

# Georges River Estuary Coastal Zone Management Plan

## Final Report

July 2013




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# **Georges River Estuary Coastal Zone Management Plan**

Prepared For: GRCCC

Prepared By: BMT WBM Pty Ltd (Member of the BMT group of companies)

## DOCUMENT CONTROL SHEET

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<b>Title :</b>	Georges River Estuary Coastal Zone Management Plan
<b>Author :</b>	Dr Philip Haines, Dr Rebecca Kelly (isNRM Pty Ltd)
<b>Synopsis :</b>	The Georges River Estuary Coastal Zone Management Plan provides a strategic framework and action plan for the future management of the Georges River Estuary. It aims to redress current issues, and conserve existing values, using a range of implementation mechanisms, including planning instruments, on-ground works, and education programs. The Plan includes an indicative costing, potential funding sources, and identifies key agencies and Councils for responsibility of implementation and future monitoring.

### REVISION/CHECKING HISTORY

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### Disclaimer

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## EXECUTIVE SUMMARY

		Details in...
<i>Goal</i>	The primary goal of the Georges River Estuary Coastal Zone Management Plan is  <i>"to conserve and improve the existing natural environment of the Georges River Estuary, and to improve the water quality of the estuary through targeted pollution reduction"</i>	Section 4
<i>Purpose</i>	This Coastal Zone Management Plan (CZMP) provides strategic direction and guidance on future strategic and environmental planning within the estuary and its catchment. It also <u>provides an Action Plan</u> for undertaking targeted works and other initiatives aimed at achieving the overall Goal of improving estuary condition.	Section 1
<i>Audience</i>	The <u>primary</u> audience of the Coastal Zone Management Plan is Councils within the Georges River Estuary catchment. Other stakeholders, including relevant government agencies and organisations, community groups and the general public, should also refer to this document in respect to management of the estuary	Section 1.3
<i>Context</i>	<p>This Coastal Zone Management Plan has been developed under the NSW Government's Estuary Management Program in accordance with the specifications of Part 4a of the <i>Coastal Protection Act 1979</i>. It complies with the requirements of the NSW Coastal Policy 1997, and the former Sydney Metropolitan Catchment Action Plan (Management Target CTECM1). It is also consistent with the Botany Bay Water Quality Improvement Plan, and follows the new Guidelines for Preparation of Coastal Zone Management Plans (DECCW, 2010b).</p> <p>This Plan covers all estuarine waters of the Georges River, from Towra Point to Liverpool Weir. The Plan covers the river foreshores, the Botany Bay foreshore between Towra Point and Cooks River (i.e. predominantly Lady Robinsons Beach) and all tidal waters that flow into the study area. Consideration has also been given to the wider Georges River catchment insofar as it impacts on estuarine quality and ecological health. This Plan does not cover any open coast sandy beaches or rocky headlands.</p> <p>This Plan presents a summary of the relevant environmental processes of the estuary, and their interactions with the human use and other social and economic values places on the estuary, its foreshores, and the wider catchment area.</p>	Section 1
<i>Status</i>	The Plan has undergone extensive review by relevant stakeholders and government agencies, as facilitated through the GRCCC and the Georges River Estuary Management Committee. With final endorsement by Councils, the Plan will be given to the Minister for the Environment for certification. Once certified, Councils will adopt the Plan and will publish it in the Government Gazette.	
<i>Relationship to other plans</i>	<p>The Coastal Zone Management Plan is complementary to planning instruments and environmental management strategies and initiatives being used and implemented by each of the Councils and other stakeholders. This includes new LEPs and DCPs for the Councils, as well as Catchment-based strategies, such as the Botany Bay Water Quality Improvement Plan.</p> <p>Implementation of this Plan, particularly the natural resource management strategies, is a key action in the former Sydney Metropolitan Catchment Action Plan (SMCMA, 2009) and will assist in achieving Priority E4 of the State Plan.</p> <p>Once gazetted, this Plan is to be consulted during all future reviews of Environmental Planning Instruments and place-based Plans across the</p>	Section 1.7

		Details in...
	catchment area. It is also to be taken into account in determining development applications under Section 79C of the <i>Environmental Planning and Assessment Act 1979</i> that may potentially have an impact on the estuary or its surrounding foreshore environments.	
<b>Management Aims</b>	<p>Nine (9) broad Aims have been developed covering the most pertinent issues:</p> <ul style="list-style-type: none"> <li>A. <b><u>Water Quality</u></b>: To optimise water quality within the Georges River Estuary and its tributaries</li> <li>B. <b><u>Aquatic and Riparian Habitat</u></b>: To protect, enhance and restore aquatic habitats and foreshore vegetation</li> <li>C. <u>Recreation and Amenity</u>: To protect and enhance public access to the foreshore</li> <li>D. <b><u>Land use Planning and Development</u></b>: To minimise the negative impacts of development in the catchment on waterway health</li> <li>E. <b><u>Bank Erosion and Sedimentation</u></b>: To actively manage bank erosion and sedimentation</li> <li>F. <u>Foreshore Protection</u>: To manage existing built foreshore assets while maximising environmental values</li> <li>G. <u>Natural and Cultural Heritage</u>: To identify, acknowledge and protect natural and cultural heritage</li> <li>H. <b><u>Climate Change and Sea Level Rise</u></b>: To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary</li> <li>I. <u>Monitoring and Evaluation</u>: To develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary</li> </ul> <p>The risk of not achieving Aims A, B, D, E and H is considered 'intolerable' (shown in bold above). The remaining Aims represent 'tolerable' (but still undesirable) risks if not achieved. Tolerable and intolerable risks were determined using a modified risk assessment approach (see Appendix C for details)</p>	Section 4.1
<b>Management Objectives</b>	<p>A total of twenty seven (27) Management Objectives have been defined, which relate to each of the nine broad aims. The Management Objectives were prioritised based on the importance of each Aim and the degree to which each Objective addresses the Aims. <u>The top 10 ranked Management Objectives (in priority order) are:</u></p> <ul style="list-style-type: none"> <li>A1. Reduce the volume &amp; pollutant load of stormwater runoff through the catchment</li> <li>A3. Improve the performance of sewer overflows</li> <li>A2. All greenfield and redevelopments should have a minimal negative impact on flow and water quality, meeting targets for water quality proposed in the Botany Bay and Catchment WQIP</li> <li>A5. Strive to protect undeveloped areas of the broader catchment that act as a buffer to water quality</li> <li>A6. Minimise the negative impacts of new and existing commercial operations in the catchment and estuary on flow and water quality</li> <li>E1. Reduce the extent and severity of bank and foreshore erosion while minimising the impacts on estuary health</li> <li>A4. Minimise build-up of gross pollutants and illegal dumping of waste into and along the estuary foreshore and waterways</li> <li>E2. Reduce the causes and impacts of sedimentation in the estuary</li> </ul>	Section 4.2

		Details in...
<i>Best Management Options</i>	<p><b>B3.</b> Protect and improve the extent and condition of estuarine and riparian vegetation</p> <p><b>B2.</b> Minimise the cause and spread of invasive species in aquatic and terrestrial habitats</p>	
	<p>A wide range of potential management options were formulated, including options canvassed from community and stakeholder representatives. An evaluation process was conducted and the options prioritised into three categories:</p> <ol style="list-style-type: none"> <li>1. Best Management Options (BMOs);</li> <li>2. Next Best Options (NBOs); and</li> <li>3. Other Options.</li> </ol> <p>For the purposes of this Plan, only the BMOs were included in the Action Plan. <b>This includes some 25 Options that help address all 9 broad Aims.</b> A summary of the BMOs is presented in Table ES-1 overleaf. Relative prioritisation for implementation of the 25 BMOs has been based on the relative ranking of the Management Objectives that the BMOs primarily address.</p> <p>The BMOs have been identified based on the 'approaches' to actions required, namely:</p> <ul style="list-style-type: none"> <li>• Strategic Planning &amp; Development Controls</li> <li>• Engineering Works &amp; Asset Management</li> <li>• Environmental Rehabilitation &amp; Monitoring</li> <li>• Environmental Planning</li> <li>• Communications &amp; Education</li> <li>• Recreation &amp; Heritage</li> <li>• Compliance</li> </ul> <p>The Action Plan provided as part of this Coastal Management Zone Plan gives implementation details for each of the BMOs, including specific locations of applicability (where relevant), costings, timing, and responsibilities for implementing the BMOs.</p>	Section 5
<i>Implementation responsibilities</i>	<p>For the majority of BMOs, the responsibility for implementation rests with the relevant departments within the local Councils. The GRCCC is also responsible for some BMOs, through the existing Riverkeeper program and may also have a role in co-ordinating and guiding some of the actions of Councils to ensure consistency of approach.</p> <p>In addition to the GRCCC, the NSW Office of Environment and Heritage (Department of Premier &amp; Cabinet) and all partner Councils shall continue to assist with the management and co-ordination of implementation of the Plan through their on-going participation on the Georges River Estuary Management Committee.</p>	Section 6
<i>Program of actions</i>	Specific actions have been identified for most BMOs to help relevant authorities with implementation. Based on the priority of the BMO, actions are recommended to commence over the next 4 years or so, with highest priority actions to commence immediately (subject to funding availabilities)	Section 6
<i>Costs and funding</i>	There are a small number of BMOs that will require significant new sources of funding. These BMOs involve a substantial number of individual works across the study area, including retrofitting new WSUD devices and various bank erosion management works, especially along the mid to upper estuary reaches. Many of the remaining BMOs only require in-kind involvement from existing staff, while other BMOs will only need relatively small external financial support, similar to existing contributions to environmental works along the	Section 6

		Details in...
<i>Indicators for success</i>	Georges River. Once gazetted, this Plan can be used as a lever for obtaining environmental funds through the Federal and/or State Governments (e.g. Estuary Management Program).	
	The ultimate success of the Georges River Estuary CZMP is to be gauged by how well the overall Aims of the Plan have been met. Given that the Aims are broad and likely to be measurable over long timescales only, a series of Performance Measures have been incorporated into the Action Plan for each BMO to identify progress and short term successes in Plan implementation.	Section 6
<i>Consultation</i>	Consultation with the relevant Councils, other stakeholders, and the community has underpinned the development of this Plan. The community will also have the opportunity to review the Plan during a public exhibition period.	Section 3
<i>Review and amendment provisions</i>	This Plan has an indicative 5-10 year timeframe. Progress with implementation should be formally reviewed annually. Contingency measures should be activated if progress is slow. A complete review and amendment of the Plan should occur after a minimum 5 years, and should redress outstanding issues, new environmental management practices, new scientific data, and changed governance and administrative arrangements.	Section 8

**Table ES-1 Summary of Best Management Options (BMOs)**

Theme / Aim	Action / Strategy	Priority	Option Approach	Costs
Water Quality	<b>MA2:</b> Update or prepare new WSUD controls within DCPs	HIGH	Strategic Planning & Development Controls	Staff time only
	<b>MA3:</b> Retrofit new WSUD devices in existing urban areas	HIGH	Engineering Works & Asset Management	<b>Very significant capital costs</b>
	<b>MA4:</b> Maintenance of WSUD devices, GPTs, SQIDs etc	HIGH	Engineering Works & Asset Management	<b>Large annual costs</b>
	<b>MA6:</b> Sediment/erosion control during & after construction	HIGH	Compliance	Staff time only
	<b>MA8:</b> Riverkeeper teams for clean-up & illegal dumping	HIGH	Environmental Rehabilitation & Monitoring	Continue existing funding + add. funding for large or special projects
	<b>MA10:</b> Develop & adopt WSUD action plans	HIGH	Environmental Planning	Staff time only
	<b>MA15:</b> SWC liaison regarding sewer problems	HIGH	Environmental Planning	Staff time only
Aquatic and Riparian Habitat	<b>MB4:</b> Rehabilitation of estuarine wetlands & riparian vegetation	HIGH	Environmental Rehabilitation & Monitoring	Staff time + Landcare grants
	<b>MB7:</b> Support and continue bushcare/landcare groups	HIGH	Environmental Rehabilitation & Monitoring	Staff time + Landcare grants
	<b>MB8:</b> Riverkeeper teams for bush regeneration & weed control	HIGH - MEDIUM	Environmental Rehabilitation & Monitoring	Continue existing funding + add. funding for large or special projects
	<b>MB9:</b> Private landholder education re: habitat & vegetation	HIGH - MEDIUM	Communications & Education	Staff time + printing costs
Recreation and Amenity	<b>MC3:</b> Interpretive education materials on recreation	LOW	Communications & Education	Staff time + printing costs
	<b>MC5:</b> Contribute to boating strategy revision	LOW	Environmental Planning	Staff time only
Land use Planning and Development	<b>MD3:</b> Use Best Management Practices for Council works	MEDIUM	Strategic Planning & Development Controls	Staff time only
	<b>MD4:</b> Consistency with CZMP in future EPI reviews	MEDIUM	Strategic Planning & Development Controls	Staff time only
	<b>MD5:</b> New & revised PoMs to be compatible with CZMP	MEDIUM	Strategic Planning & Development Controls	Staff time only
Bank Erosion and Sedimentation	<b>ME2:</b> Boat wake erosion impacts and strategies	HIGH	Environmental Planning	Staff time + Maritime input
	<b>ME3:</b> Targeted control of ad-hoc foreshore access	MEDIUM	Engineering Works & Asset Management	Relatively small costs
	<b>ME4:</b> Prioritise & remediate erosion, using vegetation, where possible	HIGH	Engineering Works & Asset Management	<b>Very significant capital costs</b>
Foreshore Protection	<b>MF1:</b> Councils to comply with eco-friendly seawall guidelines	MEDIUM	Strategic Planning & Development Controls	Staff time only
	<b>MF5:</b> Educate landholders re: eco-friendly seawalls	MEDIUM - LOW	Communications & Education	Staff time + printing costs
Natural and Cultural Heritage	<b>MG4:</b> Work with Aboriginal Groups and others to determine options for threatened heritage sites	LOW	Recreation & Heritage	Staff time only
Climate Change and Sea Level Rise	<b>MH3:</b> Mapping of Sea Level Rise and areas for vegetation retreat	MEDIUM	Environmental Planning	Relative small cost
Monitoring and Evaluation	<b>MI2:</b> Support GRCCC River Health Monitoring Program	MEDIUM	Environmental Rehabilitation & Monitoring	Continue existing funding + seek supplementary \$
	<b>MI3:</b> Support, implement & monitor CZMP effectiveness	LOW	Environmental Rehabilitation & Monitoring	Staff time only

# CONTENTS

<b>Executive Summary</b>	<b>i</b>
<b>Contents</b>	<b>vi</b>
<b>List of Figures</b>	<b>ix</b>
<b>List of Tables</b>	<b>x</b>
<b>1 INTRODUCTION AND STRATEGIC CONTEXT</b>	<b>1</b>
1.1 Why Develop a Coastal Zone Management Plan?	1
1.2 Purpose of the Plan	2
1.3 Who is this Plan for?	3
1.4 One Plan for the Whole Estuary	3
1.5 What Area Does the Plan Cover?	3
1.6 NSW Estuary Management Process	5
1.7 Key Legislation and other Instruments Guiding Estuary Management	7
1.7.1 State Environmental Planning Policies	8
1.7.2 Local Environmental Plans and Development Control Plans	8
1.7.3 State and Commonwealth Legislation and Policies	9
1.7.4 Other Natural Resource Management Initiatives	10
<b>2 PROCESSES, VALUES AND ISSUES OF THE GEORGES RIVER</b>	<b>12</b>
2.1 Preamble	12
2.2 Estuary Processes (SMEC, 2010)	13
2.2.1 Geology and Estuary Type	13
2.2.2 Sediment Processes	15
2.2.2.1 Catchment Soils	15
2.2.2.2 Sedimentation	15
2.2.2.3 Sediment Quality	17
2.2.2.4 Dredging	17
2.2.2.5 Bank erosion	18
2.2.3 Hydrodynamic Processes	19
2.2.3.1 Tides	19
2.2.3.2 Waves	19
2.2.3.3 Flooding	20
2.2.4 Water Quality	21
2.2.4.1 Flushing and Mixing Characteristics	21



2.2.4.2	<i>Factors affecting water quality</i>	22
2.2.4.3	<i>Current water quality conditions</i>	23
2.2.5	Ecology	23
<b>2.3</b>	<b>Human Usage</b>	<b>29</b>
<b>2.4</b>	<b>Estuary Values</b>	<b>31</b>
<b>2.5</b>	<b>Issues for Future Management</b>	<b>32</b>
2.5.1	Improvement in Water Quality	32
2.5.2	Conservation of Ecological Values	33
2.5.3	Improvement of Access and Recreational Function	34
2.5.4	Control of Future Catchment Development	35
2.5.5	Control of Sedimentation, Bank Erosion and Foreshore Structures	35
2.5.6	Conservation of Natural and Cultural Heritage	36
2.5.7	Climate Change and Future Planning	36
2.5.8	Improved Knowledge of the Estuary through Regular Monitoring and Evaluation	37
<b>3</b>	<b>CONSULTATION DURING DEVELOPMENT OF THE PLAN</b>	<b>39</b>
3.1	Estuary Management Committee Meetings	39
3.2	Targeted on-line survey for prioritisation of Management Options	39
3.3	Targeted consultation with Councils and other organisations	40
3.4	Community forum and on-line survey	40
3.5	Incorporation of Consultation Input	41
<b>4</b>	<b>AIMS AND OBJECTIVES FOR FUTURE MANAGEMENT</b>	<b>43</b>
4.1	Management Aims	43
4.2	Management Objectives	44
4.2.1	Water Quality	44
4.2.2	Aquatic and Riparian Habitat	45
4.2.3	Recreation and Amenity	46
4.2.4	Land Use Planning and Development	46
4.2.5	Bank Erosion and Sedimentation	47
4.2.6	Foreshore Protection	47
4.2.7	Natural and Cultural Heritage	48
4.2.8	Climate Change and Sea Level Rise	48
4.2.9	Monitoring and Evaluation	49
4.3	Ranking of Management Objectives	50
<b>5</b>	<b>POSSIBLE OPTIONS TO ADDRESS AIMS AND OBJECTIVES</b>	<b>52</b>
5.1	Evaluation of Possible Management Options	52

5.2	Prioritisation of Options	54
<b>6</b>	<b>ACTION PLAN</b>	<b>64</b>
6.1	Introduction and Explanation	64
6.2	Water Quality Sub-Plan	66
6.3	Aquatic and Riparian Habitat Sub-Plan	87
6.4	Recreation and Amenity Sub-Plan	100
6.5	Land use Planning and Development Sub-Plan	107
6.6	Bank Erosion and Sedimentation Sub-Plan	115
6.7	Foreshore Protection Sub-Plan	124
6.8	Natural and Cultural Heritage Sub-Plan	130
6.9	Climate Change and Sea Level Rise Sub-Plan	133
6.10	Monitoring and Evaluation Sub-Plan	137
<b>7</b>	<b>ACTIONS SUMMARY FOR COUNCILS</b>	<b>143</b>
<b>8</b>	<b>MONITORING AND REVIEW</b>	<b>155</b>
8.1	Georges River Estuary River Health Monitoring Program	155
8.1.1	Background	155
8.1.2	Indicators	155
8.1.3	Sampling Period and Effort	155
8.1.4	Sampling Sites	156
8.1.5	Sampling Protocols	156
8.1.6	Analysis of Data	157
8.1.7	Evaluation and Reporting	157
8.2	Monitoring of Coastal Zone Management Plan Effectiveness	158
8.2.1	Primary Performance Measures	158
8.2.2	Secondary Performance Measures	159
8.2.3	Tertiary Performance Measures	159
8.3	Factors for Success	160
8.4	Plan Review	161
<b>9</b>	<b>REFERENCES</b>	<b>163</b>
<b>APPENDIX A: RELEVANT PLAN, POLICIES AND LEGISLATION</b>		<b>A-1</b>
<b>APPENDIX B: COMMUNITY FORUM AND FEEDBACK FROM THE ON-LINE SURVEY</b>		<b>B-1</b>

<b>APPENDIX C: PRIORITISATION OF ESTUARY MANAGEMENT AIMS AND OBJECTIVES</b>	<b>C-1</b>
<b>APPENDIX D: PRIORITISATION OF ESTUARY MANAGEMENT OPTIONS</b>	<b>D-1</b>
<b>APPENDIX E: RAPID COST BENEFIT ASSESSMENT OF MANAGEMENT OPTIONS</b>	<b>E-1</b>
<b>APPENDIX F: NEXT BEST OPTIONS (NBOs) FURTHER DETAILS</b>	<b>F-1</b>
<b>APPENDIX G: CURRENT RIVERKEEPER WORK SITES</b>	<b>G-1</b>

## LIST OF FIGURES

Figure 1-1	Georges River Estuary Coastal Zone Management Plan Study Area	4
Figure 1-2	Georges River NRM Strategies (adapted from Evans & Peck, 2008)	11
Figure 2-1	Underlying geology surrounding the Georges River Estuary (Source: SMEC, 2010)	14
Figure 2-2	Paleo river channels based on bedrock profile (Source: Albani & Rickwood, 2010) (Note, land area shown in brown, seabed shown in yellow)	14
Figure 2-3	Zonation of the Georges River based on sedimentary processes (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)	16
Figure 2-4	Typical salinity profile along the Georges River Estuary (PWD, 1990)	21
Figure 2-5	Water quality condition of the Georges River Estuary (upper and mid reaches) (source: <a href="http://www.georgesriver.org.au/River-Health-Monitoring-Program.html">http://www.georgesriver.org.au/River-Health-Monitoring-Program.html</a> - refer source for detail) (see Figure 2-6 for legend)	24
Figure 2-6	Water quality condition of the Georges River Estuary (lower reaches) (source: <a href="http://www.georgesriver.org.au/River-Health-Monitoring-Program.html">http://www.georgesriver.org.au/River-Health-Monitoring-Program.html</a> - refer source for detail)	25
Figure 2-7	Significant estuarine vegetation communities along the Upper Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)	26
Figure 2-8	Significant estuarine vegetation communities along the Mid Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)	27
Figure 2-9	Significant estuarine vegetation communities along the Lower Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)	28
Figure 2-10	Land uses across the entire Georges River catchment (Source: SMCMA, 2007)	30
Figure 2-11	MER framework and the adaptive management cycle (DECCW, 2010a)	38
Figure 6-1	Water Quality Sub-Plan	67
Figure 6-2	Pollutant Load reductions from WSUD options	72
Figure 6-3	Riverkeeper rubbish removal sites 2011/12	81
Figure 6-4	Aquatic and Riparian Habitat Sub-Plan	88
Figure 6-5	Recreation and Amenity Sub-Plan	101

Figure 6-6	Land use Planning and Development Sub-Plan	108
Figure 6-7	Bank Erosion and Sedimentation Sub-Plan	116
Figure 6-8	Foreshore Protection Sub-Plan	125
Figure 6-9	Climate Change and SLR Sub-Plan	134
Figure 6-10	Monitoring and Evaluation Sub-Plan	138
Figure 7-1	Actions for Liverpool City Council	144
Figure 7-2	Actions for Fairfield City Council	146
Figure 7-3	Actions for Bankstown City Council	147
Figure 7-4	Actions for Sutherland City Council	149
Figure 7-5	Actions for Hurstville City Council	152
Figure 7-6	Actions for Rockdale City Council	153
Figure 7-7	Actions for Kogarah City Council	154
Figure 8-1	Georges River Estuary Monitoring Sites	157
Figure 9-1	Risk Level Matrix	C-2
Figure 9-2	Risk chart and categorisation of Aims based on likelihood and consequence	C-2

## LIST OF TABLES

Table 1-1	Coastal Management Principles (DECCW, 2010b) addressed by the Georges River Estuary Plan	6
Table 1-2	Local Government Planning Instruments	9
Table 2-1	Reduction targets for Chlorophyll-a and Turbidity (SMCMA, 2011)	33
Table 2-2	Stormwater reduction targets for urban development (SMCMA, 2011)	33
Table 4-1	Aims of the Coastal Zone Management Plan	44
Table 4-2	Objectives relating to the Water Quality Aim (Intolerable Risk)	45
Table 4-3	Objectives relating to the Riparian Habitat Aim (Intolerable Risk)	45
Table 4-4	Objectives relating to the Recreation and Amenity Aim (Tolerable Risk)	46
Table 4-5	Objectives relating to the Land Use Planning and Development Aim (Intolerable Risk)	46
Table 4-6	Objectives relating to the Bank Erosion and Sedimentation Aim (Intolerable Risk)	47
Table 4-7	Objectives relating to the Foreshore Protection Aim (Tolerable Risk)	48
Table 4-8	Objectives relating to the Cultural Heritage Aim (Tolerable Risk)	48
Table 4-9	Objectives relating to the Climate Change and Sea Level Rise Aim (Intolerable Risk)	49
Table 4-10	Objectives relating to the Monitoring and Evaluation Aim (Tolerable Risk)	49
Table 4-11	Results of Ranking and Prioritisation of Management Objectives (refer Appendix C for further details)	50
Table 5-1	Rapid Cost Benefit (Traffic Light) Assessment Criteria – refer Appendix E for application	53

<b>Table 5-2</b>	<b>BMOs, NBOs and Other Options (Water Quality)</b>	<b>56</b>
<b>Table 5-3</b>	<b>BMOs, NBOs and Other Options (Aquatic &amp; Riparian Habitat)</b>	<b>57</b>
<b>Table 5-4</b>	<b>BMOs, NBOs and Other Options (Recreation &amp; Amenity)</b>	<b>58</b>
<b>Table 5-5</b>	<b>BMOs, NBOs and Other Options (Land Use Planning &amp; Development)</b>	<b>59</b>
<b>Table 5-6</b>	<b>BMOs, NBOs and Other Options (Bank Erosion &amp; Sedimentation)</b>	<b>60</b>
<b>Table 5-7</b>	<b>BMOs, NBOs and Other Options (Foreshore Protection)</b>	<b>61</b>
<b>Table 5-8</b>	<b>BMOs, NBOs and Other Options (Natural &amp; Cultural Heritage)</b>	<b>62</b>
<b>Table 5-9</b>	<b>BMOs, NBOs and Other Options (Climate Change &amp; Sea Level Rise)</b>	<b>62</b>
<b>Table 5-10</b>	<b>BMOs, NBOs and Other Options (Monitoring &amp; Evaluation)</b>	<b>63</b>
<b>Table 6-1</b>	<b>Summary of Recommended Best Management Options</b>	<b>65</b>
<b>Table 6-2</b>	<b>Recommended stormwater quality reduction targets from the Botany Bay and Catchment Water Quality Improvement Plan (see SMCMA, 2011)</b>	<b>68</b>
<b>Table 8-1</b>	<b>Trigger values for River Health Monitoring Program</b>	<b>158</b>
<b>Table 8-2</b>	<b>Framework for future review of the Georges River Estuary Coastal Zone Management Plan</b>	<b>162</b>
<b>Table 9-1</b>	<b>Results of Risk Assessment and Ranking of Aims</b>	<b>C-3</b>
<b>Table 9-2</b>	<b>Results of Ranking and Prioritisation of Management Objectives</b>	<b>C-5</b>
<b>Table 9-3</b>	<b>Water Quality Potential Management Options</b>	<b>D-2</b>
<b>Table 9-4</b>	<b>Aquatic and Riparian Habitats Potential Management Options</b>	<b>D-4</b>
<b>Table 9-5</b>	<b>Recreation and Amenity Potential Management Options</b>	<b>D-5</b>
<b>Table 9-6</b>	<b>Land use Planning and Development Potential Management Options</b>	<b>D-6</b>
<b>Table 9-7</b>	<b>Bank Erosion and Sedimentation Potential Management Options</b>	<b>D-7</b>
<b>Table 9-8</b>	<b>Foreshore Protection Potential Management Options</b>	<b>D-8</b>
<b>Table 9-9</b>	<b>Natural and Cultural Heritage Potential Management Options</b>	<b>D-9</b>
<b>Table 9-10</b>	<b>Climate Change and Sea Level Rise Potential Management Options</b>	<b>D-9</b>
<b>Table 9-11</b>	<b>Monitoring and Evaluation Potential Management Options</b>	<b>D-10</b>

# 1 INTRODUCTION AND STRATEGIC CONTEXT

## 1.1 Why Develop a Coastal Zone Management Plan?

The coastal zone of NSW represents a priceless natural resource, and is immensely valuable from an ecological, social and economic perspective. In addition to the open coast beaches and headlands, the NSW coastal zone contains over 130 estuaries that vary in size from small coastal creeks and lagoons to large lakes and rivers. Estuaries contain diverse ecosystems that form the foundation of the coastal food chain. They provide important habitats for a variety of marine and terrestrial plants and animals.



Georges River (photo: OEH)

The Georges River is a highly valued estuary within the Sydney Metropolitan Area. It retains significant ecological value and also acts as a resource for a variety of recreational pursuits. The juxtaposition of natural and urban environments surrounding the Georges River Estuary demands that special management considerations are made to ensure the long term balance and sustainability of this precious resource.

The Georges River Estuary Coastal Zone Management Plan (Estuary Management Plan) (herein referred to as the Georges River CZMP) has

been prepared by environmental consultants BMT WBM, with assistance from isNRM, on behalf of the Georges River Combined Councils' Committee (representing constituent Councils: Bankstown, Fairfield, Hurstville, Liverpool, Rockdale, Kogarah and Sutherland<sup>1</sup>) and the NSW Office of Environment and Heritage (OEH), formerly known as the Department of Environment, Climate Change and Water (DECCW).

The Plan builds on the comprehensive Georges River Estuary Data Compilation and Processes Study (SMEC, 2010), in accordance with the State Government's Estuary Management Process (refer Section 1.6), to satisfy the objectives of the NSW Estuary Management Policy 1992, the NSW Coastal Policy 1997 and the *Coastal Protection Act 1979* (and amendments in 2010). It also helps to satisfy the former Sydney Metropolitan Catchment Management Authority's (SMCMA) catchment target *CTECM1: Improvement in the condition of estuaries and coastal lakes*, and contributes to the implementation of target E4 of the NSW State Plan.

Since the original commencement of the Estuary Management Process for the Georges River, the NSW Government has introduced various reforms to coastal management, including the former Sea Level Rise Policy Statement (2009) (now repealed) and new Guidelines for Preparation of Coastal Zone Management Plans (2010) (note that for the purposes of revised legislation, including the

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<sup>1</sup> Wollondilly Shire and Campbelltown City Councils are included in the GRCCC, but as they have no frontage onto the estuarine reaches of the river, they were not individually included as part of this Estuary Management Plan.



gazettal process, this document is officially called a “Coastal Zone Management Plan” for the Georges River Estuary. These types of plans were formerly known as Estuary Management Plans).

In accordance with Part 4A of the *Coastal Protection Act 1979*, this Coastal Zone Management Plan is to be gazetted by the Councils following certification by the Minister for Environment. Once gazetted, this document must be considered and taken into account when undertaking works or development, or when making new plans that cover areas affected by this plan. A breach of the Plan will result in an offence and associated penalties, as outlined in Part 4A, Division 2 of the CP Act.

Importantly, in following the ‘Guidelines for Preparation of Coastal Zone Management Plans’, Councils are considered to have acted in good faith and thus are exempt from liability relating to land affected by coastal hazards (including future hazards such as sea level rise and associated coastal inundation) as prescribed in Section 733 of the *Local Government Act 1993*.

The Georges River Estuary Coastal Zone Management Plan satisfies the intent and objectives of these new reforms and initiatives taken by the NSW Government, as well as the fundamental principles originally espoused in the Coastal Policy and the previous Estuary Management Policy.

Actions in this plan may require approval under the *Environmental Planning and Assessment Act 1979* and other legislation and should be considered as intended actions subject to these approvals. In the event of any inconsistency between a statutory instrument or development consent issued under the EP&A Act and this plan, the statutory instrument or development consent applies to the extent of the inconsistency.

Any actions, including project funding, noted in this plan for completion by or contribution from the NSW Government, its Departments or Agencies should be considered as requests for funding or action. The NSW Government will consider these requests when determining its state-wide priorities relating to coastal zone management. If any such actions are not completed in accordance with the plan, this is not to be considered a breach of Section 55L of the *Coastal Protection Act 1979*.

## 1.2 Purpose of the Plan

The primary purpose of the Georges River Estuary Coastal Zone Management Plan is to provide strategic direction and guidance on future actions within the estuary and its catchment, which will help to achieve long term balanced environmental sustainability. The fundamental goal of the Coastal Zone Management Plan is to achieve balanced and sustainable demands on the estuary from ecological needs and recreational (human) pursuits.

The Plan shall be used to inform other strategic documents that aim to manage and rationalise human activities and development within the catchment, such as Regional Strategies, Local Environmental Plans (LEPs) and Development Control Plans (DCPs).

The Plan aims to fulfil Councils’ requirement for applying the principles of Ecologically Sustainable Development (ESD) to the Georges River Estuary and its catchment. The Plan also provides an opportunity for future climate change to be considered in the strategic management and planning of the estuary and surrounding sensitive coastal lands.

## 1.3 Who is this Plan for?

The primary audience for this Coastal Zone Management Plan is Councils within the Georges River Estuary catchment. Other stakeholders, including the government departments and the general public, are also likely to take a keen interest in the future management of the estuary, and therefore have been considered during preparation of this Plan.

## 1.4 One Plan for the Whole Estuary

While the estuary and its catchment are partitioned into different Local Government Areas (LGAs) for administrative convenience, the natural processes occurring within the estuary are largely cross-jurisdictional. A coordinated approach has therefore been adopted to investigate and address management needs across the whole of the estuary.

Issues, and associated management responses, are likely to be similar across many LGAs, meaning that there are significant advantages to managing the estuary in a coordinated and integrated manner. Pooled funds and resources are also likely to be more efficiently used, without the need for duplication.

Importantly, a whole of estuary assessment is able to identify and prioritise issues and management responses at the catchment-scale, while co-ordinated and combined applications to funding bodies can also be made to support implementation. Adopting a whole-of-estuary approach allows priority actions to be implemented that will have the best overall outcome for the estuary.

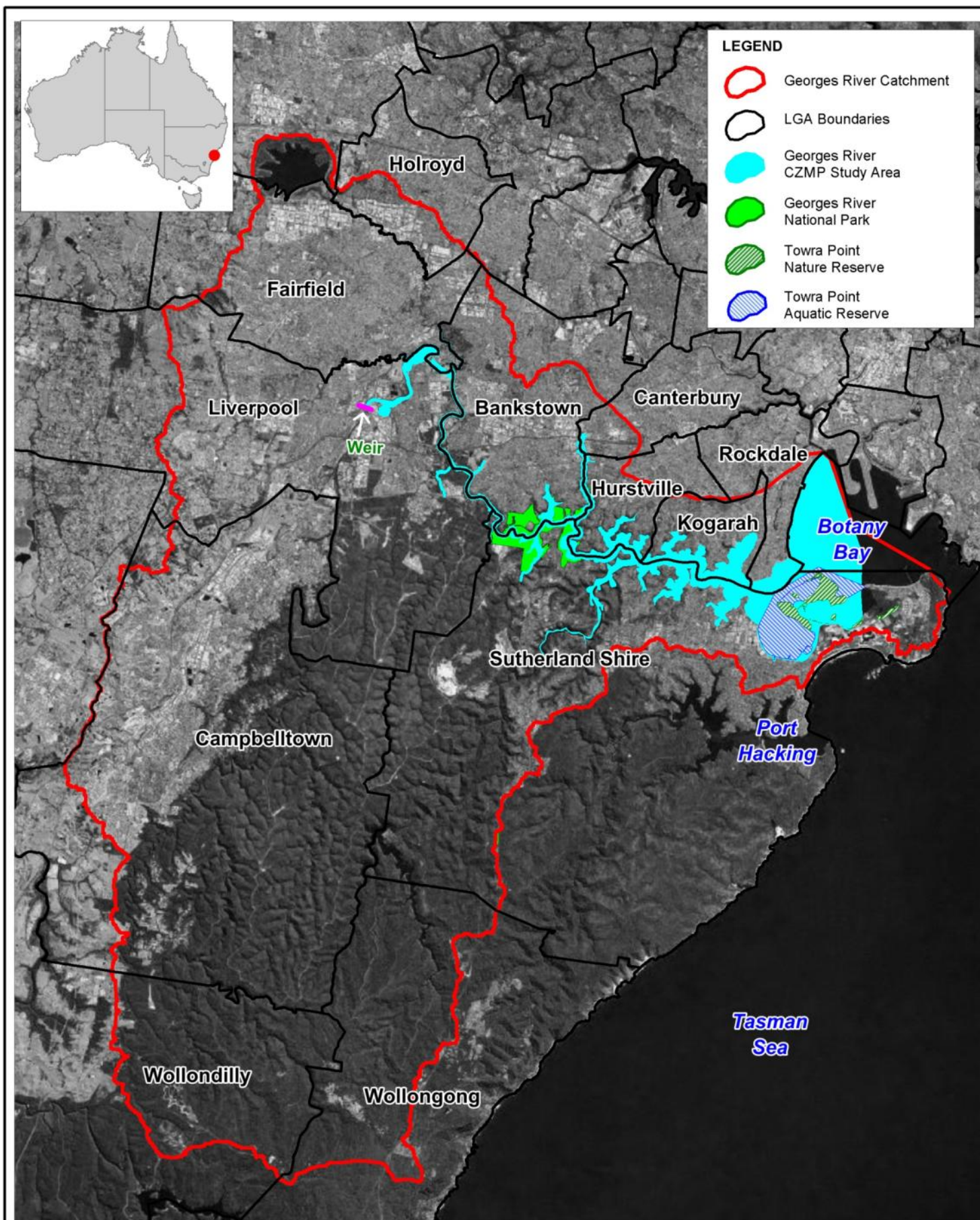
## 1.5 What Area Does the Plan Cover?

This Plan covers the entire Georges River Estuary waterway, located in the southwest of Sydney (Figure 1-1). The upstream limit of the Georges River Estuary is at Liverpool Weir, a distance of 46km from the mouth at Botany Bay. This Plan extends downstream and into Botany Bay as far as Towra Point. The Plan also covers the south and western foreshore of Botany Bay between Towra Point and the Cooks River entrance (predominantly covering Lady Robinsons Beach) and all associated tidal waterways that drain into the study area (including Scarborough Ponds).

The estuary is divided into two regions: Upper Reaches, between Liverpool Weir and Salt Pan Creek; and Lower Reaches, from Salt Pan Creek to Botany Bay. Major tidal tributaries to the estuary include Cabramatta Creek, Prospect Creek, Salt Pan Creek, and Woronora River. As activities beyond the banks of the estuary can have a significant impact on its health, the entire catchment of the Georges River has therefore also been *considered* as part of the Plan, insofar as it impacts on the condition of the estuary. The Georges River Estuary catchment area covers a significant portion of the Greater Sydney Metropolitan Region, with a population of more than a million people. The land surrounding the estuary is highly urbanised and supports many land uses including: residential, Army firing range, market gardens, agriculture, mining, industrial manufacturing, landfills and nuclear research facilities.

The lower reach of the Georges River Estuary has been heavily modified and residential development extends to the foreshore in most locations. The estuary is also a popular recreational area for many people in the surrounding communities for fishing, waterskiing, swimming and watersports.





Title:  
**Study Area**



Figure:  
**1-1**

Rev:  
**A1**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 5 10km  
Approx. Scale



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## 1.6 NSW Estuary Management Process

For the past 20 years, the Estuary Management Process in NSW has been guided by the Estuary Management Policy (1992) and Estuary Management Manual (1992). The NSW Government's *Guidelines for Preparing Coastal Zone Management Plans* (the CZMP Guidelines) have now replaced the Estuary Management Manual and combines the former coastal and estuary management processes. Under the CZMP Guidelines, estuary management is required to focus on addressing risks to the health of estuaries through practical management actions. Focus is guided towards estuary health, because this aspect is not explicitly investigated or managed through any other council or state planning process.

Fundamentally, the steps required to prepare a Coastal Zone Management Plan, in accordance with the CZMP guidelines, are:

1. Identify and discuss the planning framework relevant to management of the estuary;
2. Prioritise management objectives based on a combination of issues that need attention, and conservation of natural and social values;
3. Assess and select potential management options to achieve the objectives;
4. Detail a schedule of activities for the implementation of the best management options; and
5. Indicate responsibilities and sources of funding for implementing the best options.

The development of the Plan has been co-ordinated by the GRCCC, and overseen by the Georges River Estuary Management Committee, which has representatives from all relevant Councils as well as key state agencies and other stakeholders.

Once the Plan has been endorsed by the community, GRCCC, member councils and partner agencies, the recommended management options can start to be implemented, in accordance with the framework presented in the Plan.

A key platform of the new CZMP Guidelines is the adoption of a risk-based approach to the management of estuary health. Risk-based management of estuaries has several key advantages, including:

- all risks are assessed and compared equally, ensuring that management efforts are directed towards those areas or issues that pose the greatest risk to estuary health and sustainability;
- better streamlining of the Plan with existing Council's operational plans, as the risk approach inherently requires that existing management efforts are included in the assessment of risk, rather than a duplication of actions;
- the risk approach identifies the highest priority risks, which are not currently being managed (sufficiently) through any other process, targeting management resources towards the highest priority issues;
- management options can be designed to reduce the likelihood of the risk (e.g. planning setbacks) and the consequence of the risk (e.g. emergency management works); and
- where there is a high level of community concern regarding an issue that presents a low risk, monitoring and trigger levels can be set without absorbing funding resources unnecessarily.



Under Section 733 of the *Local Government Act 1993*, councils are taken to have acted in ‘good faith’ and receive an exemption from liability where their actions were done substantially in accordance with the “coastal management principles” given in the CZMP Guidelines (DECCW, 2010b). Further, intended changes to Section 117 of the *Environmental Planning and Assessment Act 1979* will require the CZMP Guidelines be taken into consideration when councils prepare their local environment plans (LEPs).

The “coastal management principles” (DECCW, 2010b) and how these principles have been addressed or achieved within this Georges River Estuary Management Study and Plan are given in Table 1-1.

**Table 1-1 Coastal Management Principles (DECCW, 2010b) addressed by the Georges River Estuary Plan**

	Coastal Management Principles	Addressed by Georges River Estuary Management Study and Plan	Report Section
Principle 1	Consider the objectives of the Coastal Protection Act 1979 and the goals, objectives and principles of the NSW Coastal Policy 1997 and the former NSW Sea Level Rise Policy Statement (2009)	The Georges River Estuary management objectives are aligned with the NSW Coastal Policy and former NSW Sea Level Rise Policy Statement 2009.	1.6
Principle 2	Optimise links between plans relating to the management of the coastal zone	Relevant existing plans and initiatives being adopted by state agencies and the various Councils have been identified through the consultation workshops and have been integrated into the implementation of Best Management Options	3, 6
Principle 3	Involve the community in decision-making and make coastal information publicly available	Comprehensive consultation with community and targeted stakeholders has been undertaken in developing this plan, including workshops, on-line surveys, and interviews with stakeholders and community members	3
Principle 4	Base decisions on the best available information and reasonable practise; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach	This Plan has been preceded by an exhaustive assessment of Estuary Processes (SMEC, 2010). Management options have recognised the complex interactions between catchment and estuarine environments. The on-going monitoring and evaluation requirements will ensure that management of the estuary will be adaptive, cognisant of existing and emerging issues and treatment options.	2.2, 8
Principle 5	The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practical long-term outcomes	Assessment of potential management options has recognised the public benefit as priority	Appendix D

	Coastal Management Principles	Addressed by Georges River Estuary Management Study and Plan	Report Section
Principle 6	Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risk where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented	This plan has been prepared giving consideration to ISO 31000:2009 International Standard Risk Management Principles and Guidelines. Risks associated with 'not achieving Management Aims' have been assessed, while assessment of options have considered the potential for reducing risks.	1.6, 5, Appendix D
Principle 7	Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions	The adaptability of management options to future circumstances was a consideration in selection of preferred options.	5, Appendix D
Principle 8	Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems	Specific objectives and options for prioritising rehabilitation for at risk coastal and estuarine ecosystems have been developed.	4.2.2, 5
Principle 9	Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy	Appropriate public access to estuary foreshores has been considered in developing objectives and options for this Plan.	4.2.3, 4.2.5, 5
Principle 10	Support recreational activities consistent with the goals of the NSW Coastal Policy	This plan supports the on-going use of the Georges River Estuary waterway and public foreshore areas for recreational pursuits, which is reflected in its objectives and management options	4.2.3, 5

## 1.7 Key Legislation and other Instruments Guiding Estuary Management

The Georges River Estuary and its catchment are subject to a myriad of environmental planning and management instruments and legislation, spanning some seven LGAs (each with its own planning framework, policies and plans). In addition to these instruments and statutory documents, there is also a vast array of management plans and strategies that are relevant to the Georges River, ranging from overarching Commonwealth initiatives down to site specific Plans of Management. Strategies and plans that relate just to natural resource management (NRM) within the Georges River catchment were identified previously by Evans and Peck (2008), and are summarised in Figure 1-2.

In addition to legislated Acts of Parliament, there are two main types of statutory environment planning instruments (EPIs): Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). There are also other instruments that guide management of natural resources, including the Georges River.

The existing environmental planning and strategic management frameworks relevant to the Georges River are summarised below, with further information provided in Appendix A.



### 1.7.1 State Environmental Planning Policies

There are a number of State Environmental Planning Policies (SEPPs) that may be relevant to the Georges River Estuary. These include:

- Greater Metropolitan Regional Environmental Plan No 2—Georges River Catchment (this is now regarded as a SEPP);
- SEPP 19 – Bushland in Urban Areas
- SEPP 44 – Koala Habitat Protection
- SEPP 50 – Canal Estate Development
- SEPP 62 – Sustainable aquaculture
- SEPP 71 – Coastal Protection
- SEPP (Major Development) 2005
- SEPP (Infrastructure) 2007
- SEPP (Mining, petroleum production and extractive industries) 2007
- SEPP (Western Sydney parklands) 2009

Of particular note, Division 25 of SEPP (Infrastructure) 2007 refers to waterway and foreshore environmental management activities, including riparian corridor management, bank stabilisation, weed management, revegetation activities, and the creation of foreshore accessways. In this regard, the relevant local Council is deemed to be the public authority, and as such, does not require development consent to undertake waterway and foreshore environmental management activities.

Additionally, Greater Metropolitan Regional Environmental Plan (REP) No. 2 (Georges River Catchment) is also deemed a SEPP (as REPs are phased out of the planning hierarchy). The Georges River Catchment REP aims to protect the water quality of the Georges River and its tributaries as well as the environmental quality of the whole catchment. The REP establishes the framework within which local, State and Federal agencies will consult so that there is a consistent approach to planning and development within the Georges River catchment.

Key SEPPs relevant to the Georges River Estuary are discussed further in Appendix A.

### 1.7.2 Local Environmental Plans and Development Control Plans

Local Environmental Plans (LEPs) are planning instruments produced by local councils to direct the type of development in local government areas. LEPs aim to conserve the natural environment, whilst creating attractive living areas and ensuring development complies with ecologically sustainable principles. Through planning and development controls, they allow councils to regulate the ways in which land is used by defining permissibility for different types of development across an entire LGA, as a requirement of the Environmental Planning and Assessment Act 1979. LEPs are statutory documents, meaning it is illegal to develop land contrary to that permitted by the LEP.

Development Control Plans (DCPs) are non-statutory instruments that support the LEPs, by providing specific, more comprehensive guidelines for types of development, or specific areas within a local government area. DCPs contain a specific range of conditions (including visual amenity, drainage,

access, pollution control, vegetation etc.) aimed at optimising land use in an environmentally sustainable manner.

On 31 March 2006, the Standard Instrument (LEPs) Order 2006 was gazetted. Its purpose is to reduce the number of planning documents and improve the consistency in documents across local councils by introducing a standard template LEP. The Standard Instrument provides for 34 standard zones for LEPs, for use by Councils when preparing their new LEPs according to the Standard Instrument. Councils are required to update existing LEPs to accord with the Standard Instrument Order by 2011. Within the Georges River Estuary catchment, only Liverpool has a gazetted LEP that complies with the Standard Instrument, while all other Councils have draft LEPs in preparation. A list of the LEPs and DCPs relevant to the Georges River Estuary are presented in Table 1-2.

**Table 1-2 Local Government Planning Instruments**

Local Environmental Plan	Development Control Plan
Sutherland Shire LEP 2006 (and draft 2013)	Sutherland Shire DCP 2006
Kogarah LEP 1998	Various DCPs (to be consolidated)
Hurstville LEP 1994 and 2012	Hurstville DCP1 / DCP2
Rockdale LEP 2011	Rockdale DCP 2011
Bankstown LEP 2001	Bankstown DCP 2005
Fairfield LEP 1994 and 2013	Fairfield DCP 2013
Liverpool LEP 2008	Liverpool DCP 2008

### 1.7.3 State and Commonwealth Legislation and Policies

There are a number of NSW and Commonwealth Parliamentary Acts that are relevant to the management of the Georges River Estuary and catchment. Key Acts and policies are listed below, while further details are given in Appendix A:

- *Environmental Planning and Assessment Act 1979;*
- *Coastal Protection Act 1979;*
- *Local Government Act, 1993;*
- *Crown Lands Act 1989;*
- *National Parks and Wildlife Act, 1974;*
- *Fisheries Management Act, 1994;*
- *Threatened Species Conservation Act, 1995;*
- *Heritage Act 1977;*
- *Protection of the Environment Operations Act, 1997;*

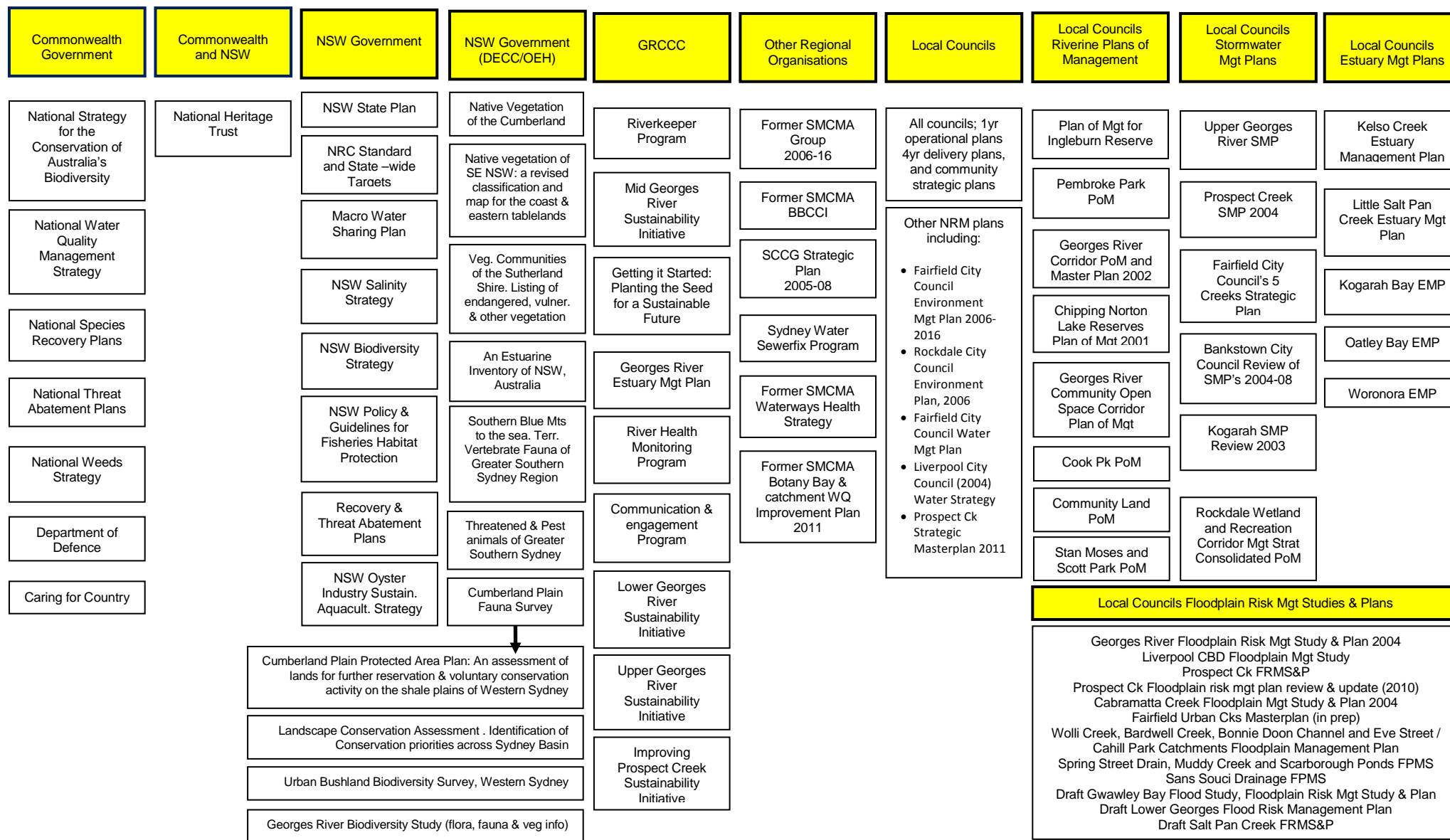
- *Noxious Weeds Act 1993*;
- *Water Management Act 2000*;
- *Native Title Act 1977*;
- NSW Coastal Policy 1997;
- Planning for Bushfire Protection 2006;
- NSW State Plan; and
- *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999*.

#### 1.7.4 Other Natural Resource Management Initiatives

During the course of this Plan development, the Sydney Metropolitan Catchment Management Authority (SMCMA) was incorporated into the Hawkesbury Nepean Catchment Management Authority (HNCMA). Before being incorporated into the HNCMA, the SMCMA prepared the Sydney Metropolitan Catchment Action Plan (CAP) 2009, which will still be relevant for some elements of natural resource management across the Georges River estuary and catchment until the draft Hawkesbury Nepean CAP 2013 – 2023 is adopted.

In addition to the CAP, there are a large number of other natural resource management initiatives that are applicable to the Georges River Estuary, ranging from peak Commonwealth strategies, down to place-based Plans of Management. An overview of existing natural resource management strategies is provided in Figure 1-2, as derived from Evans and Peck (2008).

In developing the Georges River Estuary Coastal Zone Management Plan, due consideration has been given to these existing strategies, and their potential for implementation across the LGAs relevant to the Plan.



## 2 PROCESSES, VALUES AND ISSUES OF THE GEORGES RIVER

### 2.1 Preamble

The Georges River Estuary has experienced significant change over the past 200 years. The upstream limit of the estuary, Liverpool Weir, was constructed by convict labour 175 years ago to supply water to the growing township of Liverpool. As a result, the estuary now has a clearly delimited upstream end, and the weir is listed with the National Trust.



Liverpool Weir (photo: OEH)

During the early years of settlement in the district, the estuary would have received a significant supply of sediment as the catchment was progressively cleared and then farmed. The more contemporary transition from rural to urban land use throughout the 20<sup>th</sup> Century would have also placed additional stress on the estuary through high sediment loading, contaminated leachate (including sewage) and general urban pollutant runoff. Intensification of the catchment land use continues today, and would still be potentially increasing pollutant loads to the estuary.

Uncontrolled sand extraction throughout the mid 20<sup>th</sup> century in the upper reaches of the estuary has dramatically changed the river morphology. Implications of this have been dire for the estuary, with reduced tidal flushing, accelerated bank erosion, and water pollution. Water quality within the Georges River Estuary was also significantly compromised by direct discharges from the Glenfield Sewage Treatment Plant, which continued up until 1986. Meanwhile, sediments in the estuary remain affected from a long history of commercial activities and on-going urban runoff.

Despite these notable historical impacts and stressors, the Georges River Estuary has managed to maintain significant environmental value. Large sections of the catchment to the south remain forested, while a diversity of habitats and species can still be found across the estuary, including many Endangered Ecological Communities (EECs). In many respects, the Georges River has become typical of most urban estuaries, wherein environmental values need to be balanced against the demands from a community that resides and recreates within and around the waterway. Indeed, as the urban pressures increase, the value of any residual natural environment also increases. Highlighting this point, Towra Point, at the entrance to the Georges River in Botany Bay, is the only notable area of saltmarsh left in Sydney, contains some 50% of all of Sydney's mangroves, and is an internationally recognised and significant Ramsar site (DECCW, 2010c). Towra Point also contains an Aquatic Reserve and a Nature Reserve.

The community values the Georges River estuary primarily for its environmental services, and also its recreational potential. Primary contact activities are desirable across the estuary, while the community considers that ecological conditions should be maintained at a high conservation level (but recognising that some areas are also moderately to highly disturbed) (SMCMA, 2011).

Councils and other land use managers are taking steps towards controlling runoff and improving the overall environmental health of the estuary. There are some 30 bushcare groups within the

catchment, while major investment has been made to try and rehabilitate degraded foreshores and estuarine areas (including clean-up of previous oyster farms). Also, the former Sydney Metro CMA's Botany Bay Catchment Water Quality Improvement Plan [BBWQIP] (2011) aims to reduce pollutant loads through catchment-based measures. This Coastal Zone Management Plan should complement these existing initiatives by recommending a range of measures that focus on a holistic perspective for environmental sustainability of the estuary.

## 2.2 Estuary Processes (SMEC, 2010)

A comprehensive Estuary Data Compilation and Processes Study for the Georges River was carried out by SMEC (2010), and forms the necessary prerequisite stage to this Coastal Zone Management Plan. It documents the key physical, chemical and biological processes occurring within the Georges River Estuary (and catchment) that have an impact on the existing condition of the waterway and its future management needs and limitations.

Presented below is a summary of this Data Compilation and Processes Study.

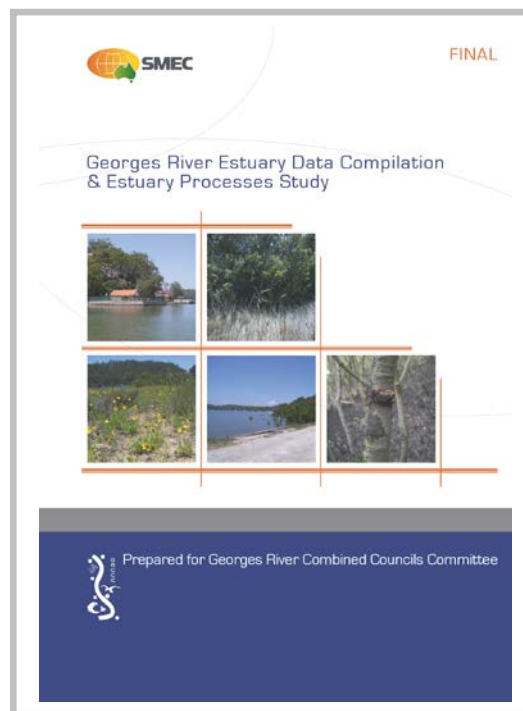
### 2.2.1 Geology and Estuary Type

The Georges River Estuary is classified as a drowned river valley. The estuary is characterised by a deep channel and steep rocky foreshores along the lower reaches, which opens up into extensive alluvial floodplains towards the upper end of the estuary. The lower reaches have been carved into Hawkesbury sandstone (shown in yellow in Figure 2-1), while the upper reaches more reflect Wianamatta shale geology of gentle undulating slopes draining to a low alluvial plains (shown in Red in Figure 2-1).

The Georges River flows into Botany Bay, which is roughly circular (8km in diameter) and has a typical depth of 4.5m. The entrance channel to Botany Bay has been dredged to a depth of 21m to accommodate vessel movements into and out of Port Botany.

The Georges River was first surveyed by Cook in 1770, although since then there have been major morphological changes, notably in the upper reaches of the estuary where extensive dredging and reclamation has occurred over the past 60-70 years. Typical depths along the Georges River estuary are about 4 m.

The total length of the Georges River (extending up to Appin, at an elevation of some 350m above sea level) is around 100km, although the estuarine component is limited by Liverpool Weir, located approximately 46km from the river mouth. Geological surveys of paleo river channels indicate that during previous glacial periods (when sea level was 100m+ lower than at present), the Georges River (as well as the Cooks River) flowed through the existing Kurnell sand dunes and across Bate Bay towards the edge of the continental shelf (Albani and Rickwood, 2010) (refer Figure 2-2).







## 2.2.2 Sediment Processes

### 2.2.2.1 Catchment Soils

The soils across the northern portion of the study area, which are derived from the underlying Wianamatta Shale geology (refer Figure 2-1), have a high potential for erosion. The fine-grained and highly dispersive nature of these soils also has a tendency to make receiving waters turbid, especially after rainfall. Compounding this issue is the fact that the northern half of the study area has been extensively developed, thus providing ample opportunity over the past 200 years to liberate sediment from the catchment, which would then have been deposited within the estuary, or advected into Botany Bay and onto the continental shelf during times of flood.

The soils overlying the sandstone regions of the catchment (refer Figure 2-1) tend to be more porous and less dispersive, although they would still be subject to water and wind erosion, especially when overlying vegetation has been disturbed.

### 2.2.2.2 Sedimentation

The Georges River Estuary (excluding Botany Bay) can be split into three broad regions of bed sediments. These are:

- the main channel reach above Como Bridge which is mainly sandy;
- the main channel reach below Como Bridge which is predominantly composed of clay and silt; and
- the large off-channel bay areas in the lower estuary where the major sediments are flocculent silts and clays.

Overall longitudinal downstream fining of sand bed sediments (i.e. the sediments become finer with distance downstream) illustrates a fluvial dominance in the estuary, especially along the upper reaches. The sediments of the estuary roughly accord to the estuarine zonation developed by Roy *et al.* (2001), with the lower reaches below Como Bridge and the large off-channel bays forming a central mud basin, transitioning to an alluvial delta upstream of Como Bridge, and then a riverine channel from about Picnic Point upstream (refer Figure 2-3). The marine flood tide delta is essentially limited to Botany Bay and areas around Towra Point, although flood tide processes have clearly changed in geological times as the previous link to the ocean became occluded through dune transgression across the Kurnell peninsula, leading to the present day connection through the mouth of Botany Bay.

The rate and location of sedimentation within the Georges River is expected to have been modified due to anthropogenic factors. Development of the catchment would have increased the amount of sediment delivered to the estuary, thus accelerating sedimentation rates. This is typical of most estuaries that have experienced catchment development. Once the development stabilises, runoff rates and hence sedimentation rates, tend to subside. Of specific relevance to the Georges River is the significant amount of dredging that has occurred throughout the upper reaches as part of historical sand extraction enterprises. The uncontrolled extraction has created several very large basins within the river and floodplain morphology, which would act as sediment basins, attracting accelerated rates of fine sedimentation. Similarly, but at a smaller scale, the construction of Liverpool Weir would also have promoted localised sedimentation in the upstream weir pool.



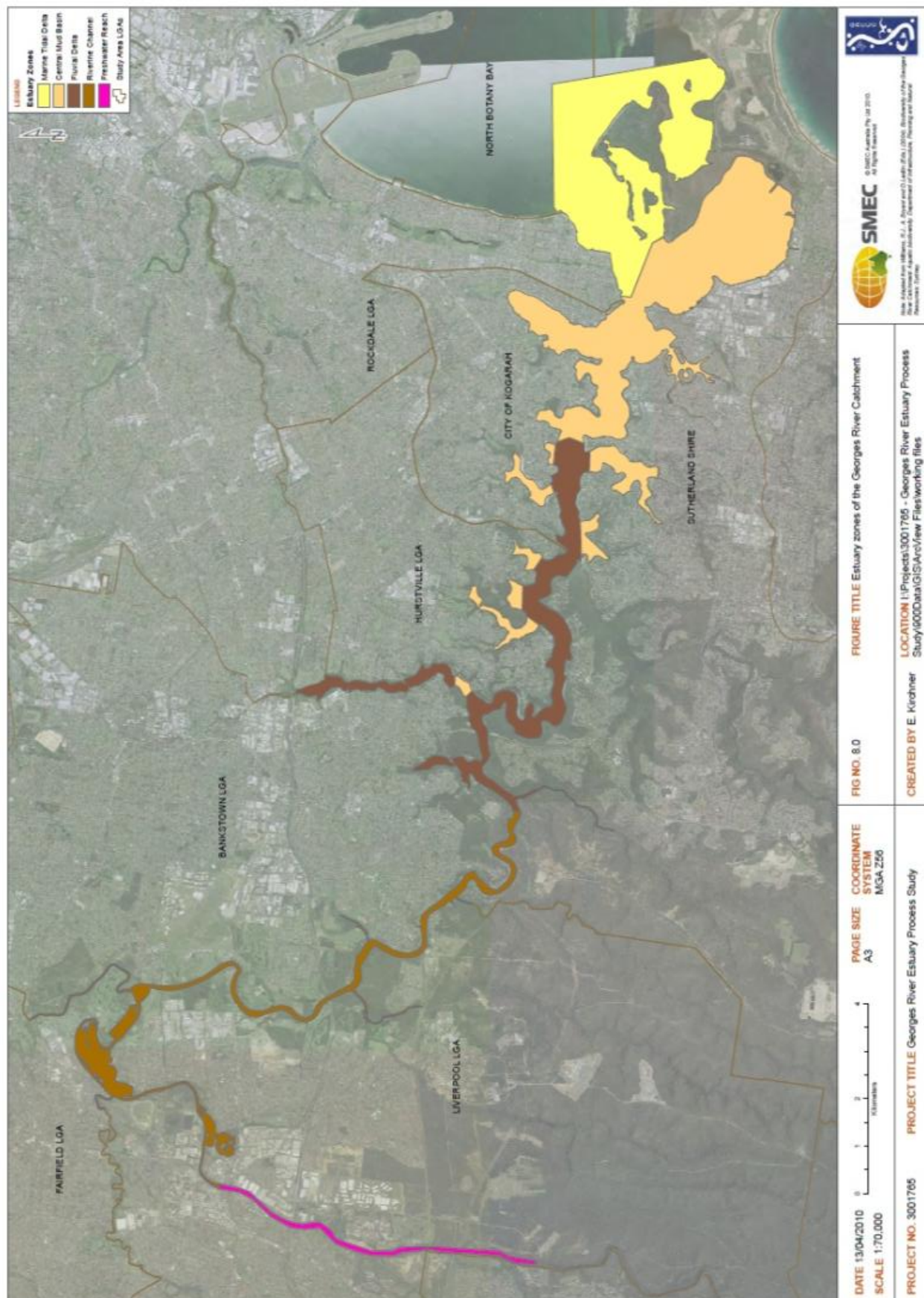


Figure 2-3 Zonation of the Georges River based on sedimentary processes (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)

Associated with the historical deep dredging in the upper reaches, some riverbanks have collapsed and retreated due to over-steep subsurface slopes. The continuing erosion and bank retreat would be contributing to sedimentation throughout the estuary.

In Botany Bay, ocean swell waves have an influence on the longshore sediment transport processes occurring along the shoreline, and in particular, Lady Robinsons Beach. Net southerly transport of sand along the southern half of Lady Robinsons Beach has led to accretion at Dolls Point, while there is a net northerly sediment transport along the northern half of the beach. There is also strong westward sediment transport along Towra Point, which is driven by the obliquity of this shoreline to the incoming swell waves.

### 2.2.2.3 Sediment Quality

The Georges River Estuary received runoff from an intensively urbanised and industrialised catchment. The estuary has also been used for a range of boating and maritime activities, and as such has been a major repository for urban and industrial waste, including metalliferous loadings (e.g. copper, zinc, nickel, lead). Waste dumps and sewerage overflows have also contributed to high pollutant loading into the estuary. Many pollutants, including metals, attach to sediments, which can accumulate within poorly flushed sedimentation zones across the estuary, including the upstream ends of bays and within deeper dredge holes.

Birch *et al.* (1996) report that the majority of estuarine areas in the Georges River have pollutant concentrations (heavy metal, PAH) in the sediments in excess of background levels, although it is considered that this work may have been influenced by localised external factors. Albani and Rickwood (2010) have thus further explored geochemistry of the Georges River Estuary noting the particular shortcomings of previous analytical approaches. Albani and Rickwood (2010) conclude that “the bottom sediments in Georges River are remarkably free of elevated concentrations of most elemental contaminants, but some of the bays and tributaries have sediment that should be considered to be mildly contaminated. For example, Prospect Creek and Salt Pan Creek samples had Zn at an elevated level that should be monitored”.

### 2.2.2.4 Dredging

Dredging has occurred in Botany Bay and along the Georges River since 1948 (SPCC, 1979). The major dredging occurring in the Georges River Catchment was at Moorebank and Chipping Norton Lakes. Chipping Norton Lakes were originally the result of illegal dredging and unregulated extraction activities between the 1950s and 1977. The average removal depth was 9.5m and 7.5m for the north and south ponds, respectively. Construction sand was also dredged around Riverland Golf Course upstream of Salt Pan Creek prior to the 1980s.

Dredging within Botany Bay has had an impact on the foreshore of the study area, more particularly along Towra Point and Lady Robinsons Beach. Dredging in Botany Bay was carried out to provide deepwater navigation to Port Botany, the Australian Oil Refinery jetty and offshore of Kyeemagh. These changes in bed depth changed the wave refraction processes within the bay, increasing wave energy along the more southern shoreline (e.g. Towra Point, Lady Robinson Beach) (SPCC, 1978).

Major dredging campaigns have also been carried out in Botany Bay to provide fill material for large foreshore reclamation projects, including the Sydney Airport, and Port Botany developments.

### 2.2.2.5 Bank erosion

The lower reaches of the Georges River are incised within a deep sandstone gorge (ie drowned river valley), and thus are not susceptible to significant bank erosion. The upper reaches on the other hand have developed across alluvial plains of friable and erodible sediment. Changes to the hydrologic flow regime of the estuary (through increased runoff due to urbanisation of the catchment) are likely to have led to a morphological response by the river channel. Indeed, as the process of channel change is slow, it is possible that the upper reaches of the Georges River will continue to

adjust for many decades (or even centuries) to come. A general channel widening has been observed between Liverpool Weir and East Hills, with some areas in the upper reaches of the river, already experiencing an increase in cross-sectional area by up to 60%.

Compounding the morphological change in the upper reaches is the broadscale dredging that has occurred, which fundamentally changes the hydrodynamic processes that are responsible for channel adjustment. Furthermore, dredging too close to the sides of the river have led to over-steep subsurface slopes, causing mass failure of riverbanks and accelerated bank



Georges River bank erosion (photo: OEH)

recession.

Other factors that are likely to have increased bank erosion along the Georges River include:

- Major floods, which scour the outside of bends – made worse if these banks are eroding due to other processes as well;
- Boat wash and wind waves (compounded if fetch lengths have been increased, e.g. across Chipping Norton Lakes);
- An increase in tidal prism within the upper reaches (i.e. creation of Chipping Norton Lakes), thus increasing tidal velocities along downstream sections; and
- Uncontrolled foreshore access and disturbance of riparian vegetation.

Informal bank protection measures have been employed at various locations along the estuary in an effort to halt bank recession. Dumped concrete blocks, bricks and other building refuse has been used in some locations, which significantly compromises the visual and environmental values of the foreshore, and may not necessarily even reduce erosion (in fact, poorly constructed walls can exacerbate erosion, especially at the edges of the structure). Recent surveys of the entire Georges River foreshores are detailed in the Estuary Processes Study report (SMEC, 2010), and indicate that Chipping Norton Lakes and Floyd Bay have mostly been stabilised through



Seawall at Howard Park (photo: SMEC, 2010)



seawall construction, as well as many foreshores around the lower estuary reaches, while the river channel upstream of Chipping Norton continues to erode significantly. High priority erosion areas have been identified for each LGA along the Georges River, and are detailed in SMEC (2010).

## 2.2.3 Hydrodynamic Processes

### 2.2.3.1 Tides

The tides in the Georges River area are typical of the NSW east coast, being semidiurnal with a diurnal inequality. Tidal range (vertical difference between high and low tide) is essentially constant along the River with differences in levels of less than 0.1m between the Liverpool Weir (mean spring tide<sup>2</sup> range of 1.31m) and Botany Bay (mean spring tide range of 1.25m). The tidal lag from Botany Bay up to Liverpool Weir is about 2.5 hours (SPCC, 1978).

The tidal prism is the volume of water held between high tide and low tide. It represents the volume of water exchanged with the estuary each time. Between 1960 and 1980, the tidal prism of the Georges River upstream of Milperra increased from 700,000 m<sup>3</sup> to 1.6 million m<sup>3</sup> due to the construction of Chipping Norton Lakes.

With a large tidal prism, the most downstream sections of the estuary are relatively well flushed. The peak tidal flow rate into the estuary is approximately 4,000 m<sup>3</sup>/s. In comparison, the dry weather freshwater inflows to the estuary are about 5 m<sup>3</sup>/s, while the peak 1 in 10yr flood flows are about 850 m<sup>3</sup>/s. Despite the strong tidal dominance, there are still some 'dead water areas' at the heads of most side embayments.

Tidal currents in both Botany Bay and Georges River are generally less than 1m/s. Dredging in Botany Bay and in the upper reaches of the Georges River have reduced these currents locally, and would likely promote sedimentation, as discussed previously.

### 2.2.3.2 Waves

Wind waves are generated where winds blow over long stretches (called fetches) of water. Larger wind waves are expected within the Chipping Norton lakes as well as Botany Bay. These waves have a characteristic period ranging from 1 to 5 seconds and contain relatively little energy, although it is directed principally over a narrow portion of the bank profile at the waters edge.

Wake generated by boats has similar wave characteristics to minor wind waves. On larger bodies of water, the boat wake energy is mostly dissipated before reaching shore, however, on narrower waterways, and in locations where boats are closer to the banks (e.g. around boat ramps), wake-induced erosion can be problematic.

Ocean swell waves penetrate the entrance of Botany Bay and are refracted by the bay bathymetry (which has been modified through dredging and reclamation) onto surrounding foreshores. The usual wave period for ocean swell waves is between 8 and 15 seconds, meaning it contains much higher

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<sup>2</sup> Spring tides are the larger tides that occur during the course of a month corresponding with full moon and new moon, when the gravitational pull of the moon is greater. The lesser tides, between the spring tides, are called 'neap' tides.

energy than wind or boat waves. Wave heights within Botany Bay are generally less than 0.5m with only 10% of the waves exceeding 1m, and rare occurrences of up to 2m in some locations.

Swell-wave induced longshore sediment transport around the foreshores of Botany Bay has been managed through the construction of shore-normal groynes. Historical changes to the bathymetry of Botany Bay have changed the internal refraction pattern, and thus the longshore processes. Some shorelines have attempted to respond to this by natural realignment (e.g. at Towra Beach).

### 2.2.3.3 Flooding

The major floodplain areas of the Georges River Estuary are located between Liverpool and East Hills, along Cabramatta Creek and along Prospect Creek. These areas are subject to the most significant flood risk as they are urbanised and located in low-elevated landscapes. The Cabramatta and Prospect Creeks floodplains are of particular concern because they are fully urbanised, with flood flows approximately 190% and 60% higher than natural conditions for these creeks, respectively. The times to reach peak flow conditions would also have reduced significantly as a consequence of urbanisation within the catchments, thus reducing flood response times and increasing risks to the community. Around 30% of the flood prone area contains residential and industrial/commercial developments, while the remaining 70% are mostly open spaces.



1986 flood in Georges River (photo: GRCCC)

Two significant flood events have occurred within the past 30 years - 1986 and 1988. These events have been determined to be about a 1 in 20 year Annual Recurrence Interval (ARI) flood (SMEC, 2010). More than 1000 residential properties along the Georges River, Cabramatta Creek and Prospect Creek were flooded by these events.

The 1956 flood was larger than the 1986 and 1988 events, but was still relatively small compared to the flood of record, in 1873, which attained peak water levels at Liverpool Weir of 10.5m AHD, which is some 3m higher than the 86/88 levels, and 1m higher than the estimated 1 in 100yr ARI flood. In total, there are approximately 8,500 properties potentially affected by flooding up to the Probable Maximum Flood (PMF) along the Georges River Estuary, with over 2,600 of these considered at high risk.

Development over the past 20 years or so (particularly in the Prospect and Cabramatta Creek catchments) is expected to have potentially modified flood risks along the Georges River. Development within the floodplain has intensified, involving the filling of large tracts of flood-prone land, and has increased exposure to risks. Meanwhile, the construction of Chipping Norton Lakes, sand extraction at Moorebank and the selective removal of homes from floodways (notably in the Milperra – Moorebank and Prospect Creek floodplain areas) are expected to have reduced overall flood risk.

Floodplain management options that have been considered and implemented to some degree within the Georges River Estuary include:

- Voluntary purchase of affected homes;
- Voluntary house raising;
- Flood protection works, such as levees;
- Basins, such as detention basins; and
- Flood warning systems.

## 2.2.4 Water Quality

### 2.2.4.1 Flushing and Mixing Characteristics

The Georges River and its tributaries are generally considered to be vertically well-mixed, with relatively small differences in water quality between the surface and bottom of the water column profile. The typical salinity gradient along the estuary is shown in Figure 2-4, highlighting near-marine conditions (i.e. 35ppt) up to Como Bridge, and then a steady decline resulting in more brackish conditions at Liverpool Weir, which has typical salinities of about 5 – 10ppt.

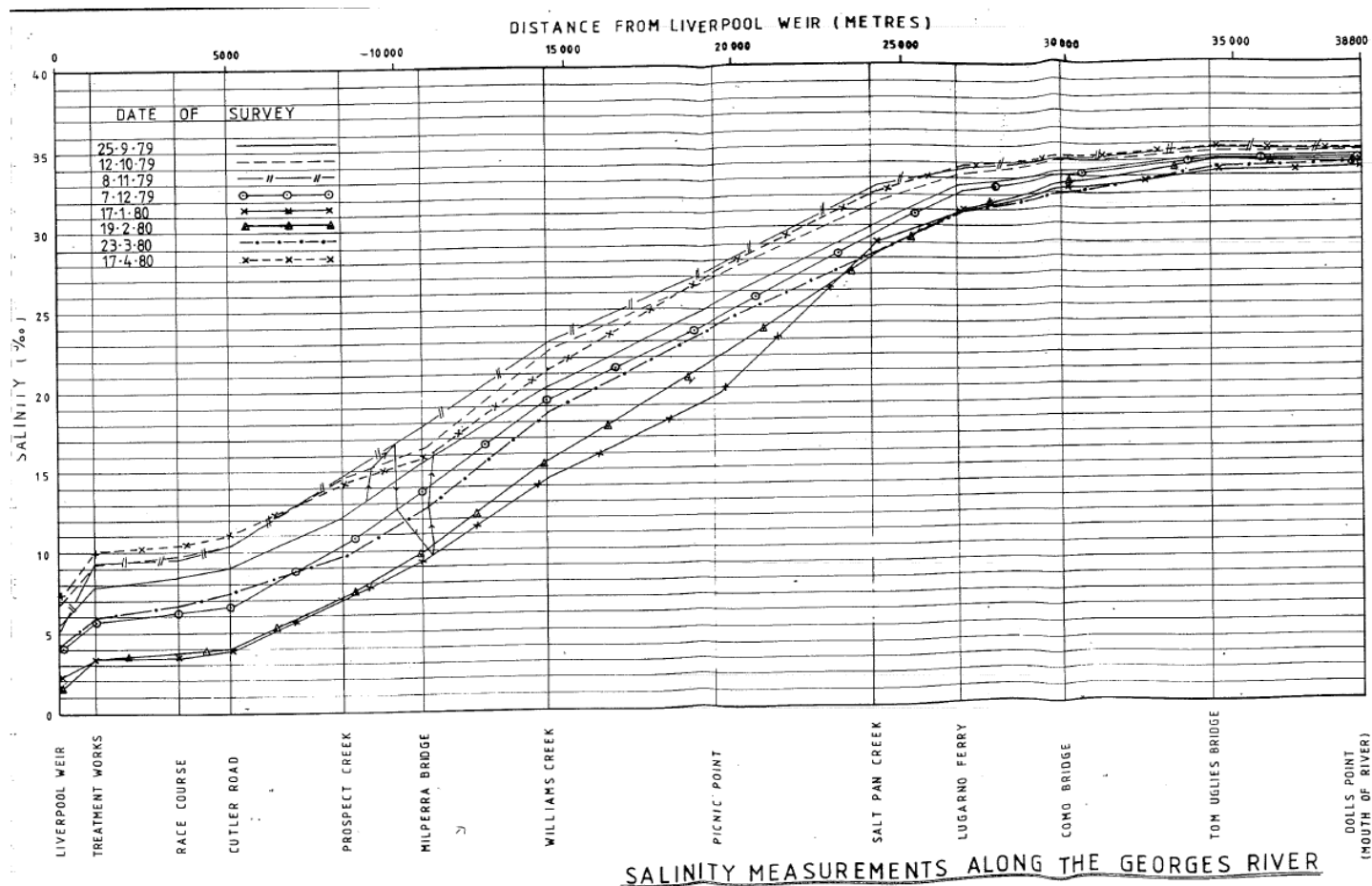


Figure 2-4 Typical salinity profile along the Georges River Estuary (PWD, 1990)

The salinity profile is a function of the typical freshwater inflows, and the relative tidal exchange occurring along the estuary. The near marine conditions downstream of Como Bridge indicate that this section of the estuary receives relatively good tidal exchange. Therefore, pollutants entering the estuary within this reach are comparatively well diluted and dispersed with incoming ocean waters. The degree of tidal exchange then reduces significantly with distance upstream. Even though the freshwater inflows are relatively small, the upper reaches of the estuary remain strongly influenced by the catchment inflows, as indicated by the suppressed salinity concentrations. Therefore, pollutant inputs to this section of the estuary are more critical as there is not as much tidal flushing and dispersion as in downstream reaches.

Under high flow conditions, much of the saltwater can be advected out of the river, particularly the upper reaches, with stratification (freshwater overlying more saline water) lasting for up to two weeks. The recovery of the salt wedge into the estuary would depend on the size of the freshwater event. SPCC (1979) found that return to 'equilibrium' conditions was slow after a freshwater event, indicating relatively poor longitudinal mixing and dispersion characteristics. Deep holes within the river (e.g. Chipping Norton Lakes) would likely retain brackish/saline conditions near the bed except for under the largest of freshwater events. It is expected that high flows would also correspond with poor water quality conditions in the river, and particularly along the upper reaches where catchment runoff would dominate the receiving water environment.

#### *2.2.4.2 Factors affecting water quality*

In addition to the natural flushing and dispersion characteristics of the estuary as described above, the water quality of the Georges River has been affected notably by a range of anthropogenic factors. For example, urbanisation of the catchment has contributed greatly to pollutant loadings and poor water quality in the estuary. Also, extensive dredging activities along the river and the eventual construction of the Chipping Norton Lakes have altered the hydrodynamics of the river (and thus flushing and mixing characteristics), and has increased turbidity through localised bank instability.

Land reclamation activities, using waste as fill material, caused the destruction of many wetlands, and have been at least partially responsible for the collapse of the oyster, prawn and fish industry in the Georges River. Sewage from the Glenfield, Holsworthy and Liverpool STPs, which is high in nutrients, pathogens and other pollutants, was directly discharged into the river up to 1986, causing widespread issues of eutrophication and poor water quality in the upper sections of the Georges River. While there has been some recovery from these past activities, many of the toxic chemicals, heavy metals and pollutants still remain in the Georges River bound to riverbed sediments.

A number of point and diffuse sources of pollution continue to contribute to the degradation of water quality in the Georges River. In addition to general catchment runoff from the highly urbanised catchment, which includes a mix of gross pollutants, heavy metals and nutrients, point source sewerage overflows occur during heavy rainfall. Sydney Water's sewerfix program aims to reduce the frequency of sewer overflows, but with aging infrastructure, the demand for remediation is high. Furthermore, some recreational activities like dirt biking and four wheel driving along the river's foreshores would increase sediment runoff and contribute to water turbidity.

Managing pollutant inputs to the estuary is now a major task for Councils and the HNCMA, with funding and projects aimed specifically at stormwater pollution, including WSUD initiatives. It has been estimated that 95% of the total contaminant load to the Georges River / Botany Bay estuary is

now derived from stormwater runoff, so the recent focus on stormwater management is considered appropriate.

#### 2.2.4.3 *Current water quality conditions*

Appraisal of the current 'snap shot' river health conditions in the Georges River using a 'report card' format, as established by the GRCCC, is shown in Figure 2-5. Despite the long history of pollution and elevated catchment runoff loads, it is considered that the water quality of the Georges River Estuary has improved in recent years. But there is still a significant range in water quality conditions across the estuary, from very good conditions within areas close to the National Park (e.g. Mill Creek, Woronora River), to highly degraded conditions within the heavily urbanised tributaries (e.g. Cabramatta, Prospect and Salt Pan Creeks).

### 2.2.5 Ecology

Estuarine vegetation found within and surrounding the Georges River Estuary has been mapped in Figure 2-7 to Figure 2-9. These include:

- Seagrass;
- Mangroves;
- Saltmarsh;
- Estuarine Reedland; and
- Swamp Oak Forest.

There is approximately 375ha of seagrass within the study area, the vast majority of which is located within and around the Towra Point Aquatic Reserve and Towra Point Nature Reserve in Botany Bay. Towra Point contains eelgrass (*Zostera*) and strapweed (*Posidonia*) species, while only eelgrass and paddleweed (*Halophila*) are found within the river channel. Seagrass is considered to be in reasonable condition, with typical levels of epiphytic growth, however, some beds contain prominent swathes that have been cut by boat propellers and mooring chains.

Approximately 470ha of mangroves have been mapped within the study area, with the majority of these again located at Towra Point. Towra Point contains some 50% of the mangroves found within the Sydney metropolitan region. Both the Grey Mangrove and the River Mangrove are present within the estuary.

The area of saltmarsh in and around the estuary covers approximately 145ha, virtually all of which is found at Towra Point, and represents the only remaining substantial saltmarsh area in Sydney. The distribution of saltmarsh has reduced in general over the whole estuary due to reclamation and urban development.



Foreshore mangroves & bushland (photo: OEH)



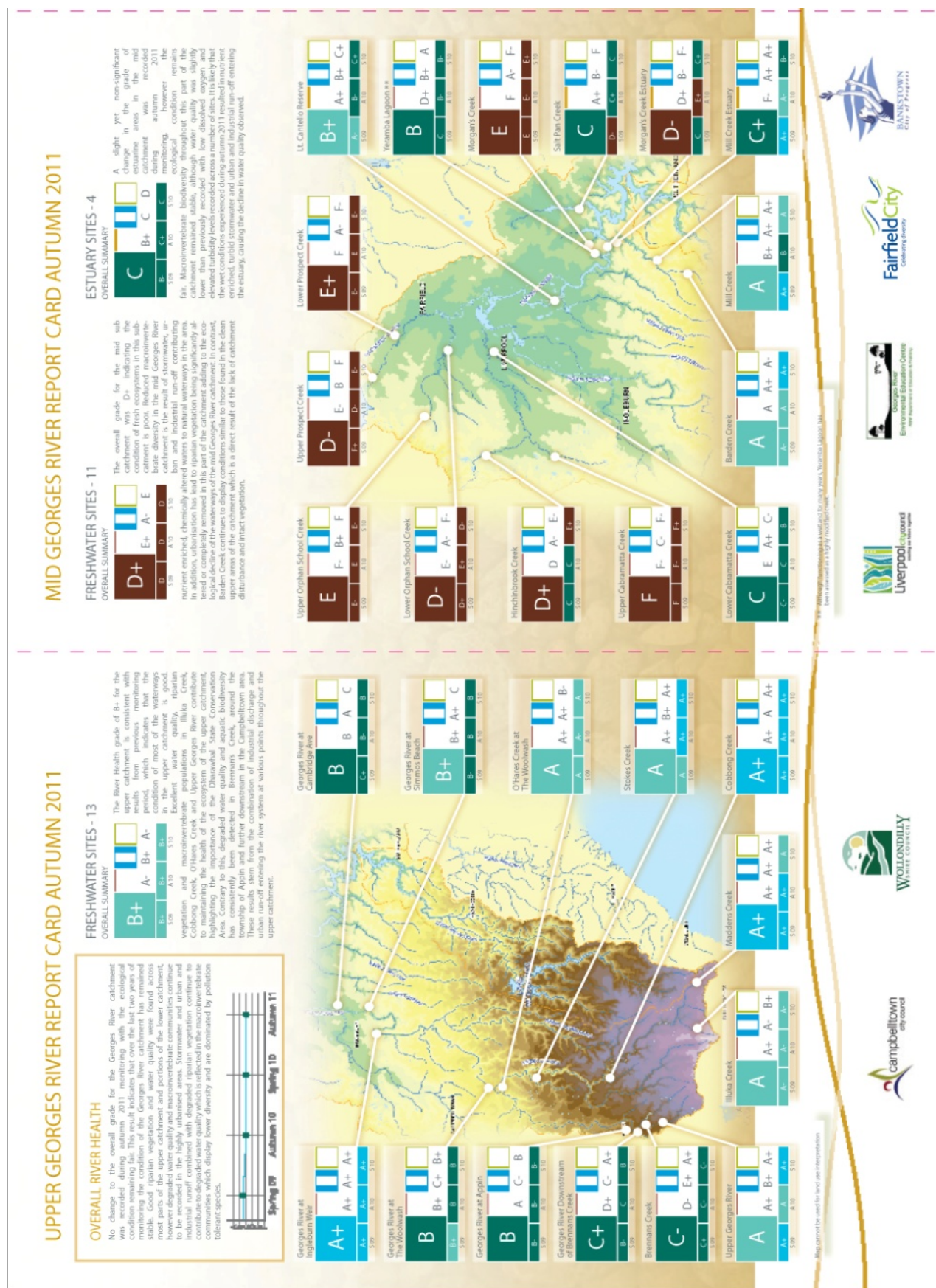


Figure 2-5 Water quality condition of the Georges River Estuary (upper and mid reaches) (source: <http://www.georgesriver.org.au/River-Health-Monitoring-Program.html> - refer source for detail) (see Figure 2-6 for legend)



## RIVER HEALTH REPORT CARD AUTUMN 2011

### A SNAP-SHOT OF RIVER HEALTH

The autumn 2011 sampling campaign for the Community River Health Monitoring Program has been completed. This is the fourth sampling event conducted under current Australian Government funding.

During sampling, several important river health indicators were monitored to provide a 'snap-shot' of catchment health: water quality, vegetation and macroinvertebrates.

By combining the results of the river health indicators and analysing monitoring data in the project moves along, we will gain a greater understanding of the Georges River system.

Findings from this program are being used to inform the ecological condition of the Georges River.

Since 2009, volunteers have contributed over 1700 hours of field work to the program and gained a valuable insight into the dynamic nature of the Georges River system.



#### MACROINVERTEBRATES

Macroinvertebrates are small animals without a backbone, such as snails, worms, yabbies and crabs. Macroinvertebrate populations provide us with valuable information on the health and quality of the aquatic ecosystem. As they are particularly sensitive to changes in water quality, monitoring macroinvertebrates is providing us with a good indication of the health of the river within the Georges River catchment and of the quality of the aquatic habitat they live in.



#### WATER QUALITY

Monitoring water quality is providing us with a better understanding of how urbanisation and changed land use practices are affecting the health of the river and estuarine ecosystems. Many organisms are sensitive to changes in water quality and populations may become stressed if changes to water quality occur. This can lead to reduced population numbers or local species extinction.



#### VEGETATION

Healthy riparian (stream bank) and estuarine vegetation are important for maintaining a functioning ecosystem. Vegetation plays a major role in providing habitat, nutrient recycling, regulation of temperature and filtration of stormwater runoff. By monitoring these vegetation communities we are gaining a better understanding of their condition and the subsequent impacts on the river. We are also monitoring the quality within the Georges River catchment.

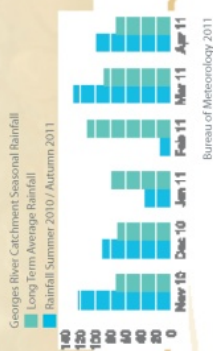
### THE GRADING SYSTEM

River health parameters are assessed against environmental guidelines allowing the award of a grade between A+ and F.

A+	EXCELLENT
A - B+	GOOD
B - C+	FAIR
D+ - F	POOR

### CATCHMENT AVERAGE RAINFALL

Above average rainfall fell across the Georges River catchment during spring 2010, which was followed by a very dry summer period resulting in rainfall levels well below long term averages. The dry spell ended in March 2011 with above average falls across the catchment throughout early and mid autumn.



### INTERPRETING GRADING ICONS

This diagram shows an example grading box. Use this example to interpret the results from the individual sub-catchments.



Acknowledgments: The Georges River Community River Health Monitoring Program was developed by C. Tipple, A. Harkin and P. Berles and is modelled on the following existing programs: 1. BHMP (2006), Ecosystem Health Monitoring Program 2006-07 Annual Technical Report, South East Queensland Healthy Waterways Partnership, Brisbane. Centre for Environmental Management, Central Queensland University. 2. WCC (2009), Coball and Terriroa Ecosystem Health Monitoring Program, 2009 technical report, International Water Centre, Brisbane. 3. Story ANZ, Anderson LE, Lynae J & Melville F (2007), Port Curtis Ecosystem Health Report Card, Port Curtis Integrated Monitoring Project (PIMP), Cover photography by C. Tipple, GRCGCC Community River Health Monitoring Program Report Card autumn 2011

## LOWER GEORGES RIVER REPORT CARD AUTUMN 2011

### FRESHWATER SITES - 7

The overall grade for the lower sub-catchment was C which indicates that the condition of the lower sub-catchment is fair. The high-ly urbanised parts of the lower catchment displayed elevated chemical properties and slightly degraded riparian vegetation. The lower end of the catchment despite an increase in the volume of the stormwater entering the lower estuary due to the wet conditions experienced during autumn 2011.

### ESTUARY SITES - 7

No change to the overall grade of estuarine areas in the lower end of the Georges River. The autumn 2011 monitoring with the ecological condition remaining fair. Slight fluctuations in macroinvertebrate communities were observed across the estuary. The lower end of the catchment despite an increase in the volume of the stormwater entering the lower estuary due to the wet conditions experienced during autumn 2011.

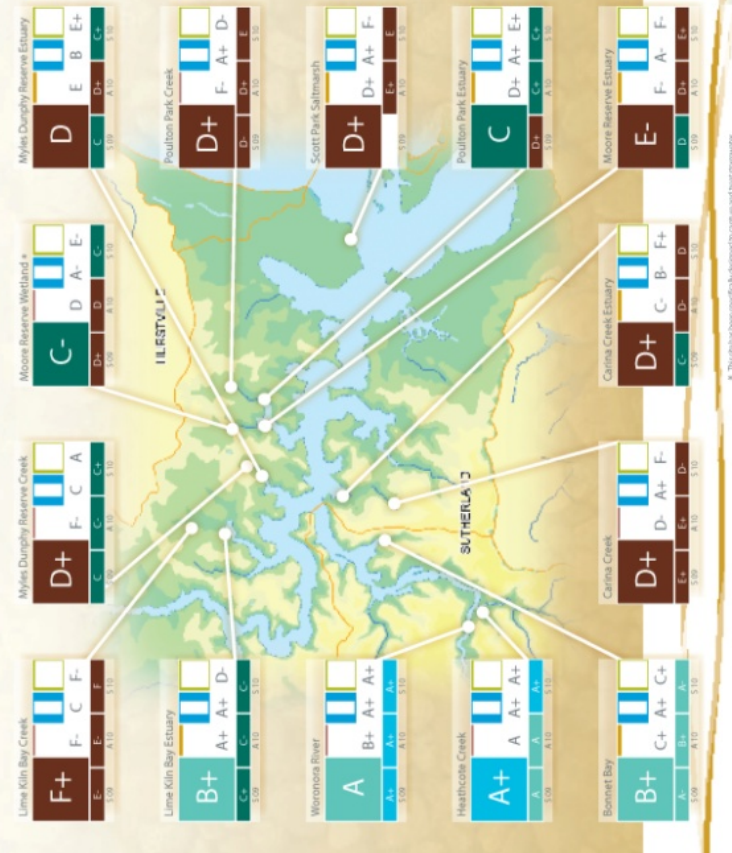
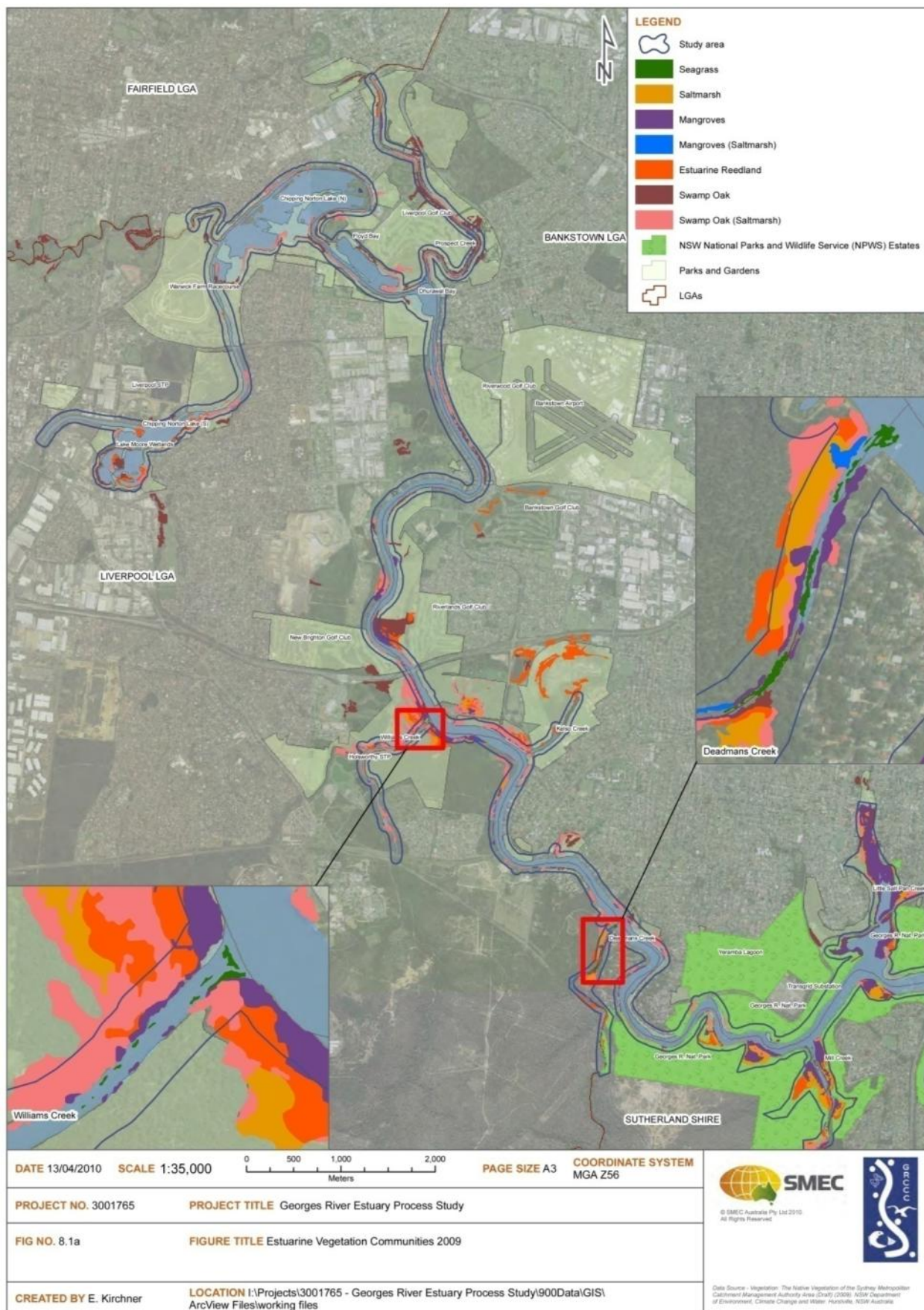


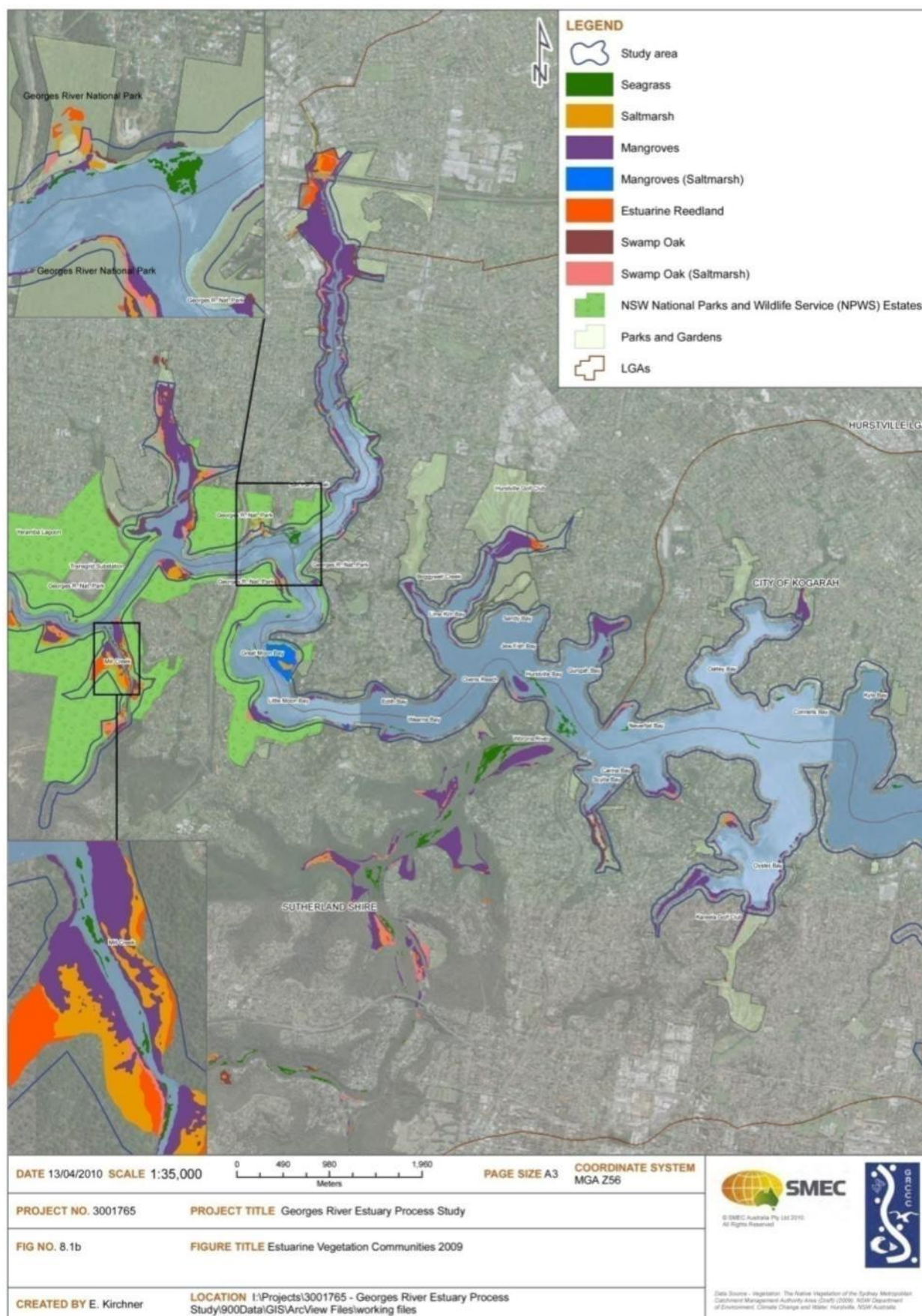
Figure 2-6 Water quality condition of the Georges River Estuary (lower reaches) (source: <http://www.georgesriver.org.au/River-Health-Monitoring-Program.html> - refer source for detail)





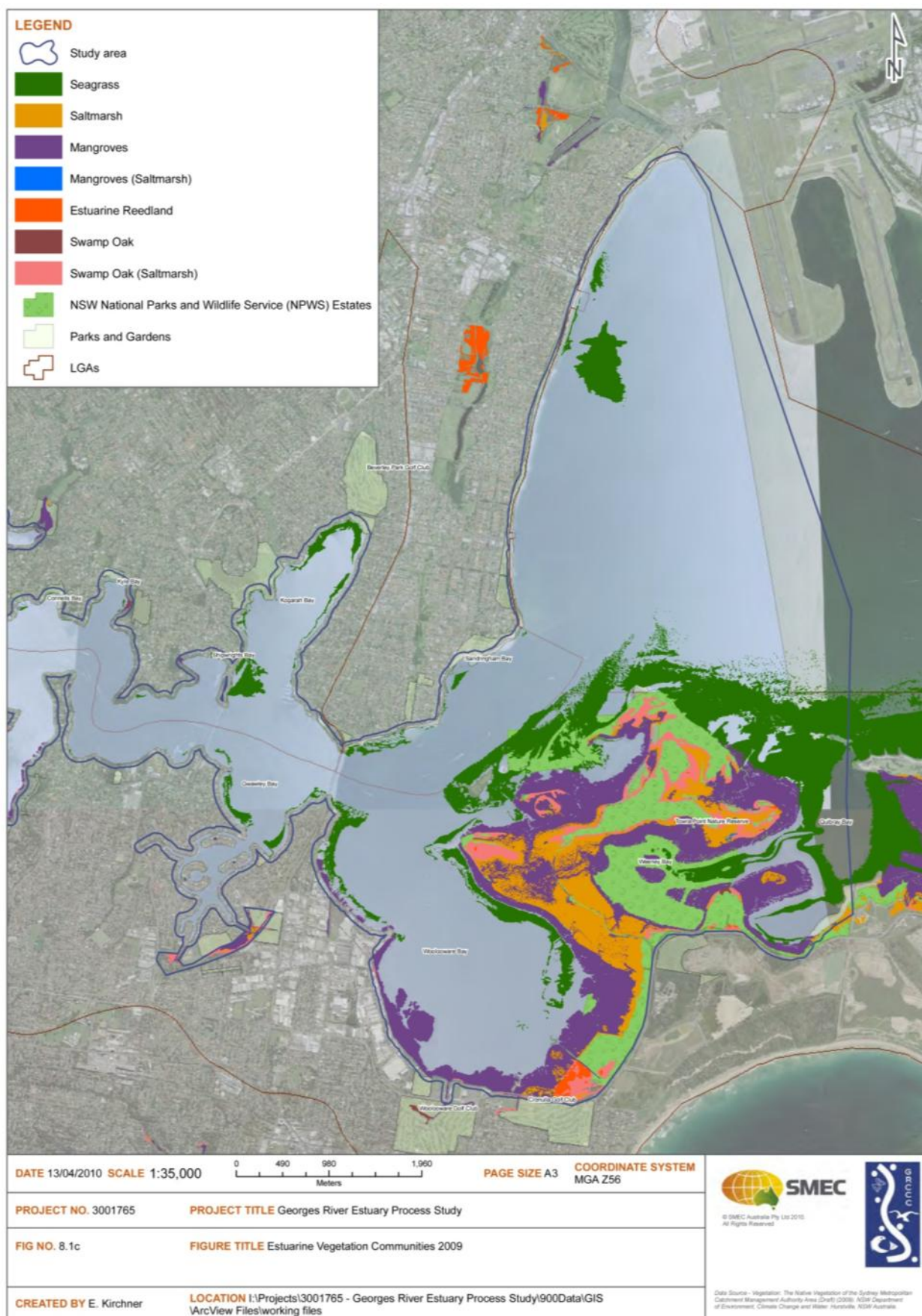
**Figure 2-7 Significant estuarine vegetation communities along the Upper Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)**





**Figure 2-8 Significant estuarine vegetation communities along the Mid Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)**





**Figure 2-9 Significant estuarine vegetation communities along the Lower Georges River Estuary (Source: SMEC, 2010) (refer to SMEC, 2010 for original high resolution mapping)**



Estuarine reedlands occur in pockets along the entire reach of the study area, from Lake Moore wetlands to Woollooware Bay. The reedlands cover an area of approximately 23ha.

Estuarine Swamp Oak Forest also occurs along the entire estuary, from Lake Moore wetlands to Quibray Bay in Botany Bay, and covers some 126ha.

Thirty riparian vegetation communities were found to occur within the areas surrounding the river. The condition of the riparian vegetation is considered mostly good with minimal invasive plants. Communities in poorer condition were typically found in the more upstream areas on more erodible soils, near stormwater outlets, close to urban areas and where rubbish tends to accumulate.

Several of the estuarine vegetation communities are Endangered Ecological Communities (EECs) under the *Threatened Species Conservation Act* 1995, while mangroves and other marine vegetation are also protected under Part 7 Division 4 of the *Fisheries Management (FM) Act* 1994. Furthermore, beds of *Posidonia australis* within Botany Bay are listed as an Endangered Population in Schedule 4 of the FM Act. Other threatened flora and fauna species are also considered likely to occur within the habitats provided by these riparian and estuarine areas. The wetlands of the study area, and Towra Point in particular, are important habitat for threatened and migratory bird species, many of which are listed under international treaties. Towra Point is a listed Ramsar wetland, with both saltwater and freshwater habitats, and where some 200 different bird species have been recorded.

## 2.3 Human Usage

The Georges River Estuary is surrounded by a variety of land uses. These land uses influence the health of the river system in different ways, with urban and industrial uses increasing pressure on the river ecosystem and degrading estuarine health.

The dominant land use surrounding the estuary is urban, which includes a mixture of residential and commercial land use (refer Figure 2-10). Threats from urban areas on estuary health include invasive plants, pollution from diffuse (i.e. stormwater runoff) and point sources (i.e. overflows from sewerage pipes), vegetation clearing, illegal dumping of waste, vandalism and predation by domestic pets.



Foreshore development (photo: OEH)

The estuary is flanked by several golf courses and sports clubs, while there are a large number of recreational facilities along the foreshores, including boatramps, jetties and cycling paths.

Historically, the river was used commercially for fishing and oyster farming. Commercial fishing in the Georges River and Botany Bay was prohibited in 2002 with Botany Bay declared a recreational fishing haven. Recreational fishing on the Georges is now high and the recreational fishing community has a strong interest in restoring aquatic habitat, with some restoration projects already funded through the Recreational Fishing Trust Habitat Actions Grants Program.

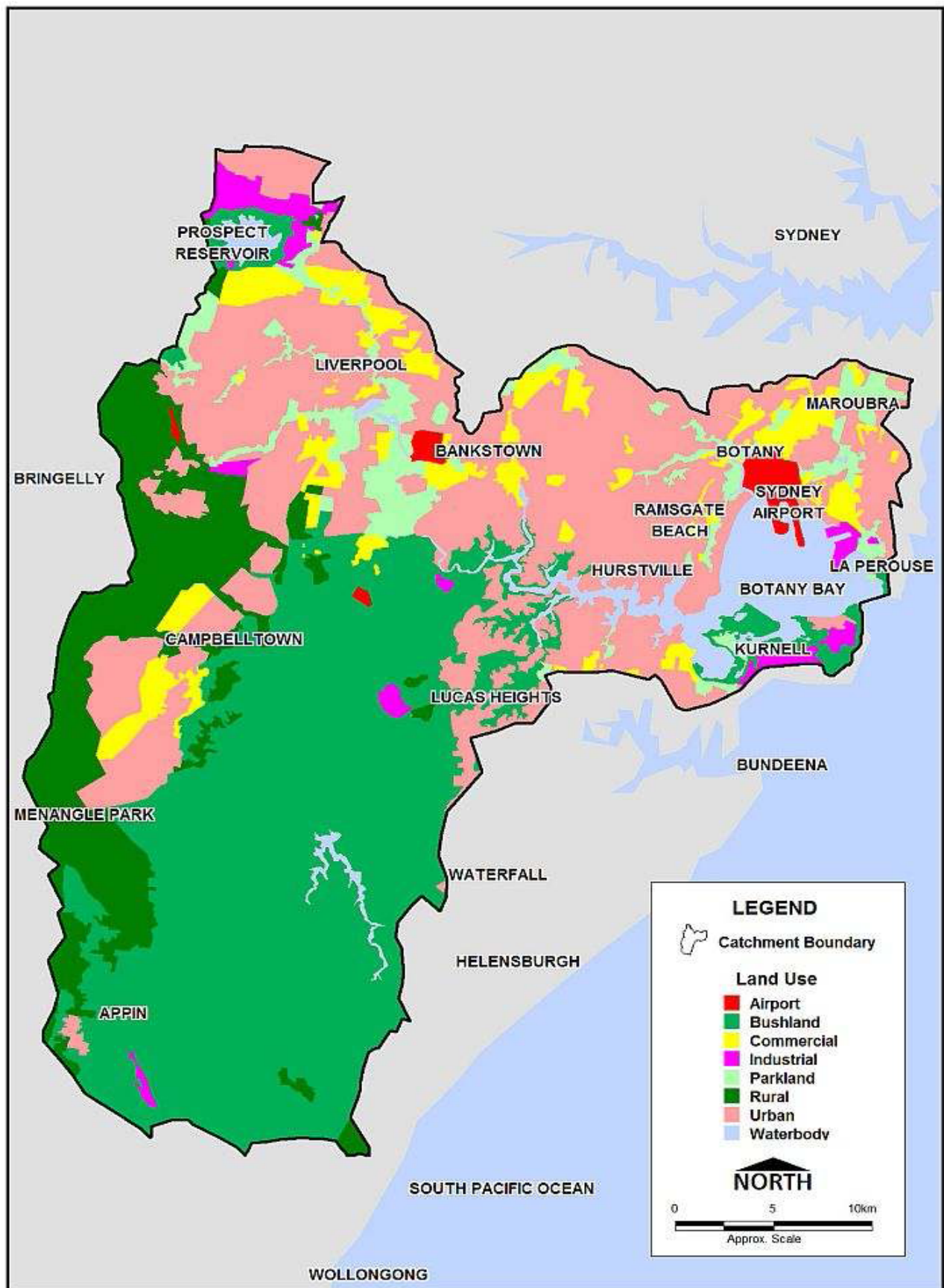


Figure 2-10 Land uses across the entire Georges River catchment (Source: SMCMA, 2007)

Oyster farming in the estuary has suffered from pollution and disease. There are only a few active oyster leases remaining today (essentially in Botany Bay), while a Government-funded clean-up program has attempted to remove the debris left behind by commercial operators, such as tar sticks and racks.

Bush regeneration is undertaken through approximately 30 individual bushcare groups across the catchment area, most of which are organised through Councils. Community groups are also involved in the environmental health monitoring program, the results of which were presented previously in Figure 2-5.

Waterway activities undertaken by the community have been determined via survey by the former SMCMA (2008). When asked '*what activities have you done in our waterways in the past 5 year period?*', 75% of respondents indicated **walking**, while 67% indicated **bushwalking** and **party/picnicking**. The majority of the highest ranking activities indicated by respondents were passive forms of recreation, including cycling, showing to visitors, educational activities, swimming, reflection and artistic pursuits. More active recreation, such as boating, cruising, power boating, jet skiing and water skiing typically ranked low, with less than about 15% of respondents having pursued these activities in the past 5 years (SMCMA, 2008).

## 2.4 Estuary Values

The social significance or value of the estuary was also explored by the former SMCMA as part of the BBCCIP (SMCMA, 2008). Two different questions asked by the survey provide information on community values of the estuary. Firstly, when asked '*what do you appreciate most about the waterways?*', 76% of responses replied with recreational use. Also appreciated by the community were the Estuary's views (68%), the peace and quiet (68%), access (65%), wildlife (63%), open space (59%) and natural pristine areas (53%). The second question asked the community '*what aspect of activities are you concerned about losing from our waterways?*'. From this, it is inferred that the community also values the following existing attributes of the estuary: water quality (87%), native vegetation (78%), local biodiversity (76%), native wildlife (75%), scenic beauty and amenity (71%) and the natural balance of the environment (68%).

The outcomes of surveys on the values of the Georges River highlight a strong connection with the waterways from both an **environmental** and **recreational** perspective. Furthermore, the recreational values provided by the estuary have a strong environmental dependency. It is evident that within the heavily urbanised metropolis of Sydney, the Georges River estuary provides a very important nature refuge, where the community can escape to and appreciate the wonders of the Australian landscape and natural environment through passive recreational pursuits.



Boating on the Georges River (photo: OEH)

Another question asked of the community by the former SMCMA (2008) was *'how would you like to be able to use the waterways in the future?'*. This is a very interesting question, as it helps to identify a future vision for the estuary. The responses to this question were largely similar to the responses relating to existing use, indicating that conservation and preservation of existing values and conditions is an important management focus. However, there was one activity that was ranked reasonably low for existing usage, but topped the list for desirable future use – this being swimming. Clearly, the community have a desire to be able to swim more in the natural waterways of the Georges River, but concerns over **water quality** (the key concern for the estuary) prevents this activity from being undertaken to its full potential.

## 2.5 Issues for Future Management

Based on an appreciation of the community values of the Estuary, combined with a detailed understanding of the physical, chemical and biological processes that are occurring within the Estuary and its catchment, the key issues driving future management of the Estuary have been established, and are discussed in further detail below.

### 2.5.1 Improvement in Water Quality

Despite current water quality monitoring efforts, there is limited data describing the historical water quality conditions of the Georges River Estuary. Water quality has historically been poor in the upper reaches of the estuary, due to a high concentration of pollutant inputs, prolific bank erosion, and low natural flushing capacity. Water quality in the lower reaches is likely to be much better, but may still be compromised from time to time by catchment runoff and/or sewerage overflows after rainfall.

Water quality data (from 1997 to 2009) from the Bankstown LGA (covering Prospect Creek, Salt Pan Creek, Little Salt Pan Creek, Kelso Creek, and the Georges River) presented in SMEC (2010) indicate that ANZECC guideline values are frequently exceeded for a range of parameters including phosphorus, nitrogen, turbidity, chlorophyll-a, dissolved oxygen and coliforms (primary contact). The interaction of potentially contaminated sediments with the overlying water quality is also of unknown consequence.

Harbourwatch bacterial monitoring results also presented in SMEC (2010) indicate occasional elevated levels of coliforms and enterococci at a number of baths in the lower estuary, including Carrs Point and Oatley Bay, as well as foreshore beaches along Botany Bay. There are many sewerage overflows located within the urbanised catchment area of the Georges River Estuary. Bacterial contamination is likely to originate from general catchment runoff as well.

Water quality control from existing urban environments can be very difficult given limited space availability along the stormwater network. The BBWQIP (SMCMA, 2011) sets out reduction targets for chlorophyll-a and turbidity within the Georges River Estuary, which have been based on the community environmental values and scientific information (refer Table 2-1).

SMCMA (2011) also define stormwater reduction targets for new urban developments within the Botany Bay catchment, as presented in Table 2-2. The BBWQIP (SMCMA, 2011) recommends that all new developments comply with these reduction targets through application of Water Sensitive Urban Design (WSUD) measures.



**Table 2-1 Reduction targets for Chlorophyll-a and Turbidity (SMCMA, 2011)**

Area	Reduction needed	
	Chl-a	Turbidity
Upper Georges River Estuary	44%	91%
Middle Georges River Estuary	38%	74%
Lower Georges River Estuary	19%	38%
Botany Bay	Target met	Target met

**Table 2-2 Stormwater reduction targets for urban development (SMCMA, 2011)**

Stormwater pollutant	Greenfield developments, Large re-developments	Multi-unit dwellings, commercial developments, industrial developments, small re-developments
Gross pollutants	90%	90%
Total suspended solids (TSS)	85%	80%
Total phosphorus (TP)	60%	55%
Total nitrogen (TN)	45%	40%

## 2.5.2 Conservation of Ecological Values

As outlined in Section 2.2.5, the Georges River Estuary contains a range of ecological communities and landscapes, which vary according to the underlying geology and topography across the catchment. Many of the ecological communities have been listed as endangered under the *NSW Threatened Species Conservation Act (1995)* or the *Fisheries Management Act (1994)*, particularly those communities located on the Cumberland Plain, while Towra Point at the mouth of the Georges River is a Ramsar listed wetland containing freshwater and saltwater habitats, including the only remaining significant saltmarsh community within the greater Sydney region. Towra Point also contains an Aquatic Reserve and a Nature Reserve, which are key contributors to the conservation of ecological values in this area. *Posidonia australis* seagrass beds in Botany Bay are listed in the FM Act as an Endangered Population.

Key community values include a range of passive recreational activities that relate to the overall well-being of the environment, such as



Saltmarsh at Bankstown (photo: OEH)



bushwalking and visual amenity. Conservation of existing ecological attributes, complemented by improvement in condition (e.g. through bush regeneration, weed and pest control), should therefore be a priority in the future management of the Estuary.

Vegetated lands within the catchment have declined historically, primarily as a consequence of urban expansion. Discharge of stormwater through remaining bushland, as well as uncontrolled access, has further reduced the condition of these habitats. Control of the proliferation of weeds through areas of native bush represents one of the biggest challenges facing the 30+ bushcare groups that are active across the Georges River catchment. Other important habitats, such as seagrass meadows and saltmarsh, have also declined in area over the past 100 years or so, impacted by sedimentation, poor water quality, land reclamation and dredging throughout the river.

There are 454 species of fauna (both aquatic and terrestrial) recorded within the Georges River Catchment, many of which have been listed under the NSW Threatened Species Act (1995). The diversity and richness of fauna varies considerably from the coastal areas, to the urban fringes, to the relative wilderness of some of the inland areas of the catchment. Unfortunately, domestic pets and other introduced animals (e.g. Fox, Rabbit) can prey on native wildlife, or damage vegetation and cause erosion.

### 2.5.3 Improvement of Access and Recreational Function

The Georges River and its tributaries form an important recreational function for local residents and visitors alike. The estuary is used for a range of land and water based recreational activities. Popular water activities include swimming, fishing, kayaking, canoeing, jetskiing and sailing. Access to the water is typically from formal and informal walking tracks and boatramps. Land based activities around the estuary undertaken include bushwalking, cycling, dirt biking and golf. Again, these are centred around formal and informal access tracks and facilities. In addition to the various public open spaces and parks, the estuary is also flanked by the Georges River National Park and the Towra Point Nature Reserve, both of which are used for hiking, fishing and nature appreciation. Towra Point Aquatic Reserve is also an important part of the study area and is used for passive recreation.



Dumped rubbish in parkland (photo: OEH)

The high usage of the bushland and natural areas along the river potentially limits their environmental values, given the disturbance created by access and some more passive recreational activities. Examples of this include erosion of unsealed and uncontrolled access to the shoreline, and propeller damage across shallow seagrass beds. High usage also unfortunately attracts rubbish, which can degrade the environment and encourage pest species.

From a future management perspective, the degree of disturbance should be minimised wherever possible to maximise the value of the remaining natural

environment around the Georges River Estuary. This could be achieved through a combination of signage and physical barriers (e.g. restricting inappropriate access), incentives (e.g. encouraging access at defined locations by provision of facilities), and education of users.

As outlined in Section 2.4, swimming in the estuary is a strong desire for the community. Ensuring that the estuary has water quality that supports swimming with minimal risk therefore should also be a key management focus. To optimise conditions for swimming, water quality would need to be improved, and in particular, reductions in turbidity, bacteria/pathogens, and algae.

#### 2.5.4 Control of Future Catchment Development

It is clear that the condition of the estuary has deteriorated largely as a consequence of development within the catchment. Given that there will continue to be on-going development, it is important that such development gives adequate and appropriate consideration of impacts on downstream receiving waters. Developments can have significant impacts during construction (particularly if there is inadequate control of on-site sediment), as well as post-construction. As outlined previously, the Botany Bay and Catchment WQIP (SMCMA, 2011) sets out targets for new developments in order to limit impacts of the estuary.

As presented in Figure 2-10, there is a significant proportion of the Georges River catchment that remains bushland, mostly within National Park and the Holsworthy firing range (Army Reserve area). It is considered that the extensive bushland helps to 'buffer' the impacts of the urbanised parts of the catchment on the health of the estuarine receiving waters. Should these undeveloped areas become urbanised without appropriate controls, then the consequences on the remaining areas of natural environment within the Georges River Estuary could be detrimental or even catastrophic.



Foreshore development (photo: OEH)

#### 2.5.5 Control of Sedimentation, Bank Erosion and Foreshore Structures

The Georges River Estuary, and particularly along its upper reaches, has a contemporary history of bank erosion, which has been exacerbated to a large degree by the uncontrolled dredging and reclamation that has occurred in this part of the river. Dredging too close to the river banks has destabilised subsurface slopes, causing mass failure and shoreline recession. Material loss due to bank erosion contributes to the on-going sedimentation issues along the river.



Eco-friendly seawall, Kogarah (photo: OEH)

The foreshores around the lower reaches of the estuary are also vulnerable to bank instabilities, which has manifest through removal of fringing foreshore vegetation and localised foreshore reclamation. Some of these foreshores have also been used historically as landfill for waste material. Seawalls now line many parts of the estuary, although the condition and integrity

of these walls varies significantly.

It is possible to construct seawalls that are more friendly to the environment. These type of walls attempt to mimic some of the rocky features found along the shoreline, rather than adopting a smooth and straight (vertical) profile. Construction of any new seawalls within the estuary should adopt more environmentally-friendly designs.

### 2.5.6 Conservation of Natural and Cultural Heritage

The Georges River Estuary has a rich cultural heritage with the presence of a range of Aboriginal and early European sites and places of significance spread across the study area (Goodall and Cadzow, 2009). There is currently insufficient knowledge of both Aboriginal and historic heritage within the study area, to ensure that such features are managed into the future.

The Georges River was an important focal point for Aboriginal life and culture in the southern Sydney region, offering both food, transport and dreamtime links. Several major language groups existed along the river: Eora to the east, Dharug to the west, north and north-east, Dharawal to the south and Gandangarra in the far south-west.

The early 1800's saw European settler's migrating to the areas along the Georges River and the river became increasingly important as a transport route. Much of the catchment was cleared for farmlands and housing, however, the banks stayed relatively untouched due to their rugged slopes. Significant urban development within the catchment began after WWII. As outlined previously, the consequences of urbanisation in the catchment are significant, with stormwater pollution, increased runoff and vegetation loss (including along riparian zones) all of great concern.



Cleared riparian vegetation (photo: OEH)

Liverpool weir, constructed in 1836 by convict labour, forms the tidal limit for the river. It was built to supply water to the town of Liverpool and to serve as a causeway across the Georges River, and is recognised for its heritage significance.

### 2.5.7 Climate Change and Future Planning

Sea level rise will have a potentially significant impact on the Georges River environment, as well as community values. At greatest risk of inundation will be the important habitats associated with Towra Point. As Towra Point is not immediately flanked by higher land, there will be limited opportunity for habitats to migrate upslope as the sea level increases. Consequently, one of the last remaining significant saltmarsh areas in Sydney is expected to be substantially affected or even lost entirely, while the sites attractiveness to migratory birds would also be reduced greatly.

Higher normal water levels throughout the estuary are likely to increase the susceptibility of surrounding areas to flooding. There are already some 8000 properties at risk of flooding up to the

PMF along the Georges River Estuary – this number may potentially increase with increasing sea level.

Around the more steeply sided lower reaches of the estuary, impacts of sea level rise on privately owned properties are expected to be less, because these areas are less able to be developed (and apply to only a narrow strip fringing existing foreshores). However, existing structures (e.g. seawalls, jetties, ramps, footpaths and even roads) may be more at risk of future inundation and may need to be modified or relocated to better accommodate the future climate conditions. Careful consideration also needs to be given to the canal estates at Gwawley Bay / Sylvania Waters.

### **2.5.8 Improved Knowledge of the Estuary through Regular Monitoring and Evaluation**

It is recognised that knowledge of the Georges River estuarine environment can be improved. On-going monitoring of the estuary is important to determine trends in its condition and health, and also to determine any improvements or benefits resulting from the implementation of this Coastal Zone Management Plan.

The NSW Government advocates a Monitoring – Evaluation – Reporting (MER) framework for all natural resource monitoring and appraisal processes. The MER approach is considered to be a continuous learning and adaptive management framework whereby decision-makers can learn from previous successes and failures. They can also use this information to continuously respond and adapt to, or replace, policies, strategies, programs and actions so that goals are realistic and NRM outcomes are continuously improved (DECCW, 2010a). The general MER process is presented in Figure 2-11. The adaptive management approach is effective in NRM, because most NRM planning and investment decisions involve a high degree of complexity and uncertainty.

Adaptive management is a way of testing assumptions and progressively reducing uncertainty without delaying action. Because it is iterative, the adaptive management cycle can be used by policy-makers, decision-makers and MER practitioners to adjust methods or change priorities as circumstances change, new data become available, and knowledge about system function improves (DECCW, 2010a).

There is scope for the community to be involved in the MER process, thereby using the process as an education tool as well. The GRCCC currently uses community groups to participate in the Community River Health Monitoring Program, the results from which were presented in Figure 2-5. The GRCCC has adapted its River Health Monitoring Program sampling methods and protocols for the estuary to ensure it complies with the NSW Government's MER requirements (2010a).



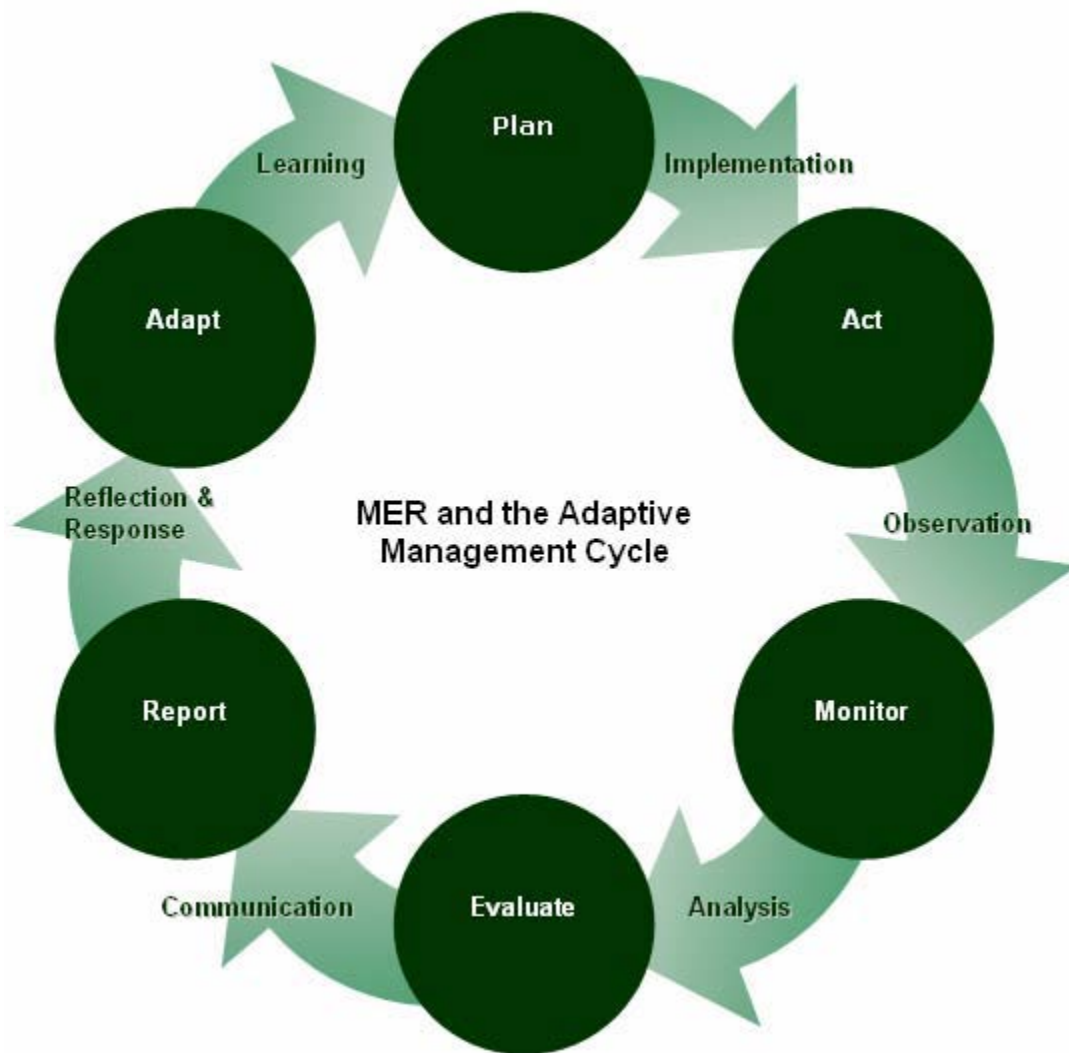


Figure 2-11 MER framework and the adaptive management cycle (DECCW, 2010a)



### 3 CONSULTATION DURING DEVELOPMENT OF THE PLAN

This chapter briefly outlines the consultation undertaken in developing the Georges River Estuary Coastal Zone Management Plan.

#### 3.1 Estuary Management Committee Meetings

Two special meetings of the Estuary Management Committee were held to develop the broad aims, objectives and management options for the draft plan. The first meeting was held on 28 April 2011 and focussed on developing a consensus set of Aims and Objectives for the Plan. The second meeting was held on 17 May 2011 and focused on developing a set of Management Options that would address the Aims and Objectives. The process for each workshop was very similar, comprising:

- A background document with a set of proposed aims and objectives (workshop 1) or management options (workshop 2) was circulated to participants in the days before the workshop.
- Participants were split into small groups to discuss the suggestions made in the background documents.
- The entire group then worked through aims and objectives or management options to develop a consensus set.

For both workshops, additional participants were invited beyond members of the Estuary Management Committee. This was aimed at having a greater level of representation and participation from Councils in the Georges River Catchment as well as ensuring other key institutional stakeholders were involved in the development of these draft aims, objectives and options.

At the first workshop a questionnaire was distributed amongst participants aimed at collecting information to help prioritise aims and objectives using a risk based approach. This questionnaire was collected back at the end of the session. A lack of time during the second workshop meant that the survey designed to assist in prioritising management options could not be distributed on the day. Instead an on-line survey was constructed and emailed to participants and others not present on the day to get their feedback on the relative importance of suggested management options.

#### 3.2 Targeted on-line survey for prioritisation of Management Options

This survey was largely targeted at those present during the second EMC workshop and was aimed at assisting with the prioritisation of suggested management options. Participants were asked to rate the relative importance of each management option to achieving the aims and objectives of the Plan. A link to the survey was sent to all those invited to the second EMC workshop, with those unable to attend invited to complete the survey and provide feedback on Management Options. There was also space within the survey for people to comment on the Management Options themselves as well as to suggest Management Actions under each option.

### 3.3 Targeted consultation with Councils and other organisations

In order to develop a feasible set of management actions that are likely to be adopted by various organisations responsible for implementing the Plan, targeted consultation has also been undertaken. In most cases, this has involved emailing a list of suggested Management Actions or specific projects to a nominated person for each organisation with the request that they discuss the contents of the document and send back feedback on:

- Management actions that should be removed and/or reworded for the purposes of the Plan; and
- Management actions that should be added.

Organisations were given a choice of conducting these discussions in-house and emailing back feedback or having a consultant present to help facilitate discussions. The approach used by organisations differed with some acting independently and simply sending feedback to the consultants when finished and others requiring further assistance. All organisations were contacted during the feedback period to see how they were progressing with the task and to offer further assistance if required. Organisations targeted for consultation in this way were:

- Bankstown City Council;
- Fairfield City Council;
- Hurstville City Council;
- Kogarah City Council;
- Liverpool City Council;
- Rockdale City Council;
- Sutherland Shire Council;
- NSW National Parks and Wildlife;
- Sydney Metropolitan CMA (now incorporated into the Hawkesbury Nepean Catchment Management Authority);
- Georges River Combined Councils' Committee;
- Department of Primary Industries: Fisheries;
- Department of Lands;
- Roads and Maritime Services; and
- Sydney Water.

The two community representatives on the Estuary Management Committee also provided invaluable input to this study.

### 3.4 Community forum and on-line survey

A community forum was held on 24 May 2011 at Club Central, Hurstville. This was designed to provide the general community with an overview of the Georges River CZMP development process

and timing as well as to seek their input on the aims, objectives, management options and actions suggested by the Estuary Management Committee for the Plan. This Forum included:

- A background presentation giving an overview of the Plan process and timing as well as outlining basic issues identified for the Georges River Estuary in the Processes study;
- An overview of the EMC ideas on the following topics followed by facilitated discussions:
  - What are we trying to achieve?
  - How are we trying to achieve this?
  - What management tools are available to us?
- An opportunity for more general feedback on the planning process or other issues relevant to the Georges River Estuary Coastal Zone Management Plan.

A feedback survey was also distributed during the forum and collected back at the end of the night covering each of these topics. This was complemented by an online survey covering the same topics for those not present on the night. For each of the questions above, people were asked to score the suggestions in terms of their importance.

In total 21 people attended the community forum and a further 20 responses were received to the online survey. The results of the community workshop and online questionnaire are presented in Appendix B. The top three aims as derived from the community responses were:

1. Aquatic habitats and foreshore vegetation protected, enhanced and restored
2. Optimum water quality in the Georges River Estuary and its tributaries
3. Negative impacts of development in the catchment on waterway health minimised

Not surprising, the highest scoring objectives for the CZMP as nominated by the community included various water quality and development objectives, with strong recognition of the link between catchment development and resulting conditions within the estuary. With respect to management options/actions/tools to address the objectives, the community responses indicated that best options were those relating to protection of vegetation, restrictions on inappropriate development and improving controls on pollution (both point source discharges and runoff from development).

### 3.5 Incorporation of Consultation Input

The consultation program was undertaken progressively through the course of the study so that relevant input could be incorporated directly into the development of the CZMP. Specifically, the initial engagement with the Estuary Management Committee was used to derive the overarching aims and objectives of this CZMP. The initial workshops also prioritised the objectives so that options and actions could be targeted on the most serious issues across the estuary.

Consultation with the Committee and other stakeholders was also used in the generation of an initial long list of potential management options/initiatives. The community forum was then used to 'ground-truth' the overall aims and objectives of the CZMP (refer Appendix C), and to gauge community opinion on the proposed options and actions for addressing the objectives of the Plan. Community

input was used directly in the multi-criteria scoring assessment for the options, which is described in detail in Section 5.1 and Appendix D.

## 4 AIMS AND OBJECTIVES FOR FUTURE MANAGEMENT

The existing values and concerns of the estuary, along with the future desirable conditions within the waterways have been used to set overarching aims and objectives for this Coastal Zone Management Plan. As discussed in Section 2.4, the environmental and passive recreation values are paramount within the Georges River Estuary, while the community would also like to swim more in the waterway. In order to achieve this, there needs to be an improvement in estuarine water quality. Therefore, the key focus or goal of this Georges River Coastal Zone Management Plan should be

*“to conserve and improve the existing natural environment of the Georges River Estuary, and to improve the water quality of the estuary through targeted pollution reduction”*

### 4.1 Management Aims

Nine broad “Aims” have been developed and agreed by consensus of participants at the EMC workshops for the future management of the Georges River Estuary. These aims cover the range of pertinent issues identified for the estuary, including water quality, habitats, recreation and infrastructure. The Aims seek to address the fundamental goal of the Coastal Zone Management Plan, which is to achieve a balance between the demands on the estuary from ecological needs and from recreational (human) pursuits.

It is important that these Aims are read and considered in a combined and integrated manner, and not in isolation. The estuarine environment of the Georges River is a complex and highly integrated structure, and as such, management of the estuarine environment needs to be multi-faceted, integrated and concurrent.

The Aims of the Georges River Estuary Coastal Zone Management Plan are listed in Table 4-1. The aims have been assessed and ranked according to the relative risks associated with their failure to be met. A modified risk assessment approach was taken to rank the Management Aims. Information and feedback from the EMC workshops was used to evaluate risks associated with the Aims of the Plan. Table 4-1 includes the outcomes of this risk assessment process, while details of the risk assessment and ranking procedure for Management Aims are provided in Appendix C. Of the nine Management Aims, five were considered to have intolerable risks if they failed to be achieved, while four were considered to have tolerable risks.

For each of the Management Aims, detailed and specific Management Objectives have been formulated, to address these Aims. These Management Objectives were also developed and agreed by consensus through the EMC workshopping process, and are discussed further below.



**Table 4-1 Aims of the Coastal Zone Management Plan**

	<i>Description</i>	<i>Associated Risk if aim not achieved</i>
<b>A</b>	<b>To optimise water quality within the Georges River Estuary and its tributaries</b>	<b>Intolerable</b>
<b>B</b>	<b>To protect, enhance and restore aquatic habitats and foreshore vegetation</b>	<b>Intolerable</b>
<b>C</b>	To protect and enhance public access to the foreshore	Tolerable
<b>D</b>	<b>To minimise the negative impacts of development in the catchment on waterway health</b>	<b>Intolerable</b>
<b>E</b>	<b>To actively manage bank erosion and sedimentation</b>	<b>Intolerable</b>
<b>F</b>	To manage existing built foreshore assets while maximising environmental values	Tolerable
<b>G</b>	To identify, acknowledge and protect natural and cultural heritage	Tolerable
<b>H</b>	<b>To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary</b>	<b>Intolerable</b>
<b>I</b>	To develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary	Tolerable

## 4.2 Management Objectives

For each Aim, a series of Management Objectives have been drafted that highlight the approaches that are required in order to achieve the Aim. Management Objectives developed for each Aim are specific, realistic, achievable, and measurable.

The Management Objectives are outlined below, for each Aim.

### 4.2.1 Water Quality

This Aim recognises that water quality within the Georges River Estuary can be highly variable and rather than state what water quality levels should be, the word ‘optimise’ has been used to reflect ‘fit for purpose’ criteria. Primary contact recreation (e.g. swimming) is desirable within the estuary, although it may be unrealistic to expect that primary recreation can be achieved throughout the estuary given the degree of urbanisation and naturally low tidal flushing in the upper reaches and ‘dead zone’ sections of side bays.

Under this Aim, six Objectives were identified and agreed through the consultation process, and are presented in Table 4-2.

**Table 4-2 Objectives relating to the Water Quality Aim (Intolerable Risk)**

	<b>Aim</b>
A.	To optimise water quality within the Georges River Estuary and its tributaries
	<b>Objectives</b>
A1	To reduce the volume and pollutant load of stormwater runoff throughout the catchment
A2	All greenfield and redevelopments should have a minimal negative impact on flow and water quality, meeting targets for water quality proposed in the Botany Bay and Catchment WQIP
A3	Improve the performance of sewer overflows
A4	Minimise build-up of gross pollutants and illegal dumping of waste into and along the estuary foreshores and waterway
A5	Strive to protect undeveloped areas of the broader catchment that act as a buffer to water quality
A6	To minimise the negative impacts of new and existing commercial operations in the catchment and estuary on flow and water quality

#### 4.2.2 Aquatic and Riparian Habitat

This Aim encompasses seagrass, saltmarsh, mangrove, mud flats, sandy shoals and other habitats as well as riparian vegetation. The Estuary Data Compilation and Processes Study (SMEC, 2010) highlighted losses and degradation of these habitats as significant issues for the Estuary.

Under this Aim, three Objectives were identified and agreed through the consultation process, and are presented in Table 4-3.

**Table 4-3 Objectives relating to the Riparian Habitat Aim (Intolerable Risk)**

	<b>Aim</b>
B.	To protect, enhance and restore aquatic habitats and foreshore vegetation
	<b>Objective</b>
B1	To minimise the impact of human uses on aquatic and terrestrial habitats
B2	To minimise the cause and spread of invasive species in aquatic and terrestrial habitats
B3	To protect and improve the extent and condition of estuarine and riparian vegetation

### 4.2.3 Recreation and Amenity

This Aim is designed to balance the needs of the public and commercial users of the estuary with environmental and ecological needs. This aim recognises that the Georges River Estuary provides recreation, amenity and commercial opportunity to a wide range of users and that the value of many of these pursuits is enhanced by maintaining a high level of ecological health.

Under this Aim, four Objectives were identified and agreed through the consultation process, and are presented in Table 4-4.

**Table 4-4 Objectives relating to the Recreation and Amenity Aim (Tolerable Risk)**

	<b>Aim</b>
C.	To protect and enhance public access to the foreshore
	<b>Objective</b>
C1	To maintain the varied legal recreational pursuits of the Georges River catchment without compromising estuary health and social amenity
C2	To reduce the impacts of commercial and recreational uses on the waterways and aquatic and terrestrial habitat
C3	To maintain and improve formal public access to the foreshore without compromising estuary health
C4	Increase enforcement of restrictions on illegal recreational uses that impact on estuary health

### 4.2.4 Land Use Planning and Development

This Aim is designed to address the potential impacts of developments by ensuring effective planning and policy measures are available across the catchment.

Under this Aim, three Objectives were identified and agreed through the consultation process, and are presented in Table 4-5.

**Table 4-5 Objectives relating to the Land Use Planning and Development Aim (Intolerable Risk)**

	<b>Aim</b>
D.	To minimise the negative impacts of development in the catchment on waterway health
<b>No.</b>	<b>Objective</b>
D1	To ensure appropriate measures are taken and maintained to reduce the erosion and

	associated pollutant exports from areas under development
D2	To ensure integration of the Georges River Estuary Coastal Zone Management Plan aims and objectives into strategic planning initiatives and developments
D3	To minimise the negative impact of commercial and private activities on catchment waterways

#### 4.2.5 Bank Erosion and Sedimentation

This Aim is complementary to Aim D in that it is targeted toward bank erosion processes rather than toward the key sources of new sediments, such as catchment development (i.e. hillslope and gully erosion). The Estuary Processes Study highlighted large stretches of bank erosion, particularly in the upper estuary and actions developed under this aim target these areas.

Under this Aim, two Objectives were identified and agreed through the consultation process, and are presented in Table 4-6.

**Table 4-6 Objectives relating to the Bank Erosion and Sedimentation Aim (Intolerable Risk)**

	<b>Aim</b>
E.	To actively manage bank erosion and sedimentation
	<b>Objective</b>
E1	To reduce the extent and severity of bank and foreshore erosion while minimising the impacts on estuary health
E2	To reduce the causes and impacts of sedimentation in the estuary

#### 4.2.6 Foreshore Protection

This Aim is complementary to Aim E and recognises that built foreshore assets, such as sea walls, have a significant role to play in maintaining integrity, access, amenity and ecological value of the foreshore. A key aspect of this aim is the promotion of environmentally friendly seawalls guidelines which facilitate both the protection of foreshore assets and the provision of ecological services.

Under this Aim, four Objectives were identified and agreed through the consultation process, and are presented in Table 4-7.

**Table 4-7 Objectives relating to the Foreshore Protection Aim (Tolerable Risk)**

	<b>Aim</b>
F.	To manage existing built foreshore assets while maximising environmental values
<b>No.</b>	<b>Objective</b>
F1	All new seawalls and repairs to existing seawalls throughout the estuary to incorporate the principles of the environmentally friendly seawall guidelines within legislative constraints
F2	<i>Not used</i>
F3	All foreshore developments to incorporate best practice environmental management
F4	Compliance on unauthorised foreshore development across the estuary is enforced

#### 4.2.7 Natural and Cultural Heritage

This Aim is designed to ensure that adequate protections are provided in this plan for natural and cultural heritage assets. Cultural assets in this context are not just restricted to those of traditional owners.

Under this Aim, two Objectives were identified and agreed through the consultation process, and are presented in Table 4-8.

**Table 4-8 Objectives relating to the Cultural Heritage Aim (Tolerable Risk)**

	<b>Aim</b>
G.	To identify, acknowledge and protect natural and cultural heritage
	<b>Objective</b>
G1	To effectively manage threats to and to enhance the natural and cultural heritage values in the catchment and waterways
G2	To ensure development minimises impacts on aesthetic and social values

#### 4.2.8 Climate Change and Sea Level Rise

This Aim was included in recognition of potential climate change impacts such as sea level rise on the estuary ecological and built assets. This aim was not intended to capture the broader climate change issues, such as reduction of CO<sub>2</sub> emissions, but instead is focussed upon ensuring adequate



planning and response mechanisms are allowed for in the future to adjust to climate change impacts. In many ways, this aim is complementary to Aim F: Foreshore Protection.

Under this Aim, two Objectives were identified and agreed through the consultation process, and are presented in Table 4-9.

**Table 4-9 Objectives relating to the Climate Change and Sea Level Rise Aim (Intolerable Risk)**

	<b>Aim</b>
H.	To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary
<b>No.</b>	<b>Objective</b>
H1	To protect public foreshore areas required for potential retreat of estuarine vegetation in response to sea level rise from development or infrastructure
H2	Plan for and adapt where possible to manage impacts on foreshore infrastructure resulting from an increase in tidal inundation and localised flooding associated with sea level rise.

#### 4.2.9 Monitoring and Evaluation

This Aim was designed to ensure that actions are identified to monitor the progress and effectiveness of this plan. In this context, monitoring may consist of annual assessments of actions completed, as well as biochemical and ecological monitoring of estuary health.

Under this Aim, two Objectives were identified and agreed through the consultation process, and are presented in Table 4-10.

**Table 4-10 Objectives relating to the Monitoring and Evaluation Aim (Tolerable Risk)**

	<b>Aim</b>
I.	To develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary
<b>No.</b>	<b>Objective</b>
I1	To build on the existing GRCCC coordinated estuary health monitoring of the Georges River to ensure compliance with the NSW Government Monitoring, Evaluation and Reporting Program
I2	To monitor the effectiveness of the plans objectives and management actions

### 4.3 Ranking of Management Objectives

Management Objectives were ranked in order to provide focus to the Coastal Zone Management Plan. That is, actions that target the most important Management Objectives were given highest priority in the Plan. Ranking of the Management Objectives followed a similar process to ranking of the overarching Management Aims, using an adaptation of the standard risk assessment framework. Again, quantification used in the risk assessment was derived from feedback from participants at the EMC workshops. Details of the ranking process are provided in Appendix C, while the resulting ranked list of Management Objectives is given in Table 4-11.

**Table 4-11 Results of Ranking and Prioritisation of Management Objectives**  
(refer Appendix C for further details)

No.	Objective	Overall rank	Classification
A1	To reduce the volume and pollutant load of stormwater runoff throughout the catchment	1	High
A3	Improve the performance of sewer overflows	2	High
A2	All greenfield and redevelopments should have a minimal negative impact on flow and water quality, meeting targets for water quality proposed in the Botany Bay and Catchment WQIP	3	High
A5	Strive to protect undeveloped areas of the broader catchment that act as a buffer to water quality	4	High
A6	To minimise the negative impacts of new and existing commercial operations in the catchment and estuary on flow and water quality	5	High
E1	To reduce the extent and severity of bank and foreshore erosion while minimising the impacts on estuary health	6	High
A4	Minimise build-up of gross pollutants and illegal dumping of waste into and along the estuary foreshores and waterway	7	High
E2	To reduce the causes and impacts of sedimentation in the estuary	8	High
B3	To protect and improve the extent and condition of estuarine and riparian vegetation	9	High
B2	To minimise the cause and spread of invasive species in aquatic and terrestrial habitats	10	High
B1	To minimise the impact of human uses on aquatic and terrestrial habitats	11	Medium
D2	To ensure integration of the Georges River Estuary Coastal Zone Management Plan aims and objectives into strategic planning initiatives and developments	12	Medium
D1	To ensure appropriate measures are taken and maintained to reduce the erosion and associated pollutant exports from areas under development	13	Medium
H1	To protect public foreshore areas required for potential retreat of estuarine vegetation in response to sea level rise from development or infrastructure	14	Medium
D3	To minimise the negative impact of commercial and private activities on	15	Medium

No.	Objective	Overall rank	Classification
	catchment waterways		
H2	Plan for and adapt where possible to manage impacts on foreshore infrastructure resulting from an increase in tidal inundation and localised flooding associated with sea level rise as outlined in the former sea level rise policy statement	16	Medium
F4	Compliance on unauthorised foreshore development across the estuary is enforced	17	Medium
I1	To build on the existing GRCCC coordinated estuary health monitoring of the Georges River to ensure compliance with the NSW Government Monitoring, Evaluation and Reporting Program	18	Medium
F1	All new seawalls and repairs to existing seawalls throughout the estuary to incorporate the principles of the environmentally friendly seawall guidelines within legislative constraints	19	Medium
F3	All foreshore developments to incorporate best practice environmental management	20	Low
C2	To reduce the impacts of commercial and recreational uses on the waterways and aquatic and terrestrial habitat	21	Low
G1	To effectively manage threats to and to enhance the natural and cultural heritage values in the catchment and waterways	22	Low
C3	To maintain and improve formal public access to the foreshore without compromising estuary health	23	Low
I2	To monitor the effectiveness of the plans objectives and management actions	24	Low
C4	Increase enforcement of restrictions on illegal recreational uses that impact on estuary health	25	Low
C1	To maintain the varied legal recreational pursuits of the Georges River catchment without compromising estuary health and social amenity	26	Low
G2	To ensure development minimises impacts on aesthetic and social values.	27	Low

## 5 POSSIBLE OPTIONS TO ADDRESS AIMS AND OBJECTIVES

A list of possible Management Options were developed by the Estuary Management Committee, and agreed by consensus of those present at the EMC workshop held on 17 May 2011. Management Options were formulated for each Aim, and later linked to specific Management Objectives (more than one in many cases). Management Options have also considered, and are consistent with, the broader policies and management actions that are in place at state and regional level.

As there is always a variety of ways to address a given issue, the possible Management Options identified utilise a variety of implementation mechanisms that can act at different levels, or on different aspects of the problem. Types of Management Options considered include:

- planning controls and policies,
- economic incentives and cost sharing arrangements,
- regulation and compliance,
- on-ground works and rehabilitation,
- investigation,
- monitoring,
- research, and
- education and public relations.

### 5.1 Evaluation of Possible Management Options

An initial 'long-list' of possible Management Options was developed, under each Management Aim. This 'long list' of options is provided in Appendix D. The potential merit of each option was assessed by determining which objectives were targeted by each option, the priority ranking (importance) of these objectives, and how well the option satisfied the particular objectives. The technical evaluation process for the options is detailed in Appendix D, and led to an overall '**total potential**' score for each possible Management Option, which accounts for its contribution to all aims and objectives of the Coastal Zone Management Plan, including environmental conservation, pollution reduction and recreational enhancement.

A multi-criteria rapid assessment tool was developed to assess the positive and/or negative costs and benefits of the various options. These costs and benefits consider more than the technical merits of the options (i.e. total potential), by including aspects such as cost, timeframe, community acceptance, ease of implementation, and considering whether there would be 'no regrets' (refer below).

The rapid assessment tool is based on a "traffic light" colour system for a range of variables, to clearly display if an aspect of an option should be cause to "stop" and reconsider, "slow" to proceed with caution or "go" with few trade-offs expected. The assessment has been conducted for each possible Management Option. It is aimed at presenting quickly and clearly the benefits and trade-offs of a particular option, to assist in the selection of a preferred option.

The criteria for the assessment of the variables in provided in Table 5-1, while the results of the assessment for every potential management option are given in Appendix E.



Table 5-1 Rapid Cost Benefit (Traffic Light) Assessment Criteria – refer Appendix E for application

	Effectiveness / Risk Reduction Potential (RRP)	Time frame	Cost	Practicality / Legal	Community Support	“No Regrets”
<b>STOP &amp; reassess</b>	Option does not provide an effective and long term solution. Risk reduction potential is relatively low <u>RRP &lt; 3.2</u>	LONG Term (> 5-10yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	High (\$300K to millions)	LOW: Will require approval to implement and significant community engagement. There is a residual risk that approval will not be able to be obtained for the proposed works/strategy. Works may also require significant resources that are presently unavailable	LOW: Unlikely to be acceptable to community and politically unpalatable. Extensive community education, endorsement of the concept by Minister(s) and Council required. Comm. Score < 3.0	
<b>SLOW</b>	Option is considered worthwhile, but does not necessarily help with long term sustainability and estuary health. <u>3.2 &lt; RRP &lt; 5.2</u>	MEDIUM Term (> 2 – 5yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	Medium (e.g. \$30,000 - \$300,000)	MEDIUM: May require approvals to be implemented, but works are generally supported. Generally these approvals would likely to be granted assuming requirements are met. May require some resources that would require redistribution of existing tasks and duties by officers.	MEDIUM: Would be palatable to some, not to others (50/50 response). Briefing by Councillors, GM and community education required 3.0 < Comm. Score < 4.0	
<b>GO</b>	Option provides an effective long term solution <u>RRP &gt; 5.2</u>	SHORT Term (tasks can commence within approximately 2 years). Generally can be completed without too many barriers	Low (< \$30,000)	HIGH: No or minimal approvals or other impediments required to implement. No significant additional resources required (can be done as part of normal duties)	HIGH: Is very politically palatable, acceptable to community. Minimal education required Comm. Score > 4.0	YES
	<u>RRP &gt; 10.0</u>				VERY HIGH: Comm. Score > 4.5	

Data for the effectiveness of the options is derived from the Total Potential scores, and is outlined in Appendix E. Information regarding timeframe, costs and the practicality / legal scale was determined through the experience of the study team and verified through the consultation process with the individual Councils. The costs reflect a 1 - 2 order of magnitude difference from “high” to “low”. Typically, higher cost options would require further investigations and approvals by Council before proceeding.

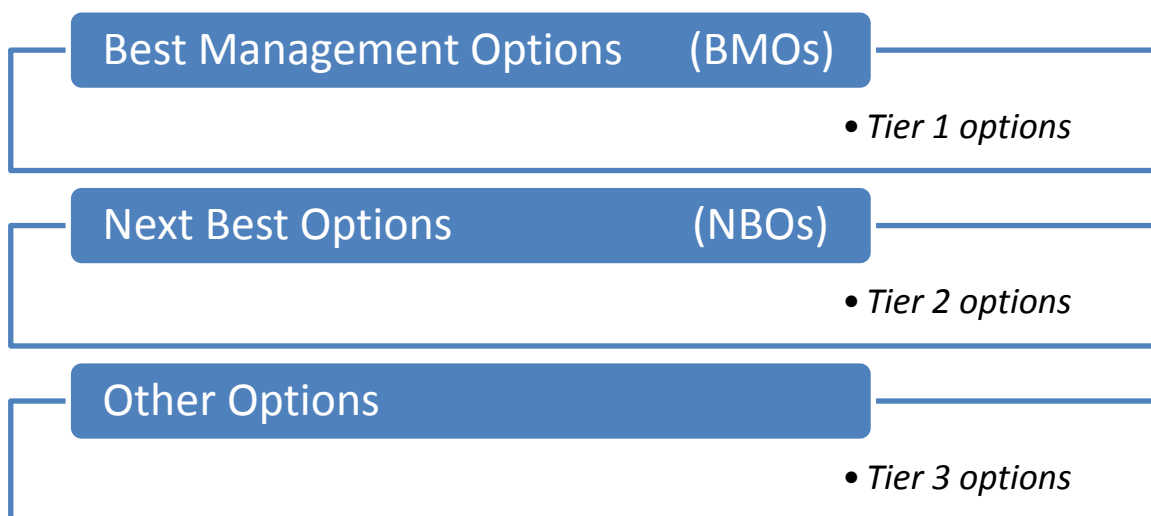
The community support scale is derived from direct community feedback on the options, as determined through returned questionnaires (also detailed in Appendix E).

Potential management options have also been considered based on whether they involve ‘no regrets’ actions or not. ‘No regrets’ refers to options that should be implemented irrespective of the specific outcomes to the Georges River Estuary, as they generally are beneficial to the broader community, and involve little or no trade-offs. These options involve on-going compliance, education and further investigations, aimed at improving resilience to threats imposed on estuarine health, and increasing preparedness and decision-making ability for broader environmental risks now and in the future, such as climate change. In general, implementation of all ‘no regrets’ options should be pursued as part of normal day-to-day duties by individual Councils and other relevant management authorities.

Following a first pass evaluation of the potential management options, the stakeholders provided further input regarding existing management initiatives and suggestions for possible additional actions (these are separate to those assessed and documented in Appendix E). Subsequently to this, and as a final step, the list of possible management options was validated and rationalised by GRCCC and OEH staff, to ensure that the options were targeted and achievable as much as possible. Through this process, a number of options were combined and/or reworded, while the final prioritisation ranking was also validated to ensure that overarching goals of the GRCCC and the NSW Government were being met.

## 5.2 Prioritisation of Options

Using the multi-criteria rapid assessment process described above, possible Management Options have been separated into the following categories:



All 'Best Management Options' (BMOs), 'Next Best Options' (NBOs) and Other Options are presented in Table 5-2 to Table 5-10 for each of the Management Aims.

**The 'Best Management Options'** are those highest priority options that are considered to create the best outcomes for the Georges River Estuary without undue constraints such as costs, practicalities of implementation and acceptance by the community. The Best Management Options also included a large number of 'No Regrets' actions.

The BMOs also primarily targeted the aims that were considered to have 'intolerable risks'. As discussed in Section 4.1, Risks to Estuary Health would be intolerable if the following aims were not addressed:

- A: Water quality;
- B: Aquatic and Riparian Habitats;
- D: Land Use Planning and Development;
- E: Bank Erosion and Sedimentation; and
- H: Climate Change and Sea Level Rise.

Implementation of the BMOs will satisfy 9 of the top 10 objectives. The only top 10 objective not addressed is Objective A5 (*Strive to protect undeveloped areas of the broader catchment that act as a buffer to water quality*).

**The 'Next Best Options'** are those options that are still likely to have notable and positive outcomes for the estuary, but did not score as highly as the Best Management Options (generally due to some constraints on costs, timing and/or practicality). Many of these options are longer term initiatives or should be progressively and continuously updated, e.g. community engagement activities. Generally the Next Best Options have more of a supporting role, and as such can be considered complementary to the BMOs and should be implemented as suitable opportunities arise.

**The 'Other Options'** not considered to be either BMOs or NBOs would still generally have some benefit to the estuary, but their relative value is generally considered to be lower than the BMOs and NBOs, or there are likely to be some challenges for implementation in terms of costs, practicalities and community endorsement. Nonetheless, these options should still be considered in the context of holistic estuary management, and reconsidered as part of the regular Plan review process to determine if conditions or circumstances have changed that would make them more attractive.

**Table 5-2 BMOs, NBOs and Other Options (Water Quality)**

Aim A: <u>Water Quality</u> : To optimise water quality within the Georges River Estuary and its tributaries		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MA2.</b> Councils to incorporate Water Sensitive Urban Design (WSUD) principles in redevelopments of urban areas, including public and private development, through the updating of existing and preparation of new Development Control Plans (DCPs)	A1, A2, A6		
	<b>MA3<sup>3</sup>.</b> Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation	A1, A6, E2		
	<b>MA4.</b> Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs and other stormwater quality improvement devices.	A1, A6		
	<b>MA6.</b> Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction	A1, A2, A6, E2		
	<b>MA8.</b> Continue the GRCCC's Riverkeeper Program to remove gross pollutants from foreshores and waterways, help minimise the impact of, and monitor incidences of, illegal dumping (on land and in water)	A4, A6		
	<b>MA10.</b> Councils to adopt WSUD action plans based on a comprehensive framework of institutional capacity and assessment	A1, A2, A6		
	<b>MA15.</b> Liaise with Sydney Water when sewers are observed to be causing water quality problems	A1, A3		
<b>Next Best Options</b>	<b>MA5.</b> Develop and implement education programs aimed at increasing community awareness regarding 'source control' of gross pollutants, nutrients and other pollutants	A1, A4, A6		
	<b>MA7.</b> Acknowledge the value of the large area of uncleared natural vegetation in the Georges River catchment and work towards the preservation of these areas	A5		
	<b>MA9<sup>4</sup>.</b> Use appropriate modelling tools such as MUSIC and/or the Botany Bay CAPER DSS and the LGRSI decision support tool to evaluate and design WSUD projects	A1, A2, A6		

<sup>3</sup> Most of the possible Management Options that address water quality focus on new development controls, or maintenance and compliance of existing measures. MA3 is the only Option that specifically targets a reduction in existing pollution levels, through retrofit of treatment measures, which is part of the primary goal of this Coastal Zone Management Plan. As such, MA3 is included as a Best Management Option despite the likely high costs and expected land management difficulties (i.e. two 'red lights' in the rapid cost assessment, refer Appendix E).



Aim A: <u>Water Quality</u> : To optimise water quality within the Georges River Estuary and its tributaries		Objectives addressed and Priority		
		H	M	L
	<b>MA16.</b> All Councils have an appropriate pollution incident response protocol in place	A1, A4, A6		
	<b>MA18.</b> Develop and implement site specific water quality monitoring programs that are in partnership with, or at least consistent with, the estuary-wide River Health monitoring program	A1	I1	
<b>Other Options</b>	<b>MA11.</b> Ensure Sydney Water continues to improve the sewage overflow performance of the sewer systems throughout the catchment	A3, A6		
	<b>MA13.</b> Engage the community in the planning, design and implementation for WSUD projects to help foster a sense of ownership and a willingness to support in the longer term	A1, A2, A6		
	<b>MA14.</b> Educate private sewer owners on their obligations for maintenance and appropriate approaches to maintaining private sewers	A5		
	<b>MA17.</b> Councils to liaise and engage with other authorities and agencies to progress WSUD in their operations including small scale projects (e.g. RTA, Rail Corp)	A1, A2, A6		

Table 5-3 BMOs, NBOs and Other Options (Aquatic &amp; Riparian Habitat)

Aim B: <u>Aquatic and Riparian Habitat</u> : To protect, enhance and restore aquatic habitats and foreshore vegetation		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MB4.</b> Identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine wetland communities (saltmarsh, mangroves, seagrass) and adjacent riparian vegetation	B3		
	<b>MB7.</b> Support the establishment and continuation of local bushcare/landcare and other groups to assist with revegetation works on both public and private lands	B2, B3		
	<b>MB8.</b> Utilise the Riverkeeper Program rubbish removal and bush regeneration teams to provide rubbish removal, weed control, bush regeneration and ongoing site maintenance to complement and support NPWS and council activities	B3	B1	

<sup>4</sup> Modelling tools should ideally be used when designing the size and location of all new WSUD devices, and as such, MA9 could be incorporated as a component of the Best Management Option MA3.

Aim B: <u>Aquatic and Riparian Habitat</u> : To protect, enhance and restore aquatic habitats and foreshore vegetation		Objectives addressed and Priority		
		H	M	L
	<b>MB9.</b> Provide information to private landowners that have key habitat and vegetation communities on their properties to describe the community, its importance to the estuary and options for its protection and management	B2, B3	B1	
<b>Next Best Options</b>	<b>MB1.</b> Education of surrounding landholders regarding the role of the community in preserving and maintaining a healthy estuarine ecosystem including provision of appropriate educational signage around the estuary foreshores	B2, B3	B1	
	<b>MB2.</b> Identification and progressive control of invasive species from foreshore areas and adjacent bushland	B2, B3	B1	
	<b>MB3.</b> Identification and progressive control of noxious species from the estuary and other waterways	B2, B3	B1	
	<b>MB12.</b> Promote and undertake compliance on unauthorised riparian and estuarine vegetation clearing	B1, B3		
<b>Other Options</b>	<b>MB6.</b> Encourage and assist revegetation of private foreshore areas	B3		
	<b>MB10.</b> Work with private owners of saltmarsh for the management of this habitat towards its protection	B2, B3	B1	
	<b>MB13.</b> Minimise the impact of boating on seagrasses	B3	B1	
	<b>MB14.</b> Encourage NSW Fisheries to periodically map the distribution of estuarine vegetation (seagrass, saltmarsh and mangroves) for the estuary	B3	B1	
	<b>MB15.</b> Prevent the introduction and spread of disease and pests	B2		
	<b>MB19.</b> Species identification and ecological health assessments of habitats and communities	B3		

Table 5-4 BMOs, NBOs and Other Options (Recreation &amp; Amenity)

Aim C: <u>Recreation and Amenity</u> : To protect and enhance public access to the foreshore		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MC3.</b> Prepare appropriate interpretative materials aimed at reducing impacts associated with legal and illegal recreational pursuits			C1, C2, C4
	<b>MC5.</b> Contribute to current revision of boating strategy with Roads and Maritime Services to manage potential recreational use			C1,

Aim C: <u>Recreation and Amenity</u> : To protect and enhance public access to the foreshore		Objectives addressed and Priority		
		H	M	L
	conflicts			C2
<b>Next Best Options</b>	<b>MC2.</b> Provide appropriate signage at selected locations around the estuary regarding recreational usage of the estuary and its foreshore reserves.			C1, C2, C3, C4
	<b>MC9.</b> Identify and engage with commercial operators through State Govt agencies to minimise impacts on the river			C2
	<b>MC10.</b> Enhance foreshore access in appropriate locations through strategic planning and the land development process and Council works			C3
<b>Other Options</b>	<b>MC1.</b> Organise community events to improve the recreational amenity of key foreshore areas			C1
	<b>MC4.</b> Support the development and application of EMS for various industries			C2, C4
	<b>MC6.</b> Ensure adequate waste disposal facilities for people aboard boats and recreational fishers on land.			C2
	<b>MC7.</b> Establish a monitoring and compliance program to monitor and address the impacts of recreation at various locations and times of year (such as peak periods), to ensure ongoing sustainability of such locations			C2, C4
	<b>MC8.</b> Maintain recognised Council assets that support legal recreational pursuits on the Georges River			C1, C3

Table 5-5 BMOs, NBOs and Other Options (Land Use Planning &amp; Development)

Aim D: <u>Land Use Planning and Development</u> : To minimise the negative impacts of development in the catchment on waterway health		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MD3.</b> Councils should ensure that best management practices to limit the export of pollutants including sediments, nutrients and acid runoff from Council projects are applied through the use of recognised checklist/part 5 assessment		D1, D3	
	<b>MD4.</b> When undertaking reviews of strategic planning instruments and initiatives (including LEPs and DCPs) and development proposals, ensure consistency with the Coastal Zone Management Plan aims and objectives		D2	

Aim D: <u>Land Use Planning and Development</u> : To minimise the negative impacts of development in the catchment on waterway health		Objectives addressed and Priority		
		H	M	L
	<b>MD5.</b> New and revised Plans of Management and/or other specific Council and NPWS environmental plans and policies should be compatible with the recommendations of the Georges River Estuary Coastal Zone Management Plan		D2	
<b>Next Best Options</b>	<b>MD1.</b> Recommendations on restrictions to land use activities including mining in the upper catchment which arose from the Upper Georges River Sustainability Symposium (16th October 2010) should be considered and where appropriate acted upon		D1, D2, D3	
	<b>MD2.</b> Environmental requirements outlined in the NSW floodplain manual should continue to be considered during development and when building flood abatement works		D2, D3	
	<b>MD6.</b> Ensure relevant regulatory and consent authorities adopt best management practices when certifying and regulating land use activities		D1, D3	
<b>Other Options</b>	<b>MD7.</b> Regulatory authorities responsible for issuing pollution control licences review minimum water quality and environmental objectives to reduce the impact of pollution from licensed premises		D3	

Table 5-6 BMOs, NBOs and Other Options (Bank Erosion &amp; Sedimentation)

Aim E: <u>Bank Erosion and Sedimentation</u> : To actively manage bank erosion and sedimentation		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>ME2.</b> Work with Roads and Maritime Services to determine the impact of wash on the waterway and strategies to minimise the effects where bank erosion is an issue and boat wake is a likely cause	E1		
	<b>ME4.</b> Prioritise active eroding foreshore areas and undertake erosion management works using techniques that maximise the use of riparian and estuarine vegetation	E1		
	<b>ME3.</b> Control ad hoc access along the foreshore to limit vegetation trampling and bank destabilisation, targeting sites of high environmental significance	E1	B1	C3
<b>Next Best Options</b>	<b>ME8.</b> Use a coordinated approach to managing bank erosion	E1		
	<b>ME10.</b> Prioritise estuarine macrophyte communities for management that are at risk of or impacted by sedimentation and associated contaminants	E2		



Aim E: <u>Bank Erosion and Sedimentation</u> : To actively manage bank erosion and sedimentation		Objectives addressed and Priority		
		H	M	L
	<b>ME11.</b> Enforce strict environmental controls on any approved dredging for public navigation channels	A6, B3, E2	B1	
<b>Other Options</b>	<b>ME5.</b> Use environmentally friendly seawalls to control erosion that cannot be managed through softer protection techniques	E1, E2	B1	
	<b>ME6.</b> Consider removal of seawalls and recreating a natural intertidal area where possible	B3, E1, E2	B1	
	<b>ME7.</b> Unification, extension or removal of short seawalls to manage erosion edge effects	E1, E2		
	<b>ME9.</b> Review management of assets on active eroding areas	E1, E2		
	<b>ME13.</b> Monitoring and selective dredging of sediment build-up	E2		

Table 5-7 BMOs, NBOs and Other Options (Foreshore Protection)

Aim F: <u>Foreshore Protection</u> : To manage existing built foreshore assets while maximising environmental values		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MF1.</b> All councils and agencies involved in the building, design and approval of new seawalls to ensure compliance with the environmentally friendly seawall guidelines within legislative requirements		F1	
	<b>MF5.</b> Educate and support private landowners on the benefits of environmentally friendly seawalls and provide details of the planning and approval process for installation		F1	F3
<b>Next Best Options</b>	<b>MF3.</b> All councils and agencies involved in the building, design and approval of new foreshore developments to ensure compliance with environmental best practices			F3
	<b>MF4.</b> Maintain compliance by relevant authorities on unauthorised or inappropriate foreshore structures and uses		F4	
<b>Other Options</b>	<b>MF2.</b> Explore options to improve the environmental value of existing seawalls through addition of habitat			F3
	<b>MF6.</b> Establish foreshore building lines for all developments		F4	F3

**Table 5-8 BMOs, NBOs and Other Options (Natural & Cultural Heritage)**

Aim G: <u>Natural and Cultural Heritage</u> : To identify, acknowledge and protect natural and cultural heritage		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MG4.</b> Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites			G1
<b>Next Best Options</b>	<b>MG5.</b> Use a coordinated approach to recording sites and values			G1
	<b>MG7.</b> Social and aesthetic values need to be considered in the review and preparation of new Development Control Plans (DCPs)			G2
<b>Other Options</b>	<b>MG1.</b> Management strategies that take into account legislative requirements relating to heritage should be developed to address potential difficulties posed by individuals, private companies, public groups, local councils and state government agencies who may own or manage land or waterways containing heritage items			G1
	<b>MG2.</b> Field inspections of sites previously identified should be carried out to ascertain their current physical condition and threats with priority given to sites last recorded before 2000			G1
	<b>MG3.</b> Field inspection of potential historic Aboriginal heritage places identified in the processes study (Appendix 6) should be carried out to ascertain whether physical evidence may survive and if further research is appropriate			G1
	<b>MG6.</b> Ensure identified sites are adequately protected under the regulatory framework			G1

**Table 5-9 BMOs, NBOs and Other Options (Climate Change & Sea Level Rise)**

Aim H: <u>Climate Change and Sea Level Rise</u> : To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MH3.</b> Identify and map areas likely to be impacted by sea level rise, and highlight areas of estuarine vegetation where there is the potential for retreat		H1	
<b>Next Best Options</b>	<b>MH2.</b> Foreshore infrastructure with likely tidal inundation risk managed in such a way as to allow adaptation to sea level rise		H2	
	<b>MH4.</b> Prioritise protection and/or restoration of estuarine vegetation where there is potential for retreat of the estuarine vegetation		H1	

Aim H: <u>Climate Change and Sea Level Rise</u> : To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary		Objectives addressed and Priority		
		H	M	L
<b>Other Options</b>	<b>MH1.</b> Public foreshore areas required for the retreat of estuarine vegetation in response to sea level rise should be identified and protected from development or infrastructure		H1	
	<b>MH5.</b> Restricting new foreshore developments in areas where tidal inundation hazards under current and future sea level rise scenarios are quantified		H1, H2	
	<b>MH6.</b> Educating the community about environmentally friendly adaptation methods to climate change/sea level rise		H1, H2	

Table 5-10 BMOs, NBOs and Other Options (Monitoring &amp; Evaluation)

Aim I: <u>Monitoring and Evaluation</u> : To develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary		Objectives addressed and Priority		
		H	M	L
<b>Best Management Options</b>	<b>MI2.</b> Ongoing support of the Georges River Health Monitoring Program coordinated by the GRCCC		I1	I2
	<b>MI3.</b> Support the implementation and monitoring of the effectiveness of Plan			I2
<b>Next Best Options</b>	<b>MI4.</b> Undertake a review of the CZMP every 5-10 years			I2
<b>Other Options</b>	<b>MI1.</b> Undertake monitoring of the interaction between estuarine vegetation communities, particularly in response to climate pressures		I1	I2

## 6 ACTION PLAN

### 6.1 Introduction and Explanation

The 'Action Plan' for the Georges River Estuary Coastal Zone Management Plan provides implementation details for the Best Management Options (BMOs) only.

It is considered impractical to attempt to implement all BMOs, NBOs and other options concurrently, and as such, only BMOs are specified within the Action Plan. Notwithstanding, further details on the Next Best Options (NBOs) are provided in Appendix F, where relevant and available. The Next Best Options are those Options / Strategies that should be pursued once progressive and substantial completion of the Best Management Options has been achieved (potentially within about 5-10 years). It is expected that during the future reviews of this Coastal Zone Management Plan, these NBOs and the Other Options would be considered further (and revised or updated as necessary), and incorporated into amended versions of the Plan as appropriate.

As well as a description of the works involved, the implementation details for the BMOs provided herein identify locations within the LGAs, where relevant, for the various works. The details also cover any relevant linkages to existing initiatives, commencement timeframes, cost and resource requirements, and mechanisms for measuring the success of the option outcomes.

BMOs that address the highest ranked objectives (refer Table 4-11) are identified as 'high priority' options. Similarly, BMOs that address medium ranked objectives are considered 'medium priority' options, while BMOs that address the lowest ranked objectives are considered 'low priority' options. It is expected that substantial implementation of all BMOs will be achieved within a 5-10 year period, and commencement of all 'high priority' BMOs within the first 2-3 years of this Plan.

The Implementation Schedules also identify the 'approach' of option, indicating the department or section of the Councils that would nominally be given the responsibility for implementation (with assistance from other agencies as appropriate). These include:

- Strategic Planning and Development Controls;
- Engineering Works and Asset Management;
- Communications and Education;
- Recreation and Heritage;
- Environmental Planning;
- Environmental Rehabilitation and Monitoring; and
- Compliance.

The Action Plan has been separated into the nine (9) key areas that reflect the different aims of the Coastal Zone Management Plan. These sub-sections of the Action Plan in effect represent 'sub-plans' (e.g. a Water Quality Sub-Plan, a Bank Erosion and Sedimentation Sub-Plan, etc).

A summary of the recommended BMOs, including the approach and relative prioritisation of the works, is provided in Table 6-1.

**Table 6-1 Summary of Recommended Best Management Options**

Theme / Aim	Recommended Action / Strategy	Priority	Option Approach
Water Quality	<b>MA2:</b> Update or prepare new WSUD controls within DCPs	HIGH	Strategic Planning & Development Controls
	<b>MA3:</b> Retrofit new WSUD devices in existing urban areas	HIGH	Engineering Works & Asset Management
	<b>MA4:</b> Maintenance of WSUD devices, GPTs, SQIDs etc	HIGH	Engineering Works & Asset Management
	<b>MA6:</b> Sediment/erosion control during & after construction	HIGH	Compliance
	<b>MA8:</b> Riverkeeper teams for clean-up & illegal dumping	HIGH	Enviro Rehabilitation & Monitoring
	<b>MA10:</b> Develop & adopt WSUD action plans	HIGH	Environmental Planning
	<b>MA15:</b> SWC liaison regarding sewer problems	HIGH	Environmental Planning
Aquatic and Riparian Habitat	<b>MB4:</b> Rehab of estuarine wetlands & riparian vegetation	HIGH	Enviro Rehabilitation & Monitoring
	<b>MB7:</b> Support and continue bushcare/landcare groups	HIGH	Enviro Rehabilitation & Monitoring
	<b>MB8:</b> Riverkeeper teams for bush regen. & weed control	HIGH - MEDIUM	Enviro Rehabilitation & Monitoring
	<b>MB9:</b> Private landholder education re: habitat & vegetation	HIGH - MEDIUM	Communications & Education
Recreation and Amenity	<b>MC3:</b> Interpretive education materials on recreation	LOW	Communications & Education
	<b>MC5:</b> Contribute to boating strategy revision	LOW	Environmental Planning
Land use Planning and Development	<b>MD3:</b> Use Best Management Practices for Council works	MEDIUM	Strategic Planning & Development Controls
	<b>MD4:</b> Consistency with CZMP in future EPI reviews	MEDIUM	Strategic Planning & Development Controls
	<b>MD5:</b> New & revised PoMs to be compatible with CZMP	MEDIUM	Strategic Planning & Development Controls
Bank Erosion and Sedimentation	<b>ME2:</b> Boat wake erosion impacts and strategies	HIGH	Environmental Planning
	<b>ME3:</b> Targeted control of ad-hoc foreshore access	MEDIUM	Engineering Works & Asset Management
	<b>ME4:</b> Prioritise & remediate erosion, using vegetation, where possible	HIGH	Engineering Works & Asset Management
Foreshore Protection	<b>MF1:</b> Councils to comply with eco-friendly seawall guidelines	MEDIUM	Strategic Planning & Development Controls
	<b>MF5:</b> Educate landholders re: eco-friendly seawalls	MEDIUM - LOW	Communications & Education
Natural and Cultural Heritage	<b>MG4:</b> Work with Aboriginal Groups and others to determine options for threatened heritage sites	LOW	Recreation & Heritage
Climate Change and Sea Level Rise	<b>MH3:</b> Mapping of SLR and areas for vegetation retreat	MEDIUM	Environmental Planning
Monitoring and Evaluation	<b>MI2:</b> Support GRCCC River Health Monitoring Program	MEDIUM	Enviro Rehabilitation & Monitoring
	<b>MI3:</b> Support, implement & monitor CZMP effectiveness	LOW	Enviro Rehabilitation & Monitoring



## 6.2 Water Quality Sub-Plan

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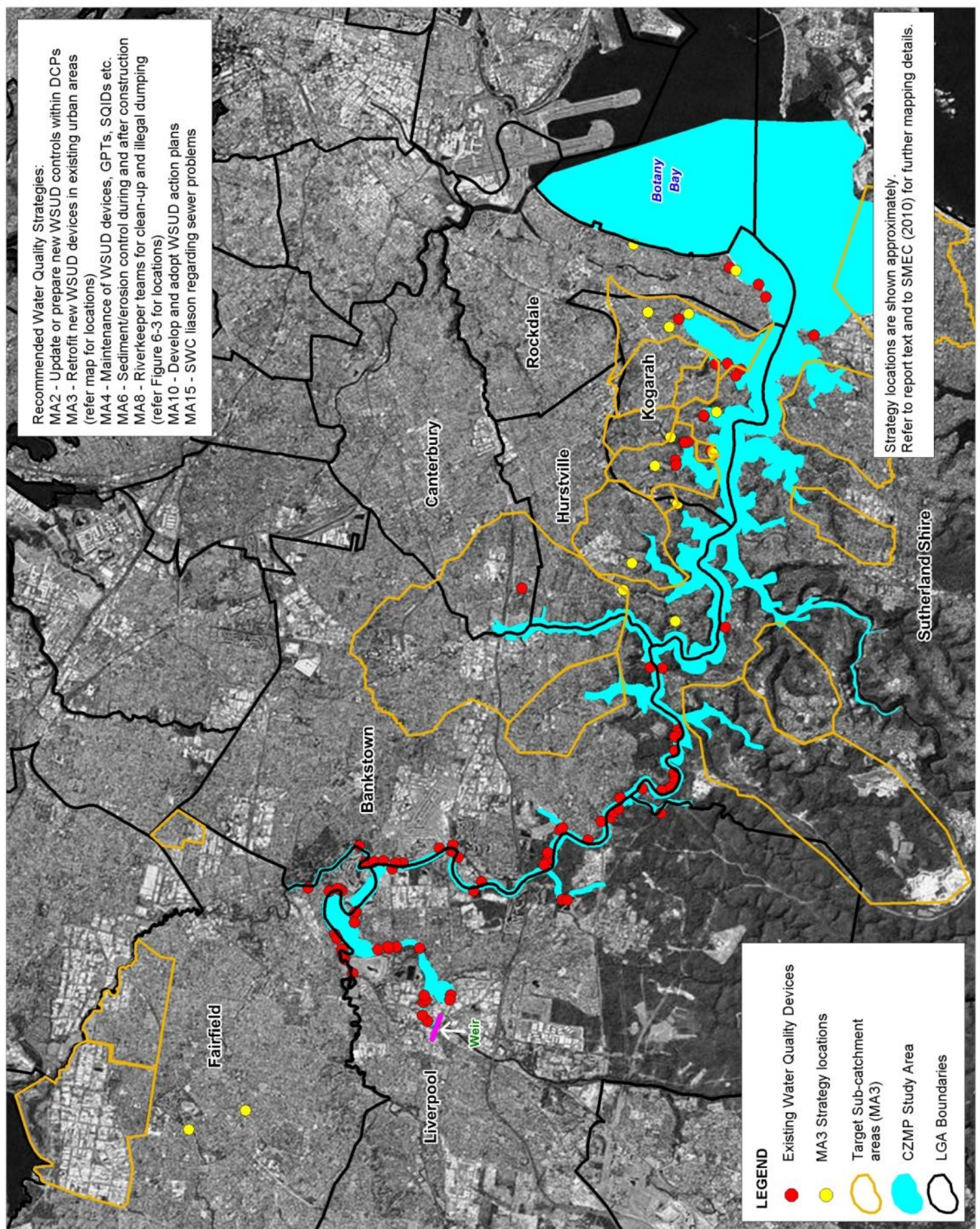
### WATER QUALITY SUB-PLAN

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**Recommended Water Quality Strategies:**

- MA2 - Update or prepare new WSUD controls within DCPs
- MA3 - Retrofit new WSUD devices in existing urban areas (refer map for locations)
- MA4 - Maintenance of WSUD devices, GPTs, SQIDs etc.
- MA6 - Sediment/erosion control during and after construction
- MA8 - Riverkeeper teams for clean-up and illegal dumping (refer Figure 6-3 for locations)
- MA10 - Develop and adopt WSUD action plans
- MA15 - SWC liason regarding sewer problems

Strategy locations are shown approximately. Refer to report text and to SMEC (2010) for further mapping details.



**Title:**  
**Water Quality Sub-plan**



**Figure:**  
**6-1**

**Rev:**  
**A1**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.




0 2.5 5km  
Approx. Scale



[www.bmtwbm.com.au](http://www.bmtwbm.com.au)

Filepath : S:\WATER\PROJECTS\S1197 - Water - Georges River EMS & EMP\Working\GIS Data\Workspaces\DRG\_002\_120504\_Water\_Quality.wor



MA-2	Councils to incorporate Water Sensitive Urban Design (WSUD) principles in developments of urban areas, including public and private development, through updating of existing and preparation of new Development Control Plans (DCPs)																							
Aims /risks targeted	A	B	C	D	E	F	G	H	I															
	yes																							
Objectives addressed	A1, A2, A6				Priority		HIGH																	
Approach / Department	Strategic Planning & Development Controls																							
Detailed description	<p>Water Sensitive Urban Design (WSUD) is one of the key management measures that can control pollutants, such as nutrients, sediments, pathogens and gross pollutants, being exported into the estuary from urban lands. The Botany Bay and Catchment Water Quality Improvement Plan proposed that WSUD be applied where practicable to all infill redevelopments and Greenfield developments, proposing pollution reduction targets for these areas as shown in Table 6-2.</p> <p><b>Table 6-2 Recommended stormwater quality reduction targets from the Botany Bay and Catchment Water Quality Improvement Plan (see SMCMA, 2011)</b></p> <table><tr><th>Stormwater Pollutant</th><th>Greenfield developments Large redevelopments</th><th>Multi-unit dwellings Commercial Industrial Small redevelopments</th></tr><tr><td>Gross pollutants</td><td>90%</td><td>90%</td></tr><tr><td>Total suspended solids (TSS)</td><td>85%</td><td>80%</td></tr><tr><td>Total phosphorus (TP)</td><td>60%</td><td>55%</td></tr><tr><td>Total nitrogen (TN)</td><td>45%</td><td>40%</td></tr></table> <p>It is recommended that Councils apply these pollution reduction targets within their Development Control Plans to help achieve proposed improvements to the quality of flows entering the Georges River estuary and subsequently Botany Bay. Using WSUD in this way, coupled with riparian revegetation actions (refer MB-4), would be expected to reduce nitrogen, phosphorus and suspended sediments delivered to the Georges river estuary by 9%, 11% and 18% respectively by 2030.</p> <p>In implementing WSUD, consideration must be given to the most appropriate devices and treatments trains for each situation and location. Consideration should include both the upfront and ongoing cost of options, as well as practical constraints to the implementation of specific options in different circumstances.</p> <p>Models such as the Botany Bay CAPER DSS and the MUSIC model can and should be used at different scales (catchment versus project scale) to assist in</p>									Stormwater Pollutant	Greenfield developments Large redevelopments	Multi-unit dwellings Commercial Industrial Small redevelopments	Gross pollutants	90%	90%	Total suspended solids (TSS)	85%	80%	Total phosphorus (TP)	60%	55%	Total nitrogen (TN)	45%	40%
	Stormwater Pollutant	Greenfield developments Large redevelopments	Multi-unit dwellings Commercial Industrial Small redevelopments																					
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	Total phosphorus (TP)	60%	55%																					
Total nitrogen (TN)	45%	40%																						
																								
Streetscape bioretention example																								
<p>deciding on what treatment trains could best meet the targets while still optimising the use of available budgets.</p> <p>Consideration should be given to whether WSUD could be designed and located to capture specific known pollution sources such as the first flush of runoff from priority roads.</p> <p>Develop a policy which provides WSUD guidelines to facilitate</p>																								

<b>MA-2 Councils to incorporate Water Sensitive Urban Design (WSUD) principles in developments of urban areas, including public and private development, through updating of existing and preparation of new Development Control Plans (DCPs)</b>		
		meeting water quality targets for BBWQIP for Council works. Council should consider developing WSUD planning controls for infill development and Greenfield developments to meet the water quality targets for the BBWQIP and incorporating these in planning policies. All State Authorities should give regard to relevant WSUD DCPs for any public development works.
Links to existing works		<p><u>Rockdale</u>: Section 4.1.3 Water Management of the Rockdale DCP 2011 (<a href="http://rccweb.rockdale.nsw.gov.au/EPlanning/Common/Common/Image.aspx?iid=255">http://rccweb.rockdale.nsw.gov.au/EPlanning/Common/Common/Image.aspx?iid=255</a>) and Clause 6.7 Stormwater of the Rockdale LEP 2011 (<a href="http://rccweb.rockdale.nsw.gov.au/EPlanning/Common/Common/Image.aspx?iid=254">http://rccweb.rockdale.nsw.gov.au/EPlanning/Common/Common/Image.aspx?iid=254</a>)</p> <p><u>Liverpool</u>: Part 1.1, Chapter 6 and pertinent chapters of site specific DCPs in Section 2 of Council's Consolidated DCP <a href="http://www.liverpool.nsw.gov.au/LCC/INTERNET/trimDownloadDocument.aspx?number=181376.2010-01">http://www.liverpool.nsw.gov.au/LCC/INTERNET/trimDownloadDocument.aspx?number=181376.2010-01</a></p> <p><u>Sutherland</u>: Sutherland Shire DCP and accompanying Environmental Specification for Stormwater Management <a href="http://www.sutherlandshire.nsw.gov.au/Building_Development/Development_Requirements/Environmental_Specifications">http://www.sutherlandshire.nsw.gov.au/Building_Development/Development_Requirements/Environmental_Specifications</a></p> <p><u>Kogarah</u>: Water Management Policy 2006 Water Quality Control Systems Practice Note #2 and Water Management Policy 2006 Water Conservation and Reuse Practice Note #3</p>
Council	Applicable	Comments
Bankstown	YES	The existing WSUD DCP needs to be implemented, with WSUD guidelines to facilitate meeting water quality targets for BBWQIP and applied to Council works.
Liverpool	YES	Existing WSUD DCP to be implemented and effectiveness monitored, and also share learnings with other councils
Hurstville	YES	WSUD controls need to be translated into all planning documents, and are proposed as part of the forthcoming DCP review WSUD measures also need to target capture of sediments in the catchments Appropriate WSUD controls will be developed and included where necessary as part of Council's forthcoming DCP review.
Fairfield	YES	Fairfield City Council may consider updating its DCP to include WSUD principles as part of future on-going revisions to the DCP. However, approval from Council is required before any actions can be supported or endorsed.
Sutherland	YES	WSUD is currently included in Sutherland Shire's DCP and accompanying Environmental Specification for Stormwater Management Example project for WSUD is Captain Cook Oval, Woollooware - Creek Restoration / Flood Mitigation project (targeting water quality and flooding)
Rockdale	YES	Existing WSUD DCP to be implemented and effectiveness monitored, and also share learnings with other councils
Kogarah	YES	A Total Water Cycle Management Plan has been prepared and is being implemented with targets set out in the Botany Bay and Catchment Water Quality Improvement Plan. Example project is sewer mining and stormwater harvesting and re-use at Beverley Park Golf Club.
National Pk	YES	Apply WSUD principles to all new infrastructure or refurbishments, and consider retrofitting in carparks and roads.

<b>MA-2</b>	<b>Councils to incorporate Water Sensitive Urban Design (WSUD) principles in developments of urban areas, including public and private development, through updating of existing and preparation of new Development Control Plans (DCPs)</b>	
Commencement	2012, to be completed and adopted ASAP	
Costs, Resources and Funding Opportunities	Works associated with this strategy would be carried out by Council staff. Implementation of this strategy therefore represents in-kind contributions from the various Councils.	
Lead Responsibilities	All Councils in Georges River Estuary Catchment	
Support Responsibilities	GRCCC, DoPI, HNCMA	
Performance Measures	<ol style="list-style-type: none"> <li>1. Inclusion of specific WSUD provisions within adopted Council DCPs.</li> <li>2. Inclusion of WSUD principles within other Council plans and policies.</li> <li>3. WSUD measures included within new developments, as per the DCP requirements.</li> </ol>	



MA-3		Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes				partly				
Objectives addressed	A1, A6, E2				Priority		HIGH		
Approach / Department	Engineering Works & Asset Management								
Detailed description	<p>Stormwater is a major source of pollutants, such as nutrients, sediments, chemicals, pathogens and gross pollutants, to the estuary. Existing urban areas are substantial contributors of these pollutants to the waterways. One way of reducing the volume of pollutants entering the estuary is to retrofit existing urban areas with appropriate WSUD devices to either reduce the volume of stormwater generated or to treat stormwater to improve its quality before it enters the estuary. These devices can include artificial wetlands, vegetated swales, bioretention systems, sediment basins, sand filters, rainwater tanks and gross pollutant traps. These systems require some on-going maintenance, such as through removal of built up sediments and gross pollutants, to operate effectively. Sufficient funding needs to be allocated to their on-going maintenance to ensure their effectiveness. In order to implement this action Councils should:</p> <ul style="list-style-type: none"><li>Investigate the potential for WSUD devices to be retrofitted to existing urban areas. This investigation should include short-listing potential sites considering on-ground physical and other constraints as well as the use of modelling tools such as the Botany Bay CAPER DSS and MUSIC model to analyse the effects of potential treatment train options. For example, grass riparian filter strips should be investigated for use in suitable areas around the estuary waterways. The CSIRO (1999) guidelines indicate that filter strips may be applied to large public grassed areas to collect sediment particles, however, the grass needs to be maintained at a suitable height and be wide enough to collect the fines containing trace metals.</li><li>Undertake detailed analysis of preferred options and short-listed sites, including detailed modelling of designs where required. On-going maintenance costs of devices should be considered in designing alternatives. Several options for priority devices include:<ul style="list-style-type: none"><li>Identify locations and construct GPTs, litter booms and an appropriate maintenance schedule for stormwater outlets to prevent gross pollutants entering the estuary.</li><li>Design and locate WSUD devices to capture runoff from priority roads and car parks. Assess target locations to optimise efficiency of budgets.</li><li>Restore and naturalise open stormwater channels where appropriate, including the use of riparian plantings.</li><li>Develop standardised small scale WSUD treatment trains to be implemented throughout the catchment.</li></ul></li><li>Implement works where this is found to be appropriate. Undertake on-going</li></ul>								





## MA-3

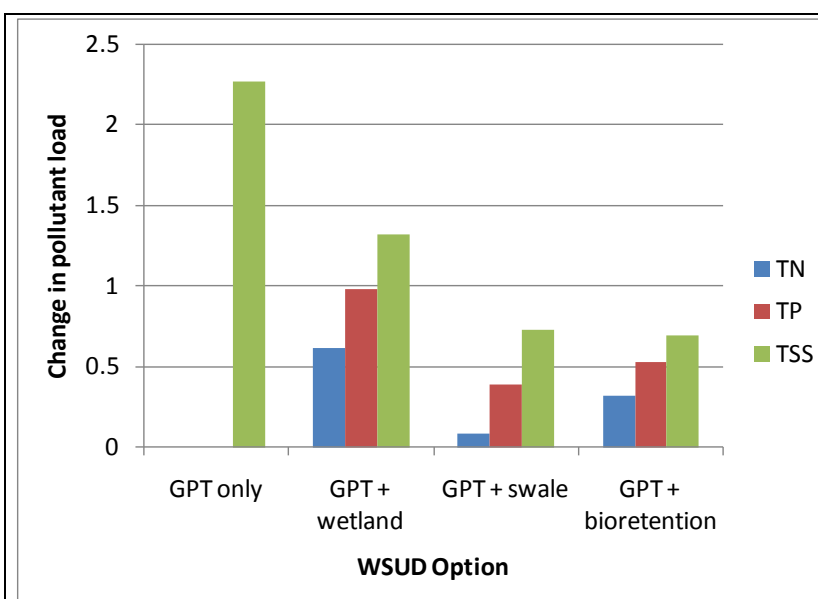
**Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation**

maintenance as required and, where possible, monitoring of the effectiveness of WSUD devices.

**An example using the Botany Bay CAPER DSS to select WSUD treatment options for Salt Pan Creek**

The Botany Bay CAPER DSS can be used to consider the impacts of various alternative WSUD treatment trains. Below is an example of results from the CAPER DSS which could be used to select investment options for Salt Pan Creek. This area was chosen as it contains significant saltmarsh and seagrass habitats that are sensitive to changes in water quality, particularly sedimentation (TSS) and eutrophication (TN, TP) and is a priority for WSUD investment.

In this example it is assumed that there is a limit of \$100,000 available per annum for maintaining the selected treatment train(s). No limit has been placed on upfront costs (for the purposes of this example only) although it would be possible to place a second limit on the funds available for upfront costs to install treatment measures. Three Councils control parts of the Salt Pan Creek catchment: Bankstown; Canterbury; and, Hurstville. Over 97% of the catchment is urbanised, making WSUD the main option for limiting pollutant loads. Four options were considered based on their high relative effectiveness (versus maintenance cost) of reducing pollutant loads: GPT only; GPTs and wetlands; swales and GPTs; and GPTs and bioretention systems (note that for this example it is assumed that the GPTs assessed would remove some sediment as well as gross pollutants – it is recognised that not all GPTs remove sediment). Given the limit on maintenance costs, the areas that could be treated by these different options are 131ha, 37ha, 22ha and 18ha, respectively. The relative change in pollutant loads to Salt Pan Creek that would result from these investments is given in Figure 6-2. These relative impacts correspond to 0- 89 kg of TN, 0-18kg of TP and 6-21 tonnes of sediment being stopped from entering the Salt Pan creek estuary each year.



**Figure 6-2 Pollutant Load reductions from WSUD options**

## MA-3

**Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation**

Figure 6-2 shows that the GPT would remove by far the most sediment (2.27%) when applied in isolation (given the larger area able to be treated) but that it would have little effect on nutrients entering the estuary. The wetland option would achieve the greatest reductions in nutrients (0.6-1%) and a relatively large proportion of sediment. The swale and bioretention options would have a similar effect on sediments (0.7%) but bioretention would decrease TN and TP (0.32%,0.53%) by a much greater amount than swales (0.08%,0.39%).

These options are associated with very different upfront costs. The total upfront cost of the GPT (\$3.5 million) and wetland (\$5.9 million) options are substantially higher than the cost associated with the swale and bioretention options (both ~\$900,000). These costs would be split between the three Councils.

The best option in any situation will depend on achieving the right balance between these upfront and maintenance costs and the benefits of reduced pollution to the catchment. It will also depend on physical constraints to implementing these options (such as space) as well as preferences due to amenity and other values attached to WSUD treatment trains (eg. the recreation and amenity values of wetland areas). These results could be used to select a treatment train option for the catchment, or could be further refined by using limits on upfront costs and/or benchmark reductions in TSS, TN and TP to be achieved.

Refer to Figure 6-1 for location details for this option.

## Links to existing works

Managing urban stormwater: harvesting and reuse (DEC, 2006)  
 Beverly Park Golf Club stormwater harvesting and sewer mining and reuse project  
 The Crest stormwater harvesting and water quality treatment (including raingarden) – completed in 2011  
 Amberdale Reserve stormwater swale – completed 2011  
 Newlands Reserve stormwater wetland – completed 2012  
<http://www.sydney.cma.nsw.gov.au/bbcci/improvement-grants.html>  
<http://www.environment.nsw.gov.au/stormwater/usp/grants/s1f0209.htm>

Council	Applicable	Comments
Bankstown	YES	Salt Pan Creek and Little Salt Pan Creek are priority catchment areas for targeted WSUD works Lake Gillawarna water quality improvement project (wetland) – to commence in 2012-3 Kelso stormwater harvesting – to commence in 2012-3
Liverpool	YES	
Hurstville	YES	Priority catchment areas/locations for targeted WSUD works include: <u>Salt Pan Creek</u> <ul style="list-style-type: none"> <li>Evatt Park – Webbs Dam Upgrade</li> </ul> <u>Lime Kiln Bay/Boggywell Creek</u> <ul style="list-style-type: none"> <li>Gannons Park – stormwater harvesting and reuse</li> <li>Hurstville Golf Course – Peakhurst Light Industrial Stormwater</li> </ul>

MA-3	Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation	
		<p>Harvesting and Reuse Scheme</p> <p><u>Gundah Bay</u></p> <ul style="list-style-type: none"> <li>• Myles Dunphy Reserve – Sediment and erosion control works</li> </ul> <p><u>Georges River</u></p> <ul style="list-style-type: none"> <li>• Priority foreshore areas</li> </ul>
Fairfield	YES	<p>Orphan School Creek and Clear Paddock Creek are two priority locations currently proposed for creek restoration, incorporating bank stabilisation, de-channelisation and planting of riparian corridors.</p> <p>Council is starting to prepare catchment management plans for catchments centred on Old Guildford, Smithfield and Wetherill Park.</p>
Sutherland	YES	<p>Priority catchment areas for targeted WSUD works (including for example SQIDs, constructed wetlands and bioretention systems) are:</p> <ul style="list-style-type: none"> <li>▪ Mill Creek</li> <li>▪ Still Creek</li> <li>▪ Oyster Creek</li> <li>▪ Gwawley Bay</li> <li>▪ Woollooware Bay</li> </ul> <p>Works to be done as part of future developments (by developers rather than Council).</p>
Rockdale	YES	<p>Priority catchment areas for targeted WSUD works (including for example GPTs, constructed wetlands and bioretention systems) are:</p> <ul style="list-style-type: none"> <li>▪ Sandringham Bay</li> <li>▪ Botany Bay</li> <li>▪ Lower Georges River</li> </ul>
Kogarah	YES	<p>Priority catchment areas for targeted WSUD works (including for example GPTs, constructed wetlands and bioretention systems) are:</p> <ul style="list-style-type: none"> <li>▪ Kogarah Bay</li> <li>▪ Oatley Bay</li> <li>▪ Middle Bays</li> <li>▪ Poulton Park (particularly combating the effects of channel scouring, sedimentation, gross pollutants and degraded water quality)</li> <li>▪ Connells Point Reserve (E91 – see SMEC, 2010) (modifications required to avoid overflows)</li> <li>▪ Moore Reserve Wetland (possible stormwater reuse)</li> <li>▪ Kogarah Bay Creek (possible naturalisation of stormwater channel)</li> <li>▪ Carss Bush Park Creek (possible naturalisation of stormwater channel)</li> <li>▪ Beverly Park (possible channel diversion through golf course)</li> </ul> <p>There are also a number of outstanding works in the existing stormwater management plan, including:</p> <ul style="list-style-type: none"> <li>▪ Harold Fraser Creek Reinstatement;</li> <li>▪ Claydon Reserve Refurbishment; and</li> <li>▪ Install the remaining proposed stormwater sediment treatment devices at:             <ul style="list-style-type: none"> <li>○ Park Road GPT and sediment control</li> <li>○ Kogarah Bay Litter and sediment trap</li> </ul> </li> </ul>


MA-3		Retrofit appropriate new WSUD devices in existing urban areas including measures such as artificial wetlands, bioretention systems, vegetated swales, and channel naturalisation
		<ul style="list-style-type: none"> <li>Carss Park car park sediment pits</li> </ul>
National Pk	NO	
Commencement		2012 and on-going. Priority areas targeted first.
Costs, Resources and Funding Opportunities		<p>Strategic assessments to determine optimum locations for retrofit WSUD can be carried out at an LGA-wide scale, or preferably across multiple LGAs covering broad catchments draining to the Georges River Estuary. Strategic assessments should use the CAPER DSS already developed, and as such, costs and resources for locating optimum WSUD would be relatively small (&lt; \$10,000 per LGA). Smaller scale community-focussed (sub-catchment) modelling and planning can also be carried out to further refine optimum locations for WSUD devices, although other constraints may ultimately determine the most feasible locations for such devices within a sub-catchment. This sub-catchment scale approach has been pioneered by Marrickville Council and further developed under the Cooks River Sustainability Initiative (CRSI).</p> <p>Costs associated with survey, design, assessment, approvals and construction of WSUD at the optimum locations is expected to vary considerably, dependent on the extent and nature of the proposed works. Small scale and site specific WSUD can be implemented for cost of &lt; \$10,000, while larger catchment-based or regional devices can cost several hundred thousand dollars.</p> <p>Funding for the installation of WSUD would primary be sourced internally through Councils' general revenue pool. Stormwater management service charges can also be charged to ratepayers to help fund these types of works under the provisions of the <i>Local Government Act 1993</i>. Additional funds may be sourced from State or Federal Government Grants Programs (e.g. Estuary Management Program, Federal Stormwater Harvesting Program).</p>
Lead Responsibilities		All Councils in Georges River Estuary Catchment
Support Responsibilities		GRCCC, OEH, HNCMA
Performance Measures		<ol style="list-style-type: none"> <li>Application of Botany Bay CAPER DSS to determine optimum locations for WSUD.</li> <li>Construction of new WSUD projects and devices.</li> <li>Improvement in water quality in areas downstream of the new WSUD measures, as well as more generally within the Georges River Estuary and Botany Bay.</li> </ol>



MA-4		Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs and other stormwater quality improvement devices.							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes								
Objectives addressed	A1, A6				Priority		HIGH		
Approach / Department	Engineering Works & Asset Management								
Detailed description	<p>WSUD devices are a key approach to reducing the pollutant loads (such as nutrients, sediments and litter) entering the estuary from urban lands. These devices can be very effective at capturing pollutants, potentially capturing 90% of total sediments, over 70% of total phosphorus, over 40% of total nitrogen and up to 100% of gross pollutants as single devices or even higher amounts of pollutants if combined with other WSUD devices in a treatment train. The devices require regular maintenance, including removal of the pollutants that have accumulated. Where this maintenance is not undertaken, devices can become ineffective and can stop capturing new pollutants or can even become a source of pollutant loads to the estuary. The MUSIC modelling in the Botany Bay CAPER DSS estimates maintenance costs of WSUD devices at between \$700 and \$7000 per hectare of the catchment treated by a device per year.</p> <p>To implement this action:</p> <ul style="list-style-type: none"><li>• The GRCCC should work with Councils to develop generic maintenance plans for WSUD devices that can be adopted and refined by all GRCCC councils.</li><li>• Councils should review and implement maintenance schedules on stormwater devices to prevent pollutants entering the Georges River.</li><li>• Where appropriate, Councils should apply the former SMCMA developed guidelines (see MI-3) for consistent monitoring of the effectiveness of WSUD devices.</li><li>• Records and reports on material removed from GPTs and other devices should be collated and reviewed annually. Water quality monitoring can be used to help identify any water quality improvements.</li><li>• Ensure existing and new WSUD devices are included in asset management plans, which are required to be prepared under the new integrated planning and reporting framework for local government.</li><li>• Councils should consider engaging a dedicated WSUD/OSD compliance officer to ensure privately owned devices are operated and maintained as intended.</li></ul>								
Links to existing works	<p>Existing GPTs and other WSUD devices are listed in Table C and associated figures in Appendix 2d of the Estuary Processes Study (SMEC, 2010).</p> <p>SMCMA (2011). Botany Bay and Catchment Water Quality Improvement Plan, Sydney: Botany Bay Water Quality Improvement Program.</p> <p>Various WSUD maintenance guideline documents</p>								
Council	Applicable	Comments							
Bankstown	YES	Maintenance schedule of stormwater devices and GPTs along the Georges River needs to be reviewed and implemented.							



MA-4		Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs and other stormwater quality improvement devices.
		Review and update Drainage Asset Management plan for WSUD devices
Liverpool	YES	
Hurstville	YES	Council's stormwater maintenance schedule is reviewed annually to ensure all devices are maintained to an appropriate standard. Maintenance requirements of all new devices, including WSUD technologies, are assessed prior to installation to ensure they can be adequately maintained in the longer term.
Fairfield	YES	Details of pollutants removed from GPTs are collected and reported in Council's SoE report. Council is now preparing maintenance plans for WSUD devices and including devices on Council's asset management plan.
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	Council's Annual Review should indicate the quantum of material removed from the GPTs across the LGA.
National Pk	NO	
Commencement		2012, and on-going
Costs, Resources and Funding Opportunities		<p>Works associated with this strategy would be carried out by Council staff, or by a Council appointed contractor. Costs are likely to vary depending on the nature of the WSUD device, and could range from &lt; \$100 (for extraction from an inlet pit basket) to &gt; \$10,000 (for a catchment-scale integrated GPT, sediment trap and wetland) per cleaning event each.</p> <p>There are very few external funding opportunities for on-going maintenance works. As such, funding would typically need to be sourced from Councils' asset management and maintenance pool derived from general rates revenue. Stormwater management service charges can be applied for maintenance of infrastructure under the provisions of the <i>Local Government Act 1993</i>, with a current maximum charge of \$25pa per normal residential block (subject to works being carried out in accordance with a management plan that has included community consultation). It is expected that potentially more than \$100,000 per year per LGA would be required for maintenance of WSUD and water quality treatment devices along the Georges River Estuary (depending on the type and number of devices located in each LGA).</p>
Lead Responsibilities		All Councils in Georges River Estuary Catchment
Support Responsibilities		GRCCC, HNCMA
Performance Measures		<ol style="list-style-type: none"> <li>1. Regular maintenance of existing WSUD devices.</li> <li>2. Reduction in pollutant loads reaching downstream waterways, including the Georges River Estuary and Botany Bay (established through targeted water quality monitoring program).</li> <li>3. Reduction in community complaints regarding pollution and litter within waterways and uncleaned stormwater devices.</li> </ol>

MA-6	Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes				partly				
Objectives addressed	A1, A2, A6, E2				Priority		HIGH		
Approach / Department	Compliance								
Detailed description	<p>The sub-division and building phases of developments are a time when the risk of significant erosion and export of sediments and nutrients is very high. During these phases, earth is disturbed and can be left exposed for significant periods of time. Little or no vegetation is available to hold soils together to prevent erosion. Moderate or large rainfall events occurring during these phases can thus generate very substantial erosion events that contribute sediments and nutrients to the waterways.</p>  <p>Sediment controls should be used to limit the amount of sediment exported off development sites during these phases. In some cases these controls may be missing or inadequately maintained to limit these damaging erosion events. Greater emphasis needs to be placed on 1) ensuring that adequate erosion and sediment controls are implemented during the building and subdivision stages of all developments, 2) ensuring these controls are properly maintained so that they adequately control sediment movement on site. This is the case for residential and commercial developments overseen by Councils as well as infrastructure projects run by State and Federal Governments.</p> <p>Appropriate sediment controls must be planned for before subdivision or building commences, then these must be subject to on-going monitoring of their presence and effectiveness. Specific actions to support this management option are:</p> <ul style="list-style-type: none"><li>• Review DCPs to ensure adequate sediment and erosion control measures are specified;</li><li>• Provide education to community and development/building industry regarding the requirements for sediment and erosion control;</li><li>• Conduct on-going on-site investigations to ensure sediment and erosion control measures are properly implemented and maintained; and</li><li>• Enforce requirements for sediment and erosion controls, including issuing fines for non-compliance.</li></ul>								
Links to existing works	<p><u>Fairfield</u>: Erosion and Sediment Control Policy 1996 <a href="http://www.fairfieldcity.nsw.gov.au/upload/vncob13398/ErosionAndSedimentControl1996.pdf">http://www.fairfieldcity.nsw.gov.au/upload/vncob13398/ErosionAndSedimentControl1996.pdf</a></p> <p><u>Bankstown</u>: Section 3, Part E1 (Demolition &amp; Construction) DCP 2005 <a href="http://dat.bankstown.nsw.gov.au/Temp/tempdoc095440.pdf">http://dat.bankstown.nsw.gov.au/Temp/tempdoc095440.pdf</a></p> <p><u>Kogarah</u>: Environmental Site Management Policy <a href="http://www.kogarah.nsw.gov.au/resources/documents/Env_Site_Manage_Policy.pdf">http://www.kogarah.nsw.gov.au/resources/documents/Env_Site_Manage_Policy.pdf</a></p> <p><u>Rockdale (and others)</u>: Soils &amp; Construction manual (Managing Urban Stormwater</p>								

MA-6		Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction
		– Landcom, 2004 [the “blue book”])
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	Council will continue to conduct regular inspections of all major construction sites within the LGA, from both a building certification and environmental compliance perspective.
Fairfield	YES	
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	
National Pk	YES	
Commencement		2012, and on-going
Costs, Resources and Funding Opportunities		The works and actions recommended for this strategy would be undertaken by Council staff, or by a Council appointed contractor. Councils should determine if existing staff resources (and contractors) are sufficient for accommodating any additional workload associated with implementation of education programs and enforcement of measures, including issuing fines for non-compliance.
Lead Responsibilities		All Councils in Georges River Estuary Catchment
Support Responsibilities		GRCCC, OEH
Performance Measures		<ol style="list-style-type: none"> <li>1. All DCPs include sediment and erosion control specifications.</li> <li>2. Auditing of construction sites.</li> <li>3. Reduction in community complaints regarding sediment runoff and turbidity within waterways downstream of development sites.</li> </ol>

MA-8	Continue the GRCCC Riverkeeper Program to remove gross pollutants from foreshores and waterways, help minimise the impact of, and monitor incidences of, illegal dumping (on land and in water)								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes								
Objectives addressed	A4, A6				Priority		HIGH		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<p>Gross pollutants impact negatively on aquatic and terrestrial habitats. Most of the rubbish that makes its way through the conventional stormwater system into the river is caused by littering in urban areas. Illegal dumping is also a significant contributing factor. The majority of the rubbish removed is plastics, including plastic bags, drink bottles, packaging and broken debris. Other kinds of rubbish removed includes dumped building and construction materials, green waste, milk crates, rubber tyres, furniture and household items trolleys, mattresses and auto parts. Riverkeeper teams also remove micro-rubbish. Micro-rubbish is the term we use to describe the smallest gross pollutants in the system. It is characterised by pieces of rubbish (&lt; 5mm) such as polystyrene, plastic bits, bottle tops and cigarette butts &amp; lighters. Polystyrene used in packaging represents the most commonly found micro rubbish. The polystyrene breaks down into ever smaller pieces and mixes with organic materials (leaves, seaweed), and is consequently very difficult to remove from the river system. Micro-rubbish, ingested by seabirds and aquatic species has been recorded as a significant cause of mortality.</p> <p>The program also removes dumped green waste such as garden clippings which can introduce weeds to riparian areas. The Riverkeeper program currently monitors incidences of illegal dumping and co-ordinates clean up of foreshore and waterway areas, with priority areas nominated by councils. The Riverkeeper program and councils should also act to educate the community about the impact of gross pollutants on the waterway.</p> <p>Consideration should be given the undertaking occasional blitzes whereby Council officers work with NSW Police and/or State Agencies to catch offenders in areas identified as hotspots for illegal dumping. Media publicity of these blitzes and any resulting prosecutions may also deter others.</p> <p>Refer to Figure 6-1 for location details for this option.</p>								
Links to existing works	<p>Full list of Riverkeeper work sites, including rubbish removal sites, is presented in <b>Appendix G</b>.</p> <p>See: <a href="http://www.georgesriver.org.au/River-Keeper-Map.html">http://www.georgesriver.org.au/River-Keeper-Map.html</a> for updates of work sites. Current sites mapped in Figure 6-3.</p> <p>GRCCC also partners with Corrective Services NSW for provision of labour for Riverkeeper Teams using offenders on Intensive Correction Orders.</p>								





MA-8

Continue the GRCCC Riverkeeper Program to remove gross pollutants from foreshores and waterways, help minimise the impact of, and monitor incidences of, illegal dumping (on land and in water)

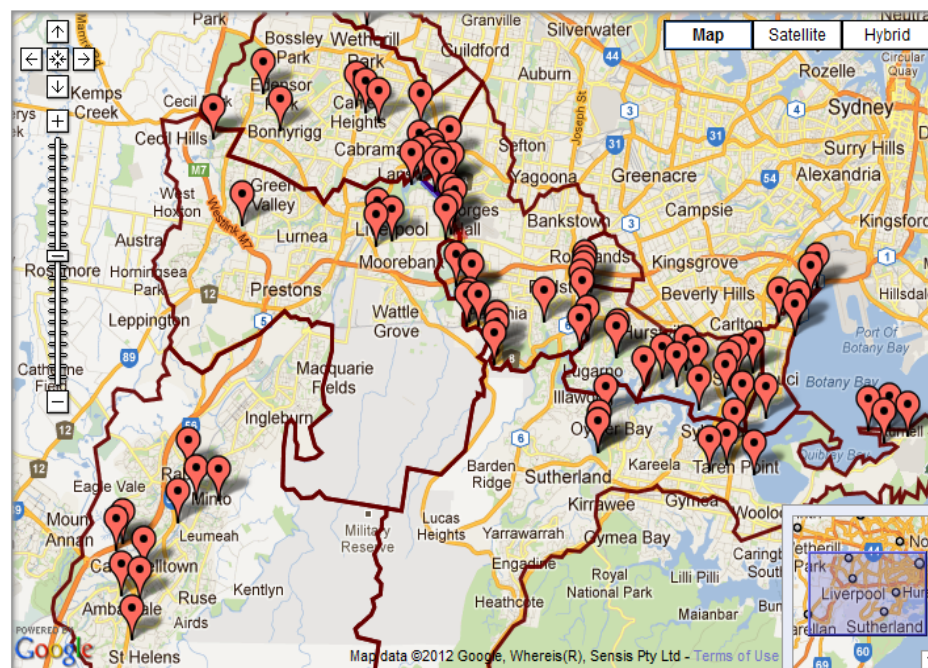



Figure 6-3 Riverkeeper rubbish removal sites 2011/12

Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	Council will continue to participate in the GRCCC Riverkeeper Cluster Group, and in the development and implementation of the annual Riverkeeper Workplan. Sites nominated for inclusion in the plan will include known hotspots where gross pollutants accumulate and can be safely accessed by program work teams.
Fairfield	YES	
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	Dover Park and Poulton Park are hotspot dumping sites.
National Pk	YES	
Commencement		Program began in 1995 but was substantially restructured in 2011 with annual strategic workplans introduced which included a significant increase in work teams and workdays for each council.
Costs, Resources and Funding Opportunities		The GRCCC Riverkeeper Program is currently funded by program contributions made to the GRCCC by member councils. Ongoing financial support from the Councils to continue the program is recommended with supplementary funding provided for large scale projects either through grant funding or additional council project contributions.
Lead Responsibilities		GRCCC, Corrective Services NSW
Support Responsibilities		All Councils in Georges River Estuary Catchment

<b>MA-8</b>	<b>Continue the GRCCC Riverkeeper Program to remove gross pollutants from foreshores and waterways, help minimise the impact of, and monitor incidences of, illegal dumping (on land and in water)</b>
Performance Measures	<ol style="list-style-type: none"><li>1. Continuation of Riverkeeper rubbish removal teams.</li><li>2. Quantum of rubbish removed from waterway and foreshore areas.</li><li>3. Reduction in community complaints regarding rubbish and litter within waterways and along foreshore areas.</li></ol>

MA-10		Councils to adopt WSUD action plans based on a comprehensive framework of institutional capacity and assessment							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes								
Objectives addressed	A1, A2, A6				Priority		HIGH		
Approach / Department	Environmental Planning								
Detailed description	<p>WSUD Action Plans have already been developed by four Councils in the Lower Georges River Estuary Council areas in conjunction with the GRCCC (comprising Hurstville, Sutherland, Rockdale and Kogarah). These action plans are based on a comprehensive framework of institutional capacity and assessment. They aim to address many of the institutional constraints to WSUD being implemented and maintained within the Councils' areas.</p>  <p>Implementation of these Action Plans would see these constraints being removed and a greater use of WSUD across the LGAs as an effective means of reducing pollutants being delivered from these Councils to the Estuary. Specific actions to support this option are:</p> <ul style="list-style-type: none"><li>• Adoption of the currently prepared WSUD Action Plan by Councils</li><li>• Implement actions presented in these Action Plans (link to <b>MA-3</b>).</li><li>• Remaining Councils in Georges River Catchment to consider development of WSUD Action Plans for their LGAs</li></ul>								
Links to existing works	<ul style="list-style-type: none"><li>• Hurstville WSUD Action Plan</li><li>• Sutherland WSUD Action Plan</li><li>• Rockdale WSUD Action Plan</li><li>• Kogarah WSUD Action Plan</li></ul>								
Council	Applicable	Comments							
Bankstown	NO								
Liverpool	NO								
Hurstville	YES	The Hurstville City Council WSUD Action Plan was adopted by Council in June 2011.							
Fairfield	YES	Council is currently considering developing a WSUD action plan with assistance from HNCMA							
Sutherland	YES								
Rockdale	YES	The Rockdale WSUD Action Plan has already been adopted by Council.							
Kogarah	YES								
National Pk	NO								
Commencement		2012, and on-going							
Costs, Resources and Funding Opportunities		The development of WSUD Action Plans involves two facilitated rapid assessment sessions. This could be done in house or through a professional facilitator with							

MA-10	Councils to adopt WSUD action plans based on a comprehensive framework of institutional capacity and assessment
	<p>costs expected to be in the range of \$5000.</p> <p>Adoption of the WSUD Action Plans is expected to involve staff time only. Implementation of the Plans, however, is expected to require considerable internal and external resources and associated funding. In combination with catchment management plans, the WSUD Action Plans outline ways of improving organisation capacity to deliver WSUD, along with proposed WSUD works and estimated costs for implementation.</p> <p>As outlined for <b>MA-3</b>, funding for the installation of WSUD would primarily be sourced internally through Councils' general revenue pool. Additional funds may be sourced from State or Federal Government Grants Programs (e.g. Estuary Management Program, HNCMA Grants Program, Federal Stormwater Harvesting Program). Stormwater management service charges can also be charged to ratepayers to help fund these types of works under the provisions of the <i>Local Government Act 1993</i>, particularly if the Action Plan has been developed with community consultation.</p> <p>Funding may also be required to improve organisational capacity (e.g. staff training, incentives etc)</p>
Lead Responsibilities	All Councils in the Georges River Catchment
Support Responsibilities	GRCCC, OEH, HNCMA (WSUD in Sydney Program)
Performance Measures	<ol style="list-style-type: none"> <li>1. Adoption of WSUD Action Plans by Councils.</li> <li>2. Implementation of WSUD Action Plans.</li> <li>3. Construction of WSUD measures (see also <b>MA-3</b>).</li> <li>4. Development and implementation of WSUD Action Plans for other Councils.</li> </ol>

MA-15		Liaise with Sydney Water when sewers are observed to be causing water quality problems							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
	yes								
Objectives addressed	A1, A3				Priority		HIGH		
Approach / Department	Environmental Planning								
Detailed description	<p>Private sewers, both legal and illegal, in addition to public sewers have the potential to be substantial contributors of pollutants to the estuary. These sewers can be associated with overflow events and failures that can deliver high loads of sediments, nutrients, pathogens and chemicals to the waterways.</p> <p>Local Council staff are often in a good position to have knowledge of the location and severity of problems associated with private and public sewers, with community members likely to contact staff when they notice a problem. Sydney Water staff may not however be aware of the presence or severity of problems associated with such sewers, even though they are in a position to act to manage the problems associated with them.</p> <p>Greater information sharing and collaboration between Councils and Sydney Water could help to identify these sewers more quickly so they can be effectively managed. Sewer overflow incidents should be reported to Sydney Water. It is noted that Sydney Water, however, only has responsibility for public sewers, while compliance of private sewers falls under the jurisdiction of councils. To support the implementation of this option, actions are:</p> <ul style="list-style-type: none"><li>• Encourage reporting of suspected sewer overflow events to Council staff and Sydney Water as appropriate;</li><li>• If relating to a public sewer, identify a Council contact responsible for liaising with Sydney Water and ensure Council staff report suspected overflows to this contact;</li><li>• If relating to a private sewer, ensure that incident is reported to relevant compliance department of Council;</li><li>• Support a collaborative relationship between Sydney Water and Council. Encourage information sharing about known problem areas and plans for these to be effectively managed;</li><li>• GRCCC to pursue formalisation of reporting on sewer overflows and monitoring with Sydney Water and EPA via a Georges River Catchment MOU with Georges River Councils.</li></ul>								
Links to existing works	Sydney Water Sewerfix Program								
Council	Applicable	Comments							
Bankstown	YES								
Liverpool	YES								
Hurstville	YES	Council will continue to liaise with Sydney Water and where appropriate report failures of sewer connections.							
Fairfield	YES								
Sutherland	YES								
Rockdale	YES								
Kogarah	YES								



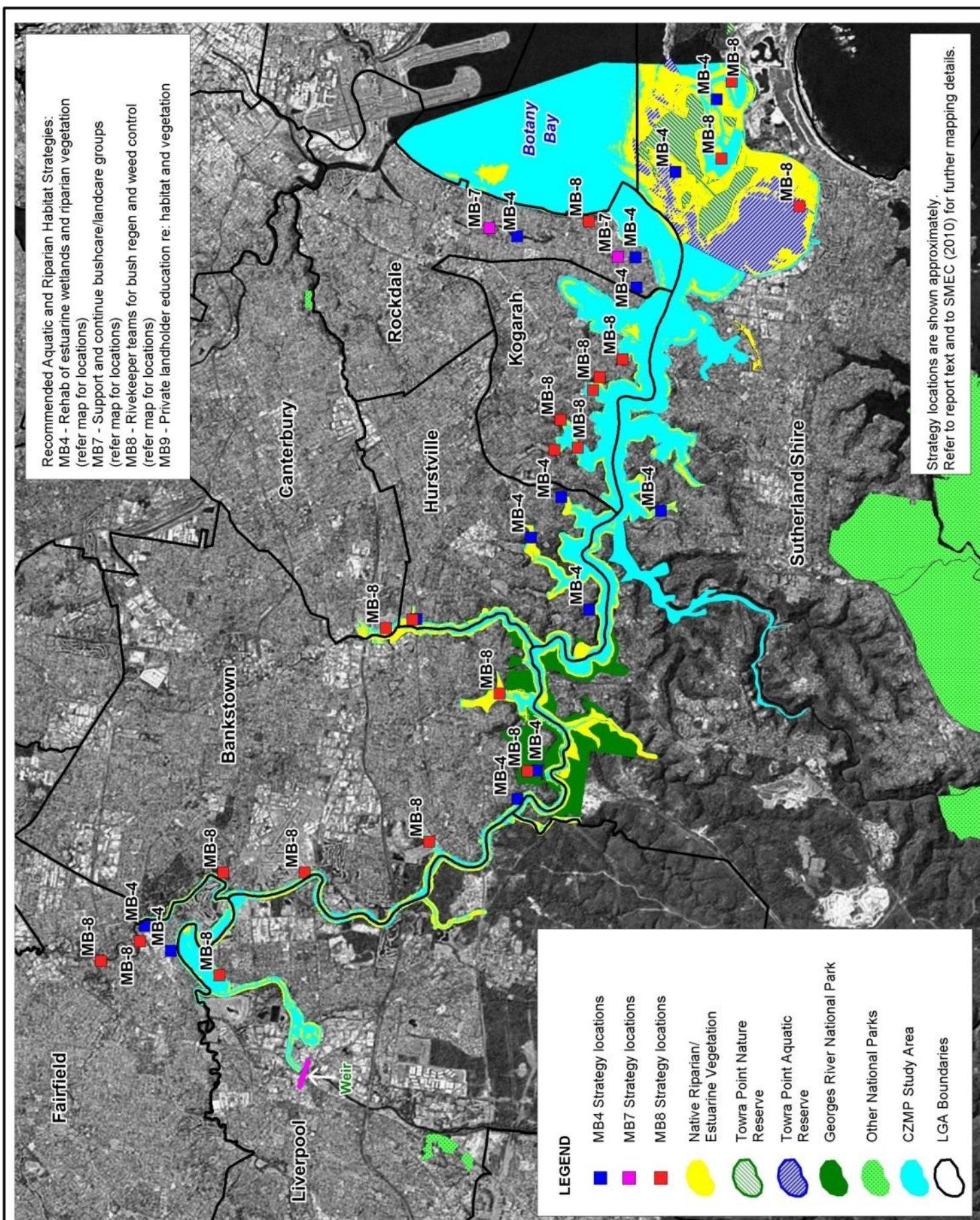
<b>MA-15</b>		<b>Liaise with Sydney Water when sewers are observed to be causing water quality problems</b>
National Pk	NO	
Commencement	2012, and on-going	
Costs, Resources and Funding Opportunities	This strategy would require staff time only, although there may be some out-of-pocket expenses associated with water testing to demonstrate overflows. No external funding is necessarily required, however, Councils should satisfy themselves that existing staff resources are sufficient for accommodating any additional workload associated with periodic liaison with Sydney Water	
Lead Responsibilities	All Councils in Georges River Catchment area	
Support Responsibilities	Sydney Water Corporation	
Performance Measures	<ol style="list-style-type: none"> <li>1. Identified point of contact in Councils to receive sewerage/wastewater queries from the community and to liaise with Sydney Water regarding any issues arising.</li> <li>2. Reduction in community complaints regarding on-going and unresolved sewer issues.</li> </ol>	

## 6.3 Aquatic and Riparian Habitat Sub-Plan

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### AQUATIC AND RIPARIAN HABITAT SUB-PLAN

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Title:  
**Aquatic and Riparian Habitat Sub-plan**



Figure:  
**6-4**

Rev:  
**A1**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 2.5 5km  
 Approx. Scale





MB-4	Identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine wetland communities (saltmarsh, mangrove, seagrass) and adjacent riparian vegetation								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
		yes							
Objectives addressed	B3				Priority		HIGH		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<div><div><p>Estuarine wetland communities provide habitat that is important to fish and other animals. They also help to hold sediments together and reduce turbidity of waterways. Many of the estuarine wetland communities (including saltmarsh and mangroves) in the Georges River estuary are in a degraded state, while some have been removed entirely. Opportunities exist to enhance and rehabilitate existing estuarine and riparian vegetation communities, as well as to create new habitat areas through saltmarsh, mangrove and seagrass plantings.</p><p>Revegetation could target intertidal areas (in respect of mangroves and saltmarsh habitat) as well as public riparian lands. Species planted should be locally indigenous. Works should also incorporate control and replacement of introduced and exotic species where appropriate.</p><p>Further, works should opportunistically remove old and obsolete structures within the waterways and along the foreshores (e.g. oyster industry relicts) and replace them with vegetation, as appropriate.</p><p>Rehabilitation and revegetation works would be expected to improve water quality, reduce bank erosion, and increase the habitat areas available to fish and other animals in the estuary. Actions to support this management option are:</p><ul style="list-style-type: none"><li>• Identify any gaps in ecological surveys undertaken to date. Fill survey gaps through co-ordinated, comprehensive surveys, as necessary;</li><li>• Complete relevant design, environmental impact assessments and construction of necessary works;</li><li>• Establish appropriate ongoing habitat monitoring programs;</li><li>• Implement management and restoration programs consistent with best practice guidelines for estuarine revegetation and management and relevant DPI Priority Action Statements.</li><li>• Monitor growth of mangroves and control where they are encroaching into saltmarsh (where feasible and appropriate).</li><li>• Monitor the populations of other significant species associated with saltmarsh communities and implement appropriate practices to ensure maintenance of viability.</li><li>• Investigate feasibility of levelling land to a suitable level for tidal inundation and saltmarsh establishment</li><li>• Integrated revegetation including invasive plant removal and replanting of saltmarsh species in areas where natural recovery potential (resilience) of</li></ul></div><div></div></div>								



MB-4		Identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine wetland communities (saltmarsh, mangrove, seagrass) and adjacent riparian vegetation
		<p>saltmarsh is not possible.</p> <ul style="list-style-type: none"> <li>Monitor the integrity and condition of estuarine vegetation communities to determine dynamics, present and/or future anthropogenic impacts resulting in intra-specific competition between communities (eg. Estuarine reedland and estuarine swamp oak forest)</li> </ul> <p>Refer to Figure 6-4 for location details for this option.</p>
	Links to existing works	<p>Georges River National Park Plan of Management Scott Park, Rockdale – saltmarsh re-establishment Various Cooks River Estuary sites <a href="http://www.environment.nsw.gov.au/stormwater/usp/grants/s1f0209.htm">http://www.environment.nsw.gov.au/stormwater/usp/grants/s1f0209.htm</a> <a href="http://www.hurstville.nsw.gov.au/Wetlands.html">http://www.hurstville.nsw.gov.au/Wetlands.html</a> Current Riverkeeper bush regeneration sites are: Bankstown – Mirrambeena Reserve &amp; Piper Keys Reserve Fairfield – Parkes Reserve, Canley Vale Hurstville – Clarendon Road Boat Ramp Kogarah – Poulton Park Foreshore Liverpool – Riverside Park Rockdale – Riverside Drive Foreshore and Scott Park, Cook Park, Kyeemagh Foreshore Dunes Sutherland – Forbes Creek Reserve Engadine, Horning Street, Kurnell See Appendix G for full list of Riverkeeper work sites.</p>
Council	Applicable	Comments
Bankstown	YES	<p>City-wide assessment required to identify sites for establishing wetland habitat, and for combining habitat outcomes with water quality improvement objectives</p> <p>Removal of abandoned structures on eastern bank of Prospect Creek mouth</p> <p>Consider the removal of groyne at S40 Lambeth Reserve (subject to heritage assessment)</p> <p>Participate in a collaborative project with NPWS and DPI Fisheries to remove Yeramba Lagoon weir to restore estuarine flows.</p> <p>Removal of abandoned structures on eastern bank of Prospect Creek (subject to heritage assessment)</p>
Liverpool	YES	
Hurstville	YES	<p>A community based foreshore mapping project could be developed to help prioritise local rehabilitation efforts.</p> <p>Wetlands within the LGA, both natural and constructed, together with areas or remnant riparian vegetation will be identified and prioritised based on their conservation and/or environmental value as part of Councils proposed biodiversity study and strategy. Prior to the completion of the strategy, rehabilitation and enhancement efforts will be focused on known communities/locations including Lime Kiln Bay, Myles Dunphy Reserve, Edith Bay and Riverwood wetlands.</p>
Fairfield	YES	<p>Rehabilitation works are being undertaken along Chipping Norton Lake foreshore and lower Prospect Creek at Lansvale Reserve. Works include noxious and environmental weed control, planting of mangroves and rubbish removal.</p>
Sutherland	YES	<p>Carina Creek Estuary and adjacent terrestrial bushland – target for weed removal, replanting and expansion of the vegetation buffer;</p>




MB-4		Identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine wetland communities (saltmarsh, mangrove, seagrass) and adjacent riparian vegetation
		<p>Update and implement Shire-wide biodiversity strategy</p> <p>Remove illegal jetties to restore continuous mangrove stands along the foreshore, such as at Quibray Bay at Towra Point</p> <p>Clean-up of oyster depot slakes and rubbish (including contamination from dumped tar)</p>
Rockdale	YES	<p>Targeted habitat establishment and enhancement (mangroves, saltmarsh, mudflats) at:</p> <ul style="list-style-type: none"> <li>• Scarborough Park Ponds</li> <li>• Bado Berong Creek (Scott Park);</li> <li>• Goomun Creek</li> </ul> <p>Ensure flow through pipes from Botany Bay (at Florence street) to Scarborough Ponds is maintained. There is a risk that growth of mangroves will restrict flows.</p>
Kogarah	YES	<p>Targeted mangrove plantings (either <i>Avicennia marina</i> or <i>Aegiceras corniculatum</i>) on fringing mud flats in Kogarah Bay (subject to advice and confirmation from DPI Fisheries).</p> <p>Renaturalisation of Kogarah Bay Creek Stormwater Channel</p>
National Pk	YES	<p>Removal of Yeramba Lagoon weir (in cooperation with Bankstown Council and DPI Fisheries) to restore estuarine flows.</p> <p>Protect and restore breeding and foraging habitat for migratory bird species in Towra Point.</p> <p>Continue to support and implement Fox TAP (including associated saltmarsh and mangrove restoration and enhancement).</p>
DPI Fisheries	YES	<p>Conservation of mangrove and seagrass communities in Towra Point Aquatic Reserve and more broadly</p>
Commencement		2012, and on-going
Costs, Resources and Funding Opportunities		<p>On-ground works associated with implementation of this strategy would be mostly undertaken by Council staff, paid contractors or volunteer labour (e.g. landcare / bushcare, GRCCC teams, Riverkeeper, Conservation Volunteers, Greening Australia, etc). Materials and resources would need to be funded through Council contributions, special Government grants, or by private philanthropic ventures, as well as the State Government Estuary Management Program.</p> <p>Bushland weed control, rehabilitation and regeneration works typically cost in the order of \$2,000 to \$10,000 per hectare, mostly comprising tube stock, herbicides, watering etc. Costs would also involve the removal of obsolete structures / barges etc (total cost unknown at this stage).</p> <p>Landcare Australia is supported by a range of Government and Industry Partners, and receives funding under the Federal Caring for our Country Program, as well as other state-based grants and private donations.</p> <p>All Councils co-ordinate local landcare/bushcare groups across their LGAs that can be used to help implement this strategy.</p>
Lead Responsibilities		All Councils, OEH (National Parks and Wildlife Service), DPI
Support Responsibilities		GRCCC, HNCMA, DPI Fisheries
Performance Measures		1. Plans and targets for estuarine and riparian rehabilitation / regeneration across all LGAs.

<b>MB-4</b>	<b>Identify locations for and undertake targeted rehabilitation, creation and enhancement of estuarine wetland communities (saltmarsh, mangrove, seagrass) and adjacent riparian vegetation</b>
	<ol style="list-style-type: none"><li></li><li>2. Implementation of estuarine and riparian rehabilitation / regeneration works.</li><li>3. Increase in the extent and quality of estuarine and riparian habitat along the Georges River Estuary.</li></ol>

MB-7	Support the establishment and continuation of local bushcare/landcare and other groups to assist with revegetation works on both public and private lands								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
		yes							
Objectives addressed	B2, B3				Priority		HIGH		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<p>Revegetation of riparian and other lands is a popular method of controlling erosion and pollutant exports to waterways. It also has the potential to provide habitat, to create links between existing vegetation communities, and to provide shade to waterways thus reducing water temperatures and the incidence of algal blooms. Revegetation can be labour intensive and revegetated areas can require maintenance such as weeding before vegetation has a chance to become fully established. Local bushcare / landcare groups have in the past provided an important source of labour to undertaking such works, on both private and public lands. Involvement of the community in these types of works also increases their awareness of the problems faced by the estuary and catchment and of the types of actions they can take to reduce these problems.</p>   <p>Works should be undertaken where possible using Riverkeeper Program and on public land and on private land using community volunteers. The Riverkeeper Program can also be used to provide training and instruction to community group and volunteers participating in Riverkeeper activities. These volunteers can then be fed into local Council bushcare groups at the end of each Riverkeeper project.</p> <p>Actions to support this management option are:</p> <ul style="list-style-type: none"><li>• Maintain a current data base of bushcare / landcare contacts and their activities. Inform them of funding, training and other opportunities.</li><li>• Help to raise the profile of bushcare / landcare groups operating in the catchment using media and other communication opportunities (eg. at events, through newsletters etc).</li><li>• Provide support to new and existing bushcare / landcare groups through the provision of funding, technical advice, equipment and training as appropriate.</li></ul> <p>Refer to Figure 6-4 for location details for this option.</p>								
Links to existing works	<p>Sutherland: Greenweb program <a href="http://www.hurstville.nsw.gov.au/Bushcare.html">http://www.hurstville.nsw.gov.au/Bushcare.html</a> HNCMA bushcare groups: <a href="http://www.sydney.cma.nsw.gov.au/our-">http://www.sydney.cma.nsw.gov.au/our-</a></p>								



MB-7		Support the establishment and continuation of local bushcare/landcare and other groups to assist with revegetation works on both public and private lands
		<a href="https://projects/sydney-community-bushcare-program.html">projects/sydney-community-bushcare-program.html</a> HNCMA community newsletter: Mambara
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	A detailed condition assessment is required to guide future works Adopt best practice bush regeneration guidelines Council will continue to support its established Bushcare Program and where appropriate participate in regional initiatives (e.g. GRCCC Riverhealth Program) to recruit new participants.
Fairfield	YES	Council to continue supporting local groups through preparing grant applications, purchasing materials and facilitating group meetings and working bees.
Sutherland	YES	Continue to support Greenweb program for rehabilitation of private lands, as well as Bushcare and Landcare groups for public lands
Rockdale	YES	Target works at: <ul style="list-style-type: none"> <li>Scarborough Park Ponds</li> <li>Bado Berong Creek</li> </ul>
Kogarah	YES	Review and complete the current Greenweb planning document Continued support to bushcare and Mayoral Green Grant Projects
National Pk	YES	GRCCC Riverkeeper Program is working with National Parks Association and other volunteers to do clean up and bush regeneration days within Georges River National Park.
Commencement		2102, and on-going
Costs, Resources and Funding Opportunities		Refer <b>MB-4</b> for details of landcare/bushcare resources and funding. In-kind contributions by Councils are required to co-ordinate efforts by various landcare/bushcare groups across the LGAs.
Lead Responsibilities		All Councils in the Georges River Estuary catchment
Support Responsibilities		GRCCC, HNCMA, Landcare Australia
Performance Measure		1. Continuation of existing, and establishment of new, landcare / bushcare groups across the LGAs. 2. Implementation of estuarine and riparian rehabilitation / regeneration works by landcare / bushcare groups (see also <b>MB-4</b> ). 3. Increase in the extent and quality of estuarine and riparian habitat along the Georges River Estuary (see also <b>MB-4</b> ).


MB-8		Utilise the Riverkeeper rubbish removal and bush regeneration teams to provide rubbish removal, weed control, bush regeneration and ongoing site maintenance to complement and support NPWS and council activities							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
		yes							
Objectives addressed	B1, B3				Priority		HIGH - MEDIUM		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<div><div><p>The Riverkeeper program is run by the GRCCC and is made up of technical officers from each member council. It focuses on undertaking on-ground works such as rubbish and weed removal, bush regeneration and conservation works as required by member councils. Works undertaken by the Riverkeeper program are agreed upon in collaboration with member councils. Councils should continue to utilise the Riverkeeper's bush regeneration teams to provide weed control, bush regeneration and on-going site maintenance to complement and support council bush regeneration works (including landcare / bushcare initiatives). Bush regeneration sites within the Georges River National Park should also be identified and should use the Riverkeeper bush regeneration teams to support works. Specific actions to support this management option are:</p><ul style="list-style-type: none"><li>Identify priority areas for weed control, bush regeneration, rubbish removal and other ongoing site maintenance.</li><li>Regularly review and update the Riverkeeper program, site selection and works in conjunction with Councils.</li><li>Work with the Riverkeeper teams to develop projects to compliment Council works in these priority areas.</li></ul><p>This strategy is linked to <b>MA-8</b>, which targets the removal of accumulated gross pollutants by the Riverkeeper teams and monitors illegal dumping of waste in the river and along the foreshores.</p><p>Refer to Figure 6-4 for location details for this option.</p></div><div></div></div>								
Links to existing works	See detailed listing under MA-8 and mapped in Figure 6-3. See also <a href="http://www.georgesriver.org.au/River-Keeper-Map.html">http://www.georgesriver.org.au/River-Keeper-Map.html</a> for most up to date listing of GRCCC work sites.								
Council	Applicable	Comments							
Bankstown	YES	<p>Can target large rubbish such as tyres and car parts, particularly after heavy rain.</p> <p>Target areas to include:</p> <ul style="list-style-type: none"><li>Yeramba Lagoon (also in National Park section)</li><li>Salt Pan Creek,</li><li>Little Salt Pan Creek</li></ul>							





MB-8		Utilise the Riverkeeper rubbish removal and bush regeneration teams to provide rubbish removal, weed control, bush regeneration and ongoing site maintenance to complement and support NPWS and council activities
		<ul style="list-style-type: none"> <li>• Kelso Creek,</li> <li>• Prospect Creek and</li> <li>• Georges River.</li> </ul>
Liverpool	YES	Target areas to include Angle Park
Hurstville	YES	<p>Target areas to include:</p> <ul style="list-style-type: none"> <li>• North of Riverwood Park, Salt Pan Creek</li> </ul> <p>Council will continue to participate in the GRCCC Riverkeeper Cluster Group, and in the development and implementation of the annual Riverkeeper Workplan. Sites nominated for inclusion in the plan will include known hotspots where gross pollutants accumulate and/or weeds proliferate. Priority regeneration sites will include those linked to Councils Bushcare Program or identified based on their environmental values.</p>
Fairfield	YES	<p>Target areas to include:</p> <ul style="list-style-type: none"> <li>• Chipping Norton Lake foreshore</li> <li>• Parts of Upper Prospect Creek</li> <li>• Orphan School Creek, Canley Vale.</li> <li>• Lower Prospect Creek.</li> </ul>
Sutherland	YES	<p>Target areas for invasive weed removal and revegetation to include:</p> <ul style="list-style-type: none"> <li>• Weeney Bay,</li> <li>• Quibray Bay,</li> <li>• Woollooware Bay</li> </ul>
Rockdale	YES	Target areas to include Cook Park dune system
Kogarah	YES	<p>Target areas for invasive weed control and revegetation include:</p> <ul style="list-style-type: none"> <li>• Oatley Bay</li> <li>• Kyle Bay</li> <li>• Shipwrights Bay</li> <li>• Moore Reserve, Poulton Pk</li> <li>• Kyle Williams Reserve (Swamp Oak Forest community and associated estuarine vegetation)</li> </ul>
National Pk	NO	
Commencement		2012, and on-going
Costs, Resources and Funding Opportunities		<p>As per <b>MA-8</b>, the GRCCC Riverkeeper rubbish removal teams are currently funded by contributions made to the GRCCC by member Councils. On-going financial support for the GRCCC by Councils will therefore contribute to the funding of this strategy.</p> <p>Where large special projects are required, supplementary funding will be required from Councils or alternative funding sources. If recommendation is to be adopted that Georges River National Park be formally included in general Riverkeeper schedule, there would need to be a financial support by the agency to support these works on an annual basis.</p>
Lead Responsibilities		All Councils in the Georges River Estuary Catchment
Support Responsibilities		GRCCC, HNCMA, OEH (NPWS), Corrective Services NSW

<b>MB-8</b>	<b>Utilise the Riverkeeper rubbish removal and bush regeneration teams to provide rubbish removal, weed control, bush regeneration and ongoing site maintenance to complement and support NPWS and council activities</b>
Performance Measure	<ol style="list-style-type: none"><li>1. Continuation of Riverkeeper rubbish removal and bush regeneration teams.</li><li>2. Implementation of rubbish removal along with estuarine and riparian rehabilitation / regeneration works by the Riverkeeper rubbish removal and bush regeneration teams (see also <b>MB-4</b>).</li><li>3. Reduction in rubbish and increase in the extent and quality of estuarine and riparian habitat along the Georges River Estuary (see also <b>MB-4</b>).</li></ol>

MB-9	Provide information to private landowners that have key habitat and vegetation communities on their properties to describe the community, its importance to the estuary and options for its protection and management								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
		yes							
Objectives addressed	B1, B2, B3				Priority		HIGH - MEDIUM		
Approach / Department	Communications & Education								
Detailed description	<div></div> <p>Large areas of key habitat and vegetation communities exist on or are adjacent to private land. This includes areas of riparian vegetation as well as communities such as seagrass, saltmarsh or mangroves where privately owned assets have the potential to impact on these communities (for example, private jetties located amongst seagrass beds).</p> <p>Private landholders have the potential to enhance or degrade these communities through their actions. Actions under this management option include:</p> <ul style="list-style-type: none"><li>• Maintain an inventory of private lands containing key EEC's or habitat for threatened species / populations. Include private assets located in key vegetation communities in the inventory.</li><li>• Inform property owners of the presence of EEC's or habitat for threatened species / populations and their importance / obligations, including:<ul style="list-style-type: none"><li>◦ Develop and distribute information packages on key habitat and vegetation communities, and steps that can be followed by property owners to minimise impacts and maximise conservation;</li><li>◦ Educate surrounding properties about garden escapees and continued bush regeneration in the area;</li><li>◦ Educate private property owners of the importance of foreshore vegetation and warn against removal;</li></ul></li><li>• Identify what support can be provided to assist landowners in the management of these areas and assets</li><li>• Support and investigate potential for conservation agreements, biobanking or covenants with interested landholders</li></ul>								
Links to existing works	Sutherland Shire Council - Greenweb								

<b>MB-9</b>		<b>Provide information to private landowners that have key habitat and vegetation communities on their properties to describe the community, its importance to the estuary and options for its protection and management</b>
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	Appropriate locations will be identified as part of Councils proposed Biodiversity Strategy.
Fairfield	YES	Brochures and pamphlets are distributed at Council offices. Educational activities such as door knocking and tree planting days are undertaken as part of grant funded bush regeneration projects along Cabramatta Creek, Orphan School Creek and Prospect Creek.
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	Target impact of seawalls, jetties, moorings and boats on seagrass at: <ul style="list-style-type: none"> <li>▪ Kyle Bay</li> <li>▪ Kogarah Bay</li> <li>▪ Connells Bay</li> </ul>
National Pk	NO	But could use NPWS materials and knowledge as part of education program
Commencement		2013, and continuing
Costs, Resources and Funding Opportunities		<p>Community education would mostly be carried out by Council staff (education and communications teams), particularly in respect to developing resources and engagement with the community.</p> <p>There is a significant opportunity for Councils to co-ordinate efforts on this strategy, thus minimising duplicated efforts, as similar resources would be developed for each LGA. The GRCCC, through its Communication and Engagement Program, is able to co-ordinate education, communication and engagement efforts across Councils to ensure consistency of message, and to minimise duplicated efforts as similar resources would be developed for each LGA.</p> <p>It is expected that some out-of-pocket expenses would be incurred for printing costs of all resources. Minor consultancies could also be used by Council to help develop the education resources.</p> <p>The need for external funding for these types of works would be relatively small, however, funding from HNCMA for education purposes may be possible.</p>
Lead Responsibilities		All Councils with estuary foreshore areas
Support Responsibilities		GRCCC, HNCMA, OEH (NPWS), DPI (Fisheries), RMS (for jetties, moorings etc)
Performance Measure		<ol style="list-style-type: none"> <li>1. Development and distribution of community education materials to property owners, boat owners, etc.</li> <li>2. Reduction in human impact, and improvement in the condition of estuarine and riparian habitat along the Georges River Estuary (see also <b>MB-4, MC-3</b>).</li> </ol>

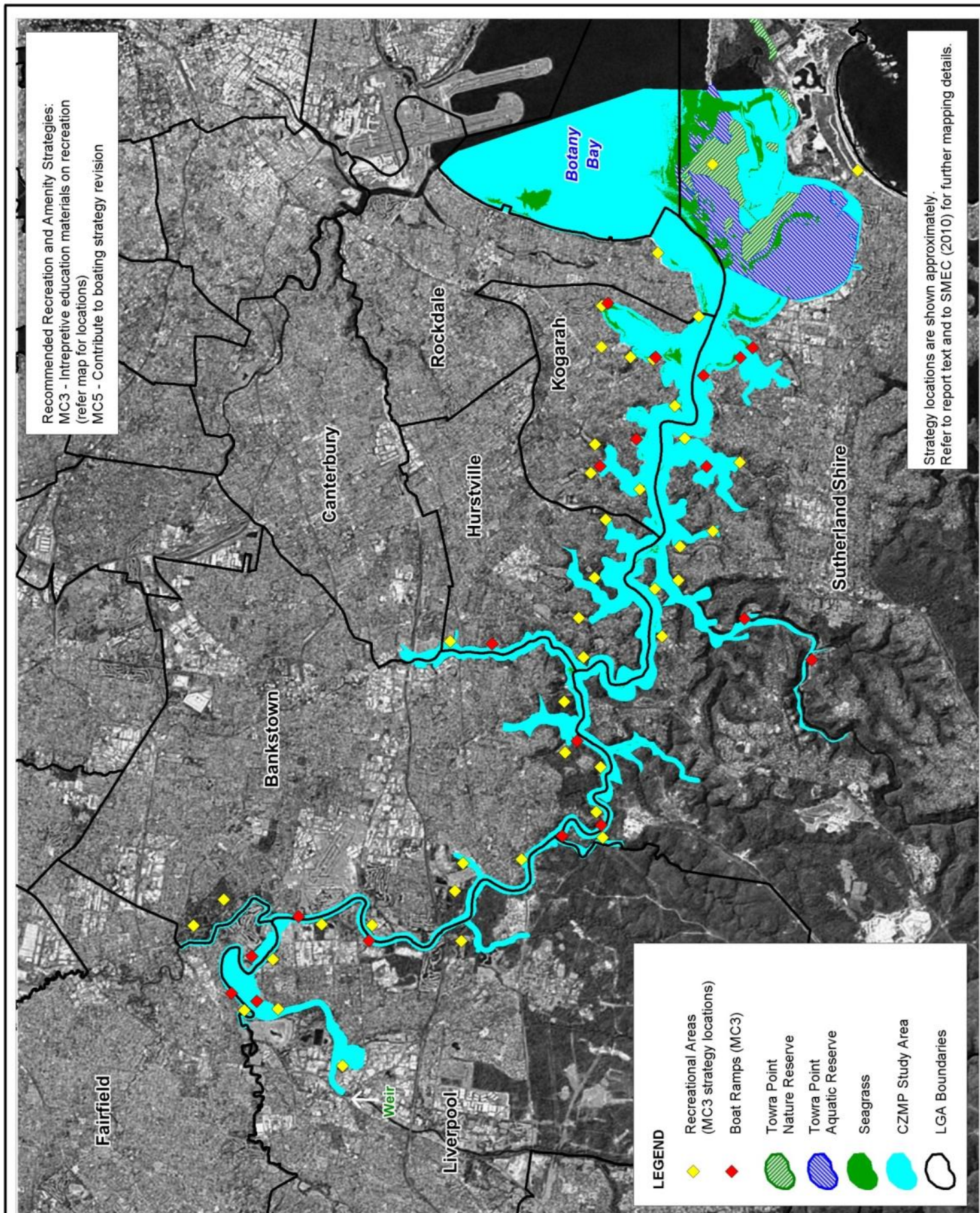
## 6.4 Recreation and Amenity Sub-Plan

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### RECREATION AND AMENITY SUB-PLAN

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Title:  
**Recreation and Amenity Sub-Plan**



Figure:  
**6-5**

Rev:  
**A1**


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MC-3	Prepare appropriate interpretative materials (e.g. signage, drain stencilling and other options) aimed at reducing impacts associated with legal and illegal recreational pursuits								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
			yes						
Objectives addressed	C1, C2, C4				Priority		LOW		
Approach / Department	Communications & Education								
Detailed description	<p>The Georges River Estuary and its foreshore are highly valued by the community for their recreational and amenity values. A range of recreational pursuits, both legal and illegal, are currently undertaken on the estuary and around the foreshore. Recreational pursuits have the potential, if not conducted in appropriate areas or with appropriate restrictions, to impact heavily on the estuary. For example, speeding boats can cause waves which erode banks and cause issues with sedimentation, rubbish and gross pollutants can be left behind by those using the estuary or foreshore area, 4WDs and dirt bikes used around the foreshore can cause erosion and sedimentation, reducing water quality and impacting on key animal species and plant communities. Interpretative materials and signage should be produced:</p> <ul style="list-style-type: none"><li>• To explain areas where particular recreational pursuits (eg. 4WDs and dirt bikes) are not able to be legally used and the reasoning behind these restrictions, including fines and other penalties associated with such use.</li><li>• To explain the values associated with areas used for legal recreation and providing direction to those using areas on behaviours and practices that can reduce any impacts associated with such use;</li><li>• With standard signage along the estuary and foreshores so people undertaking activities in different LGAs have the same message.</li></ul> <p>In most cases, the GRCCC Communications and Engagement Program can be used to coordinate development and production of these materials for foreshore and estuary areas. Councils and NPWS will need to work with the GRCCC to ensure that signage is placed in appropriate places and that information is provided to those community members most likely to be using the estuary and foreshores in these ways.</p> <p>Specific education programs that need to be run are:</p> <ul style="list-style-type: none"><li>• For boat users about wake causing erosion, including appropriate speed limits for minimising impacts</li><li>• A vessel wash education program</li><li>• ‘Drain is just for rain’ education program and stencilling of drains flowing into the estuary (e.g. within Kogarah Bay catchment)</li><li>• Advertisements for environmentally responsible products on rates notices, along with environmental messages relating to facts and solutions for the the Georges River estuary:</li></ul>								





MC-3		Prepare appropriate interpretative materials (e.g. signage, drain stencilling and other options) aimed at reducing impacts associated with legal and illegal recreational pursuits
		<ul style="list-style-type: none"> <li>• 'Adopt a waterway' school program;</li> <li>• Cleaning up after companion pets;</li> <li>• Environmentally friendly garden maintenance including minimising fertiliser use and avoiding garden escapees/weed propagation.</li> <li>• Install educational signage about erosion control projects and the importance of estuarine vegetation, including seagrass meadows</li> <li>• Activities that have the potential to contaminate sediments and endanger human health</li> </ul> <p>Refer to Figure 6-5 for location details for this option.</p>
Links to existing works		<p>Picnic Point catchment as part of MGRSI, see: <a href="http://www.georgesriver.org.au/MGRSI-Strategic-Management-Plan--Education.html">http://www.georgesriver.org.au/MGRSI-Strategic-Management-Plan--Education.html</a></p> <p>Boaters and Fishers Project (currently underway and educating recreational boaters and fishers on environmentally sound practices) – see former SMCMA web-site</p>
Council	Applicable	Comments
Bankstown	YES	Consider identifying sites for interpretive material within Bankstown (i.e. boat launching sites)
Liverpool	YES	
Hurstville	YES	Council will continue to work with the GRCCC Communication & Engagement Cluster in the development of appropriate materials/signage to be made available at key locations within the LGA including Jew Fish Bay Baths (Oatley Park), and Lime Kiln Bay and Clarendon Road Boat Ramp.
Fairfield	YES	
Sutherland	YES	In partnership with DPI Fisheries, consider environmental interpretation of Towra Point Aquatic Reserve
Rockdale	YES	
Kogarah	YES	<p>Key recreational areas include: Carss Park/Bush Park, Claydon Reserve, Sans Souci Park, Parkside Drive Reserve, Moore Reserve and Poulton Park.</p> <p>Dover Park and Oatley Bay boat ramp are access points where seagrass may be affected by access.</p> <p>Seagrass throughout Kogarah Bay and middle bays may be affected by general boating traffic</p>
National Pk	YES	Towra Point, Georges River National Park
Commencement		2015 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		<p>Similar to <b>MB-9</b>, community education would mostly carried out by Council staff, with costs primarily related to printing or production of interpretive materials (e.g. signage).</p> <p>Co-ordination of efforts between the Councils and National Parks can be facilitated through the GRCCC.</p> <p>The need for external funding for these types of works would be relatively small, however, funding from HNCMA for education purposes may be possible.</p>
Lead Responsibilities		GRCCC, All Councils with estuary foreshore areas, OEH (National Parks)

<b>MC-3</b>	<b>Prepare appropriate interpretative materials (e.g. signage, drain stencilling and other options) aimed at reducing impacts associated with legal and illegal recreational pursuits</b>
Support Responsibilities	HNCMA, RMS
Performance Measure	<ol style="list-style-type: none"> <li>1. Development and production of community-based interpretive education materials, and installation/distribution as appropriate for the target audience.</li> <li>2. Reduction in human impact, and improvement in the condition of estuarine and riparian habitat along the Georges River Estuary (see also <b>MB-4, MB-9</b>).</li> </ol>

MC-5	Contribute to current revision of boating strategy with Roads and Maritime Services to manage potential recreational use conflicts								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
			yes						
Objectives addressed	C1, C2				Priority		LOW		
Approach / Department	Environmental Planning								
Detailed description	<p>Roads and Maritime Services is currently developing a Boat Safety Plan for the Georges River Estuary. This plan aims to:</p> <ul style="list-style-type: none"><li>• ‘Protect and sustain the recreational and environmental values of a waterway</li><li>• Ensure that boating practices maximise user safety, enjoyment, public safety and amenity</li><li>• Consider the needs of shore-based estuary users as well as boating-based activities</li><li>• Review shore-based boating-related facilities or infrastructure such as launching ramps</li><li>• Provide a framework for consultation’. (Roads and Maritime Services website, 2011)</li></ul>								
<p>The GRCCC, Councils and NPWS should all contribute to this Boat Safety Plan to ensure that it is consistent with the aims and objectives of this Coastal Zone Management Plan. Particular issues that should be considered are:</p> <ul style="list-style-type: none"><li>• Appropriate placement of recreational infrastructure (e.g. moorings, jetties and marinas) to minimise impacts on key habitat and vegetation communities;</li><li>• Boating activities should be managed to ensure the minimum disturbance of the seagrass beds, mangroves and saltmarshes by berthing and anchoring activities. A specific policy for reducing the impacts of mooring, jetties and boat use on seagrasses should be developed. Consideration should be given to the replacement of single block swing moorings with seagrass friendly moorings.</li><li>• Best locations to undertake certain recreational activities (i.e. water skiing, jet skiing etc);</li><li>• Vessel washing guidelines;</li><li>• Management of rubbish and other waste;</li><li>• Boat speeds and associated wakes, especially where bank erosion is an issue.</li></ul> <p>Land &amp; Property Authority (L&amp;PA) are the land owners for the Georges River west of Capt. Cook Bridge, including tributaries. L&amp;PA provide land owners consent before they can lodge a DA with Council in relation to jetties and moorings. RMS (Maritime) and DPI Fisheries provide comment on any development and make a recommendation to the land owner before consent is granted. East of Capt. Cook Bridge, the bed of the Georges River and Botany Bay is under ownership of Roads and Maritime Services, and individuals need land owners consent from RMS before they can lodge a DA with the respective Council. RMS has jurisdiction over the placement of moorings for the whole river. Therefore both consent authorities need to be acknowledged when making reference to the Boat Safety Plan for the Georges River.</p>									





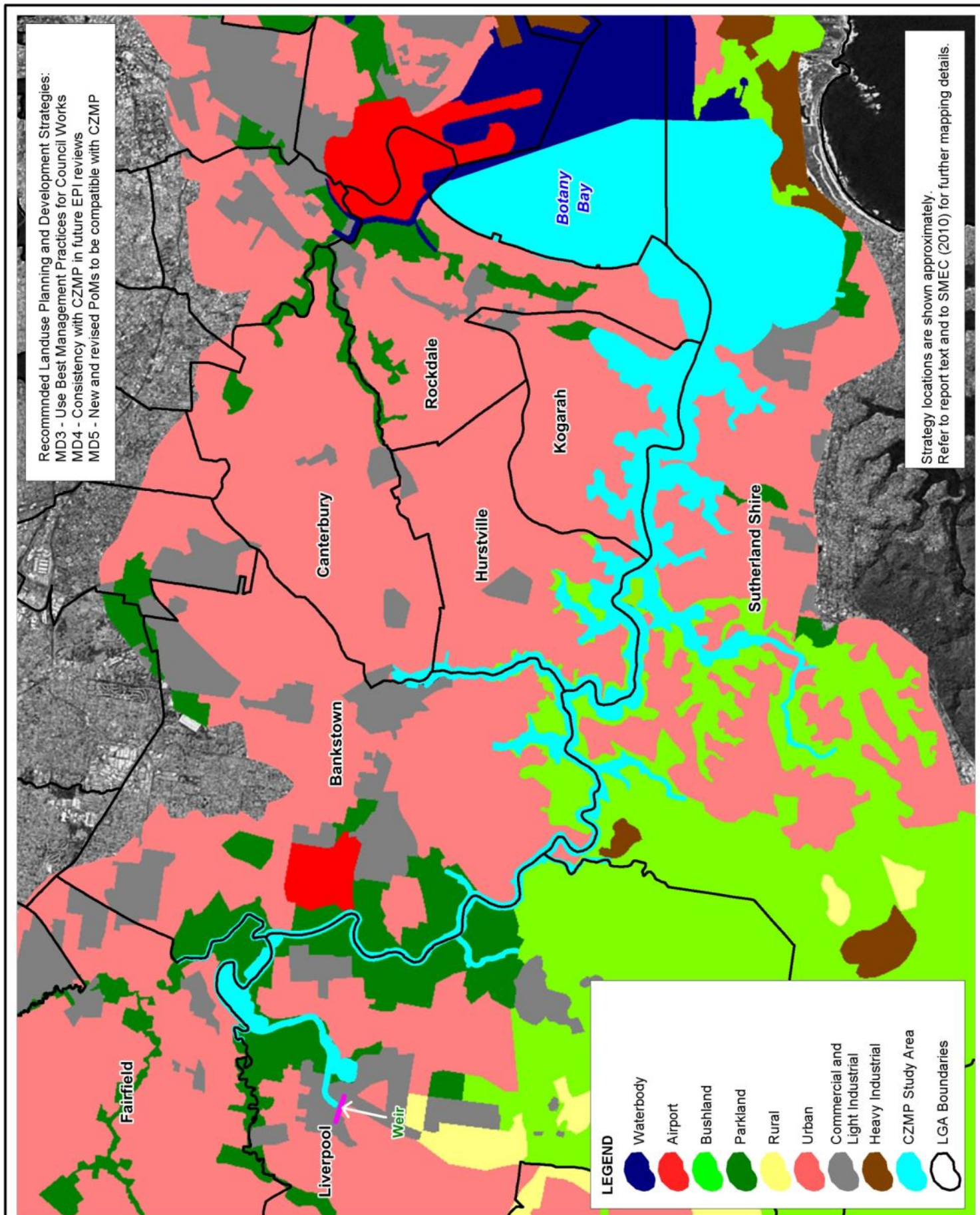
MC-5		Contribute to current revision of boating strategy with Roads and Maritime Services to manage potential recreational use conflicts
		A recreation gaps/needs analysis should be considered for the river to help inform the boating strategy and associated infrastructure works within the respective LGAs.
Links to existing works		Current Roads and Maritime Services Georges River Boating Maps: Upper: <a href="http://www.maritime.nsw.gov.au/docs/maps/9e-ugeorgesriv.pdf">http://www.maritime.nsw.gov.au/docs/maps/9e-ugeorgesriv.pdf</a> Mid: <a href="http://www.maritime.nsw.gov.au/docs/maps/9e-lgeorgesriv.pdf">http://www.maritime.nsw.gov.au/docs/maps/9e-lgeorgesriv.pdf</a> Lower: <a href="http://www.maritime.nsw.gov.au/docs/maps/botanybay_front.pdf">http://www.maritime.nsw.gov.au/docs/maps/botanybay_front.pdf</a>
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	Council will continue to work with the GRCCC on the refinement of this and other catchment/river based strategies.
Fairfield	YES	RMS is currently consulting with Council regarding increasing recreational opportunities in Chipping Norton Lake and Floyd Bay specifically.
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	Boating strategy should be complemented by a car park demand study for Moore Reserve boat ramp Strategy should target an equitable and shared use of Kogarah Bay by all active and passive users
National Pk	YES	
Commencement		2012 (timeframe for Boating Strategy Review)
Costs, Resources and Funding Opportunities		In-kind contributions of staff resources from Councils and National Parks would be required, along with support from GRCCC to co-ordinate responses and input to the Strategy Review.
Lead Responsibilities		GRCCC, All Councils in Georges River Estuary foreshore areas, OEH (NPWS)
Support Responsibilities		Roads and Maritime Services (preparing the Boating Strategy), HNCMA
Performance Measure		<ol style="list-style-type: none"> <li>Co-ordinated submissions to Roads and Maritime Services outlining the requirements of Councils and National Parks regarding recreational use of the Georges River waterway.</li> <li>Councils and National Parks comments and requirements adequately incorporated into the future Georges River Boating Safety Plan.</li> <li>Reduction in human impact, and improvement in the condition of estuarine and riparian habitat along the Georges River Estuary (see also <b>MB-4</b>, <b>MB-9</b>).</li> <li>Reduction in community complaints regarding waterway conflicts on the Georges River Estuary.</li> </ol>

## 6.5 Land use Planning and Development Sub-Plan

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### LAND USE PLANNING AND DEVELOPMENT SUB-PLAN

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Title:  
**Landuse Planning and Development Sub-Plan**



Figure:  
**6-6**

Rev:  
**A1**

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0 2.5 5km  
Approx. Scale





MD-3		Councils should ensure that best management practices to limit the export of pollutants including sediments, nutrients and acid runoff from Council projects are applied through the use of recognised checklist/part 5 assessment							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
				yes					
Objectives addressed		D1, D3			Priority		MEDIUM		
Approach / Department		Strategic Planning & Development Controls							
Detailed description		<p>Many infrastructure projects undertaken by Councils (such as those projects and works specified under SEPP-Infrastructure) are undertaken under Part 5 of the NSW <i>Environmental Planning and Assessment Act 1979</i>. As these projects are not required to go through rigorous approvals processes, they have the potential to overlook some environmental matters and consequently may contribute significant amounts of nutrients, sediments and acid runoff if they don't comply with best practice guidelines. These pollutants can significantly degrade the estuary and its waterways. In order to ensure Council projects minimise the amount of such pollutants, actions that should be undertaken include:</p> <ul style="list-style-type: none"><li>• Use a recognised process to develop a set of best practice environmental control guidelines for the councils in the Georges River catchment which consider generation and export of sediments, nutrients and acid runoff both during and following construction. The GRCCC should play a role in coordinating the development of a consistent set of guidelines that can be applied across all Councils in the Georges River Catchment.</li><li>• Apply these guidelines and associated conditions to all Council projects.</li><li>• Monitor project implementation to ensure guidelines and conditions are being adhered to.</li></ul>							
Links to existing works		<p>Soils &amp; Construction Manual (Managing Urban Stormwater – Landcom, 2004) and other relevant OEH publications <a href="http://www.environment.nsw.gov.au/stormwater/publications.htm">http://www.environment.nsw.gov.au/stormwater/publications.htm</a> “Non-structural stormwater quality best management practices – an overview of their use, value, cost and evaluation” <a href="http://www.catchment.crc.org.au/pdfs/technical200211.pdf">http://www.catchment.crc.org.au/pdfs/technical200211.pdf</a> Engineers Australia (2006) <i>Australian Runoff Quality: A guide to water sensitive urban design</i></p>							
Council	Applicable	Comments							
Bankstown	YES								
Liverpool	YES								
Hurstville	YES	Council will continue to ensure appropriate sediment and erosion control practices are put in place at its work sites. A suitable Part 5 Assessment process and Checklist will need to be developed, possibly in collaboration with the GRCCC/HNCMA to ensure a consistent catchment based approach.							
Fairfield	YES	Council has developed a comprehensive REF template for Part 5 projects. This template continues to be refined.							





MD-3		Councils should ensure that best management practices to limit the export of pollutants including sediments, nutrients and acid runoff from Council projects are applied through the use of recognised checklist/part 5 assessment
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	
National Pk	NO	
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		Resources for preparing and implementing best management practice for Council works would be sourced from existing Council staff. GRCCC should provide a co-ordinating role, to minimise the duplicated effort by Councils (recognising that Councils may indeed have particular requirements of circumstances to meet). Implementation of the Best Management Practices should become a standard process for Council work crews. Any additional costs associated with adopting alternative work practices (expected to be small) should be absorbed as part of project costs, and borne by Council.
Lead Responsibilities		GRCCC, all Councils in the Georges River Catchment
Support Responsibilities		OEH, HNCMA, RTA and other infrastructure providers
Performance Measure		<ol style="list-style-type: none"> <li>1. Each Council to have an adopted set of Best Management Practices for Council construction works.</li> <li>2. The Best Management Practices being successfully implemented by Council works crews.</li> <li>3. Reduction in sediment and pollutant loads, and thus improvement in water quality in areas downstream of developments, as well as more generally within the Georges River Estuary and Botany Bay.</li> <li>4. Reduction in community complaints regarding pollution and sedimentation emanating from Council works.</li> </ol>



MD-4		When undertaking reviews of strategic planning instruments and initiatives (including LEPs and DCPs) and development proposals, ensure consistency with the Coastal Zone Management Plan aims and objectives							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
				yes					
Objectives addressed	D2				Priority		MEDIUM		
Approach / Department	Strategic Planning & Development Controls								
Detailed description	<p>Land use and development is managed using a range of strategic planning initiatives. Local environmental plans (LEPs) are developed by Councils to guide planning decisions for local government areas. They use zoning and development controls to allow councils and other consent authorities to manage the way in which land is used. Development control plans (DCPs) are policy instruments which add detail to LEPs but which do not carry statutory force. These plans can be used to protect key habitat and environmental assets and increase the use of vegetation buffers around waterways as well as dictating the terms under which developments may go ahead, for example including targets for nutrient and sediment loads and provisions for WSUD.</p> <p>These plans are regularly reviewed to ensure they are able to produce the best outcomes given current knowledge. They are a powerful tool in ensuring that the aims and objectives of this Coastal Zone Management Plan are met, particularly those relating to habitat protection and water quality improvement, including use of WSUD. Councils should ensure that the aims and objectives of this Plan are considered when these plans are reviewed to ensure consistency and ongoing implementation of the CZMP. This would be best achieved through gazettal of this CZMP under the provisions of the amended <i>Coastal Protection Act 1979</i>. Once gazetted, Councils are required by law to take the Plan into consideration when making new Plans and Policies.</p>								
Links to existing works	<p>Existing Plans include all LEPs and DCPs relevant to each of the LGAs.</p> <p>Amendments to the <i>Coastal Protection Act 1979</i> (Part 4a) requiring certification of CZMPs by the Minister, followed by gazettal of the Plans.</p>								
Council	Applicable	Comments							
Bankstown	YES	Council should include standard clause for stormwater in LEP							
Liverpool	YES	<p>There is opportunity to increase and enhance environmental (vegetation) buffers along Upper and Lower Cabramatta Creek and Hinchinbrook Creek, with links to existing riparian corridors and remnant vegetation patches.</p> <p>Vegetation buffers on private land are required by relevant DCP controls.</p>							
Hurstville	YES	<p>Zoning should be applied in the application of the Standard LEP to protect key habitat and environmental assets</p> <p>Council will consider this document when undertaking future reviews of its planning instruments/guides to ensure key environmental assets are zoned and protected appropriately.</p>							
Fairfield	YES	Council should include standard clause for stormwater in LEP							
Sutherland	YES	Zonings / controls should be reviewed to improve protection and restoration of breeding and foraging habitat for migratory bird species in Woolooware Bay.							
Rockdale	YES	Council should include standard clause for stormwater in LEP							
Kogarah	YES	Council should include standard clause for stormwater in LEP							

<b>MD-4</b>			<b>When undertaking reviews of strategic planning instruments and initiatives (including LEPs and DCPs) and development proposals, ensure consistency with the Coastal Zone Management Plan aims and objectives</b>
National Pk	NO	But informally, NPWS could develop a guideline for works that aim to include BMPs and WSUD.	
Commencement		This strategy becomes a legal obligation once this Plan has been made and published in the Government Gazette.	
Costs, Resources and Funding Opportunities		Consideration of the aims and objectives of this Plan during future reviews of strategic planning initiatives would be the role of Councils, Agency and GRCCC staff. No external resources or funding would be required to implement this strategy.	
Lead Responsibilities		All Councils in Georges River Catchment	
Support Responsibilities		OEH, GRCCC, HNCMA	
Performance Measure		<ol style="list-style-type: none"> <li>1. Gazettal of this Plan.</li> <li>2. Consideration of this plan by Councils when reviewing and developing other strategic plans (note this is a legal obligation once the Plan is gazetted).</li> </ol>	

MD-5		New and revised Plans of Management and/or other specific Council and NPWS environmental plans and policies should be compatible with the recommendations of the Georges River Estuary Coastal Zone Management Plan							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
				yes					
Objectives addressed	D2				Priority		MEDIUM		
Approach / Department	Strategic Planning & Development Controls								
Detailed description	<p>Feedback from the community stressed the importance of consistency between government programs and plans to ensure actions undertaken by different government agencies and local councils are contributing to the same overall goals. Specific actions to support this option are:</p> <ul style="list-style-type: none"><li>Consider actions described in the Coastal Zone Management Plan when reviewing funding programs such as section 94 plans, stormwater management service charges, environmental levies, infrastructure levies.</li><li>Councils to review and incorporate, as appropriate, the recommended actions contained in this Coastal Zone Management Plan into Community Lands Plans of Management as they are produced, reviewed or updated.</li><li>Other generic and specific Plans of Management should also be reviewed where appropriate to ensure their respective recreational, environmental and cultural values are balanced and that aesthetic values are maintained. In particular consistency with the Plan of Management and Masterplan for Chipping Norton Lake should be maintained.</li><li>Any POM developed by National Parks or HNCMA should ensure consistency with this CZMP.</li></ul>								
Links to existing works	Bankstown Generic Plan of Management (Recreation lands) The Crest (Specific Area) Plan of Management								
Council	Applicable	Comments							
Bankstown	YES	<p>Integrate this Coastal Zone Management Plan with other strategic environmental initiatives, including:</p> <ul style="list-style-type: none"><li>EECs, threatened populations, and habitat for threatened species.</li><li>NSW Threatened Species “Priority Action Statements” (PAS)</li><li>Biodiversity Strategies and Community Plans of Management</li></ul> <p>Consider identifying Bankstown City Council boating infrastructure</p>							
Liverpool	YES	<i>See comment below under Fairfield</i>							
Hurstville	YES	<p>Councils proposed Biodiversity Study and Strategy will inform the future review of Council’s existing generic and specific Plans of Management. If necessary additional specific plans will be prepared to better protect key environmental assets including Endangered Ecological Communities, Threatened Species, together with culturally important landscapes and locations.</p>							
Fairfield	YES	<p>Fairfield and Liverpool Councils have recently worked with LPMA (Department of Lands) in helping to prepare a Plan of Management and Masterplan for Chipping Norton Lake.</p> <p>Integrate this CZMP with other strategic environmental initiatives, including:</p> <ul style="list-style-type: none"><li>Biodiversity strategy</li><li>Chipping Norton Lake Plan of Management (in prep)</li></ul>							

MD-5		New and revised Plans of Management and/or other specific Council and NPWS environmental plans and policies should be compatible with the recommendations of the Georges River Estuary Coastal Zone Management Plan
		<ul style="list-style-type: none"> <li>• Draft Urban Creeks Masterplan</li> <li>• Council's Creek Care Program</li> <li>• Other community plans of management.</li> </ul>
Sutherland	YES	Integrate this Coastal Zone Management Plan with other strategic environmental initiatives, including: <ul style="list-style-type: none"> <li>• Biodiversity Strategy</li> <li>• Bushland Plan of Management</li> <li>• Feral animals control Plan of Management</li> <li>• Environmental and noxious weeds Plan of Management</li> </ul>
Rockdale	YES	
Kogarah	YES	Integrate this Coastal Zone Management Plan with other strategic environmental initiatives, including: <ul style="list-style-type: none"> <li>• Moore Reserve Wetland renewal</li> <li>• Moore Reserve Creek, Poulton Park Creek restoration</li> <li>• Kogarah Bay initiatives (developed from the Southern Sydney Catchment Management Blueprint)</li> </ul>
National Pk	YES	Integrate this Coastal Zone Management Plan with other strategic environmental initiatives associated with the on-going management and protection of the Georges River National Park, including: <ul style="list-style-type: none"> <li>• Protection of EECs and other important habitat</li> <li>• Extension of reserve is an overall part of the reserve acquisition process</li> <li>• Continued management and protection as part of Towra Point Nature Reserve Management</li> <li>• Ongoing weed and pest/regeneration programs, as well as limiting public access into TPNR</li> </ul>
DPI Fisheries	YES	To consider the CZMP in reserve management and strategic planning for Towra Point Aquatic Reserve.
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		Consideration of the aims and objectives of this Plan during the preparation and review of existing environmental plans and policies would be the role of Council and National Parks staff. No external resources or funding would be required to implement this strategy.
Lead Responsibilities		All Councils in the Georges River Catchment, OEH (NPWS)
Support Responsibilities		GRCCC, HNCMA
Performance Measure		<ol style="list-style-type: none"> <li>1. Consideration of this plan by Councils and National Parks when reviewing and developing other environmental plans and policies.</li> <li>2. Integration and consistency between this Plan and other environmental plans and policies being implemented by Councils and National Parks</li> </ol>

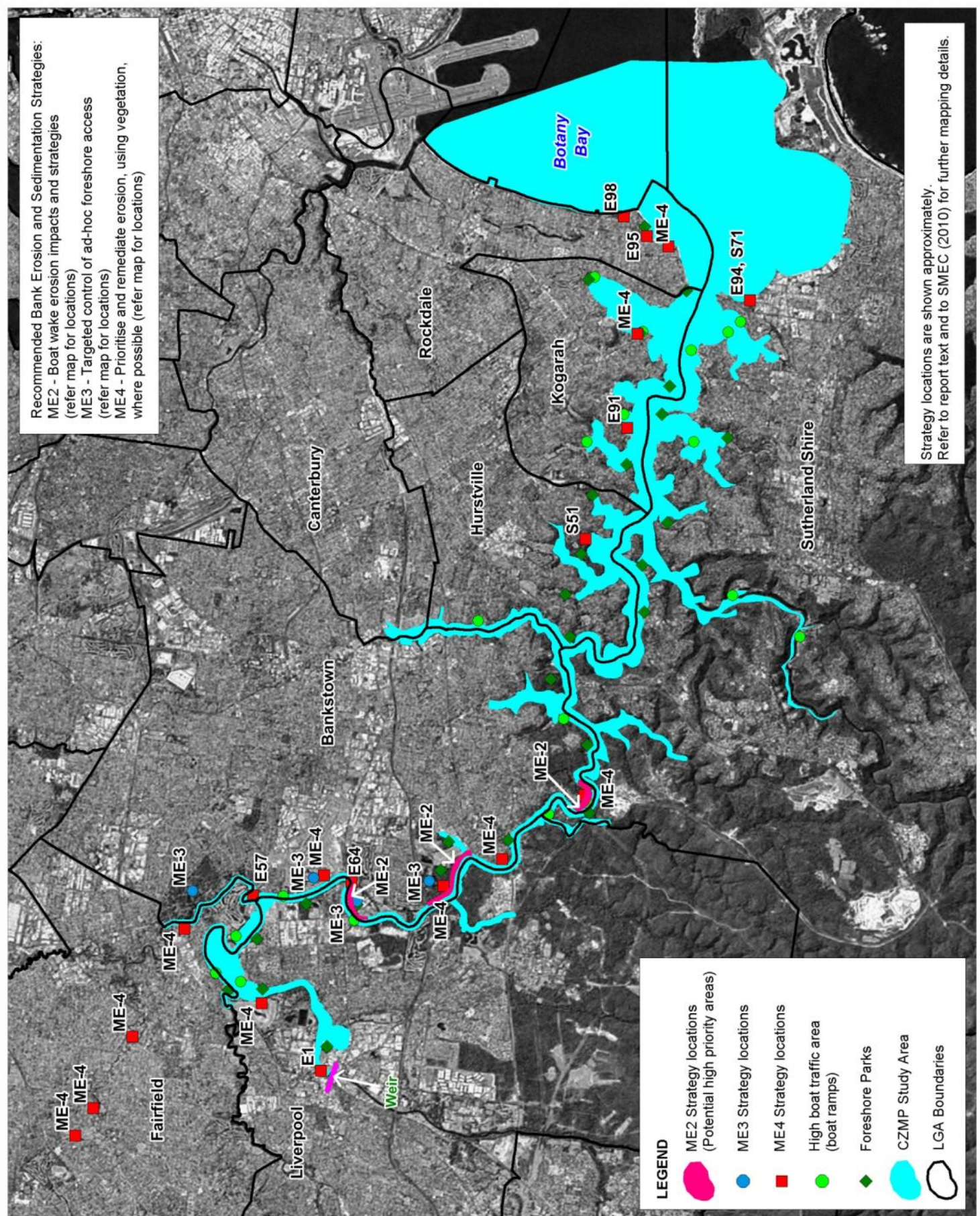
## 6.6 Bank Erosion and Sedimentation Sub-Plan

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### BANK EROSION AND SEDIMENTATION SUB-PLAN

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Title:  
**Bank Erosion and Sedimentation Sub-plan**



Figure:  
**6-7**

Rev:  
**A1**

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Filepath : S:\WATER\PROJECTS\S1197 - Water - Georges River EMS & EMP\Working\GIS Data\Workspaces\DRG\_006\_120507\_Bank\_Erosion.wor



<b>ME-2</b>		<b>Work with Roads and Maritime Services to determine the impact of wash on the waterway and strategies to minimise the effects where bank erosion is an issue and boat wake is a likely cause</b>							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
					yes				
Objectives addressed	<b>E1</b>				Priority		<b>HIGH</b>		
Approach / Department	Environmental Planning								
Detailed description	<p>Bank erosion causes significant environmental and aesthetic impacts in the estuary. Boat wake often causes or exacerbates bank erosion problems. This erosion can be minimised by the use of appropriate speed limits in areas susceptible to such erosion. It is important to ensure that appropriate speed limits are set in such areas and that these are enforced by Roads and Maritime Services. This action involves:</p> <ol style="list-style-type: none"><li>1. Identification of high priority areas (i.e. areas of significant erosion susceptibility) and communication of these areas to Roads and Maritime Services.</li><li>2. Establishment of no wash zones where necessary, in consultation with Roads and Maritime Services.</li><li>3. Working with Roads and Maritime Services to ensure better enforcement of no wash zones and permissible uses in these sensitive areas.</li></ol> <p>Refer to Figure 6-7 for location details for this option.</p>								
Links to existing works	Georges River Boat Safety Plan (currently in preparation by Roads and Maritime Services)								
Council	Applicable	Comments							
Bankstown	YES	<p>Potential high priority areas include:</p> <ul style="list-style-type: none"><li>• M5 Motorway (Milperra) to Kelso Creek</li><li>• Picnic Point Reserve</li><li>• Section from Milperra Bridge to Vale of Ah</li></ul>							
Liverpool	YES	Chipping Norton up to Liverpool Weir							
Hurstville	YES	Low lying, sparsely vegetated foreshore areas within the LGA are likely to be most susceptible and should be the target for future investigations.							
Fairfield	YES	Chipping Norton up to Liverpool Weir							
Sutherland	YES								
Rockdale	YES								
Kogarah	YES								
National Pk	YES								
Commencement		2012 / 3							
Costs, Resources and Funding Opportunities		<p>Costs would be minimal for Councils and National Parks for implementation of this strategy, as it primarily involves consultation and liaison with Roads and Maritime Services only.</p> <p>It is expected that any additional works necessary by Roads and Maritime Services would be accommodated as part of normal staff duties and associated resource allocation.</p>							




<b>ME-2</b>	<b>Work with Roads and Maritime Services to determine the impact of wash on the waterway and strategies to minimise the effects where bank erosion is an issue and boat wake is a likely cause</b>	
Lead Responsibilities	All Councils adjoining Georges River Estuary, OEH (NPWS)	
Support Responsibilities	Roads and Maritime Services, GRCCC (possibly in helping to co-ordinate input to Roads and Maritime Services)	
Performance Measure	<ol style="list-style-type: none"> <li>1. Liaison with Roads and Maritime Services regarding high priority bank erosion sites.</li> <li>2. Signage and enforcement of regulations associated with reducing boat wash impacts on already eroding foreshores</li> </ol>	

ME-3		Control ad hoc access along the foreshore to limit vegetation trampling and bank destabilisation, targeting sites of high environmental significance							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
		partly	partly		yes				
Objectives addressed		B1, C3, E1			Priority		MEDIUM		
Approach / Department		Engineering Works & Assets Management							
Detailed description		<p>Foreshore areas are highly valued for recreational activities such as fishing, walking, horse riding and cycling. Where these activities take place in an ad hoc manner they can lead to the creation of new tracks and associated vegetation damage through trampling and removal.</p> <p>This can cause problems of bank destabilisation and erosion.</p> <p>This action involves:</p> <ul style="list-style-type: none"><li>Identifying key access areas for the foreshore and ensuring adequate infrastructure such as paths to enhance access in these areas. This infrastructure should be designed to limit damage to the surrounding vegetation and foreshore areas.</li><li>Areas where ad hoc access is causing problems such as vegetation trampling and bank destabilisation and which are identified as not being appropriate for such use should be managed to limit access. Signage and other education materials should be used to educate the community about the damage caused by such access. Where appropriate, fines and warnings should be given to those that continue to use these areas in ways that are damaging to vegetation and the foreshore.</li></ul> <p>Refer to Figure 6-7 for location details for this option.</p>							
Links to existing works		nil							
Council	Applicable	Comments							
Bankstown	YES	<p>Design and implement program / systems for identifying points of ad-hoc access / impact on foreshores.</p> <p>Appropriate impact mitigation measures to be based on site characteristics and nature of access.</p> <p>Potential priority locations include:</p> <ul style="list-style-type: none"><li>Mirmabeena regional park system</li><li>Deepwater Park</li><li>Kentucky Reserve and Vale of Ah</li></ul>							
Liverpool	YES								
Hurstville	YES	<p>Council will continue to utilise the services of the GRCCC Riverkeeper Program to periodically video the LGA foreshore to identify inappropriate foreshore/vegetation management practices. Access via public land will be managed within the framework of Councils Plans of Management for community land.</p>							
Fairfield	YES	<p>Boat ramps, car parking and landscaped cycleways have been installed along the Chipping Norton Lake foreshore to provide formal access to and around the estuary. Key issue for Council is the need to establish a pedestrian link across Chipping Norton Lake and Prospect Creek to the Bankstown and Liverpool LGAs.</p>							



<b>ME-3</b>		<b>Control ad hoc access along the foreshore to limit vegetation trampling and bank destabilisation, targeting sites of high environmental significance</b>
Sutherland	YES	Note that Towra Point Aquatic Reserve and Nature Reserve have high environmental significance.
Rockdale	YES	
Kogarah	YES	All foreshore parks have pedestrian access to river
National Pk	YES	
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		Installation of any works associated with restricting access along river foreshores would be carried out by Council works crews and/or National Parks personnel. Costs associated with the works are expected to be relatively minor, as installations would be low key (e.g. bollards, chain fences, signage etc). Materials costs would typically be < \$5,000 per LGA depending on the number and extents of foreshore access to be controlled.
Lead Responsibilities		All Councils adjoining Georges River Estuary, OEH (NPWS)
Support Responsibilities		GRCCC, HNCMA (especially in respect to restricting access to high value EECs and habitats)
Performance Measures		<ol style="list-style-type: none"> <li>1. Installation of physical barriers to limit access along designated sections of foreshore.</li> <li>2. Reduction in ad hoc usage of restricted sections of foreshore, thus leading to a reduction in erosion and/or reduction of impacts on estuarine and riparian habitats.</li> </ol>



ME-4		Prioritise active eroding foreshore areas and undertake erosion management works using techniques that maximise the use of riparian vegetation							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
					yes				
Objectives addressed	E1				Priority		HIGH		
Approach / Department	Engineering Works & Asset Management								
Detailed description	<p>Stream bank erosion contributes substantial sediment and nutrient loads to the Georges River Estuary. Sediment in particular has the potential to smother key aquatic habitat such as seagrass beds. The Estuary Processes Study (SMEC, 2010) found that erosion occurs with varying degrees of severity along much of the Georges River. This erosion is caused by boat wake, tidal undercutting, stormwater and floods. Erosion can be managed using hard structures such as rock walls or can be reduced using a combination of vegetation and engineered structures. While the best technique for managing erosion in a specific site will often depend on site specific factors, it is preferred that techniques should maximise the use of riparian vegetation. These techniques provide additional habitat benefits through enhanced vegetation as well as being less likely to cause bank erosion problems on other parts of the river due to increased water velocities. This action involves:</p> <ul style="list-style-type: none"><li>• Identification of key erosion sites by Councils. The Estuary Processes Study (SMEC, 2010) includes a lengthy description of erosion sites in the catchment, an assessment of their severity and suggestions for their remediation which should be considered by Councils.</li><li>• Prioritisation of erosion sites based on their severity, the feasibility and cost of controlling erosion at the site and the impacts of ongoing erosion at the site. For example proximity to key sensitive ecological communities such as seagrass should be considered when developing management priorities.</li><li>• Encourage rectification of erosion in these areas through natural solution or environmentally friendly seawalls where necessary rather than engineered solutions.</li><li>• Apply erosion and sediment controls in DCPs in areas prone to streambank erosion.</li></ul> <p>Refer to Figure 6-7 for location details for this option.</p>								
									
Links to existing works	nil								
Council	Applicable	Comments							
Bankstown	YES	<p>The following locations are targeted (refer SMEC, 2010, for details of locations):</p> <ul style="list-style-type: none"><li>• E64. Opposite Hind Park (property north of Vale of Ah in private ownership)</li><li>• E58. South of Beatty Bay Reserve (levelling, vegetating and sand replenishment)</li><li>• Deepwater Park – banks of the Georges River and creeks within the Park</li></ul>							



ME-4 Prioritise active eroding foreshore areas and undertake erosion management works using techniques that maximise the use of riparian vegetation		
		(levelling and vegetating) <ul style="list-style-type: none"> <li>E57. Eastern bank of Prospect Creek mouth (vegetating and sand replenishment)</li> <li>Kentucky Reserve</li> <li>Picnic Point Reserve / East Hills Park</li> </ul>
Liverpool	YES	The following locations are targeted (refer SMEC, 2010, for details of locations): <ul style="list-style-type: none"> <li>Warwick Farm Racecourse (revegetation + stabilisation works)</li> <li>E1. Along the railway between Liverpool weir and Liverpool Hospital (levelling and vegetating)</li> </ul> Council does not have adequate funding and resources to undertake bank stabilisation works along the Georges River. Council will work in partnership as a non-funding partner with other parties or government agencies to complete actions.
Hurstville	YES	Preference for erosion management through natural systems (e.g. vegetation) rather than engineered solutions (e.g. rock walls) <p>The following location is targeted (refer SMEC, 2010, for details of location):</p> <ul style="list-style-type: none"> <li>S51. Jew Fish Bay Baths</li> </ul> Other priority areas may also be identified during on water assessment conducted by the GRCCC Riverkeeper Program (refer ME3)
Fairfield	YES	The following locations are targeted: <ul style="list-style-type: none"> <li>Prospect Creek (as part of the grant funded Improving Prospect Creek project)</li> <li>Hawkesbury Street, Sackville Street, Barragoola Street (stormwater funding already allocated for these sites, totalling nearly \$1m).</li> <li>Orphan School Creek (as part of Council's Creek Care Program)</li> </ul>
Sutherland	YES	The following locations are targeted (refer SMEC, 2010, for details of locations): <ul style="list-style-type: none"> <li>E94. North-western end of Woollooware Bay (sand replenishment)</li> <li>S71. North-western end of Woollooware Bay (vegetation of existing wall)</li> </ul>
Rockdale	YES	The following locations are targeted (refer SMEC, 2010, for details of locations): <ul style="list-style-type: none"> <li>E95 Eastern side of Sandringham Bay (levelling and vegetating)</li> <li>E98. Lady Robinson's Beach centre (new groyne required)</li> <li>E98. Lady Robinson's Beach centre (sand replenishment on northern side of groyne)</li> <li>Sandringham Baths (beach nourishment)</li> </ul> These works may be better addressed as part of a separate CZMP that specifically targets Lady Robinson's Beach / Botany Bay foreshores.
Kogarah	YES	The following locations are targeted (refer SMEC, 2010, for details of locations): <ul style="list-style-type: none"> <li>Dover Park West (levelling and vegetating)</li> <li>E91. Connells Point Reserve (sand replenishment using sand from extensive shoal facing the park)</li> </ul>

ME-4		Prioritise active eroding foreshore areas and undertake erosion management works using techniques that maximise the use of riparian vegetation
		<ul style="list-style-type: none"> <li>Various other foreshores (levelling and vegetating, and additional tree planting and landscaping to improve visual amenity and the strategic replacement of sections of existing training wall)</li> </ul>
National Pk	YES	Existing deteriorating seawalls can be replaced with eco-friendly walls.
Commencement		2012, subject to funding availability
Costs, Resources and Funding Opportunities		<p>Costs associated with design, assessment, approvals and construction of erosion management works along the Georges River is likely to be high (many \$m). For this reason, prioritisation of works will be necessary in order to optimise limited funding that would be available for this strategy. Depending on the height of the riverbank, erosion management works can cost in the order of \$1,000 - \$3,000 per lineal metre. Thus protection of a 100m long section of river could cost in the order of \$300,000 or more.</p> <p>The four kilometre long reach between Liverpool Weir and Chipping Norton Lakes contains substantial sections of erosion (on both riverbanks). It is envisaged that full rock protection of this reach alone would cost in the order of \$10 – 20m (and exclusively within the Liverpool LGA). Other more minor areas of erosion are also present within the other Georges River Estuary LGAs.</p> <p>It is envisaged that significant external contributions would be required for erosion management works within the Georges River. Consideration should also be given to the need for any flood mitigation works, which may be able to help offset costs for erosion management. Government grants that may be available for erosion management would include the NSW Estuary Management Program, and Federal Caring for Our Country (providing there is a substantial riparian revegetation and rehabilitation component as part of the works, i.e. eco-friendly seawalls, or a combination of hard and soft erosion measures).</p> <p>The inclusion of this action does not impact on any previous/existing agreements that Councils have with other Agencies in relation to the ongoing management or maintenance of proposed sites.</p>
Lead Responsibilities		All Councils on Georges River Estuary Foreshore
Support Responsibilities		GRCCC, OEH, HNCMA
Performance Measures		<ol style="list-style-type: none"> <li>1. Bank erosion works program outlining prioritised erosion management works within each LGA.</li> <li>2. Construction of erosion management works in accordance with bank erosion works program, and subject to funding availability.</li> <li>3. Reduction in loss of foreshore land and vegetation associated with on-going bank erosion, and associated sediment build-up within the river channels.</li> </ol>

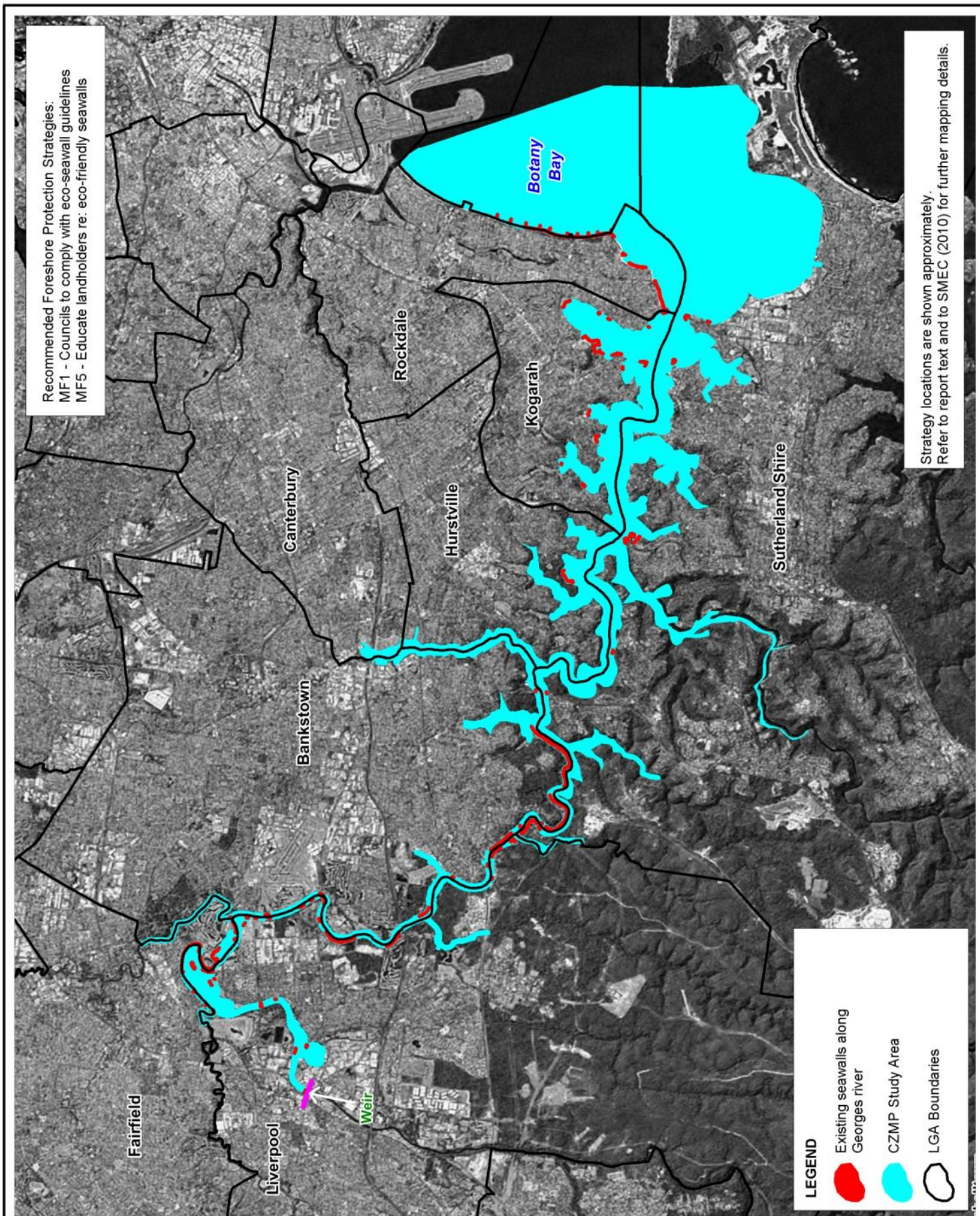
## 6.7 Foreshore Protection Sub-Plan

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### FORESHORE PROTECTION SUB-PLAN

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Title:  
**Foreshore Protection Sub-plan**



Figure:  
**6-8**

Rev:  
**A1**

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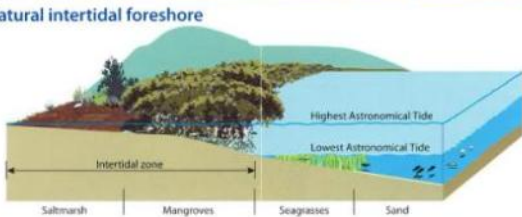
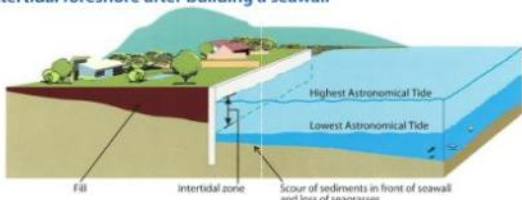




MF-1		All councils and agencies involved in the building, design and approval of new seawalls to ensure compliance with the environmentally friendly seawall guidelines within legislative constraints							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
						yes			
Objectives addressed	F1				Priority		MEDIUM		
Approach / Department	Strategic Planning & Development Controls								
Detailed description	<p>Seawalls have the potential to reduce erosion and create opportunities for habitat creation in the estuary or to increase water velocities and erosive damage to other foreshore areas and reduce available habitat depending on their design. Environmentally friendly seawalls can stabilise actively eroding foreshore areas while still providing habitat values by creating opportunities for estuarine vegetation to colonise the seawall. These types of wall are also designed to limit the creation of new eroding areas away from the wall caused by increasing water velocities at other parts of the foreshore. They can also help to restore mangrove continuity. Action required in order to implement this management option are:</p> <ul style="list-style-type: none"><li>• Develop model provision for DCPs of environmentally friendly seawalls. Also a model clause to be inserted in Councils LEPs. LEP clause will have to be developed in conjunction with Department of Planning and Infrastructure.</li><li>• Councils incorporate these conditions in their DCPs.</li></ul> <p>In priority areas, replacement of existing seawalls at the end of their design life with an environmentally friendly seawall structure as per the works carried out at Merriman Reserve Kyle Bay should be considered.</p> <p>The Data Compilation and Estuary Processes Study (SMEC, 2010) highlighted potential strategies for improving the environmental value of various sections of seawall. The reader is referred to this document for specific details of seawall augmentation.</p>								
Links to existing works	Works at Claydon Reserve, Kogarah								
Council	Applicable	Comments							
Bankstown	YES	<ul style="list-style-type: none"><li>• Picnic Point Reserve</li><li>• East bank of Prospect Creek, particularly near Garrison Point</li><li>• Kentucky Reserve</li><li>• Deepwater Reserve</li></ul>							
Liverpool	YES	New seawalls should help to restore mangrove continuity along the foreshore of Georges River							
Hurstville	YES								
Fairfield	YES								
Sutherland	YES								



MF-1		All councils and agencies involved in the building, design and approval of new seawalls to ensure compliance with the environmentally friendly seawall guidelines within legislative constraints
Rockdale	YES	
Kogarah	YES	San Souci Park seawall enhancement, Carss Park Oval seawall renewal Environmentally friendly foreshore structures are recommended within the Middle Bay area (allowing for colonisation and migration of estuarine vegetation).
National Pk	YES	
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		This strategy involves incorporating the requirement for environmentally friendly seawalls into Council plans and future development requirements. As such, the resources required to undertake this strategy would involve existing Council planning staff only. In a similar manner, any new seawalls constructed within the Georges River National Park should be subject to meeting the requirements for environmentally friendly seawalls. This could be achieved through amendments to the existing Plan of Management stating this requirement. No external funding would be required to implement this strategy.
Lead Responsibilities		All Councils on Georges River Estuary foreshore, OEH (NPWS)
Support Responsibilities		OEH (Coasts and Estuaries), HNCMA, GRCCC
Performance Measure		<ol style="list-style-type: none"> <li>1. Environmentally friendly seawall requirements incorporated into adopted development controls for each LGA, as well as the National Park PoM.</li> <li>2. Any future seawalls (either new walls, or restoration of an existing seawall) to comply with the development control requirements.</li> <li>3. Improvement in the extent and condition of estuarine and foreshore vegetation in the vicinity of erosion and/or existing seawalls.</li> </ol>

MF-5	Educate and support private landowners on the benefits of environmentally friendly seawalls and provide details of the planning and approval process for installation								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
						yes			
Objectives addressed	F1, F3					Priority	MEDIUM - LOW		
Approach / Department	Communications & Education								
Detailed description	<p>Private landowners have historically constructed seawalls to manage flooding, stabilise banks and to increase access to the waterway. In the past these seawalls were engineered, removing vegetation and aquatic habitat and acting to increase water velocities and change wave patterns, in some cases causing bank erosion in other parts of the estuary. Environmentally friendly seawalls can be used where erosion continues to be a substantial problem for stable banks while providing vegetation and habitat for aquatic species. They are designed to mimic the natural intertidal zone providing a filter for pollutants which would otherwise enter the estuary and can avoid changing flow and wave patterns in a way which would cause erosion problems further along the shoreline.</p> <p>This action involves:</p> <ul style="list-style-type: none"><li>Using the environmentally friendly seawalls brochure and guidelines previously developed by HNCMA/OEH to provide education and information to private landowners about environmentally friendly seawalls and their benefits.</li><li>Develop and use a standard approvals package across all Councils for the installation or upgrade of seawalls.</li></ul> <div><div><p>How to make your <b>Seawall</b> more environmentally friendly</p><p>Are you planning to build a new seawall or to upgrade an existing one along an estuary foreshore?</p><p>Find out how you can design your seawall to reduce erosion while improving its value to plant and animal life. Your seawall could be fish habitat!</p><p><b>CMA</b> Sydney Metropolitan Coastal Management Authority</p></div><div><p><b>Impacts of seawalls</b></p><p>When seawalls are built using traditional methods, they typically result in damage to or loss of important habitats such as saltmarsh, mangroves and seagrass beds. These habitats are vital to many animals, such as fish and shorebirds, providing food and shelter. Seawalls are also poor replacements for natural foreshores because:</p><ul style="list-style-type: none"><li>the types of habitat and area available to plant and animal life are reduced dramatically (see diagrams below)</li><li>the ability to filter pollutants from runoff is lost, leading to poorer water quality</li><li>they can change flow and wave patterns, resulting in deepening in front of the seawall and erosion further along the shore.</li></ul><p><b>Natural intertidal foreshore</b></p><p><b>Intertidal foreshore after building a seawall</b></p></div></div>								
Links to existing works	<p>Environmentally Friendly Seawalls Brochure and Guidelines (see former SMCMA website)</p> <p>Pittwater Council Best Practice Guidelines</p> <p><a href="http://www.pittwater.nsw.gov.au/environment/water/estuaries/best_practice_guidelines/best_practice_guideline_3_-_seawalls">http://www.pittwater.nsw.gov.au/environment/water/estuaries/best_practice_guidelines/best_practice_guideline_3_-_seawalls</a></p>								

<b>MF-5 Educate and support private landowners on the benefits of environmentally friendly seawalls and provide details of the planning and approval process for installation</b>		
Council	Applicable	Comments
Bankstown	YES	OEH in partnership (or consultation) with the GRCCC Communication and Engagement Cluster/Coordinator develop to develop educational material and use a standard approvals package across all LGAs
Liverpool	YES	
Hurstville	YES	
Fairfield	YES	
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	San Souci Park seawall enhancement, Carss Park Oval seawall renewal
National Pk	NO	
Commencement		2015 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		<p>Community education would mostly carried out by Council staff (education and communications teams), particularly in respect to developing resources and engagement with the community.</p> <p>There is a significant opportunity for Councils to co-ordinate efforts on this strategy, thus minimising duplicated efforts, as similar resources would be developed for each LGA. The GRCCC, through its Communication and Engagement Program, is able to work with OEH to develop the production of these materials across Councils to ensure consistency of message and to minimise duplicated effort. GRCCC to work with OEH to develop fact sheet on development and planning approval process.</p> <p>It is expected that some out-of-pocket expenses would be incurred for printing costs of all resources. Minor consultancies could also be used by Council to help develop the education resources.</p> <p>The need for external funding for these types of works would be relatively small, however, funding from HNCMA for education purposes may be possible.</p>
Lead Responsibilities		All Councils with estuary foreshore areas
Support Responsibilities		GRCCC, HNCMA, DPI (Fisheries), OEH (Coasts & Estuaries)
Performance Measures		<ol style="list-style-type: none"> <li>1. Development and distribution of community education materials to foreshore property owners, especially those that already have private seawalls.</li> <li>2. Any future seawalls (either new walls, or restoration of an existing seawall) to be environmentally friendly.</li> <li>3. Improvement in the extent and condition of estuarine and foreshore vegetation in the vicinity of erosion and/or existing seawalls (see also <b>MF-1</b>).</li> </ol>



## 6.8 Natural and Cultural Heritage Sub-Plan

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### NATURAL AND CULTURAL HERITAGE SUB-PLAN

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MG-4		Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
							yes		
Objectives addressed	G1				Priority		LOW		
Approach / Department	Recreation & Heritage								
Detailed description	<p>The Georges River Estuary Catchment is known to contain a substantial number of Aboriginal Heritage sites with over 112 known sites located within the estuary, including middens, lithic artefacts and pigment art. It is also suspected that there are many sites in the area whose location is not known. In addition, knowledge about the threats to known sites is poor. Engagement with the Aboriginal community is needed in order to best manage these sites and to determine the best management options for indigenous heritage sites. This action includes:</p> <ul style="list-style-type: none"><li>• Identification of Aboriginal groups and individuals with knowledge of heritage sites and their values and an interest in their protection.</li><li>• Working with these groups and individuals to confirm the location of sites and identify threats. Working with these groups and individuals to develop site management strategies and an implementation action plan for undertaking these strategies in a timely and responsible manner.</li><li>• Implementation of this action plan.</li></ul>								
Links to existing works	nil								
Council	Applicable	Comments							
Bankstown	YES								
Liverpool	YES								
Hurstville	YES	In addition, Council will also ensure that sites and artefacts both known and unknown are afforded adequate protection under Council land use framework.							
Fairfield	YES								
Sutherland	YES								
Rockdale	YES								
Kogarah	YES								
National Pk	YES								
Commencement		2015 (or opportunistically prior to this)							
Costs, Resources and Funding Opportunities		<p>This strategy primarily involves consultation with local Aboriginal Groups and individuals in order to develop future management options for site at risk. Therefore, resources required to implement this strategy would mostly involve staff time from Councils, National Parks and HNCMA (primarily Aboriginal liaison officers from each agency).</p> <p>External funding would not be required to undertake liaison or develop site management strategies, however, depending on the nature and extent of the site management strategies developed, funding may be required for protection or restoration works.</p>							
Lead Responsibilities		All Councils in Georges River Catchment, OEH (NPWS), HNCMA, GRCCC (co-ordinating role bringing groups and councils together)							

<b>MG-4</b>	<b>Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites</b>	
Support Responsibilities	Local Aboriginal Groups / Lands Councils	
Performance Measure	<ol style="list-style-type: none"><li>1. Consultation with Aboriginal Groups and individuals regarding heritage sites.</li><li>2. Development of site management strategies and an implementation action plan for undertaking these strategies in a timely and responsible manner.</li><li>3. Conservation and preservation of Aboriginal heritage sites along the Georges River.</li></ol>	

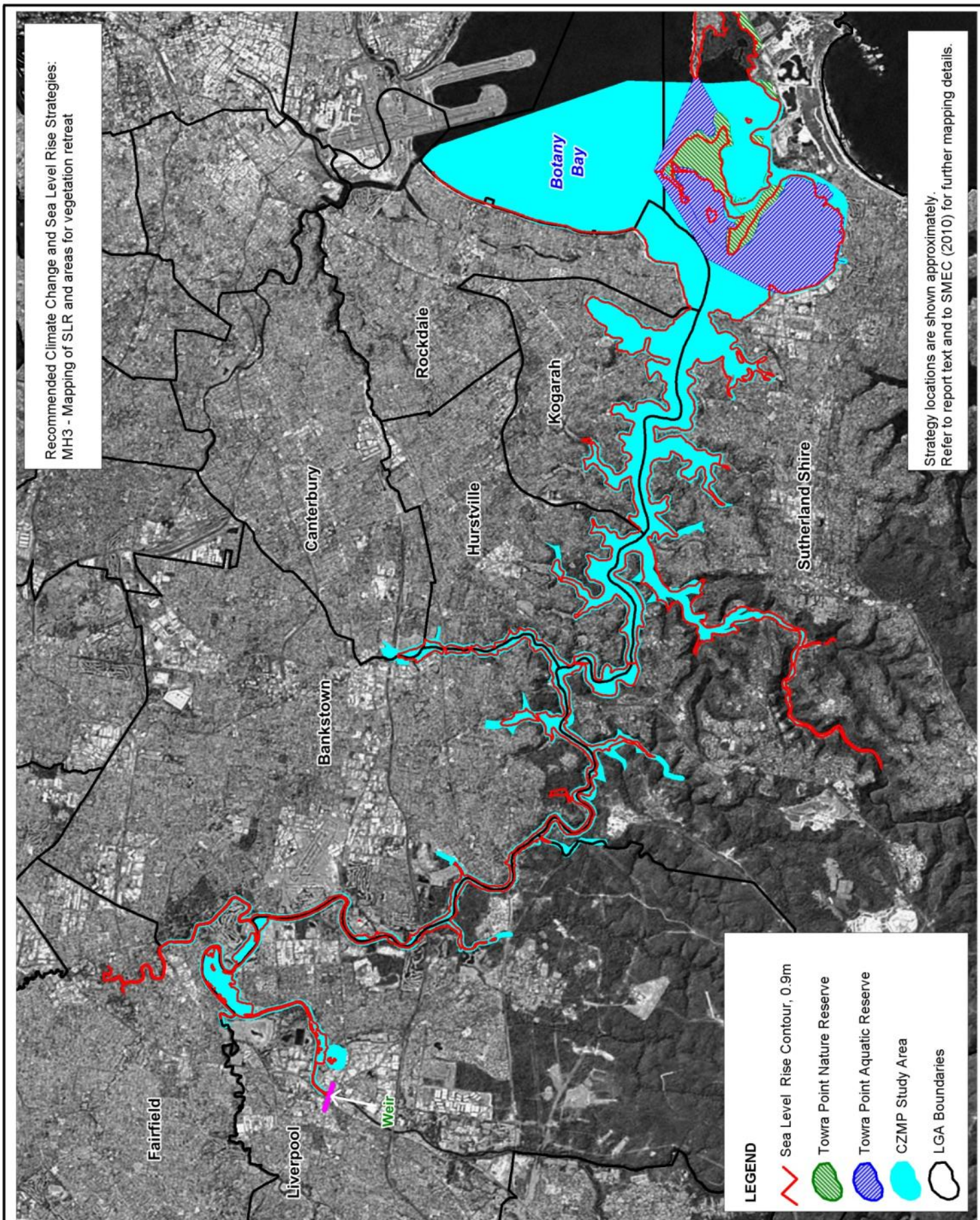
## 6.9 Climate Change and Sea Level Rise Sub-Plan

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### CLIMATE CHANGE AND SEA LEVEL RISE SUB-PLAN

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Title:  
**Climate Change and Sea Level Rise  
Sub-plan**



Figure:  
**6-9**


Rev:  
**A1**

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MH-3	Identify and map areas likely to be impacted by sea level rise, and highlight areas of estuarine vegetation where there is the potential for retreat								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
								yes	
Objectives addressed	H1				Priority		MEDIUM		
Approach / Department	Environmental Planning								
Detailed description	<div><div><p>Climate change, sea-level rise and coastal inundation</p><p>Location: SYDNEY REGION AND SURROUNDS</p><p><b>Disclaimer</b></p><p>This image has been developed to help communicate the risks of sea level rise. The image and information included here are not provided as professional advice, and should not be relied upon for site specific decision making or for making financial or other commitments. For decision making purposes, appropriate independent professional advice should be obtained.</p><p>The Commonwealth does not guarantee the accuracy or completeness of the image. The Commonwealth expressly disclaims liability for any loss, however caused and whether due to negligence or otherwise, arising directly or indirectly from the use of or reliance on this image or the information contained in it, by any person.</p><p><b>Scenario</b></p><p>This image shows a modelled high sea-level rise scenario of 1.5m above a 2100 time period. The model combines the sea level rise with a normal highest astronomical tide (HAT) value for the region to give an inundation level of 2.3m AHD. The inundation is shown in blue. The model is based on a simple, fixed bed approach and should be considered as approximate only. The actual impacts may vary as the model does not take account of existing sea walls, storm surge, erosion or other local factors. The model depicts sea level rise only and does not include additional flooding from rainfall events. Images such as these can change over time as new information emerges.</p><p>The image has been developed using a high-resolution digital elevation model that has been hydrologically conditioned and subsequently reprojected a national ground surface model (GSD) to show how water will flow over the land.</p><p>Scale = 1:40,000</p><p>0 250 500 750 1,000</p><p>Meters</p><p>0 (mAH) 2.3mAH</p><p>Interim Committee Georges River Combined Councils' Committee In Commonwealth of Australia 2015 File # 1000001000000000</p></div></div>								
<p>It is projected that climate change will lead to sea level rise along the east coast of Australia. If projected levels of rise occur then some areas of the foreshore and assets and infrastructure on these areas will be impacted by flooding. This is likely to be made worse by storm surges that are predicted to increase due to increases in storm intensity. In addition to impacts on man-made assets, some ecological assets are also likely to be affected if insufficient foreshore areas are available for these communities to retreat to. In order to better understand the scale and location of such potential impacts it is necessary to identify areas that are likely to be subject to flooding under various sea level rise and storm surge scenarios currently being predicted for the Georges River Estuary. Actions required to implement this option are:</p> <ul style="list-style-type: none"><li>• Undertake one or more studies to identify areas likely to be affected by sea level rise and possible increased storm surge in all foreshore LGAs.</li><li>• Map areas at risk due to sea level rise and storm surge under various climate change projections.</li><li>• Identify assets at risk of flooding due to sea level rise and increased storm surge and the level of threat to these.</li><li>• Identify areas of suitable topography and limited barriers for existing estuarine and riparian vegetation and habitats to migrate landward.</li></ul> <p>These works would build on the initial indicative mapping that has been completed by the Federal Government (DCC) as published through OzCoasts.</p>									

<b>MH-3 Identify and map areas likely to be impacted by sea level rise, and highlight areas of estuarine vegetation where there is the potential for retreat</b>		
Links to existing works		<p>Federal Government 'Bathtub' Sea Level Rise Mapping (Sydney Region)</p> <p>Sea Level Rise mapping completed by:</p> <ul style="list-style-type: none"> <li>• Liverpool City Council</li> <li>• Fairfield City Council</li> <li>• Bankstown City Council</li> <li>• Sutherland City Council</li> </ul>
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	
Hurstville	YES	<p>This Action will be considered as a component of Councils Climate Change Adaptation Plan and Biodiversity Strategy to confirm susceptible areas within the LGA. Confirmed impact areas within the LGA (based on Federal Government Sea Level Rise Mapping Project):</p> <ul style="list-style-type: none"> <li>• Myles Dunphy Reserve + Wetland</li> </ul>
Fairfield	YES	Council has mapped high tides across the LGA under projected sea level rise scenarios for 2050 and 2100 in line with NSW Government advice. Council will consider the impact of sea level rise on foreshore vegetation as part of future updates to Council's Biodiversity Strategy and Urban Creeks Masterplan.
Sutherland	YES	
Rockdale	YES	
Kogarah	YES	
National Pk	NO	
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		<p>As there is expected to be limited tidal attenuation impacts of sea level rise along the Georges River, a 'bath tub' approach is considered reasonable for determining SLR impacts in the estuary. As such, works associated with this strategy could be carried out by Council GIS staff, or as a minor consultancy (&lt; \$50,000 for the whole estuary).</p> <p>Sea level rise mapping has already been undertaken for four of the seven Georges River Estuary LGAs (Bankstown, Fairfield, Liverpool and Sutherland). The Sydney Coastal Councils Group (SCCG) has also done sea level rise mapping that extends into the Georges River estuary. For the remaining LGAs, there is value in having a co-ordinated approach to this strategy with consistency to the works that have already been undertaken. GRCCC could take the lead for implementation.</p>
Lead Responsibilities		GRCCC, All Councils on Georges River Estuary foreshore
Support Responsibilities		DCC, OEH (Coasts & Estuaries), SCCG, HNCMA
Performance Measures		<ol style="list-style-type: none"> <li>1. Maps prepared for anticipated sea level rise inundation extents along the whole Georges River.</li> <li>2. Identification of areas along the river where estuarine and riparian vegetation can migrate landward from their existing locations.</li> <li>3. Consideration of future sea level rise in review and development of future strategic planning documents and initiatives.</li> </ol>

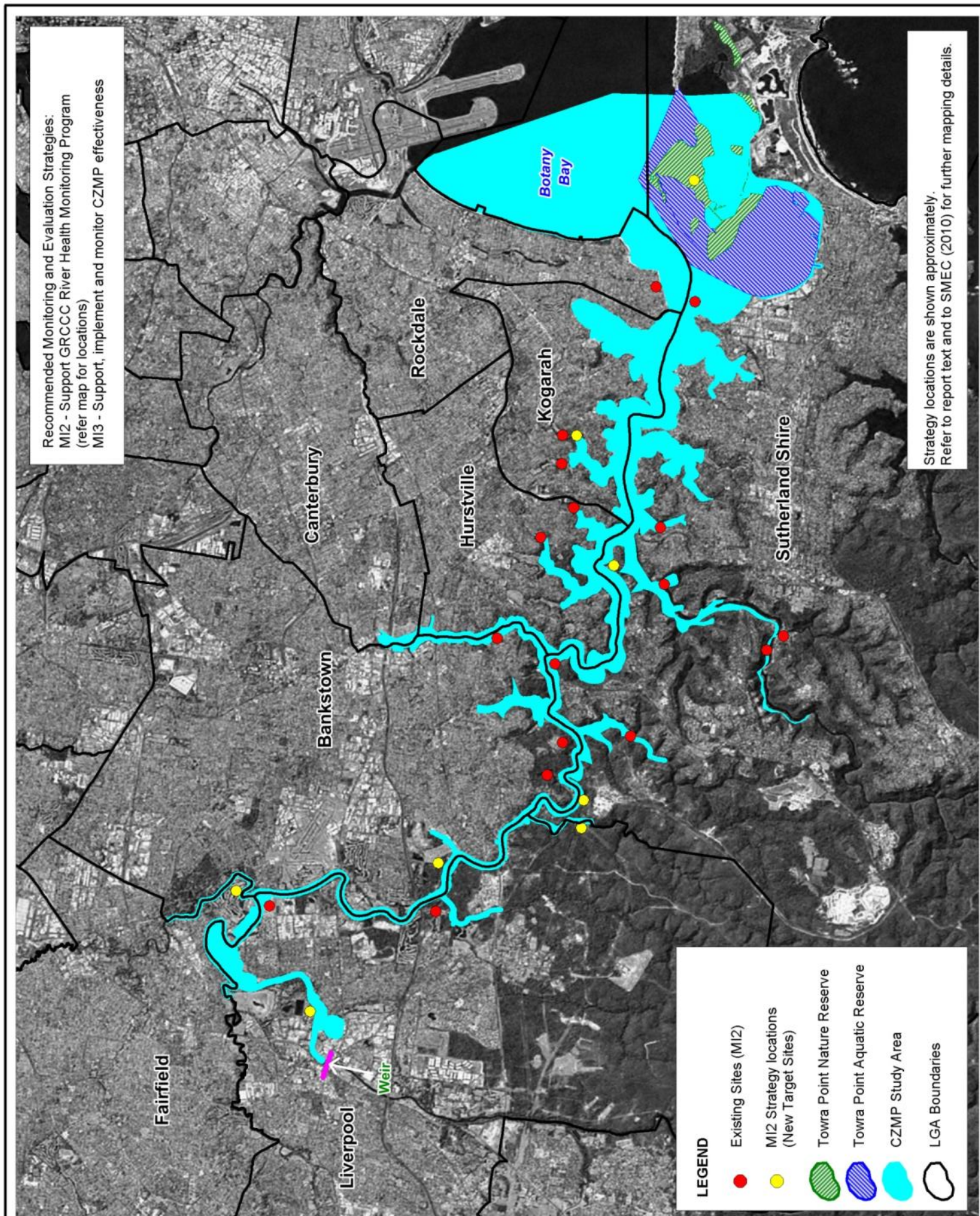
## 6.10 Monitoring and Evaluation Sub-Plan

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### MONITORING AND EVALUATION SUB-PLAN

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Title:  
**Monitoring and Evaluation Sub-Plan**



Figure:  
**6-10**



Rev:  
**A1**

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MI-2	Ongoing support of the Georges River Health Monitoring Program coordinated by the GRCCC								
Aims /risks targeted	A	B	C	D	E	F	G	H	I
									yes
Objectives addressed	I1				Priority		MEDIUM		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<p>The GRCCC's Estuary Management Committee will meet bi-annually or annually to review and report on the progress of Councils in implementing actions contained in the plan. At these EMC meetings, Councils can discuss sub-catchment approaches and develop implementation plans for actions. This will be co-ordinated by the GRCCC.</p> <p>The GRCCC currently coordinates a river health monitoring program for the Georges River Estuary. Understanding the current health of the estuary and trends in this over time is key to appropriately managing threats to the estuary. The coordination role of the GRCCC is also crucial to ensure consistency of data collected across the estuary over time and access to the data.</p> <p>It is vital that this river health monitoring program is continued over time to ensure that data is collected over the long term to allow trends in data to be captured and identified. In addition, the program should work with and have in place a water quality data sharing arrangement with participating councils, Sydney Water and community groups who are undertaking monitoring. The program should also work with Sydney Water to help identify the locations, magnitude and impacts of sewer overflows. Actions to support this option are:</p> <ul style="list-style-type: none"><li>• Continue to support Georges River Estuary Health Monitoring program through ongoing funding past 2013.</li><li>• Identify ways in which additional value can be added to this program. For example, monitoring of the foreshore area and bank erosion, or actions undertaken to implement this Coastal Zone Management Plan can be incorporated into the program.</li><li>• Development of periodic report cards or other mechanism to convey the health of the estuary and pressures from the catchment to the community.</li><li>• Monitor foreshore areas including erosion</li></ul> <p>Refer to Figure 6-10 for location details for this option.</p> <p>Also see <b>Section 8.1</b> for details of the Georges River Health Monitoring Program</p>								
Links to existing works	<p>GRCCC River Health Monitoring Program</p> <p><a href="http://www.georgesriver.org.au/River-Health-Monitoring-Program.html">http://www.georgesriver.org.au/River-Health-Monitoring-Program.html</a></p>								





<div>MI-2</div> <div>Ongoing support of the Georges River Health Monitoring Program coordinated by the GRCCC</div>		
Council	Applicable	Comments
Bankstown	YES	
Liverpool	YES	<p>Monitoring could be expanded to investigate factors for poor river health rating at Liverpool sites</p> <p>New monitoring recommended at:</p> <ul style="list-style-type: none"> <li>Southern side of Deadmans Creek - Dept of Defence land (monitor integrity of saltmarsh community)</li> </ul>
Hurstville	YES	Council will continue to work with and support the GRCCC Riverhealth Cluster Group in the ongoing refinement and delivery of the program.
Fairfield	YES	Council will shortly be reviewing its water quality monitoring program to ensure it remains relevant, cost-effective and consistent with GRCCC monitoring activities. Council may seek to have additional sampling of macro-invertebrates and fish undertaken following the review. Council is keen to examine the feasibility of undertaking continuous water quality monitoring in Lower Prospect Creek.
Sutherland	YES	<p>Monitoring could be expanded to investigate factors impacting on freshwater macroinvertebrate population of Carina Creek</p> <p>New monitoring recommended at:</p> <ul style="list-style-type: none"> <li>Quibray Bay at Towra Point (monitor mangrove condition)</li> <li>Ovens reach (monitor mangrove condition)</li> </ul>
Rockdale	YES	
Kogarah	YES	<p>Monitoring could be expanded to investigate factors for high nutrient loads at Poulton Park Creek.</p> <p>Gas emissions monitoring at Moore Reserve to continue.</p> <p>New monitoring recommended at:</p> <ul style="list-style-type: none"> <li>Poulton Park Creek and other sites as necessary (monitor Human Bacteroides Marker, as indicator for sewage contamination)</li> </ul>
National Pk	YES	Monitoring could be expanded to target threatened species communities that may be subject to degradation from natural and human induced conditions.
Commencement		2014 (or opportunistically prior to this)
Costs, Resources and Funding Opportunities		Monitoring under the existing program will continue to be carried out by the GRCCC in collaboration with Councils until current grant funded period ends in June 2013.

MI-2	Ongoing support of the Georges River Health Monitoring Program coordinated by the GRCCC
	Funding for this program is currently provided by a Federal Government Caring for our Country Grant. It is anticipated that continuation of the current River Health Monitoring Program in Georges River in the future would have the same cost and resource demands as currently incurred, however, in order to secure the long term future of the program and to ensure the program continues beyond the grant funding period of June 2013, Councils should support the program through the provision of on-going core funding, which may be supplemented by grant funding should it be obtained.
Lead Responsibilities	GRCCC, all Councils in the Georges River Catchment
Support Responsibilities	HNCMA, OEH (NPWS)
Performance Measures	<ol style="list-style-type: none"> <li>1. Councils provide financial support to the GRCCC River Health Monitoring Program</li> <li>2. River Health Monitoring Program is expanded in response to management needs, as appropriate.</li> <li>3. Monitoring results help to target restoration and remediation works and thus improve the overall environmental health of the estuary.</li> </ol>

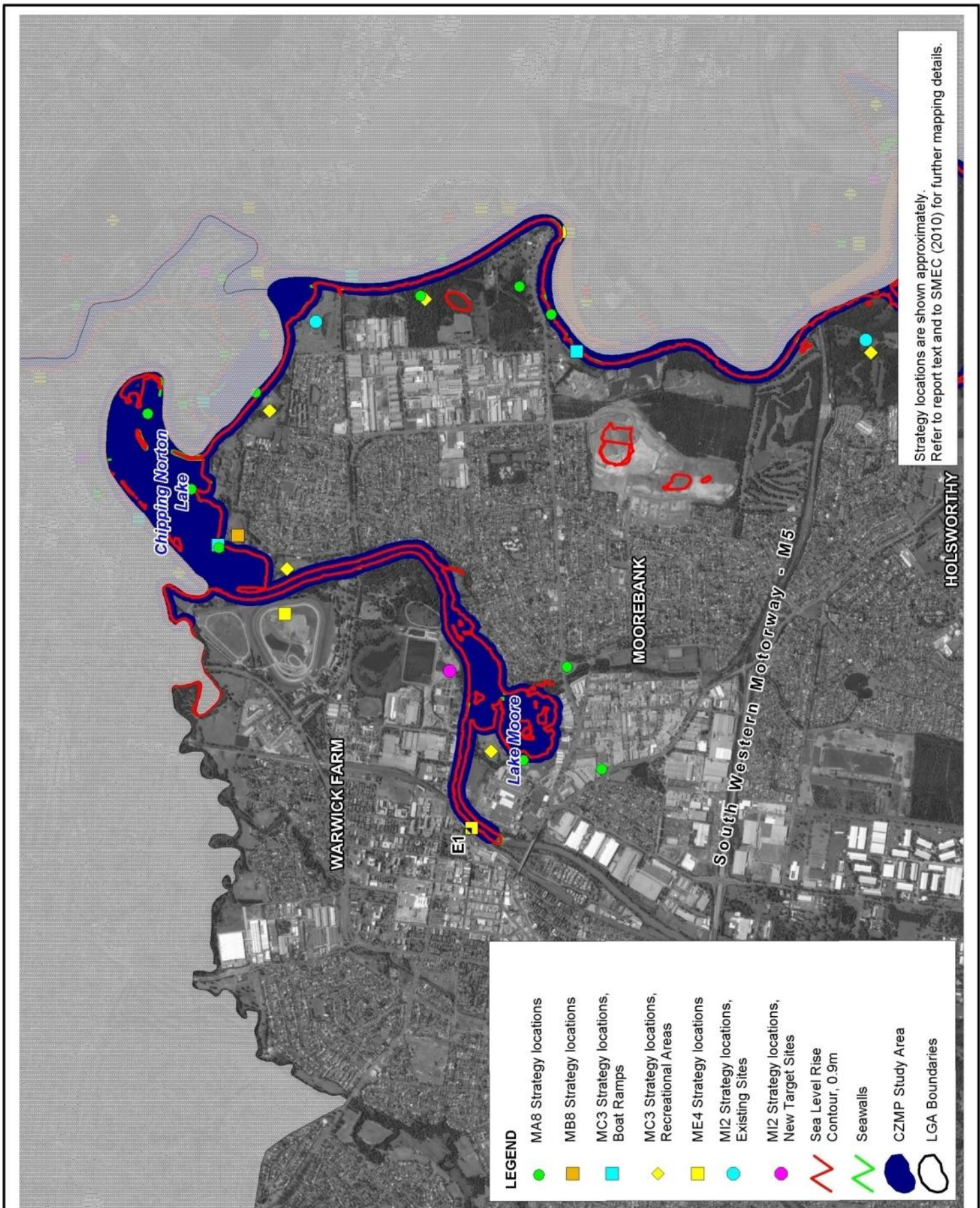
MI-3		Support the implementation and monitoring of the effectiveness of Plan							
Aims /risks targeted	A	B	C	D	E	F	G	H	I
									yes
Objectives addressed	I2				Priority		LOW		
Approach / Department	Environmental Rehabilitation & Monitoring								
Detailed description	<p>Effective implementation of the Plan requires on-going monitoring, both of the actions undertaken as part of the Plan implementation and of the outcomes of these actions. Actions to support this management option are:</p> <ul style="list-style-type: none"><li>• Provide funding to continue the River Health Monitoring Program beyond 2013 when grant funding concludes.</li><li>• GRCCC to coordinate maintaining and updating a data base on the status and completion of all projects/actions from the CZMP. This should build on existing GIS information to track the implementation of the CZMP and SMP</li><li>• HNCMA should develop guidelines for consistent monitoring of the effectiveness of WSUD devices and communicate these to Councils in the Georges River catchment.</li><li>• All councils should monitor the effectiveness of WSUD devices in line with HNCMA guidelines.</li><li>• Estuary water quality should continue to be monitored on a catchment scale to characterise water quality and to provide a measure to determine the effectiveness of the proposed estuary management actions</li></ul> <p>See <b>Section 8.1.6</b> for details of Monitoring of Plan effectiveness.</p>								
Links to existing works	GRCCC River Health Monitoring Program, HNCMA WQ monitoring program								
Council	Applicable	Comments							
Bankstown	YES								
Liverpool	YES								
Hurstville	YES								
Fairfield	YES								
Sutherland	YES								
Rockdale	YES								
Kogarah	YES								
National Pk	YES								
Commencement	2017 (or opportunistically prior to this) for major review. Annual progress review to commence 12 months after adoption of CZMP.								
Costs, Resources and Funding Opportunities	Monitoring of Plan effectiveness would be carried out by GRCCC staff, with assistance from GRCCC Councils. No external funding would be required for this strategy, unless a minor consultancy was engaged to expedite the process.								
Lead Responsibilities	All Councils in the Georges River Catchment, GRCCC,								
Support Responsibilities	HNCMA, OEH (coasts & estuaries)								
Performance Measures	<ol style="list-style-type: none"><li>1. Annual review of CZMP progress (refer <b>Section 8.1.6</b> for details)</li><li>2. Substantial review of completion and effectiveness after minimum 5 years (refer <b>Section 8.1.6</b> for details)</li></ol>								



## 7 ACTIONS SUMMARY FOR COUNCILS

The following pages provide a map-based summary of actions required to be undertaken within each of the seven LGAs that apply to this Plan. Spatially specific strategies are presented on the maps, while remaining non-spatially specific strategies have simply been listed on the relevant LGA maps.

Readers of these maps should also refer to the Georges River Data Compilation and Estuary Processes Study (SMEC, 2010) for further detailed mapping.



Title:  
**Liverpool LGA**



Figure:  
**7-1-1**

Rev:  
**A1**

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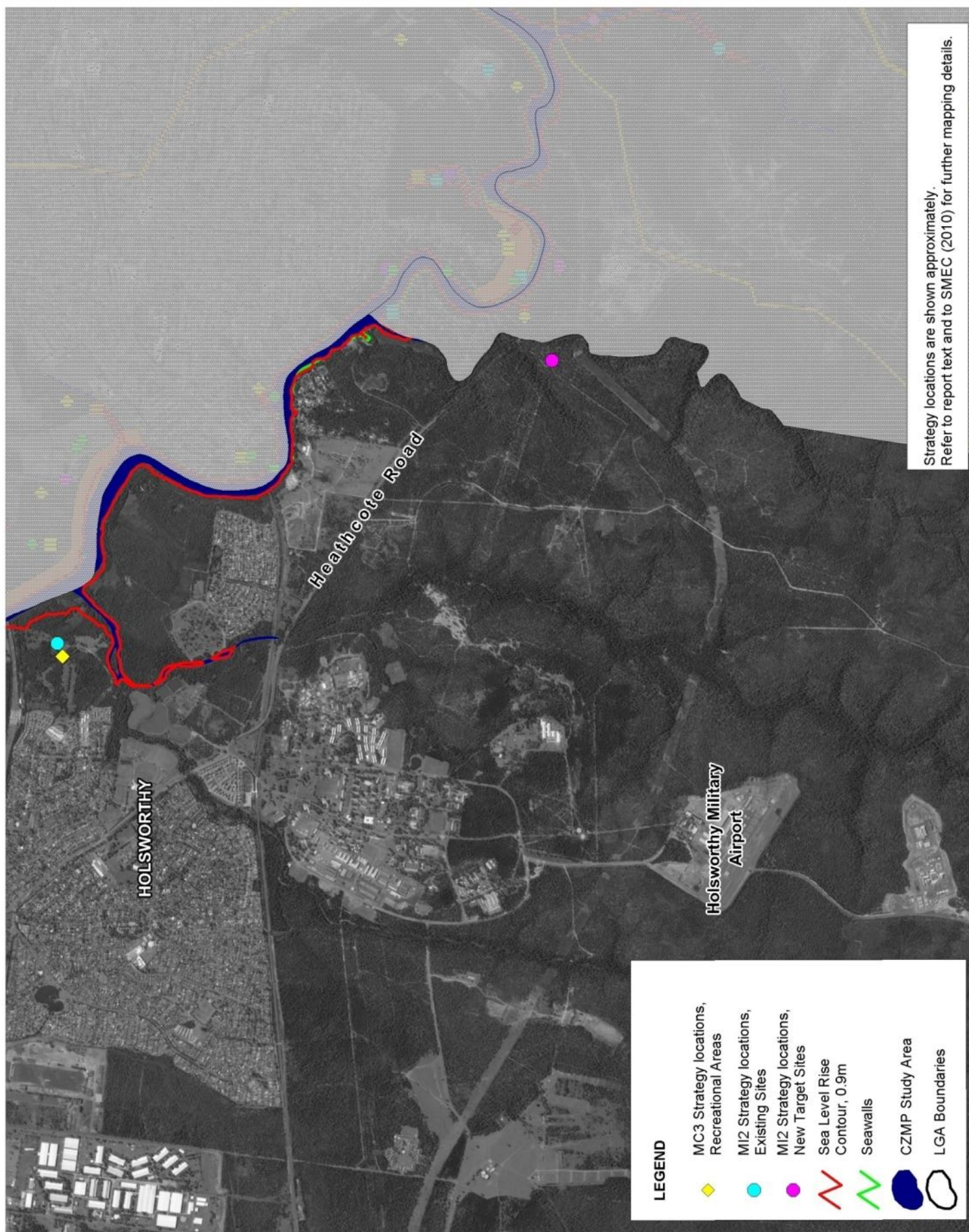


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Approx. Scale



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Title:  
**Liverpool LGA**



Figure:  
**7-1-2**

Rev:  
**A1**

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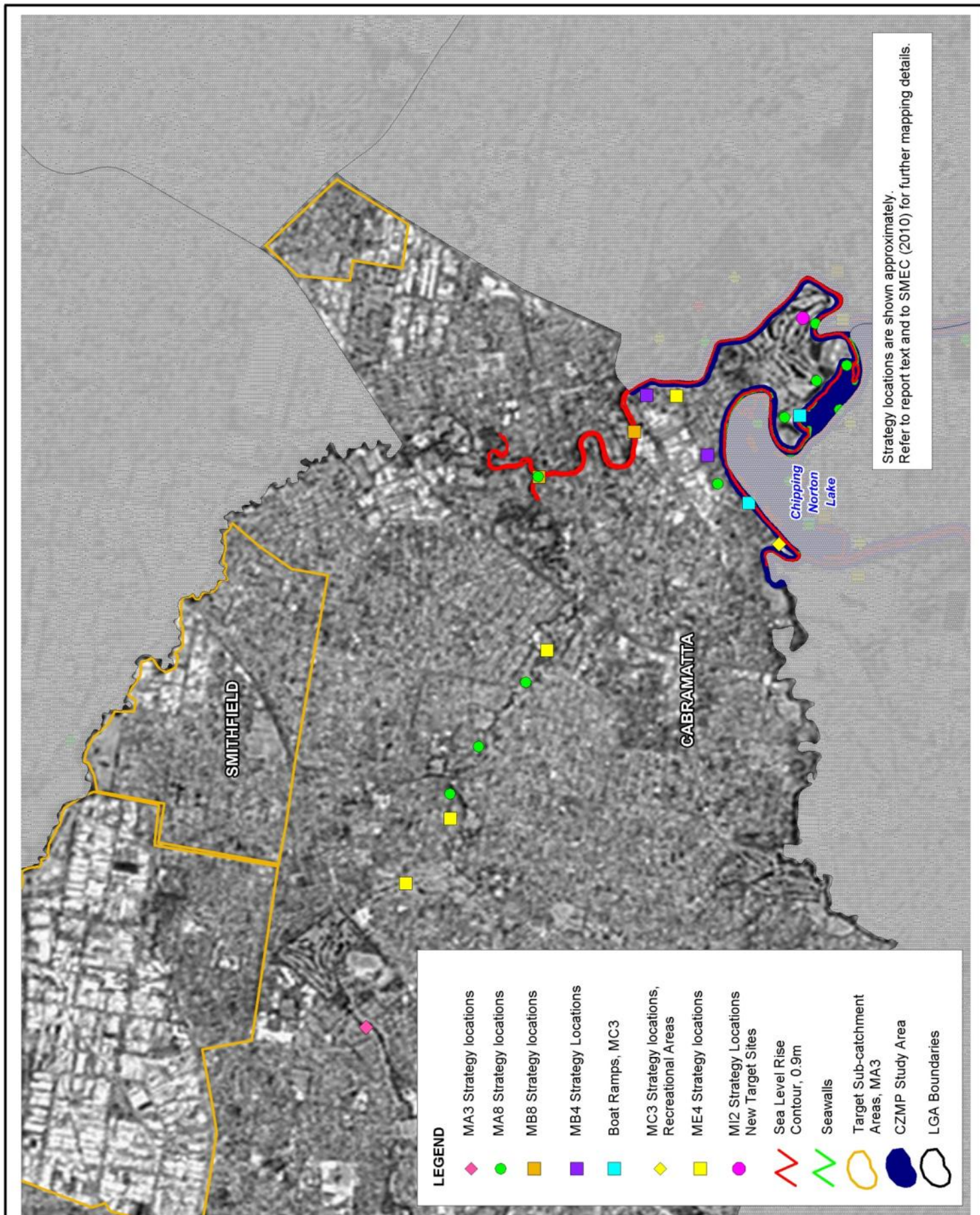


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Title:  
**Fairfield LGA**



Figure:  
**7-2**

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**A**

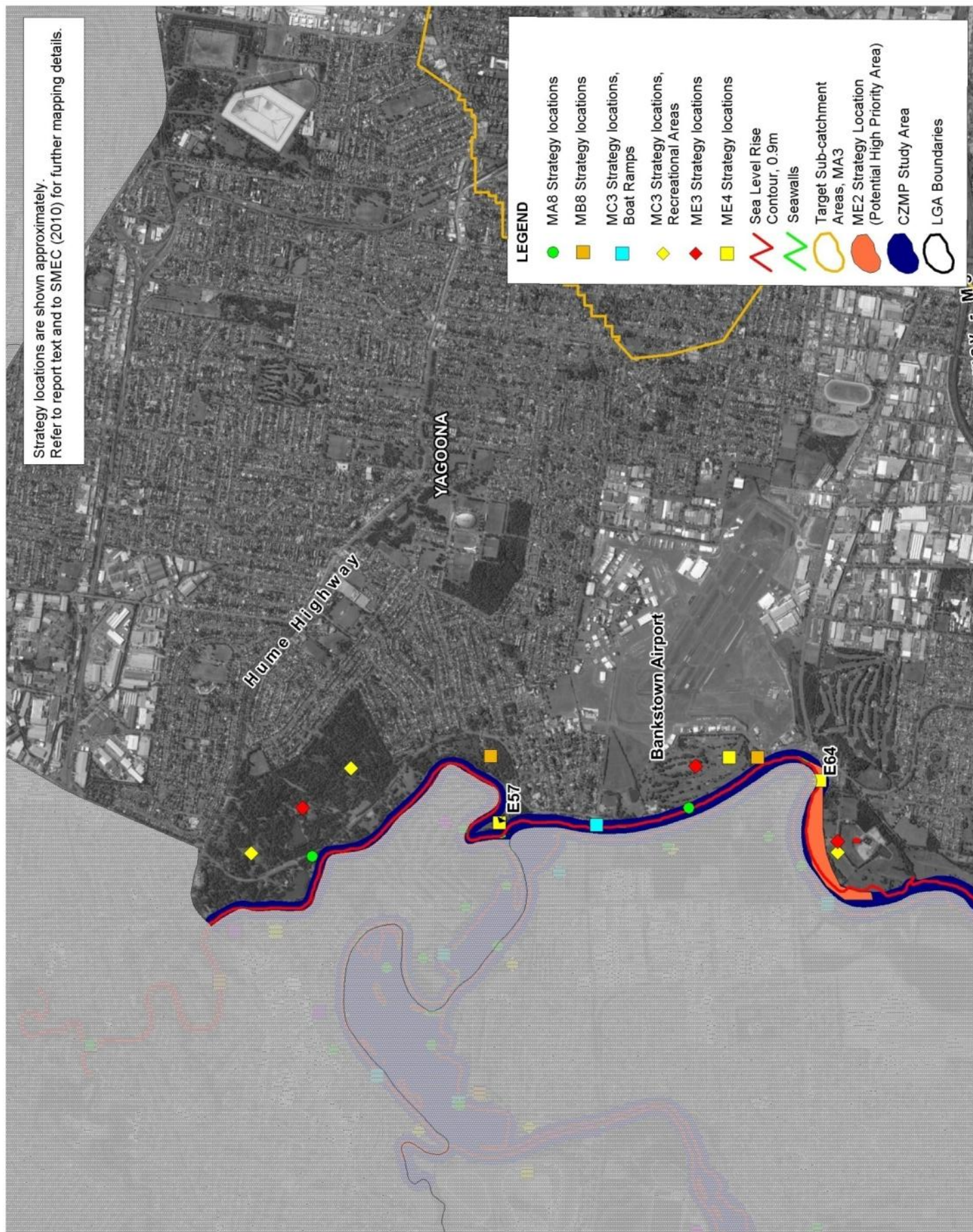
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Strategy locations are shown approximately.  
Refer to report text and to SMEC (2010) for further mapping details.



Title:  
**Bankstown LGA**



Figure:  
**7-3-1**

Rev:  
**A1**

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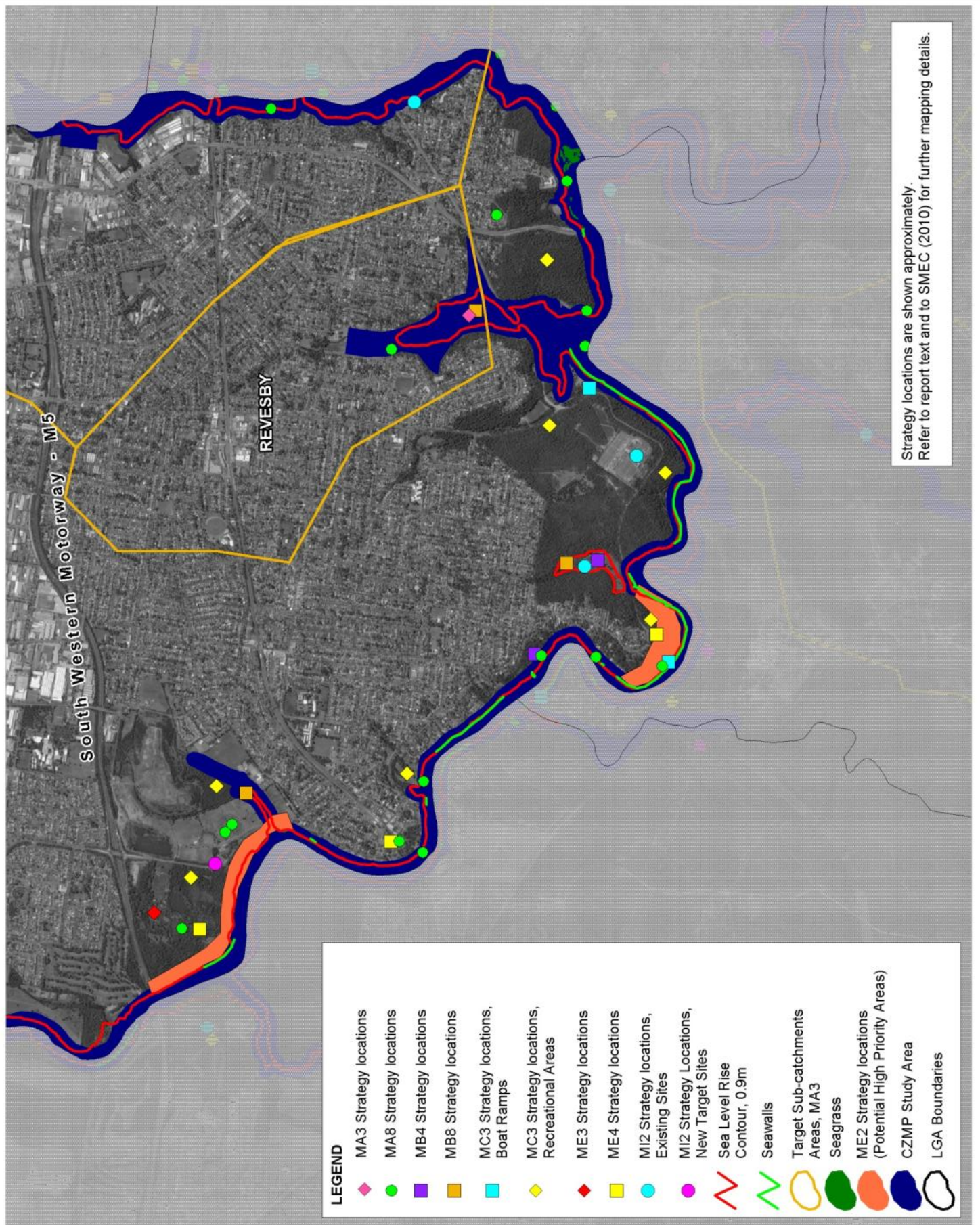


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Strategy locations are shown approximately. Refer to report text and to SMEC (2010) for further mapping details.

Title:  
**Bankstown LGA**



Figure:  
**7-3-2**

Rev:  
**A1**

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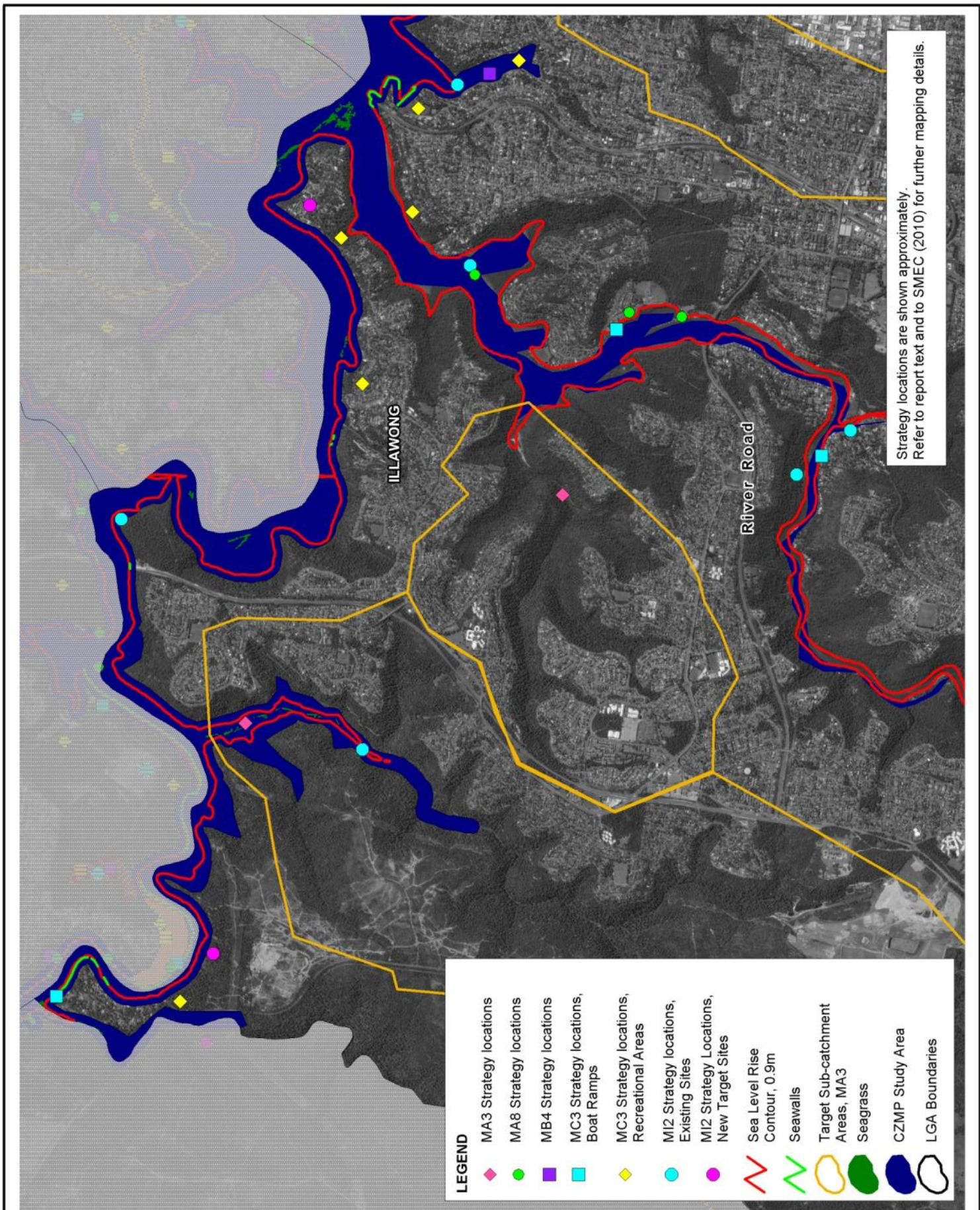


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Approx. Scale



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Title:  
**Sutherland LGA**



Figure:  
**7-4-1**

Rev:  
**A1**

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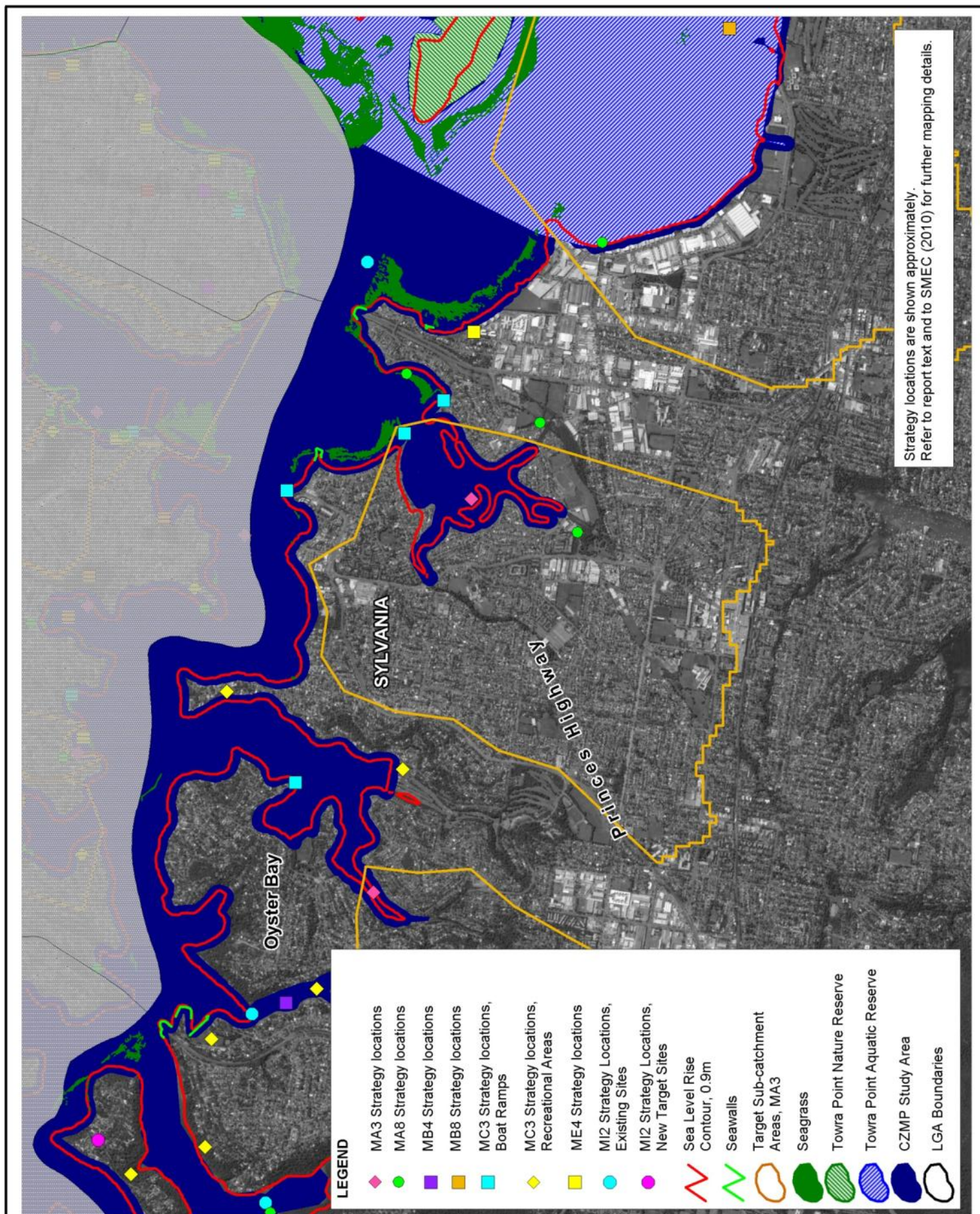
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Approx. Scale



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Title:  
**Sutherland LGA**



Figure:  
**7-4-2**

Rev:  
**A1**

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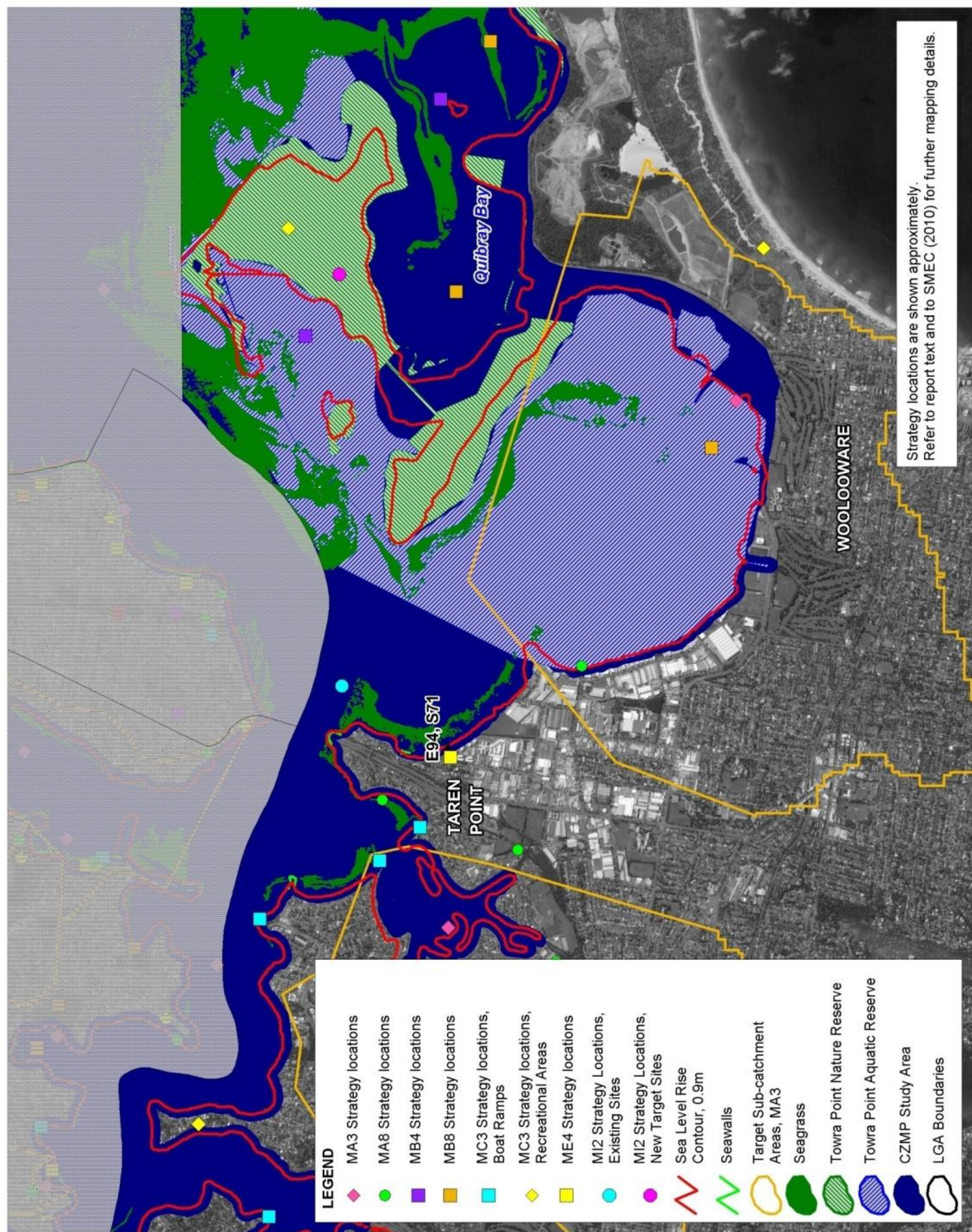


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Approx. Scale



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Title:  
**Sutherland LGA**



Figure:  
**7-4-3**

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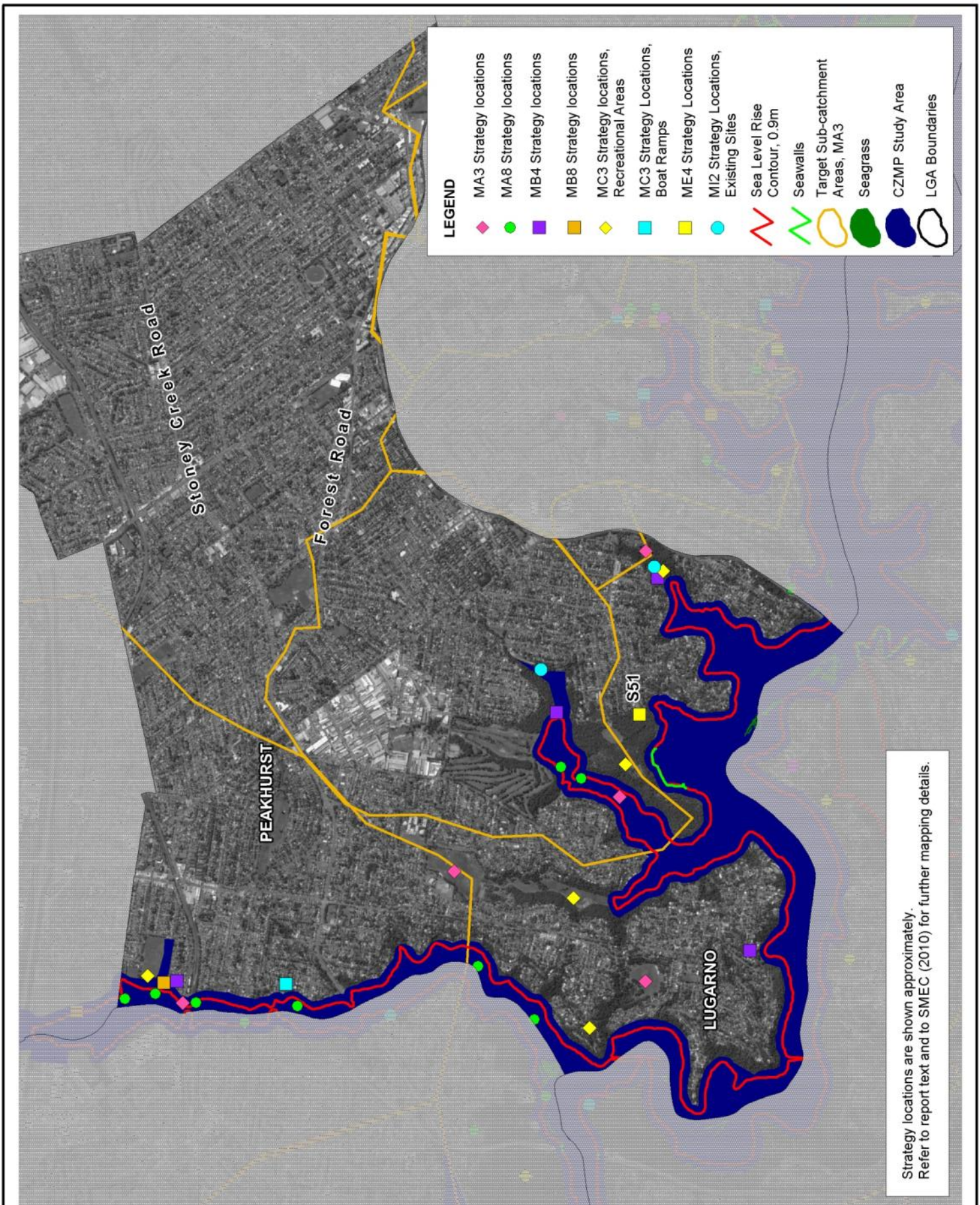


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**Hurstville LGA**



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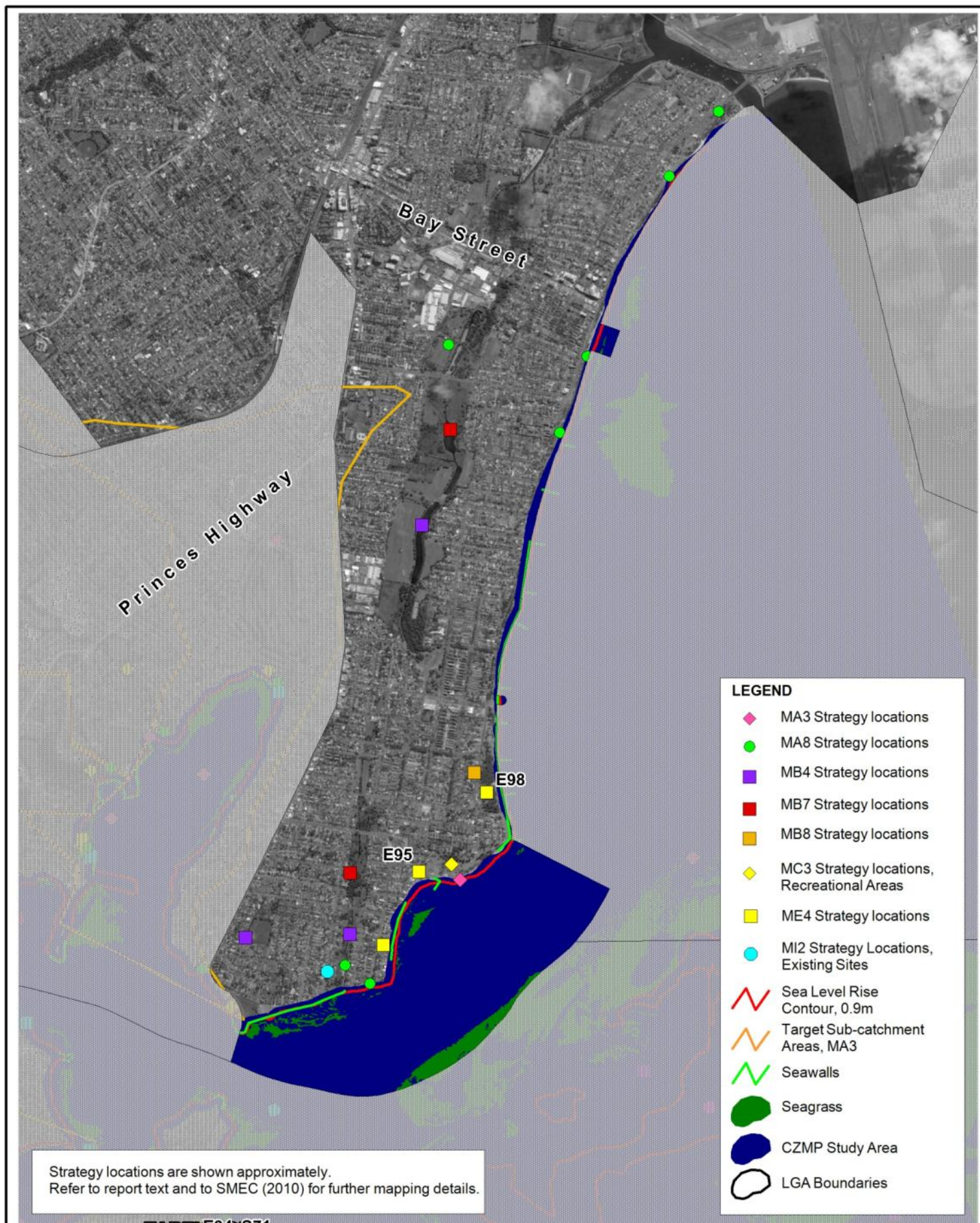


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**Rockdale LGA**



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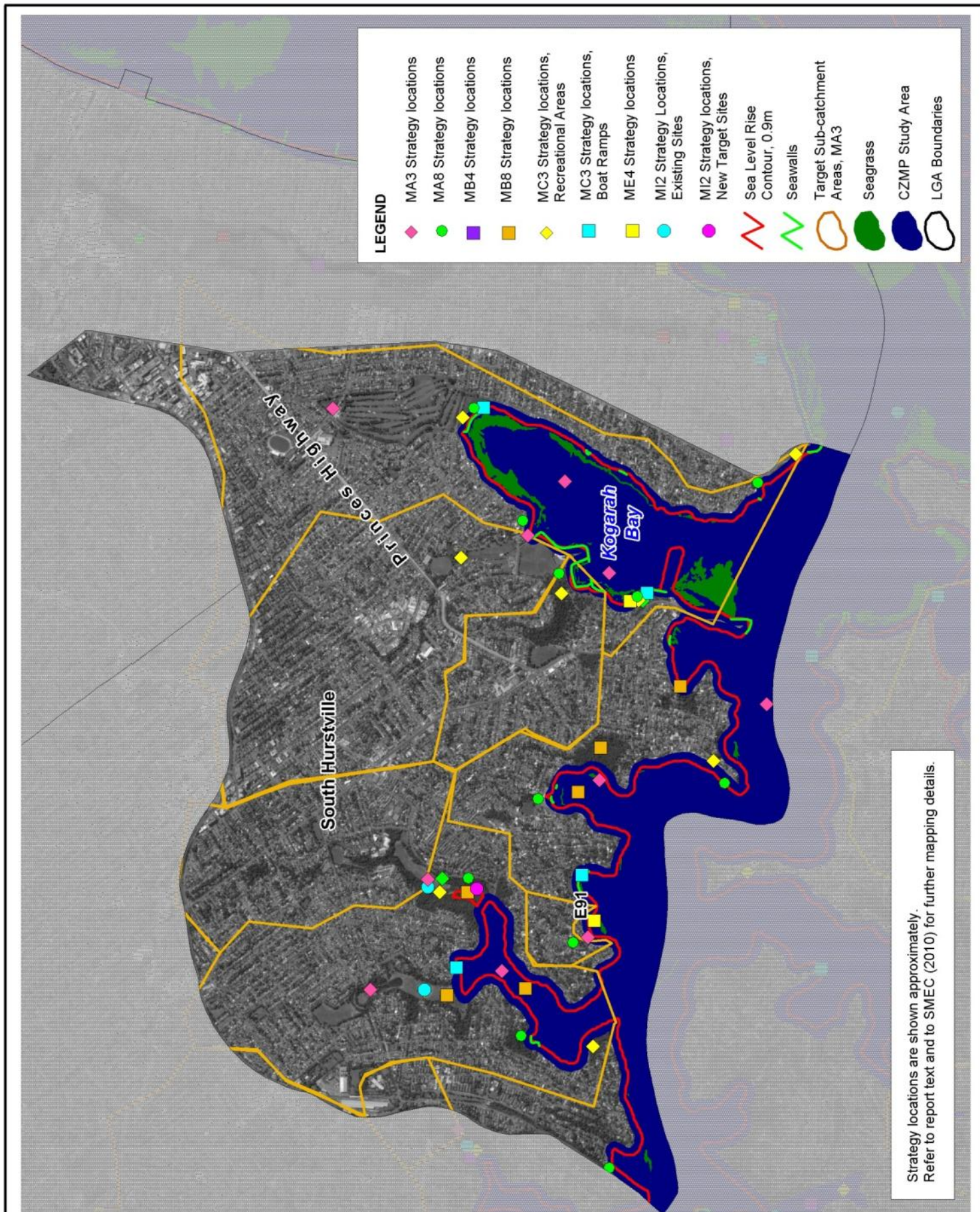
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Title:  
**Kogarah LGA**



Figure:  
**7-7**

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## **8 MONITORING AND REVIEW**

### **8.1 Georges River Estuary River Health Monitoring Program**

#### **8.1.1 Background**

Since 2009, the GRCCC have been running a river health monitoring program. This has involved extensive support from community members, member councils and partner agencies in the sampling of macro-invertebrates, collection of physico-chemical water quality parameters and vegetation assessments. While this program has been highly successful and has provided useful information for the broader river and catchment, it has been recognised that with some modifications to ensure it aligns with the States MER Program, that it could also be used to monitor the condition of the estuary as part of this Plan.

At the second committee workshop, an outline of a new estuary monitoring program was proposed that built on the existing GRCCC River Health monitoring and is consistent with the MER Program principles. The committee agreed to adopt this program for the Coastal Zone Management Plan.

Information from this monitoring program will be used as a baseline to track how well the estuary is being managed over time and whether implementation of the completed Coastal Zone Management Plan is contributing to improved estuary health. In addition, the GRCCC's River Health Monitoring Program report cards will be used to inform the community of the current health of its estuaries.

It should be noted that while this section describes the monitoring program adopted at the time of preparing this EMP, there may be changes over time to aspects such as indicators sampled, sites, sampling periods, and analysis of data. This will allow for improvements to be made once more information becomes available, or to adopt changes to Statewide programs such as MER that may be rolled out and need to be complied with.

#### **8.1.2 Indicators**

The adopted estuary health monitoring program is based around using key indicators that are monitored at the State level under the MER Program. This includes monitoring:

- Chlorophyll a
- Turbidity
- Other supporting physico-chemical indicators such as salinity, dissolved oxygen, pH, and temperature
- Estuarine Macrophytes (seagrasses, saltmarsh, mangroves) distribution change
- Riparian vegetation distribution and condition

#### **8.1.3 Sampling Period and Effort**

- Sampling monthly for chlorophyll a and turbidity (with fortnightly sampling of chlorophyll a over the warmer months – roughly mid September to end of March). Fortnightly sampling over the warmer months is recommended as algae productivity is greatest over these months and as per

MER methodology, will ensure that the chlorophyll a maxima is more likely to be accurately captured.

- One off assessments of estuarine macrophyte distribution and condition every 5 to 10 years to identify change in extent and condition over time.
- One off assessments of riparian vegetation distribution and condition every 5 to 10 years to identify change in extent and condition over time.

#### 8.1.4 Sampling Sites

Sampling sites are summarised as follows:

- To gain a representative understanding of overall estuary health for the Georges River, six sampling sites along the salinity gradient will be monitored, the locations of which can be seen in Figure 8-1. These sites occur from the lower to upper Georges River, with a focus on sampling over the mid to upper estuary rather than the lower estuary where marine influence is greatest and variability in sampled indicators is likely to be lower.
- Three Georges River sampling sites share the same location as the BBWQIP real-time water quality monitoring stations; Downstream of the confluence with Prospect Creek, the confluence with Salt Pan Creek and the mouth of Georges River where it enters Botany Bay. These sites span the lower and upper estuary and sampling at these locations will enable field validation of chlorophyll-a levels reported by the BBWQIP real-time loggers.
- Three additional monitoring sites will be included and are located approximately 250 m downstream of Liverpool Weir, approximately 250 m downstream of the M5 bridge opposite Kelso Park, and at the confluence of Little Salt Pan Ck.

#### 8.1.5 Sampling Protocols

Sampling protocols are summarised as follows:

- Water Quality parameters of pH, salinity, turbidity, dissolved oxygen and temperature will be sampled *in-situ* using a WIN-TPS flmv90 water quality logger. The logger is calibrated before each use with the appropriate standards and buffer solutions. Chlorophyll-a will be sampled in containers supplied by a NATA accredited laboratory and will broadly follow the MER sampling protocols. Chlorophyll-a will be sampled on a five minute boat drift where-by a one Litre sample is taken every 30 seconds and poured into a bucket, a total of 10 L of sample water will be drawn and homogenised in a bucket from which a 1 L sample will be collected in supplied sample container.
- Monitoring of all sites will be done by boat.
- Chlorophyll-a samples will be chilled and kept in an esky until dispatched to the laboratory, usually on the same day of collection, but no later than 48 hours after collection.
- A duplicate and field blank sample will be included every 1 in 10 samples.

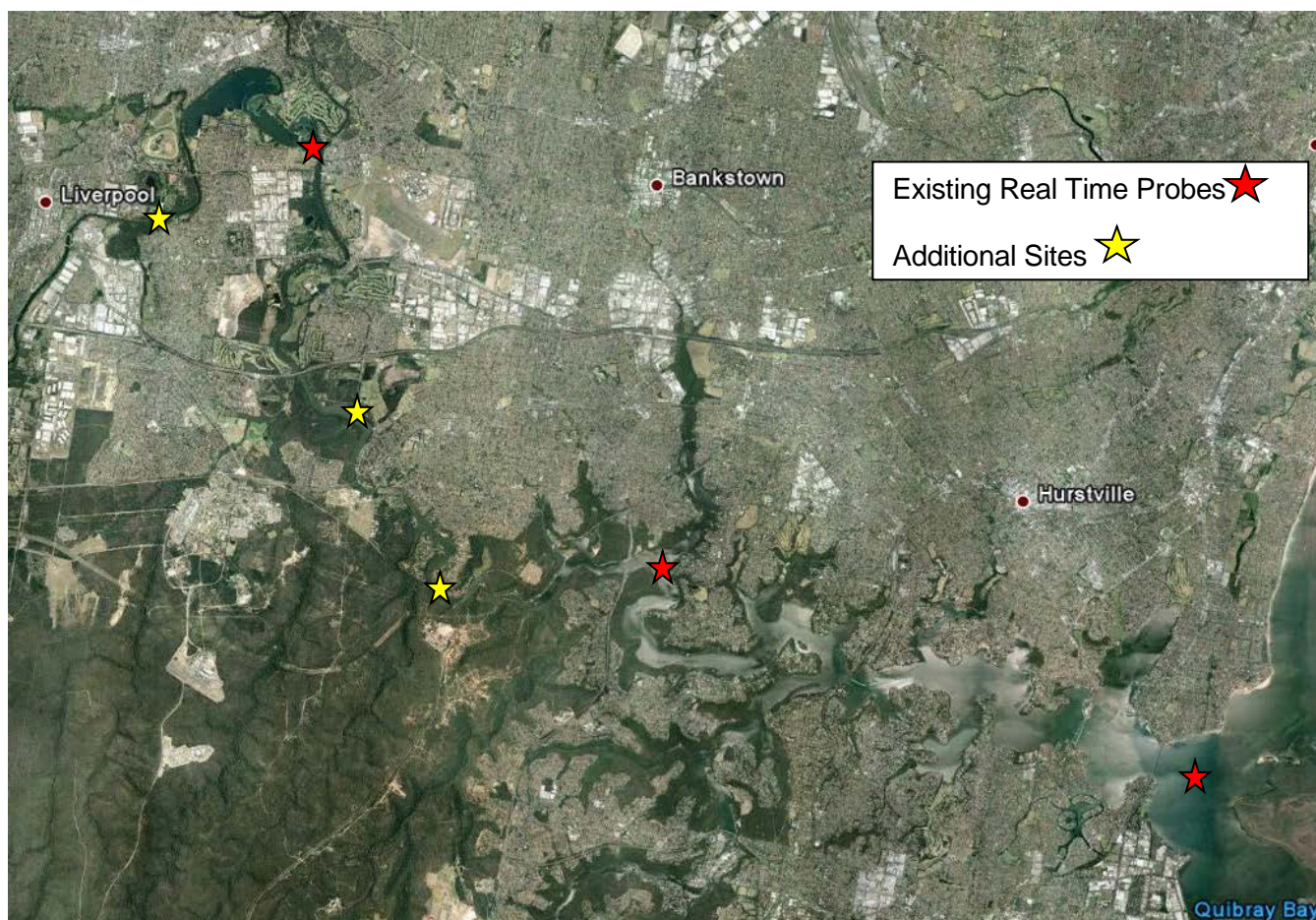


Figure 8-1 Georges River Estuary Monitoring Sites

### 8.1.6 Analysis of Data

The methodology for assessment of chlorophyll a and turbidity data will be done according to the methodology prescribed by the Office of Environment and Heritage (OEH, 2012 - currently in draft form), including using the trigger values derived for the State of the Catchment reports (Table 8-1) (Roper *et al.*, 2011). The methodology for assessing change in macrophyte distribution over time will follow the State of the Catchment Reports methodology.

### 8.1.7 Evaluation and Reporting

Evaluation and reporting is summarised as follows:

- Evaluation of the data is important for determining whether any priorities of the plan need to be amended or specific actions need to be taken. Evaluation should be an ongoing process.
- Reporting of the data is important for highlighting to key stakeholders and the community in general how the health of the Georges River is changing over time and compares to other estuaries. Reporting should be in the form of yearly report cards on estuary health / water quality.

**Table 8-1 Trigger values for River Health Monitoring Program**

Indicator	Estuary Type	Estuary Zone (based on salinity)	Trigger Value
Chlorophyll a	River	Upper <10 ppt salinity	3.4 µg/L
		Middle 10-25 ppt salinity	2.9 µg/L
		Lower >25 ppt salinity	2.3 µg/L
Turbidity	River	Upper <10 ppt salinity	13.7 NTU
		Middle 10-25 ppt salinity	8 NTU
		Lower >25 ppt salinity	5 NTU

*These trigger values were derived from data from reference estuaries sampled as part of the NSW Monitoring, Evaluation and Reporting Program (MER).*

## 8.2 Monitoring of Coastal Zone Management Plan Effectiveness

The Coastal Zone Management Plan has been developed with the provisions for evaluating its performance. Where performance is sub-optimal, contingencies should be implemented to remedy the situation. A series of performance measures applicable to the Plan outcomes are discussed below.

### 8.2.1 Primary Performance Measures

The first set of performance measures should ascertain whether the strategies are actually being implemented or not within the timeframe designated in the Plan. As such, the primary performance measures are simply a *measure of project initiation*.

Organisations (mostly Councils) responsible for implementation will need to review the Plan carefully and ensure that adequate resources are allocated to the various strategies to ensure that the timeframe for implementation of ten years is achieved.

Clearly, a high degree of co-ordination will be required to manage the successful implementation of all the strategies within the designated timeframe, particularly given the different jurisdictional boundaries that this Plan crosses. Co-ordination for implementation of the plan is to be facilitated by the GRCCC.

Specific questions to be answered are:

- What BMOs / strategies have actually been implemented (regardless of outcome – see Secondary performance measure)?



- What BMOs / strategies are outstanding, and should have been implemented within this nominated timeframe?

If it is determined that the BMOs / strategies are not being implemented to the nominated timeframe then one or both of the following *contingencies* should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding. If delays are resource-based, seek additional assistance from stakeholder agencies and/or consider using an external consultancy to coordinate implementation of the Plan; and
- Modify and update the Coastal Zone Management Plan to reflect a timeframe for implementation that is more achievable. The revised Plan would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

### 8.2.2 Secondary Performance Measures

Once a strategy has actually been implemented, the second set of performance measures relate to *measuring specific outputs* from the individual strategies, as appropriate. These “measurables” define what the specific outcome from each action should be. If these outputs are delivered as defined, then the action (or strategy) is considered to have been successful.

Outputs will vary according to the individual strategy and are identified as the “Performance Measures” with the Implementation Schedules.

The specific question to be asked here is:

- Of the BMOs / strategies that have been implemented, has the nominated “Performance Measures” been achieved?

If specific outputs, as defined by the “Performance Measures”, are not generated from implementation of the Plan then the following *contingencies* need to be adopted:

- Determine the reason for not producing the specified output. If the reason involves a lack of funding or resources, then similar contingency measures to those described for the primary performance measures should be adopted. If the reason is of a technical nature, then expertise in the area should be consulted to overcome the technical problem. OEH, HNCMA and other government agencies should have the necessary in-house expertise to assist in most cases; and
- Review the appropriateness of the specific output of the management strategy, and if necessary, modify the output described in the Plan to define a more achievable product.

### 8.2.3 Tertiary Performance Measures

The third set of performance measures are aimed at *measuring the overall aims of the Plan*, and as such relate to how the Plan has helped address the risks facing the Georges River Estuary (refer Section 4.1). One of the main mechanism for gauging whether the aims and risks have been addressed, or not, is through environmental monitoring (refer Section 8.1). Therefore, **monitoring of various elements of the physical, biological and social environment is an essential component of assessing the overall success of the Coastal Zone Management Plan.**

The specific question to be asked here is:

- Have the aims been achieved and risks managed?

If, after a reasonable period of time, the specific aims of the Plan are not being achieved by the strategies being implemented, then the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in meeting the Plan objectives;
- Commence implementation of additional management strategies that may assist in meeting Plan objectives (possibly 'fast-track' some NBOs or Other Options as necessary);
- Reconsider the objectives of the Plan to determine if they set impossible targets for future estuary conditions, and adjust the Plan, as necessary. Any such changes to the Plan would need to be endorsed by the stakeholders and relevant government agencies, as well as the public.

### 8.3 Factors for Success

The success of the Georges River Estuary Coastal Zone Management Plan can be improved by the following factors:

- Approval by the Minister and Gazettal by the Councils;
- Broad agreement on the aims, objectives, and strategies;
- Agreement on implementation by all state and local government agencies, stakeholders and the general community;
- Understanding and acceptance of responsibilities for the implementation of the various aspects of the Plan;
- Commitment by those involved to dedicate appropriate time and resources to achieve the objectives and timeframe of the Plan; and
- Sourcing of appropriate funds, through grants, user contributions, and in-kind commitments from agencies and the community.

An important aspect is the acceptance and agreement by the local community. Without significant support by the local community, Councils and the other agencies will not receive the pressure to ensure that the long-term sustainable management of the Georges River Estuary remains a high priority.

All seven Councils (Liverpool, Fairfield, Bankstown, Sutherland, Hurstville, Kogarah and Rockdale) are not responsible for all activities that occur within the estuary. Whilst the CZMP examines numerous areas and issues, implementation of the recommended strategies contained in the Plan relies heavily on an integrated approach (facilitated through the GRCCC) by the relevant key stakeholder agencies, which have been, and will continue to be, involved in the development of the Plan.

Whilst some of the recommendations may identify other agencies as responsible for implementation, each Council will be responsible for encouraging and facilitating the Plan's implementation within their LGA and will champion its on-going implementation.

Where an agency is listed as the lead responsibility in the implementation schedules (refer Section 6), a letter of formal support from that agency is required stating they support its inclusion in the CZMP. Of particular note in this regard are options to be implemented by NPWS and the former Sydney Metro CMA. All agencies have also been involved in the preparation of the CZMP and during the review process.

## 8.4 Plan Review

To facilitate review of the Coastal Zone Management Plan, it is recommended that a rolling four (4) year Estuary Action Plan (or Implementation Plan) be developed and reviewed/amended annually. A thorough audit of implementation of the Coastal Zone Management Plan should be carried out after 5-10 years, if considered necessary.

Development of an Estuary Action Plan will enable modifications/alterations to the management of the estuary, on an as-needed basis, within the context of an adaptive management framework. The development and maintenance of the Estuary Action Plan should be facilitated through the GRCCC, taking into account relative priority of works across the seven LGAs, the rolling budget allocations for Councils and other responsible agencies, anticipated grants, and in-kind contributions.

The periodic reviews of the Action Plan and overall Coastal Zone Management Plan should cover the topics described generally in Table 8-2. This table also outlines who is responsible for conducting the periodic reviews.

It is recommended that the review of the Plan be co-ordinated through the GRCCC, as this Committee has the representation of all authorities and agencies responsible for implementation. The Committee should reach agreement to any modifications to the Plan before formally amending the document. Whilst modifications to the Estuary Action Plan would be relatively straightforward (providing it remains consistent with the overall objectives and principles of the Coastal Zone Management Plan), changes to the Coastal Zone Management Plan, if gazetted, can only be effected by another gazetted document. Therefore, any required amendments to the Plan would also need to be gazetted by the Councils, following Approval by the relevant Minister.

**Table 8-2 Framework for future review of the Georges River Estuary Coastal Zone Management Plan**

<b>Review Period</b>	<b>Review tasks</b>	<b>Responsibility</b>
<b>Annual – Estuary Action Plan</b>	<ul style="list-style-type: none"> <li>Assess primary, secondary and tertiary performance measures, and determine appropriate contingencies if performance measures do not meet targets</li> <li>Review funding arrangements and allocations for current and future management strategies</li> <li>Review resourcing and staffing allocations for current and future management strategies</li> <li>Provide report on progress of Coastal Zone Management Plan implementation, results of annual review, and any modifications required to the Plan coming out of the review</li> <li>Present and where possible, interpret all environmental monitoring / research undertaken through the River Health Monitoring Program</li> <li>Provide newsletter for posting on Council web sites, disseminated via email and other avenues to community and stakeholder contacts</li> </ul>	<p>GRCCC</p> <p>To be coordinated through relevant Council Officers and reported to Councils, relevant stakeholders and government agencies</p>
<b>5-10 Yearly - Coastal Zone Management Plan</b> <i>(first review to be commenced after 2017)</i>	<ul style="list-style-type: none"> <li>Consider appointing an external consultant to undertake review</li> <li>Review latest information to determine potential changes to the condition or understanding of the Estuary Processes;</li> <li>Determine changes to community values, issues and aspirations;</li> <li>Assess the consistency of the plan with contemporary government policies and plans;</li> <li>Assess the continuing relevance of the risks and objectives;</li> <li>Determine the appropriateness of the implementation plan to meet these objectives;</li> <li>For strategies requiring on-going commitment, assess the value in maintaining implementation of those strategies;</li> <li>Assess the overall effectiveness of each management strategy implemented to date;</li> <li>Reconsider the NBOs and Other Options;</li> <li>Update the Coastal Zone Management Plan document to reflect proposed strategies for implementation over the next 5-10 year period, and seek endorsement by stakeholders, government agencies and the community.</li> <li>Consider either completely revising the document or simply updating some aspects of the existing CZMP</li> </ul>	<p>GRCCC</p> <p>To be coordinated through relevant Council Officers and reported to Councils, relevant stakeholders, government agencies and the general community</p>



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## APPENDIX A: RELEVANT PLAN, POLICIES AND LEGISLATION

### Greater Metropolitan Regional Environmental Plan No 2—Georges River Catchment

The Georges River REP is now considered a SEPP. The general aims and objectives of the REP are:

- “(a) to maintain and improve the water quality and river flows of the Georges River and its tributaries and ensure that development is managed in a manner that is in keeping with the national, State, regional and local significance of the Catchment,
- (b) to protect and enhance the environmental quality of the Catchment for the benefit of all users through the management and use of the resources in the Catchment in an ecologically sustainable manner,
- (c) to ensure consistency with local environmental plans and also in the delivery of the principles of ecologically sustainable development in the assessment of development within the Catchment where there is potential to impact adversely on groundwater and on the water quality and river flows within the Georges River or its tributaries,
- (d) to establish a consistent and coordinated approach to environmental planning and assessment for land along the Georges River and its tributaries and to promote integrated catchment management policies and programs in the planning and management of the Catchment,
- (e) (Repealed)
- (f) to provide a mechanism that assists in achieving the water quality objectives and river flow objectives agreed under the Water Reform Package.”

The REP also contains specific aims and objectives, as follows:

- Environmental protection and water quality and river flows
  - (a) to preserve and protect and to encourage the restoration or rehabilitation of regionally significant sensitive natural environments such as wetlands (including mangroves, saltmarsh and seagrass areas), bushland and open space corridors within the Catchment, by identifying environmentally sensitive areas and providing for appropriate land use planning and development controls,
  - (b) to preserve, enhance and protect the freshwater and estuarine ecosystems within the Catchment by providing appropriate development,
  - (c) to ensure that development achieves the environmental objectives for the Catchment.
- Regional role and land use
  - (a) to identify land uses in the Catchment which have the potential to impact adversely on the water quality and river flows in the Georges River and its tributaries and to provide appropriate planning controls aimed at reducing adverse impacts on the water quality and river flows,

(b) to conserve, manage and improve the aquatic environment within the Catchment which is a significant resource base for the aquaculture industry, by providing controls aimed at reducing pollution entering the Catchment's watercourses,

(c) to protect the safety and well being of the local and regional community in accordance with standards and processes aimed at improving the water quality and river flows in the Catchment to enable recreation,

(d) to aid in the improvement of the environmental quality of Botany Bay in conjunction with other regional planning instruments.

#### **SEPP 44 – Koala Habitat Protection**

*State Environmental Planning Policy 44 – Koala Habitat Protection* aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of population decline. SEPP 44 requires that consent authorities must not issue a development approval without prior investigation of potential and core koala habitat.

This SEPP applies to the study area except for land dedicated or reserved under the *National Parks and Wildlife Act 1974* or to land dedicated under the *Forestry Act 1916* as a State forest or flora reserve.

#### **SEPP 62 – Sustainable Aquaculture**

This SEPP encourages the sustainable expansion of the aquaculture industry in NSW. The policy implements the regional strategies already developed by creating a simple approach to identify and categorise aquaculture development on the basis of its potential environmental impact. The SEPP also identifies aquaculture development as a designated development only where there are potential environmental risks.

#### **SEPP 71 – Coastal Protection**

This policy seeks to ensure that the development within the coastal zone is appropriate and suitably located and is consistent with the principles of ecologically sustainable development. Under this policy the Minister for Planning becomes the consent authority for state significant development, significant coastal development and development in sensitive coastal locations.

A Sensitive Coastal Location is described in the Policy as:

- a coastal Lake (as listed in Schedule 1)
- land within 100m above mean high water mark of the sea, a bay or an estuary
- land within 100m of the waters edge of a coastal lake, a declared Ramsar Wetland, a World Heritage property, an aquatic reserve, a marine park, a national park, a nature reserve, or a wetland subject to SEPP14
- residential land within 100m of land identified under SEPP26.

As the coastal zone (as defined in section 4A of the Coastal Protection Act 1979) now includes coastal areas between Wollongong and Port Stephens, SEPP-71 is applicable to the whole Georges



River Estuary up to Liverpool Weir, including all tidal tributaries, and will need to be considered during development of management options and during implementation, as appropriate.

### **SEPP (Major Development) 2005**

The SEPP provides for the Minister to be the approval authority for major development as identified within the SEPP and schedules, subject to Part 3A of the EP&A Act. Although Part 3A of the EP&A Act has been repealed, SEPP (Major Development) remain in place for the time being.

### **SEPP (Infrastructure) 2007**

SEPP (Infrastructure) 2007 was gazetted on the 1 January 2008 and was prepared to consolidate and update planning provisions relating to infrastructure and government land. The SEPP provides a consistent planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The intent of the SEPP is to support greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency for the State.

The SEPP:

- outlines planning processes for considering classes of public infrastructure and particular infrastructure projects
- exempts some minor public infrastructure from the need for an approval
- clarifies where new infrastructure can be located and provides for additional permissible uses on government land
- requires State agencies constructing infrastructure to consult local councils when a new infrastructure development is likely to affect existing local infrastructure or services.

Division 25 of the SEPP relates to waterway or foreshore management activities. Section 129 of the SEPP identifies development which is permitted without consent and includes development for the purposes of waterway or foreshore management activities, which may be carried out by or on behalf of a public authority without consent on any land. These activities include:

- construction works;
- routine maintenance works;
- emergency works, including works required as a result of flooding, storms or coastal erosion;
- environmental management works.

The clause also relates to development for the purpose of temporary works associated with drought relief which maybe be carried out by on behalf of a public authority without consent subject to certain criteria.

Some works proposed in this Coastal Zone Management Plan fall within the above categories, and as such, SEPP Infrastructure may be considered as a pathway for development consent for these works.

### **Environmental Planning and Assessment Act, 1979**

The *Environmental Planning and Assessment Act, 1979* (EPA Act) is the principle legislation that establishes the NSW planning framework, and was intended as a system of land use control. This is essentially the overarching document which determines land use and planning in the Georges River catchment. Those Parts of the EPA Act of particular relevance to the Georges River Estuary are outlined herein.

Part 3A of the EPA Act, was repealed in early 2011 and therefore no longer applies.

#### *Part 4 of the EPA Act – Development Assessment*

Part 4 applies to the standard lodgement and consideration process for development applications, where the local council is the consent authority. In this case, the Local Environment Plans (LEPs) determine the permissibility of the development, with controls for particular sites found in the LEP and any applicable development control plan (DCP). Part 4 applies to the majority of development on land within the Georges River Estuary catchment. Note that different LEPs apply to each LGA within the catchment.

Part 4 also stipulates the need for a Controlled Activity Approval (CAA) for works on 'Waterfront Land', in accordance with Part 3 of Chapter 3 of the *Water Management Act 2000* (WM Act). 'Waterfront Land' broadly refers to land within 40 m of the highest bank of a river, and equivalent location for lakes, estuaries and coastal waters. Activities for which a CAA is required include erection of buildings, removal of material or vegetation, deposition of material, and carrying out any other activity that affects the quantity or flow of water. A large amount of development along the Georges River may lie within 'Waterfront Land' as defined by the WM Act and will require a CAA, unless it can be shown to meet an exemption to the WM Act, as defined in Clause 39A of the *Water Management (General) Regulation 2004*.

#### *Part 5 of the EPA Act – Development by the Crown*

Part 5 of the EPA Act applies to those "activities" which do not require development consent under Part 4, but do require approval from a Minister or Public Authority, or are proposed to be carried out by a Minister or Public Authority.

### **NSW Coastal Protection Act 1979**

In 2002, amendments were made to the Coastal Protection Act 1979 that requires Coastal Zone Management Plans to be prepared for parts of the NSW coastal zone. Under provisions of the Act, Coastal Zone Management Plans are required to be approved by the Minister prior to being gazetted by Councils. In order to comply with the provisions of the Act, Coastal Zone Management Plans need to address the following matters before they would be approved by the Minister:

- a. protecting and preserving beach environments and beach amenity, and
- b. emergency actions of the kind that may be carried out under the *State Emergency and Rescue Management Act 1989*, or otherwise, during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event, and

- c. ensuring continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion.

Once published in the Government Gazette, a Coastal Zone Management Plan becomes a statutory instrument under NSW legislation. In accordance with Section 55L of the Coastal Protection Act, 1979, a breach of (e.g. failure to comply with) the Plan may result in the Minister or a council bringing proceedings in the Land and Environment Court to remedy or restrain the breach.

As this CZMP does not relate to open coastal waters, there is no requirement for specifying emergency actions following storm erosion events.

### **NSW Local Government Act 1993**

The *Local Government Act 1993* provides the legal framework for an effective, efficient, environmentally responsible and open system of local government in NSW. Council's charter is outlined by the Act and includes 'to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ecologically sustainable development'.

Under the provisions of the Act, Councils have numerous functions. Chapter 6 of the Act requires that all land vested in Councils must be classified as either Community or Operational land. Community land is land which should be kept for use by the general public (e.g. a public park). Councils must prepare Plans of Management to guide the use and management of Community land. Core objectives are defined in the Act for the management of different types of Community land. Plans of Management prepared for Community land within the study area should be generally consistent with the principles of this plan.

Under Chapter 13 of the Act, Councils are required to prepare Management Plans each year. The Management Plan details the Council's activities and budget for the next financial year. Subject to the competing demands and priorities, the various Councils relevant to the Georges River Estuary will identify funding for the implementation of various elements of the Coastal Zone Management Plan through the relevant program areas.

### **NSW Crown Lands Act 1989**

The Crown Lands Act is administered by the Crown Lands Division of the Department of Lands to provide for the administration and management of Crown land in the Eastern and Central Division of the State. Crown land shall not be occupied, used, sold, leased, licensed, dedicated or reserved or otherwise dealt with unless the occupation, use, sale, lease, licence, reservation or dedication or other dealing is authorised by this Act.

Crown Lands provides a property management service for the Department of Lands where they are the custodian of Crown land status information and administer Crown land held under lease, licence or permit under the Crown Lands Act. The Division also manages vacant Crown land, land retained in public ownership for environmental protection purposes and the lands of the Crown public roads network. Crown land is allocated for public uses, including schools, hospitals, sports grounds, community recreation and housing development. Crown reserves are managed in partnership with both councils and local community groups. The goal of Crown land management is to optimise environmental, economic and social outcomes for the benefit of the people of NSW.

Within the Georges River Estuary, the major part of the Crown estate includes the bed of the river and Botany Bay. Any activity that will impact on Crown land must be referred to the Crown Lands Division of the Department of Lands for assessment of impacts and the consideration of approval of the activity by way of appropriate authorisation subject also to any Environmental Planning requirements.

#### **NSW National Parks and Wildlife Act 1974**

The NP&W Act is administered by the Office of Environment and Heritage (OEH), and addresses the protection of Aboriginal items and certain native flora and fauna.

Under the NP&W Act it is an offence to harm threatened species; buy, sell or possess threatened species; damage critical habitat; or damage the habitat of a threatened species without the issuing of a Section 120 licence.

If any identified archaeological sites or remains need to be removed or destroyed, prior to commencement of works in the area, an approval is required from the OEH for a section 87 or 90 permit.

The Georges River Estuary study area could potentially contain a number of significant Aboriginal heritage sites. Conservation of key estuary areas may be supported by the protection of flora, fauna or Aboriginal heritage under this Act.

#### **NSW Fisheries Management Act 1997**

The FM Act has as part of its objectives the protection of fish stocks, key fish habitats and threatened species and their habitats. This Act also covers the sustainable management of commercial and recreational fishing and promotion of viable aquaculture in NSW. The management of aquatic reserves, including the Towra Point Aquatic Reserve, also falls under this Act.

Harm of aquatic habitats through dredging and reclamation, blockage of fish passage, harm of marine vegetation (seagrasses, mangroves, saltmarsh and algae) and the use of explosives is regulated under the FM Act. Permits are required to be obtained prior to undertaking such activities. Approval from DPI-Fisheries is also required for any development proposals that occur or could impact upon the Towra Point Aquatic Reserve.

*Posidonia australis* seagrass in Botany Bay has been listed as an Endangered Population under the FM Act. Developments affecting this and other threatened species listed under this Act are to be assessed for significant impact in accordance with the Act. Any proposed damage to marine vegetation (including seagrass and mangroves) requires approval and a permit to be obtained from DPI (Fisheries).

#### **NSW Threatened Species Conservation Act 1995**

If a proposed development is likely to significantly affect critical habitat of a threatened species, population or ecological community, or is within critical habitat, as defined by the Act, a Species Impact Statement (SIS) must be prepared. The test of significance is defined by an eight point test that is required for potentially affected threatened species under Section 5A of the Environmental Planning and Assessment Act 1979.



A licence under the Act is generally required for the harming or picking of listed threatened plants or animals.

The NSW Biobanking Offsets Scheme has been established under the provisions of the TSC Act. Biobanking enables 'biodiversity credits' to be generated by landowners who commit to enhance and protect biodiversity values on their land through a Biobanking agreement. These credits can then be sold, generating funds for the management of the site. Credits can be used to counterbalance (or offset) the impacts on biodiversity values that are likely to occur as a result of development. The credits can also be sold to those seeking to invest in conservation outcomes, including philanthropic organisations and government.

The TSC Act applies to the Georges River Coastal Zone Management Plan as many threatened species listed under the TSC Act are present in the study area. This Act will assist in implementing strategies to ensure habitat protection and conservation within the Georges River Estuary catchment. Also, Biobanking may provide an opportunity for conservation of existing valued lands within the catchment.

### **NSW Heritage Act 1977**

The Heritage Act 1977 protects heritage items, sites, and relics and is administered by the NSW Heritage Office. A relic is defined as any item relating to European settlement that is older than 50 years. Under Section 139 an excavation permit must be obtained from the NSW Heritage Office for the excavation or disturbance of a relic.

Estuary Management strategies must ensure they do not detrimentally impact on heritage items listed under this Act.

### **NSW Protection of the Environment Operations Act 1997**

The POEO Act lists activities requiring environmental protection licences from the OEH, and details pollution offences and penalties.

The Georges River Estuary and its tributaries are subject to scheduled activities (such as mines and industry), and other forms of pollution (commercial and recreational boats, industrial development, urban development etc) that are administered under the POEO Act. Improved compliance with licence requirements may be necessary.

### **NSW Noxious Weeds Act 1993**

The Noxious Weeds Act 1993 identifies noxious weeds and specifies control measures and duties of public and private landholders. The Act provides a framework for the state-wide control of noxious weeds by the Minister and local control authorities.

The Georges River Coastal Zone Management Plan can support the management of weeds through incorporating the management strategies contained within the Act for the categories of noxious weeds listed.

**NSW Water Management Act 2000**

A controlled activity approval is required for certain types of developments and activities that are carried out in or near a river, lake or estuary. Under the Water Management Act 2000 (WMA) a controlled activity means:

- the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979), or
- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or
- the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

The *WM Act* also governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced. The Water Act 1912 is being progressively phased out and replaced by the WMA but some provisions are still in force.

The provisions of the WM Act require a permit from OEH for:

- Any works on or adjacent to existing levees; and
- 'Flood works' within a declared floodplain.

This will need to be considered when assessing management strategies for the Georges River, and in particular, any floodplain management structures or controls proposed. Note that Councils are offered some special exceptions under the WM Act, and that specific advice should be sought if provisions of the WM Act are to be triggered by any proposed works or activities.

Exemptions from the WM Act are defined in Clause 39A of the Water Management (General) Regulation 2004 and include exemptions for government authorities, with the exception of Landcom.

**NSW Native Title Act 1994**

The Native Title Act 1994 focuses on continuity of links with an area. Where this can be demonstrated, Aborigines of local derivation and specific ancestry will have a case for making claims for land interest arising from it. Measures proposed in the Georges River Estuary Coastal Zone Management Plan on Crown land must be reviewed to determine if a Native Title Claim exists.

**NSW Coastal Policy 1997**

The NSW Coastal Policy responds to the fundamental challenge to provide for population growth and economic development without placing the natural, cultural, spiritual and heritage values of the coastal environment at risk. To achieve this, the Policy has a strong integrating philosophy based on the principles of ecologically sustainable development (ESD).

The Policy addresses a number of key coastal themes including:

- Population growth in terms of physical locations and absolute limits;
- Coastal water quality issues, especially in estuaries;
- Disturbance of acid sulfate soils;
- Establishing an adequate, comprehensive and representative system of reserves;
- Better integration of the range of government agencies and community organisations involved in coastal planning and management;
- Indigenous and European cultural heritage; and integration of the principles of ESD into coastal zone management and decision making.

The management of the coastal zone is the responsibility of a range of government agencies, local councils and the community. The Policy provides a framework for the balanced and coordinated management of the coast's unique physical, ecological, cultural and economic attributes.

The Georges River and its foreshores falls within the defined coastal zone, therefore the Coastal Policy needs to be considered in the preparation of the Georges River Estuary Coastal Zone Management Plan. Councils are required to implement the policy when making local environment plans applying to land within the coastal zone and to take the provisions of the policy into consideration when determining development applications in the coastal zone.

The Policy specifically recommends that detailed management plans for estuaries be prepared and implemented in accordance with the NSW Government's Estuary Management Manual (which has now been replaced by the Coastal Zone Management Plan Guidelines – refer Section 1.6).

### **NSW State Plan**

The NSW State Plan – Priority E4 'Better Environmental Outcomes for native vegetation, biodiversity and coastal waterways' and the Natural Resource Commission's Standards and Targets are important considerations for the management of the Georges River Estuary.

### **Planning for Bushfire Protection 2006**

Areas within the Georges River catchment were devastated by bushfire in 1997. All development on Bush Fire Prone Land must now satisfy the aim and objectives of Planning for Bushfire Protection (PBP). The aim of PBP is to use the NSW development assessment system to provide for the protection of human life (including firefighters) and to minimise impacts on property from the threat of bush fire, while having due regard to development potential, on-site amenity and protection of the environment. More specifically, the objectives are to:

- (i) afford occupants of any building adequate protection from exposure to a bush fire;
- (ii) provide for a defensible space to be located around buildings;
- (iii) provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- (iv) ensure that safe operational access and egress for emergency service personnel and residents is available;

(v) provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the asset protection zone (APZ); and

(vi) ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bush fire fighting).

#### **Commonwealth Environmental Protection and Biodiversity Conservation Act 1999**

The EPBC Act requires approval by the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land.

The EPBC Act defines matters of national environmental significance as Ramsar wetlands, listed threatened species and communities, World Heritage properties, listed migratory species, the Commonwealth marine environment and nuclear actions (including uranium mining).

The Towra Point Wetlands Ramsar site is protected under this Act.

Protection measures contained in this Act should be incorporated into management strategies of the Coastal Zone Management Plan to reinforce its implementation.



## APPENDIX B: COMMUNITY FORUM AND FEEDBACK FROM THE ON-LINE SURVEY

A community forum was held on 24 May 2011. This was designed to provide the general community with an overview of the Georges River CZMP development process and timing as well as to seek their input on the aims, objectives, management options and actions suggested by the Estuary Management Committee for the Plan. This Forum included:

- A background presentation giving an overview of the Plan process and timing as well as outlining basic issues identified for the Georges River Estuary in the Processes study;
- An overview of the EMC ideas on the following topics followed by a facilitated discussions:
  - What are we trying to achieve?
  - How are we trying to achieve this?
  - What management tools are available to us?
- An opportunity for more general feedback on the planning process or other issues relevant to the Georges River Estuary Coastal Zone Management Plan.

A feedback survey was also distributed during the forum and collected back at the end of the night covering each of these topics. This was complemented by an online survey covering the same topics for those not present on the night. For each of the questions above, people were asked to score the suggestions in terms of their importance. The following scoring system was used:

1	2	3	4	5
Not at all	Small importance	Moderate importance	Major importance	Extremely important

From this scoring, a relative score and rank for each item has been produced. Note that this score and rank is based on feedback from both the on-line survey and the community forum.

This document summarises feedback and priorities derived from the community forum and on-line survey. While discussions have been summarised under the heading where they occurred, there was significant overlap between discussions and in some cases, for example, people were describing 'how' to achieve things rather than 'what' they were trying to achieve.

### What are we trying to achieve?

The list of aims was presented (with simplified language in some cases) to community members. Comments on these were as follows:

- We should be trying to achieve consistency between Councils following the same environmental practices and enforcing the same environmental controls. In particular there needs to be more consistency between different Council environmental plans.
- Siltation in Salt Pan creek was seen as being caused from infrastructure such as a bridge. This was seen to imply a need for stricter environmental controls as well as a desire for more accountability and feedback to the community on their input to infrastructure projects.

- There needs to be more enforcement of development controls and associated impacts.
- We should aim to improve people's appreciation and understanding of the value of the estuary through education.
- We need more instant monitoring and feedback.
- We need to deal with upstream areas, sewerage plants etc.
- We should be providing cheaper access to less damaging ways of using and viewing the estuary e.g. row boats.
- 'Managing large catchment areas using infiltration strategies such as those applied to the Portland Oregon'.
- 'Catchment area. Many small solutions, less big ones like GPT's (although they greatly assist)'.
- 'Need to increase fines for polluters - can the current legislation be topped up with additional fines imposed by local councils?'
- 'Where a bridge has been built like Salt Pan Creek, the back fill should be removed after completion. That way the water flow and tidal flow will get back to near normal. The mangroves should then be removed.'
- 'Not sure if "water quality" includes floating rubbish/debris. That's one of my main irritations, partly because it is so visible & seems relatively simple to solve: Gross pollutant traps at all stormwater outfalls. And while planning & installing them, make them include sediment traps. Surely a relatively infrequent "lift-out & clear" by a crane truck or barge would keep them serviceable. I don't know who's monitoring sedimentation of the riverbeds, but in only the 20 years I've lived on the river I've seen some worrying loss of river depths. I assume urban runoff is a much greater contributor than shoreline erosion because there seems a lot more loss of depth than accountable by erosion alone. After Woronora Heights was subdivided & levelled to raw exposed earth, my brother's previously deep waterfrontage on Woronora could be waded from one side to the other. Hurstville/Kogarah council area redevelopments are much smaller scale, but I fear all those token, ineffectual & unmaintained "sausage sandbags" in gutters outside every new demolition are still allowing incremental sedimentation of the river.'
- 'Public access for walkers and to an extent mountain bikes is important as they deter and bring political pressure to bear on the 4wd and trail bikes which are major destroyers of natural vegetation and hence a major erosive vector that something needs to be done about in the Menai-Sandy Point area.'
- 'Having been involved in many of the river health surveys I believe that the great majority of the general public just don't care or have little understanding of how they impact on the environment. I think that public education and including environmental studies in the school curriculum is the key to protecting our already damaged back yard'.
- 'I think you are doomed to fail with an integrated MER. It's been tried many times and failed. It's expensive, and the Councils and agencies never follow through on actions. Until there is sufficient base funding to drive a trajectory of improvement, you will never get good integrated monitoring or action based on monitoring.'
- 'It would be good to see how you plan to measure these outcomes. These are of such a scale that you couldn't object to them'

As described above, people were also asked to give a score of 1 to 5 for each of these aims, based on how important they perceived them to be. The relative score and rank of each aim is given below.

Aim	Score (out of 5)	Rank
Aquatic habitats and foreshore vegetation protected, enhanced and restored	4.6	1
Optimum water quality in the Georges River Estuary and its tributaries	4.6	2
Negative impacts of development in the catchment on waterway health minimised	4.5	3
Coordinated monitoring, reporting and evaluation programs for the Georges river estuary developed and supported	4.1	4
Bank erosion and sedimentation actively managed	4.1	5
Natural and cultural heritage identified, acknowledged and protected	4.0	6
Existing built foreshore assets managed while maximising environmental values	3.8	7
Potential impacts of climate change on the natural and built environments of the estuary planned for and adapted to	3.4	8
Public access to the foreshore protected and enhanced	3.4	9

People were also asked if any of the aims should be removed from the Plan. Very few people suggested removing aims entirely but 3 aims were nominated by at least one person to be removed from the Plan. These were:

- Public access to the foreshore protected and enhanced (2 votes)
- Bank erosion and sedimentation actively managed (1 vote)
- Existing built foreshore assets managed while maximising environmental values(1 vote).

For the first and third of these, this also confirms the low ranking given to these aims by others responding to the survey.

People were asked to nominate additional aims for the Plan to attempt to achieve. Suggestions from the surveys were as follows:

- Public education
- Salt marsh re-established wherever possible.
- Development of natural asset management plans
- Minimise gross pollutants entering the estuary
- Policing of waterway, anglers etc
- Policing of urban runoff e.g. washing of cars on street and industrial runoff
- Greater accountability to estuarine management in all development
- Greater emphasis on impacts of waterway uses and encourage low impact uses
- Regional control of local planning
- Manage compromise between recreation use and environmental values

- Improve appreciation and understanding of the value of estuaries
- Education of community re value of/preservation of the health of the waterway
- Coordination of Councils' POMs/goals etc LEPs
- Proper management of recreational and commercial boating
- Consistency amongst local government environment plans
- Cooperative management of catchments involving drainage lines into the Georges River
- Stormwater management
- Better feedback to the community on infrastructure projects, accountability, environmental controls

### **How are we trying to achieve this?**

A simplified list of objectives was presented. This list combined objectives in some cases and reduced the length of descriptions of the objectives in order to make it tractable for a community workshop of a relatively short duration. Comments from the forum and on-line survey on these objectives were as follows:

- We need to collect of pollution from stormwater drains. The flow regime of stormwater needs to be changed. We should be adopting the principles of WSUD.
- We need a reference library for documents. Eg HCC foreshore scenic protection audit 1998-2000. It was suggested by some present that that already exists but perhaps doesn't cover older documents.
- Objectives should be amalgamated where possible – seems to be some double up.
- Councils and State significant projects should adhere to foreshore setbacks. Councils agree to the rules and should be legislation so everyone is forced not to modify the rules.
- We should be aiming to eliminate sewerage overflows. We need to make sure that nothing from STPs goes into the river. How many overflow points are there?
- The wording of all the objectives should be strengthened. At present it is a bit soft (e.g. 'minimise' should be 'eliminate'). We should aim to preserve what we have.
- We should encourage human interaction and education e.g. festivals and activities such as the Cooks River sustainability festival. These should not just be environmentally focused but also highlight the heritage of the river and catchment. Councils etc should be putting in floats and education displays, linking with NGOs etc to deal with cultural issues.
- We need to think about what we do with sediments removed from systems (either captured or dredged – e.g. artificial wetlands, dredging). We need a long-term planning process for these. There needs to be more coordination by State Government.
- We need to think more about governance and funding –are there better arrangements?
- Access to foreshore areas needs to be improved where private owners are restricting access to the public. Some suggested this was being addressed by an IPART review.
- We need to work with the education system. This needs to be done by a central body (such as the GRCCC or HNCMA) not single councils. They should provide tools to teachers, play a



coordinating role and put these in a central location. This should be targeted at groups such as the scouts not just at schools.

- We should be raising the profile of rivers in planning initiatives.
- "I didn't realise there are so many concerns. All I was worried about was gross pollutant traps, and sedimentation. Now I'm more worried because I see how many ways any resource \$\$\$ are going to have to split to satisfy everybody."
- "Lime Kiln Bay - as the most polluted waterway in the Georges River - really needs help. When the ponds were first built, there was a flurry of new bird life such as Spoonbills and herons. These have long since abandoned the ponds and have vanished. The Gross pollutant trap always overflows with anything greater than moderate rainfall. As a daily visitor, it is distressing to see the degradation. I suspect that there is illegal industrial discharge from the Peakhurst Heights industrial area.
- "Please help this once pleasant waterway - where people used to picnic and enjoy the area."

People were also asked to provide a score (1 to 5) rating the relative importance of the presented objectives. The average score across both forum and on-line survey participants is given below along with the count of people who suggested removing the objective from the Plan.

Objective	Average score	Rank	Remove
Striving to protect undeveloped areas of the broader catchment that act as a buffer to water quality	4.7	1	0
Reducing the volume and pollutant load of stormwater runoff throughout the catchment	4.7	2	0
Limiting the negative impact of all developments on flow and water quality	4.6	3	1
Minimising the negative impacts of new and existing commercial operations in the catchment and estuary on flow and water quality	4.6	4	1
Ensuring appropriate measures are taken and maintained to reduce the erosion and associated pollutant exports from areas under development	4.6	5	1
Enforcing compliance on unauthorised foreshore development across the estuary	4.5	6	0
Minimising incidences of illegal dumping of waste into and along the estuary	4.4	7	0
Protecting and improving the extent and condition of estuarine and riparian vegetation	4.4	7	0
Improving the overflow sewer performance of the sewer network	4.4	9	0
Incorporating best practice environmental management in all foreshore developments	4.4	10	1
Ensuring integration of the Georges River Estuary Coastal Zone Management Plan aims and objectives into strategic planning initiatives and developments	4.3	11	0
Monitoring the effectiveness of the plans objectives and management actions	4.3	12	1

Objective	Average score	Rank	Remove
Minimising the cause and spread of invasive species in aquatic and terrestrial habitats	4.3	13	1
Increasing enforcement of restrictions on illegal recreational uses that impact on estuary health	4.3	14	0
Reducing the causes and impacts of sedimentation in the estuary	4.2	15	0
Minimising the negative impact of commercial and private activities on catchment waterways	4.2	16	2
Minimising the impact of human uses on aquatic and terrestrial habitats	4.1	17	2
Reducing the extent and severity of bank and foreshore erosion while minimising the impacts on estuary health	4.1	17	0
Reducing the impacts of commercial and recreational uses on the waterways and aquatic and terrestrial habitat	4.0	19	2
Ensuring development minimises impacts on aesthetic and social values	4.0	19	2
Building on the existing GRCCC coordinated estuary health monitoring of the Georges River to ensure compliance with the NSW Monitoring, Evaluation and Reporting Program	4.0	21	2
Effectively managing threats to and enhancing the natural and cultural heritage values in the catchment and waterways	3.9	22	1
Protecting public foreshore areas required for potential retreat of estuarine vegetation in response to sea level rise from development or infrastructure	3.8	23	1
Maintaining the varied legal recreational pursuits of the Georges River catchment without compromising estuary health and social amenity	3.7	24	2
Incorporating the principles of the environmentally friendly seawall guidelines into all seawalls being built in the estuary (within legislative constraints)	3.6	25	3
Rebuilding seawalls to incorporate the principles of the environmentally friendly seawall guidelines	3.6	26	2
Maintaining and improving formal public access to the foreshore without compromising estuary health	3.6	27	0
Planning for and adapting where possible to manage impacts on foreshore infrastructure resulting from an increase in tidal inundation associated with sea level rise	3.5	28	1

The scores of the top options are very close. These options largely relate to improving water quality or protecting undeveloped areas of the catchment.

People were also asked to nominate any additional objectives they felt should be included in the Plan. Suggestions are below:

- Stormwater pollution management
- School curriculum resources
- Community strategies - Cooks river initiative, Festivals

- More pervious areas in developments - principles of WSUD written and to be adhered to in building developments
- Councils' compliance enforced/coordination enforced
- Collection of pollution from stormwater drains
- Prepare units of work for primary schools/training teachers in how to use these units of work
- Flow regime of stormwater
- STPs need to make sure none goes into river
- Stencilled labels on stormwater drains leading to creeks and rivers
- Replanting mangroves and riparian zones
- Use stronger words than minimising in the Plan
- Stop all sewer overflow into River
- Stop illegal industrial discharge into stormwater system
- Improve public access to foreshore area - more walkways and bike paths
- Coordination of planning and management between Councils
- Support community groups to contribute from the ground up
- Foster and support community participation.

#### **What management tools are available to us?**

Management Options suggested by the Estuary Management Committee were simplified and grouped together to create a list of management tools to present to the community for feedback. General comments on these from the community forum and online survey were as follows:

- We should foster amalgamation of community groups to encourage coordination of activities and lobbying eg. Cooks River Valley Association, Cooks River Sustainability Initiative.
- Common rules should be developed for all Councils to adhere to with regard to development.
- There were some questions about whether the management tools were appropriate and whether some of them might not be aims and objectives.
- It was suggested that foreshore areas should be videotaped. Alison Hanlon (GRCCC) said this was already done, for example in Sutherland.
- Inappropriate infrastructure needs renewal. For example there are GPTs that need replacing, such as the boom litter trap adjacent to Gow's creek (Bankstown) and old GPTs in Salt Pan creek.
- Some of the other GPTs need to be maintained and cleaned out.
- We need to recognise the challenges of funding maintenance etc for WSUD. We could be using prisoner release programs or work for the dole teams to clean out systems such as pollutant traps and to undertake bush regeneration.
- We need to find ways to get the private sector to pay for infrastructure.

- We should establish consistent or common foreshore building lines and adhere to these. These need to be addressed in LEPs not DCPs.
- We need to undertake community capacity building e.g. Cook River Sustainability Initiative.
- We should develop green belt corridors on private property – have more grants for private landholders and information on the best design of vegetation.
- We should expand saltmarsh and seagrass areas.
- Where vegetation clearing is undertaken for views, signs should be installed to block the view until the vegetation grows back, there should be increased fines and enforcement. This clearing should be followed up as much as possible and signs installed as a deterrent.
- Some said we should be looking to protect ‘all’ public foreshores areas rather than ‘key’ areas from major infrastructure. Others said this should instead be ‘sensitive’.
- Rubbish gets caught in environmentally friendly seawalls.
- Lime Kiln Bay should be a focus for WSUD given it got an F for water quality from the creek.
- Specific projects people suggested were:
  - Claydon Reserve Kogarah Bay – GPT with big holes in it next to the boat ramp at the head of Kogarah Bay.
  - Botany Bay water reclamation project – electrical cables and chlorine stored in close proximity to the Bay, subject to flood risk.
  - Pipe from Depot rd from an industrial area into golf course, Lime Kiln Bay without any treatment.
  - Georges river National Park seawalls collapsing/eroding – upstream of Alfred’s point bridge, Cattle Duffers Flat.
  - Sewer outlet northern side of Boulton Park, Concert Bay.
  - Shark’s development Woollooware Bay – proposal is 30m from foreshore and would have negative effects
  - Cook Park along Botany Bay at Brighton – proposal for a major development here, not completely abandoned (Rockdale Council).
  - Sewerage overflow pipes onto beach, stormwater outlet near restaurant causing erosion.
  - Eastern arm upstream of footbridge in Lime Kiln Bay – restore tidal prism by removing reclamation.
- ‘Get National Parks to consult with the users before they make anymore dumb changes to the boat ramp and parking areas’
- ‘I am a boat user, large and small, so you might assume all my responses would be pro-boating. In one case that’s correct: I believe the impact of boat anchoring is negligible and irrelevant, although I do not like to see a seagrass bed gouged by anchoring or shallow-water grounding of boats, and I think a heap more public moorings in the few popular places would make everyone happy. I do not have a predictable pro-boating stance when it comes to speed limits and boat wakes. I believe tighter controls on this would benefit all including fellow boaters annoyed by unpleasant and even dangerous boat wash, not to mention shore erosion plus damage to



shoreline infrastructure and berthed vessels etc. There is much debate in boating magazines to enforce reduced wash everywhere. Many of us would be happy for a 4 knot speed limit for any vessel over say 9m length (exclude catamarans: hardly any wash. No, I don't own one), to be enforced everywhere upriver from say Tom Ugly's Bridge. Oatley Bay (where I live) it's a joke that the speed is 8 knots: for most boats the absolute worst speed for causing maximum wash. And hardly any boater (even Roads and Maritime Services vessels!) seems to understand what "NO Wash" means. I'd like a dollar for every surfable whitewash I could "Hang Ten" on down the length of Oatley Bay. And we wonder why Oatley Bay's shoreline has all washed into the Bay and will need dredging again? No point building the nice boat ramp & parking if boats won't be able to get out through the Bay.'

- 'The Cook's River groups have done some fantastic work. The Cook's River is readily accessible because of the bike path and walking track that goes along the river. This makes the river much more accessible and visible. How fantastic it would be if the bike path from Cook's River, along Botany Bay was then extended out along the Georges River. I appreciate the Georges River is not as accessible in all places, but much of it could be! This would help people become more engaged with the Georges River.'
- 'Protect the upper catchment - fencing, exclusion of humans etc'
- 'If a structure is deemed unauthorised and inappropriate what would it need to comply with?'

People were asked to provide a score (1 to 5) rating the relative importance of the presented management tools. The average score across both forum and on-line survey participants is given below along with the count of people who suggested removing the objective from the Plan.

Management tool	Rank	Average score	Remove
Reduce unauthorised riparian and estuarine vegetation clearing	1	4.6	0
Protection of native vegetation and uncleared areas	2	4.6	0
Enforcing effective sediment controls during development	3	4.5	0
Better control point sources of pollution	4	4.5	0
Rehabilitation, habitat creation and revegetation programs	5	4.4	0
Water sensitive urban design in new and existing urban areas – for example rain gardens, vegetated swales, artificial wetlands, gross pollutant traps	6	4.4	0
Protect key public foreshore areas from development or infrastructure	6	4.4	0
Establish foreshore building lines for all developments to protect riparian vegetation and manage flooding and erosion risks	8	4.3	0
Fix problem sewers	9	4.2	0
Review and/or better enforce speed limits where bank erosion is an issue and boat wake a likely cause	10	4.1	1
Maintain compliance on unauthorised or inappropriate foreshore structures and uses	10	4.1	2
Enforce strict environmental controls on any approved dredging for public navigation channels	12	4.1	0
GRCCC's Riverkeeper Program	13	4.1	0

Management tool	Rank	Average score	Remove
Weed, pest and disease control programs	14	4.0	0
Manage access to the estuary and foreshore – enhanced in appropriate locations and restricted in sensitive areas, controlling ad hoc access	15	4.0	0
Education and/or information programs	16	3.9	0
Manage seawalls to control erosion eg. building environmentally friendly seawalls where necessary to control erosion, modifying seawalls to increase their habitat value or removing them where appropriate	17	3.9	0
Ensure identified heritage sites are adequately protected	18	3.9	0
Minimise the impact of moorings on seagrasses	19	3.9	0
Support industries to develop their own environmental management systems	19	3.9	0
Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites	21	3.8	1
Using scientific modelling, mapping and monitoring to better understand problems and evaluate potential solutions	22	3.8	0
Increased community involvement in the design of solutions	23	3.7	0
Ensure adequate waste disposal facilities for people aboard boats and recreational fishers on land	24	3.7	0
Organise community events to improve the recreational amenity of key foreshore areas (eg. clean-up days)	25	3.7	0
Manage foreshore infrastructure with likely tidal inundation risk to allow adaptation to sea level rise	25	3.7	0
Adequately consider social and aesthetic values in the review and preparation of new Development Control Plans (DCPs)	27	3.7	0
Abandon, demolish, relocate or protect assets as appropriate in actively eroding areas	28	3.6	0

The highest ranked options all had very similar scores and related to protecting vegetation and enforcement of controls on pollution (both point sources and from developments). Very few people suggested removing any of the Management tools – the highest vote was by two people to remove the management tool relating to maintaining compliance with unauthorised or inappropriate foreshore structures.

- People were also asked to nominate any management tools they felt were missing from the list. Their suggestions were as follows:
- Identify infrastructure having an adverse impact and remove
- Identify opportunities to extend seagrass and saltmarsh area
- Clarify between an objective and a tactical/operational tool

### General feedback

People were also asked to provide general feedback on any other issues they thought relevant to the Coastal Zone Management Plan. Several comments were received from those participating in the on-line survey:

- 'There has been considerable reduction in the amount of stormwater debris flowing into Kogarah Bay from the myriad of small stormwater pipes but the debris catching nets need to be maintained.'
- 'I'm really grateful and a little bit reassured that this forum is created and supported. It's a great initiative. I believe a lot could be achieved, even with very limited resources. 3 cheers to Hurstville Council and anyone else involved & responsible.'
- 'As a waterfront resident, one of my biggest problems is dealing with debris washed up at king tides, or after heavy rain, eg, parts of poles, old jetty pieces, large branches from palms. This is apart from the usual rubbish that comes ashore from boats, which seems to be getting less.'
- 'I have been the site coordinator for the Banksia Creek Clean up Australia Day since the beginning of the campaign. The council is very active with the lead up and clean up arrangements but for the remainder of the year the activity is very poor. There are no pollutant traps in Salt Pan Creek where much of this rubbish comes from and storm water management is very poor. Alligator weed control on the foreshore is very poor even though this is a noxious weed. Control of weeds generally is non-existent.'

## APPENDIX C: PRIORITISATION OF ESTUARY MANAGEMENT AIMS AND OBJECTIVES

### Ranking of Management Aims

A risk assessment method was used to rank the Management Aims. Information and feedback from the EMC workshops was used to evaluate risks as they relate to the nine agreed aims of the Coastal Zone Management Plan, as well as the resulting Management Objectives (which are described further in Section 4.2).

Quantitative feedback on each aim was elicited from workshop participants, as follows:

*A. How big is the threat to the estuary addressed by this aim?* The ratings scale you should use for this question is below.

1	2	3	4	5
Insignificant	Minor	Moderate	Major	Catastrophic

*B. How likely is it that the threat would be realised if we don't take actions through this estuary management plan to address it?* The rating scale you should use for this question is below.

1	2	3	4	5
Rare	Unlikely	Possible	Likely	Almost certain

The feedback from workshop participants was used to construct a risk assessment as follows. As per standard risk assessment methodologies, the risk is a product of the 'consequence' (Question A) and 'likelihood' (Question B), viz:

$$R_x = C_x \times L_x$$

Where:

$R_x$  is the risk to the Georges River Estuary;

$C_x$  is the *consequence* if that threat is realised for aim x (averaged for all responses to Question A above); and

$L_x$  is the *likelihood* of the threat being realised for aim x (averaged for all responses to Question B above).

This risk was used to classify, or rank, each of the Aims, based on the risk matrix presented in Figure 9-1. Within this matrix, risks have been separated into "intolerable", "tolerable" and "acceptable" risks. Broadly, "intolerable" risks are those that must be addressed as a matter of priority, while "tolerable" risks are still considered unacceptable, but secondary to intolerable risks. The goal of the



Coastal Zone Management Plan should be to reduce intolerable and tolerable risks down to an acceptable risk level.

For risks associated with the Aims of the Georges River Estuary Coastal Zone Management Plan, the risk assessment processes yielded five intolerable risks (Aims A, B, D, E and H), and four tolerable risks (Aims C, F, G and I) (refer Figure 9-2). None of the risks were considered to be acceptable.

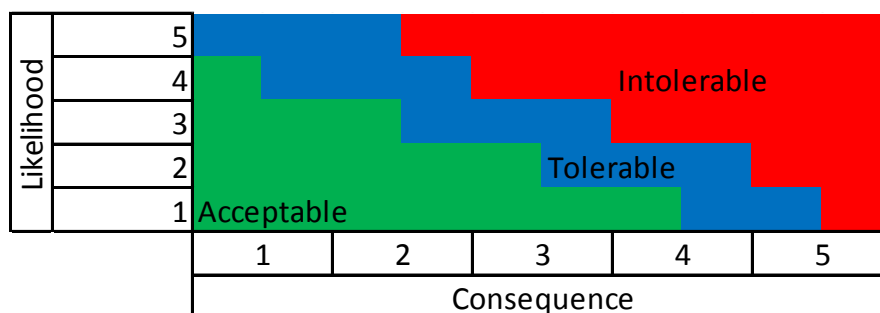


Figure 9-1 Risk Level Matrix

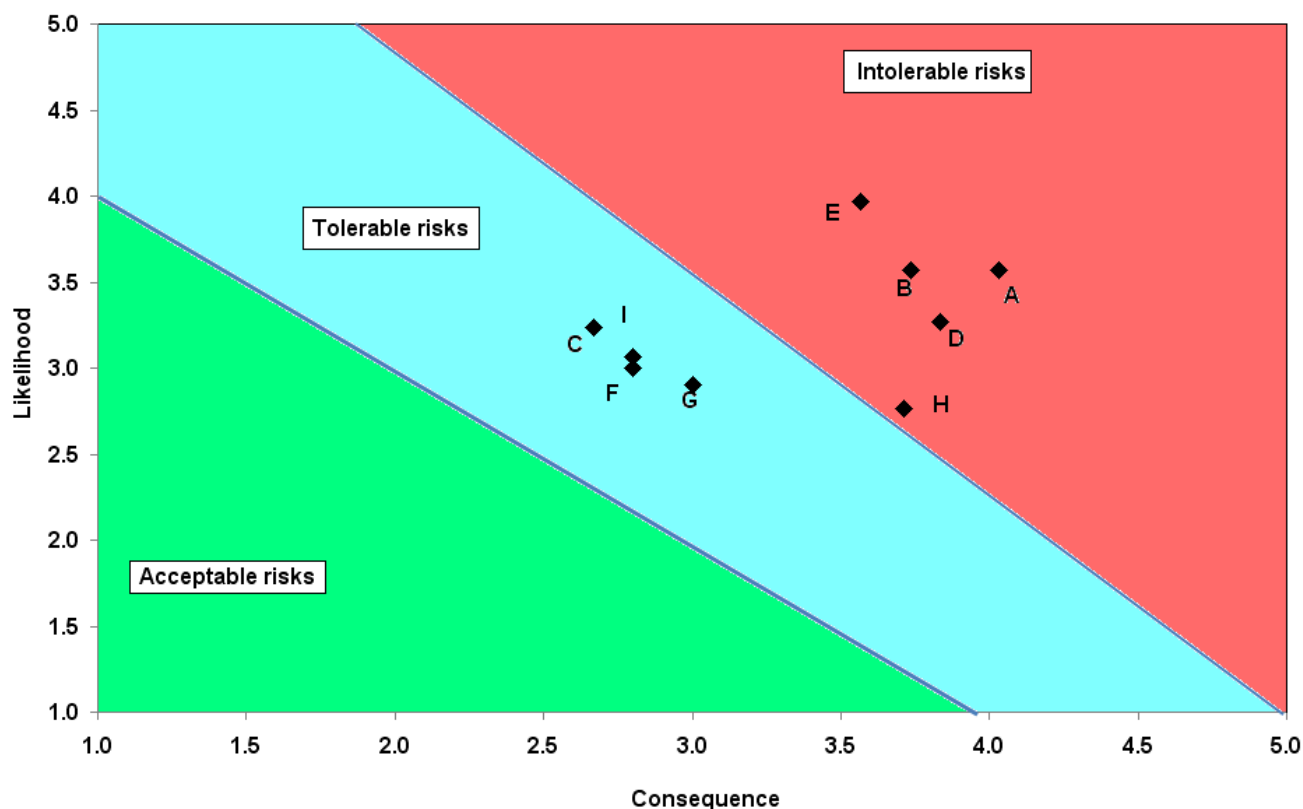


Figure 9-2 Risk chart and categorisation of Aims based on likelihood and consequence

The individual risk scores were also used to rank aims in order of priority. The rank, consequence, likelihood and total risk score for each aim is given in Table 9-1. Also presented in Table 9-1 is the relative ranking of Aims as established at the Community Forum. As can be seen, the community rank was similar to the EMC ranking, with a couple of exceptions. The community did not rank 'H –

climate change impacts' as high as the EMC, and instead ranked 'I – monitoring' notably higher than the EMC.

**Table 9-1 Results of Risk Assessment and Ranking of Aims**

Aim	Consequence	Likelihood	Risk Score	Rank	Comm. Rank	Risk category
<b>A</b> To optimise water quality within the Georges River Estuary and its tributaries	4.0	3.6	14.4	1	2	Intolerable
<b>E</b> To actively manage bank erosion and sedimentation	3.6	4.0	14.1	2	5	Intolerable
<b>B</b> To protect, enhance and restore aquatic habitats and foreshore vegetation	3.7	3.6	13.3	3	1	Intolerable
<b>D</b> To minimise the negative impacts of development in the catchment on waterway health	3.8	3.3	12.5	4	3	Intolerable
<b>H</b> To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary	3.7	2.8	10.3	5	8	Intolerable
<b>G</b> To identify, acknowledge and protect natural and cultural heritage	3.0	2.9	8.7	6	6	Tolerable
<b>C</b> To protect and enhance public access to the foreshore	2.7	3.2	8.6	7	9	Tolerable
<b>I</b> To develop and support coordinated monitoring, reporting and evaluation programs for the Georges river estuary	2.8	3.1	8.6	8	4	Tolerable
<b>F</b> To manage existing built foreshore assets while maximising environmental values	2.8	3.0	8.4	9	7	Tolerable

### **Ranking of Management Objectives**

Management Objectives have been ranged to assist with prioritisation of tasks and actions identified within this Plan. Ranking of Objectives allows the most critical issues facing the estuary to be addressed as a matter of priority.

Ranking of the Management Objectives followed a similar process to ranking of the overarching Management Aims, that is, by considering the extent to which Management Objectives could be expected to decrease the quantified risks associated with Management Aims. Again, quantification used in this estimate was derived from feedback from participants at the EMC workshops. In this regard, another question was asked of each participant relating to each Management Objective, namely:

*C. To what extent will achieving this objective resolve the threat addressed by the aim?* The ratings scale you should use for this question is below.

1	2	3	4	5
Not at all	A small contribution	A moderate contribution	A major contribution	Threat fully or almost fully addressed

The relative importance of objectives has been assessed using a risk reduction potential for the objective. This potential,  $P_i$ , is calculated as:

$$P_i = O_{x,i} \times R_x$$

Where:

$O_{x,i}$  is the extent to which objective  $i$  is expected to resolve the threats associated with Aim  $x$  (averaged for all responses to Question C above) (note, within the calculation, this score is converted to a percentage whereby a value of 5 = 100% contribution, and 1 = 0% contribution); and

$R_x$  is the risk score (calculated previously) for aim  $x$ .

Objectives were ranked, from 1 to 27, and were also grouped based on priority: the top 10 ranked objectives are 'high' priority; the next 9 are 'medium' priority; and the lowest 9 objectives are 'low' priority. The results of the ranking process for the Management Objectives are presented in Table 9-2. In addition, and for comparative purposes, Table 9-2 shows the relative scores given to each Management Objective by the community when asked about the importance of each Management Objective. In general, there was good consistency between the relative importance scores given by the community, and those given by the EMC (i.e.  $O_{x,i}$ ). It should be noted that the wording of the survey question asked of the general community was slightly different, so it is not appropriate to directly compare the two scores. Comparison of the rank of options provided by each score is, however, reasonable.

Clearly, Management Objectives that aim to address the highest priority (intolerable) aims, tend to be ranked highest (high priority), while those that address the lowest priority aims are ranked lowest (low priority).

By achieving the highest priority Management Objectives, the estuary will take the greatest steps towards its fundamental goal of improving overall ecosystem health. Management Options, as discussed in Section 5, therefore, are targeted towards achieving the highest priority Management Objectives.

**Table 9-2 Results of Ranking and Prioritisation of Management Objectives**

No.	Objective	Comm. Score (av.)	Average score (O <sub>xi</sub> )	Risk reduction potential (P <sub>i</sub> )	Overall rank	Classification
<b>Aim A: To optimise water quality within the Georges River Estuary and its tributaries</b>						
A1	To reduce the volume and pollutant load of stormwater runoff throughout the catchment	4.7	4.2	11.4	1	High
A2	All greenfield and redevelopments should have a minimal negative impact on flow and water quality, meeting targets for water quality proposed in the Botany Bay and Catchment WQIP	4.6	3.8	10.0	3	High
A3	Improve the performance of sewer overflows	4.4	3.9	10.3	2	High
A4	Minimise incidences of illegal dumping of waste into and along the estuary	4.4	3.4	8.5	7	High
A5	Strive to protect undeveloped areas of the broader catchment that act as a buffer to water quality	4.7	3.5	9.2	4	High
A6	To minimise the negative impacts of new and existing commercial operations in the catchment and estuary on flow and water quality	4.6	3.5	9.0	5	High
<b>Aim B: To protect, enhance and restore aquatic habitats and foreshore vegetation</b>						
B1	To minimise the impact of human uses on aquatic and terrestrial habitats	4.1	3.3	7.6	11	Medium
B2	To minimise the cause and spread of invasive species in aquatic and terrestrial habitats	4.3	3.4	8.0	10	High
B3	To protect and improve the extent and condition of estuarine and riparian vegetation	4.4	3.5	8.5	9	High
<b>Aim C: To protect and enhance public access to the foreshore</b>						
C1	To maintain the varied legal recreational pursuits of the Georges River catchment without compromising estuary health and social amenity	3.7	3.1	4.5	26	Low



No.	Objective	Comm. Score (av.)	Average score (O <sub>xi</sub> )	Risk reduction potential (P <sub>i</sub> )	Overall rank	Classification
C2	To reduce the impacts of commercial and recreational uses on the waterways and aquatic and terrestrial habitat	4.0	3.4	5.1	21	Low
C3	To maintain and improve formal public access to the foreshore without compromising estuary health	3.5	3.3	4.9	23	Low
C4	Increase enforcement of restrictions on illegal recreational uses that impact on estuary health	4.3	3.3	4.9	25	Low
<b>Aim D: To minimise the negative impacts of development in the catchment on waterway health</b>						
D1	To ensure appropriate measures are taken and maintained to reduce the erosion and associated pollutant exports from areas under development	4.6	3.4	7.4	13	Medium
D2	To ensure integration of the Georges River Estuary Coastal Zone Management Plan aims and objectives into strategic planning initiatives and developments	4.3	3.4	7.5	12	Medium
D3	To minimise the negative impact of commercial and private activities on catchment waterways	4.2	3.0	6.1	15	Medium
<b>Aim E: To actively manage bank erosion and sedimentation</b>						
E1	To reduce the extent and severity of bank and foreshore erosion while minimising the impacts on estuary health	4.1	3.5	8.7	6	High
E2	To reduce the causes and impacts of sedimentation in the estuary	4.2	3.4	8.5	8	High
<b>Aim F: To manage existing built foreshore assets while maximising environmental values</b>						
F1	All new seawalls and repairs to existing seawalls throughout the estuary to incorporate the principles of the environmentally friendly seawall guidelines within legislative constraints	3.6	3.5	5.3	19	Medium
F2	Not used					
F3	All foreshore developments to incorporate best practice environmental management	4.4	3.5	5.1	20	Low
F4	Compliance on unauthorised foreshore development across the estuary is enforced	4.5	3.8	5.8	17	Medium

No.	Objective	Comm. Score (av.)	Average score (O <sub>xi</sub> )	Risk reduction potential (P <sub>i</sub> )	Overall rank	Classification
<b>Aim G: To identify, acknowledge and protect natural and cultural heritage</b>						
G1	To effectively manage threats to and to enhance the natural and cultural heritage values in the catchment and waterways	3.9	3.3	4.9	22	Low
G2	To ensure development minimises impacts on aesthetic and social values.	4.0	3.1	4.5	27	Low
<b>Aim H: To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary</b>						
H1	To protect public foreshore areas required for potential retreat of estuarine vegetation in response to sea level rise from development or infrastructure	3.8	3.6	6.7	14	Medium
H2	Plan for and adapt where possible to manage impacts on foreshore infrastructure resulting from an increase in tidal inundation and localised flooding associated with sea level rise as outlined in the former sea level rise policy statement	3.5	3.3	5.8	16	Medium
<b>Aim I: To develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary</b>						
I1	To build on the existing GRCCC coordinated estuary health monitoring of the Georges River to ensure compliance with the NSW Government Monitoring, Evaluation and Reporting Program	4.0	3.6	5.7	18	Medium
I2	To monitor the effectiveness of the plans objectives and management actions	4.3	3.3	4.9	24	Low

## APPENDIX D: PRIORITISATION OF ESTUARY MANAGEMENT OPTIONS

The initial 'long-list' of potential Management Options is provided in the sections below, under each Management Aim.

Assessment of potential Management Options was based on feedback from EMC workshop participants. Via a questionnaire, participants were asked to provide responses to a series of questions for each potential Management Option.

*1. Do you have any ideas of more detailed Management actions that could/should be undertaken for each Option?*

*2. Are there any specific projects you would like to have considered for inclusion under the Plan for any of the Management Options?*

*3. To what extent do you think the Management Option will contribute to achieving the Plan's objectives?* The ratings scale you should use for this question is below.

1	2	3	4	5
Not at all	A small contribution	A moderate contribution	A major contribution	Relevant objectives fully or almost fully addressed

The relevance of individual options was to determine its "total potential" for addressing the objectives and aims of this Plan. This potential,  $P_i$ , was calculated as:

$$P_i = \sum_{\text{Objectives } (y)} R_{y,x} \times Q_{x,i}$$

Where:

$Q_{x,i}$  is the extent to which option  $i$  is expected to address the objectives from Aim  $x$  (averaged score for all responses to Question 3 above) (note, within the calculation, this score is converted to a percentage whereby a value of 5 = 100% contribution, and 1 = 0% contribution); and

$R_{y,x}$  is the risk reduction potential (calculated previously) for Management Objective  $y$ , which addresses Aim  $x$ .

The average score ( $Q_{x,i}$ ) and resulting total potential ( $P_i$ ) are also presented below. Within Table 9-3 to Table 9-11, the applicability of each management option to each management objective is denoted by a tick (✓) in the relevant column of the table. It was assumed that the primary contribution of any management option was to objectives under the aim for which it was originally defined. In doing this, it was understood that some management options may also make some contributions to objectives under other aims.

In addition, and for comparative purposes, the tables below shows the relative scores given to each Management Option by the community when asked about the likely effectiveness of each option in addressing the Management Objectives. The community tended to be quite optimistic about the potential for options to address the identified management objectives, with generally higher scores than those provided by the EMC.

**AIM A. WATER QUALITY:** To optimise water quality within the Georges River Estuary and its tributaries

Objectives A1 – A6: Refer Table 4-2 for details.

**Table 9-3 Water Quality Potential Management Options**

No.	Management Option	A1	A2	A3	A4	A5	A6	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MA1	Incorporate appropriate WSUD in redevelopments, including public and private development, of urban areas	✓	✓					4.4	3.8	<b>14.9</b>
MA2	Councils to incorporate Water Sensitive Urban Design (WSUD) principles in the review and preparation of new Development Control Plans (DCPs)	✓	✓					4.4	3.7	<b>14.3</b>
MA3	Retrofit appropriate WSUD in existing urban areas including measures such as artificial wetlands, vegetated swales, and channel naturalisation	✓	✓					4.4	3.4	<b>13.1</b>
MA4	Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs and other stormwater quality improvement devices.	✓						4.4	3.1	<b>6.0</b>
MA5	Develop and implement education programs aimed at increasing community awareness regarding 'source control' of gross pollutants, nutrients and other pollutants	✓			✓			3.9	2.6	<b>7.8</b>
MA6	Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction		✓				✓	4.5	3.3	<b>11.1</b>
MA7	Acknowledge the value of the large area of uncleared natural vegetation in the Georges River catchment and work towards the preservation of these areas					✓		4.6	3.1	<b>4.8</b>



No.	Management Option	A1	A2	A3	A4	A5	A6	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MA8	Continue the GRCCC's Riverkeeper Program to help minimise the impact of and monitor incidences of illegal dumping (on land and in water)				✓			4.1	2.9	4.0
MA9	Use appropriate modelling tools such as MUSIC and/or the Botany Bay CAPER DSS and the LGRSI decision support tool to evaluate and design WSUD projects	✓	✓					3.8	3.0	10.7
MA10	Councils should adopt WSUD action plans based on a comprehensive framework of institutional capacity and assessment	✓	✓					4.4	3.1	11.3
MA11	Ensure Sydney Water continues to improve the sewage overflow performance of the sewer systems throughout the catchment			✓				4.2	3.4	6.3
MA12	Ensure existing and new WSUD devices are included in asset management plans	✓	✓					4.4	2.6	8.3
MA13	Engage the community in the planning, design and implementation for WSUD projects to help foster a sense of ownership and a willingness to support in the longer term	✓	✓					3.7	2.4	7.7
MA14	Educate private sewer owners on their obligations for maintenance and appropriate approaches to maintaining private sewers			✓	✓			4.2	2.2	5.7
MA15	Liaise with Sydney Water when sewers are observed to be causing water quality problems			✓	✓			4.2	2.2	5.7
MA16	All Councils have an appropriate pollution incident response protocol in place						✓	4.5	2.4	3.2
MA17	Councils to liaise and engage with other authorities and agencies to progress WSUD in their operations including small scale projects (e.g. RTA, Rail Corp)	✓						4.4	2.2	3.5

**AIM B. AQUATIC AND RIPARIAN HABITAT:** To protect, enhance and restore aquatic habitats and foreshore vegetation

Objectives B1 – B3: Refer Table 4-3 for details.

**Table 9-4 Aquatic and Riparian Habitats Potential Management Options**

No.	Management Option	B1	B2	B3	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MB1	Education of surrounding landholders regarding the role of the community in preserving and maintaining a healthy estuarine ecosystem including provision of appropriate educational signage around the estuary foreshores			✓	3.9	2.7	<b>3.5</b>
MB2	Identification and progressive control of invasive species from foreshore areas and adjacent bushland		✓		4.0	3.7	<b>5.3</b>
MB3	Identification and progressive control of noxious species from the estuary and other waterways		✓		4.0	3.3	<b>4.7</b>
MB4	Identify locations for and undertake targeted rehabilitation, creation and enhancement of saltmarsh and mangrove communities			✓	4.4	3.5	<b>5.3</b>
MB5	Revegetation of intertidal areas and public riparian lands with locally indigenous species, and control and replacement of exotic species where appropriate			✓	4.4	3.3	<b>4.9</b>
MB6	Encourage and assist revegetation of private foreshore areas			✓	4.4	2.5	<b>3.2</b>
MB7	Support the establishment and continuation of local bushcare/landcare and other groups to assist with revegetation works on both public and private lands			✓	4.4	3.5	<b>5.3</b>
MB8	Utilise the Riverkeeper Bush Regeneration teams to provide weed control, bush regeneration and ongoing site maintenance to compliment and support NPWS and council bush regeneration works		✓	✓	4.4	3.5	<b>10.3</b>
MB9	Provide information to private landowners that have key habitat and vegetation communities on their properties to describe the community, its importance to the estuary and options for its protection and management	✓		✓	3.9	2.5	<b>6.0</b>
MB10	Work with private owners of saltmarsh for the management of this habitat towards its protection			✓	4.6	2.3	<b>2.8</b>
MB11	Manage access to sites of high environmental significance	✓			4.0	2.7	<b>3.2</b>
MB12	Promote and undertake compliance on unauthorised riparian and estuarine vegetation clearing			✓	4.6	3.0	<b>4.2</b>
MB13	Minimise the impact of moorings on seagrasses	✓			3.9	2.2	<b>2.2</b>

No.	Management Option	B1	B2	B3	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MB14	Encourage NSW Fisheries to periodically map the distribution of estuarine vegetation (seagrass, saltmarsh and mangroves) for the estuary			✓	3.8	2.5	3.3
MB15	Prevent the introduction and spread of disease and pests		✓		4.0	3.2	4.3

**AIM C. RECREATION AND AMENITY:** To protect and enhance public access to the foreshore

Objectives C1 – C4: Refer Table 4-4 for details.

**Table 9-5 Recreation and Amenity Potential Management Options**

No.	Management option	C1	C2	C3	C4	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MC1	Organise community events to improve the recreational amenity of key foreshore areas			✓		3.7	3.2	2.7
MC2	Provide appropriate signage at selected locations around the estuary regarding recreational usage of the estuary and its foreshore reserves.	✓	✓			4.0	2.8	4.3
MC3	Prepare appropriate interpretative materials aimed at reducing impacts associated with legal and illegal recreational pursuits	✓	✓		✓	3.9	3.2	7.9
MC4	Support the development and application of EMS for various industries		✓			3.9	2.8	2.3
MC5	Contribute to current revision of boating strategy with Roads and Maritime Services to manage potential recreational use conflicts	✓	✓			4.1	3.0	4.8
MC6	Ensure adequate waste disposal facilities for people aboard boats and recreational fishers on land.		✓			3.7	3.2	2.8
MC7	Establish a monitoring and compliance program to monitor and address the impacts of recreation at various locations and times of year (such as peak periods), to ensure ongoing sustainability of such locations	✓	✓			3.8	2.2	2.9
MC8	Maintain recognised Council assets that support legal recreational pursuits on the Georges River	✓				4.0	3.2	2.5

No.	Management option	C1	C2	C3	C4	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MC9	Identify and engage with commercial operators through State Govt agencies to minimise impacts on the river		✓			4.0	2.4	1.8
MC10	Enhance foreshore access in appropriate locations through strategic planning and the land development process and Council works			✓		4.0	3.8	3.4

**AIM D. LAND USE PLANNING AND DEVELOPMENT:** To minimise the negative impacts of development in the catchment on waterway health

Objectives D1 – D3: Refer Table 4-5 for details.

**Table 9-6 Land use Planning and Development Potential Management Options**

No.	Management Options	D1	D2	D3	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MD1	Recommendations on restrictions to land use activities including mining in the upper catchment which arose from the Upper Georges River Sustainability Symposium (16th October 2010) should be considered and where appropriate acted upon			✓	4.6	3.8	4.2
MD2	Environmental requirements outlined in the NSW floodplain manual should continue to be considered during development and when building flood abatement works			✓	3.6	3.5	3.8
MD3	Councils should ensure that best management practices to limit the export of pollutants including sediments, nutrients and acid runoff from Council projects are applied through the use of recognised checklist/part 5 assessment	✓			4.5	3.5	4.6
MD4	When undertaking reviews of strategic planning instruments and initiatives (including LEPs and DCPs) and development proposals, ensure consistency with the Coastal Zone Management Plan aims and objectives		✓		4.5	3.8	5.2
MD5	New and revised Plans of Management should be compatible with the recommendations of the Georges River Estuary Coastal Zone Management Plan		✓		nr	4.0	5.7
MD6	Ensure relevant regulatory and consent authorities adopt best management practices when certifying and regulating land use activities			✓	nr	3.3	3.4



No.	Management Options	D1	D2	D3	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MD7	Regulatory authorities responsible for issuing pollution control licences review minimum water quality and environmental objectives to reduce the impact of pollution from licensed premises			✓	4.5	2.8	2.7

**AIM E. BANK EROSION AND SEDIMENTATION:** To actively manage bank erosion and sedimentation

Objectives E1 – E2: Refer Table 4-6 for details.

**Table 9-7 Bank Erosion and Sedimentation Potential Management Options**

No.	Management option	E1	E2	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
ME1	Encourage bank and foreshore erosion control techniques that maximise the use of riparian and estuarine vegetation	✓		3.9	4.0	6.5
ME2	Work with Roads and Maritime Services to determine the impact of wash on the waterway and strategies to minimise the effects where bank erosion is an issue and boat wake is a likely cause	✓	✓	4.1	3.5	10.7
ME3	Control ad hoc access along the foreshore to limit vegetation trampling and bank destabilisation	✓	✓	4.0	3.0	8.6
ME4	Prioritise active eroding foreshore areas in close proximity to seagrass beds on an LGA basis to minimise impacts associated with smothering and increased turbidity	✓	✓	4.4	3.0	8.6
ME5	Use environmentally friendly seawalls to control erosion that cannot be managed through softer protection techniques	✓	✓	3.9	3.3	9.7
ME6	Consider removal of seawalls and recreating a natural intertidal area where possible	✓	✓	3.9	3.0	8.6
ME7	Unification, extension or removal of short seawalls to manage erosion edge effects	✓	✓	3.9	2.8	7.5
ME8	Use a coordinated approach to managing bank erosion	✓		nr	3.3	4.9
ME9	Review management of assets on active eroding areas		✓	3.6	2.3	2.7
ME10	Prioritise estuarine macrophyte communities for management that are at risk of or impacted by sedimentation and associated contaminants	✓		4.4	3.3	4.9
ME11	Enforce strict environmental controls on any approved dredging for public navigation channels		✓	4.1	2.8	3.7

**AIM F. FORESHORE PROTECTION:** To manage existing built foreshore assets while maximising environmental values

Objectives F1 – F4: Refer Table 4-7 for details.

**Table 9-8 Foreshore Protection Potential Management Options**

No.	Management option	F1	F2 not used	F3	F4	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MF1	All councils and agencies involved in the building, design and approval of new seawalls to ensure compliance with the environmentally friendly seawall guidelines within legislative requirements	✓				3.9	3.8	<b>3.6</b>
MF2	Explore options to improve the environmental value of existing seawalls through addition of habitat					3.9	2.8	<b>1.6</b>
MF3	All councils and agencies involved in the building, design and approval of new foreshore developments to ensure compliance with environmental best practices			✓		4.0	3.0	<b>2.6</b>
MF4	Maintain compliance by relevant authorities on unauthorised or inappropriate foreshore structures and uses				✓	4.1	3.0	<b>2.9</b>
MF5	Educate and support private landowners on the benefits of environmentally friendly seawalls and provide details of the planning and approval process for installation	✓				3.9	2.3	<b>2.8</b>
MF6	Establish foreshore building lines for all developments			✓		4.3	3.0	<b>2.6</b>

**AIM G. NATURAL AND CULTURAL HERITAGE:** To identify, acknowledge and protect natural and cultural heritage

Objectives G1 – G2: Refer Table 4-8 for details.

**Table 9-9 Natural and Cultural Heritage Potential Management Options**

No.	Management option	G1	G2	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MG1	Management strategies that take into account legislative requirements relating to heritage should be developed to address potential difficulties posed by individuals, private companies, public groups, local councils and state government agencies who may own or manage land or waterways containing heritage items	✓		3.9	2.5	<b>1.9</b>
MG2	Field inspections of sites previously identified should be carried out to ascertain their current physical condition and threats with priority given to sites last recorded before 2000	✓		3.9	3.0	<b>2.5</b>
MG3	Field inspection of potential historic Aboriginal heritage places identified in the processes study (Appendix 6) should be carried out to ascertain whether physical evidence may survive and if further research is appropriate	✓		3.9	2.8	<b>2.2</b>
MG4	Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites	✓		3.8	3.0	<b>2.5</b>
MG5	Use a coordinated approach to recording sites and values	✓		3.9	2.5	<b>1.9</b>
MG6	Ensure identified sites are adequately protected under the regulatory framework	✓		3.9	3.5	<b>3.1</b>
MG7	Social and aesthetic values need to be considered in the review and preparation of new Development Control Plans (DCPs)		✓	3.7	3.5	<b>2.8</b>

**AIM H. CLIMATE CHANGE AND SEA LEVEL RISE:** To plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary.

Objectives H1 – H2: Refer Table 4-9 for details.

**Table 9-10 Climate Change and Sea Level Rise Potential Management Options**

No.	Management option	H1	H2	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MH1	Public foreshore areas required for the retreat of estuarine vegetation in response to sea level rise should be identified	✓		4.4	3.8	<b>4.6</b>

	and protected from development or infrastructure					
MH2	Foreshore infrastructure with likely tidal inundation risk managed in such a way as to allow adaptation to sea level rise		✓	3.7	3.8	<b>4.0</b>
MH3	Identify areas likely to be impacted by sea level rise	✓	✓	3.7	3.5	<b>7.8</b>
MH4	Prioritise restoration of estuarine vegetation where there is potential for retreat of the estuarine vegetation	✓		4.4	3.5	<b>4.2</b>
MH5	Restricting new foreshore developments in areas where tidal inundation hazards under current and future sea level rise scenarios are quantified		✓	4.4	3.8	<b>4.0</b>
MH6	Educating the community about environmentally friendly adaptation methods to climate change/sea level rise		✓	3.9	2.0	<b>1.5</b>

**AIM I. MONITORING AND EVALUATION:** To develop and support coordinated monitoring, reporting and evaluation programs for the Georges river estuary

Objectives I1 – I2: Refer Table 4-10 for details.

**Table 9-11 Monitoring and Evaluation Potential Management Options**

No.	Management option	I1	I2	Comm Score	Av. Score (Q <sub>x,i</sub> )	Total Potent. (P <sub>i</sub> )
MI1	Undertake monitoring of the interaction between estuarine vegetation communities, particularly in response to climate pressures	✓		3.8	2.8	<b>2.5</b>
MI2	Ongoing support of the Georges River estuary health monitoring program coordinated by the GRCCC	✓		3.8	4.0	<b>4.2</b>
MI3	Support the implementation and monitoring of the effectiveness of Plan		✓	3.8	4.0	<b>3.7</b>
MI4	Undertake a review of the CZMP every 5-10 years		✓	-	3.8	<b>3.4</b>



## APPENDIX E: RAPID COST BENEFIT ASSESSMENT OF MANAGEMENT OPTIONS

Legend for table below:

	Effectiveness / Risk Reduction Potential (RRP)	Time frame	Cost	Practicality / Legal	Community Support	"No Regrets"
<b>STOP &amp; reassess</b>	Option does not provide an effective and long term solution. Risk reduction potential is relatively low <u>RRP &lt; 3.2</u>	LONG Term (> 5-10yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	High (\$300K to millions)	LOW: Will require approval to implement and significant community engagement. There is a residual risk that approval will not be able to be obtained for the proposed works/strategy. Works may also require significant resources that are presently unavailable	LOW: Unlikely to be acceptable to community and politically unpalatable. Extensive community education, endorsement of the concept by Minister(s) and Council required. Comm. Score < 3.0	
<b>SLOW</b>	Option is considered worthwhile, but does not necessarily help with long term sustainability and estuary health. <u>3.2 &lt; RRP &lt; 5.2</u>	MEDIUM Term (> 2 – 5yrs before tasks can commence). Requires prior commitment of funds, resources or other tasks to be completed first	Medium (e.g. \$30,000 - \$300,000)	MEDIUM: May require approvals to be implemented, but works are generally supported. Generally these approvals would likely to be granted assuming requirements are met. May require some resources that would require redistribution of existing tasks and duties by officers.	MEDIUM: Would be palatable to some, not to others (50/50 response). Briefing by Councillors, GM and community education required 3.0 < Comm. Score < 4.0	
<b>GO</b>	Option provides an effective long term solution <u>RRP &gt; 5.2</u>	SHORT Term (tasks can commence within approximately 2 years). Generally can be completed without too many barriers	Low (< \$30,000)	HIGH: No or minimal approvals or other impediments required to implement. No significant additional resources required (can be done as part of normal duties)	HIGH: Is very politically palatable, acceptable to community. Minimal education required Comm. Score > 4.0	YES
	<u>RRP &gt; 10.0</u>				VERY HIGH: Comm. Score > 4.5	

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
<b>Aim A: Water Quality – to optimise water quality within the Georges River Estuary and its tributaries</b> <b>(Intolerable Risk if not addressed)</b>						
MA1. Incorporate appropriate WSUD in redevelopments, including public and private development, of urban areas	14.9	SLOW	STOP	GO	GO	
MA2. Councils to incorporate Water Sensitive Urban Design (WSUD) principles in the review and preparation of new Development Control Plans (DCPs)	14.3	GO	GO	GO	GO	
MA3. Retrofit appropriate WSUD in existing urban areas including measures such as artificial wetlands, vegetated swales, and channel naturalisation	13.1	SLOW	STOP	STOP	GO	
MA4. Undertake adequate and appropriate maintenance of existing WSUD devices to maintain their effectiveness, in particular GPTs and other stormwater quality improvement devices.	6.0	GO	SLOW	GO	GO	YES
MA5. Develop and implement education programs aimed at increasing community awareness regarding 'source control' of gross pollutants, nutrients and other pollutants	7.8	GO	SLOW	GO	SLOW	YES
MA6. Enforce implementation and maintenance of effective sediment controls during the subdivision and building phases of all developments (including infrastructure projects) by undertaking regular audits of developments during construction	11.1	GO	GO	SLOW	GO	YES
MA7. Acknowledge the value of the large area of uncleared natural vegetation in the Georges River catchment and work towards the preservation of these areas	4.8	GO	GO	GO	GO	YES
MA8. Continue the GRCCC's Riverkeeper Program to help minimise the impact of, and monitor incidences of, illegal dumping (on land and in water)	4.0	GO	SLOW	SLOW	GO	YES
MA9. Use appropriate modelling tools such as MUSIC and/or the Botany Bay CAPER DSS and the LGRSI decision support tool to evaluate and design WSUD projects	10.7	GO	SLOW	GO	SLOW	YES
MA10. Councils should adopt WSUD action plans based on a comprehensive framework of institutional capacity and assessment	11.3	GO	GO	SLOW	GO	

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
MA11. Ensure Sydney Water continues to improve the sewage overflow performance of the sewer systems throughout the catchment	6.3	STOP	STOP	SLOW	GO	YES
MA12. Ensure existing and new WSUD devices are included in asset management plans	8.3	GO	GO	GO	GO	YES
MA13. Engage the community in the planning, design and implementation for WSUD projects to help foster a sense of ownership and a willingness to support in the longer term	7.7	SLOW	SLOW	GO	SLOW	
MA14. Educate private sewer owners on their obligations for maintenance and appropriate approaches to maintaining private sewers	5.7	GO	SLOW	SLOW	GO	YES
MA15. Liaise with Sydney Water when sewers are observed to be causing water quality problems	5.7	GO	GO	GO	GO	YES
MA16. All Councils have an appropriate pollution incident response protocol in place	3.2	GO	GO	GO	GO	YES
MA17. Councils to liaise and engage with other authorities and agencies to progress WSUD in their operations including small scale projects (e.g. RTA, Rail Corp)	3.5	GO	GO	GO	GO	
<b><u>Aim B: Aquatic and Riparian Habitats – to protect, enhance and restore aquatic habitats and foreshore vegetation (Intolerable Risk if not addressed)</u></b>						
MB1. Education of surrounding landholders regarding the role of the community in preserving and maintaining a healthy estuarine ecosystem including provision of appropriate educational signage around the estuary foreshores	3.5	GO	SLOW	GO	SLOW	YES
MB2. Identification and progressive control of invasive species from foreshore areas and adjacent bushland	5.3	SLOW	SLOW	SLOW	GO	YES
MB3. Identification and progressive control of noxious species from the estuary and other waterways	4.7	SLOW	SLOW	SLOW	GO	YES
MB4. Identify locations for and undertake targeted rehabilitation, creation and enhancement of saltmarsh and mangrove communities	5.3	SLOW	SLOW	GO	GO	
MB5. Revegetation of intertidal areas and public riparian lands with locally indigenous species, and control and replacement of exotic species where appropriate	4.9	SLOW	SLOW	SLOW	GO	

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
MB6. Encourage and assist revegetation of private foreshore areas	3.2	GO	SLOW	SLOW	GO	
MB7. Support the establishment and continuation of local bushcare/landcare and other groups to assist with revegetation works on both public and private lands	5.3	GO	SLOW	SLOW	GO	YES
MB8. Utilise the Riverkeeper Bush Regeneration teams to provide weed control, bush regeneration and ongoing site maintenance to compliment and support NPWS and council bush regeneration works	10.3	GO	SLOW	GO	GO	YES
MB9. Provide information to private landowners that have key habitat and vegetation communities on their properties to describe the community, its importance to the estuary and options for its protection and management	6.0	GO	SLOW	GO	SLOW	YES
MB10. Work with private owners of saltmarsh for the management of this habitat towards its protection	2.8	SLOW	SLOW	SLOW	GO	YES
MB11. Manage access to sites of high environmental significance	3.2	SLOW	SLOW	GO	GO	
MB12. Promote and undertake compliance on unauthorised riparian and estuarine vegetation clearing	4.2	GO	GO	SLOW	GO	YES
MB13. Minimise the impact of moorings on seagrasses	2.2	GO	SLOW	SLOW	SLOW	
MB14. Encourage NSW Fisheries to periodically map the distribution of estuarine vegetation (seagrass, saltmarsh and mangroves) for the estuary	3.2	GO	GO	GO	SLOW	YES
MB15. Prevent the introduction and spread of disease and pests	4.3	GO	SLOW	SLOW	GO	
<b><u>Aim C: Recreation and Amenity</u> – to protect and enhance public access to the foreshore (Tolerable Risk if not addressed)</b>						
MC1. Organise community events to improve the recreational amenity of key foreshore areas	2.7	GO	SLOW	GO	SLOW	YES
MC2. Provide appropriate signage at selected locations around the estuary regarding recreational usage of the estuary and its foreshore reserves.	4.3	GO	SLOW	GO	GO	YES



Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
MC3. Prepare appropriate interpretative materials aimed at reducing impacts associated with legal and illegal recreational pursuits	7.9	SLOW	SLOW	GO	SLOW	YES
MC4. Support the development and application of Environmental Management Systems (EMS) for various industries	2.3	GO	GO	SLOW	SLOW	YES
MC5. Contribute to current revision of boating strategy with Roads and Maritime Services to manage potential recreational use conflicts	4.8	GO	GO	GO	GO	
MC6. Ensure adequate waste disposal facilities for people aboard boats and recreational fishers on land.	2.8	STOP	STOP	SLOW	SLOW	
MC7. Establish a monitoring and compliance program to monitor and address the impacts of recreation at various locations and times of year (such as peak periods), to ensure ongoing sustainability of such locations	2.9	SLOW	SLOW	SLOW	SLOW	
MC8. Maintain recognised Council assets that support legal recreational pursuits on the Georges River	2.5	SLOW	SLOW	GO	GO	
MC9. Identify and engage with commercial operators through State Govt agencies to minimise impacts on the river	1.8	GO	GO	GO	GO	YES
MC10. Enhance foreshore access in appropriate locations through strategic planning and the land development process and Council works	3.4	SLOW	SLOW	SLOW	GO	
<b><u>Aim D: Land use Planning and Development</u> – to minimise the negative impacts of development in the catchment on waterway health (<u>Intolerable Risk</u> if not addressed)</b>						
MD1. Recommendations on restrictions to land use activities including mining in the upper catchment which arose from the Upper Georges River Sustainability Symposium (16th October 2010) should be considered and where appropriate acted upon	4.2	GO	GO	SLOW	GO	
MD2. Environmental requirements outlined in the NSW floodplain manual should continue to be considered during development and when building flood abatement works	3.8	GO	GO	GO	SLOW	YES
MD3. Councils should ensure that best management practices to limit the export of pollutants including sediments, nutrients and acid runoff from Council projects are applied through the use of recognised checklist/part 5 assessment	4.6	GO	GO	GO	GO	YES

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
MD4. When undertaking reviews of strategic planning instruments and initiatives (including LEPs and DCPs) and development proposals, ensure consistency with the Coastal Zone Management Plan aims and objectives	5.2	GO	GO	GO	GO	
MD5. New and revised Plans of Management should be compatible with the recommendations of the Georges River Estuary Coastal Zone Management Plan	5.7	GO	GO	GO	nr	
MD6. Ensure relevant regulatory and consent authorities adopt best management practices when certifying and regulating land use activities	3.4	GO	GO	SLOW	nr	YES
MD7. Regulatory authorities responsible for issuing pollution control licences review minimum water quality and environmental objectives to reduce the impact of pollution from licensed premises	2.7	GO	GO	SLOW	GO	YES
<b><u>Aim E: Bank Erosion and Sedimentation – to actively manage bank erosion and sedimentation (Intolerable Risk if not addressed)</u></b>						
ME1. Encourage bank and foreshore erosion control techniques that maximise the use of riparian and estuarine vegetation	6.5	GO	GO	GO	SLOW	YES
ME2. Work with Roads and Maritime Services to determine the impact of wash on the waterway and strategies to minimise the effects where bank erosion is an issue and boat wake is a likely cause	10.7	GO	GO	GO	GO	
ME3. Control ad hoc access along the foreshore to limit vegetation trampling and bank destabilisation	8.6	GO	SLOW	SLOW	GO	
ME4. Prioritise active eroding foreshore areas in close proximity to seagrass beds on an LGA basis to minimise impacts associated with smothering and increased turbidity	8.6	GO	GO	GO	GO	YES
ME5. Use environmentally friendly seawalls to control erosion that cannot be managed through softer protection techniques	9.7	SLOW	STOP	SLOW	SLOW	
ME6. Consider removal of seawalls and recreating a natural intertidal area where possible	8.6	STOP	STOP	STOP	SLOW	
ME7. Unification, extension or removal of short seawalls to manage erosion edge effects	7.5	STOP	SLOW	SLOW	SLOW	
ME8. Use a coordinated approach to managing	4.9	GO	GO	SLOW	nr	YES

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
bank erosion						
ME9. Review management of assets on active eroding areas	2.7	GO	GO	GO	SLOW	YES
ME10. Prioritise estuarine macrophyte communities for management that are at risk of or impacted by sedimentation and associated contaminants	4.9	GO	GO	GO	GO	YES
ME11. Enforce strict environmental controls on any approved dredging for public navigation channels	3.7	GO	GO	GO	GO	YES
<b>Aim F: Foreshore Protection – to actively manage existing built foreshore assets while maximising environmental values (<u>Tolerable Risk</u> if not addressed)</b>						
MF1. All councils and agencies involved in the building, design and approval of new seawalls to ensure compliance with the environmentally friendly seawall guidelines within legislative requirements	3.6	GO	GO	GO	SLOW	YES
MF2. Explore options to improve the environmental value of existing seawalls through addition of habitat	1.6	GO	GO	GO	SLOW	
MF3. All councils and agencies involved in the building, design and approval of new foreshore developments to ensure compliance with environmental best practices	2.6	GO	GO	GO	GO	YES
MF4. Maintain compliance by relevant authorities on unauthorised or inappropriate foreshore structures and uses	2.9	GO	GO	GO	GO	YES
MF5. Educate and support private landowners on the benefits of environmentally friendly seawalls and provide details of the planning and approval process for installation	2.8	GO	SLOW	GO	SLOW	YES
MF6. Establish foreshore building lines for all developments	2.6	SLOW	GO	SLOW	GO	
<b>Aim G: Natural and Cultural Heritage – to identify, acknowledge and protect natural and cultural heritage (<u>Tolerable Risk</u> if not addressed)</b>						
MG1. Management strategies that take into account legislative requirements relating to heritage should be developed to address potential difficulties posed by individuals, private companies, public groups, local councils and state government agencies who may own or manage land or waterways containing heritage items	1.9	SLOW	GO	SLOW	SLOW	

Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
MG2. Field inspections of sites previously identified should be carried out to ascertain their current physical condition and threats with priority given to sites last recorded before 2000	2.5	GO	SLOW	GO	SLOW	
MG3. Field inspection of potential historic Aboriginal heritage places identified in the processes study (Appendix 6) should be carried out to ascertain whether physical evidence may survive and if further research is appropriate	2.2	GO	SLOW	GO	SLOW	
MG4. Work with Aboriginal groups and individuals in the Georges River catchment to determine management options for threatened indigenous heritage sites	2.5	SLOW	GO	GO	SLOW	
MG5. Use a coordinated approach to recording sites and values	1.9	GO	GO	GO	SLOW	YES
MG6. Ensure identified sites are adequately protected under the regulatory framework	3.1	GO	GO	GO	SLOW	YES
MG7. Social and aesthetic values need to be considered in the review and preparation of new Development Control Plans (DCPs)	2.8	GO	GO	GO	SLOW	
<b><u>Aim H: Climate Change and Sea Level Rise – to plan for and adapt to the potential impacts of climate change on the natural and built environments of the estuary (Intolerable Risk if not addressed)</u></b>						
MH1. Public foreshore areas required for the retreat of estuarine vegetation in response to sea level rise should be identified and protected from development or infrastructure	4.6	SLOW	GO	STOP	GO	
MH2. Foreshore infrastructure with likely tidal inundation risk managed in such a way as to allow adaptation to sea level rise	4.0	SLOW	SLOW	SLOW	SLOW	
MH3. Identify areas likely to be impacted by sea level rise	7.8	SLOW	SLOW	GO	SLOW	YES
MH4. Prioritise restoration of estuarine vegetation where there is potential for retreat of the estuarine vegetation	4.2	SLOW	GO	GO	GO	
MH5. Restricting new foreshore developments in areas where tidal inundation hazards under current and future sea level rise scenarios are quantified	4.0	SLOW	GO	STOP	GO	
MH6. Educating the community about environmentally friendly adaptation methods to climate change/sea level rise	1.5	SLOW	SLOW	GO	SLOW	YES



Management Option	Total Potent. (P <sub>i</sub> )	Time frame	Costs	Practicality / Legal	Comm. Support	No Regrets
<b><u>Aim I: Monitoring and Evaluation</u> – to develop and support coordinated monitoring, reporting and evaluation programs for the Georges River Estuary (<u>Tolerable Risk</u> if not addressed)</b>						
MI1. Undertake monitoring of the interaction between estuarine vegetation communities, particularly in response to climate pressures	2.5	STOP	SLOW	GO	SLOW	YES
MI2. Ongoing support of the Georges River estuary health monitoring program coordinated by the GRCCC	4.2	GO	SLOW	GO	SLOW	YES
MI3. Support the implementation and monitoring of the effectiveness of Plan	3.7	GO	SLOW	GO	SLOW	YES
MI4. Undertake a review of the CZMP every 5-10 years	3.4	STOP	SLOW	GO	nr	YES

## APPENDIX F: NEXT BEST OPTIONS (NBOs) FURTHER DETAILS


### Water Quality Next Best Options

NBO Description	Comments
<b>MA5.</b> Develop and implement education programs aimed at increasing community awareness regarding 'source control' of gross pollutants, nutrients and other pollutants	Councils adopt an approach to catchment planning that includes full engagement of the community as pioneered by Marrickville Council and CRSI. The education programs should increase community interest and knowledge regarding water quality in the Georges River Catchment.
<b>MA7.</b> Acknowledge the value of the large area of uncleared natural vegetation in the Georges River catchment and work towards the preservation of these areas	Undertake bush regeneration practices or re-establishment in priority areas to develop / enhance biodiversity corridors. Plans of Management should be specific about the requirements for the site.
<b>MA9.</b> Use appropriate modelling tools such as MUSIC and/or the Botany Bay CAPER DSS and the LGRSI decision support tool to evaluate and design WSUD projects	Interrogation of the Botany Bay CAPER DSS to determine what might be the long term capital and ongoing costs associated with installing WSUD infrastructure across LGAs in order to help meet WQIP objectives. Can also use the Decision Support Tool developed by the LGRSI, which was designed to nest under the BBWQIP Decision Support Tool. This information ultimately needs to be reflected within Councils' Asset Management Plans, and prepared as part of the new integrated planning and reporting framework
<b>MA14.</b> Educate private sewer owners on their obligations for maintenance and appropriate approaches to maintaining private sewers	Sydney Water to prepare educational materials.
<b>MA16.</b> All Councils have an appropriate pollution incident response protocol in place	
<b>MA18.</b> Develop and implement site specific water quality monitoring programs that are in partnership with, or at least consistent with, the estuary-wide River Health monitoring program	GRCCC should lead development of an MOU with Sydney Water and the EPA for the catchment on behalf of all Georges River Councils that covers this issue. Rockdale <ul style="list-style-type: none"> <li>Implement recommendations from Council's Water Quality Monitoring Studies at Bicentennial Ponds, and Bado Berong Creek</li> <li>Develop and undertake an ongoing water quality monitoring program across LGA</li> </ul> Kogarah <ul style="list-style-type: none"> <li>Development of a comprehensive water quality monitoring program designed to capture routine conditions, particular stormwater events and contamination incidents. The program should also be targeted to develop a detailed understanding of the effectiveness of the existing stormwater treatment devices in the catchment (e.g. the constructed wetland at Shipwrights Bay Reserve). The program should include community and school based monitoring elements. Monitoring should be monthly and include flow monitoring, suspended solids, secchi depth, nitrate</li> </ul>

	<p>and nitrate, chlorophyll 'a', total nitrogen, total phosphorus, as well as faecal coliforms as per the beach watch program.</p> <ul style="list-style-type: none"> <li>• Water quality monitoring would assist in identifying ongoing effects of leachate entering the estuarine system.</li> <li>• Annual review of water quality monitoring programmes and results in order to establish/modify management initiatives</li> <li>• Develop a program and undertake monitoring on an annual basis to establish the level of groundwater contamination from former landfill sites in the catchment.</li> <li>• Adequate waste oil and grease collection needs to be in place in the catchment to ensure total hydrocarbons meet ANZECC (2000) guidelines.</li> <li>• Annual report on algal bloom notifications.</li> </ul>
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## Aquatic & Riparian Habitat Next Best Options

NBO Description	Comments
<b>MB1.</b> Education of surrounding landholders regarding the role of the community in preserving and maintaining a healthy estuarine ecosystem including provision of appropriate educational signage around the estuary foreshores	<p>Create Landcare Groups linked to Local Government Areas</p> <p>Bankstown</p> <ul style="list-style-type: none"> <li>• Signage / education regarding minimising boat propeller damage to seagrass near mouth of Salt Pan Creek.</li> </ul> <p>Fairfield</p> <ul style="list-style-type: none"> <li>• Example project: Canley Vale Public School – education of students about water pollution, native flora and fauna, and undertaking revegetation of parts of Orphan School Creek.</li> </ul> <p>Hurstville</p> <ul style="list-style-type: none"> <li>• Signage / education regarding foreshore and estuary management (including for example eco-friendly seawalls and illegal pruning of mangroves)</li> </ul>
<b>MB2.</b> Identification and progressive control of invasive species from foreshore areas and adjacent bushland	<p>Coordination of efforts between Councils on opposite sides of creeks to manage invasive transfer between banks and downstream (facilitated through GRCCC / Riverkeeper).</p> <p>Fairfield</p> <ul style="list-style-type: none"> <li>• Example Program: Creek Care Program, targeting Lansvale Reserve (Lower Prospect Creek), that focuses on removing weeds and revegetating riparian corridors.</li> </ul> <p>Kogarah</p> <ul style="list-style-type: none"> <li>• Priority locations include: <ul style="list-style-type: none"> <li>○ Oatley Bay</li> <li>○ Kyle Bay</li> <li>○ Shipwrights Bay</li> <li>○ Moore Reserve, Poulton Pk</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Kyle Williams Reserve (Swamp Oak Forest community and associated estuarine vegetation)</li> </ul> <p>Hurstville</p> <ul style="list-style-type: none"> <li>• Undertake invasive plant control in all EECs</li> <li>• Coordination of management efforts with neighbouring Councils (eg Bankstown Council in Salt Pan Creek)</li> <li>• Protection of seagrass</li> <li>• Hot spot: North of Riverwood Park, Salt Pan Creek</li> </ul> <p>Rockdale</p> <ul style="list-style-type: none"> <li>• Example location: Cook Park dune system</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>• Undertake invasive plant control in all EECs, and within estuarine vegetation, including reserved area in Mill Creek</li> </ul> <p>Liverpool</p> <ul style="list-style-type: none"> <li>• Undertake invasive plant control in all EECs, including River-Flat Eucalypt Forest EEC</li> <li>• Coordination of management efforts with neighbouring Councils (eg Cabramatta Creek)</li> <li>• Example location: Angle Park (<i>Lantana camara</i>)</li> </ul>
<p><b>MB3.</b> Identification and progressive control of noxious species from the estuary and other waterways</p>	<p>Identified areas and control areas should be systematically mapped to ensure good quantitative records are kept for reporting considerations.</p> <p>Bankstown</p> <ul style="list-style-type: none"> <li>• Co-ordinate control programs between different land managers to maximise effectiveness.</li> <li>• Monitor and evaluate effectiveness of noxious weed control actions.</li> <li>• Hot spot: Yeramba Lagoon.</li> </ul>
<p><b>MB12.</b> Promote and undertake compliance on unauthorised riparian and estuarine vegetation clearing</p>  <p><i>Cleared Mangroves, Georges River</i></p>	<p>Bankstown</p> <ul style="list-style-type: none"> <li>• Community education required</li> <li>• Encourage community to report incidences of illegal clearing</li> <li>• Evaluate options for most effective compliance (Council, OEH, DPI-Fisheries)</li> <li>• Hotspot locations: <ul style="list-style-type: none"> <li>○ Foreshore of Georges River</li> <li>○ Salt Pan / Little Salt Pan Creek</li> </ul> </li> </ul>



## Recreation & Amenity Next Best Options

NBO Description	Comments
<p><b>MC2.</b> Provide appropriate signage at selected locations around the estuary regarding recreational usage of the estuary and its foreshore reserves.</p>	<p>Bankstown</p> <ul style="list-style-type: none"> <li>Barriers and signage required to deter 4WD damage and trampling, and encourage responsible off-leash and leash areas, trail bikes, horses etc</li> <li>Education signage at public boat ramps, jetties and popular fishing and recreational locations.</li> </ul> <p>Kogarah</p> <ul style="list-style-type: none"> <li>Consistent catchment signage (including fonts, maps) and signpost important habitats, with management goals included.</li> <li>Possible periodic information sessions</li> <li>Regular inspection required to assess track condition and schedule maintenance as required.</li> </ul> <p>NPWS</p> <ul style="list-style-type: none"> <li>4WD access management and revegetation with saltmarsh species at southern side of the Georges River between Deadmans Creek and Mill Creek</li> <li>Barriers and signage to deter 4WD damage and trampling, where necessary only</li> <li>Increased enforcement required to deter illegal access.</li> </ul>
<p><b>MC9.</b> Identify and engage with commercial operators through State Govt agencies to minimise impacts on the river</p>	
<p><b>MC10.</b> Enhance foreshore access in appropriate locations through strategic planning and the land development process and Council works</p>	<p>Bankstown</p> <ul style="list-style-type: none"> <li>Maintenance of existing public recreation areas including boardwalks and educational signage</li> <li>Enhancement of public access to foreshore by linking discrete areas of foreshore.</li> <li>Ensure that any future provision of access protects areas of high environmental significance.</li> </ul> <p>Kogarah</p> <ul style="list-style-type: none"> <li>Example Sites: Dover Park (boat ramps and seawall); Shipwrights Bay Reserve (walking tracks)</li> </ul> <p>Rockdale</p> <ul style="list-style-type: none"> <li>Example Site: Cook Park (pedestrian beach access paths to prevent informal access through dunes)</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>Example Sites include:             <ul style="list-style-type: none"> <li>Kia Mia Way</li> <li>Bonna Point boat ramp upgrade</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Delardes</li> <li>• Prince Edward Park</li> <li>• Burnum Burnum</li> <li>• Woollooware Bay</li> <li>• Taren Point shorebird reserve</li> <li>• Como pleasure ground</li> <li>• Cylla Bay boardwalk</li> <li>• Tom Ugly's Reserve boat ramp</li> <li>• Green Point Reserve</li> </ul>
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## Land Use Planning & Development Next Best Options

NBO Description	Comments
<b>MD1.</b> Recommendations on restrictions to land use activities including mining in the upper catchment which arose from the Upper Georges River Sustainability Symposium (16th October 2010) should be considered and where appropriate acted upon	<p>Hurstville</p> <ul style="list-style-type: none"> <li>• Consistency of land use and environmental protection zones across LGAs required</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>• Botany Bay and Catchment WQIP guideline pollution levels incorporated into DCP</li> </ul> <p>Kogarah</p> <ul style="list-style-type: none"> <li>• Acquire / resume portions, or whole blocks, of land along foreshore area during redevelopment</li> <li>• Periodic review of LEP boundaries to maximise potential for rezoning and buyback/resumption</li> </ul> <p>NPWS</p> <ul style="list-style-type: none"> <li>• Acquisition of undeveloped land in upper catchment</li> </ul>
<b>MD2.</b> Environmental requirements outlined in the NSW floodplain manual should continue to be considered during development and when building flood abatement works	<p>Bankstown</p> <ul style="list-style-type: none"> <li>• Continue to implement actions outlined in adopted Flood Risk Management Plans (applicable to whole estuary)</li> </ul>
<b>MD6.</b> Ensure relevant regulatory and consent authorities adopt best management practices when certifying and regulating land use activities	<p>Kogarah</p> <ul style="list-style-type: none"> <li>• Landscaping requirements in foreshore scenic protection areas</li> </ul> <p>Hurstville</p> <ul style="list-style-type: none"> <li>• Consider environmental offset scheme</li> <li>• Ensure appropriate controls to minimise environmental problems eg. Acid Sulfate Soils, foreshore erosion</li> </ul> <p>Rockdale</p> <ul style="list-style-type: none"> <li>• Ensure all developments are setback from waterways</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>• Restrict future developments in sensitive environments including Mill creek</li> <li>• Review zoning to permit foreshore protection works</li> </ul>

## Bank Erosion & Sedimentation Next Best Options

NBO Description	Comments
<b>ME8.</b> Use a coordinated approach to managing bank erosion	<p>Bankstown</p> <ul style="list-style-type: none"> <li>Use speed limits in conjunction with on-ground works.</li> </ul>
<b>ME10.</b> Prioritise estuarine macrophyte communities for management that are at risk of or impacted by sedimentation and associated contaminants	<p>Bankstown</p> <ul style="list-style-type: none"> <li>Identify where estuarine macrophyte communities are at risk of sedimentation.</li> <li>Address priority actions identified in TSC Act Priority Action Statements and Recovery Plans (applicable across whole estuary).</li> </ul>
<b>ME11.</b> Enforce strict environmental controls on any approved dredging for public navigation channels	<p>Maritime</p> <ul style="list-style-type: none"> <li>Undertake study to determine the need for dredging within the estuary to support river health (hotspot locations include: Alfords Point, Lugarno and at the entrance to the Woronora River).</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>Monitor seagrass response to any dredging activities – sensitive seagrass areas include: <ul style="list-style-type: none"> <li>Mill Creek</li> <li>Still Creek</li> <li>Woronora River</li> <li>Gwawley Bay</li> <li>Woollooware Bay</li> <li>Towra Point</li> <li>Weeney Bay</li> <li>Quibray Bay</li> </ul> </li> </ul> <p>Kogarah</p> <ul style="list-style-type: none"> <li>Annual review of the Excavation Management Plan against available sediment quality data obtained during any excavations</li> <li>Hotspot location for sediment build-up: Silt fans in front of main stormwater channels and creeks draining into Kogarah Bay</li> </ul> <p>Liverpool</p> <ul style="list-style-type: none"> <li>Hotspot location for sediment build-up: <ul style="list-style-type: none"> <li>Deadmans Creek confluence</li> <li>Williams Creek confluence</li> </ul> </li> </ul>

## Foreshore Protection Next Best Options

NBO Description	Comments
<b>MF3.</b> All councils and agencies involved in the building, design and approval of new foreshore developments to ensure compliance with environmental best practices	CMA/OEH to develop a set of guidelines for best practice foreshore development
<b>MF4.</b> Maintain compliance by relevant authorities on unauthorised or inappropriate foreshore structures and uses	Encourage the community to report illegal/unauthorised structures

## Natural & Cultural Heritage Next Best Options

NBO Description	Comments
<b>MG5.</b> Use a coordinated approach to recording sites and values	Bankstown <ul style="list-style-type: none"> <li>Engage a consultant to develop a consistent and co-ordinated approach to recording sites and values</li> </ul>
<b>MG7.</b> Social and aesthetic values need to be considered in the review and preparation of new Development Control Plans (DCPs)	Kogarah <ul style="list-style-type: none"> <li>Implement a foreshore DCP to protect the visual amenity of the foreshore from future development.</li> </ul>

## Climate Change & Sea Level Rise Next Best Options

NBO Description	Comments
<b>MH2.</b> Foreshore infrastructure with likely tidal inundation risk managed in such a way as to allow adaptation to sea level rise	Bankstown <ul style="list-style-type: none"> <li>Undertake a study to determine the extent of the impacts of Sea Level River in the LGA</li> <li>Undertake a study to assess the impacts of Sea Level Rise on natural and built assets</li> </ul> Rockdale <ul style="list-style-type: none"> <li>Undertake a study to assess the ability of existing infrastructure to cope with sea level rise</li> </ul> Sutherland <ul style="list-style-type: none"> <li>Conduct risk assessment of natural and built assets</li> </ul>
<b>MH4.</b> Prioritise protection and/or restoration of estuarine vegetation where there is potential for retreat of the estuarine	Bankstown <ul style="list-style-type: none"> <li>Undertake prioritisation program once risks have been determined.</li> </ul>



vegetation	<p>Rockdale</p> <ul style="list-style-type: none"> <li>• Example of potential habitat retreat: Scott Park saltmarsh</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>• Possibly construct saltmarsh in response to sea level rise at: <ul style="list-style-type: none"> <li>○ Oyster Bay</li> <li>○ Scylla Bay</li> </ul> </li> </ul>
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## Monitoring & Evaluation Next Best Options

NBO Description	Comments
<b>MI4.</b> Undertake a review of the CZMP every 5-10 years	<p>Bankstown (applicable to all Council areas)</p> <ul style="list-style-type: none"> <li>• GRCCC to coordinate and maintain a database on the status and completion of all projects/actions from the CZMP.</li> <li>• Undertake a mini review of the CZMP 5 years after gazettal.</li> <li>• Consider undertaking a major review of the CZMP 10 years after gazettal.</li> </ul> <p>Hurstville</p> <ul style="list-style-type: none"> <li>• Contribute to the GR EMPC to evaluate and update the CZMP</li> </ul> <p>Sutherland</p> <ul style="list-style-type: none"> <li>• Include estuary management actions under the integrated planning and reporting framework</li> </ul>

## APPENDIX G: CURRENT RIVERKEEPER WORK SITES

LGA	SITE LOCATION	UPPER MID or LOWER	SUB CATCHMENT
Bankstown	Little Salt Pan Reserve, Padstow	Mid	Little Salt Pan
Bankstown	Virginius Reserve Mangroves, Padstow	Mid	Little Salt Pan
Bankstown	Little Palt Pan Creek, Padstow	Mid	Little Salt Pan
Bankstown	Bill Delauney Reserve Wetlands, Revesby	Mid	Little Salt Pan
Bankstown	Deepwater Park, Milperra	Mid	Open River Mid
Bankstown	Alan Ashton Reserve, Picnic Point	Mid	Open River Mid
Bankstown	Lambeth & Picnic Point Reserves	Mid	Open River Mid
Bankstown	Monash Reserve	Mid	Open River Mid
Bankstown	Kelso Beach Foreshore, Milperra	Mid	Open River Mid
Bankstown	Kelso Creek North, Milperra	Mid	Open River Mid
Bankstown	Vale of Ah, Milperra	Mid	Open River Mid
Bankstown	East Hills Reserve Foreshore, East Hills	Mid	Open River Mid
Bankstown	East Hills Reserve, Cook Crescent, East Hills	Mid	Open River Mid
Bankstown	Piper-Keys Reserve, Milperra	Mid	Open River Mid
Bankstown	Morgans Creek Reserve, River Road, Revesby	Mid	Open River Mid
Bankstown	Gordon Parker Reserve, Milperra	Mid	Open River Mid
Bankstown	Mirambeena Reserve, Georges Hall	Mid	Prospect
Bankstown	Garrison Point & Boom, Georges Hall	Mid	Prospect
Bankstown	Kentucky Reserve, Georges Hall	Mid	Prospect
Bankstown	Keswick Reserve	Mid	Prospect
Bankstown	Salt Pan Reserve, Revesby	Mid	Salt Pan
Bankstown	Stuart Street Reserve Mangroves, Padstow	Mid	Salt Pan
Bankstown	Bridge Street Reserve Mangroves, Padstow	Mid	Salt Pan
Bankstown	Gow Street, Padstow	Mid	Salt Pan
Fairfield	Joe Broad Reserve, Mount Pritchard	Mid	Cabramatta
Fairfield	Prout Park, Oliphant St, Mount Pritchard	Mid	Cabramatta
Fairfield	Cutler Road Foreshore, Lansvale	Mid	Chipping Norton
Fairfield	Floyd Bay Foreshore, Lansvale	Mid	Chipping Norton
Fairfield	Shearer Park, Lansvale (Including Coot Island)	Mid	Chipping Norton
Fairfield	Howard Park, Lansvale	Mid	Chipping Norton
Fairfield	Rosford Street Reserve, Smithfield	Mid	Prospect
Fairfield	Parkes Reserve, Togil St, Canley Vale	Mid	Prospect
Fairfield	Burns Creek, Horsley Drive, Fairfield	Mid	Prospect
Fairfield	Allambie Road Reserve, Endensor Park	Mid	Prospect
Fairfield	Widemere Road, Wetherill Park	Mid	Prospect
Fairfield	Hassal Road, Wetherill Park	Mid	Prospect
Fairfield	Smithfield Road, Bonnyrigg	Mid	Prospect
Fairfield	Parklea Parade, Canley Vale	Mid	Prospect
Fairfield	Prince Park, West Fairfield	Mid	Prospect
Fairfield	Baragoola Crescent, West Fairfield	Mid	Prospect
Hurstville	Lime Kiln Bay, Jinna Street, Peakhurst	Lower	Open River Lower
Hurstville	Blackbutt Ave, Lugarno	Mid	Salt Pan
Hurstville	Clarendon Road Boat Ramp, Peakhurst	Mid	Salt Pan
Hurstville	Cypress Drive, Lugarno	Mid	Salt Pan
Hurstville	Basil Street Reserve, Riverwood	Mid	Salt Pan

LGA	SITE LOCATION	UPPER MID or LOWER	SUB CATCHMENT
Hurstville	Harvey Dixon Reserve Foreshore, Peakhurst	Mid	Salt Pan
Hurstville	William Road, Riverwood	Mid	Salt Pan
Hurstville	Coleridge Road, Riverwood	Mid	Salt Pan
Kogarah	Carrs Park	Lower	Kogarah Bay
Kogarah	Dover Park, Blakehurst	Lower	Kogarah Bay
Kogarah	Claydon Reserve, Sans Souci	Lower	Kogarah Bay
Kogarah	Kogarah Bay Foreshore, Kogarah Bay	Lower	Kogarah Bay
Kogarah	Kyle Bay Foreshore, Kyle Bay	Lower	Open River Lower
Kogarah	Connells Point Reserve, Connells Point	Lower	Open River Lower
Kogarah	Donnelly Park, Kyle Bay	Lower	Open River Lower
Kogarah	Poulton Park Foreshore, Connells Point	Lower	Open River Lower
Kogarah	Neverfail Bay, Oatley	Lower	Open River Lower
Kogarah	Oatley Bay Pleasure Grounds, Oatley	Lower	Open River Lower
Kogarah	Sans Souci Park, Sans Souci	Lower	Open River Lower
Kogarah	Poulton Park Mangrove Walk, Connells Point	Lower	Open River Lower
Kogarah	Oatley Bay Boat Ramp Foreshore, Hurstville Grove	Lower	Open River Lower
Kogarah	Oatley Creek Stormwater, Hurstville Road, Hurstville Grove	Lower	Open River Lower
Kogarah	Oatley Bay Mangroves, Moreshead Drive, Connells Point	Lower	Open River Lower
Liverpool	Hoxton Park Reserve, Hoxton Park	Mid	Cabramatta
Liverpool	Cecil Hills Lakes, Cecil Hills	Mid	Cabramatta
Liverpool	Lurnea Canal, Hill Rd, Lurnea	Mid	Cabramatta
Liverpool	Brickmakers Creek, Hume Hwy, Liverpool	Mid	Cabramatta
Liverpool	Bedwell Park, West Hoxton	Mid	Cabramatta
Liverpool	Freeman Oval & Boom, Warwick Farm	Mid	Cabramatta
Liverpool	Bugong Street, Prestons	Mid	Cabramatta
Liverpool	Angle Park, Chipping Norton	Mid	Chipping Norton
Liverpool	Blackmuscat Park, Chipping Norton	Mid	Chipping Norton
Liverpool	Heron Park, Chipping Norton	Mid	Chipping Norton
Liverpool	Homestead Park, Chipping Norton	Mid	Chipping Norton
Liverpool	Haigh Park, Lake Moore, Moorebank	Mid	Chipping Norton
Liverpool	Clinches Pond, Moorebank	Mid	Chipping Norton
Liverpool	Kelso Crescent, Moorebank	Mid	Chipping Norton
Liverpool	Davy Robinson Park, Chipping Norton	Mid	Open River Mid
Liverpool	Riverside Park, Chipping Norton		Open River Mid
Rockdale	Cook Park, Brighton Le Sands	Lower	Bay Foreshore
Rockdale	Kyeemagh Beach	Lower	Bay Foreshore
Rockdale	Kyeemagh Foredune, Kyeemagh	Lower	Bay Foreshore
Rockdale	Riverside Drive Foreshore & Scott Park, Sandringham	Lower	Bay Foreshore
Rockdale	Botany Bay Foreshore, Bath St to President Ave, Monterey	Lower	Bay Foreshore
Rockdale	Botany Bay Foreshore, Henson St to Bestic St, Brighton Le Sands	Lower	Bay Foreshore
Rockdale	Botany Bay Foreshore, President to Brighton Baths, Brighton Le Sands	Lower	Bay Foreshore
Rockdale	Dolls Point Foreshore, Dolls Point	Lower	Bay Foreshore
Rockdale	Bicentennial Park, Rockdale	Lower	Scarborough Wetlands
Rockdale	Tonbridge Creek, Ramsgate	Lower	Scarborough

LGA	SITE LOCATION	UPPER MID or LOWER	SUB CATCHMENT
			Wetlands
Rockdale	Monterey St Riparian Area, Monterey	Lower	Scarborough Wetlands
Rockdale	Burlington St Riparian Area, Monterey	Lower	Scarborough Wetlands
Sutherland	Horning Street Saltmarsh, Kurnell	Lower	Kurnell & Towra
Sutherland	Silver Beach & Bonna Point, Kurnell	Lower	Kurnell & Towra
Sutherland	Marton Park, Kurnell	Lower	Kurnell & Towra
Sutherland	Port Hacking Road Reserve, Sylvania Waters	Lower	Open River Lower
Sutherland	Taren Point Reserve, Taren Point	Lower	Open River Lower
Sutherland	Woolooware Bay Cycleway, Taren Point	Lower	Open River Lower
Sutherland	Mangrove Boardwalk, Woolooware	Lower	Open River Lower
Sutherland	Production Road, Taren Point	Lower	Open River Lower
Sutherland	Gwawley Oval Mangrove & Saltmarsh, Taren Point	Lower	Open River Lower
Sutherland	Sylvania Heights Oval, Sylvania Heights	Lower	Open River Lower
Sutherland	Heritage Oyster Farm, Taren Point	Lower	Open River Lower
Sutherland	Solander Playing Field Mangroves, Woolooware	Lower	Open River Lower
Sutherland	Bonnet Bay Reserve & Burnum Burnum Reserve, Bonnet Bay	Lower	Woronora
Sutherland	Lakewood City Reserve, Bonnet Bay	Lower	Woronora
Sutherland	Forbes Creek Reserve, Engadine	Lower	Woronora
Sutherland	Bonnet Bay Boat Ramp, Bonnet Bay	Lower	Woronora





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