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11 September, 2009

Your Ref:
Our Ref: EM Renewable Energy
File No:
Contact: Warren Mortlock

Rob Hansen
Research Director
Environment and Resources Committee
Parliament House
BRISBANE QLD 4000

Dear Mr Hansen,

Please find enclosed Redland City Council's submission to the Environment and Resources Committee's Parliamentary Inquiry into Energy Efficiency Improvements. The attached submission provides a background followed by comments specific to each issue.

The submission has been endorsed by Council's Planning and Policy Committee which met on 9 September 2009. The General Council meeting is scheduled for 30 September, 2009 at which time Council may make further comments prior to ratifying Planning and Policy Committee's endorsement.

Thank you for the opportunity to submit comments on this rapidly developing and significant issue of energy efficiency improvements to regional south east Queensland.

Yours sincerely

Gary Photinos
A/General Manager,
Planning and Policy

14 August 2009

Rob Hansen
Research Director
Environment and Resources Committee
Parliament House
BRISBANE QLD 4000

Dear Mr Hansen,

Redland City Council welcomes the opportunity to provide a submission to the Environment and Resources Committee's Parliamentary Inquiry into Energy Efficiency Improvements. Please find below Redland City Council's submission to the inquiry addressing the terms of reference as set forth in *Paper No 1: Inquiry into Energy Efficiency Improvements.*

1. Background

Redland City Council (RCC) owns and manages a wide range of asset types with an equally wide range of energy requirements. This includes commercial office buildings, public facilities such as libraries and community halls, waste treatment plants and amenities blocks, barbeques and boat ramps, amongst many others. RCC has previously conducted several investigations of it's corporate energy efficiency, including: an Energetics led review of five main facilities including the potential for energy efficiency improvements (2004); an ARUP led review of resource use efficiency across a sample of Council assets (2008); and an ARUP led comprehensive audit of Council's greenhouse gas emissions (2009).

RCC has been a participant in the Cities for Climate Protection Program (CCP) since 1999. The CCP Milestone 5 Report completed in July 2007 showed Council's GHG emission reductions were about halfway (11% emission reduction) towards the target set under the LGAP of 25% of 1998 emissions by 2010. However, excluding Redland Water's reductions revealed a 22% increase across the rest of Councils corporate buildings, fleet, street lighting and waste areas since 1998. Community emissions were similarly increasing, with a 29% increase from the 1996 base year to 2001, despite a target of 15% reduction by 2010.

An immediate, coordinated and significantly resourced corporate commitment required by Council to meet its 2010 targets was recognised, and Council resolution (GM October 2007) acknowledged a funding shortfall of $2.4million between 2007/08 and 2010/11 to achieve the currently adopted LGAP target based on the Milestone 5 findings. It was also resolved to develop carbon accounting and performance measures (KPIs) to track progress toward corporate LGAP targets, and to use a cross Council Carbon Savers Working Group to prioritise projects for funding, implement and monitor progress.

On April 3rd 2008, Environmental Management, on behalf of the Carbon Savers Working Group, submitted a proposal to the ELG to undertake a suite of 'ready to go' efficiency projects (including a detailed Carbon Audit) to address the shortfall in meeting the LGAP target. The ELG directed that a Carbon Audit be carried out to improve understanding of emission sources and where efficiencies may be gained, prior to committing to major expenditures.

In August 2008, the Corporate Environmental Policy (POL-2644) was amended to state that Council is committed to "Reduce the greenhouse gases emitted by Council and the community to levels and within a time acceptable to the wider community".

2. The economic and environmental costs and benefits arising from energy efficiency improvements

- The results of previous audits of Council assets identified significant opportunities for the potential improvement of corporate energy efficiency.
- The opportunities ranged from easy to implement 'low hanging fruit', which have largely been pursued, to more difficult investments in efficiencies with substantial payback periods.
- The Energetics led review (2004) of five main Council facilities identified potential annual cost savings ranging from $1,000 to $50,000 at each facility with an average simple payback period of 4.5 years.
- The 2004 Energetics review also indicated that the implementation of these recommendations had the potential to reduce corporate greenhouse gas emissions by approximately 1000t of CO_2 per annum.
- Energy efficiency improvements across Council have been responsible for a reduction in buildings and facilities greenhouse gas emissions intensity per staff member of 14% over the past decade.

3. Potential barriers and impediments to improved energy efficiency

- Within RCC, a range of barriers have been previously encountered during attempts to improve energy efficiency.
- Easily implemented, low capital cost, 'low hanging fruit' initiatives have generally been applied promptly. However the road from the identification of an opportunity to achieving it may involve change management within the organisation – to which all the usual difficulties of change management accrue. Unless supported at a senior management level and enshrined in policy and procedures of an organisation, such measures are unlikely to have staying power or lasting success. A project focus is not ideal for implementing such measures, and has led to their collapse once a project is completed. Even simple behavioural changes requested of staff must be embedded in staff induction and training programs for the longer term to be successful. Many seemingly simple changes for energy efficiency reasons can lead to protracted and complex negotiations about work place standards, remuneration packages, or prerequisite works.

- The allocation of funding within the budget for larger projects is often long and complex as it moves through the organisation. Past experiences have also shown difficulty in securing budget allocation for capital intensive projects with long and or uncertain payback periods. Information on payback periods is sketchy and poorly shared between organisations inside and outside of local government. Learnings about actual payback experience compared to predicted are particularly absent.
- Detailed measurement (sub metering) of energy consumption within RCC, particularly on a building floor or work area basis, has been largely overlooked until quite recently. There are obvious implications for Council's ability to now manage energy efficiency. RCC is now implementing a sub metering plan but many of our efficiency measures were put in place prior to reliable measurement. This is also a potential impediment for others following an energy efficiency plan.
- RCC's experience with the Cities for Climate Protection (CCP) program has highlighted the difficulty in achieving gross, organisation wide targets which fail to adequately account for growth. At the corporate level, RCC is well short of its CCP target set under the Local Greenhouse Action Plan 2003 of 25% of 1998 emissions by 2010. This shortfall is the result of a number of factors and comes despite a reduction by 14% in the greenhouse gas intensity measured on a per capita (staff member) achieved since 1998. The biggest factors mitigating against meeting the corporate target are the annual increases in population of 2% in this local government area, and the consequent 45% increase in staff numbers the period, the construction of new community facilities and the delivery of ever increasing service levels.
- These experiences highlight the need for future energy efficiency management frameworks to consider the impacts of sustained growth. The growth external to an organisation (over which it has influence but no direct control) and the growth within an organisation may require different approaches. There is an issue over how guidelines for benchmarking and reporting may take into account measurement of whole of organisation contribution to global reductions in GHG, and per capita reductions across the organisation (per staff or a per m^2 basis for buildings).
- RCC's experiences also highlight the need to take into consideration the flow on consequences of third party policy or decisions on energy that have consequences for our corporate carbon footprint. For example in the case of street lighting, increases in the number of streetlights required within the local government area are inevitable as a result of population growth whilst improvements in their efficiency are largely dependent on the work of external bodies such as the Energy Efficiency Public Lighting Working Group. Councils rent streetlights through Energex but have no control over the efficiency of the infrastructure for the majority of lighting provided.

4. Potential policy options for energy efficiency improvements, with an emphasis on initiatives that are cost effective for individual producers and consumers

- Given the close link between government and the community, local governments are placed in a unique position to lead by example on the issue of energy efficiency, and to implement policies for efficiency in the community. However, Council has only a limited rate base on which to base any programs. RCC has trialled some community awareness and retrofit encouragement programs. However our capacity in this area is quite limited. Councils such as Newcastle (NSW – their GAIN Program) stand out as exceptional. State government must drive energy efficiency and policies and incentives should acknowledge and incorporate a high level of support to local governments where they seek to involve local government in implementing energy efficient initiatives.

- Our experience with trial programs delivered to residents is that one-on-one targeting is very expensive and impractical despite its successes (eg Climate Smart). While these gain good public exposure and are successful, their high cost could eventually see them discontinued in favour of systemic changes in legislation, codes and compliance. The State could take an early lead in regulating on energy efficiency and provide certainty and clarity during the coming years on this issue.
- The extension of the availability of low or no interest 'green loans' to local government authorities would assist in ensuring high capital cost projects with long payback periods are able to be implemented whilst not affecting the provision of funding to other essential community services. This particularly applies to investment in alternative energy generation initiatives. Redland City has tested the market through and expression of interest sought from the national Renewable Energy sector for the supply of renewable energy in Redland City on a build, own and operate basis. The overall recommendation from the EOI process was for RCC not to invite a tender from any of the EOI proponents. Instead, in the short term (at least the next two to three years) Council resolved to purchase additional Green Power and continue investment in energy efficiency. Council believes that the capital requirements and project risks for Council from pursuing any of these EOIs would be too high, and that none currently represent a cost-effective, realistic and viable approach. The EOI process has demonstrated that the market does not see a cost effective investment in renewable energy in the Redlands area. However this situation is likely to change and Council considers that State government partnership on such initiatives to share costs and risks would be a significant issue in acceptance of proposals in future.
- Legislative support should be provided to ensure all new buildings and major refurbishments to existing structures completed by local governments consider energy efficiency and overall sustainability, similarly to the policies of the State Government.
- Electricity pricing for large, commercial consumers should take into account real time pricing based on demand in order to provide an incentive to implement energy efficiency improvements which reduce demand at the peak periods for commercial customers.

5. The role of the Carbon Pollution Reduction Scheme (CPRS) and other Commonwealth Government initiatives in encouraging energy efficiency

- Alongside direct liabilities for Scope 1 emissions from waste operations, RCC would also be vulnerable to increases in the price of CPRS impacted goods and services such as fuel and electricity. Modelling suggests that under a carbon price of $20/t, retail electricity costs to commercial customers would increase by 15%, resulting in increased costs to Council in the magnitude of $100,000 - $200,000 per annum for tenant light and power at facilities[1].
- This is likely to have a significant impact on the simple payback period and thus viability of new energy efficiency improvement opportunities in addition to those previously identified by various audits and not yet implemented.
- At this stage, uncertainty remains regarding the role and effect of voluntary abatement measures such as energy efficiency improvements under the CPRS.
- Further increases in the retail price of electricity as a result of the proposed expanded renewable energy target of 20% by 2020 are likely to have a similar influence.
- The National Framework for Energy Efficiency (NFEE) detailed by COAG in July 2009 is likely to play a positive role in encouraging energy efficiency in the built environment through amendments to the Building Code of Australia (BCA).
- A selection of council assets are likely to be affected by amendments to the BCA requiring the mandatory disclosure of a commercial building's energy efficiency when being sold or new leases arranged if it is over $2000m^2$.
- This move towards greater transparency is likely to result in a higher community and marketplace expectation for energy efficient buildings.
- Clearer guidance, however, should be provided within the regulations proposed by COAG regarding increasing the stringency of energy efficiency requirements for all classes of commercial buildings.

6. Conclusion

Redland City Council welcomes the inquiry into energy efficiency improvements and the opportunity to provide a submission on this issue. Energy efficiency has been proven to have significant environmental and financial benefits at a relatively low cost, particularly in contrast to other methods of greenhouse gas abatement.

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[1] Assuming the full cost of CPRS emissions permits are passed onto consumers. Source: Australian Sustainable Built Environment Council (2008) *The Second Plank – Building a Low Carbon Economy with Energy Efficient Buildings*

Summary of Review and Conclusions from the Expression of Interest ENM-0006 for:

"Greenhouse Gas Reduction: Renewable and Low-carbon Energy Generation Options for Redland Shire"

Monday, 2 June 2008

Expression of Interest ENM-0006 (EOI) attracted nine proposals from interested parties for renewable energy options suitable to be installed and operated in Redland City. These were subsequently reviewed by Maunsell AECOM consultants and Council. The summary results of the review and the conclusions drawn from it are presented in this document.

Expressions of Interest were sought from the national Renewable Energy sector for the supply of renewable energy in Redland City on a build, own and operate basis.

The type of technologies and number of EOIs proposed were:

- gasification of biomass with subsequent combustion of the syngas (1) - Corky's Sustainable Energy;
- using tidal streams or ocean currents to generate electricity (2) - Titan Manufacturing and Current to Current;
- the collection of heat from the sun to drive a thermal engine (1) - Ambient Industries;
- generating electricity directly from standard photovoltaic panels (4) - Choice Electric, Solar Harvest Solar, Energy Impact, Renewable Energy Solutions; and
- the concentration of sunlight onto solar photovoltaic cells using arrays of reflective dishes (1) - SMEC/Sol Focus.

The proposals ranged from relatively low risk, proven, but common solar photovoltaic panels, through to the comparatively high risk and unproven technology of the ocean based projects and a thermal engine.

The **key requirements** of any low-carbon energy generation proposal/options were that they:

1. Demonstrate the ability to meet a significant part (minimum 20 kW installed capacity), if not all, of Council's electricity needs while emitting low or no carbon;
2. May be installed, operated, maintained and managed by an external operator (i.e. an entity **other than** Council);
3. May be built and operated at a high level of efficiency and effectiveness for supplying power to Council buildings and operations and potentially to the local community grid or beyond;
4. Low-carbon energy generation capacity beyond Council's own power needs should ideally attract income from sale through the SEQ Grid (limited by the capacity of the grid to accept such power) and attract REC certificates, which also have a value.

Review and Recommendations

Independent consultants Maunsell AECOM were appointed on the basis of industry relevant and practical experience to assist Redland City Council in evaluating responses received to the EOI. Maunsell's full evaluation of each of the options has been provided to Council for its consideration. Briefly, the report identified the following key issues:
In undertaking its review of responses received to the EOI, Council indicated it would take the following considerations into account. Submitters were encouraged to address these issues in preparing their submissions and EOI documentation:

Technical Potential

- Review of existing technical reports, test data, results from similar technologies in operation elsewhere (where available) and the potential of this technology to perform as claimed at start-up and over time.
- Projection of the energy (kWh/year) to be generated (for each technology), or total energy benefit for non-electricity outputs, inclusive of system efficiencies and downtime for maintenance;
- Validity of any projection of the annual maintenance costs for the proposed technologies;
- Expert opinion sought from industry consultants on whether any proposed energy generation technology is proven technology or is still at a pre-commercialization stage, and any implications on Council's goal to obtain reliable cost-effective energy generation now and into the future.

Economic Potential

Council used an economic model to assess the nine responses, to ensure that relevant economic parameters were used and consistently applied. The Net Present Value of proposals was calculated over a number of time horizons, inclusive of all expenses and revenue streams.

- Capital and operating costs including but not limited to:
  - Any proposed/likely capital cost to Council for the proposed energy generation system;
  - The expected life of the energy generation system and any additional capital costs throughout the expected lifecycle;
  - Assessment of baseline costs and benefits to accrue from low-carbon generation projects suitable for Redland Shire;
  - As assessment of the operation and maintenance costs, including staff costs, advertising/marketing, insurance, (on an annual basis);
  - Network connection fees estimated from discussions with potential electricity retailers and/or from previous experience in power purchase agreements for similar technologies
  - Financing options to deliver cost value to Council (against the LCA)
  - Identification of probable additional capital projects that may be required by Council to pursue this low-carbon energy opportunity (including roads, buildings, electrical rooms, public display areas, etc).
- Revenue streams including, but not limited to:
  - Energy purchase price as estimated through discussions with potential Queensland electricity retailers and/or from previous experience in power/energy purchase agreements for similar low-carbon energy systems
  - Price premium for power generated during periods of peak load: the estimated duration for which this premium may apply, and estimated annual revenue from such premium. Develop up to three scenarios for modelling different timing and pricing structures.

- Apportionment and commercial value from acquittal of RECs, as substantiated by the energy generation projections above

In addition to the economic model, Council also considered NPV per tonne CO_2 abated and description of ownership models for similar municipal technologies and the strengths and weaknesses of each.

Planning and Environmental Considerations

- Accepted planning considerations and environmental impacts, including:
  - Redland Shire Plan and Building Approval Requirements
  - Air and noise pollution
  - Visual amenity and aesthetics
  - Environmental risks (e.g. fuel storage)
  - Likely community acceptability
  - Public safety
  - Impacts to natural areas and wildlife
  - Consistency with planning intents for the locations.

Summary of Key Issues

- None of the proposals had a high annual electricity output, and none of the proposals would have had a significant impact on the greenhouse gas profile of Council's electricity consumption;
- The ownership models presented in the EOIs were almost all turnkey type proposals, where RCC would have owned and operated the system;
- The economic model indicated strongly that Green Power is a much cheaper way for RCC to purchase net emissions reductions than investing in local renewable energy generation;
- The economic model was most sensitive to either a reduction in technology costs or an increase in energy output;
- Many existing technologies would need a step-change in NPV per MWh of output to become a favoured investment option; and
- Overall the EOI process has demonstrated that the market does not believe that the Redlands area can provide cost effective renewable energy, and that there are better renewable energy investments available elsewhere.

The overall recommendation from the EOI process was for RCC not to invite a tender from any of the EOI proponents. Instead, in the short term (at least the next two to three years) Council resolved to purchase additional Green Power and continue investment in energy efficiency. Council believes that the capital requirements and project risks for Council from pursuing any of these EOIs would be too high, and that none currently represent a cost-effective, realistic and viable approach.

The EOI process has demonstrated that the market does not see a cost effective investment in renewable energy in the Redlands area. On the other hand, Green Power remains an efficient way to access low cost renewable energy and the associated net reductions in greenhouse gas emissions. Green Power also has much lower risks to Council than pursuing any of the EOIs.

Redland City Council

Redland City Council
GHG Emissions

Detailed Audit of Council Greenhouse Gas Emissions

ISSUE

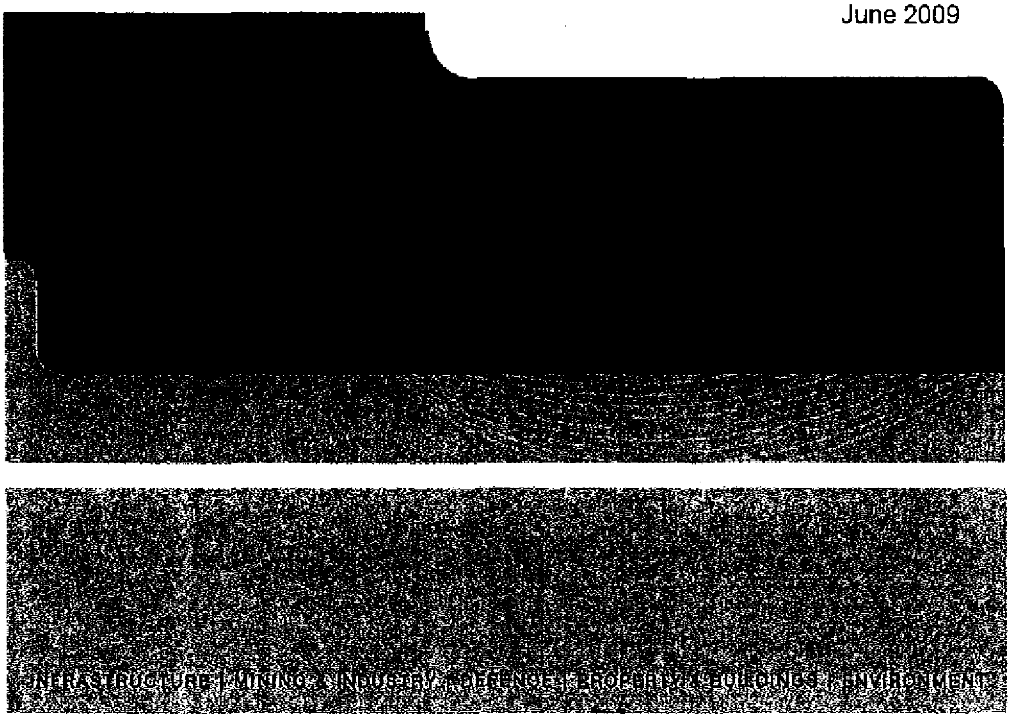
CLIENTS|PEOPLE|PERFORMANCE

Redland City Council

National Greenhouse and Energy Reporting System

Redland Water Inventory 2008/09

June 2009



Redland City Council

Redland City Council GHG Emissions

Detailed Audit of Council Greenhouse Gas Emissions

ISSUE

Redland City Council

Redland City Council GHG Emissions

Detailed Audit of Council Greenhouse Gas Emissions

February 2009

Arup
Arup Pty Ltd ABN 18 000 966 165

This report takes into account the particular instructions and requirements of our client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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Job number 205802

ARUP

Job title	Redland City Council GHG Emissions	Job number 205802	
Document title	Detailed Audit of Council Greenhouse Gas Emissions	File reference	
Document ref			

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Contents

Appendices

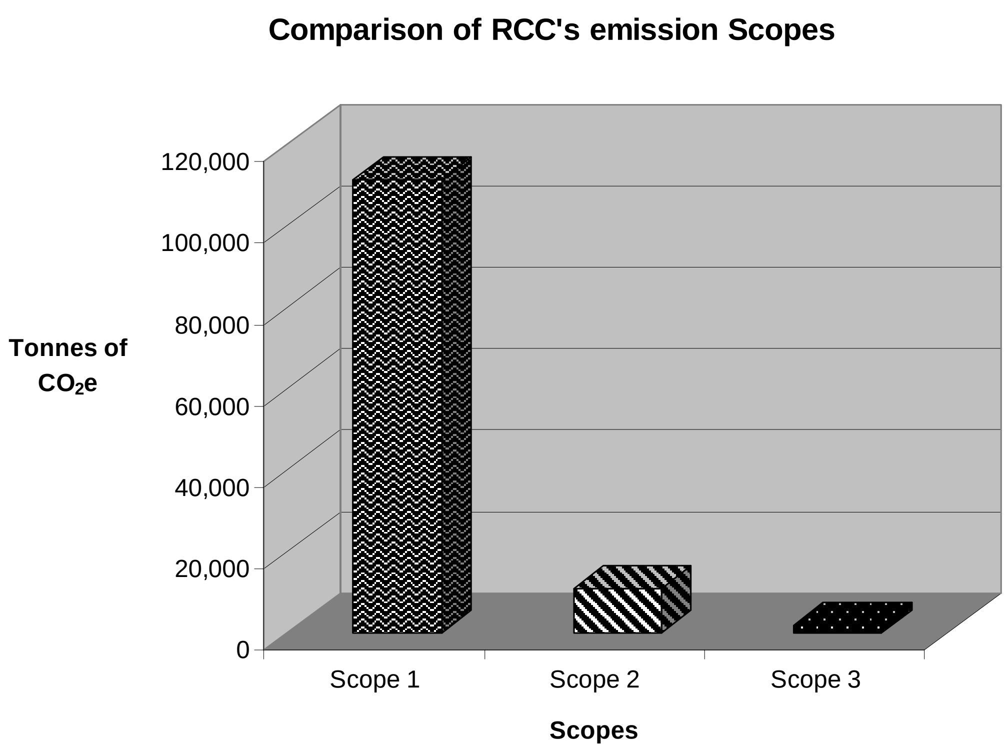
Executive Summary

Redland City Council (RCC) has been proactive in addressing climate change through efforts to monitor and reduce its greenhouse gas emissions. The RCC commenced work voluntarily on greenhouse gas inventories over five years ago and developed its Local Greenhouse Action Plan (LGAP) in 2004 under the Cities for Climate Protection (CCP) program. Whilst Council has had a number of successes in carbon abatement, there have also been issues with managing carbon, particularly around the implementation of identified initiatives.

Since that time the Federal Government has introduced *the National Greenhouse and Energy Reporting (NGER) Act 2007* (NGER Act) and released Green and White Papers for the proposed Carbon Pollution Reduction Scheme (CPRS). This has dramatically shifted the policy landscape.

The implications of this White Paper include that after July 2010, Council will be faced with a two fold emissions focus: the mandatory need to report and be involved in the CPRS through landfill emissions, and the need to reduce consumption of CPRS impacted goods and services (such as fuel and electricity) due to increased prices. The CPRS will likely lead to a significant shift away from voluntary abatement for many organisations. The commencement of the CPRS times well with the completion of the CCP voluntary targets and Local Greenhouse Action Plan (LGAP), however during the 18 month period between now and the commencement of the CPRS the policy landscape will continue to shift and evolve. There is, however, still a community need for Council leadership on emissions abatement in the post-2010 environment particularly with regard to waste management.

Council's footprint is significantly different under the NGER methodology to the CCP methodology. The majority of this difference relates to the inclusion of emissions from landfill within Council's footprint (as required by the NGER Act). Arup has identified a total of 124,011 tonnes of CO_2e in the 2007/08 financial year. Scope 1 emissions equated to 111,539 tonnes of CO_2e, 90% of the total emissions. Scope 2 emissions accounted for 10,738 tonnes of CO_2e, contributing 9% of RCC's total emissions while Scope 3 emissions account for 1,734 tonnes, 1% of total emissions.



The table below compares the 1998 and 2005/06 CCP Greenhouse Gas (GHG) emissions with the 2007/08 NGER footprint for the three common areas of buildings and facilities; vehicle fleet and street lights. Water and wastewater emissions were also included in the 1998 footprint, and as identified landfill emissions included in the 2007/08 footprint (but are not given in the table).

Key Council Operational Areas	1998 CCP GHG Emissions	2005/06 CCP GHG Emissions	2007/08 GHG Emissions	Change 1998 compared to 2007/08	
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	%
Buildings and facilities	5,317	5,740	6,687	1,370	26%
Vehicle fleet	1,472	2,010	1,836	364	25%
Street lights	4,073	5,707	5,585	1,512	37%
Total	**10,862**	**13,457**	**14,108**	**3,246**	**+30%**

Under the CCP categories Council emissions show a 30% increase between 1998 and 2007/08 to 14,108 t CO2e. This is driven by all three key Council operational areas, with streetlights showing the greatest increase. This is significantly above the CCP target of a 25% reduction on 1998 emissions by 2010, which would equal 8,146 t CO2e. A 42% reduction on 2007/08 figures would be required by 2010 to achieve the CCP target. As emissions from streetlights are largely outside Council's control, achievement of the target would require a 70% reduction in emissions from buildings and facilities, and fleet by 2010 (assuming streetlight emissions remain constant). This is not achievable and therefore Council is unable to achieve the established CCP corporate target.

With planned and proposed abatement a potential 15% reduction on the 2007/08 figures may be achieved by 2009/10, however this is still a 18% increase on 1998 CCP figures, rather than the target of a 25% decrease.

The planned and proposed measures include air conditioning upgrades, lighting upgrades, building management systems and metering, improved fleet efficiency and upgrades to plant and equipment such as air conditioners, refrigerators and hot water systems. A number of additional measures have been identified for implementation over the next two financial years. These include further fleet and building changes and upgrades, and engagement programs with council officers.

Whilst there are drivers to track performance towards the CCP target, such as improved financial efficiency, current indications are that emissions from landfill are likely to be the key issue for Council under the CPRS.

Recommendations identified are provided below.

Recommendation 1.0: When Council's CPRS position is clear, detailed investigations and studies should be undertaken into options to reduce the emissions from landfill through better quality data, reduced waste quantities and increased landfill gas capture efficiency.

Recommendation 2.0: When the emissions policy landscape becomes clear Council should undertake an investigation firstly to identify if a Council target is necessary, and if so to establish the target (likely to be in 2010 at the earliest).

Recommendation 3.0: Develop and implement an engagement program to drive efficiency of CPRS impacted goods and services such as electricity and fuel.

Recommendation 4.0: Take steps to improve the quality and availability of Scope 1 and Scope 2 data to increase the ease and accuracy of future carbon footprints.

1 Introduction

The purpose of this project was to provide a detailed audit of Redland City Council's (RCC or Council) Greenhouse Gas Emissions. This includes investigation and documentation of Council's carbon footprint, recent abatement, mitigation measures and, importantly, a plan for further efficiencies. Redland City Council's current corporate emissions derive from four main sectors:

- buildings and facilities;
- streetlights;
- waste; and
- transport fleet and minor plant equipment.

RCC has been proactive in addressing climate change through efforts to monitor and reduce its greenhouse gas emissions. The RCC commenced work voluntarily on greenhouse gas inventories over five years ago and developed its Local Greenhouse Action Plan (LGAP) in 2004 under the Cities for Climate Protection (CCP) program.

Since that time the Federal Government has introduced the *National Greenhouse and Energy Reporting (NGER) Act 2007* (NGER Act) and released Green and White Papers for the proposed Carbon Pollution Reduction Scheme (CPRS). The CCP methodology differs in some ways from the international standards referenced in the NGER Act, the most significant difference being the inclusion of landfill emissions within Council's footprint under the NGER Act. This has a significant impact on Council's footprint.

Whilst much work has been done by RCC to date, this project seeks to realign Council's footprint with international standards in line with the NGER Act whilst providing comparison to previous figures calculated through the CCP program.

This report includes the NGER carbon footprint. As requested by RCC the CCP target comparisons, analysis of key functional areas, abatement projections, strategy and plan focuses on corporate actions and efficiencies and do not address community landfill emissions.

Significant change is currently occurring which impacts RCC's emissions actions. This change includes the completion of the LGAP plan in 2010, the introduction of the NGER Act in 2007, and Carbon Pollution Reduction Scheme which is due for introduction in 2010. This report is the basis for establishing Council's direction on carbon emissions to 2010, based on available information at the time of writing. 2010 marks the end date for CCP targets and LGAP plan and the commencement of the CPRS.

In detail, this report includes:

- an audit of Council's greenhouse gas emissions (using internationally recognised standards);
- an audit of council's recent, planned and proposed greenhouse gas abatement actions (based on information supplied by Council); and
- a corporate 'Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan' (the Plan).

The report and the Plan are intended to have a focus beyond specific detailed mitigation issues and to identify and address obstacles faced by Council to date in implementing change and achieving targets.

1.1 Redland City Council

Redland City Council (RCC) was formed in 1949 as Redland Shire Council and became Redland City Council in 2008. As one of the fastest growing areas in south-east Queensland, Redland's population is expected to increase from the 2007 population of 132,971 to 182,678 by 2026[1]. RCC covers 537 square kilometres of mainland and Moreton Bay islands and is bordered by Brisbane, Gold Coast and Logan Councils. The drivers for RCC to undertake this project revolve around the council embracing the concepts of sustainability and recognising the growing public concern surrounding climate change.

Redland City Council is also committed to playing its role in reducing its greenhouse gas (GHG) emissions. This is demonstrated by RCC's voluntary efforts to reduce its GHG emissions including the completion of Milestone 5 commitments under the CCP Program. The program commitments included establishing a baseline emissions inventory, setting greenhouse emission reduction targets and developing a Local Greenhouse Action Plan. This has given RCC invaluable experience with data collection, collation and management, in the context of the CCP accounting process.

Council has established a corporate carbon target of a 25% reduction in 1998 emissions by 2010. Given the expected population growth in Redland City the achievement of total carbon reductions such as the CCP target requires significant per capita efficiencies. Council's efforts and initiatives to meet this target have recently been complicated by changes to organisational boundaries and emissions calculation methodologies, notably the inclusion of landfill under the NGER Act and the reallocation of the water operations. These issues are discussed in this report.

Whilst Council has had a number of successes in carbon abatement, there have also been issues with managing carbon, particularly around the implementation of identified initiatives. This report will also address some of these issues and provide a plan for carbon management into the future.

1.2 Managing Carbon

Carbon management is a complex issue. No single department or unit within an organisation will ever have sufficient control or influence to successfully manage carbon in isolation. Successful carbon management requires a number of key organisational features including:

- executive commitment;
- accurate measurement, monitoring and communication of emissions levels;
- knowledge and understanding across all levels of the organisation;
- appreciation of drivers of carbon emissions;
- empowerment of staff to act individually and in relation to their job responsibilities; and
- identified steps and actions to reduce emissions.

Unlike an issue such as water management, carbon is less visible, and therefore is not always front of mind. It is also the responsibility of a wide range of stakeholders and therefore requires widespread organisational awareness and empowerment to achieve real outcomes. This is further complicated when considering emissions from activities that involve external stakeholders, such as a Council operated landfill which is largely a community service.

[1]More 2 Redlands, n.d. Living in the Redlands – Population. Date viewed; 28th November 2008. http://www.more2redlands.com.au/Life/LivingInTheRedlands/Pages/default.aspx

1.3 Acknowledgements

Arup would like to sincerely acknowledge the efforts of all who contributed to this report particularly Warren Mortlock, Karina Spence and Elizabeth Giles. Arup also acknowledges the many RCC staff who contributed data and information for this report.

1.4 Key Contact

In line with the relevant Australian Standard, contact details of the key contact are provided below:

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Senior Advisor

Environmental Protection

Environmental Management Group

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Email: warrenm@redland.qld.gov.au

2 The Policy Landscape

Recent changes to the carbon policy landscape have and will impact RCC's policy position. Additionally this area is rapidly evolving with the release of the CPRS White Paper and lack of clarity in this paper on issues critical to Council.

This project was started in a pre-CPRS policy landscape and during the course of the project a number of major influencing documents were released most significantly the CPRS White Paper. The implications of this White Paper include that after July 2010, Council will be faced with a two fold emissions focus: the mandatory need to report and be involved in the CPRS through landfill emissions, and the need to reduce consumption of CPRS impacted goods and services (such as fuel and electricity) due to increased prices. The CPRS will likely lead to a significant shift away from voluntary abatement for many organisations. The commencement of the CPRS times well with the completion of the CCP voluntary targets and Local Greenhouse Action Plan (LGAP) in 2010, however during the 18 month period between now and the commencement of the CPRS the policy landscape will continue to shift and evolve.

Therefore in the next 18 months, the focus of action should be on CPRS goods and services efficiencies as these are assured of relevance in the post-CPRS environment. The same holds true for data management and the development of Key Performance Indicators which should be focused on improvements which will continue to have relevance in the future.

This section of the report looks at the policy landscape in more detail and discusses the drivers for mandatory and voluntary abatement now and into the future.

2.1 International Obligations

In 2007, the Australian Government committed to tackling climate change by ratifying the Kyoto Protocol. Australia was instrumental in securing agreement on the Bali Roadmap at the 2007 United Nations Climate Change Conference on the island Bali in Indonesia in December, 2007. This Roadmap provides a pathway for the international community to agree on post 2012 action on climate change.

Based on International Energy Agency and Inter-Governmental Panel on Climate Change estimates, Australia's share of world emissions was approximately 1.5% in 2006[2]. However on a per capita basis, Australia is listed with the highest greenhouse gas emission per person out of all Annex 1 countries[3]. Australia has reduced its emissions per capita over the period 1990 to 2006 by 13.8% from 32.6 to 28.1 tonnes CO_2e. Australia's total national emissions in 2006 were 576 million tonnes CO_2e which equates to 104.2% of 1990 levels. As the nation's largest contributor on a state and territory basis, Queensland accounted for 107.9 million tonnes of CO_2e, just under 30% of Australia's overall emissions (These emissions are measured according to the Kyoto accounting provisions).

Under the Kyoto agreement, Australia's target for the period 2008 to 2012 is 108% of 1990 levels. More recently, the Federal Government has announced a long term target of a 60% reduction in 2000 emissions by 2050. A short term unconditional target of a 5% reduction in 2000 emissions by 2020 was announced in late 2008.

A sectoral analysis of Australia's national emissions found stationary energy to be the largest emission source contributing 49.9% of overall emissions. Transport and Agriculture are the next largest emissions sources constituting 15.6% and 13.7% of Australia's total emission respectively.

[2] Department of Climate Change, 2008. *National Greenhouse Gas Inventory 2006 – Accounting for the Kyoto Target*. Commonwealth of Australia.
[3] World Resources Institute, 2005. *Navigating the Numbers - Greenhouse Gas Data and International Climate Policy.*

The *National Greenhouse and Energy Reporting (NGER) Act 2007* and Carbon Pollution Reduction Scheme (CPRS) are the major mechanisms for facilitating the achievement of post-Kyoto international obligations.

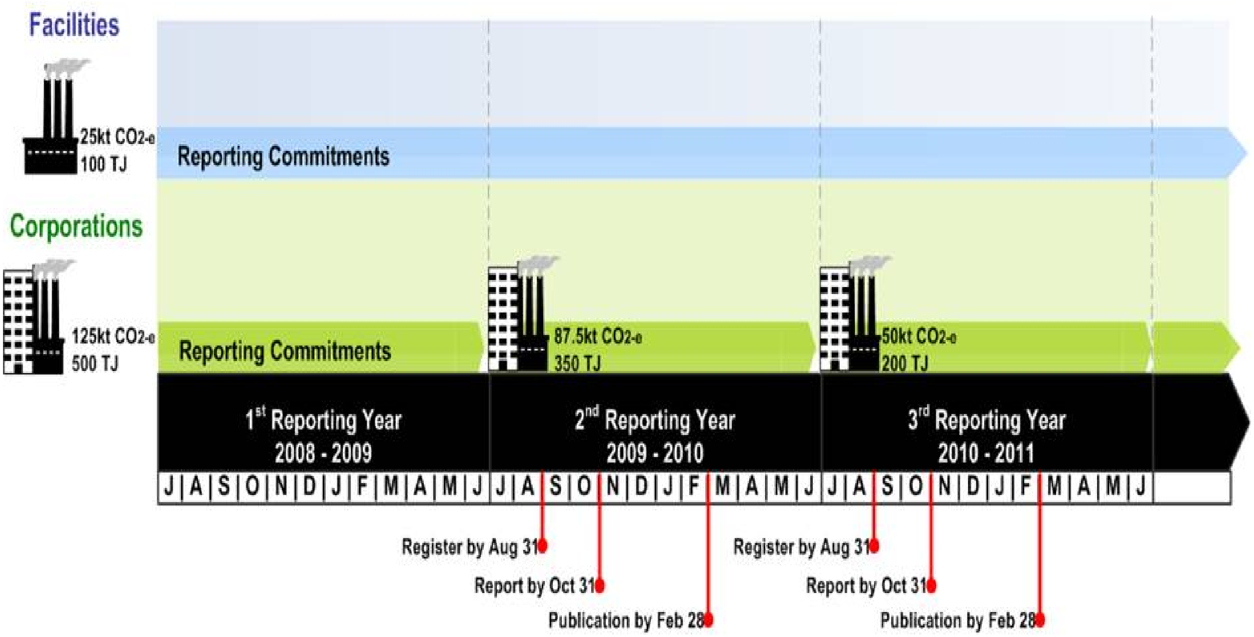
2.2 NGER Act 2007

The Federal Government introduced the *National Greenhouse and Energy Reporting (NGER) Act 2007* in July 2007, and the first reporting year commenced in July 2008. This significant legislation has mandatory reporting for businesses that emit more than the following thresholds which will be applied to determine an organisation's reporting liability:

1. a company-level threshold to be phased in during the first three years following commencement of the legislation, set at:
    a. 125,000 tonnes (125 kt) of carbon dioxide equivalent (CO_2e) or 500 terajoules (TJ) of energy annually for the first year;
    b. 87,500 tonnes (87.5 kt) CO_2e or 350 TJ of energy annually for the second year; and
    c. 50,000 tonnes (50 kt) CO_2e or 200 TJ of energy annually for the third and subsequent years.
2. a facility-level threshold of 25,000 (25 kt) CO_2e or 100 TJ of energy annually to apply from the start of the new system.

The regulations pertaining to the Act were informed by the 2004 World Business Council for Sustainable Development (WBCSD) and World Resources Institute's (WRI) *Greenhouse Gas Protocol; A Corporate Accounting and Reporting Standard* (The GHG Protocol).

The *NGER Act 2007* reporting thresholds for facilities and corporate groups



kt = kilotonnes of carbon dioxide equivalent of greenhouse gases emitted

TJ = terajoules of energy consumed or produced

Figure 1 Reporting timeline for the NGER Act 2007

2.1 Carbon Pollution Reduction Scheme (CPRS)

During the course of this project the Federal Government's Carbon Pollution Reduction Scheme (CPRS) White Paper was released which provided further detail on the structure of the CPRS and potential impact for Council.

The Green Paper had stated that:

> *"Unincorporated entities with operational control over a covered facility would also have obligations under the scheme. This could include partnerships, trusts, government and non-government organisations (for example, where waste landfill sites are operated by unincorporated local government councils), or individuals (who are involved in large facilities). The National Greenhouse and Energy Reporting Act 2007 would be amended to oblige such unincorporated entities to report their emissions to the Government."*

This would require Council to participate in the CPRS and report under the provisions of the NGER Act; despite the NGER Act being limited to corporations (Queensland Local Governments are not corporations under current legislation).

The White Paper provides further clarity to Council on a range of issues however there are still a number unresolved. These include issues around the inclusion or exclusion of legacy emissions (emissions from the decomposition of landfill deposited in previous years), methodologies to be used for calculating emissions and methodologies for methane capture and abatement.

Policy Position 6.17 of the White Paper provides some guidance on the potential impact for Council. This section states that:

"Emissions from landfill sites closed prior to 30 June 2008 will not be covered.

Subject to participation thresholds, all other landfills will be covered from Scheme commencement.

To ameliorate the impact of emissions from past waste streams (known as 'legacy' emissions) estimated emissions from waste deposited in the past will be exclude from the Scheme until 2018.

Methane that is captured will be allocated equally between legacy and new emissions.

Legacy emissions will be reported and counted towards participation thresholds."

This indicates that Council's open landfills will be included, subject to thresholds; however it is not clear from the policy document whether legacy emissions are included. This is an important issue as the majority of emissions from Council's landfills are legacy emissions. Excluding legacy emissions, Council's emissions from Birkdale landfill for 2007/08 would be 14,172 tCO_2e taking account of an proportional reduction for flared emissions. This is below the 25,000 tCO_2e threshold.

Recent discussions with the Department of Climate Change (DCC) (Fiona Gilbert, 10 February 2009) have provided a number of clarifications on the impact of the CPRS for Council. In summary, legacy emissions are intended to be included for calculations to determine participation based on the 25,000 tCO_2e threshold, however legacy emissions are excluded from liabilities until 2018. Whether legacy emissions are those from waste deposited before 30 June 2010 or 30 June 2008 has not been clarified by DCC however this does not impact the fact that Council emissions including legacy emissions will be greater than the 25,000 tCO_2e threshold and therefore Council will be required to participate in the CPRS. Council will be required to obtain permits for some emissions from the landfill, with the quantity of emissions covered by the CPRS currently unclear.

2.2 Local Government Implications

2.2.1 CPRS

The CPRS now dominates and fundamentally alters GHG mitigation in Australia. Effectively, our national commitment (stated in the White Paper) to reducing global emissions below 450ppm CO_2 will mainly be met by the large corporate/industrial emitters (approximately 1,000 companies covering 75% of emissions in Australia) through compliance with the CPRS. These emitters are expected to pass the costs of compliance with the CPRS on to those who purchase their goods and services. Hence, this regulatory regime will drive significant economic reform.

The CPRS overhauls previous state regulatory approaches (none in Qld) and sidelines voluntary approaches to GHG mitigation. Council and the community now need only to meet their CPRS obligations, which for most is paying the additional cost for impacted goods and services (such as fuel and electricity). Increasingly, the CPRS drives consumers to seek savings through efficiencies in the face of rising costs for goods and services provided by the big emitters.

Impact on voluntary abatement

There is now an uncertain (seemingly little) role for voluntary emissions reduction by those in the non-covered sectors who previously championed the cause – such as CCP, local governments (including Redland City Council), community groups, eco-warriors, green groups and environmentalists.

Indeed, voluntary abatement carried out by anyone not required to report under the scheme (non-covered sectors) is linked to and influences the total amount of emissions that the scheme is designed to achieve in any year through permits levied on the top 1,000 emitters (i.e. covered sectors). When the cap is reviewed annually, voluntary abatement in the non-covered sectors lowers the ‘burden’ placed on the covered sectors (large emitters). Those who undertake voluntary abatement do so at additional cost to that paid by the rest of the community (unless the intention is to generate offsets for sale under the CPRS for financial gain).

A debate will no doubt arise over whether voluntary emissions reduction by individuals and corporate entities in the non-covered sector is counter-productive, desirable, or necessary - and how in any case it might be achieved equitably.

CPRS covers landfill

In December, the CPRS White Paper indicated that Council’s open landfills will be included within the scope of the scheme. Council may therefore anticipate the requirement to report through the NGER Act with NGER Act amendments expected in early 2009. The NGER Act requires reporting of both Scope 1 and Scope 2 emissions, though only certain Scope 1 emissions are covered by the CPRS.

Based on recent clarifications provided by DCC, Council would likely need to buy permits for a proportion of the emissions from the Birkdale landfill facility. Until further clarifications regarding legacy emissions are provided by DCC the likely quantity of permits required cannot be identified. Since the landfill is closing and may not continue to operate at current rates, the issue of legacy emissions is significant in determining the level of Council’s liability under the CPRS.

Apart from landfills, there are at this stage no other direct obligations under the CPRS. However, Council will need to focus on reducing the cost of CPRS impacted goods and services purchased by Council through efficiencies and use of alternatives where these are available.

2.2.2 Impact on CCP and LGAP

The final 18 months of the Local Greenhouse Action Plan period, and therefore the LGAP target, is impacted by the issues described above, some of which are challenging on both the corporate and community perspectives. In particular, RCC's current and proposed corporate carbon management is dominated by pre-CPRS voluntary abatement thinking, which may not be appropriate in the post CPRS environment. Current and proposed abatement projects, the development of carbon management and carbon KPIs, and even the Arup Audit itself should now be considered in the light of the post CPRS environment.

There is likely to be continuing uncertainty throughout much of 2009 until the CPRS legislation and its implications are clarified. In that period, the 'safe' corporate expenditures and actions in regard to GHG emissions reduction are those that:

- target investment at efficiencies that return cost savings on short timeframes, primarily in the fuel and electricity use areas (buildings and facilities, and fleet);
- if Council's expected CPRS landfill liability is confirmed by DCC, target investment and management at waste emissions reductions or waste volume reductions; and
- target staff practices and behaviours that reduce costs efficiently, primarily in the fuel and electricity use areas (buildings and facilities, and fleet).

The LGAP expires in 2010, around the same time as the commencement of the CPRS on June 30th 2010.

The purpose of the LGAP is to outline the actions Council will undertake to meet the emission reduction goals established under (Milestone 2) the CCP TM program. These targets were established at a time when there we no Federal or State targets set, few if any government programs or rebate schemes in existence. The Federal Government has now set a target in the range of between a 5% and 15% reduction in emissions from 2000 levels by 2020 – and climbs to a 'long term' target of 60% reduction by 2050. This maintains a now well established target that is mirrored in Queensland's ClimateSmart 2050. Queensland and national government abatement programs and rebate schemes are in place and more are foreshadowed.

These requirements and initiatives have overtaken the Local Greenhouse Action Plan in its ability to influence the wider community. Importantly in the current policy, Council can no longer unilaterally encourage voluntary abatement. The ethical position on encouraging continuing voluntary emissions reduction in the community has shifted. Any investment in such voluntary actions is in addition to the costs that will soon accrue through the CPRS. In this situation, the focus will shift to:

- schemes that target financial drivers and return cost savings for the take-up of certain practices, behaviours and technologies; and
- promotion, advice and assistance with efficient ways of saving on heating, cooling, fuel and power use.

Arguably, these are primarily roles for State and Federal governments, and the role for local government abatement targets and therefore Local Greenhouse Action Plans has all but evaporated. At this stage, it appears that there may be no continuing role for local targets or an LGAP after 2010. However, a decision on the role of the LGAP may be held over to 2010 when further policy clarity will be available.

3 Methodology

3.1 Accounting Standards

Since 2004 international consensus has been emerging on the manner in which organisations should account for their greenhouse gas emissions (GHG). This consensus was initially expressed in the general acceptance and use of the World Business Council for Sustainable Development / World Resources Institute ‘Greenhouse Gas Protocol Corporate Accounting and Reporting Standard’. This Standard has now been adopted as the reference document for the development of the AS/ISO 14064 standard for reporting GHG emissions.

Arup has used these two international accounting standards in the preparation of this carbon footprint:

1. World Business Council for Sustainable Development and World Resources Institute, 2004. *Greenhouse Gas Protocol; A Corporate Accounting and Reporting Standard* (The GHG Protocol); and
2. AS ISO 14064.1 – 2006 *Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals* (AS ISO 14064).

It should be noted that AS ISO 14064 cross references the GHG Protocol, so these two standards are complimentary.

The National Greenhouse and Energy Reporting Act Explanatory Guidelines[4] refer to these two international standards. Therefore the selection of these methodologies is consistent with international practice and should minimise any inconsistencies between program objectives encountered in the development of the carbon footprint.

3.2 General Approach to Emission Calculations

Greenhouse Gases

Greenhouse gases are gaseous constituents of the atmosphere that control energy flows by absorbing infra-red radiation. For the purposes of this report reference to greenhouse gases means the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).

As different greenhouse gases have different Global Warming Potentials (GWP), the Carbon Dioxide Equivalent (CO_2e) has been adopted as the universal unit of measurement to evaluate greenhouse gases against a common basis. CO_2e indicates the global warming potential expressed in terms of the GWP of one unit of carbon dioxide. The GWP of several greenhouse gases are listed in the table below.

[4] Department of Climate Change 2008. *National Greenhouse and Energy Reporting Guidelines*. Commonwealth of Australia.

Table 1 The Global Warming Potential of GHG's.

Greenhouse Gas	Chemical Formula	IPPC 1996 GWP
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxides	N_2O	310
HFC-23	CHF_3	11,700
HFC-134	$C_2H_2F_4$ (CHF_2CHF_2)	1,000
HFC-134a	$C_2H_2F_4$ (CH_2FCF_3)	1,300
Perfluoropropane	C_3F_8	7,000
Sulphur hexafluoride	SF_6	23,900

Emission Factors

Once data is collected, emissions from an organisation's activities are quantified by multiplying activity data (e.g. kilowatts of electricity used) with the appropriate 'emission factor' (e.g. kg CO_2e/kWh of electricity).

$$\boxed{\text{Activity data} \times \text{emission factor} = \text{emissions}}$$

The Department of Climate Change has determined a set of National Greenhouse Accounts (NGA) Factors for Australia. These Factors establish consistency across Australian business and industry and are intended to be used by companies and individuals to estimate and report their greenhouse gas emissions in accordance with their obligations under the NGER Act and other programs.

NGA emission factors are activity specific. Identifying the relevant emission factor can depend on several aspects including:

- whether consumption of the input results in greenhouse gas emissions directly or indirectly;
- how the input creates emissions (i.e. consumption or generation); and
- the location of the activity.

For example, in the National Greenhouse Accounts Factors workbook, the emission factor for the generation of electricity varies from state to state as electricity is generated by various processes using various sources. Victoria predominantly uses brown coal resulting in a relatively high emission factor while Tasmanian electricity is predominantly generated by hydropower resulting in a much lower emission factor.

Emission factors used in this report are from the National Greenhouse Accounts (NGA) Factors 2008[5], with three notable exceptions:

- Emissions from landfill gas have been calculated using the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2008 v1.1. The NGA Factors refer those organisations that operate landfill sites to these guidelines.
- Emissions from air travel have been calculated using the GHG Protocol Business Travel Calculator. This calculator categorises flight legs into short, medium and long and applies different factors for each category of flight. Arup has used these factors and applied them to data supplied by RCC to calculate emissions from air travel.

[5] Department of Climate Change 2008, *National Greenhouse Accounts (NGA) Factors*, Australian Government.

- Emissions from refrigerant losses from vehicle air conditioning systems and domestic refrigeration (i.e. kitchen refrigerators) have been calculated using the Australian Greenhouse Office (AGO) Factors and Methods Workbook 2006. Reference to specific refrigerant systems such as mobile and domestic refrigerant systems is not available in the NGA Factors 2008. As these systems have a lower emission factor than commercial refrigeration and air conditioning systems, Arup considers this approach to be more accurate for RCC's operations.

The 2008 NGA Factors were released in November 2008, during the course of this project, and so these factors were not utilised in earlier work for this project and the document was not included as the relevant reference in earlier project reports prepared by RCC or Arup. However all relevant factors have now been updated in order to provide RCC with an up to date footprint.

Other Assumptions relevant to the Footprint Calculation

Further to the above, obtaining data on refrigerant leakages from each vehicle's air conditioning system in RCC's large and diverse vehicle fleet is an almost impossible task. Grouping of vehicles into similar vehicle sizes that represent equal or similar refrigerant recharge capacities was determined to be a more efficient method of quantifying emissions. For example, all sedans, station wagons, 4WD's, trucks etc were grouped into categories and the average recharge capacity for each vehicle size applied. This presented a good estimate of annual refrigerant losses for a fleet with a large number of vehicles.

Taxi travel emissions were estimated by adopting the Victorian Environmental Protection Agency's method using RCC's monthly taxi expenditure, the cost per kilometre travelled and the taxi fuel usage per kilometre travelled. As RCC's data is limited to monthly expenditure and individual trip information is unavailable, Arup therefore made several assumptions.

Firstly, it was assumed that all trips took place in Liquefied Petroleum Gas (LPG) fuelled taxi's which approximately use 0.16 Litres every kilometre travelled[6]. Hence, the LPG emission factor for transport fuel was used for all calculations. Secondly Arup assumes that all trips took place in South East Queensland (SEQ) between 7am and 7pm, Monday to Friday and on non-public holidays. This enabled the SEQ 'normal hours' charge rate of $1.60/km travelled to be applied.

3.2.1 Waste

Emissions released from the solid waste disposal on land are calculated by using the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2008 v1.1. This guideline allows for the calculation of Scope 1 emissions for organisations that operate landfill sites. The Measurement Guidelines refer to carbon dioxide (CO_2) emissions generated from waste to be from biomass sources and not included in calculations. Therefore, only the methane content from landfill gas is estimated (omitting the CO_2 from calculations). The flaring of methane also excludes CO_2 from calculations.

The quantity of the methane generated from landfill sites is based on the decay of degradable organic carbon stock and reflects the waste disposal activity over the life of the landfill. Since its opening year in 1993, Birkdale Landfill has received various waste mix types (i.e. food, paper and paper board, wood and wood waste, nappies, rubber and leather etc) amongst the three waste streams: municipal solid waste; commercial and industrial; and construction and demolition. Waste calculations involve the ratio of each waste stream and mix type applied to the degradable organic carbon value and methane generation constant associated with each waste mix type.

Gaps in RCC's historical waste data for Birkdale landfill resulted in the application of the default values for waste mix types from the Measurement Guidelines. The total amount for Birkdale's annual waste previous to 2001/02 was estimated by decreasing the overall waste amount by 5.5% each year to 1993. This percentage is the average annual waste reduction from the four years of total waste data provided by RCC.

A consistent approach was utilised to calculate emissions from the Giles Road Landfill site. Historical data was also unavailable for this landfill site previous to 2001/02. An annual reduction rate of 5.5% was therefore applied for the remaining operating years.

3.2.2 Street light emissions

Obtaining accurate, robust and complete streetlight data from RCC's energy retailer has proven difficult. RCC's annual streetlight data was provided in only graph form with approximated electricity usage obtained from visual estimates. Previous reports however have indicated that estimates are consistent with historical and current billing data. Given this consistency and the large proportion streetlight emissions contribute to RCC's overall carbon footprint, it is believed that the inclusion of estimated 2007/08 streetlight data provides a greater level of accuracy than not including this information.

In the future, it would be beneficial to require suppliers to provide improved billing and consumption calculations.

3.3 Explanation of Scopes 1, 2 & 3

Fundamental to the accounting standards is the separation of emissions into three categories based on direct and indirect emissions. In accordance with this standard, RCC's emissions have been categorised as follows:

Table 2 Categorisation of RCC emissions

Scope	Reporting basis	RCC's emissions to be reported
Scope 1	Scope 1 emissions are from sources that are owned or controlled by the Council	• Landfill gas from landfill operations • Fuels burnt in 'on road' transport fleet • Fuels burnt in 'heavy load' transport fleet • Fuels burnt in 'light plant' equipment • Refrigerants from air conditioning (building AC systems and vehicle AC systems) and refrigeration systems
Scope 2	Scope 2 emissions are the result of purchased electricity consumed by the Council	• Electricity consumed by RCC assets
Scope 3	Scope 3 emissions are a consequence of the activities of the Council, but occur from sources not owned or controlled by the Council	• Employee air travel • Employee taxi travel • Employee ferry and barge travel • Fuel extraction, production and transport, and purchased electricity transmissions and distribution line losses

Under the Federal government NGER reporting standards, Scope 1 and Scope 2 emissions are required to be reported, while Scope 3 emissions are optional. As discussed with RCC, available Scope 3 emissions are included in 2007/08 calculations demonstrating a proactive initiative in reporting beyond statutory requirements.

Scope 3 emissions from fuel extraction, production and transport, and purchased electricity transmissions and distribution line losses are included in 2007/08 calculations to allow comparison to CCP reporting. CCP reporting includes these related Scope 3 emissions but they are not separated into different scopes.

Separation of Scope 1 and 2 emissions is also important for reporting purposes. For example Council's liability to report under the NGER Act 2007 is determined by the combination of all Scope 1 and 2 emissions and Council's status as a 'corporation', whereas liability under the CPRS is determined by Scope 1 emissions only.

Along with providing transparency and helping distinguish between direct and indirect emission sources, emissions are categorised in this manner to avoid double counting. Double counting occurs when two or more organisations reporting on their greenhouse gas emissions take ownership of the same emissions or reductions in the same category[7]. To avoid double counting it is important that Scope 1 emissions are only counted on one occasion and not added to Scope 2 and 3 emissions to calculate a total for RCC's carbon footprint. An example of this would be if emissions from Council's waste were included as Scope 3 emissions in additional to being Scope 1 emissions for council as the operator of the landfill.

3.4 Operational Boundaries

The Greenhouse Gas Protocol defines the parts of the organisation's activities that are to be included in the inventory the 'boundaries' of the organisation. As an organisation is rarely a static entity with the same overall areas of activity from year to year, the issue of boundaries must be addressed every time a carbon footprint report is compiled.

At the inception meeting, the team discussed the operational boundary of RCC with Council staff. It was agreed the emissions caused by the following four main areas of activity would be included in the organisational boundary for RCC:

- Buildings and facilities
- Streetlights
- Waste
- Transport fleet and minor plant equipment

Of significance is the exclusion of GHG emissions from water. Prior to 2008, water services were the responsibility of local government and accordingly GHG emissions from potable water reticulation were included in the carbon footprints of Queensland local governments. Under the Council's emissions profile in its CCP Milestone 5 report of 2004, the RCC estimated emissions from the combined water/wastewater sector to be 57%. However, in 2008, the Queensland Government gained control of water supply and treatment from Local Government. Thus, GHG emissions from the water sector will not be considered in the Council's carbon footprint.

Whilst this change in operational control translates to a 57% reduction in carbon emissions in a 12 month period, and therefore the instant achievement of corporate objectives, this is an inaccurate interpretation. The actual reduction achieved in the preceding 12 months is the reduction achieved across those items that have remained in Council's organisational boundary (and so within Council's sphere of influence) over the 12 month period. It is worth

[7] World Business Council for Sustainable Development (WBCSD)/World Resources Institute (WRI); The Greenhouse Gas Protocol; A Corporate Accounting and Reporting Standard (Revised Edition); 2004

noting that Council's targets were set and decisions were made in the knowledge that most gains would be made in the pumping sector relating to water and wastewater treatment. For example in the CCP Milestone 5 report, an overall 11% reduction was achieved due to a 27% reduction from Redland Water and Wastewater, there was in fact a net increase of 3-13% in all other council operations. Therefore the removal of water from Council's footprint has in fact made the 25% target more difficult to achieve.

Waste is another issue for discussion. Whilst waste emissions are included in Council's organisational boundary the waste is largely generated by parties other than council. Council's ability to manage waste related emissions is limited to the transport of waste, management of waste disposal sites and influencing community practices in relation to the quantity of waste sent to landfill. Arguably the waste related emissions are more appropriately considered as a 'community emission' rather than a direct (and manageable) consequence of Council's activities.

Emissions from Birkdale and Giles Road Landfills only have been included in this footprint. Detailed data was not available for all landfills and a number of landfills are closed or now operating as waste transfer stations. Whilst these closed landfills will continue to emit carbon for decades, there is insufficient available information to quantify these emissions and limited ability of RCC to influence these emissions.

Corporately, RCC does not currently accurately record the amount of waste produced by its activities. Records are kept of the size and number of bins and collection frequency; however this does not assist with identifying actual amounts of material disposed. Even with this information, Council's corporate waste emissions (Scope 3) would not be included separately in the carbon footprint as this waste is already included in the emissions from landfill. A number of council collected bins such as the park bins and performing arts centre bins are also likely to contain largely community waste making the future separation of Council's corporate waste emissions inaccurate.

3.5 Base Year and Years of Calculation

The year for calculation of the RCC's carbon footprint will be the financial year period from the 1st of July 2007 to 30th June 2008. The use of the financial year reporting period aligns with the budgeting process for the RCC.

3.6 GHG Accounting Principles

The WRI promotes five GHG accounting principles that are intended to support all aspects of accounting, quantification and the reporting of GHG emissions. The principles provide creditability and consistency across the various industries and organisations reporting GHG emissions, including RCC. The five GHG accounting principles are summarised below.

Relevance

Ensure the GHG inventory appropriately reflects the GHG emissions of the organisation and serves the decision-making needs of users – both internal and external to the organisation.

Completeness

Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.

Consistency

Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

Transparency

Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

Accuracy

Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

To the best of our knowledge, Arup has reported carbon information in a creditable and unbiased manner with adherence to these GHG principles and setting an implicit standard worldwide. This is to provide the most accurate and fair representation of RCC's emissions.

3.6.1 Application of the WRI Principles

While every effort was made to carry out a comprehensive desktop study of the carbon footprint of RCC as per the project scope, no direct measurements were conducted as part of the methodology. Data received from RCC consisted of records kept by various departments (i.e. RCC fleet department and facilities) and results reported.

Arup has performed the carbon footprint analysis based on data provided by RCC. Data received from RCC consisted of records kept by various departments (i.e. RCC fleet department and facilities). As outlined above, the Greenhouse Gas Protocol's five accounting principles emphasise completeness and consistency in calculating a company's carbon footprint. These principles, along with the other three, must be applied to ensure a fair representation of RCC's emissions results.

3.7 Materiality

Materiality is defined as whether an error or omission in the calculation of the carbon footprint is a material discrepancy or not. Some data issues have the potential to be improved, although they are not expected to represent more than 5% of the total emissions.

Any areas omitted from the determination are not expected to be greater that 5% of the total emission.

Calculations of RCC's building air-conditioning systems emissions generated from the leakage of refrigerant gases are limited to systems where name plates were attached. Therefore refrigerant leakage data for building air-conditioning systems is not complete for the whole of RCC's facilities.

Diesel used by back up generators is also not included in this year's carbon footprint as data was unavailable. As emissions for each of these sources will not exceed 5% of RCC's total carbon footprint, emissions are regarded as immaterial.

3.8 Comparison of CCP and NGER Methodologies

The table below presents the emission sources reported under the CCP and NGER methodology. The distinct differences between the two methodologies include: waste (Scope 1); employee travel in addition to fleet vehicles; refrigerant gases; and the inclusion of LPG usage (stationary energy).

Adhering to the NGER guidelines for RCC's 2007/08 carbon footprint has resulted in a significant increase in total GHG emissions. This is primarily due to the inclusion of landfill emissions as Scope 1.

The inclusion of emissions from fuel extraction, production and transport, and purchased electricity transmissions and distribution line losses, also varies in the two methodologies however, are accounted for in both methodologies. In the CCP methodology these emission sources are included in the fuel and electricity calculations by applying the full fuel cycle emission factor to energy consumption. As these emissions are regarded as indirect emissions, emissions RCC can not directly control, the NGER methodology presents emissions in Scope 3 with a Scope 3 emission factor applied.

Table 3 Comparison of NGER and CCP Methodologies

Emission sources reported	CCP-corporate	NGER
Passenger fleet	✓	✓
Heavy fleet	✓	✓
Plant equipment	✓	✓
LPG usage (stationary energy)	✘	✓
Electricity usage (incl. streetlights)	✓	✓
Air travel	✘	✓
Ferry/barge travel	✘	✓
Taxi travel	✘	✓
All landfill Waste (Scope 1)	✘	✓
Council Waste (Scope 3)	✓	✘ **(included within Scope 1 landfill waste)**
Refrigerant gas	✘	✓
Fuel extraction, production & transport, & purchased electricity transmissions & distribution line losses.	✓	✓ **(Scope 3)**

4 Carbon Footprint Results

This section of the report provides the results of the carbon footprint broken down into scope 1, 2 and 3 emissions. Each scope is interrogated in more detail to provide meaningful results for Council and to guide mitigation recommendations.

Using the methods detailed in previous sections and data provided by RCC, Arup has identified **124,011 tonnes of CO_2e** in the 2007/08 financial year (refer Table 5). Scope 1 emissions equated to 111,539 tonnes of CO_2e, 90% of the total emissions. Scope 2 emissions accounted for 10,738 tonnes of CO_2e, contributing 9% of RCC's total emissions while Scope 3 emissions are 1,734 tonnes, 1% of total emissions.

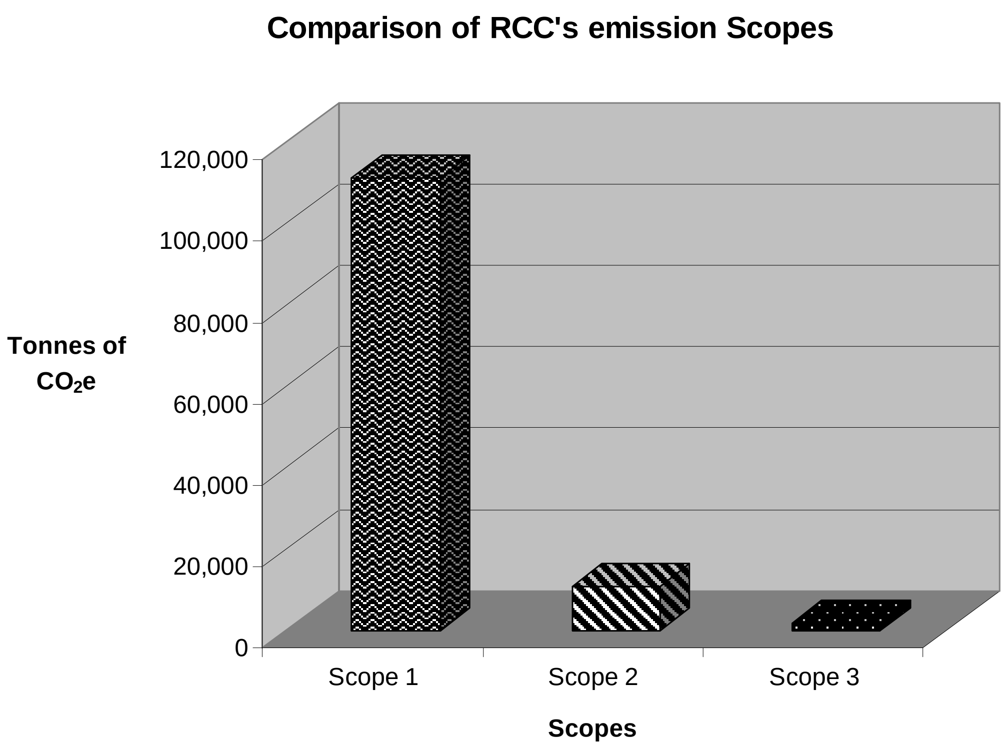


Figure 2 All RCC carbon emissions by Scope

4.1 Scope 1 Emissions – 111,539 tonnes CO_2 e

Under the GHG Protocol it is mandatory to report all Scope 1 emissions. RCC's Scope 1 emissions consisted of landfill gas emissions, fuels burnt in fleet vehicles and heavy plant, refrigerant gases (building refrigerators and vehicle and building AC systems) and stationary Liquefied Petroleum Gas (LPG) use.

In this reporting period, Scope 1 emissions are dominated by the landfill gas emissions. The Birkdale Landfill emits over 105,000 tonnes of CO_2e, which equates to 85% of the overall emissions while the Giles Road Landfill emits over 5,000 tonnes of CO_2e contributing 4% of RCC's overall emissions.

Next in order of significance are emissions associated with the fuel used to provide Council with various forms of transport and services. Fuels used include diesel, unleaded, ethanol blended unleaded petrol, LPG and Lead Replacement Petrol resulting in over 1,676 tonnes of CO_2e (1% of RCC's total emissions).

Emissions associated with refrigerant losses contributed 43 tonnes of CO_2e (0.04%) of RCC's overall carbon footprint. Synthetic refrigerant gases that leak from refrigerators and building and vehicle air-conditioning systems typically have high Global Warming Potentials (GWP) of around 2,000; however they contribute relatively small quantities to the overall inventory due to the small amounts allowed to escape to the atmosphere.

The use of LPG for stationary energy purposes emitted 4 tonnes of CO_2e. LPG stored in cylinders is used at landfill sites and transfer stations. This is insignificant when compared to other emissions.

4.2 Scope 2 Emissions – 10,738 tonnes CO_2 e

Under the GHG Protocol it is mandatory to report all Scope 2 emissions, which are the indirect GHG emissions are associated with the purchase of electricity. A total of 11,800,450kWh of electricity was consumed throughout the reporting period equating to 9% of RCC's overall emissions.

Electricity usage for street lighting and other outdoor lighting (traffic lights, watchman lights, park lights etc) has increased from past reporting years with usage accounting for 46% of RCC's Scope 2 emissions. Street lighting therefore remains RCC's largest Scope 2 emission source emitting 4,887 tonnes of CO_2e. Council has limited ability to influence streetlighting emissions, and therefore this aspect of emissions is not investigated in significant detail through this report.

RCC's electricity consumption from facilities is dominated by Council's buildings which account for 36% of overall electricity usage. Community and park facilities are the next largest contributors, accounting for 9% and 7% respectively.

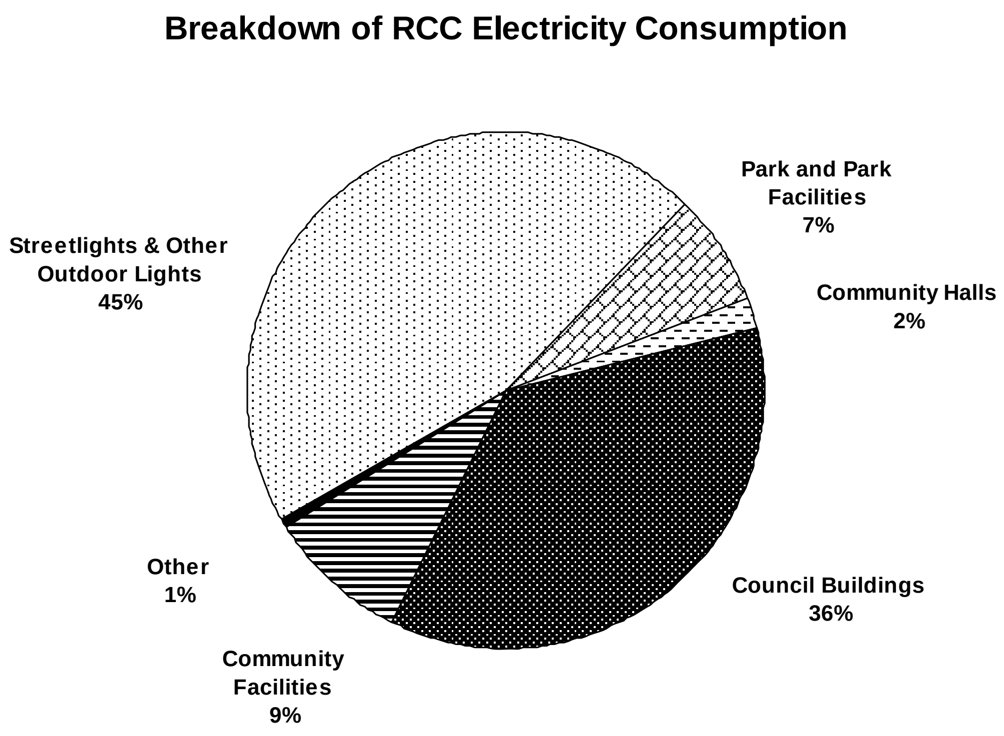


Figure 3 Separation of RCC electricity consumption

The breakup of Council building emissions identifies the Council Chambers as the largest energy user accounting for 47% of all Council buildings emissions. The Cleveland Library is the 2nd largest energy consumer of Council buildings followed by the South Street Depot. Capalaba Place and the Performing Arts Centre are RCC's 4th and 5th largest building electricity users. These five buildings account for 96% of the energy consumption of all council buildings.

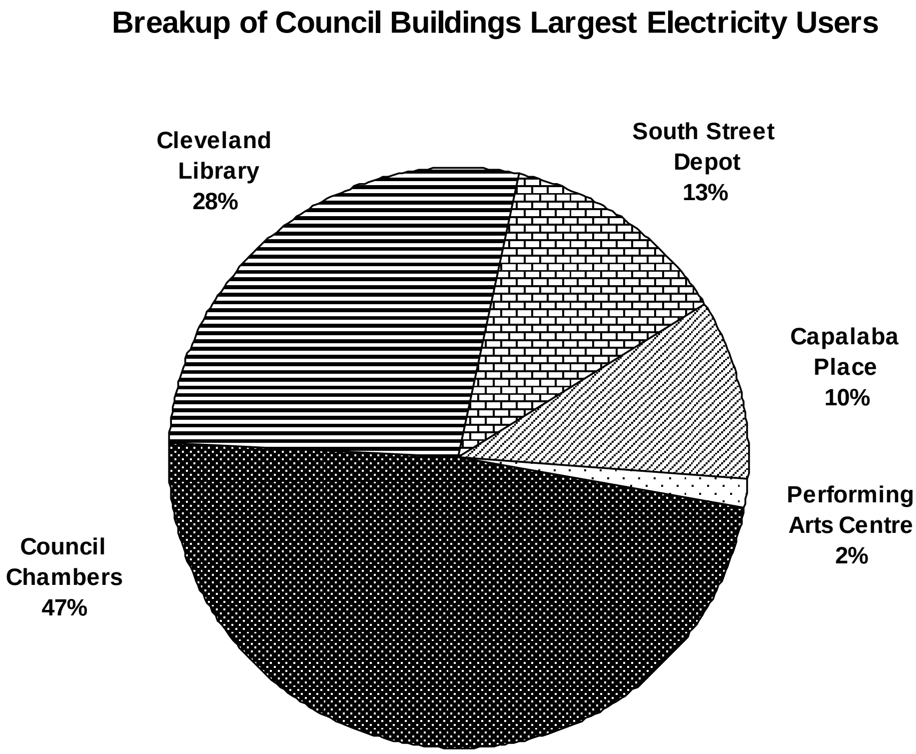


Figure 4 Breakup of Council buildings largest electricity users

An initial investigation into benchmarking the electricity consumption of these buildings has been undertaken (refer Table 2 below). This has included an allocation of emissions per staff member for the administration, Cleveland library and Capalaba Place buildings. Whilst comparison between these buildings has limited value due to the different uses of the buildings, this will allow these buildings to be tracked over time with staff numbers taken into account.

Table 4 Analysis of main buildings based on staff numbers and floor area

	Emissions (t CO_2e)*	Staff Numbers	t CO_2e / staff member	Floor area (m^2)	t CO_2e /m^2
Administration building	2047	471	4.35	7245	0.283
Cleveland Library	1181	275	4.29	4671	0.253
Capalaba Place	426	30	14.2	NA	NA

*Per building figures include both Scope 2 and 3 emissions associated with electricity consumption to allow comparison to CCP figures.

4.3 Scope 3 Emissions – 1,734 tonnes CO_2e

Scope 3 emissions are not mandatory for reporting under the Greenhouse Gas Protocol or the NGER Act. Emissions in this category could potentially come from a very wide range of issues related to the core organisational activity. For some organisations Scope 3 emissions make up the majority of the footprint, whereas for RCC Scope 3 are a small proportion of the total footprint.

Examples of Scope 3 emissions include emissions calculated from supply chain issues such as materials and transportation of goods to the emissions indirectly from business including air and taxi travel. However, there is little benefit in reporting emissions under this category if there is no capacity or intention to start to manage these emissions. Arup advises that it is beneficial to report Scope 3 emissions over which RCC has reasonable control. Other Scope 3 emissions categories can be included in subsequent years as experience with the process is gained.

Scope 3 emissions be considered (in order of magnitude): fuel extraction, production and transport, and purchased electricity transmissions and distribution line losses; employee ferry and barge travel; employee air travel; and, employee taxi travel.

Fuel extraction, production and transport, and purchased electricity transmissions and distribution line losses accounted for 1,695 tonnes of CO_2e. The purchased electricity transmission and distribution line loss accounted for 90% of the total emission source while the extraction, production and transport of fuel consumed in fleet vehicles contributed 10%.

Ferry and barge travel is a frequent form of vehicle transportation and passenger travel for RCC employees. RCC undertook an estimated 63,226 km of ferry and barge travel during 07/08 emitting a total of 19 tonnes of CO_2e.

RCC undertook an estimated 150,000 km of air travel emitting 18 tonnes of CO_2e. Air travel by RCC staff consisted predominantly of domestic flights with one international flight. Air travel emissions are calculated by using the GHG Protocol Business Travel Calculator which categorizes flight legs into short, medium and long and applies different factors for each category of flight.

Emissions from taxi travel accounted for 2 tonnes of CO_2e to RCC's carbon footprint.

Scope 3 emissions accounted for just over 1% of RCC's overall emissions including landfill emissions, or 12% of the emissions excluding landfill emissions. Additionally the majority of Scope 3 emissions are associated with electricity consumption and fuel use. These issues will be directly addressed through efficiency actions to reduce Scope 1 and 2 emissions. Therefore Scope 3 emissions are not considered a significant focus area.

Table 5 RCC's NGER greenhouse gas emission summary

Redland City Council Carbon Footprint Summary Table (2007/2008)	Consumption	Consumption Units	CO_2-e (tonnes)	% of total emissions
Scope 1 - Direct emissions			**111,539**	**89.94%**
Fuels burnt in RCC passenger vehicles	475	kL	1,104	0.89%
Fuels burnt in RCC heavy fleet	368	kL	559	0.45%
Fuels burnt in RCC light plant equipment	9	kL	13	0.01%
Refrigerant gases from building and vehicle AC and refrigerator systems	30	kg	43	0.04%
Emissions from RCC operated landfills (with flaring abatement included)	90,963	tonnes	109,816	88.55%
LPG use	3	kL	4	0.00%
Scope 2 - Emissions associated with the use of electricity			**10,738**	**8.66%**
Purchased electricity for tenant light and power at facilities	11,800,450	kWh	10,738	8.66%
Scope 3 - Indirect emissions			**1,734**	**1.40%**
Air travel	150,128	km	18	0.01%
Taxi travel	1	kL	2	0.00%
Ferry/barge travel	63,226	km	19	0.02%
Fuel extraction, production & transport, & purchased electricity transmissions & distribution line losses.	NA*	NA*	1,695	1.37%
Net Carbon Emissions			**124,011**	**100%**

* Consumption is related to the Scope 1 and Scope 2 usage of each energy source.

4.4 2007/08 Emissions compared to the CCP footprint

In the past, RCC have reported GHG emissions under the CCP reporting guidelines while this years GHG emissions follow the NGER reporting guidelines.

There are significant differences between the methodologies for the two guidelines, both in terms of the emissions included and in terms of the detailed calculations to identify emissions quantities.

One clear distinction between the CCP and NGER reporting guidelines is the inclusion of landfill gas emissions from the RCC community landfill sites in RCC's GHG inventory. The NGER guidelines require landfill operators to report landfill gas emissions in the Scope 1 emissions category as opposed to this being considered as a community emission.

The table below compares the 1998 and 2005/06 CCP GHG Emissions with the 2007/08 footprint for the 3 common areas of buildings and facilities; vehicle fleet and street lights. Water and wastewater emissions were also included in the 1998 footprint, and as identified landfill emissions included in the 2007/08 footprint (but are not given in the table).

Table 6 Comparison of 1998 and 2005/06CCP GHG Emissions with the 2007/08 footprint

Key Council Operational Areas	1998 CCP GHG Emissions	2005/06 CCP GHG Emissions	2007/08 GHG Emissions*	Change 1998 compared to 2007/08	
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	%
Buildings and facilities	5,317	5,740	6,687	1,370	26%
Vehicle fleet	1,472	2,010	1,836	364	25%
Street lights	4,073	5,707	5,585	1,512	37%
Total	**10,862**	**13,457**	**14,108**	**3,246**	**30%**

*Figures include both Scope 2 and 3 emissions associated with electricity and fuel consumption to allow comparison to CCP figures.

Under the CCP categories Council emissions show a 30% increase between 1998 and 2007/08 to 14,108 t CO2e. This is driven by all three key Council operational areas, with streetlights showing the greatest increase (refer Figure 5 below). This is significantly above the CCP target of a 25% reduction on 1998 emissions by 2010, which would equal 8146 t CO_2e. A 42% reduction on 2007/08 figures would be required by 2010 to achieve the CCP target. As emissions from streetlights are largely outside Council's control, achievement of the target would require a 70% reduction in emissions from buildings and facilities, and fleet by 2010 (assuming streetlight emissions remain constant). This is not achievable and therefore Council is unable to achieve the established CCP corporate target.

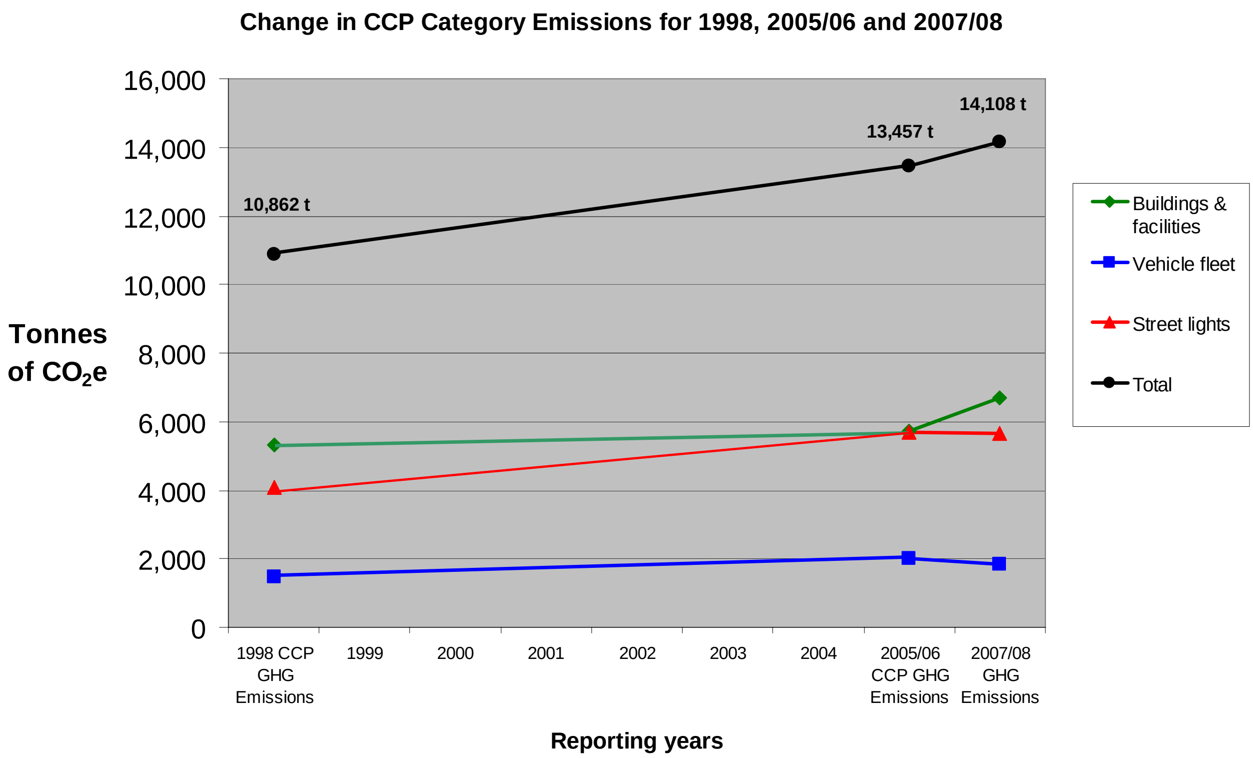


Figure 5 Comparison of 1998 and 2005/06CCP GHG Emissions with the 2007/08 footprint

Figure 6 is provided to give some scale to the different footprint results using different methodologies. It shows the impact of both removing the water emissions in the 2007/08 footprint and including the landfill waste emissions. Several emission sources in the 2007/08 footprint are too small to be practically represented in the graph below (refrigerant gases, LPG usage and Scope 3 emissions) and are therefore grouped to form the category, 'Other emissions'.

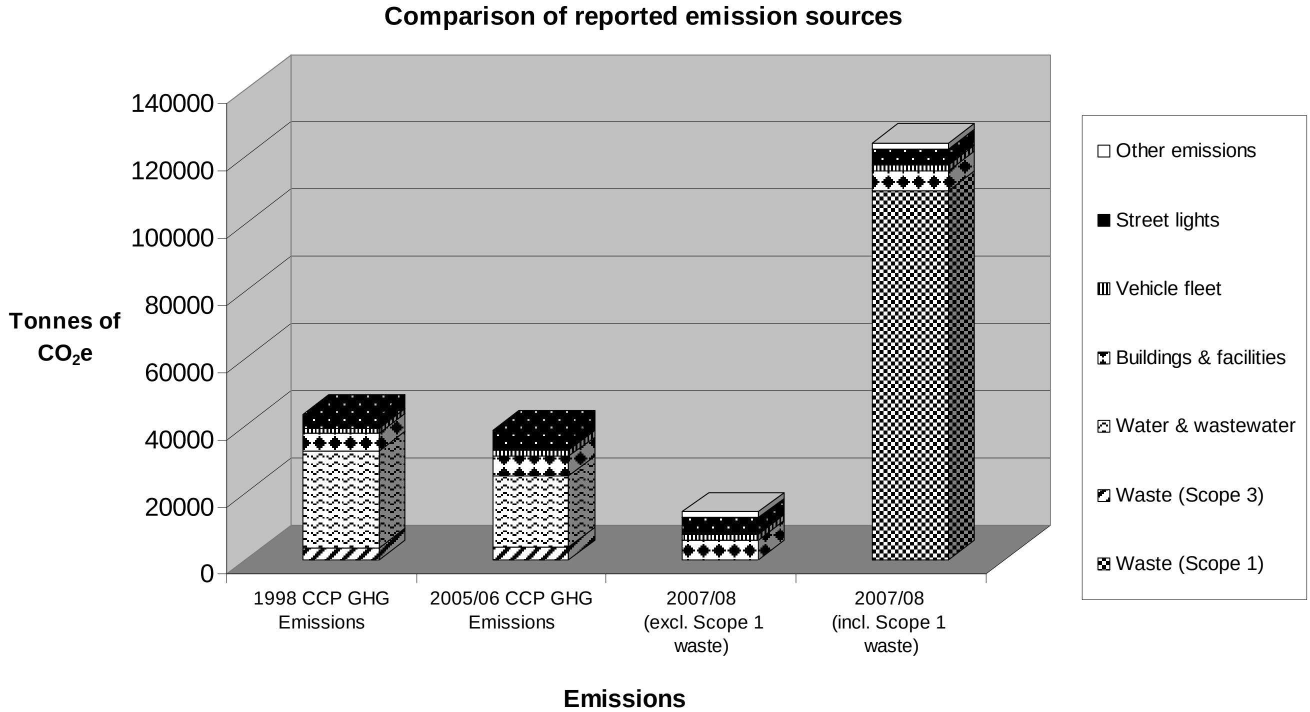


Figure 6 Comparison of reported emissions sources.

This data is included in Table 7 below where the emissions for each operational area are identified. .

Table 7 Comparison of reported emissions sources.

Key Council Operational Areas	1998 CCP GHG Emissions	2005/06 CCP GHG Emissions	2007/08 (excl. Scope 1 waste)	2007/08 (incl. Scope 1 waste)
	t CO_2e	t CO_2e	t CO_2e	t CO_2e
Waste (Scope 1)	Not CCP Corporate	Not CCP Corporate	NA	109,816
Waste (Scope 3)	3,352	3,855	NA	Included in Scope 1 emissions above
Water and wastewater	28,937	21,106	NA	NA
Buildings and facilities	5,317	5,740	5,851	5,851
Vehicle fleet	1,472	2,010	1,676	1,676
Street lights	4,073	5,707	4,887	4,887
Fuel and electricity extraction, production & transportation	Included in Scope 1 & 2 emissions above	Included in Scope 1 & 2 emissions above	1,695	1,695
Other Scope 1 emissions*	No data	No data	47	47
Other Scope 3 emissions**	No data	No data	39	39
Total	43,151	38,418	14,195	124,011

* 'Other Scope 1 emissions' include LPG usage and refrigerant gases.

** 'Other Scope 3 emissions' include air travel, taxi travel, and ferry and barge travel.

4.5 Potential Drivers of Emissions Increases

There are a number of reasons why Council emissions may have increased. These include increases in the number of facilities, increases in fleet size, increases in RCC population, and increases in staff numbers. For example, RCC staff numbers have increased from 887 in 1998 to 1292 in 2008. This represents a 45% increase.

Council's efficiency during this time has improved. For the buildings and facilities, emissions have reduced from 6 t CO_2e per staff member per annum in 1998 to 5.17 t CO_2e per staff member per annum in 2007/08. This represents as 14% increase in efficiency.

For fleet, the emissions have reduced from 1.66 t CO_2e per staff member per annum in 1998 to 1.41 t CO_2e per staff member per annum. This represents a 15% increase in efficiency. Based on a per vehicles calculation, the emissions per vehicle for passenger fleet have decreased by 45% to 2.8 t CO_2e per vehicle per annum.

There have also been a number of new facilities during the period 1998-2008. These include the Victoria Point library and the Performing Arts Centre. The emissions from these facilities included in the 2007/08 footprint total 289 t CO_2e. Excluding these facilities a 17.6% reduction on CCP 1998 emissions has been achieved.

The population of the Redland local government area has also increased from 107,697 in 1998 to 132,971 in 2007. This represents a 23% increase in population.

It is important to note that the target set by Council in 1998 was not a pro-rata or per captia target and as such these figures are provided for discussions and information only.

4.6 Key focus areas

The largest single contributor to the RCC carbon footprint is landfill gas emissions (90%). As these emissions from landfill gas are undoubtedly the largest source of RCC's total emissions, the relative magnitude of other emission sources is more clearly represented when the landfill gas is temporarily removed from the picture. Figure 5 conveys a clearer picture of the remaining key emission sources.

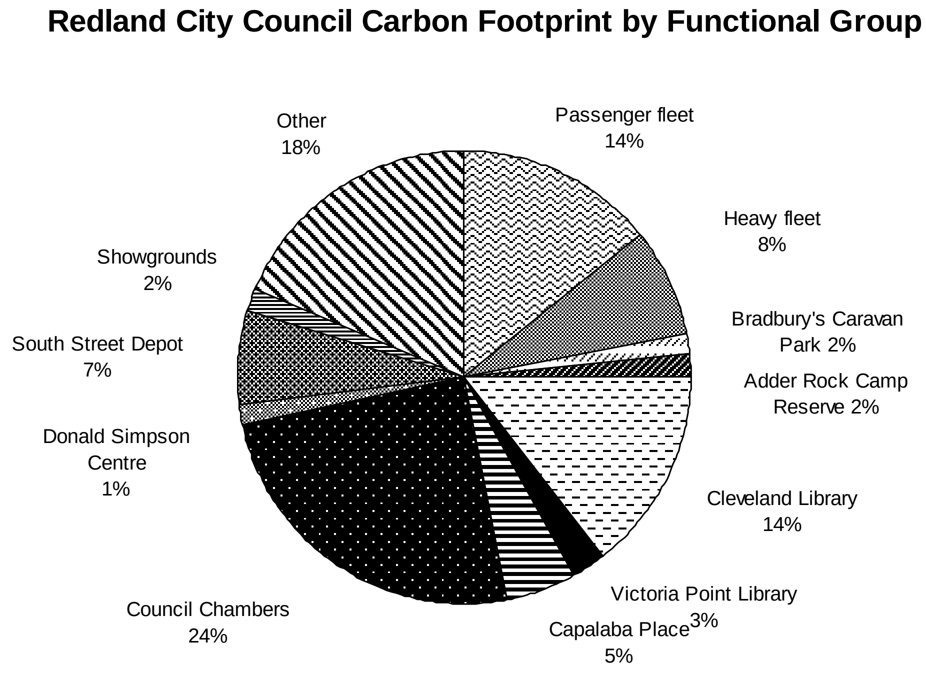


Figure 7 RCC Carbon footprint by functional group

The graph shows that the two key areas for action are the main Council buildings (54% of the functional group emissions) and fleet (22% of the functional group emissions). Street lighting has been included in the 'Other' category as it is largely outside Council's control. Rate 3 streetlight usage (streetlights installed and maintained by Council) are also included in the 'Other' category as the majority of these lights are unmetered. For information Rate 3 streetlight emissions are estimated to reflect less than 0.5% of emissions.

4.7 Future projections based on historical data

The table below shows the key assets for which historical data is available. This graph shows the general trends of emissions from these assets. Full fuel cycle emissions (Scope 2 and 3) have been used to allow comparison of NGER figures with previous CCP figures. Using these trajectories, adjustments can be made to the current emissions figures to provide estimates for future years. These estimates are based on a number of assumptions such as the continuation of previous trends in emissions. Arup are also aware that a number of additional facilities are likely to be included in future carbon footprints which will impact future projections.

Table 8 Analysis of fleet and main buildings emissions changes

Functional Area	1998		2003/04		2005/06		2007/08	
	Usage (km)	CO_2e	Usage (L)	CO_2e	Usage (km)	CO_2e	Usage (L)	CO_2e
Passenger Fleet (Scope 2 and 3)	3,282,054	1,058	No data	No data	5,731,293	1,325	473,778	1,188
Heavy Fleet (Scope 2 and 3)	879,246	347	No data	No data	912,775	545	367,386	634
	Usage (kWh)	CO_2e	Usage (kWh)	CO_2e	Usage (kWh)	CO_2e	Usage (kWh)	CO_2e
Council Chambers (Scope 2 and 3)	No data	No data	2,057,412	2,263	1,711,299	1,813	1,968,693	2,047
Capalaba Place (Scope 2 and 3)	No data	No data	392,160	431	403,883	428	410,000	426
South Street Depot (Scope 2 and 3)	No data	No data	374,590	412	495,580	530	522,379	543
Cleveland Library (Scope 2 and 3)	No data	No data	1,030,080	1,133	1,061,569	1,124	1,135,918	1,181
Donald Simpson House (Scope 2 and 3)	No data	No data	132,641	146	106,224	117	112,819	117

The table below shows the results of future projections for 2008/09 and 2009/10 emissions based on 2007/08 figures and historical changes in key assets. These figures show that emissions changes are expected to be minor, with some assets increasing emissions and others decreasing. Without the implementation of planned and proposed abatement, the 30% increase currently recorded against the CCP target is expected to be effectively maintained in 2009/10. Section 5 analyses in more detail the additional RCC emissions abatement anticipated by 2010 once planned and proposed abatement is taken into account.

Table 9 Future RCC emissions projections based on historical trends

Key Council Operational Areas	1998 CCP GHG Emissions	2007/08 GHG Emissions	Estimated 2008/09 GHG Emissions before planned abatement	Estimated 2009/10 GHG Emissions before planned abatement	Change 1998 compared to 2009/10	
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	%
Buildings and facilities	5,317	6,687	6,685	6,687	1,370	26%
Vehicle fleet	1,472	1,836	1,818	1,819	347	24%
Street lights	4,073	5,585	5,585	5,585	1,512	37%
Total	**10,862**	**14,108**	**14,088**	**14,091**	**3,229**	**30%**

5 Abatement Projections

This section of the report includes general discussion of abatement actions undertaken by Council, as well as identification of any significant abatement planned into the future. The key issue is abatement that is in the system or proposed in budget submissions that will cause differences in Council emissions trajectories from previous years. Where possible these activities have been identified and the abatement estimated. This provides a more accurate estimate of Council's emissions for 2009/10 to allow comparison against the CCP target.

Abatement is the term used to describe the reduction in greenhouse gas emissions from current and recent activities. Redland has undertaken a range of abatement activities in response to drivers including the CCP program and a general push for improved energy and financial efficiency. The abatement activities can be classified into different activity areas including:

- Buildings and equipment;
- Green Power;
- Fleet;
- Streetlights; and
- Waste/landfill flaring.

Each of these areas is discussed in more detail below.

Additional abatement has been undertaken in the form of tree planting however due to NGER requirements and available data these have not been included in this abatement section. It is noted however that a significant number of trees have been planted by RCC, over 76,000 in 2007/08.

Council is commended for identifying and implementing a range of abatement activities in the recent past. This abatement extends across a range of areas of council and activity areas, demonstrating that a level of coordination and responsibility for reduction emissions has been achieved. It is apparent, however, from the footprint results and investigations that Council requires an additional 10% reduction to achieve the corporate target based on 2007/08 footprint figures and that there have been a number of issues with implementing identified efficiencies.

5.1 Buildings and Equipment

5.1.1 Building Energy Efficiency

Work to improve building energy efficiency has been focused on Council's five largest facilities. This aligns with the results in Section 4 which indicate that these five buildings represent a large proportion of Councils emissions (excluding landfill).

Over the past few years a number of building energy efficiency programs have been implemented. The efficiency benefits of these programs are largely reflected within the energy consumption figures for 2007/08. There are a number of additional measures which have been implemented or are planned which will impact building efficiency in future years.

Previous building abatement measures implemented in one or more buildings include:

- Retrofit lighting to replace globes with Compact Fluorescent Lights;
- Replacement of inefficient Emergency Lighting with LED lighting;
- Turning off an underutilised cool room;
- Replacement of hot water boilers;

- Modifying the Heating, Ventilation and Air Conditioning (HVAC) system to change the operating times to better reflect working hours and switch off unused areas on weekends.
- Awareness labelling and education of staff, throughout Council buildings;
- EcoOffice program to encourage staff to save paper and energy;
- Energy efficient T5 fluorescent lights are being used to replace old fluorescent lights as maintenance is required, throughout Council buildings; and
- Timing clocks have been installed to control air-conditioning at Council's five largest facilities.

Future building abatement measures which are planned or recently implemented include:

- Recent replacement of air conditioning chillers for the administration and Cleveland Library Buildings.
- Planned replacement of air conditioning chillers for the Capalaba Place building in April 2009.
- Planned use of floating set points for air conditioning temperatures from early 2009.
- Planned Building Management System (BMS) for South street and Capalaba library: Upgrade of the current BMS to include energy metering of air conditioning systems at the Administration, Capalaba Place and Cleveland Library buildings. Installation of a BMS at the South Street Depot.
- Planned Metering: Installation of energy sub-meters across 4 main buildings to monitor electricity use by HVAC chillers, lights and by floor and also server rooms at Administration Building and South Street Depot.
- Planned Lighting: Upgrade of lighting across Council to improved efficiency devices including occupancy sensors within meeting rooms and other suitable rooms across various sites; energy reduction units at the Administration, Capalaba Place and South Street Depot sites; and replacement of T8 with T5 fittings and lights at the Administration, Capalaba Place, South Street Depot and Cleveland Library sites.
- Planned Plant and equipment replacement: Replace high energy consuming and carbon emitting plant and equipment with efficient devices as part of a targeted campaign. The following will be replaced:
    - Refrigerators (50 units 10 years and older
    - Air conditioning units (25 units small aging systems across Council sites);
    - Hot water installations replaced with solar hot water (across Council sites) - 25 units.

The estimated abatement from these measures is shown in Section 5.6 below to allow estimation of their impact on future projections to be undertaken.

5.1.2 IT Equipment

Over the past few years a number of IT equipment energy efficiency programs have been implemented. These include the replacement of all CRT monitors with LCD monitors as these use much less electricity and Council participation in the EcoOffice program. The efficiency benefits of these programs are largely reflected within the energy consumption figures for 2007/08. There are a number of additional opportunities identified by the IT team which may be implemented in future years. These include:

- A multi-function printer roll out to replace up to three existing peripheral devices in most areas; and
- Undertaking remote monitoring of computers to assess how many are left on each night, coupled with an education and engagement program to reduce energy consumption. The potential use of software to turn off computers automatically has also been investigated but is not proposed.

The IT department identified a preference for behaviour change programs rather than software or hardware changes. They also believe there is a significant opportunity to work with other areas of Council on opportunities such as:

- Work processes upgrades such as the use of hot desks for some staff to minimise computer numbers;
- Use of teleconference and videoconference facilities;
- Use of just-in-time printing to prevent re-printing and wastage, and/or
- Pin number and/or user-pays printing systems.

These are all worthwhile options for future investigation, but are not considered sufficiently developed to be included in adjustments to future abatement projections. Additionally, the IT department expect electricity consumption from IT equipment to remain relatively constant the next few years.

5.2 GreenPower Purchases

Council utilises 5% GreenPower at four of the largest buildings, which have large single electricity accounts. Based on details of purchases of GreenPower identified for 2007/08 this has resulted in a 184 tonne CO_2e reduction. This figure is not expected to change significantly over the coming years.

5.3 Fleet

A number of fleet efficiency actions have been implemented over recent years or are planned for the future.

The number of six cylinder vehicles has been reduced over recent years in favour of four cylinder vehicles. It is estimated that each such change results in a 10% emissions reduction. About 80% of the passenger vehicles are now four cylinders.

Council has informed Arup of the recent change in RCC's vehicle purchasing policy. A policy will be rolled out over the coming years minimising the opportunity to purchase 6 cylinder vehicles. This is a significant change in RCC's purchasing policy and is highly a commendable strategy to deal with greenhouse gas abatement and financial efficiency.

All officers driving RCC vehicles are also encouraged to use e10 but it is not mandated at this point. RCC advised that it will shortly become a requirement under Council's Fleet Card Guidelines.

Council has also undertaken an ethanol injection trial with 43 vehicles fitted with the ethanol device. Council are hoping to extend that number to all diesel fleet in the next financial year. The benefits of adding ethanol to diesel include a reported 3% reduction in greenhouse gas emissions and reduced emissions of some air pollutants.

The other immediate measure undertaken by fleet is vehicle emissions testing on an annual basis (software and hardware has recently been installed and establishment of a wireless connection in the workshop will finalise installation).

The estimated future abatement from relevant measures above is shown in Section 5.6 below to allow future projections to be undertaken.

5.4 Streetlights

Council does not have direct control over street lighting. RCC rent the (rate 1) streetlight infrastructure from ENERGEX and the power comes from Origin Energy. Under this arrangement Council has limited ability to influence greenhouse abatement. The issue of greenhouse emissions from public lighting is being addressed at a regional level by the Energy Efficiency Public Lighting Working Group, of which ENERGEX is a member. The Energy Efficiency Public Lighting Working Group, comprising the Queensland Department of Mines and Energy, ENERGEX, Brisbane City Council, Gold Coast City Council, and Maroochy Shire Council.

This group has been working on streetlight efficiency for a number of years and have concluded that the best way forward is to conduct a trial of energy efficient bulbs for street lighting. The group commissioned the “Street lighting in South East Queensland: Opportunities for Energy Efficiency and Cost Savings” scoping paper in 2006 , resulting in the recommendation for this extensive trial to resolve the technical issues identified.

The Queensland Department of Energy have been promoting the use of a new energy efficient street light. This street light is available for use by Councils in NSW, Victoria and the Northern Territory, however is not current available for use within Queensland.

The Pierlite Green Street fitting is designed and made in Australia using the latest high efficiency lamps and equipment. It uses between 50% and 65% less energy than the standard 50W and 80W mercury vapour fittings most commonly used in Redlands streets. Currently, almost 75% of RCC’s 12000 streetlights have 50W or 80W mercury vapour lamps.

A combined State Government/Energex trial using several of the new lighting heads is currently underway in South east Queensland but results are not expected until 2011. In the short term, the use of alternatives to the standard Mercury or Sodium fittings for rate 1 and 2 lighting would not appear to have much support although a close watch will be maintained on this continuously evolving area[8].

5.4.1 Local public lighting

Lights installed and maintained by Council (rate 3) are generally solar systems at present and there have been numerous energy efficiency trials of different sorts in the last couple of years. RCC indicates that a standard installation streetlight has not occurred for some time.

Recent such solar light installations include the Valentine Park Bikeway and the Ross Creek Bikeway. A number of additional installations are proposed on the piers at Victoria Point Ramp, Queens Esplanade Cycleway, East coast Road, Donald Simpson Centre carpark and pathway, Weinam Creek and Victoria Point Reserve.

Discussions with the manager for streetlights has identified that energy consumption from all streetlights is not expected to change significantly in 2008/09 from 2007/08, with the savings from solar installations counteracted by a slight increase in streetlight numbers or the fact that these solar systems may be new system and not replacing existing inefficient streetlights.

[8] RCC, CCA Increase in Streetlighting Tarrifs, 5 August 2008.

5.5 Waste and Landfill Gas Flaring

In order to reduce the impact of methane emissions from the Birkdale landfill, Council participated in development of a landfill gas flaring facility. The purpose of flaring is to dispose of the flammable constituents, particularly methane, safely and to control a range of health risks and adverse environmental impacts. This facility reduces the effective emissions from waste at the Birkdale landfill by 10.01% in 2005/06 and 12.26% in 2007/08.

The quantity of emissions reduced through flaring is not anticipated to greatly increase disproportionally to the total quantity of emissions generated. Therefore there does not appear to be any reason for a significant reduction in emissions from Birkdale landfill in coming years. As the Council generated waste figure is not able to be accurately calculated and used in this methodology, no reduction in this figure associated with flaring is needed.

Whilst there is also an extensive green waste diversion program, this reduces the quantity of emissions and cannot also be deducted from the total emissions.

Arup is also aware that Council has identified and implemented a number of corporate waste reduction initiatives in recent years. These include waste recycling bins at all sites including for paper, cardboard, printer cartridges and co-mingled recyclables.

5.6 Abatement Estimates

The key issue discussed in this section is abatement that is in the system or proposed in budget submissions that will cause differences in Council emissions trajectories from previous years.

Where possible these abatement activates have been identified and the abatement estimated outlined in the table below. This has been collected through a number of sources including reports and information provided by RCC and from telephone conversations and meetings with RCC staff responsible for various activities.

Table 10 Estimation of Planned and Proposed Abatement

Action	Estimated Abatement	Relevant Assumptions
Recent replacement of air conditioning chillers for the administration and Cleveland Library Buildings Planned replacement of air conditioning chillers for the Capalaba Place building in April 2009. Also includes rebalancing and recommissioning.	238tCO_2e	Chillers estimated at 30-50% of HVAC energy consumption, 30% has been used. Expect 10% increase in efficiency of chillers. Recommissioning: "Energy savings in the order of 5-15% achievable ('Energy Innovators Initiative Technical Fact Sheet' 2005, Natural Resources Canada).
Planned use of floating set points for air conditioning temperatures from early 2009.	206tCO_2e	Expect 10% improvement on HVAC loads.
BMS for South street and Capalaba library: Upgrade current Building Management System (BMS) to include energy metering of air conditioning systems at the Administration, Capalaba Place and Cleveland Library buildings. Installation of a Building Management System (BMS) at the South Street Depot. Metering: Installation of energy sub-meters across 4 main buildings to monitor electricity use by HVAC chillers, lights and by floor and	209tCO_2e	5-15% reduction ('The Effectiveness Of Feedback On Energy Consumption' 2006, Sarah Darby, Environmental Change Institute: Oxford University).

Action	Estimated Abatement	Relevant Assumptions
also server rooms at Administration Building and South Street Depot.		
Lighting: Upgrade of lighting across Council to improved efficiency devices including occupancy sensors within meeting rooms and other suitable rooms across various sites; energy reduction units at the Administration, Capalaba Place and South Street Depot sites; and replacement of T8 with T5 fittings and lights at the Administration, Capalaba Place, South Street Depot and Cleveland Library sites.	225 tCO_2e	25-30% saving of lighting energy use can generally be achieved with this initiative. Get lighting figures for each building from energetic and update numbers.
Refrigerators (50 units 10 years and older); changing from inefficient to efficient.	50 tCO_2e	1 tonne of GHG and $130 each year per fridge.
Air conditioning units (25 units small aging systems across Council sites).	12.5 tCO_2e	Based on figures from www.energysmart.com.au
Hot water installations replaced with solar hot water (across Council sites) - 25 units.	87.5 tCO_2e	Reductions of approximately 3.5 tonnes of CO_2 per year/per system (dependant on size of system and usage) (Department of Infrastructure and Planning, Improving Sustainable Housing in Queensland).
Converting the rest of the diesel fleet to ethanol injection.	8 tCO_2e	Estimated 3% saving on emissions for the remainder of the heavy diesel fleet.
Converting the remaining 6 cylinder cars to 4 cylinder cars.	20 tCO_2e	Allowing for some 6 cylinder cars to be retained for operational reasons.
Purchasing of 5% GreenPower.	184 tCO_2	Based on 2007/08 figure.
TOTAL	**1240 tCO_2e**	

The data above provides a more detailed estimate of Council's emissions for the 2009/10 financial year to allow comparison to the CCP target. This is provided in the table below. This shows a potential 15% reduction on the 2007/08 figures by 2009/10, however this is still an 18% increase on 1998 CCP figures, rather than the target of a 25% decrease. This is based on the effective implementation of the measures outlined above.

Table 11 Comparison of 1998 and 2007/08 with projected 2009/10 GHG Emissions including abatement

Key Council Operational Areas	1998 CCP GHG Emissions	2007/08 GHG Emissions	Estimated 2009/10 GHG Emissions including proposed abatement	Change 1998 compared to 2009/10	
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	%
Buildings and facilities	5,317	6,687	5,473	+156	+ 3%
Vehicle fleet	1,472	1,836	1,791	+ 319	+ 22%
Street lights	4,073	5,585	5,585	+ 1,512	+ 37%
Total	**10,862**	**14,108**	**12,849**	**+ 1,987**	**+ 18%**

6 Review of RCC Carbon Efficiency Approach

This section of the report provides a review of the broad efficiency approach by RCC to date as a basis for clear recommendations on the approach in future. Whilst Council has had a number of successes in carbon abatement, there have also been issues with managing carbon, particularly around the implementation of identified initiatives. Council has also been under pressure to provide services for a rapidly growing community.

The corporate governance status of the RCC is typical of the status of greenhouse and energy management amongst business and organisations: systems are yet to be adapted; risks are still being identified and quantified and KPIs and reporting structures are in need of review.

The efficiency opportunities identified in the Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan (the Plan) include a number of initiatives that have been previously identified to council. For example, Council has previously commissioned Energetics to undertake detailed building audits. The outcome was detailed costing of potential abatement opportunities. This work was generally not implemented. Such mixed implementation success is not uncommon in Councils for a number of reasons including:

- Lack of specific targets for different areas of council to drive implementation;
- Difficulties in quantifying energy and cost savings from retrofit programs;
- Competing priorities for funding;
- Lack of corporate support for energy saving initiatives, and/or; and
- Lack of rigour in metrics applied to demonstrate achievement of goals.

More specifically, RCC identified that three key issues that hampered implementation of efficiencies were:

- Efficiencies were poorly budgeted;
- Implementation was attempted at too low levels in Council, and
- Insufficient corporate level guidance was provided.

Many implementation issues can be addressed by the establishment of appropriate targets and objectives for relevant areas of Council, particularly with regard to the key sources of carbon emissions, and clear communication of these targets and objectives to Council staff and the community. This approach embeds the targets and objectives in decision making and performance assessment. In the case of the current Redland carbon footprint, targets and objectives would focus on the implementation of carbon reduction initiatives.

Additionally, the majority of organisations undertaking their first NGER compliant carbon footprint are identifying significant data management issues. This is the case with RCC. Anecdotal evidence suggests that other council's in SEQ are also identifying significant data management issues. The methodology, level and detail of data required for a NGER carbon footprint is significantly different from a CCP carbon footprint. Council's data is generally in a basic form and requires significant resources and time to collate to allow a carbon footprint to be calculated. Significant steps are required to improve the quality and comprehensiveness of RCC data.

However the above issues need to be considered in the context of the evolving carbon policy landscape as discussed in **Section 2**. In this context, data management is likely to focus on the landfill data and NGER Act requirements as a priority, and abatement implementation on waste emissions, and cost efficiencies.

Recommendations and further discussion on the issues identified in this section is included in the Plan.

7 Community Waste Emissions

There is a significant strategic imperative to consider community waste and reduction of emissions at landfill sites in the future. As requested by RCC the strategy and plan focuses on corporate actions and efficiencies and does not address community waste in detail. A number of general comments are provided in this section.

Whilst waste emissions from landfill are included in Council's organisational boundary under the methodologies required for the CPRS, this waste is largely generated by parties other than council. Council's ability to manage waste-related emissions is limited to the transport of waste, management of waste disposal sites and influencing community practices in relation to the quantity and type of waste sent to landfill. Arguably the waste related emissions are more appropriately considered as a 'community emission' rather than a direct (and manageable) consequence of Council's activities. However under the CPRS these emissions are Council emissions. There are three main strategic waste emissions actions for future consideration by Council. These are outlined below.

- The improvement of waste data.
    - In the absence of any further detail on waste methodologies from the Federal Government, the collection of detailed waste sampling data in accordance with the NGA Factors will facilitate the estimation of an accurate footprint. This approach will also minimise the use of default values which are not required if sufficiently detailed and appropriate alternatives are available. This may lead to a reduction in Council's waste emissions, and subsequently an increased emission capture rate.
- Reduction in the quantity of emissions generated at the landfill through reducing high organic carbon waste.
    - The key areas contributing organic carbon to the landfill are food, paper and cardboard, and green waste from the municipal solid waste (MSW) stream, and paper and cardboard and wood and waste wood from the commercial and industrial stream. Council's Domestic Kerbside Waste Audit Results 2005 identified that the percentages of food and garden and park waste in Kerbside bins are higher than the default NGA figures. This document also identifies that a significant portion of MSW waste is paper and cardboard despite council's recycling bin collection. This may be due to personal behaviour, or that the recycling bin requires more frequent collection.
- Increased in the capture of emissions once they have been generated.
    - Whilst methane flaring is present at Birkdale landfill, there may be opportunities to improve the efficiency of this capture and flaring process. A feasibility study into these options may be worthwhile once Council's CPRS position is clear.

Detailed investigations and studies should be undertaken into options to reduce the emissions from landfill through better quality data, reduced waste quantities sent to landfill and increased capture efficiency.

Recommendation 1.0: When Council's CPRS position is clear, detailed investigations and studies should be undertaken into options to reduce the emissions from landfill through better quality data, reduced waste quantities sent to landfill and increased landfill gas capture efficiency.

8 Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan (the Plan)

The ‘Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan’ (the Plan) has been developed to provide clear recommendations on the steps Council should take with regard to corporate greenhouse gas efficiencies (Refer Appendix A). In particular the plan proposes actions to respond to key issues identified during the audit of Council’s emissions. These include the obstacles that have been encountered in previous abatement efforts and in the calculation of this carbon footprint.

As requested by RCC this strategy and plan focuses on corporate actions and efficiencies and does not address community waste.

To support the proposed plan, a number of key strategic issues are discussed including:

- Identified of efficiency opportunities identified during the site audits and the greenhouse audit of Council’s emissions;
- Discussion of targets and of Key Performance Indicators (KPIs) at different levels of council, and
- Discussion on data management and reporting.

Successful delivery of the plan will involve the input, commitment and assistance of all levels of council.

However the above issues need to be considered in the context of the evolving carbon policy landscape as discussed in Section 2. In this context, data management is likely to focus on the landfill data and NGER Act requirements as a priority, and abatement implementation on waste emissions, and cost efficiencies. Recommendations and abatement efficiencies have therefore been developed in consideration of these issues.

9 Conclusion

RCC has been proactive in addressing climate change through efforts to monitor and reduce its greenhouse gas emissions. RCC commenced work voluntarily on greenhouse gas inventories over 5 years ago and developed its Local Greenhouse Action Plan (LGAP) in 2004 under the Cities for Climate Protection (CCP) program. Whilst Council has had a number of successes in carbon abatement, there have also been issues with managing emissions reduction, particularly around the implementation of identified initiatives.

More recently the Federal Government has introduced the National Greenhouse and Energy Reporting (NGER) Act 2007 (NGER Act) and released Green and White Papers for the proposed Carbon Pollution Reduction Scheme (CPRS). This has dramatically shifted the policy landscape and will influence Council abatement decisions into the future.

10 Glossary

Abatement Reducing GHG emissions produced

Baseline A hypothetical scenario for what GHG emissions, removals or storage would have been in the absence of the GHG project or project activity; emissions that would have resulted under a 'business as usual' scenario.

Base Year A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time

Base year emissions GHG emissions in the base year

Boundaries GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, and target boundaries. The inventory boundary determines which emissions are accounted and reported by the organisation.

Carbon Dioxide Equivalent (CO_2e) The universal unit of measurement to indicate the global warming potential (GWP) of each of the six Kyoto Protocol greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.

CPRS The Carbon Pollution Reduction Scheme is the national emissions trading scheme administered by the Department of Climate Change.

Direct emissions Emissions from sources that are owned or controlled by the reporting company

Emission intensity Refers to the amount of CO_2e emitted per unit of activity

Fugitive emissions Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals.

Global Warming Potential is the radiative forcing impact contributing to global warming relative to one unit of $CO_{2.}$ CO_2 is used as a reference as it always has the GWP of 1.

Greenhouse Gases (GHG) GHG's are gaseous constituents of the atmosphere that control energy flows by absorbing infra-red radiation. For the purposes of this report, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).

Indirect emissions Emissions that are a consequence of the operations of the reporting company, but occur at sources owned or controlled by another company.

ISO The International Organisation for Standardisation is a network of the national standards institutes of 157 countries, on the basis of one member per country.

Materiality Whether an error or omission in calculation of the carbon footprint is a material discrepancy or not.

Scope 1 emissions are direct greenhouse gas (GHG) emissions occurring from sources that are owned or controlled by the company

Scope 2 emissions are GHG emissions resulting from the generation of purchased electricity consumed by the company.

Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company

Source Anything that produces GHG emissions

WRI The World Resources Institute.

Appendix A

The Corporate ‘Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan’ (the Plan)

A1 The Corporate 'Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan' (the Plan)

A1.1 Introduction

The 'Efficiencies for Greenhouse Gas Reduction Strategy and Action Plan' (the Plan) has been developed to provide clear recommendations on the steps Council should take with regard to corporate greenhouse gas efficiencies. In particular the plan proposes actions to respond to key issues identified during the audit of Council's emissions. These include the obstacles that have been encountered in previous abatement efforts and in the calculation of this carbon footprint.

This plan should be read in conjunction with the report 'Detailed Audit of Council Greenhouse Gas Emissions' for the 2007/08 financial year. As requested by RCC the strategy and plan focuses on corporate actions and efficiencies only and does not address community waste.

To support the proposed plan, a number of key strategic issues are discussed including:

- Discussion of targets and of Key Performance Indicators (KPIs) at different levels of council;
- Discussion on data management and reporting; and
- Identified of efficiency opportunities.

Successful delivery of the plan will involve the input, commitment and assistance of all levels of council.

However the above issues need to be considered in the context of the evolving carbon policy landscape as discussed in Section 2. In this context, data management is likely to focus on the landfill data and NGER Act requirements as a priority, and abatement implementation on waste emissions, and cost efficiencies. Recommendations and abatement efficiencies have therefore been developed in consideration of these issues.

A1.2 Council CCP Target

Based on the findings of this report, Redlands is currently not going to achieve the CCP target of a 25% reduction on 1998 emissions by 2010.

A number of alternate target options have been considered including extending the timeframe of the target to 2012 or 2015 however, as discussed in detail in Section 2 of the report, in the current policy landscape the role of voluntary abatement and targets is unclear. Given the LGAP expires in 2010 it is unnecessary for Council to take any formal steps to abandon the CCP target. Until the implications of the CPRS are clearer it would be premature to establish a revised council target.

Other factors to be taken into account if a revised target is identified include:

- Changes in inventory methodology from the CCP program (including removal of water and addition of landfill);
- The constantly evolving climate change science;
- Community awareness and understanding; and
- Alignment with State and Federal long term emission targets.

Recommendation 2.0: When the emissions policy landscape becomes clear Council should undertake an investigation firstly to identify if a Council target is necessary, and if so to establish the target (likely to be in 2010 at the earliest).

A1.3 Future Efficiency Plan

Introduction

This project was started in a pre-CPRS policy landscape and during the course of the project a number of major influencing documents were released most significantly the CPRS White Paper. The implications of this White Paper include that after July 2010, Council will be faced with a two fold emissions focus: the mandatory need to report and be involved in the CPRS through landfill emissions, and the need to reduce consumption of CPRS impacted goods and services (such as fuel and electricity) due to increased prices. The CPRS will likely lead to a significant shift away from voluntary abatement for many organisations. The commencement of the CPRS times well with the completion of the CCP voluntary targets and Local Greenhouse Action Plan (LGAP), however during the 18 month period between now and the commencement of the CPRS the policy landscape will continue to shift and evolve.

This section of the report summarises a number of key efficiency and mitigation opportunities available to Council. Priority is given to those efficiencies which show the greatest reduction in emissions (and therefore greatest financial savings) for the least investment.

This information has been based on a number of information sources including walk-through audits of a number of sites, audits undertaken during previous projects, desktop research, previous Council abatement activities and the results of the carbon footprint. Summary results from the site audits are included in a separate technical document.

It is also noted that this section deals with efficiencies and does not address switching energy sources or offsetting emissions. A separate Resource Efficiency Report has also been developed by Arup and provides a range of recommendations for water, waste, energy and fleet efficiency.

The table is organised as summarised below.

- Mitigation measure: details of the proposed measure.
- Estimated level of investment: based on high, medium and low, quantified as:
  - low: up to $15,000;
  - medium: $15,000 to $50,000; and
  - high: $50,000 and above.
- Likely emission reduction.
- Timing and responsibility for implementation.

Appropriate feedback and reporting mechanisms are discussed elsewhere in this report.

Key Areas of Focus

The two key areas that have been identified for delivering efficiencies are buildings and fleet, particularly the five major buildings. The most cost efficient savings are made through using existing systems and vehicles effectively, before major investment is made. The table below includes some key actions to encourage efficient use, in addition to a number of actions requiring more significant investment. The specific behaviour and training items below are in addition to the general KPIs identified.

Efficiency can only reduce the emissions from Council facilities a finite amount. Council may need to consider switching energy sources or offsetting emissions in future, such as increasing the proportion of GreenPower purchased. However if the actions identified in the report are effectively implemented the CCP target should be achievable without such switching or offsetting.

Communication and Engagement

Behavioural change is one of the most effective tools in reducing greenhouse gas emissions. Engagement and empowerment of council staff is a key step to achieving further corporate efficiencies. Research has shown that up to 15% savings in energy consumption can be achieved through appropriate education and engagement programs. A range of general KPIs have been identified above which address this behaviour change. Arup recommend Council develop an engagement program to address the general KPIs recommended.

We acknowledge Council's existing proposed communication programs, including steps by the IT department to communicate the number of computers left on at night and on the weekends. The proposed program seeks to expand these measures.

Communication and engagement is generally based around efficiency not investment so financially it is very sound and cost effective. Such programs can be as simple as a few lines on an email, newsletter or screensaver, through to large sophisticated programs.

Communication and engagement will be vital to the success of the plan and achievement of the CCP target.

Assumptions and Limitations of mitigation recommendations

It is often difficult to accurately define the potential carbon savings and refine the level of investment in more detail than currently provided due to the number of variables involved. Such variables include, but are not limited to:

- the number of buildings;
- the different types and sizes of buildings;
- the fact that some recommendations include different options; and
- in many cases the accurate costing of initiatives will require estimation from a quantity surveyor, actual trade quotes or further feasibility studies.

Whilst it is not within the scope of Arup's current commission to specifically define potential investment in this detail, Arup are happy to work with RCC to step this process forward as an extension to the current project. This may involve activities such as, but not limited to, organising input from a quantity surveyor, developing briefs for technical engineers or trades, undertaking more detailed feasibility studies of specific initiatives or advising on the most effective means of procuring certain projects.

> **Recommendation 3.0:** Develop and implement an engagement program to drive efficiency of CPRS impacted goods and services such as electricity and fuel.

Implementation Period (Budget years)	Mitigation Measure	Responsibility	Estimated Level of Investment*	Potential Emission Reduction**	Potential Payback
08/09	Mandate the use of E10 fuel in all applicable fleet vehicles.	Fleet manager	Nil	232 tCO_2e	No cost
08/09	Implement use of floating set points for all centrally controlled air conditioning. This involves changing the set point to be 1 degree cooler in winter and 1 degree warmer in summer.	Facilities Management	Nil	206 tCO_2e	No cost
08/09	Encourage the use of set point of 23 or 24 degrees for summer and 21 degrees for winter the South Street Depot manually controlled air conditioning systems. This could also be recommended for other split-systems throughout Council sites.	Facilities Management	Nil	15 tCO_2e	No cost
08/09	Minimise vehicle use- communication to all staff regarding sustainable transport strategies, such as walking to local sites, minimising trips, combining travel and encouraging teleconferences.	Eco-financial efficiencies	Nil	Up to 80 tCO_2e saving	No cost
Ongoing	Continue to offer driver training program on fuel efficient driving behaviour.	Fleet Manager	Low	80 tCO_2e	1-3 years
09/10	Clearly label all light switches and develop a culture that encourages staff to turn off lights when possible.	Eco-financial efficiencies	Low	Up to 10t CO_2e	1-3 years
09/10	Upgrade lighting across Council to improved efficiency devices including occupancy sensors within meeting rooms and other suitable rooms across various sites; energy reduction units at the Administration, Capalaba Place and South Street Depot sites; and replacement of T8 with T5 fittings and lights at the Administration, Capalaba Place, South Street Depot and Cleveland Library sites.	Facilities Management	Medium-High	225 tCO_2e	1-5 years
09/10	Upgrade current Building Management System (BMS) to include energy metering of air conditioning systems at the Administration, Capalaba Place and Cleveland Library buildings. Install energy sub-meters across four main buildings to monitor electricity use by HVAC chillers, lights and by floor and also server rooms at Administration Building and South Street Depot.	Facilities Management	Low-Medium	189 tCO_2e	2-5 years
09/10	Install of solar or heat exchange hot water systems. Hot water installations replaced with solar hot water (across Council sites) - 25 units.	Facilities Management	Low-Medium	87.5 tCO_2e	3-5 years
09/10	Replace refrigerators of 10 years and older with minimum 4 star energy rated models of smaller size.	Facilities Management	Low	50 tCO_2e	3-6 years

Implementation Period (Budget years)	Mitigation Measure	Responsibility	Estimated Level of Investment*	Potential Emission Reduction**	Potential Payback
09/10	Replace old air conditioners. Air conditioning units (25 units small aging systems across Council sites).	Facilities Management	Low	12.5 tCO_2e	6-10 years
10/11	Develop efficient buildings guidelines for Council assets with the aim of reducing the increases in emissions due to the addition of new facilities, and reduce the need to retrofit new facilities.	Eco-financial efficiencies	Low - Med	Up to 30% reduction in the emissions from new facilities.	Dependent on new facilities
10/11	Rebalance and recommission HVAC Plant at South Street Depot and Donald Simpson Centre (sites where recent upgrades involving recommissioning has not occurred or is not planned).	Facilities Management	Low - Med	25 tCO_2e	3-5 years
10/11	Installation of a Building Management System (BMS) at the South Street Depot.	Facilities Management	High	20 tCO_2e	6-10 years
10/11	Install time limited demand based switching air-conditioning for all large meeting/conference rooms/individual offices in the administration and library buildings.	Facilities Management	Medium	Dependent on level of unoccupied space..	5-10 years
11/12	Encourage sustainable transport- provide bike parking at all major council sites (in addition to those existing at the library and administration buildings).	Eco-financial efficiencies	Medium	Dependent on use.	Dependent on use.
11/12	Council Chambers building fabric. Invest in measure to improve building fabric at council properties which will reduce summer cooling loads due to heat gain and can also reduce winter heating loads and lighting demand. This may include internal blinds, external shading of walls and glazing and the installation of insulation and roof venting.	Facilities Management	High	Dependent on measures up to 30% reduction in energy consumption.	Dependent on measures.

*NOTE: All costings provided are indicative only and do not include fitting/installation and labour costs. Low <$15,000, Medium $15,000-$50,000, High >$50,000. Costs are per building, item or task unless noted otherwise.

**NOTE: Emission reductions and efficiency figures are indicative only and based on published literature and other projects.

A1.4 Data Management and reporting

Council's data is generally in a basic form and requires significant resources and time to collate to allow a carbon footprint to be calculated. Significant steps are required to improve the quality and comprehensiveness of RCC data. The RCC environmental team have a detailed understanding of the data, its availability and limitations. This is valuable information which should be captured and used to improve the accuracy of future carbon footprints. The improvement of data should include the capturing of quantities in addition to costs wherever possible, and expansion of metering provision for energy consuming assets.

Accurately documenting the process of developing the annual greenhouse inventory is vital. This can be done by preparing a greenhouse inventory management plan. This plan should describe the boundaries, processes, data systems and other activity data sources, and factors and methods used to prepare the annual inventory. The inventory management plan can be integrated into RCC's Environmental Management System.

An excellent example of a greenhouse inventory management plan is the Environmental Protection Agency (EPA) Victoria 2007, 'Greenhouse Gas Inventory Management Plan', which can be found at:
http://www.epa.vic.gov.au/climate%2Dchange/carbon%2Dmanagement/

An appropriate data management system is critical to support Council targets and proposed KPIs. Such a system will support regular reporting such as monthly or quarterly short summary of emissions from key assets for the year. This allows for proactive management rather than a significant lag between a problem occurring and its identification.

Regular reporting and monitoring will be critical to tracking performance against revised corporate emissions targets. It is recommended that this reporting occur at a range of levels particularly in support of an established KPI.

The implications of the CPRS include that the drives for voluntary abatement, and therefore voluntary reporting, have effectively been superseded. However it is likely that the NGER Act will be amended in the future to include Local Governments. The NGER Act requires reporting of both Scope 1 and Scope 2 emissions and therefore there is still a significant driver to improve Council's emissions data management. Given the likelihood that Council will be required to report all Scope 1 and 2 emissions, Council could consider data management steps such as:

- The development of a greenhouse inventory management plan in line with the Environmental Protection Agency (EPA) Victoria to integrate with the EMS. Implement by June 09.
- The implementation of an "Emissions Profile Tracking Database" data management system to effectively manage and report on carbon emissions to support KPIs and abatement recording.
- The establishment of an annual carbon reporting cycle. Monthly or quarterly reporting should be established as a preference particularly to support any KPIs which are established.

Specific issues relating to waste data are identified in **Section 7** of this audit report. Regardless of the implementation of the above steps it is recommended that Council take steps to improve the quality and timeliness of Scope 1 and Scope 2 data.

Recommendation 4.0: Take steps to improve the quality and availability of Scope 1 and Scope 2 data to increase the ease and accuracy of future carbon footprints.

A1.5 Key Performance Indicators (KPIs)

Many implementation issues can be addressed by the establishment of appropriate targets and objectives for relevant areas of Council, particularly with regard to the key sources of carbon emissions and energy consumption, and clear communication of these targets and objectives to Council staff and the community. This approach embeds the targets and objectives in decision making and performance assessment.

The use of KPIs is seen as a key step in improving the implementation of emissions efficiencies. KPIs need to be appropriate to be effective. Two common types of KPIs include specific targets (such as a 25% reduction), and presence/absence or general targets (such as whether an action occurred). Different situations and circumstances require different use of such targets. Discussions with RCC have identified that both specific absolute targets and general presence/absence targets can be utilised within Council. Based on this information and investigations into a number of key energy consuming assets, a range of general and specific targets are recommended. General KPIs are proposed largely where data is incomplete or where multiple managers are responsible and it is therefore difficult to identify direct accountability. Over time, general targets may evolve into specific target KPIs as data and organisational understanding improves.

These recommended KPIs have been discussed with the RCC Environment team and where possible specific responsible managers have been identified. The formalisation of any KPIs is a matter for Council and it is recommended that responsible managers be included in such discussions.

Asset specific target KPIs have been identified as below. The targets represent a 10% reduction in emissions on the 2007/08 figures by 2009/10.

Key Energy Consuming Asset	Responsibility	Potential Target KPIs for 2009/10
Passenger Fleet	Brian Lewis	1070 tCO_2e/annum
Heavy Fleet	Brian Lewis	570 tCO_2e/annum
South Street Depot	John Frew/Brian Lewis	488 tCO_2e/annum
Bradbury's Caravan park	Greg Jensen	116 tCO_2e/annum
Adder Rock Camp reserve	Greg Jensen	122 tCO_2e/annum

General target KPIs are believed to be appropriate for the following facilities:

- Council Chambers/Administration Building
- Cleveland Library
- Donald Simpson
- Capalaba Place
- Victoria Point Library, and
- RPAC.

Recommended general KPIs to be implemented on a facility by facility basis as appropriate are identified below:

- All staff are aware of Council's CCP target;
- All staff are trained in emissions efficiencies and aware of actions they can take;
- All staff are made aware of or training in driving techniques to increase fuel efficiency;
- All staff are encouraged to use sustainable forms of transport;
- All staff are reminded monthly to turn off lights and equipment when not in use;
- The details of results from the installation of energy meters are emailed to staff quarterly;
- All staff are encouraged to use self-controlled air conditioning systems efficiently; and
- 95% of computers are turned off at night and over the weekends.

For Rate 3 streetlights the ability to set a specific KPI is limited because a large proportion of Rate 3 lights are unmetered. It is recommended that the Rate 3 KPI to be implement 95% solar streetlights for rate 3 lighting.

The above set of KPIs are provided for RCC consideration. Once the CPRS policy landscape is clear Council may wish to review and implement these KPIs as a means of increasing energy and therefore cost efficiency for CPRS impacted goods and services.

CLIENTS | PEOPLE | PERFORMANCE

Redland City Council

National Greenhouse and Energy Reporting System

Redland Water Inventory 2008/09

June 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Glossary

AAT	Aerobic Anoxic Tank
A/C	Air conditioning
APT	Activated Primary Tank
BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
CH_4	Methane
COD	Chemical Oxygen Demand
CO_2-e	Carbon dioxide equivalent emissions (emissions of other greenhouse gases are multiplied by their GWP so that their effects can be compared to emissions of carbon dioxide)
CPRS	Carbon Pollution Reduction Scheme
d	day
DAF	Dissolved Air Flotation
DCC	Department of Climate Change
DEFRA	Department of Environment, Food and Rural Affairs
d.s.	Dry solids
EF	Emission Factor
GEDO	Greenhouse and Energy Data Officer
GHG	Greenhouse Gas
GWP	Global Warming Potential (the relative potency of emissions of various greenhouse gases compared to carbon dioxide)
h	Hour
HFCs	Hydrofluorocarbons
IAT	Intermittent Aeration Tank
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
km	Kilometre
kW, kWh	Kilowatt, Kilowatt-hour

m	Metre
ML	Megalitre
N	Nitrogen
N_2O	Nitrous Oxide
NDBEPR	Nitrification Denitrification Biological Excess Phosphorus Removal
NGA	National Greenhouse Accounts
NGERS	National Greenhouse and Energy Reporting System
OD	Oxidation Ditch
OSCAR	Online System for Comprehensive Activity Reporting
P	Phosphorus
p.km	Passenger kilometres
R	Refrigerant
RAS	Return Activated Sludge
STP	Sewage Treatment Plant
t	Tonne
TJ	Terajoule
TN	Total Nitrogen
VS	Volatile Solids
WAS	Waste Activated Sludge
WB	Water Booster Station
WSAA	Water Services Association of Australia
y	year

1. Introduction

1.1 Background

GHD has been engaged to assist Redland Water with the preparation of its 2008/09 National Greenhouse and Energy Reporting System (NGERS) inventory for its water facilities and operations.

The NGER System is a new piece of Federal legislation, enacted in 2007, designed to provide a single, streamlined reporting point for all energy and greenhouse reporting obligations. It will underpin the Federal Government's Carbon Pollution Reduction Scheme (CPRS), proposed to now commence in 2011. Under NGERS, any "facility" using more than 100 TJ of energy or emitting more than 25,000 tonnes of Scope 1 and Scope 2 carbon dioxide equivalents (CO_2-e) per annum will be required to report to the Federal Department of Climate Change (DCC). Similarly, any "corporation" using more than 500 TJ of energy or emitting more than 125,000 tonnes of CO_2-e will be required to report to the DCC. These corporate thresholds will decrease by 150 TJ and 37,500 tonnes CO_2-e each year for the next two reporting years.

Under these broad NGERS regulations, it is anticipated that Redland City Council will probably trigger the reporting thresholds at a corporate level, and possibly at a facility level. Recent advice from the Greenhouse and Energy Data Officer (GEDO), who administrates the system, to the Water Services Association of Australia (WSAA) is that a "water facility" should be treated as two separate continuous systems: 1) from water source and extraction, through treatment and distribution; and 2) sewage collection, sewage treatment and effluent discharge. Allocation of emissions to different corporate entities will then depend on who has "operational control" of the various elements of the "facility".

1.2 NGERS Inventory Assessment

Redland Water's NGERS inventory assessment is based on the general principles of:

- The National Greenhouse and Energy Reporting Act 2007, including amendments;
- The National Greenhouse and Energy Reporting Regulations 2008, including amendments;
- The National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2008 v1.1;
- National Greenhouse Accounts (NGA) Factors, November 2008;
- *The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard*, April 2004, developed by the World Business Council for Sustainable Development and World Resources Institute (GHG Protocol); and
- *GHG Protocol Guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty* (2003), and calculation worksheets, World Business Council for Sustainable Development and World Resources Institute.

2. Scope of NGERS Inventory

2.1 Description of Redland Water Activities

Redland Water is a business unit of Redland City Council, and specialises in water reticulation, wastewater collection and treatment, and related customer service and business performance. Redland Water's major activities are:

- Reticulating potable water to households and businesses in the Redland water catchments;
- Collecting, treating and disposing of wastewater (sewage) produced in the Redland sewerage catchments:
  - Treatment of wastewater occurs at the seven plants located at Capalaba, Cleveland, Thorneside, Victoria Point, Mount Cotton, Dunwich and Point Lookout; and
- Related office work activities.

2.2 Reporting Boundaries

2.2.1 System Boundaries and Geographical Limits

The system boundary of the Redland Water 2008/09 NGERS inventory assessment report is defined by the inputs, outputs and activities from all of Redland Water facilities and operations in the financial year 2008/09.

Note: At the time of writing, most source data was only available to May 2009.

The geographical limits of the inventory are defined by the Redland Water supply and sewerage catchment facilities, including offices, workshops, pump stations and treatment plants (refer to Appendix A for a full listing of facilities).

Exclusions and limitations to the scope of the inventory are described in Section 2.3.

2.2.2 Reporting Scopes

The *National Greenhouse and Energy Reporting Regulations 2008* and the *GHG Protocol* define three scopes of greenhouse gas emissions into which total emissions should be separated:

- Scope 1: Direct emissions from sources within the boundaries of an organisation as a result of its activities. For example, the combustion of fuels within, or fugitive emissions from, equipment or processes owned and/or operated by the organisation.
- Scope 2: Indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation. Scope 2 emissions arise from the combustion of fuel to generate electricity, steam or heat, and do not include emissions from the extraction and refining of fuels, or transmission line losses.

- Scope 3: All other indirect emissions that arise as a consequence of an organisation's activities, but occur outside its boundaries, from sources that it does not own or control. These emissions are physically produced by the activities of other organisations.

  Under NGERS, reporting of Scope 3 emissions is voluntary. These are indirect emissions that may be caused by Redland Water activities, but are attributed to another organisational entity (e.g. emissions from air travel, emissions from disposed solid waste, embodied emissions in chemicals consumption, embodied emissions from consumables, such as paper, etc.).

This Inventory is focused upon Redland Water's Scope 1 and Scope 2 emissions, as required by NGERS. Given the voluntary nature of Scope 3 emissions under NGERS, Scope 3 emissions have been included only where information was readily available and quantifiable with a reasonable degree of confidence (refer to Appendix E). Calculation methodologies for Scope 3 emissions are not documented in the main body of this report, but full workings are attached in Appendix G.

2.2.3 Greenhouse Gases Considered

Greenhouse gases considered in this inventory are carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and hydrofluorocarbons (HFCs).

Redland Water does not directly use, store or generate any perfluorocarbons or sulphur hexafluoride. However, these gases may be indirectly included in the embodied (Scope 3) emissions of upstream inputs to the business.

2.3 Exclusions and Limitations

The 2008/09 Redland Water NGERS inventory has the following exclusions and limitations:

- Given that reporting of Scope 3 emissions is voluntary under NGERS, Scope 3 emissions have been limited only to readily available information. Only the following Scope 3 emissions sources have been accounted for:
  - Purchase of Electricity from Network (indirect emissions due to purchased electricity extraction, production, transport and transmission losses);
  - Combustion of Liquid Fuels (indirect emissions due to extraction, production and transport of fuels combustion – flights, fleet and contractors);
  - Chemicals Consumption (emissions due to chemicals production and transport to STPs); and
  - Biosolids Disposal (emissions due to biosolids transport from STPs and emissions at the Ti Tree biosolids disposal site).

  All other Scope 3 emissions are excluded. Scope 3 emissions that have been excluded cannot be quantified with any reasonable degree of confidence.

- The NGERS Inventory has been prepared by GHD based on a summary of source information provided by Redland Water. For the purposes of further formal submissions to the DCC, Redland Water should provide fully auditable records of the source information for the relevant reporting period.
- At the time of writing (16 June 2009), not all Redland Water source information relevant to the 1 July 2008 to 30 June 2009 period was available (refer to Periods of Data Collection in Section 3). For the purposes of further formal submissions to the DCC, Redland Water should update the inventory with all source information relevant to the full period.
- Specific exclusions and assumptions are detailed in section 3 for each calculation.

3. Inventory Calculations

A description of the calculation procedures for all greenhouse gas emissions is set out below for each Part of the NGERS *Technical Guidelines* (v1.1). This description details the origin and representativeness of the activity data, and the emissions calculation method. It also describes the statistical uncertainty associated with key activity data (refer to Figure 1, *GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty*, 2003).

Emission factors that are used in the inventory calculations are summarised in Appendix C. Where possible, factors have been sourced from the NGERS *Technical Guidelines* (v1.1). If factors have been sourced elsewhere then evidence, references and documentation to demonstrate that the factors are relevant and accurate have been provided. All inventory data have been converted into quantities of carbon dioxide equivalent (CO_2-e) emissions, as shown in Appendix G.

Wherever possible, measurements with high accuracy have been used to calculate the NGERS inventory. Under NGERS only statistical uncertainty (due to random variability of sample data) at the corporation level should be reported. The statistical uncertainty has been estimated quantitatively where sufficient data is available. Where there is insufficient data for a statistical analysis, an estimate of the uncertainty range has been made, in accordance with typical ratings used in the *GHG Protocol* uncertainty tool, as follows:

Table 1 Data Accuracy Rating

Interval as Percent of Mean Value	Data Accuracy*	Uncertainty
± 5%	High	Low Uncertainty
± 15%	Good	Moderate Uncertainty
± 30%	Fair	High Uncertainty
More than 30 %	Poor	Very High Uncertainty

*Typical data accuracy rating and corresponding intervals used in the *GHG Protocol* uncertainty tool (Table 2, *GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty*, 2003)

The NGERS sections that are not applicable to Redland Water are summarised in Section 3.1.

The calculation methodologies for NGERS sections relevant to Redland Water's Inventory are described in Sections 3.2 to 3.5.

Section 0 describes the total uncertainty calculation methodology.

3.1 Excluded NGERS Sections

The following table documents the GHG reporting sections under NGERS that are not applicable to Redland Water, because no relevant activities were undertaken in these areas.

Table 2 Excluded NGERS Sections and Justification

NGERS Technical Guidelines Section	Description	Comments
Part 2.2	Combustion of Solid Fuels	Based on the data provided for 2008/09, Redland Water undertook no activities related to the combustion of solid fuels (e.g. coal, wood, bagasse, biomass, charcoal). No greenhouse gas emissions are reportable.
Part 2.3	Combustion of Gaseous Fuels	Based on the data provided for 2008/09, Redland Water undertook no activities related to the combustion of gaseous fuels (e.g. natural gas, coke oven gas, blast furnace gas, sludge biogas, etc.). No greenhouse gas emissions are reportable.
Chapter 3 (Parts 3.1 to 3.4)	Fugitive Emissions from Fuels Production	Based on the data provided for 2008/09, Redland Water undertook no activities related to the production of fuels (e.g. coal mining, oil and natural gas, carbon capture and storage). No greenhouse gas emissions are reportable.
Chapter 4 (Parts 4.1 to 4.4)	Industrial Processes Emissions	Based on the data provided for 2008/09, Redland Water undertook no activities related to the relevant industrial production processes (cement clinker, lime, carbonates, soda ash, ammonia, nitric acid, adipic acid, carbide, titanium dioxide, synthetic rutile, iron and steel, ferro-alloys, aluminium). No greenhouse gas emissions are reportable.
Part 4.5 (Sulphur Hexafluoride only)	Emissions of Sulphur Hexafluoride	Based on the data provided for 2008/09, Redland Water undertook no activities related to the emissions of sulphur hexafluoride (e.g. no gas insulated switchgear and circuit breaker applications). No greenhouse gas emissions are reportable.
Part 5.2	Solid Waste Disposal on Land	Based on the data provided for 2008/09, Redland Water undertook no activities related to the operation of solid waste landfill facilities. All biosolids are disposed of off-site. No greenhouse gas emissions are reportable.

NGERS Technical Guidelines Section	Description	Comments
Part 5.4	Wastewater Handling (Industrial)	Based on the data provided for 2008/09, Redland Water undertook no activities related to the operation of industrial wastewater handling facilities. No greenhouse gas emissions are reportable.
Part 5.5	Waste Incineration	Based on the data provided for 2008/09, Redland Water undertook no activities related to the operation of waste incineration facilities. No greenhouse gas emissions are reportable.
Part 6.1	Energy Production	Based on the data provided for 2008/09, Redland Water undertook no activities related to the primary production of energy (e.g. solid fuel, gaseous fuel, liquid fuel, electricity). No energy production volumes are reportable.
Part 6.2	Energy Consumption	Based on the data provided for 2008/09, Redland Water did not consume solar, wind, water or geothermal energy, combust sulphur for energy, use hydrogen or uranium energy sources, use electricity not purchased from the grid or other energy commodities (steam, compressed air, waste gas). No energy consumption volumes are reportable.

3.2 Combustion of Liquid Fuels (NGERS Part 2.4)

Redland Water Fleet

NGERS *Technical Guidelines* reference	Division 2.4.2 – Method 1
Data collection method	Redland Water provided a list of the fleet assets, total litres and type of fuel used for each vehicle
Period of data collection	July 2008 to **May 2009**
Units	Litres
Representativeness	Moderate – All vehicles and fuel types are accounted for, all fuel types used are listed under NGERS

Exclusions and assumptions	Division 2.4.2 Table 2.4.2A ◗ Gasoline o Energy content = 34.2 GJ/kL o Scope 1 emission factor = 69.6 $kgCO_2$-e/GJ ◗ Diesel o Energy content = 38.6 GJ/kL o Scope 1 emission factor = 69.9 $kgCO_2$-e/GJ
Calculation method	Emissions (tCO_2-e) = Litres × Energy Content (GJ/L) × Emission Factor ($kgCO_2$-e/GJ) × 10^{-3} (t/kg)
Statistical Uncertainty ◗ Qualitative ◗ Quantitative	 High – Fuel consumption volumes based on Redland Water estimations ± 30% (refer to Table 1)

Contractors Fleet

NGERS *Technical Guidelines* reference	Division 2.4.2 – Method 1
Data collection method	Redland Water provided an estimation of the contractors' fleet fuel consumption and type of fuel used.
Period of data collection	July 2008 to June 2009
Units	Litres
Representativeness	Low – There are assumptions in the data collection: type of vehicle, type of fuel used, and fuel consumption
Exclusions and assumptions	Division 2.4.2 Table 2.4.2A ◗ Diesel o Energy content = 38.6 GJ/kL o Scope 1 emission factor = 69.9 $kgCO_2$-e/GJ
Calculation method	Emissions (tCO_2-e) = Litres × Energy Content (GJ/L) × Emission Factor ($kgCO_2$-e/GJ) × 10^{-3} (t/kg)
Statistical Uncertainty ◗ Qualitative ◗ Quantitative	 High – No quantitative data available. Based on Redland Water estimations ± 30% (refer to Table 1)

3.3 Emissions of Hydrofluorocarbons (NGERS Part 4.5)

NGERS *Technical Guidelines* reference	Part 4.5 – Method 1
Data collection method	Redland Water provided information of the number of air conditioning units (27) and refrigerated auto-samplers (7).
Period of data collection	July 2008 to June 2009
Units	kg of refrigerants
Representativeness	Low – All A/C units and auto samplers are accounted for, but quantities and types of refrigerants are assumed
Exclusions and assumptions	◗ It is assumed that all units (air conditioning and auto-samplers) use refrigerant R22 with a Global Warming Potential (GWP) of 1700. ◗ As an initial estimate, the refrigerant capacity of each unit was assumed to be 4 kg. ◗ The emissions of hydrofluorocarbons have been considered for the purposes of this report, however under NGERS *Technical Guidelines* section 4.100 (b), if the total amount of refrigerant per unit is below 100 kg, it is considered a minor source of emissions, and there is no need to report it. ◗ Redland Water should confirm refrigerant type and stocks in all units.
Calculation method	Emissions (tCO_2-e) = ΣR_i (kg) × 0.09 × GWP ($kgCO_2$-e/ kg R_i) × 10^{-3} (t/kg) where ◗ 0.09 = Default annual leakage rate of gas for commercial air conditioning ◗ R_i = mass of refrigerant (kg) ◗ GWP = global warming potential of refrigerant, R_i
Statistical Uncertainty ◗ Qualitative ◗ Quantitative	 Moderate – All A/C and refrigerator units are accounted for, but assumptions have been made on mass and type of refrigerant used ± 15% (refer to Table 1)

3.4 Wastewater Handling (Domestic and Commercial) (NGERS Part 5.3)

3.4.1 Methane from Wastewater Handling – Wastewater and Sludge Treatment

<table>
<tr><td>NGERS Technical Guidelines reference</td><td>Part 5.3, Division 5.3.2 – Methods 1 and 2</td></tr>
<tr><td>Data collection method</td><td>The NGERS Inventory has been prepared by GHD based on a summary of source information provided by Redland Water. For the purposes of further formal submissions to the DCC, Redland Water should provide fully auditable records of the source information.</td></tr>
<tr><td>Data collection</td><td>Where available, data was collected for each treatment plant as stated below. A summary of the assumptions made in data collection is shown below:
<table>
<tr><th>Data</th><th>Units</th><th>Period</th><th>Assumption</th></tr>
<tr><td>Influent Plant Flow</td><td>ML/d</td><td>Apr 08 - Apr 09</td><td>Median value from weekly test results for each STP</td></tr>
<tr><td>Influent COD Concentration</td><td>mg/L</td><td>N/A</td><td>Historical median value (2001-2003) weekly test results for each STP</td></tr>
<tr><td>Effluent BOD Concentration</td><td>mg/L</td><td>Apr 08 - Apr 09</td><td>Median value from weekly test results for each STP</td></tr>
<tr><td>Biosolids</td><td>tonnes / y</td><td>Jul 07 - Nov 08</td><td>Historical Value (2007-2008), flow proportioned for each plant from average total wet tonnes for all STPs</td></tr>
<tr><td>Biosolids Solids Content</td><td>% d.s.</td><td>N/A</td><td>Historical Value (April 2008) – average value from two sampling days for each STP</td></tr>
<tr><td>Volatile Solids in Disposed Biosolids</td><td>%VS</td><td>N/A</td><td>Historical Value (April 2008) – average value from two sampling days for each STP</td></tr>
</table></td></tr>
<tr><td>Representativeness</td><td>Moderate – There are some assumptions in the data collection. However, all data was collected from actual plants</td></tr>
<tr><td>Exclusions and assumptions</td><td>
- No sludge biogas captured, flared, or transferred out in any of the plants, as shown in Appendix B.
$Q_{captured} = 0$, $Q_{flared} = 0$, and $Q_{transf} = 0$
- Fraction of COD in wastewater anaerobically treated by plant, $F_{wan} = 0$, and Fraction of COD in sludge anaerobically treated by plant, $F_{slan} = 0$, given that all STPs have well managed fully aerobic treatment, as detailed in Appendix B.
- All sludge removed from the wastewater is transferred out of the plant and removed to a landfill or to another site, as detailed in Appendix B.
$COD_{sl\_transfer} = COD_{sl}$</td></tr>
</table>

Exclusions and assumptions (cont.)	◗ It is assumed that there are no methane emissions from fermenters. These are short time residence reactors where anaerobic reactions of hydrolysis, acidogenesis and acetogenesis take place, converting solids to soluble compounds, and this in turn into volatile fatty acids. The short residence time and uncontrolled pH environment of these reactors create an optimum environment for acid and acetic forming acid bacteria. On the other hand, methane forming (methanogenic) bacteria have a slow growth rate (24-72 hours) and are highly sensitive to pH (6.8 – 8), requiring long residence time and strict pH control to develop. It is assumed that given the short residence time, high pH and suboptimal temperature conditions of fermenters, methane forming bacteria are unlikely to grow in this environment. Therefore, methane formation is considered nil in fermenters.
Calculation method	$E_j = \left[CH_4^* - \gamma\left(Q_{captured} + Q_{flared} + Q_{transf}\right)\right]$ where: ◗ E_j = emissions of CH_4 released by the plant (tCO_2-e/y) ◗ CH_4* = estimated quantity of CH_4 in sludge biogas released by the plant (tCO_2-e/y) ◗ γ = $6.784 \times 10^{-4} \times 21$ (tCO_2-e/m^3 CH_4) at standard conditions (15ºC, 1atm) ◗ $Q_{captured}$ = CH_4 in sludge biogas captured for combustion for use by the plant (m^3 CH_4/y) ◗ Q_{flared} = CH_4 in sludge biogas flared by the plant (m^3 CH_4/y) ◗ Q_{transf} = CH_4 in sludge biogas transferred out of the plant (m^3 CH_4/y) For $Q_{captured}$ / CH_{4gen} < 0.75 ,Division 5.3.2, subsection 5.25 (2) applies: $CH_4^* = CH_{4gen}$ where: $CH_{4gen} = \left(COD_w - COD_{sl} - COD_{eff}\right) \times F_{wan} \times EF_{wij} + \left(COD_{sl} - COD_{sl\_transfer}\right) \times F_{slan} \times EFs_{slij}$ where: ◗ CH_{4gen} = quantity of methane in sludge biogas produced by the plant (tCO_2-e/y) ◗ F_{wan} = fraction of COD in wastewater anaerobically treated by plant (tCOD/y)

Calculation method (cont.)	◗ EF_{wij} = default methane emission factor for wastewater = 5.3 tCO_2-e / tCOD ◗ F_{slan} = fraction of COD in sludge anaerobically treated by plant (tCOD/y) ◗ EF_{slij} = default methane emission factor for sludge = 5.3 tCO_2-e / tCOD ◗ COD_w = quantity of COD in influent to plant (tCOD/y) = influent COD concentration (mg/L) × influent plant flow (ML/d) × 10^{-3} (t/kg) ◗ COD_{sl} = COD removed as sludge from wastewater and treated in the plant (tCOD/y) ◗ COD_{eff} = quantity of COD in effluent leaving the plant (tCOD/y) = influent COD concentration (mg/L) × influent plant flow (ML/d) × 10^{-3} (t/kg) ◗ $COD_{sl\_transfer}$ = quantity of COD in sludge transferred out of the plant and removed to a landfill or to other site (tCOD/y) ***F_{wan} and F_{slan} were assessed as zero for all wastewater treatment processes, therefore methane generation was zero for all processes.***
Statistical Uncertainty ◗ Qualitative ◗ Quantitative	 High Uncertainty – no COD data was available for the relevant reporting period ± 30% (refer to Table 1)

3.4.2 Nitrous Oxide from Wastewater Handling

NGERS *Technical Guidelines* reference	Part 5.3, Division 5.3.5 – Method 1
Data collection method	The NGERS Inventory has been prepared by GHD based on a summary of source information provided by Redland Water. For the purposes of further formal submissions to the DCC, Redland Water should provide fully auditable records of the source information.
Data collection	Where available, data was collected for the period 30th June 2008 to 30th June 2009 period for each treatment plant. A summary of the assumptions made in data collection is shown below:

Data collection (cont.)	<table><tr><th>Data</th><th>Units</th><th>Period</th><th>Assumption</th></tr><tr><td>Influent Plant Flow</td><td>ML/d</td><td>Apr 08 - Apr 09</td><td>Median value from weekly test results for each STP</td></tr><tr><td>Effluent Plant Flow</td><td>ML/d</td><td>Apr 08 - Apr 09</td><td>Median value from weekly test results for each STP</td></tr><tr><td>Effluent TN Concentration</td><td>mg/L</td><td>Apr 08 - Apr 09</td><td>median value from weekly test results</td></tr><tr><td>Biosolids</td><td>tonnes / y</td><td>Jul 07 - Nov 08</td><td>Historical Value (2007-2008), flow proportioned for each plant from average total wet tonnes for all STPs</td></tr><tr><td>Biosolids Solids Content</td><td>% d.s.</td><td>N/A</td><td>Historical Value (April 2008) - average value from two sampling days for each STP</td></tr><tr><td>Total N Concentration in Disposed Biosolids</td><td>kgN/ kg d.bs.</td><td>N/A</td><td>Typical Value (June 2009 test results not available at the time of writing)</td></tr></table>
Representativeness	Moderate – there are some assumptions in the data collection. However, all data was collected from actual plants
Exclusions and assumptions	◗ The population is estimated by dividing the influent plant flow by 200 L/per capita /d (typical domestic wastewater plant flow)
Calculation method	$E_j = \left[(N_{in} - N_{tr} - N_{out}) \times EF_{sec\,ij} + N_{out} \times EF_{disij}\right]$ where: ◗ E_j = emissions of N_2O from domestic sewage treated by the plant (tCO_2-e/y) ◗ N_{in} = quantity of nitrogen entering the plant (tN/y) = Protein × $Frac_{Pr}$ × P where: o Protein = 36 kg protein per capita per year o $Frac_{Pr}$ = 0.16 kg nitrogen per kg protein o P = Population serviced by the plant during the year. ◗ N_{tr} = quantity of nitrogen in sludge transferred out of the plant and removed to a landfill or other site (tN/y) = biosolids (t/y) × solids content (%d.s.) × TN concentration in disposed biosolids (%) ◗ N_{out} = quantity of nitrogen leaving the plant in effluent (tN/y) = influent plant flow (ML/y) × effluent TN concentration (mg/L) × 10^{-3} (t/kg) ◗ EF_{secij} = N_2O emission factor for wastewater treatment = 4.9 tCO_2-e / tN ◗ EF_{disij} = N_2O emission factor for effluent disposal = 4.9 tCO_2-e / tN

<table>
<tr>
<td>Statistical Uncertainty
◗ Qualitative</td>
<td>Statistical uncertainty has been calculated for influent plant flow and effluent TN concentration for all plants as follows:
<table>
<tr><th>Data</th><th>Thorneside</th><th>Cleveland</th><th>Victoria Point</th><th>Capalaba</th><th>Mt Cotton</th><th>Point Lookout</th><th>Dunwich</th></tr>
<tr><td>Influent Plant Flow</td><td>±2.0%</td><td>±2.4%</td><td>±2.6%</td><td>±1.7%</td><td>±5.1%</td><td>±5.1%</td><td>±3.0%</td></tr>
<tr><td>Effluent TN Conc.</td><td>±18.0%</td><td>±18.4%</td><td>±8.5%</td><td>±7.5%</td><td>±15.8%</td><td>±9.9%</td><td>±21.7%</td></tr>
</table>
High uncertainty for Biosolids tonnage, solids content and nitrogen content is estimated from limited and less representative data.</td>
</tr>
<tr>
<td>◗ Quantitative</td>
<td>Overall uncertainty is estimated as ± 30% (refer to Table 1)</td>
</tr>
</table>

3.5 Scope 2 Emissions — Purchase of Electricity from Network (NGERS Part 7.2)

NGERS *Technical Guidelines* reference	Part 7.2 – Method 1
Data collection method	Redland Water provided the electricity consumption data for the following: ◗ Offices: o Dunwich Depot, South St Depot, Cleveland Library Level 1 ◗ STPs: o Capalaba, Thorneside, Cleveland, Victoria Point, Mt Cotton, Dunwich and Point Lookout. ◗ Water Supply Assets: o Bunker Rd WB, Rainbow Cres Reservoir, Tallowood Court WB, Tramican St WB, Booran St WB, Lucinda Cres Reservoir, Howlett Rd WB, Tazi Rd Reservoir, Duncan Rd WB, and Gilles Rd Reservoir. ◗ 157 Pump Stations
Period of data collection	July 2008 to June 2009 Electricity consumption prior to 1 July 2008 was not considered. Where the first electricity invoice for the period included electricity consumption prior to 1 July, the total kWh were divided by the number of days and only days of the reporting period were considered.
Units	kWh
Representativeness	Moderate – All premises are connected to the electricity grid in Queensland. Data was unavailable for some invoicing periods for pump stations, water supply assets, offices and STPs.

Exclusions and assumptions	NGERS *Technical Guidelines*, Table 7.2: ◗ QLD Scope 2 emission factor = 0.91 kgCO2-e / kWh
Calculation method	Scope 2 Emissions (tCO_2-e) = Q (kWh) × 0.91 ($kgCO_2$-e / kWh) × 10^{-3} (t/kg) where: ◗ Q = annual electricity consumption (kWh)
Statistical Uncertainty ◗ Qualitative ◗ Quantitative	 Moderate – Some electricity meter readings appeared to be based on estimates only ± 15% (refer to Table 1)

3.6 Total Uncertainty

The overall total uncertainty associated with the NGERS inventory is calculated using the root-sum-of-squares technique (*GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty*, 2003), as follows:

$$\pm U_T = \frac{\sqrt{\sum (E_i \times U_i)^2}}{\sum E}$$

where

U_T = Total uncertainty (cumulated) for inventory (%);

E_i = Emissions for each inventory item, *i* (tCO_2-e); and

U_i = Uncertainty for each inventory item, *i* (%).

4. Results and Conclusions

4.1 Results

This 2008/09 NGERS inventory report is suitable for Redland Water to prepare its own formal submission to the DCC (via OSCAR – On-line System for Comprehensive Activity Reporting), subject to further reporting and record keeping as outlined in Section 5.

A summary of the NGERS inventory results, Scope 1 and 2, is presented in Table 3, detailing for each section the method, emissions by scope, proportion of total inventory, rank and uncertainty. A summary of the voluntarily reportable Scope 3 emissions is presented in Appendix E.

Figure 1 below shows the Scope 1 and 2 emissions associated with each STP catchment.

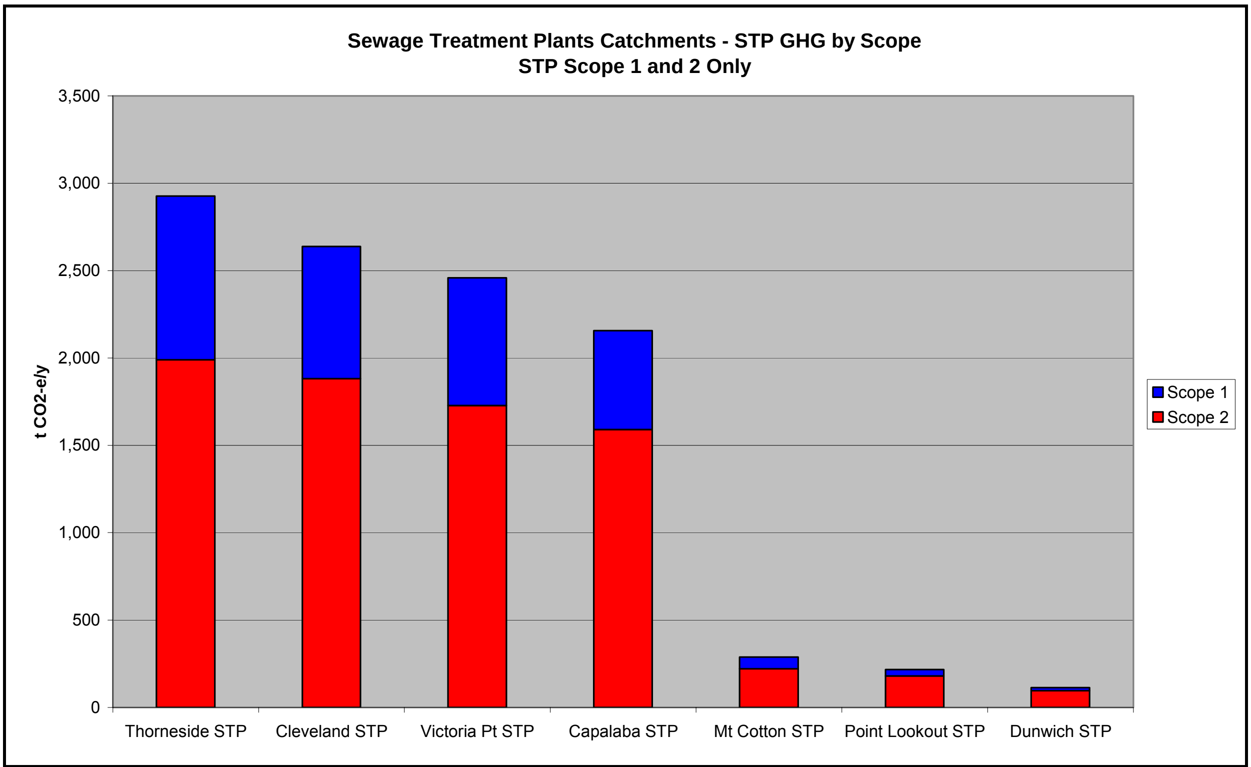


Figure 1 STP Emissions by Scope 1 and 2

Overall STP catchments inventory results by scope, tCO_2-e per ML and process are shown in the figures of Appendix F.

Table 3 NGERS Inventory Summary (Scope 1 and 2)

NGER (Measurement) Technical Guidelines v1.1	NGERS Method	Scope 1 Emissions (tCO_2-e)	Scope 2 Emissions (tCO_2-e)	Proportion of Total Inventory	Rank	Uncertainty (± %)	Scope 1 Uncertainty (± tCO_2-e)	Scope 2 Uncertainty (± tCO_2-e)
7.2 Scope 2 Emissions — Purchase of Electricity from Network	1	-	7,858	69.7%	1	15%	-	1,179
5.3 Wastewater Handling (domestic and commercial)	1	3,111	-	27.6%	2	30%	933	-
2.4 Combustion of Liquid Fuels	1	305	-	2.7%	3	30%	92	-
4.5 Hydrofluorocarbons and Sulphur Hexafluoride	1	4	-	0.0%	4	15%	1	-
Subtotal		3,421	7,858					
Total		**11,279**				**13%**	**1,506**	

4.2 Conclusions

Based on these results, Redland Water does not independently trigger the “corporate” or “facility” NGERS reporting threshold of 125,000 or 25,000 tonnes of CO_2-e (Scopes 1 and 2), respectively.

However, as a business unit of the Redland City Council, Redland Water may be obliged to report to the Department of Climate Change.

5. Recommendations

This NGERS Inventory report has been prepared by GHD based on a summary of source information provided by Redland Water. For the purposes of further formal submissions to the DCC, Redland Water should provide fully auditable records of the source information.

Recommendations for future reporting and record keeping are shown in Table 4. Indicative priorities have been outlined, using a qualitative scale based on the relative proportion of the inventory.

At the time of writing (16 June 2009), not all Redland Water source information relevant to the 1 July 2008 to 30 June 2009 period was available. For the purposes of further formal submissions to the DCC, Redland Water should update the inventory with all source information relevant to the full period. Information to be updated for the 2008/09 Inventory period has been indicated in the table below.

Table 4 Further Reporting and Record Keeping Requirements

Record	Recommended Frequency	Priority	Recommended Action
STP Cumulative Influent Flow	Yearly	High	Update current inventory with latest June 2009 data
STP Influent TN	Monthly	Moderate	Estimate N_2O using Method 2 in future inventories
STP Influent COD	Monthly	Low	Estimate CH_4 using Method 2 in future inventories
STP Effluent TN	Monthly	High	Update current inventory with latest June 2009 data
STP Effluent COD	Monthly	Low	Estimate CH_4 using Method 2 in future inventories
STP Cumulative Biosolids	Yearly	Moderate	Update current inventory with more accurate data with STP specific data
STP Nitrogen Content of Biosolids	Quarterly	High	Update current inventory with latest June 2009 data, with STP specific data
Biosolids Solids Content	Quarterly	Moderate	Update current inventory with more accurate data
Volatile Solids in Disposed Biosolids	Quarterly	Moderate	Update current inventory with more accurate data
Fuel Cumulative Use – Fleet and Contractors	Yearly	Low	Update current inventory with more accurate data

Record	Recommended Frequency	Priority	Recommended Action
Electricity Cumulative Use	Yearly	High	Update current inventory with latest June 2009 data
Refrigerants Type and Stock	N/A	Low	Update current inventory with latest June 2009 data

Appendix A

Redland Water Supply and Sewerage Catchment Facilities

Table 5 Redland Water Supply and Sewerage Catchment Facilities

OFFICES	STREET ADDRESS	SUBURB
Redland Water Main Office	Level 1, Library Building, Corner of Middle and Bloomfield Streets	Cleveland
Council Depot	Corner of South and Wellington Streets	Cleveland
Redlands Laboratory	Redland Laboratry, Capalaba WTP	Capalaba
North Stradbroke Depot	Mitchell Crescent	Dunwich
WATER BOOSTER STATIONS	**STREET ADDRESS**	**SUBURB**
Mt Cotton	Mt Cotton Reservior, Adjacent to 4 Tallow Wood Court	Mt Cotton
Booran Street	Opposite 13 Booran Street	Pt Lookout
Howlett Road	223 Mount Cotton Road	Capalaba
Tramican Street	23-25 Tramican Street	Pt Lookout
Dunwich Resevior	End of Rainbow Crescent	Dunwich
Duncan Road	Adjacent to 613 Mt Cotton Road	Sheldon
SEWAGE TREATMENT PLANTS	**STREET ADDRESS**	**SUBURB**
Capalaba STP	34 Smith Street	Capalaba
Cleveland STP	Weippin Street	Cleveland
Thorneside STP	220 Quarry Road	Thorneside
Victoria Point STP	153 Link Road	Victoria Point
Mt Cotton STP	341 German Church Road	Mt Cotton
Dunwich STP	Ballow Road	Dunwich
Pt Lookout STP	Tramican Street	Point Lookout
SEWAGE PUMP STATIONS	**STREET ADDRESS**	**SUBURB**
1	Adjacent to 171 Shore Street	CLEVELAND
2	Middle Street, Near Wharf Street	CLEVELAND
3	Princess Street, Near Erobin Street	CLEVELAND
4	Middle Street, Near Island Street	CLEVELAND
5	Cultural Centre, 2-16 Middle Street	CLEVELAND

6	Cleveland Showgrounds, 44 Smith Street	CLEVELAND
8	McDonald Road, North of Flinders Street	ALEXANDRA HILLS
9	Cleveland WWTP Land - Flinders Street	ALEXANDRA HILLS
11	65 Redland Bay Road	THORNLANDS
12	Adjacent to 1 Cleary Street	CLEVELAND
13	Shore Street East, Near Cross Street	CLEVELAND
14	Shore St North, Northen End	CLEVELAND
16	4A Whitehall Avenue, Near Tingalpa Creek	BIRKDALE
19	Adjacent to 20 Ostend Court	CLEVELAND
21	Cnr William Street & Crown Road	ALEXANDRA HILLS
22	8 Link Road	VICTORIA PT
23	36A Brewer Street	CAPALABA
24	164 Old Cleveland Road	CAPALABA
25	126 Old Cleveland Road	CAPALABA
26	30 Old Cleveland Road	CAPALABA
28	1-29 St Andrews Avenue	BIRKDALE
29	Eva Street	THORNSIDE
30	Queens Esplanade, Near Helen Street	THORNSIDE
31	Queens Esplanade, Near Mark Street	THORNSIDE
32	Queens Esplanade, Near Bates Drive	BIRKDALE
33	226 Birkdale Road	BIRKDALE
34	56 Thomas Street	BIRKDALE
35	347 Birkdale Road	BIRKDALE
36	Opposite Jellicoe Street, Main Road	WELLINGTON PT
37	Adjacent to 9-11 Acacia Street	WELLINGTON PT
38	Adjacent to 232 Main Road	WELLINGTON PT
39	122 Main Road	WELLINGTON PT
40	49 Main Road	WELLINGTON PT
41	38 Fernbourne Road	WELLINGTON PT
42	51 Hilliard Street	ORMISTON
43	Opposite 248 Wellington Street	ORMISTON
44	56A Glover Drive	ALEXANDRA HILLS

45	46-48 Troy Street	ORMISTON
47	Frost Street, Near Sprirt Drive	CAPALABA
48	Opposite 32 Victor Street	BIRKDALE
49	Simon Street, Near Sharr Street	VICTORIA PT
52	Easement beside 35 Counihan Street	ORMISTON
53	Cnr Noeleen Street and Morten Bay Road	CAPALABA
54	Adjacent to 4 Pelican Street	VICTORIA PT
55	Reserve at end of Wilson Street	VICTORIA PT
56	Adjacent to 8-10 Wilson Street	VICTORIA PT
57	23A Wilson Esplanade	VICTORIA PT
58	Adjacent to 13-15 Pt O'Halloran Road	VICTORIA PT
59	Opposite 20 Mallet Street	VICTORIA PT
60	Cnr Orana Street & Orana Esplanade	VICTORIA PT
61	50 Orana Street	VICTORIA PT
62	31-37 Killarney Cresent	CAPALABA
65	15 Pittwin Road North	CAPALABA
66	2 Robin Parade, Near Jordana Court	VICTORIA PT
67	Reserve beside 66 Fir Street	VICTORIA PT
68	East of Boundary Road, Near Roundabout	THORNLANDS
69	Reserve behind 71 Tramican Street	PT LOOKOUT
70	End of Roseby Court	PT LOOKOUT
71	George Nothling Drive, Near Mooloomba Road	PT LOOKOUT
72	Adjacent to 85 Dickson Way	PT LOOKOUT
73	Bowsprit Parade, Opposite Bollard Street	CLEVELAND
74	Adjacent 2 Sentinel Court	CLEVELAND
75	44 Anchorage Drive	CLEVELAND
81	173 Redland Bay Road	THORNLANDS
82	Cricket grounds, 143 Ftizroy Street	CLEVELAND
83	Adjacent to 1 Ruth Street	BIRKDALE
84	1A Bath Street	BIRKDALE
85	Adjacent to 36 Makaha Drive	BIRKDALE
86	Cleveland WWTP land	CLEVELAND

87	Southern end of Passage Street	CLEVELAND
88	Opposite 39 Esplanade	REDLAND BAY
89	Behind 2 Bay Street	REDLAND BAY
90	46-72 Banana Street, Near Weinam Street	REDLAND BAY
91	Opposite 2A Marine Street	REDLAND BAY
92	7 Donald Road	REDLAND BAY
93	Adjacent to 9 Catherine Street	BIRKDALE
95	33 Anita Street	REDLAND BAY
96	10 Tipplers Street	VICTORIA PT
97	24 Tipplers Street	VICTORIA PT
98	22 Dorsal Drive	BIRKDALE
99	68 Dorsal Drive	BIRKDALE
100	Adjacent to 45 Albicore Drive	THORNLANDS
101	16 Beachside Court	VICTORIA PT
103	Adjacent to Cylinder Beach Caravan park	PT LOOKOUT
104	Southern end of Bimba Street	PT LOOKOUT
106	8 Esplanade	WELLINGTON PT
107	Adjacent to 2 Sentinel Court	CLEVELAND
109	3 Keel Street	BIRKDALE
110	30 Downwind Court	BIRKDALE
111	Opposite 8 Christopher Street	REDLAND BAY
112	29 Mcwilliam Street	REDLAND BAY
113	Opposite 6 Sommersea Drive	CLEVELAND
114	24 Caravel Court	CLEVELAND
115	7 Mainsail Street	BIRKDALE
116	84 Sunshine Drive	CLEVELAND
117	Adjacent 1 Raby Bay Boulevard	CLEVELAND
118	48 Prescoter Drive, Opposite Troon Court	VICTORIA PT
119	3-11 Sommersea Drive, Opposite Martingale Drive	CLEVELAND
120	25 Piermont Place	CLEVELAND
121	Adjacent 21 Raby Bay Boulevard	CLEVELAND
122	48-58 Masthead Drive	CLEVELAND

123	End of easement between 72 and 76 Hanover Drive	ALEXANDRA HILLS
124	1 Buggy Place	REDLAND BAY
125	351-353 Mount Cotton Road	CAPALABA
126	190-262 Redland Bay Road	THORNLANDS
128	229 Long Street (Booster Station)	CLEVELAND
129	54 Fryar Street	VICTORIA PT
130	6 Cayman Cresent	ORMISTON
131	Kennedy Drive, near SLSC	PT LOOKOUT
132	18 Moores Road	REDLAND BAY
134	off the Eastern end of Hardwood Drive	MT COTTON
135	64 Aspect Drive	VICTORIA PT
136	23 Weippin Street	CLEVELAND
138	Opposite 52 Penzance Drive	REDLAND BAY
139	31 Manning Esplanade	THORNLANDS
140	Railway Parade, Behind Canoe Club Toilet Block	THORNSIDE
141	165 South Street	CLEVELAND
142	Ballow Road	DUNWICH
143	Flinders Avenue	DUNWICH
144	East Coast Road	DUNWICH
145	Opposite 2 Tindappah Drive	THORNLANDS
146	12 Lincoln Close	ALEXANDRA HILLS
147	Opposite 4 Lorikeet Drive	THORNLANDS
151	354 German Church Road	MT COTTON
152	Victoria Parade, Northern Side	COOCHIEMUDLO
153	Victoria Parade, Eastern Side	COOCHIEMUDLO
154	Victoria Parade, Southern Side, Near Barge ramp	COOCHIEMUDLO
155	Victoria Parade, Western Side, Near Golf Course	COOCHIEMUDLO
156	Adder Rock Caravan Park	PT LOOKOUT
157	Adder Rock Caravan Park	PT LOOKOUT

Appendix B

STP Processes

Process Flow Diagrams and Brief Descriptions

Cleveland, Thorneside and Victoria Point STP have similar treatment processes, that is, Biological Nutrient Removal (BNR) plants with well managed fully aerobic treatment, comprised of a conventional oxidation ditch (OD) with upstream fermenter (also called anaerobic reactor or anaerobic tank).

Thorneside STP

The current works was designed to meet an enhanced effluent discharge licence incorporating limits on both nitrogen (N) and phosphorus (P). The works incorporates the following process units:

- Pre-treatment, comprising
  - One mechanically raked and one manually raked screen
  - Two aerated grit tanks with one drum screen for grit dewatering
  - Venturi flume for sewage flow metering
- One Activated Primary Tank (APT) for prefermentation of sewage. The APT incorporates a screened recycle.
- Nutrient removal activated sludge process comprising one biological reactor and two secondary clarifiers. The biological reactor is subdivided into a fermenter and an oxidation ditch. The return activated sludge (RAS) is screened. Scum is harvested from the oxidation ditch.
- Waste Activated Sludge (WAS) and scrum dewatering on two belt filter presses.
- Chemical systems comprising:
  - Lime dosing to the inlet works for pH control
  - Alum dosing to the OD outlet (weir) for supplementary P removal
  - Chlorination of effluent for disinfection
  - Polymer dosing of belt filter press feed
- Odour control of the APT and RAS screens and whole APT by housing and ventilation to two activated carbon scrubbers.

Cleveland STP

The Cleveland STP was upgraded from a trickling filter plant to a biological nutrient removal (BNR) standard in 2002. The upgraded plant has a final effluent quality of 5 mgN/L as total N and 1 mgP/L as total P (both on long term 50th percentile basis) and a design equivalent population (EP) rating of 38,000 EP

The plant is located near Hilliards Creek at the end of Weippin Road, off Wellington Street in Cleveland.

Effluent discharges to three effluent storage lagoons. Water from these lagoons is reused for irrigation, with the overflow being discharged to Hilliards Creek.

- The new BNR plant incorporates the following process units Inlet Works:
  - 1 No. duty mechanical fine step screen
  - 1 No. by-pass manually-raked coarse screen
  - 1 No. screenings conveyor and screw wash press unit
  - 1 No. vortex grit tank
  - 1 No. vortex / inclined screw-type conveyor grit classifier
  - 2 No. flowmeters.
- Bioreactors:
  - 1 No. oxidation ditch with upstream fermenter for biological nutrient removal (i.e. 3 stage Phoredox-type process)
  - 3 No. vertical shaft surface aerators
  - Scum removal equipment from oxidation ditch
- Secondary Clarifiers:
  - 2 No. circular clarifiers
  - Scum harvesting equipment
- Return Activated Sludge (RAS) System:
  - 6 No. direct coupled end suction RAS pumps
  - 1 No. RAS screen
- Waste Activated Sludge (WAS) System:
  - 2 No. helical rotor, variable speed WAS pumps
  - WAS is removed from the oxidation ditch
- Disinfection:
  - 1 No. chlorine contact tank
  - Chlorine gas dosing facilities
- Chemical Dosing:
  - Liquid alum facilities (2 No. dosing pumps, 1 No. storage tank)
  - Liquid magnesium hydroxide facilities (1 No. dosing pump, 1 No. mixing tank);
  - Powder polymer facilities
  - Powder zeolite facilities
- Sludge Thickening and Dewatering:
  - 2 No. gravity drainage tables
  - 1 No. belt filter press (existing with old plant)

- 1 No. belt filter press
- 2 No. washwater pumps

A simplified process flowsheet is provided (DRAFT Cleveland STP Operating and Maintenance Manual, February 2003, GHD).

Capalaba STP

The Capalaba STP was originally constructed in 1978 and in 1998 major upgrade works were conducted to provide a 30,000 EP BNR plant. The existing process consists of:

- 1 No. Inlet works (1 No. step screen and 1 No. vortex grit tank);
- Emergency (by-pass) bar screen (20 mm aperture);
- 1 No. Primary settlement tank used as a flow balancing tank;
- 1 No. Pre-fermenter (not in use);
- Nitrification Denitrification Biological Excess Phosphorus Removal system (NDBEPR) Process (2 No. parallel treatment trains consisting of pre anoxic zones, anaerobic zones, anoxic zones, aerobic zones, post anoxic zones re-aeration zones);
- 3 No. Blowers;
- 3 No. Secondary clarifiers;
- 1 No. Chlorine Contact Tank with associated chlorination system;
- 1 No. Dissolved Air Flotation (DAF) for WAS thickening;
- 1 No. Primary sludge digester (not in use) and 1 No. Secondary digester used as a sludge concentrator;
- 1 No. Centrifuge for digested sludge thickening;
- 1 No. Lime treatment tank (not in use);
- 1 No. Lime dosing facility and 1 No. Alum dosing facility;

Victoria Point STP

Major equipment for Victoria Point STP is similar to Cleveland and Thorneside STP in that it has an inlet works with screenings and grit removal, oxidation ditch with fermenter, secondary clarifiers, RAS pumps and screens, chlorine contact tank, WAS pumps, sludge dewatering, alum and chlorine dosing. To further reduce the nitrogen concentration in the effluent the plant has tertiary filtration via conventional single-medium gravity sand filters.

Mt Cotton STP

The Mt Cotton plant was commissioned in 1995 as a biological nutrient removal, activated sludge process. The works comprise the following unit processes:-

- Preliminary treatment
  - Screening
- Biological treatment
  - Anoxic tanks
  - Aerobic tanks
  - Anaerobic tanks
  - Secondary clarifier
  - Return activated sludge pumping
  - Waste activated sludge pumping
  - Aerobic-Anoxic recycle
- Effluent reuse
  - Effluent storage
  - Effluent irrigation
  - Effluent pumping
  - Service water
  - Disinfection using hypochlorite
- Sludge handling
  - Sludge dewatering facility
  - Waste activated sludge thickening

Dunwich STP

The Dunwich STP uses the intermittently decanted extended aeration (IDEA) process to treat wastewater for a maximum of 1000EP. The wastewater treatment process comprises the following components:

- Raw sewage screening and grit removal by Huber (Ro5) complete plant (spiral sieve for removal of screenings, grit, scum and grease)
- Aerobic anoxic tank (AAT) with two 4 kW Sinkair aerators, a pH probe and DO prove. The tank operates on aeration or mix cycles depending on the DO and time settings.
- Intermittent aeration tank (IAT) contains a stilling baffle, two 4kW Sinkair aerators, a RAS pump, a WAS pump and a decanted. This tank follows a sequence of aeration, mix, settle and decant based

on time settings which are increased/decreased according to plant load.

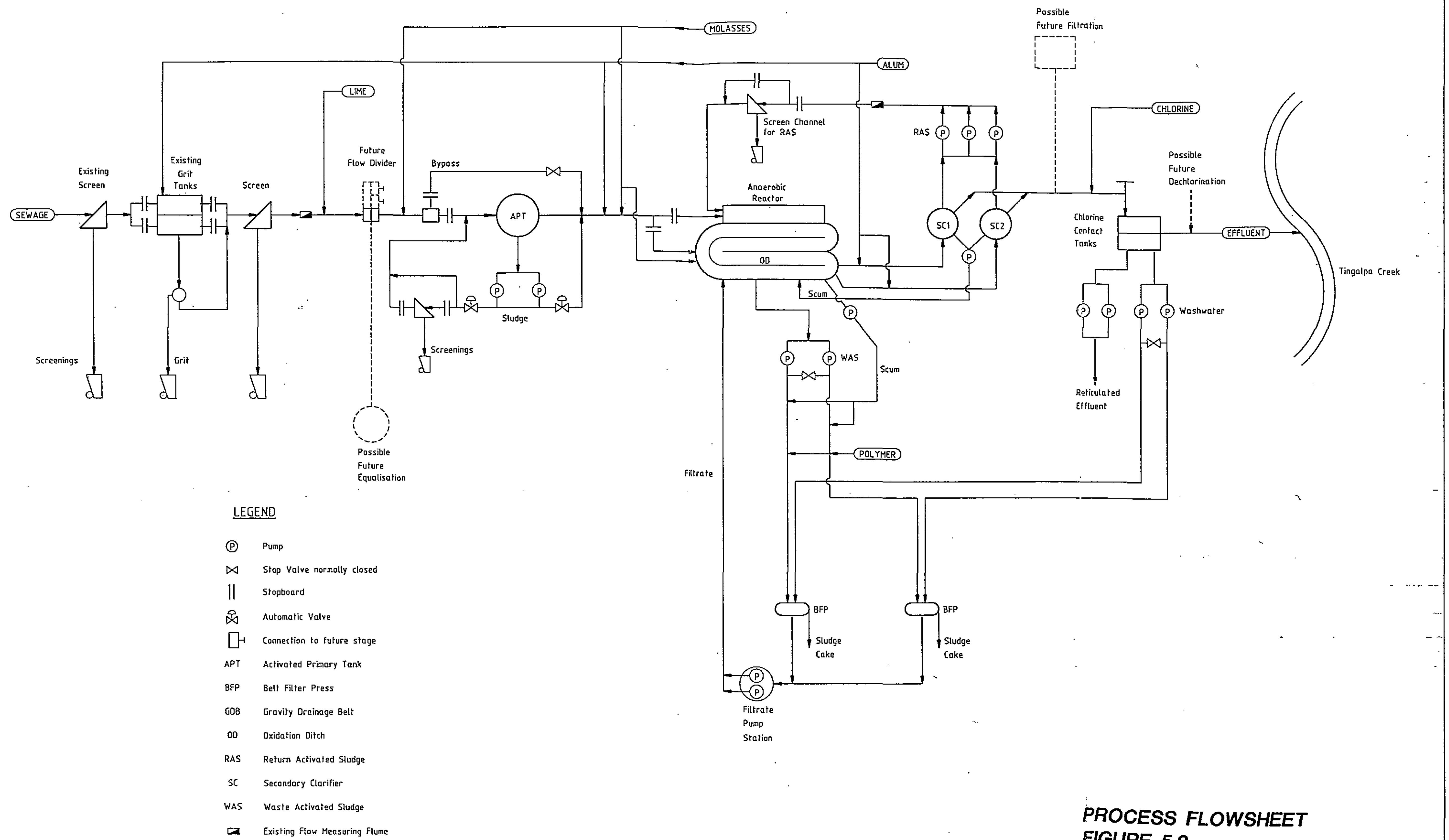
- WAS thickening in sludge storage thickening tank
- Effluent filtration – there are two filtration units (alternating between duty and standby) capable of treating 8L/sec each. Each unit consists of one feed pump, two filter vessels in parallel and a controller.
- Chemical dosing (alum for P removal, soda ash for pH adjustment and sodium hyphochlorite for disinfection)

A Process Flow Diagram is attached (scanned from Dunwich Wastewater Treatment Plant Operation & Maintenance Manual, Volume 1, Aeration Treatment Systems, February 2003).

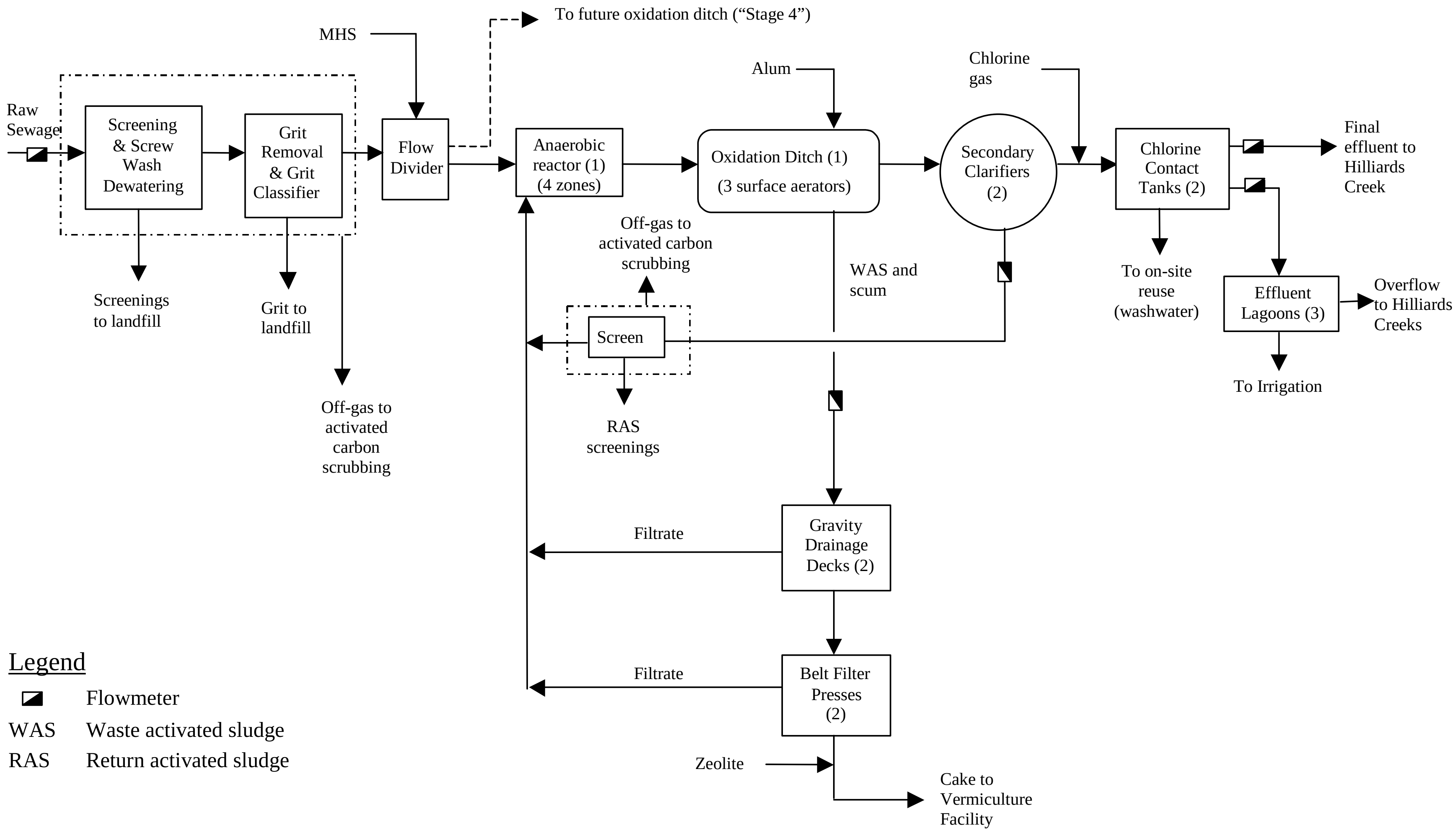
Point Lookout STP

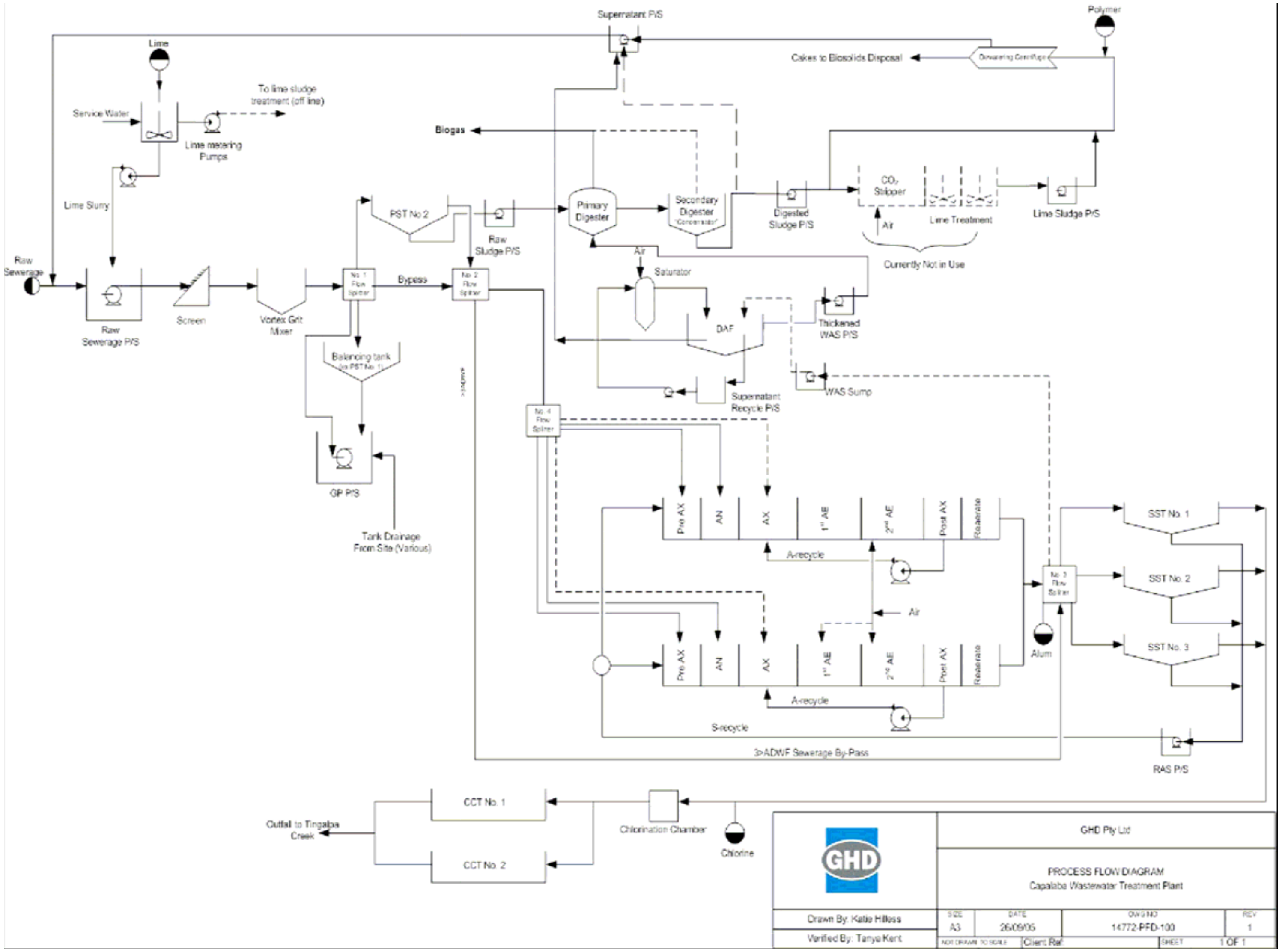
The existing Point Lookout STP consists of three stand-alone activated sludge plants designed to treat up to 1,750 EP. Plant 1 and 2 are designed to each treat 500 EP and Plant 3 to treat 750 EP. The current contributing population is approximately 1,800 EP increasing to 4,000 EP during peak holiday periods.

Each process train consists of screening, intermittently aerated activated sludge bioreactor, final clarifier and chlorine disinfection. The final effluent is disposed via three infiltration basins. Currently there is no positive control of the inflow to the three component plants, this has consequently led to poor load distribution. During peak loading periods the plant fails to achieve full compliance with the effluent licence.



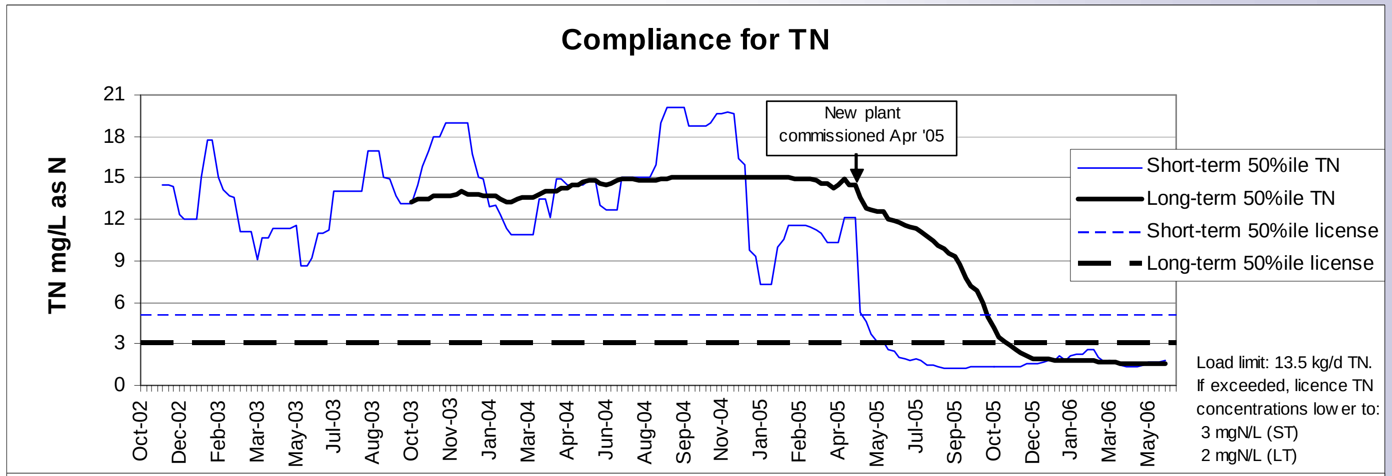
PROCESS FLOWSHEET
FIGURE 5.2

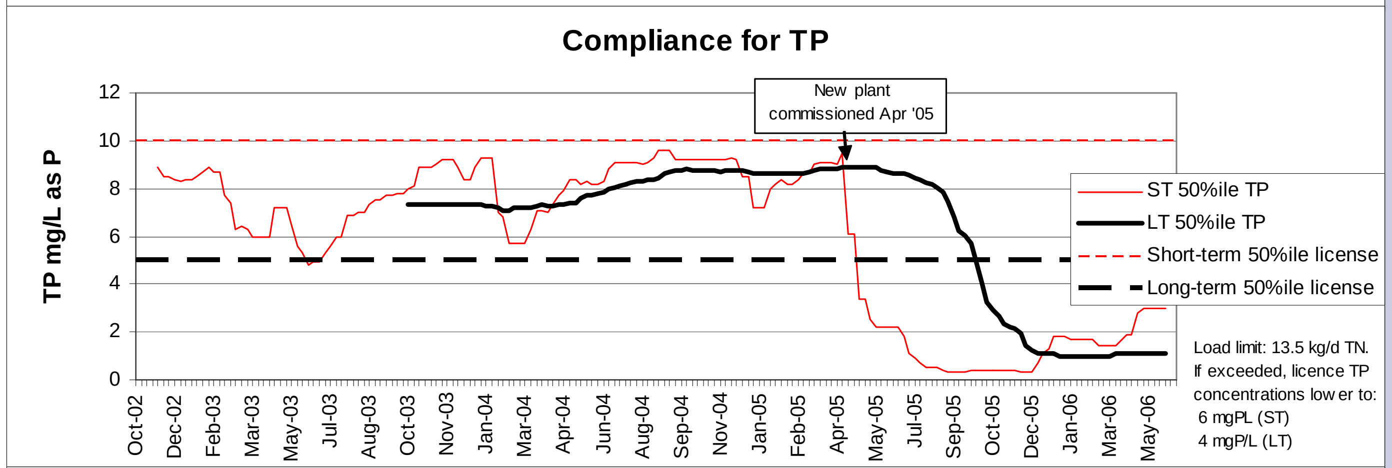

To future oxidation ditch ("Stage 4")
MHS
Alum
Chlorine gas
Raw Sewage
Screening & Screw Wash Dewatering
Grit Removal & Grit Classifier
Flow Divider
Anaerobic reactor (1) (4 zones)
Oxidation Ditch (1)
(3 surface aerators)
Secondary Clarifiers (2)
Chlorine Contact Tanks (2)
Final effluent to Hilliards Creek
Screenings to landfill
Grit to landfill
Off-gas to activated carbon scrubbing
Off-gas to activated carbon scrubbing
WAS and scum
To on-site reuse (washwater)
Effluent Lagoons (3)
Overflow to Hilliards Creeks
Screen
To Irrigation
RAS screenings
Filtrate
Gravity Drainage Decks (2)
Filtrate
Belt Filter Presses (2)
Zeolite
Cake to Vermiculture Facility
Legend
Flowmeter
WAS Waste activated sludge
RAS Return activated sludge

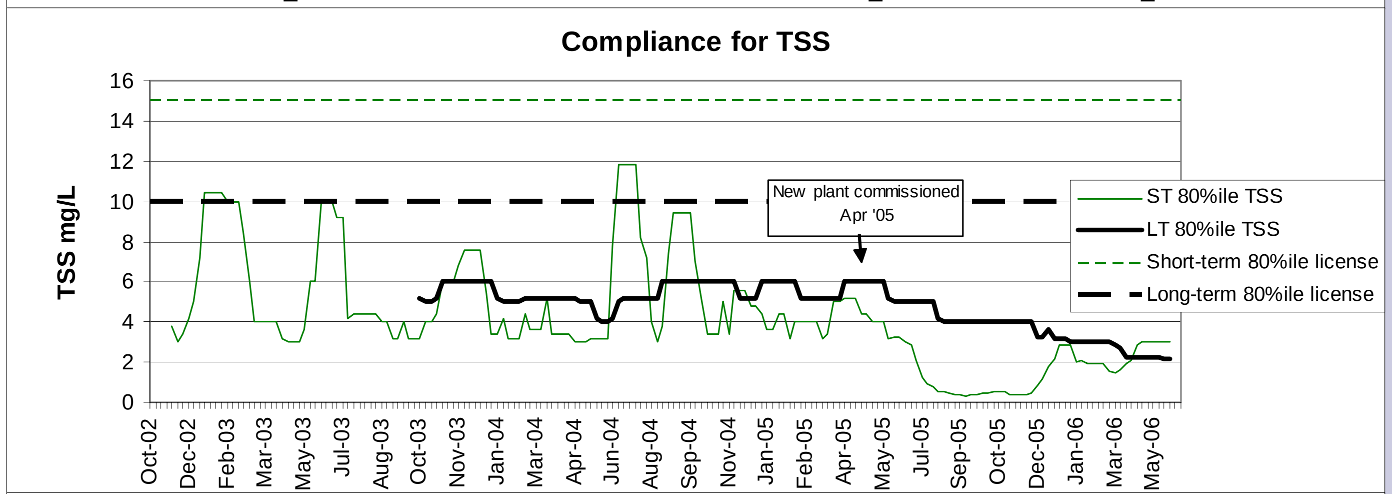

Supernatant P/S
Polymer
Lime
Cakes to Biosolids Disposal
Dewatering Centrifuge
To lime sludge treatment (off line)
Service Water
Lime metering Pumps
Biogas
Lime Slurry
PST No 2
Raw Sludge P/S
Primary Digester
Secondary Digester
Digested Sludge P/S
CO2 Stripper
Lime Treatment
Air
Lime Sludge P/S
Currently Not in Use
Raw Sewerage
Raw Sewerage P/S
Screen
Vortex Grit Mixer
No. 1 Flow Splitter
Bypass
No. 2 Flow Splitter
Saturator
DAF
Thickened WAS P/S
Balancing tank
Supernatant Recycle P/S
WAS Sump
No. 4 Flow Splitter
GP P/S
Tank Drainage From Site (Various)
Pre AX
AN
AX
1st AE
2nd AE
Post AX
Reaerate
A-recycle
SST No. 1
SST No. 2
SST No. 3
No. 3 Flow Splitter
Alum
S-recycle
3>ADWF Sewerage By-Pass
RAS P/S
CCT No. 1
CCT No. 2
Outfall to Tingalpa Creek
Chlorination Chamber
Chlorine
GHD
GHD Pty Ltd
PROCESS FLOW DIAGRAM
Capalaba Wastewater Treatment Plant
Drawn By: Katie Hilless
Verified By: Tanya Kent
SIZE
A3
DATE
26/09/05
DWG NO
14772-PFD-100
REV
1
NOT DRAWN TO SCALE
Client Ref
SHEET
1 OF 1

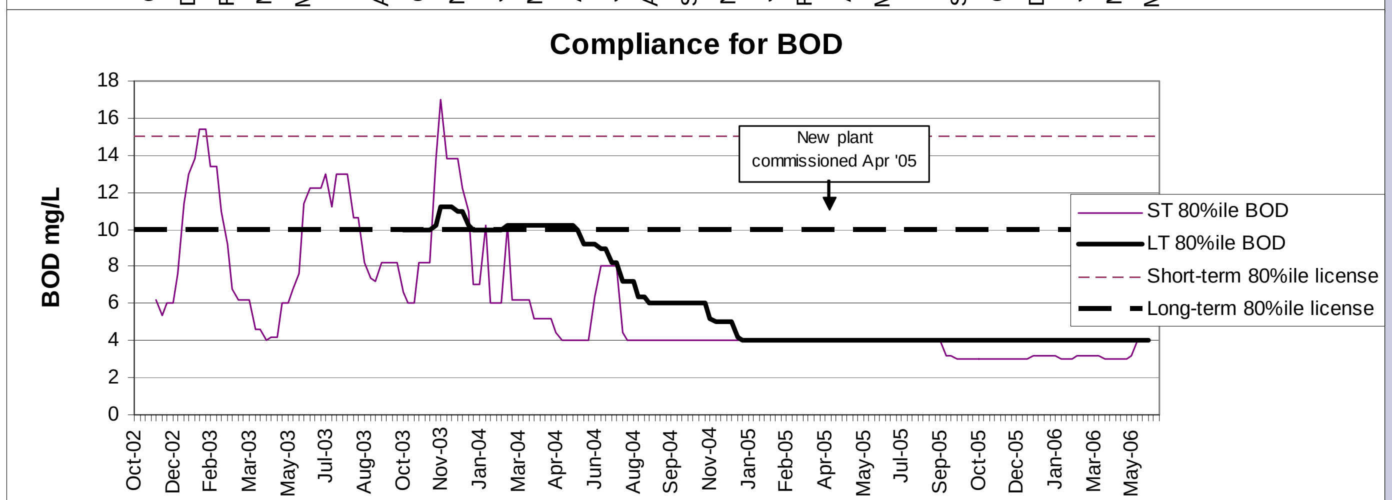
PERFORMANCE

Long term (LT): 50 consecutive weeks
Short term (ST): 5 consecutive weeks









Created by David de Haas, June 2006

Victoria Point STP

Sewage Treatment Plant

Site information sheet

Prepared for

Redland Water & Waste

Site contact:

Tel. 07 3207 8716

Operator (Ray Taylor): 0409 344934

Manager (Brad Taylor): 07 3829 8522

RWW Logo here

GHD

iwes

BACKGROUND

Dating back to 1978, Victoria Point STP was originally configured as a simple aerobic activated sludge plant, preceded by primary sedimentation with anaerobic sludge digestion. Over the years this plant was augmented and upgraded to a modified Ludzack-Ettinger (anoxic-aerobic) process with a capacity of approx. 13,000 EP. By early 2001 it was obvious that this plant was overloaded (~18,000 EP). An environmental study showed that particularly the nitrogen load from this plant was having a significant impact on the water quality of the Creek, to which it discharges, and ultimately on Moreton Bay. Planning studies in 1999-2001 indicated that to achieve the proposed new license requirements, it would be less cost effective to retain the existing plant than to build a new plant. Design of the new plant commenced in 2002, and construction proceeded through 2004-5. The new plant was commissioned in April 2005, except the filters which were delayed in construction for contractual reasons (completion expected in mid-2006). The new plant has produced a dramatic improvement in effluent quality and opens up new water recycling possibilities in the future.

New plant, commissioned April 2005.
Designed by GHD & built by United KG.

Old plant, built in stages 1978-1992
Currently decommissioned.
The old plant secondary clarifiers have been used in the plant design for effluent balancing / storage. Other tanks have will be retained for possible future use.

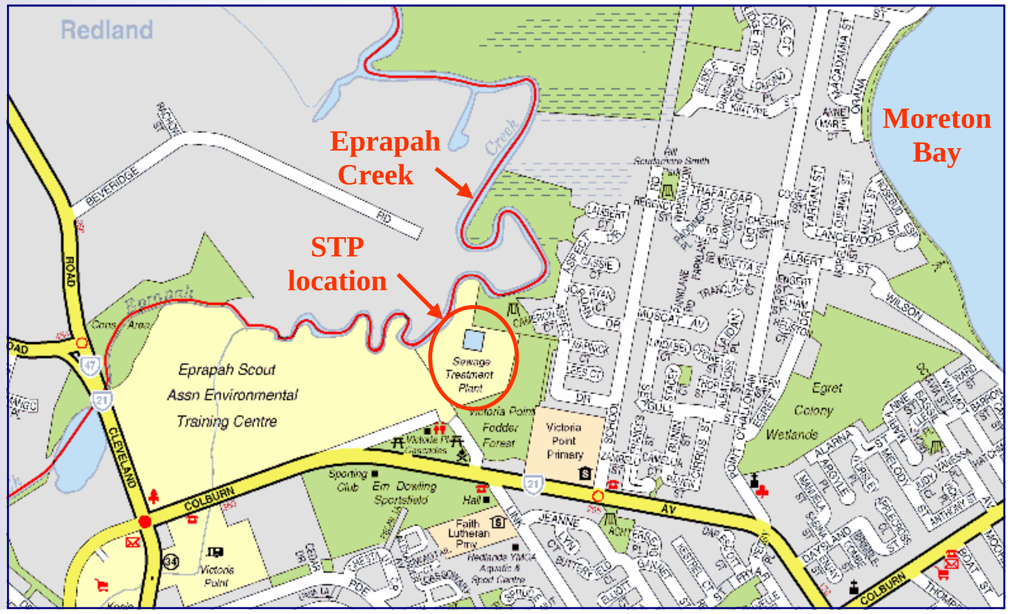
LOCATION

Victoria Point STP is located on Colburn Avenue adjacent to Eprapah Creek. The treated effluent from the plant discharges to the Creek; a portion is reused for irrigation on a golf course in the neighbourhood. Eprapah Creek is tidal and flows into Moreton Bay. Concerns over eutrophication of the Bay have led to the EPA issuing stringent requirements for nutrient removal in the environmental license for this plant.

Operators

Jeff Alvisio

Ray Taylor



DESIGN EFFLUENT QUALITY

This plant was one of the first in SE QLD to be issued with an environmental license with a mass load limit for Total N discharge. A load limit of 13.5 kg/d Total N is permitted for discharge to the Creek and the effluent TN concentration shall be <2 mgN/L as a long-term 50%ile (50 consecutive weeks). The initial design target for the BNR process was 50%ile 3 mgN/L TN, with provision for chemical supplementation (using molasses) and effluent filtration to achieve the lower target of 2 mgN/L TN. The plant currently achieves a long- term 50%ile of <2 mgN/L TN without molasses dosing or filtration but the filters are due for commissioning later in 2006. Other effluent quality limits include: BOD and TSS both <10 mg/L (long-term 80%ile); TP <4 mgP/L (long-term 50%ile); faecal coliforms <150/100 mL median.

PROCESS DETAILS

Design population: 34,000 EP @ 230 L/(EP.d)
Design Flow: 7.82 ML/d
Current flow (May 2006): 6.3 ML/d
Design 50%ile COD/ TKN/TP: 500/55/11 mg/L O_2/N/P
Design sensitivity check COD/ TKN/TP: 550/65/14
Current 50%ile COD/ TKN/TP: 442/61/11 mg/L O_2/N/P

Inlet Works:

- Peak flow 559 L/s (5 x ADWF; 42,000 EP ultimate)
- Screen: 3 mm step screen
- Vortex grit tank: 4.5 m diameter with auto air-lift pump and grit classifier

Biological nutrient removal activated sludge reactor:

- Oxidation ditch with anaerobic pre-selector reactor
- Ditch volume: 8.55 ML; channel 3.9 m deep; 8.2 m wide
- Anaerobic reactor: 0.95 ML (4 no. zones)
- Total process volume: 9.5 ML
- Design sludge age: 25 days
- Design MLSS: 3850 (50%ile); 4600 mg/L (90%ile)
- Surface aerators (3 no., 2 no. duty): 110 kW each
- Aeration requirement: Ave. 60 kg/h; Peak 282 kg/h SOTR

Clarifiers:

- 2 no. 34.5 m diameter, circular centre-scraped (provision in civil design for future 3rd clarifier)
- PWWF = 453 L/s (1630 m3/h), two clarifiers operating
- 90%ile MLSS 4600 mg/L; DSVI 185 mL/g
- RAS pumps: 6 No. (2 No. duty/ 1 No. standby per clarifier); 94 L/s each at 5.7m head, direct coupled, end suction, centrifugal pumps. PWWF (max.) RAS recycle rate = 150 L/s (Ave. = 36 to 45) per clarifier

Chemical dosing:

- Alum (30 kL bulk storage): 50%ile use 495 kg/d as 46% m/m solution, 29 mg/L dose as dry alum @ 7.82 ML/d ADWF; 90% ile use 622 kg/d solution, 48 mg/L dose @ 10.2 ML/d flow
- Magnesium hydroxide solution MHS min. 58% w/w $Mg(OH)_2$ (1 m^3 pallecon storage): 50 %ile use 67 L/d (13 mg/L as CaCO3 @ 7.82 ML/d ADWF); 90%ile use: 131 L/d (19 mg/L as CaCO3 supplement @ 10.2 ML/d ADWF)
- Chlorine (gas stored in 900 kg drums): 50%ile dose: 5 mg/L at 7.82 ML/d; 90%ile dose: 7 mg/L at 10.8 ML/d; 99%ile dose: 10 mg/L at PDWF (2 x ADWF)
- Current chemical use (May 2006): alum 30 mg/L as dry alum; MHS 39 mg/L as CaCO3; chlorine 4.5 mg/L as Cl_2

Filters:
4 No. filter cells, 40 m^2 each; Average filtration rate: 6 m/h; 50%ile solids loading in feed <10 mg/L TSS

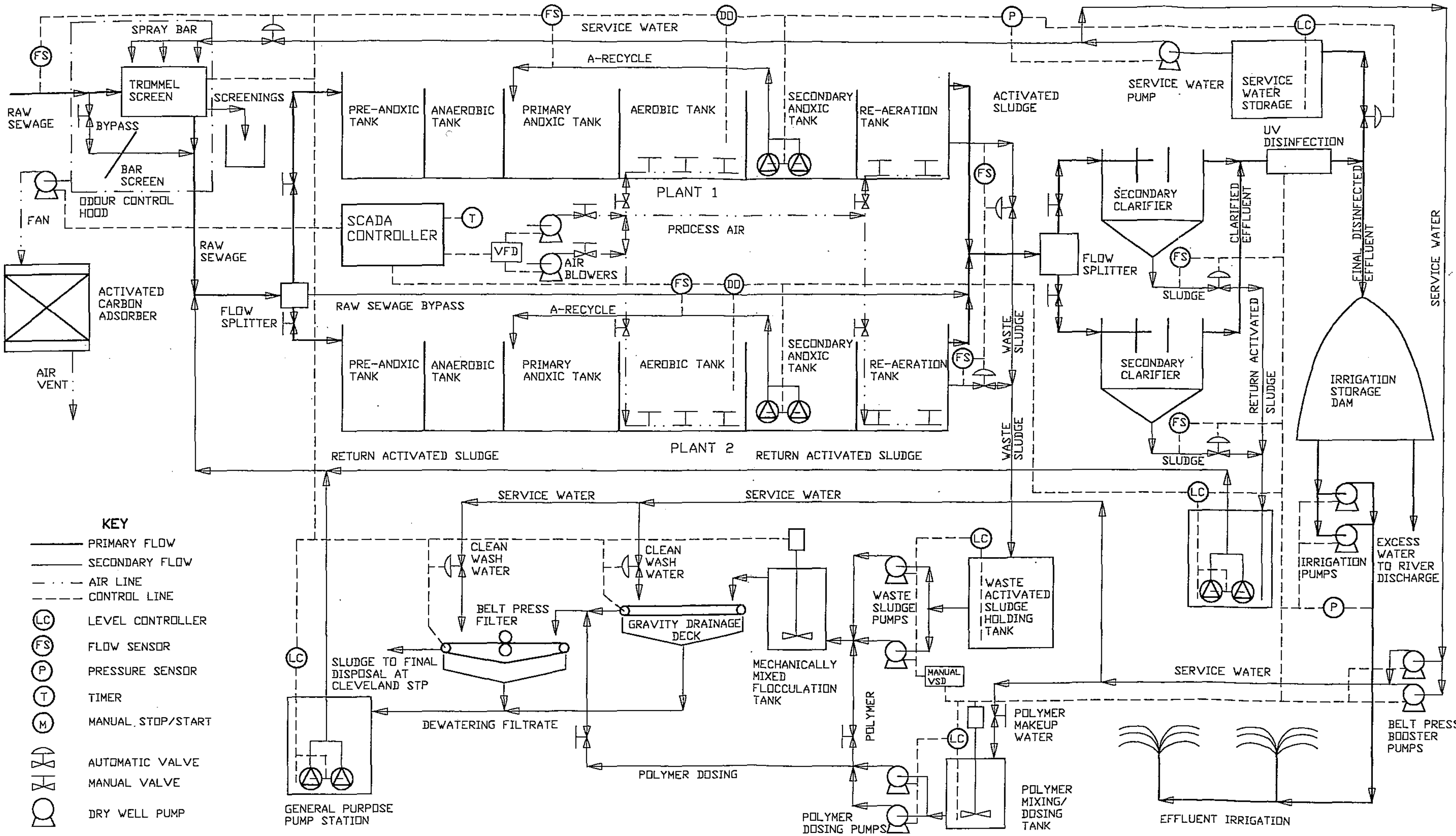
Dewatering:
2 no. 2.0 m wide belt presses (with gravity drainage decks); Max. 60 m3/h (17 L/s) waste activated sludge per GDD-BFP unit; MLSS 4,600 mg/L (90% ile); operating 35 h/week

Power Consumption: 580 kWh/ML treated (7.2 ML/d average)

Biosolids production: ~1400 kg/d dry solids, 14-18% cake

WATER RECYCLING/ EFFLUENT REUSE

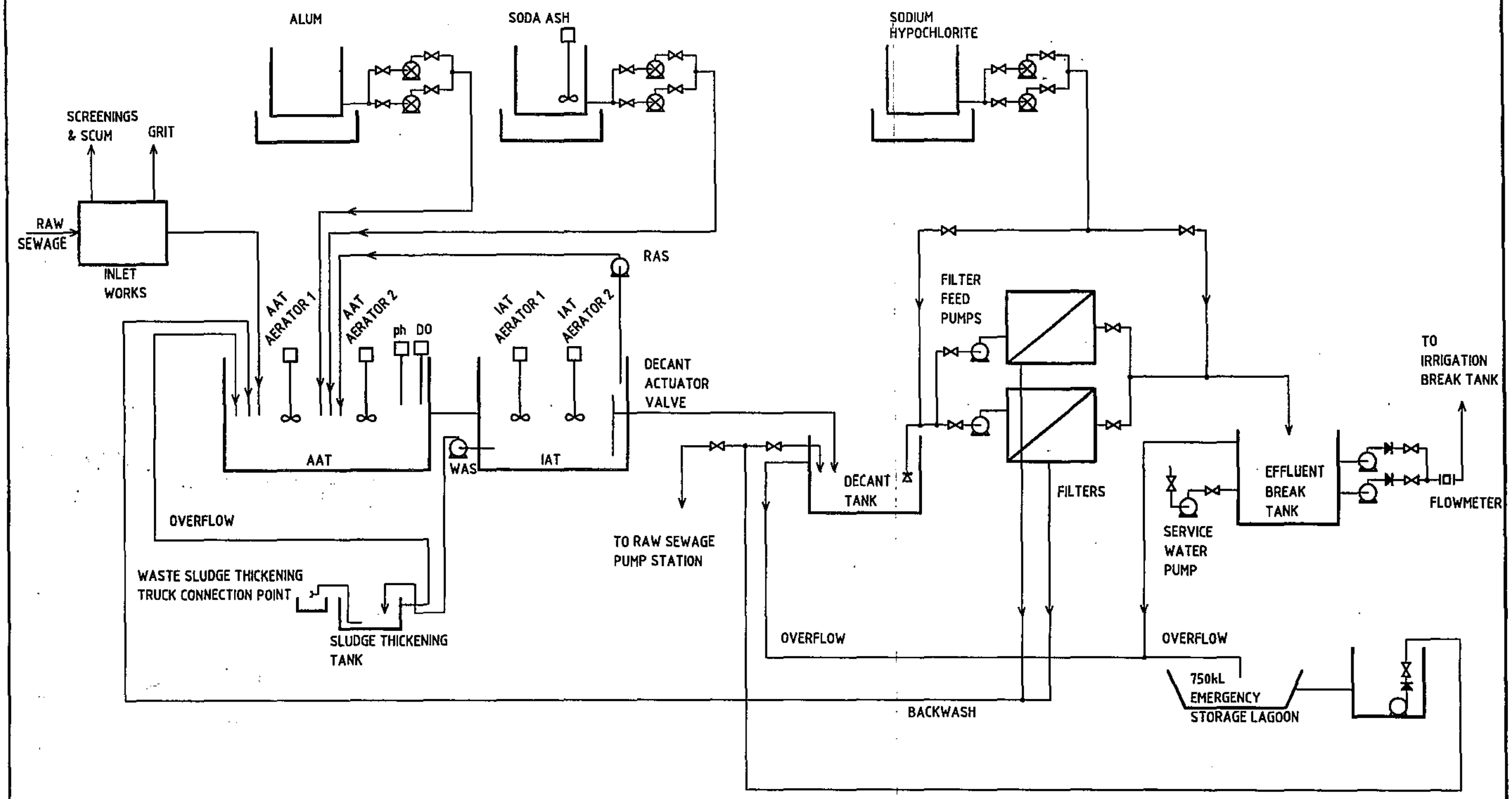
A proportion (approx. 0.3 Ml/d) of the current effluent (6.3 ML/d ADWF) is currently reused through irrigation of a nearby golf course. It is foreseen that additional reuse opportunities will be sought in future in order to limit nutrient loads to the Creek, particularly as flows increase with a growing population base.



REDLAND SHIRE COUNCIL
MT. COTTON STP
PROCESS FLOW SHEET

FILE: 375JB01A.DWG

Figure 3.2



PROCESS FLOW DIAGRAM

	REVISIONS A - 4.02.03 - FIRST ISSUE	AUSCAD DRAFTING PTY. LTD. 90 BEAUDESERT ROAD, MOOROOKA, 4105 Ph. (07) 3848 7863 FAX (07) 3892 3618, PO BOX 144 SALISBURY 4107 BSA Reg. No. 65551 - Building & Residential Design	SCALE NTS DRAWN D.H.B. CHECKED A.M. DATE 31.01.03 04.02.03 THIRD ANGLE PROJECTION	AERATION TREATMENT SYSTEMS P/L 16 SHETTLESTON STREET ROCKLEA P.O. BOX 210 BRISBANE MARKETS 4106	PROJECT REDLAND WATER AND WASTE DUNWICH SEWAGE TREATMENT PLANT NORTH STRADBROKE ISLAND	IF IN DOUBT - ASK A3 CLIENT REF. No. DRAWING No. D-001 A

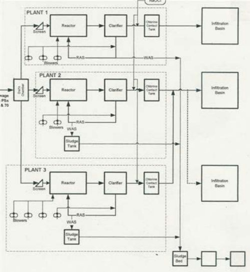


Figure 3.1 Process Flowsheet

Appendix C

Global Warming Potential (GWP) and Emission Factors

Table 6 Global Warming Potential (GWP) and Emission Factors – Scope 1 and 2

Data	Units	Value	Source
Methane Global Warming Potential	tCO_2-e / tCH_4	21	NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3
Nitrous Oxide Global Warming Potential	tCO_2-e / tN_2O	310	NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3
(Indirect) Electricity Generation Emission Factor	$kgCO_2$-e / kWh	0.91	NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
Methane Emission Factor - wastewater	tCO_2-e / tCOD	5.3	NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
Emission Factor for Nitrous Oxide (Treatment and Disposal)	tCO_2-e / tN	5.9	NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2) & (3)
GHG emissions due to Carbon Dioxide in Secondary Treatment and Sludge	tCO_2-e / y	0	Biogenic CO_2 is a neutral GHG under NGERS Guidelines

Table 7 Emission Factors – Scope 3

Data	Units	Value	Source
(Indirect) Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	$kgCO_2$-e / kWh	0.13	NGA Factors (November 2008) - p.59 - Table 39
Full Fuel Cycle Emission Factor for Automotive Diesel	$kgCO_2$-e / L	2.89	NGA Factors (November 2008) - p.15, Table 3; p.58, Table 38
Emissions Factor for Alum, due to Production	$kgCO_2$-e / kg dry Alum	0.539	SimaPro v.7.1.0 - Australian LCA Data Library
Emissions Factor for $Ca(OH)_2$, due to Production	$kgCO_2$-e / kg dry Ca(OH)2	1.64	SimaPro v.7.1.0 - Australian LCA Data Library
Emissions Factor for Polymer, due to Production	$kgCO_2$-e / kg	1.182	SimaPro v.7.1.0 - Australian LCA Data Library
Emissions Factor for Chlorine Gas, due to Production	$kgCO_2$-e / kg	1.124	SimaPro v.7.1.0 - Australian LCA Data Library

Data	Units	Value	Source
Emissions Factor for Sodium Hypochlorite, due to Production	$kgCO_2$-e / kg	1.15153 6585	SimaPro v.7.1.0 - Australian LCA Data Library. Convert on mass basis for active chlorine (12%) + 0.3% NaOH
Emissions Factor for Soda Ash, due to Production	$kgCO_2$-e / kg	1.5	SimaPro v.7.1.0 - Australian LCA Data Library.
Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	kgN_2O-N / kgN	0.009	AMEGGES 2006: Agriculture, Table 15, p.45. N_2O emission factor (% of applied N) for sewage sludges = 0.9%
Indirect Emission Factor for Nitrous Oxide Volatilisation from Biosolids Disposal	kgN_2O-N / kgN volatilised	0.01	IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
Emission Factor for Landfill Disposal of Screenings & Grit	$kgCO_2$-e / kg waste	1.6	NGA Factors (November 2008) - p.63, Table 42: Emission factor for municipal solid waste

Appendix D

Scope 3 – Chemicals and Biosolids Parameters

Data	Units	Thorneside		Cleveland		Victoria Point		Capalaba		Mt Cotton		Point Lookout		Dunwich	
		Thorneside STP	Data Collection Period	Cleveland STP	Data Collection Period	Victoria Point STP	Data Collection Period	Capalaba STP	Data Collection Period	Mt Cotton STP	Data Collection Period	Point Lookout STP	Data Collection Period	Dunwich STP	Data Collection Period
Consumption of Alum Solution	tonnes/y	336	Mar/08-Apr/09	215	Apr/08-Apr/09	48	May/08-Jul/08	239	Apr/08-Apr/09	26	Aug/08-Feb/09	0	N/A	0	N/A
Consumption of Dry Lime	tonnes/y	117	May/08-Apr/09	0	N/A	0	N/A	93	Apr/08-Apr/09	0	N/A	0	N/A	0	N/A
Consumption of Dry Polymer for Sludge Thickening & Dewatering	kg / y	1800	Aug/08-Mar/09	2046	Feb/09-Apr/09	3000	Oct/08-Mar/09	5400	Apr/08-Apr/09	1500	Nov/08-Nov/08	0	N/A	0	N/A
Consumption of Chlorine Gas	kg/y	17480	May/08-May/09	18400	Mar/08-Mar/09	13800	Jun/08-May/09	10120	May/08-Apr/09	0	N/A	0	N/A	0	N/A
Consumption of Sodium Hypochlorite Solution	L / y	0	N/A	0	N/A	0	N/A	0	N/A	11768	May/08-Apr/09	17036	May/08-Apr/09	11877	May/08-Apr/09
Consumption of Soda Ash	kg / y	0	N/A	0	N/A	0	N/A	0	N/A	12000	Apr/08-May/09	0	N/A	0	N/A
Delivery Volume of Alum Solution	tonnes	25	Mar/08-Apr/09	25	Apr/08-Apr/09	25	May/08-Jul/08	25	Apr/08-Apr/09	13	Aug/08-Feb/09	25	N/A	25	N/A
Delivery Mass Load of Lime Solution	tonne	20	May/08-Apr/09	20	N/A	20	N/A	20	Apr/08-Apr/09	20	N/A	20	N/A	20	N/A
Delivery Weight of Polymer	kg	900	Aug/08-Mar/09	1,020	Feb/09-Apr/09	750	Oct/08-Mar/09	900	Apr/08-Apr/09	750	Nov/08-Nov/08	900	N/A	900	N/A
Delivery Mass of Chlorine Gas (in drums)	kg	920	May/08-May/09	920	Mar/08-Mar/09	920	Jun/08-May/09	920	May/08-Apr/09	920	N/A	920	N/A	920	N/A
Delivery Volume of Sodium Hypochlorite Solution	L	2,000	N/A	2,000	N/A	2,000	N/A	2,000	N/A	2,000	May/08-Apr/09	2,000	May/08-Apr/09	2,000	May/08-Apr/09
Delivery mass of Soda Ash	kg	2,400	N/A	2,400	N/A	2,400	N/A	2,400	N/A	2,400	Apr/08-May/09	2,400	N/A	2,400	N/A
Average Distance Travelled for Delivery of Alum (round trip)	km	99	N/A	105	N/A	113	N/A	100	N/A	95	N/A	169	N/A	136	N/A

Data	Units	Thorneside		Cleveland		Victoria Point		Capalaba		Mt Cotton		Point Lookout		Dunwich	
		Thorneside STP	Data Collection Period	Cleveland STP	Data Collection Period	Victoria Point STP	Data Collection Period	Capalaba STP	Data Collection Period	Mt Cotton STP	Data Collection Period	Point Lookout STP	Data Collection Period	Dunwich STP	Data Collection Period
Average Distance Travelled for Delivery of Lime (round trip)	km	49	N/A	56	N/A	59	N/A	40	N/A	71	N/A	119	N/A	86	N/A
Average Distance Travelled for Delivery of Polymer (round trip)	km	43	N/A	54	N/A	52	N/A	42	N/A	54	N/A	113	N/A	80	N/A
Average Distance Travelled for Delivery of Chlorine Gas (round trip)	km	1,426	N/A	1,122	N/A	1,138	N/A	1,092	N/A	1,156	N/A	1,184	N/A	1,152	N/A
Average Distance Travelled for Delivery of Sodium Hypochlorite (round trip)	km	28	N/A	49	N/A	65	N/A	32	N/A	83	N/A	111	N/A	78	N/A
Average Distance Travelled for Delivery of Soda Ash (round trip)	km	19	N/A	6	N/A	19	N/A	16	N/A	31	N/A	68	N/A	35	N/A
Average Distance Travelled for Delivery of Screenings and Grit Disposal (round trip)	km	12	N/A	14	N/A	27	N/A	12	N/A	47	N/A	75	N/A	42	N/A
Average Distance Travelled for Delivery of Biosolids Disposal (round trip)	km	458	N/A	468	N/A	470	N/A	454	N/A	452	N/A	536	N/A	500	N/A

Appendix E

Scope 3 – Summary Results

Table 8 Scope 3 – Summary Results

Scope 3 Emissions	Scope 3 Emissions (tCO_2-e)
Purchase of Electricity from Network (indirect emissions due to purchased electricity extraction, production, transport and transmission losses)	1,123
Combustion of Liquid Fuels (indirect emissions due to extraction, production and transport of fuels combustion - flights, fleet and contractors included, biosolids disposal excluded)	24
Chemicals Consumption (emissions due to chemicals production and transport to STPs)	244
Biosolids Disposal (emissions due to biosolids transport from STPs and emissions at biosolids disposal site)	1,944
Total	**3,334**

Appendix F

STP Results - Including Scope 1, 2 and 3

STP GHG Emissions per ML

STP GHG Emissions by process type

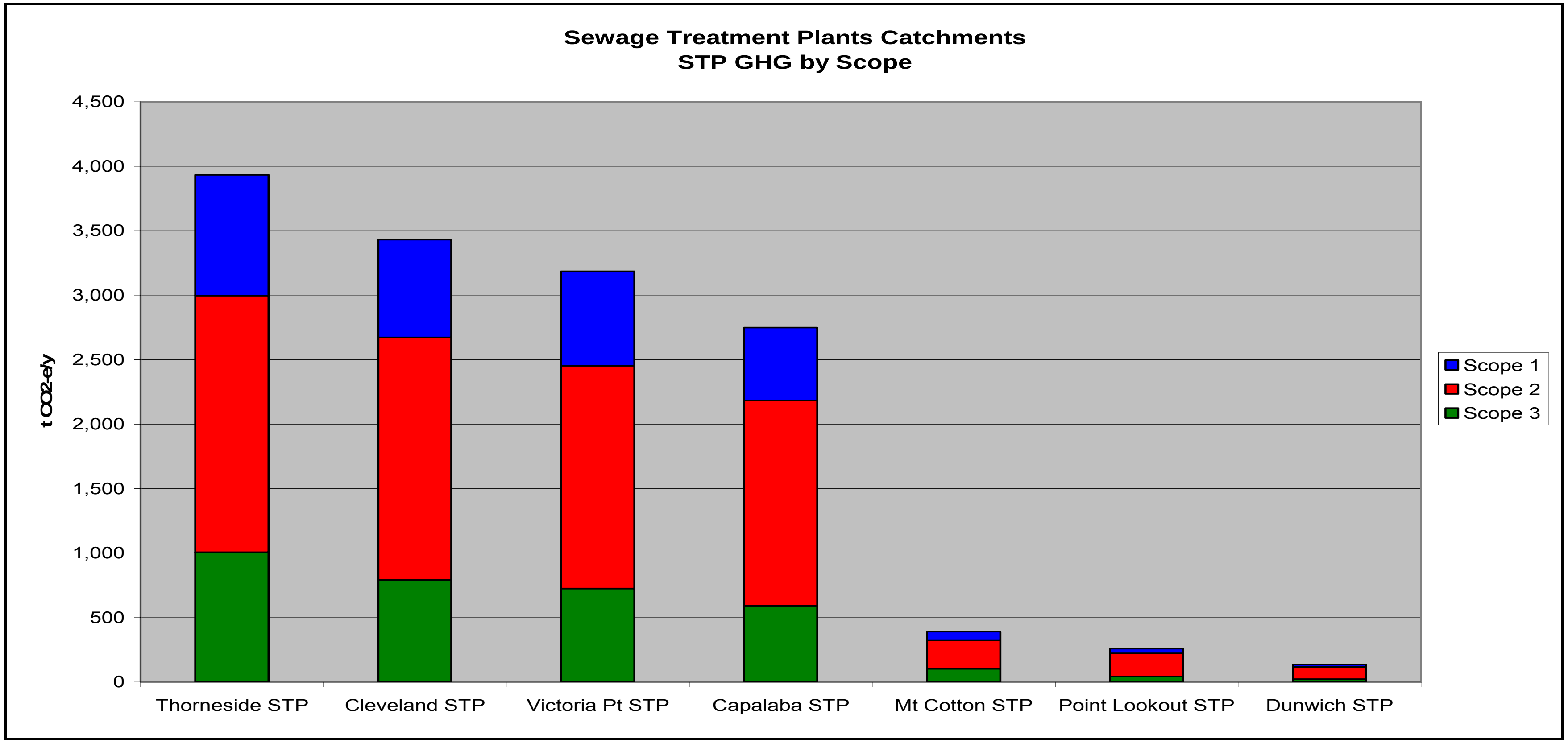


Figure 2 STP Emissions by Scope 1, 2 and 3

Note: Figure 2 includes STP related Scope 2 and 3 emissions as follows:

- Scope 2 electricity emissions: wastewater collection (pumps) and wastewater treatment (STP's electricity consumption); and
- Scope 3 emissions: STP chemicals consumption and biosolids disposal.

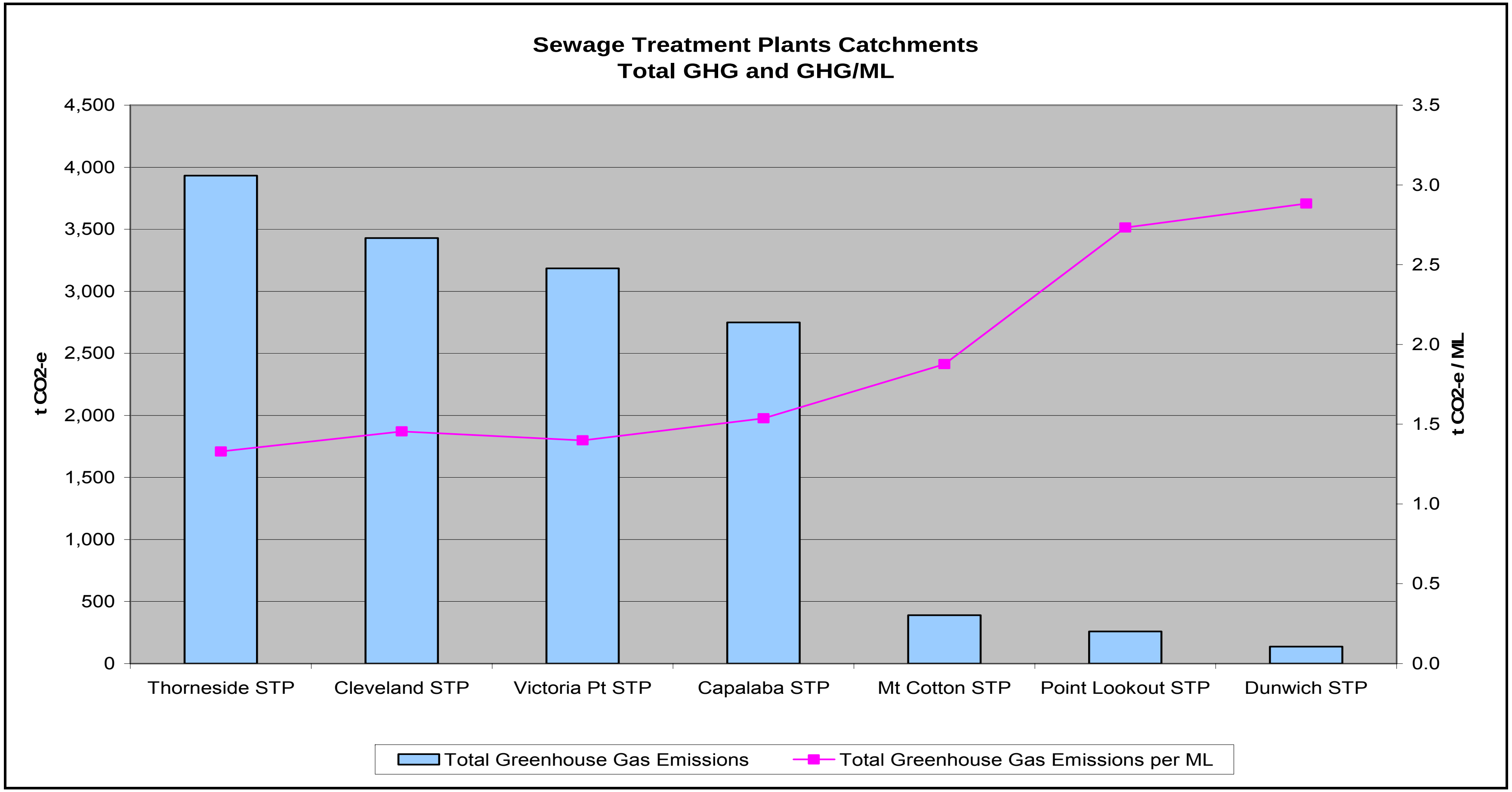


Figure 3 STP Emissions per STP Flow (tCO_2-e per ML)

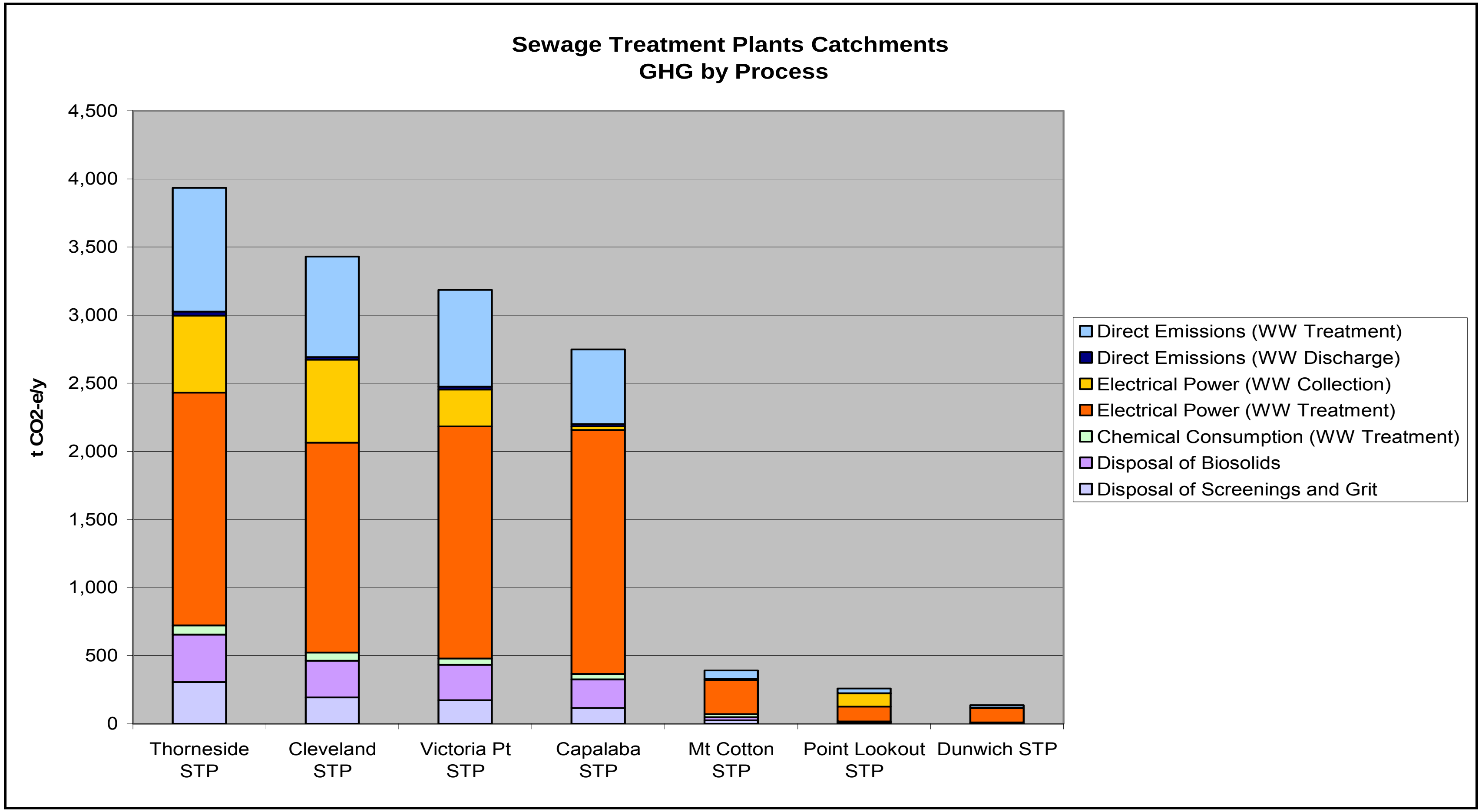


Figure 4 STP Emissions by Process Type

Appendix G

Inventory Calculations

NGERS Inventory Calculator Redland.xls (Summary).

STP Capalaba.xls

STP Cleveland.xls

STP Dunwich.xls

STP Mt Cotton.xls

STP Point Lookout.xls

STP Victoria Pt.xls

STPs Summary.xls

Electricity.xls

NGER (Measurement) Technical Guidelines v1.1	NGERS Method	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Proportion of Total Inventory	Rank	Uncertainty (+-%)	Scope 1 Uncertainty (+- t CO2-e)	Scope 2 Uncertainty (+- t CO2-e)	Reference Worksheet
7.2 Scope 2 Emissions — Purchase of Electricity from Network	1	-	7,858	69.7%	1	15%	-	1,179	Electricity.xls
5.3 Wastewater Handling (domestic and commercial)	1	3,111	-	27.6%	2	30%	933	-	STPs Summary.xls
2.4 Combustion of Liquid Fuels	1	305	-	2.7%	3	30%	92	-	Fleet & Flights.xls
4.5 Hydrofluorocarbons and Sulphur Hexafluoride	1	4	-	0.0%	4	15%	1	-	Refrigerants.xls
Subtotal		3,421	7,858						
Total		**11,279**				**13%**	**1,506**		

Scope 3 Emissions	Scope 3 Emissions (t CO2-e)	Reference Worksheet
Purchase of Electricity from Network (indirect emissions due to purchased electricity extraction, production, transport and transmission losses)	1,123	Electricity.xls
Combustion of Liquid Fuels (indirect emissions due to extraction, production and transport of fuels combustion - flights, fleet and contractors included, biosolids disposal excluded)	24	Fleet & Flights.xls
Chemicals Consumption (emissions due to chemicals production and transport to STPs)	244	STPs Summary.xls
Biosolids Disposal (emissions due to biosolids transport from STPs and emissions at biosolids disposal site)	1,944	STPs Summary.xls
Total	**3,334**	

Redland Water
Liquid Fuels
Summary

Liquid Fuels	Energy Content factor		Scope 1 EF	Scope 2 EF	Scope 3 EF		
Petrol (Gasoline)	34.2	GJ/kL	69.6	0	5.3	kg CO2e/GJ	NGA Factors - Nov 08 Table 4 & 38
Diesel	38.6	GJ/kL	69.9	0	5.3	kg CO2e/GJ	NGA Factors - Nov 08 Table 4 & 38
LPG	26.2	GJ/kL	60.8	0	5.3	kg CO2e/GJ	NGA Factors - Nov 08 Table 4 & 38

		Total (Q)	Units			Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)
Flights	Short Haul	-				-	-	-	-
	Medium Haul	7,030.00	Km			-	-	0.86	0.86
	Long Haul	-				-	-	-	-
Fleet	Petrol (Gasoline)	40173.5	Litres	1373.93	GJ	95.63	0.00	7.28	102.91
	Diesel	72755.84	Litres	2808.38	GJ	196.31	0.00	14.88	211.19
Contractors	Fleet	5000	Litres	193.00	GJ	13.49	0.00	1.02	14.51
Total						**305.42**	**-**	**24.05**	**329.47**

Redland Water
Flights

		Scope 3 Emission Factor (EF)	Unit	Source
Short Haul	< 450 Km	0.18	kg CO2-e/pkm	Reference 1
Medium Haul	> 450 < 1600 Km	0.126	kg CO2-e/pkm	Reference 1
Long Haul	> 1600 Km	0.11	kg CO2-e/pkm	Reference 1

No. of trips per year	From	To	Distance (Kms)	Short Haul	Medium Haul	Long Haul	Total Return Kms Short Haul	Total Return Kms Medium Haul	Total Return Kms Long Haul	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)	Method
2	Brisbane	Melbourne	1381		1381			5524				0.696024	0.696024	Q x EF/1000
1	Brisbane	Sydney	753		753			1506				0.16566	0.16566	Q x EF/1000
Total				**-**	**2,134.00**	**-**		**7,030.00**				**0.86**	**0.86**	

Source Brad's Taylor email

Reference

Reference 1 DEFRA, UK 2005 "Guidelines for Company Reporting on Greenhouse Gas Emissions"

Redland Water

Contractors Fleet

Diesel

Model	Type	Total Litres
1	Vehicle	2500
1	Vehicle	2500
Total litres of diesel		**5,000.00**

Redland Water
Fleet

Petrol (Gasoline)

Asset	Make	Model	Type	Rego	GL Account	Total Litres
271371	TOYOTA	CAMRY	SEDAN	390LAU	56008.311.0034	3759
266744	TOYOTA	CAMRY	SEDAN	408KPW	56008.311.0034	1473
261178	TOYOTA	CAMRY	SEDAN	964KFL	56008.311.0034	2199
244292	FORD	BFRTV	SINGLECAB	051JRP	56008.311.0034	2306
236927	FORD	BFRTV	SINGLECAB	318JGC	54000.313.0034	2808
236883	HOLDEN	VZ	SINGLECAB	833IST	53034.193.0034	3545
244293	HOLDEN	VZ	SINGLECAB	176JQR	56008.311.0034	1606
252643	HOLDEN	VIVAJF	STATIONWAGON	265JXP	56009.311.0034	2131
236769	TOYOTA	HILUX	DUALCAB	982IAJ	52035.187.0034	800
236774	TOYOTA	HILUX	SINGLECAB	007HLB	52035.187.0034	800
259865	HOLDEN	VIVAJF	HATCHBACK	541KBG	56014.309.0034	1150.88
236952	HOLDEN	RODEO	DUALCAB	378JHK	53032.294.0034	1786.74
266743	TOYOTA	CAMRY	SEDAN	409KPW	56001.309.0034	3996.13
264217	FORD	BF	SEDAN	780KJU	55031.175.0034	1980.18
255065	TOYOTA	CAMRY	SEDAN	734JZA	53027.294.0034	2103.43
244507	HOLDEN	VZ	SINGLECAB	238JQR	52020.187.0034	3518.73
267333	TOYOTA	CAMRY	SEDAN	435KPW	56000.308.0034	1710.41
						2500
Total litres of gasoline						**40,173.50**

Diesel

Asset	Make	Model	Type	Rego	GL Account	Total Litres
261625	FORD	PJ	DUALCAB	945KHK	54000.313.0034	1907
263916	FORD	PJ	SINGLECAB	474KIN	52010.326.0034	1697
264940	FORD	PJ	SINGLECAB	813KJU	54000.313.0034	1323
264939	FORD	PJ	SINGLECAB	814KJU	54000.313.0034	1419
265178	FORD	PJ	SINGLECAB	005KKC	53010.194.0034	1695
236852	TOYOTA	LANDCRUISER	SINGLECAB	405ILL	53006.194.0034	1200
265764	VWGROUPA	PASSAT	STATIONWAGON	515KKJ	56008.311.0034	2961
263190	ISUZU	NPR400	TRUCKSINGLE	005KHF	54000.313.0034	2746
238750	ISUZU	FRR550	TRUCKSINGLE	777JDY	54000.313.0034	3482.71
260891	ISUZU	NPR200	TRUCKSINGLE	017KEB	52076.187.0034	800
285648	ISUZU	D-MAX	DUALCAB	179LRA	52035.187.0034	3000
236954	FORD	COURIER	DUALCAB	225JHE	55031.175.0034	3678.22
236988	JCB		BACKHOE	C44536	52035.187.0034	6006.7
236675	ISUZU	FVR950	TRUCKSINGLE	677IQO	52025.187.0034	5617.6
236676	ISUZU	FVR950	TRUCKSINGLE	672IQO	53032.294.0034	5053.75
236677	ISUZU	NPR400	TRUCKDUAL	741ISU	53032.294.0034	2974.94
236674	ISUZU	NPR400	TRUCKDUAL	673IQO	53021.294.0034	3067.89
279034	FORD	PJ	EXTRACAB	590LKA	52035.187.0034	832.26
266141	ISUZU	NPR400	TRUCKDUAL	046KNJ	52035.187.0034	3999.43
265408	FORD	PJ	DUALCAB	815KJU	53027.294.0034	1400
265823	FORD	PJ	DUALCAB	462KMF	52035.187.0034	2000.26
263170	ISUZU	NPR400	TRUCKDUAL	006KHF	53032.294.0034	3142.33
263187	ISUZU	NPR300	TRUCKSINGLE	018KHF	52035.187.0034	2000
260892	ISUZU	NPR300	TRUCKSINGLE	016KEB	52035.187.0034	2607.09
258549	TOYOTA	HILUX	EXTRACAB	580KBU	52035.187.0034	2139.89
258550	TOYOTA	HILUX	EXTRACAB	581KBU	52035.187.0034	2838.74
253811	TOYOTA	HILUX	DUALCAB	643JZA	52035.187.0034	1966.03
236704	ISUZU	NPR200	TRUCKSINGLE	172JDQ	52076.187.0034	1200
Total litres of diesel						**72,755.84**

Asset	Make	Model	Type	Rego	GL Account	Total Litres
253392	FASSI	F65A	CRANE		54000.313.0034	
236603	PALFING	3700	CRANE		54000.313.0034	
236600	FASSI	M10A11	CRANE		52035.187.0034	0

Sources

Fleet Assets by SGA - vehicles only.xls
Fleet Assets by SGA - vehicles only (4).xls

From Brad Taylor:
The process of arriving at the fuel usage was:
.- obtain the data from the maximo records
.- as data is only up to the end of May there is a need to extrapolate to the end of the financial year
.- multiply the totals by 12/11 to provide a full year of use

Redland Water
HFCs

			Source
Default Annual Leakage Rate of Gas	Commercial air conditioning	0.09	NGA Factors - November 2008
Refrigerant type		R22	
Refrigerant GWP		1700	

	Status	JP Type	Description	Asset	Asset Status	Asset Loc	Model	Type of Refrigerant	Total kg (Q)	Method	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)
Air Conditioners	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Lab	113632	OPERATING	CAP STP	MUHGA35VBA1	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Lunch Room	113633	OPERATING	CAP STP	FUJITSU	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Thorneside WWTP - 113642	113642	OPERATING	THRN STP	PANASONIC CK _ 2473KR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Thorneside WWTP - 113643	113643	OPERATING	THRN STP	PANASONIC CUA24BKPS	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Control Room	113644	OPERATING	VICPT WWTP	FUJITSU AST14RVBLW	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Mt Cotton WWTP - 113645	113645	OPERATING	MTCTSTP	PANASONIC CS1873K2	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Mt Cotton WWTP - 113646	113646	OPERATING	MTCTSTP	PANASONIC CW-972FR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Mt Cotton WWTP - 113647	113647	OPERATING	MTCTSTP	PANASONIC CWC90KR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - 113648	113648	OPERATING	CLEV STP	MITSUBISHI MSH-12NJ	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - 113649	113649	OPERATING	CLEV STP	MSC GB35KIT	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - 113650	113650	OPERATING	CLEV STP	PANASONIC LS/770KR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - 113652	113652	OPERATING	CLEV STP	LG LB-E0684HL	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - 113653	113653	OPERATING	CLEV STP	LG LBE4881HL	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Dunwich WWTP Control Building	117783	OPERATING	DUN WWTP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP Old Control Room	117784	OPERATING	CLEV STP	LG LSK243H-1	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Lab	206002	OPERATING	VICPT WWTP	FUJITSU AST14RVBCW	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Lunch Room	206003	OPERATING	VICPT WWTP	FUJITSU AST14RVBCW	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Main Switchroom - Ox Ditch End	223736	OPERATING	VICPT WWTP	FUJITSU AOT54RPA3L	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Main Switchroom - Sludge Dewater End	223737	OPERATING	VICPT WWTP	FUJITSU AOT54RPA3L	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Victoria Point WWTP - Sludge Dewater Switchroom	224050	OPERATING	VICPT WWTP	FUJITSU AOT30RMBL	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Lime Switchroom	244296	OPERATING	CAP STP	PANASONIC CS-V24DKR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Switch Room (Genset End)	244297	OPERATING	CAP STP	PANASONIC CS-V24DKR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Switch Room (Lab End)	244311	OPERATING	CAP STP	PANASONIC CS-V24DKR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Cleveland WWTP - #4	250286	OPERATING	CLEV STP	LG	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Pt Lookout WWTP Control Building	250287	OPERATING	PTLK STP	MUH-GA35VB A1	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Dunwich WWTP MCC Switch Room	250288	OPERATING	DUN WWTP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Air Conditioner - Capalaba WWTP - Blower Switchroom	260716	OPERATING	CAP STP	MITSUBISHI MSH GA8Q	R22	4	Q x EF x GWP / 100	0.612			0.612
Autosamplers	ACTIVE	AIRCONMNT	6M - Autosampler - Capalaba WWTP Effluent	14400	OPERATING	CAP STP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Capalaba WWTP Inlet Works	220450	OPERATING	CAP STP	ISCO 3700FR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Victoria Point WWTP Effluent	223681	OPERATING	VICPT WWTP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Victoria Point WWTP Inlet Works	224110	OPERATING	VICPT WWTP	PANASONIC CS-V24DKR	R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Thorneside WWTP Effluent	54508	OPERATING	THRN STP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Cleveland WWTP Effluent	95784	OPERATING	CLEV STP		R22	4	Q x EF x GWP / 100	0.612			0.612
	ACTIVE	AIRCONMNT	6M - Autosampler - Cleveland WWTP Inlet Works	95952	OPERATING	CLEV STP	SIGMA	R22	4	Q x EF x GWP / 100	0.612			0.612
Total									28.00		4.28			4.28

STPs Summary

Units	Totals	Thorneside STP	Cleveland STP	Victoria Pt STP	Capalaba STP	Mt Cotton STP	Point Lookout STP	Dunwich STP		
tCO2-e / y	**Total Greenhouse Gas Emissions**	**3,933**	**3,430**	**3,184**	**2,749**	**390**	**259**	**137**	14,082	total
tCO2-e / ML	**Total Greenhouse Gas Emissions per ML**	**1.3**	**1.5**	**1.4**	**1.5**	**1.9**	**2.7**	**2.9**	2	median
	ML / y	2,960	2,358	2,278	1,789	208	95	47		

Scope 1
For Inventory
Summary)

	GHG by Scope	Scope 1	Scope 2	Scope 3	Totals	Direct Emissions (WW Treatment)	Direct Emissions (WW Discharge)	Electrical Power (WW Collection)	Electrical Power (WW Treatment)	Chemical Consumption (WW Treatment)	Disposal of Biosolids	Disposal of Screenings and Grit	Direct Emissions (WW Collection)	Electrical Power (WW Discharge)	Chemical Consumption (WW Collection)	Direct Emmissions (WW Treatment & Discharge)
tCO2-e / ML	Thorneside STP	936	1,990	1,007	Thorneside STP	907	29	566	1,708	67	349	306	0	0	0	936
tCO2-e / ML	Cleveland STP	757	1,882	791	Cleveland STP	738	18	609	1,541	60	269	193	0	0	0	757
tCO2-e / ML	Victoria Pt STP	731	1,728	726	Victoria Pt STP	709	22	270	1,704	47	260	172	0	0	0	731
tCO2-e / ML	Capalaba STP	566	1,590	593	Capalaba STP	548	18	27	1,790	39	210	117	0	0	0	566
tCO2-e / ML	Mt Cotton STP	67	221	103	Mt Cotton STP	62	5	2	251	23	23	25	0	0	0	67
tCO2-e / ML	Point Lookout STP	37	180	43	Point Lookout STP	34	2	97	109	4	5	7	0	0	0	37
tCO2-e / ML	Dunwich STP	18	96	23	Dunwich STP	17	1	4	106	3	2	4	0	0	0	18
	TOTAL	**3,111**	**7,685**	**3,286**		3,016	96	1,574	7,209	244	1,120	824	0	0	0	**3,111**

Redland City Council / Redland Water

NGERS Inventory 2008-09

Capalaba STP

Denotes User Input

Denotes Model Parameter (see references)

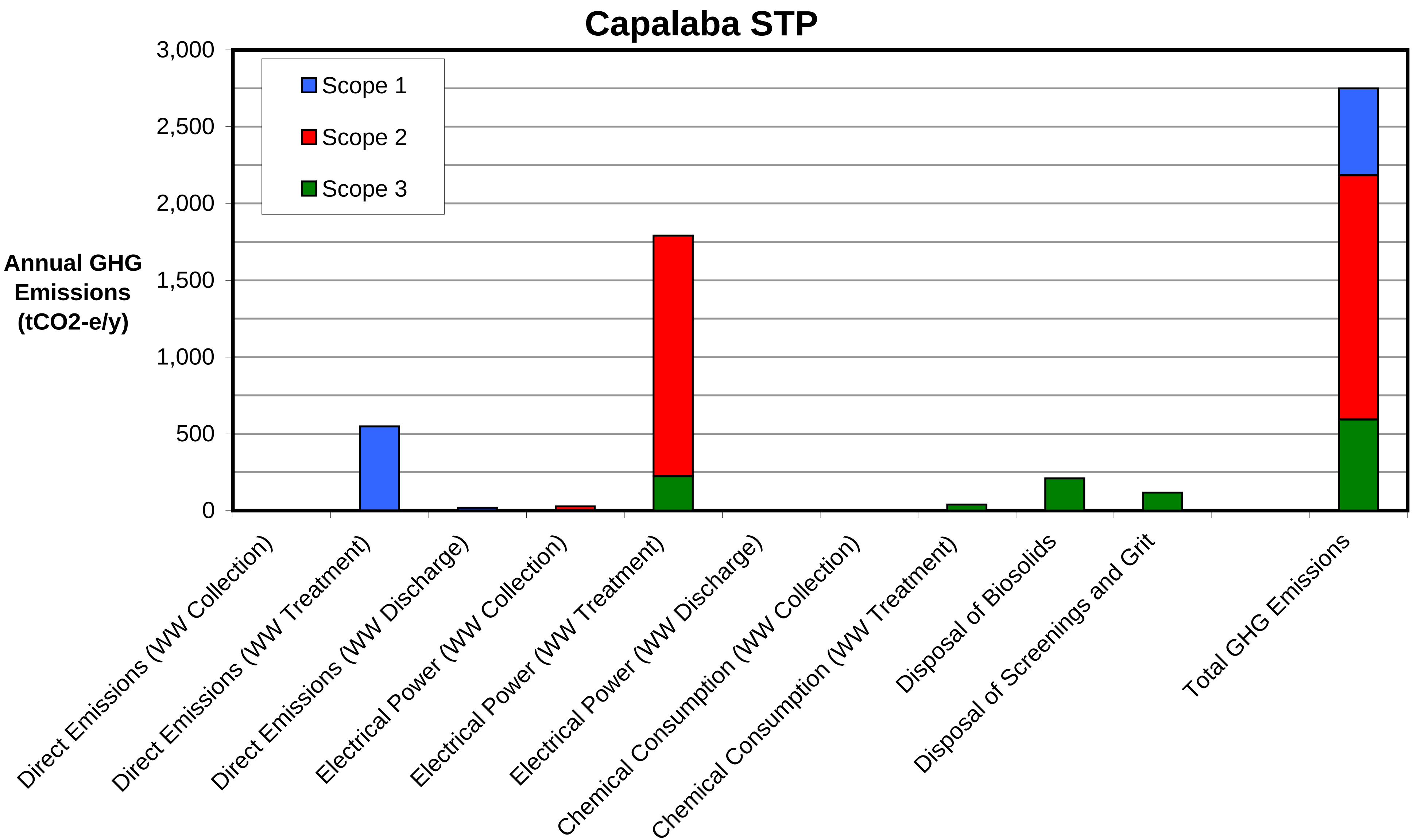
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	General Calculation Parameters							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	Plant Input Parameters							
	Total Raw Sewage Flowrate	Q	ML / y	1,789				
	Raw Sewage COD Concentration	Raw_COD	mg / L	570				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	75.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	2.05				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	3,423,202				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	15%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	72%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	25,787				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	1,721,307				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	239.5				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	93				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	5,400				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	10,120				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	0				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	72,384				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	Wastewater Collection System							
3.1	Scope 1 - Direct Emissions							
3.1.1	*Wastewater Collection - Carbon Dioxide*							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	*Wastewater Collection - Methane*							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	*Wastewater Collection - Nitrous Oxide*							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	Scope 2 - Indirect Emissions due to Electricity Use							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**23,467**		
3.3	Scope 3 - Other Indirect Emissions							
3.3.1	*Electricity Use*							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**3,352**	
3.3.2 ***Chemicals Consumption - Magnesium Hydroxide***							
Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3 ***Chemicals Consumption - Ferric Chloride***							
Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0 Wastewater Treatment							
4.1 Scope 1 - Direct Emissions							
4.1.1 ***Secondary Treatment Off-Gases - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2 ***Secondary Treatment Off-Gases - Methane***							
Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	1,019,445				
COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
Effluent COD Mass Load	MEff_COD	kgCOD / y	23,251				
COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
Biosolids COD Mass Load	MWAS_COD	kgCOD / y	547,165				
Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3 ***Secondary Treatment Off-Gases - Nitrous Oxide***							
Total Nitrogen Removed by Denitrification	MNdn	kgN / y	111,780				200 L/EP/d NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (1)
Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	1,767				
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**547,720**			
4.1.4 ***Sludge Treatment Off-Gases - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5 ***Sludge Treatment Off-Gases - Methane***							
COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	547,165				Assume all sludge is transferred out of the plant
Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6 ***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**1,566,389**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**223,770**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	62				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	100				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	1,510				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**1,572**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	152				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	40				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	293				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**446**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	6,383				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	42				
Delivery Weight of Polymer	W_Poly	kg	900				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	397				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**6,780**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	11,375				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,092				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	18,936				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**30,311**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	0				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				SimaPro v.7.1.0 - Australian LCA Data Library. Convert on mass basis for active chlorine (12%) + 0.8% NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	0				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	32				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**0**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	16				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	58				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**17,965**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	115,814				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	12				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	913				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**116,727**	

Parameter		Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3	***Biosolids Disposal***							
	Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	513,480				
	Average Distance Travelled for Disposal (round trip)	Dist_b	km	454				
	Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
	GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	81,667				
	Fate of Disposed Biosolids	Fate_b		Agriculture				
	Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
	Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
	Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	414				
	GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**210,148**	
6.0	**Totals**	**GHG_Scope**	**kgCO2-e / y**		**565,685**	**1,589,856**	**593,106**	
		GHG_Total	**kgCO2-e / y**			**2,748,647**		
		GHGperML	**kgCO2-e / ML**			**1,537**		
7.0	**Summary by Process**							
	Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
	Direct Emissions (WW Treatment)		kgCO2-e / y	547,720	547,720			
	Direct Emissions (WW Discharge)		kgCO2-e / y	17,965	17,965			
	Electrical Power (WW Collection)		kgCO2-e / y	26,819		23,467	3,352	
	Electrical Power (WW Treatment)		kgCO2-e / y	1,790,159		1,566,389	223,770	
	Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
	Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
	Chemical Consumption (WW Treatment)		kgCO2-e / y	39,109			39,109	
	Disposal of Biosolids		kgCO2-e / y	210,148			210,148	
	Disposal of Screenings and Grit		kgCO2-e / y	116,727			116,727	
	Total GHG Emissions		**kgCO2-e / y**	**2,748,647**	**565,685**	**1,589,856**	**593,106**	



Capalaba STP
3,000
2,500
2,000
1,500
1,000
500
0
Annual GHG Emissions (tCO2-e/y)
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

http://www.climatechange.gov.au/reporting/guidelines/p http://www.climatechange.gov.au/workbook/pubs/workbook-oct2008.pdf
NGER (Measurement) Technical Guidelines 2008 (v1 NGA Factors (Oct 2008) - p.59 - Table 39
Used to estimate: EF_E EF_E_T

State	Scope 2	Scope 3	Full Fuel Cycle
ACT	0.89	0.17	1.06
NSW	0.89	0.17	1.06
NT	0.69	0.11	0.79
QLD	0.91	0.13	1.04
SA	0.84	0.14	0.98
TAS	0.12	0.01	0.13
VIC	1.22	0.08	1.31
WA	0.87	0.1	0.98

http://www.climatechange.gov.au/workbook/pubs/workbook-oct2008.pdf
NGA Factors (October 2008) - p.15 - Table 3 Used to estimate: EF1_Fuel_

		Scope 1 emission factors kgCO2-e/GJ (relevant oxidation factors incorporated)					
Stationary Fuel	Energy content factor (GJ/kL)	CO2	CH4	N2O	Scope 1 EF (kgCO2-e/L)	Scope 3 EF (kgCO2-e/GJ)	Scope 3 EF (kgCO2-e/L)
Biodiesel	34.6	0	0.06	0.2	0.01	57.20	1.98
Diesel	38.6	69.2	0.1	0.2	2.68	5.30	0.20
LPG	25.7	59.6	0.1	0.2	1.54	5.30	0.14
Petrol	34.2	66.7	0.2	0.2	2.29	5.30	0.18

Receiving Water Body	Emission Factor
Estuary	0.01000
Irrigation	0.01000
Ocean	0.01000
River	0.01000
Wetlands	0.01000

Fate of Biosolids
Agriculture
Composting
Incineration
Landfill
Stockpiled

Redland City Council / Redland Water

NGERS Inventory 2008-09

(yellow)	Denotes User Input
(pink)	Denotes Model Parameter (see references)

Cleveland STP

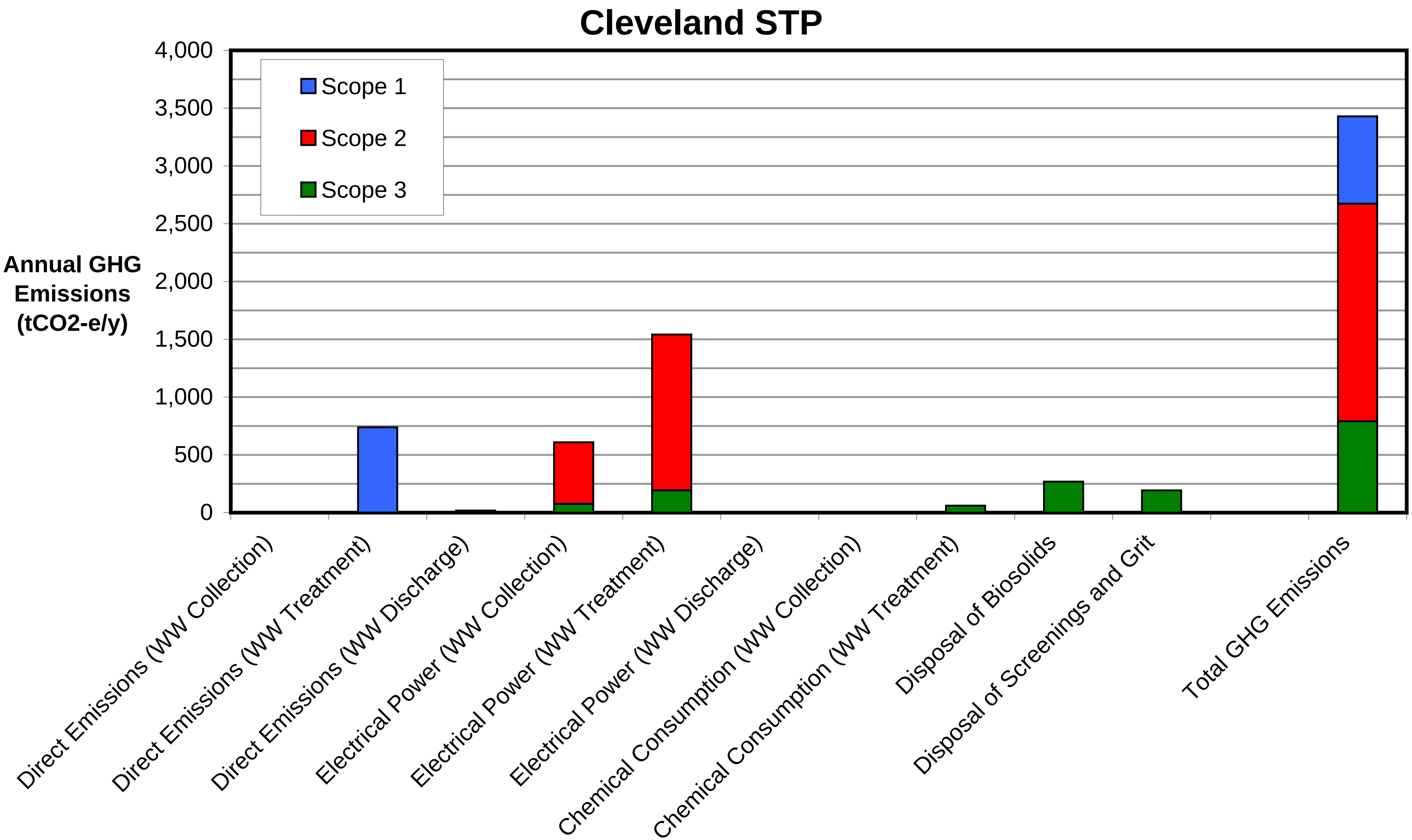
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	**General Calculation Parameters**							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	**Plant Input Parameters**							
	Total Raw Sewage Flowrate	Q	ML / y	2,358				
	Raw Sewage COD Concentration	Raw_COD	mg / L	509				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	42.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	1.60				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	4,513,038				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	14%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	77%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	585,759				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	1,481,832				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	215.2				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	0				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	2,046				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	18,400				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	0				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	119,808				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	**Wastewater Collection System**							
3.1	**Scope 1 - Direct Emissions**							
3.1.1	***Wastewater Collection - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	***Wastewater Collection - Methane***							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	***Wastewater Collection - Nitrous Oxide***							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	**Scope 2 - Indirect Emissions due to Electricity Use**							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**533,041**		
3.3	**Scope 3 - Other Indirect Emissions**							
3.3.1	***Electricity Use***							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
	GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**76,149**	
3.3.2	***Chemicals Consumption - Magnesium Hydroxide***							
	Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
	Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
	GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
	Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
	GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3	***Chemicals Consumption - Ferric Chloride***							
	Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
	GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
	Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
	GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0	Wastewater Treatment							
4.1	Scope 1 - Direct Emissions							
4.1.1	***Secondary Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2	***Secondary Treatment Off-Gases - Methane***							
	Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	1,200,171				
	COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
	Effluent COD Mass Load	MEff_COD	kgCOD / y	30,653				
	COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
	Biosolids COD Mass Load	MWAS_COD	kgCOD / y	720,028				
	Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3	***Secondary Treatment Off-Gases - Nitrous Oxide***							
	Total Nitrogen Removed by Denitrification	MNdn	kgN / y	150,684				
	Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
	Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	2,382				
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**738,352**			
4.1.4	***Sludge Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5	***Sludge Treatment Off-Gases - Methane***							
	COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	720,028				Assume all sludge is transferred out of the plant
	Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
	GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6	***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**1,348,467**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**192,638**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	56				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	105				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	1,430				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**1,486**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	56				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	0				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**0**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	2,418				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	54				
Delivery Weight of Polymer	W_Poly	kg	1,020				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	172				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**2,590**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	20,682				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,122				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	35,376				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**56,057**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	0				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				SimaPro v.7.1.0 - Australian LCA Data Library. Convert on mass basis for active chlorine (12%) + 0.5% NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	0				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	49				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**0**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	6				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	60				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**18,486**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	191,693				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	14				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	1,712				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**193,405**	

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3 ***Biosolids Disposal***							
Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	631,825				
Average Distance Travelled for Disposal (round trip)	Dist_b	km	468				
Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	110,988				
Fate of Disposed Biosolids	Fate_b		Agriculture				
Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	510				
GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**269,079**	
6.0 Totals	**GHG_Scope**	**kgCO2-e / y**		**756,838**	**1,881,508**	**791,405**	
	GHG_Total	**kgCO2-e / y**			**3,429,751**		
	GHGperML	**kgCO2-e / ML**			**1,455**		
7.0 Summary by Process							
Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
Direct Emissions (WW Treatment)		kgCO2-e / y	738,352	738,352			
Direct Emissions (WW Discharge)		kgCO2-e / y	18,486	18,486			
Electrical Power (WW Collection)		kgCO2-e / y	609,190		533,041	76,149	
Electrical Power (WW Treatment)		kgCO2-e / y	1,541,105		1,348,467	192,638	
Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
Chemical Consumption (WW Treatment)		kgCO2-e / y	60,133			60,133	
Disposal of Biosolids		kgCO2-e / y	269,079			269,079	
Disposal of Screenings and Grit		kgCO2-e / y	193,405			193,405	
Total GHG Emissions		**kgCO2-e / y**	**3,429,751**	**756,838**	**1,881,508**	**791,405**	


Cleveland STP
Annual GHG Emissions (tCO2-e/y)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland City Council / Redland Water

NGERS Inventory 2008-09

(yellow)	Denotes User Input
(pink)	Denotes Model Parameter (see references)

Dunwich STP

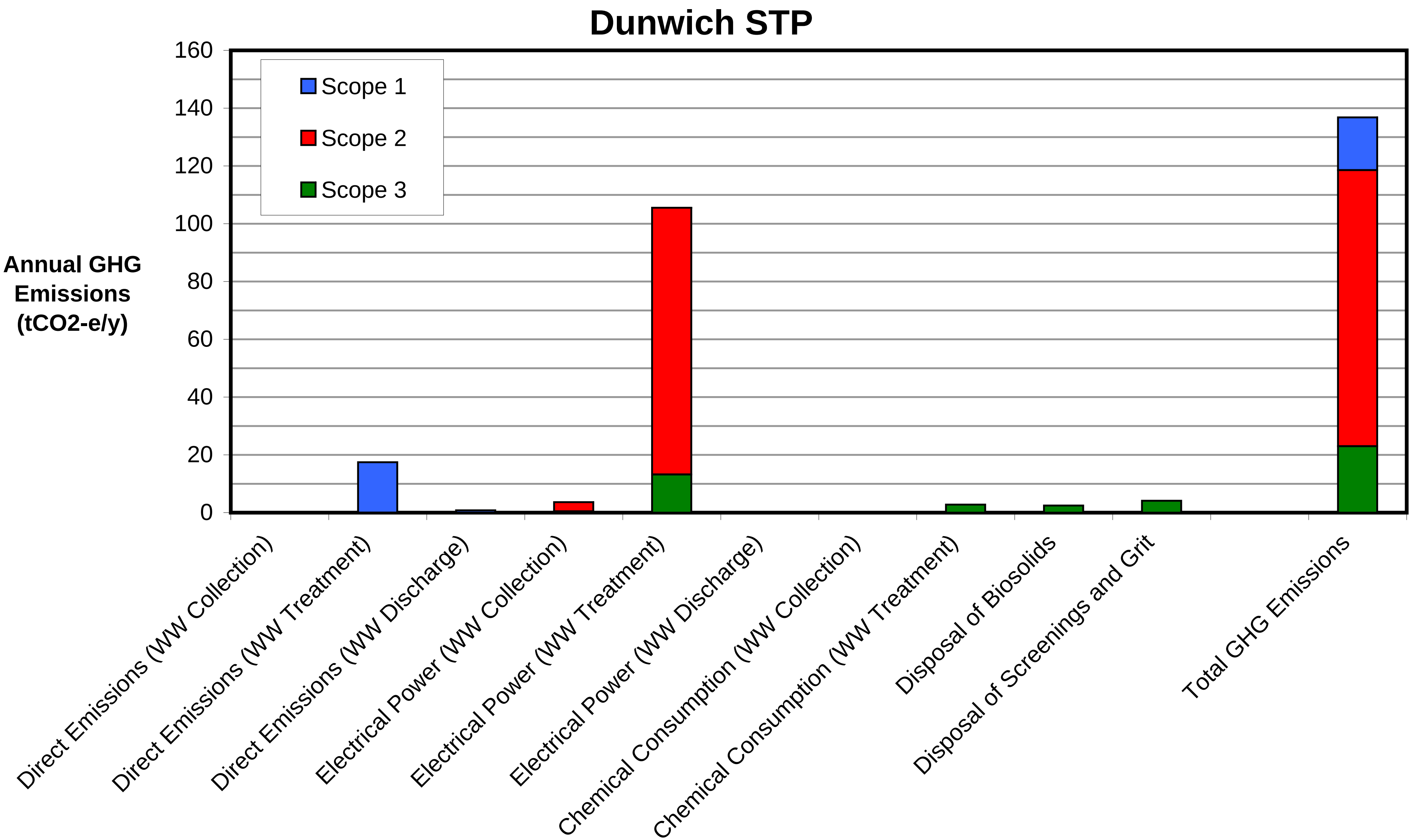
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	**General Calculation Parameters**							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	**Plant Input Parameters**							
	Total Raw Sewage Flowrate	Q	ML / y	47				
	Raw Sewage COD Concentration	Raw_COD	mg / L	324				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	45.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	3.50				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	90,820				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	0.35%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	0.90%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	3,497				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	101,480				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	0.0				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	0				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	0				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	0				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	11877				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	2,496				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	**Wastewater Collection System**							
3.1	**Scope 1 - Direct Emissions**							
3.1.1	***Wastewater Collection - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	***Wastewater Collection - Methane***							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	***Wastewater Collection - Nitrous Oxide***							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	**Scope 2 - Indirect Emissions due to Electricity Use**							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**3,182**		
3.3	**Scope 3 - Other Indirect Emissions**							
3.3.1	***Electricity Use***							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
	GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**455**	
3.3.2	***Chemicals Consumption - Magnesium Hydroxide***							
	Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
	Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
	GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
	Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
	GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3	***Chemicals Consumption - Ferric Chloride***							
	Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
	GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
	Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
	GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0	Wastewater Treatment							
4.1	Scope 1 - Direct Emissions							
4.1.1	***Secondary Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2	***Secondary Treatment Off-Gases - Methane***							
	Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	15,374				
	COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
	Effluent COD Mass Load	MEff_COD	kgCOD / y	617				
	COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
	Biosolids COD Mass Load	MWAS_COD	kgCOD / y	4				
	Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3	***Secondary Treatment Off-Gases - Nitrous Oxide***							
	Total Nitrogen Removed by Denitrification	MNdn	kgN / y	3,562				
	Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
	Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	56				
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**17,454**			
4.1.4	***Sludge Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5	***Sludge Treatment Off-Gases - Methane***							
	COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	4				Assume all sludge is transferred out of the plant
	Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
	GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6	***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**92,347**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**13,192**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	0				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	136				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	0				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**0**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	86				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	0				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**0**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	80				
Delivery Weight of Polymer	W_Poly	kg	900				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	0				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**0**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,152				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	0				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**0**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	1782				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				SimaPro v.7.1.0 - Australian LCA Data Library. Convert on mass basis for active chlorine (12%) + 0.5% NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	2,052				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	78				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	734				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**2,785**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	35				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	3				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**814**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	3,994				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	42				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	111				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**4,105**	

	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3	***Biosolids Disposal***							
	Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	318				
	Average Distance Travelled for Disposal (round trip)	Dist_b	km	500				
	Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
	GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	2,386				
	Fate of Disposed Biosolids	Fate_b		Agriculture				
	Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
	Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
	Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	0				
	GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**2,466**	
6.0	**Totals**	**GHG_Scope**	**kgCO2-e / y**		**18,268**	**95,529**	**23,003**	
		GHG_Total	**kgCO2-e / y**		**136,800**			
		GHGperML	**kgCO2-e / ML**		**2,883**			
7.0	**Summary by Process**							
	Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
	Direct Emissions (WW Treatment)		kgCO2-e / y	17,454	17,454			
	Direct Emissions (WW Discharge)		kgCO2-e / y	814	814			
	Electrical Power (WW Collection)		kgCO2-e / y	3,637		3,182	455	
	Electrical Power (WW Treatment)		kgCO2-e / y	105,539		92,347	13,192	
	Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
	Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
	Chemical Consumption (WW Treatment)		kgCO2-e / y	2,785			2,785	
	Disposal of Biosolids		kgCO2-e / y	2,466			2,466	
	Disposal of Screenings and Grit		kgCO2-e / y	4,105			4,105	
	Total GHG Emissions		**kgCO2-e / y**	**136,800**	**18,268**	**95,529**	**23,003**	



Dunwich STP
Annual GHG Emissions (tCO2-e/y)
160
140
120
100
80
60
40
20
0
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland City Council / Redland Water

NGERS Inventory 2008-09

Mt Cotton STP

(yellow)	Denotes User Input
(pink)	Denotes Model Parameter (see references)

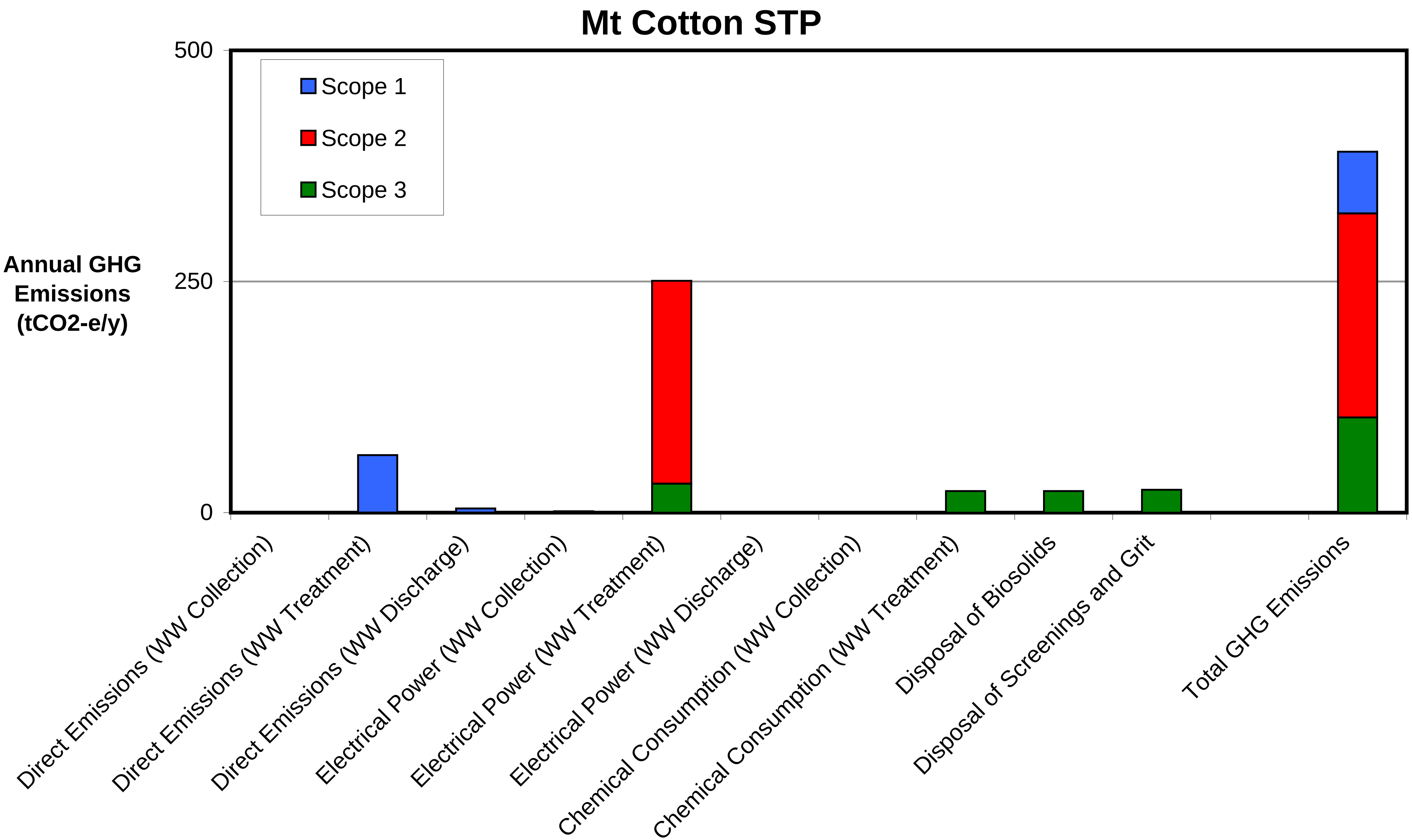
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	**General Calculation Parameters**							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	**Plant Input Parameters**							
	Total Raw Sewage Flowrate	Q	ML / y	208				
	Raw Sewage COD Concentration	Raw_COD	mg / L	574				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	45.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	4.50				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	398,209				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	14%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	69%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	1,484				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	241,056				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	26.1				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	0				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	1,500				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	0				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	11768				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	12000				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	14,976				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	**Wastewater Collection System**							
3.1	**Scope 1 - Direct Emissions**							
3.1.1	***Wastewater Collection - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	***Wastewater Collection - Methane***							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	***Wastewater Collection - Nitrous Oxide***							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	**Scope 2 - Indirect Emissions due to Electricity Use**							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**1,350**		
3.3	**Scope 3 - Other Indirect Emissions**							
3.3.1	***Electricity Use***							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
	GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**193**	
3.3.2	***Chemicals Consumption - Magnesium Hydroxide***							
	Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
	Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
	GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
	Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
	GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3	***Chemicals Consumption - Ferric Chloride***							
	Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
	GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
	Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
	GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0	Wastewater Treatment							
4.1	Scope 1 - Direct Emissions							
4.1.1	***Secondary Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2	***Secondary Treatment Off-Gases - Methane***							
	Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	119,421				
	COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
	Effluent COD Mass Load	MEff_COD	kgCOD / y	2,705				
	COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
	Biosolids COD Mass Load	MWAS_COD	kgCOD / y	56,931				
	Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3	***Secondary Treatment Off-Gases - Nitrous Oxide***							
	Total Nitrogen Removed by Denitrification	MNdn	kgN / y	12,692				
	Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
	Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	201				
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**62,192**			
4.1.4	***Sludge Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5	***Sludge Treatment Off-Gases - Methane***							
	COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	56,931				Assume all sludge is transferred out of the plant
	Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
	GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6	***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**219,361**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**31,337**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	7				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	95				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	13				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	300				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**307**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	71				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	0				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**0**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	1,773				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	54				
Delivery Weight of Polymer	W_Poly	kg	750				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	172				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**1,945**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,156				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	0				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**0**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	1765				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	2,033				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	83				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	770				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**2,803**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	18,000				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	31				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	244				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**18,244**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	15				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**4,588**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	23,962				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	47				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	733				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**24,695**	

Parameter		Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3	***Biosolids Disposal***							
	Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	55,749				
	Average Distance Travelled for Disposal (round trip)	Dist_b	km	452				
	Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
	GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	9,458				
	Fate of Disposed Biosolids	Fate_b		Agriculture				
	Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
	Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
	Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	45				
	GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**23,408**	
6.0	**Totals**	**GHG_Scope**	**kgCO2-e / y**		**66,780**	**220,712**	**102,931**	
		GHG_Total	**kgCO2-e / y**			**390,422**		
		GHGperML	**kgCO2-e / ML**			**1,877**		
7.0	**Summary by Process**							
	Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
	Direct Emissions (WW Treatment)		kgCO2-e / y	62,192	62,192			
	Direct Emissions (WW Discharge)		kgCO2-e / y	4,588	4,588			
	Electrical Power (WW Collection)		kgCO2-e / y	1,543		1,350	193	
	Electrical Power (WW Treatment)		kgCO2-e / y	250,698		219,361	31,337	
	Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
	Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
	Chemical Consumption (WW Treatment)		kgCO2-e / y	23,298			23,298	
	Disposal of Biosolids		kgCO2-e / y	23,408			23,408	
	Disposal of Screenings and Grit		kgCO2-e / y	24,695			24,695	
	Total GHG Emissions		**kgCO2-e / y**	**390,422**	**66,780**	**220,712**	**102,931**	



Mt Cotton STP
500
250
0
Annual GHG Emissions (tCO2-e/y)
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland City Council / Redland Water

NGERS Inventory 2008-09

Point Lookout STP

Denotes User Input

Denotes Model Parameter (see references)

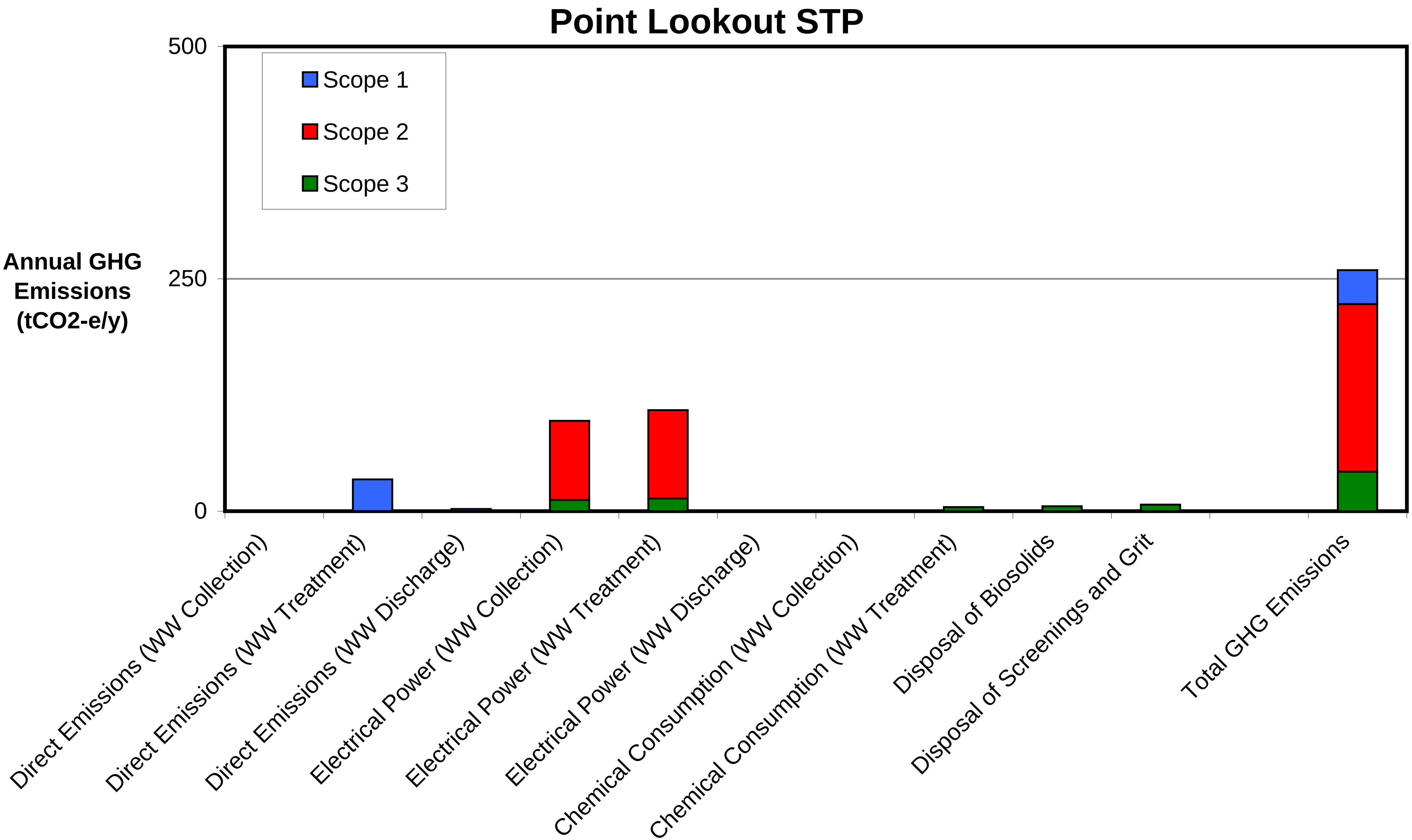
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	General Calculation Parameters							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	Plant Input Parameters							
	Total Raw Sewage Flowrate	Q	ML / y	95				
	Raw Sewage COD Concentration	Raw_COD	mg / L	449				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	52.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	5.10				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	181,639				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	0.35%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	0.90%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	93,450				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	104,539				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	0.0				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	0				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	0				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	0				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	17036				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	4,243				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	Wastewater Collection System							
3.1	Scope 1 - Direct Emissions							
3.1.1	*Wastewater Collection - Carbon Dioxide*							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	*Wastewater Collection - Methane*							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	*Wastewater Collection - Nitrous Oxide*							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	Scope 2 - Indirect Emissions due to Electricity Use							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**85,040**		
3.3	Scope 3 - Other Indirect Emissions							
3.3.1	*Electricity Use*							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

Parameter		Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
	GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**12,149**	
3.3.2	***Chemicals Consumption - Magnesium Hydroxide***							
	Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
	Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
	GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
	Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
	GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3	***Chemicals Consumption - Ferric Chloride***							
	Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
	GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
	Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
	GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0	Wastewater Treatment							
4.1	Scope 1 - Direct Emissions							
4.1.1	***Secondary Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2	***Secondary Treatment Off-Gases - Methane***							
	Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	42,610				
	COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
	Effluent COD Mass Load	MEff_COD	kgCOD / y	1,234				
	COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
	Biosolids COD Mass Load	MWAS_COD	kgCOD / y	8				
	Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3	***Secondary Treatment Off-Gases - Nitrous Oxide***							
	Total Nitrogen Removed by Denitrification	MNdn	kgN / y	6,972				
	Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
	Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	110				
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**34,164**			
4.1.4	***Sludge Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5	***Sludge Treatment Off-Gases - Methane***							
	COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	8				Assume all sludge is transferred out of the plant
	Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
	GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6	***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**95,130**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**13,590**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	0				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	169				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	0				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**0**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	119				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	0				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**0**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	113				
Delivery Weight of Polymer	W_Poly	kg	900				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	0				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**0**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,184				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	0				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**0**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	2555				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	2,943				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	111				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	1,496				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**4,439**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	68				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	8				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**2,372**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	6,789				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	75				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	336				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**7,125**	

Parameter		Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3	***Biosolids Disposal***							
	Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	636				
	Average Distance Travelled for Disposal (round trip)	Dist_b	km	536				
	Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
	GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	5,116				
	Fate of Disposed Biosolids	Fate_b		Agriculture				
	Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
	Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
	Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	1				
	GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**5,275**	
6.0	**Totals**	**GHG_Scope**	**kgCO2-e / y**		**36,535**	**180,170**	**42,578**	
		GHG_Total	**kgCO2-e / y**			**259,283**		
		GHGperML	**kgCO2-e / ML**			**2,732**		
7.0	**Summary by Process**							
	Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
	Direct Emissions (WW Treatment)		kgCO2-e / y	34,164	34,164			
	Direct Emissions (WW Discharge)		kgCO2-e / y	2,372	2,372			
	Electrical Power (WW Collection)		kgCO2-e / y	97,188		85,040	12,149	
	Electrical Power (WW Treatment)		kgCO2-e / y	108,721		95,130	13,590	
	Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
	Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
	Chemical Consumption (WW Treatment)		kgCO2-e / y	4,439			4,439	
	Disposal of Biosolids		kgCO2-e / y	5,275			5,275	
	Disposal of Screenings and Grit		kgCO2-e / y	7,125			7,125	
	Total GHG Emissions		**kgCO2-e / y**	**259,283**	**36,535**	**180,170**	**42,578**	



Point Lookout STP
Annual GHG Emissions (tCO2-e/y)
500
250
0
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland City Council / Redland Water

NGERS Inventory 2008-09

(yellow)	Denotes User Input
(pink)	Denotes Model Parameter (see references)

Thorneside STP

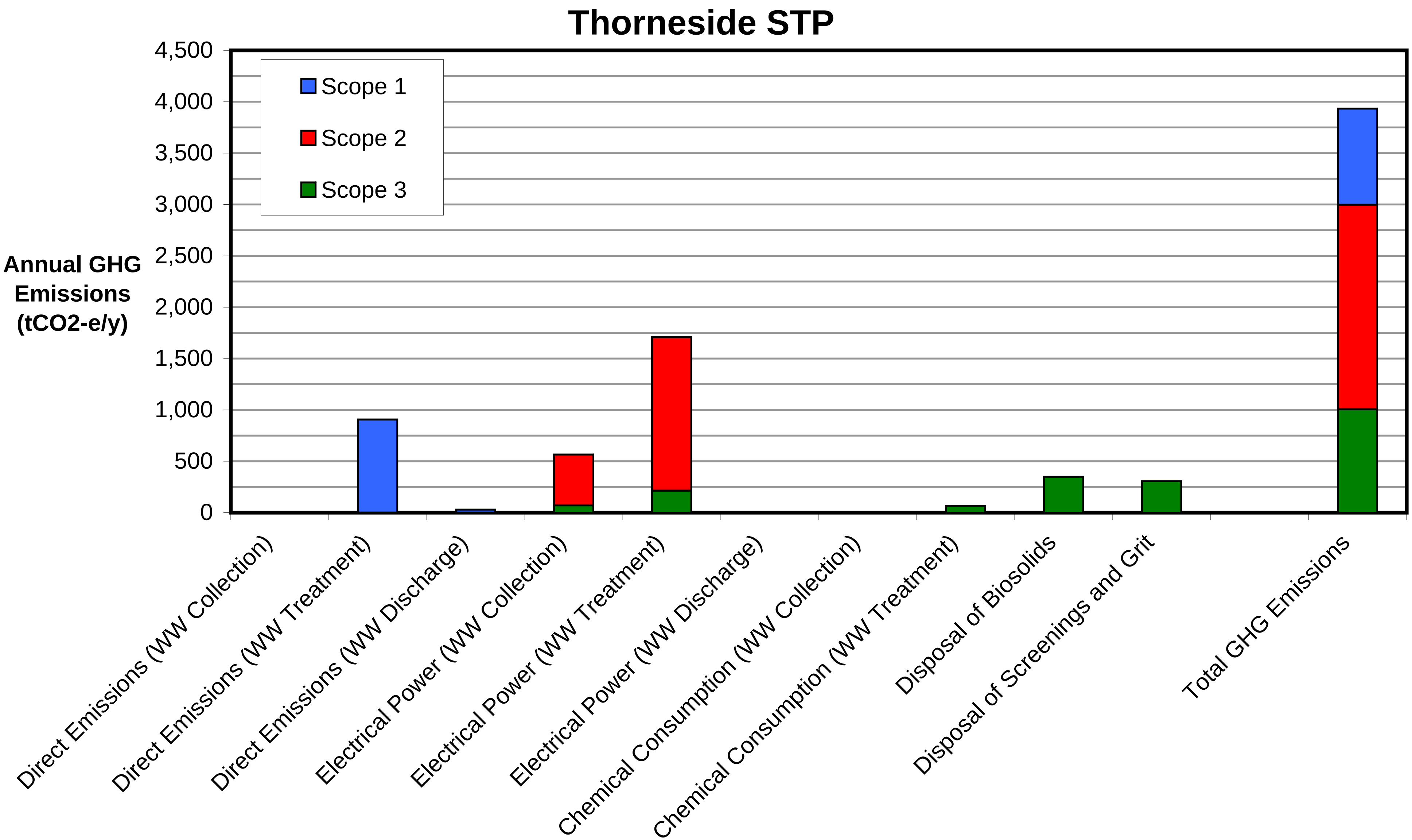
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	**General Calculation Parameters**							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	**Plant Input Parameters**							
	Total Raw Sewage Flowrate	Q	ML / y	2,960				
	Raw Sewage COD Concentration	Raw_COD	mg / L	450				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	66.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	2.00				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	5,665,749				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	15%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	71%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	544,053				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	1,642,727				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	335.6				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	117				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	1,800				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	17,480				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	0				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	189,696				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	**Wastewater Collection System**							
3.1	**Scope 1 - Direct Emissions**							
3.1.1	***Wastewater Collection - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	***Wastewater Collection - Methane***							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	***Wastewater Collection - Nitrous Oxide***							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	**Scope 2 - Indirect Emissions due to Electricity Use**							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**495,088**		
3.3	**Scope 3 - Other Indirect Emissions**							
3.3.1	***Electricity Use***							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**70,727**	
3.3.2 ***Chemicals Consumption - Magnesium Hydroxide***							
Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3 ***Chemicals Consumption - Ferric Chloride***							
Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0 Wastewater Treatment							
4.1 Scope 1 - Direct Emissions							
4.1.1 ***Secondary Treatment Off-Gases - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2 ***Secondary Treatment Off-Gases - Methane***							
Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	1,332,068				
COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
Effluent COD Mass Load	MEff_COD	kgCOD / y	38,482				
COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
Biosolids COD Mass Load	MWAS_COD	kgCOD / y	893,035				
Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3 ***Secondary Treatment Off-Gases - Nitrous Oxide***							
Total Nitrogen Removed by Denitrification	MNdn	kgN / y	185,155				
Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	2,927				
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**907,257**			
4.1.4 ***Sludge Treatment Off-Gases - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5 ***Sludge Treatment Off-Gases - Methane***							
COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	893,035				Assume all sludge is transferred out of the plant
Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6 ***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**1,494,882**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**213,555**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	87				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	99				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	2,086				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**2,173**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	192				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	49				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	457				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**649**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	2,128				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	43				
Delivery Weight of Polymer	W_Poly	kg	900				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	134				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**2,262**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	19,648				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,426				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	42,712				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**62,360**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	0				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	0				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	28				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**0**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	19				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	94				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**29,009**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	303,514				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	12				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	2,353				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**305,866**	

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3 ***Biosolids Disposal***							
Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	849,862				
Average Distance Travelled for Disposal (round trip)	Dist_b	km	458				
Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	136,359				
Fate of Disposed Biosolids	Fate_b		Agriculture				
Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	686				
GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**349,006**	
6.0 Totals	**GHG_Scope**	**kgCO2-e / y**		**936,267**	**1,989,970**	**1,006,598**	
	GHG_Total	**kgCO2-e / y**			**3,932,835**		
	GHGperML	**kgCO2-e / ML**			**1,329**		
7.0 Summary by Process							
Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
Direct Emissions (WW Treatment)		kgCO2-e / y	907,257	907,257			
Direct Emissions (WW Discharge)		kgCO2-e / y	29,009	29,009			
Electrical Power (WW Collection)		kgCO2-e / y	565,815		495,088	70,727	
Electrical Power (WW Treatment)		kgCO2-e / y	1,708,436		1,494,882	213,555	
Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
Chemical Consumption (WW Treatment)		kgCO2-e / y	67,444			67,444	
Disposal of Biosolids		kgCO2-e / y	349,006			349,006	
Disposal of Screenings and Grit		kgCO2-e / y	305,866			305,866	
Total GHG Emissions		**kgCO2-e / y**	**3,932,835**	**936,267**	**1,989,970**	**1,006,598**	


Thorneside STP
Annual GHG Emissions (tCO2-e/y)
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Scope 1
Scope 2
Scope 3
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland City Council / Redland Water

NGERS Inventory 2008-09

Victoria Pt STP

	Denotes User Input
	Denotes Model Parameter (see references)

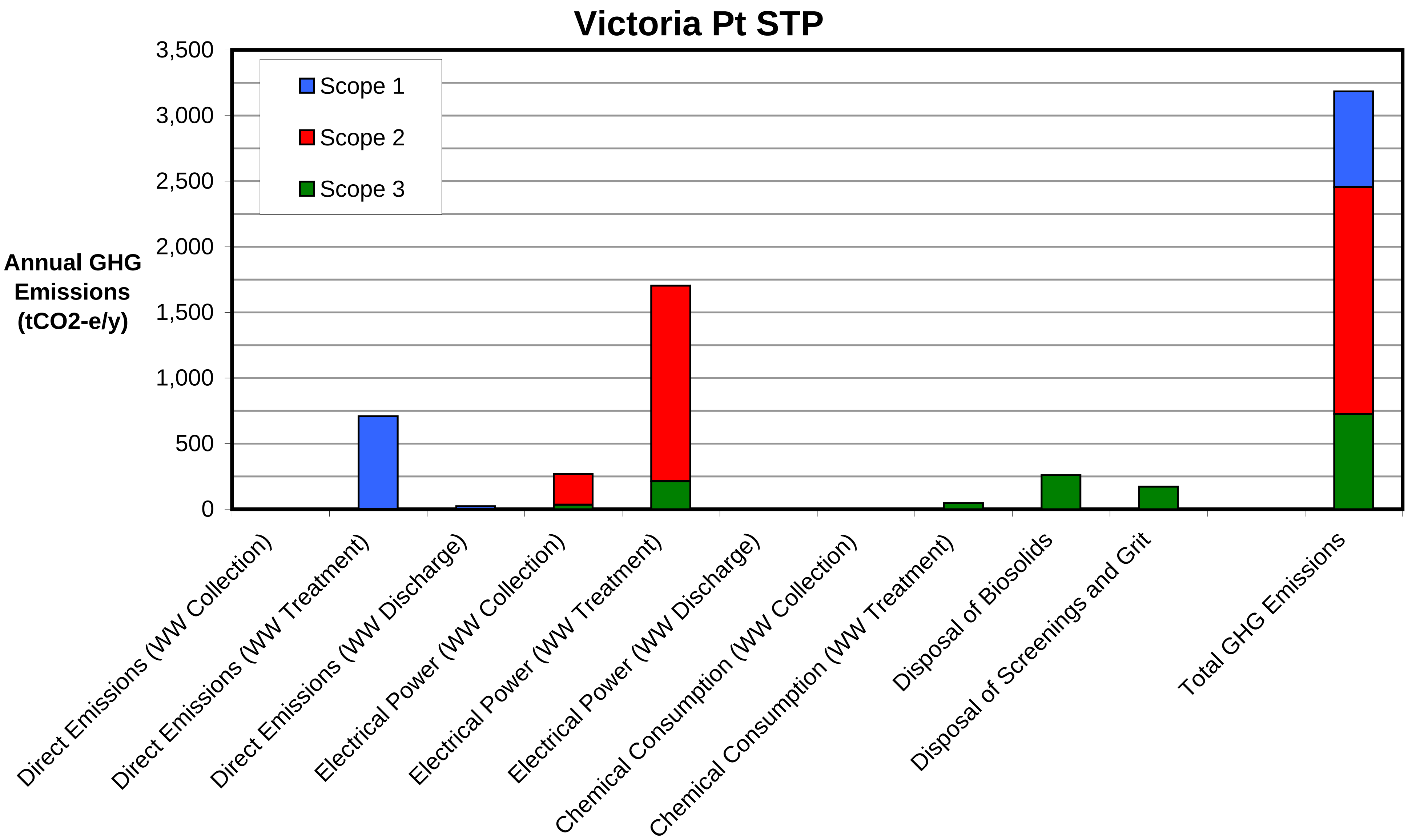
	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
1.0	General Calculation Parameters							
	Methane Global Warming Potential	GWP_CH4	kgCO2-e / kgCH4	21				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =21
	Nitrous Oxide Global Warming Potential	GWP_N2O	kgCO2-e / kgN2O	310				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Schedule 3 - GWP =310
	State in Australia	State		QLD				
2.0	Plant Input Parameters							
	Total Raw Sewage Flowrate	Q	ML / y	2,278				
	Raw Sewage COD Concentration	Raw_COD	mg / L	449				
	Effluent BOD Concentration	Eff_BOD	mg / L	5				
	Raw Sewage Total N Concentration	Raw_TN	mgN / L	52.0				
	Effluent Total N Concentration	Eff_TN	mgN / L	2.00				
	Wet Weight of Disposed Biosolids	MXtb_wet	kg / y	4,359,343				Wet mass of biosolids produced after dewatering
	Biosolids Solids Content	DS_b	% d.s.	14%				
	Volatile Solids in Disposed Biosolids	VS_b	%VS	77%				
	Total N Concentration in Disposed Biosolids	Frac_N_b	kgN / kg d.s.	5%				
	Methane in Captured Biogas	CH4_bg	m3 / y	0				Measured at NGERS standard conditions (15oC, 1 atm)
	Total Electricity Consumption (Sewerage)	E_SEW	kWh / y	259,551				
	Total Electricity Consumption (Treatment)	E_t	kWh / y	1,638,806				
	Total Electricity Consumption (Discharge)	E_EFF	kWh / y	0				
	Consumption of Alum Solution	Alum	tonnes / y	48.2				
	Consumption of Dry Magnesium Hydroxide	MgOH_dw	kg / y dry Mg(OH)2	0				
	Consumption of Ferric Chloride Solution	FeCl3	L / y	0				Assuming 58wt% solution, SG = 1.5
	Consumption of Dry Lime	Lime_dw	tonnes / y dry Ca(OH)2	0				
	Consumption of Dry Polymer for Sludge Thickening & Dewatering	Poly	kg / y	3,000				
	Consumption of Liquid Polymer for Sludge Thickening & Dewatering	Poly_liq	kg / y	0				
	Consumption of Chlorine Gas	Chlorine	kg/y as Cl2	13,800				Chlorine gas assume 100% Cl2
	Consumption of Sodium Hypochlorite Solution	NaOCl_liq	L / y	0				
	Consumption of Soda Ash	Na2CO3	kg / y as Na2CO3	0				
	Weight of Disposed Screenings and Grit	MXt_sc_gr	kg / y	105,664				1.26 m3/wk screenings, 0.48 m3/wk grit. Assume bulk density = 0.8 kg/m3
3.0	Wastewater Collection System							
3.1	Scope 1 - Direct Emissions							
3.1.1	*Wastewater Collection - Carbon Dioxide*							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_SEW**	**kgCO2-e / y**		**0**			
3.1.2	*Wastewater Collection - Methane*							
	GHG Emissions due to Methane Production	**GHG_CH4_SEW**	**kgCO2-e / y**		**0**			
3.1.3	*Wastewater Collection - Nitrous Oxide*							
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SEW**	**kgCO2-e / y**		**0**			
3.2	Scope 2 - Indirect Emissions due to Electricity Use							
	Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Section 7.2 Table 7.2
	GHG Emissions due to Electricity Generation	**GHG_E_SEW**	**kgCO2-e / y**			**236,191**		
3.3	Scope 3 - Other Indirect Emissions							
3.3.1	*Electricity Use*							
	Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39

Parameter		Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
	GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_SEW**	**kgCO2-e / y**				**33,742**	
3.3.2	***Chemicals Consumption - Magnesium Hydroxide***							
	Flowrate of Magnesium Hydroxide Solution	MgOH	L / y	0				Assuming 58wt% solution, SG = 1.5
	Emissions Factor for Mg(OH)2, due to Production	EF_MgOH_P	kgCO2-e / kg dry Mg(OH)2	1.640				Estimate, assuming same as Lime (SimaPro v.7.1.0 - Australian LCA Data Library)
	GHG Emissions due to Production of Magnesium Hydroxide	GHG_MgOH_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_MgOH	km	0				
	Delivery Volume Load of Magnesium Hydroxide Solution	Vol_MgOH	L	0				
	GHG Emissions due to Transport of Magnesium Hydroxide Solution	GHG_MgOH_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Magnesium Hydroxide	**GHG_MgOH**	**kgCO2-e / y**				**0**	
3.3.3	***Chemicals Consumption - Ferric Chloride***							
	Emissions Factor for FeCl3, due to Production	EF_FeCl_P	kgCO2-e / kg FeCl3	0.000				No data available
	GHG Emissions due to Production of Ferric Chloride	GHG_FeCl_P	kgCO2-e / y	0				
	Average Distance Travelled for Delivery (round trip)	Dist_FeCl	km	0				
	Delivery Volume Load of Ferric Chloride Solution	Vol_FeCl	L	0				
	GHG Emissions due to Transport of Ferric Chloride Solution	GHG_FeCl_T	kgCO2-e / y	0				
	GHG Emissions due to Imported Ferric Chloride	**GHG_FeCl**	**kgCO2-e / y**				**0**	
4.0	Wastewater Treatment							
4.1	Scope 1 - Direct Emissions							
4.1.1	***Secondary Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_2o**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.2	***Secondary Treatment Off-Gases - Methane***							
	Raw Sewage COD Mass Load	MRaw_COD	kgCOD / y	1,022,642				
	COD:BOD Conversion Factor	COD_BOD	kgCOD / kgBOD	2.6				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.3 paragraph 5.26 (2) (b)
	Effluent COD Mass Load	MEff_COD	kgCOD / y	29,609				
	COD:VS Conversion Factor	COD_VS	kgCOD / kg VS	1.48				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (7)
	Biosolids COD Mass Load	MWAS_COD	kgCOD / y	695,507				
	Methane Emission Factor	EF_max	kg CH4 / kgCOD	0.25				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Fraction of COD anaerobically treated by plant	Fwan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	GHG Emissions due to Methane Production	**GHG_CH4_2o**	**kgCO2-e / y**		**0**			NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
4.1.3	***Secondary Treatment Off-Gases - Nitrous Oxide***							
	Total Nitrogen Removed by Denitrification	MNdn	kgN / y	144,641				
	Specific Nitrous Oxide Production	N2O_N	kgN2O-N / kgN denitrified	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (3)
	Total Nitrous Oxide Production in Secondary Treatment	MN2O_2o	kgN2O / y	2,286				
	GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_2o**	**kgCO2-e / y**		**708,743**			
4.1.4	***Sludge Treatment Off-Gases - Carbon Dioxide***							
	GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Sl**	**kgCO2-e / y**		**0**			Biogenic CO2 is a neutral GHG under NGERS Guidelines
4.1.5	***Sludge Treatment Off-Gases - Methane***							
	COD in sludge transferred out of the plant	COD_sltr	kgCOD/y	695,507				Assume all sludge is transferred out of the plant
	Fraction of COD in sludge anaerobically treated by plant	Fslan	kgCOD/y	0.00				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (5)
	Methane Conversion Factor	Gamma	tCO2-e / kgCH4	0.01425				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
	GHG Emissions due to Methane Production	**GHG_CH4_Sl**	**kgCO2-e / y**		**0**			(Ej) NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.2 subsection 5.25 (1)
4.1.6	***Sludge Treatment Off-Gases - Nitrous Oxide***							

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
GHG Emissions due to Nitrous Oxide Production	**GHG_N2O_SI**	**kgCO2-e / y**		**0**			
4.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_WWT**	**kgCO2-e / y**			**1,491,313**		
4.3 Scope 3 - Other Indirect Emissions							
4.3.1 *Electricity Use*							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_WWT**	**kgCO2-e / y**				**213,045**	
4.3.2 *Chemicals Consumption - Alum*							
Alum Solution Strength	Alum_dw	kg dry alum / kg solution	0.48				
Emissions Factor for Alum, due to Production	EF_Alum_P	kgCO2-e / kg dry Alum	0.539				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Alum	GHG_Alum_P	kgCO2-e / y	12				
Full Fuel Cycle Emission Factor for Automotive Diesel	EF_diesel	kgCO2-e / L	2.9				NGA Factors (October 2008) - p.15, Table 3; p.58, Table 38
Average Fuel Consumption for (Heavy) Diesel Truck	Fuel_Eff	L / km	0.546				AGO Factors & Methods Workbook (2006) - Table 4, p.11
Average Distance Travelled for Delivery (round trip)	Dist_Alum	km	113				
Delivery Volume of Alum Solution	Vol_Alum	tonnes	25				
GHG Emissions due to Transport of Alum Solution	GHG_Alum_T	kgCO2-e / y	342				
GHG Emissions due to Imported Alum	**GHG_Alum**	**kgCO2-e / y**				**354**	
4.3.3 *Chemicals Consumption - Lime*							
Emissions Factor for Ca(OH)2, due to Production	EF_Lime_P	kgCO2-e / kg dry Ca(OH)2	1.640				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Lime	GHG_Lime_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Lime	km	59				
Delivery Mass Load of Lime Solution	Mass_Lime	tonne	20				
GHG Emissions due to Transport of Lime Solution	GHG_Lime_T	kgCO2-e / y	0				
GHG Emissions due to Imported Lime	**GHG_Lime**	**kgCO2-e / y**				**0**	
4.3.4 *Chemicals Consumption - Polymer*							
Dry Polymer Content of Liquid Polymer	Poly_liq_ds	% w/w dry total solids	48%				Typically 25 - 50%
Emissions Factor for Polymer, due to Production	EF_Poly_P	kgCO2-e / kg	1.182				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Polymer	GHG_Poly_P	kgCO2-e / y	3,546				
Average Distance Travelled for Delivery (round trip)	Dist_Poly	km	52				
Delivery Weight of Polymer	W_Poly	kg	750				Assume delivery of 5 no. 1 tonne pallets (i.e. 50 x 20 kg bags)
GHG Emissions due to Transport of Imported Polymer	GHG_Poly_T	kgCO2-e / y	329				
GHG Emissions due to Imported Polymer	**GHG_Poly**	**kgCO2-e / y**				**3,875**	
4.3.5 *Chemicals Consumption - Chlorine Gas*							
Emissions Factor for Chlorine Gas, due to Production	EF_Cl2_P	kgCO2-e / kg	1.124				SimaPro v.7.1.0 - Australian LCA Data Library
GHG Emissions due to Production of Chlorine Gas	GHG_Cl2_P	kgCO2-e / y	15,511				
Average Distance Travelled for Delivery (round trip)	Dist_Cl2	km	1,138				
Delivery Mass of Chlorine Gas (in drums)	Delivery_Cl2	kg	920				
GHG Emissions due to Transport of Imported Chlorine gas	GHG_Cl2_T	kgCO2-e / y	26,910				
GHG Emissions due to Imported Chlorine gas	**GHG_Cl2**	**kgCO2-e / y**				**42,421**	
4.3.6 *Chemicals Consumption - Sodium Hypochlorite*							
Mass of Dosed Sodium Hypochlorite	NaOCl_mass	kg/d as dry NaOCl	0				Assume 12wt% solution, SG = 1.25
Emissions Factor for Sodium Hypochlorite, due to Production	EF_Cl_P	kgCO2-e / kg	1.152				SimaPro v.7.1.0 - Australian LCA Data Library. Convert on mass basis for active chlorine (12%) + 0.3% NaOH
GHG Emissions due to Production of Sodium Hypochlorite	GHG_Cl_P	kgCO2-e / y	0				

Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
Average Distance Travelled for Delivery (round trip)	Dist_Cl	km	65				
Delivery Volume of Sodium Hypochlorite Solution	Vol_NaOCl	L	2,000				Assume delivery in 2,000 litre Tanker
GHG Emissions due to Transport of Imported Sodium Hypochlorite Solution	GHG_Cl_T	kgCO2-e / y	0				
GHG Emissions due to Imported Sodium Hypochlorite	**GHG_Cl**	**kgCO2-e / y**				**0**	
4.3.7 ***Chemicals Consumption - Soda Ash***							
Emissions Factor for Soda Ash, due to Production	EF_Na2CO3	kgCO2-e / kg	1.500				SimaPro v.7.1.0 - Australian LCA Data Library.
GHG Emissions due to Production of Soda Ash	GHG_Na2CO3_P	kgCO2-e / y	0				
Average Distance Travelled for Delivery (round trip)	Dist_Na2CO3	km	19				Assume manufacture near Melbourne
Delivery mass of Soda Ash	W_Na2CO3	kg	2,400				Assume 2400kg per delivery
GHG Emissions due to Transport of Soda Ash	GHG_Na2CO3_T	kgCO2-e / y	0				
GHG Emissions due to Imported Soda Ash	**GHG_Na2CO3**	**kgCO2-e / y**				**0**	
5.0 Wastewater and Biosolids Disposal							
5.1 Scope 1 - Direct Emissions							
5.1.1 ***Effluent Disposal - Carbon Dioxide***							
GHG Emissions due to Carbon Dioxide Production	**GHG_CO2_Eff**	**kgCO2-e / y**		**0**			
5.1.2 ***Effluent Disposal - Methane***							
GHG Emissions due to Methane Production	**GHG_CH4_Eff**	**kgCO2-e / y**		**0**			
5.1.3 ***Effluent Disposal - Nitrous Oxide***							
Effluent Disposal to Receiving Water (portion not irrigated)	Eff_fate		Estuary				
Emission Factor for N2O in Receiving Water	EF_eff_N2O_water	kgN2O-N / kgN	0.010				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Division 5.3.5 subsection 5.31 (2)
GHG Emissions due to N2O from Disposal to Receiving Water Body	GHG_N2O_water	kgN2O / y	72				
GHG Emissions due to Effluent Disposal	**GHG_N2O_Eff**	**kgCO2-e / y**		**22,320**			
5.2 Scope 2 - Indirect Emissions due to Electricity Use							
Electricity Generation Emission Factor	EF_E	kgCO2-e / kWh	0.91				NGER (Measurement) Technical Guidelines 2008 (v1.1) - Table 7.2
GHG Emissions due to Electricity Generation	**GHG_E_EFF**	**kgCO2-e / y**			**0**		
5.3 Scope 3 - Other Indirect Emissions							
5.3.1 ***Electricity Use***							
Electricity Emission Factor - Fuel Extraction, Transport, Transmission etc.	EF_E_T	kgCO2-e / kWh	0.13				NGA Factors (Oct 2008) - p.59 - Table 39
GHG Emissions due to Electricity - Extract., Trans., T/mission	**GHG_ET_EFF**	**kgCO2-e / y**				**0**	
5.3.2 ***Screenings and Grit Disposal***							
Emission Factor for Landfill Disposal of Screenings & Grit	EF_solidwaste	kg CO2-e / kg waste	1.60				NGA Factors (Oct 2008) - p.63, Table 42: Emission factor for municipal solid waste
GHG Emissions from Landfill Disposal of Screenings & Grit	GHG_sc_gr_waste	kgCO2-e / y	169,062				
Average Distance Travelled for Disposal (round trip)	Dist_sc_gr	km	27				
Weight of Disposed Screenings & Grit per Trip	W_sc_gr	kg	1,500				Assume approx. one trip per week
GHG Emissions due to Transport of Disposed Screenings & Grit	GHG_sc_gr_T	kgCO2-e / y	3,021				
GHG Emissions due to Disposal of Screenings & Grit	**GHG_sc_gr**	**kgCO2-e / y**				**172,083**	

	Parameter	Abbreviation	Units	Value	Scope 1	Scope 2	Scope 3	Comments
5.3.3	***Biosolids Disposal***							
	Dry Weight of Disposed Biosolids	MXtb_dry	kg / y d.s.	610,308				
	Average Distance Travelled for Disposal (round trip)	Dist_b	km	470				
	Weight of Disposed Biosolids per Trip	W_b	kg	30,000				
	GHG Emissions due to Transport of Biosolids	GHG_b_T	kgCO2-e / y	107,666				
	Fate of Disposed Biosolids	Fate_b		Agriculture				
	Direct Emission Factor for Nitrous Oxide from Biosolids Disposal	EF_b_N2O	kgN2O-N / kgN	0.009				AMEGGES 2006: Agriculture, Table 15, p.45. N2O emission factor (% of applied N) for sewage sludges = 0.
	Fraction of Applied N Volatilised as NH3 and NOx	Vol_b	kgN / kgN applied	0.20				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Indirect Emission Factor for Volatilisation	IEF_b_N2O	kgN2O-N / kgN volatilised	0.01				IPCC 2006 Guidelines for NGGI, Vol. 4, Table 11.3, p.11.24: Volatilisation from all organic fertilisers = 0.20
	Fraction of Applied N Lost by Leaching / Run-Off	Leach_b	kgN / kgN applied	0.00				Assume evaporation is greater than mean rainfall for all months of the year
	Nitrous Oxide Emissions from Biosolids Disposal	GHG_b_N2O	kgN2O / y	493				
	GHG Emissions due to Disposal of Biosolids	**GHG_b**	**kgCO2-e / y**				**260,374**	
6.0	**Totals**	**GHG_Scope**	**kgCO2-e / y**		**731,063**	**1,727,504**	**725,894**	
		GHG_Total	**kgCO2-e / y**		**3,184,462**			
		GHGperML	**kgCO2-e / ML**		**1,398**			
7.0	**Summary by Process**							
	Direct Emissions (WW Collection)		kgCO2-e / y	0	0			
	Direct Emissions (WW Treatment)		kgCO2-e / y	708,743	708,743			
	Direct Emissions (WW Discharge)		kgCO2-e / y	22,320	22,320			
	Electrical Power (WW Collection)		kgCO2-e / y	269,933		236,191	33,742	
	Electrical Power (WW Treatment)		kgCO2-e / y	1,704,358		1,491,313	213,045	
	Electrical Power (WW Discharge)		kgCO2-e / y	0		0	0	
	Chemical Consumption (WW Collection)		kgCO2-e / y	0			0	
	Chemical Consumption (WW Treatment)		kgCO2-e / y	46,651			46,651	
	Disposal of Biosolids		kgCO2-e / y	260,374			260,374	
	Disposal of Screenings and Grit		kgCO2-e / y	172,083			172,083	
	Total GHG Emissions		**kgCO2-e / y**	**3,184,462**	**731,063**	**1,727,504**	**725,894**	


Victoria Pt STP
Scope 1
Scope 2
Scope 3
Annual GHG Emissions (tCO2-e/y)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Direct Emissions (WW Collection)
Direct Emissions (WW Treatment)
Direct Emissions (WW Discharge)
Electrical Power (WW Collection)
Electrical Power (WW Treatment)
Electrical Power (WW Discharge)
Chemical Consumption (WW Collection)
Chemical Consumption (WW Treatment)
Disposal of Biosolids
Disposal of Screenings and Grit
Total GHG Emissions

Redland Water
Summary

	Emission Factor (EF)	Units	Source
Scope 1			
Scope 2	0.91	kg CO2-e/kWh	NGA Factors - November 2008
Scope 3	0.13	kg CO2-e/kWh	NGA Factors - November 2008
Total	1.04	kg CO2-e/kWh	

	Site	Total kWh (Q)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)	PS Catchment
STP	Capalaba STP	1,721,306.82	-	1,566.39	223.77	1,790.16	
	Thorneside STP	1,642,727.12	-	1,494.88	213.55	1,708.44	
	Cleveland STP	1,481,831.75	-	1,348.47	192.64	1,541.11	
	Victoria Pt STP	1,638,805.72	-	1,491.31	213.04	1,704.36	
	Mt Cotton STP	241,056.11	-	219.36	31.34	250.70	
	Dunwich STP	101,480.00	-	92.35	13.19	105.54	
	Point Lookout STP	104,539.00	-	95.13	13.59	108.72	
Office Space	Dunwich Depot	-	-	-	-	-	
	South St Depot	8,096.18	-	7.37	1.05	8.42	
	Cleveland Library L1	33,169.27	-	30.18	4.31	34.50	
Water Assets	Bunker Rd WB	-	-	-	-	-	
	Rainbow Cres Reservoir	463.67	-	0.42	0.06	0.48	
	Tallowood Court WB	18,333.75	-	16.68	2.38	19.07	
	Tramican St WB	11,268.77	-	10.25	1.46	11.72	
	Booran St WB	33,834.79	-	30.79	4.40	35.19	
	Lucinda Cres Reservoir	-	-	-	-	-	
	Howlett Rd WB	9,520.00	-	8.66	1.24	9.90	
	Tazi Rd Reservoir	60,369.00	-	54.94	7.85	62.78	
	Duncan Rd WB	13,980.19	-	12.72	1.82	14.54	
	Giles Rd Reservoir	426.00	-	0.39	0.06	0.44	
	PS1	11,311.79	-	10.29	1.47	11.76	Cleveland STP
	PS2	4,282.00	-	3.90	0.56	4.45	Cleveland STP
	PS3	3,214.65	-	2.93	0.42	3.34	Cleveland STP
	PS4	6,742.94	-	6.14	0.88	7.01	Cleveland STP
	PS5	52,922.59	-	48.16	6.88	55.04	Cleveland STP
	PS6	139,254.00	-	126.72	18.10	144.82	Cleveland STP
	PS7	-	-	-	-	-	
	PS8	1,600.00	-	1.46	0.21	1.66	Cleveland STP
	PS9	15,063.00	-	13.71	1.96	15.67	Cleveland STP
	PS10	-	-	-	-	-	
	PS11	11,017.86	-	10.03	1.43	11.46	Cleveland STP
	PS12	13,002.00	-	11.83	1.69	13.52	Cleveland STP
	PS13	411.04	-	0.37	0.05	0.43	Cleveland STP
	PS14	53.00	-	0.05	0.01	0.06	Cleveland STP
	PS15	-	-	-	-	-	
	PS16	3,457.00	-	3.15	0.45	3.60	Thorneside STP
	PS17	-	-	-	-	-	
	PS18	-	-	-	-	-	
	PS19	3,705.36	-	3.37	0.48	3.85	Cleveland STP
	PS20	-	-	-	-	-	
	PS21	-	-	-	-	-	Capalaba STP
	PS22	896.00	-	0.82	0.12	0.93	Victoria Pt STP
	PS23	649.00	-	0.59	0.08	0.67	Capalaba STP
	PS24	7,329.00	-	6.67	0.95	7.62	Capalaba STP
	PS25	1,921.23	-	1.75	0.25	2.00	Capalaba STP

Site		Total kWh (Q)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)	PS Catchment
	PS26	820.89	-	0.75	0.11	0.85	Capalaba STP
	PS27	-	-	-	-	-	
	PS28	31,841.00	-	28.98	4.14	33.11	Thorneside STP
	PS29	126,234.00	-	114.87	16.41	131.28	Thorneside STP
	PS30	864.87	-	0.79	0.11	0.90	Thorneside STP
	PS31	2,487.38	-	2.26	0.32	2.59	Thorneside STP
	PS32	3,301.85	-	3.00	0.43	3.43	Thorneside STP
	PS33	232,250.00	-	211.35	30.19	241.54	Thorneside STP
	PS34	4,953.01	-	4.51	0.64	5.15	Thorneside STP
	PS35	40,687.96	-	37.03	5.29	42.32	Thorneside STP
	PS36	-	-	-	-	-	Thorneside STP
	PS37	39.23	-	0.04	0.01	0.04	Thorneside STP
	PS38	165.83	-	0.15	0.02	0.17	Thorneside STP
	PS39	1,633.87	-	1.49	0.21	1.70	Thorneside STP
	PS40	278.43	-	0.25	0.04	0.29	Thorneside STP
	PS41	75,265.00	-	68.49	9.78	78.28	Thorneside STP
	PS42	7,373.44	-	6.71	0.96	7.67	Thorneside STP
	PS43	4,875.36	-	4.44	0.63	5.07	Thorneside STP
	PS44	583.00	-	0.53	0.08	0.61	Capalaba STP
	PS45	1,350.84	-	1.23	0.18	1.40	Cleveland STP
	PS46	-	-	-	-	-	
	PS47	3,322.84	-	3.02	0.43	3.46	Capalaba STP
	PS48	1,689.32	-	1.54	0.22	1.76	Thorneside STP
	PS49	35,037.97	-	31.88	4.55	36.44	Victoria Pt STP
	PS50	-	-	-	-	-	
	PS51	-	-	-	-	-	
	PS52	2,268.97	-	2.06	0.29	2.36	Cleveland STP
	PS53	2,130.02	-	1.94	0.28	2.22	Capalaba STP
	PS54	7,421.00	-	6.75	0.96	7.72	Victoria Pt STP
	PS55	94.00	-	0.09	0.01	0.10	Victoria Pt STP
	PS56	8,171.00	-	7.44	1.06	8.50	Victoria Pt STP
	PS57	1,113.03	-	1.01	0.14	1.16	Victoria Pt STP
	PS58	2,363.13	-	2.15	0.31	2.46	Victoria Pt STP
	PS59	-	-	-	-	-	Victoria Pt STP
	PS60	2,188.80	-	1.99	0.28	2.28	Victoria Pt STP
	PS61	19,142.00	-	17.42	2.49	19.91	Victoria Pt STP
	PS62	7,469.69	-	6.80	0.97	7.77	Capalaba STP
	PS63	-	-	-	-	-	
	PS64	-	-	-	-	-	
	PS65	1,214.00	-	1.10	0.16	1.26	Capalaba STP
	PS66	2,114.00	-	1.92	0.27	2.20	Victoria Pt STP
	PS67	100,111.00	-	91.10	13.01	104.12	Victoria Pt STP
	PS68	778.00	-	0.71	0.10	0.81	Victoria Pt STP
	PS69	9,927.00	-	9.03	1.29	10.32	Point Lookout STP
	PS70	23,075.98	-	21.00	3.00	24.00	Point Lookout STP
	PS71	25,710.08	-	23.40	3.34	26.74	Point Lookout STP
	PS72	27,001.92	-	24.57	3.51	28.08	Point Lookout STP
	PS73	-	-	-	-	-	Cleveland STP
	PS74	3,248.81	-	2.96	0.42	3.38	Cleveland STP
	PS75	932.63	-	0.85	0.12	0.97	Cleveland STP
	PS76	-	-	-	-	-	
	PS77	-	-	-	-	-	
	PS78	-	-	-	-	-	
Pump Stations	PS79	-	-	-	-	-	
	PS80	-	-	-	-	-	
	PS81	4,099.76	-	3.73	0.53	4.26	Cleveland STP
	PS82	7,219.40	-	6.57	0.94	7.51	Cleveland STP
	PS83	156.09	-	0.14	0.02	0.16	Thorneside STP

Site	Total kWh (Q)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)	PS Catchment
PS84	760.91	-	0.69	0.10	0.79	Thorneside STP
PS85	623.19	-	0.57	0.08	0.65	Thorneside STP
PS86	67,473.00	-	61.40	8.77	70.17	Cleveland STP
PS87	120.00	-	0.11	0.02	0.12	Cleveland STP
PS88	1,598.00	-	1.45	0.21	1.66	Victoria Pt STP
PS89	320.00	-	0.29	0.04	0.33	Victoria Pt STP
PS90	7,919.49	-	7.21	1.03	8.24	Victoria Pt STP
PS91	65.00	-	0.06	0.01	0.07	Victoria Pt STP
PS92	23,462.86	-	21.35	3.05	24.40	Victoria Pt STP
PS93	1,125.00	-	1.02	0.15	1.17	Thorneside STP
PS94	-	-	-	-	-	
PS95	3,169.00	-	2.88	0.41	3.30	Victoria Pt STP
PS96	1,087.87	-	0.99	0.14	1.13	Victoria Pt STP
PS97	271.00	-	0.25	0.04	0.28	Victoria Pt STP
PS98	226.00	-	0.21	0.03	0.24	Thorneside STP
PS99	229.00	-	0.21	0.03	0.24	Thorneside STP
PS100	25,051.49	-	22.80	3.26	26.05	Cleveland STP
PS101	6,855.55	-	6.24	0.89	7.13	Victoria Pt STP
PS102	-	-	-	-	-	
PS103	4,462.67	-	4.06	0.58	4.64	Point Lookout STP
PS104	2,081.83	-	1.89	0.27	2.17	Point Lookout STP
PS105	-	-	-	-	-	
PS106	997.65	-	0.91	0.13	1.04	Thorneside STP
PS107	1,176.02	-	1.07	0.15	1.22	Cleveland STP
PS108	-	-	-	-	-	
PS109	1,873.64	-	1.71	0.24	1.95	Thorneside STP
PS110	241.69	-	0.22	0.03	0.25	Thorneside STP
PS111	2,362.68	-	2.15	0.31	2.46	Victoria Pt STP
PS112	10,092.07	-	9.18	1.31	10.50	Victoria Pt STP
PS113	2,461.17	-	2.24	0.32	2.56	Cleveland STP
PS114	218.00	-	0.20	0.03	0.23	Cleveland STP
PS115	-	-	-	-	-	Thorneside STP
PS116	1,062.00	-	0.97	0.14	1.10	Cleveland STP
PS117	342.26	-	0.31	0.04	0.36	Cleveland STP
PS118	76.00	-	0.07	0.01	0.08	Victoria Pt STP
PS119	1,325.57	-	1.21	0.17	1.38	Cleveland STP
PS120	407.00	-	0.37	0.05	0.42	Cleveland STP
PS121	-	-	-	-	-	Cleveland STP
PS122	253.37	-	0.23	0.03	0.26	Cleveland STP
PS123	2,111.67	-	1.92	0.27	2.20	Cleveland STP
PS124	472.00	-	0.43	0.06	0.49	Victoria Pt STP
PS125	347.78	-	0.32	0.05	0.36	Capalaba STP
PS126	1,652.33	-	1.50	0.21	1.72	Cleveland STP
PS127	-	-	-	-	-	
PS128	96,593.00	-	87.90	12.56	100.46	Cleveland STP
PS129	792.59	-	0.72	0.10	0.82	Victoria Pt STP
PS130	611.31	-	0.56	0.08	0.64	Cleveland STP
PS131	1,190.78	-	1.08	0.15	1.24	Point Lookout STP
PS132	11,671.05	-	10.62	1.52	12.14	Victoria Pt STP
PS133	-	-	-	-	-	
PS134	-	-	-	-	-	Mt Cotton STP
PS135	-	-	-	-	-	Victoria Pt STP
PS136	860.00	-	0.78	0.11	0.89	Cleveland STP
PS137	-	-	-	-	-	
PS138	-	-	-	-	-	
PS139	-	-	-	-	-	Cleveland STP
PS140	10.00	-	0.01	0.00	0.01	Thorneside STP
PS141	89,468.00	-	81.42	11.63	93.05	Cleveland STP

	Site	Total kWh (Q)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)	PS Catchment
	PS142	-	-	-	-	-	Dunwich STP
	PS143	3,228.10	-	2.94	0.42	3.36	Dunwich STP
	PS144	269.00	-	0.24	0.03	0.28	Dunwich STP
	PS145	5,816.40	-	5.29	0.76	6.05	Cleveland STP
	PS146	412.00	-	0.37	0.05	0.43	Thorneside STP
	PS147	7,056.00	-	6.42	0.92	7.34	Cleveland STP
	PS148	-	-	-	-	-	
	PS149	-	-	-	-	-	
	PS150	-	-	-	-	-	
	PS151	1,484.00	-	1.35	0.19	1.54	Mt Cotton STP
	PS152	2,495.34	-	2.27	0.32	2.60	Victoria Pt STP
	PS153	691.52	-	0.63	0.09	0.72	Victoria Pt STP
	PS154	6,151.11	-	5.60	0.80	6.40	Victoria Pt STP
	PS155	567.79	-	0.52	0.07	0.59	Victoria Pt STP
	PS156	-	-	-	-	-	Point Lookout STP
	PS157	-	-	-	-	-	
Total		**8,634,789.74**	**-**	**7,857.66**	**1,122.52**	**8,980.18**	

Summary of Pump Station Emissions by Catchment

STP Catchment	Total kWh (Q)	Scope 1 Emissions (t CO2-e)	Scope 2 Emissions (t CO2-e)	Scope 3 Emissions (t CO2-e)	Total Emissions (t CO2-e)
Capalaba STP Catchment	25787.46	0.00	23.47	3.35	26.82
Thorneside STP Catchment	544052.72	0.00	495.09	70.73	565.81
Cleveland STP Catchment	585759.21	0.00	533.04	76.15	609.19
Victoria Pt STP Catchment	259550.84	0.00	236.19	33.74	269.93
Mt Cotton STP Catchment	1484.00	0.00	1.35	0.19	1.54
Dunwich STP Catchment	3497.10	0.00	3.18	0.45	3.64
Point Lookout STP Catchment	93450.26	0.00	85.04	12.15	97.19
TOTAL PS Emissions	**1513581.59**	**0.00**	**1377.36**	**196.77**	**1574.12**

STP

	Total usage (kWh)						
	Capalaba STP	Thorneside STP	Cleveland STP	Victoria Pt STP	Mt Cotton STP	Dunwich WWTP	Point Lookout WWTP
Jul-08	162223	170494	147734	168628	21052	26140	7505
Aug-08	161343.37	166482.21	143377.2	162178.06	21428.49		9058
Sep-08	158259.35	171273.56	139230.6	157993.19	21939.78		9891
Oct-08	160095.15	168489.68	143607.9	162670.43	23252.89		10803
Nov-08	170914.91	160490.05	151893.15	166530.88	22890.81	23140	9558
Dec-08	178747.76	170259.18	159548.25	178037.19	31788.05		13255
Jan-09	187348.52	171082.39	149684.4	164223.01	29534.78		15641
Feb-09	173028.25	149287.82	140869.95	151075.53	22255.96	26896	10085
Mar-09	190035.86	160375.37	158614.35	163559	23482.88		8850
Apr-09	179310.65	154492.86	147271.95	163910.43	23430.47	25304	9893
May-09							
Jun-09							
Total	**1721306.82**	**1642727.12**	**1481831.75**	**1638805.72**	**241056.11**	**101480**	**104539**

Sources Electricity Comparisons STPs_Mainland.xls
Stradbroke_WWTPs.xls
July_2008_all_WWTP.xls

Colour Code
No information required
No information provided
Estimated readings
Needs to be checked

Office Space

30/06/2008

	Dunwich Depot	South St Depot	Cleveland Library L1
Total building area		2291.8 m^2	4630.8 m^2
Total area occupied by RW		180.2 m^2	248.4 m^2
Area occupied (%)	10%	7.86%	5.36%

	Dunwich Depot				South St Depot				Cleveland Library L1			
	Date read taken	Days	kWh	RW kWh	Date read taken	Days	kWh	RW kWh	Date read taken	Days	kWh	RW kWh
Jul-08				0	18/07/08	18	8864	696.959944				0
Aug-08				0	19/08/08	32	9136	718.346802				0
Sep-08				0	22/09/08	34	10148	797.918492	30/09/08	30	77103.42	4135.892
Oct-08				0	22/10/08	30	9980	784.708962	31/10/08	31	82251.61	4412.045
Nov-08				0	19/11/08	28	9936	781.249324	30/11/08	30	73421.06	3938.367
Dec-08				0	18/12/08	29	11044	868.369317	31/12/08	31	75414.27	4045.285
Jan-09				0	20/01/09	33	10232	804.523257	31/01/09	31	80275.22	4306.03
Feb-09				0	17/02/09	28	10660	838.176106	28/02/09	28	78275.20	4198.747
Mar-09				0	20/03/09	31	12152	955.48931	31/03/09	31	82484.67	4424.547
Apr-09				0	22/04/09	33	10816	850.442098	30/04/09	30	69133.04	3708.354
May-09				0				0				0
Jun-09				0				0				0
Total		**0**	**0**	**0**		**296**	**102968**	**8096.18361**		**242**	**618358.49**	**33169.27**

Total days of reporting period	0	296	242

Source Office_space.xls

Colour Code

- No information required
- No information provided
- Estimated readings
- Needs to be checked

Water Supply Assets

30/06/2008

	Bunker Rd WB				Rainbow Cres Reservoir				Tallowood Court WB				Tramican St WB				Booran S	
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days
Jul-08					30/07/08	91	1000	329.67	23/07/2008	93	1487	367.753					24/07/2008	29
Aug-08													29/08/2008	88	2867	1954.77	28/08/2008	35
Sep-08																		
Oct-08									24/10/2008	93	6417	6417					30/10/2008	63
Nov-08																		
Dec-08													2/12/2008	95	4146	4146	29/12/2008	32
Jan-09									27/01/2009	188	5684	5684					29/01/2009	31
Feb-09					2/02/09	90	134	134					27/02/2009	87	5168	5168	26/02/2009	28
Mar-09																	26/03/2009	28
Apr-09									22/04/2009	85	5865	5865						
May-09																		
Jun-09																		
Total		**0**		**0**		**181**		**463.67**		**459**		**18333.8**		**270**		**11268.8**		**246**
Total days of reporting period					120				389				242				241	

Source Water_Assets.xls

Colour Code

- No information required
- No information provided
- Estimated readings
- Needs to be checked

t WB		Lucinda Cres Reservoir				Howlett Rd WB				Tazi Rd Reservoir				Duncan Rd WB				Giles Rd Reservoir			
kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
2675	2213.79									30/07/2008	30	6547	6547								
4620	4620									31/08/2008	32	14558	14558								
						23/09/2008	85	9520	9520					24/09/2008	93	6348	5870.19				
6890	6890																				
										27/11/2008	88	22378	22378								
4461	4461													23/12/2008	90	6210	6210				
6419	6419									20/01/2009	54	16886	16886					14/01/2009	198	426	426
4760	4760													23/02/2009	185	1900	1900				
4471	4471																				
	33834.8		**0**		**0**		**85**		**9520**		**204**		**60369**		**368**		**13980.2**		**198**		**426**

			204	361	198

Pump Stations

30/06/2008

	PS1				PS2				PS3				PS4			
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
Jul-08																
Aug-08	18/08/08	97	6847	3458.79					13/08/08	93	2022	956.65	20/08/08	93	4039	2214.94
Sep-08																
Oct-08																
Nov-08																
Dec-08																
Jan-09																
Feb-09	14/02/09	89	7853	7853.00	16/02/09	91	4282	4282.00	14/02/09	94	2258	2258.00	17/02/09	90	4528	4528.00
Mar-09																
Apr-09																
May-09																
Jun-09																
Total		**186**		**11312**		**91**		**4282**		**187**		**3215**		**183**		**6743**

	PS5				PS6				PS7				PS8		
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh
Jul-08	23/07/08	28	6520	5355.39	19/07/08	19	22159	22159.00							
Aug-08	22/08/08	30	6890	6889.60	20/08/08	32	28425	28425.00					4/08/08	35	778
Sep-08	26/09/08	35	7384	7383.60	18/09/08	29	23547	23547.00							
Oct-08	27/10/08	31	6258	6257.60											
Nov-08													5/11/08	93	822
Dec-08	24/12/08	32	6825	6824.80											
Jan-09															
Feb-09	16/02/09	28	6888	6888.40											
Mar-09	25/03/09	33	6662	6661.60	22/03/09	30	25580	25580.00							
Apr-09	27/04/09	33	6662	6661.60	22/04/09	31	39543	39543.00							
May-09															
Jun-09															
Total		**250**		**52923**		**141**		**139254**		**0**		**0**		**128**	

	PS1	PS2	PS3	PS4	PS5	PS6	PS7	PS8
Total days of reporting period	138	91	138	141	245	141	0	128

Source Electricity_Data_Working_copy.xls

Colour Code
- No information required
- No information provided
- Estimated readings
- Needs to be checked

	PS9				PS10				PS11				PS12			
kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
									18/07/08	28	1252	804.86				
778.00	4/08/08	35	4746	4746.00					19/08/08	32	2547	2547.00				
									23/09/08	35	228	228.00				
									22/10/08	29	1006	1006.00				
822.00	5/11/08	93	5015	5015.00									8/11/08	92	6135	6135.00
									18/12/08	29	1783	1783.00				
	6/02/09	89	5302	5302.00					17/02/09	28	1186	1186.00	7/02/09	89	6867	6867.00
									20/03/09	31	1323	1323.00				
									22/04/09	33	2140	2140.00				
1600		**217**		**15063**		**0**		**0**		**245**		**11018**		**181**		**13002**
	217				0				235				181			

PS13				PS14				PS15				PS16				PS1	
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days
18/08/08	97	299	151.04	18/08/08	49	53	53.00										
												9/10/08	91	1901	1901.00		
14/02/09	89	260	260.00														
												9/03/09	89	1556	1556.00		
	186		**411**		**49**		**53**		**0**		**0**		**180**		**3457**		**0**
138				49				0				180				0	

7		PS18				PS19				PS20				PS21				PS22				PS23				PS24				PS25			
		Date read				Date read				Date read				Date read				Date read				Date read				Date read				Date read			
kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh	taken	Days	kWh	kWh
						15/08/08	89	2454	1268.36																								
																														18/09/08	91	602	529.23
																						9/10/08	92	293	293.00	9/10/08	92	2490	2490.00				
																						8/12/08	89	356	356.00	8/12/08	89	2436	2436.00	17/12/08	90	689	689.00
						16/02/09	91	2437	2437.00									6/02/09	92	896	896.00												
																										5/03/09	87	2403	2403.00	20/03/09	93	703	703.00
	0		**0**		**0**		**180**		**3705**		**0**		**0**		**0**		**0**		**92**		**896**		**181**		**649**		**268**		**7329**		**274**		**1921**

	0	137	0	0	92	181	268	263

PS26				PS27				PS28				PS29			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
21/07/08	27	131	101.89					22/07/08	22	9326	9326	22/07/08	22	11443	11443.00
20/08/08	30	141	141.00					22/08/08	32	3146	3146.00	22/08/08	31	13148	13148.00
24/09/08	35	163	163.00					25/09/08	34	3217	3217.00	25/09/08	34	13403	13403.00
23/10/08	29	130	130.00					24/10/08	29	2437	2437.00	24/10/08	29	10294	10294.00
												21/11/08	28	12176	12176.00
22/12/08	32	8	8.00					23/12/08	32	4580	4580.00	23/12/08	32	15203	15203.00
												20/01/09	29	11230	11230.00
18/02/09	28	11	11.00					20/02/09	29	2388	2388.00	22/01/09	30	10758	10758.00
23/03/09	93	257	257.00					24/03/09	32	2653	2653.00	24/03/09	32	12099	12099.00
23/04/09	31	9	9.00					24/04/09	31	4094	4094.00	24/04/09	31	16480	16480.00
	305		**821**		**0**		**0**		**241**		**31841**		**298**		**126234**
	299				0				241				298		

PS30				PS31				PS32				PS33				PS3	
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days
21/07/08	92	420	95.87	25/07/08	88	1089	309.38	28/07/08	91	1475	453.85					23/07/08	94
												31/08/08	62	64649	64649.00		
21/10/08	92	377	377.00	28/10/08	95	1101	1101.00	28/10/08	92	1364	1364.00					23/10/08	92
												28/12/08	119	85758	85758.00		
												20/01/09	23	15969	15969.00		
												18/02/09	29	21521	21521.00		
												19/03/09	29	18095	18095.00		
29/04/09	89	392	392.00	29/04/09	89	1077	1077.00	29/04/09	89	1484	1484.00	22/04/09	34	26258	26258.00	24/04/09	87
	273		**865**		**272**		**2487**		**272**		**3302**		**296**		**232250**		**273**
	202				209				209				296				202

4		PS35				PS36				PS37				PS38				PS39				PS40				PS41				PS42			
kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
2207	540.01	16/07/08	92	17566	3054.96					16/07/08	93	228	39.23	16/07/08	92	137	23.83	16/07/08	92	580	100.87	16/07/08	92	221	38.43	9/07/08	9	7047	7047.00				
																										11/08/08	33	8755	8755.00	22/08/08	52	3611	3680.44
																										8/09/08	28	6202	6202.00				
2184	2184.00	17/10/08	93	17515	17515.00									17/10/08	93	142	142.00	17/10/08	93	705	705	17/10/08	93	240	240.00	8/10/08	30	6410	6410.00				
																										11/11/08	34	7254	7254.00	18/11/08	89	3693	3693.00
																										8/12/08	27	9934	9934.00				
																										11/01/09	34	8817	8817.00				
																										10/02/09	30	6535	6535.00				
																										11/03/09	29	6475	6475.00				
2229	2229.00	21/04/09	89	20118	20118.00													20/04/09	89	828	828					8/04/09	28	7836	7836.00				
	4953		**274**		**40688**		**0**		**0**		**93**		**39**		**185**		**166**		**274**		**1634**		**185**		**278**		**282**		**75265**		**141**		**7373**
		198				0				16				109				198				109				282				141			

PS43				PS44				PS45			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
21/08/08	88	2820	1666.36					25/08/08	90	821	511
				29/09/08	91	188	188				
				31/12/08	93	192	192				
17/02/09	92	3209	3209					18/02/09	90	840	840
				31/03/09	90	203	203				
	180		4875		274		583		180		1351
144				274				146			

PS46				PS47				PS48			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
								18/07/08	94	8822	1689
				19/09/08	89	1092	994				
				19/12/08	91	1167	1167				
				19/03/09	90	1162	1162				
	0		0		270		3323		94		1689
0				262				18			

PS49				PS50				PS51			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
15/07/08	96	2675	418								
14/10/08	91	11455	11455								
15/04/09	90	23165	23165								
	277		35038		0		0		0		0
196				0				0			

PS52				PS53				PS54			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
22/08/08	88	1305	786								
				18/09/08	91	521	458				
								13/10/08	95	3119	3119
				17/12/08	90	457	457				
18/02/09	92	1483	1483								
				20/03/09	93	1215	1215				
								14/04/09	90	4302	4302
	180		**2269**		**274**		**2130**		**185**		**7421**

PS55				PS56				PS57			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
								28/08/08	94	529	332
10/10/08	92	94	94	10/10/08	91	2514	2514	13/10/08	96	269	269
				7/11/08	93	2536	2536				
								26/02/09	92	512	512
				9/04/09	86	3121	3121				
	92		**94**		**270**		**8171**		**282**		**1113**

PS58				PS59				PS60			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
29/08/08	93	1358	876					28/08/08	93	1267	804
25/02/09	90	1487	1487					25/02/09	89	1385	1385
	183		**2363**		**0**		**0**		**182**		**2189**

145	263	185	92	270	247	150	0	148

Pump Stations

30/06/2008

	PS61				PS62				PS63				PS64			
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
Jul-08																
Aug-08	28/08/08	59	9630	9630.00												
Sep-08					15/09/08	91	2589	2190.69								
Oct-08																
Nov-08	27/11/08	9525	91	91	12/11/08	87	2148	2148								
Dec-08					3/12/08	91	3131	3131								
Jan-09																
Feb-09	25/02/09	90	9421	9421												
Mar-09																
Apr-09																
May-09																
Jun-09																
Total		**9674**		**19142**		**269**		**7470**		**0**		**0**		**0**		**0**
Total days of reporting period	9674				255				0				0			

	PS65				PS66				PS67				PS6	
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days
Jul-08									25/07/08	25	9613	9613		
Aug-08									25/08/08	31	9457	9457		
Sep-08	17/09/08								30/09/08	36	11034	11034		
Oct-08									30/10/08	30	8649	8649	30/10/08	90
Nov-08									27/11/08	28	10068	10068		
Dec-08	15/12/08	89	695	695										
Jan-09									20/01/09	54	17803	17803		
Feb-09					6/02/09	92	2114	2114						
Mar-09	12/03/09	87	519	519									2/03/09	96
Apr-09									22/04/09	92	33487	33487		
May-09														
Jun-09														
Total		**176**		**1214**		**92**		**2114**		**296**		**100111**		**186**
Total days of reporting period	176				92				296				186	

Source Electricity_Data_Working_copy.xls

Colour Code
- No information required
- No information provided
- Estimated readings
- Needs to be checked

8		PS69				PS70				PS71				PS72				PS73				PS74				PS75				PS76			
kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
										24/07/08	29	3164	2618																				
						29/08/08	89	5283.3	3561.78	28/08/08	35	4260	4260	29/08/08	89	10082.4	6797.12					21/08/08	93	2085	1166	25/08/08	97	616	356				
		1/09/08	63	3321	3321																												
405	405									30/10/08	63	8912	8912																				
										27/11/08	32	3128	3128																				
		2/12/08	92	3395	3395	2/12/08	95	7676	7676					1/12/08	94	10776	10776																
		27/02/09	87	3211	3211	27/02/09	87	11838.2	11838.2	26/02/09	28	3356	3356	27/02/09	88	9428.8	9428.8					18/02/09	90	2083	2083	18/02/09	89	577	577				
373	373									26/03/09	28	3434	3434																				
	778		242		9927		271		23076		215		25710		271		27002		0		0		183		3249		186		933		0		0
		242				242				210				242				0				142				145				0			

PS77				PS78				PS79				PS80			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
	0		0		0		0		0		0		0		0
0				0				0				0			

PS81				PS82				PS83				PS84				PS85			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
31/07/08	92	3706	1249					25/07/08	88	120	34.1	22/07/08	92	192	45.91	22/07/08	93	711	168
				8/08/08	89	4492	1968.4					22/08/08	92	156	156				
								28/10/08	95	122	122	22/10/08	92	208	208	21/10/08	91	455	455
5/02/09	97	2851	2851	7/02/2009	88	5251	5251					20/02/09	88	153	153				
												22/04/09	88	198	198				
	189		4100		177		7219		183		156		452		761		184		623
128				127				120				382				113			

PS86				PS87				PS88			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
18/07/08	18	6602	6602								
19/08/08	32	7092	7092								
22/09/08	34	7589	7589								
22/10/08	30	6647	6647					2/10/08	92	830	830
19/11/08	28	6144	6144								
18/12/08	29	7039	7039								
20/01/09	33	5922	5922								
17/02/09	28	5931	5931	7/02/09	89	120	120				
20/03/09	31	6771	6771								
22/04/09	33	7736	7736					2/04/09	85	768	768
	296		**67473**		**89**		**120**		**177**		**1598**
296				89				177			

PS89				PS90				PS91			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
				9/07/2008	91	3645	360.5				
2/10/08	92	320	320	9/10/2008	92	3676	3676	2/10/08	92	31	31
				8/04/2009	86	3883	3883	2/04/09	87	34	34
	92		**320**		**269**		**7919**		**179**		**65**
92				187				179			

PS92				PS93				PS94		
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh
18/07/08	28	3744	2407							
20/08/08	33	2888	2888							
23/09/08	34	2836	2836							
22/10/08	29	2204	2204	9/10/08	91	394	394			
				12/11/08	92	413	413			
18/12/08	29	3428	3428							
18/02/09	29	2780	2780							
20/03/09	30	2920	2920	9/03/09	88	318	318			
22/04/09	33	4000	4000							
	245		**23463**		**271**		**1125**		**0**	
235				271				0		

	PS95				PS96				PS97				PS98				PS99				PS100				PS101				PS102				PS103			
kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
													21/07/08	21	62	62	23/07/08	97	146	34.6																
					28/08/08	93	717	455	28/08/08	93	186	118									5/08/08	95	4622	1751	1/08/08	87	6135	2257					27/08/08	91	2036	1298
	30/09/2008	92	996	996																																
													21/10/08	92	60	60	21/10/08	90	229	229																
																					5/11/08	92	7208	7208												
	31/12/2008	92	1103	1103																																
													22/01/09	93	59	59																				
					25/02/09	90	633	633	25/02/09	92	153	153									6/02/09	93	16092	16092	6/02/09	92	4599	4599					25/02/09	89	3165	3165
	31/03/2009	90	1070	1070																																
													22/04/09	90	45	45																				
0		**274**		**3169**		**183**		**1088**		**185**		**271**		**296**		**226**		**90**		**229**		**280**		**25051**		**179**		**6856**		**0**		**0**		**180**		**4463**
	274				149				151				296				113				221				124				0				147			

PS104				PS105				PS106			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
								16/07/08	92	435	75.7
29/08/08	92	702	458								
								17/10/08	93	427	427
1/12/08	94	792	792								
								21/01/09	96	58	58
27/02/09	88	832	832								
								20/04/09	89	437	437
	274		2082		0		0		370		998
242				0				294			

PS107				PS108				PS109			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
								21/07/08	97	839	182
21/08/08	94	790	437								
								20/10/08	91	859	859
19/02/09	90	739	739								
								22/04/09	90	833	833
	184		1176		0		0		278		1874
142				0				202			

PS110				PS111				PS112			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
25/07/08	88	101	28.7	18/07/08	94	1048	201	16/07/08	91	4266	750.1
20/102008	91	107	107	15/10/08	89	1080	1080	15/10/08	91	4192	4192
22/04/09	90	106	106	17/04/09	87	1082	1082	17/04/09	87	5150	5150
	269		242		270		2363		269		10092
206				194				194			

PS113				PS114				PS115				PS116			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
25/08/08	92	1607	978	22/08/08	53	74	74								
				24/11/08	94	70	70								
20/02/09	91	1483	1483	12/02/09	88	74	74					9/02/09	94	1062	1062
	183		**2461**		**235**		**218**		**0**		**0**		**94**		**1062**
147				235				0				94			

PS117				PS118				PS119				PS120			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
18/08/08	97	244	123					25/08/08	92	433	264	18/08/08	49	141	141
												17/11/08	91	106	106
12/02/09	87	219	219	9/02/09	95	76	76	20/02/09	91	1062	1062	12/02/09	87	160	160
	184		**342**		**95**		**76**		**183**		**1326**		**227**		**407**
136				95				147				227			

Pump Stations

30/06/2008

	PS121				PS122				PS123				PS124			
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
Jul-08									21/07/08	27	204	158.67				
Aug-08					21/08/08	93	133	74.37	21/08/08	31	261	261				
Sep-08									24/09/08	34	216	216	30/09/08	92	241	241.00
Oct-08									23/10/08	29	165	165				
Nov-08																
Dec-08									22/12/08	32	556	556	31/12/08	92	231	231
Jan-09																
Feb-09					18/02/09	90	179	179	19/02/09	29	181	181				
Mar-09									23/03/09	32	203	203				
Apr-09									23/04/09	31	371	371				
May-09																
Jun-09																
Total		**0**		**0**		**183**		**253**		**245**		**2112**		**184**		**472**
Total days of reporting period	0				142				239				184			

	PS125				PS126				PS127				PS128			
	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
Jul-08					31/07/08	93	457	152					31/07/08	31	12071	12071
Aug-08																
Sep-08	4/09/08	92	206	147.78									1/09/08	32	10180	10180
Oct-08					30/10/08	91	452	452					30/09/08	29	9291	9291
Nov-08													2/11/08	33	9743	9743
Dec-08	4/12/08	91	200	200									1/12/08	29	14573	14573
Jan-09													1/01/09	31	11401	11401
Feb-09													1/02/09	21	9607	9607
Mar-09					2/03/09	96	1048	1048					1/03/09	28	10149	10149
Apr-09													1/04/09	31	9578	9578
May-09																
Jun-09																
Total		**183**		**348**		**280**		**1652**		**0**		**0**		**265**		**96593**
Total days of reporting period	157				218				0				265			

Source Electricity_Data_Working_copy.xls

Colour Code
- No information required
- No information provided
- Estimated readings
- Needs to be checked

PS129				PS130				PS131				PS132			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
31/07/08	87	591	211									10/07/08	93	4976	535.1
				25/08/08	91	371	228	27/08/08	90	490	316				
												9/10/08	91	4908	4908
4/02/09	92	582	582	24/02/09	97	383	383	25/02/09	89	875	875				
												9/04/09	90	6228	6228
	179		793		188		611		179		1191		274		11671
123				153				147				191			

PS133				PS134				PS135				PS136				PS137			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
												31/01/09	87	860	860				
	0		0		0		0		0		0		87		860		0		0
0				0				0				87				0			

PS138				PS139				PS140				PS141				PS142				PS143				PS144				PS145				PS146			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
												31/07/08	31	11287	11287					30/07/08	91	1429	471												
																												1/08/08	93	1091	375	18/08/08	49	207	207
												1/09/08	32	9892	9892																				
								21/10/08	92	2	2	30/09/08	29	8606	8606													29/10/08	89	1591	1591				
												2/11/08	33	9042	9042																	14/11/08	88	205	205
												1/12/08	29	11563	11563																				
								24/01/09	95	3	3	1/01/09	31	10092	10092																				
												25/02/09	31	9376	9376					2/02/09	90	1345	1345	2/02/09	90	149	149	3/02/09	97	1567	1567				
												1/03/09	28	9917	9917																				
								23/04/09	89	5	5	1/04/09	31	9693	9693					29/04/09	86	1412	1412	29/04/09	86	120	120								
																												5/05/09	91	2283	2283				
	0		0		0		0		276		10		275		89468		0		0		267		3228		176		269		370		5816		137		412

0	0	276	275	0	206	176	309	137

PS147				PS148				PS149			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
31/10/08	88	2012	2012								
2/02/09	94	3324	3324								
30/04/09	87	1720	1720								
	269		**7056**		**0**		**0**		**0**		**0**
269				0				0			

PS150				PS151				PS152			
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
								26/08/08	92	340	210.3
								26/11/08	92	596	596
				23/01/09	92	956	956				
								24/02/09	90	1689	1689
				22/04/09	89	528	528				
	0		**0**		**181**		**1484**		**274**		**2495**
0				181				239			

PS153				PS154				PS155		
Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh
26/08/08	92	112	69.52	26/08/08	92	567	351.1	26/08/08	92	119
26/11/08	92	304	304	26/11/08	92	2844	2844	26/11/08	92	244
24/02/09	90	318	318	24/02/09	90	2956	2956	24/02/09	90	250
	274		**692**		**274**		**6151**		**274**	
239				239				239		

	PS156				PS157			
kWh	Date read taken	Days	kWh	kWh	Date read taken	Days	kWh	kWh
73.79								
244								
250								
568		**0**		**0**		**0**		**0**
	0				0			

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
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