



Sediment and Erosion Project

Final Report | April 2014



TABLE OF CONTENTS

GLOSSARY OF TERMS AND ACRONYMS.....	4
ACKNOWLEDGEMENT	5
EXECUTIVE SUMMARY	6
1. INTRODUCTION	8
2. PHASE 2 PROJECT OBJECTIVES.....	15
3. PHASE 2 PROJECT METHODOLOGY	15
3.1 Desktop Review	15
3.2 Trial Design and Approach	16
3.2.1 Implementation of the Trial	16
3.2.2 Final Report.....	16
4. EXISTING CONTROLS AND EFFECTIVENESS	17
4.1 Subdivisional Civil Works	17
4.1.1 Activity and Process.....	18
4.1.2 Controls	18
4.1.3 Adequacy of Controls - Key Findings	23
4.2 Development.....	25
4.2.1 Activity and Process.....	26
4.2.2 Controls	27
4.2.3 Adequacy of Controls and Key Findings.....	27
4.3 Exempt Developments and Public Works	28
4.3.1 Adequacy of Controls and Key Findings.....	30

4.4 Dwelling and Building Construction.....	31
4.4.1 Process	34
4.4.2 Controls	34
4.4.3 Adequacy of Controls and Key Findings.....	35
5. POTENTIAL CONTROLS.....	54
5.1 Local Law.....	36
6. SUMMARY	40
6.1 Subdivisional Civil Works	40
6.2 Development.....	40
6.3 Exempt Developments and Public Works	41
6.4 Dwelling and Building Construction.....	41
6.4.1 Health Local Laws as Effective Control Tools	41
7. TRIAL PHASE: METHODOLOGY AND IMPLEMENTATION	43
7.1 Methodology	43
7.2 Site Selection	45
8. TRIAL RESULTS.....	54
CONCLUSION AND RECOMMENDATIONS	58
APPENDIX 1: TIMING OF TRIAL ACTIVITIES.....	62
APPENDIX 2: LETTERS TO UDIA, MBA AND HIA	63
APPENDIX 3: CITY OF ARMADALE'S DRAFT WARNING LETTER.....	69
APPENDIX 4: CITY OF GOSNELLS WARNING LETTER.....	70
APPENDIX 5: PAMPHLET - 'A HOUSING CONSTRUCTION INDUSTRY GUIDE'	71
APPENDIX 6: RESIDENTIAL DWELLING CONSTRUCTION EVALUATION SCORE CARD	73

GLOSSARY OF TERMS AND ACRONYMS

BMP: Best Management Practice - methods that have been determined to be the most effective, practical means of addressing a management issue; in this instance, preventing or reducing pollution from non-point sources

DoP: Department of Planning

Erosion: the detachment and removal of soil materials from a given area, by the processes of wind, water and/or gravity.

Erosion and Sediment Control Plan: a plan showing how potential erosion and sedimentation relating to a given site, as a result of a land use, building or development activity, will be minimised.

HIA: Housing Industry Association

HRAP: Healthy Rivers Action Plan

MBA: Master Builders Association

SAT: State Administrative Tribunal

Sand: means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel

Sand Drift: means sand that is released or escapes from land or premises, whether by means of wind, water or any other cause, onto adjoining or nearby land to cause a nuisance, risk to health, hazard or environmental damage

SCWQIP: Swan Canning Water Quality Improvement Plan

Sedimentation: the settling out of solid material held in suspension and being transported by water or wind.

The Trust: Swan River Trust

SR-WQIP: Southern River Catchment Water Quality Improvement Plan

Subdivision: refers to the dividing of land into parts

TN: Total Nitrogen

TP: Total Phosphorus

UDIA: Urban Development Institute of Australia

WAPC: West Australian Planning Commission

WQIP: Water Quality Improvement Plan

ACKNOWLEDGEMENT

The Swan River Trust would like to acknowledge and thank Wayne van Lieven (City of Gosnells), Neil Burbridge (City of Armadale) and Pat Hart, Chair of the South East Centre for Urban Landcare (SERCUL) for their contribution and commitment to this process as part of the Sediment and Erosion committee that developed and managed the project.

It is due to the ongoing persistence of Pat Hart and her genuine concerns about the impact of sediment on the Canning River that this project became a reality. The issue has been around since urban development commenced and continues to be very topical in its management and impacts on the environment.

Wayne and Neil were instrumental in enabling the project officer to gather information and complete the case study within the local governments and provided invaluable guidance and advice to the officer and the committee. Special thanks to the cities of Armadale and Gosnells for the in-house management and administration of the Sediment and Erosion Project Officer position and the ongoing support provided by the staff at the municipalities.

EXECUTIVE SUMMARY

The Sediment and Erosion Project was developed in response to management strategies identified in the Southern River Water Quality Improvement Plan 2009. The Southern River Catchment is identified as a high priority catchment in the Healthy Rivers Action Plan (HRAP) 2008-13 and a water quality improvement plan (WQIP) was developed using similar methodology to the Swan Canning Water Quality Improvement Plan 2009 (SCWQIP) to deliver river health outcomes. The SCWQIP also identified the Southern River Catchment as requiring greater than 45% reduction in nutrient loads for Total Nitrogen and Total Phosphorus to achieve the modelled water quality targets.

The Southern River Catchment WQIP (SR-WQIP) identified a series of management strategies to address excessive nutrients being exported from the catchment and stakeholders prioritised sedimentation of the Canning and Southern rivers as the most important action to be addressed. Erosion and sediment transportation exacerbates nutrient enrichment as particles carry nutrients.

The release of sediment is generally not ongoing once development is completed. Researchers in Queensland estimate that around 90% of cumulative soil loss or sand drift over the first 20 year life of an urban subdivision occurs during the first five years. The cities of Armadale and Gosnells are located in the Southern River Catchment and incorporate rapidly advancing development fronts so were chosen as case study councils to assess the effectiveness of controls over erosion and sand drift. The study incorporated:

1. A desktop review of existing controls over subdivisional, development and building activities;
2. A conclusion on the effectiveness of controls identified in the desktop review with associated recommendations for improvement;
3. Identification of key risk areas in both cities (i.e. stages of development likely to be contributing greatest volumes of eroded material).
4. Formulation of an appropriate strategy to enhance erosion and sand drift controls as part of a trial program, engaging local developers and/or builders; and:
5. Completion of trial with a view to improving controls, using a combination of education, voluntary compliance and, if necessary, punitive action.

The study provided numerous photographic examples of sand drift resulting from poor practices on building sites but there was no quantification of the impact that sand drift has on infrastructure or sensitive receiving aquatic environments. The photographic evidence suggests that this is a serious issue and causes significant costs to local governments for drain education, road sweeping and retrofitting/renewal of drainage systems.

The study identified opportunities at the subdivision and development stages for the enhancement of control mechanisms, summarised as follows:

- Improve awareness at organisational and officer levels of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development;

- Enhance understanding of the potential for Urban Water Management Plans to address control issues (for example, through street sweeping requirements);
- Clarify responsibilities for monitoring and compliance action in relation to sand drift, erosion and sedimentation; and:
- Ensure adequate resourcing is in place for monitoring and compliance activities.

Through the analysis of development sites in both Cities, this study concludes that the key area of risk is the poor management of housing construction sites. This is supported by regular site inspections, with photos documenting sand drift impacting infrastructure during construction.

The key control mechanism in relation to housing construction is the Building Code of Australia. Conditions of approval can be attached to Building Licenses but only in relation to the requirements of the Code. However, this is principally concerned with the integrity of structures, rather than site management practices. This study has found that applying Building License conditions that seek to control the drift of sand and other similar materials or erosion on the building site is not possible under the Code. Given that there is no legislative imperative, erosion control mechanisms are rarely adopted by the industry.

Both the City of Gosnells and the City of Armadale have Health Local Laws. This study concludes that local laws are potentially significant tools in the control of sand drift, erosion and sedimentation at the housing construction stage.

Given that local laws provide an opportunity for improvement in the key risk area of housing construction, the most relevant recommendations of this study address the application of local laws. For successful application local governments should consider and define responsibilities, in addition to resources, for enacting local laws where erosion and sand drift are an issue. As it stands, unless building sites have the potential to impact on human health, responsibilities for compliance are not well defined. For example, it is often unclear, which division of the local government administers the local laws where the impacts predominantly relate to the failure of the drainage network due to sedimentation.

1. INTRODUCTION

The Healthy Rivers Action Plan (HRAP) identifies eight priority catchments on the Swan Canning Coastal Plain that contribute high levels of nutrients to the Swan and Canning rivers. The HRAP states that where Catchment Management Plans do not exist, Water Quality Improvement Plans (WQIPs) will be developed for all of the priority catchments. The Southern River Catchment is a priority one catchment and continues to fail the HRAP long term targets for Total Nitrogen (TN: 1.0 mg/L) and Total Phosphorus (TP: 0.1 mg/L).

The Swan Canning Water Quality Improvement Plan 2009 (SCWQIP), (SRT, 2009a) modelling identified the Southern River Catchment as having unacceptable water quality and a reduction of greater than 45% is required in the loads for TN and TP. The SCWQIP provides a treatment train approach which is a suite of management practices designed to function together to improve water quality effectively and efficiently. The management practices implemented along nutrient pathways from their source as a combined approach is more effective than a single treatment in reducing nutrient loads.

The Southern River Catchment Local Water Quality Improvement Plan (SR-WQIP) 2009 was developed by the Swan River Trust (Trust) in partnership with the cities of Armadale and Gosnells; the Australian Government; Departments of Environment and Conservation; Water; Planning and the Western Australian Planning Commission; South East Center for Urban Landcare (SERCUL); Armadale Gosnells Landcare Group (AGLG); Commonwealth Science and Industrial Research Organisation (CSIRO); Water Corporation; Armadale Redevelopment Authority and Perth Region Natural Resource Management (PRNRM). The SR-WQIP was developed using the same methodology as the SCWQIP but was tailored to meet the water quality issues and conditions of the Southern River Catchment. In developing the SR-WQIP, the Trust committed to providing \$125,000 as an investment to initiate the implementation phase of the plan.

The SR-WQIP working group identified sedimentation of the Southern and Wungong rivers as a major issue and prioritised management strategies (Table 1: Excerpts from SR-WQIP relevant to the Sediment and Erosion Project) to deal with sand drift from development as the management strategy to be funded through the \$125,000 allocated by the Trust for investment.

Table 1: Excerpts from SR-WQIP relevant to the Sediment and Erosion Project

Treatment Train Approach	Management Strategies	Implementation
1. Prevention Land use and planning	1.2 Implement local planning policies, strategies and planning conditions incorporating best management practices	<ul style="list-style-type: none"> • Examine planning mechanisms to help control and manage sediment from urban development • Developers to prepare and implement erosion and sediment control plans as part of condition for approval
3. Reduction Source control	<p>3.1 Soil and sediment best management practice trial*</p> <p>3.3 Reduce outputs by developers</p>	<ul style="list-style-type: none"> • Develop and implement trial of best management practice to reduce sediment before entering the Southern and Wungong rivers and their tributaries • Implement sediment reduction program, developed through trial outcomes and learning

The particular focus on sand drift and resulting sediment acknowledges the potential environmental impacts of transported sand materials on waterways. For example, phosphorus adheres to particles transported into waterways, ultimately resulting in problems such as eutrophication. In addition, deposition of sediment can have a significant impact on rivers, filling natural pools and preventing water flow. This, in turn, can reduce dissolved oxygen levels in the water column. This can lead to the death of fish and invertebrates. Elevated sediment and turbidity in the water column can impact plant growth and distribution and cause clogging of fish gills. Significant modifications to waterways can severely impact on fish or invertebrate breeding sites. The Trust has commenced a program to identify pools in the Canning River that are being impacted by sedimentation.



Figure 1: Sedimentation altering natural hydrology occurring along the Canning River

Loss of sand from development sites also has the potential to impact on newly constructed stormwater management infrastructure, including areas with water sensitive urban design treatments. This decreases their effectiveness, and often leads to maintenance works to re-establish the infrastructure, with the cost generally borne by local government (unless within the two year care and maintenance period).

As evident in the figures opposite, poor management of development can result in significant sand drift, delivery to the stormwater system by water or wind movement, and subsequent filling of silt traps, pipes, swales and rain gardens.



Figure 2: Sand drift and erosion to stormwater entry pit



Figure 3: Silt trap and pipes filled with sediment



Figure 4: Sediment damage to rain garden

The release of sediment is generally not ongoing once development is completed. Researchers in Queensland estimate that around 90% of cumulative soil loss or sand drift over the first 20 year life of an urban subdivision occurs during the first five years - the land clearing, earthworks and construction periods (Matthews, 2008). This research also argues that the construction phase provides the most cost-effective opportunity for the management of erosion and sediment. However, it is also noted that government funding for research and capacity building is primarily allocated to operation and maintenance of the urban built form (i.e. post-construction).

Sediment and erosion regulation in the majority of Australian states, including Queensland, Victoria, New South Wales and South Australia, is well established under state legislation. The matter is not specifically addressed by legislation in Western Australia.

Anecdotally and observationally, the above issues are a feature of metropolitan Perth in subdivisional civil works, and subsequent housing and commercial development. The absence of appropriate regulations and prioritisation of erosion and sediment management by the SR-WQIP working group prompted the Trust to fund the Sediment and Erosion Project in the course of implementing the SR-WQIP. The Trust has been supported in the project by generous in-kind contributions from the cities of Armadale and Gosnells.

The project was managed by the Sediment and Erosion Project Committee (SEPCOM), comprised of representatives from the Trust, City of Armadale, City of Gosnells and SERCUL. The purpose of the Committee was to ensure the project complied with the project brief and to regularly monitor progress against the deliverables.

The project was split into two phases. Phase 1 was undertaken by consultants Essential Environmental Services (EES) on behalf of the Trust, and involved a detailed desktop investigation into planning, statutory and policy mechanisms for controlling and enforcing management of erosion and sedimentation from subdivisional works, residential dwelling construction and public works, with a view to improving the management of erosion and the control of sediment from development activities.

Local governments, including the cities of Armadale and Gosnells, were canvassed, and officers interviewed in the course of the study. Other stakeholders, including the Department of Planning, Department of Water, Housing Industry Association, Urban Development Institute of Australia and SERCUL were consulted.

The resulting Southern River Sediment and Erosion Project Report (EES, 2010) found that there are existing mechanisms as part of the planning system that State and local governments can use to control erosion, sedimentation and sand drift from development. These mechanisms operate at different stages of the planning and development process, and should be employed at each stage of the process. The mechanisms with the most potential to provide effective control were identified by EES to be:

- conditions of subdivision;
- conditions of development;
- building license requirements; and
- environment and nuisance local laws.

EES indicated that effective implementation of these mechanisms to control erosion and sand drift could be improved by:

- Increasing the level of knowledge regarding the need for better erosion and sediment control across industry and the general community, including political or strong leadership;
- Consistent application of conditions of subdivision and development and potentially building licenses necessitating the preparation and implementation of erosion and sediment control plans and dust management plans;
- Clear standards of performance to be achieved via erosion and sediment control efforts at all stages of the development process, appropriate to the risk factors on site and which contain measures for ongoing and adaptive management;
- Comprehensive guidelines and simple information to aid the preparation of effective management plans and building site practices; and
- Well-resourced enforcement officers with transparent audit standards and the ability to issue substantial fines.

The EES report also provided recommendations to guide the design of Phase 2 of the project and improve the control and management of erosion and sediment from development in Southern River:

- Identify the major source of sediment to the Southern River and its waterways and focus actions towards improving those particular practices
- Develop example dust management and erosion and sediment control plans for key risk factors (which need to be differentiated) and provide clear guidance about what

mechanisms are required at each stage and what level of performance is required to facilitate clearance of the conditions

- Develop better information for builders which outlines simple, cost effective measures which can be put in place across development sites in the Southern River catchment and actively inform builders of the requirements as part of a pro-active enforcement of the Environment, Animals and Nuisance Local Law
- Participate in the Department of Planning's consultation process for model subdivision conditions to improve the wording of the recommended erosion control condition to address the timing issue and to include a standard condition for dust management.

Phase 2 involved the recruitment of a Sediment and Erosion Project Officer to:

- Liaise with relevant stakeholders to understand current application and effectiveness of controls such as Urban Water Management Plans, subdivision and development approval conditions, Building Licence conditions and Local Laws, and to drive legislative, regulatory and policy change where required
- Evaluate and, where suitable, implement suitable source control mechanisms identified during Phase 1 or through project investigative work with the two cities
- Monitor subdivision and building works in the catchment to ensure source controls are implemented, and maintain a photographic and written record of industry baseline performance and improvement
- Undertake 'enforcement', in areas where source controls are not in place, in accordance with the recommendations of Phase 1
- Influence sand drift management and erosion control on the ground through education and capacity building
- Prepare a final report to present an overview of the project's activities, findings, outputs and conclusions.

2. PHASE 2 PROJECT OBJECTIVES

The Sediment and Erosion Project was established to identify and test appropriate mechanisms to reduce sediment loads entering the Wungong and Southern Rivers and, subsequently the Canning and Swan Rivers. The ultimate objective of the Sediment and Erosion Project is to make recommendations with regard to the effectiveness and efficacy of measures trialled.

The municipalities of the cities of Armadale and Gosnells, covering the bulk of the Southern River Catchment, were the focus of the project. It was anticipated that the implementation of best practice in these local government areas may be readily applicable to others in the metropolitan area. Furthermore, these two areas were subject to active urban development fronts, presenting an ideal opportunity to apply and trial different approaches.

3. PHASE 2 PROJECT METHODOLOGY

The Sediment and Erosion Project comprised four key steps. The broad approach to each is outlined below.

3.1 Desktop Review

Review the recommendations of the Southern River Sediment and Erosion Project Report (EES, 2010) and evaluate locally relevant planning, statutory and policy mechanisms for controlling and enforcing the management of erosion and sand drift associated with:

- Subdivisional civil works (excavation, fill, headworks, road construction etc.)
- Development
- Building (construction of dwellings or premises).

It was noted that EES (2010) identified public works, for which there is generally no requirement of planning approval, as potentially significant sources of erosion and sedimentation. Public works include works associated with the installation of new services such as drainage, roads, sewer, water, power lines (including underground services), as well as the activities associated with their maintenance or upgrade.

The SEPCOM determined, given limited project resources that public works would be beyond the capacity and scope of Phase 2.

In the course of the desk top review the Sediment and Erosion Project Officer undertook to establish good communication with key officers in the planning, engineering and environmental units of each local government. Through this network, matters associated with approvals, infrastructure impacts, enforcement, available or potential regulatory tools and their functionality, and resourcing issues were discussed and evaluated.

The Sediment and Erosion Project Officer was also required to develop a high level of familiarisation with land use change and development in the cities, and collect evidence to ascertain the extent of any issues identified. An assessment was made to determine in which of the stages of development the problem was found to be more pronounced.

3.2 Trial Design and Approach

Based on the desktop review and evaluation of regulatory and behaviour change tools, the project identified the most appropriate methods to be tested in discrete trial areas to facilitate improvements in erosion and sand drift management. These control mechanisms could comprise a combination of educative and punitive measures, including deployment of the most appropriate planning, policy or statutory mechanism(s).

Trial sites were selected from amongst active subdivisional development areas at different stages of implementation in both cities so that the project could cover a collective temporal spectrum from initial civil works stage to the near-final residential development construction stage. Site selection was also influenced by any evident environmental risk, such as the development's close proximity to a waterway

3.2.1 Implementation of the Trial

The initial approach was to communicate best management practices to the housing industry and builders as part of a 'trial' to improve erosion and sand drift management through voluntary compliance.

Following a period during which evaluation of voluntary compliance was undertaken, the intent to undertake compliance action in the study areas, utilising the most appropriate planning, policy or statutory mechanism(s) in conjunction with punitive measures if necessary was communicated to the housing industry and builders.

An objective scoring and recording system was developed for the trial sites to evaluate and quantify the impact of the behaviour change and regulatory tools applied and the quantum of their success.

3.2.2 Final Report

This document constitutes a synopsis of findings from the trial, including a series of recommendations for improvements that would be applicable to local governments at each stage of the development process. These stages are considered below.

4. EXISTING CONTROLS AND EFFECTIVENESS

4.1 Subdivisional Civil Works

Poor management of subdivision works can result in significant sand drift, mobilisation of sediment to the stormwater system by water or wind, and clogging of silt traps, pipes, swales and rain gardens. Figure 5 shows the results of poor controls over practices during subdivision works.



Figure 5: Erosion and sediment runoff into a drain during subdivision works

4.1.1 Activity and Process

The subdivision stage primarily includes clearing of land, and civil infrastructure works including the importation and levelling of fill, road construction, construction of drainage infrastructure (including water sensitive urban design features), incorporation of services (water, electric) and creation of lots arising from the subdivision of the land.

Prior to the commencement of subdivision works, the developer is generally required to clear a number of planning approval conditions, including some related to how construction activities are implemented and managed. These conditions are applied by the Western Australian Planning Commission (WAPC) on the advice of local government and other agencies. The WAPC has the right to determine whether or not recommended conditions from local government and agencies are included in the final approval conditions.

Prior to obtaining Certificate of Title over the subdivided lots, the developer must demonstrate that all of the planning approval conditions have been met to the satisfaction of the clearing authority, in which case they are "cleared".

4.1.2 Controls

There are two available controls on subdivisions addressing sand drift and erosion arising from civil works. These controls are generally addressed through the condition setting process, and exist as pro-forma conditions in the WAPC's Model Subdivisions Conditions Schedule and most local governments' corresponding Standard Conditions for Subdivision and Development.

4.1.2.1 Preparation and implementation of a Sediment and Erosion Management Plan

A Sediment and Erosion Management Plan (SEMP) details how risks of wind and/or water borne erosion and sedimentation will be minimised during subdivision works. This type of control is considered potentially appropriate to addressing the matter of erosion and sedimentation from subdivision works.

The Model Subdivision Conditions Schedule (WAPC, 2012) provides the following condition:

D9 A management plan detailing how risk of erosion and sedimentation impacts into nearby water bodies will be minimised during subdivision is to be:

- a) prepared by the landowner/applicant and approved prior to the commencement of subdivisional works; and
- b) implemented during subdivisional works. (Swan River Trust)

WAPC (2012) advises that the situation to which the condition would apply is "*only where likelihood of erosion and sedimentation impacts exists without appropriate management adjacent to the Swan and Canning Rivers*". In situations outside of this scope, the WAPC is unlikely to support the imposition of the condition unless sufficient justification is provided by the referral agency recommending the condition. This is likely to be the case where development is located some distance from the rivers, although still connected via existing drainage controls.

The preparation and implementation of a SEMP can be applied, as appropriate, by the application of the Standard Condition. This type of plan is generally directed towards the management of material leaving the site, but may be appropriately drafted to address the management of sand drift and erosion internal to the development site, which is generally the material that finds its way into stormwater networks.

In terms of managing sand drift, erosion and sedimentation in sites distant from the rivers, though, this condition may not be considered applicable by the WAPC.

Within the local governments, there may not be specific compliance activity with regard to the implementation of Sediment and Erosion Plans. Anecdotal advice indicates that non-compliance is generally identified as a result of a complaint, or through incidental observation.

Interviews with engineering, building and health officers who, in the course of their regular duties, visit sites that may be subject to a Sediment and Erosion Plan highlighted a lack of awareness that sand drift, erosion and sedimentation is more than just a nuisance issue that may affect other landholders.

4.1.2.2 Preparation and implementation of Urban Water Management Plan

Planning Bulletin 92 *Urban Water Management* (WAPC, 2008) advises that an Urban Water Management Plan (UWMP) is to be prepared by the landowner/developer, and to accompany an application for subdivision approval.

In considering urban water management for new subdivisions, WAPC will have regard to:

- *State Planning Policy 2.9 Water Resources* (WAPC, 2006) including schedules 1 and 4
- *State Planning Policy 2.10 Swan Canning River System* (WAPC, 2006)
- *Better Urban Water Management* (DoW, 2008)
- the provisions of *Liveable Neighbourhoods* (WAPC, 2009) with specific reference to element 5 (urban water management)
- the relevant provisions of policies DC 1.1, 2.3 and 6.3 (the latter superseded by Statements of Planning Policy 2.7 *Public Drinking Water Source* and 2.9 *Water Resources*)
- any relevant urban water management strategy or water management plan
- any comments from the Department of Water, Swan River Trust, relevant local government agencies and relevant service providers.

The Model Subdivision Conditions Schedule (WAPC, 2012) provides the following condition:

D2 Prior to the commencement of subdivisional works, an Urban Water Management Plan(UWMP) is to be prepared and approved, in consultation with the Department of Water, consistent with any approved Local Water Management Strategy/Drainage and Water Management Plan. (Local Government)

UWMPs address the requirements of *Better Urban Water Management* (DoW, 2008), determining the type of drainage infrastructure required within the subdivision and address water quality and quantity, including any necessity for urban water sensitive design features. The framework for UWMP preparation provides for the UWMP to address the management of subdivisional works, including dust, sediment and erosion control. This control is considered appropriate to addressing the matter of erosion and sedimentation from subdivision works.

UWMPs are not usually applicable to brownfield, infill, small scale subdivisions or development proposals unless there are 'water management issues' (i.e. the site is adjacent to wetlands, significant vegetation, waterways, watercourse areas, high groundwater areas, etc.) (DoW, 2008). The UWMP can be a very effective instrument that requires the land developer to firstly present and then implement various water and environmental management measures.

Local governments have subtle differences regarding the clearance of the condition requiring the preparation of the UWMP; some take a lead role in clearing the conditions while others rely more heavily on the Department of Water. This has no impact on the inclusion of appropriate controls in the UWMP as, in both cases, local government has the opportunity to provide input to drafts of the document. Local government review of draft UWMPs provides the opportunity to ensure that erosion control measures during civil works are specifically addressed.

It is apparent, through interviews with a selection of relevant local government officers, that there is an opportunity to enhance understanding of the ability of the UWMP process to improve stormwater infrastructure protection. Stipulations can be made through this process to prevent sand drift and erosion. There is also a general lack of understanding of environmental implications outside of staff in the environmental sections of the local governments.

UWMPs provide a schedule of activities and responsibilities, dealing with, and subsequent to, the civil works stage.

Through the UWMP's "management of subdivisional works" provision, stormwater infrastructure can be required to be protected by the developer from sand drift, erosion and sediment during the civil works period.

The types of controls that can be stipulated in a UWMP include:

- A requirement for programmed street sweeping to ensure the protection of "hard" and "soft" drainage infrastructure and in turn the environment (particularly where

drainage networks deliver stormwater directly or indirectly to rivers, watercourses and wetlands)

- A requirement to construct and maintain erosion and sand drift controls, including specific controls to protect "soft" infrastructure such as rain gardens, swales and bioretention features, for the period of construction (this may also be addressed in a separate Construction Environmental Management Plan, if a planning approval condition so requires).



Figure 6: Rain gardens impacted by sand drift

Street sweeping, to remove sand from roadways and prevent its entry to stormwater infrastructure, has proven a difficult control to prescribe. The required frequency of prescribed street sweeping is difficult to establish. There is no known evaluation of the method's effectiveness or guidance as to optimum intervals between sweeping. The requirement for frequency of street sweeping varies between local governments. In the case study area, street sweeping is generally required at intervals of between 2 - 4 weeks.

The ability to quantify solid pollutant reductions from street sweeping is challenging given the range and variability of factors that impact its performance, such as the street sweeping technology, frequency of the activity and conditions of operation, in addition to variable seasonal weather characteristics.

Seasonal weather variability also has a role in the application of street sweeping. It is reasonably understood that a higher risk of sandy material transport to stormwater infrastructure exists where wet weather is more prevalent, and that an increased frequency of sweeping should apply.

Further, the matter of responsibility for street sweeping following the completion of civil works and into the housing construction phase, when significant amounts of sand drift, erosion and sedimentation can occur, remains unclear.



Figure 7: Street sweeping removes sand drift from the roadway, but poor site management will see its return

Ensuring compliance with a UWMP street sweeping requirement has also proven difficult in practice, in that no real-time reporting of activity is required of the developer, or provided to the local government. Any reporting that is provided is generally after the fact and on, at best, an annual basis through the mandatory reporting on the implementation of the UWMP.

Discussions with officers indicate that there is a lack of monitoring and compliance enforcement of street sweeping during the civil works stage. Possible causes for this are the lack of identified responsibility for the task, human resources to undertake the task, understanding of the importance of the issue, and clear definition of what is required from the developer. This is further considered in the 'Adequacy of Controls' section.

With regard to the construction and maintenance of erosion and sand drift controls, including specific controls to protect "soft" infrastructure such as rain gardens, swales and bioretention features, for the period of construction, anecdotal advice is that several issues exist:

- The implementation of controls is not generally adequate to the civil works environment, where construction activity presents a real risk of disturbance or damage
- Responsibility for keeping controls in place post-subdivision and into the housing construction phase is poorly defined and may result in their potential failure
- Damage to "soft" infrastructure, including sedimentation that affects the design capacity of the system, and causes vegetation mortality, is generally part of the landscape maintenance requirement of the developer. Reinstatement to specification has been found through this study to not be the norm, which has a potential negative impact on the system's capacity and performance.

Upon "practical completion" (sign-off of stormwater infrastructure by the local government) the responsibility for managing "hard" drainage infrastructure such as pipes and silt pits falls to local government. "Soft" stormwater infrastructure such as swales, bioretention structures and rain gardens generally fall within the landscape maintenance responsibility of the developer, which is generally for a two year period following practical completion.

The maintenance of "hard" stormwater infrastructure is a critical aspect for local government, as the cleaning of sediment from silt traps and pipes that arises as a result of sand drift and erosion from the subsequent housing construction phase presents a cumulatively significant financial cost to local government.

4.1.2.3 Erosion Prevention and Sediment Control Policy

A further control, unique to the City of Armadale, derives from the City of Armadale's *Erosion and Sediment Control Manual for the Darling Range*. In June 2001, Agriculture Western Australia in partnership with the Upper Canning/Southern Wungong Catchment Team produced the manual, which aims to provide detailed control measures to assist in mitigating impacts from erosion issues, specifically arising from the land development process. The manual also provided a comprehensive summary of erosion types, causes, impacts and recommendations for controls.

A proforma *Erosion Prevention and Sediment Control Policy* for town planning schemes is provided within the manual. This was adopted as a formal policy in the City of Armadale, referred to as *Local Planning Policy 2.5 – Erosion Prevention and Sediment Control* (Policy PLN2.5). This sits within the City of Armadale's Town Planning Scheme.

The policy is, however, limited to planning-approved development such as subdivisions and development of multiple dwellings. As a consequence, single dwelling development activities are not captured. The policy indicates that Sediment and Erosion Management Plans should be required as a condition of approval.

4.1.3 Adequacy of Controls - Key Findings

There are several areas where the above controls require improvement to be effective. The approach adopted by local governments to address sand drift and sediment control across the metropolitan area is likely to be variable. A consistent approach to the matter by local government would be more effective in managing the issue.

4.1.3.1 Approval Condition - Sediment and Erosion Management Plan

The scope for the standard condition requiring a Sediment and Erosion Management Plan is defined by the *Model Subdivision Conditions Schedule* (WAPC, 2012), as "*only where likelihood of erosion and sedimentation impacts exists without appropriate management adjacent to the Swan and Canning Rivers*". This is a limitation in the ability of Condition D9 to address the issue at a catchment level. However, there is potential for the standard condition to be applied catchment-wide where adequate justification is provided by the referral authority.

The absence of dedicated and targeted compliance activity related to the implementation of Sediment and Erosion Plans should be addressed through adequate provision of resources and allocation of roles and responsibilities within local governments. .

In order that Sediment and Erosion Plans developed and implemented as a Condition of planning approval adequately address the issue, the following matters should be addressed:

Sediment and Erosion Management Plan

- 1 Referral agencies should provide justification when requesting that the WAPC apply Standard Condition D9 in the broader catchment.
- 2 Local governments should budget and clearly assign responsibility for periodic site inspections to ensure Sediment and Erosion Management Plans are implemented
- 3 Local governments should raise awareness and understanding amongst relevant staff of the impact of sand drift, erosion and sedimentation on "hard" and "soft" stormwater infrastructure and the receiving environment. This could be achieved through relaying key messages and providing tools from this project

4.1.3.2 Approval Condition - Urban Water Management Plans

As discussed above, a key existing control for sand drift, erosion and sedimentation, as it relates to this project is the implementation of a sufficiently well informed UWMP. It is apparent, though, that monitoring and compliance enforcement, as a relatively new requirement, is not afforded sufficiently high priority, does not have a clearly assigned internal responsibility, and/or is not adequately resourced.

It considered that a number of inherent weaknesses undermine the potential of UWMPs to provide for real control of sand drift, erosion and sedimentation, and that the following matters should be addressed:

Urban Water Management Plans

- 1 Consider whether UWMPs should be applied to brownfield, infill, small scale subdivisions or development proposals when Better Urban Water Management (WAPC, 2008) is reviewed

- 2 Enhance understanding in local governments (organisationally and at officer level) of the risks to assets and the environment of sand drift and sedimentation. Communicate the key messages of this report.
- 3 Ensure local governments and relevant officers are aware that UWMPs can be a useful tool to manage erosion and sedimentation.
- 4 Officers assessing UWMPs should consider requiring street sweeping at a frequency of between 2 - 4 weeks, as part of the construction management commitments identified in the UWMP.
- 5 Ensure maintenance responsibilities for stormwater management infrastructure, including rain gardens, are clearly defined in the UWMP so that they are not compromised (e.g. by damage to vegetation and/or the soil media) during subdivision works and the following housing construction phase.
- 6 Ensure that roles, responsibilities and the duration of street sweeping or other controls required are clearly defined in the UWMP.
- 7 Future work could include an assessment of street sweeping to confirm the ideal frequency to maximise effectiveness.

4.1.3.3 Erosion Prevention and Sediment Control Policy

The City of Armadale's *Erosion Prevention and Sediment Control Policy*, deriving from its *Erosion and Sediment Control Manual for the Darling Range* (2001), is a promising initiative but is limited in its scope.

Erosion Prevention and Sediment Control Policy

- 1 Local governments should consider adopting policies such as the City of Armadale's Erosion Prevention and Sediment Control Policy.
- 2 Implementation of local government Erosion Prevention and Sediment Control policies should be supported by adequate resourcing, and responsibilities within local government for the enforcement of the policies clearly allocated.

4.2 Development

The scope of this study included the investigation of control mechanisms for sand drift, erosion and sedimentation, and their implementation, associated with developments other than urban subdivisions. For the purpose of the study, "development" includes

multiple dwellings, developments subject to a Detailed Area Plan, and stand-alone developments.

4.2.1 Activity and Process

"Development" is defined by the WAPC as:

"The development or use of any land including any demolition, erection, construction, alteration of or addition to any building or structure on the land and the carrying out on the land of any excavation or other works and as in the case of a place to which a conservation order made under section 59 of the Heritage of Western Australia Act 1990 applies, also includes any act or thing that:

- (a) is likely to change the character of that place or the external appearance of any building; or*
- (b) would constitute an irreversible alteration of the fabric of any building."*

The construction of residential dwellings does not generally require Development Approval, except where a Detailed Area Plan exists, or in areas near the Swan Canning river system where Clause 30A of the Metropolitan Region Scheme applies (EES, 2010).

Prior to the commencement of works, the developer is generally required to clear a number of planning approval conditions, including some related to how development activities are implemented and managed.

Three general scenarios¹ arise with regard to the determination of development applications in Western Australia:

1. Approval determined by local government

In the case where approval to commence development is required, local government has delegated authority from the WAPC (with some exceptions, such as on MRS zoned Parks and Recreation lands) to issue planning approval with conditions. Local governments generally have a set of Standard Conditions for application to development approvals, but also have discretion to impose other reasonable conditions that may pertain to specific situations and not be covered by Standard Conditions. In such instances, condition(s) related to the prevention of sand drift, erosion and sedimentation can be applied by the local government.

2. Approval determined by Development Assessment Panel (DAP)

Under the Development Assessment Panel (DAP) regulations, each DAP will determine development applications that meet set type and value thresholds as if it were the responsible authority under the relevant planning instrument, such as the local planning scheme or region planning scheme. The DAP regulations state that DAP applications

¹ *Note: Where developments are abutting, partly in or likely to affect waters in the Swan River Trust's Development Control Area, Clause 30A of the Metropolitan Region Scheme applies and development approval is required.

cannot be determined by local government or the Western Australian Planning Commission (WAPC).

The role of DAPs is to determine development applications within a certain type and value threshold set in the DAP regulations. Any such proposal is initially forwarded to local government, where the opportunity exists to recommend conditions.

3. No approval required

Planning approval is not required for Exempt Development and Public Works, and for dwelling and building construction. Where there is no requirement for development approval, there is no apparent process by which conditions may be applied to address the issue of sand drift erosion and sedimentation arising from those activities.

This is discussed in detail in 4.3 and 4.4.

4.2.2 Controls

Conditions may be attached to planning approvals and enforced under the provisions of the *Planning and Development Act 2005*. Local Governments can attach any control it sees fit, but all conditions are appealable to the State Administrative Tribunal (SAT) within 45 days of issue.

During the course of the project differences in how conditions of development approval are applied have been identified between local governments. Conditions that relate specifically to sand drift and erosion can be attached at the discretion of the local government, usually by the assessing planning officers. Planners within the City of Armadale are guided by the *Erosion Prevention and Sediment Control* policy. To this end, the following standard condition has been drafted, with commensurate advice notes and guidelines:

"All soil shall be retained on site and appropriate measures implemented to prevent soil erosion by wind and rain during and after development."

The City of Gosnells can apply, as appropriate, Standard Condition D8.7 Sediment and Erosion Management:

" Prior to the commencement of development works, the applicant is to submit, have approved, and thereafter implement, a management plan detailing how risks of wind and/or water borne erosion and sedimentation will be minimised during the works, to the satisfaction of the City."

4.2.3 Adequacy of Controls and Key Findings

Local governments have immediate access to appropriate controls for sand drift, erosion and sedimentation by applying conditions requiring the preparation and implementation of a Sediment and Erosion Management Plan.

The adequacy of controls is predicated, though, upon the circumstance of the development, and is directly related to the resources available to a local government to monitor and enforce compliance.

It appears there may be a lack of resources, and an unclear demarcation of responsibility for monitoring and lack of understanding of the matter of erosion itself, which are considered to undermine planning controls on sand drift, erosion and sedimentation.

In order that Sediment and Erosion Management Plans developed and implemented as a condition of planning approval adequately address the issue, the following matters should be addressed:

Sediment and Erosion Management Plans

- 1 Ensure that relevant local government officers are aware of the opportunity to control sediment and erosion from developments by applying conditions requiring Sediment and Erosion Management Plans where planning approval is required.
- 2 Roles and responsibilities for monitoring of compliance with conditions of development approval should be clearly defined and resourced to enable regular site inspections.

4.3 Exempt Developments and Public Works

The Metropolitan Region Scheme (MRS) requires that approval to commence development is obtained for all development except for:

- works on land reserved for primary regional roads or other regional roads for the purpose of or in connection with a road
- works on land reserved for port installations for the purpose of or in connection with a port
- works on land reserved for railways for the purpose of or in connection with the supply of water, electricity or gas, or the drainage or treatment of waste, water or sewerage
- works on land reserved for railways for the purpose of or in connection with a railway, but not including the construction or alteration of a railway station or any related car parks, public transport interchange facilities, or associated means of pedestrian or vehicular access
- works on land reserved for regional open space where the works are in accordance with a management plan endorsed by the WAPC
- works on land for public purposes- high school for the purpose of or incidental to a high school
- operational works on land reserved for state forests for the purpose of or incidental to a state forest.

It is considered that, in situations where no approval is required for a development, there is a significant gap in achieving best practice, and little or no opportunity for local

government to be a party to ensuring best practice sand drift, erosion and sedimentation management.

The scale of such developments, particularly in the case of many public works, is generally large and has potentially very significant off-site impacts through sand drift and erosion.

The matter of the recent construction of the 2003-2005 Tonkin Highway extension from Mills Road West in Gosnells to South Western Highway, Mundijong, for which development approval was not required, has been cited as an example of inadequate erosion management. Several instances of serious erosion and sedimentation of the Canning River were recorded by the Cities of Armadale and Gosnells during the development's lifetime.



Figure 8: Erosion associated with the construction of the Tonkin Highway

In a similar vein, poor management of the construction of a sewer main in Balfour Street, Gosnells resulted in significant erosion material being delivered to the Sutherlands Park branch drain, which feeds into the Southern River. In this instance, a number of infringements for sediment discharge were issued by the DEC under the Environmental Protection (Unauthorised Discharges) Regulations 2004.



Figure 9: Erosion from sewer works into branch drain leading to the Southern River

4.3.1 Adequacy of Controls and Key Findings

Exempt Development and Public Works present an anomaly to the control of sand drift, erosion and sediment control through available tools. Public Works were largely outside the scope of this study, but where the project officer was made aware of relevant case studies, they were considered. No certainty or confidence was found in either of the cities of Gosnells and Armadale that the issue was being adequately addressed through other processes.

It is understood that a minority of Public Works, generally those of a large scale, are referred by the WAPC to the EPA, and that appropriate conditions are applied in those instances.

The example of the Tonkin Highway extension, though, highlights inadequacies even when a formal level of Environmental Impact Assessment is applied and conditions imposed. The proponent had committed, in documentation forwarded for assessment, to the preparation and implementation of a Design and Construction Environmental Management Plan to address, amongst other issues, water quality, erosion and sedimentation control.

Erosion and sedimentation were not specifically identified as relevant environmental factors in EPA Bulletin 1043, but the proponent's commitment was to address the issue. However the cities of Gosnells and Armadale experienced significant impacts, particularly where the highway crossed the Canning River, but also at a variety of locations.

Exempt Developments and Public Works

- 1 Consider mechanisms to improve management of public works so that erosion and sediment control are appropriately addressed. Options may include engaging with key agencies/authorities responsible for public works, capacity building and/or more formal arrangements such as Memoranda of Understanding.

4.4 Dwelling and Building Construction

The construction of residential dwellings, particularly in new subdivisions, has been observed in this study to be a significant and consistent contributor to sediment loads in stormwater networks.



Figure 10: Poor site management delivers sand to the stormwater system.

The design and construction of subdivisional stormwater infrastructure is guided by Better Urban Water Management (DoW, 2008). As a general rule, a minimum of 2% of the catchment is set aside for stormwater quality and quantity treatment.

Stormwater from construction impervious surfaces generated during 1 year, 1 hour Annual Recurrence Interval (ARI) rainfall events (which accounts for approximately 95% of all rainfall events) should be retained or detained on site, as high in the catchment and as close to the source as possible. As a result, sand drift that enters the stormwater system will generally remain within the system until removed as part of programmed management initiatives or when mobilised by larger, less frequent, rainfall events.



Figure 11: Erosion material transported to drains

During the housing construction stage of development, sand drift and erosion have the potential to “charge” the system if adequate regular maintenance is not performed by the local government. In areas under housing construction, appropriately programmed maintenance is a potential control to avoid a “pulse” of sand and silt that may be mobilised by a larger rainfall event. The frequency of such maintenance should be tied to the level of construction activity.

Prevention of sand drift, erosion and sedimentation should be the ultimate goal of local government, as it bears the financial cost when remedial action is required during the housing construction phase to ensure the function of stormwater infrastructure is not compromised.

The construction of individual dwellings and other buildings presents an issue with regard to the management of sand drift, erosion and sedimentation, but this is considered largely a matter of poor industry practice. In new subdivisions, poor industry practice regarding site management during the construction of dwellings is driven and/or exacerbated by extreme spatial constraints and the often very high and focused level of construction activity and vehicle access.

The extended temporal scale of this aspect, given the level of land use change forecast in the coming decades, compounds the problem and suggests that it requires serious attention.



Figures 12 and 13: Sand drift from poor site management is delivered directly to stormwater infrastructure

4.4.1 Process

The construction of a dwelling or building can only be undertaken following the issue of a Building Licence by local government. These are required for all forms of built work, even minor works such as sheds and pergolas. However, for the purposes of this study the focus is on the construction of single house dwellings (given that this accounts for the bulk of construction activity having the potential for erosion and sand drift).

4.4.2 Controls

A planning application for the construction of a single dwelling is not required in the majority of cases (key exceptions are the construction of buildings in a location where a Detailed Area Plan exists or in areas near the Swan Canning river system where Clause 30A applies). Regardless, in all instances of building construction, a Building License is required.

Conditions of approval can be attached to Building Licenses but only in relation to the requirements of the Building Code of Australia, which are directly concerned with the integrity of the structure. This study has found that the imposition of Building License conditions that seek to control the drift of sand and other similar materials or erosion on the building site – even as they relate to the management practices of the site – is not possible under the Building Code.

While the WA Building License Board has guidelines to promote best construction management practice, including measures to mitigate sand drift and erosion, these are not compulsory or enforceable. Given that there is no legislative imperative, the guidelines are rarely adopted by the industry. Observations made during the course of this study suggest that current industry poor practice in the matter of sand drift and erosion is being compounded as the industry is increasingly constructing within smaller lots with narrow street frontages and narrower roadways. Hence, opportunities for improved practice and site management are countered by the increasingly limited space available for site activities and control measures for sand drift and erosion..

It should be noted that the matter of sediment and erosion control is considered an important aspect of environmental protection in the majority of Australian states, including Queensland, Victoria, New South Wales and South Australia, and is well established under state legislation in other parts of Australia. The various legislations, amongst other aspects of sand drift, erosion and sediment control, specifically address building construction and site management. As advised earlier in this report, no such legislation exists in Western Australia.

4.4.3 Adequacy of Controls and Key Findings

Attaching erosion and sediment controls to a Building License would be *ultra vires* given the issue does not directly relate to the Building Code (unless it could be demonstrated that erosion/water management requirements threaten the integrity of buildings/footings).

It would be possible, though, and only as an educational and awareness raising exercise, to attach to the Building License an Advice Note that informs the builder and/or applicant with best practice site management in regard to retaining all materials on-site. This could be supplemented by the provision of a pamphlet or similar practical advice, illustrating examples of best practice. NOTE: A pamphlet was developed in the course of this project (see below, in relation to the trialling of potential compliance tools).

Dwelling and Building Construction

- 1 An advice note addressing sand drift and erosion control should be applied to Building Licenses, and the best practice pamphlet developed as part of this project should be enclosed with all Building Licenses issued.

5. POTENTIAL CONTROLS

5.1 Local Law

This study identified the housing construction phase of new subdivisional developments as a significant and, in all reality, an uncontrolled significant source of sand drift, erosion and sedimentation delivered to stormwater infrastructure. This material is ultimately required to be cleaned from the system by local government or conveyed to the receiving environment.

The brief for this project required the investigation of potential regulatory tools for the control of sand drift, erosion and sedimentation where controls were inadequate or absent. Further to the findings of the study on controls and their adequacy, the study was directed to the investigation and field testing of regulatory tools that were relevant to the task and available, but not necessarily being applied to the task.

In this case, the lack of regulatory control for the residential dwelling construction phase of new subdivisional development was identified as a priority for investigation, and Local Laws were highlighted as a potential tool.

Local governments can make Local Laws under the Local Government Act 1995. Both the cities of Armadale and Gosnells administer Local Laws whose provisions provide clear scope for the control of sand drift and erosion, shown in Table 2 below.

Table 2: City of Armadale and Gosnells Local Laws relevant to the Sediment and Erosion Project

Local Government	Local Law
City of Armadale	Environment, Animals and Nuisance Local Law 2002
City of Gosnells	Animals, Environment and Nuisance Local Law 2009

Key features of the laws are discussed below:

City of Armadale: Environment, Animals and Nuisance Local Law 2002

The management of sand drift and erosion is specifically covered as part of these regulations

PART 3 - BUILDING, DEVELOPMENT AND LAND CARE

Division 2 – Sand Drift and Dust

Prevention of erosion and the escape of sand and dust

42. An owner or occupier of any land shall take all practicable measures to ensure that:

- (a) no sand is carried by water
 - (i) off the particular lot or lots of land; or
 - (ii) directly or indirectly into any creek, stream, river or any other natural water course; and
- (b) no sand is released from or escapes from the particular lot or lots, whether by means of wind or any other cause

“sand” means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel;

These provisions apply to any landholding, irrespective of the landowner (developer or residential) or the extent to which it is developed.

City of Gosnells: Animals, Environment and Nuisance Local Law 2009

The issue is also specifically mentioned in the City of Gosnells law:

PART 3 – BUILDING, DEVELOPMENT AND LAND CARE

Division 2 – Prevention of dust and liquid waste

21. Containment of dust and liquid waste

An owner or occupier of land must take effective measures to –

- (a) stabilise dust on the land;
- (b) contain all liquid waste on the land; and
- (c) ensure no dust or liquid waste is released or escapes from the land whether by means of wind, water or any other cause so as to cause a nuisance.

("dust" means any visible granular or particulate material which has or has the potential to become airborne and includes organic and non-organic matter and sand, but does not include smoke)

Again, this applies to any landholding, irrespective of the landowner or the extent to which it is developed.

Delegations

The implementation of a Local Law occurs through the delegation to appropriate local government officers of the right to discharge a duty on behalf of the Council. This aspect is considered below in relation to the local governments in the study area.

City of Armadale

The Chief Executive Officer is the delegated authority to discharge the powers and functions of the City of Armadale's *Environment, Animals and Nuisance Local Law 2002*. Delegation from the Chief Executive Officer to appropriate City officers is provided in the City's Delegation Register. Table 3 below outlines the scope of powers that have been further delegated within the organisation:

Table 3: Local Law City of Armadale delegation

Description of Delegation	Delegatee
The Chief Executive Officer is delegated authority to discharge the following powers and functions under the City of Armadale Environment, Animals and Nuisance Local Laws 2002:	Health Services Manager Senior Environmental Health Officer
The granting, refusal, cancellation and setting conditions of approval to conduct activities;	
The carrying out of works in default of a duly served notice;	
Any other powers and functions where, in the opinion of the Health Services Manager, immediate action is necessary to prevent or alleviate a public health hazard.	

City of Armadale officers advised that the City's Environment, Animals and Nuisance Local Law 2002 had never been applied to the control of sand drift and erosion.

Discussions were initiated on the application of the Local Law to the control of sand drift and erosion. The City's Health Services department has delegated authority under the Local Law, but only in relation to public health matters. The City also has a comprehensive list of 'authorised' officers across the organisation, empowered to carry out statutory functions under the Environment Animals and Nuisances local law act on behalf of the City:

- Health Services Manager and Officers;
- Manager Parks;
- Coordinator Technical Services;

- Manager Civil Works;
- Senior Subdivision Engineer; and:
- Manager Ranger and Emergency Services and Rangers.

A consensus could not be reached on who would enact the local law in relation to sand drift, even where the risk presented was considered to be related to damage to City assets and subsequent financial implications. Health Services are likely to only have delegated authority for matters related to health. This discussion highlighted the need to extend delegations to cover different aspects of risks associated with sand drift (e.g. risk of drain blockage and financial implications). It was also noted that there would need to be adequate resources in place to facilitate compliance activities in relation to this local law.

City of Gosnells

Officers are authorised by the Chief Executive Officer, in accordance with the provisions of the Local Government Act 1995 section 9.10 *Appointment of Authorised Persons* to act on behalf of the City in accordance with specific legislation, including the *Animals, Environment and Nuisance Local Law 2009*.

A similar discussion was held at the City of Gosnells where the authority to apply the *Animals, Environment and Nuisance Local Law 2009* resides primarily with the City's Environmental Health section. They advised that the matter of applying the Dust and Liquid Waste provisions of the Local Law, where no public health risk was evident, was not be considered the responsibility of that section. They also concurred on the need for extra resources to assume responsibility for a "new" role. It was suggested that this role was more appropriate to other sections of the organisation.

With specific reference to this project, and the trialling of potential compliance tools, the Sediment and Erosion Officer was authorised by the Chief Executive Officer to apply the *Animals, Environment and Nuisance Local Law 2009*.

Local Law

- 1 Local governments should clearly assign responsibility for the enforcement of local law provisions, in accordance with the provisions of the Local Government Act 1995 section 9.10 Appointment of Authorised Persons.
- 2 Ensure that adequate resources are available to act on any such assignment of responsibility.
- 3 Raise awareness and understanding, at both organisational and officer levels, of the issue of sand drift, erosion and sedimentation.

6. SUMMARY

6.1 Subdivisional Civil Works

Existing planning controls are:

- WAPC Standard Condition D9 requiring a Sediment and Erosion Management Plan
- WAPC Standard Condition D2 requiring an Urban Water Management Plan
- The City of Armadale's *Local Planning Policy 2.5 – Erosion Prevention and Sediment Control*.

These controls are adequate to administratively address the issue of sand drift, erosion and sedimentation.

The key issues that currently influence the effectiveness of controls are:

- A low level of awareness, at the organisational and officer levels, of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development
- A generally poor understanding of the potential of UWMPs to address the issue
- Unclear allocation of responsibility for monitoring and compliance action
- Limited resourcing of monitoring and compliance
- Limited spatial scope of WAPC's Standard Condition D9
- The need for Council policy on the matter of sand drift, erosion and sedimentation.

6.2 Development

Existing planning controls are:

- Standard Condition D8.7 requiring a Sediment and Erosion Management Plan
- The City of Armadale's *Local Planning Policy 2.5 – Erosion Prevention and Sediment Control*.

These have been found to be adequate to administratively address the issue of sand drift, erosion and sedimentation.

The key issues that currently influence the effectiveness of controls are:

- A low level of awareness, at the organisational and officer levels, of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development
- Unclear allocation of responsibility for monitoring and compliance action
- Limited resourcing of monitoring and compliance
- The need for Council policy on the matter of sand drift, erosion and sedimentation.

6.3 Exempt Developments and Public Works

Given the exemption from planning approval of these works, there is no opportunity for local government to ensure best practice regarding sand drift, erosion and sedimentation. Local government relies on the processes of state government to ensure that the issue is adequately addressed.

Exempt developments and public works, whose scale and spatial extent is often significant, present a high level of risk at the individual and collective levels. Based on the recent experience of the Tonkin Highway extension, significant impacts can and do occur.

Based on experience in the two local government areas, the key issues that currently influence the effectiveness of controls are:

- An apparent low level of awareness, at the state government level, of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development
- An apparent reliance on self-regulation by developers for monitoring and compliance action
- Limited communication from state government to local government of exempt developments, within their municipalities, for which approval has been granted.

6.4 Dwelling and Building Construction

Although identified by this study as presenting the most consistent and predictable risk to stormwater quality and the receiving environment, an almost complete lack of control currently exists with regard to the prevention of sand drift, erosion and sedimentation. This project's review of constructed areas of subdivision at the subsequent housing construction stage has highlighted that there is often not a serious problem with sand drift and erosion control.

It is clear, from the observations and enquiries of this study, that a key area of risk with regard to sand drift, erosion and sedimentation is the poor management of housing construction sites, and that the role of the building industry should be to prevent the situation arising.

6.4.1 Health Local Laws as Effective Control Tools

Both the City of Gosnells and the City of Armadale have current Health Local Laws that this study has found to be useful tools in the control of sand drift, erosion and sedimentation.

The key issues that currently influence the effectiveness of these controls are:

- A low level of awareness at the organisational and officer levels of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development

- Resourcing to enable implementation of the local laws. Defining responsibilities and appropriate delegated authority within local governments for monitoring and compliance with the local laws.

7. TRIAL PHASE: METHODOLOGY AND IMPLEMENTATION

The Sediment and Erosion Project scope provided for a "trial" and evaluation of potential tool(s) for the control of sand drift, erosion and sediment. The review of statutory and policy mechanisms, in conjunction with the risk assessment of the different types of development and their sedimentary potential, strongly directed the study to focus on residential dwelling construction. This activity consistently contributes significantly to sand drift, erosion and sedimentation of stormwater drainage systems and the receiving environment.

Field investigations and engagement with builders and contractors highlighted an apparent lack of awareness of the issue and its importance in the industry. There is a need for informative material to enhance an industry appreciation of the issues associated with sand drift, erosion and sedimentation.

It was also clearly understood from engaging with builders and contractors in the study area that a level of voluntary compliance might be achieved through awareness raising and education initiative(s), but that this should be reinforced by regulatory measures to provide incentive for compliance amongst those who chose not to voluntarily improve site management.

The most appropriate and readily available regulatory tools, currently under-utilised, to enable local governments to bring about change in the building industry are the Health Local Laws, such as the City of Armadale's *Environment, Animals and Nuisance Local Law 2002*, and the City of Gosnells' *Animals, Environment and Nuisance Local Law 2009*.

The Trial Phase of the project was directed towards "testing" the application of the Health Local laws in each City, and behaviour change initiatives. The Trial Phase would evaluate the effectiveness of initiatives, and attempt to quantify the resource requirements for the initiatives trialled.

7.1 Methodology

A Trial Phase program was prepared, including:

- The identification of three appropriate study areas in each City with high levels of residential housing construction;
- Communication of the project, its objectives and the trial phase to industry bodies;
- Communication of the project, its objectives and the trial phase to building companies active in the two Cities;
- Media releases in local print media to supplement industry communication, and to inform the general community of the issue;
- One-on-one engagement with builders and contractors on-site, discussing the project and trial, and distributing the project's best practice pamphlet;

- Inspections of the study areas to evaluate voluntary compliance and maintain face to face contact between the builders and the Sediment and Erosion Officer; photographic records and quantification of issues;
- First warning letters to builders evaluated as not voluntarily complying with the sand drift, erosion and sediment provisions of the relevant Local Law;
- Inspections of the study areas to further evaluate the level of compliance following the first warning letter, and to maintain face to face contact between the builders and the Sediment and Erosion Officer; photographic records and quantification of issues;
- Final notice letters to builders in charge of non-compliant sites;
- Inspections of the study areas to evaluate improvement in compliance following the final notice letter, and to maintain face to face contact between the builders and the Sediment and Erosion Officer; photographic records and quantification of issues; and
- The issuing of infringement notices to non-compliant builders under the provisions of the relevant Local Law.

The Trial Phase schedule was implemented in the following sequence (see Appendix 1 for further details):

Table 4: Trial timescales

Activity	Purpose
Preparation	<ul style="list-style-type: none"> • Media release to summarise objectives of project and trial. • Letters provided to UDIA, HIA and MBA indicating project scope and objectives (see Appendix 2). • Emails to local developers and builders giving project background.
Site Inspection 1	<ul style="list-style-type: none"> • Establish baseline situation in the study areas. • Photographic record. • Distribute pamphlet to contractors. • Discuss project with contractors.
Site Inspection 2	<ul style="list-style-type: none"> • Assess overall level of voluntary improvement in the study areas. • Identify sites where no voluntary change has been initiated.
Email to builders	<ul style="list-style-type: none"> • Project reminder, seek voluntary controls.
Media release	<ul style="list-style-type: none"> • Report on project progress.
Site Inspection 3	<ul style="list-style-type: none"> • Assess overall level of voluntary improvement in the study areas. • Identify laggards to whom letters of caution will be issued.
Letter of caution	<ul style="list-style-type: none"> • 14 days to comply with Local Law or be issued with infringement notice (see Appendices 3 and 4).
Site Inspection 4	<ul style="list-style-type: none"> • Assess overall level of voluntary improvement in the study areas.

- Identify laggards to whom infringements will be issued.
- Infringement**
- Final measure to achieve compliance.

Awareness raising was identified as an essential tool for bringing about behavioural change in study areas.

A pamphlet ‘*Sand Drift and Waste Management – A housing construction industry guide*’ (see Appendix 5) was developed for distribution. The design of the pamphlet was largely based on a similar initiative associated with the Clean Site project, which was initiated by the state government in 2006 to address sand drift, erosion and sedimentation from housing construction sites, but shortly thereafter terminated.

The pamphlet provides clear guidance on how to improve building site management practices. It was provided to builders and subcontractors in the course of one-on-one engagement in the six trial areas, and was also forwarded to the Urban Development Institute of Australia (UDIA), Housing Industry Association (HIA) and Master Builders Western Australia (MBWA) with a summary of the project and its objectives.

Improvements and/or deterioration in the performance of building site management in the study areas were evaluated using a scoring system based on a proforma scorecard (Appendix 6). This assigned scores from 1 to 5 (1 being poorest and 5 being best) to site management based on initiatives addressing sand drift, erosion and sediment control as well as building waste practices. Each study area was visited four times over a four-month period as part of the trial.

7.2 Site Selection

All sites, with the exception of Camfield Estate on the Darling Scarp in the City of Armadale, were located on the Coastal Plain portion of the Southern River catchment.

Proximity to a water course or sensitive receiving environment was a factor in site selection. The study has assumed a direct relationship between environmental risk and distance to the receiving environment. Site selection achieved a range of distances from 50 metres to 5 kilometres to a watercourse.

Table 5: Study sites for the trial

Local Government	Housing Estate
City of Armadale	CY O'Connor Estate, Piara Waters Harrisdale Green Estate, Harrisdale Camfield Heights and Bedfordale
City of Gosnells	Bletchley Park, Southern River Riverbank Estate, Southern River Golden Estate and Maddington

At the commencement of the field trial in February 2012, a total of 149 dwellings were under construction in the 6 study areas. Detailed information on each of the study areas follows.

City of Armadale - CY O'Connor Estate, Piara Waters



Site Name	CY O'Connor Estate, Piara Waters
Site address	Bounded by Warton Road to the north, Columbia Parkway to the east, Wright Road to the south and Mason Road to the west.
Area of dwelling construction	6 hectares
Proximity to sensitive receiving environment	Balannup Drain 150m to the east, leading into Forrestdale Main Drain and ultimately Southern River
Soil type	Sandy soils with an area of cemented silty sands
Topography	Slight gradient decline to the west
Stage of subdivision development	Civil works complete, residential dwellings under construction
Dwellings under construction	26
Fill required for site	1.2m above natural ground level
Stormwater infrastructure	Discharge treatment areas will be by bubble up pits into rain gardens.

City of Armadale - Harrisdale Green Estate, Harrisdale



Site Name	Harrisdale Green Estate- Harrisdale
Site address	Bounds of Warton Road to the north, Ranford Road to the east and Wright Road to the south
Area of dwelling construction	16 hectares
Proximity to sensitive receiving environment	Water to be retained on-site
Soil type	Sandy soils
Topography	Relatively flat
Stage of subdivision development	Civil Works complete, residential dwelling under construction
Dwellings under construction	47
Fill required for site	Cut and fill over site ranging from -3m – 2.5m above natural ground level
Stormwater infrastructure	9.2% rain garden infrastructure

City of Armadale - Camfield Heights, Bedfordale



Site Name	Camfield Heights – Bedfordale
Site address	Located in the hills of the Darling Scarp, bounded by Settlers Common to the south and Canns Road to the east in Bedfordale.
Area of dwelling construction	18 ha
Proximity to sensitive receiving environment	Two drains – one leads to the east and joins a tributary to the Canning (tributary is 30m away). The second drain feeds a tributary to the Neerigen Brook at a point 400m to the Southwest
Soil type	Clay
Topography	Significant gradient decline to west
Stage of subdivision development	Civil works complete, residential dwelling under construction
Dwellings under construction	4
Fill required for site	No – Earthworks follow natural contours of the site.
Stormwater infrastructure	Interconnected underground stormwater, with rock swales to contain run off.



Above: Sediment transported downstream because no installation of sand or sediment control barriers to ensure it remains onsite.

Below: The force of sediment being transported by wind and water has eroded the rock swale.



City of Gosnells - Lillyfields at Bletchley Park Estate, Southern River



Site Name	Lillyfields at Bletchley Park
Site address	Southern River Road x Aldenham Drive
Area of dwelling construction	18.6 hectares
Internal road length/frontage	2.4km
Proximity to sensitive receiving environment	Immediately abuts Lake Balannup, stormwater drains via Forrrestdale Main Drain to Southern River 3.5km away
Soil type	Duplex sand/clay
Topography	Relatively flat
Stage of subdivision development	Civil works complete, residential dwellings under construction
Dwellings under construction	26
Fill required for site	1.5 to 2.0m
Stormwater infrastructure	Roadside tree pits and rain gardens connected to piped network

City of Gosnells - Riverbank Estate, Southern River



Site Name	Riverbank Estate
Site address	Southern River Road x Leslie Street
Area of dwelling construction	5.5 hectares
Internal road length/frontage	1.12km
Proximity to sensitive receiving environment	400 metres to Southern River
Soil type	Sandy
Topography	Flat
Stage of subdivision development	Stages 1 and 2 civil works complete, residential dwelling construction commenced
Dwellings under construction	33
Fill required for site	Yes
Stormwater infrastructure	Road runoff to rain gardens, connected by pipes to POS swales

Below: The destruction of Riverbank's Estate rain gardens caused by sand drift escaping from building sites.



City of Gosnells - Golden Estate, Maddington



Site Name	Golden Estate
Site address	Burslem Drive x Niobe Link
Area of dwelling construction	4.6 hectares
Road length/frontage	0.98km
Proximity to sensitive receiving environment	Abuts Canning River. Swales and settlement basins in foreshore reserve, 50 to 150m from river.
Soil type	Clay loam
Topography	Gradual slope to river, steep foreshore area to west of site
Stage of subdivision development	Stages 1 and 2 civil works complete, dwellings under construction.
Dwellings under construction	13
Fill required for site	Approximately 2m above natural ground level
Stormwater infrastructure	Piped infrastructure delivers to "Living streams" and settlement basins in river foreshore

8. TRIAL RESULTS

Table 5 provides a measure of behaviour change with regard to dwelling construction site management. The scoring system is highlighted chronologically in accordance with the Trial timescales highlighted above in Table 4. The rationale for the scoring system is presented in Appendix 6. The pro-forma score card results provide a numeric measure of change over time, demonstrating the impact of compliance activities.

Note, Appendix 7 highlights photographic evidence from the sites selected.

Table 6: Evaluation Scores of Sand Drift and Building Waste Control - Camfield Estate, Bedfordale

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	3	4
Site inspection 2 Voluntary compliance following engagement and pamphlet distribution	3	4
Site inspection 3 voluntary compliance following written reminder	4	4
Site inspection 4 Ongoing voluntary compliance	4	4

Table 7: Evaluation Scores of Sand Drift and Building Waste Control - Harrisdale Green, Harrisdale

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	1	3
Site inspection 2 voluntary compliance following engagement and pamphlet distribution	2	3
Site inspection 3 voluntary compliance following written reminder	2	3
Site inspection 4 Ongoing voluntary compliance	2	3

Table 8: Evaluation Scores of Sand Drift and Building Waste Control - CY O'Connor Village, Piara Waters

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	0	2
Site inspection 2 voluntary compliance following engagement and pamphlet distribution	1	3
Site inspection 3 voluntary compliance following written reminder	1	3
Site inspection 4 voluntary compliance following letter of caution with 14 days to comply (12 issued)	2	3
Infringements Instances of non-compliance potentially subject to infringement: 12 in this study area of 26 building sites		

Table 9: Evaluation Scores of Sand Drift and Building Waste Control - Golden Estate, Maddington

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	1	3
Site inspection 2 voluntary compliance following engagement and pamphlet distribution	1	3
Site inspection 3 voluntary compliance following written reminder	2	3
Site inspection 4 Ongoing voluntary compliance	3	3

Table 10: Evaluation Scores of Sand Drift and Building Waste Control – Lillyfields at Bletchley Park Estate, Southern River

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	1	2
Site inspection 2 voluntary compliance following engagement and pamphlet distribution	2	2
Site inspection 3 voluntary compliance following written reminder	2	3
Site inspection 4 voluntary compliance following letter of caution with 14 days to comply (8 issued)	3	3
Infringements Instances of non-compliance potentially subject to infringement:8 in this study area of 26 building sites		

Table 11: Evaluation Scores of Sand Drift and Building Waste Control - Riverbank Estate, Southern River

	Sand drift control (score 1 - 5)	Building waste control (Score 1 - 5)
Site Inspection 1 baseline - no project influence	0	4
Site inspection 2 voluntary compliance following engagement and pamphlet distribution	1	3
Site inspection 3 voluntary compliance following written reminder	0	3
Site inspection 4 voluntary compliance following letter of caution with 14 days to comply (16 issued)	2	3
Infringements Instances of non-compliance potentially subject to infringement:16 in this study area of 33 building sites		

Summary

Five of the six case study sites demonstrated a generally continuous improvement towards the management of sand drift and building waste during the study period.

One site demonstrated a regression at site inspection 3, although this was improved by site inspection 4. This was largely due to an increase in building activity at that site, a consequent reduction in vacant land available for the storage of waste materials and resulting in materials frequently spilling out into verges and roads.

In total 36 caution letters (see Appendices 2 and 3) were issued to builders in 3 of the 6 study areas. The percentages provide an indication of the persistent and significant degree of non-compliance despite engagement and provision of information:

- CY O'Connor Estate – 46% non-compliance
- Lillyfields at Bletchley park - 31% non-compliance
- Riverbank Estate – 48% non-compliance.

No infringement notices were issued under either of the Cities' Local Laws at the conclusion of the study. A number of instances were identified where infringements could have been applied to non-compliances. However, internal delegations to issue infringements were not clear and enforcement measures were not feasible within the timeframes of the project.

In any case, infringement notices are only one available tool for improving site management and reducing sand drift, erosion and sedimentation. Awareness raising and education initiatives to achieve voluntary compliance were applied in the first instance. The improvements noted throughout the trial may have been due to the regular presence of the Sediment and Erosion Officer, strengthening the argument for a dedicated compliance role within local governments.

CONCLUSION AND RECOMMENDATIONS

This study has examined the controls over erosion and sand drift at each stage of development in the cities of Armadale and Gosnells. These jurisdictions provide an indication of potential mechanisms that can be used to improve management of erosion and sedimentation. Opportunities to introduce more effective controls include, but are not limited to:

- Improving awareness at the organisational and officer levels, of sand drift, erosion and sedimentation as a key water quality, environmental and stormwater infrastructure maintenance issue in subdivisional development;
- Enhancing understanding of the potential for Urban Water Management Plans to address control issues (for example, through street sweeping requirements);
- Clarifying responsibility within local governments for monitoring and compliance action in relation to sand drift, erosion and sedimentation at subdivisional and development stages; and
- Ensuring adequate resourcing is in place for monitoring and compliance activities.

Through the analysis of development sites in both cities, this review concludes that a key area of risk is the management of housing construction sites. This is based on anecdotal and qualitative photographic evidence. Both local governments involved in this study have Local Laws that may be used as a compliance tool. However, clarity is required on which officers may enact this law and under what scenarios. Furthermore, sufficient resources must also be in place to facilitate this.

A full list of recommendations associated with the review is listed as follows by relevant mechanisms to control sand drift and erosion:

Table 5: Recommendation to improve current mechanisms for controlling sand drift and erosion

Sediment and Erosion Management Plan	
1	Referral agencies should provide justification when requesting that the WAPC apply Standard Condition D9 in the broader catchment.
2	Local governments should budget and clearly assign responsibility for periodic site inspections to ensure Sediment and Erosion Management Plans are implemented.
3	Local governments should raise awareness and understanding amongst relevant staff of the impact of sand drift, erosion and sedimentation on "hard" and "soft" stormwater infrastructure and the receiving environment. This could be achieved through relaying key messages and providing tools from this project.

Urban Water Management Plans

- 1** Consider whether UWMPs should be applied to brownfield, infill, small scale subdivisions or development proposals when Better Urban Water Management (WAPC, 2008) is reviewed.
- 2** Enhance understanding in local governments (organisationally and at officer level) of the risks to assets and the environment of sand drift and sedimentation. Communicate the key messages of this report.
- 3** Ensure local governments and relevant officers are aware that UWMPs can be a useful tool to manage erosion and sedimentation.
- 4** Officers assessing UWMPs should consider requiring street sweeping at a frequency of between two and four weeks, as part of the construction management commitments identified in the UWMP.
- 5** Ensure maintenance responsibilities for stormwater management infrastructure, including rain gardens, are clearly defined in the UWMP so that they are not compromised (e.g. by damage to vegetation and/or the soil media) during subdivision works and the following housing construction phase.
- 6** Ensure that roles, responsibilities and the duration of street sweeping or other controls required are clearly defined in the UWMP.
- 7** Future work could include an assessment of street sweeping to confirm the ideal frequency to maximise effectiveness.

Erosion Prevention and Sediment Control Policy

- 1** Local governments should consider adopting policies such as the City of Armadale's Erosion Prevention and Sediment Control Policy.
- 2** Implementation of local government Erosion Prevention and Sediment Control policies should be supported by adequate resourcing, with responsibilities within local government for the enforcement of the policies clearly allocated.

Exempt Developments and Public Works

- 1** Consider mechanisms to improve management of public works so that erosion and sediment control are appropriately addressed. Options may include engaging with key agencies/authorities responsible for public works, capacity building and/or more formal arrangements such as Memoranda of Understanding.

Dwelling and Building Construction

- 1** An advice note addressing sand drift and erosion control should be applied to Building Licenses, and the best practice pamphlet developed as part of this project should be enclosed with all Building Licenses issued.

Local Law

- 1** Local governments should clearly assign responsibility for the enforcement of Local Law provisions, in accordance with the provisions of the Local Government Act 1995 section 9.10 Appointment of Authorised Persons.
- 2** Ensure that adequate resources are available to act on any such assignment of responsibility.
- 3** Raise awareness and understanding, at both organisational and officer levels, of the issue of sand drift, erosion and sedimentation.

References

City of Armadale (2012), *Delegations Register; May 2012*. City of Armadale

Department of Environment and Resource Management (2010), *Erosion and Sediment Control: Construction Sites and Waterway Health in south-east Queensland*, Queensland.

Department of Local Government and Regional Development (2007), *Delegations – Local Government Operational Guidelines*. November 2007. Western Australia.

Department of Water (2008). *Urban Water Management Plans – Guidelines for preparing plans and for complying with subdivision conditions*, Department of Water, Perth.

Essential Environmental Services (2010) Southern River Sediment and Erosion Project Report. Swan River Trust, Perth, Western Australia

Forecast.id (2012). *Population and Household Forecasts*. City of Armadale

Keep Australia Beautiful Victoria (2008). Clean Site – Building a Better Environment, Final Report. Keep Australia Beautiful Victoria, Victoria.

Matthews, M. (2008). *Managing Urban Development for Waterway Resilience*, proceedings of River Symposium 2008.

Upper Canning/Southern Wungong Catchment Team (2001). *Erosion and Sediment Control Manual for the Darling Range, Perth Western Australia*. Misc. Pub 17/2001. Agriculture Western Australia, Perth.

Swan River Trust (2012). *Sand drift and building waste management – a housing construction industry guide*. Brochure. Swan River Trust, Western Australia

Swan River Trust (2008b) Healthy Rivers Action Plan, Swan River Trust, Perth, Western Australia

Swan River Trust (2009) Swan Canning Water Quality Improvement Plan, Swan River Trust, Perth, Western Australia

APPENDIX 1 - TIMING OF TRIAL ACTIVITIES

January to mid February

- Pre-engagement correspondence to Housing Institute of Australia (HIA), Urban Development Institute of Australia (UDIA) and Master Builders Association (MBA) was sent and outlined the following:
 - a) What and why we are undertaking this process;
 - b) Seeking voluntary compliance/cooperation;
 - c) Where to obtain more information.
- An email distribution was sent to developers and builders advising of the project's intentions.
- Media releases published in local newspapers for both CoA and CoG.
- Publication of sand drift and building waste pamphlet.

February

- First round of site inspections was undertaken to collect baseline data.

Late February to March

- Education/Awareness campaigning onsite – handing out pamphlets and face to face engagement with builders (primarily the site managers). This liaising period with external stakeholders was to provide information and guidelines on what builders can do to bring their practices into compliance.
- Second round site inspections to collect data and identify offenders who will be contacted individually by email.
- The data collected was collated in an email to be sent to the builders/developers.
- Media release published advising the progression of field program.
- Third round site inspections to establish who will receive caution letters. The cautions will also clearly explain the steps for not complying within the given timeframe (14 days).
- Issue caution letters.

March to May

- 14 day grace period for those builders who received a caution letter to comply with those instructions outlined in the letter.
- Fourth round of site inspections to determine who will receive infringements.
- Collect final data in order to compare improvements (if any).

June

- Issue Infringements
- Compliance period where liaison with builders who challenge the fines or seek other political ways of not having to pay the fine.

APPENDIX 2: LETTERS TO UDIA, MBA AND HIA

Urban Development Institute of Australia (WA)
Level 5
150 St Georges Terrace
PERTH WA 6000

Attention: Mark Schneider

10 February 2012,

Dear Sir,

Management of Sand Drift and Sedimentation

Thank you for the support offered by the Urban Development Institute of Australia (UDIA) WA in respect to raising awareness on the environmental impacts of sand drift and sedimentation on building sites. As you are already aware the City of Gosnells has advised the UDIA on its initiative to combat sand drift and sedimentation within its locality.

I am now writing to you about a similar program running concurrently in the City of Armadale. The City proposes to undertake the same trial program, and together with the City of Gosnells seeks to work with the Urban Development Institute of Australia (UDIA) WA and its members to reduce these impacts through improved site management. As part of its stakeholder engagement, the City is also writing to the Housing Institute of Australia (WA) and the Master Builders Western Australia.

The Southern River Local Water Quality Improvement Plan (Swan River Trust, 2009), which covers the bulk of current urban development areas in the City of Armadale and Gosnells, identifies as a priority the reduction of the amount of erosion and sedimentation in the catchment, which contributes to environmental issues of the Southern River.

The issue of good site management in subdivisional development and dwelling construction works has independently been of concern to the City of Armadale for some time.

The City has been working, over the past 18 months, with the Swan River Trust and the City's Southern River catchment neighbour the City of Gosnells, towards the improvement of site management to reduce sediment and erosion impacts upon rivers and receiving waterbodies, as well as stormwater management infrastructure.

The management of sand drift and sediment is covered by the City's Environment, Animals, and Nuisance Local Law 2002, which provides that:

PART 3 – BUILDING, DEVELOPMENT AND LAND CARE

Division 2 – Sand Drift and Dust

Prevention of erosion and the escape of sand and dust

42. An owner or occupier of any land shall take all practicable measures to ensure that:

- (a) no sand is carried by water
 - (i) off the particular lot or lots of land; or
 - (ii) directly or indirectly into any creek, stream, river or any other natural water course; and
- (b) no sand is released from or escapes from the particular lot or lots, whether by means of wind or any other cause

“sand” means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel;

The City's preferred approach is one of cooperation with industry, rather than enforcement.

In February 2012, the City will commence a three-month trial program of awareness-raising, educational and behaviour change initiatives that will include local print media, printed best practice guidance and direct contact with builders. The trial will focus on three subdivisional locations.

The application of the Local Law will be reserved for situations where a positive response to the proposed cooperative approach is not evident.

The trial will provide the opportunity to evaluate the effectiveness of the awareness-raising and educational program. It will also enable quantification of the resource implications of a compliance-based approach to the management of sediment.

Should you have any queries regarding this advice, please contact the Sediment and Erosion Project Officer, Ms Kylie Bacon, on 9399 0415 or kbacon@armadale.wa.gov.au.

Yours faithfully

Neil Burbridge
Environmental Coordinator

Master Builders Western Australia
PO Box 167
WEST PERTH WA 6872

10 February 2012,

Dear Sir/Madam,

Management of Sand Drift and Sedimentation

As you are well aware the City of Gosnells has advised your Association of an initiative to combat sand drift and sedimentation within its locality. I am now writing to you about a similar program running concurrently in the City of Armadale. The City proposes to undertake the same trial program, and together with the City of Gosnells seeks to work with your Association and its members to reduce the impacts through improved site management. As part of its stakeholder engagement, the City is also writing to the Urban Development Institute of Australia (WA) and the Master Builders Western Australia.

The Southern River Local Water Quality Improvement Plan (Swan River Trust, 2009), which covers the bulk of current urban development areas in the City of Armadale and Gosnells, identifies as a priority the reduction of the amount of erosion and sedimentation in the catchment, which contributes environmental issues in the Southern River.

The issue of good site management in subdivisional development and dwelling construction works has independently been of concern to the City of Armadale for some time.

The City has been working, over the past 18 months, with the Swan River Trust and the City's Southern River catchment neighbour the City of Gosnells, towards the improvement of site management to reduce sediment and erosion impacts upon rivers and receiving waterbodies, as well as stormwater management infrastructure.

The management of sand drift and sediment is covered by the City's Environment, Animals, and Nuisance Local Law 2002, which provides that:

PART 3 – BUILDING, DEVELOPMENT AND LAND CARE

Division 2 – Sand Drift and Dust

Prevention of erosion and the escape of sand and dust

42. An owner or occupier of any land shall take all practicable measures to ensure that:

- (a) no sand is carried by water
 - (i) off the particular lot or lots of land; or
 - (ii) directly or indirectly into any creek, stream, river or any other natural water course; and
- (b) no sand is released from or escapes from the particular lot or lots, whether by means of wind or any other cause

“sand” means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel;

The City's preferred approach is one of cooperation with industry, rather than enforcement.

In February 2012, the City will commence a three-month trial program of awareness-raising, educational and behaviour change initiatives that will include the local print media, printed guidance on best practice and direct contact with builders. The trial will focus on three subdivisional locations.

The application of the Local Law will be reserved for situations where a positive response to the proposed cooperative approach is not evident.

The trial will provide the opportunity to evaluate the effectiveness of the awareness-raising and educational program. It will also enable quantification of the resource implications of a compliance-based approach to the management of sediment.

The City of Armadale seeks the Housing Industry Association's support and feedback on this initiative to raise the level of awareness and positive action amongst developers, builders and associated trades. The City would also like to keep the Association informed as the program progresses.

Should you have any queries regarding this advice, please contact the Sediment and Erosion Project Officer, Ms Kylie Bacon, on 9399 0415 or kbacon@armadale.wa.gov.au.

Yours faithfully

Neil Burbridge
Environmental Coordinator

Housing Industry Association (WA)
22 Parkland Road
OSBORNE PARK WA 6017
Attn: James Skouros

10 February 2012,

Dear Mr. Skouros,

Management of Sand Drift and Sedimentation

As you are aware the City of Gosnells has advised your Association of an initiative to combat sand drift and sedimentation within its locality. I am now writing to you about a similar program running concurrently in the City of Armadale. The City proposes to undertake the same trial program, and together with the City of Gosnells seeks to work with your Association and its members to reduce the impacts through improved site management. As part of its stakeholder engagement, the City is also writing to the Urban Development Institute of Australia (WA) and the Master Builders Western Australia.

The Southern River Local Water Quality Improvement Plan (Swan River Trust, 2009), which covers the bulk of current urban development areas in the City of Armadale and Gosnells, identifies as a priority the reduction of the amount of erosion and sedimentation in the catchment, which contributes environmental issues in the Southern River.

The issue of good site management in subdivisional development and dwelling construction works has independently been of concern to the City of Armadale for some time.

The City has been working, over the past eighteen months, with the Swan River Trust and the City's Southern River catchment neighbour the City of Gosnells, towards the improvement of site management to reduce sediment and erosion impacts upon rivers and receiving waterbodies, as well as stormwater management infrastructure. The management of sand drift and sediment is covered by the City's Environment, Animals, and Nuisance Local Law 2002, which provides that:

PART 3 – BUILDING, DEVELOPMENT AND LAND CARE

Division 2 – Sand Drift and Dust

Prevention of erosion and the escape of sand and dust

42. An owner or occupier of any land shall take all practicable measures to ensure that:

- (a) no sand is carried by water
 - (i) off the particular lot or lots of land; or
 - (ii) directly or indirectly into any creek, stream, river or any other natural water course; and
- (b) no sand is released from or escapes from the particular lot or lots, whether by means of wind or any other cause

“sand” means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel;

The City's preferred approach is one of cooperation with industry, rather than enforcement.

In February 2012, the City will commence a three-month trial program of awareness-raising, educational and behaviour change initiatives that will include the local print media, printed guidance on best practice and direct contact with builders. The trial will focus on three subdivisional locations.

The application of the Local Law will be reserved for situations where a positive response to the proposed cooperative approach is not evident.

The trial will provide the opportunity to evaluate the effectiveness of the awareness-raising and educational program. It will also enable quantification of the resource implications of a compliance-based approach to the management of sediment.

The City of Armadale seeks the Housing Industry Association's support and feedback on this initiative to raise the level of awareness and positive action amongst developers, builders and associated trades. The City would also like to keep the Association informed as the program progresses.

Should you have any queries regarding this advice, please contact the Sediment and Erosion Project Officer, Ms Kylie Bacon, on 9399 0415 or kbacon@armadale.wa.gov.au.

Yours faithfully

Neil Burbridge
Environmental Coordinator

APPENDIX 3: CITY OF ARMADALE'S DRAFT WARNING LETTER FOR CONTRAVENING CLAUSE 42 OF THE CITY OF ARMADALE'S ENVIRONMENT, ANIMALS AND NUISANCE LOCAL LAW 2002.

Date

Enquiries:

Insert Address

Dear Sir/Madam,

Non-Compliance of Sand Drift Control at No.....(Lot)- 14 Days Notice to Comply.

The City of Armadale is working to reduce the impact of building waste and sand drift on rivers, creeks and wetlands, as well as drainage infrastructure. One of the sites identified for improvement in the management of sand drift is managed by your company. Presently, your site located at (insert address including lot no) has contravened clause 42 of the City of Armadale's *Environment, Animals and Nuisance Local Law 2002* which provides:

42. An owner or occupier of any land shall take all practicable measures to ensure that:

- (a) no sand is carried by water
 - (i) off the particular lot or lots of land; or
 - (ii) directly or indirectly into any creek, stream, river or any other natural water course; and
- (b) no sand is released from or escapes from the particular lot or lots, whether by means of wind or any other cause.

The provision of sand drift is defined as 'sand' under the Local Law:

"sand" means granules or particles of rock, earth, clay, loam, silt and any other granular, particulate or like material, and includes dust and gravel;

When a breach is identified, the owner or occupier of the land is required to contain all sand and any stock piles on site, and remove any sand drift from public roadways and footpaths within **14 days** of the date of this notice. Should compliance not occur within the prescribed 14 days, an infringement notice will be issued to your company, as the occupier of the property. This will result in a financial penalty. The City's preferred approach, though, is to achieve the management of sand drift through cooperation with industry.

Should you have any queries regarding this advice, please contact (insert officer title and name) on 9399 ... or (insert email address)

Yours faithfully,

Authorising Signature

**APPENDIX 4: CITY OF GOSNELLS WARNING LETTER FOR CONTRAVENING
CLAUSE 21 OF THE CITY OF GOSNELLS ANIMALS, ENVIRONMENT AND
NUISANCE LOCAL LAW 2009.**

2120 Albany Highway Gosnells WA 6110
Mail to: PO Box 662 Gosnells WA 6990

T 08 9397 3000
F 08 9397 3333
E council@gosnells.wa.gov.au
W www.gosnells.wa.gov.au
ABN 18 374 412 891

Date

Insert Address

Enquiries:

Dear Sir/Madam,

Non-Compliance of Sand Drift Control at No.....(Lot)- 14 Days Notice to Comply.

The City of Gosnells is working to reduce the impact of building waste and sand drift on rivers, creeks and wetlands, as well as drainage infrastructure. One of the sites identified for improvement in the management of sand drift is managed by your company. At this time your site located (insert address including lot no) has contravened clause 21 of the City of Gosnells *Animals, Environment and Nuisance Local Law 2009* which provides:

21. Containment of dust and liquid waste

An owner or occupier of land must take effective measures to –

- (a) stabilise dust on the land;*
- (b) contain all liquid waste on the land; and*
- (c) ensure no dust or liquid waste is released or escapes from the land whether by means of wind, water or any other cause so as to cause a nuisance.*

The provision of sand drift is defined as 'dust' under the Local Law, whose definition is:

"dust" means any visible granular or particulate material which has or has the potential to become airborne and includes organic and non-organic matter and sand, but does not include smoke.

Where a breach has been identified, the owner or occupier of the land is required to contain all sand and any stock piles on site, and remove any sand drift from public roadways and footpaths within **14 days** of the date of this notice. Should this notice not be complied within the prescribed 14 days, an infringement notice will be issued to your company, as the occupier of the property, resulting in a financial penalty. The City's preferred approach, though, is to achieve the management of sand drift through cooperation with industry.

Should you have any queries regarding this advice, please contact (insert officer title and name) on 9399 ... or (insert email address)

Yours faithfully
Authorising Signature

APPENDIX 5 - PAMPHLET - 'A HOUSING CONSTRUCTION INDUSTRY GUIDE'

Unacceptable building practices

Sand drift



Soil from building sites can be a major source of sediment pollution in our drainage systems and waterways.

Building waste



All hard waste and litter must be stored on-site in a way to prevent any materials from entering adjacent land or the storm water system by wind or water action.

How does building impact the environment?

The process of land development is being increasingly recognised as having significant potential to increase sediment loads to waterways, impacting on aquatic ecosystems and diminishing water quality.

Stormwater acts as a carrier for pollution picked up from various sources including building sites. This pollution is transported through drains to our waterways and wetlands.

Litter is one of the most visible forms of stormwater pollution. Sand, although less obvious, compromises the capacity of drainage systems, silts up our waterways and smothers bottom-dwelling fauna.

We, as members of the same community, all have a role in looking after our water resources.

How can you help?

All building construction works must be carried out in a way that is reasonable and practical to reduce any environmental impact and stop the entry of any pollution into the stormwater system.

For further information:

Sediment and Erosion Project
 City of Gosnells
 Phone 9397 3000
 City of Armadale
 Phone 9399 0111



Sand drift and waste management



A housing construction industry guide

APPENDIX 5 – PAMPHLET - 'A HOUSING CONSTRUCTION INDUSTRY GUIDE'

Ways to reduce erosion and control sediment on a building or construction site

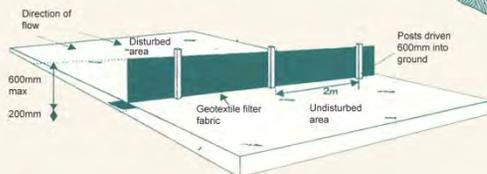
Follow these site management practices and you will help reduce the impact on our environment

1. Limit disturbance when excavating

Preserve grassed areas where possible, as this not only improves the appearance of your site, it also filters much of the sediment from stormwater run-off before it reaches the drainage system.

2. Diversion drains and perimeter banks

Where practical allow for diversion of up slope stormwater around the work site and other disturbed surfaces.



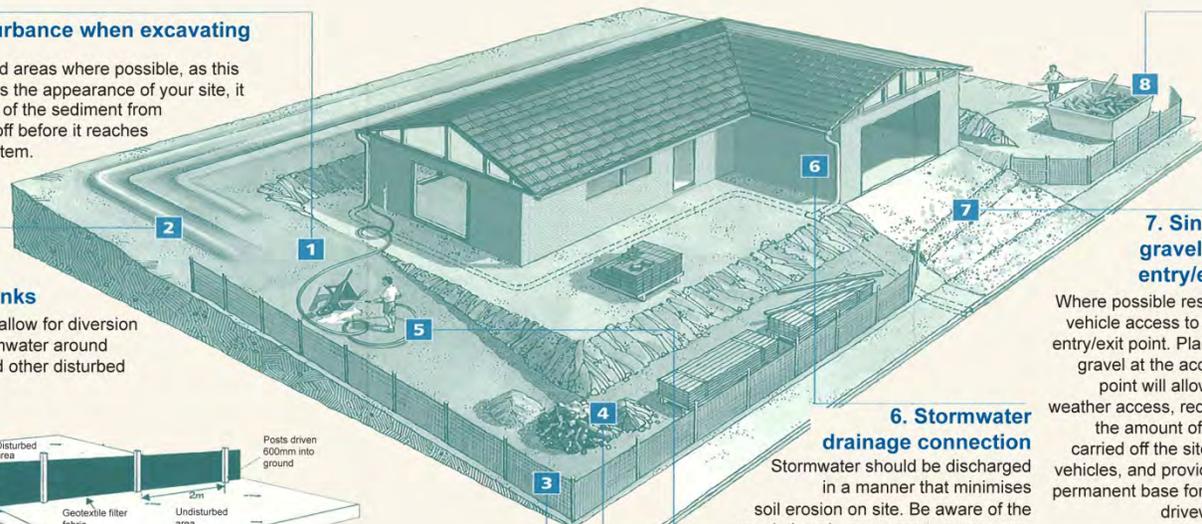
3. Install an erosion/sediment barrier

Erosion/sedimentation barriers catch sand and coarse sediment before it can wash or blow offsite into gutters, drains and waterways.

Sediment barrier techniques

- geotextile sediment fabric attached to posts with the geotextile buried in an upstream trench;
- place turf of a minimum 600mm width along the kerb line; or
- straw bales, staked in a 100mm (minimum) deep trench.

Diagram courtesy of Keep Australia Beautiful Council



8. Litter and building waste

All hard waste and litter must be stored in a way to prevent any materials from entering adjacent land or the stormwater system through wind or water action. Use a waste contractor that recycles waste material rather than sending it to landfill.

7. Single gravelled entry/exit

Where possible restrict vehicle access to one entry/exit point. Placing gravel at the access point will allow all weather access, reduce the amount of soil carried off the site by vehicles, and provide a permanent base for the driveway.

6. Stormwater drainage connection

Stormwater should be discharged in a manner that minimises soil erosion on site. Be aware of the regulations in your area to ensure you will not face possible infringement.

5. Wash water and wastes

Wash waters and waste from concrete, plaster, paint or brickwork must not be allowed to wash into gutters or the street.

4. Sand and soil stockpiles

Stockpiles should be placed wholly on the construction site and behind a sediment barrier. Soil or cement should be covered at the end of each day if excessive wind or rain is likely.

Local law penalties apply

APPENDIX 6: RESIDENTIAL DWELLING CONSTRUCTION EVALUATION SCORE CARD

Residential Dwelling Construction

Assessment Table	
Sediment and Erosion Controls (Best Management Practices)	
Purpose	To provide a set of Best Practice site management procedures to control the severity and extent of soil erosion and pollutant transport during the residential construction phase.
Statute	City of Gosnells Animals Environment and Nuisance Local Law 2009.
Scoring	
0 Score	No Controls Implemented If the site has one or both of the points below, a score of 0 is achieved.
	<ul style="list-style-type: none"> a) No reasonable and practicable measures are being taken to control sediment runoff from the site. b) At least 50% of foot paths and/or road reserves are covered in sediment and sand drift.
0.5 Score	Inadequate Controls Implemented If the site achieves the point below, a score of 0.5 is achieved.
	<ul style="list-style-type: none"> a) Sediment and sand drift is evident but is kept to a minimum. (i.e. side of roads or is only tracked from sediment piles).
NB	To decide whether a score of a 0 or 0.5 is given, the amount of sand drift escaping from sites/lots will be the deciding factor. For example; if sediment and sand drift covers more than 50% of roads or you can't see the road pavement for the amount of sand covering it, a score of 0 is given. However, if sand drift is evident on the sides of the road and/or only present in isolated areas within the site/lot then a score of 0.5 is given.

**1, 2, 3, 4 & 5
Score**

Implementation and use of Best Management Practices

The table below outlines what score is given depending on how many best management practices are achieved.

BMP Achieved	Score
1 or 2	1
3	1.5
4	2
5	2.5
6	3
7	3.5
8	4
9	4.5
10 or higher	5

1. All trades people working on the site have been informed of the erosion and sediment control requirements of the site (project specific).
2. Public roadways are clear of sand/sediment.
3. Footpaths that abut a kerb shall be kept clear of sand drift.
4. The site has established one entry/exit point.
5. All sand drift adjacent to the construction site cleaned and removed at the end of the day.
6. Diversion drains are appropriately diverted through the site in a non - erosive manner.
7. Temporary downpipes have been correctly connected to any installed roof gutters.
8. Stockpiles of sand/soil are to be contained so they do not pose a risk of being transported by wind, rain, and stormwater flow and shall not to be located closer than 2 metres from a stormwater inlet, unless stormwater inlet is protected from sediment flow or the pit is inactive and covered.
9. Evidence of sediment traps or installation of swales and buffer strips.
10. Silt and dust fences have been correctly installed (e.g. fabric buried and standing up-slope of stakes) and are free of damage and are well maintained.
11. Appropriate sediment controls have been placed adjacent to, or around, stormwater inlets—as appropriate for the type of inlet.
12. Any other reasonable and practicable measures are being taken to control sediment runoff from the site that has not been mentioned above.

Building Waste Control	
1 Score	<p>Inadequate Controls Implemented If the site clearly portrays one or both of the points below, then a score of 1 is achieved.</p>
	<ul style="list-style-type: none"> a) No evidence of on-site waste receptacles. b) Litter and building waste either dumped/scattered over the whole site, and or litter blowing around.
2 Score	<p>Average Controls Implemented If the site portrays the point below, a score of 2 is achieved.</p>
	<ul style="list-style-type: none"> a) Evidence of on-site waste receptacles not being used.
3, 4 and 5 Score	<p>Implementation and use of Best Management Practices If the site has established one of the requirements below a score of 3 is achieved. If the site achieves two of the requirements below, a score of 4 is achieved and if three of the requirements are achieved a score of 5 is given.</p>
	<ul style="list-style-type: none"> a) Install on-site waste receptacles (mini-skips, bins, wind-proof litter receptors) and ensure they are being used. b) The construction site is clear of unconfined rubbish. c) Smaller litter items contained in covered bins or cages. d) Loads on utilities, trailers and trucks secured to prevent litter, sediment and rubble blowing from vehicles or trailers.

www.swanrivertrust.wa.gov.au

Caring for the Swan Canning Riverpark

