1 upstream. There were patchy filamentous algae and thin periphyton mats noted on the harder substrate components of the bed during the survey. Aquatic macrophytes were recorded at intervals along the stream margins. The small area of macrophytes was sweep-sampled at site 2 and the woody

substrate and the limited area of cobble-boulder substrate were kick-sampled for macroinvertebrates at this site.

The survey was performed 27 days after a fresh in excess of 3 times median flow and 30 days after a fresh in excess of 7 times median flow in the catchment in accordance with Taranaki Regional Council biomonitoring fieldwork protocols.

Macroinvertebrates

A number of surveys have been performed previously at these two sites. Results of the current and past surveys are summarised in Table 2 and the results of the current survey presented in Table 3.

Table 2 Results of the current and previous surveys (since April 1986) performed at sites 1 and 2 in the Herekawe Stream in relation to the Omata Tank Farm and other stormwater discharges

Site	Number of previous surveys	Numbers of taxa			MCI values		
		Median	Range	Current Survey	Median	Range	Current Survey
1	56	18	11-23	23	86	68-99	90
2	56	15	9-22	16	72	54-96	64

Table 3 Macroinvertebrate fauna of the Herekawe Stream in relation to Omata Tank Farm and other stormwater discharges sampled on 4 February 2014

Taxa List	Site Number	MCI score	1	2
	Site Code		HRK000085	HRK000094
	Sample Number		FWB14038	FWB14039
NEMERTEA	Nemertea	3	R	-
NEMATODA	Nematoda	3	R	-
ANNELIDA (WORMS)	Oligochaeta	1	VA	VA
HIRUDINEA (LEECHES)	Hirudinea	3	-	R
MOLLUSCA	*Potamopyrgus*	4	XA	XA
	Sphaeriidae	3	-	R
CRUSTACEA	Copepoda	5	-	R
	Ostracoda	1	-	R
	Paracalliope	5	XA	VA
	Paratya	3	-	A
	Paranephrops	5	R	R
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	-
	Coloburiscus	7	C	-
	Deleatidium	8	R	-
PLECOPTERA (STONEFLIES)	*Megaleptoperla*	9	R	-
COLEOPTERA (BEETLES)	Elmidae	6	R	-
TRICHOPTERA (CADDISFLIES)	*Psilochorema*	6	R	-
	Oxyethira	2	C	C
	Triplectides	5	C	A
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	-
	Eriopterini	5	R	-
	Chironomus	1	-	VA
	Maoridiamesa	3	R	-
	Orthocladiinae	2	A	R
	Polypedilum	3	C	C
	Tanypodinae	5	R	C
	Empididae	3	R	R
	Austrosimulium	3	R	-
	Tanyderidae	4	R	-
		No of taxa	23	16
		MCI	90	64
		SQMCIs	4.2	3.4
		EPT (taxa)	6	1
		%EPT (taxa)	26	6
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa		

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 1 (upstream of stormwater discharges)

A moderate richness of 23 taxa was recorded at this site, which was five taxa more than the median and equal with the maximum numbers of taxa from previous surveys at this site (Table 2), and above richnesses typically found in the lower reaches of small coastal streams elsewhere in Taranaki (TRC, 1999 (updated 2013)).

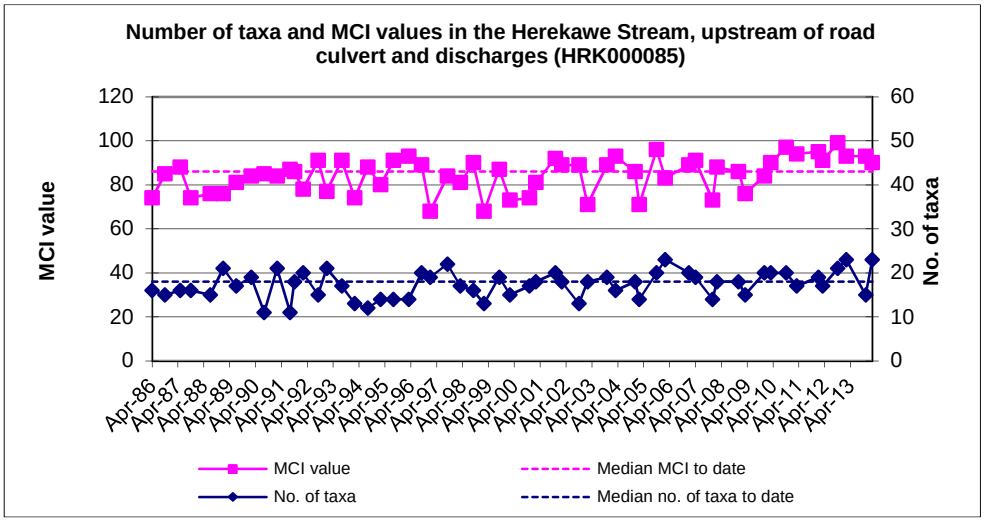

Figure 2 Number of taxa and MCI values in the Herekawe Stream upstream of the Centennial Road culvert since monitoring began in 1986

There were only four taxa dominant in the community (Table 3). These included one 'moderately sensitive' taxon [extremely abundant amphipod (*Paracalliope*)] and three 'tolerant' taxa [snail (*Potamopyrgus*), oligochaete worms, and orthoclad midges]. Most of these taxa are commonly found in habitats typical of the lower gradient reaches of small coastal streams, many of which are particularly abundant in association with periphyton and/or aquatic macrophytes. However, some of the more 'sensitive' taxa also present at this site (e.g. mayflies, stonefly, beetles, and some caddisflies) are associated with swifter flowing, harder substrates, and also amongst aquatic vegetation (e.g. amphipods, craneflies, and caddisfly).

Characteristic macroinvertebrate taxa in the communities at this site prior to this summer 2014 survey are listed in Table 4.

Table 4 Characteristic taxa (abundant, very abundant, extremely abundant) recorded in the Herekawe Stream at Centennial Drive between April 1986 and November 2013 [56 surveys], and by the summer 2014 survey

Taxa List		MCI Score	Total abundances	% of Surveys	Survey Summer 2014
ANNELIDA	Oligochaeta	1	33	59	VA
MOLLUSCA	*Potamopyrgus*	4	56	100	XA
CRUSTACEA	Ostracoda	1	2	4	
	Paracalliope	5	35	63	XA
EPHEMEROPTERA	*Austroclima*	7	4	7	
	Coloburiscus	7	11	20	
PLECOPTERA	*Acroperla*	5	1	2	
TRICHOPTERA	*Aoteapsyche*	4	1	2	
	Oxyethira	2	12	21	
	Triplectides	5	12	21	
DIPTERA	*Aphrophila*	5	4	7	
	Orthocladiinae	2	25	45	A
	Polypedilum	3	2	4	
	Austrosimulium	3	17	30	

Prior to the current survey, 14 taxa had characterised the community at this site on occasions. These have comprised six 'moderately sensitive' and eight 'tolerant' taxa i.e. an absence of 'highly sensitive' taxa and a relatively high proportion of 'tolerant' taxa as would be expected in the lower reaches of a small coastal stream. Predominant taxa have included only the one 'moderately sensitive' taxon [amphipod (*Paracalliope*)] and two 'tolerant' taxa [oligochaete worms and snail (*Potamopyrgus*)]. This snail taxon has characterised this site's community on every occasion.

Four of the historically characteristic taxa were dominant in the summer 2014 community and comprised all three of the predominant taxa (above) together with another one 'tolerant' taxon which previously had been characteristic of this site's communities on 45% of occasions (Table 4).The three taxa which were recorded as very or extremely abundant in summer had characterised this site's communities on 59% to 100% of past surveys.

The MCI score (90 units) reflected the presence of a significant proportion of 'sensitive' taxa (52% of richness). The score was four units above the median of scores, but nine units lower than the maximum, found by previous surveys (Table 2, Figure 2). It was also a significant (Stark, 1998) 12 units higher than the median score found by 188 previous surveys of sites below 25 masl in similar lowland coastal streams (TRC, 1999 (updated, 2013)). The moderate $SQMCI_s$ value of 4.2 units (Table 3) reflected the numerical dominance of the 'tolerant' snail and 'sensitive' amphipod in particular at this site. The presence of a relatively high proportion of 'sensitive' taxa indicated reasonably good physicochemical water quality conditions preceding this survey.

Site 2 (downstream of stormwater discharges)

A slightly above median richness of 16 taxa was found at this slower flowing site although it was noticeably more sandier and less of a cobble-boulder substrate habitat than usual. This richness was seven taxa fewer than recorded upstream (Table 2, Figure 3) although it should be noted that seven of these taxa (44% of richness) were recorded as rarities (less than 5 individuals per taxon). Although nine of these taxa were also present at the upstream site 1 and the two sites shared three of the dominant taxa (with two ('tolerant') and one ('moderately sensitive') other taxa characteristic at this site (2)), the two sites had only 34% of taxa in common of the total taxa (29) found over this short reach. Neither of the two 'highly sensitive' taxa present upstream (although only as rarities) was found at this site.

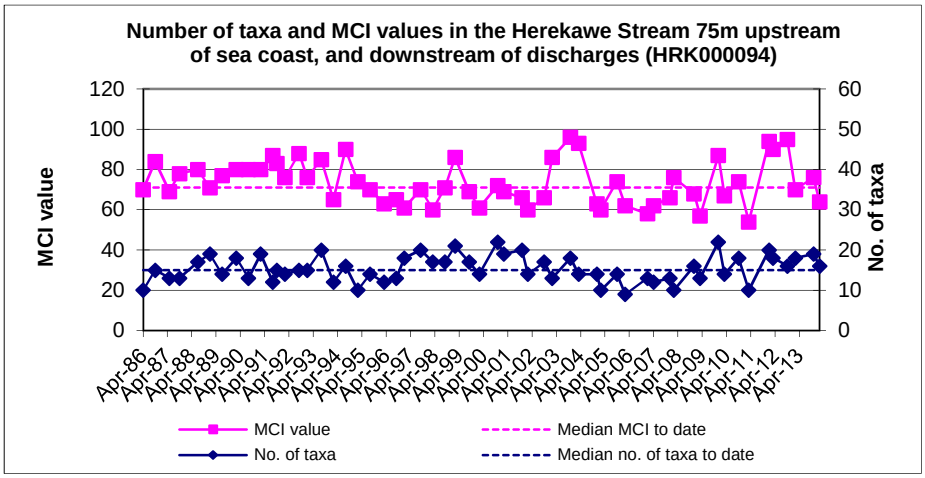

Figure 3 Number of taxa and MCI values in the Herekawe Stream downstream of industrial stormwater discharges since monitoring began in 1986

There was an increase (of 21%) in the proportion of 'tolerant' taxa in this community with 69% of the total taxa number. This was due mainly to the loss of six 'sensitive' taxa present (although mainly as rarities) at the upstream site. Taxa characteristic of this community included the one 'moderately sensitive' taxon and two 'tolerant' taxa dominant at the upstream site together with another one 'moderately sensitive' taxon [vegetation-cased caddisfly (*Triplectides*)] and two 'tolerant' taxa [very abundant midge *(Chironomus*); and freshwater shrimp (*Paratya*)].

Characteristic macroinvertebrate taxa in the communities at this site prior to this summer 2014 survey are listed in Table 5.

Table 5 Characteristic taxa (abundant, very abundant, extremely abundant) recorded in the Herekawe Stream downstream of Centennial Drive between April 1986 and November 2013 [56 surveys], and by the summer 2014 survey

Taxa List		MCI Score	Total abundances	% of Surveys	Survey
					Summer 2014
NEMERTEA	Nemertea	3	1	2	
ANNELIDA	Oligochaeta	1	31	55	VA
MOLLUSCA	*Physa*	3	1	2	
	Potamopyrgus	4	52	93	XA
	Sphaeriidae	3	2	4	
CRUSTACEA	Ostracoda	1	10	18	
	Paracalliope	5	27	48	VA
	Paratya	3	1	2	A
EPHEMEROPTERA	*Coloburiscus*	7	5	9	
ODONATA	*Xanthocnemis*	4	1	2	
HEMIPTERA	*Sigara*	3	3	5	
TRICHOPTERA	*Hydrobiosis*	5	2	4	
	Oxyethira	2	15	27	
	Triplectides	5	7	13	A
DIPTERA	*Aphrophila*	5	4	7	
	Chironomus	1	11	20	VA
	Maoridiamesa	3	1	2	
	Orthocladiinae	2	35	63	
	Polypedilum	3	4	7	
	Empididae	3	1	2	
	Austrosimulium	3	8	14	
ACARINA	Acarina	5	2	4	

Prior to the current survey, 22 taxa had characterised the community at this site on occasions. These have comprised six 'moderately sensitive' and sixteen 'tolerant' taxa i.e. an absence of 'highly sensitive' taxa and a very high proportion of 'tolerant' taxa as would be expected in the lower reaches of a small coastal stream, particularly with a softer, more sedimented substrate. Predominant taxa have included only the three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and orthoclad midges].

Six of the historically characteristic taxa were dominant in the current survey community and comprised two of the predominant taxa (above) together with another two 'tolerant' and two 'moderately sensitive' taxa which previously had been characteristic of this site's communities (Table 5). The four taxa which were recorded as very or extremely abundant in summer had characterised this site's communities on 48% to 93 % of past surveys.

The MCI value of 64 units was an insignificant eight units lower than the median of previous values (Table 2) but a significant (Stark 1998) 26 units less than the score recorded at site 1. This was due to the much smaller proportion of 'sensitive' taxa in the community (particularly the absence of all mayflies, stoneflies, and beetles which are more commonly associated with harder substrates and swifter flow conditions), as a result of the more ponded and slower flow of water and the higher proportion of fine-sedimented substrate at this site. This reflected the very different habitat to that at the upstream 'control' site 1, rather than the effects of stormwater discharges. Sand inundation and saltwater penetration have occurred at this site in the past as a result of very high tides coincident with low stream flow conditions. However, many of the differences between the communities at sites 1 and 2 related to the presence/absence of taxa rarities (less than five individuals per taxon), rather than significant differences in individual taxon abundances [Note: removing these rarities from the two communities' compositions reduced the downstream decrease in MCI score to 18 units]. The two significant downstream differences in numerically increased abundances of individual 'tolerant' taxa and decreased abundances of individual 'moderately sensitive' taxa recorded between sites, resulted in a decrease of only 0.8 unit in $SQMCI_s$ value at the downstream site 2, despite the similarity in numerically most dominant (characteristic) taxa between sites.

Discussion

The MCI values recorded since monitoring of these sites began in 1986 are illustrated in Figure 4.

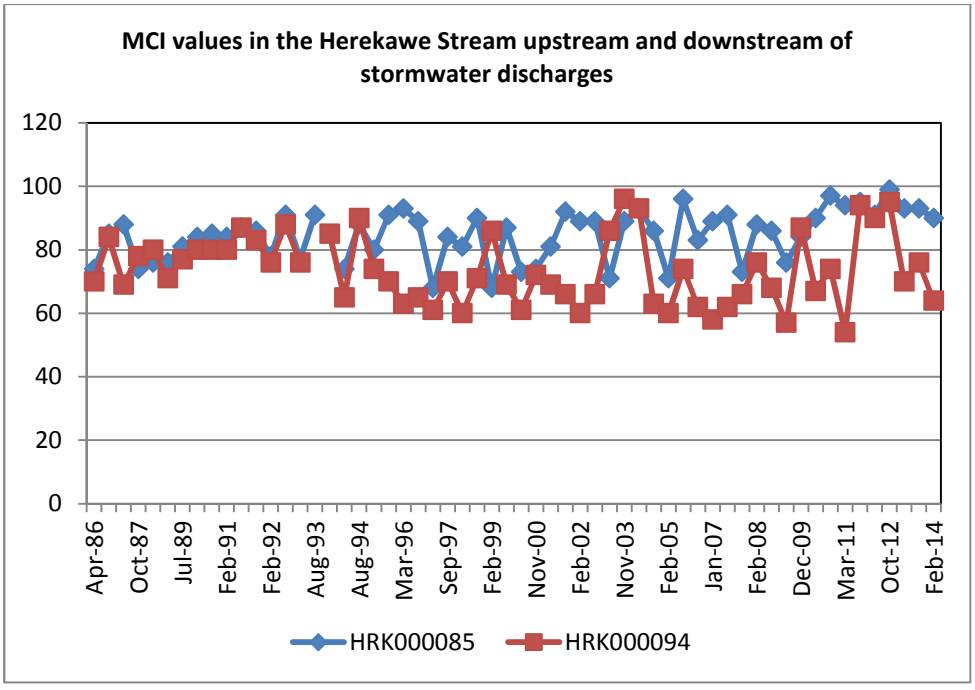

Figure 4 MCI values at sites upstream (site 1) and downstream (Site 2) of the stormwater discharges from the Omata tank farm area since monitoring began in 1986

There was a distinct change in the MCI values in 1995 when values at site 2 decreased markedly in comparison with those recorded at site 1, upstream of the culvert. Between March and September 1995 the habitat in the Herekawe Stream at site 2 changed significantly. Prior to the September 1995 survey, the stream at this site had a more riffle-like habitat. Although the water was slower flowing (compared to site 1), the stream had been shallower and contained a greater proportion of cobbles. A natural dam of debris and rocks

appeared downstream between these two surveys, causing the stream to pond around site 2, becoming deeper and very slow flowing. The substrate became more dominated by silt and macrophyte beds developed. This habitat generally supports fewer 'sensitive' taxa and therefore MCI values generally reflected a poorer community. The very low flow conditions surveyed at the time of post 2002 summer surveys however, indicated more similar conditions at site 2 to pre-1995 habitat, particularly the absence of aquatic macrophytes, reversing recent trends in MCI scores. Ponding at site 2 became more apparent again during many of the last fourteen (spring and summer) surveys, and at the time of the current survey, with the MCI value reflecting such a habitat.

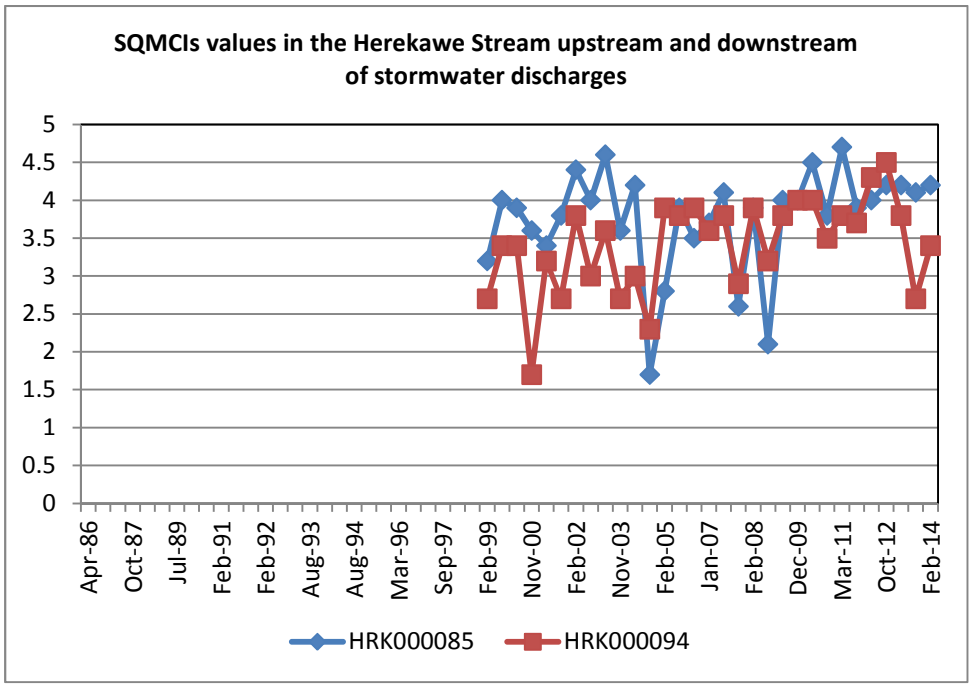

Figure 5 $SQMCI_s$ values for surveys conducted in the Herekawe Stream since 1999 (when $SQMCI_s$ was first implemented)

The $SQMCI_s$ values over the surveys conducted since 1999 suggest that while there have been differences in community composition, it is likely that the dominant taxa on many occasions were similar between sites, and $SQMCI_s$ values at both sites have followed a similar pattern (Figure 5). The exception has been certain post-2004 surveys when the $SQMCI_s$ highlighted some significant differences in community composition at site 2 in terms of increased abundances within several individual 'sensitive' taxa in a downstream direction. Since this date, with two exceptions (spring 2008, spring 2010, spring 2013, and on this occasion), the two sites have had relatively similar $SQMCI_s$ values. This had been the case at the time of the four surveys immediately prior to spring 2013, in particular.

It is unlikely that any differences in macroinvertebrate communities between site 1 and site 2 in recent years have been due to stormwater discharges from the Omata Tank Farm, NPDC or DowAgro Sciences. There have been no records of major changes to community compositions, i.e. significant loss of characteristic taxa, at the site (2) below these discharges, indicative of minimal impacts of stormwater discharges.

Conclusions

This summer 2014 survey of the Herekawe Stream performed under low flow conditions indicated that the streambed communities had not been detrimentally affected by discharges of stormwater to the stream from the Omata Tank Farm, New Plymouth District Council, or other industrial sites. The macroinvertebrate communities at the sites both upstream and downstream of the discharges contained quite different proportions of 'sensitive' macroinvertebrate taxa which were most probably related to variations in stream habitat with a lower proportion present at the slower flowing, more sedimented downstream site, but the two sites had similar numerically most dominant (characteristic) taxa.

The numbers of taxa and MCI scores were insignificantly different and mainly higher than the respective medians of results found by previous surveys at each site. The MCI value downstream was 26 units lower than that recorded upstream at the time of this summer survey due to marked physical habitat differences (softer substrate and slower flowing nature of the site) downstream of the discharges. This was a similar deterioration in MCI score to that found by several previous surveys principally since the mid 1990's when habitat changed markedly at the downstream site. There was a much lower proportion of 'sensitive' taxa in the community at this site, and there was an increase in the number of dominant 'tolerant' taxa and some changes in the composition of the dominant taxa.

Larger differences in the MCI value between sites 1 and 2 have been illustrated by historical data since 1995. Before 1995 both of these sites contained similar numbers of taxa and MCI values. A change in the habitat occurred at site 2 in 1995 when the faster flowing stream with substrate more characteristic of a riffle altered to a slow flowing, deeper, and ponded area with silt and from time to time macrophyte beds dominating the substrate. Saltwater penetration as far upstream as the road culvert (Figure 1), under extremely high tide and very low stream flow conditions, may have influenced community composition at site 2 on occasions. These changes in habitat are more likely to be the cause of lower MCI values at this downstream site since 1995 and at the time of the current survey rather than stormwater discharges from the Omata Tank Farm area. [However, under the low flow conditions of some of the more recent summer surveys, this trend in MCI scores was reversed (e.g. in 2009, 2010, and 2011) and in spring 2012].

Summary

The Council's standard 'kick-sampling' and 'sweep-sampling' techniques were used at two established sites, to collect streambed macroinvertebrates from the Herekawe Stream. Samples were sorted and identified to provide the number of taxa (richness) and MCI and $SQMCI_s$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may be the more appropriate index if non-organic impacts are occurring.

Significant differences in either the MCI or $SQMCI_s$ between sites may indicate the degree of adverse effects (if any) of the discharges being monitored.

This summer macroinvertebrate survey indicated that the discharge of treated stormwater and discharges from the Omata Tank Farm or Dow Agro Sciences sites had not had any detrimental effect on the macroinvertebrate communities of the stream. Stormwater discharges had occurred on several occasions in the three months since the preceding spring survey. A significant change in the MCI scores between the upstream 'control' site and site downstream of the discharges was more attributable to habitat differences between these sites. There were several changes in the number and composition of dominant taxa in communities in a downstream direction (as reflected in a moderate decrease in $SQMCI_s$ scores) but there were no significant changes in terms of historical community compositions at the downstream site.

The macroinvertebrate communities of the stream were generally dominated by more 'tolerant' than 'sensitive' taxa, particularly at the downstream site. Taxonomic richnesses (numbers of taxa) were higher at the time of this summer survey at the upstream site but lower at the downstream site, compared to the previous spring survey, while MCI scores were lower.

MCI and $SQMCI_s$ scores indicated that the stream communities deteriorated from 'fair' (upstream) to 'poor' health at the slower flowing, weedier downstream site, where the health was below the typical condition recorded in similar small Taranaki coastal streams. However, the relatively recent community initiatives to create the Herekawe walkway and extensive adjacent riparian planting in the 1.5 km reach immediately upstream of Centennial Drive (Report: CF485) should maintain or contribute towards a gradual improvement in stream health over future years, and it is noted that this summer MCI score at the upstream site was 4 units above the median for the 28-year period of monitoring. This site has recently shown a more positive improvement in MCI scores which has become a statistically significant temporal trend for the 18-year period between 1995 and 2013 (TRC, 2014).

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Appendix V

Dow AgroSciences Annual Air Discharge Report 2013-2014

Dow AgroSciences

Air Discharge Report

1 July 2013 – 30 June 2014

Consent No. 4020-3

15 July 2014

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Introduction

Dow AgroSciences (NZ) Ltd formulates agricultural chemicals at the New Plymouth site. All sources of air emissions from the Dow AgroSciences site are permitted by Air Discharge Permit (Consent 4020-3) granted and monitored by the Taranaki Regional Council ("TRC").

This report details the results obtained from sampling and analysis of air discharged from the process vents and the high temperature incinerator stack during the 2013-14 year.

Changes Made During the Year

Process Changes

During the 2013-14 year, the following process changes were made.

Two new products were introduced to the site:

- eNtrench™ Nitrogen Stabliser which contains Nitrapyrin which falls under the HSNO Fertiliser Group Standard. This product is imported and repacked into smaller containers on site for the Australian market.
- Cobalt™ Advanced Insecticide which contains Lambda-cyhalothrin and Chlorpyrifos. This product is imported as a packed finished product and is stored only on site for distribution throughout New Zealand.

Two new products were manufactured in the Herbicides Plant using existing actives:

- FallowBoss TORDON™ Herbicide
- TORDON™ RegrowthMaster Herbicide

Permit Changes

No changes were made to the air discharge permit (Consent 4020-3) during the 2013-14 year.

Monitoring Changes

All required monitoring was completed during the year, with no changes made to the monitoring plan.

Process Vents

Insecticides Plant (Vent No. 03-5)

Permit Conditions

Emission Component: Chlorpyrifos

Performance Criteria:

The discharge shall not increase the background levels *"by more than 1/30th of the relevant Occupational Threshold Value - Time Weighted Average for any eight hour period of measurement, or by more than the short term Exposure Limit for any fifteen minute period of measurement, or, if no short term exposure limit is set, by more than three times the Time Weighted Average for any fifteen minute period of measurement."*

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Maximum Emissions Guideline

Chlorpyrifos: The guideline used to evaluate emissions from the Insecticides Plant to comply with the discharge consent for chlorpyrifos is a maximum emission of 3.333 mg/m^3.

This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be $1/30^{th}$ of TWA 0.2 mg/m^3 chlorpyrifos *(Source: Department of labour, Occupational Safety & Health Services - NZ Workplace Exposure Standards effective from 2002)* multiplied by the dilution factor of 500, that is, 3.333 mg/m^3 chlorpyrifos.

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Insecticides Plant, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to Appendix 1 *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Insecticides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.*

The formulating and packing activities carried out during the sampling period were typical for the Insecticides Plant.

Plant Operating Conditions

Chlorpyrifos is an organophosphate active ingredient used in liquid insecticide formulations. Chlorpyrifos is obtained in a solid form and melted in a hot water bath before use. Chlorpyrifos is pumped into a vessel containing solvent(s) and emulsifiers. The product is mixed, transferred to a bulk tank and packed.

Emissions may occur during the melting and pump-out of the active ingredient and during the packing of finished product.

Local exhaust ventilation removes vapour from the hot water melt bath, drum pump-out station, the top of the blending vessel, the bulk tank and the pack-off point. The extracted air is passed through a wet scrubber (BS1400) containing alkaline sodium hypochlorite solution before being vented to atmosphere.

The process technician monitors the condition of the scrubber solution. Results are logged and are available for inspection during visits by officers of the Taranaki Regional Council.

Air Discharge Monitoring Results

For details of the Insecticide Plant air discharge monitoring results refer to Appendix 1: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Insecticides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.*

i. Three (3) samples were collected for chlorpyrifos from the Insecticides Plant vent during the batch formulating and packing of chlorpyrifos based products, over the periods 16th to 18th September 2013.

ii. The maximum concentration of chlorpyrifos in the air discharged from the vent ranged from being less than 0.0016mg/m^3 to less than 0.0018 mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

iii. The results of the chlorpyrifos analysis indicated concentrations less than the limit of detection for the sampling method.

Conclusion

Under normal operating conditions, the maximum emission of chlorpyrifos from the Insecticides Plant vent (#03-5) was less than 0.0018 mg/m^3, which is below the discharge consent maximum emission of 3.333 mg/m^3 for chlorpyrifos.

These results indicate the performance of the Insecticides Plant meets the conditions of the air discharge permit.

Spinosad Plant (Vent No. BB600)

Permit Conditions

Emission Component: Spinosad / Spinetoram

Performance Criteria:

The discharge shall not increase the background levels *"by more than 1/30th of the relevant Occupational Threshold Value - Time Weighted Average for any eight hour period of measurement, or by more than the short term Exposure Limit for any fifteen minute period of measurement, or, if no short term exposure limit is set, by more than three times the Time Weighted Average for any fifteen minute period of measurement."*

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Maximum Emissions Guideline

Spinosad / Spinetoram: The guideline used to evaluate emissions from the Spinosad Plant to comply with the discharge consent for spinosad / spinetoram is a maximum emission of 5.0 mg/m^3.

This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be $1/30^{th}$ of TWA 0.3 mg/m^3 spinosad / spinetoram. While there is no New Zealand Workplace Exposure Standard for spinetoram there is a Dow Industrial Hygiene Guideline of 0.3 mg/m^3 TWA for spinosad *(Source: Spinosad Technical, Dow AgroSciences Safety Data Sheet)* multiplied by the dilution factor of 500, that is, 5.0 mg/m^3 spinosad. There is currently no defined TWA for spinetoram, but because it is from the same product family as spinosad and is similar in properties, the same maximum emission guideline has been used.

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Spinosad Plant, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to Appendix 2: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Spinosad Plant, February 2014, Source Testing New Zealand Limited, issued March 2014.*

The formulating and packing activities carried out during the sampling period were typical for the Spinosad Plant.

Plant Operating Conditions

Spinosad and spinetoram are naturally produced metabolites from living organisms and are the active ingredients used in several liquid insecticide formulations. Spinosad and spinetoram are obtained in a solid form and loaded into a vessel containing solvent(s) and emulsifiers. The product is mixed and packed.

The process ventilation system extracts air from the loading hood and blender area. The process air passes through a bag filter, pre-filter and absolute filter before discharge.

The process technician monitors the condition of, and the pressure across, the filters. Results are logged and are available for inspection during visits by officers of the Taranaki Regional Council.

Air Discharge Monitoring Results

For details of the Spinosad Plant air discharge monitoring results refer to Appendix 2: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Spinosad Plant, February 2014, Source Testing New Zealand Limited, issued March 2014.*

i. Three (3) samples were collected, during the loading of the spinetoram technical (solid) and mixing of the finished product, from the Spinosad Plant vent over the period of 11th to 13th February 2014.

ii. The maximum concentration of spinetoram in the air discharged from the vent ranged from less than 0.004 mg/m^3 to less than 0.005mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

iii. The results of the spinetoram analysis indicated concentrations less than the limit of detection for the sampling method.

Conclusion

Under normal operating conditions, the maximum emission of spinetoram from the Spinosad Plant vent (#BB600) was less than 0.005 mg/m^3, which is below the discharge consent maximum emission of 5.0 mg/m^3 for spinosad / spinetoram.

These results indicate the performance of the Spinosad Plant meets the conditions of the air discharge permit.

Granulated Herbicides Plant (Vent No. 03-14)

Permit Conditions

Emission Component: Picloram

Performance Criteria:

The discharge shall not increase the background levels *"by more than 1/30th of the relevant Occupational Threshold Value - Time Weighted Average for any eight hour period of measurement, or by more than the short term Exposure Limit for any fifteen minute period of measurement, or, if no short term exposure limit is set, by more than three times the Time Weighted Average for any fifteen minute period of measurement."*

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Maximum Emissions Guideline

Picloram: The guideline used to evaluate emissions from the Granulated Herbicides Plant to comply with the discharge consent for picloram is a maximum emission of 167 mg/m^3.

This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be 1/30th of TWA 10 mg/m^3 picloram *(Source: Department of labour, Occupational Safety & Health Services - NZ Workplace Exposure Standards effective from 2002)* multiplied by the dilution factor of 500, that is, 167 mg/m^3 picloram.

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Granulated Herbicides Plant, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to Appendix 3: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Granulated Herbicides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.*

The formulating and packing activities carried out during the sampling period were typical for the Granulated Herbicides Plant.

Plant Operating Conditions

Picloram is a herbicide active ingredient used in a granule formulation. Picloram is obtained in a solid form and dissolved in an amine solution before mixed with and dried onto inert granules.

The process ventilation system extracts air from the loading hood, blender and packing area. The process air passes through a bag filter and absolute filter before discharge. Product caught on the filters is returned to the following batches.

The process technician monitors the condition of, and the pressure across, the filters. Results are logged and are available for inspection during visits by officers of the Taranaki Regional Council.

Air Discharge Monitoring Results

For details of the Granulated Herbicides Plant air discharge monitoring results refer to Appendix 3: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Granulated Herbicides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.*

i. Three (3) samples were collected for picloram from the Granulated Herbicides Plant vent during the batch formulating and packaging over the period 16th to 18th September 2013.

ii. The maximum concentration of picloram in the air discharged from the vent ranged from less than 0.00007 mg/m^3 to less than 0.00010 mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

iii. The results of the picloram analysis indicated concentrations less than the limit of detection for the sampling method.

Conclusion

Under normal operating conditions, the maximum emission of picloram from the Granulated Herbicides Plant vent (#03-14) was less than 0.00010 mg/m^3, which is below the discharge consent maximum emission of 167 mg/m^3 for picloram.

These results indicate the performance of the Granulated Herbicides Plant meets the conditions of the air discharge permit.

Herbicides Plant (Vent No. 03-8)

Permit Conditions

Emission Component: 2,4-D (acid and ester)

Performance Criteria:

The discharge shall not increase the background levels *"by more than 1/30th of the relevant Occupational Threshold Value - Time Weighted Average for any eight hour period of measurement, or by more than the short term Exposure Limit for any fifteen minute period of measurement, or, if no short term exposure limit is set, by more than three times the Time Weighted Average for any fifteen minute period of measurement."*

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Maximum Emissions Guideline

The guideline used to evaluate emissions from the Herbicides Plant to comply with the discharge consent for 2,4-D is a maximum emission of 167 mg/m^3.

This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be $1/30^{th}$ of TWA 10 mg/m^3 2,4-D *(Source: Department of labour, Occupational Safety & Health Services - NZ Workplace Exposure Standards effective from 2002)* multiplied by the dilution factor of 500, that is, 167 mg/m^3 2,4-D.

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Herbicides Plant, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to Appendix 4: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Herbicides Plant, February 2014, Source Testing New Zealand Limited, issued April 2014.*

The packing activities carried out during the sampling period were typical for the Herbicides plant.

Plant Operating Conditions

2,4-D ester as the formulated product is a liquid and is pumped from a bulk tank and packed.

The process ventilation system extracts air from the packing area. The process air passes through pre-filters followed by activated carbon filters before discharge.

The process technician monitors the condition of the pre-filters and activated carbon filters. Results are logged and are available for inspection during visits by officers of the Taranaki Regional Council.

Air Discharge Monitoring Results

While only 2,4-D ethyl hexyl ester was being used in the Herbicides Plant when the emissions monitoring was carried out, there is potential for the ester to hydrolise to the acid in the process ventilation system. Hence both 2,4-D acid and 2,4-D ethyl hexyl ester discharges were monitored and reported as a Total 2,4-D discharged.

For details of the Herbicides Plant air discharge monitoring results refer to Appendix 4: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Herbicides Plant, February 2014, Source Testing New Zealand Limited, issued April 2014.*

i. A total of three (3) samples were collected on the 11th to 13th February 2014, during the packing of the finished 2,4-D ethyl hexyl ester product.

ii. The quality control samples analysed at the laboratory did not produce the expected results. It is believed one of the reagents converted the 2,4-D ethyl hexyl ester back to 2,4-D acid during the analytical procedure.

iii The maximum concentration of Total 2,4-D (acid and ester) in the air discharged from the vent ranged from 0.00003 mg/m^3 to 0.00015 mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

Conclusion

Under normal operating conditions, the maximum emission of Total 2,4-D (acid and ester) from the Herbicides Plant vent (#03-8) was 0.00015 mg/m^3, which is below the discharge consent maximum emission of 167 mg/m^3 for 2,4-D.

These results indicate the performance of the Herbicides Plant meets the conditions of the air discharge permit.

Commodity Herbicides Plant (Vent No. 48-1)

Permit Conditions

Emission Component(s): 2,4-D (acid & ester) and 2-ethyl hexanol

Performance Criteria:

The discharge shall not increase the background levels *"by more than 1/30th of the relevant Occupational Threshold Value - Time Weighted Average for any eight hour period of measurement, or by more than the short term Exposure Limit for any fifteen minute period of measurement, or, if no short term exposure limit is set, by more than three times the Time Weighted Average for any fifteen minute period of measurement."*

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Maximum Emissions Guideline:

a. **2,4-D:** The guideline used to evaluate emissions from the Commodity Herbicides Plant to comply with the discharge consent for 2,4-D is a maximum emission of 167 mg/m^3.

   This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be $1/30^{th}$ of TWA 10 mg/m^3 2,4-D *(Source: Department of labour, Occupational Safety & Health Services - NZ Workplace Exposure Standards effective from 2002)* multiplied by the dilution factor of 500, that is, 167 mg/m^3 2,4-D.

b. **2-ethyl hexanol:** As there is no New Zealand Workplace Exposure Standard for 2-ethyl hexanol, the guideline used to evaluate emissions from the Commodity Herbicides Plant is based on n-Butyl alcohol (butanol) with a maximum emission of 2500 mg/m^3.

   This is based on the assumption that a dilution of 500 times from the vent occurs at the maximum ground-level concentration at the site boundary. Therefore, the maximum concentration for the vent would be $1/30^{th}$ of TWA 150 mg/m^3 n-Butyl alcohol (butanol) *(Source: Department of labour, Occupational Safety & Health Services - NZ Workplace Exposure Standards effective from 2002)* multiplied by the dilution factor of 500, that is, 2500 mg/m^3 2-ethyl hexanol.

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Commodity Herbicides Plant, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to Appendix 5: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Commodity Herbicides Plant, May 2014, Source Testing New Zealand Limited, issued June 2014.*

The production and formulating activities carried out during the sampling period were typical for the Commodity Herbicides Plant.

Plant Operating Conditions

2,4-D acid is esterified with an alcohol (2-ethyl hexanol or iso-butanol) into 2,4-D ester, which is an active ingredient used in various herbicide formulations. The 2,4-D ester is mixed with solvent(s) and emulsifiers to formulate the finished 2,4-D ester. It is tested and transferred to a bulk tank to be packed in the Herbicides Plant at a later date.

The process ventilation system extracts air from the loading hood and process areas. The process air passes through a caustic scrubber and activated carbon filter before discharge.

The process technician monitors the condition of the caustic scrubber and the activated carbon filters. Results are logged and are available for inspection during visits by officers of the Taranaki Regional Council.

Air Discharge Monitoring Results

For details of the Commodity Herbicides Plant air discharge monitoring results refer to Appendix 5: *Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Commodity Herbicides Plant, May 2014, Source Testing New Zealand Limited, issued June 2014.*

a. 2,4-D (acid & ester)

i. Three (3) samples were collected for 2,4-D acid and 2,4-D ethyl hexyl ester from the Commodity Herbicides Plant vent over the period 27th to 28th May 2014.

ii. The maximum concentration in the air discharged from the vent for total 2,4-D (acid and ester) ranged from 0.0004 mg/m^3 to 0.0009 mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

b. 2-Ethyl-hexanol

i. Three (3) samples were collected for 2-ethyl hexanol from the Commodity Herbicides Plant vent over the period 27th to 28th May 2014.

ii. The maximum concentration of 2-ethyl hexanol in the air discharged from the vent was 0.43 mg/m^3 (corrected to 0°C, 101.3 kPa dry gas basis).

Conclusion

Under normal operating conditions, the maximum emission of Total 2,4-D (acid and ester) from the Commodity Herbicides Plant vent (#48-1) was 0.0009 mg/m^3, which is below the discharge consent maximum emission of 167 mg/m^3 for 2,4-D.

Under normal operating conditions, the maximum emission of 2-ethyl hexanol from the Commodity Herbicides Plant vent (#48-1) was 0.43 mg/m^3, which is below the discharge consent maximum of 2500 mg/m^3 used for 2-ethyl hexanol.

These results indicate the performance of the Commodity Herbicides Plant meets the conditions of the air discharge permit.

Incinerator

High Temperature Incinerator (Vent No. 64-1)

Permit Conditions

Emission Component: PCDDs & PCDFs, and Hydrogen Chloride

Performance Criteria:

Consent Conditions 10, 11, 12, 15, 16, 17 & 18:

Cond. 10: *The opacity of discharges from the incinerator stack shall not exceed 20%.*

Cond. 11: *Discharge of hydrogen chloride shall not exceed 1.5 kg/hr in aggregate.*

Cond. 12: *The discharge of polychlorinated dibenzodioxins and polychlorinated dibenzofurans from any incinerator stack shall not exceed an average concentration of 0.1 ng/m^3 [adjusted to 0 degrees Celsius, dry gas basis, 101.3 kPa pressure, and 11% oxygen], nor a mass discharge rate of 5.0 µg/hour, when expressed as the equivalent amount of 2,3,7,8 tetrachloro dibenzo-p-dioxin according to NATO toxic equivalent factors. The average concentration shall be determined over not less than 3 sampling runs within any 12-month period, each of which shall be taken while the incinerator is fed on different waste types unless specifically approved otherwise by the Chief Executive, Taranaki Regional Council.*

Cond. 15: *The oxygen concentration within the secondary combustion chamber of the solids incinerator shall be maintained between 6% and 9% [by volume] as far as is practicable, and shall not be less than 4.5% [by volume] for more than 60 seconds at any time during the incineration of material during any 24-hour period.*

Cond. 16: *The temperature in the secondary combustion chamber shall not be less than 1100 degress Celsius, any time during the incineration of material.*

Cond. 17: *The temperature at the exit from the liquids incinerator chamber shall be not less than 1000 degrees Celsius and the total proportion of halogens within the feedstocks shall not exceed 0.8%.*

Cond. 18: *The temperature of the exhaust gases from the solids incinerator stack shall not be less than 700°C immediately prior to discharge.*

Sampling Plan & Methods

An Air Quality Scientist with STNZ (Source Testing New Zealand Limited, Wellington) was commissioned by Dow AgroSciences (NZ) Ltd to undertake air discharge monitoring of the Incinerator, coordinate the analyses of the samples with an accredited laboratory and prepare a report.

For details of the sampling methodology and quality control refer to:

Appendix 6: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, October 2013 & February 2014, Source Testing New Zealand Limited, issued April 2014.

Appendix 7: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, October 2013, Source Testing New Zealand Limited, issued April 2014.

Appendix 8: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

Appendix 9: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

The waste incinerated during the sampling programmes was typical of waste disposed of through the incinerator.

Incinerator Operating Conditions

The high temperature incinerator typically operates up to seven days/week and up to 24 hours/day, for the majority of the year. It is used to burn solid and liquid waste from the formulating and packaging plants. This waste includes all chemically contaminated materials including: packaging, contaminated drums, used protective clothing and production plant wastes. The liquids nozzle allows the burning of liquid wastes such as wash water.

Every day the high temperature incinerator is operated a log sheet is completed during the day detailing various operating parameters and including the times at which waste was placed in the high temperature incinerator, the quantity and a description of the waste. The primary and secondary chamber temperatures, and stack gas oxygen and carbon monoxide concentrations are continuously monitored and recorded on a chart which is attached to each log sheet at the completion of the "burn". Process messages and alarms are printed and this is attached to each log sheet. This information is retained for future reference and available for inspection during visits by officers of the Taranaki Regional Council. All information relating to the operating conditions during the sampling runs is also retained.

Air Discharge Monitoring Results

STNZ carried out annual compliance monitoring of the high temperature incinerator using the modified USEPA Method 23 sampling train incorporating a water-cooled probe.

For details of the incinerator air discharge monitoring results refer to:

Appendix 6: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, October 2013 & February 2014, Source Testing New Zealand Limited, issued April 2014.

Appendix 7: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, October 2013, Source Testing New Zealand Limited, issued April 2014.

Appendix 8: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

Appendix 9: Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

a. Dioxins & Furans (PCDD/PCDF)

i. Over the period 10th October 2013, 25th to 27th February 2014 and 4th to 6th June 2014, the incinerator was monitored for discharges of dioxins and furans (PCDD/PCDF).

ii. Four-hour samples were collected from each of the following three streams: crushed drums, liquid waste, and general waste.

iii. The concentrations of PCDD/PCDF for all three waste streams were low, the overall maximum concentration being 0.0587 ng/m^3 I-TEQ (corrected for 0°C, 101.3 kPa, 11 % O_2, dry gas basis).

TABLE 1: PCDD/PCDF Maximum Concentration & Emission Rate[3]

Sampling Date	Waste Type	Laboratory Blank PCDD/PCDF Max. Concentration (ng/m^3)[1,2]		PCDD/PCDF Max. Concentration (ng/m^3)[1,2] (Not corrected for laboratory blank)		PCDD/PCDF Emission Rate (ng/hr) (Not corrected for laboratory blank)	
		Total WHO-TEQ	Total I-TEQ	Total WHO-TEQ	Total I-TEQ	Total WHO-TEQ	Total I-TEQ
10 Oct 13	Crushed Drums	0.00333	0.00403	0.0629	0.0587	189	176
25 Feb 14	Crushed Drums	0.00217	0.00182	0.0107	0.0115	31.8	33.9
26 Feb 14	General Waste	0.00217	0.00182	0.00217	0.00213	5.8	5.7
27 Feb 14	Liquid Waste	0.00217	0.00182	0.00276	0.00245	7.3	6.4
4 Jun 14	General Waste	0.00373	0.00309	0.00365	0.00363	9.2	9.1
5 Jun 14	Crushed Drums	0.00373	0.00309	0.0355	0.0404	90.2	103
6 Jun 14	Liquid Waste	0.00373	0.00309	0.00840	0.00878	18.3	19.1

[1] Corrected to 0°C, 101.3 kPa, dry gas basis
[2] Corrected to 11% oxygen
[3] Equivalent concentrations and mass emissions rates using the laboratory blank concentrations and the average emission testing data

b. Hydrogen Chloride (HCl)

i. On the 8th October 2013 and the 3rd June 2014 the incinerator was monitored for discharges of hydrogen chloride.

ii. Two-hour samples were collected from each of the following waste sources: crushed drums, liquid waste, and general waste.

iii. The results of the HCl air discharge showed that the mass emissions of HCl from the Incinerator ranged from 0.0037 to 0.732 kg/hr.

TABLE 2: Hydrogen Chloride Maximum Concentration & Emission Rate

Date	Waste Type	Hydrogen Chloride Concentration (mg/m^3)[1]	Hydrogen Chloride Emission Rate (kg/hr)
8 Oct 2013	Crushed Drums	336	0.732
8 Oct 2013	General Waste	92.7	0.213
8 Oct 2013	Liquid Waste	5.7	0.011
3 Jun 2014	Crushed Drums	317	0.574
3 Jun 2014	General Waste	84.6	0.155
3 Jun 2014	Liquid Waste	2.1	0.0037

[1] Corrected to 0°C, 101.3 kPa, dry gas basis
[2] Values are at actual O_2 concentrations

c. Particulate Matter

i. On the 8th October 2013 and the 3rd June 2014 the incinerator was monitored for discharges of particulate matter.

ii. One 2-hour sample was collected from each of the following waste sources: crushed drums, liquid waste, and general waste.

iii. The results of the particulate matter air discharge monitoring showed that the concentration of particulate matter ranged from 16.9 to 72.9 mg/m^3 (corrected for 0°C, 101.3 kPa, 11 % O_2, dry gas basis) with the particulate matter mass emissions ranging from 0.0493 to 0.218 kg/hr.

TABLE 3: Particulate Matter Air Discharge Maximum Concentration & Emission Rate

Date	Waste Type	Particulate Matter Concentration (mg/m^3)[1]	Particulate Matter Emission Rate (kg/hr)
8 Oct 2013	Crushed Drums	72.9	0.218
8 Oct 2013	General Waste	16.9	0.0493
8 Oct 2013	Liquid Waste	53.1	0.144
3 Jun 2014	Crushed Drums	35.7	0.0923
3 Jun 2014	General Waste	45.9	0.108
3 Jun 2014	Liquid Waste	46.5	0.102

[1] Corrected to 0°C, 101.3 kPa, dry gas basis

Conclusion

Under normal operating conditions, the maximum emission of PCDD/PCDF from the incinerator stack was 0.0587 ng/m^3 I-TEQ, less than the consent limit of 0.1 ng/m^3 I-TEQ (corrected for 0°C, 101.3 kPa, 11 % O_2, dry gas basis).

Under normal operating conditions, the maximum emission of hydrogen chloride from the incinerator stack was 0.732 kg/hr, which is below the discharge consent maximum of 1.5 kg/hr.

These results indicate the performance of the Incinerator meets the conditions of the air discharge permit.

Vegetation Monitoring

Performance Criteria

The discharge shall not *"give rise to any direct significant adverse ecological effect on any off-site ecosystems, including, but not limited to habitats, plants, animals, microflora and microfauna."*

Monitoring Plan

During the period vegetative monitoring stations including Potato Vine *(Solanum jasminoides)*, Jasmine *(Jasmine officinale)*, Rock Rose (Cistus cyprius) and Norfolk Island Hibiscus (Lagunaria patersonii) were monitored. These plants have been chosen for their susceptibility to growth regulator herbicides and ALS inhibitors, and they are reported to be hardy to wind and salt.

Results and Comments

Visual monitoring shows no sign of the characteristic deformities caused by phenoxy herbicides or herbicides which are ALS inhibitors.

General

Air Quality Inspections

Officers of the Taranaki Regional Council undertook regular air quality inspections during the period.

Incident Review

No incidents occurred during the 2013-14 period.

Community Consultation

The Company planned to hold a site meeting with members of the local community to discuss general aspects of the company's operation on the 28th May 2014. The Taranaki Regional Council, and the original submitters to the air discharge consent were specifically invited (where up-to-date contact addresses were available) along with interested local residents including the New Plymouth District Council Trade Waste Officer.

Due to poor RSVP attendance response, the company cancelled this meeting. This is the first year where this meeting has been cancelled due to low interest.

Appendices

Appendix 1 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Insecticides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.

Appendix 2 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Spinosad Plant, February 2014, Source Testing New Zealand Limited, issued March 2014.

Appendix 3 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Granulated Herbicides Plant, September 2013, Source Testing New Zealand Limited, issued October 2013.

Appendix 4 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Herbicides Plant, February 2014, Source Testing New Zealand Limited, issued April 2014.

Appendix 5 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the Commodity Herbicides Plant, May 2014, Source Testing New Zealand Limited, issued June 2014.

Appendix 6 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, October 2013 & February 2014, Source Testing New Zealand Limited, issued April 2014.

Appendix 7 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, October 2013, Source Testing New Zealand Limited, issued April 2014.

Appendix 8 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Compliance Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

Appendix 9 Dow AgroSciences (NZ) Ltd, New Plymouth, Air Discharge Monitoring of the High Temperature Incinerator, Particulate Matter Monitoring, June 2014, Source Testing New Zealand Limited, issued June 2014.

Dow AgroSciences (NZ) Ltd
New Plymouth

AIR DISCHARGE MONITORING OF THE INSECTICIDES PLANT, SEPTEMBER 2013

Issue

October 2013

new zealand accredited laboratory

STNZ
AIR QUALITY MONITORING SPECIALIST

Dow AgroSciences (NZ) Ltd
New Plymouth

AIR DISCHARGE MONITORING OF THE SPINOSAD PLANT, FEBRUARY 2014

Issue

March 2014

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Dow AgroSciences (NZ) Ltd
New Plymouth

AIR DISCHARGE MONITORING OF THE GRANULATED HERBICIDES PLANT, SEPTEMBER 2013

Issue

October 2013

new zealand accredited laboratory

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AIR QUALITY MONITORING SPECIALIST

Dow AgroSciences (NZ) Ltd
New Plymouth

AIR DISCHARGE MONITORING OF THE HERBICIDES PLANT, FEBRUARY 2014

Issue

April 2014

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AIR DISCHARGE MONITORING OF THE COMMODITY HERBICIDES PLANT, MAY 2014

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AIR DISCHARGE MONITORING OF THE HIGH TEMPERATURE INCINERATOR

COMPLIANCE MONITORING OCTOBER 2013 & FEBRUARY 2014

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April 2014

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AIR DISCHARGE MONITORING OF THE HIGH TEMPERATURE INCINERATOR

PARTICULATE MATTER MONITORING, OCTOBER 2013

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AIR DISCHARGE MONITORING OF THE HIGH TEMPERATURE INCINERATOR

COMPLIANCE MONITORING JUNE 2014

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AIR DISCHARGE MONITORING OF THE HIGH TEMPERATURE INCINERATOR

PARTICULATE MATTER MONITORING,

JUNE 2014

Issue

June 2014

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Appendix VI

Dow AgroSciences Annual Groundwater Monitoring Report 2013-2014

Dow AgroSciences

Groundwater Management Report
New Plymouth site

1 July 2013 – 30 June 2014

15 July 2014

Table of Contents

1. INTRODUCTION

Dow AgroSciences (NZ) Ltd (formerly DowElanco (NZ) Ltd) has proactively conducted an Environmental Assessment Project (EAP) at the Paritutu Road (New Plymouth) site to assess the impacts of historical operations on groundwater. Field investigations commenced in 1993 and concluded in May 1996. The site investigation identified two locations where soil and/or groundwater have been impacted by constituents of concern. The constituents of concern fall into two groups, phenoxy herbicides and chlorophenols.

From 1997 until August 2000 the evaluation of groundwater and protection of soil and groundwater on the site was subject to the conditions detailed in the Environmental Assessment Project Management Plan (28 July 1997). From September 2000, the evaluation of groundwater and protection of soil and groundwater on the site is subject to the conditions detailed in the Environmental Assessment Project Management Plan (August 2000).

The installation and use of piezometers is subject to conditions detailed in TRK0016WLL issued by the Taranaki Regional Council (TRC). Detailed standard operating procedures have been developed and implemented to ensure compliance with these conditions.

The last *Environmental Assessment Project (EAP) Report* was submitted to the Taranaki Regional Council on 28 March 2001. In June 2001, the Taranaki Regional Council approved the replacement of the Environmental Assessment Project Management Plan (August 2000) with the Groundwater Management Plan (June 2001). The Taranaki Regional Council agreed to the frequency of groundwater monitoring being changed from biannual to annual and supported the closure of several investigative wells no longer of use.

Dedicated sampling pumps were installed into all the sampling wells in May 2002.

The detection limit for chlorophenols and phenoxy (acid) herbicides was 30 µg/L up until 2004. From 2005, the detection limit changed to 0.05 µg/L for chlorophenols and 0.3 µg/L for phenoxy (acid) herbicides when a contract laboratory was commissioned to undertake the analyses. In 2012, the laboratory reporting limits for phenoxy (acid) herbicides was 0.04 µg/L and for chlorophenols was 0.05 µg/L.

As part of the annual sampling of designated groundwater wells, the results from monitoring carried out in August 2013, are attached to this report along with a copy of the original report from ERM New Zealand Limited.

2. CHANGES MADE DURING THE PERIOD

2.1 YEAR 2013-2014

2.1.1 No changes were made to the Groundwater Management Plan during the reporting year.

2.1.2 Monitoring wells 20, 32, 39J, 41 and 47 were redeveloped on the 14th and 15th August 2013 to provide more reliable groundwater levels for low flow sampling techniques and to free up a dedicated sampling pump in monitoring well 20.

3. AQUIFER MONITORING

3.1 SHALLOW AQUIFER

3.1.1 Performance Criteria

Sampling of groundwater from site perimeter shallow aquifer wells 1 and 21 to be carried out and analysed for the following analytes at the laboratory reporting limits specified:

Phenoxy (acid) Herbicides	0.04 µg/L
Chlorophenols * (component dependent)	0.05 µg/L

Results of sampling and analysis to be reported to the Taranaki Regional Council.

As per the Groundwater Monitoring Plan (June 2001) the following action levels were established in consultation with the Taranaki Regional Council:

Total Phenoxy (acid) Herbicides *[2,4-D, MCPA, 2,4,5-T & MCPB]*	50,000 µg/L
Total Chlorophenols *[2,4-DCP, PCOC, 2,4,5-TCP & 2,4,6-TCP]*	10,000 µg/L

Results in excess of these action levels to be reported to the Taranaki Regional Council as soon as practicable.

3.1.2 Monitoring

The sampling frequency for the shallow perched aquifer was once per quarter (every 3 months) for the first year (1998), then every 6 months for the next 2 years (1999 and 2000), then annually from 2001 onwards.

As per the monitoring schedule detailed in the Groundwater Management Plan (June 2001) and agreement with the TRC, groundwater sampling was carried out in August 2013.

3.1.3 Results

The total phenoxy (acid) herbicides and total chlorophenol concentrations for groundwater samples collected during the period are detailed in Table 1 of this report.

3.2 DEEPER REGIONAL AQUIFER

3.2.1 Performance Criteria

Sampling of groundwater from site perimeter deep regional aquifer wells 20, 32, 41, 42 and 47 to be analysed for the following analytes at the laboratory reporting limits specified:

Phenoxy (acid) Herbicides	0.04 µg/L
Chlorophenols * (component dependent)	0.05 µg/L

Results of sampling and analysis to be reported to the Taranaki Regional Council.

As per the Groundwater Monitoring Plan (June 2001) the following action levels were established in consultation with the Taranaki Regional Council:

Total Phenoxy (acid) Herbicides *[2,4-D, MCPA, 2,4,5-T & MCPB]*	50,000 µg/L
Total Chlorophenols *[2,4-DCP, PCOC, 2,4,5-TCP & 2,4,6- TCP]*	10,000 µg/L

Results in excess of these action levels to be reported to the Taranaki Regional Council as soon as practicable.

Note: Non-site perimeter Wells 39J and 46A are also sampled for interest but are not subject to the established action levels.

3.2.2 Monitoring

The sampling frequency for the deeper regional aquifer was once per quarter (every 3 months) for the first year (1998), then every 6 months for the next 2 years (1999 and 2000), then annually from 2001 onwards.

As per the monitoring schedule detailed in the Groundwater Management Plan (June 2001) and agreement with the TRC, groundwater sampling was carried out in August 2013.

3.2.3 Results

The total phenoxy (acid) herbicides and total chlorophenol concentrations for groundwater samples collected during the period are detailed in Table 1 of this report.

4. GROUNDWATER RESULTS SUMMARY

The shallow perimeter wells (1 and 21) showed no concentrations above the laboratory reporting limits.

Deep perimeter wells 20 and 32 showed no concentrations detected above the laboratory reporting limits.

Deep perimeter well 47could not be sampled due to insufficient water within the monitoring well.

In the other deep perimeter wells (41 and 42) very low concentrations were detected above the laboratory reporting limits. Deep perimeter well 41 showed low levels of Phenoxy Herbicides (≤0.18 µg/L) with no Chlorophenols detected. Deep perimeter well 42 showed low levels of Phenoxy Herbicides (≤0.27 µg/L) and Chlorophenols (≤0.25 µg/L). All levels were well below the action levels of 50,000 µg/L for Phenoxy Herbicides and 10,000 µg/L for Chlorophenols.

Non-perimeter well 39J showed low levels of Phenoxy Herbicides (47.9 µg/L) and Chlorophenols (≤6.71 µg/L) whilst non-perimeter well 46A showed low levels of Phenoxy Herbicides (2.9 µg/L) and Chlorophenols (≤1.3 µg/L).

These non-perimeter wells are sampled for interest and are not subject to the established action levels.

5. GROUNDWATER FLOW DIRECTION

Gauging of all available wells was conducted on the 6th May 2010, confirming consistency with historical groundwater flow evaluations [*refer to 2010 Groundwater Monitoring Event, Dow AgroSciences, Paritutu Road, New Plymouth, issued February 2012 by ERM New Zealand Limited., Figures 3 & 4*].

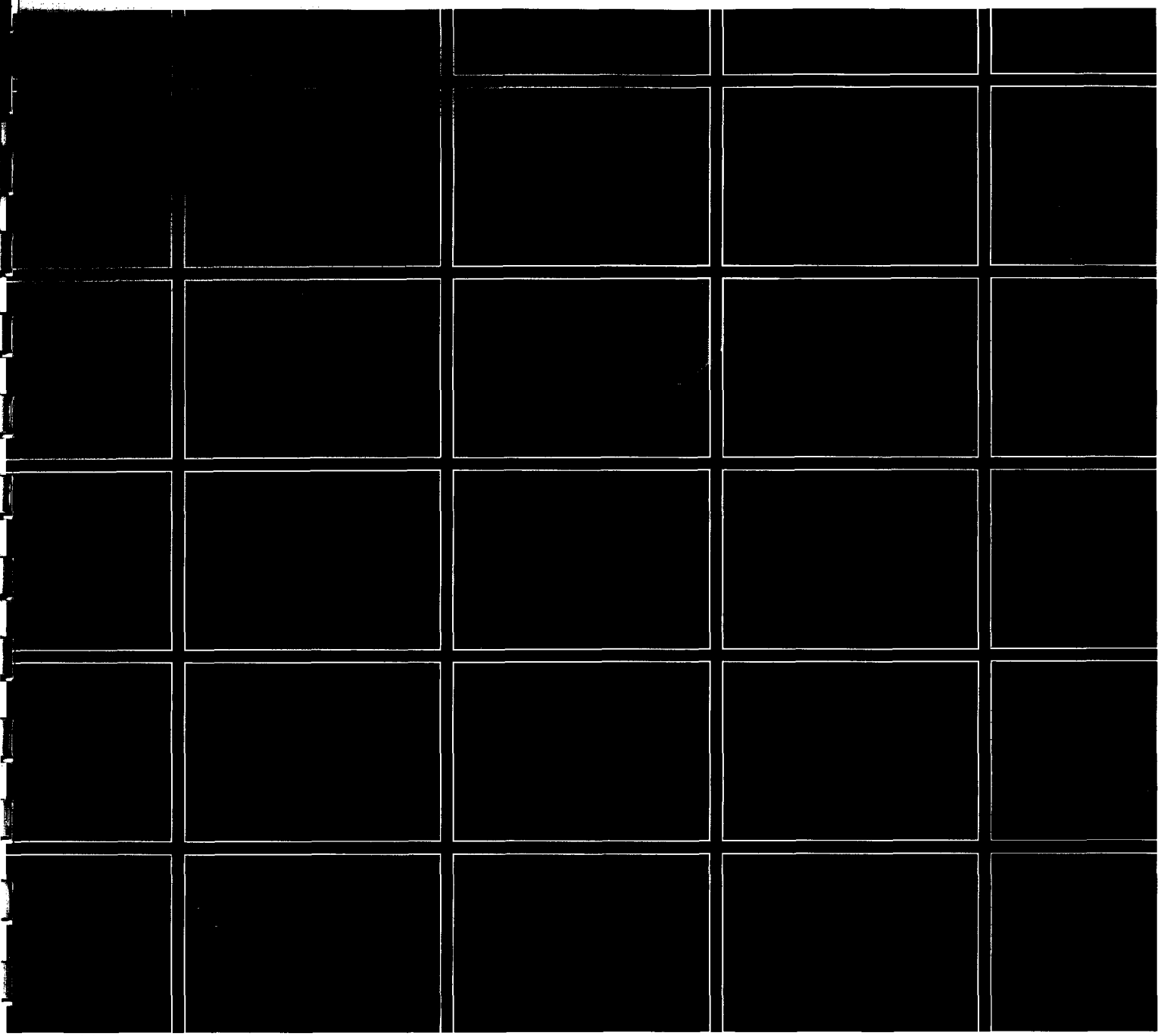
In accordance with the Groundwater Management Plan (June 2001), gauging will be conducted every five years. The next gauging event will be carried out in 2015.

Table 1: Total Phenoxy Herbicides and Total Chlorophenol Concentrations for New Plymouth Groundwater (August 2013)

Well Identification No.	Phenoxy Herbicides[1] Concentration (ug/L)	Chlorophenol[2] Concentration (ug/L)
Shallow Perimeter Wells:		
1	ND[3]	ND[3]
21	ND[3]	ND[3]
Deep Perimeter Wells:		
20	ND[3]	ND[3]
32	ND[3]	ND[3]
41	≤0.18	ND[3]
42	≤0.27	≤0.25
47	NS[4]	NS[4]
Additional Non-perimeter Wells:		
39J	47.9	≤6.71
46A	2.9	≤.3
Trigger Levels	50,000	10,000

Note [1]: Phenoxy Herbicides [2,4-D; 2,4,5-T; MCPA; MCPB]
Note [2]: Chlorophenols [2,4-DCP; 2,4,5-TCP; 2,4,6-TCP; PCOC]
Note [3]: ND = Below laboratory reporting limits (<0.16 µg/L for Phenoxy Acids and <0.2 µg/L for Chlorophenols)
Note [4]: NS = Not sampled due to either being unsuitable for sampling or not meeting sampling requirements

All samples collected were obtained using in-well bladder pumps, in accordance with "Low Flow Sampling Methodology" except for MW47 due to insufficient water within monitoring well



2013 Groundwater Monitoring Event
89 Paritutu Road
New Plymouth,
New Zealand

For Dow AgroSciences (NZ) Ltd

October 2013

Final

0210427

Delivering sustainable solutions in a more competitive world

ERM

Appendix VII

Technical review report required under consent 4020 special condition 3

AIR DISCHARGE PERMIT (TRK954020) - SPECIAL CONDITION 3

Under Special Condition 3 of the air discharge permit regulating emissions from the Dow AgroSciences plant on Paritutu Road, the Company is required to provide a report detailing the following:

(a) Reviewing technological advances relevant to the reduction or mitigation of any discharge to air from the site, particularly but without limitation to discharges of dioxin, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances;

(i) Plant Vents

Monitoring of plant vents shows the discharge levels to be below maximum ground level concentrations for the particular contaminants as detailed in the permit requirements of condition 8. The emission results are very low, several orders of magnitude below the maximum ground level concentrations. Copies of these results are available in the annual reports submitted to the Taranaki Regional Council each year. Accordingly no changes to technology are considered necessary.

(ii) Incinerator

Since the previous report in 2011, measured levels of polychlorinated dibenzodioxins and polychlorinated dibenzofurans from the site incinerator have averaged 0.00397 ng I-TEQ/Sm^3 (ranging from 0.00311 to 0.00513 ng I-TEQ/Sm^3). These levels are below the permit requirement of 0.1 ng I-TEQ/Sm^3 and applicable international standards.

The latest technical review in 2012 of the high temperature incinerator by Dr Ulrich Wallbaum, Senior EH&S Research Scientist from Dow Chemical's EH&S Operations Tehnology Center endorsed comments from the 2006 technical review by Kurt Zunker, Senior Technology Associate from Dow Chemical's Environmental Technology Centre, which noted:

- *The site incinerator is consistent with the technology of similar incinerators. The incinerator's combustion process is controlled by monitoring the temperature and ensuring excess oxygen is available and monitored. The continuous measurement of low carbon monoxide (less than 100 ppm) is considered reliable ongoing proof of complete combustion and minimized emissions. The site incinerator's carbon monoxide levels are typically measured at less than 1ppm.*

- *While hydrogen chloride is not continuously monitored it is controlled by adjusting the load size of the waste based on the chlorine content. As these levels are low there is not enough chlorine to warrant a quench or scrubber system. The low carbon monoxide emission level indicates a very high destruction efficiency of the introduced waste*

- *In view of these low emissions and conclusions from the technical review, no changes to technology are considered necessary.*

In addition, Dr Ulrich Wallbaum also noted the following from his review:

- *The site incinerator has a proven track record of ultra low dioxin emissions at the edge of detection ability when using certified sampling and analytical methodology. The January 2012 test series results are hardly distinguishable from the laboratory method blank data and show emission levels between 0 – 3% of the widely international accepted dioxin emission standard of 0.1 ng I-TEQ/* Sm^3*. When calculating the 'Medium Bound' emission concentrations by using 50% of the detection limits for all 17 dioxin and furan isomers which were not detected, these values increase to 2–5% of the 0.1 ng I-TEQ/* Sm^3 *standard including the laboratory blank at 2% itself.*

- *The technology of this incinerator provides all properties and conditions such as a high incineration and stack emission temperature for effective destruction of potential precursors to keep dioxin emissions at an extreme minimum. The total absence of medium range temperatures (200 – 500 deg C) and short residence times eliminate any potential for dioxin reformation in downstream equipment often found in other incineration devices.*

- *There are no dioxin mitigation technologies that exist for this particular incinerator that would result in any significant reduction of already extremely low dioxin emissions.*

(b) *Assessing any other issue relevant to the minimization or mitigation of discharges to air from the site that the Chief Executive, Taranaki Regional Council, considers should be included.*

The following technology and operational improvements have been made since June 2011 in an effort to further mitigate odours from occurring. Many of the technology improvements noted were in progress prior to the occurrence of an objectionable odour beyond the boundary of the site on the 23rd June 2011 involving 2,4-D.

- Storage warehouse (Building 04) ventilation system (US$150M) commissioned and started up in late June 2011.

- Installation, commissioning and start-up of a general building ventilation system (US$190M) in the Commodity Herbicides Plant in August 2011.
- Improved tank vent collection system within the Commodity Herbicides Plant.
- Plant roller door policy for the Commodity Herbicides Plant established to minimize the length of time they are open and to ensure they are closed at all times for specific process activities.
- Storage of wooden pallets from 2,4-D bulk bags are now stored indoors to mitigate any possible chlorophenol odours that can occur when pallets become wet.

(c) ***Detailing any inventory of discharges to air from the site of such contaminants as the General Manager, Taranaki Regional Council may from time to time specify following consultation with the consent holder.***

This information is currently provided by Dow AgroSciences on an annual basis as set out in the annual compliance-monitoring programme.