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## PRACTICAL MANAGEMENT OF URBAN STORMWATER

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# PRACTICAL MANAGEMENT OF URBAN STORMWATER

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## Abstract

To have effective and practical management of urban stormwater, local governments need to assess catchment areas, undertaking base line monitoring, assess the catchment uses and risks, highlighting and identifying target pollutants, implementing of cost effective control measures, monitoring and implementing corrective actions.

An effective stormwater management program must include the education of the community as the whole due to the difficulties in managing all the land users in the catchment. Obviously the efforts and benefits of community education is directly related to generational change, so it is seen that in the future the efforts that we contribute now will change the culture of the future.

This paper discussed Citiworks Townsville's Approach to Stormwater Management.

**Key Words: drainage, environmental compliance, stormwater management, Community Education, Conservation Volunteers Australia, Treatment trains**

## Introduction

Citiworks Townsville is an independent business unit of Townsville City Council with management responsibility for all aspects of Townsville's road, traffic and drainage infrastructure. Due to Townsville's climatic and geographical variations, the operation and maintenance of Townsville's drainage infrastructure plays a major part of Citiworks business which is also a major concern of the community which we serve.

The perimeters of Townsville City Council boundaries extend to the northern beaches of Cape Pallarenda in the North, to Cungula in the south and to include Magnetic Island to the East. With these boundaries the following environmental significant areas exist:

- The Great Barrier Reef World Heritage Area
- Dugong Protection Area

- "Ramsar" internationally recognised wetlands of Bowling Green Bay
- Fish habitat areas of Townsville Town Common, Louisa Creek, Ross River and Ross Creek.

Other environmental issues and concerns that affect our every day business include the following:

- Working within tidal lands and mangrove areas
- Acid sulphate soils
- Working in and round wetland areas
- Coastal environments
- Stormwater quality improvement
- Spill response
- Dredging and excavation of drainage paths

This paper discusses the constraints that Citiworks Townsville has on its daily business and the pro-active approach it takes in developing a balance between drainage activities and achieving environmental outcomes, to ensure that the works conducted by our workforce adhere to Council's Environmental Policies and playing a role in creating sustainable outcomes. The design and implementation of stormwater treatment trains in Northern Australia is a new concept and has trended to be overlooked by research and southern design guidelines with respect to climatic differences and rainfall intensities.

- Local Government Act 1993
- Marine Parks Act 1982
- Native Title Act 1993
- Nature Conservation Act 1992
- Queensland Fisheries Act 1994
- Queensland Heritage Act 1992
- Water Act 2000
- State Development and Public Works Organisation Act 1971

## Legislation

With the increase in community awareness with respect to environmental issues and concerns, environmental legalisation has too, increased in both detail, with reference to obtaining permits/approvals and the increase in financial fines for breaches or non conformance with legislative requirements. A recent review of legislative requirements highlighted the following statutory documents affecting our operations:

- Beach Protection Act 1968
- Canals Act 1958
- Environmental Protection Act 1994
- Environmental Protection Regulations 1998
- Environmental Protection Policies (Water, Noise, Air)
- Environmental Protection & Biodiversity Conservation Act 1999
- Freedom of Information Act 1992
- Great Barrier Reef Marine Parks Act 1975
- Harbours Act 1955
- Transport Infrastructure Act 1994

## Environmental Protection Act 1994

The most governing piece of legislation in Queensland, is the Environmental Protection Act 1994 (EPA 1994). This states that "every person, company, corporation and industry has a general environmental duty to prevent environmental harm through activities". The legislation also states that "a person must not wilfully or unlawfully cause environmental harm", this can lead to fines and imprisonment.

## Environmental Protection (Water) Policy.

The Environmental Protection (Water) Policy (EPP (Water)) states under Section 31 the "Prohibition on deposit or release of certain things" which includes:

- Rubbish;
- Scrap metal;
- Motor vehicle parts;
- Building wastes;
- Sawdust;
- Solid or liquid wastes;
- Cement or concrete;

- Degreasing agents;
- Paints or varnish or thinners;
- Insecticide/herbicide/fungicide/biocide
- Oil.

With reference to drainage S31(2) of the EPP(Water) which states that a person must not deposit or release a thing

- Into a roadside gutter, stormwater drain, or a water body
- In a place where it could reasonably expect to move or be washed into a gutter, stormwater drain or water body.

The EPP (Water) also highlights that a person must not release stormwater runoff into a roadside gutter, stormwater drain or water that results in a build up of sand, silt or mud in the gutter, drain or water. Obviously this piece of legislation has considerable impact on the business of Citiworks and played a major part in the development of management plans for drainage operations and activities which is discussed further in this paper.

Urban stormwater quality management is also flagged in the EPP(Water) and nominated to Local Governments to develop and implement an environmental plan to undertake urban stormwater management that improves the quality of stormwater in a way that is consistent with the water quality objectives of the area. The development of the USQMP is also discussed further in this paper.

## **Stormwater Management**

The purpose of stormwater management is to reduce the degradation of our waterways (which includes creeks, rivers, estuaries and seas) and to reduce the contaminate loads on the environment and it's aquatic inhabitants, protecting them for future generations. Townsville City Council has adopted a catchment based approach to water quality management, due to many

factors that can be tainted from both point sources and non point sources within the catchment and the affects that they can cause. To better the catchment approach, Council has developed a Urban Stormwater Quality Management Plan (USQMP). The USQMP makes an assessment and consideration of environmental values of our local waterways and drainage paths. The USQMP develops the water quality criteria for the drainage paths based on the environmental values, water quality testing and ANZECC water quality guidelines. The plan highlights management priorities, and areas where physical treatment can be implemented.

Common Stormwater Pollutants include:

- Sediment via erosion
- Nutrients – fertilisers and organics
- Oxygen demanding material
- Heavy metals
- Toxic Waste
- Hydrocarbons
- Litter and Gross Pollutants

The most effective tool in preventing stormwater pollution is through community education and awareness. The benefits may not be able to be measured initially, but changing the attitudes of all the users in the catchment will reduce the loads on the water quality in the future.

The key areas for implementing effective Stormwater management are as follows:

- Identify areas of high environmental value and assess the potential or risk of degradation
- Identify target pollutant through undertaking background monitoring
- Design and implement a method of reducing the identified target pollutants.

- Undertake performance monitoring
- Regular inspections and maintenance
- Develop a community based education program

## Urban Stormwater Initiative and Louisa Creek Projects

As part of priorities highlighted in the USQMP, Council has embraced the urban stormwater initiative (USI) project, which forms a part of the Living Cities Program TCC under the National Heritage Trust and has been developed in conjunction with USI CBD Urban Waterway Project. The USI is a project that encapsulates a catchment management approach to urgent known stormwater issues. The project consists of the implementation and the construction of stormwater treatment devices at five major sites, which include:

- Curralea Lake – Stormwater Treatment Train
- Paradise Lake - Stormwater Treatment Train
- Railway stormwater drain – pipelining to reduce an ingress of pollutant and litter collection
- Reid Park Stormwater treatment train and litter collection
- End of line litter collection device.

The Louisa Creek Stormwater projects have included the installation of stormwater treatment devices into existing industrial catchments. These projects received a Highly Commended Engineering Excellence Award in 2002 at the State Institute Public Works Engineers conference in 2002. These projects will be briefly discussed in the paper from a performance point of view.

To Briefly discuss the Curralea lake – stormwater treatment train. Baseline monitoring was conducted before the design

process was started to ensure that the design could reduce the pollutants entering the stormwater. The objectives of the treatment train where as follows:

- To reduce litter, debris and gross pollutants entering the lakes system
- Reduce coarse sediments and nutrient loads
- Reduce target pollutants entering the lake via a purification pond (heavy metals from urban run-off including lead, copper and cadmium)
- The system was not to impede drainage
- Be cost effective
- The system must be maintainable and allow access
- Must not affect public safety
- The design had to deal with the limitations in size due to the drainage reserve, ensure that flooding did not occur.

Key design factors for the treatment train included:

- The budget allocation
- Retrofitting the design to fit the existing drainage reserve
- Conflicting with existing underground services
- Major input of gross pollutants
- Minimal hydraulic grade line
- Due to high rainfall intensities in the topics and subsequent volume of stormwater, the design targets first flush events as monitoring had shown that highest concentration of pollutants are during the first 15-25mm of rainfall

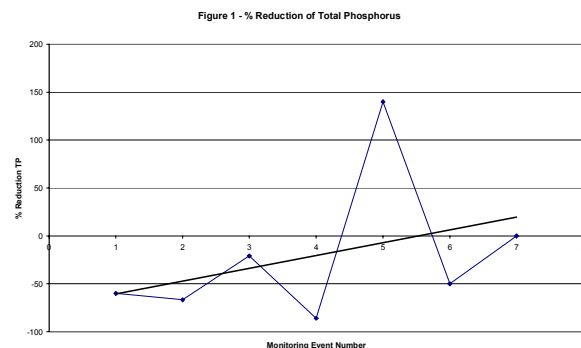
- Ensuring treatment during the dry season
- Erodible soils.

The design of the Curralea Lake treatment train through consultation with key stakeholders (JCU, ACTFR, CRC, Sunfish and EMS staff) formalised the stormwater treatment train into the following key areas to include:

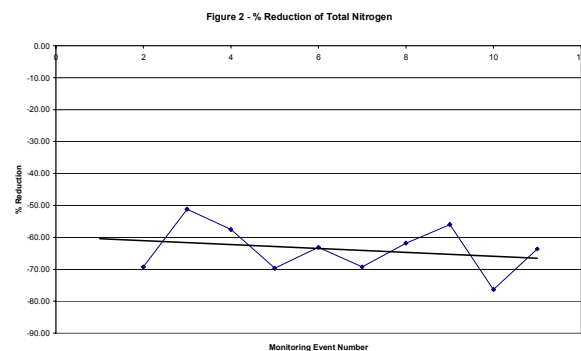
- A gross pollutant litter trap that minimises the effect of hydraulics on the system. Based on hydraulics of the system, a 300mm high galvanised steel flat plated grated trap. To prevent the litter being washed away during high flows a 150mm 'C' section was place on top to trap floatables.
- Sediment basin with erosion protection
- A grass swale to reduce both sediments and uptake pollutants
- Purification pond retaining a diverse structure of wetland plants. The edges of the pond were specifically stepped to enable the diversity and also enabling minimal effects of seasonal change due to the diversity. The wetland plants reduce dissolved pollutants.
- The water then outlets the purification pond via a 5 meter wide rock riffle structure. The riffle serves a number of purposes. The rock riffle enables the outgoing water to become aerated prior to entering the lakes system. The riffle also acts as a filter for both fine sediments and nutrients, as during times of high nutrient loads, and low rainfall events a biofilm would grow over the rocks – removing dissolved pollutants.
- To keep the wetland system, specifically the purification pond functional during the dry season, a circulation pump was installed. This pumps water from the lakes system via an industrial sand filter and

activated carbon filter before entering the purification pond. The backwash from the filtration units is discharged to sewer, removing pollutants from the system.

Currently the systems performance is being monitored based on first flush events, there is however limited data due to the period of low rainfall we are currently experiencing. However the monitoring has shown a reduction in total phosphorus of greater than 80%. Refer to Figure 1 - % reduction of Total Phosphorus



The Louisa Ck stormwater treatment train at Camuglia St (which consists of three 6 m diameter sedimentation basins, and wetland treatment) is also reducing significant stormwater pollutants. Through our regular maintenance program, we have removed over 150 cubic meters of sediment and have recorded reductions of between 70 and 80 percent in Total Nitrogen. We have now commenced an investigation into nutrient uptake with the wetland plants.



Based on the limited monitoring events (based on rainfall over the past year) to date and through some rough post card calculations, it is estimated that Citiworks/TCC are reducing loads of nitrogen of up to 5 tonnes per year and reducing phosphorus of up to 12 tonnes per year. This is significant and reduces the impacts on the receiving waters and is of the quantum of discharges of Sewerage treatment facilities.

## **Community Education**

When using the catchment based approach to stormwater management, there are always vast amounts of land users, which activities are well out of the control of local government. For example, Mr Joe resident fertilisers the his prize winning lawn with Nitrogen and Phosphorus. When a rainfall event occurs, the applied fertiliser dissolves into the stormwater leaving his/hers property and flows into the Kerb and Channel into the underground stormwater system.

Both Citiworks and Townsville City Council (TCC) has recognised the potential effectiveness of Community education programs. Both Citiworks and the Environmental Management Services a Department of TCC have joined forces with Conservation Volunteers Australia – Townsville Region to develop a community education package. This package targets community groups and local schools. Through the joint funding of all parties we have secured a Community Education Facilitator

The educational package targets the Total Water Cycle where it all starts, looking at water usage, stormwater, creeks and streams, water and sewerage and the marine environment.

The funds also go into programmes such as Louisa Ck Watch which is facilitated by Conservation Volunteers Australia and also partly funded by Citiworks and Townsville City Council – Environmental Management Services Department . The Louisa Ck Watch targets community and land use members who live within the catchment. Louisa Ck watch undertakes water quality testing, riparian vegetation works, fish monitoring and surveying, and weed reduction. This enables the community to have a sense of ownership for the creek, and hence creating a watchful eye on neighbouring activities and improve the environmental outcomes of the area.

Obviously the benefits of community education is directly related to generational change, so it is seen that in the future the effort that we undertake now will change the culture of the future.

## **Stormwater Management with Construction Projects**

Implementation of Stormwater Management with construction projects has the following key principals, which are:

- Erosion and sediment control measures and plans
- Development of Environmental Management plans and identification of the risks
- Acid Sulphate Management
- Development of monitoring programs
- Timing major works to occur during the “dry season”
- Training staff in appropriate management techniques

Erosion and sediment control is one of the key items to stormwater management both during the construction and operational phases, as sedimentation is the direct result of erosion and therefore controlling erosion is

the primary objective. Key items which need investigation and thought are as follows:

- The assessment of geology and soils
- Assessment of catchment hydrology
- Assessment of existing water quality issues

Control measures that should be implemented are as follows:

- Diversion of clean water around or away from the construction site
- Minimisation of soil disturbance and progressive revegetation
- Timing works during the “dry season”
- Installation of protection measures such as sediment basins, filter fences, check dams.

You must remember that all measures require regular checking and will require maintenance after rainfall.

## **Conclusion**

To have effective and practical management of urban stormwater, local governments need to assess the catchment areas, undertake base line monitoring, assessment of the catchment uses and risks, highlighting and identifying target pollutants, implementing of cost effective control measures, monitoring and implementing corrective actions.

An Effective stormwater management program must include the education of the community as the whole due to the difficulties in managing all the land users in the catchment.

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## **Author Biography**

No photo available

Adam is a Chartered Professional Environmental Engineer and has been with Citiworks Townsville for 2 years and has had over 6 years in the engineering industry. Experience lies in Stormwater Management, water quality issues, development and implementation of operational and construction procedures ensuring practical and sustainable outcomes for Townsville's roads and drainage infrastructure.

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