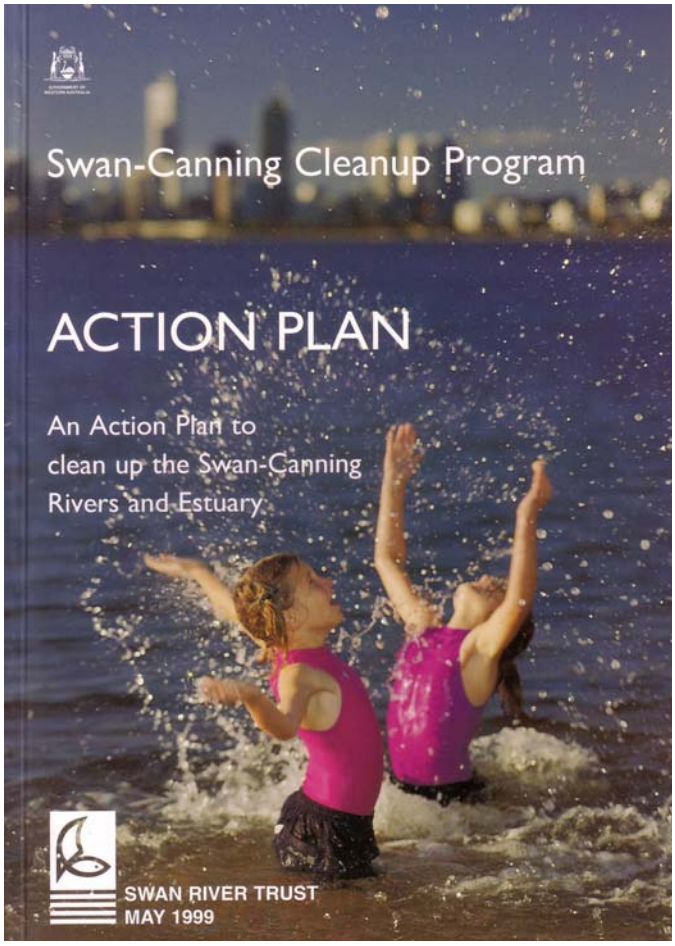

Evaluation of the Swan Canning Cleanup Program Action Plan

Final Evaluation Report

Part A: Key Evaluation Findings

Prepared for: **The Swan River Trust**

Prepared by: **Oceanica Consulting Pty Ltd**

June 2005

Report No. 394/6

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This report is "Draft" until the author and director have signed it off for final release. A "Draft" report should not be used for any purpose other than to be reviewed with the intention of generating a "Final" version.

Approved for final release: 

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Background

The Swan and Canning Rivers flow through the heart of metropolitan Perth, and have been an important economic, recreational and environmental focus for Western Australia since the establishment of the Swan River Colony in 1829. The importance of these rivers to Western Australians was highlighted in 2004 by the declaration of the Swan River as Western Australia's first Heritage Icon in commemorations for the 175th Anniversary of the Swan River Colony.

Although the Swan-Canning system is largely in a healthy state, the extent and frequency of algal blooms in its waterways has been an issue of concern for the past 20 years. In 1999 the Swan River Trust (SRT) launched the Swan-Canning Cleanup Program (SCCP) Action Plan (the Action Plan), to tackle the increasing incidence of algal blooms in the Swan-Canning system. The primary cause of the algal blooms was identified as excessive nutrient inputs to the river system.

The Action Plan was implemented as a large-scale, multi-disciplinary program that focused on four key action areas, as follows:

- Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs;
- Action Area 2. Improve planning and land use management to reduce nutrient inputs;
- Action Area 3. Modify river conditions to reduce algal blooms; and
- Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community.

The Action Plan contains 10 key recommendations and 44 sub-recommendations for actions needed to tackle algal blooms, and the original 19 projects of the Action Plan were developed specifically to address these recommendations. The Action Plan was established with flexibility for adaptive management, with an evaluation planned in the fifth year to ensure that work remained appropriate, effective and efficient. Oceanica Consulting Pty Ltd in association with Market Equity was appointed by the SRT to conduct this evaluation in June 2004.

The first five years of the Action Plan has involved 34 projects (including subsidiary projects) and a budget of approximately $17.5 million (see table below). Over $10 million external funding has also been secured. There are presently over 50 employed staff and an even greater number of individuals across industry, and catchment, community and other groups, working on Action Plan projects.

List of SCCP projects and associated level of SCCP and external funding

Project	SCCP funding	External funding
Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs	**$10,639,291**	**>$8,191,572**
• SCCP Project Management	$1,276,843	-
• Community Awareness	$1,721,638	$40,000
• Ribbons of Blue	$600,000	>632,344
• Priority Catchment Funding	$2,206,908	$6,392,154
• Swan Alcoa Landcare Program / Restoration Works - Foreshore	$998,997	$571,829
• Catchment Management - Farm Plans	$787,000	-

Project	SCCP funding	External funding
• Swan Catchment Centre	$951,000	Unknown
• Local Government Natural Resource Management (LG NRM) Policy Development	$571,825	$34,000
• Water Quality Protection Notes (WQPN) for Best Management Practices (BMPs)	$31,102	>$1,500
• Nutrient Intervention Program (includes three projects: Constructed Wetlands, Water Sensitive Design and Nutrient Intervention Program)	$1,493,978	>$519,745
Action Area 2. Improve planning and land-use management to reduce nutrient inputs	**$351,340**	**>$381,396**
• Swan-Canning Industry Survey	$50,543	$100,000
• Statutory Mechanisms	$54,638	-
• Drain Licensing	$20,000	-
• Swan Environmental Protection Policy (EPP)	$74,592	-
• Best Management Practices (BMPs) Swan-Canning, including Light Industry Project	$151,567	>$281,396
Action Area 3. Modify river conditions to reduce algal blooms	**$2,533,200**	**$1,065,655**
• Sediment Remediation	$1,230,420	$394,151
• River Oxygenation Methods (includes three projects: River oxygenation methods, Canning Oxygenation, Swan Oxygenation)	$1,092,422	$597,754
• Canning River Management Plan	$205,358	$73,750
• Landfill Leachate Investigation	$5,000	-
Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community	**$3,964,016**	**$374,956**
• Environmental Performance & Progress Reporting (includes Water Quality and Quantity, and Logistical Support)	$3,126,855	-
• Decision Support Model Expertise	$587,162	>$5,000
• Sediment Nutrient Cycling	$249,999	>$369,956

An evaluation of this work is presented in this document, as part of a two volume final evaluation report to the SRT. Two documents were prepared to ensure that the SRT obtained maximum value from the evaluation: it was important to avoid unnecessary detail that would obscure the higher level findings for the overall Action Plan and its four Action Areas, yet at the same time to present findings of benefit to the Action Plan's individual projects. The two evaluation documents are:

- **Final Evaluation Report Part A: Key Evaluation Findings**. A distillation of the high level findings of the evaluation, comprising key findings for the Action Plan as a whole, as well as the four individual Action Areas.
- **Final Evaluation Report Part B: Supporting Information**. Detailed information on the individual projects of the Action Plan, as well as important background and contextual information collected for the evaluation.

This document is the **Final Evaluation Report Part A: Key Evaluation Findings**.

Evaluation methodology

Key evaluation questions

The evaluation was based on key evaluation questions that were developed to meet specific outcomes identified by the SRT. These evaluation questions focus on three particular issues: **reflection** on the work that has been undertaken to date; **planning** for the future; and **future**

monitoring and evaluation. The key evaluation questions that were developed are shown below. A sub-set of more specific evaluation questions was also used to address each of the different action areas.

Key evaluation questions

SRT required outcome	Key evaluation question
Reflection	What has been achieved? (relative to recommended actions, stated goals and objectives of the Action Plan)
	What has been the impact of the work undertaken?
	What are the gaps in the Action Plan implementation?
Planning	How can the Action Plan implementation be improved?
	What opportunities are there to form new partnerships and strengthen links with other programs?
Future monitoring & evaluation	What are appropriate measures and targets for monitoring, evaluating and reporting future outcomes?

The approach

The SRT identified two key requisites for the evaluation: (1) the involvement of an Expert Reference Panel comprising local, national and international experts in relevant fields; and (2) close involvement of the staff and stakeholders of the SCCP Action Plan.

Key evaluation questions and the evaluation methodology were developed in close consultation with the SCCP Evaluation Working Team, an 11 member sub-committee of SRT personnel and SCCP Action Plan Project Managers, established to provide advice throughout the evaluation process. The evaluation methodology was also reviewed by the 10 members of the Expert Reference Panel.

Due to its size and complexity, the Action Plan was evaluated at three levels, as follows:

- The individual projects (ongoing and historical);
- The four Action Areas; and
- The overall Action Plan.

Techniques used to obtain information for the evaluation were:

- A project pro forma, completed by each of the current individual project managers. Pro formas for past projects were completed by the SCCP project management team.
- Examination and assessment of relevant project material (eg reports, newsletters, brochures, videos, training materials) provided by Action Plan personnel.
- Examination and assessment of the Project Management System database used to manage the SCCP Action Plan.
- Individual interviews and focus group meetings with Action Plan staff and stakeholders.
- A broad-scale survey to ascertain the level of Action Plan awareness within the general community.
- Targeted surveys of participants in Action Plan education/awareness activities, to ascertain the level of Action Plan awareness and any behaviour changes relating to nutrient reduction.
- Comparison of the Action Plan against other large-scale, multi-disciplinary programs aimed at the reduction of nutrient inputs to waterways.

The evaluation culminated in a 2-day Evaluation Forum attended by members of the Expert Reference Panel and Action Plan staff and stakeholders, where the progress of the Action Plan was reviewed and ways to improve it were discussed.

Evaluation findings

Key evaluation findings for the overall Action Plan are summarised below. Findings for the individual Action Areas are presented in the main document.

Reflection on the first phase of the Action Plan

The Action Plan aims to reduce nutrient inputs to the Swan-Canning system in order to improve its nutrient-related water quality, as measured by a reduction in the frequency, severity and duration of algal blooms. However, nutrient inputs to the Swan-Canning system are from 'diffuse' sources such as catchment runoff and groundwater (rather than point sources such as pipeline discharges), and decadal time scales are needed to address the large-scale natural resource management issues involved. Hence it was too soon to judge the overall effectiveness of the Action Plan on the basis of water quality in the Swan-Canning system. Therefore, the evaluation was based on indicators of achievement at the Action Area and project levels, particularly the level of implementation of Action Plan recommendations.

In all, 34 of the 44 Action Plan sub-recommendations have been implemented (see Table below). At the Evaluation Forum the Expert Reference Panel was, in general, impressed with many of the achievements made by the Action Plan over the past five years. The Panel considered that the return on investment, overall, was most commendable. A highlight of the Action Plan was the considerable level of external funding obtained: over $10 million was obtained from external sources, resulting in significant 'value-adding' to the $17.5 million of the Action Plan.

Status of the implementation of SCCP Action Plan (1999) recommendations

Status of SCCP Action Plan (1999) recommendations	Status of sub-recommendations
Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs (14 out of 15 sub-recommendations achieved or partly achieved)	
Recommendation 1. *Strengthen Integrated Catchment Management in the Swan-Canning catchment and support ICM groups.*	6 achieved 1 partly achieved 1 not achieved
Recommendation 2. *Raise awareness and provide support to enable the participation of land-holders, catchment and river management groups, local government and the broad community in catchment and river management (3 sub-recommendations).*	3 achieved
Recommendation 3. *Improve government coordination and support.*	1 achieved 3 partly achieved
Action Area 2. Improve planning and land-use management to reduce nutrient inputs (4 out of 9 sub-recommendations achieved / partly achieved)	
Recommendation 4. *Use statutory mechanisms including regulations, by-laws, town planning schemes and statements of planning policy to modify land-use practices and prevent or relocate polluting activities.*	1 partly achieved 2 not achieved
Recommendation 5. *Develop and adopt Best Management Practices for nutrient reduction in current land management practices and in all future developments, redevelopments and stormwater drainage schemes.*	2 partly achieved
Recommendation 6. *Use economic and regulatory mechanisms to encourage catchment, wetland and river foreshore management for nutrient reduction.*	1 partly achieved 3 not achieved
Action Area 3. Modify river conditions to reduce algal blooms (7 out of 9 sub-recommendations achieved / partly achieved)	
Recommendation 7. *Develop and implement river manipulation and remediation techniques to reduce algal blooms in the Swan-Canning system.*	6 achieved 1 partly achieved 2 not achieved

Status of SCCP Action Plan (1999) recommendations	Status of sub-recommendations
Action Area 4. Monitor river health, fill critical gaps in knowledge & report progress to the community (9 out of 11 sub-recommendations achieved / partly achieved)	
Recommendation 8. *Adopt recommended water quality targets for the freshwater tributaries and estuarine portions of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan.*	2 achieved
Recommendation 9. *Undertake investigations to fill critical knowledge gaps, monitor the river conditions and produce a "State of the Swan-Canning River System" report every five years.*	4 achieved 2 partly achieved 2 not achieved
Recommendation 10. *Report progress regularly to the community and ensure that there are opportunities for feedback and for involvement in the adoption and implementation of the Action Plan.*	1 achieved

The key achievements of the first five years of the Action Plan were as follows:

Action Area 1 Support Integrated Catchment Management to reduce nutrient inputs

- A network of catchment coordinators and catchment education officers has been established to help coordinate community and local government catchment management efforts, including fund raising. Over $6 million was raised to help fund additional staff and undertake on-ground restoration and revegetation projects works (estimated 800,000 plants; 280 km fencing, and $475,000 of weeding).
- The Swan River Trust/Alcoa landcare program has funded considerable on-ground works by community groups. 14 drains have been converted to 'living streams', 74 km of fencing has been installed, 203,000 seedlings planted and 24.8 km of foreshores along creeks, streams and rivers have been enhanced.
- The development of a well established network of catchment and community groups has been supported.
- A 3 hectare 'state-of-the-art' artificial wetland has been constructed at Liege St, to help reduce nutrient inputs to the Canning River.
- The work of the Swan Catchment Centre, 'Ribbons of Blue' school education program, and community groups has been supported, expanding the community's awareness of the problems facing the rivers and increasing its involvement in helping to keep the rivers healthy.
- Rural property holders have been helped to develop their land management skills—about 1,000 property plans have been prepared.
- The Action Plan's 'Great Gardens' program has helped urban gardeners to develop the skills that enable them to reduce nutrient losses from their gardens.
- The Eastern Metropolitan Regional Council has been funded for the development of local government environmental management policies and guidelines for improved land use management and planning.
- Water Quality Protection Notes and a Cleaner Production directory have been prepared for use by industry and local government, identifying ways to reduce contaminant inputs to the Swan-Canning system from industry.

Action Area 2 Improve planning and land-use management to reduce nutrient inputs

- A stakeholder workshop on water sensitive urban design, and a report on 'Water Sensitive Urban Design and the Development Approval Process – Identification of Issues and Potential Solutions for Better Implementation'. This work provides input to the broader issue of drainage management in the Swan-Canning catchment that is currently being examined by the State Government.
- Cleaner Productions training has been provided to assist small and medium sized businesses prevent pollution. There have been demonstrated improvements in the

environmental performance of Cleaning Industry participants following training in the Cleaner Production programme.

Action Area 3 Modify river conditions to reduce algal blooms

- Effective oxygenation techniques have been developed and applied to 2.3 km of the Canning River. Use of this technology is a 'first' for Australian waterways. Although algal blooms were not prevented (due to nutrient inputs from drains), a better habitat was created for riverine biota.
- Work has been undertaken in collaboration with CSIRO to develop and use the modified clay Phoslock™ in conjunction with oxygenation to reduce phosphorus levels in the Canning River. This is also a 'first' for Australian waterways. Phoslock™ offers considerable promise for drain treatment.
- A Canning River Management Plan, entitled 'Caring for the Canning', has been produced and is being implemented. Work has also commenced on environmental flows in the Canning River.

Action Area 4 Monitor river health, fill critical gaps in knowledge and report progress to the community

- A sound understanding has been developed of the ways in which nutrients enter the rivers and feed algal blooms.
- A comprehensive monitoring program for water quality in the estuary and catchments has been implemented. Data are placed on the Swan River Trust's 'Algal Alert' website every week, and the community is kept informed.
- Procedures have been developed and personnel trained that enable a swift response to any toxic algal blooms or fish kills in the Swan-Canning system.
- Knowledge has increased about the general ecology of the rivers and of the importance of summer groundwater flows in carrying nutrients into the rivers.
- Technically rigorous management targets have been set for the waters of the catchment and estuary, and a sampling program devised to determine compliance to those targets.
- Knowledge has increased about the role of river sediments in releasing phosphorus and nitrogen when oxygen levels in the rivers are low. It has been found that the natural sediment processes that help remove nitrogen and phosphorus from the ecosystem are unusually low in Swan-Canning estuarine sediments.
- Models have been developed that enable prediction of the quality and quantity of catchment runoff entering the Swan-Canning system. These have already been used to predict the impact of new urban development in the Southern River catchment.

Issues constraining the effectiveness, appropriateness and/or efficiency of the Action Plan were identified by collation of comments made during interviews with over 60 staff and stakeholders of the Action Plan. These issues were further discussed during the Evaluation Forum. In general terms, the consensus was that project personnel are committed, the overall program is seen as extremely worthwhile, most of the individual projects are run quite well, but the time and effort required for strategic thinking and integrated program management have been underestimated. This problem is not unique to the Action Plan: it is endemic in most large programs and large organisations.

Planning for the next phase of the Action Plan

Priority issues identified by both Action Plan personnel and Panel members were the development of a new strategic plan for the Action Plan, and the need for clear identification of roles, responsibilities and accountabilities. There is presently no clearly articulated

framework for the Action Plan that addresses these issues, and it needs to be done on two levels:

- How the Action Plan is organised INTERNALLY to ensure effective integration of projects, good leadership and direction, accountability etc; and
- How the Action Plan is organised EXTERNALLY, that is, how it fits within the overall regional picture. A framework is needed that includes all players such as the Water Corporation, Swan Catchment Council, local governments, Department for Planning and Infrastructure, and catchment groups.

During the Evaluation Forum, discussion focussed on helping to improve the overall program by identifying ways to define its strategic direction and improve coordination and management. Eight key recommendations were developed to guide the future of the Action Plan, as follows:

Key Recommendation 1: Develop a 'whole-of-Government' approach to address river health and catchment management issues. Members of the evaluation's Expert Reference Panel were unanimous on the need for a 'whole of catchment' management approach to achieve the SCCP (and SRT) goals of maintaining a healthy Swan-Canning system. The Panel recommended expanding the Swan River Trust's management responsibilities to the whole catchment (the geographical boundary of which is considered to be the Swan-Avon catchment) with a particular focus on activities that affect the estuary, preferably (in the view of many Panel members) by enacting new legislation. In addition, the existing SRT arrangements could be strengthened by:

- **Establishing the implementation of the Action Plan as a 'standing item' on the agenda of an appropriate Ministerial Council; and**
- **Providing serious support of the Action Plan by a Senior Officers Group (SOG) comprising representatives from the relevant Government agencies. Any appointees to the SOG are to be at a Director level (or higher), to ensure they can make decisions on behalf of their respective agencies/institutions.**

A whole-of-Government approach is needed to properly address the health of the rivers; particularly as healthy rivers are only achievable when the surrounding catchment is also healthy. Land-use planning, infrastructure and local government decision-making have to be undertaken on a catchment basis: there is no other way to achieve the goals of the SRT/Action Plan. A catchment-based approach would also provide significant advantages in facilitating actions, gaining efficiencies and avoiding duplication. The Expert Reference Panel was concerned that the mandate of the SRT is not sufficient to achieve this 'catchment focus' without the engagement and commitment of agencies responsible for planning, water management and agriculture, and Local Governments. It was noted that the SRT recognises this issue, and is recommending legislative changes to address it.

Key Recommendation 2. Develop the strategic direction of the next phase of the Action Plan, and a business plan that reflects the strategic direction. This should incorporate the following components:

- **Revision of the Action Plan goals and objectives;**
- **A conceptual model of nutrient inputs to, and environmental processes in, the Swan-Canning system;**
- **The scale of nutrient reduction needed, how this is to be achieved (allowing for the impacts of urban expansion, land use change and climate change) and the time-frames involved;**
- **Clarification of the role of the community and community capacity, and a review of the mechanisms by which the existing community/NRM framework participates and delivers outcomes in the Action Plan;**

- **Prioritisation and integration of the existing Action Areas and projects; and**
- **Inclusion of new approaches and/or projects (as appropriate).**

The Action Plan was produced in 1999. Given the vast number of project achievements, and other changes that have occurred over the past five years, it is important to review the initial SCCP objectives and develop the strategic direction for the next phase of the program.

A lot of good work has been achieved at a project level, but the program needs a 'big picture', or conceptual framework to guide the program and integrate knowledge and achievements from the different projects. No evidence was seen of any integration of the achievements across projects or Action Areas. It is important to develop a conceptual model that encapsulates the most current environmental understanding of the Swan-Canning catchment and waterways: this model should identify the contribution and significance of different nutrient sources (such as industry, urban areas, groundwater, drains, rural areas) to ascertain what can be done to address each of these components. The potential impacts of future urban expansion, land use change and climate change will also need to be examined. This conceptual model should be used to re-examine and affirm the SCCP Action Plan, and develop an implementation strategy for the next 5 years. The strategic plan must be based on the best available information on the scale of nutrient reduction required to reduce algal blooms, and how this is to be achieved.

A key task to undertake while developing the strategic approach would involve research to identify the perceived barriers and benefits of each activity that is related to the health of the Swan and Canning Rivers; and use this information to design a more effective overall program. This strategic plan needs to be based on consideration of the community's expectations for the Swan-Canning system, the efficacy of various management approaches/techniques and the willingness of identified parties to implement them, and the socio-economic costs of implementing those management approaches/techniques. Long term issues are being addressed, and require a commitment to work through long-term time frames, with in-built review at regular intervals, as is recognised in the NRM framework.

The business plan that accompanies the strategic plan for the next stage of the Action Plan should reflect the prioritisation of projects to best achieve the overall goals and objectives/direction. The business plan should then be used as a basis for discussion/negotiation with collaborative partners (and for funding leverage). The strategic plan and/or business plan must include short-term and long-term milestones, and how they contribute towards the achievement of the SCCP goals and objectives.

The SRT has an opportunity to revitalise the SCCP, retaining everything of value and producing a strategic framework that integrates the Action Areas and projects, and reassesses the balance of effort directed into various activities, using a more adaptive management approach. This must be based on a realistic assessment of the ability of current management approaches/techniques to achieve required outcomes. The revised Action Plan thus produced should then get commitment/sign-off by collaborative partners (who should also have been involved in this exercise), to reinforce and ensure the whole-of-Government approach.

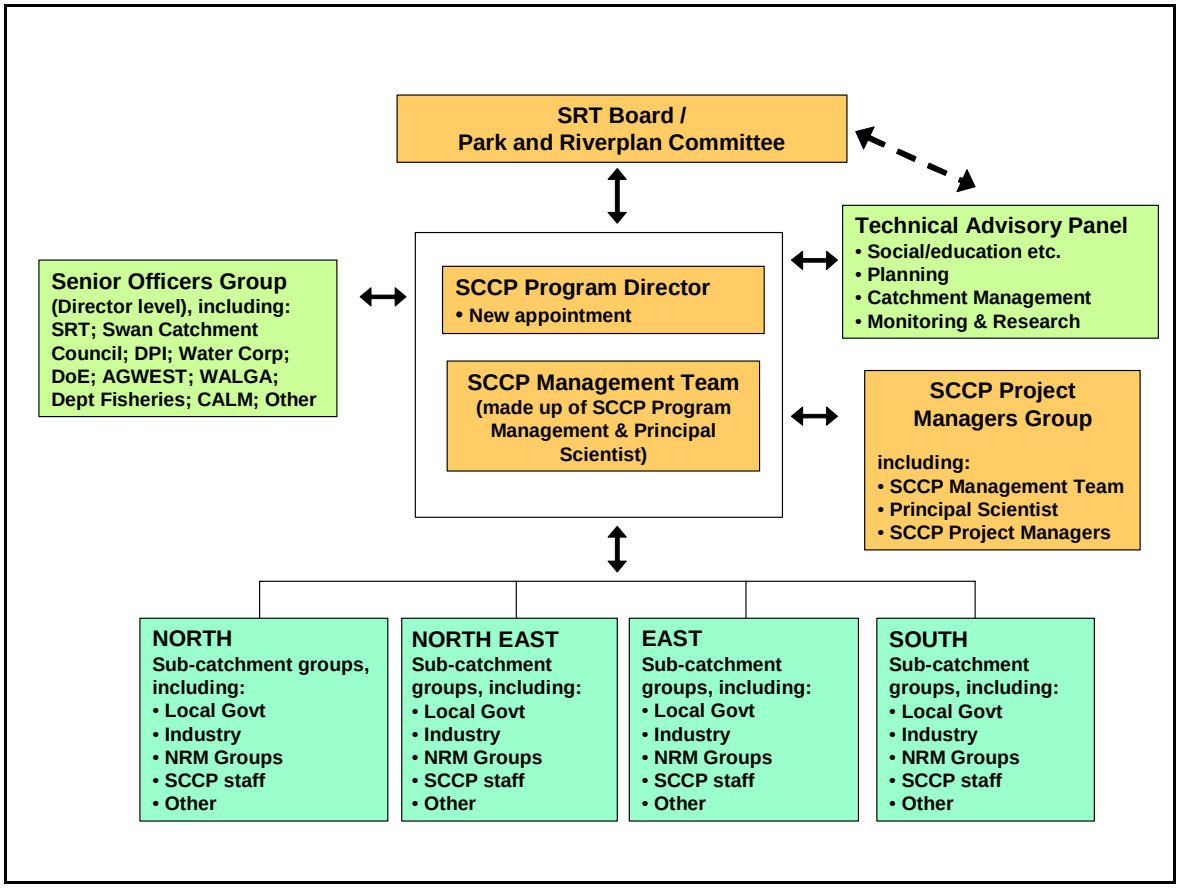
Key Recommendation 3. Improve the program management, coordination and leadership of the Action Plan by:

- **Appointing a Program Director and a Principal Scientist;**
- **Establishing an external Technical Advisory Panel;**
- **Continuing the SRT's recently established Park and Riverplan Committee; and**
- **Re-convening the Senior Officers Group with appointees at the Director level.**

The SCCP Action Plan is the SRT's 'flagship' program and is allocated over half of the Trust's budget. The size and complexity of the Action Plan, and the expansion of ICM/NRM in the region, necessitates more effective program management, coordination and leadership than currently exists for the program. Important considerations for improvement are:

- The appointment of a Program Director who reports directly to the SRT Board, and is primarily responsible for the ongoing management of the strategic direction, effective delivery, reporting and continued development of the program. The person must have a proven capability in managing a large-scale and diverse project.
- The appointment of a Principal Scientist (who is also an excellent communicator) with responsibility for the quality and relevance of the scientific effort, and for the effective integration and application of its outcomes. The Principal Scientist should also be expected to support the Program Director in promoting the value of the program to all stakeholders, particularly in regard to the scientific achievements and their application to better management of the river catchments.
- Higher level involvement in Action Plan management by the Swan River Trust's senior Planner, to assist with program direction and meshing of planning, science & catchment management activities etc.
- Provision of advice from an external, independent Technical Advisory Panel (TAP) that has members with expertise in the fields of estuarine ecology, planning, catchment management, program management, monitoring, research, social science etc. Several models for TAP function and operation can be examined (eg based on other large scale programs) to choose the most appropriate one.
- Use the SRT's Park and Riverplan Committee to ensure more effective strategic ('top-down') management of the Action Plan.
- Advice and management of inter-agency relationships and activities at the most senior level with the Senior Officers Group.

An example of how the program might be more effectively coordinated is presented below.



Note: Sub-catchment areas proposed in recognition of existing NRM sub-regional groups of the Swan-Canning region.

Key Recommendation 4. Develop and implement an appropriate monitoring and evaluation framework, and key performance indicators (KPIs) for the short-term (1–5 years), medium-term (5–10 years) and long term (>10 years) to directly gauge the overall effectiveness of the SCCP towards reducing nutrients and improving water quality. These include indicators of both 'outputs' and 'outcomes' that can be assessed against specified targets, for example:

- **Operational outcomes (such as relative changes in community awareness (%); or adoption of BMPs over time); and**
- **Environmental outcomes (such as relative changes in nutrient levels (%), or other indicators of ecosystem health).**

Considerable difficulty was experienced in evaluating the effectiveness of the Action Plan, mainly because there were no specific criteria or key performance indicators (KPI) to compare against the achievements. KPIs need to address **outcomes** (changes in community awareness and behaviour, changes in ecosystem condition), not just **outputs** (e.g. number of workshops held or BMPs implemented). Both operational (e.g. % community awareness achieved) and environmental condition objectives (eg. % nutrient reduction achieved) need to be established to gauge the extent of success. In particular, information on the extent of reduction of nutrient inputs into the waterways is required in order to be able to assess the overall program's effectiveness. The time frames required to achieve changes in nutrient inputs need to be recognised, by means of short-term (1–5 years), medium-term (5–10 years) and long term (>10 years) KPIs. There is also a need for more ecosystem health indicators (eg seagrass health, the absence of fish kills), in order to be able to determine whether estuarine health is improving or deteriorating.

The monitoring and evaluation framework and KPIs should be developed by staff and stakeholders during a series of workshops, as part of the strategic review identified in Key Recommendation 2.

Key Recommendation 5. Focus on building effective partnerships

No matter what overall structure is finally agreed, the effective management of the Swan-Canning system will only be achieved if effective partnerships are built with local government, the Water Corporation, State Government agencies (especially the Department for Planning and Infrastructure) and ICM/NRM groups (especially the Swan and Avon Catchment Councils). Significant opportunities for building such partnerships are identified in this document.

The commitment and effort to develop effective partnerships should not be underestimated. Considerable effort should be spent in investigating and developing real and mutually beneficial relationships.

Key Recommendation 6. Secure funding for high priority, long-term projects. Funding needs to be secured for the time-frames realistically needed for completion of the projects in order to:

- **Enable complex, inter-related catchment and waterways issues to be adequately addressed.**
- **Increase the capacity to lever additional funds from other sources; and**
- **Attract and retain competent project staff.**

It is recommended that Action Plan projects of high priority are provided with security of funding that extends beyond one financial year. It is important to secure funding for such projects for at least a 3-5 year period. As the SCCP addresses long-term management issues, funding for some projects will need to be secured for even longer periods—which also requires recognition of the ongoing management cost. The extension of funding

commitments to individual projects (for salaries particularly) over a longer term would greatly benefit the program for the reasons listed above.

Key Recommendation 7. Develop and implement a research and development program for the SCCP

Currently, there exists sufficient knowledge of the Swan-Canning estuary to permit clear management priorities to be established. However, this is not the case for the catchment, where considerably more information is urgently required. At the Evaluation Forum, Expert Reference Panel members were surprised that the Action Plan did not include a research and development program.

It is recommended that a R&D program be established as part of any future Action Plan. Management of the Swan-Canning system will only be effective if it is underpinned by good scientific knowledge of the system. In addition, the community awareness / education component of SCCP would benefit greatly from research into the different methods and approaches used to elicit social behaviour change; and applying this knowledge to develop a more focussed and effective program.

Key Recommendation 8. Address land-use planning issues by collaborating with local governments to investigate ways to formally incorporate nutrient reduction strategies in their local planning strategies.

As highlighted in Key Recommendation 1, land-use planning, infrastructure and local government decision-making have to be undertaken on a catchment basis to address the health of the Swan Canning system: healthy rivers are only achievable when the surrounding catchment is also healthy. The Expert Reference Panel considered that planning and land use management to reduce nutrient inputs has been the least successful component of the Action Plan implementation; despite its critical role in ensuring the success of the Program. As the success of the Action Plan ultimately depends on managing existing land uses and new developments in the catchment, it is vital that the SCCP works collaboratively with State and local planning authorities. Land use planning needs to address issues such as:

- Regional planning and policies that recognise the significance of managing nutrients in from land activities both within the Management Area and throughout the catchment;
- Modification of current town planning practices to focus on local planning strategies that will address land use and drainage conflicts;
- Implementation of Best Management Practices for nutrient reduction in current and future developments and stormwater drainage schemes;
- Investigation of mechanisms to encourage improvements in catchment, wetland and river foreshore management; and
- Continued development of catchment management plans and ICM/NRM activities.

Greater emphasis should attach to local planning strategies, rather than reliance on planning by-laws and scheme provisions. Work would be best facilitated by basing local planning strategies on a sub-catchment level, and should include provision for incentives and entitlements.

In overview, it is recommended that the SRT immediately undertakes a strategic review of the Action Plan to determine its future directions. This would encompass the production of an updated SCCP Action Plan, and will require a series of forward planning workshops or similar processes over about six months addressing each of the different Action Areas and the program as a whole. In addition, discussions and negotiations with different State agencies and local governments need to be commenced to ensure commitment and ownership of the

strategic direction. The Program Director appointment (see Key Recommendation 3) should be actively pursued during this time, with an appointment being made as early as possible.

A series of recommendations for each of the four Action Areas is also provided in this document.

Future monitoring and evaluation of the Action Plan

There are many approaches to monitoring and evaluation frameworks, and even more key performance indicators (KPIs), that could potentially be used for the Action Plan. Key Recommendation 4 specifies that a monitoring and evaluation framework and KPIs be developed by staff and stakeholders during a series of workshops, as part of the strategic review identified in Key Recommendation 2. It was considered more appropriate for Action Plan staff and stakeholders to undertake this exercise, rather than adopting the views of an external party, as a greater sense of understanding and ownership (and more relevant KPIs) will be achieved. Some potential KPIs are identified in this document, as input to this exercise.

Key Recommendation 2 also includes a workshop of staff and stakeholders to revise and re-structure the Action Plans goals and objectives, and re-cast the Action Areas. This approach is recommended because the existing goals and objectives of the Action Plan were derived during extensive discussions by the original Action Plan Task Force, and subsequently reinforced by community consultation. Therefore it is also appropriate that the revised goals, objectives and Action Areas be made available for public comment. The revised goals and objectives should also be the basis for the prioritisation of projects and ultimately the strategic business plan. Comments on the Action Plan's goals and objectives are provided in this document, as input to this process.

Finally, it is important to acknowledge that while efforts to reduce nutrient inputs and the occurrence of algal blooms are underway within the Action Plan, two significant external factors are also impacting on the Swan-Canning system:

1. The population of Perth continues to expand, via increased housing density in established suburbs and urban development of new areas. The nutrient concentrations of catchment runoff and groundwater from urban areas can be higher than from rural areas, and are certainly higher than from undeveloped land. The expected degree of urban development over the next 20 years has the potential to outstrip the efforts of the Action Plan, unless there are strict planning controls in place for new developments.
2. In the past 30 years there have been declines in rainfall and greater declines in catchment runoff and groundwater recharge. The overall effect on the Swan-Canning system has been less river runoff and lower nutrient inputs to the system, but this has been countered by less flushing of the system and an extended 'autumn' period, with stratified conditions that favour the growth of certain algae such as the recent *Karlodinium* blooms.

Future monitoring and evaluation of the SCCP Action Plan will therefore need to factor in any impacts due to population growth and climate change. This is covered in Key Recommendation 2, which requires the inclusion of such impacts in the revised strategic plan.

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List of commonly used acronyms

Abbreviation	Name
Action Plan	Swan-Canning Cleanup Program Action Plan
AGWEST	Department of Agriculture Western Australia
BICM	Bayswater Integrated Catchment Management
BMP	Best Management Practice
CALM	Department of Conservation and Land Management
CMP	Catchment Management Plan
DEP	Department of Environmental Protection
DOE	Department of Environment
DPI	Department for Planning & Infrastructure (formerly Ministry for Planning)
EPA	Environmental Protection Authority
EWT	Evaluation Working Team
ICM	Integrated Catchment Management
LCDC	Land Conservation District Committee
LCG	Local community group
LG	Local Government
MfP	Ministry for Planning (currently Department for Planning & Infrastructure
MRS	Metropolitan Regional Scheme
NHT	Natural Heritage Trust
NRM	Natural Resource Management
PMG	Project Managers Group
RMC	River Management Committee
SAICM	Swan Avon Integrated Catchment Management
SCC	Swan Catchment Council
SCCP	Swan-Canning Cleanup Program
SCEPP	Swan-Canning Environmental Protection Policy
SOG	Senior Officers Group
SRT	Swan River Trust
WRC	Water & Rivers Commission
SPP	Statement of Planning Policy
TPS	Town Planning Scheme
WAERF	Western Australian Estuarine Research Foundation
WAMA	Western Australian Municipal Association
WAPC	Western Australian Planning Commission
WC	Water Corporation
WSD	Water Sensitive Design
WSUD	Water Sensitive Urban Design

1. Introduction

1.1 Background to the Swan-Canning Cleanup Program (SCCP) Action Plan

The Swan-Canning system is a network of rivers, watercourses, drains and tidally affected waterways on the coastal plain around Perth, Western Australia. The Swan and Canning Rivers flow through the heart of metropolitan Perth (Figure 1.1), a city of more than 1.4 million people. The Swan-Canning system and the nearby coastal plain are an important historical, economic, recreational and environmental focus for Western Australia, and have been since the establishment of the Swan River Colony in 1829. The importance of these rivers to Western Australians was highlighted in 2004 by the declaration of the Swan River as Western Australia's first Heritage Icon in commemorations for the 175th Anniversary of the Swan River Colony.

Figure 1.1 City of Perth, located adjacent to the Swan River, Western Australia (Photo: D. Tracey, Aquatic Sciences Branch, Water & Rivers Commission)

Although the Swan-Canning system is largely in a healthy state, the extent and frequency of algal blooms in these waterways has been an issue of concern for the past 20 years. In 1994 the State Government commissioned the Swan River Trust (SRT) to undertake a five-year program to investigate the cause(s) of algal blooms and prepare a comprehensive plan to reduce their extent, frequency and duration. This became the Swan-Canning Cleanup Program (SCCP). A Task Force was established in late 1995 to advise on this program, prepare an Action Plan and report back to the Trust and Government. The Program produced a final five-year Action Plan, including an Implementation Strategy, in 1999.

In 1999, the SRT launched the Swan-Canning Cleanup Program Action Plan (the Action Plan); a large-scale, multi-disciplinary program designed to tackle the increasing incidence of algal blooms in the Swan and Canning Rivers. The cause of the algal blooms had been identified as excessive nutrient inputs from rural and urban catchments, and the Action Plan originally comprised 19 major projects

involving several State agencies, regional and local governments, and catchment groups, aimed at reducing these nutrient inputs. Approximately $17.5 million has been spent implementing the Action Plan over the past five years.

The Action Plan is based on a four-point approach to reduce algal blooms in the Swan-Canning estuarine system, as follows:

- Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs;
- Action Area 2. Improve planning and land use management to reduce nutrient inputs;
- Action Area 3. Modify river conditions to reduce algal blooms; and
- Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community.

The Action Plan contains 10 key recommendations (and 44 sub-recommendations) for specific actions needed to tackle algal blooms. The original projects of the Action Plan were developed specifically to address these recommendations and sub-recommendations.

The Action Plan was also established with flexibility for adaptive management, with an **evaluation** planned in the fifth year (i.e. in 2004) to ensure that work remained appropriate, effective and efficient.

1.2 The evaluation

1.2.1 Requirements of the evaluation

In June 2004 Oceanica Consulting Pty Ltd in association with Market Equity Pty Ltd was appointed by the SRT to conduct the evaluation of the first five years of implementation of the Action Plan. The purpose of this evaluation was to ascertain the achievements of the Action Plan to date, and refocus it in the light of scientific information and inevitable changes in institutional arrangements and community priorities that have occurred since 1999. The SRT plans to use the evaluation to help define the next suite of actions needed to secure the health of the Swan-Canning system.

Due to the size and complexity of the Action Plan, the SRT specified that the evaluation should include:

- Involvement of an Expert Reference Panel to oversee the evaluation project and participate in an evaluation forum; and
- Close involvement of SCCP staff and stakeholders to access their knowledge and ideas relating to the implementation of the SCCP Action Plan. Key individuals and groups involved included: SRT staff; SRT Senior Officers Group; SCCP Project Managers Group; and SCCP Evaluation Working Team (EWT, a sub-committee of SRT personnel and SCCP Project Managers, specifically established to provide advice throughout the evaluation process).

The SRT also specified that the evaluation be undertaken in four stages, each with specific deliverables, as shown in Table 1.1. The reports that were produced by Oceanica and Market Equity to address each of these stages are also listed.

Table 1.1 Project stages and deliverables for SCCP Action Plan evaluation specified by Swan River Trust

Project stage	Deliverables & associated reports produced
Stage 1. Development of methodology	**Deliverable:** • The Swan River Trust approves the methodology, evaluation questions, membership of the Expert Reference Panel and project time line. **Report:** • Oceanica, 2004. Evaluation of the Swan-Canning Cleanup Program Action Plan: Report on Evaluation Methodology, August 2004, Report no. 394/1.

Stage 2. Data gathering, collation and preliminary interpretation	**Deliverable:**
	• Preliminary report presenting the evaluation data and findings for consideration by the Expert Reference Panel;
	• Arrangements for the evaluation forum including convening the Expert Reference Panel in place.
	Reports:
	• Oceanica, 2004. Evaluation of the Swan-Canning Cleanup Program Action Plan: Completed pro formas for Action Areas 1, 2, 3 and 4 (four volume set), Report no. 394/2.
	• Oceanica, 2004. Evaluation of the Swan-Canning Cleanup Program Action Plan: Preliminary Evaluation Results. Two versions:
	  • Report to Expert Reference Panel, November 2004, Report No. 394/3.
	  • Report to Senior Officers Group and Project Managers Group, February 2005, Report No. 394/4.
	• Market Equity, 2004. Swan-Canning Cleanup Program Evaluation Research, December 2004, Report No. J3812.
	• Oceanica, 2005. Evaluation of the Swan-Canning Cleanup Program Action Plan. National and International Approaches to Nutrient Management in Waterways, April 2005, Report 394/8.

Stage 3. SCCP Evaluation Forum, involving Expert Reference Panel	**Deliverables:** • A completed evaluation forum, with a forum debrief report completed by the Expert Reference Panel. **Report:** • Oceanica, 2005. Evaluation of the Swan-Canning Cleanup Program Action Plan: Evaluation Forum 7th & 8th December 2004, February 2005, Report No. 394/5

Stage 4. Follow up from SCCP evaluation forum and preparation of Evaluation Report	**Deliverable:**
	• A final evaluation report, that reports on the outcomes of the Evaluation Forum following exploration of the feasibility of possibilities identified in the Evaluation Forum and that:
	  • Provides a definitive statement on implementation of the SCCP Action Plan since 1999; and
	  • Reports on indicators of effectiveness of the SCCP Action Plan's four action areas and project scales; and
	  • Makes recommendations for future priorities for SCCP and opportunities to improve it.
	Report:
	• Oceanica, 2005. Evaluation of the Swan-Canning Cleanup Program Action Plan: Final Evaluation Report, April 2005. Two document set :
	  • Part A: Key Evaluation Findings. Report No. 394/6.
	  • Part B: Supporting Information. Report No. 394/7.

1.2.2 This document

This document addresses Stage 4 of the evaluation, the results of which have been structured as a two volume report to the SRT, as follows:

- Final Evaluation Report Part A: Key Evaluation Findings.
- Final Evaluation Report Part B: Supporting Information.

A two document approach was adopted to ensure maximum value from the evaluation: it was important to avoid unnecessary detail that would obscure the higher level findings for the overall Action Plan and the four Action Areas, yet at the same time impart findings of benefit to the individual projects of the Action Plan. Hence, Part A contains a distillation of the key findings of the evaluation, while Part B contains detailed information about the Action Plan projects collected and collated for the evaluation, as well as environmental and contextual information on the Swan-Canning system.

This document is the **Final Evaluation Report, Part A: Key Evaluation Findings**.

The document is structured as follows:

- **Chapter 1:** Background to the evaluation, and a brief description of the evaluation approach;
- **Chapter 2:** An overview of the SCCP Action Plan;
- **Chapter 3:** Key evaluation findings for the overall Action Plan;
- **Chapter 4:** Key evaluation findings for Action Area 1 – Support Integrated Catchment Management to reduce nutrient inputs;
- **Chapter 5:** Key evaluation findings for Action Area 2 – Improve planning and land-use management to reduce nutrient inputs;
- **Chapter 6:** Key evaluation findings for Action Area 3 – Modify river conditions to reduce algal blooms; and
- **Chapter 7:** Key evaluation findings for Action Area 4 – Monitor river health, fill critical gaps in knowledge and report progress to the community.

Interpretation and recommendations provided in this document have been examined, discussed and amended/endorsed by the Expert Reference Panel.

1.3 Evaluation approach

1.3.1 Development of methodology

The evaluation methodology was developed with the close involvement of the EWT established specifically for the evaluation. The EWT included Action Plan senior personnel, and representatives from the Action Plan's four Action Areas, as follows:

- Dr Jane Latchford, Environmental Manager, Swan River Trust;
- Adrian Tomlinson, SCCP Program Manager, Swan River Trust;
- Kirilee King, SCCP Evaluation Project Manager, Swan River Trust;
- Wendy Yorke, Communications Manager, Swan River Trust;
- Kelly Exell, SCCP Catchments Project Manager, Swan River Trust;
- Peter Tapsell, Senior Planner, Swan River Trust (a late inclusion in the EWT);

- Malcolm Robb, Manager, Aquatic Sciences Branch, Department of Environment;
- Greg Ryan, Eastern Metropolitan Regional Council;
- Liz Western, Swan Catchment Centre;
- Marion White, Swan Catchment Centre; and
- Nancye Gannaway, Project Manager, Property Planning project, Department of Agriculture.

The evaluation methodology was reviewed by the Expert Reference Panel and approved by the SRT Board, and is available as a stand alone document (see Stage 1 in Table 1.1).

1.3.2 Key evaluation questions

The Action Plan is a large and complex program which necessitated evaluation at three different levels, as follows:

- The individual projects;
- The four Action Areas; and
- The overall Action Plan.

The evaluation was based around six key evaluation questions that were developed to meet the outcomes specified by the SRT (Table 1.2). The key evaluations questions were intentionally broad and non-specific, and so were used at all three levels.

Table 1.2 Key evaluation questions addressed across the SCCP Action Plan

SRT required outcome	Key evaluation question
Reflection	What has been achieved? (relative to SCCP recommendations, stated goals and objectives)
	What has been the impact of the work undertaken?
	What are the gaps in the Action Plan implementation?
Planning	How can the Action Plan implementation be improved?
	What opportunities are there to form new partnerships and strengthen links with other programs?
Future monitoring & evaluation	What are appropriate measures and targets for monitoring, evaluating and reporting future outcomes?

Evaluation questions specific to individual projects and Action Areas were also developed and used, due to major differences in the type of work undertaken. For example, Action Area 1 involves projects that emphasis community awareness and training, while Action Area 3 is largely technical in nature and involves complex scientific research.

The evaluation also had to consider whether the project or Action Area was addressing short (0–5 years), medium (5–10 years) or long-term (>10 years) ways of improving water quality. This was because the nutrients responsible for the algal blooms in the Swan-Canning system are largely from 'diffuse' sources, comprising surface runoff and groundwater from urban and rural land. The reduction of diffuse nutrient sources involves considerable time and effort: it requires changes in land use planning and management; changes in community awareness, attitude and behaviour; and time for all these changes to actually take effect. The time frames typically involved are recognised in the National Natural Resource Management (NRM) Monitoring and Evaluation Framework (Figure 1.2).

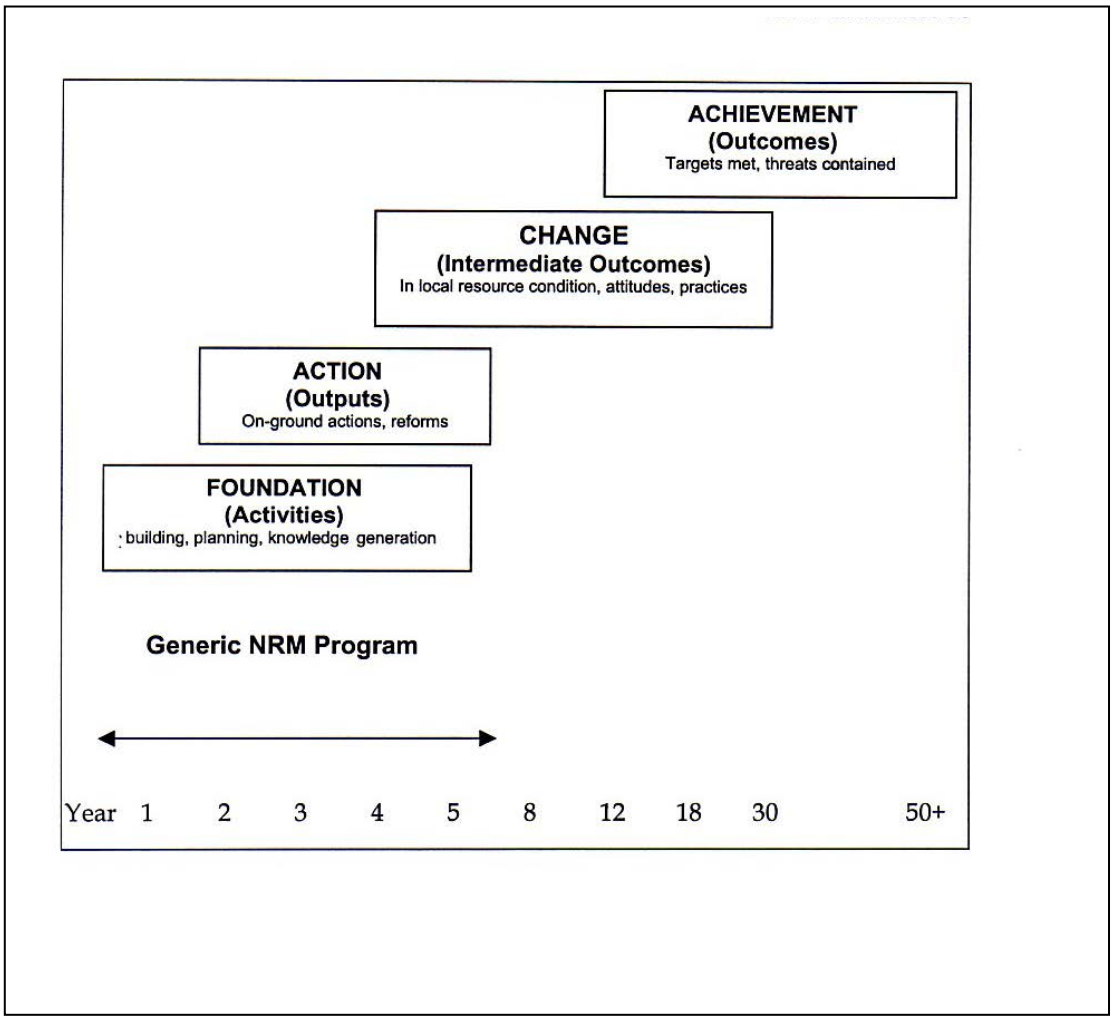


Figure 1.2 NRM timeframes

1.3.3 Information used

Multiple sources of information were used in the evaluation, as follows:

- Project pro formas completed by the current project managers, containing basic information on project objectives, deliverables, outputs/outcomes, constraints etc. The pro forma approach was used because initial consultation revealed there were large differences in the amount and availability of information for different projects. Also, project personnel were not always aware of the linkage of their project to Action Plan recommendations, and so 'primary' and 'secondary' responsibilities for fulfilling the recommendations were designated by the EWT, SCCP Program Management staff, or relevant project managers.
- Relevant project material provided by the project manager and/or project management team, including scientific reports, annual reports, promotional material (newsletters, brochures, videos etc), educational and training material, Ministerial briefing notes, briefing notes to the SRT Board, meeting minutes, evaluation reports, and any other relevant material.
- The Project Management System database used to manage the Action Plan.
- Individual interviews and focus group meetings with approximately 60 SRT staff, Action Plan project staff and stakeholders. 15 interviews were undertaken with project managers in Phase 1 (project familiarisation) and over 30 interviews in Phase 2 (evaluation). About half of the interviews in Phase 2 were with individuals, and half with two or more participants.

- A broad-scale survey undertaken to ascertain the level of **awareness** of the Action Plan within the general community, the level of **knowledge** about the causes of algal blooms and what individuals can do to help, and what interviewees were doing to help (**action**). Based upon advice from Panel member Dr Doug McKenzie-Mohr, questions were also included to determine the **barriers** preventing people from taking action.
- Targeted surveys of people involved in specific Action Plan education/awareness raising activities, undertaken to assess their level of **knowledge** before and after involvement in the activities, what they were doing differently as a result, and any **barriers** preventing them from taking action. The targeted surveys were also undertaken to compare the effectiveness of the various activities in achieving their specific 'teaching messages', and included some questions from the general community survey to see if the level of **awareness**, **knowledge** and **action** about the Action Plan and algal blooms differed from results for the general community survey. The Action Plan activities surveyed were:
  - Great Gardens;
  - Corporate Care Days;
  - Heavenly Hectares/Property Planning; and
  - Swan River Action Kit.
- Comparison of the SCCP against other similar programs from interstate and overseas. This was achieved via a literature review of three case studies that were chosen for two reasons. Firstly, they covered a range of water bodies (from turbid, tropical coastal waters to a clear, temperate freshwater lake) and approaches to nutrient management (from a voluntary, collaborative approach to one based more on regulation). Secondly, the evaluation's Expert Reference Panel included three members who are involved in these programs, thereby allowing a more complete analysis than readily obtainable from documentation. The case studies were:
  - Moreton Bay Waterways and Catchment, South-East Queensland
  - Glenelg-Hopkins Catchment, Victoria; and
  - Lake Taupo, Central North Island, New Zealand.

The majority of the information obtained from the above sources is documented in the Preliminary Evaluation Results Report (see Stage 2 in Table 1.1), and has also been distilled in the Final Evaluation Report Part B. The pro formas for Action Areas 1, 2, 3 and 4 are also available as separate documents, as is the report on the general community survey and targeted surveys, and the literature review of the case studies (see Stage 2 in Table 1.1). Comprehensive notes from meetings and interviews with Action Plan personnel have also been prepared, but interviewees provided feedback on the understanding that they would remain anonymous. Therefore meeting notes cannot be made available without the prior permission of the interviewees.

1.3.4 Involvement of the Expert Reference Panel

The members of the Expert Reference Panel (the Panel) were chosen in consultation with the EWT and the SRT Board, and comprised local, national and international experts in fields of relevance to the Action Plan. The Panel members are listed in Table 1.3, along with a brief description of their relevant areas of expertise.

Table 1.3 Members of the Expert Reference Panel and their area of expertise

Panel Member & Affiliation	Action Area	Area of Expertise
International		
Dr Doug McKenzie-Mohr McKenzie-Mohr & Associates, Canada	1	Social behaviour change, survey research, evaluation, marketing.
Dr Tony Petch Environment Waikato, New Zealand	1 - 4	Catchment management, community involvement, science for planning.
National		
Dr Eva Abal Moreton Bay Waterways & Catchments Partnership, Brisbane	1 - 4	Catchment and waterways research and management, ecosystem health monitoring, planning and strategy development, stakeholder engagement and community programs.
Prof Barry Hart Water Studies Centre, Monash University, Victoria; CRC for Freshwater Ecology	1 & 4	Aquatic chemistry (heavy metal and nutrient biogeochemistry), water quality management and ecological risk assessment.
Dr Rod Connolly Griffith University, QLD	1 & 4	Aquatic processes, ecological function of estuaries and intertidal wetlands
Prof Neil Gunningham School of Resources, Environment & Society, Australian National University, Canberra	2	Regulatory and other approaches for control of non point source pollutants.
Local		
Mr Anthony Sutton Department of Environment	1 - 4	Cockburn Sound Environmental Management Plan, Geocatch Catchment Council
Mr Terry Martin WAPC	2, 3 & 4	Planning and water issues
Dr Roy Green Deputy Chairman, EPA	1-4	Environmental/Natural resource management
Ms Kathleen Broderick CRC for Salinity, University of WA	1 & 4	Community involvement and education, particularly in relation to catchment management.

The involvement of the Panel was mainly through examination of the Preliminary Evaluation Results (PER) report, and (for most Panel members) subsequent participation in a 2-day Evaluation Forum (7th & 8th December 2004) along with past and present staff and stakeholders of the Action Plan. The PER report documented the achievements of the Action Plan implementation, plus feedback from Action Plan staff and stakeholders on the achievements of the work undertaken, gaps in the program, and areas for improvement. This information was supplemented during the Evaluation Forum by presentations from Action Plan staff, followed by discussions between Panel members and Action Plan staff and stakeholders. Those Panel members who were unable to attend the Forum provided feedback on the PER report, the outcomes of the Forum, and (in the case of Dr Doug McKenzie-Mohr) the results of the general community survey and targeted surveys undertaken for the evaluation.

During the Evaluation Forum the Panel reviewed the progress of the Action Plan, discussed its future directions, and derived key recommendations for the evaluation. The outcomes of the Evaluation Forum provide much of the content in this Final Evaluation Report. The results of the Evaluation Forum are also available as a separate document (see Stage 3 in Table 1.1).

2. The SCCP Action Plan

2.1 Development of the Action Plan

The Action Plan was designed to meet six objectives that were, in turn, considered necessary to achieve the five goals of the SCCP (Table 2.1). The specific actions required in the Action Plan were identified in 10 key recommendations (and 44 sub-recommendations), for implementation across the four Action Areas (Table 2.2).

Table 2.1 Goals and objectives of the SCCP

SCCP Goals	SCCP Objectives
1. Public health and amenity: Algal blooms are kept at a level where there is no threat to public health and amenity and they are not a nuisance to the community. Toxic algal blooms are kept to a minimum. **2. Ecological function**: Water quality in the Swan-Canning system is suitable for maintaining a healthy ecosystem. People can swim or catch fish at any time. **3. Catchments and targets**: Contaminants in stream runoff leaving the catchments are within set targets. Rural catchments are managed to be productive and profitable, and are attractive and affordable places to live. **4. New urban and industrial areas**: Areas are designed so that discharges have reduced contaminant levels and meet set targets before entering the rivers, while they still remain attractive and affordable places to live and productive and profitable places to work. **5. Older urban and industrial areas**: Older urban and industrial areas are modified over time to reduce contaminant levels so that drainage discharges meet set targets before entering the rivers.	1. Understand the mechanisms that trigger algal blooms and control their growth. 2. Identify how and where nutrients enter and cycle within the rivers and determine the best way to minimise these inputs. 3. Help maintain water quality both now and in the future by managing river sediments to reduce the store of organic material and nutrients. 4. Help change land-use categories and practices, planning processes and decision-making to reduce the amount and concentration of contaminants, especially nutrients, leaving rural and urban catchments; and to obtain greater community, government and business involvement in the catchments to reduce nutrient inputs. 5. Inform the community and involve it in developing the Swan-Canning Action Plan. 6. Reduce the frequency of occurrence of algal blooms.

Table 2.2 Action Areas and 10 key recommendations of the SCCP Action Plan (44 sub-recommendations not shown)

Recommendations
Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs
Recommendation 1. *Strengthen Integrated Catchment Management in the Swan-Canning catchment and support ICM groups.*
Recommendation 2. *Raise awareness and provide support to enable the participation of land-holders, catchment and river management groups, local government and the broad community in catchment and river management.*
Recommendation 3. *Improve government coordination and support.*
Action Area 2. Improve planning and land-use management to reduce nutrient inputs
Recommendation 4. *Use statutory mechanisms including regulations, by-laws, town planning schemes and statements of planning policy to modify land-use practices and prevent or relocate polluting activities.*
Recommendation 5. *Develop and adopt Best Management Practices for nutrient reduction in current land management practices and in all future developments, redevelopments and stormwater drainage schemes.*
Recommendation 6. *Use economic and regulatory mechanisms to encourage catchment, wetland and river foreshore management for nutrient reduction.*
Action Area 3. Modify river conditions to reduce algal blooms
Recommendation 7. *Develop and implement river manipulation and remediation techniques to reduce algal blooms in the Swan-Canning system.*

Recommendations
Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community
Recommendation 8. *Adopt recommended water quality targets for the freshwater tributaries and estuarine portions of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan.*
Recommendation 9. *Undertake investigations to fill critical knowledge gaps, monitor the river conditions and produce a "State of the Swan-Canning River System" report every five years.*
Recommendation 10. *Report progress regularly to the community and ensure that there are opportunities for feedback and for involvement in the adoption and implementation of the Action Plan.*

As noted in Section 1.1, the original projects of the Action Plan were developed to address the recommendations of the Action Plan. For the most part, each project has been created to address a particular recommendation or sub-recommendation, but there is a degree of overlap, with projects often contributing to the achievement of recommendations other than those for which they have the primary responsibility. A simplified list of the projects undertaken, including the SCCP funding and external funding received, is provided below (Table 2.3) [The various mergers, divisions and name changes with projects over the past five years have been omitted to avoid confusion]. Comprehensive details of these projects are provided in Final Evaluation Report B: Supporting Information.

Table 2.3 Action Plan projects and associated SCCP funding and external funding

Project title	SCCP funding	External funding
Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs	**$10,639,291**	**>$8,191,572**
• SCCP Project Management	$1,276,843	-
• Community Awareness	$1,721,638	$40,000
• Ribbons of Blue	$600,000	>632,344
• Priority Catchment Funding	$2,206,908	$6,392,154
• Swan Alcoa Landcare Program / Restoration Works - Foreshore	$998,997	$571,829
• Catchment Management - Farm Plans	$787,000	-
• Swan Catchment Centre	$951,000	Unknown
• LG NRM Policy Development	$571,825	$34,000
• Water Quality Protection Notes (WQPN) for Best Management Practices (BMPs)	$31,102	>$1,500
• Nutrient Intervention Program (includes three projects: Constructed Wetlands, Water Sensitive Design and Nutrient Intervention Program)	$1,493,978	>$519,745
Action Area 2. Improve planning and land-use management to reduce nutrient inputs	**$351,340**	**>$381,396**
• Swan-Canning Industry Survey	$50,543	$100,000
• Statutory Mechanisms	$54,638	-
• Drain Licensing	$20,000	-
• Swan Environmental Protection Policy (EPP)	$74,592	-
• Best Management Practices (BMPs) Swan-Canning, including Light Industry Project	$151,567	>$281,396
Action Area 3. Modify river conditions to reduce algal blooms	**$2,533,200**	**$1,065,655**
• Sediment Remediation	$1,230,420	$394,151
• River Oxygenation Methods (includes three projects: River oxygenation methods, Canning Oxygenation, Swan Oxygenation)	$1,092,422	$597,754
• Canning River Management Plan	$205,358	$73,750

Project title	SCCP funding	External funding
• Landfill Leachate Investigation	$5,000	-
Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community	**$3,964,016**	**$374,956**
• Environmental Performance & Progress Reporting (includes Water Quality and Quantity, and Logistical Support)	$3,126,855	-
• Decision Support Model Expertise	$587,162	>$5,000
• Sediment Nutrient Cycling	$249,999	>$369,956

It is the Action Plan's recommendations and sub-recommendations that have been the key parameters used to evaluate its achievements and effectiveness.

2.2 Implementation of the Action Plan

2.2.1 Role of the Swan River Trust

The Swan River Trust (SRT) was established in 1989 and constituted under the Swan River Trust Act 1988. It is a State Government Agency responsible to the Minister for the Environment. The SRT works with State and local government and the community to protect and manage the Swan and Canning River systems.

The SRT consists of an eight-member Board, supported by a core staff unit of about 35, with extra administrative and technical support provided by the Water and Rivers Commission[1] under the Swan River Trust Act 1988.

The functions of the SRT are to:

- Manage and protect the river system and work with local government and other bodies to provide facilities around the rivers;
- Advise the Minister for the Environment on development proposals within the Trust's Management Area;
- Control and prevent pollution of the rivers and keep them clear of rubbish;
- Advise on and control erosion of river banks;
- Provide advice to local governments and the Western Australian Planning Commission on town planning issues affecting the rivers; and
- Promote community awareness of issues affecting the health of the river system and increase community involvement in river protection and restoration.

The SRT Board meets twice per month, while daily operation of the SRT is conducted by its professional, technical and administrative staff. Decisions are made by the SRT Board based on advice from its staff, and any other technical or professional personnel it considers necessary to perform its function.

[1] The Water and Rivers Commission, the Department of Environmental Protection and the Keep Australia Beautiful Council are to be amalgamated into a Department of Environment, but legislation reflecting these changes has yet to be passed by Parliament.

2.2.2 Coordination and management of the Action Plan

Senior Officers Group and Project Managers Group

When implementation of the Action Plan commenced in 1999, a Senior Officers Group (SOG) and Project Managers Group (PMG) were established to coordinate the agencies involved, oversee implementation of the projects and make sure the objectives of the Action Plan were achieved. The SOG and PMG were formed in direct response to Action Plan recommendations 3.2 and 3.3, respectively, with the PMG intended to report to the SOG. The role of the PMG was to coordinate projects and activities to implement the Action Plan, and the role of the SOG was to audit and manage agreements defining responsibilities for implementation of the Action Plan.

Implementation Plan

In order to coordinate and monitor implementation of the Action Plan, allocate resources and ensure that an agreed process was followed, an Implementation Plan was prepared that outlined actions necessary to implement the specific recommendations and allocate responsibility to particularly agencies. The Implementation Plan also covered coordination of community awareness and involvement programs and set standards for accountability.

Accountability

The Action Plan recognised that Government initiatives must be formally accountable to Treasury, Cabinet and the public, and that open accountability would allow parties to monitor progress and provide the opportunity to influence changes in directions where necessary. Annual reporting against Performance Indicators was identified as one way of demonstrating accountability.

Accountability also requires clear identification of responsibilities, and so the Action Plan identified the need to define and allocate responsibility for implementing the Action Plan and developing Partnership Agreement and Memorandums of Understanding: this was seen as a task for the SOG.

The Environment Manager of the Swan River Trust presently reports the progress of the Action Plan directly to the SRT Board via briefing notes, presentations at Board meetings, and annual reports.

3. Evaluation of overall Action Plan

3.1 Reflection on the first phase of the Action Plan

3.1.1 Background

The first five years of the Action Plan has involved 34 projects (including subsidiary projects) and a budget of approximately $17.5 million. There are presently over 50 employed staff and an even greater number of individuals across industry, and catchment, community and other groups, working on Action Plan projects.

A summary of funding for the Action Plan is provided in Table 3.1, and compared to the funding allocation originally envisaged when the Action Plan was developed ($14 million). The additional $3,500,000 provided has mostly been for river modification techniques (Action Area 3) and monitoring (Action Area 4).

Table 3.1 Summary of funding for Action Plan

Action Area	Original funding in Action Plan		Actual expenditure, 1999 to 2004	
	Amount	% of total	Amount	% of total
Action Area 1	$10,000,000	71.4%	$10,639,291	60.8%
Action Area 2	$500,000	3.6%	$351,340	2.0%
Action Area 3	$2,000,000	14.3%	$2,533,200	14.5%
Action Area 4	$1,500,000	10.7%	$3,964,016	22.7%
TOTAL	$14,000,000	100%	$17,487,847	100%

3.1.2 Achievements

In terms of the time scales required for natural resource management, the first five years of the Action Plan has largely involved a capability building and partnership building phase, and it is too soon to judge the effectiveness of efforts to reduce diffuse nutrient inputs in terms of water quality in the Swan-Canning system. For this reason, Action Plan achievements were assessed on the basis of the Action Plan recommendations implemented. The major achievements of the Action Plan are summarised below.

In all, 34 of the 44 Action Plan recommendations have been implemented. The extent of implementation of each recommendation has been simply represented by a tick or a cross, in the four tables below (Table 3.2 to Table 3.5). **It is important to highlight that there are numerous underlying assumptions and qualifiers associated with the level of implementation of each of the recommendations.** For example, the appropriateness, effectiveness and efficiency with which these individual recommendations were implemented are not shown; nor are the significant barriers or constraints of some projects accounted for. The Final Evaluation Report Part B must be referred to in order obtain a more complete understanding of the project achievements.

Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs

The status of the recommendations from Action Area 1 is presented in Table 3.2.

Table 3.2 Status of Action Area 1 recommendations from Action Plan

Rec'n. No.	Recommendation	Achieved
1.1	Provide executive and administrative support for Integrated Catchment Management Groups in the Swan-Canning system	✓
1.2	Appoint Catchment Coordinators to support completion and implementation of Catchment Management Plans in the four focus catchments (Ellen Brook, Southern-Wungong River, Canning River and Bayswater Main Drain) to reduce nutrient input	✓
1.3	Support and establish additional ICM groups and appoint Catchment Coordinators to further ICM processes and to develop and implement Catchment Management Plans in the other catchments that have high nutrient concentrations entering the rivers and estuary (South Belmont Main Drain, Bennett Brook, Bannister Creek, Mills Street Main Drain, Blackadder Creek, Yule Brook, Susannah Brook and Bickley Brook)	✓
1.4	Complete the development and implementation of the Swan Avon regional strategy ("Working together" document prepared by the SAICM and the Swan Catchment Centre) which develops partnerships with key stakeholder groups involved in planning and management of the river and catchment	✓
1.5	Prepare catchment management guidelines for the reduction of nutrient losses from rural and urban catchments	✗
1.6	Provide support for development and implementation of approved farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities, including part-time farm activities	✓ (partly
1.7	Provide seed funding to determine feasibility and cost effectiveness to design and construct artificial wetlands as demonstration sites for stripping nutrients in the Mills Street and South Belmont main drains	✓
1.8	Provide funds to fence, stabilise, and revegetate watercourses in the catchments as part of developing and implementing Catchment Management Plans	✓
2.1	Implement a cross-media public awareness campaign involving a variety of information sources for the general public to encourage changes in individual behaviour and involvement in river-care and catchment management	✓
2.2	Through the Swan Catchment Centre provide locally applicable technical and administrative support, information, advice and training to those involved in or affected by catchment management to enable their effective involvement in catchment management decision-making and practical activities	✓
2.3	Extend Ribbons of Blue program to ensure better support of school and community education programs linked to practical action for the Swan-Canning river environment	✓
3.1	Establish formal and financial agreements involving State government agencies and local governments defining responsibilities for implementation of the Action Plan and ICM and audit progress after five years	✓ (partly)
3.2	Establish a Senior Officers Group to audit and manage agreements defining responsibilities for implementation of the Action Plan	✓ (partly)
3.3	Establish a Project Managers Group that reports to the Senior Officer Group to coordinate projects and activities to implement the Action Plan and an Interdepartmental Catchment Management Liaison Unit to review land-use controls and define agency responsibilities	✓ (partly)
3.4	Financially support the appointment of environmental officers to formulate and prepare local government natural resource management strategies and policies	✓

The major achievements of Action Area 1 are:

- A network of catchment coordinators and catchment education officers has been established to help coordinate community and local government catchment management efforts, including fund raising. Over $6,000,000 extra funds were raised to help fund additional staff and undertake on-ground restoration and revegetation projects works (800,000 plants; 280 km fencing, and $475,000 of weeding).
- The joint-funded Swan River Trust/Swan Alcoa Landcare Program has funded considerable on-ground works by community groups. 14 drains have been converted to 'living streams', 74km of fencing installed, 800,000 seedlings planted and 24.8 km of foreshores along creeks, streams and rivers enhanced.
- The development of a well established network of catchment and community groups has been supported.
- A 3 hectare 'state-of-the-art' artificial wetland has been constructed at Liege St, to help reduce nutrient inputs to the Canning River.
- The work of the Swan Catchment Centre, Ribbons of Blue, and community groups has expanded community awareness of the problems facing the rivers and the community has become increasingly prepared to play their part in helping to keep the rivers healthy.
- Rural property holders have been helped to develop their land management skills—about 1,000 property plans have been prepared.
- The 'Great Gardens' program has helped urban gardeners to develop the skills that enable them to reduce nutrient losses from their gardens.
- The Eastern Metropolitan Regional Council has been funded for the development of local government environmental management policies and guidelines for improved land use management and planning.
- Water Quality Protection Notes and a Cleaner Production directory have been prepared for use by industry, and local government.

Action Area 2. Improve planning and land-use management to reduce nutrient inputs

The status of the recommendations from Action Area 2 is presented in Table 3.3.

Table 3.3 Status of Action Area 2 recommendations from Action Plan

Rec'n. No.	Recommendation	Achieved
4.1	Incorporate Water Sensitive Design and nutrient source reduction principles and goals of the Swan Canning Clean Up Program and the Swan-Canning Environmental Protection Policy, in regional planning and town planning schemes and scheme amendments to ensure that proposed developments are consistent with these principles and goals	✓ (partly)
4.2	Prepare a statement of planning policy for the Swan-Canning coastal catchment that incorporates the principles and goals of the Action Plan and that is also complementary to the Swan-Canning Environmental Protection Policy; and establish a group to review land-use tables in town planning schemes to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them.	✗
4.3	Improve land-use controls for intensive agriculture such as horticulture that are not adequately addressed by present legislation or planning policy to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them	✗

Rec'n. No.	Recommendation	Achieved
5.1	Establish a Best Management Practice (BMP) working group to evaluate existing BMPs and prepare a program to develop and implement BMPs to achieve SCCP objectives	✓ (partly)
5.2	Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management	✓ (partly)
6.1	Evaluate the establishment of and mechanism for financing a land acquisition fund to buy back sensitive or degraded land and change current land-uses	✗
6.2	Develop foreshore management agreements with landowners to reduce nutrient losses to watercourses, through fencing and rehabilitation of foreshores and erosion control with initial priority given to Ellen Brook and Southern-Wungong River	✗
6.3	Provide State and local government incentives to encourage catchment rehabilitation by rewarding landowners for adopting practices that reduce nutrient inputs to the river	✗
6.4	Investigate licensing for drains discharging into the Swan-Canning rivers, as a tool for controlling nutrient inputs	✓ (partly)

The major achievements of Action Area 2 are:

- A stakeholder workshop on water sensitive urban design, and a report on 'Water Sensitive Urban Design and the Development Approval Process – Identification of Issues and Potential Solutions for Better Implementation'. This work provides input to the broader issue of drainage management in the Swan-Canning catchment that is currently being examined by the State Government.
- Cleaner Productions training has been provided to assist small and medium sized businesses prevent pollution. There have been demonstrated improvements in the environmental performance of Cleaning Industry participants following training in the Cleaner Production program.

Action Area 3. Modify river conditions to reduce algal blooms

The status of the recommendations from Action Area 3 is presented in Table 3.4.

Table 3.4 Status of Action Area 3 recommendations from Action Plan

Rec'n. No.	Recommendation	Achieved
7.1	Develop river oxygenation methods to an operational scale, undertake oxygenation trial in the Swan River to reduce nutrient availability and implement if successful	✓
7.2	Operate oxygenation plant in the Canning River to reduce nutrient availability	✓
7.3	Develop sediment remediation methods to an operational scale and apply the technique in the Swan and Canning rivers to reduce nutrient availability	✓
7.4	Develop and evaluate new river intervention techniques to reduce algal blooms	✓
7.5	Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques	✓

Rec'n. No.	Recommendation	Achieved
7.6	Evaluate nutrient and pollution risk from former landfill sites bordering the rivers and drains	✗
7.7	If risk is unacceptable undertake appropriate management action to reduce nutrient and pollutant leaching from former landfill sites bordering the rivers and drains	✗
7.8	Develop and implement a management plan for the Canning River based on environmental flow allocations and controlled discharges from the Kent Street Weir	✓
7.9	Restore ecological function of the Swan-Canning foreshores and secure erosion protection	✓ (partly)

The major achievements of Action Area 3 are:

- Effective oxygenation techniques have been developed and applied to 2.3 km of the Canning River. Use of this technology is a 'first' for Australian waterways. Although algal blooms weren't prevented (due to nutrient inputs from drains), a better habitat was created for riverine biota.
- Work has been undertaken in collaboration with CSIRO to develop and use the modified clay Phoslock™ in conjunction with oxygenation to reduce phosphorus levels in the Canning River. This is also a 'first' for Australian waterways. Phoslock™ —which is being patented—offers considerable promise for drain treatment.
- The Canning River Management Plan, entitled 'Caring for the Canning', has been produced. Work has also commenced on environmental flows in the Canning River.

Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community

The status of the recommendations from Action Area 4 is presented in Table 3.5.

Table 3.5 Status of Action Area 4 recommendations from Action Plan

Rec'n. No.	Recommendation	Achieved
8.1	Adopt recommended water quality targets for the freshwater tributaries (Table 8) of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan	✓
8.2	Prepare water quality targets and a compliance table for the estuarine and tidal portions of the Swan-Canning system for nutrients, dissolved oxygen, chlorophyll and phytoplankton cell counts	✓
9.1	Implement a monitoring program and report on: all water quality data and compliance against targets annually; water quality trends at intervals of 3 years; success of catchment management actions after 5 years; data against goals and objectives targets established by the Action Plan every 5 years	✓ (excluding 5-year report)
9.2	Investigate nitrification-denitrification and carbon cycles in relation to estuarine sediment nutrient cycling	✓
9.3	Complete development and validation of estuary and catchment models and use them to model system fluxes of nutrients including carbon	✓ (partly)
9.4	Develop decision support systems to predict and demonstrate the consequences of changes to the catchment or the estuarine system, to optimise management practices	✓ (partly)
9.5	Develop expertise within the WRC in the application of WAERF estuarine process and decision support models	✓
9.6	Evaluate the relationship between zooplankton and low levels of contaminants other than nutrients in the Swan-Canning system	✗

Rec'n. No.	Recommendation	Achieved
9.7	Investigate sediments in areas for potential dredging in the Swan River	✗
9.8	Investigate sediments in relation to groundwater flows and nutrient fluxes in the Canning River	✓
10.1	Coordinate reporting to the community and ensure that there are opportunities for community feedback on implementation of the Action Plan	✓

The major achievements of Action Area 4 are:

- A sound understanding of the ways in which nutrients enter the rivers and feed algal blooms has been achieved.
- A comprehensive monitoring program for water quality in the estuary and catchments has been implemented. Data are placed on the Swan River Trust's 'Algal Alert' website every week, and the community is kept informed.
- Procedures have been developed and personnel trained that enable a swift response to any toxic algal blooms or fish kills in the Swan-Canning system.
- Knowledge has increased about the general ecology of the rivers and of the importance of summer groundwater flows in carrying nutrients into the rivers.
- Technically rigorous management targets have been set for the waters of the catchment and estuary, and a sampling program devised to determine compliance to those targets.
- Knowledge has increased about the role of river sediments in releasing phosphorus and nitrogen when oxygen levels in the rivers are low. It has been found that the natural sediments processes that help remove nitrogen and phosphorus from the ecosystem are unusually low in Swan-Canning estuarine sediments;
- Models have been developed that enable prediction of the quality and quantity of catchment runoff entering the Swan-Canning system. These have already been used to predict the impact of new urban development in the Southern River catchment.

At the Evaluation Forum the Expert Reference Panel was, in general, impressed with many of the achievements made by the Action Plan over the past five years. The Panel considered that the return on investment, overall, was most commendable.

Another key achievement of the first five years of the Action Plan was the level of external funding obtained (Table 3.6). Over $10 million was obtained from external sources, resulting in considerable 'value-adding' to the Action Plan.

Table 3.6 Action Plan funding and external funding

Action Area	Action Plan funding	External funding
Action Area 1	$10,639,291	$8,191,572
Action Area 2	$351,340	>$381,396
Action Area 3	$2,533,200	$1,065,655
Action Area 4	$3,964,016	>$374,956
TOTAL	**$17,487,847**	**>$10,013,579**

3.1.3 Gaps

During the Evaluation Forum, the following major gaps in the Action Plan were identified:

1. The goals and objectives of the SCCP can only be achieved by a whole-of-catchment-based approach that includes both the Swan and Avon catchments. The present exclusion of the Avon catchment from scientific and management aspects of the Action Plan is not helpful. The Action Plan needs to be part of an overall Swan-Canning catchment management strategy, and (in the view of many ERP members) preferably under the direction of a strong catchment management authority. .
2. There is insufficient strategic direction or vision for this large-scale, multi-disciplinary program. While considerable achievements have been made at an individual project level (and commended by the Panel), these activities and achievements have not been coordinated and integrated with sufficient attention to their contribution to the delivery of the overall objectives of the program. Considered and detailed strategic direction is required for each of the projects, four Action Areas, and for the overall program. Insufficient strategic direction has resulted in the following effects:
    a. Management and prioritisation of projects in the Action Plan has been predominantly from the 'bottom up'. Implementation of the different projects has proceeded with unstandardised and variable levels of tracking, review and coordination by the SCCP Project Team, SRT and the SOG. The project scope and direction has therefore (necessarily) been determined independently by individual project managers and/or officers to a large extent; and some projects have subsequently deviated from the project's initial purpose. This is particularly evident in the catchment management projects from Action Area 1 (e.g. Priority Catchment Funding, Farm Plans, Swan Catchment Centre, Foreshore Restoration Works projects); where the focus on achieving the Action Plan recommendations has been 'diluted' to varying degrees, invariably by issues that are of considerable importance in their own right, but issues that are not central to achieving the objectives of the Action Plan nor that should be funded by the Action Plan. Given the extremely high level of commitment by catchment groups and staff to the Action Plan, it is essential that there be a more balanced approach that includes 'top down' leadership and management. 'Top-down' strategic direction is particularly important in prioritising the different components of the program, including partitioning of resources between the four Action Areas, as well as prioritising the different components of individual projects.
    b. A number of projects are stretched and under-resourced (note particularly the Light Industry Project and Environmental Flows for the Canning River Management Plan). Prioritisation of projects would help to alleviate this problem, recognising that low priority projects may need to be sacrificed in order to achieve the greater good.
    c. A major focus of the Action Plan has been on the four 'first priority' and eight 'second priority' sub-catchments within the region (from a total of 15 out of 31 sub-catchments initially monitored). It is important to incorporate the protection of other sub-catchments that are still in a healthy condition.
3. It is critical to establish effective external linkages and partnerships with other agencies to ensure the success of the Program, particularly the water service providers (Water Corporation), planning authorities (Department for Planning & Infrastructure) and land use managers (Local Government Authorities and Department of Agriculture). It is not possible to achieve the SCCP goals and

objectives without the commitment, ownership and active participation of these organisations.

4. Internal coordination and linkages between Action Areas needs improving. Currently, the extent of coordination and linkage of projects largely depends on the networking initiatives of individual project managers and officers. A process is needed to ensure better integration and coordination of the set of projects forming the overall program. Communication and education have a critical role to play across all projects.
5. Audit & review – Fiscal and performance reporting and review have been insufficient. Rigorous and formal independent audit and review of all projects is essential on an annual basis for the effective management of this large-scale Program.
6. Gaps in system understanding. The extent of nutrient reduction needed to reduce/minimise algal blooms (in terms of a % load reduction) is not known. Information on nutrient loads from different sources within the catchments is required, as is an allocation of where the effort should be focused to reduce these inputs. This includes determination of "the size of elephant" (i.e. the nutrient input problem), and using performance indicators for environmental condition. An important point related to this issue has subsequently been raised, extending this challenge to consider the scale of environmental change, as well as the cost and time required to achieve the desired change. Addressing these challenges would create a realistic expectation of what is required and what can actually be achieved within a particular timeframe.
7. There is widespread interest in the activities and outcomes of this program, from senior government to community-based level. Hence, more extensive reporting of the program needs to be undertaken across all levels. It was evident from the evaluation that considerable knowledge about SCCP and related issues, as well as corporate and project history, have been lost from the SCCP over the past five years as a result of insufficient reporting. Gaps in the reporting include:
    a. A strategic plan and vision for the program.
    b. Detailed, collated information on projects, Action Areas (particularly Action Area 1 and 2) and the overall program.
    c. Quality controlled and assured fiscal (and milestone) data management.
    d. Lack of available communication tools, such as descriptive models, or 'catchment pictures' that synthesise the understanding of the Swan-Canning system, and relevant information that could be used by senior officers to engage other agencies in the program.
    e. An implementation plan/strategy for the program, including details of priorities and activities of the Action Areas.
    f. Sufficiently detailed scope of works, performance indicators and milestones for all projects.
    g. Detailed annual reporting on individual projects, addressing project aims, achievements, budgets and expenditure so that progress is recorded. This should include a review of how the individual projects are progressing in delivering the objectives of the Action Plan (and therefore provide the rationale for any changes in project specifications).
    h. A detailed annual report of the Action Plan implementation that collates information from individual project reports; and provides a useful reference to SCCP project staff and SRT stakeholders on the work that has been undertaken (e.g. why, where and who was involved), providing

information on the overall program and hence tracking the overall delivery of Action Plan objectives.

3.2 Planning for the next phase of the Action Plan

3.2.1 Issues / Areas for improvement

General comments

Large, multidisciplinary programs require 'top-down' strategic direction and frameworks. Programs that spend public money must be designed to achieve results efficiently and effectively (and demonstrate transparency and accountability). Work towards goals is best directed within a consistent framework, otherwise resources are wasted on re-inventing wheels, or on inefficient approaches—as can happen with a purely and untargeted 'bottom-up' approach to management. The feedback from interviews with Action Plan staff and stakeholders, and discussions with Expert Reference Panel members, is that the Action Plan is presently driven more by the 'bottom-up' approach. 'Bottom-up' support is, of course, also essential to achieve program goals. Without the support of those who actually have to run the program, operational components will not be implemented, or will be implemented in a slow and inefficient manner.

In general terms, the Action Plan is like most large programs, in that project personnel are committed, the program is seen as extremely worthwhile, most of the individual projects are run quite well, but the time and effort required for strategic thinking, integrated program management and the synthesis of results have been underestimated. This problem is not unique to the SCCP Action Plan: it is endemic in most large programs and large organisations.

Lessons from national / international case studies: common factors contributing to success

As described in Section 1.3.2, the evaluation included examination of three national / international programs that tackle nutrient inputs to waterways, and that were of a similar scale and complexity to the Action Plan. The three case studies were:

- Moreton Bay Waterways and Catchment, South-East Queensland
- Glenelg-Hopkins Catchment, Victoria; and
- Lake Taupo, Central North Island, New Zealand.

None of the case studies was without challenges, but there was a suite of key attributes that were central to the frameworks developed for successfully managing nutrients. These were as follows:

- Appropriate statutory frameworks.
- Strong leadership and co-ordination.
- Strong and consistent political and agency commitment.
- Strong co-operative and collaborative stakeholder partnerships.
- Close links between management agencies and Local Government.
- Clear identification of roles, responsibilities and accountabilities.
- Integration of environmental, social, cultural and economic considerations and integration across jurisdictions and science/policy/implementation.

- Commitment to an adaptive management framework.
- High levels of stakeholder and broader community ownership and involvement.
- Effective management of conflict between different stakeholders.
- Funding over and above agency budgets and targeted investment.
- Compatible and comprehensive incentives and disincentives.
- Specific and measurable performance indicators.
- Enforceable management actions.
- Auditing of environmental outcomes.

The Action Plan

When the SCCP Action Plan was devised, it was recognised that the development of decision support systems and models for the Swan-Canning system would enable future actions and recommendations to be prioritised, but that realistically this would not occur until after the first five years of implementation. This point has now been reached with the information collected to date, and the decision support tools developed. A clearly articulated conceptual model of how the Swan-Canning system works would not only serve to synthesise the current understanding of the system, but more importantly would be a useful basis for prioritising management actions. This in turn would enable a key issue for the Action Plan to be addressed: development of a strategic plan.

Another key issue (also highlighted during examination of the case studies) was the need for clear identification of roles, responsibilities and accountabilities. There is presently no clearly articulated framework for the Action Plan that addresses this, and it needs to be done on two levels:

- How the Action Plan is organised INTERNALLY to ensure effective integration of projects, good leadership and direction, accountability etc; and
- How the Action Plan is organised EXTERNALLY, that is, how it fits within the overall regional picture, A framework is needed that includes all players such as Water Corporation, Swan Catchment Council, local governments, Department for Planning and Infrastructure, and catchment groups. There is currently a relatively low level of commitment from other State agencies (compared to other similar programs being undertaken elsewhere).

3.2.2 Key Recommendations for overall Action Plan

During the Evaluation Forum the available information gathered/presented was examined and used to develop key recommendations to help improve the overall Action Plan. These recommendations address recurring issues that emerged during examination of the four Action Areas as well as the overall Action Plan, and form the basis of the eight final recommendations from the evaluation.

Key Recommendation 1: Develop a 'whole-of-Government' approach to address river health and catchment management issues. Members of the evaluation's Expert Reference Panel were unanimous on the need for a 'whole of catchment' management approach to achieve the SCCP (and SRT) goals of maintaining a healthy Swan-Canning system. The Panel recommended expanding the Swan River Trust's management responsibilities to the whole catchment (the geographical boundary of which is considered to be the Swan-Avon catchment) with a particular focus on activities that affect the estuary, preferably (in the view of many Panel members) by

enacting new legislation. In addition, the existing SRT arrangements could be strengthened by:

- **Establishing the implementation of the Action Plan as a 'standing item' on the agenda of an appropriate Ministerial Council; and**
- **Providing serious support of the Action Plan by a senior officers group (SOG) comprising representatives from the relevant Government agencies. Any appointees to the SOG are to be at a Director level (or higher), to ensure they can make decisions on behalf of their respective agencies/institutions.**

The goodwill and intent of the SCCP Action Plan to achieve a healthy Swan-Canning system is recognised, but a clear assessment of limitations is needed. The Action Plan needs to ascertain what work can be achieved, and what can be realistically influenced, through the SRT.

The Expert Reference Panel was unanimous about the need for a whole-of-catchment approach to properly address the health of the rivers; particularly as healthy rivers are only achievable when the surrounding catchment is also healthy. This can only be achieved by a whole-of-government and whole-of-community approach to catchment management. Land-use planning, infrastructure and local government decision-making have to be undertaken on a catchment basis: there is no other way to achieve the goals of the Trust/SCCP. A catchment-based approach would also provide significant advantages in facilitating actions, gaining efficiencies and avoiding duplication. The Panel was concerned that the mandate of the SRT is not sufficient to achieve this 'catchment focus' without the engagement and commitment of agencies responsible for planning, water management and agriculture, and Local Governments. It was noted that the SRT recognises this issue, and is recommending legislative changes to address it.

Key Recommendation 2. Develop the strategic direction of the next phase of the Action Plan, and a business plan that reflects the strategic direction.

This should incorporate the following components:

- **Revision of the Action Plan goals and objectives;**
- **A conceptual model of nutrient inputs to, and environmental processes in, the Swan-Canning system;**
- **The scale of nutrient reduction needed, how this is to be achieved (allowing for the impacts of urban expansion, land use change and climate change) and the time-frames involved;**
- **Clarification of the role of the community and community capacity, and a review of the mechanisms by which the existing community/NRM framework participates and delivers outcomes in the Action Plan;**
- **Prioritisation and integration of the existing Action Areas and projects; and**
- **Inclusion of new approaches and/or projects (as appropriate).**

The SCCP Action Plan was produced in 1999. Given the vast number of Action Plan project achievements, and other changes that have occurred over the past 5 years, it is important to review the initial SCCP objectives and develop the strategic direction for the next phase of the program.

It is recommended that this undertaking includes a workshop of staff and stakeholders to revise and re-structure the Action Plans goals and objectives, and re-cast the Action Areas (see Section 3.2.3 for background). The revised goals, objectives and Action Areas should then be made available for public comment. The

revised goals and objectives should also be the basis for the prioritisation of projects and ultimately the strategic business plan.

A lot of good work has been achieved at a project level, but the program needs a 'big picture', or conceptual framework to guide the program and integrate knowledge from the different projects. This suggestion was frequently made during interviews with SCCP staff, as many officers were keen to receive feedback on how their project contributed to the overall Program. No evidence was seen of any integration of the achievements of the different projects.

It is important to develop a conceptual model (i.e. diagram/s) that encapsulates the most current environmental understanding of the Swan-Canning catchment and waterways, particularly in relation to SCCP. This model should identify the contribution and significance of different nutrient sources (such as industry, urban areas, groundwater, drains, rural areas) to ascertain what can be done to address each of these components. The potential impacts of future urban expansion, land use change and climate change will also need to be examined.

The SCCP Action Plan needs to be re-examined and affirmed; and an implementation strategy developed for the next 5 years of the Program. The strategic plan must be based on the best available information on the scale of nutrient reduction required to reduce algal blooms, and how this is to be achieved. This in turn needs to be based on consideration of the community's expectations for the Swan-Canning system, the efficacy of various management approaches/techniques and the willingness of identified parties to implement them, and the socio-economic costs of implementing those management approaches/techniques. Long term issues are being addressed, and require a commitment to work through long-term time frames, with in-built review at regular intervals, as is recognised in the NRM framework.

It is also important that the next phase of the Action Plan:

- Firstly undertakes preliminary research to identify the perceived barriers and benefits of each activity that is related to the health of the Swan and Canning Rivers; and uses this information to design a more effective overall program;
- Re-assesses prioritisation of the different Action Areas, and projects within those Action Areas [Project prioritisation should be based on a consideration of ecological risk. Many hazards exist in a catchment but they may not result in adverse effects. Consideration of the likelihood or probability of an adverse effect (i.e. the risk) is also needed.];
- Improves the understanding of the role of the community and community capacity in the Action Plan, and reviews the mechanisms by which the existing community/NRM sub-regional framework participates and deliver outcomes in the Action Plan;
- Considers re-aligning and implementing the already established Action Areas across spatial / geographic areas rather than management action areas;
- Establishes a robust and targeted research and development program across all Action Areas (see also Recommendation 7);
- Develops processes to deal with innovation/new funding opportunities;
- Adopts a coordinated delivery mechanism; and
- Develops an integrated communication plan across all Action Areas.

There are also considerable potential benefits from having political and scientific 'champions' (high profile people of acknowledged credibility and influence) for the SCCP. The scientific 'champion' should ideally be the Program Director, supported by the Principal Scientist, to provide and drive the overall strategic direction of the program.

The business plan that accompanies the strategic plan for the next stage of the Action Plan should reflect the prioritisation of projects to achieve the overall goals and objectives/direction. The business plan should then be used as a basis for discussion/negotiation with collaborative partners (and for funding leverage). Social and economic information has considerable potential to strengthen the 'case' for the Action Plan (and therefore attract more funding), and is an aspect that needs to be addressed in the Action Plan. The strategic plan and/or business plan should indicate short-term and long-term milestones and how they contribute towards the achievement of the SCCP goals and objectives.

The SRT has an opportunity to revitalise the SCCP Action Plan, retaining everything of value and producing a strategic framework that integrates the Action Areas and projects, and reassesses the balance of effort directed into various activities, using a more adaptive management approach. This must be based on a realistic assessment of the ability of current management approaches/techniques to achieve required outcomes. The issue of concern is riverine and estuarine health, but the solution largely relies on improved land management, often distant from Perth.

The revised Action Plan thus produced should then get commitment/ sign-off by collaborative partners (who should also have been involved in the revision process), to reinforce and ensure the whole-of-Government approach.

Key Recommendation 3. Improve the program management, coordination and leadership of the Action Plan by:

- **Appointing a Program Director and a Principal Scientist;**
- **Establishing an external Technical Advisory Panel;**
- **Continuing the SRT's recently established Park and Riverplan Committee; and**
- **Re-convening the Senior Officers Group with appointees at the Director level.**

The SCCP is the SRT's 'flagship' program and is allocated over half of the SRT's budget. The size and complexity of the Action Plan, and the expansion of ICM/NRM in the region, necessitates more effective program management, coordination and leadership than currently exists for the program. Important considerations to achieve these are:

- The appointment of a Program Director who reports directly to the SRT Board, and is primarily responsible for ongoing management of the strategic direction, effective delivery and continued development of the program. The person appointed to this position must have a proven capability in successfully managing a large-scale and diverse environment-focused project.
- The appointment of a Principal Scientist (who is also an excellent communicator) with responsibility for the quality and relevance of the scientific effort, and for the effective integration and application of its outcomes. The Principal Scientist should also be expected to support the Program Director in promoting the value of the program to all stakeholders, particularly in regard to the scientific achievements and their application to better management of the river catchments.

- Higher level involvement in Action Plan management by the Swan River Trust's senior Planner, to assist with program direction and meshing of planning, science & catchment management activities etc.
- Provision of advice from an external, independent Technical Advisory Panel (TAP) that has members with expertise in the fields of estuarine ecology, planning, catchment management, monitoring, research, social science etc. Several models for TAP function and operation can be examined (e.g. based on other large scale programs). It is envisaged that the TAP would also seek input from other experts to address specific issues, as the need arose.
- Use the SRT's Park and Riverplan Committee to ensure more effective strategic ('top-down') management of the Action Plan.
- Advice and management of inter-agency relationships and activities at the most senior level with the Senior Officers Group. It is important that effort is focussed on increasing the ownership of the Action Plan at senior level both within the SRT and with external agencies (e.g. for the Senior Officers Group and the SRT Park and Riverplan Committee).

Evaluation of the Action Plan after 5 years since its inception revealed that there are a number of program management issues that need to be addressed as a priority by the Program Director, outlined below.

- The use of public funds demands clear and open accountability, in terms of project delivery compared to what was promised. The formal reporting on the Action Plan that is presently undertaken as part of the SRT's statutory annual reporting is very limited, and needs to be considerably expanded and more closely aligned to the SCCP goals and objectives. Fiscal and performance indicators should be established for each project and for the overall program.
- The data base used for project management of the Action Plan (called "Project Management System") needs considerable improvement to ensure that all information stored in the database is correct and up-to-date.
- The internal communication process requires strengthening within and across the Action Areas.
- To ensure the Action Plan remains adaptive, a culture of innovation and excellence should be fostered amongst staff (eg by encouraging staff to keep up to date with literature in relevant areas of science and management, attend workshops and conferences, seek expert advice, and think of new ways to tackle problems).
- All Action Plan projects should be peer reviewed, preferably at the initial project formulation stage and at completion. Comprehensive external review mechanisms should be implemented for the Action Plan at all levels, and should be outcome based.

An example of how the program might be more effectively coordinated is presented in Figure 3.1.

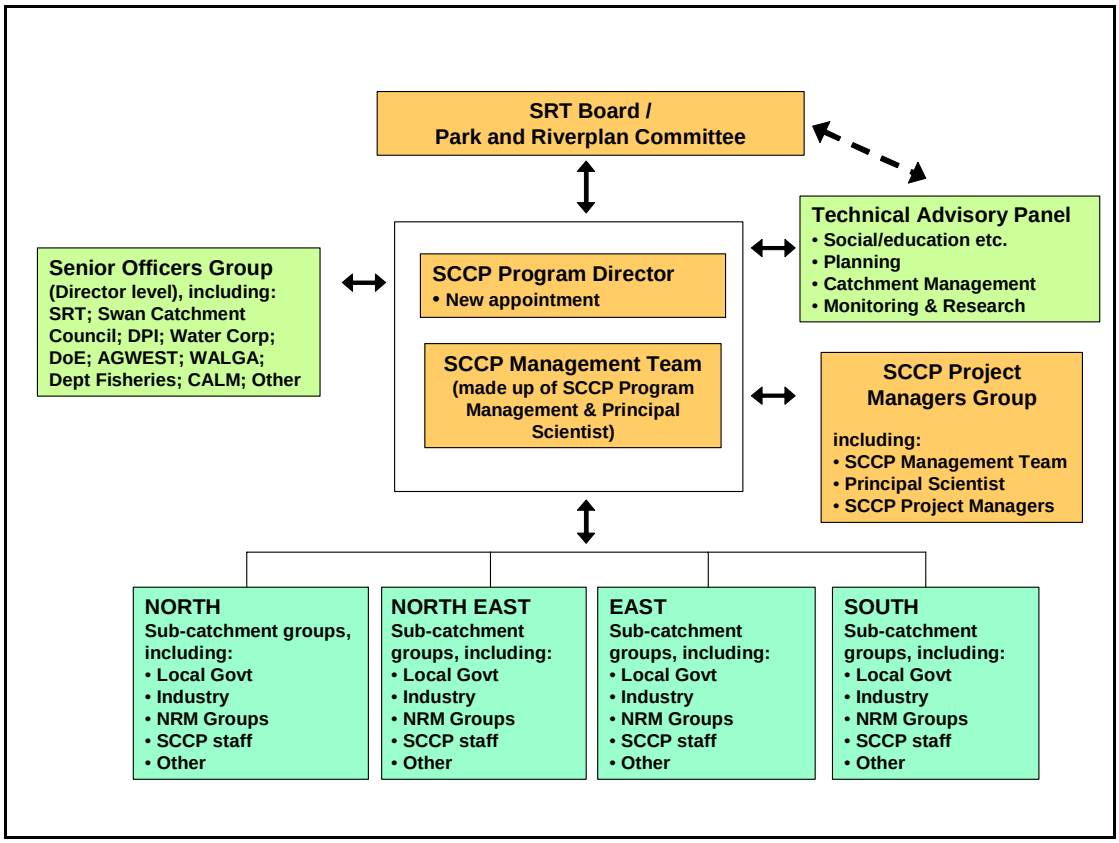


Figure 3.1 Incorporation of a SCCP Program Director, Principal Scientist and Technical Advisory Committee into the SCCP

Note: Sub-catchment areas proposed in recognition of existing NRM sub-regional groups of the Swan-Canning region.

Key Recommendation 4. Develop and implement an appropriate monitoring and evaluation framework, and key performance indicators (KPIs) for the short-term (1–5 years), medium-term (5–10 years) and long term (>10 years) to directly gauge the overall effectiveness of the SCCP towards reducing nutrients and improving water quality. These include indicators of both 'outputs' and 'outcomes', for example:

- **Operational outcomes (such as relative changes in community awareness (%); or adoption of BMPs over time; versus a specified target); and**
- **Environmental outcomes (such as relative changes in nutrient levels (%), or other indicators of ecosystem health).**

Considerable difficulty was experienced in evaluating the effectiveness of the Action Plan, in particular because the program did not possess specific criteria or key performance indicators (KPI) at the project, action area or Program level to compare against the achievements. This was exacerbated by a lack of detailed reporting on the overall Action Plan and its projects (particularly Action Areas 1 and 2), which made it difficult to know how the various components of the Action Plan fit together, and what had been achieved.

Performance indicators need to address outcomes (changes in community awareness and behaviour, changes in ecosystem condition), not just outputs (e.g. number of workshops held or BMPs implemented). Both operational (e.g. % community awareness achieved) and condition objectives (eg. % nutrient reduction achieved) need to be established to gauge the extent of success. In particular, information on the extent of reduction of nutrient inputs into the waterways is required in order to be able to assess the overall program's effectiveness. The time frames required to

achieve changes in nutrient inputs also need to be recognised, by means of short-term (1–5 years), medium-term (5–10 years) and long term (>10 years) KPIs.

There is also a need for more ecosystem indicators, to be able to determine whether estuarine health is improving or deteriorating. At present, the Action Plan has several water quality indicators for the catchment waterways and estuary (e.g. nutrient concentrations, the number of blooms of toxic species of phytoplankton) that are audited each year, but these are not *ecosystem health* indicators. Ecosystem health indicators for catchment waterways and the estuary that characterize a 'good outcome' (eg healthy seagrass, no fish kills) need to be developed (and will also foster more public 'buy-in'). These additional ecosystem health indicators do not necessarily need to be audited.

The monitoring and evaluation framework and key performance indicators should be developed by staff and stakeholders during a series of workshops, as part of the strategic review identified in Key Recommendation 2. The monitoring and evaluation framework should include annual reporting (to the SRT) against KPIs and milestones.

Key Recommendation 5. Focus on building effective partnerships

No matter what overall structure is finally agreed, the effective management of the Swan-Canning system will only be achieved if effective partnerships are built with local government, the Water Corporation, Department for Planning and Infrastructure and other State government agencies. ICM/NRM regional bodies, such as the Swan and Avon Catchment Councils, also need to be involved. These partnerships are essential to develop as the SRT does not have the capacity, nor the responsibility for implementing all of the Action Plan recommendations without the support and contribution from the other agencies. The Expert Reference Panel has identified significant opportunities for building such partnerships (see chapters 4–7, on the individual Action Areas). Some examples of issues that the SRT could be addressing in partnership with these other agencies/authorities are outlined below.

- Department of Environment & Water Corporation: Environmental flows – the controlled release of sufficient water from dams into the waterways to maintain stream and estuarine health. Environmental flows is core Department of Environment business, while water supply is core business for the Water Corporation.
- Universities and research centres (eg CSIRO): Opportunities for new research partnerships need coordination at both the program level and higher level, and to be actively promoted and encouraged.

The commitment and effort required to develop effective partnerships should not be underestimated. For example, there are more than 30 local councils within the Swan Canning catchment that could be more closely involved in the SCCP. The political and scientific 'champions' mentioned in Key Recommendation 2 could also be of considerable value in helping to develop these.

Formal contract agreements need to be established for any collaborative / partnership arrangements, to ensure clarity on responsibilities, outcomes, deliverables and timeframes.

Key Recommendation 6. Secure funding for high priority, long-term projects. Funding needs to be secured for the realistic time-frames needed for completion of the projects in order to:

- **Enable complex, inter-related catchment and waterways issues to be adequately addressed.**
- **Increase the capacity to lever additional funds from other sources; and**
- **Attract and retain competent project staff.**

The importance of prioritising the existing (and new) SCCP projects for the next phase of the Action Plan has been raised previously. It is recommended that Action Plan projects of high priority are provided with security of funding that extends beyond one financial year. It is important to secure funding for such projects for at least a 3-5 year period. As the SCCP addresses long-term management issues, funding for some projects will need to be secured for even longer periods—which also requires recognition of the ongoing management cost. The extension of funding commitments to individual projects (for salaries particularly) over a longer term would greatly benefit the program for the reasons listed above.

Key Recommendation 7. Develop and implement a research and development program for the SCCP

Currently, there exists sufficient knowledge of the Swan-Canning estuary to permit clear management priorities to be established. However, this is not the case for the catchment, where considerably more information is urgently required. The Expert Reference Panel was surprised to find that the Action Plan did not include a research and development program.

An R&D program needs to be established as part of any future Action Plan. Management of the Swan-Canning system will only be effective if it is underpinned by good scientific knowledge of the system. In addition, the community awareness / education component of SCCP would benefit greatly from research into the different methods and approaches used to elicit social behaviour change; and applying this knowledge to develop a more focussed and effective overall program.

Key Recommendation 8. Address land-use planning issues by collaborating with local governments to investigate ways to formally incorporate nutrient reduction strategies in their local planning strategies.

The significance of the Swan-Canning system is presently recognised in regional planning for Perth with its reservation for Parks and Recreation in the Metropolitan Region Scheme, and establishment of the Swan River Trust to carry out planning and management functions along the river. However, as highlighted in Key Recommendation 1, land-use planning, infrastructure and local government decision-making have to be undertaken on a catchment basis to address the health of the Swan Canning system: healthy rivers are only achievable when the surrounding catchment is also healthy.

The Expert Reference Panel considered that planning and land use management to reduce nutrient inputs has been the least successful component of the Action Plan implementation; despite its critical role in ensuring the success of the Program. As the success of the Action Plan ultimately depends on managing existing land uses and new developments in the catchment, it is vital that the SCCP works collaboratively with State and local planning authorities. Land use planning needs to address issues such as:

- Regional planning and policies that recognise the significance of managing nutrients in from land activities both within the Management Area and throughout the catchment;
- Modification of current town planning practices to focus on local planning strategies that will address land use and drainage conflicts;
- Implementation of Best Management Practices for nutrient reduction in current and future developments and stormwater drainage schemes;
- Investigation of mechanisms to encourage improvements in catchment, wetland and river foreshore management; and
- Continued development of catchment management plans and ICM/NRM activities.

Work would be best facilitated by basing local planning strategies on a sub-catchment level, and should include provision for incentives and entitlements. The report 'Regulatory design for water quality management in Perth, Western Australia' currently being finalised by the Australian National University (see Section 5.3) should be a key resource for this exercise.

3.2.3 The Goals and Objectives of the Action Plan

The SRT requested that the evaluation include a review of the Action Plan's goals and objectives (see Table 2.1). It is noted that the Action Plan's goals and objectives were derived by the SCCP Action Plan Task Force over a series of meetings, and then endorsed by local governments and community groups via feedback during numerous presentations.

The evaluation highlighted both merit and faults with the existing goals and objectives, but it was concluded that it would be inappropriate to offer alternatives to the end product of extensive discussions by the Action Plan Task Force that were subsequently reinforced by community consultation. Any revision of the goals and objectives should be done by Action Plan personnel as part of a consultative process. This has been included as part of Recommendation 2.

The following observations on the current goals and objectives are offered as input to this process:

- The goals are fundamentally sound and retain their currency, but cover a broader range of issues than can be dealt with by a program that focuses on nutrients alone. For example, pathogens and toxic substances are encompassed by the goal "*Ecological function: Water quality in the Swan-Canning system is suitable for maintaining a healthy ecosystem. People can swim or catch fish at any time*."
- As the goals cover contaminants other than nutrients, and also extend to cost/benefit issues, they may be more appropriate as overarching goals for the Swan River Trust, not just the SCCP Action Plan.
- Phase 1 (i.e. the first five years) of the Action Plan is complete, and some of the objectives are—wholly or partly—irrelevant, or need refining. For example, the first objective has largely been met, the key data gaps for the second objective are the role of groundwater and sediments, and for the third objective there is now a good understanding of the benefits and limitations of river intervention techniques.

- Each goal should have aligned objectives (for example, the goal of ecosystem health could have objectives of (i) the maintenance and preferably expansion of existing seagrass beds and (ii) the maintenance of abundant and diverse fish populations). This is not easy with the present set of goals and objectives. The present 'goals' are also a mixture of goals, and the means to attain some of the goals; for example goals 3, 4 and 5 have to be attained before goals 1 and 2 can be attained. This also makes it difficult to link the present goals and objectives to a monitoring and evaluation framework.

3.3 Future monitoring & evaluation of the Action Plan

Present Action Plan progress reporting is largely via an annually held public forum, and an 8 or 16 page community brochure. There are few indicators for the effectiveness and efficiency of the program. The Action Plan has developed some water quality targets for catchment waters and estuarine waters as performance indicators for the overall Action Plan, but there are no performance indicators for Action Areas or individual projects. Nor is there a monitoring and evaluation framework that links the various projects and Action Areas in the Action Plan, and reports on progress and outcomes at the project, Action Area and overall program levels.

There are many approaches to monitoring and evaluation frameworks, and even more key performance indicators (KPIs), that could potentially be used for the Action Plan. However, as for the goals and objectives of the SCCP Action Plan, it was considered it would be more appropriate for Action Plan staff and stakeholders to develop a monitoring and evaluation framework and KPIs for the Action Plan, rather than adopting the views of an external party. A greater sense of understanding and ownership (and more relevant KPIs) will be achieved if those directly involved in the program undertake this exercise.

A recommended approach for developing a monitoring and evaluation framework and KPIs for the Action Plan has been addressed to some degree in Recommendation 4. Some additional comments are made here that specifically address the existing goals and objectives of the Action Plan. Linkage of the present SCCP Action Plan goals and objectives to a monitoring and evaluation framework will not be easy (see Section 3.2.3), and a more simplified approach based on the Action Areas may be more appropriate. Possible monitoring and evaluation frameworks that might be used include:

- A logical framework approach (commonly abbreviated to a "log-frame" approach), in which the (revised) goals and objectives of the SCCP Action Plan are reorganised into a logical framework that differentiates betweens 'means' and 'ends'. An example is provided in Figure 3.2.
- A log-frame approach, based around the Action Areas of the Action Plan.
- The WA State Sustainability Strategy framework, with reporting based on the State of Environment model (i.e. pressure-state-response reporting).

Annual reporting to the SRT should incorporate KPIs and milestones for the Program; and include information that addresses both short-term (1–5 years), medium-term (5–10 years) and long term (>10 years) targets for nutrients and algal blooms. Suggestions for KPIs for the different Action Areas are identified in Chapters 4–7, as input to this exercise.

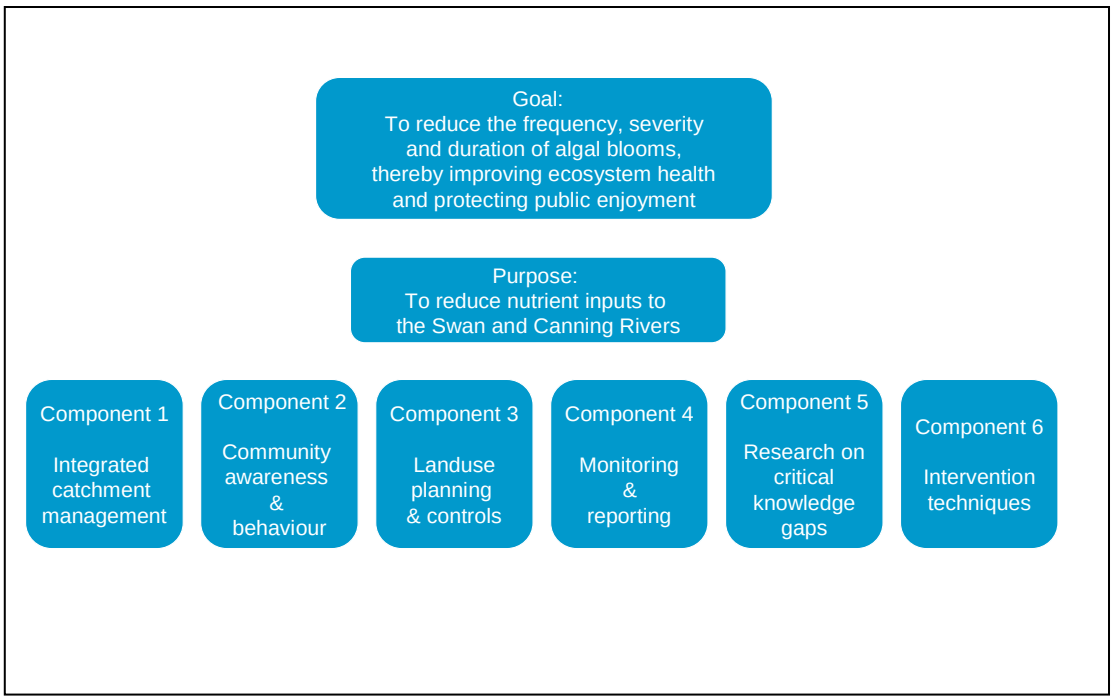


Figure 3.2 A possible logic framework for monitoring and evaluation of the SCCP Action Plan

Finally, it is important to acknowledge that while efforts to reduce nutrient inputs and the occurrence of algal blooms are underway within the Action Plan, two significant external factors are also impacting on the Swan-Canning system:

1. The population of Perth continues to expand, via increased housing density in established suburbs and urban development of new areas. The nutrient concentrations of catchment runoff and groundwater from urban areas can be higher than from rural areas, and are certainly higher than from undeveloped land. The expected degree of urban development over the next 20 years has the potential to outstrip the efforts of the Action Plan, unless there are strict planning controls in place for new developments.
2. In the past 30 years there have been declines in rainfall and greater declines in catchment runoff and groundwater recharge. The overall effect on the Swan-Canning system has been less river runoff and lower nutrient inputs to the system, but this has been countered by less flushing of the system and an extended 'autumn' period, with stratified conditions that favour the growth of certain algae such as the recent *Karlodinium* blooms.

Future monitoring and evaluations of the SCCP Action Plan will therefore need to factor in any impacts due to population growth and climate change. This is covered in Key Recommendation 2, which requires the inclusion of such impacts in the revised strategic plan.

Further recommendations, addressing the Action Plan at the lower levels, are also provided in the Final Evaluation Report Part B.

3.4 Where to from here

The main purpose of the evaluation is to help the SRT define the next suite of actions needed to secure the health of the Swan-Canning system. To this end, it is

recommended that the SRT immediately undertakes a strategic review of the SCCP Action Plan to determine the future directions of the program. This would encompass the production of a revised and revitalised SCCP Action Plan, and will require a series of forward planning workshops or similar processes over about six months addressing each of the different Action Areas and the program as a whole. In addition, discussions and negotiations with different State agencies and local governments need to be commenced to ensure commitment and ownership of the strategic direction. The Program Director appointment should be actively pursued during this time, with an appointment being made as early as possible.

4. Evaluation of Action Area 1

4.1 Reflection on the first phase of the Action Plan

4.1.1 Background

Action Area 1 is: "Support integrated catchment management to reduce nutrient inputs", and is addressed by three Action Plan recommendations.

- Recommendation 1: Strengthen Integrated Catchment Management in the Swan-Canning catchment and support ICM groups;
- Recommendation 2: Raise awareness and provide support to enable the participation of land-holders, catchment and river management groups, local government and the broad community in catchment and river management; and
- Recommendation 3: Improve government coordination and support.

Integrated Catchment Management (ICM) describes the process of coordinated planning, use, management and protection of water, land, vegetation and other natural resources on a river or groundwater catchment basis. It involves the whole community of the catchment including landholders, businesses, residents, industry, local government and State agencies. In recent years ICM processes, activities and networks have developed considerably; and this is now more commonly referred to as Natural Resources Management (NRM).

Excluding Project Management, activities in Action Area 1 fall into two broad categories:

- Community awareness and education (Swan Catchment Centre, Community Awareness, Ribbon of Blue, WQPN, Local Govt NRM), and
- Those with a focus on on-ground works (Priority Catchment Funding, Farm Planning, Nutrient Intervention, SALP).

The projects that have been undertaken in Action Area 1 include:

- SCCP Project Management;
- Swan Catchment Centre;
- Community Awareness;
- Water Quality Protection Notes for Best Management Practice;
- Ribbons of Blue;
- Local Government Natural Resources Management Policy Development.
- Priority Catchment Funding;
- Farm Plans;
- Nutrient Intervention;
- Restoration Works – Foreshore (also referred to as the Swan Alcoa Landcare Program or SALP); and
- Local Government Natural Resources Management Policy Development.

These projects are described in detail in Final Evaluation Report Part B: Supporting Information.

A total of $10,639,291 SCCP funding has been spent on implementing Action Area 1 over the past five years. Over $8,191,572 funding has been obtained from other sources such as Natural Heritage Trust, State and Local Government and industry contributions. This includes an estimate of volunteer labour worth $416,244 (Table 4.1).

Table 4.1 Summary of funding for Action Area 1

Action Plan Project	Action Plan Funding		External funding
	Amount	% of Action Area 1	Amount
Priority Catchment Funding	$2,206,908	20.7%	$6,392,154
Swan Catchment Centre	$951,000	8.9%	Unknown
Farm Planning	$787,000	7.4%	-
Nutrient Intervention (includes three projects: Constructed Wetlands, Water Sensitive Design, and Nutrient intervention Program	$1,493,978	14.0%	>$519,745
Swan Alcoa Landcare Program	$998,997	9.4%	$571,829
Community Awareness	$1,721,638	16.2%	$40,000
Water Quality Protection Notes	$31,102	0.3%	-
Ribbons of Blue	$600,000	5.6%	>$632,344
Project Management	$1,276,843	12.0%	>$1,500
Local Government NRM	$571,825	5.4%	$34,000
TOTAL	**$10,639,291**		**>$8,191,572**

4.1.2 Achievements

Action Area 1 addresses Action Plan recommendations 1, 2 and 3, which comprise 15 sub-recommendations. Eleven of the 15 sub-recommendations have been implemented; although there are a number of shortfalls or gaps identified for some of these associated activities. The remaining four sub-recommendations, three of which are in Recommendation 3, have not been achieved.

The overall achievements and extent of works undertaken within Action Area 1 were commended at the Evaluation Forum. In particular, it was recognised that Action Area 1 faced a major challenge in its first stage of implementation which was to increase community awareness and engage stakeholders and the community in ICM across the region. It is clear that this challenge has been met within the Swan-Canning region, as demonstrated by:

- The current widespread awareness of the SCCP within the general Perth community (>60% population aware of program);
- The high level of interest and involvement of volunteers in undertaking on ground works (labour calculated in financial terms as $416,244); and
- The considerable growth and expansion of the catchment groups into four coordinated sub-regional groups.

There were a number of specific achievements that were commended by the Expert Reference Panel, including:

- The establishment of a partnership between Ribbons of Blue and the WA Department of Education that accepts the Ribbons of Blue program as part of the school curriculum; and
- Construction of the wetland at Liege St, particularly in overcoming the initial concerns of local governments and the Water Corporation.

The achievements of work undertaken for Action Area 1 are provided below.

Achievements of work undertaken for Action Plan Recommendation 1
Recommendation 1.1. *Provide executive and administrative support for Integrated Catchment Management Groups in the Swan-Canning system*
• A full-time catchment officer based at the SRT has provided ongoing executive and administrative support to the catchment groups. • The Swan Catchment Centre has also provided extensive support to catchment groups as part of their core business.
Recommendation 1.2. *Appoint Catchment Coordinators to support completion and implementation of Catchment Management Plans in the four focus catchments (Ellen Brook, Southern-Wungong River, Canning River and Bayswater Main Drain) to reduce nutrient input; &* ***Recommendation 1.3.*** *Support and establish additional ICM groups and appoint Catchment Coordinators to further ICM processes and to develop and implement Catchment Management Plans in the other catchments that have high nutrient concentrations entering the rivers and estuary (South Belmont Main Drain, Bennett Brook, Bannister Creek, Mills Street Main Drain, Blackadder Creek, Yule Brook, Susannah Brook and Bickley Brook)*
• $1,894,018 SCCP funding has been allocated to catchment groups within the SCCP priority catchments. The majority of this funding has been allocated to salaries for catchment coordinators, other staff, administrative and operational costs. About half of the 14-15 catchment coordinators in the region have been supported by SCCP funding over the last five years. • $6,392,154 additional funds have been obtained by the catchment groups, mainly through Natural Heritage Trust, other SCCP initiatives, Local Governments, Industry and the Swan Alcoa Landcare Program (joint SCCP-funded). • There has been considerable strengthening and continued development of catchment groups, and re-alignment into sub-regional groups, particularly in response to the Natural Heritage Trust (NHT) Federal initiatives.
Recommendation 1.4. *Complete the development and implementation of the Swan Avon regional strategy ("Working together" document prepared by the SAICM and the Swan Catchment Centre) which develops partnerships with key stakeholder groups involved in planning and management of the river and catchment.*
• The Swan Region Strategy for Natural Resources Management has been developed; and has recently been accredited by the Australian Government. This Strategy supercedes the Swan Avon region strategy (“Working Together” document).
Recommendation 1.6. *Provide support for development and implementation of approved farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities, including part-time farm activities*
• A novel program to engage small landholders in developing farm management plans has been delivered through the Dept. Ag. via Heavenly Hectares seminars, Property Planning Workshops and Farm Field Days. This is a relatively non-technical, popular program targeted towards engaging ‘hobby farmers’ or similar.
Recommendation 1.7. *Provide seed funding to determine feasibility and cost effectiveness to design and construct artificial wetlands as demonstration sites for stripping nutrients in the Mills Street and South Belmont main drains*
• Artificial ‘demonstration’ wetland has been constructed in Liege Street: environmental outcome of 3 ha of habitat restoration; and its potential for stripping nutrients are under investigation. This has been done as an alternative to the original nominated sites. • Extensive monitoring has been undertaken in the Mills Street and South Belmont main drains
Recommendation 1.8. *Provide funds to fence, stabilise, and revegetate watercourses in the catchments as part of developing and implementing Catchment Management Plans*
• $647,615 provided to fence, stabilise and revegetate watercourses in the catchment through Swan Alcoa Landcare Program (jointly funded by SCCP); and $105,582 towards foreshore restoration as part of the SCCP program. • 192 projects funded for on-ground works in the Swan-Canning region. • Basic estimates of the extent of works undertaken indicate: 14 drains have been converted to ‘living streams’; 58 hectares of bushland/wildlife corridor and 85 hectares of wetland/reserves have been restored and/or protected; 25 km of foreshore has been restored via fencing, weeding, and revegetation.

Achievements of work undertaken for Action Plan Recommendation 2
Recommendation 2.1: *Implement a cross-media public awareness campaign involving a variety of information sources for the general public to encourage changes in individual behaviour and involvement in river-care and catchment management*
• A cross-media public awareness campaign involving a variety of information sources for the general public has been implemented; and included Corporate Care Days, promotional material, algal activity reports on television (weekly), and an Urban Garden Strategy. • In 2002-2004, 62-65% of the general Perth community surveyed was aware of the SCCP. Half of these people associated the program with either algal blooms, nutrients, or foreshore degradation. • The Urban Garden Strategy has been effective in educating over 5,000 people about sustainable garden practices, increasing their knowledge, and facilitated changes to their gardening behaviour. • Approximately 40,000 plants were planted as part of the Corporate Care Day Program.
Recommendation 2.2: *Through the Swan Catchment Centre provide locally applicable technical and administrative support, information, advice and training to those involved in or affected by catchment management to enable their effective involvement in catchment management decision-making and practical activities*
• The Swan Catchment Centre has provided considerable resource material, information, training and support to those involved in catchment management activities, including community groups, friends of groups, catchment groups, the Catchment Officer Support Network and the Swan Catchment Council. • ICM/NRM activities in the Swan-Canning region have grown considerably over the past five years. • There has been strengthening and continued development of catchment groups, and re-alignment into sub-regional groups
Recommendation 2.3: *Extend Ribbons of Blue program to ensure better support of school and community education programs linked to practical action for the Swan-Canning river environment*
• 75–141 schools/groups engaged in Ribbons of Blue monitoring each year, 14–36 community groups supported each year, up to 12 workshops/year for community and teacher training. Numerous one day events attended by over150 school groups. A range of information sources and material produced. • The Ribbons of Blue program is now accepted as part of the school curriculum by the WA Education Department.

Achievements of work undertaken for Action Plan Recommendation 3
Recommendation 3.4: *Financially support the appointment of environmental officers to formulate and prepare local government natural resource management strategies and policies*
• The "Local Government Natural Resources Management Manual" has been produced by the Eastern Metropolitan Regional Council as a reference document for use by local government officers. This document includes issue specific strategies for local governments, provided as guidelines and checklists. • Water Quality Protection Notes and a Cleaner Production directory have been prepared for use by industry, and local government

4.1.3 Gaps

Considerable progress has been made towards Recommendation 1, which targets the strengthening of ICM within the region. However, what is missing from this recommendation is the detailed planning and prioritisation component for the ICM activities, for development of catchment management plans. To a large extent, it appears that considerable investment and effort has been made in establishing ICM within the region through on-ground works and networking; however some of the fundamental components of ICM, such as establishing a formal structure for prioritising, coordinating and undertaking work within each sub-region, have not been adequately addressed. These components are crucial in order to ensure that efforts are focussed on achieving the objectives of the Action Plan.

No major gaps were identified in Recommendation 2.

The largest gap within Action Area 1 relates to Recommendation 3—Improve government coordination and support. Three of the 4 sub-recommendations have not been achieved. This is a critical gap because Recommendation 3 covers a core component of the SCCP, that is, commitment of external agencies (including state government and local governments and others) to implementing the program.

A summary of the gaps in work undertaken for Action Area 1 is provided below.

Gaps in work undertaken for Action Plan Recommendations 1 and 3
Recommendation 1.2. *Catchment coordinators to support completion and implementation of Catchment Management Plans in the four focus catchments (Ellen Brook, Southern-Wungong River, Canning River and Bayswater Main Drain) to reduce nutrient input; &* ***Recommendation 1.3.*** *Support and establish additional ICM groups and appoint Catchment Coordinators to further ICM processes and to develop and implement Catchment Management Plans in the other catchments that have high nutrient concentrations entering the rivers and estuary (South Belmont Main Drain, Bennett Brook, Bannister Creek, Mills Street Main Drain, Blackadder Creek, Yule Brook, Susannah Brook and Bickley Brook)*
• The development and implementation of Catchment Management Plans was identified as an important task to complete particularly in the high priority catchments. These were intended to be undertaken by catchment coordinators with the assistance of the SRT, WRC, AGWEST and local governments. The Action Plan deemed this work as critical, either because these catchments have been identified as large contributors of nutrients or because community concern had created impetus for action. The current status of the CMPs is not clearly known; and limited (if any) assistance by the abovementioned agencies has been provided.
Recommendation 1.5. *Catchment management guidelines for the reduction of nutrient losses from rural and urban catchments still require development.*
• Initially, it was intended that Catchment Management Guidelines would be developed to help the catchment groups (and farmers) prepare CMPs; however these guidelines have not been developed. Catchment coordinators particularly have identified that development of these guidelines would still be highly relevant and extremely useful for the catchment groups.
Recommendation 1.6. *Provide support for development and implementation of approved farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities, including part-time farm activities*
• Farm planning over the past five years has focused mainly on small landholders, and has not targeted or involved intensive, commercial, or large landholders (as originally intended). • Farm plans are not required or approved by Dept. Ag., and the number and quality of farm plans produced is not known. • There is a rather limited focus on the importance of nutrient reduction from farm activities compared to other farming aspects such as biosecurity and weed management. • Intensive and commercial farmers, and large landholders (such as cattle grazers), have not been targeted in the farm planning program despite their potential for significant nutrient inputs.
Recommendation 3.1. *Establish formal and financial agreements involving State government agencies and local governments defining responsibilities for implementation of the Action Plan and ICM and audit progress after five years*
• Only very limited formal agreement involving State and local governments defining responsibilities for implementation of the Action Plan and ICM has been made for SCCP. As such, there is very limited formal commitment from the State government and local government agencies to achieve the SCCP goals and objectives. This lack of formal and financial commitment by State government agencies and local governments had constrained implementation of the SCCP, and limited its overall effectiveness.
Recommendation 3.2. *Establish a Senior Officers Group (SOG) to audit and manage agreements defining responsibilities for implementation of the Action Plan*
• A Senior Officers Group comprising representatives from different agencies (such as WRC, SRT, MfP, AgWest, Swan-Avon ICM Group, WA Municipal Association and Department of Environment) was established during the early stages of the project; but did not fulfill its responsibilities of auditing and managing agreements defining responsibilities for implementation of the Action Plan. • This lack of high level management has had a major impact on the program as key state and local government agencies have not been involved in SCCP implementation. • The lack of formal commitment by external agencies has been a major constraint for the implementation of a considerable number of SCCP activities at a project level.

Gaps in work undertaken for Action Plan Recommendations 1 and 3
Recommendation 3.3. *Establish a Project Managers Group that reports to the Senior Officer Group to coordinate projects and activities to implement the Action Plan and an Interdepartmental Catchment Management Liaison Unit to review land-use controls and define agency responsibilities*
• The Project Managers Group has not effectively reported to the Senior Officers Group (or equivalent higher level management) to coordinate projects and activities to implement the Action Plan; resulting in a lack of strategic management and leadership for the SCCP. • No Interdepartmental Catchment Management Liaison Unit has been established; and subsequently review of land use controls and definition of agency responsibilities has not been undertaken.

A summary of the key gaps identified at a project-specific level are provided in the Final Evaluation Report Part B: Supporting Information.

4.2 Planning for the next phase of the Action Plan

4.2.1 Issues / Areas for improvement

Overall Action Area

It is important to recognise that the outcomes of the on-ground works, in terms of environmental response, are presently unknown. Catchment management efforts take time, and the on-ground works completed to date—although impressive in their own right—are not yet not on a scale (given a coastal plain catchment of ~260,000 hectares) that is sufficiently advanced to produce an overall improvement for the Swan-Canning system.

Key issues / areas for improvement of Action Area 1 identified during interviews with project staff and stakeholders, and/or at the Evaluation Forum, are provided below.

- There have been significant outputs achieved from the different community awareness, education and integrated catchment management projects within Action Area 1. However, there is a distinct lack of information available on the social, environmental and other outcomes of these activities, particularly in relation to their contributions towards achieving the SCCP goals.
- To a large extent, the individual projects within this Action Area have been undertaken quite independently of each other—as well as independently of the other Action Areas—despite the extra benefits and overall effectiveness that could have been gained from adopting a more strategic, coordinated approach. Better communication and coordination between the Community Awareness section of the SRT and the Swan Catchment Centre was recommended for the education components of this Action Area.
- A Communication Strategy that linked the various education and community awareness programs of the Action Plan was considered worthwhile to avoid duplication of effort, and foster creative approaches. This particularly includes developing synergies between the Swan Catchment Centre and the SRT.
- At this stage, it is not clear to the Action Plan staff involved (when questioned) or to the Expert Reference Panel and other forum participants, whether this Action Area is addressing a community education/capacity building program, or a nutrient reduction program, through integrated catchment management activities. Without a strategy in place that specifies what the set priorities, measures or expected environmental outcomes are for this Action Area (and its projects), the actual effectiveness of the activities cannot be gauged. As

expressed simply by one Panel member: "It's critical to know: how big is the elephant?". The desired/expected outcomes need to be clarified for Action Area 1.

- The Action Plan needs to address questions such as:
  - What can be achieved with education overall? What is the best mix of education tools to use?
  - What are the main nutrient sources and issues for each sub-catchment?
  - What is the extent of nutrient reduction that can be achieved with BMPs, such as farm plans and constructed wetlands?
  - What environmental outcomes can be achieved by on ground ICM works?
  - Which on-ground works (i.e. fencing, weeding, re-planting, other) is the most effective at reducing nutrient inputs?
  - What amount and combination of fencing, weeding, other on-ground works is required to reduce nutrient inputs to an acceptable level?
  - What proportion of the total works needed have been done so far (eg. % waterways fenced)?
- The potential contribution of education and ICM towards reducing nutrient inputs (Action Area 1) versus other mechanisms (such as financial incentives or legislation/enforcement) also needs to be ascertained, for effective allocation of Action Plan resources.
- The restoration of priority catchments, as well as the protection of healthy/non-priority catchments, needs to be incorporated in the strategic plan.
- While it was acknowledged that the main aim of Action Area 1 initially was to engage the stakeholders and the community in ICM, it is now critical to begin channelling the keenness and energies of these groups into effective, prioritised works (that have been optimised spatially using scientific information) in order to optimise the environmental benefits. It was observed at the Evaluation Forum that the current Action Area 1 projects have "captured the keenness", but because activities have not been optimised (in terms of activities undertaken and/or their spatial application) their impact on nutrient inputs is equivocal (their impact on awareness-raising is not questioned).
- It was clear that this Action Area has been run from the 'bottom up'. There is a lack of direction for this Action Area, particularly in terms of prioritising activities, as well as coordinating and integrating these projects/efforts. More strategic coordination and adaptive management is required from the top.
- One of the constraints highlighted by project staff in prioritising areas within the Action Plan was the lack of detailed land use information available to identify areas of potential risk from industry/other sources. This is critical information to obtain, and a priority for the Action Plan. In addition, information on the locations and extent of Action Plan activities (via a GIS database) was identified as vital, to develop improved coordination of activities and understanding within the program.
- Care must be taken to ensure that the focus on nutrients within the SCCP is not lost or diluted by the establishment of NRM in the region; but rather that it is embedded as a core component of the NRM regional strategy. Hence, partnerships/collaborations with NRM groups at the outset are important.
- A common observation made at the Evaluation Forum was that personnel working on Action Area 1 projects were predominantly relatively young people on 1 year projects with little to no permanency provided in these positions; and this Action Area had a noticeable history of high staff turnover. Funding

uncertainty is a real issue for catchment groups. Continuity of personnel is essential in this area.

- It was a concern highlighted by Action Plan personnel and the Panel that there is a lack of engagement and commitment by the different State Government agencies; particularly as it was constraining the progress of numerous projects; and a considerable number of activities funded by the Action Plan were deemed to be core business of these agencies (such as farm management planning). It was noted that agency partnerships in southeast Queensland (SEQ) are run by a Board with the Minister and heads of agencies, and that this approach might be effective for the Action Plan.
- The level of coordination and integration within the program is currently insufficient and this affects communication and partnerships. For example, the Minister for Environment and the CEO of the Department of Environment have an *ad hoc* role to play in the program, launching events and attending functions upon invitation, but have no clear prop with which to promote the SCCP Action Plan.
- Monitoring of ICM activities is important to address, so that the impact of catchment work can be ascertained. At the Evaluation Forum it was acknowledged that this is a difficult issue to address, but it was viewed as extremely important to resolve.
- The status of catchment management plans within the Swan-Canning region is not clearly known. Production of quality catchment management plans that have received technical input, are still deemed as a high priority to complete.
- Commercial and intensive farming industries have not been included in the Farm Management Plans project. The Panel considers it is important to engage this sector in this project given their relatively high level of nutrient input potential.
- The Swan Catchment Centre would be more accessible to other SCCP and state government staff, catchment groups, and the community if it was located in a more central location. Ellam Street was suggested by a number of people as being a much better location.

Education / Communication components – Review by Dr. Mackenzie-Mohr

The education and communication components of Action Area 1 were independently reviewed by Dr. Doug Mackenzie-Mohr, an Environmental Psychologist who specialises in Social Behaviour Change. This review focused on approaches required to bring about more effective and long-lasting community awareness building and behaviour change with respect to the Action Plan. This section presents a distillation of Dr. Mackenzie-Mohr's key suggestions; with some additional context provided by Oceanica. Full text, including comments on the community survey report and a relevant case study, are provided as Appendices in the Final Evaluation Report Part B: Supporting Information.

In order to develop an effective education/communication program, it is extremely important to identify the **perceived barriers** and **benefits** to each activity that is related to the health of the Swan and Canning Rivers. Without this baseline information it is very difficult to develop effective programs. Barrier and benefit research has to be collected at the level of specific activities as the primary literature indicates that the barriers and benefits are unique for each activity that might be promoted (e.g., reduced fertilizer use). To date, this essential first step to effective social marketing has not been addressed in any meaningful way for the SCCP Action Plan. That is, there is no indication that the barriers and benefits are known to

specific activities that have been and/or will be promoted. To conduct this type of research, it is necessary to conduct focus groups and interviews both with householders / businesses / farmers who are engaged in the activity as well as those who are not. The focus groups and surveys should be composed of items that will measure potential barriers and benefits for each specific activity (usually only 2-3 activities can be addressed in one focus group or survey). It is important to use multivariate statistics to analyse this information as they provide the opportunity of not only identifying which barriers and benefits distinguish between those who are active and inactive for a specific activity, but also the relative importance of these barriers and benefits.

The absence of this type of careful preliminary research was considered to be a major limitation of the entire SCCP Action Plan (i.e. not just the education / communication components). In lieu of knowing the actual barriers and benefits, program designers across these many initiatives are simply guessing as to what they are. What this suggests is that the vast majority of behaviour change programs that make-up the Swan-Canning program are being delivered in a knowledge vacuum.

The following suggestions have been made to overcome this:

1. The activities to be promoted are prioritized in terms of importance. *That is, from the perspective of the vitality of the catchment, which activities impact water quality most significantly?*
2. Next, focus groups are conducted with the target groups for the behaviour change. These focus groups are divided, as with the telephone survey, into those who are active and inactive.
3. Building on the information gleaned from the qualitative focus groups, telephone surveys are conducted to quantitatively identify the barriers and benefits for the most important activities. These surveys must make use of multivariate statistics, as descriptive statistics (upon which past survey work has relied) is incapable of prioritizing barriers and benefits.
4. Funding for behavioural change initiatives is tied to the extent to which specific initiatives address barriers and benefits.
5. Funding is also provided for pilot studies **prior to** broad scale implementation, and behavioural change and/or demonstrable changes in river quality are the required evaluation measures. Broad scale implementation **does not proceed** unless the pilot studies shows the desired outcomes can be achieved.

Moving to a community-based social marketing approach to fostering behavioural changes requires a fundamental re-thinking of how to facilitate behavioural changes on the part of those involved in delivering these programs. In reviewing the Action Plan materials Dr Mackenzie-Mohr found frequent examples of pamphlets and the like being prepared as a means of bringing about changes in awareness and behaviour. While such approaches may change awareness and attitudes (though nowhere near as well as the personal conversations that would occur in the workshops) they have little likelihood of changing behaviour. They are based on the mistaken assumption that attitude and awareness changes lead to changes in behaviour. Ideally, those individuals who have the task of delivering these types of programs need to understand the limitations of information-intensive programs in facilitating behavioural changes and that there are far more effective alternatives. Further, changes in the funding guidelines, as set out above, can have a significant impact upon the uptake of these approaches. These changes in guidelines are

unlikely to come about unless those directing the program understand the inherent challenges in facilitating behaviour change.

Results from the community survey undertaken as part of the SCCP Action Plan evaluation clearly demonstrate that the vast majority of Perth residents have not participated in Action Plan programs. This information suggests that alternative approaches need to be considered to more effectively reach far greater numbers of residents. Examples of successful alternative approaches are provided in Appendix B of the Final Evaluation Report Part B: Supporting Information.

4.2.2 Recommendations

Key recommendations to improve Action Area 1 are provided below:

- Development of a comprehensive strategic plan for Action Area 1; and clarification of the desired outcomes and expectations of this Action Area. In particular, identify whether this Action Area is primarily a community awareness/education program versus a nutrient reduction program.
- Determination of the scale and extent of on-ground works needed to reduce nutrient inputs to the waterways (i.e. km of waterways needing fences, riparian vegetation), and tracking of the extent of Action Plan-related activities undertaken (in terms of % of total needed) to monitor progress of on-ground works.
- Catchment work to be prioritized (optimized spatially, and based on good scientific information), coordinated and implemented on a consistent basis.
- The restoration of priority catchments, as well as the protection of healthy/non-priority catchments, to be incorporated in the strategic plan.
- A more proactive approach to influencing sub-regional and regional NRM plans, especially investment plans (note: it is recognised that, even in the absence of leadership, some catchment and sub-regional people have been very proactive in the NRM regional planning process);
- Prioritisation of the development, revision, and implementation of good quality catchment management plans (CMPs) aimed specifically at nutrient reduction (note: it is anticipated that CMP's will also cover other issues but SCCP aims need to be clearly articulated in them). Catchment coordinators should prepare the CMPs in consultation with stakeholders such as local governments and others, but (at least) the Trust and the Aquatic Science Branch of the DoE should provide technical guidance and also review the CMPs to ensure their effectiveness, technical rigour and consistency.
- Evaluation of the effectiveness of BMPs by means of an appropriately designed monitoring program. Scientifically rigorous monitoring programs should be designed by appropriately qualified scientists (from within the Action Plan, or external experts), and implemented—preferably by appropriately trained personnel, or failing this by untrained personnel under expert guidance.
- Investment in the development of a comprehensive land use map that accurately displays the location and extent of the catchment management projects and associated on-ground works;
- Assessment of the importance of involvement of commercial and intensive farming properties in the Action Plan, and engagement of this sector in the Farm Management Plans project.
- Research into the effectiveness of the different education programs in community awareness and behaviour change; and consideration of alternative

overall approaches (as suggested in Section 4.2.1). Independent, external evaluation of the various programs is also needed to find the 'best mix' for any given catchment. (note: experiences in WA and NSW suggest a research approach would be best. While the education programs have been effective in educating people and raising awareness, their effect on changing behaviour and reducing nutrient inputs is not clear.).

- Improvement of coordination of Action Plan 1 activities with the environmental monitoring undertaken in Action Area 4. In particular, addressing of the issue of monitoring the impact or effectiveness of catchment work.
- A strategic approach to catchment efforts (through catchment management plans/the Swan Region Strategy) to ensure maximum return for effort. This should include tracking the spatial scale of all catchment efforts in a GIS database, as is done for the Farm Plans project.
- Funding uncertainty is a real issue for catchment groups. Continuity of personnel is needed.

4.3 Future monitoring and evaluation of the Action Plan

At present, the only KPIs for the SCCP are water quality targets for 'bottom of catchment' waters (total nitrogen and total phosphorus) and within the estuary (total nitrogen and total phosphorus concentrations, chlorophyll 'a' levels, oxygen levels, the number of blooms of toxic species of phytoplankton). The outcomes of the on-ground works to date, in terms of environmental response, are presently unknown. Catchment management efforts take time, and the on-ground works completed to date are not yet on a scale that is sufficiently advanced to produce an effect at those sites in the Swan-Canning system that the Action Plan's monitoring program presently focus on. However, it should be possible to undertake monitoring at a smaller scale to detect the impact of the catchment works in some areas, with project-specific KPIs tailored accordingly. This monitoring is needed for two reasons:

- To determine the degree of nutrient reduction that can actually be achieved by catchment works and so determine what is realistically achievable in terms of reducing nutrient inputs to the Swan-Canning system; and
- Provide the community groups with feedback on the impact of their work.

A strategic approach to catchment efforts (through catchment management plans/the Swan Regional Strategy) is also needed to ensure maximum return for effort, and must include tracking the spatial scale and extent of all work undertaken. The need for this approach can be demonstrated by a simple example: establishment of the relative importance of primary, secondary, tertiary and quaternary streams in contributing nutrients. KPIs for Action Area 1 should reflect this strategic focus, and encompass both **outputs** (eg % of CMPs completed to an accepted standard, % of priority waterways that are fenced/revegetated, changes in fertiliser application rates) and **outcomes** (eg community awareness / attitude / behaviour, groundwater condition, waterways condition). Some suggestions are provided below.

Catchment condition

- Proportion of total stream length with healthy riparian vegetation (based on a selected set of attributes):
  - Primary streams
  - Secondary streams

    - Tertiary streams
    - Quaternary streams
- Proportion of total stream length with no, or degraded riparian vegetation:
    - Primary streams
    - Secondary streams
    - Tertiary streams
    - Quaternary streams
- Water quality (nutrient concentrations, total suspended solids) in streams, including load-based / event-based monitoring of nutrients.
- Groundwater quality (nutrient concentrations).
- See also Section 7.3.

Catchment management

- Key issues/areas requiring management identified.
- Key issues/areas requiring management prioritised.
- Catchment management plan prepared (includes identification of relevant planning policies and guidelines, codes of practice and recommended practices) and reviewed.
- Proportion of pasture with perennial species.
- Fertilizer application rate (agriculture type-specific).
- See also Section 5.3.

Community awareness/behaviour

- Level of participation in catchment/landcare groups or activities.
- Level of participation in environmental education activities.
- Number of partnership agreements between community groups and managers.
- Level of behavioural change (lawn size reduced, fertilise-wise practices adopted, native species planted, community group joined).

5. Evaluation of Action Area 2

5.1 Reflection on the first phase of the Action Plan

5.1.1 Background

Action Area 2 is: "Improve planning and land-use management to reduce nutrient inputs", and is addressed by three Action Plan recommendations.

- Recommendation 4: Statutory Mechanisms including by-laws, town planning schemes and statements of planning policy to modify land-use practices and prevent or re-locate polluting activities;
- Recommendation 5: Best Management Practices for nutrient reduction in current and future developments and stormwater drainage schemes; and
- Recommendation 6: Economic and Regulatory Mechanisms to encourage catchment, wetland and river foreshore management for nutrient reduction.

The Action Plan advocates a partnership between the State and local governments, the public and the business community to improve planning and land use management to meet the goals of the Action Plan. This entails State and local government examining and revising statutory tools such as regulations, town planning schemes and State policies, and the community participating in the review and amendment of such tools, and in other public statutory processes such as environmental assessments. Other means to improve land management practices and restore degraded land that are identified by the Action Plan include the use of Best Management Practices (BMPs) (in agriculture and industry), economic incentives (tax incentives, buying back land, differential tax rates for sustainable land uses), the development of management agreements with landholders (Government and landholders both contributing resources to improve land use), and licensing of drains.

The projects that have been undertaken in Action Area 2 include:

- Statutory Mechanisms;
- Swan Environmental Protection Policy (EPP);
- Swan-Canning Industry Survey;
- Light Industry Project;
- Best Management Practices (BMPs) Swan-Canning; and
- Drain Licensing.

These projects are described in detail in Final Evaluation Report Part B: Supporting Information.

A total of $351,340 has been spent on implementing Action Area 2 over the past five years. A summary of funding for the various projects is provided in Table 5.1. The BMPs project also obtained external funding of >$381,396, mostly from Coast and Clean Seas grants, and a NHT grant.

Table 5.1 Summary of the funding for Action Area 2

Action Plan Project	Project Funding	% of Action Area 2 Funding	External Funding
Statutory Mechanism	$54,638	15.6%	-
Swan Environmental Protection Policy (EPP)	$74,592	21.2%	-
Swan-Canning Industry Survey	$50,543	14.4%	$100,000
Light Industry Project	$30,826	8.8%	-
Best Management Practices (BMPs) Swan-Canning	$120,741	34.4%	>$281,396
Drain licensing	$20,000	5.7%	-
TOTAL	**$351,340**		**>$381,396**

5.1.2 Achievements

Action Area 2 is addressed by Action Plan recommendations 4, 5 and 6, which in turn comprise nine sub-recommendations. Three of the nine sub-recommendations for Action Area 2 have been implemented. Little or no work has been completed on the remaining six recommendations. At the Evaluation Forum, Action Area 2 was considered the least successful Action Area overall; despite its critical role in ensuring the success of the SCCP program. However, the Expert Reference Panel commended the Swan-Canning Light Industry / BMPs project for its high level of achievement, particularly as it has been implemented on a very small budget in recent years. In particular, the Panel was impressed with:

- The continued development of the program since its inception;
- Addressing an area (i.e. industry) that needed attention;
- Working in collaboration with other agencies and stakeholders; and
- Achieving the recently approved 'unauthorized discharge' regulations under the Environmental Protection Act, which gives local governments the authority to issue spot fines over a list of prescribed wastes discharged from commercial premises.

The key achievements of work undertaken for Action Area 2 are provided below.

Achievements of work undertaken for Action Plan Recommendation 4
Recommendation 4.1*. Incorporate Water Sensitive Design and nutrient source reduction principles and goals of the Swan-Canning Cleanup Program and the Swan-Canning Environmental Protection Policy, in regional planning and town planning schemes and scheme amendments to ensure that proposed developments are consistent with these principles and goals*

• Stakeholder workshop on water sensitive urban design (WSUD), and report on "Water Sensitive urban Design and the Development Approval Process—Identification of Issues and Potential Solutions for Better Implementation". This work provides input to the broader issue of drainage management in the Swan-Canning catchment that is currently being examined by the State Government.
• Other achievements largely through activities external to SCCP-funded work. The Department for Planning & Infrastructure has actively implemented recommendation 4.1 through new initiatives & joint agency programs, including:
  • Schedule 4 of the recently released draft Water Resources Statement of Planning Policy, which outlines the objectives and principles of WSUD.
  • Draft "Liveable Neighbourhoods Edition 3" operational policy (WA Planning Commission) (for greenfield or large infill sites), which emphasises WSUD.
  • The draft WA Stormwater Management Manual.

Achievements of work undertaken for Action Plan Recommendation 5
***Recommendation 5.1**. Establish a Best Management Practice (BMP) working group to evaluate existing BMPs and prepare a program to develop and implement BMPs to achieve SCCP objectives.*
• BMP working group initially established in 1996, prior to implementation of the Action Plan, to address non-prescribed premises, and activities that affect the river. Working Group has continued the implementation phase of the SCCP Action Plan, including the production of policies and BMPs on air conditioner waste, bait worm digging, and yacht club management, and industry training packages.
***Recommendation 5.2**. Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management.*
• Cleaner Productions trials and information packages developed for industry. • Demonstrated improvement in environmental performance by Cleaning Industry participants following training in the Cleaner Production program. • Extensive development of partnerships and networks, on-ground support, programs and resources (eg guidance documents for activities impacting on the Swan-Canning system). • Key role in achieving the 'unauthorized discharge' regulations under the Environmental Protection Act, which gives local governments the authority to issue spot fines over a list of prescribed wastes discharged from commercial premises

Achievements of work undertaken for Action Plan Recommendation 6
***Recommendation 6.4**. Investigate licensing for drains discharging into the Swan-Canning rivers, as a tool for controlling nutrient inputs*
Investigated as a 1-year project, and a 'Drain Licensing Report' prepared that discussed licensing options.

5.1.3 Gaps

There were considerable gaps in the work undertaken to address Action Area 2, as shown below.

Gaps in work undertaken for Action Plan Recommendations 4, 5 and 6
***Recommendation 4.2**. Prepare a Statement of Planning Policy for the Swan-Canning coastal catchment that incorporates the principles and goals of the Action Plan and that is also complementary to the Swan-Canning Environmental Protection Policy; and establish a group to review land-use tables in town planning schemes to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them.*
• No work undertaken.
***Recommendation 4.3**. Improve land-use controls for intensive agriculture such as horticulture that are not adequately addressed by present legislation or planning policy to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them*
• No work undertaken.
***Recommendation 6.1**. Evaluate the establishment of, and mechanism for, financing a land acquisition fund to buy back sensitive or degraded land and change current land-uses.*
• No Action Plan project developed.
***Recommendation 6.2**. Develop foreshore management agreements with landowners to reduce nutrient losses to watercourses, through fencing and rehabilitation of foreshores and erosion control with initial priority given to Ellen Brook and Southern-Wungong River.*
• No Action Plan project developed.
***Recommendation 6.3**. Provide State and local government incentives to encourage catchment rehabilitation by rewarding landowners for adopting practices that reduce nutrient inputs to the river*
• No Action Plan project developed.
***Recommendation 6.4.** Investigate licensing for drains discharging into the Swan-Canning rivers, as a tool for controlling nutrient inputs.*

Gaps in work undertaken for Action Plan Recommendations 4, 5 and 6
• No further work pursued since initial consultation on the Drain Licensing Report in 2001. This area has been largely overtaken by other State Government initiatives, such as the 2003 Drainage Management Forum, the Drainage Reform Group (ongoing work) and the Australian National University's study on regulatory design for water quality management (final draft in prep.)

A summary of the key gaps identified at a project-specific level are provided in the Final Evaluation Report Part B: Supporting Information.

5.2 Planning for the next phase of the Action Plan

5.2.1 Issues / Areas for improvement

At the Evaluation Forum, discussion on the Issues/Areas for Improvement for Action Area 2 focused predominantly on Statutory Mechanisms (Action Plan recommendation 4) and Economic and Regulatory Mechanisms (Action Plan recommendation 6). The issues affecting Best Management Practices (Action Plan recommendation 5) were largely encompassed by the over-arching issues of the overall program (Section 3.2), including resources, on-going funding commitment, lack of clarity about roles and responsibilities, and coordination.

The Expert Reference Panel considered Statutory Mechanisms as a "core of the Action Plan and yet the weakest link", and was very concerned with the relatively low level of progress over the past five years. The Panel noted:

- A lack of common vision between Action Plan participants about what is and isn't achievable;
- Uncertainty whether the science is there to make defensible decisions about controls on landuse—and if decisions should be delayed until the 'science is right'; and
- Uncertainty whether statutory mechanisms or management mechanisms were the most appropriate tools to use.

It appears that the issues and constraints concerning the Statutory Mechanisms project have been discussed by Action Plan participants at various levels, but never satisfactorily resolved.

With respect to Statutory Mechanisms, the Water Resources Statement of Planning Policy (SPP) addresses the development of **new** land (greenfield) to the highest level of planning policy that is possible, but real progress in reducing nutrient inputs requires changes to **existing** uses. Planning legislation protects existing uses, which can only be bought out or compensated: funding propositions to do this are not 'planning'. The Action Plan needs to investigate opportunities with Local Government to plan catchment strategies. Sub-catchment condition improvement is possible, via incentives to encourage a change in land use (which is better than the buy-back option of Action Plan Recommendation 6.1). This is an area not indicated in the Action Plan at present, and can proceed without waiting for 'better science' to provide definitive answers.

Throughout interviews with project staff and stakeholders, and at the Evaluation Forum, it was also questioned whether the degree of nutrient reduction required by the Action Plan in areas of existing landuse was achievable by measures that rely only on a voluntary approach (eg BMPs). Many participants considered there was a

need for mandatory controls and/or penalties, as backup for instances when voluntary mechanisms and positive incentives do not work.

5.2.2 Recommendations

Key recommendations developed during the Evaluation Forum to improve Action Area 2 were:

- Action Area 2 highlights the requirement for a greater level of leadership by the SRT, and partnership with other agencies, to establish and achieve SCCP priorities. Senior level partnerships should be a priority to establish. Action Area 2 is the core of the success of the program, and should also drive the science undertaken.
- The Action Plan must accept that other State government agencies currently have primary responsibilities for land use planning and drainage. It is essential to keep abreast of advances by those agencies towards greater sustainability.
- The Planning aspects of the Action Plan (i.e. Recommendations 4.1, 4.2 and 4.3) need to be addressed as a matter of urgency by the SRT and Department for Planning and Infrastructure (DPI). A scoping of why this particular project did not/could not deliver needs to be undertaken. The scoping needs to include: identification of barriers; and recommendations to move forward with a timeline included. Action Plan recommendations 4.1, 4.2, and 4.3 need to be reviewed and revised. A lack of scientific information is not considered justification for no progress in these recommendations. The links between Planning and Science need to be developed. (note: The SRT's own Planning Section does not seem to have been engaged with this aspect of the Action Plan, nor with water sensitive urban design in general. Perhaps this can be considered as part of the 'Networked City' review which is addressing current plans and planning processes, with sustainability as the major driver).
- Develop a conceptual model of the Swan-Canning system that identifies the different nutrient sources (such as industry, urban areas, groundwater, drains, rural areas) and their associated nutrient loads, and ascertain what can be done to address each of these components.
- More emphasis should be given to developing and broadening the scope of BMPs, including determination of their efficacies, in light of the fact that statutory and other regulatory mechanisms have not been implemented. This should also be core business for the Department of Environment, and should not be carried by the SRT alone.
- More effective involvement and collaboration should be sought with industry and Local government on nutrient related activities.
- The SCCP needs to be proactive in influencing the sub-regional and regional NRM plans and investment strategies; particularly to ensure that the focus of works on nutrient reduction is continued.
- Action Plan Recommendations 6.1, 6.2, and 6.3 require further consideration if they are to be achieved. A time scale and appropriate methodology need to be developed.
- Expert Reference Panel member Professor Neil Gunningham is just completing the final report of a 3-year study of regulatory design for water quality management in WA, for the State Government. This report 'Regulatory design for water quality management in Perth, Western Australia') offers several innovative ways (incentives and penalties) to address water quality issues in urban, industrial and agricultural areas, that should be considered in revising and implementing Action Plan Recommendations 4 & 6.

5.3 Future monitoring and evaluation of the Action Plan

Potential KPIs for Action Area 2 include the availability of appropriate tools, awareness of the scale of the issue to be addressed, awareness and use of existing planning and landuse controls, and the development and use of new incentives/controls. For example:

- % completion of user-friendly BMPs for those activities nominated by the Action Plan as significant contributors of nutrients.
- Number of local councils that have catalogued their areas of inappropriate land use.
- Level of local council awareness of existing tools to implement nutrient reduction measures (planning policies, BMPs, etc).
- Level of local council use of existing tools to implement nutrient reduction measures.
- The development and implementation of local council strategic plans to reduce nutrient inputs (including incentives/rewards and penalties/controls) (note: the strategic plans may need to be benchmarked).
- % of land managed by local councils (eg reserves, playing fields, public gardens) that is 'water-wise' and 'fertilise-wise'.
- % of (type specific) industries that have implemented BMPs.

6. Evaluation of Action Area 3

6.1 Reflection on the first phase of the Action Plan

6.1.1 Background

Action Area 3 is: "Modify river conditions to reduce algal blooms", and is addressed by one Action Plan recommendation:

- Recommendation 7: Develop and implement river manipulation and remediation techniques to reduce algal blooms in the Swan-Canning system.

The Action Plan recognises that changes in catchment management practices will take time to implement and take effect, and that, realistically, it might be 20 years before nutrient inputs to the Swan-Canning system are significantly reduced. Intervention techniques that reduce the availability of nutrients to algae in the rivers and estuarine basins were identified as an interim means of lessening the ill effects of nutrient enrichment, until catchment management measures take effect. The SCCP undertook considerable research and trials to develop a 'tool box' of intervention techniques, with oxygenation and sediment remediation offering the most promise, and therefore worth further investigation in the Action Plan. Another form of 'intervention' identified for examination was water flow in Canning River (the upper reaches of which are dammed for potable water), and the potential to balance the needs of potable supplies and adequate environmental flows.

The projects that have been undertaken in Action Area 3 include:

- River oxygenation;
- Sediment remediation;
- Landfill leachate investigation; and
- Canning River Management Plan.

These projects are described in detail in Final Evaluation Report Part B: Supporting Information.

A total of $2,533,200 SCCP funding has been spent on implementing Action Area 3 over the past five years (Table 6.1). An additional $1,065,555 of external funding for three of the four projects has also been obtained from external sources (Table 6.1), largely Commonwealth Coasts and Clean Seas grants.

Table 6.1 Summary of funding for Action Area 3

Action Plan Project	Action Area 3 funding		External funding
	Amount	% of total	
Oxygenation (includes three projects: River oxygenation methods, Canning oxygenation, Swan oxygenation)	$1,092,422	43.1%	$597,754
Sediment remediation	$1,230,420	48.6%	$394,151
Landfill leachate investigation	$5,000	0.2%	-
Canning River Management Plan	$205,358	8.1%	$73,750
TOTAL	**$2,533,200**		**$1,065,655**

6.1.2 Achievements

Action Area 3 is addressed by Action Plan recommendations 7, which in turn comprises nine sub-recommendations. Eight of the nine sub-recommendations for Action Area 3 have been implemented: one of these had significant gaps associated with the work undertaken, but considerable progress was made in the others, particularly in the areas of river oxygenation, sediment remediation and in the development of a management plan for the Canning River.

The key achievements of work undertaken for Action Area 3 are provided below.

Achievements of work undertaken for Action Plan Recommendation 7
***Recommendation 7.1**. Develop river oxygenation methods to an operational scale, undertake oxygenation trial in the Swan River to reduce nutrient availability and implement if successful*
• An operational scale, mobile oxygenation unit was successfully developed. It provides the technical groundwork for a large-scale unit should this be warranted by future serious deterioration in the Swan River.
***Recommendation 7.2.** Operate oxygenation plant in the Canning River to reduce nutrient availability*
• A large scale oxygenation plant sufficient to oxygenate 2.3 km of the Canning River was successfully built and operated from October to May during the first five years of the Action Plan. • Algal blooms were not prevented, but oxygen levels were increased, nutrient levels significantly reduced, habitat improved for invertebrate fauna and fish, and aesthetics improved (less odours). • Knowledge and understanding of algal bloom dynamics in the Canning River, and the use of oxygenation techniques, has increased considerably. • There is the capability to effectively address high nutrient input events (eg unseasonal rainfall) that might otherwise cause fish and invertebrate kills.
***Recommendation 7.3.** Develop sediment remediation methods to an operational scale and apply the technique in the Swan and Canning rivers to reduce nutrient availability*
• Methods using Phoslock™ were developed and applied to the Canning River. • Phoslock™ considerably reduced phosphorus availability in the sediments, but there are still sufficient nutrient sources entering the Canning to sustain algal blooms. • Phoslock™ offers promise as a drain treatment.
***Recommendation 7.4**. Develop and evaluate new river intervention techniques to reduce algal blooms*
• New river techniques are being developed and/or have been evaluated, but none has yet proved to reduce algal blooms in the Swan-Canning system.
***Recommendation 7.5**. Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques*
• Design principles for artificial wetlands on the Swan Coastal Plain have been developed.
***Recommendation 7.6**. Evaluate nutrient and pollution risk from former landfill sites bordering the rivers and drains*
• Groundwater bores installed and groundwater samples collected at Centenary Park (Canning River), and chemically analysed.
***Recommendation 7.8**. Develop and implement a management plan for the Canning River based on environmental flow allocations and controlled discharges from the Kent Street Weir*
• The document "Caring for the Canning: A plan to revitalise the Canning, Southern and Wungong Rivers" was completed. • Implementation of the management plan is underway, particularly addressing environmental flow allocations. • Production of the "Caring for the Canning" document involved considerable consultation, resulting in increased public awareness and knowledge of issues, the formation of government / community partnerships, and commencement of ICM by catchment groups.
***Recommendation 7.9**. Restore ecological function of the Swan-Canning foreshores and secure erosion protection*
• Largely addressed outside of SCCP Action Plan, in the 'River*bank*' program. Some work done in 53103 Restore Works – Foreshore (see Section 4.2)

Overall achievements within Action Area 3 have been considerable. In particular, significant advances in 'state of the art' river intervention techniques have been

made; and the scientific understanding of the Swan-Canning system has expanded. During the Evaluation Forum the technical difficulty associated with the tasks undertaken was acknowledged, and projects within Action Area 3 were viewed as very good value for money. The Expert Reference Panel made the following comments about specific projects:

- The Sediment Remediation project (i.e. development of Phoslock™) is to be congratulated. It is a good success story, and not an easy task to accomplish.
- The Canning River Management Plan – Environmental Flows project is a big and time consuming issue. Project personnel are congratulated on tackling such a task, particularly on such a limited budget.

During the Evaluation Forum it was also acknowledged that although the ecosystem condition has not yet changed as a result of Action Plan efforts, some ecosystem function in the Canning River has been regained due to oxygenation and application of Phoslock™.

6.1.3 Gaps

Gaps in the work undertaken to address Action Area 3 are listed below.

Gaps in work undertaken for Action Plan Recommendation 7
Recommendation 7.2. *Operate oxygenation plant in the Canning River to reduce nutrient availability*
• The oxygenation infrastructure requires upgrading.
Recommendation 7.3. *Develop sediment remediation methods to an operational scale and apply the technique in the Swan and Canning rivers to reduce nutrient availability*
• Techniques have yet to be developed that can be applied to the Swan River (Phoslock™ only works in freshwater systems).
Recommendation 7.4*. Develop and evaluate new river intervention techniques to reduce algal blooms*
• More research is needed on macrophytes in the Canning River to see if they can be utilised in preventing algal blooms. • River intervention techniques that reduce nitrogen availability would be very beneficial; however an extensive literature search has revealed that (world-wide) no effective methods are currently available.
Recommendation 7.5*. Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques*
• Project could not be completed due to significant constraints. Initial sites selected in Ellen Brook sub-catchment were not possible due to Aboriginal Heritage concerns, and development of subsequent sites within new urban development was stalled due to local council concerns over wetland maintenance and responsibility (Re-assigned to Action Area 1, see Section 4.2)
Recommendation 7.6*. Evaluate nutrient and pollution risk from former landfill sites bordering the rivers and drains*
• There does not appear to have been any interpretation of the groundwater data collected, or reporting.
Recommendation 7.7*. If risk is unacceptable undertake appropriate management action to reduce nutrient and pollutant leaching from former landfill sites bordering the rivers and drains*
• Not carried out.
Recommendation 7.8*. Develop and implement a management plan for the Canning River based on environmental flow allocations and controlled discharges from the Kent Street Weir*
• The plan has been developed, but implementation is considerably restricted by funding and support from other key stakeholders.

A summary of the key gaps identified at a project-specific level are provided in the Final Evaluation Report Part B: Supporting Information.

6.2 Planning for the next phase of the Action Plan

6.2.1 Issues / Areas for improvement

Key issues / areas for improvement of Action Area 3 identified during interviews with project staff and stakeholders, and/or at the Evaluation Forum, are provided below.

- An overarching Research and Development Program is required for Action Area 3 to address the strategic direction of the river intervention program. The intervention techniques that have been developed need to be properly integrated if they are to have environmental benefits. The potential for application of these different remediation techniques within the Swan-Canning waterways need to be examined and spatial optimisation approaches determined.
- There are some considerable constraints affecting the progress of the Environmental Flows and ecological function project component of the Canning River Management Plan project (including the future management of Kent Street Weir):
    1. The level of engagement and commitment (funding and support) from agencies outside the Trust is minimal (particularly the Department of Environment and the Water Corporation). Environmental flows (as part of water allocation) is core business of the Department of Environment;
    2. The core funding provided is inadequate for this project given the size, complexity and importance of the issue that it is addressing.
- The efficacy of existing or proposed BMPs in urban, industrial and rural areas needs to be quantified.
- The relative contribution of groundwater to nutrient inputs needs to be quantified.
- It is important to present a broad-scale model that paints a big picture of the nutrient-related problems in the Swan-Canning region to Government and the public (with accompanying paper). This model needs to contain as much information as possible about the issues in a simple form, and present information about what costs and scale of effort and works are involved in properly addressing these issues. The urgency for action needs to be made clear when reporting, to get other agencies on board and obtain the funding required.
- No additional river modification techniques were identified as warranting investigation for the Swan and Canning Rivers at this stage. However, it was highlighted that the current impacts occurring on the waterways are inevitably bigger than are currently reported. For example, hypoxic conditions resulting from an algal bloom would also be killing “less noticeable” animals than just reported numbers of fish. Climate change effects, leaching from acid sulphate soils would all be having a cumulative impact on the ecosystems as well as algal blooms and enriched nutrient conditions.
- More contextualisation of the scientific information collected needs to be undertaken; and communicated more regularly and effectively. For example, there is no clear conceptual model of the catchment and river estuaries that shows what the main nutrient sources, loads and impacts are. A conceptual model should be developed (and made readily available) that shows the proportions of each of the different nutrient sources (agricultural uses, urban drains, groundwater and sediments). This information is critical for

determining where the greatest environmental gains can be made from management, and how these can be done most effectively.

- For land use which is inappropriate, research should be on the polluting impacts, the change in land use required and any associated losses and gains (including profit) that the change will cause. The objective of research should be to build a case that justifies to the WA Planning Commission that priority of the land for agriculture should be shifted.
- There needs to be much greater integration of Planning and Land Use Management (Action Area 2) with the Science (Action Areas 3 & 4). Planning has specific requirements for scientific information, and scientific investigations within the program should be re-focused and prioritised to address this.
- There needs to be better communication between the Science-based projects (Action Areas 3 and 4) and on-ground works and management (Action Area 1).

6.2.2 Recommendations

Key recommendations developed during the Evaluation Forum to improve Action Area 3 were:

- Action Area 3 would benefit from external input and review, such as an external technical advisory committee;
- Action Area 3 should consider re-focussing of effort from investigation and development of river intervention techniques to more targeted application. These techniques should be applied in a whole of catchment approach to have effect in other sub-catchments where urgent action is needed, rather than just continue as R&D for existing projects (i.e. Phoslock™, oxygenation). Spatial optimization of the application of river intervention techniques should be examined by a technical advisory group and implemented (source control). This can be facilitated by modelling scenarios –the efficacy of such techniques and their overall impacts on the health of the Swan-Canning system can be determined. This is critical to get support from a collaborative/funding partner.
- Understanding and effective implementation of environmental flows is critical for the health of the Canning River. However, the investigation and management of Environmental Flows is considered to be core business of the Department of Environment; and beyond the responsibility of the Action Plan.
- Develop a strategic plan for this Action Area that addresses priorities and works to be undertaken within the Swan-Canning region.
- Continuation of the Landfill Leachate program is considered an important aspect to address within the Action Plan.
- Key knowledge gaps that warrant investigation include: Groundwater inputs (their scale, and importance), the role of sediments in nutrient cycling, the effectiveness of BMPs in reducing nutrient inputs, and the role of zooplankton grazing in controlling algal blooms.

6.3 Future monitoring and evaluation of the Action Plan

KPIs for Action Area 3 should logically be tied to:

- timely production of reports documenting the progress and results of the river intervention techniques examined;
- successful implementation of techniques at the pilot scale and full scale; and
- the environmental outcomes (eg measures of ecosystem health, aesthetics) that the implementation of the techniques produce.

7. Evaluation of Action Area 4

7.1 Reflection on the first phase of the Action Plan

7.1.1 Background

Action Area 4 is: "Monitor river health, fill critical gaps in knowledge and report progress to the community", and is addressed by three Action Plan recommendations.

- Recommendation 8: Adopt recommended water quality targets for the freshwater tributaries and estuarine portions of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan;
- Recommendation 9: Undertake investigations to fill critical knowledge gaps, monitor the river conditions and produce a "State of the Swan-Canning River System" report every five years; and
- Recommendation 10: Report progress regularly to the community and ensure that there are opportunities for feedback and for involvement in the adoption and implementation of the Action Plan.

The Action Plan requires effective monitoring of the catchment and estuary to track trends in water quality, measure compliance against management targets, and determine the effectiveness of catchment and estuary management measures. This monitoring work needs to be supported by a well directed and applied research program, to ensure constant improvements in management and decreased risks in decision making. The importance of community involvement in the Action Plan, plus the need for accountability, also demands that monitoring and research results be reported to the community on a regular basis.

The projects that have been undertaken in Action Area 4 include:

- Environmental Performance & Progress Reporting (includes Water Quality and Quantity and Logistical Support);
- Sediment Nutrient Cycling; and
- Decision Support Model Expertise

These projects are described in detail in Final Evaluation Report Part B: Supporting Information.

A total of $3,964,016 has been spent on implementing Action Area 4 over the past five years. A summary of funding to the various projects is provided in Table 7.1. The Sediment Nutrient Cycling project also attracted external funding of >$369,956 from the Australian Geological Survey Organisation (now Geosciences Australia).

Table 7.1 Summary of the funding for Action Area 4

Action Plan Project	Action Plan funding		External funding
	Amount	% of total	
Environmental performance & progress reporting (includes Water Quality and Quantity, and Logistical support)	$3,126,855	78.9%	-
Sediment Nutrient Cycling	$249,999	6.3%	>$369,956
Decision support model expertise	$587,162	14.8%	>$5,000
TOTAL	**$3,964,016**		

7.1.2 Achievements

Action Area 4 is addressed by Action Plan recommendations 8, 9 and 10, which in turn comprise eleven sub-recommendations. Eight of the 11 sub-recommendations for Action Area 4 have been implemented; although there are a number of shortfalls or gaps identified for some of the associated activities.

The key achievements of work undertaken for Action Area 4 are provided below.

Achievements of work undertaken for Action Plan Recommendation 8
***Recommendation 8.1**. Adopt recommended water quality targets for the freshwater tributaries (Table 8) of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan*
• Total nitrogen and total phosphorus targets have been adopted and refined. • A statistically rigorous basis for target compliance has been determined.
***Recommendation 8.2**. Prepare water quality targets and a compliance table for the estuarine and tidal portions of the Swan-Canning system for nutrients, dissolved oxygen, chlorophyll and phytoplankton cell counts*
• Statistically rigorous targets for total nitrogen and total phosphorus, dissolved oxygen and chlorophyll have been developed. • A statistically rigorous basis for target compliance has been determined.

Achievements of work undertaken for Action Plan Recommendation 9
***Recommendation 9.1**. Implement a monitoring program and report on: all water quality data and compliance against targets annually; water quality trends at intervals of 3 years; success of catchment management actions after 5 years; data against goals and objectives targets established by the Action Plan every 5 years*
• A comprehensive, quality assured monitoring program for weekly monitoring of water quality in the estuary (20 sites) and fortnightly monitoring in the catchments (15 sites) has been implemented. • Compliance is reported weekly.
***Recommendation 9.2**. Investigate nitrification-denitrification and carbon cycles in relation to estuarine sediment nutrient cycling*
• A comprehensive and scientifically rigorous study of benthic nutrient cycling processes was carried out. Sediment nutrient release rates were determined at a range of sites throughout the Swan-Canning system, under a range of seasonal conditions. • Knowledge and understanding of sediment nutrient cycling processes have been greatly increased. • Data have been obtained that will improve computer models of ecosystem processes, and therefore their ability to predict the impacts of various environmental scenarios. This will aid future decision-making. • Dosing rates for river intervention techniques (oxygenation, Phoslock™) were determined, and their performance optimised.
***Recommendation 9.3**. Complete development and validation of estuary and catchment models and use them to model system fluxes of nutrients including carbon*
• The catchment model LASCAM has been developed and validated. • A collaborative project is underway with the CRC for Catchment Hydrology to implement the catchment model EMSS
***Recommendation 9.4**. Develop decision support systems to predict and demonstrate the consequences of changes to the catchment or the estuarine system, to optimise management practices*
• LASCAM has been used as a decision support tool to predict the effect of land development in the Southern River catchment
***Recommendation 9.5**. Develop expertise within the WRC in the application of WAERF estuarine process and decision support models*
• In house expertise in catchment models has been developed.

Achievements of work undertaken for Action Plan Recommendation 10
Recommendation 10.1*. Coordinate reporting to the community and ensure that there are opportunities for community feedback on implementation of the Action Plan*
• Data from the water quality monitoring program are placed on the SRT's 'Algal Alert' website every week, and the community is kept informed.

At the Evaluation Forum the Panel commended the work that has been undertaken within this Action Area, and the progress achieved as a consequence of the high level of planning and rigour. Overall, the monitoring program particularly has proven to be a very successful, robust program. There has also been a substantial increase in the scientific understanding of the rivers/estuaries over the past five years. The Panel also congratulated the Decision Support Model Expertise project for the achievements to date in using existing models.

7.1.3 Gaps

Gaps identified for the work undertaken in Action Area 4 are provided below.

Gaps in work undertaken for Action Plan Recommendation 9
Recommendation 9.1*. Implement a monitoring program and report on: all water quality data and compliance against targets annually; water quality trends at intervals of 3 years; success of catchment management actions after 5 years; data against goals and objectives targets established by the Action Plan every 5 years*
• Infrastructure (eg. Gauging stations) needs upgrading. • There is no Research & Development budget. • Water quality in the catchments has not been measured or technically assessed. • Monitoring of the impact of on-ground works/activities from Action Area 1 is limited (primarily due to lack of knowledge about what and where these works are). • The 5-yearly synthesis report is not prepared yet.
Recommendation 9.3*. Complete development and validation of estuary and catchment models and use them to model system fluxes of nutrients including carbon* ***Recommendation 9.4****. Develop decision support systems to predict and demonstrate the consequences of changes to the catchment or the estuarine system, to optimise management practices*
• The catchment and estuary models are both constrained by the quality and quantity of available input data (water flow, water quality, landuse, impact of land management practices and remediation strategies etc) • A useable estuary model has yet to be developed.

A summary of the key gaps identified at a project-specific level are provided in the Final Evaluation Report Part B: Supporting Information.

7.2 Planning for the next phase of the Action Plan

7.2.1 Issues / Areas for improvement

Key issues / areas for improvement of Action Area 4 identified during interviews with project staff and stakeholders, and/or at the Evaluation Forum, are provided below.

- The current level of scientific understanding of waterways is good. However, the current scientific understanding of catchments, and the effectiveness of BMPs is not as detailed, and warrants further investigation.
- The areas to tackle for the Environmental monitoring/research/reporting component include:

1. The role of non-nutrient contaminants;
2. Ecosystem health indicators in the catchment (it is acknowledged that this is difficult for ephemeral streams), which is particularly important for engaging community interest, and
3. Better identification of nutrient sources.

- The impact of climate change needs to be considered, as it has a huge potential to influence water quality, and override any improvements due to reductions in nutrient inputs.
- The current monitoring program is only related to the estuary and the 'bottom end' of catchment waters. It was not initially designed to track changes in catchment use. A revision of the monitoring program may need to occur to expand further up into the catchment to link with catchment management and land use.
- Some of the gauging stations are in serious need of maintenance so accurate flow data can be used for loads and modelling purposes.
- The current process of data extraction from the Department of Environment's central database WIN (Water Information Network) was highlighted as a concern, as it is not very 'user-friendly'.
- The issues of landfill leachates, and septic system leachates in older suburbs, still need to be addressed.
- There is little connectivity between Integrated Catchment Management activities being undertaken in Action Area 1 and monitoring activities of Action Area 4. This linkage between on ground works and monitoring the effect is critical for ascertaining the level of program success. The lack of connectivity between the Action Areas is due to a number of different factors, some of which include:
  - No monitoring and evaluation framework for Action Area 1 or Action Area 4.
  - Detailed and collated information about the activities of each Action Area are not readily available (such as in a scope of works document or implementation plan). This information is very diffuse.
  - The Aquatic Sciences Branch has insufficient time available to address this issue, as it is already fully committed with undertaking its existing work.
  - The staff changeover rate within Action Area 1 (particularly with extension officers such as Catchment Coordinators) is so great that the majority of efforts in training and communication spent by the Aquatic Sciences Branch in the past have already been lost.
- If possible, it would be worthwhile reducing monitoring duplication by coordinating activities of community and other groups. It is recognised that the extent of works that can be undertaken is limited by available time and cost.
- Monitoring has been very successful, but the present performance indicators (nutrient and chlorophyll concentrations) should not be the sole drivers of environmental management. A set of ecosystem health indicators is needed that characterises a good environmental outcome/condition, that can be used in a non-auditable sense to determine what management needs to aim for. These should be developed in consultation with catchment managers and participants as their strength lies in their potential to communicate the health of the estuary and rivers.
- There needs to be some strategic mechanism of prioritizing, reviewing and improving R&D/monitoring/modelling. This could be facilitated via a

Technical Advisory Panel comprising a group of strategic thinkers. Once research priorities are identified, work should be carried out in partnerships with universities and CSIRO. Linkage grants should be used to generate more funds.

- There is little research and development undertaken at present. Some of the areas where additional understanding is required are the importance of groundwater, intertidal flats, climate change and gauged catchments.
- There are some delays in publishing science material and information, either in the internal review, publishing process or from the research analysis, and at times information appears out of date. The SCCP publication process needs to be streamlined.
- It is acknowledged that the modelling work has been hampered by lack of good input data and a historical obligation to use certain models. The need for working models is not questioned (particularly for predictive work), but the philosophical approach to the use of models needs reviewing, including the type of models used. There is a need to ensure the models are robust and well-defined, so that they can still be applied in future times when staff and input structures are likely to have changed. Appropriate input data will also be required, as will validation data to make sure the models correctly simulate the effect of various ecosystem processes, land uses and BMPs.

7.2.2 Recommendations

Key recommendations developed during the Evaluation Forum to improve Action Area 4 were:

- Establish an independent Technical Advisory Panel to prioritise and constantly review monitoring, modelling, and research and development. Members should be strategic thinkers, and without conflicts of interest that might arise through furthering their own research programs or models.
- This Action Area would benefit considerably from incorporation of a Research & Development program. Work is needed on the role/importance of:
    1. Groundwater;
    2. Sediments (including intertidal flats); and
    3. Zooplankton.
- Partnerships should be established with research agencies, such as universities and CSIRO, for innovative research and development. There is considerable scope for new approaches and information which add value to this Action Area with increased collaboration via ARC Linkage grants (through the universities) etc. Grant applications etc. should be facilitated through the Action Plan Project Director and possibly the proposed Technical Advisory Panel as they will presumably have contacts with the universities and CSIRO. (note: catchment management, institutional arrangements, communication and education are all areas which could benefit from a research linked approach, not just Action Area 4).
- The Panel is currently concerned with the vulnerability of the modelling project due to its dependence on one staff member to operate the complex catchment model, LASCAM. The Panel recommends investigation of the comparability of LASCAM with other more user-friendly models, and perhaps scoping of the adoption of other models as soon as possible to overcome this. Appropriate documentation of the model is critical, or perhaps investment in training another modeller.

- The use and limitations, as well as future development of the existing models, should be reviewed.
- The spatial resolution of modelling, in the catchment and the estuary, should match as nearly as possible the scale of on-ground remediation works and responses in aquatic biota expected from conceptual models.
- The philosophical approach to the use of models needs reviewing, including the types of models used. Other models (eg Bayesian models) should be examined.
- Targets – both concentration and load-based targets are needed. Where possible, these should be linked to community values (eg. if the P load entering the estuary is reduced by 40% the frequency of algal blooms will be reduced by 80%). It is important that targets, and the associated indicators, are disseminated to the community in terms which they can readily interpret, and which convey clear meaning of the values and/or issues (eg when quoting levels of nitrogen or phosphorus, relate them to levels which are likely to cause algal blooms).
- Information across Action Areas 3 and 4 particularly should be collated to develop a detailed (yet simple) conceptual model of the Swan-Canning catchment and waterways. The main nutrient sources, loads (agricultural uses, urban drains, groundwater and sediments) and impacts should be incorporated into the model. This information is critical for determining where the greatest environmental gains can be made from management, how these can be done most effectively, and what are the key knowledge gaps.
- The present water quality indicators that are audited each year are not ecosystem health indicators. Ecosystem health indicators for catchment waterways and estuary that characterize a 'good outcome' (eg healthy seagrass, no fish kills) need to be developed (and will foster more public 'buy-in' too). These should not necessarily become numerical targets to be used for auditing.
- Strengthen linkages between Aquatic Science Branch monitoring and community groups. Try to get more out of community monitoring, reduce duplication, and improve consistency and QA/QC.
- The potential impact of climate change needs to be examined, and incorporated into the planning process as necessary.
- The effects of catchment management efforts need to be monitored. The role of community monitoring in the overall monitoring framework should be reviewed.
- The upgrade of gauging stations is a priority for the environmental monitoring project given their importance in the collection of monitoring data.

7.3 Future monitoring and evaluation of the Action Plan

KPIs for the Action Area 4 should logically be tied to:

- Timely reporting of monitoring data on the SRT's 'Algal Alert' website;
- The timely production of project reports; and
- Indicators of a healthy ecosystem, including ecosystem processes, biological patterns and water chemistry. A selection is provided below (excluding ones already measured in the Action Plan), many of which might also be appropriate for Action Area 1 and the overall Action Plan.

Ecosystem processes in catchment waterways and estuary

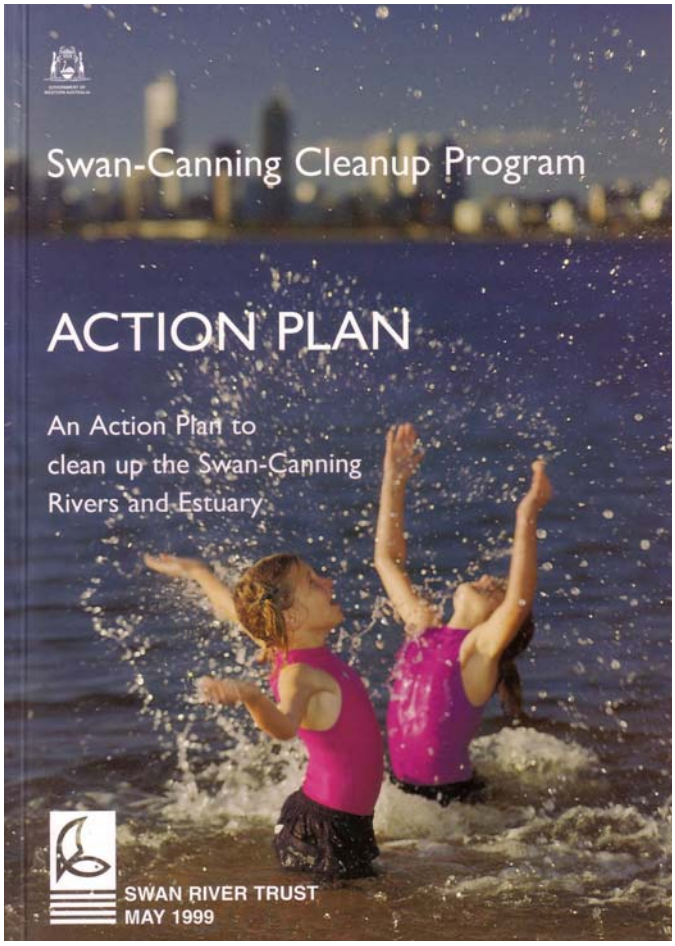
- Benthic (i.e. river bed or estuary bed) metabolism (eg Gross primary production).
- Change in sediment denitrification potential.
- Levels of macroalgae (an indicator of whether nutrient supply or light is controlling aquatic plant growth).
- Depth of oxygen penetration in sediments.

Biological patterns in catchment waterways and estuary

- Structure and function of fish communities.
- Fish condition/fish kills.
- Structure and function of invertebrate communities.
- Structure and function of macrophyte communities.
- Structure and function of benthic microbial communities.
- Structure and function of phytoplankton communities.
- Extent and abundance of significant 'indicator' species (of polluted conditions or healthy conditions).
- Extent and condition of estuarine habitats (eg seagrass meadows, saltmarsh, intertidal flats).

Water chemistry in catchment waterways and estuary

- Nutrient flux to and from sediments.
- Turbidity.
- Total suspended solids.



Evaluation of the Swan Canning Cleanup Program Action Plan

Final Evaluation Report

Part B: Supporting Information

Prepared for: **The Swan River Trust**

Prepared by: **Oceanica Consulting Pty Ltd**

June 2005

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Preface

In 1999 the Swan River Trust (SRT) launched the Swan-Canning Cleanup Program (SCCP) Action Plan (the Action Plan), to tackle the increasing incidence of algal blooms in the Swan-Canning River System in Perth, Western Australia. The primary cause of the algal blooms was identified as excessive nutrient inputs to the river system.

The Action Plan was implemented as a large-scale, multi-disciplinary program that focused on four key action areas, as follows:

- Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs;
- Action Area 2. Improve planning and land use management to reduce nutrient inputs;
- Action Area 3. Modify river conditions to reduce algal blooms; and
- Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community.

The Action Plan was established with flexibility for adaptive management, with an evaluation planned in the fifth year to ensure that work remained appropriate, effective and efficient. In June 2004, Oceanica Consulting Pty Ltd in association with Market Equity was appointed by the SRT to conduct this evaluation.

To ensure maximum value from the evaluation it was important to avoid unnecessary detail that would obscure the higher level findings, yet at the same time present findings of benefit to individual projects. For this reason the results of the evaluation have been structured as two documents:

- Final Evaluation Report Part A: Key Evaluation Findings.
- Final Evaluation Report Part B: Supporting Information.

This document is the **Final Evaluation Report Part B: Supporting Information**. It is intended as a companion document to Part A, and provides detailed and collated information addressing the individual projects of the Action Plan, as well as important information collected for the evaluation. As the Action Plan is a large and complex program the amount of information collected was considerable, and concerted efforts were made to ensure that this information was as accurate as possible. Prior to the document being finalised, the information contained herein was widely circulated for review, in the form of a Preliminary Evaluation Report (to individual Project Managers of the Action Plan, the SCCP Project Management Team, the SRT Board, and the Senior Officers Group), and as a draft of this report (to the SCCP Project Management Team, and the SRT Board).

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List of commonly used acronyms

Abbreviation	Name
Action Plan	Swan-Canning Cleanup Program Action Plan
AGWEST	Department of Agriculture Western Australia
BICM	Bayswater Integrated Catchment Management
BMP	Best Management Practice
CALM	Department of Conservation and Land Management
CMP	Catchment Management Plan
DEP	Department of Environmental Protection
DOE	Department of Environment
DPI	Department for Planning & Infrastructure (formerly Ministry for Planning)
EPA	Environmental Protection Authority
EWT	Evaluation Working Team
ICM	Integrated Catchment Management
LCDC	Land Conservation District Committee
LCG	Local community group
LG	Local Government
MfP	Ministry for Planning (currently Department for Planning & Infrastructure
MRS	Metropolitan Regional Scheme
NHT	Natural Heritage Trust
NRM	Natural Resource Management
PMG	Project Managers Group
RMC	River Management Committee
SAICM	Swan Avon Integrated Catchment Management
SCCP	Swan-Canning Cleanup Program
SCEPP	Swan-Canning Environmental Protection Policy
SOG	Senior Officers Group
SRT	Swan River Trust
WRC	Water & Rivers Commission
SPP	Statement of Planning Policy
TPS	Town Planning Scheme
WAERF	Western Australian Estuarine Research Foundation
WAMA	Western Australian Municipal Association
WAPC	Western Australian Planning Commission
WC	Water Corporation
WSD	Water Sensitive Design
WSUD	Water Sensitive Urban Design

1. Introduction

This document, the *Final Evaluation Report Part B: Supporting Information*, contains: (1) detailed information collected on Swan-Canning Cleanup Program Action Plan (the Action Plan) projects; and (2) considerable background and contextual material on the Swan-Canning system. The latter was required due to the involvement in the evaluation of an Expert Reference Panel, which comprised a panel of local, national and international experts in relevant fields. The overseeing of the evaluation by an Expert Reference Panel was a condition specified by the SRT, given the size and complexity of the Action Plan.

The document is structured as follows:

- **Chapter 2:** An overview of the environmental characteristics of Swan-Canning system (context for the evaluation, and background material for ERP members).
- **Chapter 3:** A description of the SCCP Action Plan (context for the evaluation, and background material for ERP members);
- **Chapter 4:** Action Area 1 – results of interviews with project personnel and reviews of available documentation/products.
- **Chapter 5:** Action Area 2 – results of interviews with project personnel and reviews of available documentation/products.
- **Chapter 6:** Action Area 3 – results of interviews with project personnel and reviews of available documentation/products.
- **Chapter 7:** Action Area 4 – results of interviews with project personnel and reviews of available documentation/products.
- **Chapter 8:** Results of general community survey and targeted surveys.
- **Chapter 9:** Literature review of the three national/international case studies.
- **Chapter 10:** Discussion.

The individual elements of the different projects implemented to address the SCCP Action Plan were organised within an evaluation framework according to the following categories (see Chapter 1 of the *Final Evaluation Report Part A: Key Evaluation Findings* for a description of evaluation methodology):

- Situation (Program/project information);
- Inputs (What has been invested);
- Outputs (Activities/Achievements, Participation); and
- Outcomes (Impacts).

These categories met the SRT's requirement to ascertain what had been achieved to date (outputs and outcomes), and the cost effectiveness and efficiency of the projects was provided by information on the level of investment (i.e. inputs) to achieve the outputs/outcomes. The 'situation' column was also carefully considered, as the evaluation included a review of the goals and objectives of the overall program and elected projects for implementation of the future SCCP Action Plan.

The information on the Action Plan projects in Chapter 4–7 has been reviewed for accuracy by the SCCP Project Management Team and individual Project Managers of the Action Plan. The literature review provided in Chapter 9 has been reviewed by ERP members Professor Barry Hart (Glenelg-Hopkins case study), Dr Eva Abal (Moreton Bay case study) and Dr Tony Petch (Lake Taupo case study).

2. The Swan-Canning System

2.1 Environmental setting

The environmental characteristics of the Swan-Canning system have been described in considerable detail in numerous SCCP reports; particularly the '*River Science*' series (see Sections 6 & 7). A summary of the key features of the Swan-Canning system, prepared as background material for the evaluation, is provided below.

2.1.1 Climate, geology and geomorphology

Perth's climate is classified as Mediterranean, consisting of wet, mild winters and hot, dry summers. The coolest month (August) has daily maximum and minimum temperatures of 18°C and 9°C, respectively, and the hottest month (February) has corresponding temperatures of 31°C and 20°C. The Perth area has a yearly average of 8 hours of daily sunshine—more hours of sunshine than any other capital city in Australia. The long-term average annual rainfall is 880 mm, but the large majority of this falls in four months of the year (June to September inclusive), and so the rivers and drains flow with freshwater in winter and early spring, but largely dry out in summer and early autumn.

The Swan-Canning system is permanently open to the ocean. A 9 km long, 500 m wide inlet channel with an average depth of 5 m widens into an estuarine basin that is relatively large (12 km long by up to 2 km wide) and deep (average depth 7 m, but about one third of the area is less than 3 m deep). The tidal river channels of the Swan and the Canning Rivers both discharge into the estuarine basin. The Swan River is connected to the estuarine basin by the broad shallow expanse of Perth Waters, which rapidly constricts further upstream to become a narrow river channel (<250 m wide) with an average depth of about 3 m. The Canning River connects to the estuarine basin via a 17 km long channel that is relatively broad (250–750 m) and deep (2.5–5 m), but that rapidly constricts and shallows for several kilometres before encountering the Kent Street weir. At the weir, wooden boards prevent saline water from moving upstream in summer (so the upper Canning essentially becomes a freshwater pool), but are removed from the upper level of the weir in winter to allow the river to flow downstream (to prevent flooding).

The Swan coastal plain is quite flat, and consists largely of sandy sediments that have poor nutrient-binding capabilities. As such, the waters of the Swan-Canning system flow quite slowly, and they receive runoff from land that readily loses any nutrients (i.e. fertiliser) applied to it.

Due to the porous nature of coastal plain sediments, a large amount of winter rain also accumulates in the groundwater, which is quite close to the surface (less than 5 m) in low-lying areas: Perth's numerous wetlands are largely surface expressions of groundwater. Although surface runoff from rain largely ceases by the end of spring, groundwater enters the larger rivers throughout the year. A small amount of flow also enters the rivers in summer from stormwater drains in urban areas—largely runoff from the watering of public recreational areas and suburban gardens. The porous nature of the coastal plain sediments is such that the groundwater is also easily contaminated by fertiliser, while stormwater flow from public recreational areas and suburban gardens is invariably contaminated by fertiliser too.

The Swan-Canning system therefore has open, slow-moving watercourses that experience mild to hot, sunny conditions for most of the year. The surface runoff,

groundwater and stormwater flowing into the system are from catchments with sandy soils that have low nutrient-binding capabilities, and so are easily contaminated by fertiliser. This combination of warm temperatures, lots of sunlight, slow-moving waters and (potentially) plenty of nutrients is ideal for algal growth, and so the Swan-Canning system is naturally susceptible to algal blooms.

2.1.2 Catchment, and catchment runoff

The total catchment of the Swan-Canning system is large—approximately 126,500 square kilometres, but the coastal plain portion of the total catchment is only approximately 2,600 square kilometres (Figure 2.1). It is the coastal plain portion of the catchment that is the focus of the SCCP Action Plan.

The coastal plain portion of the catchment has 31 major sub-catchments, some dominated by urban land use, and some dominated by rural land use (Table 2.1). There is little conventional broad-acre cropping (e.g. wheat) in the coastal plain catchment, but horticulture, turf farms, vine and tree crops (fruit), and grazing (cattle, horses) are common, and there are also intensive pig and poultry farms. There are also large numbers of small landholdings, run as part-time or 'hobby' farms rather than on a commercial basis.

Table 2.1 Area and main land use of sub-catchments of the Swan-Canning system

Sub-catchment	Area occupied (hectares)	Main land use
Ellen Brook	71,543	Rural
Millendon	~4,000, but largely a conduit for flow from Avon catchment	Rural
Susannah Brook	5,506	Rural
Jane Brook	13,769	Rural
Blackadder Creek	1,702	Urban
Helena River	17,566	Rural
Perth Airport North	2,812	Urban
Belmont Central	373	Urban
Belmont South	989	Urban
Mills Street Main Drain	1,230	Urban
Perth Airport South	2,461	Urban
Yule Brook	45,300 (catchments upstream of Kent St weir)	Rural
Bickley Brook		Rural
Helm Street		Rural
Ellis Brook		Rural
Munday Brook		Rural
Upper Canning River		Rural
Southern/Wungong		Rural
Bannister Creek	2,335	Urban
Lower Canning	58,641	Urban
Bullcreek	4,326	Urban
South Perth	4,076*	Urban
Downstream	2,062	Urban
Central Business District	1,349	Urban
Claisebrook Main Drain	1,636	Urban
Maylands	1,872	Urban
Bayswater Main Drain	2,725	Urban
Bennet Brook	11,210	Rural
Upper Swan	3,943**	Rural
St Leonards Creek	1,160	Rural
Henley Brook	1,346	Rural
Total area with mainly urban land use	**88,589 (34% of total))**	**-**
Total area with mainly rural land use	**171,343 (66% of total))**	**-**
TOTAL CATCHMENT	**259,932**	**-**

** 2,308 hectares draining into the Swan, and 1,768 draining into the Canning*

*** 3,005 hectares in Upper Swan North (largely rural) and 938 hectares in Upper Swan South (largely urban)*

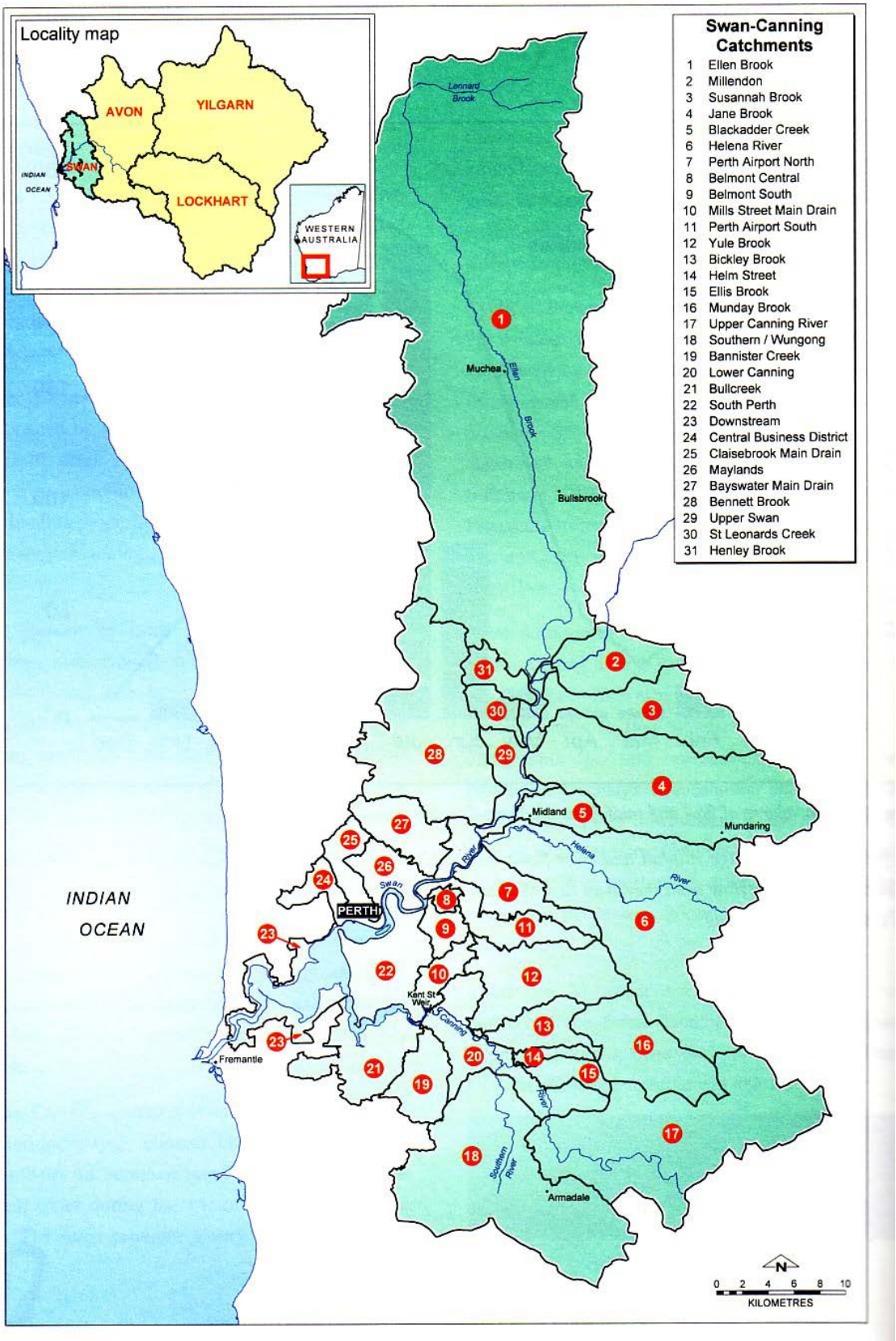


Figure 2.1 Catchments of the Swan-Canning system on the coastal plain

The amount of catchment runoff is far more variable than annual rainfall, as it depends not only on the amount of rainfall, but the time of onset, frequency, duration and intensity of winter rainfall. Catchment runoff and discharge are maximised when rainfall occurs as short periods of heavy rain. The annual discharge can vary between 100–1,500 x 10^6 m^3, but in a year of average rainfall is 400–500 x 10^6 m^3. In years of average or above average rainfall, much of the river flow in winter also

moves out through the mouth of the Swan River into local coastal waters (River Science No. 4).

The majority of the annual discharge (about two thirds) comes from the Avon River catchment. Of the one third of total flow that comes from the coastal plain catchment, most comes from tributaries of the Swan: less than 15% of total discharge comes from the Canning River.

The quality of runoff varies considerably between sub-catchments. For example, the Ellen Brook and Southern River sub-catchments deliver the second and third largest volumes of water to the Swan-Canning system, respectively, and both have moderate to high nutrient concentrations (total nitrogen [TN] concentrations of 1–3 mg/L and total phosphorus [TP] concentrations of 0.1–0.3 mg/L). These two sub-catchments drain predominantly semi-rural land, and also have strong groundwater gradients: the main sources of nutrients in their waters are believed to be fertiliser from pasture, livestock faecal waste, and naturally occurring organic deposits. In contrast, runoff from the Jane Brook, Helena River and Canning River sub-catchments—and from the Avon River catchment—has low nutrient concentrations (TN <1 mg/L and TP <0.1 mg/L), and tends to 'dilute' poor quality runoff flowing in from other sub-catchments.

Based on nutrient concentrations in sub-catchment runoff, the SCCP Action Plan identified four 'first priority' catchments (Ellen Brook, Bayswater Main Drain, Canning River and Southern River) and eight 'second priority' sub-catchments (Bennett Brook, Susannah Brook, Blackadder Creek, Yule Brook, Bickley Brook, Bannister Creek, Mills Street Main Drain, South Belmont Main Drain) for management attention (Figure 2.2).

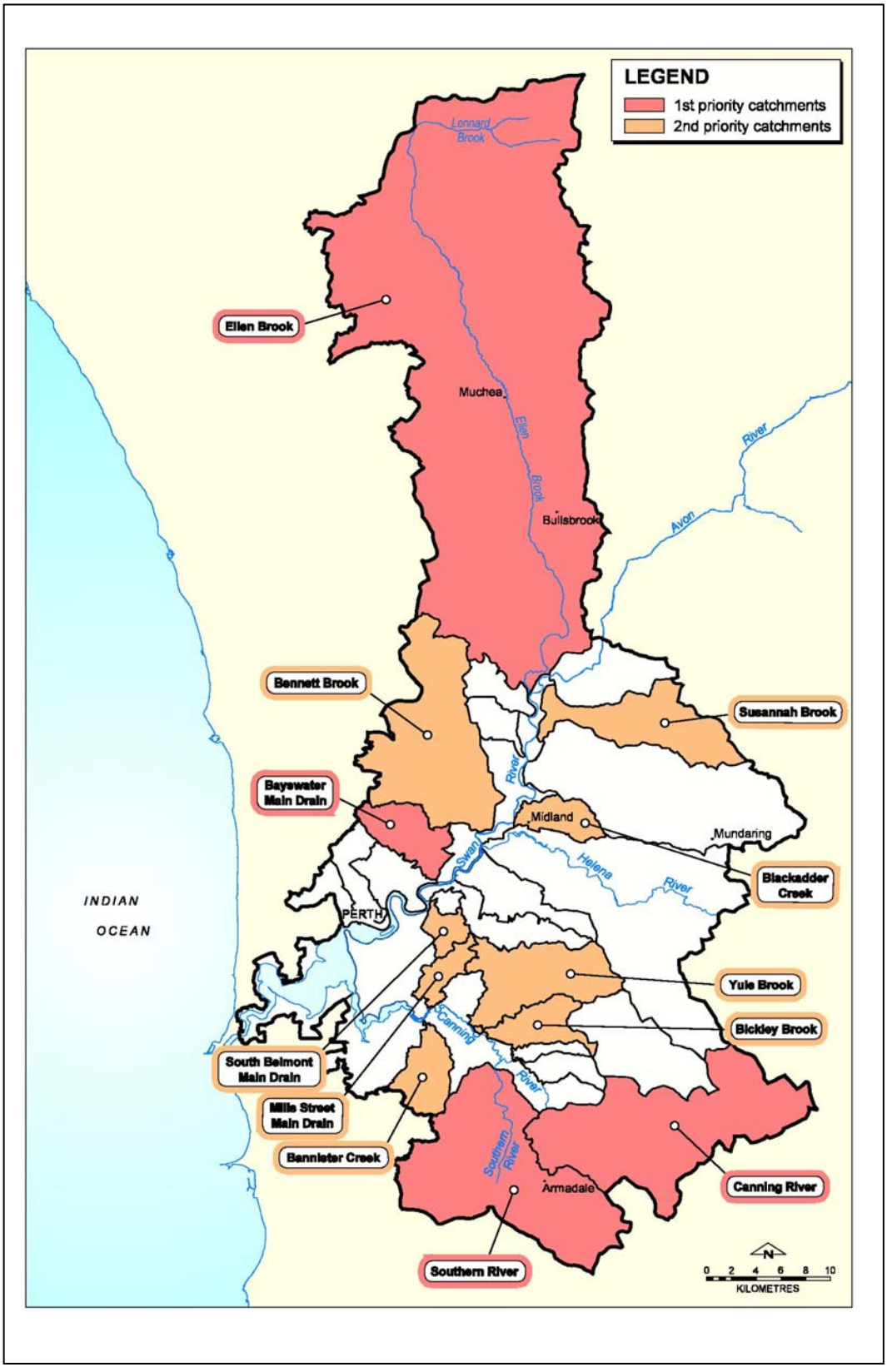


Figure 2.2 Priority catchments of the Swan-Canning system

2.1.3 Algal blooms

Algal blooms in the Swan-Canning system are fuelled by high concentrations of nitrogen and phosphorus, with overall growth usually limited by nitrogen supply. It is the dissolved, inorganic forms of nutrients (nitrate, ammonium, and phosphate) that fuel algal growth, and so total nutrient inputs (which include forms bound up organic and inorganic particles) do not always provide the best indication of the potential impact of a nutrient source. The nutrients come from several sources: catchment runoff, sub-surface flow, groundwater, and nutrients released from river sediments. To help understand algal blooms in the Swan-Canning system, further information on factors influencing sediment nutrient release is also provided below.

Sediment nutrient release: the 'salt wedge', and stratification in the Swan-Canning system

The salinity of the Swan-Canning system varies from fresh to brackish in winter/spring, to salty in summer/autumn. The estuarine basin and inlet channel are strongly influenced by ocean exchange and have marine salinities for much for the year: only their surface waters become fresh to brackish in winter and spring, depending on the amount of river runoff. In the tidal river channels of the Swan and the Canning River, runoff begins by making the surface waters fresh in autumn, but after several weeks to two months has usually pushed the salt water back to the estuarine basin and made the tidal river channels fresh throughout. With the cessation of river runoff in spring, marine water starts moving up the estuary again, reaching the upper Swan and the Kent Street weir by late spring/early summer.

Freshwater is less dense than salty water, and so river runoff flows downstream as a surface layer over the salty water. When tides are strong, the salty water travels upstream along the river bottom as a 'wedge', while the lighter, fresher water flows downstream on top. Every spring, a dense wedge of salty water moves upstream, according to tidal and barometric influences. This layering of fresh water over denser salt water is called stratification, and it restricts the mixing of bottom waters with surface waters. Stratification prevents oxygen in surface waters from moving downwards to replenish the oxygen used in the decomposition of organic material in sediments. Conditions of low oxygen can enhance nutrient release from the sediments, and the stratification also ensures that any nutrients released accumulate in the bottom waters. Thus, as the salt wedge moves upstream in spring, it is often associated with nutrient-rich but oxygen-poor bottom waters. Stratification also occurs in the tidal river channels in autumn, when initial river runoff is only sufficient to lower the salinity of surface waters.

Salinity stratification does not occur in the Canning River above the Kent Street weir, but temperature stratification does. In summer, the impounded freshwater weir pool above the Kent Street weir becomes stratified, with cool, heavier waters near the bottom and lighter, warmer waters near the surface. This temperature stratification leads to low oxygen levels and high nutrient levels in bottom waters, in much the same way as salinity stratification in the tidal waterways.

Types of algae

The main types of phytoplankton (microscopic algae) in the Swan-Canning system are as follows:

Chlorophytes – singled celled green algae that grow in fresh water, and are beneficial to food chains.

Diatoms – algae with cells walls largely made of silica, that can occur as single cells, or in chains or simple colonies. Different species prefer different salinities. Diatoms are usually beneficial to estuarine food chains

Dinoflagellates – single-celled algae with one or more large flagella (whip-like tails) that enable them to swim through the water. Dinoflagellates form tough 'cysts' that can endure poor conditions for long periods, and can rapidly germinate when conditions are favourable. Many dinoflagellates exhibit animal-like behaviour (ingesting other microscopic organisms for food) as well as plant-like behaviour (i.e. using sunlight to grow). Different species prefer different salinities. Some species are potentially toxic.

Other flagellates – small, single celled flagellates such as cryptophytes, that prefer salty water. Some species are potentially toxic.

Cyanobacteria – also called **blue-green algae** – 'algal-like' bacteria that generally prefer low salinities, calm conditions and warm temperatures. Some species can 'fix' their own nitrogen supply from atmospheric nitrogen, and can out-compete other species when phosphorus supplies are high and nitrogen supplies are low. Some species are potentially toxic.

Algal bloom cycles

A regular cycle of algal blooms occurs in the Swan-Canning system each year, usually from spring to autumn. The species that bloom depends on conditions of salinity, temperature, nutrient supply, water movement and light: different species are favoured by different conditions. The typical pattern (Figure 2.3) is as follows:

- Winter and early spring. Nutrients are present in high concentrations in river runoff, as is silica (which diatoms require), but flowing water, cold temperatures and short day lengths restrict growth. In late winter/early spring, when flows slow and temperatures and day lengths increase, chlorophyte blooms occur in the upper estuary, and diatoms in the lower estuary (where waters are brackish, and nutrients and silica are still in high supply).
- Spring. Diatoms blooms occur throughout the estuary. Dinoflagellate blooms are associated with the leading edge of the salt wedge as it passes upstream of Perth Water: they can use their flagella to swim to the water surface to grow in the sunlight during the day, and swim down to bottom waters at night take up nutrients from nutrient-rich bottom waters. Diatoms and dinoflagellates can grow and reproduce rapidly, and reach high numbers in short periods of time. Dinoflagellate blooms can form 'red tides', rusty to dark brown coloured blooms from mid to late spring. Dinoflagellate blooms can be followed by diatom blooms
- Summer. Red and brown coloured blooms of dinoflagellates, other flagellates and diatoms often occur in the middle to upper reaches of the estuary, where waters have become saline. The size of these blooms depends on the amount of nutrients released from the decomposition of previous blooms, as well as other inputs (groundwater, sediment release, stormwater discharge, unseasonal runoff).
- Autumn. Mixed blooms of diatoms, dinoflagellates and marine algae often occur in the upper reaches of the estuary. Some species bloom if early autumn rains occur, bringing a flush of nutrient-rich waters yet not reducing salinity significantly. The dinoflagellate *Karlodinium*, a species toxic to fish, is one such species that flourished in waters throughout the tidal river channels of the Swan and Canning between April and June 2003, when rainfall in April brought an inflow of water rich in nitrate.

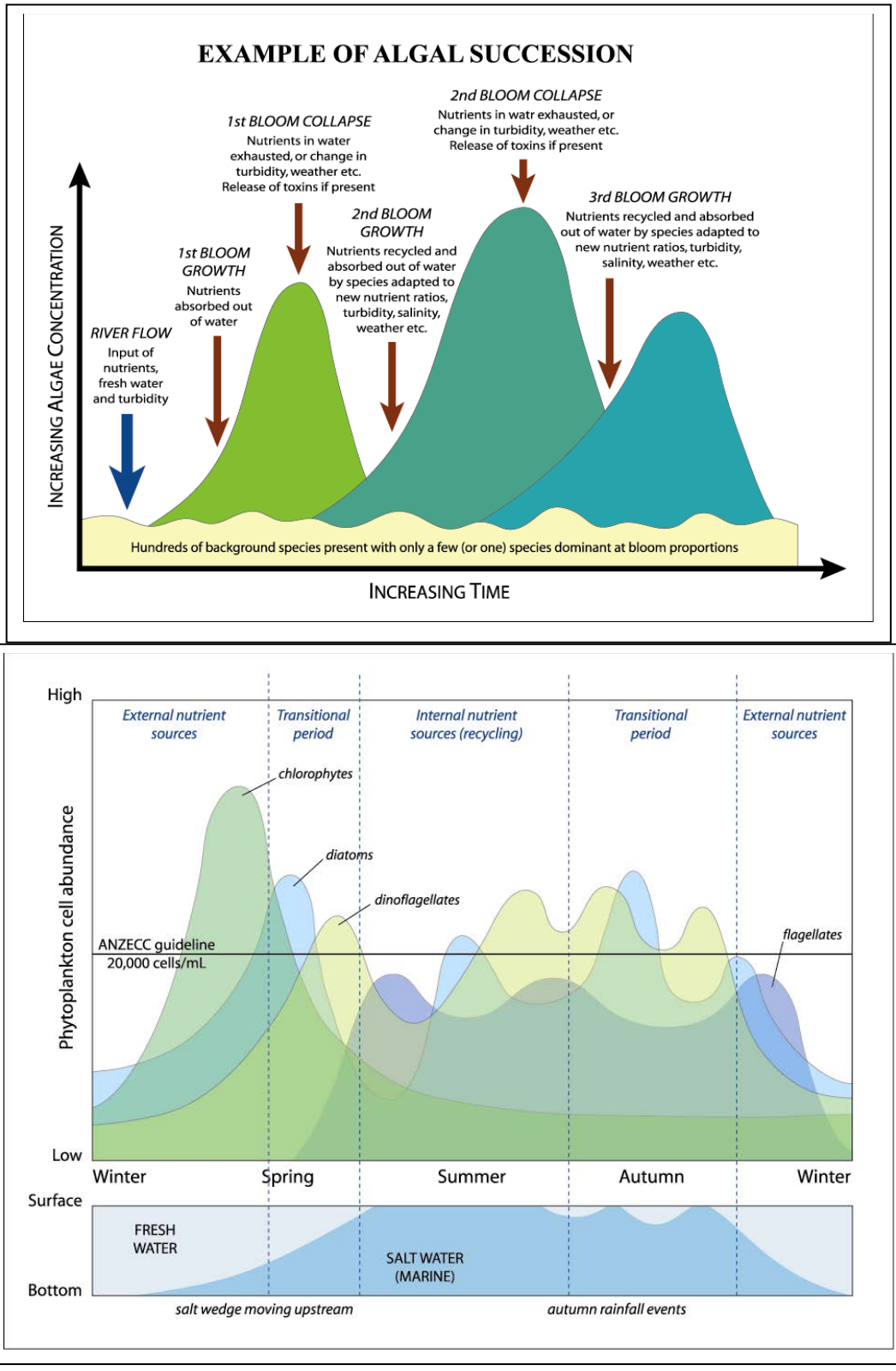


Figure 2.3 Generalised bloom cycle for phytoplankton (top) and bloom cycle typical of the Swan-Canning system

Note: Vertical scale is arbitrary. Peaks in abundance are many times higher than shown.

As mentioned previously, the Upper Canning (i.e. above the Kent Street weir) essentially becomes a freshwater pool in spring, summer and autumn. Like the Swan-Canning it also undergoes a cycle of algal blooms, but with freshwater species (eg chlorophytes, freshwater diatoms, blue-green algae). Chlorophyte blooms occur in spring, but in late spring and summer, when the water warms up, blooms of blue-green algae can occur. Blooms of toxic blue-green algae such as *Anabaena* and

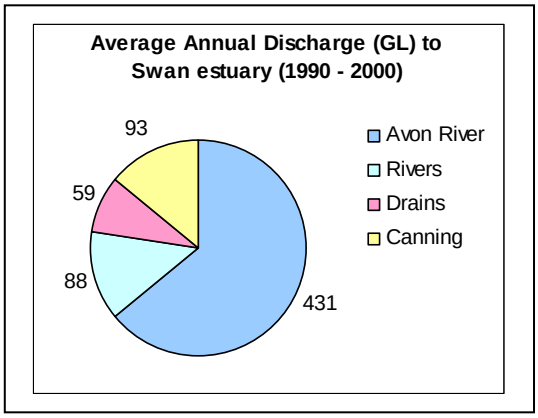
Microcystis are relatively common, often requiring the waters to be closed to public recreation. Large freshwater macrophytes such as pondweed (*Hydrocotyle*) and duckweed (*Azolla*) can also become abundant, although these are viewed more as an aesthetic nuisance.

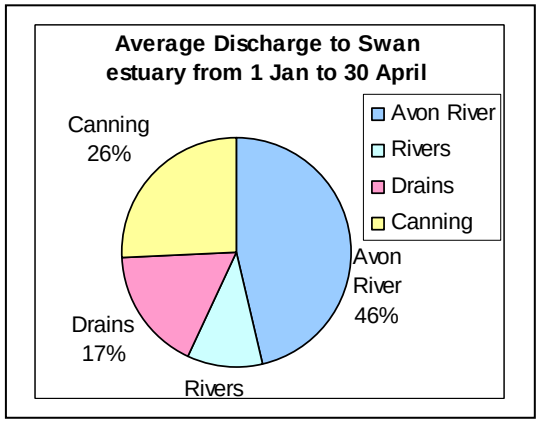
The importance of different nutrient sources

As can be seen from the above discussion, an analysis of the relative importance of various sources of nutrients to the Swan-Canning system could give an incomplete picture, if based solely on annual inputs of total nitrogen and total phosphorus. The importance of a nutrient input is a matter of its form (dissolved inorganic, or particulate), concentration, timing and duration, as well as the total amount (i.e. load). The physical characteristics of the Swan-Canning system also have a strong influence on nutrient dynamics (e.g. export of nutrients in winter runoff to coastal waters, stratification and sediment nutrient release) and algal blooms.

It is worth noting that **the highest nutrient concentrations in sub-catchment runoff are actually associated with urban land rather than rural land, but the volume of runoff from urban catchments is less**. This can be seen in Figure 2.4: the nutrient export per unit area of urban land is far greater than rural land, and this situation is even more pronounced in the 'low flow' period (defined as 1st January to 30th April). Only about 5% of river flow and nitrogen load is delivered in the 'low flow' period, but this underestimates its importance to the ecology of the Swan-Canning system because much of the nitrogen load associated with winter flow is discharged to coastal waters. Nor is the magnitude and importance of groundwater inputs to the Swan-Canning system well understood. The importance of groundwater inputs to the ecology of the system in late spring and the 'low flow' period may also be greater than indicated by a simple analysis of their contribution to total nutrient load.

a)





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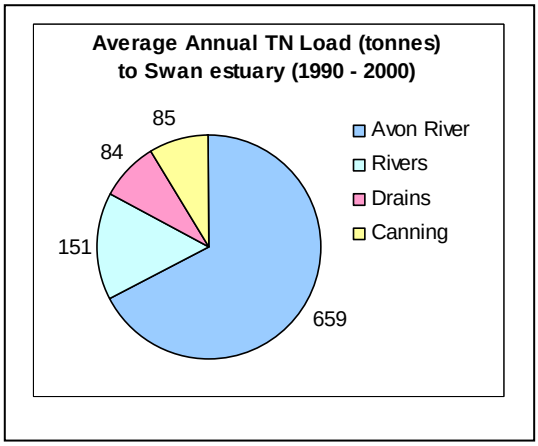

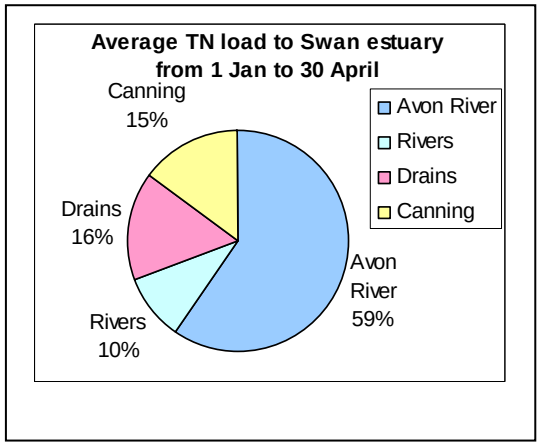

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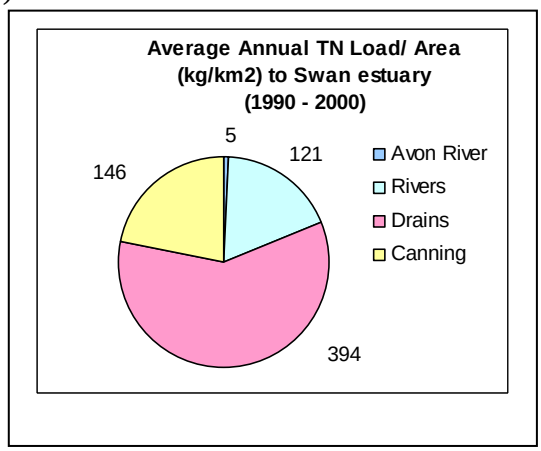


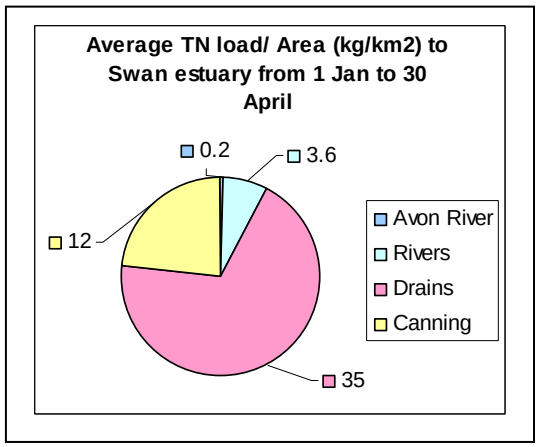


Figure 2.4 a) Annual flows, b) annual nitrogen loads and c) annual nitrogen load/unit area for the Swan-Canning System (left hand graphs) compared with results for the 'dry season' (right hand graphs)

Source: Water and Rivers Commission catchment modelling group. Note that 'Avon River' signifies inputs from the Avon catchment, 'Rivers' signifies input from Swan coastal plan sub-catchments dominated by rural land use, 'Drains' signifies input from coastal plan sub-catchments dominated by urban land use, and 'Canning' signifies input from sub-catchments upstream of Canning Bridge.

2.2 Statutory and strategic setting

Any recommendations arising from this evaluation must be consistent with the broader planning and resource management framework that the Action Plan sits under. Within this context, key State legislation, strategies and policies are briefly discussed below.

2.2.1 State legislation

Swan River Trust Act

The Swan River Trust (SRT) was established in 1989 and constituted under the Swan River Trust Act 1988. The SRT is a State Government Agency responsible to the Minister for the Environment.

The Swan River Trust Management Area includes the waters of the Swan-Canning river system and a narrow strip of land that comprises adjoining parks and recreation reservations, from the Fremantle traffic bridge to Moondyne Brook on the Avon River, to the lower diversion dam on the Helena River, along the Southern River to the Allen Road crossing, and along the Canning River to its confluence with Stinton Creek (Figure 2.5).

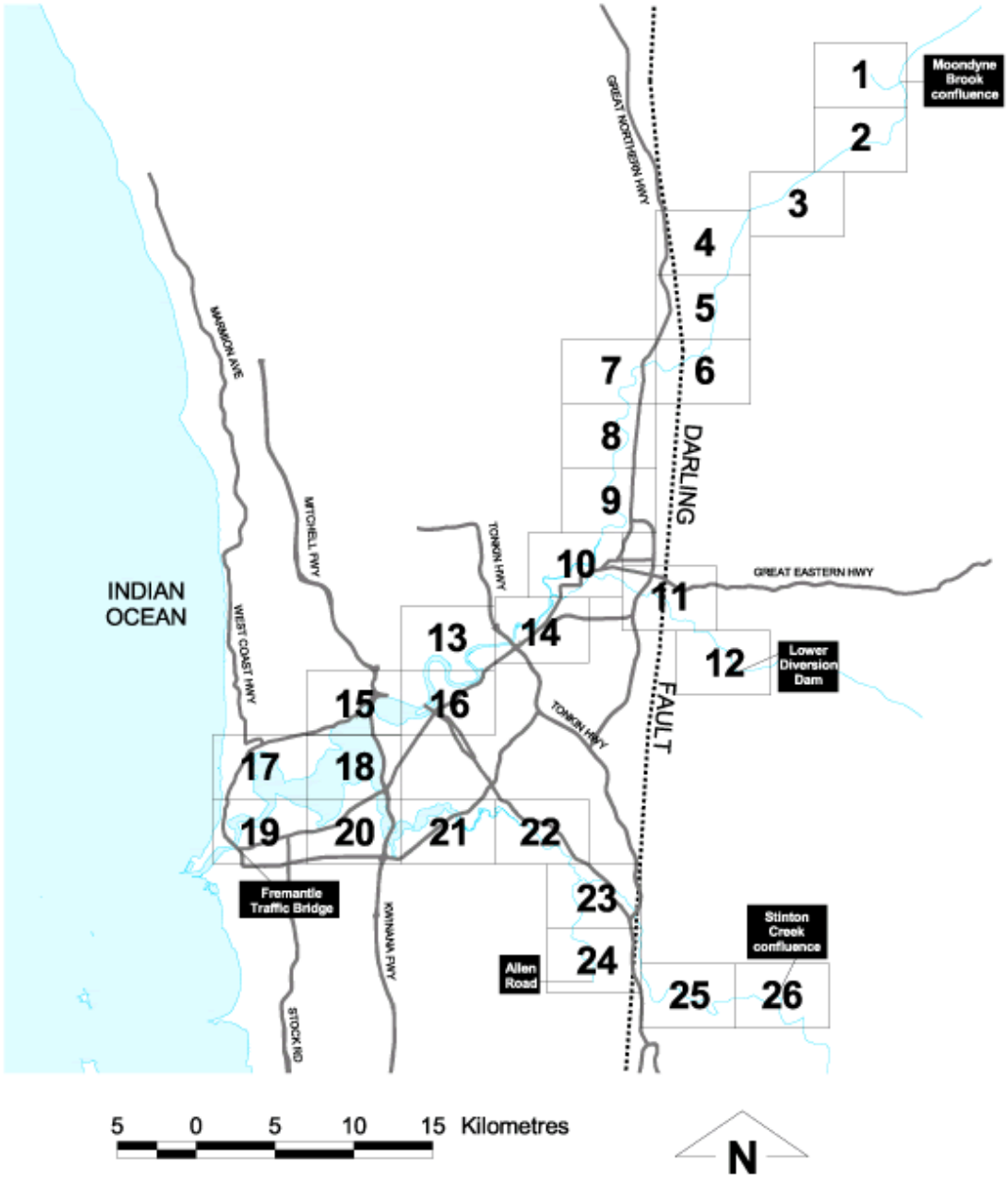


Figure 2.5 Swan River Trust management area

The SRT has authority for planning, protecting and managing the SRT Management Area, but can't limit or restrict the functions performed under the Environmental Protection Act, Health Act, or law relating to wildlife conservation, navigation or regulation of shipping. No aspect of SRT functions can be applied to land outside

the Management Area. Thus, the SRT lacks adequate authority to address influences on water quality that arise in the broader catchment area. By virtue of the SRT Act, the SRT is constrained in its ability to perform its primary function. The SRT therefore relies on cooperation and collaboration with State and local government and the community, which requires a considerable investment in time and effort. For example, there are 28 local governments in the Swan-Canning system (Figure 2.6).

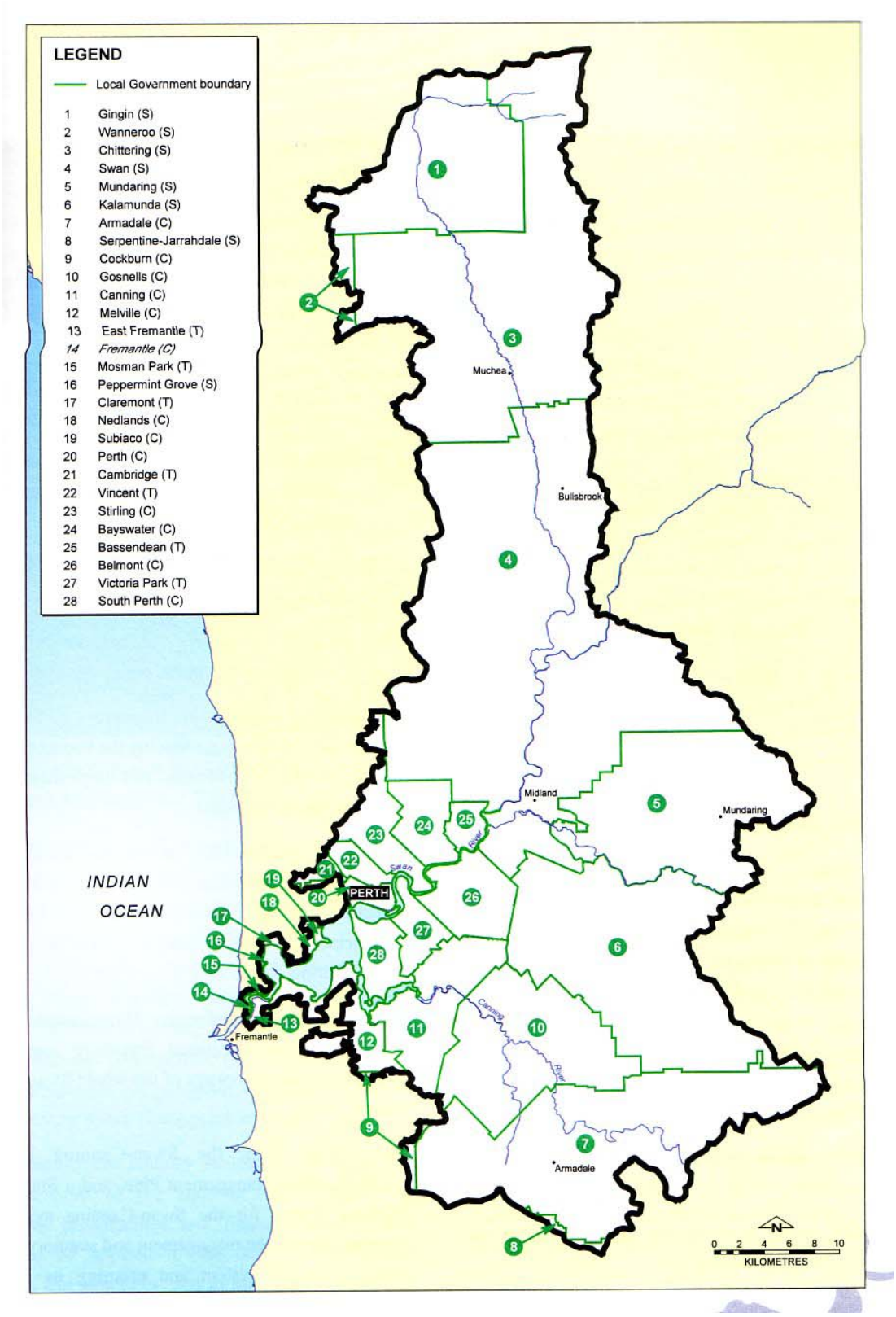


Figure 2.6 Local government boundaries in the Swan-Canning system

The limitations of the SRT Act have been recognised, and a new Act is presently being prepared that will give the SRT powers to influence activities in the Swan-Canning catchments that affect river health.

Environmental Protection Act

The Environmental Protection Act 1986 (EP Act) provides for the prevention, control and abatement of pollution and environmental harm. The EP Act provides considerable control over new developments to minimise their risk of environmental harm, and over existing developments and activities should they cause pollution or environmental harm.

The regional framework for the environmental protection of the Swan-Canning system is provided by the Environmental Protection (Swan and Canning Rivers) Policy 1998 (Swan-Canning EPP). EPPs are gazetted by the Minister for the Environment under the EP Act, and as such have the force of law: the Swan-Canning thus gives legal basis to the management of the rivers. The purpose of the EPP is to "restore, enhance, preserve and protect the environmental quality, ecological processes and ecological integrity of the Swan and Canning Rivers." The EPP area includes the waterways, Swan-Canning catchment and Avon catchment.

The EPP itemises the beneficial uses of the Swan-Canning system that need protecting, and identifies threats to those beneficial uses. It encompasses a broader range of issues than the SCCP Action Plan, including habitat destruction/alteration, environmental flows, discharge of contaminants, fishing, and introduced pests/exotic flora and fauna. The general environmental quality objective is to restore and maintain the beneficial uses. The EPP requires the preparation of a Comprehensive Management Plan (CMP) to achieve the environmental quality objective; the CMP to include a management framework that identifies agency roles and responsibilities, and criteria to measure environmental quality.

The SRT is accountable to the Environmental Protection Authority (EPA) for coordinating management and implementation of the EPP. The EPP is due for review in mid-2005.

State Planning legislation

The Town Planning and Development Act 1928 (TP&D Act) provides direction and control of land use and development in Western Australia. The Western Australia Planning Commission (WAPC) administers elements of the TP&D Act through the WAPC Act 1985, including the amendment and management of the Perth Metropolitan Region Scheme (MRS), which controls land use and development in the Perth area. Mechanisms to amend the MRS are provided in the Metropolitan Region Town Planning Scheme Act 1959 (MRTPS Act).

Section 5AA of the TP&D Act also provides for the preparation of Statement of Planning Policies (SPPs), which are implemented through town planning schemes (i.e. local government). Local governments are obligated to 'have regard to' SPPs, and direct town planning schemes or amendments to schemes. Town planning schemes are usually updated every five years or more, at which time amendments to reflect SPPs take effect. Local government can, however, choose to be guided by SPPs before their town planning schemes are amended.

SPP No. 2 Environmental and Natural Resources Policy (2003) has as its objective "to integrate environment and natural resource management with broader land use planning and decision making". This SPP sets out broad environmental and resources management policies, including measures for the protection and use of

water resources. The policy measure for water resources recognises the State Water Quality Management Strategy (that implements the National Water Quality Management Strategy), and states that "planning strategies, schemes and decision making should consider mechanisms to 'protect, manage, conserve and enhance waterways…" and "encourage urban water management through water sensitive design approaches that better manage stormwater quality and quantity….". The WAPC has also prepared a draft Water Resources SPP 2.9, consistent with and complementary to SPP No. 2, that provides additional guidance on water resources. Draft SPP 2.9 includes guiding principles for water sensitive urban design.

The WAPC has also prepared a draft Swan-Canning River System SPP to address the impacts of land use and development on the Swan and Canning Rivers in a wholistic manner, and encompass the joint role and responsibilities of the WAPC and the SRT. The draft SPP will give effect to a Precinct Planning Project (PPP) developed by the SRT and WAPC that applies to 23 precincts along the rivers. At the discretion of the WAPC, the SRT was included in the draft SPP as an administrator of the PPP and as an approval agency (with the WAPC). The precincts have been developed based on landscape descriptions that consider environmental, social and historical character, and the PPP is intended to guide subdivision and development of the precincts in an integrated manner, with consideration of social, environmental, cultural, development and design factors.

2.2.2 State and regional policies and strategies

RiverPlan

RiverPlan is the Comprehensive Management Plan and Implementation Strategy developed for the Swan-Canning EPP. The Strategy identifies river management responsibilities and activities, drawing together State Government agencies, local government, community groups and industry groups in a management framework to ensure that values of the Swan and Canning Rivers are protected. It also provides a legislative basis for the SCCP's actions, responsibilities and environmental targets.

The environmental management framework is based on that of the State Water Quality Management Strategy (that implements the National Water Quality Management Strategy): it comprises a hierarchy of environmental values (EVs), environmental quality objectives (EQOs—management goals to ensure EVs are protected) and environmental quality criteria (EQC—performance targets which determine whether EQOs are met, and therefore if a management response is required). EQC indicators that will be required include measures of: water quality, the abundance and diversity of aquatic flora and fauna, the health of riparian vegetation, and presence of weeds and nuisance organisms. The zones used to identify EVs will initially be the 23 zones identified by the Swan and Canning Rivers Precinct Planning Project.

The Strategy will operate principally through existing management mechanisms, and so emphasises the importance of partnership agreements and memoranda of understanding. The Strategy will focus on the Swan-Canning catchment (although the role of the Avon catchment is recognised), and SRT will coordinate implementation of the Strategy. The guiding principles for implementing the Strategy have been identified as: integrated catchment management, sustainability, community involvement, shared responsibility and partnerships, stewardship of natural resources, prioritising, accountability and transparency, and adaptive management.

Swan Regional Strategy

Natural Heritage Trust (NHT) funding of community groups, local government and agencies involved in natural resource management (NRM) has changed from the highly localised focus and proponent-direct funding of Phase 1 (NHT1), to a regional delivery approach in Phase 2 (NHT2). Regional delivery of NRM in the Swan Region is being managed by the Swan Catchment Council. Integrated catchment management is an integral process for coordinating the many activities involved in achieving regional NRM. The Swan Catchment Council and Avon Catchment Council coordinate natural resource management activities and support catchment groups in the Swan region and Avon region, respectively. Regional NRM strategies are being developed and are required to meet Federal accreditation standards to enable access to NHT2 funding. The Swan Catchment Council and Avon Catchment Council's Draft Regional Natural Resource Management Strategies are 50-year action plans for a coordinated approach to NRM in these Regions.

The core objectives of the Swan Regional Strategy are biodiversity conservation, sustainable use of natural resources, and community capacity building and institutional change. The Strategy addresses management of a broad range of assets, including land, water, biodiversity, coastal and marine, air, cultural heritage, and regional capacity. The Strategy also sets targets according to The National Framework for NRM Standards and Targets, which establishes three types of targets to guide investment in NRM, as follows:

- **Aspirational targets** - these include reference to long-term targets with associated statements about the desired condition of natural resources in the longer term (eg 50+ years). These targets are guides for the Region's planning and set a context for the measurable and achievable targets required under the National Framework.
- **Resource condition targets** - these include reference to specific, time-bound and measurable resource condition targets. The timeframe to achieve these targets is likely to be in the order of 10–20 years. Nonetheless, the targets are pragmatic and achievable. The targets will be developed iteratively and will be examined using benefit / cost analysis.
- **Management action targets** - these include reference to short-term targets (1-5 years), relating to management actions or capacity building. These targets relate to management actions that will ensure progress towards the longer-term resource condition targets.

State Sustainability Strategy

The State Sustainability Strategy promotes the integration of environmental protection, social advancement and economic prosperity. The Strategy is based on a Sustainability Framework of eleven sustainability principles, six visions for Western Australia and six goals for government. It presents actions across government that support the framework, to be implemented over a ten-year period and beyond. For example, the goal of "Value and protect our environment and ensure the sustainable management and use of natural resources" advocates the use of "Statements of Planning Policy and other mechanisms to coordinate the actions of local governments, regional councils and State natural resource management agencies on priority natural resource issues (eg regional drainage, biodiversity corridors, local community services and coastal planning)", and "building community values into regulatory approaches to natural resources management".

The Strategy is extremely wide ranging in scope, and provides overarching guidance to 42 areas of State government. At its core, it has a strong emphasis on a regional approach, the development and implementation of State Government-Local Government partnerships, and the involvement of community and industry groups.

Drainage

A number of State and National initiatives for drainage management are currently underway, principally:

- The Drainage Management Forum, Swan-Canning Catchment (24-25, and 29 November 2003);
- The Drainage Reform Group, facilitated by CSIRO Land and Water and involving State agencies, Local Government and industry working cooperatively to reform drainage management throughout WA (a discussion paper on drainage reform in WA has been released).
- The Australian National University research project on regulatory design for water quality management; and
- The Department of Environment's new "Stormwater Management Manual for Western Australia", which updates old technical guidelines for stormwater management.

The most recent of these, the Drainage Management Forum, was convened to explore the issues and possible solutions related to drainage management in the Swan-Canning Catchment and derive recommendations for a way forward. This forum provided input to the Environmental Protection Authority's (EPA's) response to the Minister's request for strategic advice on the means to improve co-ordination and statutory responsibility for the control and management of the impact of urban drainage on these rivers (EPA, 2004). The EPA noted that the present governance framework does not provide clarity or accountability for improving river health, and made the following recommendations:

1. Drainage in the Swan-Canning Catchment be managed as a water resource as part of the total water cycle with the dual objectives of optimising stormwater runoff/groundwater levels and reducing nutrient and other contaminant flows into rivers and streams.
2. A three-tiered governance model be implemented based on a Policy and Approval Authority, Catchment Manager and Service Provider. The Policy and Approval Authority role to be undertaken by the Department of Environment (Water and Rivers Commission). The Catchment Manager role to be undertaken by the **Swan River Trust**, with the necessary legislative backing, in partnership with the Swan Catchment Council. The Service Providers, the Water Corporation and Local Government, to plan and deliver drainage services at a regional or local level. The role of the Policy and Approval Authority could be to regulate, develop policy, review and approve catchment including drainage plans, and evaluate and report progress. The Catchment Manager would develop catchment based plans including water quality targets, and monitor and report progress. Service Providers to develop drainage plans, and construct, operate and maintain drainage infrastructure.
3. A study be conducted into the resourcing of drainage across the catchment including the application of a whole of catchment drainage rate. The rate should cover at least stormwater, groundwater and nutrient management including the retrofitting of existing drains and operation of new drains.

Consolidated funding be provided for the role of the Catchment Manager and any Community Service Obligations implemented by other agencies.

4. The Catchment Manager in cooperation with key stakeholders, develop a business plan including resourcing for the application of best management practices to the priority sources of contaminant input as a basis for possible implementation and continue to explore innovative best management practices.
5. The Catchment Manager establish a monitoring and reporting framework and targets including nutrient, contaminant, ecosystem health and management targets for the Swan-Canning system and specific sub-catchments and drains.
6. The WA Planning Commission provide the leadership for and incorporate water sensitive urban design principles, criteria and outcomes in its strategic land use planning, policies, structure plans and subdivision approval conditions.

The future institutional arrangements for drainage management are yet to be decided by Government.

2.3 A changing environment

Two key interrelated issues that affect the health of the Swan-Canning system are (1) the amount and quality of catchment runoff (and probably groundwater discharge), and (2) land use in the catchments. Both of these are changing due to two factors outside the control of the Action Plan: climate change; and increased housing density in established suburbs plus urban expansion into new areas, due to population growth.

2.3.1 Climate change

The Mediterranean nature of Perth's climate has become even more extreme in the last 30 years. Since 1975 there has been an overall 12% drop in rainfall in WA's southwest, characterised by later winter rains (ie. a significant decrease in rainfall between May and July and a small increase between August and October), and the winters have been warmer. Perth's long term annual rainfall is 880mm, but the average from 1975 to 2001 was only 790mm. Catchment runoff has decreased proportionately more: this is probably due to a combination of changes in the pattern of rainfall, and progressive drying out of catchment soils so that more rain is required to saturate the catchment before surface runoff commences. This has also had profound effects on Perth's potable water supply: between 1911 to 1974 an average of 338 Gigalitres/year entered Perth's dams, but from 1975 to 2001 this dropped to only 167 Gigalitres (http://www.watercorporation.com.au/index.cfm).

It is not known whether this climate change is part of natural variability, or a more permanent change due to global warming. Irrespective, the effect on the Swan-Canning system has been as follows:

- Less river runoff and less nutrient input to the system; and
- Less flushing of the system and an extended 'autumn' period, with stratified conditions that favour blooms of dinoflagellates such as *Karlodinium*.

2.3.2 Population growth and urban expansion

Between the 1996 census and 2001 census, Perth's population grew by 7.2%, with much of this growth being in the outer suburbs. The population density of the inner suburbs also increased substantially. Perth's population is presently growing at

around 1.7% per year, and is expected to reach 2 million by around 2025, that is, a 40% increase in the next 20 years.

As noted earlier, the catchment runoff from urban areas has higher nutrient concentrations than rural areas. The expected degree of urban development over the next 20 years has the potential to outstrip the efforts of the Action Plan, unless strict planning controls are in place for new developments.

2.4 References

- DoE, 2004. *RiverPlan. An Environmental Management Framework for the Swan and Canning Rivers*. Comprehensive Management Plan and Implementation Strategy for the Environmental Protection (Swan and Canning Rivers) Policy 1998. Department of Environment, Perth, Western Australia.
- EPA, 2004. *Drainage Management, Swan-Canning Catchment*. Section 16(e) report and recommendations of the Environmental Protection Authority. Bulletin 1131. Environmental Protection Authority, Perth Western Australia.
- Government of Western Australia, 2003. *Hope for the future: the Western Australian State Sustainability Strategy*. Department of Premier and Cabinet, Perth, Western Australia.
- Swan Catchment Council, 2004. *The Swan Region Strategy for Natural Resource Management*. Draft for public comment, April 2004. Perth, Western Australia.

3. The SCCP Action Plan

3.1 Action Plan goals and objectives

The Action Plan recommends strategies to achieve the Cleanup Program's goals, which are as follows:

- **Public health and amenity:** Algal blooms are kept at a level where there is no threat to public health and amenity and they are not a nuisance to the community. Toxic algal blooms are kept to a minimum.
- **Ecological function:** Water quality in the Swan-Canning system is suitable for maintaining a healthy ecosystem. People can swim or catch fish at any time.
- **Catchments and targets:** Contaminants in stream runoff leaving the catchments are within set targets. Rural catchments are managed to be productive and profitable, and are attractive and affordable places to live.
- **New urban and industrial areas:** Areas are designed so that discharges have reduced contaminant levels and meet set targets before entering the rivers, while they still remain attractive and affordable places to live and productive and profitable places to work.
- **Older urban and industrial areas:** Older urban and industrial areas are modified over time to reduce contaminant levels so that drainage discharges meet set targets before entering the rivers.

To attain these goals, the following objectives were identified for the Action Plan:

- Understand the mechanisms that trigger algal blooms and control their growth.
- Identify how and where nutrients enter and cycle within the rivers and determine the best way to minimise these inputs.
- Help maintain water quality both now and in the future by managing river sediments to reduce the store of organic material and nutrients.
- Help change land-use categories and practices, planning processes and decision-making to reduce the amount and concentration of contaminants, especially nutrients, leaving rural and urban catchments; and to obtain greater community, government and business involvement in the catchments to reduce nutrient inputs.
- Inform the community and involve it in developing the Swan-Canning Action Plan.
- Reduce the frequency of occurrence of algal blooms.

3.2 Action Plan recommendations

The specific actions required to meet the objectives and attain the goals of the Action Plan are identified in 10 key recommendations, for implementation across the four Action Areas (Table 3.1). Under each recommendation, there is a set of more specific sub-recommendations (44 sub-recommendations in total), and the Action Plan also identified the agencies responsible for implementing the sub-recommendations.

Table 3.1 Key recommendations of the SCCP Action Plan

Recommendations
Action Area 1. Support Integrated Catchment Management to reduce nutrient inputs
Recommendation 1. Strengthen Integrated Catchment Management in the Swan-Canning catchment and support ICM groups.
Recommendation 2. Raise awareness and provide support to enable the participation of land-holders, catchment and river management groups, local government and the broad community in catchment and river management.
Recommendation 3. Improve government coordination and support.
Action Area 2. Improve planning and land-use management to reduce nutrient inputs
Recommendation 4. Use statutory mechanisms including regulations, by-laws, town planning schemes and statements of planning policy to modify land-use practices and prevent or relocate polluting activities.
Recommendation 5. Develop and adopt Best Management Practices for nutrient reduction in current land management practices and in all future developments, redevelopments and stormwater drainage schemes.
Recommendation 6. Use economic and regulatory mechanisms to encourage catchment, wetland and river foreshore management for nutrient reduction.
Action Area 3. Modify river conditions to reduce algal blooms
Recommendation 7. Develop and implement river manipulation and remediation techniques to reduce algal blooms in the Swan-Canning system.
Action Area 4. Monitor river health, fill critical gaps in knowledge and report progress to the community
Recommendation 8. Adopt recommended water quality targets for the freshwater tributaries and estuarine portions of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan.
Recommendation 9. Undertake investigations to fill critical knowledge gaps, monitor the river conditions and produce a "State of the Swan-Canning River System" report every five years.
Recommendation 10. Report progress regularly to the community and ensure that there are opportunities for feedback and for involvement in the adoption and implementation of the Action Plan.

3.3 Action Plan projects

The original projects of the Action Plan were developed specifically to address the recommendations and sub-recommendations of the Action Plan. It is the Action Plan's recommendations and sub-recommendations that have been the key parameters used to evaluate the program's achievements and effectiveness.

Of the 19 original projects of the Action Plan, two have been completed, but the majority involve ongoing work. Many of the ongoing projects have also evolved in response to changing circumstances. For example, a number of projects have had name changes, are referred to internally under different names, have been merged with other projects, and/or have been divided into a number of different projects, over the past five years. Several new projects have been initiated. A full list of the main projects is provided in Table 3.2.

At present, there are over 50 employed staff and an even greater number of individuals across industry, and catchment, community and other groups, working on Action Plan projects.

Table 3.2 Action Plan projects

Project title	SRT Project reference number
Action Area 1.	
SCCP Project Management	53036
Community Awareness	53060
Ribbons of Blue	53098
Corporate Support	53099
Catchment Management - Priority Catchment Funding	53101
Restoration Works - Foreshore	53103
Catchment Management - Farm Plans	53105
Catchment Management - Swan Catchment Centre	53107
Constructed Wetlands	53109
Holding Account – Evaluation	53110
LG NRM Policy Development	53119
Water Quality Protection Notes (WQPN) for Best Management Practices (BMPs)	53125
Water Sensitive Design	53128
Environmental Education	53139
Urban Garden Strategy	53140
Nutrient Intervention Program	53141
Restoration Works (SALP) (Carryover)	53146
Community Catchment Rehabilitation	53149
Action Area 2	
Swan-Canning Industry Survey	53088
Statutory Mechanisms	53102
Drain Licensing	53104
Swan Environmental Protection Policy (EPP)	53108
Light Industry Project	42116 / 69008*
Best Management Practices (BMPs) Swan-Canning, including Light Industry Project	53120, 42116 / 69008*
Action Area 3	
Sediment Remediation	53006
River Oxygenation Methods	53090
Canning River Management Plan	53106
Canning Oxygenation	53116
Swan Oxygenation	53117
Landfill Leachate Investigation	53121
Action Area 4	
Environmental Performance & Progress Reporting	53091
Decision Support Model Expertise	53096
Water Quality and Quantity	53097
Sediment Nutrient Cycling	53112
Logistical Support	53123

**** Water and Rivers Commission internal code***

3.4 Implementation of the Action Plan

3.4.1 Role of the Swan River Trust

The Swan River Trust (SRT) was established in 1989 and constituted under the Swan River Trust Act 1988. It is a State Government Agency responsible to the Minister

for the Environment. The SRT works with State and local government and the community to protect and manage the Swan and Canning River systems.

The SRT consists of an eight-member Board, supported by a core staff unit of about 35, with extra administrative and technical support provided by the Water and Rivers Commission[1] under the Swan River Trust Act 1988.

The SRT's officers work in six sections – Assessment and Planning, Environmental Management, Waterways Management, Communications, Strategic Programs, and Administration. The Environmental Management section aims to develop and guide the SRT's three main environmental management programs for the rivers:

- The Swan-Canning Cleanup Program;
- The River*bank* Program (foreshore condition assessment and restoration, in cooperation with local government); and
- The Drain Nutrient Intervention Program (development of initiatives to reduce the amount of nutrients entering the waterways through nutrient intervention technologies).

The current organisational structure of the Swan River Trust, and how SCCP Action Plan is placed within this structure, is shown in Figure 3.1.

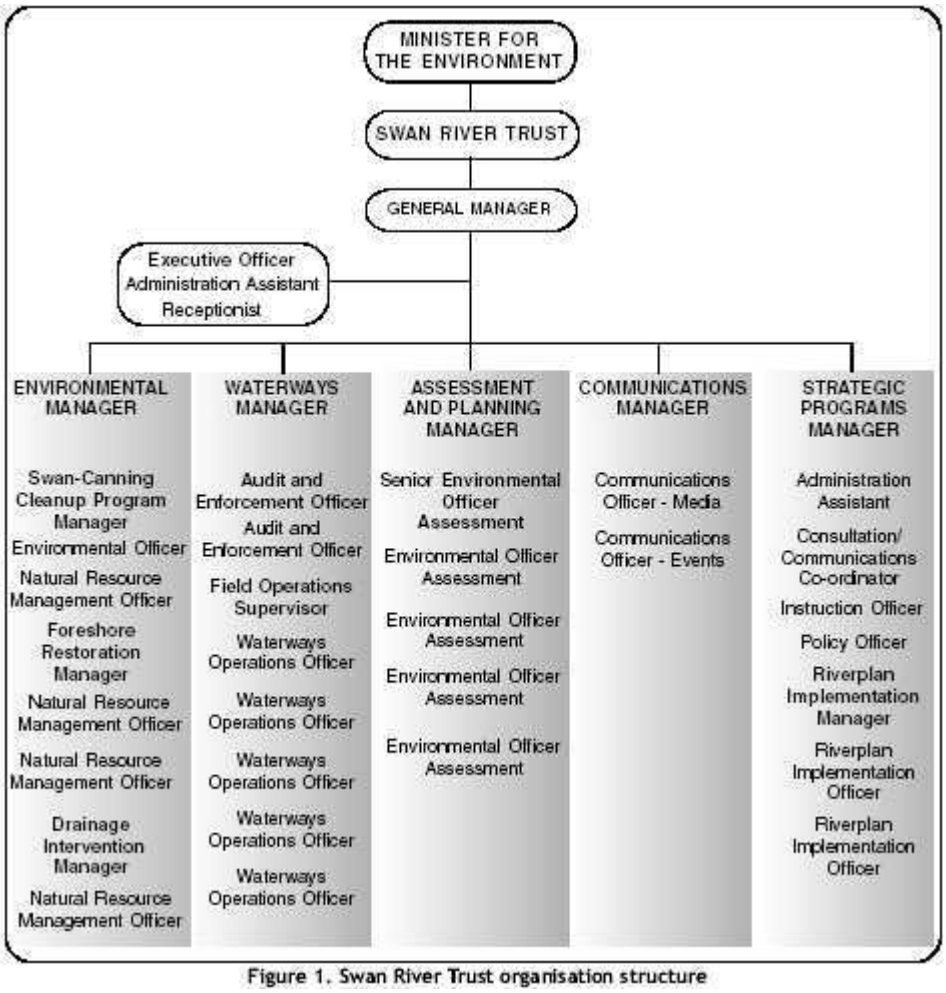


Figure 1. Swan River Trust organisation structure

Figure 3.1 Organisational structure of the Swan River Trust

The functions of the SRT are to:

[1] The Water and Rivers Commission, the Department of Environmental Protection and the Keep Australia Beautiful Council are to be amalgamated into a Department of Environment, but legislation reflecting these changes has yet to be passed by Parliament.

- Manage and protect the river system and work with local government and other bodies to provide facilities around the rivers;
- Advise the Minister for the Environment on development proposals within the SRT's Management Area;
- Control and prevent pollution of the rivers and keep them clear of rubbish;
- Advise on and control erosion of river banks;
- Provide advice to local governments and the Western Australian Planning Commission on town planning issues affecting the rivers; and
- Promote community awareness of issues affecting the health of the river system and increase community involvement in river protection and restoration.

The SRT Board meets twice per month, while daily operation of the SRT is conducted by its professional, technical and administrative staff. Decisions are made by the SRT Board based on advice from its staff, and any other technical or professional personnel it considers necessary to perform its function.

3.4.2 Coordination and management of the Action Plan

Senior Officers Group and Project Managers Group

When implementation of the Action Plan commenced in 1999, a Senior Officers Group (SOG) and Project Managers Group (PMG) were established to coordinate the agencies involved, oversee implementation of the projects and make sure the objectives of the Action Plan were achieved. The SOG and PMG were formed in direct response to Action Plan recommendations 3.2 and 3.3, respectively, with the PMG intended to report to the SOG. The role of the PMG was to coordinate projects and activities to implement the Action Plan, and the role of the SOG was to audit and manage agreements defining responsibilities for implementation of the Action Plan.

Implementation Plan

In order to coordinate and monitor implementation of the Action Plan, allocate resources and ensure that an agreed process was followed, an Implementation Plan was prepared that outlined actions necessary to implement the specific recommendations and allocate responsibility to particularly agencies. The Implementation Plan also covered coordination of community awareness and involvement programs and set standards for accountability.

Accountability

The Action Plan recognised that Government initiatives must be formally accountable to Treasury, Cabinet and the public, and that open accountability would allow parties to monitor progress of the plan and provide the opportunity to influence changes in direction where necessary. Annual reporting against Performance Indicators was identified as one way of demonstrating accountability.

Accountability also requires clear identification of responsibilities, and so the Action Plan identified the need to define and allocate responsibility for implementing the Action Plan and developing Partnership Agreement and Memorandums of Understanding: this was seen as a task for the SOG.

The Program Manager of the Action Plan presently reports the progress of the Action Plan directly to the SRT Board via briefing notes, presentations at Board meetings, and annual reports.

4. Action Area 1: Support integrated catchment management to reduce nutrient inputs

4.1 Background

Integrated Catchment Management (ICM) is the process of coordinated planning, use and management of water, land, vegetation and other natural resources on a river or groundwater catchment basis. It involves the whole community of the catchment including landholders, businesses, residents, local government and State agencies.

The aim of integrated natural resource management is sustainable use, protection and management of natural resources now and in the future. ICM is a process for coordinating the many activities involved in achieving this: it is a complex task that encompasses environmental, social and economic issues, and that requires a range of actions.

4.2 Action Plan Recommendations

Action Plan recommendations for Action Area 1 are listed in Table 4.1 along with the main Action Plan projects developed to address them. Table 4.1 also lists the section of this document where each project is discussed. It is important to note that some projects also contribute to the achievement of recommendations other than those for which they have the primary responsibility. For example, the Swan Alcoa Landcare Program has primary responsibility for Recommendation 1.8, but Priority Catchment Funding and Swan Catchment Centre activities play a supporting role.

Table 4.1 Action Area 1: Action Plan recommendations and projects

Rec. No.	Recommendation	Action Plan project	Document section
1.1	Provide executive and administrative support for Integrated Catchment Management Groups in the Swan-Canning system	53101 Catchment Management (Priority Catchment Funding)	4.3
1.2	Appoint Catchment Coordinators to support completion and implementation of Catchment Management Plans in the four focus catchments (Ellen Brook, Southern-Wungong River, Canning River and Bayswater Main Drain) to reduce nutrient input		
1.3	Support and establish additional ICM groups and appoint Catchment Coordinators to further ICM processes and to develop and implement Catchment Management Plans in the other catchments that have high nutrient concentrations entering the rivers and estuary (South Belmont Main Drain, Bennett Brook, Bannister Creek, Mills Street Main Drain, Blackadder Creek, Yule Brook, Susannah Brook and Bickley Brook)		
1.4	Complete the development and implementation of the Swan Avon regional strategy ("Working together" document prepared by the SAICM and the Swan Catchment Centre) which develops partnerships with key stakeholder groups involved in planning and management of the river and catchment.	53107 Catchment management extension (Swan Catchment Centre)	4.3
1.5	Prepare catchment management guidelines for the reduction of nutrient losses from rural and urban catchments	Not specified	4.3

Rec. No.	Recommendation	Action Plan project	Document section
1.6	Provide support for development and implementation of approved farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities, including part-time farm activities	53105 Catchment management farm plans	4.5
1.7 & 7.5	- Provide seed funding to determine feasibility and cost effectiveness to design and construct artificial wetlands as demonstration sites for stripping nutrients in the Mills Street and South Belmont main drains - Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques	53128 SCCP Water sensitive design (SRT name only) & 53141 Nutrient Intervention Program. 53109 Constructed wetlands (all discussed under heading of 'Nutrient Intervention')	4.6
1.8	Provide funds to fence, stabilise, and revegetate watercourses in the catchments as part of developing and implementing Catchment Management Plans	53103 Restoration works – Foreshore – Swan Alcoa Landcare Program	4.7
2.1	Implement a cross-media public awareness campaign involving a variety of information sources for the general public to encourage changes in individual behaviour and involvement in river-care and catchment management	53060 SCCP Community awareness	4.8
2.2	Through the Swan Catchment Centre provide locally applicable technical and administrative support, information, advice and training to those involved in or affected by catchment management to enable their effective involvement in catchment management decision-making and practical activities	53107 Catchment management extension (Swan Catchment Centre) & 53125 Water Quality Protection Notes	4.4 & 4.9
2.3	Extend Ribbons of Blue program to ensure better support of school and community education programs linked to practical action for the Swan-Canning river environment	53098 Ribbons of Blue	4.10
3.1	Establish formal and financial agreements involving State government agencies and local governments defining responsibilities for implementation of the Action Plan and ICM and audit progress after five years	53036 SCCP Project Management	4.11
3.2	Establish a Senior Officers Group to audit and manage agreements defining responsibilities for implementation of the Action Plan years		
3.3	Establish a Project Managers Group that reports to the Senior Officer Group to coordinate projects and activities to implement the Action Plan and an Interdepartmental Catchment Management Liaison Unit to review land-use controls and define agency responsibilities.		
3.4	Financially support the appointment of environmental officers to formulate and prepare local government natural resource management strategies and policies	53119 LG NRM Policy development	4.12

** Originally placed under Action Area 3, but relocated to Action Area 1*

4.3 Catchment Management - Priority Catchment Funding

4.3.1 Situation

Integrated catchment management (ICM) first became established in the Swan-Canning catchment in the 1990s. The Swan Avon ICM program began in 1995; and ICM groups in the Swan region were established and supported on the basis of community interest. In 1994-95, the only active ICM group in the Swan-Canning system was the Bayswater Main Drain ICM Group; but by mid 1998, 13 ICM groups and four Land Conservation District Committees (LCDC) with catchment-wide membership and interests had been established (Table 4.2).

Table 4.2 Catchment groups within the Swan-Canning system in 1999, taken from SCCP Action Plan (Swan River Trust, 1999)

Catchments within the Swan-Canning System	Date established
Bayswater Integrated Catchment Management (BICM)	February 1991
Swan Catchment Council (formerly Swan Working Group) – Coordinating group for the Swan Avon ICM Program in the Swan-Canning catchment	April 1995
Canning Catchment Coordinating Group	May 1995
Litoria Catchment Care Group	1995
Bennett Brook Catchment Group	December 1995
Ellen Brook Integrated Catchment Group	January 1996
Upper Canning / Southern-Wungong Catchment Team	April 1996
Bannister Creek Catchment Group	May 1996
Blackadder Woodbridge Catchment Group	June 1997
Jane Brook Catchment Group	September 1997
Claise Brook Catchment Group	November 1997
Belmont Victoria Park Catchment Management Group	April 1998
Helena River Catchment Group	May 1998
Gingin LCDC	1984
Woorooloo LCDC	1989
Chittering LCDC	1991
North Swan LCDC	1997

The Action Plan identified that continued strengthening and expansion of ICM in the Swan-Canning catchments, and supporting catchment groups to specifically include strategies for reducing nutrient losses from the catchments, was necessary in order to achieve the goals of the Cleanup Program (Swan River Trust, 1999). It highlighted that the nutrient hotspots in 'focus catchments' (i.e. Ellen Brook, Southern Wungong River, Canning River and Bayswater Main Drain) were a priority to address. However, the Action Plan also recognised that support for community-based ICM was required across the whole Swan-Canning region to prevent problems as Perth expanded, and to address problems if and when they arose.

A lack of ongoing salary support had been recognised as a barrier to catchment groups forming long-term partnerships with stakeholders, such as industry, and local and state governments. The Priority Catchment Funding project was therefore established to provide financial, executive and administrative support for the logistical components of catchment group operations; to give groups security that was needed to pursue other funding opportunities and allow officers to work directly

with community members and local authorities in implementing on-ground activities (Hoechstadt, 2004).

4.3.2 Inputs

The Priority Catchments Funding project has received a total of $2,206,908 SCCP Action Plan funding over the past five years which includes salary for a Catchment officer within the Swan River Trust to liaise with Catchment Groups and the Swan Catchment Council, and manage the Swan River Trust's involvement in community driven natural resource management.

Funding of Catchment Management Officer

The Priority Catchment Funding project was initiated in 1999. In its first year of implementation, a SCCP Catchment Management Officer was appointed at the Swan River Trust to: liaise with and coordinate administrative and financial support to catchment groups; provide support to stakeholders in catchment management; monitor and report on catchment management projects; and represent the SCCP on nominated committees and catchment management groups (Swan River Trust, 2000). Additional roles of this officer have involved the coordination of SCCP funding for an additional project—the Swan Alcoa Landcare Project, SALP (refer 'Restoration Works Foreshore' section); liaison with the Swan Catchment Council; and management of the Swan River Trust's involvement in community driven NRM activities. A total of $312,890 has been spent on funding this position.

Funding for catchment groups

Over the past five years, a total of $1,894,018 has been allocated directly to catchment groups by SCCP Priority Catchment Funding (Hoechstadt, 2004). A breakdown of funding allocations to the first priority, second priority, and other catchment groups for each year is provided in Table 4.3. The majority of this funding has provided salaries for catchment coordinators, followed by other salaries (including project officers, education officers and Landcare trainees), administration, and some operational support.

The Priority Catchment Funding project also provides financial support to catchment groups on an annual basis, using a formal assessment process (Hoechstadt, 2004). Each year, catchment groups submit an application to the Swan River Trust, specifying their current funding requirements. In addition, the catchment groups are requested to report on how SCCP funding provided in the previous year (if applicable) was used, what other partnership support was obtained, and details of subsequent activities undertaken (under headings of Catchment Management Planning; Environmental Protection and Restoration; Education; Awareness Raising; and Other). A reporting template was developed during 2000/2001 and was used in 2001 for 2002 funding applications. The first reporting period also retrospectively considered activities conducted in the first two years of SCCP funding.

Table 4.3 Indicative allocation of SCCP funds to different catchment and sub-regional groups over the past five years

Catchment Group	Year	Purpose	SCCP funding ($)
Canning Catchment Coordinating Group (1st priority)	99/00	Coordinator (10,000); Admin (5,000)	15,000
	00/01	Coordinator (20,000); Operations (5,000); Admin (2,000);	27,000
	02/03	Coordinator (35,802); Admin (5,280);	41,082
Ellen Brook Integrated	99/00	Admin (7,900); Operational (5,000)	12,900

Catchment Group	Year	Purpose	SCCP funding ($)
Catchment Group (1st priority)	00/01	Coordinator (54,936); Admin (8,064); Trainee (8,000)	71,000
	01/02	Coordinator (86,680) Other salary (12,000); Admin (2,500);	101,180
	02/03	Coordinator (63,000): Admin (2,500)	65,500
Ellen Brockman	03/04	Coordinator (60,808); Admin (1,000)	61,808
Bayswater ICM (1st priority)	99/00	Operational (10,500); Trainee (8,000); Coordinator (1,850);	20,350
	00/01	Coordinator (26,400); Trainee (8,000); Other (5,500)	48,330
	01/02	Coordinator (52,000); Other salary (20,000); Admin (4,000)	76,000
North East Catchment Committee (created from merging of Bayswater ICM & Bennett Brook CCG)	02/03	Project officer (30,400); Admin (12,000); Coordinator (4,375); Project officer (2,320)	49,095
Upper Canning & Southern Wungong CT (1st priority)	99/00	Trainee (8,000); Operational (750);	8,750
	00/01	Coordinator (55,790); Admin (2,450); Operations (2,100)	60,340
	01/02	Other salary (43,175); Admin (4,000);	47,175
Armadale-Gosnells Catchment Group (used to be Upper Canning & Southern Wungong Catchment Team)	02/03	River restoration officer (46,400); Admin (6,000)	52,400
Bennett Brook CCG (2nd priority)	99/00	Trainee (10,000); Operational (6,000); Admin (2,000)	18,000
	00/01	Coordinator (52,500); Admin (5,000); Operations (1,500)	59,000
	01/02	Other salary (21,600); Coordinator (16,000); Admin (4,000)	41,600
Urban North	03/04	Stormwater officer (38,200); Education officer (21,587); Water projects officer (6,818); Admin (8,000)	74,605
Blackadder Creek CG (2nd priority)	99/00	Operational (18,400)	18,400
Blackadder-Woodbridge Yule & Susannah Brooks	00/01	Coordinator (26,250); Trainee (8,500); Admin (1,500)	36,250
	01/02	Other salary (26,290); Admin (4,000)	30,290
	02/03	Education officer (27,859); Admin (4,500)	32,359
Canning Plain CG (2nd priority)	01/02	Coordinator (27,337); Admin (4,000)	31,337
	02/03	Coordinator (56,410); Project officer (21,216); Admin (6,000)	83,626
Belmont-Victoria Park CG (2nd priority)	99/00	Coordinator (18,000); Operational (5,000); Admin (5,000)	28,000
	00/01	Coordinator (16,500); Admin (8,000); Other (2,000)	26,500
	01/02	Coordinator (41,586); Admin (4,000)	45,586
	02/03	Coordinator (56,410); Project officer (21,216)	83,626
Bannister Creek CCG (2nd priority)	99/00	Salary (15,600); CMP (13,000); Trainee (10,000); Admin (5,000),	43,600
	00/01	Coordinator (8.58); Other (8); Admin (7.5)	24,080

Catchment Group	Year	Purpose	SCCP funding ($)
	01/02	Coordinator (19,952); Other salary (17,880); Admin (4,000)	41,832
	02/03	Bush regeneration officer 9,590); Admin (5,500); Assistant coordinator (2,208)	17,298
South East	03/04	BVPCP Catchment officer (55,969); BCCG Catchment officer (53,966); PAG Coordinator (50,319); AGLG Project Officer (45,939); Admin (24,091); BVPCP Project officer (23,968)	254,252
Mills St Main Drain CG (2nd priority)	00/01	Coordinator (20,000); Admin (2,500)	22,500
Canning accommodation	99/00	Operational (20,000)	20,000
Eastern Hills	03/04	Education officer (32,380); Admin (4,000)	36,380
Claise Brook CG	99/00	CMP (10,000)	10,000

Preliminary review of the annual reports from the catchment groups by the Priority Catchment Funding staff in October 2004 has revealed that the total partner funding for the catchment groups obtained throughout this 5-year period was $6,392,154 (Hoechstadt, 2004). Therefore, combined SCCP and partner funding for the catchment groups during this period has been estimated to be $8,286,172 (Figure 4.1).

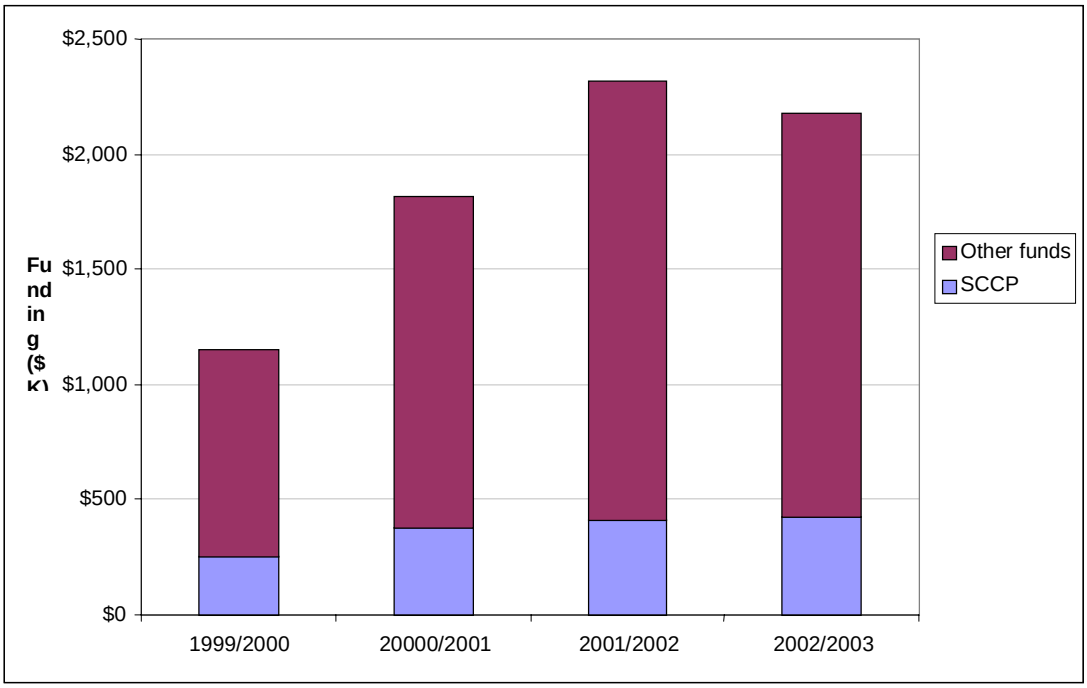


Figure 4.1 Comparison of SCCP Priority Catchment Funding versus Other Funding (indicative only) for ICM within the Swan-Canning over the past five years (using data from the Priority Catchment Funding summary report by Hoechstadt, 2004)

Note: 2002/03 "Other funds" represent the first 9 months (pro rata) of the funding period and so are understated. Estimates for the full 12 month period have been made at $2,194,992 (A. Tomlinson, SCCP Manager, pers comm.).

Information collected by the Priority Catchment Funding project over the past five years has shown the major funding providers to catchment groups in the Swan-Canning region have been (in order): NHT, SCCP, local governments, industry and

the Swan Alcoa Landcare Program (also co-funded by SCCP) (Table 4.4). However it is important to note here that both the catchment officers themselves, and the Priority Catchment Funding staff, have identified that the funding values provided are approximate figures and often understated (Hoechstadt, 2004). This highlights the difficulty in trying to estimate the total partnership funding directed to environmental restoration through the natural resource framework network. This is particularly because established partnership arrangements between Catchment Groups and "Friends of" groups, industries and Local Governments that further lever resources for environmental restoration activities are not captured through the Priority Catchment Funding reporting process (A. Tomlinson, SCCP Manager, pers comm). Also, in kind contributions from volunteer labour have been significant; but not accurately tracked (as indicated by the very large discrepancy between the 2000/2001 and 2001/2002 estimates).

Table 4.4 Estimates of funding provided to catchment groups from 1999/2000 to 2002/2003 provided by Priority Catchment Funding project

Fund provider	1999/2000	2000/2001	2001/2002	2002/2003	TOTAL
NHT	$338,017	$460,844	$512,844	$263,808	**$1,575,513**
SCCP	$250,000	$375,000	$415,000	$424,976	**$1,464,976**
LGA	$263,050	$404,020	$211,175	$354,096	**$1,232,341**
Industry	$24,400	$28,000	$510,900	$99,865	**$663,165**
SALP	$67,300	$179,210	$61,450	$165,907	**$473,867**
Other Government	$41,650	$251,828	$140,023	$36,981	**$470,482**
Volunteers	$69,035	$2,490	$263,000	$81,719	**$416,244**
Landholders	$99,108	$82,000			**$181,108**
University		$3,328	$116,500	$3,800	**$123,628**
Envirofund				$83,067	**$83,067**
Catchment Group					**$65,250**
Sponsorship				$61,500	**$61,500**
Community / Friends Groups		$24,000	$6,575	$7,400	**$37,975**
Schools			$9,850		**$9,850**
Living Wetlands Fund			$8,000		**$8,000**
Community Conservation Grant		$2,500	$4,000		**$6,500**
WA Landcare Trust				$2,000	**$2,000**

Review of the data on catchment group budgets within the priority catchment areas clearly shows that all of the catchment groups that have received SCCP funding have also obtained considerable funding from other sources (Figure 4.2). This was a fundamental objective of the Priority Catchment Funding project.

It is important to note that it is extremely difficult to accurately present the various funding sources and allocations for the various catchment groups, given that all of these groups have undergone merging and re-structuring into regional groups over the past five years. Consequently, comparisons between groups in obtaining funds and undertaking on-ground works between first and second priority catchments has not been undertaken.

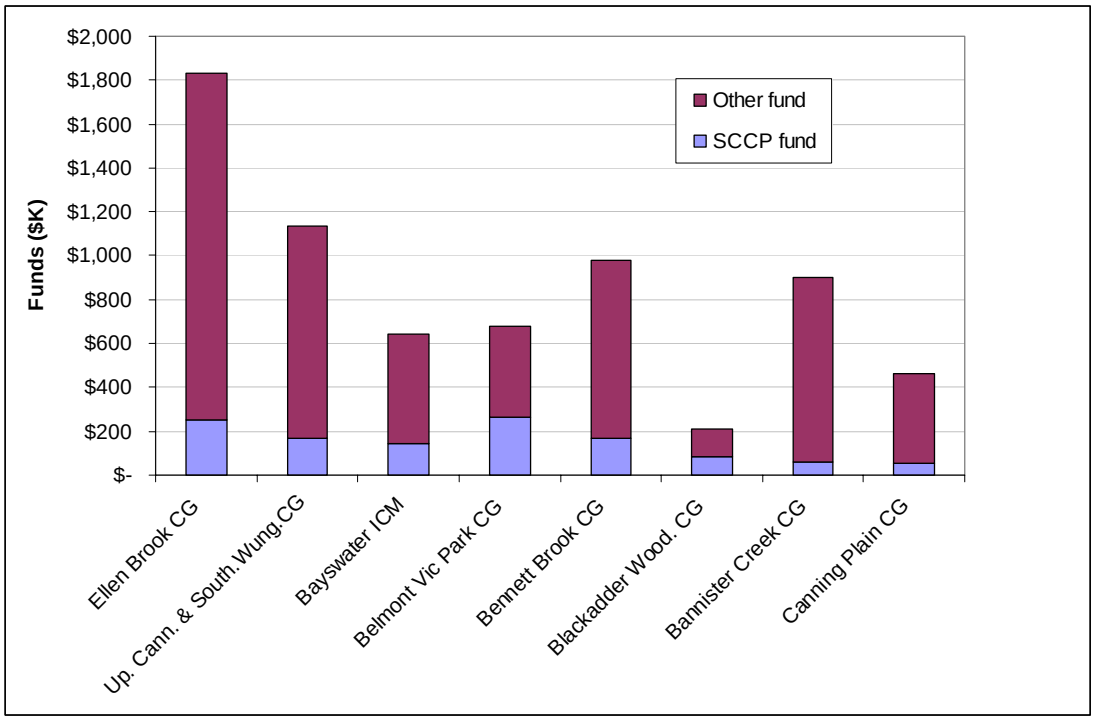


Figure 4.2 Funding obtained by the different catchment groups from SCCP Priority Catchment Funding and other sources (such as NHT, local government)

4.3.3 Outputs and Outcomes

Establishment and re-structuring of catchment groups

Over the past five years there has been a considerable evolution in the approach to urban landcare in the region. A new catchment group – the Canning Plains Catchment Group – was established in 2000/2001 with facilitation by the Swan Catchment Centre. For the past two years there has been a considerable merging and consolidation of catchment groups with the organisation of catchment groups into sub-regions (Figure 4.3). The organisational structure of catchment groups within the sub-regions is shown in Figure 4.4.

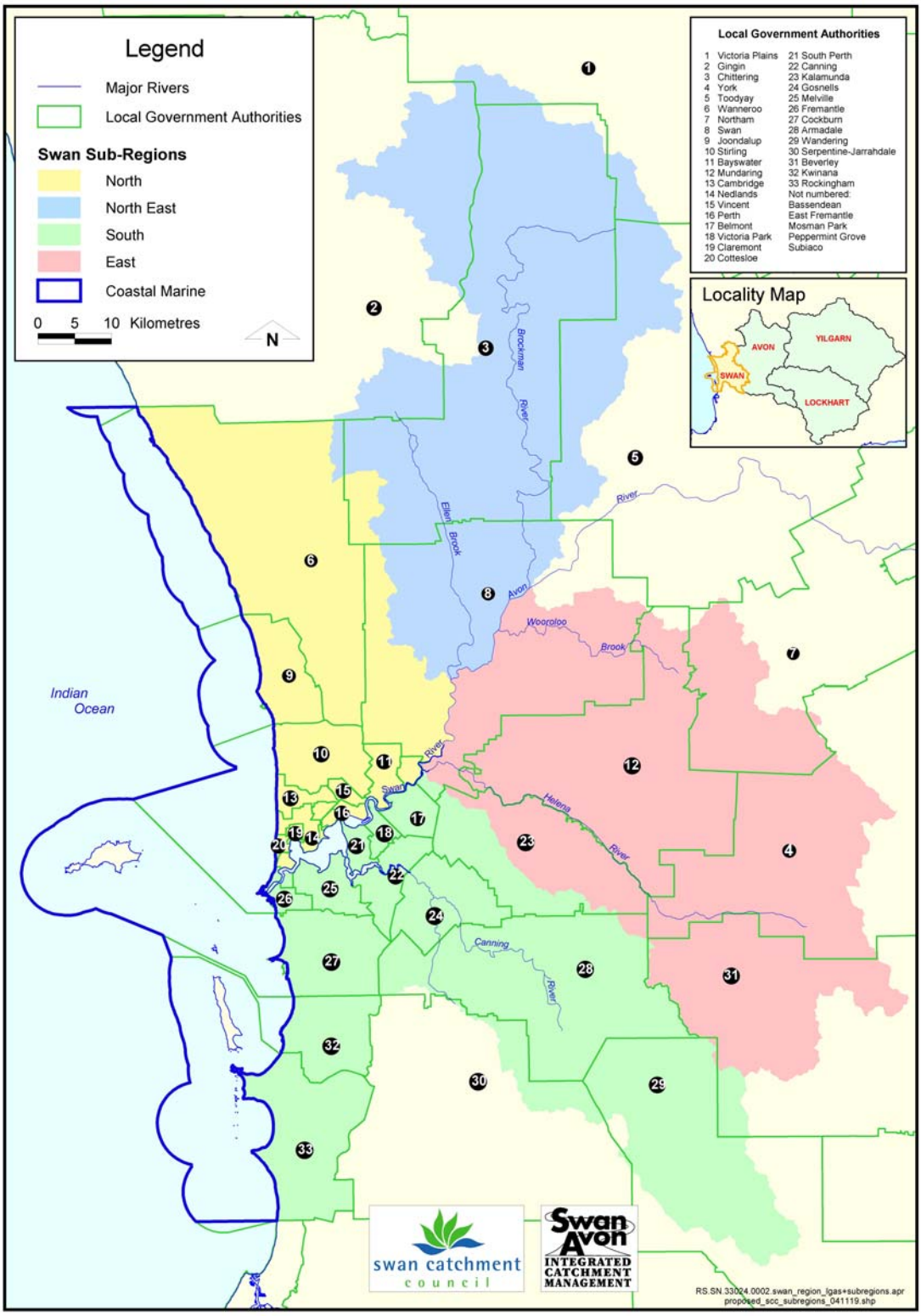


Figure 4.3 Sub-regional groups recently formed within the Swan-Canning region

Swan Region Organisational Structure

Swan Catchment Council

Partnership agreement

Swan Catchment Centre (Dept of Environment)

- Program Manager
- Catchment Support Officer
- Education Officer
- Communications Officer
- Regional Support Officer
- Ribbons of Blue

5 Community members
3 State Agency representatives (Dept Agriculture, Department of Environment, Dept of Conservation and Land Management)
1 Local Government representative
1 Community Landcare professional
1 Indigenous representative
4 Regional Delivery Reference Panel representatives

- Swan Catchment Council, General Manager
- Administrative Officer
- Executive Support Officer
- Regional Facilitator (Commonwealth)
- Indigenous Officer
- Local Government Officer
- Biodiversity Program Manager
- Water Management Program Manager
- Sustainable Production Program Manager
- Coast & Marine Program Manager

South Sub-Region	North Sub-Region	North East Sub-Region	East Sub-Region	Coastal and Marine Sub-Region (outside SCCP catchments)
South East Regional Centre for Urban Landcare *	**North East Catchment Committee ***	**Ellen-Brockman Integrated Catchment Group ***	**Eastern Hills Catchment Management Project ***	*Coastcare Central Metropolitan Region*
Armadale-Gosnells Landcare Group (formally Upper Canning Southern Wungong Catchment Group) **Bannister Creek Catchment Group** **Two Rivers Catchment Group** (formally Canning Plain Catchment Group and Belmont-Victoria Park Catchment Group) **Phosphorus Action Group** (works across all sub-regions)	*Claise Brook Catchment Group (funded through the Drainage Nutrient Intervention Program)* *Yellagonga Catchment Group* (Please note: North East Catchment Committee formed from the merger of the Bennett Brook Catchment Group and Bayswater Integrated Catchment Management Team)	**Chittering Land Conservation District Committee** **Gingin Land Conservation District Committee** **North Swan Land Conservation District Committee** *Wannamal Lakes Catchment Group*	**Blackadder Woodbridge Catchment Group** *Helena River Catchment Group* *Jane Brook Catchment Group* *Rocky Gully Catchment Group* **Susannah Brook Catchment Group** *Urban Hills Land Conservation District Committee* *Woorooloo Brook Land Conservation District Committee*	*Various Coastcare Groups*

* Sub-Regional NRM Group with coordinating role for the Sub-region.
Please note; italics indicate non SCCP supported groups, including groups who are working outside of SCCP priority catchment areas.

Catchment Management Plans

The development and implementation of Catchment Management Plans was identified as an important task particularly in the high priority catchments, and were to be undertaken by catchment coordinators with the assistance of the SRT, WRC, AGWEST and local governments. The Action Plan deemed this work as critical, either because these catchments have been identified as large contributors of nutrients (eg. Ellen Brook, Bayswater Main Drain, Southern-Wungong River and Canning River catchments), or because community concern has created impetus for action.

Initially, it was intended that guidelines would be developed to help the catchment groups (and farmers) prepare Catchment Management Plans; however only some of these guidelines have been developed. An 'ICM Handbook' has apparently been developed to help guide the establishment of catchment groups and identify issues for consideration when developing Catchment Management Plans (A. Tomlinson, pers comm.); however its availability appears limited as this document was not provided for the evaluation, nor was its existence known about by the catchment coordinators interviewed. Catchment coordinators have identified, however, that Catchment Management Plan guidelines would still be highly relevant and extremely useful for the catchment groups.

Review of the SCCP funding allocations provided in the evaluation pro forma indicated that a total of $20,000–$30,000 has been allocated towards developing catchment management plans. Information on the status of catchment management plans within the Swan-Canning region is not readily available, as this has not been reported previously. The following table contains information provided by SCCP Management Team (Table 4.5).

Table 4.5 Status of catchment management plans in the priority catchments, as advised by sub-regional coordinators of the Swan region (October, 2004)

Sub-Region and relevant SCCP Priority Catchment	Priority status of catchment	Relevant Management Plan	Status of Management Plan*
North Sub-region			
Bayswater Main Drain Catchment	First priority	Bayswater Integrated Catchment Management Strategy	An Implementation Strategy was developed in 2003 that incorporated both of these plans. Implementation plan currently being implemented.
Bennett Brook Catchment	Second priority	Bennett Brook Catchment Management Plan	
North East Sub-region			
Ellen Brook Catchment	First priority	Ellen Brook Catchment Management Plan	Draft competed in 2000. Needs reviewing and updating.
South Sub-region			
Bannister Creek Catchment	Second priority	No CMP. Bannister Creek Reserve Management Plan	Completed in 1999 and now being implemented
Bickley Brook Catchment Canning River Catchment Southern River Catchment	Second priority	Upper Canning Southern Wungong Catchment Management Plan	Completed in 1998 and now being implemented
Mills Street Main Drain Catchment	Second priority	Canning Plain Catchment Management Plan	Draft completed in 2004. Needs an Implementation Plan written. Potential sites for restoration have been prioritised.

Sub-Region and relevant SCCP Priority Catchment	Priority status of catchment	Relevant Management Plan	Status of Management Plan*
South Belmont Main Drain Catchment	Second priority	No CMP.	Relevant sections of the Canning Plain Catchment Management Plan may be adopted for this catchment.
Yule Brook	Second priority	No CMP.	Relevant sections of the Canning Plain Catchment Management Plan may be adopted for this catchment.
Eastern Sub-region			
Blackadder Creek Catchment	Second priority	Swan Mundaring ICM Plan	Swan Mundaring ICM Plan completed in 1999 and now being implemented.
Susannah Brook Catchment	Second priority	Swan Mundaring ICM Plan	

** Note: All Catchment Management Plans will be considered in the sub-regional planning process that will develop plans to guide implementation of the Swan Region Strategy for NRM at the sub-regional level.*

Considerable effort has been spent by catchment coordinators and other officers in developing the Swan Region Strategy for NRM. An additional $25,000 was provided to the Swan Catchment Council by SCCP to assist catchment groups to continue their activities during the Council's review of catchment group boundaries and operations (Swan River Trust, 2002). Sub-regional coordinators highlighted that it would have been extremely useful to have had up-to-date catchment management plans to refer to when deriving the regional NRM strategy.

On-ground works

Extensive on-ground works have been undertaken by catchment and community groups in the Swan-Canning region over the past five years, and included catchment and waterways projects. However, a key issue that has been identified by the Priority Catchment Funding team, as well as catchment groups themselves, is that the full extent of works undertaken by these groups has not been adequately tracked or reported. Historically, community-based groups were not required to report back in full detail on the outcomes of their activities in order to ensure that the administrative load of undertaking catchment management was balanced with the need for on-ground restoration work. (e.g. such as occurred to a large extent with NHT funded projects); nor were they necessarily aware of the kind of information that they were required to provide. The repercussion of this is that the achievements of the catchment and community groups are often under-represented (this is a commonly occurring problem, and not just restricted to the Swan-Canning region). A reporting process was implemented into the SCCP Priority Catchment Funding project in 2002 and included retrospective reporting on Catchment Group finances and activities for 2000 and 2001.

Collation of information from annual funding applications submitted to the Priority Catchment Funding project has revealed the following overall achievements:

- Raising public awareness about environmental issues in an effort to increase community involvement within their catchment (such as engaging 480 industrial premises and 74 teachers);
- Involved 112 school groups in catchment management;
- Developed and/or implemented management plans for their catchments;
- Undertaken on-ground restoration work (such as erecting 91km of fencing; planting an estimated 819,970 plants; engaging 1,101 volunteers); and

- Formed partnerships with local government, industry and others (Hoechstadt, 2004).

Some more detailed examples of individual projects undertaken (whether NHT, part funded or otherwise) are provided below to give an indication of the diversity and extent of on-ground works that have been undertaken.

Bannister Creek Catchment Group:

- Conversion of Bannister Main Drain to Bannister Creek through a Living Streams project. The project has resulted in ecological improvements to the area (recently celebrating the return of turtle to the area), greater stewardship of catchment and reported increases in property values near the creek.

Ellen Brook Integrated Catchment Group (provided by Sub-Regional Coordinator):

- Environmental outcome: The Ellen Brook Draft Management Plan identified and prioritised two major themes in reducing nutrient export from its catchment: restricting stock access to Ellen Brook and its tributaries and engaging the community to undertake fencing and revegetation. This group celebrated the completion of 100 km of waterway fencing and planting of 500,000 trees in 2003.
- Social outcome: Coordinator has established an on-going partnership with Department of Agriculture to increase community capacity to establish perennial Rhodes grass pastures. When the program began in 1999 the establishment of perennial pastures was seen as a Best Management Practice. EBICG and Dept Ag set up demonstration sites and field days to both promote the benefits of perennial pastures as well as train the community if their establishment. In 2004 perennial Rhodes grass is accepted as a regional standard practice with establishment knowledge being passed between landholders.
- Economic outcome: Seed funding from SCCP has enabled the group to secure over $1 million in funding to the Ellen Brook catchment, not including in-kind support. This money is injected into the local economy where possible, creating opportunities for local people and businesses.

North East Catchment Committee (provided by Sub-Regional Coordinator)

- Development of a Local Plants Community Education Strategy for Local Government;
- Development of a Community Stormwater Education Strategy for the WESROC Strategies;
- Development of an auditing program for light industry in the Bayswater and Wangara Industrial areas
- Development of the Nursery Factsheets for the Nursery Industry Association with the Phosphorus Action Group;
- Development of baseline water quality monitoring programs for Bennett Brook and St. Leonards Creek.
- Winner of the 2003 State Environment Awards. It has also extended its reach through establishment of Bennett Brook Environmental Services which provides further landcare and environmental services on a commercial basis.

Phosphorus Action Group (housed in SERCUL)

- Has extended its reach to become a region wide program for encouraging nutrient reduction activities.

More extensive information on the achievements of the different catchments groups would probably be available by directly contacting each group, or reviewing individual funding applications; however it has not been feasible to follow up these avenues for this evaluation. Extensive details of the on-ground works undertaken as part of the Swan Alcoa Landcare Program are provided in the section "Foreshore Restoration Works".

Three completed 2003 Priority Catchment Funding applications by different catchment groups were provided for review as part of the evaluation. These application forms clearly demonstrated that this funding is extremely important to the catchment groups. Considerable information was provided on the achievements of the catchment groups from the previous year in these particular examples.

4.3.4 Status of Action Plan Recommendations

The Priority Catchment Funding Project addresses the following recommendations:

Recommendation 1.1 *Provide executive and administrative support for ICM groups in the Swan-Canning System*

Recommendation 1.2 *Appoint catchment coordinators to support completion and implementation of catchment management plans in the four focus catchments (Ellen Brook, Southern Wungong River, Canning River and Bayswater Main Drain) to reduce nutrient input into the Swan-Canning River system*

Recommendation 1.3 *Support and establish additional ICM groups and appoint Catchment Coordinators to further integrated catchment management (ICM) processes and to develop and implement catchment management plans in the other catchments that have high nutrient concentrations entering the rivers and estuary.*

Recommendation 1.5 *Prepare catchment management guidelines for the reduction of nutrient losses from rural and urban catchments*

Table 4.6 Status of Recommendations 1.1, 1.2, 1.3 & 1.5

Rec'n No.	Status	Outputs & Outcomes
1.1	Achieved, ongoing	**Outputs** The SRT has provided $2,206,908 to the Priority Catchment Funding project over the past five years. A full-time Catchment Management Officer has been appointed at the SRT to provide executive and administrative support to the catchment groups. Executive and administrative support has also been provided to ICM groups by the Swan Catchment Centre, as part of their core business.
1.2 & 1.3	Partly achieved, ongoing	**Outputs** The SRT has allocated $1,894,018 to catchment groups over the past five years through the Priority Catchment Funding project. The majority of this funding has been allocated to salaries for catchment coordinators, other staff, administrative and operational costs. Given the merging of catchment groups across the region over the past five years, partitioning of funds between the four focus catchments versus other catchments is not clearly distinguishable. However, catchment groups in both the four focus catchments (Rec'n 1.2) and other priority catchments (Rec'n 1.3) have been financially supported. The SRT has allocated $20,000-$30,000 to the development of catchment management plans over the past five years. The extent of development and

Rec'n No.	Status	Outputs & Outcomes
		implementation of the catchment management plans varies considerably between the different groups. A number of these plans still require finalisation or review. **Outcomes** All catchment groups in the priority catchments are implementing extensive on ground works (but not necessarily via a catchment management plan). The establishment of additional ICM groups was facilitated to some extent by the Swan Catchment Centre. Catchment groups have been strengthened and become well established in the Swan-Canning region. An network now exists for continuing support to catchment coordinators: the Catchment Officers Support Network (COSN). The capacity for catchment groups to negotiate larger and longer projects has increased. ***Social:*** The overall participation in community and catchment groups to undertake on ground works and community awareness/educational activities over the past five years has grown. The role of the catchment coordinators has changed markedly to accommodate for the growth in community involvement, office management responsibilities, and increase in on-ground works. Catchment groups have formed partnerships with Local Governments, State & Federal agencies, community groups & service providers. Approx. 480 industrial premises and 1,100 volunteers have been engaged in catchment activities. ***Environmental:*** Considerable on ground works have been undertaken within the Swan-Canning catchment; particularly fencing, weed removal, revegetation, and restoration of drains to living streams. The extent of nutrient reduction as a result of these works is currently unknown. On ground activities have included (but are not restricted to): - Planting of 820,000 plants - Fencing 91km of waterways to protect them from damage by stock ***Economic:*** SCCP funding has facilitated catchment groups in securing approximately $6,392,154 funding for integrated catchment management from NHT, local & other state government, SALP and other sources.
1.5	Commenced, not achieved	**Outputs** Limited information is available about the development of guidelines for catchment management. There are no catchment management guidelines available to catchment groups at this stage; but there in an ongoing need for this information.

4.3.5 Gaps / Key issues identified by project staff

Gaps / key issues for Priority Catchment Funding are listed below (Table 4.7).

Table 4.7 Gaps/key issues identified by project staff for Priority Catchment Funding

Project	Key Issues / Gaps
Priority Catchment Funding	Issues include: • Annual funding cycles and low levels of job security for catchment staff; • High administrative loads for Catchment Groups; • Difficulty in achieving a consistent level of reporting across the region; • Perceived duplication of effort between SCCP Priority Catchment Funding and the Natural Heritage Trust (NHT) Program; • Perceived duplication within the SCCP Priority Catchment Funding (PCF) application and reporting form.

4.3.6 Future plans by project staff

Future plans identified by project staff for Priority Catchment Funding are listed below (Table 4.8).

Table 4.8 Future plans for Priority Catchment Funding

Project	Future
Priority Catchment Funding	The future for Priority Catchment Funding project: • opportunity for single SCCP/NHT application and reporting process; • opportunity to move toward an 'outcome focused' program; • opportunity for partnership arrangement with Swan Catchment Council (SCC) and shared delivery of outcomes through sub-regional NRM plans and SCC's 'regional delivery programs' • opportunity for increased direction for Sub-Regional NRM Groups regarding activities, outcomes, deliverable's and focus areas

4.3.7 Sources of information

- SCCP Evaluation Project Pro Formas
- Hart, R. 2001. *Establishing the Reporting Needs for the Swan-Canning Cleanup Program's Priority Catchment Funding*.
- Hoechstadt, M. (October 2004). *Swan-Canning Cleanup Program Priority Catchment Funding Summary Report*.
- Meetings with: Priority Catchment Funding project staff; and Sub-Regional Coordinators of Catchment Officer Support Network.
- Swan River Trust. 1999. *Swan-Canning Cleanup Program Action Plan. An Action Plan to cleanup up the Swan-Canning Rivers and Estuary*. Produced by the Swan River Trust in conjunction with the Water & Rivers Commission. 102 pp.
- Swan River Trust. 2000. *Swan-Canning Cleanup Program Action Plan Implementation: Year 1 in Review Summary*.

4.4 Catchment Management - Swan Catchment Centre

4.4.1 Situation

The Swan Catchment Centre was established in 1995 in response to community requests to provide support to ICM groups; and is the NRM unit affiliated with the Swan Goldfields Agricultural Regional Office of the Department of Environment. The Swan Catchment Centre was set up to be a local focal point for networking, supporting catchment groups, information exchange, publicising activities and accessing training and resources for the community. Initially the Centre was based in the city, but it was subsequently re-located to Midland (approximately 45 minutes drive from CBD). The Action Plan identified the continuation of funding to the Swan Catchment Centre as being 'crucial' for catchment and community groups; as it could provide these groups with 'one stop shop' access to information and technical advice, and distribute relevant material from government agencies. The Swan Catchment Centre provides integral support to the Swan Catchment Council, the Catchment Officers Support Network (COSN), and regional NRM activities within the Swan-Canning region.

Along with NHT, the Swan Catchment Centre has been part funded by the SCCP for the past five years to undertake two main projects:

- Provision of Community Resource Materials and Training; and
- Community Development and Education.

The Provision of Community Resource Materials and Training project is self-explanatory. The purpose of this project is to provide support, in the form of information and training to the ICM and Friends groups within the Swan Region, focussing on the priority catchments. It involves the development of brochures, maps, technical materials, information packages and display materials.

The purpose of the Community Development and Education project is to build awareness, knowledge and capacity in the community to enable interested individuals to become active partners in catchment management; and involves:

- The development and support of catchment groups by the Community Development Officer, particularly in priority catchments;
- Implementation of the Swan River Community Action Program, based on the Swan River Action Kit, by the Community Education Officer; and includes
- Ongoing support of environmental education activities and networks in the region that support and link with the SCCP program.

A third project of the Swan Catchment Centre involves providing support for the regional Ribbons of Blue program; but this is addressed separately under the Ribbons of Blue section.

4.4.2 Inputs

Over the past five years the Swan Catchment Centre has been provided with $951,000 to implement these two projects (i.e. excluding funding for Ribbons of Blue). This has included funding for the appointment of a Community Development Officer, and subsequently a Community Education Officer to implement the Community Development and Education Project. The total Swan Catchment Centre expenditure on these projects was $927,136 with $16,833 carried forward to 2004/2005 (i.e. a total of $943,969). Note the saving of $6,031 was used to balance other Department of Environment SCCP project costs.

Breakdown of the 5-year SCCP budget shows that: $169,091 has been funded to the Provision of Community Resource Materials and Training project over the past five years; $722,024 has been provided to Community Development and Education; and $36,021 for a Promotions and training officer. Information on external or other funding to implement these projects was not provided.

4.4.3 Outputs and Outcomes

Provision of Community Resource Materials and Training

The 'Provision of Community Resource Materials and Training' commenced at the Swan Catchment Centre in 1999/2000. During the first year, training needs of ICM groups were identified through the establishment and consultation with a stakeholder group, and a subsequent training program developed and implemented.

A key program that has been developed by the Swan Catchment Centre is the 'Skills for Nature Conservation' program. This is a joint-funded program by EcoPlan, Greening Australia, NHT and Department of Environment and Department of Conservation and Land Management. The SCCP has contributed approximately $4,000 per year towards the running of this program since it was first developed in 2001/2002. This program provides free training in aspects of bushland, wetland and waterways conservation. It is open to individual landholders, members of voluntary community conservation groups, environmental management students, members of the general public, and State and Local Government conservation officers.

In 2000/2001, work to identify the community needs for resource materials and training was continued; and encompassed the following activities:

- Production of appropriate resource materials for community groups
- Development of the Swan Catchment Centre and SRT Community Conservation Directory and the Swan Catchment Centre database;
- Development of Swan Catchment Centre and SRT Corporate Catchment Care Days;
- Sponsorship of: the Australian Association for Bush Regenerators Conference; and for Swan ICM group members to attend State Landcare Conference and other training courses; and
- Development of Fauna Friendly Gardening brochures.

The following training workshops and events (not a comprehensive list) have been undertaken over the past five years:

- Fauna Friendly Gardening series;
- 8th River Restoration Workshop with WRC staff;
- Goods & Services Tax workshop;
- Communication for members of Swan ICM;
- Presentation skills training for members of Swan ICM;
- Interpretation workshop for Swan ICM Catchment Officers;
- 'What Scum is that?' in conjunction with DEP & GAWA;
- Safe operation & maintenance of chainsaws;
- Community Monitoring of Aquatic Macroinvertebrates;
- Coordination of the WRC/SRT Corporate Care Work Day;
- Coordination of the Western Power Corporate Care Work Day;
- Coordination of Swan Catchment Council Workshop with chairs and coordinators;
- Best Practice Fertiliser Workshop for Local Government;
- 5 Indigenous Training Workshops (Cultural Heritage) delivered to community members and NRM professionals; and
- Support of training and information needs of Swan Catchment Council, including Mapping the Catchments workshop.

The majority of these above-mentioned workshops were undertaken in 2000/2001. It is likely therefore that additional coordination of technical and other training for Swan ICM group members has been undertaken in other years, but the details of these other workshops have not yet been collated.

Community Development and Education

The Community Development and Education project commenced in 1999/2000, with the appointment of a Community Development Officer based at the Swan Catchment Centre. The role of the Community Development Officer has changed over time. During the initial stages of Action Plan implementation, this officer's role was to work in priority catchments to stimulate the formation of new catchment groups and facilitate their development, to the point where a dedicated Catchment Coordinator could be appointed by the group to implement actions in their catchments. In 2002/2003, the focus changed to supporting effective groups in catchment

management, rather than developing new groups; identifying efficiencies at a strategic and operational level across the catchments; and working towards the development of the Swan NRM Regional Strategy.

The Community Education Officer was appointed in 2000/2001 to develop a strategic plan for the implementation of a new program, the Swan River Community Action Program. This program involved the preparation and management of an adult education program called 'Learning Circles', using the Swan River Action Kit (discussed below). This program was implemented through a facilitated adult learning program targeted at river user groups (yacht and canoe clubs), service groups, adult education services (eg. UWA Summer School) and other interested community groups.

Learning Circles and the Swan River Action Kit

The Swan River Action Kit is a package of resources and suggestions for a structured, but very flexible program, to introduce people to the Swan and Canning Rivers. It has been developed for use by anyone with an interest in the rivers and their future—individuals, service clubs, learning centres, community and catchment groups, sporting or recreation clubs that use the river environment, or informal groupings of friends and neighbours with a common interest in their local environment.

The Kit contains a book 'A Guide to using the Swan River Action Kit' that gives advice on how to set up and run a discussion group or 'learning circle', make choices about a program that suits the interests of the group, and select topics and places to visit. It provides guidelines for facilitators, and lists where to get information and support.

The Kit also contains a collection of resources including:

- 'Spirit of the Swan' and 'Algal Blooms and Nutrients' videos.
- 'The Swan-Canning River System' folder containing information on how the river system works, its plant and animal life, issues including algal blooms and pollution, and management activities in the Swan-Canning Cleanup Program.
- 'Taking Action' folder containing ideas for individual action – what you can do at home and in volunteer activities in the community.
- 'River and Catchment Management' folder containing advice and information on techniques for river restoration and catchment management.

A network of trained learning circle facilitators was established (with facilitation training offered regularly). Several organisations have also adopted the Kit and learning circles as a method for learning. A summary of the participation of Learning Circles and the Swan River Action Kit (using only information provided from the project pro formas) are outlined below:

- 50 facilitators trained to run Learning Circles and direct implementation of four Learning Circles in 2000/2001;
- Training workshops and community education through Learning Circles involving 540 people; 130 kits distributed to groups and individuals; and establishment of a Learning Circles Facilitators Network in 2001/2002;
- Distribution of 100 Swan River Action Kits; promotion of Learning Circles through Adult Learners Week & Channel 31 in 2002/2003.

- Support to organisations and the running of learning circles using the Swan River Action Kit - Supported several facilitators to run learning circles in community learning centres. In 2002/2003, a Learning Circle organised for Canning Plain Catchment Group resulted in a group forming to restore a polluted compensation basin and organise future community education. Coordinate the development of Catchment Education Strategy for catchment groups working with schools - Catchment Education Strategy flier produced to promote to stakeholders.
- The Swan River Action Kit is also used by the Ribbons of Blue program.

Environmental education activities

The Community Development and Education project at the Swan Catchment Centre has grown and extended considerably since first being initiated. This project has endeavoured to be responsive to changes in environmental education of the region; and to provide a supportive network to environmental educators and organisations and is taking a strategic and developmental role in coordinating environmental education into the region.

A wide range of other environmental education and networking activities have been undertaken by the community development and education project over the past five years, and these are summarised below:

Advice & general support to catchment and community groups:

- Ongoing advice and support in relation to ICM and NRM to community groups and catchment groups;
- Support to Claise Brook ICM Group. Claise Brook Catchment Group have initiated a strategic plan to consolidate their on-ground activities, and were granted one-off funding support for a catchment coordinator through the SCCP Program (2000/2001);
- Development of ICM group in Mill St catchment, including identification and meeting with key stakeholders and public meeting to establish ICM group (2000/2001)
- Introduction of Belmont Vic Park Coordinator to the catchment and network (2000/2001);
- Initiation of new ICM group in Upper Yule Brook catchment - Continuing development of catchment group is dependent on catchment boundary review (2001/2002); and
- Sub-regional structure established in Coastal Lakes subregion (2003/2004).

Management and workshops:

- Prepare Mapping the Catchments Situation Paper. Community Development Officer coordinating preparation of Swan NHT2 Regional Investment Proposal (2002/2003);
- Develop, coordinate, deliver, assess and act on the outcomes of the Coordinating Environmental Education Workshop in Swan Region in collaboration with SCCP Task - Facilitated the establishment of the EE Working Group for SCCouncil as an outcome of workshop. (2002/2003);
- Strategic environmental education coordination in Swan Region - Coordinated the development of the Waterwise Catchments project in partnership with Water Corporation and catchment groups. (2002/2003);
- Preparation of NHT2 priority project 'Community Education and Training' (2002/2003);

- Coordinate the development of Catchment Education Strategy for catchment groups working with schools - Catchment Education Strategy flier produced to promote to stakeholders. (2002/2003);
- Facilitated workshops for Gingin Brook Community to resolve water allocation issue. (2002/2003);
- Facilitate catchment boundary and resource review with catchment groups and Swan Catchment Council - The south east and north east regional structures have been adopted. (2002/2003);
- Facilitated internal SME industry workshop (2002/2003); and
- Coordinate strategic environmental education in Swan region - Taking lead role in developing two Icon Projects, Stormwater Education and Waterwise Catchments (2003/2004).

Planning & review:

- Strategic planning with catchment groups: Claise Brook CG; Belmont Victoria Park CG; and Canning Plan CG (2000/2001);
- Joined the Skills for Nature and Conservation planning team to develop the training program for 2003 and negotiate partner agency roles (2002/2003);
- Facilitated the Ribbons of Blue Swan Region team to review and develop the strategic plan for their program and identify priorities of their program (2002/2003);
- Provide strategic input and facilitate community consultation process for development of Swan NRM strategy Regional Capacity Section (2003/2004);
- Coordinate subregional review and structure support for communities in the Swan region - Working with North Coastal region in developing a sub-regional structure with a Regional Coordinator (2003/2004);
- Reorganisation of Community Support and Education roles (2003/2004); and
- Prepare and distribute three year project report (2003/2004).

Budgets, grant applications, partnership agreements:

- Prepare partnership agreement with key stakeholder organisations (2000/2001);
- CMP funding agreement reached - Mills St MD CG - Stakeholders will meet in early July to finalise the partnership agreement ready for endorsement at local government level (2000/2001);
- Support SCCP priority catchment funding process for key ICM groups (2001/2002);
- Facilitate Canning Plain Catchment Group involvement in CMP negotiations with Local Government and Water Corporation (2001/2002);
- Coordinated DEP ministerial grants (2002/2003);
- Support Catchment group coordinators in SCCP Priority Catchment Funding round - Supported catchment coordinators to apply for SCCP Priority Catchment Funding. Assisted in clarifying SCCPs support in NHT2 bid for catchment support officers (2002/2003); and
- Support SCCP Priority Catchment Funding process - application development and assessment (2003/2004).

Recruitment:

- Education officer for Community Development & Education Project (2000/2001);
- Assistance to Belmont Vic Park catchment group to appoint Coordinator (2000/2001);
- Coordinator employed for Canning Plain Catchment Group (2001/2002);
- 'Employing Right' information package prepared for catchment groups (2001/2002); and
- Management of the process for employing the Belmont-Vic Park Catchment Coordinator (2002/2003).

Reports:

- Promotional strategy and material supporting activities related to project;
- Mapping the Catchments Report to SRT and Swan Catchment Council;
- Extra promotional materials developed on an 'as needs' basis; and
- Catchment Education Strategy materials.

4.4.4 Status of Action Plan Recommendations

The Catchment Management - Swan Catchment Centre project addresses the following recommendations:

Recommendation 1.1 *Provide executive and administrative support for Integrated Catchment Management Groups in the Swan-Canning system.*

Recommendation 1.4 *Complete the development and implementation of the Swan Avon regional strategy ("Working together" document prepared by the SAICM and the Swan Catchment Centre) which develops partnerships with key stakeholder groups involved in planning and management of the river and catchment.*

Recommendation 2.2 *Through the Swan Catchment Centre provide locally applicable technical and administrative support, information, advice and training to those involved in or affected by catchment management to enable their effective involvement in catchment management decision-making and practical activities.*

Table 4.9 Status of Recommendations 1.1, 1.4, 2.2

Rec'n No.	Status	Outputs & Outcomes
1.1	Achieved, ongoing	**Outputs** The Swan Catchment Centre has provided considerable executive and administrative support for ICM groups in the Swan-Canning system. This is core business of the Swan Catchment Centre.
1.4	Changed focus, partly achieved	**Outputs** The Swan Region Strategy for Natural Resources Management (Draft), April 2004 has superceded the completion and implementation of the Swan Avon regional strategy ("Working Together" document). The Swan Region Strategy encompasses the SCCP (and larger) area for NRM This Strategy is currently in draft form and NHT accreditation is being sought.

Rec'n No.	Status	Outputs & Outcomes
2.2	Achieved, ongoing	**Outputs** The Swan Catchment Centre has provided considerable resource material, information, training and support to those involved in catchment management activities, including community groups, friends of groups, catchment groups, the Catchment Officer Support Network and the Swan Catchment Council. **Outcomes** ICM/NRM activities in the Swan-Canning region have grown over the past five years. There has been strengthening and continued development of catchment groups, and re-alignment into sub-regional groups

4.4.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for Catchment Management – Swan Catchment Centre are provided below (Table 4.10).

Table 4.10 Gaps/key issues for Swan Catchment Centre

Project	Key Issues / Gaps
Swan Catchment Centre	• Regional approach is more workable than direct servicing of catchment groups, but are trying hard not to lose links with catchment/community groups in process.

4.4.6 Future plans by project staff

Future plans identified by project staff for Catchment Management – Swan Catchment Centre are provided below (Table 4.11).

Table 4.11 Future plans for Swan Catchment Centre

Project	Future
Swan Catchment Centre / Ribbons of Blue	• Significant role in delivering regional capacity • Support sub-regional groups and officers in delivery of Swan Strategy for NRM and SCCP Action Plan • Strengthen existing partnerships and explore new partnership opportunities

4.4.7 Sources of information

- SCCP Evaluation Project Pro Formas
- Swan Catchment Council. 2004. *The Swan Region Strategy for Natural Resource Management.* Draft for public comments, April 2004.
- Ryan, B., & L. Western. 2001. *Evaluating the effectiveness of the Swan Catchment Centre: Learning Project Report.*
- Grybb, H. 1998. *Review of the Swan Catchment Centre and Avon Catchment Centre Network for the Water & Rivers Commission.*
- Dolva, G. 2004. Swan River Action Kit development/evaluation/upgrade notes.
- Dolva, G. 2004. Submission paper for Adult Learner's Week Awards, September 2004
- Dolva, G. 2004. Summary information requested for SCCP evaluation.
- Gole, K. 2003, Skills for Nature summary diagrams
- Miles, R. 2003. *Skills for Nature Conservation. Who is accessing our training?* An analysis of the Skills for Nature Conservation Course Program 2003 YTD.
- Swan River Trust. 2001. Swan River Action Kit promotional brochure.

4.5 Catchment Management Farm Plans

4.5.1 Situation

Preliminary land-use estimates within the Swan-Canning catchment indicate that there are approximately 86,000 hectares of farm land within this region (raw data provided by N. Gannaway, Department of Agriculture, WA). There is a relatively small amount of conventional broad-acre cropping within this region; but horticulture, turf farms, vine and tree crops and cattle and horse grazing enterprises are common (Swan River Trust, 1999). There are also intensive pig and poultry farms within the region. Many properties are also run as part-time or 'hobby' farms, rather than commercial enterprises. The small landholder group covers approximately 26,000 hectares within the area (i.e. about 10% of the Swan Coastal Plain catchment), comprising approximately 10,000 properties, with more than half of these properties in the 2-100 hectare range.

It is widely acknowledged that agricultural practices can affect water quality mainly through fertiliser and pesticide application, animal waste, and soil loss from erosion; and the Swan-Canning catchment has been no exception. Significant areas of vegetation have been cleared from the catchment and along watercourses to support agriculture; and this has also contributed to poor water quality by increasing nutrient-enriched leaching and runoff (Swan River Trust, 1999).

The Action Plan has identified that the impact of farm activities (particularly traditional and large-scale activities such as cattle grazing) on the environment needs to be minimised by adopting farm management plans that identify sustainable methods and set goals to reduce erosion, over-fertilising and vegetation activities. It also identifies that guidelines and Best Management Practices for part-time farm activities are developed.

The SCCP commissioned the Department of Agriculture (formerly AGWEST) to develop a farm management planning project for the Swan-Canning region in 1999/2000. The Department of Agriculture was keen to ensure that agricultural land is maintained as a resource for production, and ensure that weeds that could impact agriculture are managed better. The Department of Agriculture is responsible for the Soil and Land Conservation Act and Agriculture Protection Acts. These require involvement with small land holders to ensure the provisions are met. The Department of Agriculture has identified that small landholders represent a potential threat to agricultural industries and the environment; as they manage an extensive portion of the landscape (i.e. about 30% of the agricultural land in the Swan coastal plain catchment) yet potentially lack the skills to do so appropriately (Dept. Agriculture, 2004). Rural populations are changing with 'lifestyle' developments creating a demand for land bordering on agricultural areas.

This project, Catchment Management Farm Plans, aims to improve the management capacity of rural landholders in the catchment. It does so by providing learning events, including property planning, through a network of commercial consultants and Community Landcare Coordinators (Memo Brian Lloyd April 2000 reporting to Swan River Trust).

4.5.2 Inputs

The SCCP has provided $787,000 to the Department of Agriculture over the past five years to develop and implement farm management plans with the Swan-Canning

catchment. This is predominantly for salary costs, for the personnel coordinating and running the learning events.

4.5.3 Outputs and Outcomes

The Farm Plans Project is managed by the Department of Agriculture; and commenced in 1999/2000. Project implementation involved the following activities in the first year:

- Identification of potential stakeholders;
- Development of the project's scope of works, communication strategy, tender documents for contractors;
- Development and management of tenders for contractors; and
- Development of marketing material, including promotional kits, information products & brochures.

A suite of three different farm planning events were developed for the farm planning project; and included 'Heavenly Hectares' seminars, Property Planning workshops, and Farm Field Days. These different types of events are described in the following sections. Much of the description provided comes directly from a recent paper compiled about this program (Department of Agriculture, 2004). The number of events and attendees for the three different types of events are summarised in Table 4.12.

Table 4.12 Number of farm planning events (and attendance at each event) held between 1999/2000 and 2003/2004

Year	Heavenly hectares		Property Planning		Farm Field Days		Comment
	Events	Attendees	Events	Attendees	Events	Attendees	
1999/00	0	0	0	0	0	0	
2000/01	0	0	13	291	10	514	
2001/02	20	Not known	19	Not known	20	Not known	1776 attendees, but events not specified
2002/03	20	~800	6	124	12	~500	
2003/04	17	780	19	560	7	418	
Total	**57**	**1580+**	**57**	**975+**	**49**	**1432+**	

"Heavenly Hectares" seminars

This is a free, three-hour seminar that introduces small landholders to the broad concepts of managing properties in an environmentally sustainable way. This seminar was developed as a mechanism to engage participants in subsequent property planning activities. The Seminar structure is based on participative and adult learning principles; using visual aids and a number of other mechanisms to make it a useful learning experience. A variety of aspects are covered, as shown in (Table 4.13).

The program also relies heavily on sponsors contributing prizes to add to the colour, excitement and interest of the event. Content is delivered at a fairly low or basic level, and large numbers of information products collected from a range of sources are used to create links to more in depth information. A total of 57 Heavenly Hectares workshops have been held over the past five years, with an attendance of more than 1,580 people. The group size for each seminar ranges from 30-90 individuals.

Landholders have the chance to win several prizes relevant to a small property, such as soil test kits, fertiliser, herbicide and mulch. They can put their names down for

specific one-day property planning workshops, which run within four weeks of the Heavenly Hectares seminar.

Details of all the participants and their interests are taken and added to a database, which is used to inform them of upcoming field walks and seminars in their local area on topics they are interested in. Participants are encouraged to think about what they want to eventually do on their property and then come along to specific field walks to get hands-on experience and further information on particular topics.

In 2003/2004, the Heavenly Hectares program was a finalist in the 'Promote Sustainable Behaviours' category of the WA State Environment Awards.

Table 4.13 Topics covered by the different activities in the Catchment Management Farm Plan project (provided by project manager)

Heavenly Hectares	Property Planning	Field Walks
An introduction to: Weed Control Fire management Windbreaks Soils and their characteristics Controlling animal pests (including insects, birds) Property planning / design Orchards Fertiliser use Soil erosion Salinity	General Planning Weed Control Fire management Windbreaks Soils and their characteristics Controlling animal pests (including insects, birds) Property planning / design Orchards Soil testing Fertiliser use Soil erosion Salinity	Weed Control Horses and Pasture Poultry Management Salinity Management Revegetation Cattle management Revegetation Ground water Fencing A Day in the life of an Alpaca Alternative businesses

Property Planning Workshops

This is the next stage in the learning process. Participants register for the workshop and order an aerial photograph of their property (coordinated by the Project Manager). One-day introductory property planning workshops are organised for landholders, where they can get help to develop their own plan. The workshop involves a group size of 16 families – up to 36 individuals. Basic Learning principles are applied and content are more or less the same. However the program goes into greater depth on topics and the information is presented in the context of individual properties (Table 4.13). Like a farm or station plan, existing infrastructure, land capabilities and proposed improvements are mapped on separate plastic overlays. The participants are strongly encouraged to update their property plan as their ideas and situations change. They can also add more detail to their plan as they gain more knowledge and skills from other sources, such as field walks, websites or grower associations. Specific problem identification and solving is supplied in a close to one to one environment.

A self-guided learning workbook that allows landholders to develop a farm plan/land management plan by themselves was published by the Department of Agriculture in 2002. This workbook entitled "Property Planning Manual for the Swan-Canning Catchment" is used as part of the property planning workshops, and also caters for those individuals who are not able to attend a workshop.

A total of 57 workshops have been undertaken over the past five years, with an attendance of more than 975 people.

The details of those participants that have completed Property Planning are now identified geographically within the Department of Agriculture's CRIS database. An example of the maps to demonstrate geographic coverage achieved by this portion of the project is provided below (with properties marked in red).

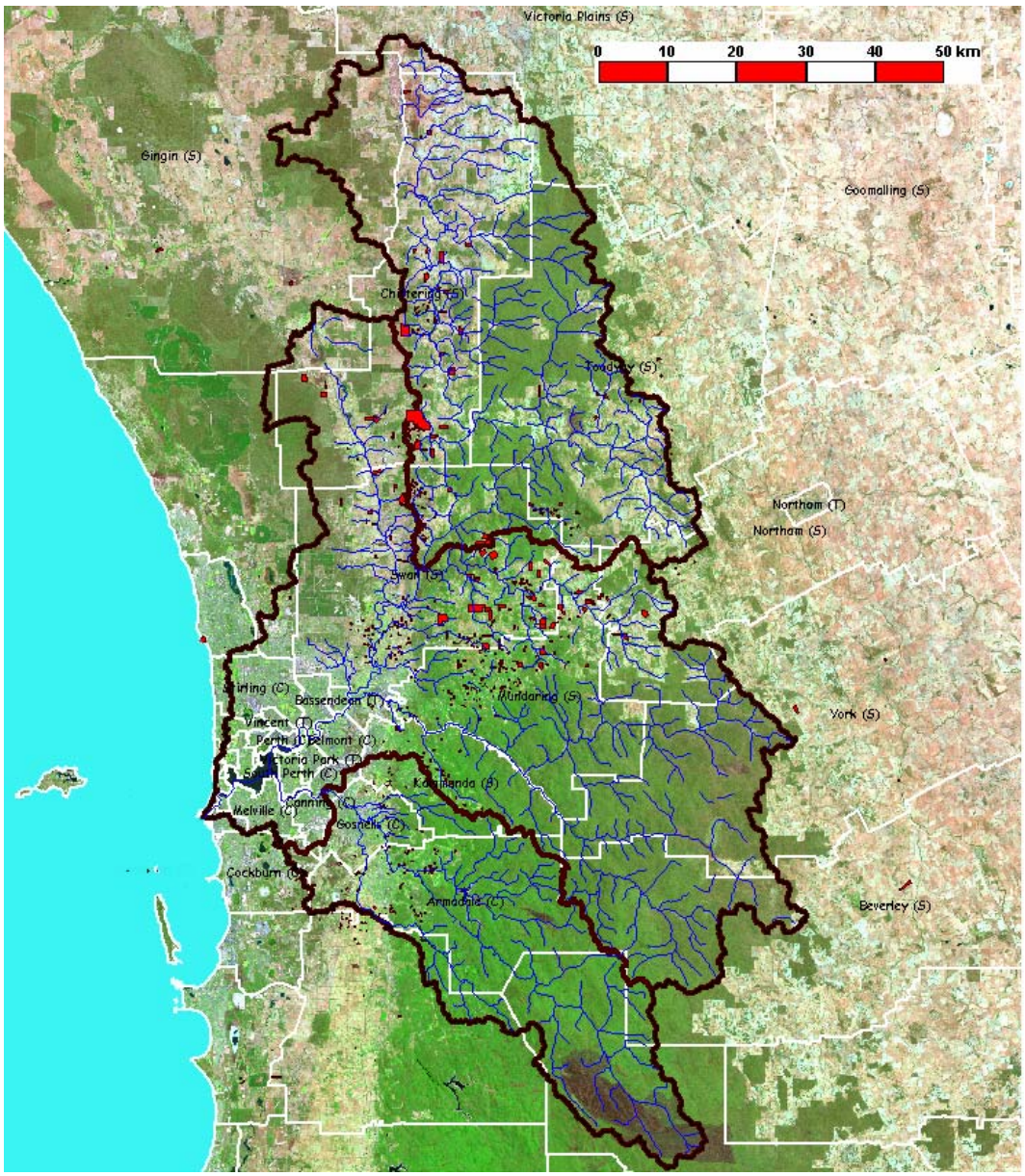


Figure 4.5 Geographic coverage achieved by the Property Planning Project (provided by Dept Agriculture, September 2004)

Farm Field Walks

Farm field walks specifically focus on topics covered broadly in the first two learning events. Some of the events that have been organised include: Horse and pasture management; Chicken health and management (Table 4.13). These events can attract new participants to the first two events described (either Heavenly Hectares or Property Planning), however generally the progress is from one of both of the first two events into these field walks. Information delivered is more in depth and will usually include physical demonstrations. Again, adult learning principles are applied wherever possible. There are usually information displays on hand to supplement, value add and promote sponsors.

Field walks and seminars are run at many venues throughout the catchment so landholders get a local perspective of particular topics. They are mostly three hours long and are held on weekends to make it convenient for most small landholders (who work full-time during the week) to participate. The group size varies from 20 to 70 families depending on the event.

A total of 49 Farm Field Days have been undertaken over the past five years, with an attendance of more than1,432 people.

Marketing and communication

Marketing and communication are important components for informing participants about activities of the Catchment Farm Plans Project. Over the past five years, the following products and materials have been produced:

- Property Planning Manual (2000/01);
- 5 Farmnotes for small landholders;
- 3 Bulletins for small landholders;
- Erosion and Sediment Control Manual (published on the website and linked to the City of Armadale website);
- Development of 'Soils Peels' as an educational/promotional tool
- Media campaigns/products (advertisements, media releases, flyers, fridge magnets etc);
- Development and distribution of posters and street signs; and
- Monthly report to Biosecurity Communications Group.

The different farm plan events have been advertised in a variety of ways including:

- Advertising in a prominent position in the state-wide Saturday newspaper;
- Posting flyers throughout the catchment;
- Putting flyers and posters in stock firms, roadhouses and real estate agents throughout the catchment;
- Direct mail-outs to landholders, who, through a previous event, have indicated they have a specific interest in a topic, and
- Radio advertising.

Information on the effectiveness of these different approaches has been collected and analysed throughout the five-year period, and the marketing efforts realigned to most effectively reach the stakeholders in different areas.

Other promotional activities of this project have included:

- Internal Awareness Campaign, Department of Agriculture (2000/01);
- Promotion: Royal Show in the Landcare Pavilion (2000/01);
- Catchment Tour with LCDC in Upper Wooroloo (2000/01);
- Contact Radio FM to promote project (2000/01);
- Attending shows/ expos to promote the project (2001/02);
- Contribution to Biosecurity Communication Group - to feed information to state and federal initiatives that may lead to new products for project use (2003/04);

- Sponsorship relationship developed in partnership with Department of Agriculture and Countryman Newspapers to develop 'print media service targeting client group (2003/04);
- Event Specification development including matrix for assessing suitability of events (2003/04); and
- Meetings have been held with other agencies (including FESA and Nework Real Estate Agents to discuss partnerships and advocacy of the project.

Other activities

Other key activities that have been undertaken as part of this project are summarised below:

- Project data aligned with Department of Agriculture's emergency response database CRIS (2003/04).
- Update and development of project database (2003/04).
- Initiation of skill / knowledge transfer to Landcare Coordinators (2003/04).
- Strategy development to 'wean' participants off project and into landcare groups activities. Includes the initiation of a service provider reference group (2003/04).

The program has been supported by sponsors in an ongoing basis in the Swan-Canning catchment—the most recent round of the program had 39 different sponsors/supports. Nine of the sponsors/supporters were shire and shire-based landcare practitioners. However, a number of the business contractors are long term partners: one company has contributed 8 brush cutters for prizes over the last four years.

Extensive feedback from participants of the Heavenly Hectares seminars, Property Planning workshops and Farm Field Days has been collected by the different project managers over the past five years. This has enabled each of these activities to be progressively revised and improved by the project manager (as needed) throughout the entire period. Participants are routinely asked what farm management topics they are interested to learn more about, and field days etc. are organised to meet these information requirements.

The current Project Manager has acknowledged that there is no distinct focus or field day held on 'nutrient reduction to waterways' in the program. This is primarily because this sort of topic is not being identified as an issue of interest by the small landholders. The approach taken is that once the participants are involved, then the session will involve discussions on activities that would lead to improved farm management that would subsequently reduce nutrient inputs (such as in the type of pasture used, or sustainable fertilisation rates). For example, it has been shown that effective pasture management, and the use of Rhodes grass instead of other grasses, can reduce nutrient runoff from farms by as much 50%.

A second important point raised by the Project Manager is with regard to development of farm management plans by commercial farmers and large landholders. The Department of Agriculture does not currently assess or require farm management plans for any farming sector. However, it is anticipated that the commercial farmers (such as viticulturists, fruit growers) particularly would be receiving guidance on BMPs from their relevant associations – however this information has not been verified.

Substantial information has been collected on self-reported farm management changes following attendance at an event, via participant surveys. In the sample survey reviewed, 89% of people had reported that they were doing something different in relation to: pastures, water resources management, soils, planning, weed control, vegetation management etc., with only 11% responding with "no change as yet".

4.5.4 Status of Action Plan Recommendations

The Catchment Management Farm Plans project addresses the following recommendation:

Recommendation 1.6. *Provide support for development and implementation of approved farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities, including part-time farm activities.*

Table 4.14 Status of Recommendation 1.6

Rec'n No.	Status	Outputs & Outcomes
1.6	Achieved, ongoing	**Outputs** The Department of Agriculture has developed and implemented the Catchment Management Farm Plans project, which engages small landholders to educate these stakeholders about farm management and planning. This project does not target large landholders or commercial farms. Based on the number of property planning days, it is estimated that 975+ farm plans have been developed by small landholders, as part of the 1-day Property Planning workshops. This number may be an under-estimate, given that the number of attendees to the workshops in 2001/02 was not specified. In addition, some individuals may have independently developed a property plan using the Property Planning Manual, rather than attending a workshop. However, it is also possible that this number is an over-estimate, as there may have been more that one attendee working on the development of a single property plan (eg. husband and wife team attending = 2 attendees, but development of only 1 property plan). The Property Planning workshops provide an indication of the number of property plans *developed*, but the number of property plans that have been *implemented* is not accurately known. Farm plans from small landholders do not receive formal approval from the Department of Agriculture. The project has focussed on engaging the small landholders as opposed to the more intensive, commercial farms in the region. Recommendation 1.6 recommends farms plans that reduce loss from farm activities – which also include all farm activities, not just those of the small landholders. **Outcomes** ***Social:*** Self reported behaviour changes (via surveys) has indicated that people are making changes to their farming practices following participation in this project. ***Environmental:*** Improved farming practices have potentially been implemented over ~1,800 hectares of agricultural land. Information is not available on the extent to which development and implementation of farms plans has reduced nutrient loss from farm activities, including part-time activities. ***Economic:*** Increased exposure of sponsors to participants has improved their exposure to potential customers

4.5.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for Farm Plans project are provided in Table 4.15.

Table 4.15 Gaps/Key issues for Farm Plans project

Project	Key Issues / Gaps
Farm Plans	• How to capture those small landholders that have yet to be reached and/or respond to advertising?

4.5.6 Future plans by project staff

Future plants identified by project staff for Farm Plans project are provided below (Table 4.16).

Table 4.16 Future plans for Farm Plans projects

Project	Future
Farm Plans	• Targeting small landholders not yet reached.

4.5.7 Sources of information

- Department of Agriculture (2002). *Property Planning Manual for the Swan-Canning Catchment*, Misc. Publication No. 14/2002. ISSN 1326-4168, June 2002.
- Department of Agriculture (Draft, 2004). Biosecurity Awareness and Small Landholders. Draft Sponsorship Material. Paper provided by Project Manager of 'Catchment Management Farm Plans' project.
- SCCP Evaluation Project Pro Formas.
- Lloyd, B. (2003). 'Helping small landholders achieve their Heavenly Hectares'. Media Statement.
- Two meetings with Project Manager.
- Assorted data files from 'Catchment Management Farm Plans' project.

4.6 Nutrient Intervention

4.6.1 Situation

A major initiative of the Action Plan is to develop drain retrofitting and constructed wetland technologies to strip nitrogen and phosphorus from catchment runoff before delivery into receiving waters. When implementation of the Action Plan began in 1999, available stormwater designs either poorly addressed the water quality component or were based on East Coast scenarios which were potentially unsuitable for Swan Coastal Plan conditions, and ineffective at reducing nutrient and toxicants in stormwater. Previous attempts by various organisations to construct artificial wetlands on the Swan Coastal Plan had also failed as they neglected to account for prevalent shallow groundwater and deep high leaching sands.

The Action Plan initiated two projects to address constructed wetland and drain retrofitting technologies: the Constructed Wetlands project, and the Water Sensitive Design project.

Constructed Wetlands

This project aimed to design and construct an artificial wetland to demonstrate the nutrient stripping capabilities of wetlands when designed for Swan Coastal Plain conditions. The intention was to build a wetland specifically to reduce nitrogen and phosphorus entering the Swan River from the Ellen Brook catchment (an Action Plan priority catchment). In addition to the nutrient stripping function, the wetland was intended to enhance the ecological value of the selected site. This project received

funds from both the Action Plan, and the National Coasts and Clean Seas Program ($569,000) to assist in the design and construction of a site-specific wetland, and to produce generic guidelines for the design of wetlands on the Swan Coastal Plain.

A series of expert workshops resulted in the completion of the wetland design which integrates the hydrological and geomorphic site conditions. The design features a fully vegetated meandering low flow channel to maximize biological, chemical and physical processes to improve water quality through filtration and interception of stormwater pollutants (a flood plain will treat both the overflow of baseflow channels and rising groundwater). Successful demonstration of the wetland will include not only successful nutrient stripping but acceptable maintenance costs as well so it becomes an attractive option to developers and local council.

Sites for the wetland were chosen in the Ellen Brook catchment, however, subsequent site investigations raised Aboriginal Heritage concerns. Early in the 2000/2001 financial year, archaeological and ethnographical investigations at the two locations identified that these sites were not suitable for constructing wetlands, in that at least one Aboriginal Group was not supportive of the natural streamline being diverted into a man-made wetland. The project then looked at finding other typical coastal plain sites within a new urban development, where it could be part of an integrated Water Sensitive Urban Design (WSUD) approach: this approach had not been attempted within Western Australia at that time, yet was deemed critical if development is to proceed in an environmentally sustainable manner. Significant time was spent negotiating with Local Government Authorities and other State Government departments to find a suitable site. In late 2000, negotiations with State Department of Housing and Works (through its program LandStart) enabled use of a site within its new urban development at Albion (St Leonards Creek sub-catchment).

During 2001 and 2002 there were extensive discussions and negotiations with the local council, that was reluctant to support the developments drainage design because it had not been costed and trialled under Western Australian conditions. The council was concerned it would have to carry the costs and risks associated with long-term maintenance of the development. Months of discussions over ownership and maintenance of the Albion development's drainage resulted in delays in the ability to commit to 2002/2003 expenditure timelines. As a result, Coast and Clean Seas redirected $439,000 of its original funding commitment of $569,000, allowing the remaining funds to be used for further site investigation and wetland design only. The timeline delays meant that inclusion of the wetland into the Albion development was not feasible. As a result, work after the 2001/2002 financial year switched focus to the Mills Street Main Drain catchment, which drains into the Canning River. This work supported the Water Sensitive Design project.

Water Sensitive Design

This project aimed to evaluate and implement structural best management practices in an urban drain, Mills St Main Drain. This drain discharges into the Canning River, which experiences frequent outbreaks of algal blooms in summer and autumn due to nutrient releases from the sediment and delivery of nutrient rich water from urban drains. Regular monitoring in the Mills St catchment near the discharge zone highlighted that it was very high in nutrients. To reduce this nutrient export from the catchment, this project identified potential source areas and investigated drain retrofitting options suitable for implementation in the catchment, such as streamlining sections of the drain, basin re-design and vegetation and the installation of gross pollutant traps in strategic locations all with the aim of improving water quality.

A report assessing the current condition of the drainage system and outlining drain retrofitting recommendations has been produced, together with a supporting report summarising the key findings from a snapshot program of surface water, sediment and groundwater sampling for nutrient and toxicant analysis throughout the catchment. The on-ground drain retrofitting recommendations have yet to be implemented, with this project highlighting the constraints associated with current institutional arrangements in Western Australia.

Activities in 2003/2004

In 2003/2004 the Constructed Wetland project was amalgamated with the Water Sensitive Design project, since the projects' objectives (i.e. development of BMPs on Swan Coastal Plain) became closely aligned.

Work focussed on the design and construction of a stormwater treatment wetland at Liege and Cockram St Main Drains in the Canning River Regional Park. Due to the site's location and current management, the wetland project involved many key stakeholders. A Project Steering Committee was therefore formed comprising representatives from the project partners: the Department of Conservation and Land Management (CALM), City of Canning, the local catchment group (representing the community), the Swan River Trust and the Water Corporation.

Funding for implementation of the Liege St wetland project was provided by the new **Nutrient Intervention Program**, in a one-off allocation of $750,000 in 2003/2004. This project was conceived after the Action Plan, but extends the work on the Mills St Main Drain catchment and the adjacent Liege, Wharf and Lacey St Drains.

Initially, the Nutrient Intervention Program consisted of funds mainly for the Liege St wetland. However, in January 2004 the State Government announced a commitment of an additional $4,000,000 for the Program over the next four years: this needs to be considered as part of that component of the evaluation that addresses planning the Action Plan's future to best achieve Action Plan goals.

The Nutrient Intervention Program funding is for projects in the urban drainage system that could bring about a rapid reduction in nutrients from known nutrient hotspots. A secondary outcome is for projects to deliver broader social and environmental benefits and increase community stewardship of drainage catchments. Activities are divided into four broad focus areas:

1. Drainage improvement works (principal site was the Liege St demonstration wetland);
2. Phoslock™ catchment applications program;
3. A Request for Proposals for nutrient intervention technologies ready for pilot scale trialling; and
4. A Framework for drainage improvement works.

The Mills St Main Drain catchment and the adjacent Liege, Wharf and Lacey St Drains were the focus in 2003/2004. Other **urban** drains with poor water quality that are discharging to the Swan and Canning Rivers, and that have potential for drainage improvement, could also be considered subject to funding availability. The initiative will also focus on opportunities for nutrient reductions in **rural** catchments with known nutrient concerns (eg Ellen Brook, Henley Brook and Southern River).

4.6.2 Inputs

Funding provided by the Action Plan for the three nutrient intervention projects is shown in Table 4.17, and other funding sources in Table 4.18. The majority of Action Plan funding (~90%) for the Constructed Wetlands and Water Sensitive Design projects was for staffing costs. The majority of Action Plan funding for the Nutrient Intervention Program (over $630,000) was for operational costs.

Table 4.17 Action Plan funding for different nutrient intervention projects

Year	Constructed Wetlands	Water Sensitive Design	Nutrient Intervention Program	TOTAL
99-00	$94,200	$50,000	-	
00-01	$77,095	$46,644	-	
01-02	$91,195	$61,203	-	
02-03	$77,279	$38,269	-	
03-04	Merged with Water Sensitive Design	$163,043	$767,446	
TOTAL	**$339,769**	**$359,159**	**$767,446**	**$1,466,374**

Table 4.18 Other funding/in-kind support for nutrient intervention projects

Year	Constructed Wetlands	Water Sensitive Design	Nutrient Intervention Program	TOTAL
99-00	$22,474[1]	$34,760[2]	-	
00-01	$49,916[1]	$8,472[2]	-	
01-02	$29,565[1]	$43,523[2]	-	
02-03	$27,826[1]	$23,209[2]	-	
03-04	Merged with Water Sensitive Design	$0	$280,000 + Un-costed[3]	
TOTAL	**$129,781**	**$109,964**	**>$280,000**	**>$519,745**

[1] *Commonwealth Coast and Clean Seas Program Grant (27056)*
[2] *Commonwealth Coast and Clean Seas Program Grant (27058)*
[3] *$280,000 from City of Canning, + un-costed in-kind support from Water Corporation, Department of Conservation and Land Management, and community time and effort.*

4.6.3 Outputs and Outcomes

Constructed Wetlands (1999 to 2003)

1999/2000

- Expert design workshop held in October 1999, including both National and International participants with expertise in wetland design for water quality control. A report was produced on Workshop Proceedings which outlined design criteria and concept design for a site in Ellen Brook catchment.
- Selection of two potential wetland sites within the Ellen Brook catchment (owned by Defence Estate Organisation), and site investigations commenced.
- Development of designs, and estimated construction costings for wetlands at Bulls Brook and Neaves Rd sites (Preliminary Cost Estimate for Design and Construction of Ellen Brook Constructed Wetland report prepared by consultant group Parsons Brinkerhoff).

2000/2001

- Original site identified as unsuitable and another site selected.

- Agreement between Department of Housing and Works (proponent) and Water and Rivers Commission to use a site within Albion urban development for constructing demonstration wetland.

2001/2002

- Detailed site investigation completed, including ground-water monitoring, site contour and surface vegetation mapping and soil descriptions.
- Site specific design workshop, and development of concept design by National wetland experts Assoc. Professor Tony Wong (CRC for Catchment Hydrology, Monash University), Dr Peter Breen (CRC for Freshwater Ecology, Monash University) and local expert Dr Kathy Meney (consultant group Syrinx Environmental). Design was finalised in a report incorporating descriptions of hydrological modelling to support the design, treatment capacities, vegetation structure plan and proposed urban design features to increase amenity values.

2002/2003

- Completion of site specific design drawings and report for proposed Albion wetland at stage where ready to go to tender.
- Draft 'River Science' document produced on 'Design principles of constructed wetland on Swan Coastal Plain.'

Additional outputs

Relationships were established and strengthened. In 1999/2000 the project built relationships with the local catchment group at Ellen Brook, who have shown interest and support for the project. In 2000/2001 new relationships were established with the State Department for Housing and Works, and City of Swan. In 2001/2002 internal relationships (Department of Environment) with the Stormwater Management section were strengthened to ensure intra-agency co-ordination of policies regarding constructed wetlands on the Swan Coastal Plain.

Water Sensitive Design (1999 to 2004)

1999/2000

- Stakeholder workshop held to discuss management options in Mills St MD catchment. Workshop proceedings produced and distributed to participants.
- Survey and snapshot sampling conducted throughout the Mills St MD catchment.

2000/2001

- Contribution towards development of Canning Plain Catchment Group.
- Drainage water and sediment sampling, and groundwater monitoring of three bores over catchment used to develop of understanding of nutrient and toxicants in catchment. Results presented to Canning Plain Catchment Group and at community forums.
- Report on feasibility (and likely costs) of placing Gross pollutant Traps in Mills St Main Drain Catchment prepared by consultant group Parsons Brinkerhoff.
- Streamlining survey of Mills St Main Drain sub-catchment undertaken with Water and River Commission project staff and Dr Kathy Meney (Syrinx Environmental).

2001/2002

- Six monitoring bores installed in the drainage discharge zone of the Wilson wetland to determine extent of nutrient contamination in underlying groundwater in the wetland and its potential impact on the wetland and Canning River (data on groundwater levels and water quality provide baseline data for future restoration works).
- Sampling and analysis of drainage water and sediment throughout catchment continued and the analysis of these data.

2002/2003

- Ongoing involvement and support to Canning Plain Catchment Group, including assistance with development of a catchment management plan.
- 20 bores installed throughout the catchment, immediately up-gradient of the major compensating basins, to assist in determining the extent of contamination and prioritise areas in need of work.
- Nutrient and toxicant snapshot sampling in South Belmont catchment (another Action Plan priority catchment).
- Continued monitoring of Wilson wetland bores and stage heights.
- Project documents produced:
    - Swan River Trust, 2003. Canning River drain study—1999. Water quality in five urban main drains. Swan River Trust. SCCP Report No. 30. This report examined water quality of five drains flowing into the Canning River upstream of the Kent Street weir during the 'low flow' period (summer/autumn)
    - Swan River Trust, 2003. Nutrient and contaminant assessment of the Mills Street Main Drain Catchment. Swan River Trust. SCCP Report No. 31. This report describes the results produced from a snapshot sampling program of the drainage water and sediment, basin sediment and groundwater quality in the catchment.
    - Swan River Trust, 2003. Drainage Improvement Framework for the Mills St Main Drain Catchment. Swan River Trust. SCCP Report No. 32. This report divides the Mills St catchment into 9 management sub-areas based on drainage system sub-catchments and land uses zones. The report gives a current assessment of the condition of each sub area, summarises known water and sediment quality and outlines recommendations to improve water and sediment quality.
- Interactive mapping package on CD-ROM, specific to Mills St MD catchment.

2003/2004

- Successful design and construction of Liege St wetland with considerable support from project partners. Activities included:
    - Collection of baseline data;
    - Extensive stakeholder and project partner liaison,;
    - Management of Syrinx Environmental's contract to design wetland;
    - Various consultants report produced for Liege St Demonstration wetland, including 'Concept Design', 'Revegetation specifications', 'Engineering and Civil Specifications', 'Maintenance Plan'; and
    - Formation of Project Steering Group and executive officer role at Project Steering Group meetings.
- Snapshot sampling in Two Rivers Catchments in water and sediment for nutrient and toxicant analysis.

- Continued groundwater investigations in Mills St MD catchment, including Wilson Wetland.
- Commenced collation of community assessment information on South Belmont Main Drain sub-catchment (collected by Belmont-Victoria Park Catchment Group) and water quality information collected by DoE and City of Belmont.

Additional outputs

- During 2000/2001, water and sediment analysis at Bunnings basins showed contamination. This finding resulted in removal of sediment from Bunnings basin and audit of nearby industry suspected of contributing high nutrient and metals to the Mill St Main Drain.
- Input to DoE's new Stormwater Manual, especially the Drain Retrofitting chapter.

Constraints / Opportunities for Improvement

From 2000/2001 to 2002/2003, retrofitting of sites (the original objectives) was not undertaken because the Water Corporation was reluctant to support the drain retrofitting measures which they believed had the potential to impede the flow and storage capacity of the drain. These issues of institutional arrangements are larger than this project, and efforts to address them are underway through a Drain Reform project being led by key stakeholders (see Section 2.2). Significant negotiations continued with the Water Corporation in conjunction with the catchment group to achieve changes in the institutional procedures that will allow future modifications to the drainage system to also address water quality issues. Negotiations with the Water Corporation and City of Canning have now developed to a stage where several sites within Mills St MD catchment and adjacent catchments have now been identified for future on-ground works.

It should be noted that funds were not directly allocated through SCCP for restoration of Main Drains until the drain Nutrient Intervention Program commenced in 2003/2004. Also, under current operating arrangements there are not explicit requirements of drainage service providers to carry out water quality improvement works. These factors should be considered in assessing the extent of drainage improvements in established catchments undertaken to date, and potential for catchment wide drain restoration.

In 2003/2004 there were major time constraints in getting the Liege St wetland built on schedule, but this was achieved due to major efforts of all project partners. The extensive consultation required through all aspects of the project consumed enormous amounts of time and effort.

Nutrient Intervention Program (2003/2004 only)

On Ground Works

The design and development of the Liege Street Main Drain Restoration Wetland Project was undertaken. This involved stakeholder consultation; collection of baseline data at the Liege Street Main Drain; co-ordination of stakeholder and project partner input into the wetland design and approval for construction. The earthworks for the project have been completed and revegetation of the area has commenced. This project is anticipated to achieve SCCP catchment water quality targets in the Liege St Main Drain for the summer and autumn months. 60,000 plants are to be returned to the 3 hectare site, with substantial costs in establishment anticipated for the next three years, plus monitoring and evaluation.

Phoslock™ Application
The Mill Street Main Drain was dosed with phosphorus binding clay (Phoslock™) at two locations for four months and a second system on the Liege Street Main Drain was operated for three months.

Nutrient Intervention Technologies
A Nationwide request for proposals for new nutrient intervention technologies was issued. These have been assessed in collaboration with the Department of Environment and independent reviewers. Several new approaches are being considered as part of this process.

Support To Community-Led Nutrient Reduction Initiatives

- 50% of a full time officer working from South East Regional Council Urban Landcare was funded from the program to enable the Two Rivers Catchment Group to coordinate community involvement in the Liege St Demonstration wetland and other projects. This also enabled the catchment group to lead planting activities at the site.
- A catchment officer was also funded to work for the Claisebrook Catchment Group in brokering drainage improvement works in the Claisebrook Main Drain and Perth CBD catchments.
- A grant of $15,000 provided to Ellen Brook Integrated Catchment Management Group to develop a nutrient stripping and biodiversity corridor along public land along the lower sections of Ellen Brook.

Water Quality Snapshots
In January 2004 the State Government announced an additional $1,350,000 would be made available to the Swan River Trust for further water quality monitoring over 2005 to 2008, to extend programs which monitor nutrient, phytoplankton and non-nutrient contamination levels in the waterways, catchment areas and drains. Apparently project design and assignment of responsibility for delivery will occur following the SCCP evaluation.

4.6.4 Status of Action Plan recommendations

The three nutrient intervention projects address the following recommendations:

Recommendation 1.7 *Provide seed funding to determine feasibility and cost effectiveness to design and construct artificial wetlands as demonstration sites for stripping nutrients in the Mills Street and South Belmont main drains.*

Recommendation 7.5 *Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques.*

Table 4.19 Status of Recommendations 1.7 and 7.5

Rec'n No.	Status	Outputs & Outcomes
1.7	Achieved, and extended.	**Outputs** Liege Street artificial wetland constructed: environmental outcome of 3 ha of habitat restoration. Phoslock™ trial in drains. **Outcomes** ***Environmental*** Drain retrofitting yet to implemented. Concerns from Water Corporation in relation to flood mitigation. Nutrient stripping capabilities of Liege St wetland, and Phoslock™ trial on Mills St and Liege St MDs, yet to be determined.
7.5	Not achieved	**Outputs** Design principles prepared. **Outcomes** Project could not be completed due to significant constraints. Initial sites selected in Ellen Brook sub-catchment were not possible due to Aboriginal Heritage concerns, and development of subsequent sites within new urban development was stalled due to local council concerns over wetland maintenance and responsibility.

4.6.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for the Nutrient Intervention project are provided below (Table 4.20).

Table 4.20 Gaps/key issues for Nutrient Intervention project

Project	Key Issues / Gaps
Nutrient Intervention	• Project timeline delays due to difficulties in finding suitable sites which met objectives (i.e. didn't have suitable site first). • Inertia of drainage service providers and reluctance of some LGAs to trial new innovations in drainage solutions, perceived risks: unknown maintenance costs and responsibilities; Scepticism - do these BMPs work?; Responsibility for water quality improvement not clearly assigned. (Liege St wetland monitoring and maintenance will help in addressing these issues.) • Aboriginal Heritage issues. Lessons learnt: • Involve all stakeholders in early planning and design, including Aboriginal consultation. • Partnerships are important, especially where long term maintenance is critical. • Need to be flexible in design and implementation, and multi-objective.

4.6.6 Future plans by project staff

Future plans identified by project staff for the Nutrient Intervention project are provided in Table 4.21.

Table 4.21 Future plans for Nutrient Intervention project

Project	Future
Nutrient Intervention	*Future Directions – Project level* 1. Continue sampling drainage water, sediments and groundwater: Aim of identifying "hot spots" suitable for further restoration. 2. Monitoring and evaluation of BMPs: Real performance data - improve designs. Use data to refine models (eg MUSIC, LASCAM).

	Adapt BMP's for WA conditions. 3. DNIP ($4M over 4 years) for continuation of BMP works: Reduce nutrients from drains, initial focus on Canning Plain catchment. Roll out to other Swan and Canning drains. *Future Directions – strategic approach* • Define roles and responsibilities through Drainage Reform Process; • Define performance standards for drainage – environmental performance versus management actions; • Engagement of Water Corporation and LGAs; • Ensure works fit within plans for regional drainage; • Explicitly recognise water quality as well as conveyancing as part of the drainage role; • Determine cost of water quality improvement measures and factor this into rating systems; and • Mechanism for cost effective decision making (eg drain improvement versus source control). *Future Needs identified:* 1. Technical assessment of all proposed nutrient reduction works - Documentation of aims, performance; Approval rating tool. 2. Coordinated R&D program - New innovative BMPs for urbanisation of rural land with high watertable (eg Southern River); Monitor, calibrate and measure performance. 3. Total Water Cycle Management 4. Integrate BMPs development with modelling to support NHT, NAP investment planning. 5 Increased consultative approach - between agencies, service providers, community, Indigenous groups, developers

4.6.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Water and Rivers Commission internal report. *Design of a Constructed Wetland to Remove Nutrients from Ellen Brook, Western Australia*. Workshop Proceedings.
- Swan River Trust, 2003. *Canning River drain study—1999. Water quality in five urban main drains*. Swan River Trust. SCCP Report No. 30.
- Swan River Trust, 2003. *Nutrient and contaminant assessment of the Mills Street Main Drain Catchment*. Swan River Trust. SCCP Report No. 31.
- Swan River Trust, 2003. *Drainage Improvement Framework for the Mills St Main Drain Catchment*. Swan River Trust. SCCP Report No. 32.
- Syrinx Environmental, 2002. *Albion Demonstration Wetland and Community Park*. Report to the Water and Rivers Commission. Syrinx Environmetal Pty Ltd, Perth, Western Australia.
- Water and Rivers Commission, 1999. *Design of a Constructed Wetland to Remove Nutrients from Ellen Brook, Western Australia, 13th to 15th October 1999*. Workshop Proceedings. Internal Report of the Water and Rivers Commission, Perth Western Australia.
- Water and Rivers Commission, 2000. *Reducing Nutrient Export from Mills Street Main Drain. Results of Workshop, 10th–11th April 2000.* Internal Report of the Water and Rivers Commission, Perth Western Australia.
- Water and Rivers Commission, 2004. *Liege Street Main Drain. Restoration design workshop notes, 3rd November 2003. A project of the Nutrient*

Intervention Program. Internal Report of the Water and Rivers Commission, Perth Western Australia.

- Water and Rivers Commission. Draft *River Science 26*. Constructed Wetland Design.

4.7 Restoration Works - Foreshore

4.7.1 Situation

Clearing, stock access to foreshores, loss of watercourse vegetation and poor fertiliser and waste management practices have led to high nutrient inputs from rural and semi-rural catchments over the long-term (Swan River Trust, 1999). In conjunction with this, foreshores have largely lost their natural ability to slow water movement, take up nutrients and filter out suspended sediments.

The Action Plan identified the need to restore the foreshores by developing foreshore management plans and undertaking restoration works of foreshores (along with catchments, wetlands, streams and drains) to improve nutrient retention in these environments. It also highlighted that the establishment of foreshore management agreements with landowners can be an effective mechanism to improve management of foreshores and watercourses along private property.

The 'Restoration Works – Foreshore' project was initially developed to provide resources and establish a process to undertake restoration and rehabilitation of catchment and foreshores, including the use of agreements so that ICM and community catchment groups can operate and be effective (SCCP implementation plan, 1999).

The Restoration Works – Foreshore project encompasses the following SCCP projects:

- Restoration Works - Foreshore (full 5-year period);
- Restoration Works (SALP) Carryover (2003/2004 only); and
- Community Catchment Rehabilitation (2003/2004 only).

The Restoration Works – Foreshore project predominantly involves the joint funding with the company Alcoa, via the Swan Alcoa Landcare Program (SALP). This program provides funds for community groups involved in on-ground environmental improvements, such as revegetation and rehabilitation projects, within the Swan and Canning catchments (SALP, 2003). This program also assists in raising community awareness and supports community groups in gaining partnership funding for restoration projects. Funding is available for a wide range of landcare activities within the Swan region that address the following regional priorities:

- Retention, restoration and management of bushland, wetland and riverine vegetation;
- Protection and enhancement of the quality of surface water (streams, rivers, drains, wetlands, dams) and groundwater.

Between 1998 and the end of the 2003/2004 financial year, the Swan Alcoa Landcare Program jointly funded 192 projects with SCCP across the metropolitan area. Many projects but not all are catchment based with anticipated nutrient reduction benefits.

It is an essential criteria for any approved projects to have community involvement and partnership contributions from Government and business.

4.7.2 Inputs

The jointly funded projects for this period total $1,219,445. The SCCP has provided $647,615, and Alcoa has provided $571,829 towards these projects (calculated from SCCP project files). In addition, Alcoa has provided a further $675,550 funding for on ground works that are separate to the SCCP program, making the overall SALP project total $1,894,993. An additional $250,000 was provided to the Swan Catchment Council for applications in May 2003, with funding to be disbursed to local groups in 2004/2005.

The Swan Alcoa Landcare Program is managed by the Swan Catchment Council; with administrative support from staff at the Swan Catchment Centre and technical support provided by the SCCP funded Catchment Officer at the Swan River Trust (funded from the Priority Catchment Funding Project).

Community involvement has played a key role in developing the SALP funding process. All projects involve partnerships between community groups and their local councils, other local sponsors or state government agencies. Community assessment panels decide which projects are worthy of funding. Overall, the Swan River Trust contribution is for community environment groups to undertake projects to fence, stabilise and revegetate watercourses in the Swan-Canning catchments (SCCP Project Management Team, pers comm.). Community-based decision making helps to ensure that projects meet local environmental priorities. Sub-regional assessment groups were aligned to the new Swan Catchment Council sub-regional boundaries.

Application for funding is via an Expression of Interest process with minimum reporting impost to minimise barriers to community participation in the scheme. Outcomes are both direct environmental improvements and raising community awareness. Project selection criteria developed in 2002/2003 to assess the projects are shown below (Table 4.22).

Table 4.22 Selection criteria for project assessment developed in 2002/2003

Priority	Criteria
Essential	1. Have an off-site or wider environmental benefit to the community. 2. Feature physical on-ground works (protection, repair etc). 3. Are undertaken by community based groups or local government in partnership with community 4. Have approval of the landowner/manager to proceed. 5. Are technically sound. 6. Do not seek funds to replace those that are readily available from other sources
Desirable	1. Projects that involve adjacent landholders, or build on, or connect works across adjoining properties. 2. Projects which demonstrate innovation 3. Projects with the potential of attracting funds from other sources. 4. Projects which have support of the wider community. 5. Projects which utilise local plant species 6. Projects which protect or enhance native fauna habitats. 7. Projects which are part of or complement an existing regional, catchment or local management plan.

In kind support and additional funding from project partners such as Local Governments substantially increases the total value of SALP. However, overall

estimates of additional ICM/NRM related funding from leverage or partnerships have been discussed in the section Priority Catchment Funding.

4.7.3 Outputs and Outcomes

Small and large projects are funded by SALP (ranging from $321 to $40,452 joint funding). An approximate breakdown of on ground activities collated by the SCCP project staff shows the relative proportions of funding that have been provided to undertake different on-ground works (Figure 4.6). It shows that:

- Almost $800,000 has been allocated to revegetating the Swan-Canning Catchment in the six years the program has been operating. Based on an average cost of $1 per seedling, this means nearly 800,000 plants have been planted in the catchment.
- Damage to waterways and remnant bushland vegetation caused largely by stock has been addressed by the allocation of $370,000 to fencing. Based on an average contribution of $1,300 per km SALP has committed to supporting approximately 280km of fencing. Control of invasive weeds has been supported through the allocation of $475,000 (SALP statistics 99-2004).

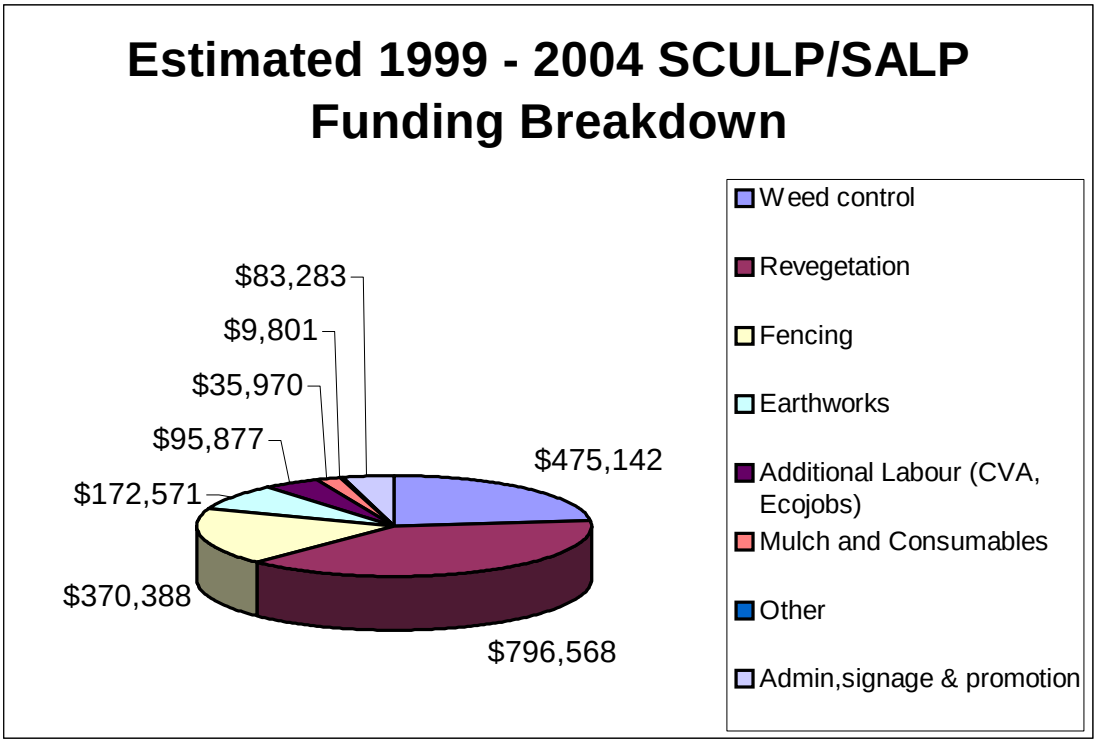


Figure 4.6 Approximate break down of on ground works undertaken as part of SALP

All of the SALP projects that have been funded (either jointly or exclusively) by SCCP over the past five years have been sorted by catchment / community groups; and the works undertaken collated, to show the extent of SCCP-related activities undertaken through the SALP project (Table 4.23).

Table 4.23 Summary of all on-ground works projects co-funded by the SCCP that have been undertaken by different catchment and community groups using SALP funding over the past five years

Applicant	On ground works project	SALP Funds
Ellen Brook Integrated Catchment Group	Fence off 74 km of Ellen Brook to restrict stock access & reduce riparian zone degradation; Plant 200,000+ trees at various locations in catchment; Construct water quality improvement treatment train; Build 3 stock crossings, 3 riffles and use woody debris to stabilize banks; Administration support.	$158,272 (13 grants)
Blackadder Woodbridge Catchment Group	Control weeds in riparian zones to allow regeneration of native vegetation. Control erosion within channel through placement of woody debris and directing flow. Re-establish natural ecosystem by re-introducing habitat & local native vegetation. Demonstrate techniques for creek restoration through establishment of 8 demonstration sites. Raise awareness of environmental values & involve community in rehabilitation.	$109,570 (21 grants)
Bennett Brook Catchment Group	Establish wildlife corridor between Whiteman Park & Swan R. including revegetated buffer along Bennett Brook. Includes a number of restoration sites.	$100,412 (8 grants)
Armadale Gosnells Landcare Group	Rehabilitation of Upper Canning R., Wungong Brook and Southern R. at approx. 15 locations. Works include bank protection, understorey revegetation, habitat creation & weed control.	$94,766 (14 grants)
Bannister Creek Catchment Group	Bannister Creek Living Streams Project & revegetating Tom Bateman Wetlands. Weed control & revegetation of redeveloped wetland. Site joins two significant bush forever sites. Large project reconstructing & streamlining Bannister Creek.	$86,230 (5 grants)
Belmont City Council and Belmont-Victoria Park Catchment group Inc.	Revegetation & rehabilitation of Tomato Lake foreshore; Earthworks & stream restoration to create living stream at Streatley Rd Recharge basin. Construct living stream, vegetative buffer & wetland detention basin at Coolgardie Main Drain, Garvey Park; Create sanctuary on 25 ha Ascot Waters Island (weeding, revegetation, signage, monitoring & mulching). Revegetation of compensating basins at Ashworth St & Alexander Rd. Garvey Park Swan R. construction of 5 fishing platforms & foreshore restoration.	$66,567 (9 grants)
Bayswater Integrated Catchment Management Committee	Maintain & protect living streams & remnant bush in Bayswater. Fencing off remnant bushland; weeding & re-planting with native vegetation (at Noranda, Light St, Russell & Mooney St wetlands, Fairford & Paterson St); Rehabilitate Berringa wetland Reserve, Maylands R. foreshore & other regions); BICM creation of bush & living streams sites from urban drains with schools & scouts environmental education program (11 bush or wetland rehabilitation projects with 11 of 19 schools in Bayswater Main Drain catchment; Promotion & support of schools participation in bushland & waterways management at 16 school sites & promotion of community involvement at 7 wetland sites.	$61,959 (8 grants)
Wilson Wetland Action Group Inc	Mill Street Stream Restoration & flood plain management project: Translocation of local flora to Canning River Regional Park, weeding. Restoration of Wilson Lagoon/Mills St Stream.	$47,762 (5 grants)
North East Catchment Committee	Enhancing biodiversity & improving water quality within North East Catchment compensation basins & stormwater drains, including: Norah Hughes Lake, Browns Lake, Russel St Compensation basin, Fairford St Drain, Mooney St Compensation Basin, Peters Place Drain, Hillcrest PS, & Bowden St; enhancing biodiversity within degraded fringing bushlands within North East Catchment, including: Clarry Small, Marshall Rd Rehabilitation Area, Swan R. SVHC, Lord St Bushland, BBEC Block, Wonga Drain Confluence, BB Pond & Garden Vale Rehab Complex.	$40,149 (16 grants)
North Swan Land Conservation District Committee	Landcare in North Swan Bullsbrook Biodiversity Corridor Stage 6 – revegetation of Bullsbrook; Administrative support; Fencing & revegetation of a wetland within the Bulls Brook Biodiversity Corridor; Control weeds, fencing, including preparation & revegetation of approx. 20ha at Bullsbrook Biodiversity Corridor project site. Major weeds of concern at the project site are Cape Tulip & Arum Lily.	$36,804 (6 grants)

Applicant	On ground works project	SALP Funds
Town of Cambridge	Lake Monger revegetation, nutrient ponds & fauna habitat – Creation of vegetated retention ponds & diverting road drains into these ponds instead of the lake, restoring natural wetland vegetation to provide refuse & nest sites for the many native water birds and adding to the recreational values of the lake. Weed control, revegetation, extension of waterfowl breeding island, enhancement of nutrient stripping potential of system & creation of Aboriginal cultural garden.	$30,345 (2 grants)
Friends of Queens Park Bushland (Inc)	Restoration of riparian vegetation to Black Creek Drain & Queens Park Bushland – To create an artificial wetland on a drain in the Mill St catchment & revegetate surrounding area. 1999 carryover commitment.	$30,000 (2 grants)
Claise Brook Catchment Group (Inc)	Monitoring of drains & signage - Community information sign at Smiths Lake Rehabilitation project. To fund a sign with black and white text and map showing proposed changes to the lake & rationale for changes. Robertson Park Wetland – Re-creation of a seasonal wetland in Robertson Park.	$29,736 (2 grants)
Helena River Catchment Group	Nyaania Creek Restoration Project - Phase 3 of an ongoing project to restore Nyaania Creekline. The project aims to control invasive weeds, encourage natural regeneration including creekline and bushland, motivate & support private landholders to undertake restoration work & promote community education; Bellevue Wetlands Restoration Project - Weed control & revegetation at 3 sites within Bellevue Wetlands; Camfield Reserve Stream Restoration - Stream restoration involving weed control & revegetation; Weed control at Piesse Brook - Creekline & bushland restoration. Weed control in Piesse Brook, Schipp Reserve, Humeston Road Reserves - project aims to systematically control various weeds, encouraging natural regeneration of the existing seed bank, seed collection from adjacent areas of high quality bushland for progressive restoration works, revegetation, raise community awareness.	$29,110 (6 grants)
Friends of Lion Mill Creek	Restoration of Lion Mill Creek. To control all weeds, re-establish natural ecosystem, promote education & awareness & demonstrate the techniques of creek restoration. Funding for weed control (mainly kikuyu and annual weeds), revegetation of area with local trees, shrubs, sedges and rushes, construction of stone riffles to slow water flow, trap sediment & provide habitat.	$23,920 (5 projects)
Friends of Attadale Foreshore	Restoration of ecological integrity of Attadale foreshore and protection of migratory & local water birds - Foreshore protection and habitat enhancement of Attadale foreshore. Restoration works include revegetation and construction of a physical barrier to deter dog access to water.	$2,1920 (2 projects)
Jane Brook Catchment Group	Kensitt Street Jane Brook Restoration Project – restoration, weed control and revegetation of 2 sites along Jane Brook& Public access management at Old Parkerville Quarry Reserve - Management of public access and weed control within Old Parkerville Quarry Reserve and Clifton Rd Reserve.	$21,364 (3 projects)
Town of Bassendean	Upgrade river parks at Sandy Beach Reserve & Pickering Park in Bassendean through extensive native planting's foreshores & establishment of walking trails. Channelling of pedestrian movement will reduce erosion of banks & improve appearance &upkeep of bank area.	$20,400 (1 project)
Upper Canning & Southern-Wungong Catchment Team Inc. and Friends of Goolamrup Reserve	Goolamrup Reserve revegetation & rehabilitation - Weed control & revegetation of understorey species along Canning R.; Roley Pools foreshore rehabilitation - Weed control and revegetation; Restoring riparian vegetation to Canning & Southern Rivers - signage of 1998 revegetation; Weed control along Canning R. - control of blackberry & bridal creeper will be undertaken with the use of a Traxcavator (Dozer6HXR) to enable access for follow up weed control by a contractor and community members; Fish habitat restoration of Southern R. (Palomino Reserve) - UCSWCT aim to provide a diversity of resources including shelter and shade for native fish species over 2km of the Southern River. Habitat enhancement by means of riffle construction, the introduction of large wood debris and revegetation.	$17,280 (5 projects)

Applicant	On ground works project	SALP Funds
Guildford Catchment Group	Restoration of Spring Creek – Weed control in riparian zone of Spring Creek including re-establishment of the middle & understorey vegetation along the creek. Community awareness raising through the use of demonstration sites; Helena River restoration, West Midland - Site 1: To revegetate an access way as a corridor with local native species, fence from stock and revegetate the remnant and new Helena River channels, raise awareness in the local community and involve local land managers in the rehabilitation activities. Site 2: Undertake woody weed control & eradicate grassy & bulbous weeds, revegetate the channel & banks with local wetland species, re-establish & protect local biodiversity & raise community awareness of the ecosystem.	$16,925 (2 projects)
Sawyers Valley Residents and Ratepayers	To assist with the restoration & revegetation of Jarrah Creek Reserve, a degraded winter wetland site. Funding for weed control & seeds & plants to revegetate site; & re-creation of meanders.	$14,050 (3 projects)
Eric Singleton Bird Sanctuary Advisory Committee	Eradication of kikuyu grass & replacement with local flora at Eric Singleton Bird Sanctuary, Bayswater (includes signage, community awareness raising through involvement & mulching); Linking Eric Singleton Bird Sanctuary to Baigup Reserve through creation of wildlife corridor; Eradicate blackberry thicket.	$11,250 (3 projects)
Roleystone Dieback Action Group Inc	Protection of remnant bushland reserves from dieback & weeds in Roleystone (7 sub projects).	$11,200 (1 project)
Araluen Botanic Park Foundation (Inc)	Weed control & installation of “eco-walk” circuit trail within 2 ha of Upper Canning; Weeding & rehabilitation of Canning R. foreshore & Stinton Creek, Araluen Botanic Park.	$11,023 (3 projects)
Wooroloo Brook LCDC	Weed control and revegetation along Susannah Brook (Loton Rd, Midland Brook, 12 Mile Well, Williams Regeneration Plan); Creation of wildlife corridor linking bushland to Susannah Brook (Upper Willow Brook).	$10,473 (7 projects)
City of Fremantle - Friends of North Fremantle Foreshore	North Fremantle Wetland project to re-create a tidal estuarine wetland habitat, set an ecological & design precedent for Swan R., construct a gross sediment trap for the Fremantle Stirling Bridge stormwater outlet & provide educational and training opportunities.	$10,000 (1 project)
High Wycombe/Forrestfield Lions Club	To restore creekline & riparian vegetation along degraded 420m section of Lesmurdie Brook. Funding for contractors to spray the Watsonia, Paspalum, Pampas & Arundo along creekline, clearing of Pampas & Arundo, the purchase of 3000 native seedlings & wetland species, the planting of seedlings & wetland species, fencing off parts of the creekline to protect seedlings & prevent disturbance of eroded or erosion prone banks and project signage.	$10,000 (1 project)
City of Melville in partnership with the Bull Creek Wetlands Working Group.	Weed control & rehabilitation of Bull Creek Park. 3-year project so restoration works can be gradual given the presence of a rare species of dragonfly which may be using the blackberry thicket as habitat.	$7,730 (1 project)
Friends of Lightning Swamp Bushland	Rehabilitate severely degraded areas of Lightning Swamp; Continue planing in old farm site, install information boards & conduct soil testing.	$7,646 (2 projects)
Friends of Piesse Brook Inc	Rehabilitation of section of Piesse Brook, involving weed control and planting.	$7,421 (1 project)
Rocky Gully Catchment Group	Protect Rocky Gully Creek from stock, improve water quality & replace weeds with native plants. Stream restoration including weed control, revegetation, construction of rock riffles to reduce stream velocity, fencing.	$7,138 (6 projects)
City of Bayswater and the Friends of Gobba Lake	Typha orientalis control & revegetation at Gobba Lake.	$6,215 (1 project)
Friends of Kensitt Street	Rehabilitate section of Jane Brook.	$6,142 (1 project)

Applicant	On ground works project	SALP Funds
Bicton Foreshore Group	Bicton foreshore. Involve local school, community & City of Melville to replant & control weeds. Create & extend habitat for Black Swan. Restoration of riparian vegetation and erosion control techniques.	$6,000 (1 project)
Canning River Residents Environment Protection Association	Trial effectiveness of mulch as buffer between turf & native foreshore vegetation along 800m of Shelley Rossmoyne foreshore.	$5,760 (1 project)
Midland FROGS Inc	Creek & wetland rehabilitation, raising of community awareness at 2 sections of Blackadder Creek.	$5,755 (2 projects)
Susannah Brook Catchment Group	Creation of revegetated corridor to link 2 areas of remnant vegetation; Protect existing revegetated areas with fencing Fencing off two areas of remnant bushland, weed control & planting.	$5,724 (3 projects)
Friends of Blue Wren Reserve	Revegetation & weed control at Blue Wren Reserve, Stoneville. Development of wildlife corridor & link to Avon National Park. Expansions of Reserve revegetation program to include dam, winter stream & outlying bush.	$5,056 (3 projects)
Brentwood & Mount Pleasant Foreshore Alliance	Revegetation of Brentwood and Mount Pleasant Foreshore Area as degraded reclaimed foreshore. Replant trees & sedges to create habitat for birds, provide shade for walkers & aid bank stabilisation.	$5,000 (1 project)
Mt Henry Peninsula Conservation Group	Continuation of weed control program for Mt Henry Peninsula.	$3,818 (2 projects)
City of Swan	Blackadder Creek PBP. Management plan development, faunal study, revegetation & weed control.	$3,627 (1 project)
Canning River Regional Park Volunteers Inc	"Greenpower" Stage 2. Translocation of indigenous sedges from development site to Canning River Regional Park.	$3,287 (1 project)
Friends of Armadale Shale Quarry	Eradication of non-endemic shrubs & trees from floor & walls of Armadale Shale Quarry.	$1,900 (1 project)
Bungendore Park Management Committee	Continue weed eradication program at Bungedore Park. Continue gravel pit revegetation and habitat enhancement. Minimise impact of European honey bee by chemical control.	$1,380 (1 project)
Friends of Statham Wetland	Weed removal (Giant Reed, Arundo donax) & revegetation of Statham Wetland.	$1,370 (1 project)
Friends of Weld Square Bushland	Weld Square Bush Regeneration Project. Weed control, path construction, planting & maintenance of banksia woodland.	$1,207 (1 project)
Friends of Darlington Station Reserve	Weed control & revegetation of Darlington Station Reserve to maintain water quality.	$1,147 (1 project)
Kewdale Primary School Bush Regeneration Committee	Bush Regeneration within School Grounds. Revegetate & create buffer zone between leach highway and the school ground.	$1,010 (1 project)
Friends of Talbot Road	Blackadder Creek Reserve Stratton Rehabilitation Project Friends of Talbot Road Rehabilitation Project – weed control & re-planting.	$1,000 (1 project)
La Salle College Eco-club	Continued rehabilitation of part of Blackadder Creek, weed control, replanting and rubbish removal.	$925 (1 project)

Applicant	On ground works project	SALP Funds
Friends of Mandoon Park & Darlington Ratepayers & Residents Association	Weed control & revegetation within Mandoon Park, Darlington.	$800 (1 project)
Friends of Biala Inc.	To rehabilitate Gugeri Creek. Year 1: fence creek to exclude livestock & clear weeds; Year 2: Plant riparian zone.	$500 (1 project)
Nature Reserves Preservation Group	Signage of 1998 weed control program at John St and Torwood Ave Creek Reserve.	$400 (1 project)

Some very simple calculations were undertaken by Oceanica in an attempt to quantify the extent of on ground works achieved by this project. The assumptions made to do this are shown below:

- Unless specified, protection and restoration projects of bushland and wildlife corridors are 5 hectares;
- Unless specified, restoration, weeding and revegetation projects of wetlands, parks, and reserves are 2 hectares;
- Streams, riparian, or foreshore restoration projects cover 500m distances along river

Assigning the abovementioned values to the projects listed above indicates that:

- **14 drains and basins** have been improved, some of these through the 'living streams' project
- **58 hectares of bushland/wildlife corridors** have been protected, fenced, weeded or re-vegetated
- **85 hectares of wetlands**, parks and reserves have been protected, fenced, weeded, revegetated, or maintained.
- **24.8 km of foreshores** along creeks, streams and rivers have been weeded, re-planted, or maintained.
- **74 km of fencing** has been undertaken (definite underestimate as bushland/wildlife corridors have also been fenced, and only those that specified the extent of fencing have been included)
- **800,000 plants** have been planted based on $800,000 been spent on revegetation under SALP from 1999-2003 and calculating $1 per plant.

Restoring ecological function

The Restoration Works – Foreshore project allocated a proportion of its SCCP funding ($105,582) for the restoration of degraded foreshores of estuaries, in an effort to recover their ecological function. This work was focused towards supporting partnership projects that involved Local Governments. Available information on the work undertaken by this project is provided below (Table 4.24).

In 2002/2003, a new program called 'River*bank*' was established. This program became the Swan River Trust's mechanism for working with Local Governments on foreshore restoration; so the sub-project was transferred from the SCCP program to River*bank*. A workshop was also held for river restoration practitioners (principally

in Local Government) to advance best management practice understanding and encourage uptake of the River*bank* program.

Table 4.24 Specific foreshore restoration projects to restore ecological function

Year	Funding	Restore ecological function
1999/2000	$25,707	Foreshore maintenance in Mosman Park. Batter boards installed (including monitoring and evaluation) at Jeff Joseph Reserve, Melville.
2000/2001	$13,820	Beach protection at John Tonkin Park. Restoration in Town of Claremont. Monitoring and evaluation at Jeff Joseph Reserve, Melville.
2001/2002	$41,482	Beach protection at John Tonkin Park. Restoration in Town of Claremont Monitoring and evaluation at Jeff Joseph Reserve, Melville.
2002/2003	$24,573	Foreshore condition assessment work. Complimented the newly established $125,000 River*bank* program; and so was re-aligned with River*bank* and removed from SCCP.
2003/2004	None specified	None specified, as sub-project transferred to River*bank* program
Total SCCP funding: $105,582		

4.7.4 Status of Action Plan Recommendation

The Restoration Works–Foreshore project addresses the following recommendation:

Recommendation 1.8. *Provide funds to fence, stabilise, and revegetate watercourses in the catchments as part of developing and implementing Catchment Management Plans.*

Table 4.25 Status of Recommendation 1.8

Rec'n No.	Status	Outputs / Outcomes
1.8	Achieved, ongoing	**Outputs** The SRT has provided $647,615 to fence, stabilise and revegetate watercourses in the catchment through SALP; and $105,582 towards foreshore restoration as part of the SCCP program. 192 projects have been funded in the Swan-Canning catchment for on-ground works The Action Plan states that funding for on ground works was intended to be used for implementation of catchment management plans once they had been finalised. The extent of these on ground works as part of implementation of a catchment management plan has not been ascertained. One of the key deliverables identified for this project was to establish foreshore management agreements with land owners to formalise a commitment of landowners to better riparian management. This was to enable ICM and community groups to operate effectively and put physical and biological restoration changes on the ground. The status of these agreements has not been ascertained. **Outcomes** Extensive on ground works have been undertaken by catchment/community groups. ***Environmental:*** Very simple estimates of the extent of works undertaken, indicates 14 drains or basins have been improved (a number via the 'living streams'); 58 hectares of bushland/wildlife corridor; 85 hectares of wetland, parks and reserves; 24.8 km of foreshore has been restored via fencing, weeding, and revegetation.

4.7.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by staff for the Restoration Works – Foreshore project are provided below (Table 4.26).

Table 4.26 Gaps/key issues for Restoration Works-Foreshore project

Project	Key Issues / Gaps
Restoration Works – Foreshore (SALP)	Issues include the need to: • Maintain a simple process for community to access funding for a wide range of environmental restoration projects; • Balance a simple process with a clear understanding of the outcomes of the program; • Secure long-term funding for the program and extend the number of contributing partners; • Retain high levels of community involvement in the assessment and decision making process.

4.7.6 Future plans by project staff

Future plans identified by project staff for Restoration Works – Foreshore project are provided below (Table 4.27).

Table 4.27 Future plans for Restoration Works - Foreshore

Project	Future
Restoration Works – Foreshore (SALP)	The future for the Swan Alcoa Landcare Program involves opportunities to: • further expand the program; • potential linkages with other Trust programs including the DNIP and River*bank* Program (non SCCP); • review the aims of SALP funding and ability of program to meet these aims; • 'focus areas' within the program; • link the program to the implementation of sub-regional plans; • an indigenous component to the program.

4.7.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Swan Alcoa Landcare Program. 2003. SALP Swan Alcoa Landcare Program Brochure, August 2003.
- Swan Alcoa Landcare Program. 2004. Call for Applications for 2005 Funding
- Electronic files: SALP statistics 99-2004.
- Interviews and communications with Project Leader and SCCP Action Plan Program Manager.

4.8 Community Awareness

4.8.1 Situation

Community concern about the health of the river in the 1990s was the catalyst for government investment and action to clean up the Swan-Canning system (SCCP Action Plan, 1999). It was realised in 1999 that community awareness of environmental issues was generally high, but that the awareness was not necessarily supported by understanding.

In 1999, the Action Plan identified a need to explain to the public:

- What is happening to the river's water quality and ecology;
- The management issues;
- The possible roles of community groups and individuals; and
- Where people can find more information or opportunities to participate.

Community consultation by the SRT in 1995 substantiated the strong need for a broad community awareness campaign. It advised that the focus needed to be on empowering individuals and groups to play their parts in the cleanup through their own actions, for example appropriate water and fertiliser use in their 'catchment-friendly' gardens. This would enhance and support activities of community groups and other organisations. Signs that inform the public of the names of watercourses and drains were also considered useful in helping to raise awareness and educate the public about their watercourses.

The Community Awareness program is a key component of the SCCP Action Plan; and encompasses the following different projects:

- SCCP/SRT Communications (1999/2000 only);
- Community Awareness;
- Environmental performance & progress reporting;
- Environmental Education (commenced in 2003/2004); and
- Urban Garden Strategy (commenced in 2003/2004).

The Community Awareness project is the largest of these five abovementioned projects; and is the core SCCP community awareness project. With the exception of SCCP/SRT Communications which was merged with Community Awareness 2000/2001, all other projects have been implemented as subsidiary projects of the main program.

4.8.2 Inputs

The total combined SCCP budget for the Community Awareness program over the past five years is $1,884,627. A breakdown of funding for the different projects is provided below (Table 4.28).

Table 4.28 Action Plan funding for different community awareness components

Year	SCCP/SRT Communications	SRT/SCCP Community Awareness	Environmental Education	Urban Garden Strategy
99-00	Merged with Community Awareness	$138,111	-	-
00-01	-	$287,521	-	-
01-02	-	$318,957	-	-
02-03	-	$265,594	-	-
03-04	-	$233,440	$333,225	$144,791
TOTAL		**$1,243,623**	**$333,225**	**$144,791**

4.8.3 Outputs and Outcomes

Community Awareness

The core components of the Community Awareness program are implemented via the Community Awareness project. This program has delivered a Cross Media Public Awareness Campaign (CMPAC) over the past five years that aims to motivate

and empower general behaviour change to generate support and contribution to activities for the protection of the Swan and Canning rivers. This has been achieved through the implementation of communications strategies, including: public participation; sponsorship; media enhancement; interactive engagement and corporate engagement.

Market research commissioned annually by the Swan River Trust over the past three years has indicated that between 62-65% of the Perth community were aware of the SCCP (Patterson Market Research, 2004). Approximately half of the people that had heard of the program had some idea of what the program targets. Those people that were aware of the SCCP targets identifying the program as addressing problems of either algal blooms (~49%), nutrient levels (16%) or foreshore degradation (10%).

A summary of the different achievements and activities undertaken as part of this project is provided below.

Corporate Care Day

The Corporate Care Day program has been developed as an initiative to give the corporate sector the opportunity to be involved in the SCCP. In particular, it gives the staff the opportunity to take part in revegetation and restoration projects that assist Integrated Catchment Management groups achieve on-ground environmental outcomes. A Corporate Care Day may include: planting; weeding; construction of access tracks, boardwalks or fences; installing fauna and fish habitat structures in streams; or rubbish removal. The activities undertaken are seasonally and site dependent. Volunteers are more aware of activities that contribute to the degradation of the system, what they can do to help and how they can continue to become involved. Each business and every volunteer receives a certificate of appreciation recognising their efforts in catchment care.

A total of 18 Corporate Care Days have been undertaken between July 01 (when the program with SRT began) and end June 04. A total of 568 people have participated in predominantly planting, and to a lesser extent weeding, around the Swan-Canning catchment. It is estimated that 40,800 plants have been planted over the past three years as a result of this program. This program is useful as participants generally plant in areas that are being rehabilitated by catchment/community groups, such as turning drains into living streams.

Evaluation forms completed by participants following involvement in a Corporate Care have shown their experience to have been a positive and satisfying one overall. Participants rated the overall experience as good; learnt new information by being involved; and would encourage organisation of a second Corporate Care Day.

The Drain Game

The SCCP has developed an innovative activity – the Drain Game – designed as a fun educational activity. Promoting the message “don’t let your river go down the drain”, the activity presents a ‘hands on’ approach to community environmental education.

Aimed at children as well as their parents and carers, the activity entertains while demonstrating how everybody in the community can ‘help keep our rivers healthy’ by keeping rubbish and garden waste out of the stormwater drains. An activity sheet reinforcing the messages is also handed out to children who play the game.

Making sure that only rain goes down the drain is an important aspect of the SCCP.

The drain game has been used at a range of different community events that includes: Perth Royal Show; Rural/Regional Shows; School fetes; Australia Day celebrations; Garden Week and Environment-based festivals.

The Drain Game has been used at 46 separate events over the past two years.

Riverview

"Riverview" is a quarterly newsletter that was in production by the SRT prior to the implementation of SCCP. Since the SCCP program commenced, this newsletter has allocated two of the four pages to reporting news from SCCP, and 18 issues have been produced. The 2004 issues have been increased from four to eight pages in length, and the number of newsletter produced has also increased from approximately 2000 per issue up to at least 4000 for each issue in 2004.

Copies of this newsletter and the annual report are routinely distributed to stakeholders and interested members of the community (Table 4.29).

Table 4.29 Distribution list for communications such as Annual Report and Riverview

Distribution list		
Aboriginal Community	Government Agencies	Public Library
Catchment Groups	Government CEOs	River Management
Catchment Chairs	Industry	Rotary Clubs
Catchment Coordinators	Interested Community	SCCP Project Partners
Commonwealth Parliamentary Officer	Legislative Assembly	Schools
Consultants	Legislative Council	SRT Board
Environmental Educators	Local Government, including Mayors, CEOs, Councillors, Libraries, Environmental Officers & other staff	Universities & Research
Environmental Protection Authority	Media	Water & Rivers Commission Board
Fishing Community	Ministers (including members of the Opposition	

Media releases, product launches and displays

The Community Awareness program has implemented a marketing campaign encompassing media releases, product launches, displays and promotional material. Over the past five years approximately 100 media releases have been produced about the SCCP program over the past five years. Topics covered include the different SCCP projects and activities, environmental issues (such as fish kills and the occurrence of algal blooms), and waterways and catchment management.

There have been at least 16 product launches (including the five annual community forums) for the SCCP program over the past five years. Some of these launches are outlined below:

- 1999/2000: draft Ellen Brook Catchment Management Plan.
- 2000/2001: Swan River Action Kit.
- 2001/2002: Industry Project Training Package; and Caring for the Canning: A Plan to Revitalise the Canning and Southern and Wungong Rivers.
- 2002/2003: Local Government NRM Policy Manual.
- 2003/2004: Turf Sustainability Manual.

The SRT Calendar shows that the Community Awareness Campaign has been involved in 194 displays and promotions for the SCCP over the past 4 years (information was not provided for 1999/2000). The past three years have been particularly active, with between 49 and 68 separate activities being undertaken each year. The types of promotions and events undertaken by SCCP have been varied, and are summarised below:

- Boat shows, races, open days and fun runs;
- Clean up Australia Days, Australia Day, World Environment Day;
- Product launches;
- Regional, Community Festivals, Show Days and School Fetes; and
- Workshops and environmental conferences, 'theme' weeks such as Science Week and Garden Week.

Promotional material

The following promotional material has been produced over the past five year as part of the SCCP community awareness program:

- Floating key ring (for boat use);
- Stickers (including SCCP bumper sticker, swan, fish, frog, seahorse with "You can make a difference" and "Help Keep our rivers healthy" messages); and
- SCCP t-shirt, magnet, notepad, calico bag.

A number of brochures addressing various aspects of the SCCP program have also been produced and distributed, including:

- Swan-Canning Cleanup Program – Help Keep our Rivers Healthy.
- Fishing for a Healthy River – Advice for recreational fishers to protect the Swan and Canning Rivers.
- Contributing to health of the Swan and Canning Rivers – Swan-Canning Cleanup Program.
- Cleaner Production Training – Protect your Profits. Protect your River.
- Corporate Care Day Program.
- It's your land… Be sure its in good hands (for farm plan project).
- Swan River Action Kit – Resources and activities for environmental discovery.
- You can make the difference.
- Swan Alcoa Landcare Program (2 brochures).
- Algae in the Swan-Canning Estuary.
- You can Help Keep Our Rivers Healthy and Frequently Asked Questions.

Environmental performance and progress reporting

This project is delivered by the Community Awareness project but addresses Recommendation 10 under Action Area 4. The Action Plan identified that because of the importance of community involvement in the Action Plan implementation, as well as for funding accountability, the public must be kept informed of progress in implementing the Action Plan, achievements in improving river health and the projects in which they can participate. This purpose of this project is to deliver the SCCP performance reporting to the community through an annual community forum, video production and printed reporting brochure. The aim of the Community Forum

is to communicate the latest information about the achievements of the SCCP; and to provide an opportunity for community feedback. The locations and approaches used for the Community Forum have varied from year to year.

Table 4.30 Summary of annual reporting approaches over the past five years, including attendance at Community Forum and production of Annual Report and promotional videos

Year	Community forum	Annual Report	Video
99-00	Alexander Library 62 people attended Detailing the Action Plan	8 page brochure (2,000 copies)	Yr 1 Implementation (30 copies)
00-01	City of Gosnells Admininstration Centre 110 people attended	8 page brochure (4,000 copies)	Yr 2 Implementation (250 copies)
01-02	Burswood on Swan 100 people attended Showcase of Action Plan projects	8 page brochure (4,000 copies)	Yr 3 Implementation (250 copies)
02-03	Forrest Place Unknown no. people attended as 'walk through' in city mall Trade fair of all SCCP projects	16 page brochure (5,000 copies)	You can make the difference – recruitment video (450 copies)
03-04	Perth Convention & Exhibition Centre – "WA on show" No. people attended <30 (people left once Aboriginal dancers finished their welcome ceremony) Approximately 5-minute talk by Environment Minister summarising SCCP achievements with Introduction by Chair of SRT	16 page brochure (10,000 copies)	You can make the difference 03/04 (500 copies + 150 CDs)

The format of the Community Forums has varied considerably from year to year. The following general comments have been made by SCCP staff about the community forums:

- The same community members seem to attend from year to year, so only a very small proportion of the community is being informed through the Community Forums;
- Only very general information about SCCP is provided, and a number of projects are either not mentioned at all or are under-represented;
- Little to no scientific information is presented;
- Quite often, the audience comprises supporting SCCP staff, rather than members of the community; and
- It is not providing a particularly effective medium for community members to provide feedback or become involved in the SCCP.

The Annual Report targeted at informing the general community about SCCP is well received. Over the past five years, the reports have increased in size; and the number of reports produced has been progressively increased to cater for the growing interest in this program. Similarly, the number of videos produced has also been increased for the same reason.

The reports and videos are distributed to: libraries; catchment groups; SCCP project partners and project managers; Local Government environmental officers; and schools, sport & leisure groups and environmental educators (Table 4.29).

Environmental Education

The objective of the Environmental Education project is to develop and deliver increased environmental education, community knowledge and skills, and involvement with environmental education activities to the community. In particular, this project is targeted towards the general public, social groups and schools. New media partnerships established in 2003/2004 are providing opportunities for TV programming, print media advertising, and radio. This project also covers the provision of enhanced website information, printed publications, display materials, talks and presentations, public forum, and in particular the delivery of the new weekly Algae Activity Report.

Algae Activity Reports for the Swan and Canning Rivers (using collated information collected by the Environmental Performance and Progress Reporting project) are now featured weekly on the Channel 9 news and Swan River Trust website (www.swanrivertrust.wa.gov.au). The reports by the SRT are made possible by extra government funding allocated to the SCCP following the 2003 autumn algal bloom. The Algae Activity Report has been developed to provide more frequent information about algal activity in the Swan-Canning estuary, including helping Perth residents to understand the seasonal algal patterns within the estuary. The Algae Activity Report is aired each Friday during the weather report shortly before 6:30pm.

Urban Garden Strategy

Development and implementation of the Urban Garden Strategy was made possible in 2003/2004 by provision of additional funding for community education from the SRT.

The Urban Garden Strategy includes the following activities:

- Sponsorship of 'Great Gardens Workshops' undertaken in Spring 2003 and Autumn 2004. This included marketing and advertising in TV, radio and print outlets and working with the Water Corporation, NGIA and Local Governments within the catchment;
- $40,000 support for the Phosphorus Action Group to carry key SCCP messages to local community fairs, schools talks and public events within the catchment, providing a strong identity focus with Phosphorus Action Group and SCCP/SRT badging;
- Financial support for the Phosphorus Action Group's Fertilise Wise campaign, including printing of brochures ("Fertilisewise: Growing a better garden") and distribution to garden outlets;
- New media partnerships with Radio Mix Austereo and Channel 9 to air Healthy Rivers advertising campaigns.

Great Gardens workshops

The Great Gardens workshops are a series of free, 3-hour gardening workshops for the community; held at 10 different urban locations around the Swan-Canning catchment. These workshops enable a new focus to be directed towards urban landcare and reduced nutrient losses from urban properties. It delivers nutrient, fertilise-wise and water-wise information to the community, and increases their knowledge and skills in 'river-friendly' gardening practices. The workshops involve teaching the community about best practise management for gardening with least environmental impact, reducing nutrient loses from urban properties. It raises awareness of how everyone in the community can play their part to HELP KEEP OUR RIVERS HEALTHY; and provides an opportunity to promote other activities

within the Cleanup Program. Great Gardens also established a website and a phone hotline for bookings.

Since it was launched, the Great Gardens program has sparked a groundswell of community interest in sustainable gardening techniques. Continued development and support will see it grow to fulfil its potential to become the state's pre-eminent gardening and landscaping public education program.

More than 5000 Perth residents attended the autumn and spring Great Gardens workshops, supported by the Water Corporation with endorsement from the Nursery and Garden Industry Association of WA. Market research and community feedback demonstrated that behaviour changes in domestic urban landcare were taking place as a result of these new initiatives. Members of the community continued to seek consultation with the Great Gardens team and requested more workshops.

Over 35 Great Gardens workshops were held between September 2003 and June 2004 (limit of evaluation period), and 2858 people attended the workshops during this time. This does not include people that also attended mini-workshops held during 'Garden Week' and the '2004 Autumn Festival'.

Collated results of 1,981 surveys completed by Great Gardens participants clearly show that this program has a positive effect on participants attitudes and understanding towards water and nutrient wise gardening (Table 4.31). The majority of participants across the Spring and Autumn series of workshops rated their overall workshop experience, knowledge of presenters, stimulation of interest, and quality of the workshops as "excellent/outstanding", including its rating as a learning event. In addition, 61% of participants indicated an interest to attend a more in-depth, 6-hour, garden design workshop.

Table 4.31 Summary of personal responses from 1,981 surveys completed by Great Gardens participants demonstrating an increase in their knowledge of sustainable gardening

Personal ratings of participants understanding of:	BEFORE attending Great Gardens	AFTER attending Great Gardens
The role urban gardeners can play to help save the Swan and Canning Rivers	Average	More knowledge than most
Waterwise and Fertilisewise techniques	Average	More knowledge than most
Sustainable garden design	Little understanding - Average	More knowledge than most
Participants capacity to manage their gardens more sustainably	Little understanding - Average	More knowledge than most

Phosphorus Action Group

As part of an Urban Garden Strategy, the SCCP support a local community group called the "Phosphorus Action Group" to produce a Fertilise Wise Guide. This new community resource advises urban domestic gardeners on appropriate fertiliser types and application rates for 5 different types of Perth soils and was launched at the Perth Flower and Garden Show 2003. As part of the new strategy being developed, the guide will feature through a series of Great Gardens workshops in catchment urban areas.

In 2003/04, the 'Phosphorus Action Group' was engaged to represent SCCP at local community festivals, community and school talks, and an increased number of

planting days. The SCCP provided the Phosphorus Action Group with an additional $40K for this purpose.

The main constraint to the Community Awareness program identified by project staff is limited staff resources and funding. In particular, the $200K funding for the Urban Garden Strategy and Environmental Education provided in 2003/2004 was for a pilot project and is not secured for subsequent years.

4.8.4 Status of Action Plan Recommendations

The Community Awareness program addresses the following recommendations:

Recommendation 2.1. *Implement a cross-media public awareness campaign involving a variety of information sources for the general public to encourage changes in individual behaviour and involvement in river care and catchment management.*

Recommendation 10.1. *Coordinate reporting to the community and ensure that there are opportunities for community feedback on implementation of the Action Plan.*

Table 4.32 Status of Recommendations 2.1 and 10.1

Rec'n No.	Status	Outputs & Outcomes
2.1	Achieved, ongoing	**Outputs** A cross-media public awareness campaign involving a variety of information sources for the general public has been implemented to encourage changes in individual behaviour and involvement in river care and catchment management. **Outcomes** ***Social:*** In 2002-2004, 62-65% of the general Perth community surveyed was aware of the Swan-Canning Cleanup Program; and half of these people associated the program with either algal blooms, nutrients, or foreshore degradation. The Urban Garden Strategy has been effective in educating over 5,000 people about sustainable garden practices, increasing their knowledge, and facilitated changes to their gardening behaviour. ***Environmental:*** Approximately 40,000 plants were planted as part of the Corporate Care Day Program.
10.1	Achieved, ongoing	**Outputs** Reporting to the community is achieved via a range of information sources. In particular, the SCCP annual report (presented as a colourful community-friendly brochure) meets the reporting component. Numerous opportunities for community feedback are provided as an integral component of the cross-media public awareness campaign. However the annual SCCP Community Forums particularly was implemented to provide an opportunity for direct community feedback on implementation of the Action Plan.

4.8.5 Gaps / Key issues identified by project staff

Gaps / key issues identified by project staff for Community Awareness are provided in Table 4.33.

Table 4.33 Gaps / key issues for Community Awareness project

Project	Key Issues / Gaps
Community Awareness	• Resourcing.

4.8.6 Future plans by project staff

Future plans identified by project staff for Community Awareness are provided below (Table 4.34).

Table 4.34 Future plans for Community Awareness project

Project	Future
Community Awareness	Logo & key messages reinforcement. Continue existing programs (ie. Drain Game; Healthy Rivers advertising; Postcards editorial; sponsorship of Gardening WA; Algae Activity Report with Channel 9; fund Phosphorus Action Group; sponsor Great Gardens. Extension of existing projects or commencement of new projects: Corporate Care Days extension; new Corporate Care Day promotional material; extended events sponsorship and participation;. new SCCP displays.

4.8.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Landcare Solutions. 2004. Great Gardens – Towards the creation of sustainable urban landscapes: Spring 2003 Interim Review. Prepared by Gary Heady. 10 pp.
- Landcare Solutions. 2004. Great Gardens – Towards the creation of sustainable urban landscapes: Autumn 2004 Review. Prepared by Gary Heady. 12 pp.
- Great Gardens Promotional Brochure & Great Gardens website: http://www.greatgardens.info/docs
- Patterson Market Research. 2004. A Report on the Swan-Canning River Catchment Survey. Prepared for Swan River Trust, April 2004
- SRT Riverview newsletters: No. 17-34.
- Swan-Canning Cleanup Program Media Statements: 1999-2004.

SCCP Brochures:

- Swan-Canning Cleanup Program – Help Keep our Rivers Healthy.
- Fishing for a Healthy River – Advice for recreational fishers to protect the Swan and Canning Rivers.
- Contributing to health of the Swan and Canning Rivers – Swan-Canning Cleanup Program.
- Cleaner Production Training – Protect your Profits. Protect your River.
- Corporate Care Day Program.
- It's your land… Be sure its in good hands (for farm plan project).
- Swan River Action Kit – Resources and activities for environmental discovery.
- You can make the difference.
- Swan Alcoa Landcare Program (2 brochures).
- Algae in the Swan-Canning Estuary.
- You can Help Keep Our Rivers Healthy and Frequently Asked Questions.

4.9 Water Quality Protection Notes (WQPN) for Best Management Practice (BMP)

4.9.1 Situation

The Department of Environment (DoE) is responsible for managing and protecting the State's water resources. It is also a lead agency for water conservation and reuse.

Action Plan funding was provided to the DoE's Water Source Protection Branch to provide guidance notes on specific land use Best Management Practices (BMPs) necessary to prevent or control loss of harmful contaminants to the environment; and to provide technical advice and strengthen linkages with the Light Industry Project Officer and the LG NRM manual.

Water Quality Protection Notes (WQPNs) were prepared on topics that the SCCP management team agreed were water quality issues for the Swan-Canning system. The WQPNs offer:

- DoE current consolidated views on specific land uses and environmental management topics;
- Guidance on acceptable practices used to protect the quality of Western Australian water resources; and
- A basis for the development of a multi-agency code or guidelines designed to balance the views of industry, government and the community, while sustaining a healthy environment.

The notes are intended as a general guide on issues of environmental concern, and to offer potential solutions based on the DoE's professional judgment and precedent. Their intended audience is industry groups and local councils, and to support other Action Plan initiatives such as the Industry Working Group and BMPs Swan-Canning (see Section 5.6). They do not override any statutory obligation or Government policy requirement, nor are they Departmental policy position on any specific matter.

The DoE also prepared an Environmental Management and Cleaner Production Directory, that listed national and international environmental and cleaner production guidelines for small and medium businesses. Cleaner production is about the efficient use of energy, water and material resources, and the Directory was intended for use by DoE staff, local governments, industry associations and catchment groups to assist businesses to achieve cleaner production and adopt practices that protect the environment.

4.9.2 Inputs

Action Plan funding over the three years of this project was $30,263 (Table 4.35), the larger part of which ($27,883) was for personnel (0.17 FTE). Some in-kind administrative support was provided by the DoE.

Table 4.35 WQPN funding

Year	Action Plan funding	Dept of Environment funding
99-00	Not applicable	Not applicable
00-01	Not applicable	Not applicable
01-02	$10,263	Unknown[1]
02-03	$10,000	Unknown[1]

Year	Action Plan funding	Dept of Environment funding
03-04	$10,000	~$1,500[1]
TOTAL	**$30,263**	**>$1,500**

[1] *DoE in-kind support, for updating (revised formatting and new data) of WQPN as required.*

4.9.3 Outputs and Outcomes

WQPNs produced were:

- "Radiator repairers", "Contaminant spills-emergency response", "Nurseries and Garden Centres" and "Nutrient and irrigation management plans" (2001/2002).
- "Chemical Blending", "Floriculture" and "Mobile mechanical servicing and cleaning" (2002/2003).

The draft WQPNs were subjected to a quality assurance process prior to finalisation and posting on the WRC/DoE website, and supplied in printed or electronic format as required.

In 2003/2004 the Environmental Management and Cleaner Production Directory was prepared. This was a 65 page document especially suited to use on the Internet, detailing local, national and international guidance sources for 42 types of industrial and commercial activities occurring within the SC catchment. The directory covers the topics of cleaner production, water conservation, environmental best practice, energy efficiency, and chemical containment.

Constraints / Opportunities for improvement

Funding for this project was modest, and the number of WQPNs that could be prepared was constrained by budget.

The effectiveness of the WQPNs requires an effective extension program (as per Action Plan Recommendation 5.2), and that industry adopts practices to contain contaminants previously released to groundwater and waterways that feed into the Swan-Canning system. It also requires that the information supplied to the extension program is in a suitable form. Feedback from internal SCCP Action Plan stakeholders was as follows:

- The WQPN are quite technical, and appear to be targeted more for the use of regulators than the business community. The WQPN need to be made simpler and more user-friendly if they are to be used by industry and/or small businesses.
- Some of the WQPN have been incorporated into the Local Government NRM Manual.
- The Cleaner Production Directory is not considered very useful to small to medium-sized industry in its present form, mainly because many small to medium-sized industries do not use the internet extensively. It is considered that this information is a more appropriate resource that could be used by environmental officers in providing directions to small and medium-sized industries.

4.9.4 Status of Action Plan recommendations

The WQPN for BMPs Project does not have primary responsibility for any Action Plan recommendation, but provides support to the following recommendations:

Recommendation 2.2 *Through the Swan Catchment Centre provide locally applicable technical and administrative support, information, advice and training to those involved in or affected by catchment management to enable their effective involvement in catchment management decision-making and practical activities.*

Recommendation 5.2 *Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management.*

Table 4.36 Status of Recommendations 2.2 and 5.2

Rec'n No.	Status	Outputs & Outcomes
2.2	Achieved, within constraints of budget	**Outputs** Seven WQPNs, and an Environmental Management and Cleaner Production Directory prepared. **Outcomes** ***Environmental*** Swan Catchment Centre has access to technical information and advice on BMPs and cleaner production for a range of light and medium industries.
5.2	Achieved, within constraints of budget	**Outputs** Seven WQPNs available for extension program, and incorporated in Local Government NRM Manual. **Outcomes** The extent to which BMPs are being adopted by the relevant industries has yet to be assessed. Therefore Social and Environmental outcomes are unknown.

4.9.5 Gaps / Key issues identified by project staff

No major gaps were identified. However the extent of usage of the products from this project were not fully known.

4.9.6 Future plans by project staff

Project staff has reported that the scope of future work for this project will be directed by the SRT.

4.9.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Meetings with Project Manager.
- Two meetings with internal SCCP Action Plan Stakeholders.
- WQPNs.
- Cleaner Production Directory.

4.10 Ribbons of Blue

4.10.1 Situation

Ribbons of Blue was initiated as a schools water quality monitoring program in 1989. The Western Australian Ribbons of Blue/Waterwatch WA program became part of the Australia-wide network in 1994, and has retained its strong association with schools, but has also expanded to included greater community involvement.

The program uses water quality monitoring and catchment management activities to develop awareness and understanding of water quality issues (eg diffuse pollution and algal blooms) and catchment management concepts (including ecological function). The program provides water quality monitoring opportunities for schools and community, and facilitates links to key stakeholders such as local government, community and catchment groups, education providers and other State government agencies. Activities include events, displays, talks, and professional development and skills training (particularly for teachers). Community group support takes the form of: designing and implementing monitoring programs; help with funding applications; and advice on equipment, resources, information sources. Overall, the program promotes behaviour change and encourages groups to participate in local on-ground action projects, with the aim of building a sense of shared responsibility for the management of local environments.

Action Plan funding was provided to expand the Ribbons of Blue program of the Swan Region, as part of SCCP Action Plan community education and awareness. The intention was to extend the Ribbons of Blue program to ensure better support of school and community education programs linked to practical action for the environment of the Swan-Canning system.

Ribbons of Blue staff for the Swan-Canning region also relocated to the Swan Catchment Centre in 2002, which strengthened links to community groups and the NRM network.

4.10.2 Inputs

Between 1999 and 2004 the Action Plan provided $585,645 to the Ribbons of Blue program (Table 4.37), most of which ($499,111) funded 1.8 full time employee (FTE) equivalents (2 x 0.4 FTE coordinators in the Swan region, and 1.0 FTE Environmental Officer for the State Team). Additional money from NHT and Ribbons of Blue corporate funding supported 1.2 full time employees, to give a total of three employees: two regional coordinators working full time on the Swan-Canning region, and the Environmental Officer working part-time on the Swan-Canning region.

Table 4.37 Ribbons of Blue funding

Year	SCCP funds	Other funds
99-00	$111,878	Unknown[1]
00-01	$123,172	$133,206[2]
01-02	$117,398	$272,650[3]
02-03	$108,234	$141,842[4]
03-04	$124,963	$84,646[5]
TOTAL	**$585,645**	**>$632,344**

** CF =Corporate Funding , NHT = National Heritage Trust*
[1] Specifics unknown – part of larger fund for State Ribbons of Blue
[2] In part for Swan salary and operations
[3] NHT = $264,400 (1.2 FTE and operational?, managed by State team), CF = $8,250 (operational only)
[4] NHT = $133,592 (1.2 FTE and operational?, managed by State team), CF = $8,250 (operational only)
[5] NHT = $80,396 (1.2 FTE and operational?, managed by State team), CF = $4,250 (operational only)

4.10.3 Outputs and Outcomes

The Ribbons of Blue program is largely an education and awareness raising program. For monitoring activities, the focus is on physical and biological water quality, particularly macro-invertebrates. The same parameters are measured, but not all groups do all parameters. The choice of monitoring location is largely driven by community/catchment groups, although guided by Ribbons of Blue to some extent.

There is some monitoring of areas that have undergone integrated catchment management activities (eg revegetation): increases in macro-invertebrates have been noticed, but no change in water quality yet.

The Ribbons of Blue program monitors its own performance with key performance indicators that include the number of groups engaged in water quality monitoring, the number of community groups supported, the number of participants doing skills/professional development training (Table 4.38), and (more recently) the number of groups participating in 'Snapshot' events.

Table 4.38 Participation in Ribbons of Blue activities

Year	No. of schools/education institutions engaged	No. of community groups supported	No. of community and teacher training events
99-00	75	14	5
00-01	83	15	unknown
01-02	141	21	2**
02-03	115	36	unknown
03-04	80	20	12**

** 'Data to Action' workshops*
*** 9 skills training workshops for 90 community members and teachers participating in water quality monitoring and in designing monitoring programs, and 3 teacher professional development workshops*

'Snapshot' events involve schools and the community in annual snapshots of water quality across the region. A macro-invertebrate snapshot is held in September (first held in 2000) and Saltwatch in May (first held in 2002). Participation in the macro-invertebrate 'Snapshot' events has been as follows:

- 27 school groups in 1999/2000.
- 33 school groups in 2000/2001.
- 28 groups in 2001/2002.
- 30 groups in 2002/2003.
- 36 school and community groups in 2003/2004.

A 'Water Wonders' (nutrient-based water quality) Snapshot was added in 2002/2003, and held in partnership with the Department of Environment's Phytoplankton Ecology Unit and Aquatic Science Branch. It involved 7 catchment groups monitoring 32 drains/waterways leading into the Swan-Canning Estuary, and formed positive partnerships between Ribbons of Blue, the Phytoplankton Ecology Unit and Aquatic Science Branch. In 2003/2004, 36 groups participated.

Some additional key activities/highlights are as follows:

- 2000/2001
  - Two schools from Swan region were finalists in Waterwatch Australia's 'Race around the Catchment' competition, and one of these schools won.
- 2001/2002
  - The event 'AquaFest" was held in National Water Week to bring together and celebrate the work of school and community groups in the Swan Region.
  - The State Ribbons of Blue competition "Living Water" attracted over 500 entries across the State. Swan Region schools were winners in all 3 categories.

    - The Bayswater Integrated Catchment Management group won the National Waterwatch Competition (Community/Individual Category) "Race Around the Catchment".
    - Floatwell competition was run to paint two floatwells (gauging stations that house equipment to monitor water levels) at Kent Street Weir.
- 2002/2003
    - Joint projects with 12 Local Government Authorities and 5 environmental education programs.
    - Development of site reference file, which identifies water quality issues, management/restoration plans at specific sites to facilitate collaborative action projects.
- 2003/2004
    - Incorporation of Swan River Action Kit into the program.
    - Development, promotion and delivery of first Swan River Education Kit (linked to Swan River Action Kit) workshop, for teacher professional development.
    - Facilitation of Learning Circles by Ribbons of Blue coordinators, based on Swan River Action Kit.
    - Floatwell design competition for Garrett Road Bridge floatwell.
    - Integration of the Ribbons of Blue program with Scouts and Guides.

Documents produced and activities regularly undertaken as part of the Ribbons of Blue program include:

- Annual operational plans;
- Ribbons of Blue/Waterwatch Annual reports;
- Maintenance of WaterWatch database;
- Updating of the Swan region's comprehensive web page;
- Input to SCCP Action Plan annual reports;
- Quarterly progress reports;
- Newsletters;
- Feedback from workshops and professional development;
- 'Snapshot' reports; and
- Written media (educational/promotional), such as 'Waterfacts' sheets.

Evaluation of Statewide Ribbons of Blue program

In June 2003 a comprehensive evaluation was undertaken of the Statewide Ribbons of Blue, to address the following key evaluation questions:

- Review progress – what has been achieved?
- How well have the needs of the target audience met?
- How well does the program meet the objectives of its four key sponsors (which include the SCCP Action Plan)?
- How well do the program objectives reflect and articulate the objectives of the four key sponsors and the needs of its target audience?
- What is the best way to deliver the program in the future?

In general, most participants, staff, regional hosts, sponsors and stakeholders returned positive comments about the program's usefulness and benefits, saw value

in continuing it, and would like to see more funding and resources devoted to it. Regional coordinators were seen as a key factor contributing in the success or otherwise of the programs delivery. The findings can be summarised as follows:

- Achievements. There was sufficient evidence to indicate that the program had brought about a greater awareness of water quality and environmental issues, as well as in some case attitudinal changes and tangible positive changes in loca environmental action. This was gauged in terms of: respondee feedback; the expansion of the database; the increased number of projects and remedial action; increased numbers of sampling sites and participants; and extension into new regions.
- The needs of target audience were met reasonably well. Participants rated the program moderate to reasonably high.
- Objectives of the four key sponsors were met reasonably well. Participants rated the program moderate to reasonably high.
- Program objectives were viewed as appropriate (the broadness of objectives allowed flexibility to tailor program delivery across regions, which was viewed as a strength).
- Future improvements. Suggestions included further integration within the NRM structure, more streamlined and better enforced QA/QC procedures, more appropriate and standardised reporting and documentation, and improvements to the website

Constraints / Opportunities for improvement

Constraints

Constraints included staff turnover (and their training needs), and ability to meet the high (and increasing) demand. Large number of schools want intensive consecutive lessons, and some teachers find it difficult to adjust to not having a Regional Coordinator deliver all lessons/sessions.

Sub-regional and catchment groups were not always able to provide on-ground support to school groups. There were sometimes issues with the integrity of data collected by community and school groups.

Opportunities for improvement

Feedback from interviews with stakeholders and staff suggested that improvements could be achieved by integration of the delivery of all SCCP Action Plan communication and education programs. Presently, all education programs seem to stand alone and don't integrate. There is willingness to work together better with the other programs.

Valid suggestions for improvement are also listed above, from the Statewide evaluation of Ribbons of Blue.

4.10.4 Status of Action Plan recommendations

The Ribbons of Blue project addresses the following recommendations:

Recommendation 2.3 *Extend Ribbons of Blue program to ensure better support of school and community education programs linked to practical action for the Swan-Canning river environment*

Table 4.39 Status of Recommendations 1.1, 2.1 and 2.2

Rec'n No.	Status	Outputs & Outcomes
2.3	Achieved, ongoing.	**Outputs** 75–141 schools/groups engaged in Ribbons of Blue monitoring each year, 14–36 community groups supported each year, up to 12 workshops/year for community and teacher training. Numerous one day events attended by over150 school groups. A range of information sources and material produced. **Outcomes** ***Environmental*** Evaluation report on Statewide program reported a greater awareness of water quality and environmental issues, as well as in some case attitudinal changes and tangible positive changes in loca environmental action.

4.10.5 Gaps / Key issues identified by project staff

No gaps or key issues were identified for Ribbons of Blue.

4.10.6 Future plans by project staff

Future plans identified by Ribbons of Blue project staff are provided below Table 4.40).

Table 4.40 Future plans for Ribbons of Blue

Project	Future
Ribbons of Blue	• Potential to broaden Ribbons of Blue 'Rivercare' activities to include monitoring & evaluation component to address changing community & local government needs

4.10.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Ribbons of Blue website: www.wrc.wa.gov.au/ribbons/swan_region.html
- Stamfords, 2003. *Department of Environment. Ribbons of Blue/Waterwatch WA Evaluation*. Final Report, 15 September 2003. Stamfords Advisors Consultants, Perth, Western Australia.
- Interviews with Project Manager and Stakeholders (Swan Catchment Centre).

4.11 SCCP Project Management

4.11.1 Situation

The SCCP Project Management project provides support and management for the implementation of the Action Plan. The project entails project management of budgets for all SCCP projects, program coordination and support, and progress reporting.

This project also incorporates two other projects: Corporate Support and Holding Account (see Table 3.2). These projects are for internal funds management and implemented by officers funded through this project.

4.11.2 Inputs

Total expenditure on project management over the past five years has been $1,284,842, comprising $799,909 on SCCP Project Management (i.e. average of

~$160,000/year), plus $435,032 on Corporate Support and $49,901 on internal funds management/evaluation.

4.11.3 Outputs and Outcomes

General

This project is responsible for the overall management and coordination of the SCCP implementation. Key deliverables for this project (provided by the Project Manager) are outlined below:

- Program coordination;
- Recoup to WRC;
- Mid term review reporting required of all project managers;
- Mid-year CEO / Ministerial reporting;
- Executive support and reporting to Project Management Group, Senior Officers Group, River Management Committee;
- SCCP officer inductions;
- Support SCCP team and provide information and team building opportunities through 'Scoop on SCCP' and 'SCCP Big Day Out';
- Input to SCCP and SRT annual reports;
- Incorporation of new projects into SCCP;
- SRT approval to reconvene new SOG;
- Financial reporting and overseeing of Action Plan projects;
- Identification of project carryovers;
- Participate in & contract manage the SCCP evaluation.

Formal and financial agreements

It was recommended in the Action Plan that formal and financial agreements involving State government agencies and local governments were established to define responsibilities for implementation of the Action Plan and ICM.

In 1999/2000, the following program partnership agreements were established:

1. SRT and AGWEST has been signed and funds disbursed to provide support to AGWEST for development and implementation of farm management plans that ensure sustainable farm practices while reducing nutrient loss from farm activities. (*completed*)
2. SRT and EMRC to provide environmental officer support to Local Governments (*completed*).
3. SRT and Ministry for Planning for the Statutory Mechanisms project.

At this stage, there do not appear to have been any further formal agreements made with the external agencies. Numerous project partnerships are developed by project managers in order to implement projects.

SRT Board

The Program Manager of the Action Plan presently reports the progress of the Action Plan directly to the SRT Board via briefing notes, presentations at Board meetings, and annual reports.

Senior Officers Group

The establishment of a Senior Officers Group was recommended in the SCCP Action Plan in order to audit and manage agreements defining responsibilities for implementation of the Action Plan. At its inception in July 1998, the Senior Officers Group contained representatives from the following agencies:

- Water & Rivers Commission;
- Swan River Trust;
- Ministry for Planning;
- Agriculture Western Australia;
- Swan-Avon ICM Group;
- West Australian Municipal Association; and
- Department of Environmental Protection.

A representative from the Department of Conservation & Land Management was included in the group in April 1999.

The role of the Senior Officers Group was discussed at the inception meeting in July 1998. It was agreed that the Senior Officers Group would provide primary coordination of implementation activities. On-ground and individual projects would be managed by their respective responsible agencies (SOG, July 1998). The latest version of the Terms of Reference for this group is provided below (Table 4.41):

Table 4.41 Terms of Reference for Senior Officers Group

Terms of Reference
1. Coordinate and oversee the implementation of the Action Plan
2. Coordinate relevant agency projects and funding with the new initiatives of the Action Plan to ensure they meet the objectives of SCCP
3. Evaluate and report to government on implementation and outcome of the SCCP Action Plan
4. Coordinate Cabinet submissions for the financial resources required to implement the Action Plan
5. Negotiate inter-agency Memoranda of Understanding and where appropriate Partnership Agreements to ensure successful implementation of the Action Plan
6. Establish inter-agency project management for projects recommended in the Action Plan.
7. Act as the review group for the Comprehensive Management Plan and Implementation Strategy for the Swan and Canning Rivers Environmental Protection Policy 1998
8. Review role of the Senior Officers Groups an Terms of Reference after 2 years of establishment.

The SOG has held 14 meetings over the past five years. The first 10 meetings were held throughout 1998 and 1999; with subsequent meetings held in December 2001, November 2002, and in September and November 2003. It was identified in December 2001 that Senior Officers Group actions from its previous meeting were "no longer considered relevant" following the almost two year delay since the last meeting (SOG, December 2001).

Review of the meeting minutes reveals the following issues were addressed, and activities undertaken, by the Senior Officers Group between July 1998 and November 1999 (not a comprehensive list):

- Agency commitment to the implementation of the Action Plan were addressed;
- Letters requesting endorsement of the SCCP Action Plan were sent to stakeholder agency CEOs;
- The SCCP Implementation Plan was endorsed;

- Formats for MoUs between DEP and other agencies were developed; and
- Comment and review of the development of the draft Swan-Canning EPP Comprehensive Management Plan and Riverplan.

Two notable differences in meetings held from December 2001 onwards (i.e. following the two year delay in meeting) are:

- The distinct increase in SRT representation and decrease in external agency representation; and
- The change of focus in topics from executive / inter-agency agreements to SCCP project updates.

Review of the meeting minutes reveals that attendance by representatives at the SOG meetings was reasonably inconsistent, particularly by the Chair of SOG and representatives from external agencies.

It is worth noting that a new SOG is currently being established by the Swan River Trust.

River Management Committee

A River Management Committee (RMC) comprising representatives from the Swan River Trust, Water Corporation, Water & Rivers Commission, Department of Health and other river experts, was established by the Swan River Trust prior to commencement of the SCCP Action Plan implementation. In the early years of the Action Plan, reporting was to the River Management Committee. The RMC was intended to allow review of Action Plan activities in more detail (technical and strategic) than achievable at SRT Board meetings. The RMC met once a month: brief updates on different SCCP projects and issues were presented by the SCCP Project Manager and other project staff, and Action Plan progress was reviewed. The RMC then reported in turn to the full SRT Board.

A sample list of meeting agendas and/or minutes for the River Management Committee was supplied for the evaluation, not the full set of agendas, and so the actual frequency of meetings and topics covered could not be ascertained. The final meeting of the River Management Committee was August 2003, in favour of direct reporting of Action Plan progress to the full SRT Board.

Project Managers Group

A Project Managers Group was established to coordinate projects and activities to implement the Action Plan, and the inaugural meeting was held in November 1999. Project Managers Group meetings are generally held quarterly. Each project manager is required to produce a one page written report of project progress outlining any issues and possible solutions. These reports form the basis of the PMG agenda, and issues from these also formed part of the SOG agenda (from December 2001). Feedback from current Project Managers reveals that these meetings are a useful means of communication between the Project Managers of the different projects. However, they are **not used** to resolve particular project issues, better integrate activities of different projects, nor to review the achievements or direction of the SCCP program.

A fair proportion of SCCP project officers have suggested that their optional attendance at the Project Managers Group meetings would be a very useful way to find out more about what other SCCP activities are being undertaken outside of their own project. Project officers do not consider that information from the Project

Managers Group meetings is disseminated to project officers, and **there is a general feeling that project officers are not sufficiently informed about the SCCP**.

Table 4.42 Terms of Reference for Project Managers Group

Terms of Reference
1. Implement and report on the objectives of the Action Plan; including: - Milestone schedule development; - Integration of project milestones into management programs; - Assess needs for changes to SCCP Implementation Plan; and - Report on SCCP Implementation Plan budget and schedules. 2. Manage information and public information exchange. 3. Act as the coordinating group for the implementation of the Swan-Canning Environmental Protection Policy Comprehensive Management Plan (Riverplan). 4. Assess achievement of SCCP Action Plan objectives.

Interdepartmental Catchment Management Liaison Unit

The establishment of an Interdepartmental Catchment Management Liaison Unit was recommended (Action Plan Recommendation 3.3) to review land use controls and define agency responsibilities. To date, there has been no progress towards establishing such a unit.

SCCP evaluation

It was recommended in the SCCP Action Plan that the progress for implementation was to be audited after 5 years. Each year, a portion of SCCP funds has been allocated for an evaluation of the SCCP program after 5 years of implementation. The SCCP evaluation commenced in June 2004, and will be completed in March 2005. Note that funds for this project have been carried forward to 2004/05.

Corporate support

The Project Management team is responsible for managing the Corporate Support account as defined in the WRC–SRT (1999 to 2003) and Department of Environment–SRT (2003/2004) Service Agreements. This involves the annual contribution of funds to Water & Rivers Commission for additional overhead costs associated with SCCP implementation of SCCP. It does not address a specific action plan recommendation. A total of $435,032 has been spent on this management component over the five year period.

Financial and project management

The SCCP Project Team is responsible for the financial management of the overall program. Over the past five years, $17,486,847 has been spent implementing the program.

Key management activities include:

- Business planning for project out-years;
- Project management and budget management throughout each year;
- Recoup to WRC and payment of external projects;
- Carryovers management; and
- SRT annual reporting and Treasury reporting.

In order to coordinate and monitor implementation of the Action Plan, allocate resources and ensure that an agreed process is followed, an Implementation Plan was prepared in 1999 that outlines actions necessary to implement the specific recommendations and allocates responsibility to particularly agencies. The

Implementation Plan also covers coordination of community awareness and involvement programs and sets standards for accountability (SCCP Action Plan, 1999).

A draft implementation plan was first presented to the Senior Officers Group in 1998, endorsed in 1999, but was discontinued in 2000/2001. Implementation of the SCCP Action Plan is currently managed using the Project Management Systems Database. This database contains key project management information, such as: project description, justification, high level deliverables and budgets. Project tasks and progress can be tracked by the Project Management team, as well as accessed by SCCP project staff, using this database. Details of specific project tasks are maintained on the Department of Environment, rather than the Swan River Trust, Project Management System. However, the Project Management Team can access these more detailed deliverables and project progress, by accessing this related database.

The Project Management System (PMS) is the key electronic system used to manage the overall SCCP program. It contains fundamental information about the different SCCP projects, such as: Description; Justification; Deliverables; Budgets; Carryover; Project changes etc. The PMS is accessed, and information entered, by both Department of Environment and Swan River Trust staff. SCCP staff members have reported that improvement to the procedures, and level of quality assurance and quality control, are required to ensure that all data contained in the PMS are accurate and appropriately tracked. This is demonstrated by three different aspects highlighted by SCCP staff:

- If a key task or milestone was recorded on the system but had not been achieved, it could be deleted off the system with no formal process in place to require approval from the Swan River Trust (the change is archived with an explanation of the circumstances leading to its deletion, but this is not readily accessible).
- Information is entered in an 'ad hoc' manner and with no standardised approach/content between individual project managers.
- Information (with references to past dates etc) is sometimes reported incorrectly, and is reported in the wrong year (e.g. statement of financial agreements between agencies).

Nor can the current PMS link back to Action Plan recommendations.

The SCCP projects are currently only reviewed informally by the Project Manager on an annual basis, with occasional involvement by the SRT Environmental Manager. Three different approaches are currently used (which depends on the type of project being implemented) in reviewing proposals and allocating funds for projects from year to year, outlined below.

- **Approach 1:** Review of project proposals or memo submitted each year by the Project Manager. This is the approach largely applied for projects within Action Areas 3 and 4.
- **Approach 2:** Meeting held between SCCP Program Manager and Project Manager to discuss proposed project for the following year. OR
- **Approach 3:** Partnerships are signed, such as with community groups for Integrated Catchment Management.

Reporting and communication

Over the past five years, the SCCP Manager has provided reports and updates on the SCCP implementation to the Senior Officers Group, the River Management Committee and the SRT Board. Each month a brief update report on the SCCP Program is provided to the SRT. While it operated, reports were presented to the SRT's River Management Committee by the SCCP Program Manager and included as an agenda item for noting in the following SRT meeting. After the River Management Committee was discontinued, SCCP reports were provided directly to the SRT. In addition to these routine briefings, project specific presentations have been also been provided.

Reporting of the key achievements of individual projects is provided within the Project Management System, and with the submission of a (generally) 1–4 page annual report of achievements for each project that is used by the Communications Manager for production of the community-focused annual report brochures and input into the SRT Annual Report. The SCCP Project Management team provides input into the SRT Annual Report and the community-friendly SCCP Annual Report (and video). However, over the past five years, no detailed annual reports have been produced that address the core components of the Action Plan implementation with respect to achieving Action Plan recommendations or objectives (e.g. Description; Justification; Deliverables; Budgets; Outcomes; Outputs; Project changes etc.). Similarly, no detailed annual reports have been produced for the individual projects. Information on the overall program—and the majority of projects in Action Area 1 due to the nature of community-based projects—is highly diffuse. In contrast, the technically-based projects in Action Areas 3 and 4 have presented extensive amounts of discrete information (particularly on their outputs and outcomes) in scientific papers, technical reports, community newsletters etc.

For (at least) the past few years, regular meetings have been held between the SCCP Program Manager and SCCP staff (particularly the Project Managers) to discuss and review projects on an individual basis. The frequency of meetings generally ranges from monthly to quarterly, depending on the project and whether or not there are any issues to address.

The Project Management Team produces an electronic newsletter on SCCP activities called "Scoop on SCCP". Twenty-two newsletters have been produced over the past five years (Number of issues each year: 2000/2001 = 5; 2001/2002 = 11; 2002/2003 = 3; and 2003/2004 = 3).

A team building and cross program information exchange event, called the "SCCP Big Day Out" has been held annually to enable SCCP staff to meet and interact in an informal setting. Events such as canoeing and barbeques are organised annually, and are considered an important team building activity. These days are very popular with SCCP staff.

4.11.4 Status of Action Plan Recommendations

Status of Recommendations

Recommendation 3.1 *Establish formal and financial agreements involving State government agencies and local governments defining responsibilities for implementation of the Action Plan and ICM and audit progress after 5 years.*

Recommendation 3.2 *Establish a Senior Officers Group (SOG) to audit and manage agreements defining responsibilities for implementation of the Action Plan.*

Recommendation 3.3 *Establish a Project Managers Group that reports to the SOG to coordinate projects and activities to implement the Action Plan and an interdepartmental catchment management liaison unit to review land use controls and define agency responsibilities.*

Table 4.43 Status of recommendations 3.1, 3.2, & 3.3

Rec'n No.	Status	Outputs & Outcomes
3.1	Partly achieved	**Outputs** Three formal agreements involving government agencies and local governments defining responsibilities for implementation of the Action Plan and ICM were developed in 1999/00 (i.e. Department of Agriculture, EMRC & Department for Planning & Infrastructure). The formal agreement between DPI and SRT is non-functional. SCCP is currently being audited after five years of implementation via the SCCP Evaluation.
3.2	Partly achieved	**Outputs** A Senior Officers Group was established to audit and manage agreements defining responsibilities for implementation of the Action Plan. Achievements of the Senior Officers Group were limited, and did not manage inter-agency agreements throughout the five-year period. A new Senior Officers Group is currently being established.
3.3	Partly achieved	**Outputs** A Project Managers Group has been established. Issues from the Project Managers Group meetings were put on the agenda of the Senior Officers Group meetings This group has not reported to the Senior Officers Group for a number of years No interdepartmental catchment management liaison unit has been established to review land use controls and define agency responsibilities.

4.11.5 Gaps / Key issues identified by project staff

Gaps key issues identified by project staff are provided in Table 4.44.

Table 4.44 Gaps/key issues for SCCP Project Management

Project	Key Issues / Gaps
Project Management	• Partner involvement recognised at a sufficiently high level in their organisations • Project reporting focused on tasks, milestones expenditure with qualitative reporting on impact • Definition of standards eg. badging, publication approval - especially where SCCP is one of a number of contributors • Staff turnover/ induction limits SCCP awareness and cross project connections • Cost of successful continuing projects limits potential to commence new initiatives • Annual budget approval cycle has limited continuity especially in smaller organisations • Delays in statutory assignment of responsibility limiting uptake of capacity building projects • New projects and environmental response have taken time from program support

4.11.6 Future plans by project staff

Future plans identified by staff for SCCP Project Management are provided in Table 4.45.

Table 4.45 Future plans for SCCP Project Management

Project	Future
Project Management	• Partner sign on at the appropriate level (facilitated through SOG) • Outcome based service agreements with formalised reporting • System for storing outcomes • Monitoring and evaluation framework • Project tracking • Standards and process definition: - Publication approval - Badging

4.11.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Senior Officers Group meeting minutes.
- River Management Committee minutes 1998-2002.
- SCCP Project Managers Meeting Minutes.
- SCCP 5 year budget from PMS (electronic database).
- Assorted files: SCCP Program Management Tasks Sheet.
- SCCP Evaluation meeting notes.

4.12 LG NRM Policy Development

4.12.1 Situation

There are 28 Local Governments in the Swan-Canning catchment. It has been identified that these agencies have a key role to play in reducing the amount of nutrients to the Swan and Canning River systems, particularly in controlling developments, managing current land uses and putting in place provisions to manage future land uses.

The LG NRM Policy Development Project is aimed at improving the environmental performance of land use activities by addressing the development of BMP Policies and guidelines for Local Government. This project specifically targets all those Local Governments in the SCCP Priority Catchments on the eastern side of the Swan Coastal Plan, and includes:

- Town of Bassendean;
- City of Bayswater;
- City of Belmont;
- City of Swan;
- City of Armadale;
- City of Canning;
- Shire of Chittering;
- City of Gosnells;
- City of Melville;
- City of South Perth; and
- Town of Victoria Park.

The focus of the project is on policy and strategy development, with subsequent tasks related to the implementation of those policies and strategies. There are many policies/strategies relevant to land uses that are common to all Local Governments (e.g. Residential Development, Light Industry, Commercial etc) and some specific to particular land uses in designated areas (eg intensive stabling, annual horticulture). An anticipated outcome of this project is that participating Local Governments will improve their overall environmental management skills and abilities through a range of mechanisms such as policies, strategies, guidelines and checklists.

While this project focuses on Local Governments within this region, the program aims to establish a product that can be utilised by all councils with the Swan-Canning catchment.

4.12.2 Inputs

The Eastern Metropolitan Regional Council (EMRC) Environmental Service expressed an interest in delivering a number of SCCP Action Plan recommendations, including Recommendation 3.4 which related mainly to Local Governments in the Eastern Swan Coastal Plain, which included both member Councils of the EMRC and non-member Councils. The EMRC has received $571,825 SCCP funding over the past five years to undertake this project. The funding is largely (about two thirds) for salary costs. Additional external funding of $34,000 has been obtained to project manage two other projects, discussed below.

4.12.3 Outputs and Outcomes

LG NRM Policy Manual

The outputs of the LG NRM Policy Manual project have followed a logical series of key milestones over the past five years. The key outputs and milestones associated with the project are:

- Completion of the Policy Inventory (Mar 2001);
- Preparation of Draft Policy Development Program (July 2001);
- Completion of Council Reports/Presentations (July-September 2001);
- Completion of Revised Policy Development Program (August 2000); and
- Preparation of Policies, Strategies, Guidelines and Checklists (Ongoing, NRM Manual launched Nov 2002, including production of CD).

EMRC considered that it was more appropriate for the local governments to have issue-specific strategies adopted through BMPs provided as guidelines and checklists, rather than producing a big strategy that no-one actually adopts or uses. In 2002, the Local Government NRM Policy Manual was published and distributed to Local Governments and other agencies. The guidelines are for use by Local Government officers in urban, regional and rural settings in the following areas:

- **Land use planning** – the strategic and statutory planning system; Rural living; Horticulture; Animal Industries; Urban; Commercial; Legislative & Advisory Roles of Agencies;
- **Urban design** – the design of the public domain and infrastructure: Water sensitive urban design' and Streetscaping & Landscaping;
- **Land management** – council operations and development of sites: Foreshores, Wetlands; Bushland; and Recreation (not yet completed);

- **Stormwater treatment and flow management structural measures:** (Best Management Practice Guidelines); and
- **Source controls**: Best management practices for Nutrient and irrigation management; Erosion & sediment control; Cleaner production and pollution prevention; Waste management; and De-watering.
- **Education and awareness** through media, education programs and business and community involvement.

The following topics have been identified by project staff for the development of policies and guidelines by the NRM project: Foreshore management; Turf nutrient and irrigation management; Community awareness; Waste management; Recreation; De-watering; Bushland and wetland management; Horticulture; and Small lot rural living. Other suggestions for useful policy topics made by council officers and officers from other agencies in March 2004 include: Streetscaping and development; Biodiversity; Acid sulphate soils in development and environmentally sensitive areas; as well as land contamination policy to integrate into town planning schemes; Extractive industry – clay, gravel, sand; Mosquito control in salt marsh areas; Purchasing – procurement policies – waste, efficiency and green purchasing; and Volunteering, awareness raising, community education (Australian Community Research, 2004).

A qualitative evaluation of the NRM Policy Development Project was undertaken in March 2004 (Australian Community Research, 2004). This evaluation drew information from two elements: A survey of 27 people (16 council officers, 3 councillors and 8 people from other organisations) who hold NRM manuals, receive newsletters, or are involved through related organisations; and a focus group which was conducted and invitations were sent to manual holders, and involved Councillors, and officers from rural and urban councils.

Key conclusions drawn from this evaluation on awareness and impact of the LG NRM manual include:

- Two-thirds of Council officers said that the NRM project has assisted in increasing the capacity of their Council in NRM to protect the Swan and Canning Rivers;
- The NRM policies are being used by Local Governments and other organisations;

Council officers and people from other organisations were asked to indicate which of the NRM policies or guidelines they had used, rate its usefulness (out of 10) and provide general comment. The responses provided are summarised in Table 4.46.

Table 4.46 Summary of evaluation results on the usefulness and adoption of the LG NRM Manual by local governments

Policy/ Guideline	Use of policies	Type of use	Usefulness rating	No. councils adopted policy	Comment
Guidelines for Animal Based Industries	12% council 12% other	Information, assessing development applications	8/10 (council) 8/10 (other)	0	Right amount of detail; Not implemented as relevant, not a priority, or insufficient time or resource to address it
Stormwater Best Practice	41% council 50% other	Information, policy development,	8/10 (council) 8/10 (other)	1	Some felt right amount of detail, others would like more detail

Policy/ Guideline	Use of policies	Type of use	Usefulness rating	No. councils adopted policy	Comment
Management Guidelines		assessing development applications			
Erosion and sediment control	26% council 25% other	Information, policy development, assessing development applications	7/10 (council) 8/10 (other)	1	One officer suggested to add more detail
Cleaner Production and Pollution Prevention	22% council 12% other	Information, policy development	6/10 (council) 8/10 (other)	1	One officer suggested to add more detail; and expressed frustration at lack of organisation within council
Water sensitive Urban Design	37% council; 38% other	Information, policy development, assessing development applications	7/10 (council) 7/10 (other)	1	Suggested topics to add: issues with landscaping, streetscapes & biodiversity; acid sulphate soils; mosquito control; Procurement policies; community education
NRM Newsletter	Most respondents receive newsletter	Information	6/10 (council) 7/10 (other) 9/10 (councillors)	Not relevant	Make it easy & practical to use; Include procedural information on timeframes & policy from other levels of government; Provide some examples of successful results Well written & contains interesting material

Overall, the majority of Council officers (64%) felt that the NRM Project either met or exceeded their expectations. Two councillors who responded felt that it had not yet met expectations, and want to see more achieved through the NRM project. Among those from other organisations who felt able to provide a rating, a total of 80% felt it had either met or exceeded their expectations.

The following constraints were identified as impacting on the implementation of the NRM policies and guidelines by local governments:

- The lack of a statutory basis for water sensitive urban design and limits of a BMP voluntary lead approach to urban development and drainage design (eg Water Corporation) has been a barrier for implementation by Local Government (pers comm., Local Government representative).
- The lack of regulation for pollution and stormwater quality; limited local data on performance of BMPs; institutional fragmentation for urban development, environmental and water management; and resistance from development industry to implement water sensitive urban design (sub-consultants report, 2002/2003).
- The length of time to undertake (Town Planning) scheme reviews; the amount of political "push" required; officers becoming daunted; and resistance from engineering and planning departments.

This has resulted in some refocussing of the NRM project to address including the proposed formation of a Project reference committee/group.

Project staff considers that the initial intent of this project has essentially been achieved; particularly in addressing high priority issues relevant to local governments. As such, the project is now focusing on working through the lower

priority issues. EMRC is keen to concentrate efforts on training and local government engagement, but SRT would firstly needs to agree providing the training resource. The necessary capacity building and cultural change are long term commitments of 5–10 years.

TurfSustain Manual

The EMRC was also provided with $14,000 by Lotteries to project manage the compilation and production of a practical guide to sustainable turf management, called 'TurfSustain: A Guide to Turf Management in Western Australia'. The EMRC officers launched the Turf Sustain Handbook, and drafted policy and guidelines for landscaping with local plants, small rural properties, and foreshore management. The manual contains current information and 20 proven case studies on all aspects of turf management including grass and soil types, fertilizer, irrigation, mowing, renovation, weeds and pesticides. Using industry best practice, the guide is a useful resource for turf practitioners to assist in making informed decisions on turf management.

Turf Sustain is an important link between the turf industry, research institutions and government agencies responsible for protecting the environment. It is presented as an easily accessible 'hands on' field reference. The manual contains information on soils, water, and turf species of the Coastal Plain of WA.

A Turfs Up Seminar was held with Swan Catchment Centre in February 2002.

EMRC newsletter and other outputs

The EMRC has undertaken a number of additional projects and responsibilities as part of the LG NRM Project, as outlined below.

- Production of Local Government NRM Project Quarterly Newsletter, with the first issue produced in January 2001;
- Range of presentations on LG NRM Manual and Water Sensitive Urban Design at local and national level conferences and workshops over past 5 years;
- Draft Communication Plan developed and implemented;
- Policy Outcomes Defined for priority issues;
- Sub-consultants survey report on Barriers to uptake of Water Sensitive Urban Design completed;
- Agreement reached with stakeholders to trial Stormwater Management Plan process in Canning Plains;
- Work Experience officer started research for Foreshore Management Guidelines;
- Submissions following review of: the Swan River Trust (Mar 02); the Model Scheme Text by Department for Planning & Infrastructure (June 02); Department of Environment Stormwater Manual (commenced 2002/2003) and draft Stormwater Position Paper; the Swan Region Natural Resource Management Strategy; and Swan Industry Project Strategic Plan;
- Stormwater Quality Management Forum held at EMRC (June 03); and
- Project Management of Irrigation Efficiency Benchmarking Project; Canning Plains Catchment Management Plan Project ($20,000 provided by Department of Environment).

4.12.4 Status of Action Plan Recommendations

The LG NRM Policy Development project addresses the following recommendation:

Recommendation 3.4 *Financially support the appointment of environmental officers to formulate and prepare local government natural resource management strategies and policies.*

Table 4.47 Status of recommendation 3.4

Rec'n No.	Status	Outputs & Outcomes
3.4	Achieved	**Outputs** The SRT has provided $571,825 financial support to the EMRC for this project, which included funding for 2 FTE positions from 2000/01 to 2003/04 inclusive. The nature of the appointment of environmental officers for this project was modified at the outset of the project, with a proposal by EMRC to appoint environmental officers at a Regional Council, rather than Local Council level. This was an alternative proposal approved by the SRT, deemed to be more effective than part-time funding support to officers within different councils. Local government strategies, policies, guidelines and checklists have been formulated, prepared and collated into a Local Government NRM Manual. **Outcomes** *Social:* Increased awareness of NRM issues by council officers and councils; Local governments and other agencies are using the NRM manual for information purposes. One council has adopted the main guidelines from the NRM manual *Environmental:* The NRM project has assisted in increasing the capacity of councils in NRM to protect the Swan and Canning Rivers; Anecdotal evidence that nutrient inputs to waterways would be reduced following implementation of the guidelines in the NRM manual, however environmental data has not been collected.

4.12.5 Gaps / Key issues identified by project staff

Gaps / key issues identified by project staff for Local Government NRM Policy Development project are provided in Table 4.48.

Table 4.48 Gaps/key issues for Local Government NRM Policy Development project

Project	Key Issues / Gaps
Local Government NRM Policy Development	• Adoption of guidelines etc in Local Government NRM Policy Manual has been low, despite their high rating of usefulness. Additional guidance/involvement by Department for Planning & Infrastructure would have assisted with its adoption by local governments.

4.12.6 Future plans by project staff

Future plans identified by project staff for Local Government NRM Policy Development are provided below (Table 4.49).

Table 4.49 Future plans for Local Government NRM Policy Development project

Project	Future
Local Government NRM Policy Development	• Complete remaining sections of the LG NRM manual and update existing (improve the SRT publication approval process); • Greater engagement by Local Government in NRM needed (in terms of governance, political and corporate support), including: Broader LG representation in NRM governance structures; Better integration and clarity of roles for State agencies/Local Government; • Capacity building for staff and councillors, eg multi-discipline approaches (eg WSD); • New statutory and institutional framework (EPP-River Plan, Swan Catchment Council, SPPs, the Swan River Trust Act/Drainage reform)?

4.12.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Eastern Metropolitan Regional Council. 2002. *Local Government Natural Resource Management Policy Manual*. ISBN 0-9750016-0-4, EMRC 2002.
- Australian Community Research. 2004. *Natural Resource Management NRM Policy Development Project Evaluation, March 2004*. 36 pp.
- EMRC. 2000. Swan-Canning Cleanup Program. Local Government Natural Resource Management (NRM) Policy Development Project Brief.
- EMRC NRM Newsletters. Issues 13, 14 & 15.

5. Action Area 2: Improve planning and land-use management to reduce nutrient inputs

5.1 Background

The Action Plan advocates a partnership between the State and local governments, the public and the business community to improve planning and land use management to meet the goals of the Action Plan. This entails State and local government examining and revising statutory tools such as regulations, town planning schemes and State policies, and the community participating in the review and amendment of such tools, and in other public statutory process such as environmental assessments. Other means to improve land management practices and restore degraded land that are identified by the Action Plan include the use of Best Management Practices (BMPs) (in agriculture and industry), economic incentives (tax incentives, buying back land, differential tax rates for sustainable land uses), the development of management agreements with landholders (Government and landholders both contributing resources to improve land use), and licensing of drains.

5.2 Action Plan recommendations

Action Plan recommendations for Action Area 2 are listed in Table 5.1 along with the main Action Plan projects developed to address them. Table 5.1 also lists the section of this document where each project is discussed.

Table 5.1 Action Area 2: recommendations and Action Plan projects

Rec. No.	Recommendation	Action Plan project	Document section
4.1	Incorporate Water Sensitive Design and nutrient source reduction principles and goals of the Swan-Canning Clean Up Program and the Swan-Canning Environmental Protection Policy, in regional planning and town planning schemes and scheme amendments to ensure that proposed developments are consistent with these principles and goals	53102 Statutory mechanisms	5.3
4.2	Prepare a Statement of Planning Policy for the Swan-Canning coastal catchment that incorporates the principles and goals of the Action Plan and that is also complementary to the Swan-Canning Environmental Protection Policy; and establish a group to review land-use tables in town planning schemes to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them.	& 53108 Swan-Canning EPP	& 5.4
4.3	Improve land-use controls for intensive agriculture such as horticulture that are not adequately addressed by present legislation or planning policy to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them	53102 Statutory mechanisms	5.3
5.1	Establish a Best Management Practice (BMP) working group to evaluate existing BMPs and prepare a program to develop and implement BMPs to achieve SCCP objectives	53088 Swan-Canning Industry Survey 69008 Light Industry Project 53120 BMPs Swan-Canning	5.5 5.6 5.6

Rec. No.	Recommendation	Action Plan project	Document section
5.2	Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management.	53088 Swan-Canning Industry Survey 69008 Light Industry Project 53120 BMPs Swan-Canning (also 53125 Water quality protection notes for BMPs)	5.5 5.6 5.6 See Section 4.9
6.1	Evaluate the establishment of and mechanism for financing a land acquisition fund to buy back sensitive or degraded land and change current land-uses	No project.	n/a
6.2	Develop foreshore management agreements with landowners to reduce nutrient losses to watercourses, through fencing and rehabilitation of foreshores and erosion control with initial priority given to Ellen Brook and Southern-Wungong River	No project.	n/a
6.3	Provide State and local government incentives to encourage catchment rehabilitation by rewarding landowners for adopting practices that reduce nutrient inputs to the river	No project.	n/a
6.4	Investigate licensing for drains discharging into the Swan-Canning rivers, as a tool for controlling nutrient inputs	53104 Drain Licensing	5.7

5.3 Statutory mechanisms

5.3.1 Situation

The aim of this project is to identify how and what statutory mechanisms (including regulations, by-laws, town planning schemes and statements of planning policy) can be used to modify existing and future land-use practices, and prevent or relocate polluting activities within the Swan-Canning catchment. This includes (but is not necessarily limited to):

- Incorporation of water sensitive design and nutrient source reduction principles and goals in the planning of proposed developments (Recommendation 4.1);
- Preparation of a statement of planning policy for the Swan-Canning coastal catchment that incorporates SCCP principles and goals; and identifies and phases out high nutrient land-use activities (Recommendation 4.2); and
- Improvement of land-use controls for high nutrient intensive agriculture not adequately addressed by present legislation of planning policy (Recommendation 4.3).

5.3.2 Inputs

In 1999/2000, the SRT allocated $110,000 to this project, but this remained unspent because a partnership agreement was not signed until March 2001. In 2000/2001 the SRT budgeted $60,000, of which $54,638 was spent ($54,545 provided to the Ministry for Planning, now DPI).

In 2004, the DPI spent $7,000 (with prior approval from the SRT) to run a Water Sensitive Urban Design workshop (discussed below).

5.3.3 Outputs and Outcomes

Initial discussion of the objectives of the Statutory Mechanisms project was undertaken between the Department for Planning & Infrastructure and the SCCP Project Manager in 1999/2000. A draft project brief was prepared, and a partnership agreement established, for the project in 2000/2001. Despite the establishment of this agreement, work on this project has largely been undertaken through activities external to the SCCP over the past five years.

The DPI has advised that the fundamental intent of some of the planning and land-use recommendations can not be achieved; explaining their position in the project pro formas for this evaluation.

DPI: *"The planning system only deals with applications and proposals for new land uses. Town Planning Schemes cannot be used to retrospectively "disallow" an approved use within the appropriate zone over large areas of land without serious legal consequences and issues of compensation being triggered. DPI cannot deliver the desired outcomes of the current recommendations, and has suggested that the purpose and wording of the recommendations need to be reviewed and the whole range of implementation options investigated. The incorporation of the water sensitive urban design into the planning approval system can be achieved.."* (SCCP evaluation pro forma information).

Despite the barriers identified above, a number of achievements towards implementing Recommendation 4.1 have been made by the DPI. These achievements have been made through several complementary government programs and initiatives dealing with incorporating water sensitive urban design into the land use planning system (external to the SCCP).

Below is a summary of their achievements (taken directly from the information presented by the DPI at the SCCP Evaluation Forum).

Water Resources Statement of Planning Policy (SPP) and water quality and quantity targets

The recently released draft Water Resources SPP identifies policy measures relating to total water cycle management and integrated urban water management. It contains a Schedule 4, which outlines the objectives and principles of water sensitive urban design.

A key element in achieving best practice urban water management is the identification of appropriate targets and design objectives. The specification of targets and design objectives gives urban planners, hydrologists and engineers something to design to, as without this guidance, the desired end-state is not known. The importance of targets is recognised in the draft Water Resources SPP, which states that "Derivation of water quality targets is key to the achievement of many aspects of this policy". [DPI has had issues addressing the SCCP water quality targets, as they are an "end state" target for the overall Swan Canning estuary, and are not clearly related to the quality of incoming drainage from urban areas].

The DoE is coordinating a consultative process to evaluate proposed design criteria for stormwater management in Western Australia. Draft design criteria are currently

being reviewed by the Environmental Standards and Criteria Committee of key stakeholders.

Two workshops were coordinated by the Water Corporation to identify appropriate modelling techniques, including stormwater targets and design objectives, for district plans. The outcomes of these workshops are being considered by the Environmental Standards and Criteria Committee.

Liveable Neighbourhoods

The WAPC recently released the draft Liveable Neighbourhoods Edition 3 operational policy for public comment. Liveable Neighbourhoods is an operational policy that addresses both strategic and operational aspects of structure planning, subdivision and development in order to achieve a more sustainable community. It applies generally in greenfield or large infill sites where 2 or more lots are proposed to be created. Liveable Neighbourhoods Edition 3 contains eight elements that address key areas of urban planning. Element 5 is Urban Water Management. This Element promotes the integration of urban water management measures into the urban form and public open space.

The review of Liveable Neighbourhoods Edition 2 involved a significant consultation program including a series of workshops to identify and address key issues. This process highlighted the need to provide more detailed guidance on how to achieve urban water management outcomes through the planning process. The revised Element 5 has been updated to reflect the core objectives and design principles of integrated urban water management, consistent with the draft Water Resources SPP. This includes an increased emphasis on protecting water quality, managing water quantity (including the addition of a guide for stormwater infrastructure requirements as a function of road hierarchy), integrating stormwater treatment into the landscape and water conservation through reducing the reliance on potable water sources.

Element 5 describes many methods of integrating urban water management into urban areas through design. It identifies the need for preparation of urban water management strategies and the use of best planning practices (BPPs). It also refers to the DoE's Stormwater Management Manual (2004) as a key technical resource. It is considered, however, that further guidance in the form of diagrams would improve understanding and use of BPPs. The addition of illustrations of BPPs should be explored through the public consultation phase.

Stormwater Management Manual for Western Australia

The DoE is in the process of developing a manual for stormwater management. The Manual is a revised version of 2 earlier documents: "Planning and Management Guidelines for Water Sensitive Urban (Residential) Design", State Planning Commission, 1994; and "A Manual for Managing Urban Stormwater Quality in Western Australia", WRC, 1998. The Stormwater Management Manual for Western Australia is referenced in both Liveable Neighbourhoods and the Water Resources SPP.

This manual has been released in an incomplete form, as chapters are released as they are finalised. The chapters currently available are the introductory and policy chapters (Ch 1: Introduction & Ch 2: Understanding the context) and Ch 8: Education and awareness for stormwater management. The remaining chapters are:

Chapter 3: Best planning practice for stormwater management;

Chapter 4: Water sensitive urban design;
Chapter 5: Stormwater management plans;
Chapter 6: Retrofitting;
Chapter 7: Non-structural controls;
Chapter 9: Structural controls;
Chapter 10: Performance monitoring and evaluation;
Chapter 11: Implementation; and
Chapter 12: Further information.

The DoE sees this Manual as a tool that demonstrates an integrated approach to better stormwater management for planners, designers and engineers to improve implementation of WSUD as it relates to stormwater.

SCCP funded activities

In March 2004, the DPI held a stakeholder workshop to address issues of Water Sensitive Urban Design and the Development Approval Process. A portion ($7,000) of SCCP funding was used to sponsor this workshop. Following the workshop, a report was prepared, entitled "Water Sensitive Urban Design and the Development Approval Process – Identification of Issues and Potential Solutions for Better Implementation". The DPI has suggested that the Drainage Management Forum currently established to investigate drainage management in the Swan-Canning catchment may be another vehicle to assist in the achievement of the desired outcomes.

5.3.4 Status of Action Plan Recommendations

The Statutory Mechanisms project addresses the following recommendations:

Recommendation 4.1 *Incorporate water-sensitive design and nutrient source reduction principles and goals of the Swan-Canning Cleanup Program and the Swan-Canning Environmental Protection Policy, in regional planning and town planning schemes and scheme amendments to ensure that proposed developments are consistent with these principles and goals.*

Recommendation 4.2 *Prepare a statement of planning policy for the Swan-Canning coastal catchment that incorporates the principles and goals of the Action Plan and that is also complementary to the Swan-Canning Environmental Protection Policy; and establish a group to review land-use tables in town planning schemes to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them.*

Recommendation 4.3 *Improve land-use controls for intensive agriculture such as horticulture that are not adequately addressed by present legislation or planning policy to identify and phase out high-nutrient land-use activities that are unable to meet nutrient reduction objectives and determine what steps are required to eliminate or manage them.*

Table 5.2 Status of Recommendations 4.1, 4.2, & 4.3

Rec'n No.	Status	Outputs & Outcomes
4.1	Substantial progress made.	**Output** Progression of several State Government programs that address WSUD and nutrient source reduction principles at the State level, rather than Action Plan-specific exercises. A stakeholder workshop (and subsequent report produced) addressing issues of Water Sensitive Urban Design and the Development Approvals process.
4.2	Not achieved	DPI claims that this recommendation can not be achieved.
4.3	Not achieved	DPI claims that this recommendation can not be achieved.

5.3.5 Gaps / Key issues identified by project staff

The DPI has identified budget, staff resources, intent and definition of project objectives as constraints to this project; in addition to the fundamental issue that DPI claims these recommendations can not be achieved.

Recommendation 4.2
At the Evaluation Forum, the presenting DPI officer highlighted conceptually Recommendation 4.2 makes some sense. It is a great idea to manage, phase out or eliminate the high nutrient land use activities unable to meet reduction objectives. How to do it and have a rational scientific basis for determining those land uses to be phased out or eliminated (over the 28 local authorities and 31 sub-catchments that comprise the total Swan Canning system) is another matter.

The DPI considers it is problematic to prepare an SPP for the total Swan Canning catchment that incorporates the principles and goals of the SCCP Action Plan as:

- There is a lack of scientific information to prove the link between cause (individual land use) and effect (high nutrient load in Swan Canning system).
- The catchment characteristics are too varied.

Recommendation 4.3
This recommendation relates to improving land use controls for existing and future intensive agriculture and refers to phasing out or eliminating those unable to meet nutrient targets, or managing uses to meet targets.

The DPI provided the comment on this recommendation at the Evaluation Forum.

DPI: Existing uses have legal rights to operate under a Town Planning Scheme (TPS). Often rural zones in TPS do not specify single land use activities (e.g. grazing, fertiliser use etc) in detail. The Planning system has limited control on existing uses. Therefore this recommendation may be more appropriately addressed by education and promotion of best management practices in relation to fertiliser application methods, livestock management etc), rather than Planning.

It is worth noting that there have been some long-term issues associated with the development and implementation of this Planning project. Review of the SCCP Taskforce meeting minutes reveals that the intent of these recommendations was not appropriate. The Senior Officers Group identified inconsistencies with planning approaches being undertaken by the Department for Planning & Infrastructure and the Water & Rivers Commission in 2001. The group recommended at this time that a meeting be held for all planners of DEWCP; and recommended that the project be

terminated and that a proposal for alternative action to be taken will be prepared, however this did not eventuate. A follow up meeting was held between WRC, DPI and SRT following the SOG meeting in February 2002. From this meeting there were recommendations to re-scope the project; and the SRT engaged Hamilton Integrated Management Pty Ltd to prepare a draft project brief to review the SCCP planning recommendations. The brief has not been advertised but provides a detailed scoping document of the requirements for comprehensively incorporating natural resources management approaches into the land use planning system. The matter remained unresolved and was brought back to the SOG at its meeting in the following year.

A summary of the Key Issues/Gaps presented at the Forum by SCCP staff for Action Area 2 is provided in Table 5.3. Detailed coverage of the Key Issues/Gaps for this project is provided in the Evaluation Forum Report.

Table 5.3 Summary of Key Issues / Gaps presented for Action Area 2 projects

Project	Key Issues / Gaps
Statutory Mechanisms	• Insufficient scientific information available on water quality targets and objectives for management/planning purposes • No agreed scope of works with the SRT • A broad level SPP can't deal with all the uncertainties and variations in specific land-use activities, existing uses and sub catchment characteristics. • Problems with wording and intent of the Recommendation 4.2.

5.3.6 Future plans by project staff

Future plans for this project were not provided.

5.3.7 Sources of information

- SCCP evaluation pro formas: 1999/2000; 2000/2001; 2001/2002; 2002/2003; 2003/2004.
- SCCP 5 year budget from PMS (electronic file).
- Meeting with project staff.
- Evaluation Forum presentation notes on Statutory Mechanism (full text presented in Appendix B, Evaluation Forum Report).

5.4 Swan EPP

Please note: Information on this project is provided as background information only. It is not to be assessed as part of the SCCP evaluation.

5.4.1 Situation

In July 1998, the State Government gazetted an EPP for the Swan and Canning rivers, the Environmental Protection (Swan and Canning Rivers) Policy 1998. The purpose of the EPP was (and still is), to restore, enhance, preserve and protect the environmental quality, ecological processes and ecological integrity of the Swan and Canning Rivers. The EPP was prepared by the SRT and the Department of Environmental Protection during the same period as the SCCP Task Force was developing the Action Plan. The Action Plan was made complementary to the EPP; and recognised the requirement for a Comprehensive Management Plan to be developed by the Environmental Protection Authority and the SRT to provide an implementation framework for the EPP.

The Action Plan, the Swan-Canning EPP and Comprehensive Management Plan, and a Statement of Planning Policy for the Swan-Canning system were anticipated to together provide the management and statutory basis for cleaning up the system and ensuring its long-term health.

5.4.2 Inputs

The SRT provided a total of $74,592 SCCP funding over two years to support the development of a Comprehensive Management Plan; with $69,589 being funded in 1999/2000; and $5003 in 2000/2001.

5.4.3 Outputs and Outcomes

Comprehensive Management Plan

A Comprehensive Management Plan was prepared, and stakeholder consultation undertaken, by the Swan River Trust in 1999, under delegation from the Environmental Protection Authority. The Comprehensive Management Plan was presented to the Minister by 1 December 1999 to meet a statutory requirement under the EPP. However, the Environmental Protection Authority recommended that the Comprehensive Management Plan be revised prior to release for public comment. The Comprehensive Management Plan was not released for public comment. This project was then transferred to the Environmental Protection Agency, and SCCP was no longer involved in the development of this plan.

River Plan

Since the draft Comprehensive Management Plan was submitted to the Minister, the following management initiatives have been developed. The Swan River Trust began implementing the Swan-Canning Cleanup Program and the Swan Catchment Council and Avon Catchment Council drafted their Natural Resource Management Strategies for the Swan and Avon Regions. Riverplan builds on these activities and provides a framework for the coordinated environmental management of the Swan and Canning rivers together with an Implementation Strategy for the EPP.

5.4.4 Status of Action Plan Recommendations

Recommendations 4.1 and 4.2 proposed adoption of land use planning legislation to protect the Swan-Canning that was contingent on the Swan-Canning EPP (presented in Section 5.3 Statutory Planning). This project was not implemented to address any specific recommendation of the Action Plan.

5.4.5 Sources of Information

- SCCP Evaluation Project Pro Forma: 1999/2000; 2000/2001.
- Government of Western Australia. 2004. *Riverplan: An environmental management framework for the Swan and Canning Rivers. Comprehensive Management Plan and Implementation Strategy for the Environmental Protection (Swan and Canning Rivers) Policy 1988*. August 2004. ISBN 1920947639.

5.5 Swan-Canning Industry Survey and Pollution Prevention

5.5.1 Situation

During the development of the SCCP, it was identified that there was a distinct lack of information and projects to assist and encourage light industry, small businesses

and local government to address point and diffuse sources of pollution. The Swan-Canning Industry Survey and Pollution Prevention project addressed the environmental impacts from industry and small business on the Swan-Canning system, such as nutrient and contaminant runoff during the first two years of the SCCP Action Plan implementation.

The Swan-Canning Industry Survey Project was split into two projects in December 1999. A project entitled "Non Prescribed Industry Management" (also known as the Light Industry Project) was initiated (and managed by Water and Rivers Commission) to engage industry groups and provide training; as well as continue to coordinate the Swan-Canning Industry Working Group. A second project run by the SRT entitled "BMPs for Swan-Canning" was established to focus on other land practices such as yacht clubs, air conditioner wastewater and bait worm digging policy that had not been investigated before. These two related projects are addressed under the section "Best Management Practices (BMPs) Swan-Canning, including Light Industry Project".

5.5.2 Inputs

This project was funded by $50,543 from SCCP and $100,000 from Coasts and Clean Seas. This project works with industry groups and local government to establish best management practices.

5.5.3 Outputs and Outcomes

Swan-Canning Industry Survey Final Report

An extensive pilot study of light industrial premises was conducted in 1997, as part of the Swan-Canning Cleanup Program (prior to SCCP Action Plan implementation). Surveys were undertaken by local government Environmental Health Officers, Water and Rivers Commission and Swan River Trust officers; and involved the on-site inspection and assessment of more than 550 light industrial premises to determine what practices were in place for chemical storage and bunding, waste management, wastewater management, stormwater management, emergency management and general management practices. The survey also assessed the extent to which current industrial practices pose a threat of pollutants entering the Swan-Canning river system.

The Swan-Canning Industry Working Group (initially called the Industrial Wastes Audit Task Group) was established in 1996 as part of the SCCP. The Group was formed to address the issue of point and diffuse-source pollutants entering the Swan-Canning system from non-prescribed industrial premises. The approach of this group was to involve as many stakeholders as possible throughout the pilot survey and work together to identify and solve issues. The group began with representatives from four local governments, Water & Rivers Commission and the Swan River Trust. Four more local governments became involved at a later stage, along with the Department of Environmental Protection. Key industry organisations helped in promoting the project and distributing information to members. This group continued its involvement with implementation of the Action Plan (see section "Best Management Practices (BMPs) Swan-Canning, including Light Industry Project").

This Swan-Canning Industry Survey and Pollution Prevention project was continued into the SCCP implementation phase. A draft report on the findings of these surveys was released for public submissions in December 1999, and the final report published in August 2000. The Swan-Canning Industry Survey documented poor environmental management performance of many industries that present a pollution

threat to the river and groundwater on the sandy soils of the Swan coastal plain. The project takes a proactive approach to the problem by developing partnerships with local government to undertake industrial audits and take up the responsibility of pollution prevention at this level. In dealing with a broad range of industrial pollutants it complements the nutrient focus of the SCCP and is an element in the implementation of the Swan-Canning EPP.

Six main factors were identified as contributing to the environmental risk of a light industrial operation, including:

- Chemical type, storage method and bunding;
- Waste management;
- Wastewater management;
- Stormwater management;
- Emergency management; and
- Management practices.

Five key recommendations (with 18 sub-recommendations) of this report were accepted by the Swan River Trust, and provided a two-year strategy to reduce the pollution risk of light industries in the Swan-Canning catchment.

These 5 key recommendations identified were:

- Develop a framework to facilitate local government management of local light industry pollution issues;
- Develop and implement a communication and marketing strategy to support the communication plan for the Swan-Canning Cleanup Program Action Plan;
- Promote Best Management Practice (BMP) in pollution prevention as the preferred approach to managing environmental risk;
- Establish environmental systems to prevent pollution; and
- Increase industry participation in the adoption of appropriate environmental management systems as part of their operational processes.

Cleaner production training and materials

A training program for local government Environmental Health Officers and industry personnel commenced in May 1999 to teach participants about “cleaner production” processes aimed at reducing pollution. The training focused on reducing resource inputs and waste throughout the production process. Fifteen local government Environmental Health Officers and fifteen small business/light industry personnel participated in the pilot training program.

Initially there was little response to the Cleaner Production training program and information nights held did not generate sign up for program as anticipated. Further communication avenues were used via Local government, industry groups etc to advertise the program. Consequently this delayed the information packs being distributed until training sessions had occurred.

In addition, the following tasks were undertaken:

- Industry information sheets and packages to enable self-evaluation and improve environmental management were published and distributed;

- An Oracle database was developed and maintained to incorporate information from the Industry Survey;
- Coordination and support was provided to the Swan-Canning Industry Working Group.

The cleaner production training and materials activities have been continued and further developed via the "Best Management Practices (BMPs) Swan-Canning, including Light Industry Project".

5.5.4 Status of Action Plan Recommendations

The Swan-Canning Industry Survey and Pollution Prevention project addresses the following recommendations:

Recommendation 5.1 *Establish a Best Management Practice (BMP) working group to evaluate existing BMPs and prepare a program to develop and implement BMPs to achieve SCCP objectives.*

Recommendation 5.2 *Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management.*

Table 5.4 Status of Recommendations 5.1 and 5.2

Rec'n No.	Status	Outputs & Outcomes
5.1		Refer Best Management Practices Swan-Canning, including Light Industry Project
5.2		Refer best Management Practices Swan-Canning, including Light Industry Project

5.5.5 Gaps / Key issues identified by project staff

Not provided.

5.5.6 Future plans by project staff

This project has been completed.

5.5.7 Sources of Information

- SCCP Evaluation Project Pro Formas.
- SRT. 2000. *Swan-Canning Cleanup Program: Swan-Canning Industry Survey Final Report Pilot Survey Findings.* ISBN 0-7309-7483-9, 14 pp.

5.6 Best Management Practices (BMPs) Swan-Canning, including Light Industry Project

5.6.1 Situation

As mentioned previously, the Swan-Canning Industry Survey and Pollution Prevention project was split into two projects in December 1999: "BMPs for Swan-Canning" and "Non Prescribed Industry Management" (also known as the Light Industry Project).

"Non Prescribed Industry Management" was initiated (and managed by Water and Rivers Commission) to engage industry groups and provide training; as well as continue to coordinate the Swan-Canning Industry Working Group. A second project run by the SRT entitled "BMPs for Swan-Canning" was established to focus on overall river management issues; including land practices such as yacht clubs, air conditioner wastewater and bait worm digging policy that had not been investigated before. These two projects are collectively referred to as Best Management Practices (BMPs) Swan-Canning as their activities have overlapped to some extent over different years.

In the first year of operation the Best Management Practices project was to provide salary for an officer to support the Swan-Canning Industry Working Group and develop best management practices for other activities such as yacht clubs, air conditioner wastewater, and mosquito control.

In 2001/2002, the project had two components. One was to provide salary for an officer to establish policies and best management practices for yacht clubs, bait work digging, air conditioner wastewater from CBD buildings etc. The second component was to provide money for an officer in the Swan Goldfields Office of Water & Rivers Commission to support the Swan-Canning Industry Working Group which provides advice and partnerships between different industry groups and local government. It also helps provide resources for training and highlight areas in which industry groups require assistance such as best management practices and training.

The Light Industry Project (Non-prescribed Industry Management Project) was established with the Swan Goldfields Agricultural Region of the Water and Rivers Commission in January 2001. This project aims to engage small business/light industry in environmental best management practice and cleaner production initiatives; and reduce discharges and contaminants leaving the catchments and entering rivers. The Non-prescribed Industry Management project has developed collaborative partnerships with industry, government and the community to coordinate and develop resources, on-ground support, training, incentives, planning processes and a regulatory framework to support small business/light industry adopt environmental best management practices to reduce their cumulative impact on the river and environment.

5.6.2 Inputs

A total of $151,567 has been funded by SCCP over the past five years; with $120,741 provided to the BMP project, and $30,826 allocated to the Light Industry Project. A breakdown of the various components is provided below. At least $281,396 has been obtained from other funding sources, with an unspecified amount of in kind support also provided by the Water and Rivers Commission.

Table 5.5 Breakdown of funds for BMP project

Year	Light Industry Project	BMP	Other funds (specified in Light Industry Project)	Other funds (specified in BMP project)
99-00	Not applicable	Not applicable	Not applicable	Not applicable
00-01	Not applicable	27,516	$26,514[1] $51,734[2]	In kind support from WRC (salary)
01-02	7,903	34,292	$22,300[3] $47,761[4]	In kind support from WRC (salary)

Year	Light Industry Project	BMP	Other funds (specified in Light Industry Project)	Other funds (specified in BMP project)
02-03	11,144	32,337	$28,256[5] $22,433[6]	In kind support from WRC (salary)
03-04	11,779	26,596	$59,972[7] $22,426[8]	In kind support from WRC (salary)
TOTAL	**$30,826**	**$120,741**	**$281,396**	**Not specified**

[1]SRT CF ($7,354 salary 0.15 FTE, $19,160 operational)
[2]Coasts & Clean Seas (operational)
[3]WRC CF ($21,799 salary 0.42 FTE, $501 operational)
[4]Coasts and Clean Seas (Operational)
[5]Coasts and Clean Seas (operational)
[6] WRC CF (salary 0.38 FTE)
[7]NHT (salary 1.0 FTE)
[8]WRC CF (salary 0.2 FTE)

5.6.3 Outputs and Outcomes

Best Management Practices

Achievements of this project include:

- Air conditioner policy established, but not implemented (2001/2002);
- Draft mosquito policy distributed to stakeholders for comment (2001/2002), and modified (2002/2003);
- Draft bait work policy distributed for comment. This was then approved and finalised for printing in the form of a brochure. A communication plan was established for distribution and exposure of the brochure. This included campaigning fishing outlets, fishing shows, and an article in the West Australian newspaper (2001/2002);
- Yacht club steering committee was established with regular meetings, and an environmental management system template was given to yacht clubs of which only one club took on board. This one yacht club modified the template to customise it to their business and then disseminated this to other yacht clubs;
- Industry training package has been redeveloped to incorporate an introductory video (2001/2002);
- Development of survey and compliance database for air conditioner policy implementation (2002/2003); and
- SRT contribution to development of Riverplan (2002/2003; 2003/2004).

Light Industry Project - Swan-Canning Industry Working Group

In light of the survey results from the Swan-Canning Industry Survey, the Swan-Canning Industry Working Group developed a number of recommendations contained in the Swan-Canning Industry Survey Final Report (2000) to address these issues. From 2000 to 2003 the Swan-Canning Industry Working Group has worked to implement these recommendations. These recommendations were designed to be evaluated and reviewed within two years of the final report.

The Swan-Canning Industry Working Group is the steering group for the Swan-Canning Industry Project and meets approximately six times per year to provide stakeholder input and guide implementation of the Project. Current representation from the different organisations is shown in Table 5.6.

Table 5.6 Current representatives on Swan-Canning Industry Working Group

Organisation	No. Representatives
Centre of Excellence in Cleaner Production	1
Chamber of Commerce and Industry WA	1
City of Armadale	1
City of Belmont	2
City of Canning	1
City of Gosnells	2
City of Joondalup	1
City of Melville	1
City of Stirling	1
City of Swan	1
Department of Environment	4
Swan River Trust	1
Eastern Metropolitan Regional Council	1
Master Cleaners Guild of WA	1
Motor Trade Association of WA	1
Nursery and Garden Industry WA	1
Printing Industries Association	1
South East Regional Centre for Urban Landcare	1
Southern Metropolitan Regional Council	1
Swan Catchment Council	1
North East Catchment Committee	1
Swan TAFE	1

This group has been active for 7 years and is currently evaluating the outcomes of the project. The group has recognised that there is duplication of work by various agencies and that improved coordination is required.

Some of the achievements of the Swan-Canning Industry Working Group and the Working Group Coordinator during the first four years of SCCP implementation are outlined below:

2000/2001

- Support to the Motor Trades Association to develop local guidelines for automotive industries.
- Review of the Industry Survey form to make it simpler to use and to target the key areas of concern.
- Liaison with the DEP on the draft Unauthorised Discharges Regulations and have investigation of statutory mechanisms under the LG Act that may be used to enable cost recovery for LGA involvement in managing pollution from non-prescribed industry.

2002/2003

- Held internal meetings to coordinate DEWCP approach to small industry – Swan-Canning Industry Working Group provided external stakeholder input into this process.
- Developed a strategic plan to guide project for next few years and attribute responsibility to more stakeholders (replaces recommendations in the Swan-Canning Industry Survey 2000).
- Developed important links to Swan Region NRM Strategy and Swan Catchment Council. Project incorporated into Foundation Funding bid for NHT

(for a Project Officer), and will provide mechanism to engage industry in the implementation of the NRM Strategy.

- Presentation of project to Waste & Recycle Conference 2002.
- Provided support to industry associations.
- Scoped the development of a Green Stamp accreditation/training project for the Master Cleaners Guild (industry association). Conducted a baseline survey. Developed draft objectives, accreditation criteria and supporting resources.
- Collated Industry Survey/Assessment data from all local governments who had conducted surveys from 1999-2003.

2003/2004

A full-time Coordinator for this project was appointed in 2003/2004, and the following activities were undertaken throughout that year.

Coordination of Working Group

- Developed 'Terms of Reference'/membership guidelines for the Swan-Canning Industry Working Group.
- Developed a new profile/project name to reflect the new strategic direction of the SCIWG. Project is now known as the Swan Region 'Light Industry Project/Working Group.
- Contributed to the development of fact sheets for light industry - Nursery and Garden Industry Environmental Best Practice Fact Sheets (joint project between Nursery and Garden Industry, North East Catchment Committee, Phosphorous Action Group, Department of Environment/SCCP) and an Environmental Law Fact Sheet (NECC, DoE).

Coordination of networks and partnerships

- Provided light industry stakeholder input into regional and state planning consultation processes such as RiverPlan, Strategic Direction for Waste Management in WA, the ANU's Draft Working Paper on managing light industry, Draft Swan Regional NRM Strategy etc.
- Delivered various presentations and held meetings with various stakeholders to identify links between projects and develop partnerships in order to coordinate the delivery of environmental management to light industry/small business.

On-ground support

- Lobbied and applied for various funding including NHT, SCCP, Water Corporation Icon, Waste Management Board, DEH – Eco-efficiency, corporate sponsorship etc for the provision of on-ground support to industry.
- Completed a ten month trial of the Cleaners Green Stamp Environmental Accreditation Program - involved numerous site visits, meetings and workshops with trial participants to develop the accreditation process, criteria, auditing requirements, resources and support. Conducted an evaluation of the trial and produced a report.
- Provided support to other on-ground programs such as the Motor Trade Association Green Stamp program, Printing Industry Association Green Stamp program and the North East Catchment Committee Industry Officer.

Communication/Education tools

- Draft Green Stamp Resources developed for the Cleaning Industry.

- Draft Nursery and Garden Industry Environmental Best Management Practice Fact Sheets developed (joint project between NGIA, NECC, PAG and DoE).
- Draft Environmental Law for Small Business Fact Sheet developed.
- Circulate regular Light Industry Information Bulletins to Working Group and other stakeholders.

Promotion & Marketing

- Developed and implemented a Summary Communications and Marketing Plan for the Swan-Canning Industry Project.

New Premises Development and Planning

- Provision of Environmental BMP advice to Regional DoE Landuse Planning Officers (2003/2004).
- Provided input into the environmental/sustainable development of new light industrial areas/precincts such as the Armadale Redevelopment Authority Forrestdale Industrial Park sustainability workshop and provision of advice to Shire of Chittering Industrial Precinct redevelopment.

Regulation & Enforcement

- Unauthorised Discharge Regulations gazetted. Implementing a range of strategies to encourage and support Local Government to adopt UDRs and use them proactively to manage light industry/small business - eg. briefings, training and education/awareness tools.
- Liaising with Swan Goldfields Agricultural Department of Environment staff on the Swan-Canning Industry Project and identified possible links to other regional functions such as Environmental Protection licensing, landuse permitting in Water Source Protection Areas, statutory referrals/landuse planning, pollution incident reporting and enforcement.

Policy & processes

- Liaising with the Western Australian Local Government Association to discuss and identify linkages with the program they are developing to support sustainable procurement/purchasing in Local Government (similar to Eco-Buy Victoria).

Future directions

The Swan-Canning Industry Working Group has devised a plan to provide strategic direction for the Group over the next few years. It is consistent with the objectives and strategies of the Swan Regional NRM Strategy, the State Sustainability Strategy, and National Strategy for Ecologically Sustainable Development. The aim/vision of the project is that all small and medium sized businesses in the Perth Region will apply best practice environmental management. There are approximately 115,000 small to medium enterprises in the Perth metropolitan area. The priority is to work with those businesses that pose the highest environmental risk, including: Automotive, Engineering/manufacturing, Chemical blenders, Nurseries, Service industries, Dry cleaners and Printers. There will be some geographical focus to the project.

The overarching goals for the program in the near future are:

- Goal one: Develop and coordinate resources for the delivery of environmental management and cleaner production activities to small and medium businesses;

- Goal two: Develop ownership and increase adoption of environmental management and cleaner production practices by small and medium businesses; and
- Goal three: Develop a regulatory framework for the environmental management of small and medium sized businesses.

Strategies, actions, tasks, responsibilities, costs and timeframes have been defined.

Cleaner Production

The continued development of Cleaner Production training for industry has been undertaken over the past few years to be able to assist businesses in pollution prevention and cleaner production methodologies that can be applied to their own business.

The following development activities were undertaken:

- Presentation of Cleaner Production training certificates to industry representatives took place on the 6/4/2001 at the Centre for Excellence in Cleaner Production, Curtin University (2000/2001).
- Cleaner Production training delivered for 10 Metropolitan Local Government Officers and 7 priority Catchment Coordinators (2001/2002).
- The development of a broad communication strategy for the Industry Training Package (2001/2002).
- Completion of two-tiered training package - Level 1 Environmental Awareness Video in Cleaner Production and Level 2 Environmental Auditing Program for Cleaner Production (2001/2002).

A Cleaner Production trial was undertaken in 2003 with the Building Service Contractors Association of Australia – WA division, as this Association was interested in enhancing the environmental profile of its cleaning industry. Ten association members, consisting of four carpet cleaners and six contract cleaning companies, participated in the trial and committed to achieving the Green Stamp accreditation within a 12-month period. The aim of the trial was to explore which environmental practices could be realistically implemented within the cleaning industry and to offer assistance for business owners and managers to make the adequate changes in their work practices.

To obtain a better understanding of the threats posed to the environment by the cleaning industry, several companies underwent a comprehensive baseline survey. The survey aimed to highlight the current industry practices that needed addressing, such as chemical usage and storage, improper discharge of wastewater and solid waste management. Using this survey information, a set of sustainable work practices that minimise the environmental impacts of the cleaning industry were developed. Criteria were designed to meet two levels of accreditation, the first level was for businesses that comply with environmental laws and regulations and begin integrating environmental best management practices into their business operations. The second level recognises businesses that go beyond this and are eco-efficient in the majority of their work practices. The criteria were further refined into a one page Checklist that provided the participants with an easy to use self-assessment of the business and its practices, indicating the areas that need to be addressed if the company was to become accredited. Once the checklists were completed by the participants and assessed by the Green Stamp Coordinator, a series of workshops and

site visits were conducted to assist the participants in working towards meeting these criteria.

A Resource Kit (outlined below) was constructed and distributed to the participants:

- *Checklist* – self assessment or audit against the accreditation criteria
- *Greener Cleaning Plan* – A template for an Environmental Management Plan for businesses.
- *Environmental Product and Services Directory* – Service providers and product suppliers available in the Perth metropolitan area.
- *Local Government Recycling Services* – A list of all Local Government recycling services.
- *Information Sheets* – For businesses and clients on a range of environmental topics related to the industry.

After several months of refining work practices, these participants were visited again and audited to asses the feasibility of the program. The results of this trial showed that the program had been effective in improving the environmental performance of all participants involved (Figure 5.1). The most notable improvements in their practices were: development of Environmental Management Plans; use of more environmentally friendly products where possible (e.g. phosphate free); use of spill kits; and improved wastewater disposal.

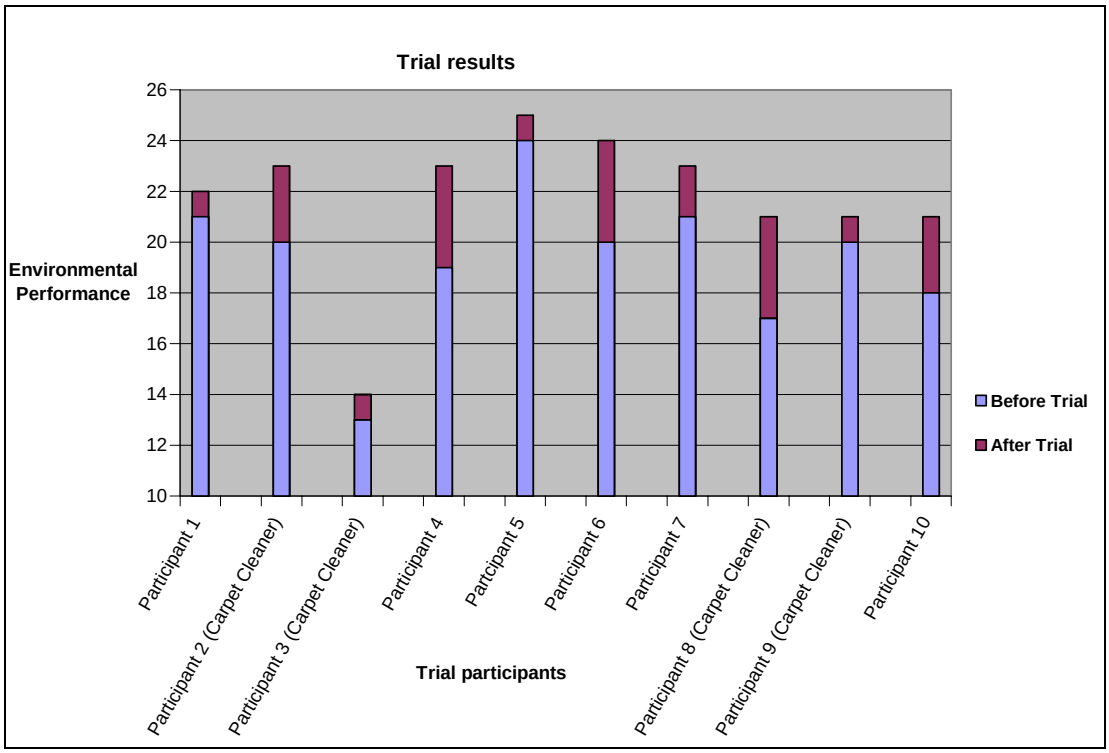


Figure 5.1 Environmental performance ratings of participants from the cleaning industry, before and after their involvement in the 2003 Cleaner Production trial

5.6.4 Status of Action Plan Recommendations

The Best Management Practices (BMPs) Swan-Canning/Light Industry projects address the following recommendations:

Recommendation 5.1 *Establish a Best Management Practice (BMP) working group to evaluate existing BMPs and prepare a program to develop and implement BMPs to achieve SCCP objectives.*

Recommendation 5.2 *Establish an extension program to facilitate development and implementation of Best Management Practices (e.g. Water-Sensitive Design, Integrated Pest Management, Nutrient Irrigation Management Plans, industrial waste disposal, spill and washdown practices) by training practitioners whose practices contribute nutrients to the river system and land managers who are responsible for land and water resource planning and management.*

Table 5.7 Status of Recommendations 5.1 & 5.2

Rec'n No.	Status	Outputs & Outcomes
5.1	Achieved, ongoing	**Outputs** A Best Management Practice working group was initially established in 1996, prior to implementation of the SCCP Action Plan; and addressed issues relating to point and diffuse-source pollutants from non-prescribed industrial premises. The Working Group has continued into the implementation phase of the SCCP Action Plan, and is still ongoing.
5.2	Partly achieved, ongoing	**Outputs** Cleaner Productions trials and information packages have been developed for industry. **Social & environmental outcome:** Demonstrated improvement in environmental performance by Cleaning Industry participants following training in the Cleaner Production program

5.6.5 Gaps / Key issues identified by project staff

A summary of the Key Issues/Gaps presented at the Forum by SCCP staff for the Light Industry project is provided in Table 5.3.

Table 5.8 Summary of Key Issues / Gaps presented for the Light Industry project

Project	Key Issues / Gaps
Light Industry Project (formerly Swan-Canning Industry Project)	• Lack of on-going funding commitment • Lack of resources • Lack of coordination • Lack of clarity of roles and responsibilities

5.6.6 Future plans by project staff

Future plans identified by project staff for the Light Industry project are provided below (Table 5.9).

Table 5.9 Future plans for Light Industry project

Project	Future
Light Industry Project (formerly Swan-Canning Industry Project)	• Sustainable Production (Light Industry) Regional Delivery Program • Appointment of staff • Reference group • Industry representative on Swan Catchment Council • Investment planning for future projects

5.6.7 Sources of Information

- SCCP Evaluation Project Pro Formas.
- Various draft resources and an evaluation report produced as a part of the Cleaning Industry Green Stamp program Trial (2003/2004).

- Draft Swan-Canning Industry Project Strategic Plan (2002/2003).

5.7 Drain licensing

5.7.1 Situation

Perth contains an extensive network of drains throughout the metropolitan region; and this has significantly modified the natural hydrological environment within the region. Most drains in the Perth metropolitan area manage normal surface water runoff events (including storm events of up to 1 in 10 year intensity) and help to minimise flooding. Water that enters the drains is redirected to lakes, ponds and watercourses. Many stormwater drains discharge into compensation basins and detention ponds to allow temporary storage of run and reduce the need for large-capacity storm drains. It has been estimated that 200-300 kilometres of mainly urban drains are managed by the Water Corporation; and that over 2500 kilometres of surface and sub-surface drains are under metropolitan Local Government control (SRT, 1999).

The water quality of drain water in the Perth metropolitan area is generally very poor, as the drains collect and contain runoff from residential, commercial, and industrial areas. Both nutrients and contaminants become concentrated in the drains, and in some cases the drains are effectively converting non-point sources into point sources as they discharge into large water resources. Many older drains also intercept and drain high water-tables and can flow all year round, continuously transporting nutrients and contaminants into the watercourses of the Swan-Canning system (SRT, 1999).

The Swan-Canning Cleanup Program Action Plan identified that if drains could be considered as point sources, then a regulatory approach could license drains and potentially better manage these pollution sources. The aim of this would be:

- To prescribe targets or drainage practices that would enable achievement of water quality catchment targets in new and established drainage areas; and
- Encourage improved management of nutrients at the source and reduction of nutrients in drains before they discharge into the Swan and Canning Rivers.

5.7.2 Outputs/outcomes

Drain Licensing Report

This project involved the allocation of $20,000 to the DEP to manage a consultancy (Alan Tingay and Associates) to investigate the feasibility of licensing options for drains discharging into the Swan-Canning River System. A draft report was produced by the consultants in 1999/2000 that presented a number of options for regulating drains, but this report did not particularly recommend the application of any one option. Consultation by the DEP on the draft continued through the following year, and the SCCP Senior Officers Groups was briefed on the paper and DEP's response in October 2002.

The Drain Licensing Report was provided to Oceanica in November, 2004. Unfortunately there was insufficient time available review this document in time for this report.

The responsibility and resourcing for addressing water quality issues in drainage management was raised as an important issue.

The paper provided background to a recent large-scale initiative by the Western Australia government—the Drainage Reform (see Section 2.2.2).

5.7.3 Status of recommendations

The Drain Licensing project addresses the following recommendation:

Recommendation 6.4 *Investigate licensing for drains discharging into the Swan-Canning rivers as a tool for controlling nutrient inputs* (**DEP, WC, WRC,** LGs).

Table 5.10 Status of Recommendation 6.4

Rec'n No.	Status	Outputs & Outcomes
6.4	Achieved, ongoing	**Outputs** Licensing for drains discharging into the Swan-Canning rivers as a tool for controlling nutrient inputs was investigated via a 1-year project.

5.7.4 Gaps / Key issues identified by project staff

This information has not been provided.

5.7.5 Future plans by project staff

This information has not been provided.

5.7.6 Sources of information

- SCCP Evaluation Project Pro Formas.

6. Action Area 3: Modify river conditions to reduce algal blooms

6.1 Background

The SCCP Action Plan recognised that changes in catchment management practices would take time to implement and take effect, and that, realistically, it might be 20 years before nutrient inputs to the Swan-Canning system were significantly reduced. Intervention techniques that reduce the availability of nutrients to algae in the rivers and estuarine basins were identified as an interim means of lessening the ill effects of nutrient enrichment, until catchment management measures took effect. The SCCP undertook considerable research and trials to develop a 'tool box' of intervention techniques, with oxygenation and sediment remediation offering the most promise, and therefore worth further investigation. Another form of 'intervention' identified for examination was water flow in Canning River (the upper reaches of which are dammed for potable water), and the potential to balance the needs of potable supplies and adequate environmental flows.

6.2 Action Plan recommendations

Action Plan recommendations for Action Area 3 are listed in Table 6.1 along with the main Action Plan projects developed to address them. Table 6.1 also lists the section of this document where each project is discussed. Note that most of the work to address Recommendation 7.9 (Restore ecological function of the Swan-Canning foreshores and secure erosion protection) is no longer part of the SCCP Action Plan. Works on foreshore protection and restoration (including the construction and maintenance of retaining walls) are now part of a separate 'River*bank*' program, which is funded for $4,000,000 over the next four years, and will involve the SRT working with local government. Some work to address Recommendation 7.9 is done under the Swan Alcoa Landcare Program (see Section 4.7).

Table 6.1 Action Area 3: recommendations and Action Plan projects

Rec. No.	Recommendation	Action Plan Project	Document section
7.1	Develop river oxygenation methods to an operational scale, undertake oxygenation trial in the Swan River to reduce nutrient availability and implement if successful	53117 Swan Oxygenation	6.3
7.2	Operate oxygenation plant in the Canning River to reduce nutrient availability	53090 River oxygenation methods 53116 Canning River oxygenation	
7.3	Develop sediment remediation methods to an operational scale and apply the technique in the Swan and Canning rivers to reduce nutrient availability	53006 Sediment remediation - Phoslock™	6.4
7.4	Develop and evaluate new river intervention techniques to reduce algal blooms	53006 Sediment remediation - Phoslock™	6.4
7.5	Construct an artificial wetland to strip nutrients from Ellen Brook using oxygenation, sediment remediation and other techniques	53109 Constructed wetlands. Re-assigned to Action Area 1	See Section 4.6
7.6	Evaluate nutrient and pollution risk from former landfill sites bordering the rivers and drains	53121 SCCP Landfill leachate investigation	6.5

Rec. No.	Recommendation	Action Plan Project	Document section
7.7	If risk is unacceptable undertake appropriate management action to reduce nutrient and pollutant leaching from former landfill sites bordering the rivers and drains		
7.8	Develop and implement a management plan for the Canning River based on environmental flow allocations and controlled discharges from the Kent Street Weir	53106 Canning River management plan	6.6
7.9	Restore ecological function of the Swan-Canning foreshores and secure erosion protection	Largely addressed outside of SCCP Action Plan, in the 'River*bank*' program. Some work done in 53103 Restore Works - Foreshore	See Section 4.7

6.3 River oxygenation

6.3.1 Situation

When oxygen levels in waters are high, decomposition and recycling processes function efficiently: organic material in sediments is rapidly broken down, and a significant proportion of nutrients present in the organic material is rapidly removed from the system rather than becoming available to fuel algal blooms. If low oxygen levels develop in the bottom waters of waterways (eg during stratified conditions), decomposition and recycling processes can become less effective, and this can lead to enhanced release of nitrogen and phosphorus. Oxygenation of stratified waters can (theoretically) help restore efficient processes, provided it is done correctly.

There are a variety of techniques and devices available to increase oxygen concentrations in water, and either air (aeration) or pure oxygen (oxygenation) can be used. A review of available techniques carried out in the SCCP recommended initial trials using a 'sidestream' oxygenation plant, where oxygen-poor water is pumped out of the river to be oxygenated, and then returned to the river. This method ensures minimal disturbance to the river bed, and allows the oxygenated water to be directed to the bottom waters where it is most needed. Trials were carried out during summer in 1997/98 over a 300m stretch of the Canning River upstream of Kent Street weir (in an area of known water quality problems), and in the same location in 1997/98 but over a 1 km stretch of river. The 1998/99 trial saw an improvement in dissolver efficiency, with 85% of the injected oxygen remaining in dissolved form compared to 50–75% in the earlier trial. Effects on nutrient concentrations were encouraging, and so the SCCP Action Plan included the Canning River oxygenation project, which was established to build a larger scale plant to oxygenate a longer stretch of river, and run for three summers: 1999/2000, 2000/2001 and 2001/2002.

A different approach was taken for oxygenation of the Swan River. In this case, the area of low oxygen to be targeted was the salt water 'wedge' that moves upstream in spring and summer (see Section 2.1.3). The salt wedge is, however, a moving target, and so the intention was to build a prototype mobile oxygenation vessel, using an existing Swan River Trust barge, and trial it over two summers: 1999/2000 and 2001/2002.

6.3.2 Inputs

Action Plan funding for oxygenation projects is shown in Table 6.2. The large majority of funds was for operational costs: design, construction and materials.

Table 6.2 Action Plan funding for oxygenation projects

Year	Swan Oxygenation	River oxygen methods (pilot plant, Canning River)	Canning Oxygenation	TOTAL
99-00	$39,951	$91,556	-	
00-01	$67,516	-	$285,000	
01-02	$30,000	-	$285,000	
02-03	$0	-	$140,022	
03-04	-	-	$136,988	
TOTAL	**$137,467**	**$91,556**	**$847,010**	**$1,076,033**

The oxygenation projects were undertaken in collaboration with the company BOC gases, and also attracted Commonwealth Coast and Clean Seas grants. Additional funding from these sources is shown in Table 6.3.

Table 6.3 Additional funding for oxygenation projects

Year	Swan Oxygenation	River oxygen methods (pilot plant, Canning River)	Canning Oxygenation	TOTAL
99-00	$250,000[1]	$234,943[2]	-	
00-01	$111,100[2]	-	$1,811[2]	
01-02	-	-		
02-03	-	-		
03-04	-	-		
TOTAL	**$361,000**	**$234,943**	**$1,811**	**$597,754**

[1] *Coasts and Clean Seas grant $200,000. BOC $50,000*
[2] *Coasts and Clean Seas grant*

6.3.3 Outputs and Outcomes

Swan River oxygenation

Oxygenation equipment was fitted to an existing SRT barge the 'Seagull' in January 2000: this was the first construction of a mobile oxygenation plant for natural waters in Australia. The 2 trial periods of the prototype oxygenation barge were: 6th March 2000 to 19th April 2000, and 6th November 2000 to 1st February 2001. The barge operated at Maylands, Ron Courtney Island and Success Hill.

The barge and oxygenation equipment were developed in collaboration with BOC Gases. Hypoxic bottom water was pumped through a U tube dissolver on board the barge, where it was injected with pure oxygen before being returned to the bottom of the estuary. The hypolimnetic system used in this project has already been tested and found to be effective in the Canning River. Oxygenation in this manner has been used on the Seine and Thames Rivers, and is used in rivers in the US with beneficial results.

1999/2000

The main output of the first year was the design and construction of the barge. As this was the first time an oxygenation barge had been attempted in Australia there were a number of design issues that required solving. These included developing the appropriate technology (especially with respect transportation of hazardous goods, plant capacity, and diffuser configuration), and practical and logistical aspects of the barges operation, especially staffing and security).

The barge was designed in conjunction with BOC Gases and involved the use of a different oxygen dissolution system to the static plants on the Canning River and an extension to the deck of the barge.

Good media coverage was received.

A SCCP 'River Science' report was produced: River Science 15. Report on the 1999/2000 Swan barge oxygenation trial.

2001/2002
The efficiency of the barge's operation was improved. The general design of the oxygenation equipment proved sound and practical given the constraints of the equipment. The barge was operated for 10 weeks from November 2000 to February 2001.

2002/2003
Reporting of the results was completed:

- Greenop, B. and Robb, M. 2003. The Swan Estuary Oxygenation Project: A prototype mobile oxygenation barge for improving water quality, a summary report. March 2003. Swan River Trust, Western Australia.
- Greenop, B. and Robb, M. 2003. Swan estuary oxygenation project: A prototype mobile oxygenation barge for improving water quality, March 2003. Swan River Trust, Western Australia.

Elevated levels of dissolved oxygen were recorded up to 50 m from the barge, but the oxygenation plant was not able to consistently and significantly raise oxygen levels over 5 m from the sparger at the Success Hill and Ron Courtney Island sites. The barge was not large enough to make a significant impact on dissolved oxygen concentrations in the river, due to a lack of space on the vessel and budget constraints. The current Swan Estuary water quality does not justify the expense of large-scale oxygenation, and this approach is only likely to be reconsidered in the event of a number of high-profile, widespread water quality problems (e.g. major fish kills, prolonged algal blooms). However, should such a plant be required, the data obtained in this study can provide a sound basis for the feasibility study that would be necessary before large-scale works were undertaken.

Canning River oxygenation

1999/2000
Environmental approvals for the oxygenation plant were obtained. BOC Gases were contracted to design, build, operate and own the oxygenation plant for three years. The existing oxygenation plant was extended and another one was built, so that 2.3 km of the Kent St Weir pool could be oxygenated between October and May.

Monitoring of water quality was undertaken at oxygenated areas and control areas. Dissolved oxygen concentrations were higher in the oxygenated area than the control area (190% higher in bottom waters). The frequency that dissolved oxygen concentrations at the bottom was greater than or equal to three milligrams per litre was 168% greater in the oxygenated area than in the control area. Effects on nutrient concentrations proved harder to interpret, because control areas also had low concentrations (relative to historical data). Interpretation was also complicated by extreme weather: December was the hottest on record, and January the wettest on record (103 mm). However, a preliminary survey of aquatic fauna undertaken by

researchers from the University of Western Australia and Curtin university found evidence to suggest oxygenation had a beneficial impact on fish, freshwater prawn and benthic invertebrate populations, which were in higher densities in the oxygenated areas than the controls sites.

Three SCCP 'River Science' reports were produced: River Science 13, Oxygenating the Swan and Canning Rivers; River Science 14, 1998/1999 Canning River Oxygenation Trial; and River Science 18, Report on the 1999/2000 Canning River oxygenation project.

2000 to 2002
The oxygenation plants were operated between October and May in both years, and monitoring was undertaken in oxygenated areas and control areas. Two technical reports were produced:

- Manning, C. and Greenop, B., 2001. Canning River Oxygenation Project 2000-2001 period. Report to BOC Gases on performance of oxygenation plant. Water and Rivers Commission unpublished report.
- Greenop B., Lovatt K. and Robb M. 2001. The use of artificial oxygenation to reduce nutrient availability in the Canning River, Western Australia. Water Science and Technology Vol 43 No 9 pp133-144. IWA Publishing 2001.

In 2001/2002, dissolved oxygen concentrations in the treatment area were maintained at satisfactory levels throughout this treatment period, while bottom concentrations at control sites were markedly lower. However, a concurrent Phoslock™ trial made interpretation of data more complicated in some respects. The automatic control system on the oxygenation plant was a lot more effective than in previous years, allowing the plants to be run in off peak times to minimise power consumption, and also to minimise the amount of gas used.

As results had proved satisfactory for the three year trial, funding was received to maintain the plants and operate them for limited periods of time in the next financial year. From 2002/2003 on, the operation of the oxygenation plant has been on a year by year basis with BOC gases.

2002 to 2004
The oxygenation plants were operated between October and May in both years, and monitoring was undertaken in oxygenated areas and control areas. Two technical reports were produced:

- Greenop, B. and Robb, M., 2003. Improving water quality in the Kent Street Weir, Canning River Western Australia, through artificial oxygenation. Swan River Trust, Western Australia.
- Greenop, B. and Robb, M., 2003. The Canning River Oxygenation Project: Improving water quality in the Kent Street Weir pool with artificial oxygenation, 1999 – 2002, a summary report. June 2003. Swan River Trust, Western Australia.
- Greenop, B. and Robb, M., 2003. Improving water quality in the Kent Street Weir, Canning River Western Australia, through artificial oxygenation. Swan River Trust, Western Australia.

There were some problems in 2003/2004 with automatic control system, movement of spargers, and electrical and mechanical problems at the Bacon St plant hampered

the effectiveness of the plants. Due to the additional time spent maintaining the plants, and the needs of other projects, A 'River Science' publication planned to present all the Canning data was not completed, and the field program was fairly minimal.

Overall

The objective of this project was to maintain oxygen concentrations in a 2.3 km stretch of waters upstream of Kent Street weir over summer, with the objectives of enhancing nitrogen cycling and processing of organic carbon, and reducing phosphorus release from sediment. The overarching goal was a limitation in algal growth due to a reduction in nutrient concentrations. The work undertaken to date shows that oxygenation has greatly increased oxygen concentrations, reduced nutrient concentrations and positively impacted aquatic fauna, but has not prevented algal blooms.

The main benefits of oxygenation at present are to:

- Maintain an aerobic environment and lower nutrient levels to assist the development of a more robust ecosystem, which is less vulnerable to phytoplankton blooms.
- React to incidents such as the deoxygenation of the water column following rainfall events delivering a high organic load to the Weir pool.
- Achieve goals for the protection of natural diversity being developed in the Swan Region Strategy.

The monitoring, data analysis and reporting component of the project has also added to the knowledge of algal bloom dynamics in the Kent Street weir pool. In addition, the delivery of this project has developed a knowledge base that has enabled the evaluation of other techniques and waterway remediation options for waterways State-wide.

Constraints / Opportunities for improvement

The oxygenation equipment for the Canning River needs major maintenance work (Approx. $150,000 worth).

It is recommended that oxygenation of the Canning River be continued until catchment nutrient inputs are significantly reduced and/or algal blooms are reduced by other means. The Canning River frequently experiences severe anoxia, and although oxygenation does not appear to prevent algal blooms, it will produce an improved environment for invertebrates and fish. Some of the underlying scientific assumptions about the use of oxygenation need to be revisited, and alternative (less expensive) methods (eg aeration rather than oxygenation) may be worth revisiting.

6.3.4 Status of Action Plan recommendations

The oxygenation projects address the following recommendations:

Recommendation 7.1 *Develop river oxygenation methods to an operational scale, undertake oxygenation trial in the Swan River to reduce nutrient availability and implement if successful.*

Recommendation 7.2 *Operate oxygenation plant in the Canning River to reduce nutrient availability.*

Table 6.4 Status of Recommendations 7.1 and 7.2

Rec'n No.	Status	Outputs & Outcomes
7.1	Achieved.	**Outputs** An operational scale, mobile oxygenation unit was successfully developed, but was too small to have more than highly localised effects on oxygen levels in the Swan River. **Outcomes** It was concluded that the costs to implement the scale of works required to oxygenate the waters of the Swan are not justifiable at present. This may change if water quality deteriorates seriously.
7.2	Achieved	**Outputs** A large scale oxygenation plant sufficient to oxygenate 2.3 km of the Canning River has been successfully built and operated from October to May during the last five years. Water quality data have been collected, and a series of River Science publications and Technical reports produced. **Outcomes** ***Environmental*** Oxygen levels have been increased and nutrient levels significantly reduced. Although algal blooms have not been prevented, the environment has improved for invertebrate fauna and fish: abundance and biodiversity were enhanced. Knowledge and understanding of algal bloom dynamics in the Kent Street weir pool has increased. There is the ability to respond to high nutrient input events (unseasonal rainfall) that might otherwise cause fish and invertebrate kills A knowledge base has been developed that has enabled the evaluation of other techniques and waterway remediation options for waterways State-wide. ***Social*** Anecdotal feedback from the public is that the Canning River is more aesthetically pleasing (less odours)

6.3.5 Gaps / Key issues identified by project staff

Key issues / gaps identified by project staff for the Oxygenation project are provided below (Table 6.5).

Table 6.5 Key issues / gaps for the Oxygenation project

Project	Gaps/ Key issues
Oxygenation	• The oxygenation infrastructure requires upgrading

6.3.6 Future plans by project staff

Future plans of project staff for the Oxygenation project are provided in Table 6.6.

Table 6.6 Future plans for the Oxygenation project

Project	Future
Oxygenation	Canning River • Its working, public acceptance • Continue with long term contract, re issue • Upgrade, maintain and extend? • Will be putting a case to the SRT to modify and continue • Redesign Swan River • Watching Brief • Potential for emergency relief • Will need lead time and funding • Fixed or mobile dependent on nature of collapse

6.3.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Three interviews with project personnel.
- Greenop, B. and Robb, M., 2003. *The Canning River Oxygenation Project: Improving water quality in the Kent Street Weir pool with artificial oxygenation, 1999 – 2002, a summary report. June 2003*. Swan River Trust, Western Australia.
- Greenop, B. and Robb, M. 2003. *The Swan Estuary Oxygenation Project: A prototype mobile oxygenation barge for improving water quality, a summary report*. March 2003. Swan River Trust, Western Australia.
- Swan River Trust, 2000. *River Science 13. Oxygenating the Swan and Canning Rivers*. Swan–Canning Cleanup Program publication, Swan River Trust, Perth , Western Australia.
- Swan River Trust, 2000. *River Science 14. 1998/1999 Canning River Oxygenation Trial*. Swan–Canning Cleanup Program publication, Swan River Trust, Perth , Western Australia.
- Swan River Trust, 2000. *River Science 15. Report on the 1999/2000 Swan barge oxygenation trial*. Swan–Canning Cleanup Program publication, Swan River Trust, Perth , Western Australia.
- Swan River Trust, 2000. *River Science 18. Report on the 1999/2000 Caning River oxygenation project*. Swan–Canning Cleanup Program publication, Swan River Trust, Perth , Western Australia.

6.4 Sediment remediation

6.4.1 Situation

The use of sediment modification to immobilise nutrients, particularly phosphorus, was the subject of an exhaustive review during the preparation of the SCCP Action Plan. At that time, available methods were deemed unsuitable. As a result, CSIRO Land and Water in partnership with the Water and Rivers Commission and the Swan River Trust, undertook extensive laboratory studies and concluded that modified clays offered some potential. Phoslock™ is an innovative modified clay developed by CSIRO in collaboration with the Water and Rivers Commission and the Swan River Trust. A small scale river trial in 1996 showed promising results, as did a larger trial in Lake Monger in the summer of 1997/98, and a small trial in the Canning River in early 1998.

The Action Plan provided funding for the application of Phoslock™ to a portion of the Canning River in the summers of 1999/2000 and 2000/2001 and made provision for funding for application in subsequent years based on the trial application results. The WRC is also funding State-wide applications and commercialisation activities.

It is important to note that Phoslock™ only removes phosphorus in fresh water conditions.

6.4.2 Inputs

Funding sources for the Sediment Remediation project are shown in Table 6.7.

Table 6.7 Funding for Sediment remediation project

Year	Action Plan	Other funding sources	TOTAL
99-00	$482,181	$50,000[1]	
00-01	$317,009	$0	
01-02	$99,243	$178,199[2]	
02-03	$94,751	$165,952[2]	
03-04	$105,459	$0	
TOTAL	**$1,098,643**	**$394,151**	**$1,492,794**

[1] *CSIRO*
[2] *Commonwealth Coast and Clean Seas grant*

6.4.3 Outputs and Outcomes

1999/2000

A pilot scale application of Phoslock™ to Helena Lake was completed, and a field trial consisting of a full scale application of Phoslock™ to an 800m section of the Canning River. A small amount of Phoslock™ was also applied to drains leading to Canning River near the treated area. The field trial experienced some delays due to the environmental approvals process, and the requirement for ecotoxicity work.

The following tasks were completed for the field trials:

- Environmental Approvals (Consultant firm Sinclair Knight Merz contracted for this task).
- Design and Site Selection (WRC and CSIRO).
- Phoslock™ Manufacture (IMO). A Western Australian company was contracted by the commercial partners to produce Phoslock™ at a large scale, and apply it to trial areas. Independent Metallurgical Organisation (IMO) located in Welshpool set up a commercial mixing facility and designed application methods appropriate to the trials. Phoslock™ is applied as a slurry to surface waters.
- Clay formulation R&D (CSIRO).
- Sampling and Analysis program prepared (WRC for water chemistry, UWA and Curtin University for biota surveys, CSIRO Centre for Advanced Analytical Chemistry for ecotoxicology studies, CSIRO Land and Water for microbiology studies).
- Ecotoxicology testing of Phoslock™

For the field trial, subsurface curtains were used to separate the river into three zones: Phoslock™ treated, Phoslock™ combined with oxygenation, and an untreated control zone. An extensive sampling program was undertaken to assess the effectivness of Phoslock™, and to see if there were any wider environmental impacts. There was excellent media coverage of the trial.

The following reports were produced:

- Stauber, J.L. 1999. *Restricted investigation report CET/IR202R. Further toxicity testing of modified clay leachates using freshwater and marine organisms*. Prepared for CSIRO Land and Water.
- Stauber, J.L. 2000. *Toxicity testing of modified clay leachates using freshwater organisms*. Report No. ET/IR267R.

- Douglas, G.B., Adeney, J.A. and Zappia, L.R.. 2000. *Sediment remediation project: 1998/9 laboratory trials report*. CSIRO Land and Water technical report 6/00, March 2000.
- Douglas, G.B. and Newman, B.L. 2000. *Sediment remediation project: Further investigations of the performance of Phoslock™ under saline conditions.*

2000/2001

Application of Phoslock™ to the Canning River, and associated monitoring continued (20 tonnes of Phoslock™ applied to an 800m section of the Canning River in February 2001, with sampling of treated area continued to the end of April 2001. Timing of the trial was delayed by approvals processes, and some problems with the mixing of the Phoslock™.

The WRC continued involvement with CSIRO technology development and commercialisation process.

A 'River Science' brochure (River Science 17) describing the Canning River 1999-2000 Phoslock™ trial was produced, and opportunities were taken to promote the Canning River Phoslock™ trials and the Swan-Canning Cleanup Program (e.g. the March 2001 trial was launched by the Minister for Water Resources).

The following reports were completed:

- Douglas, G.B., Adeney, J.A. 2001. *2000 Canning River Phoslock™ Trial*. Report to the Water and Rivers Commission. CSIRO Land and Water Technical Report.
- Stauber, J.L. 2001. *Canning River Phoslock™ Field Trial - Ecotoxicity Testing Final report.* Prepared for CSIRO Land and Water and the Water and Rivers Commission.
- Storey, A., and Rippingale, R. 2000. *Canning River Oxygenation and Sediment Remediation Field Trial December 1999 – March 2000: Aquatic Biota Monitoring*. Report to the Water and Rivers Commission and Swan River Trust.
- Hancock, D., Rogers, S., and Toze, S. 2000. *Microbiological Monitoring of the Oxygenation Trial on the Canning River: Stage III*.

2001/2002

Funds received early in the financial year from the Coasts and Clean Seas program enabled extensive Phoslock™ applications and monitoring to be conducted on the Canning River over the summer period. A total of 45 t of Phoslock™ was applied to a 1.6km section of the Kent St Weir pool. Timing of Phoslock™ applications was constrained by problems with the Phoslock™ mixing process. The first application of 30 t occurred in November 2001 and the balance of 15 t was applied in January 2002. Monitoring of water quality was conducted from October to May. Water quality in the weir pool was relatively good for most of the summer period but a cyanobacterial bloom formed near Kent St Weir in March 2002. Warning signs were in place until 23 April 2002.

The following reports were produced:

- Stauber, J.L. 2001. *Canning River 2001 Phoslock™ Field Trial: Ecotoxicity Testing report*. Prepared for CSIRO Land and Water and the Water and Rivers Commission.
- Stauber, J.L. 2002. *Canning River December 2001 Phoslock™ Field Trial - Ecotoxicity Testing report.* Prepared for CSIRO Land and Water and the Water and Rivers Commission.
- Robb M. and Douglas, D., 2002, in prep. *Application of Phoslock™, an innovative phosphorus binding clay, to two Western Australian waterways – preliminary findings.*

A final report by CSIRO Land and Water on the February 2001 and December 2001/January 2002 field trials is still in preparation.

Three locations on the Mills St main drain were also monitored from December 2001 through to May 2002 to see the nutrient concentrations in various parts of the drainage system and their variation over summer. A small trial application of Phoslock™ was conducted in May on a 250m section of the drain adjacent to the Mills St compensating basin. The work in the Mills St drain was not strictly relevant to the Action Plan recommendations that the Sediment Remediation project addresses, but reflected a growing concern with the inputs of the drains to the Canning River over summer. It also offered an opportunity to see if Phoslock™ could be applied to catchments.

2002/2003

Field trials involved application of 26t dry equivalent Phoslock™ to a 1500m reach of the Canning River. The monitoring program was expanded to collect data on the abundance and distribution of cyanobacterial resting spores as well as water quality within the weir pool.

As well as work on Phoslock™, a mesocosm trial using flocculating clay was undertaken. In the USA, the application of suspended clay particles is considered a promising method to flocculate and settle out algal cells. In Western Australia, CSIRO Land and Water has been developing a potential treatment option involving the use of a modified clay with a net positive charge (and have lodged a provisional patent application). A one-day field trial in the Vasse River (in the southwest of Western Australia) in February 2002 produced a substantial decline in algae. The mesocosm trial showed similar results. Considerable research remains to be done, and is the subject of a confidentiality agreement between CSIRO, Independent Metallurgical Operations, and the Department of Environment.

2003/2004

Ongoing monitoring of cyanobacterial resting spores in the Canning River was carried out. Support was provided for Phoslock™ applications in the Mills St and Liege St catchments, including of monitoring in the Mills and Liege St catchments. There was a change in focus from the river to the catchment in response to the Nutrient Intervention Program.

Murdoch University Honours student studying algae/macrophyte interactions in Canning and Vasse Rivers were sponsored and assisted. There is the potential for macrophytes to play a role in suppressing algal blooms (eg shading the phytoplankton, and/or completing for nutrients). Conversely, the decomposition of large areas of macrophytes can release nutrients and fuel blooms.

A field trial using flocculating clay in the Kent St Weir pool was undertaken in February 2004, during a blue-green algal bloom. The data of this trial are presently being analysed and written up.

Support was provided to prepare an Expression of Interest calling for new nutrient intervention technologies.

Overview

Extensive toxicity, ecotoxicity and environmental impact assessments conducted throughout the trials indicate that Phoslock™ has negligible toxicity to a range of tested organisms and causes minimal environmental disturbance. Modification of application techniques will further reduce any disturbance.

Phoslock™ is effective in intercepting P released from the sediments and can strip dissolved P from the water column when applied as a slurry. This and previous studies showed that this technique will only be effective in controlling algal blooms in combination with source control and sensible catchment management. Although Phoslock™ is very effective at immobilising phosphorus in the sediments of the Canning River, there is still sufficient phosphorus input from drains/groundwater to maintain algal blooms. In this respect, Phoslock™ has considerable potential for use in the treatment of urban and rural drains, and agricultural sources.

This project has developed knowledge that has enabled evaluation of other techniques and sediment remediation options for State-wide waterways. The Canning field trial results have also provided valuable insight to the ecosystem response to reduced nutrient concentrations in summer. This has focused attention on interactions between algae and other primary producers (macrophytes) in the Kent Street weir pool, as well as forcing a more rigorous approach to identifying all summer nutrient sources entering the Canning River.

Although the major component of the sediment remediation work involves Phoslock™, other sediment remediation possibilities have been investigated. These include the flocculating clay trialled in February 2004, and others such as the use of zeolite to reduce nitrogen as ammonia. In addition other algal remedial techniques such as the use of barley straw were evaluated as they became known. To date, Phoslock™ and flocculating clays still offer the most promise.

6.4.4 Status of Action Plan recommendations

The following Action Plan recommendations are addressed by the Sediment Remediation project:

Recommendation 7.3 *Develop sediment remediation methods to an operational scale and apply the technique in the Swan and Canning Rivers to reduce nutrient availability.*

Recommendation 7.4 *Develop and evaluate new river intervention techniques to reduce algal blooms.*

Table 6.8 Status of Recommendations 7.3 and 7.4

Rec'n No.	Status	Outputs & Outcomes
7.3	Partially achieved, ongoing.	**Outputs** Methods using Phoslock™ have been developed and applied to the Canning RIver. Techniques have yet to be developed that can be applied to the Swan River. **Outcomes** ***Environmental*** Phoslock™ considerably reduces phosphorus availability in the sediments, but there are still sufficient nutrient sources entering the Canning to sustain algal blooms.
7.4	Partially achieved, ongoing	**Outputs** New river techniques are being developed and/or have been evaluated, but none has yet proved to reduce algal blooms in the Swan-Canning system.

6.4.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for Sediment Remediation are provided below (Table 6.9).

Table 6.9 Gaps/key issues for the Sediment Remediation project

Project	Gaps/ Key issues
Sediment Remediation	• Phosphorus release from sediment reduced • Up to 95% reduction in available P • River still N limited • Drain inputs provide enough P for growth • Aquatic vegetation - key role in nutrient cycling • Phoslock™ can be applied to source control

6.4.6 Future plans by project staff

Future plans identified by project staff for the Sediment Remediation project are provided below (Table 6.10).

Table 6.10 Future plans for the Sediment Remediation project

Project	Future
Sediment Remediation	• Phoslock™ • Currently only in freshwater • Effective in sediment and water column • Effective in drains or end point polishing • Drippers in drains, even to Ellen Brook and Sthrn River Scale • More efficient dosing technology • Now at $1500 tonne • Evaluation of commercial supply - QA • Evaluating other techniques eg Floccing clays and myriad off the wall

6.4.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Three interviews with project personnel.
- Swan River Trust, 2000. *River Science 17. Phosphorus in the Canning – 1999–2000 Phoslock™ trials*. Swan–Canning Cleanup Program publication, Swan River Trust, Perth , Western Australia.

- Department of Environment, 2004. *Mills Street Macroinvertebrate Monitoring Project – Phoslock™ Project*. Internal Report prepared by Aquatic Sciences Branch, Department of Environment, Perth, Western Australia.

6.5 SCCP Landfill leachate investigation

6.5.1 Situation

Groundwater and surface drainage from waste disposal sites can be significant sources of nutrients and other contaminants to waterways. Older waster disposal sites pose a greater risk that newer sites, as the latter tend to be better sited, or have lined disposal pits and other features to minimise environmental impacts. The Action Plan identified many abandoned landfill and liquid waste disposal sites that were close to drains entering the Swan-Canning system, with the amount of groundwater flowing through them considered a key factor in their potential impact.

The SCCP landfill leachate investigation was initiated in 2000/2001 to:

- Better quantify the impact of the old landfills to determine the relative effort that should be devoted to addressing this issue.
- Identify how and where nutrients enter the Swan-Canning system, and if they are a significant nutrient source either historically or on a continuing basis.
- Examine both total flux of nutrients and also seasonal inflow of nutrients, as groundwater inflow continues during summer could be a significant factor in localised algal blooms.

The first site to be examined was Centenary Park on the Canning River, and work was undertaken as a joint project with the Chemistry Centre of WA. Drilling and construction of a series of monitoring bores followed by groundwater sampling and analysis, was the proposed method of investigation. The required project outcomes were defined as follows:

- Assessment of the groundwater discharge zone from the abandoned landfill site entering the river system;
- Increased understanding for local and state agencies on the environmental impact and management of the abandoned landfill sites near the river;
- Refinement of a method that will provide a benchmark for assessing potential impact from landfill leachate bordering the Swan-Canning Estuary;
- Initiation of co-responsibility between key stakeholders agencies in the management of old landfill sites that continue to be a pollution risk to the river systems; and
- Promotion of joint funding arrangement with other stakeholders to continue assessing the other neglected landfill sites bordering the Swan-Canning Estuary.

6.5.2 Inputs

Action Plan funding in 2000/2001 was approximately $2,964 (salary) and $1,800 (operational). The Chemistry Centre of WA contributed chemical services (analysis and advice) to the value of $8,000 and approximately $3,000 in salary, plus on-costs from the Land Use Impacts Branch of the Science and Evaluation Division.

6.5.3 Outputs and Outcomes

Historical assessment of the site, bore construction, bore surveying and groundwater sampling have been completed. A total of 14 bores was constructed across the site, and offsite between the site and the Canning River. Initial results of groundwater sample analysis indicated that high levels of nutrients occurred in the groundwater down gradient of the landfill. Scoping of the second stage of investigation has been partially completed, which was likely to include offshore bore installation in the Canning River to measure the direct impact of the landfill leachate on the River.

The project was not funded after the first year. Un-interpreted data are available on the Department of Environment database.

6.5.4 Status of Action Plan recommendations

The SCCP Landfill Leachate Investigation project addressed the following recommendations:

Recommendation 7.6 *Evaluate nutrient and pollution risk from former landfill sites bordering the rivers and drains.*

Recommendation 7.7 *If risk is unacceptable undertake appropriate management action to reduce nutrient and pollutant leaching from former landfill sites bordering the rivers and drains.*

Table 6.11 Status of Recommendations 7.6 and 7.7

Rec'n No.	Status	Outputs & Outcomes
7.6	Not achieved	Groundwater bores installed and groundwater samples collected and analysed. No data interpretation or reporting appears to have been done.
7.7	Not achieved	Not carried out.

6.5.5 Gaps / Key issues identified by project staff

This information was not provided.

6.5.6 Future plans by project staff

This information was not provided.

6.5.7 Sources of information

- SCCP Evaluation Project Pro Formas.

6.6 Canning River Management Plan

6.6.1 Situation

The Canning and Southern Rivers and Wungong River (hereafter referred to as the Canning River system) are a significant natural asset of the southern suburbs of Perth. The Canning River system is an important ecological corridor that provides a source of drinking water and recreational opportunities to the Perth community. It also has important cultural and spiritual significance to Aboriginal communities and historical significance to people in the Canning catchment.

As with many urban river systems, the Canning River system is showing signs of stress from its multitude of uses, not least of which is an estimated 96% reduction in historical flows due to damming of its tributaries for potable water. Water is

manually released from environmental release points along the rivers by the Water Corporation as directed by the Department of Environment. Historically, the releases were undertaken as a means of providing irrigation supplies for nearby properties, but in recent times the emphasis has changed to also provide water for ecological and environmental needs. The Kent Street weir also ensures that the system effectively becomes a freshwater pool for much of the year, by blocking tidal flow up the river. River pools are stagnant and anoxic, the foreshores degraded, and urban drains discharge poor water quality into the system. Intense, often toxic algal blooms have been regularly recorded in the river system since 1994, an indication that it is under significant stress. There is a high degree of community concern about the health of the Canning River.

The SCCP Action Plan identified that better management of dam releases and manipulation of the Kent Street Weir was required as a means of improving the river flow regimes of the Canning River system. It also recommended that these and other issues be addressed in integrated solutions within the development and implementation of a management plan. These tasks were addressed in the Canning River Management Plan project.

6.6.2 Inputs

The Action Plan has provided a total of $205,358 to the Canning River Management Plan Project over the past five years. The majority of this funding (approximately $170,000) was provided in the first two years while the Management Plan was being developed. For the past three years, only $10,000-$15,000 per year has been allocated by SCCP funds (SCCP 5 year budgets from PMS). External funding for this project was obtained in 2003/2004 from NHT2 ($64,000 for salary) and the Water Corporation ($9,750 for operational costs) for work on Environmental flows.

6.6.3 Outputs and Outcomes

Caring for the Canning

Preparation of the development of a management plan for the Canning River commenced in 1999/2000, with the appointment of an Environmental Officer and Steering Committee for this project. Soon after, a Working Group of local stakeholders was established to assist in the development of the plan.

A draft management plan was compiled in 2000/01 and released for public comment; and was subsequently revised and finalised in 2001/2002. The final management plan "Caring for the Canning – A plan to revitalise the Canning, Southern and Wungong Rivers" was launched at the 2002/2003 SCCP Community Forum.

The 'Caring for the Canning' Management Plan was prepared to complement an existing management framework for the Canning Catchment. It is a river management plan, and as such focuses on the riparian zone, dealing with catchment issues where appropriate. The major issues affecting the Canning River system that were identified were:

- Flow in the Canning River system has been significantly reduced. This has contributed to the degradation of ecological values, a loss of river power and flooding flows.
- Meeting the ecological water requirements of the river along will not improve the ecological health of the river. It is only one part of river restoration and management.

- The Kent St Weir creates an impounded body of water upstream of the weir during summer. Low flow and insufficient mixing of the water column leads to conditions favourable to algal blooms;
- There has been a loss of social focus and importance of the Canning River system. Community awareness and knowledge of river management issues need to be raised to promote behavioural change and community participation in catchment and river management;
- The Canning River is still highly utilised for private abstraction. Abstraction peaks during periods of low flow and over-abstraction can contribute to drought.
- Nutrient losses from a variety of land uses reach the river, and contribute to algal blooms. Improved nutrient, contaminant and water management within each land use is required to reduce losses from the land to surface water and shallow groundwater that subsequently enters the river system;
- Many tributaries have been modified into drainage networks. This had led to a loss of tributary habitat, biodiversity, landscape amenity and recreational opportunity, and ability to process nutrients. Drains can have ecological value and improve nutrient retention and processing functions if they are properly designed and maintained.
- Fringing vegetation has been lost through stock grazing, human development and the creation of drains.
- River pools are an important summer refuge for aquatic and terrestrial flora and fauna. River pools have been lost due to sedimentation and modification of the flow regime.
- Urban development in the Canning Catchment is growing at a rapid rate. Development often results in increased nutrient export if best management practices are not incorporated into developments.

Objectives, management responses, recommendations and responsibilities have been derived to address each of these key issues in the management plan.
The vision of the plan is to "revitalise the Canning River to a healthy ecosystem where algal blooms are kept to a minimum and a diverse range of aquatic life exists, and to ensure it is a resource that can be enjoyed and used responsibly by all people". To achieve this vision, the Working Group developed a number of recommendations that will be implemented through seven management programs. The seven management programs are:

- Manage flow regime;
- Manage Kent St Weir;
- Implementation and training in best management practices;
- Environmental evaluation and monitoring;
- Legislation and policy development;
- Restore riparian zone and ecological function; and
- Increase awareness and participation in catchment and river management.

Each of the proposed recommendations has been assigned to an organisation that is considered to have key responsibilities in a particular area. It will be responsibility of each of these organisations to facilitate the implementation of specific recommendations contained within the plan, in consultation with key stakeholders. The plan is being implemented and its future success will rely on coordinated approach with a number of organisations and groups working together in partnership

to achieve the vision identified in the plan. The plan is intended to guide certain aspects of river management in the Canning Catchment for the next five years (i.e. to 2007). It is assumed that after this time, the recommended actions and management programs will need to be revisited by the major stakeholders operating in the catchment.

Canning Environmental Flows project

As part of developing "Caring for the Canning", it was important for the Water & Rivers Commission to determine the Ecological Water Requirements (EWR) of the Canning River system. A number of activities regarding EWRs were undertaken, during the management plan's development, including:

- Environmental Water Requirements Workshop was held with stakeholders and the community (1999/2000);
- A comprehensive environmental water requirements study to determine the water requirements of important ecological values of the river. This included fish, macro-invertebrates, vegetation and flows required to maintain pools and flush out sediment. The study also identified a significantly modified flow regime with a lack of seasonality of flow. This is due to the regulation of this river system through construction of water supply dams, private dams, riparian and licensed water usage along the river and installation of weirs.
- An ecological monitoring program was established.

After the delivery of the Caring for the Canning management plan, the Canning Environmental Flows project was established. This project aims to revitalise the Canning River System through the development of environmental water provisions that appropriately account for ecological, social, consumptive and economic water requirements of the river system. An Environmental Water Provisions Work Plan was prepared in consultation with Water Corporation, Canning Catchment Coordinating Group, Armadale Gosnells Landcare Group and Local Government in 2002/2003.

This project is currently in its first year of implementation, following the appointment of a full-time project coordinator to the Canning Environmental Flows Project in 2003 (NHT2 funded). A community-based steering committee – the Canning Environmental Flows Steering Committee – was established in 2003/2004 to guide the development of establishing interim Environmental Water Provisions for the Canning River System. An Inter-agency Technical Working Group (TWG) was also established in 2003/2004, comprising relevant experts within Department of Environment, SRT, University of Western Australia and Water Corporation.

A flow investigation program strategy has been developed by TWG in consultation with Steering Committee and consultant. Gauging stations have been installed, and flow investigations have started. It is envisaged that establishing environmental water provisions for the Canning River System will be a 5-staged process taking place over a 5-year period, as follows:

Stage 1: Identify social, economic and ecological values.
Stage 2: Investigate and model flows and undertake baseline ecological monitoring.
Stage 3: Trial flows and monitor.
Stage 4: Determine Environmental Water Provisions.
Stage 5: Prepare water allocation plan.

This project also works towards achieving regional outcomes in that it is establishing a framework/model for development of environmental water provisions that can be applied to other river systems within the region; and is building partnerships between State government, local government, catchment and community groups, local communities and the Water Corporation.

Communication and promotional activities

The Canning River Management Plan project included the following communication and promotional activities:

- Holding the Canning River Festival in 2000/01 and 2001/02;
- Publication of Fertilise Wise brochure in partnership with Phosphorus Action Group, and preparation of "Flows in the Canning River System" brochure;
- Articles featured in: Living on the River (local landcare group newsletter); Riverview (SRT); The Swan (Swan Catchment Council newsletter);
- Public advertisements and media statements in local newspapers notifying wider community of workshops;
- Three 'Desired Future State' Community Workshops held in consultation with Steering Committee during November & December 2003;
- Presentations: Environmental Water Requirements given at three community workshops; Allocation processes for the Canning & Wungong Rivers to Steering Committee.
- Project coordinator gave presentation about process of determining Environmental Water Requirements/ Provisions for the Canning to River Restoration Workshop participants in December 2003.
- Project information updated on website.

Constraints / Opportunities for improvement

Project staff identified the following project constraints:

- There is a reluctance of the Water Corporation (with prime responsibility of controlling discharges along the Canning River) to make a long term financial commitment towards the project;
- Trial release was postponed due to Water Corporation reluctance to trial additional flows in summer due to drought conditions;
- Community consultation workshops not as well attended as anticipated. It has been difficult to engage enough people to participate (2003/2004); and
- Lack of security with ongoing funding.

A key achievement of this program so far has been the partnerships that have been formed between state government, local government, Water Corporation and the community, and the time that each of these stakeholders has invested in the project. A keen community-based steering committee has been formed, and an enthusiastic panel of experts make up the technical working group. The project team is keen to continue with the work required, however at this stage continued funding for the coordinators position (provided externally through NHT) is uncertain.

6.6.4 Status of Action Plan recommendation

The Canning River Management Plan project addresses the following recommendation:

Recommendation 7.8 *Develop and implement a management plan for the Canning River based on environmental flow allocations and controlled discharges from the Kent Street Weir.*

Table 6.12 Status of Recommendation 7.8

Rec'n No.	Status	Output / Outcome
7.8	Achieved, ongoing	**Outputs** ***Environmental*** Caring for the Canning: A plan to revitalise the Canning, Southern and Wungong Rivers was finalised in August 2002. Implementation of the management plan is underway, particularly addressing environmental flow allocations. Options for controlled discharges from the Canning Reservoir to Kent Street Weir are being investigated. **Outcomes** The consultation and promotional activities undertaken during preparation of the Caring for the Canning management plan has led to the following outcomes: ***Environmental*** ICM is being undertaken by associated catchment groups. ***Social*** There is increased public awareness and knowledge about the Canning River system. Partnerships have been formed between state government, local government, Water Corporation and the community.

6.6.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for the Canning River Management Plan project are provided below (Table 6.13).

Table 6.13 Gaps / Key issues for Canning River Management Plan project

Project	Gaps/ Key issues
Canning River Management Plan	• Chlorine concentration in releases toxic to aquatic fauna? • Inter-catchment transfer of water down the Birrega drain & loss of water released for the Wungong River • Kent Street Weir

6.6.6 Future plans by project staff

Future plans identified by project staff for the Canning River Management Plan project are provided below (Table 6.14).

Table 6.14 Future plans for the Canning River Management Plan project

Project	Future
Canning River Management Plan	• Develop EWPs and manage flows accordingly • Continuous monitoring & review of EWPs • Developing a framework to be applied to other regulated river systems eg. Helena River • More strategic planning of projects within the region eg. River restoration

6.6.7 Sources of information

- Interviews with project personnel.
- SCCP Evaluation project Pro Formas.
- Storey, A., P.M. Davies & S. Creagh. 2002. *Preliminary Ecological Water Requirements for the Canning River System.* Report prepared for the Water & Rivers Commission, June 2002.
- Swan River Trust, 2002. *Caring for the Canning. A plan to revitalise the Canning, Southern and Wungong rivers.*

7. Action Area 4: Monitor river health, fill critical gaps in knowledge and report progress to the community

7.1 Background

The Action Plan requires effective monitoring of the catchment and estuary to track trends in water quality, measure compliance against management targets, and determine the effectiveness of catchment and estuary management measures. This needs to be supported by a well directed and applied research program, to ensure constant improvements in management and decreased risks in decision making. The importance of community involvement in the Action Plan, plus the need for accountability, also demands that monitoring and research results be reported to the community on a regular basis.

7.2 Action Plan recommendations

Action Plan recommendations for Action Area 4 are listed in Table 7.1 along with the main Action Plan projects developed to address them. Table 7.1 also lists the section of this document where each project is discussed. It should be noted that no Action Plan projects were specifically developed to address recommendations 9.6, 9.7 and 9.8

Table 7.1 Action Area 4: recommendations and Action Plan projects

Rec. No.	Recommendation	Action Plan Project	Document section
8.1	Adopt recommended water quality targets for the freshwater tributaries (Table 8) of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan	53091 Environmental performance & progress reporting 53097 Water quality & quantity measurement 53123 Logistical support – Environmental performance & reporting	7.3
8.2	Prepare water quality targets and a compliance table for the estuarine and tidal portions of the Swan-Canning system for nutrients, dissolved oxygen, chlorophyll and phytoplankton cell counts		
9.1	Implement a monitoring program and report on: all water quality data and compliance against targets annually; water quality trends at intervals of 3 years; success of catchment management actions after 5 years; data against goals and objectives targets established by the Action Plan every 5 years		
9.2	Investigate nitrification-denitrification and carbon cycles in relation to estuarine sediment nutrient cycling	53112 Sediment nutrient cycling	7.4
9.3	Complete development and validation of estuary and catchment models and use them to model system fluxes of nutrients including carbon	53096 Decision support modelling	7.5
9.4	Develop decision support systems to predict and demonstrate the consequences of changes to the catchment or the estuarine system, to optimise management practices		
9.5	Develop expertise within the WRC in the application of WAERF estuarine process and decision support models		
9.6	Evaluate the relationship between zooplankton and low levels of contaminants other than nutrients in the Swan-Canning system	No project.	n/a
9.7	Investigate sediments in areas for potential dredging in the Swan River	No project.	n/a

Rec. No.	Recommendation	Action Plan Project	Document section
9.8	Investigate sediments in relation to groundwater flows and nutrient fluxes in the Canning River	No project.	n/a
10.1	Coordinate reporting to the community and ensure that there are opportunities for community feedback on implementation of the Action Plan	53091 Environmental performance & progress reporting	7.3

7.3 Environmental performance & progress reporting

7.3.1 Situation

The Environmental Performance and Progress Reporting project is based around a monitoring program that collects water quality information from estuarine-tidal portions in the Swan-Canning Estuary every week, and from the major tributaries on the coastal catchment every two weeks. The riverine portion of the Canning above Kent St Weir, and event and reactive sampling are also included in this sampling program. The project is undertaken and managed the Aquatic Sciences Branch of the Water and Rivers Commission.

The program follows on from a three year intensive data collection phase carried out during the development of the Action Plan, and that was completed in 1997/98. In 1998/99 the program was modified to include trial compliance water quality monitoring with the aim of reducing some routine monitoring to allow funds for some intensive events-based data collection. This was continued in 1999/2000, when implementation of the Action Plan commenced.

Routine monitoring program

Weekly water samples collected from the Swan-Canning estuary and the Canning River are analysed for nutrients, phytoplankton species and phytoplankton cell density. Nine sites are sampled in the Swan Estuary and seven sites in the Canning, with an additional four sites in the Canning during summer to provide early warnings of blooms (Figure 7.1). Vertical profiles of conductivity, temperature, oxygen, pH and turbidity measurements are also taken at each site. The analysis of phytoplankton species and cell density provides for public health warnings where appropriate. The program is also tightly linked to monitoring field trials and experiments associated with river intervention projects funded by the SCCP Action Plan (see Section 6).

In the catchment sampling program, water samples are collected bi-weekly, and analysed for nutrients, conductivity and total suspended solids at 15 sites (Figure 7.2). Sampling is focused on 'bottom of catchment' measures rather than assessment of catchment or stream condition. The water level at each site is also recorded from a staff gauge or by other means. At some locations, gauging stations are operated by the Swan Region of the WRC and the Water Corporation, and provide continuous flow data. Three stations have Continuous Load Auto-Samplers maintained by the Aquatic Science Branch, with the third unit recently commissioned in 1998/99.

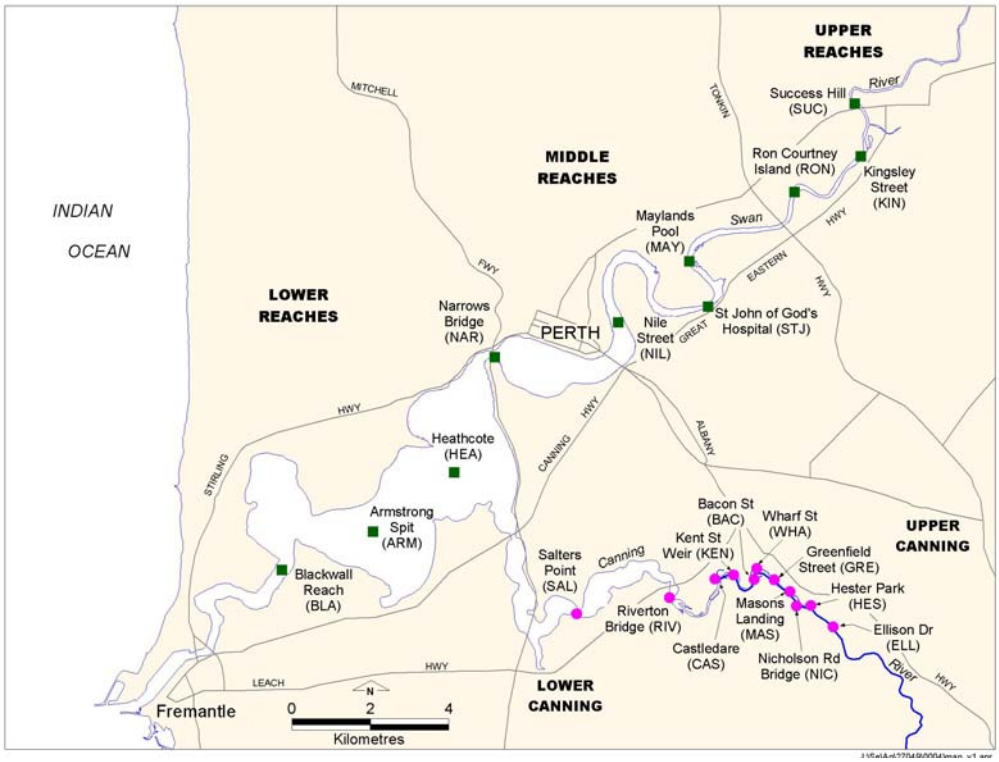


Figure 7.1 Sampling sites for Swan-Canning weekly monitoring program

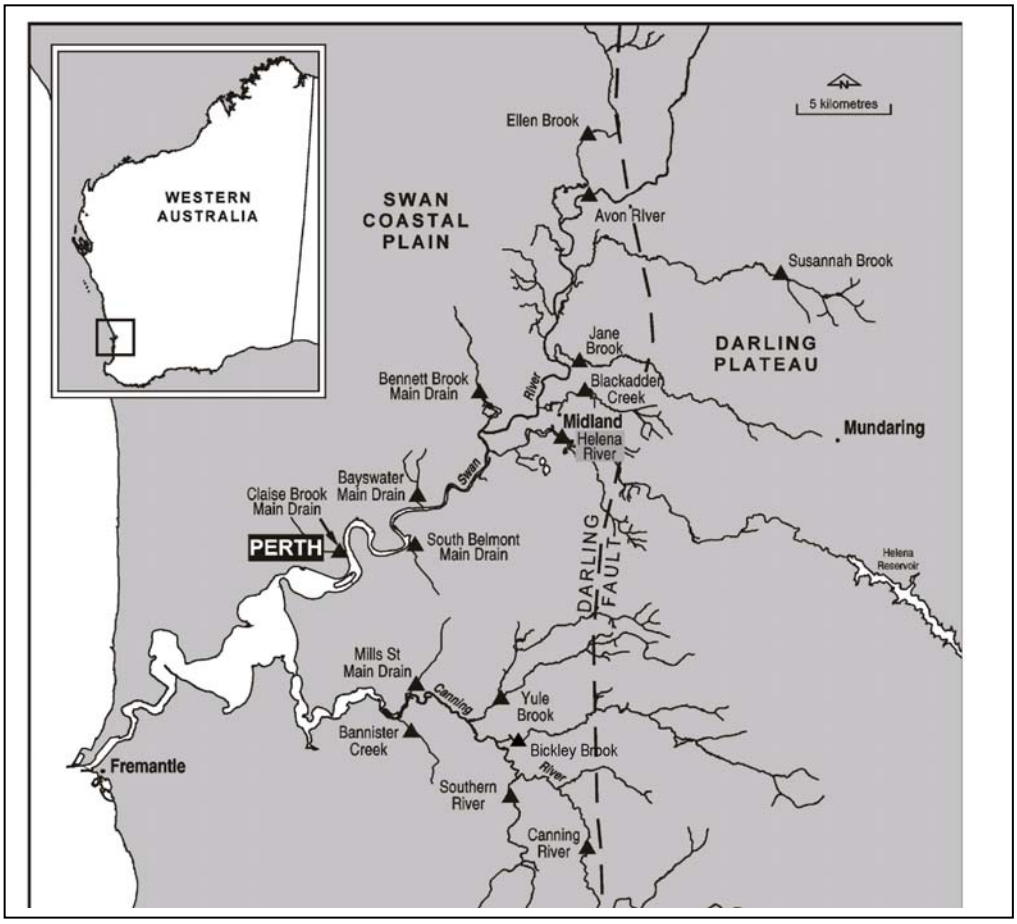


Figure 7.2 Sample sites for bi-weekly monitoring of catchments

Water quality targets

With the Action Plan's emphasis on compliance monitoring, it was necessary to develop and implement rigorous data management and retrieval procedures. Catchment and estuarine water quality targets were developed, and a compliance measurement program developed and tested against the targets. Catchment targets and estuarine targets are now reported as annual effectiveness indicators.

Indicators chosen for SCCP Action Plan targets were water quality indicators measuring environmental characteristics that will be influenced by Action Plan management initiatives. The indicators chosen were:

- Catchment monitoring: Total nitrogen and total phosphorus concentrations.
- Swan-Canning estuary monitoring: chlorophyll a concentrations (a measure of phytoplankton abundance), the number of blooms of gazetted toxic species of phytoplankton, dissolved oxygen concentrations, total nitrogen and total phosphorus concentrations.

Catchment targets

Catchment targets were based on a 1997 SRT classification scheme for tributaries of the Swan-Canning catchment, which was developed using 10 years of nutrient data. In recognition of the long time frames required for catchment management to affect nutrient levels, both short-term and long-term targets were developed (Table 7.2). The long-term targets correspond closely to default trigger values for slightly disturbed lowland rivers in south-west Australia, that are recommended in national water quality guidelines (ANZECC/ARMCANZ, 2000).

Table 7.2 SCCP Action Plan targets for median (50th percentile) total nitrogen and total phosphorus

Target	Total nitrogen	Total phosphorus
Short-term	2.0 mg/L	0.2 mg/L
Long-term target	1.0 mg/L	0.1 mg/L

Compliance with catchment targets is based on a statistically robust approach, using data from the main river discharge period in **winter/spring**. Data from three years are combined (giving a total of about 30 samples) and used to calculate the number of samples that exceed the target value, and the 90% confidence value associated with the number of exceedances. Compliance or non-compliance is based on whether the 90% confidence interval lies above (= exceedance) or below (= compliance) the target value. Decisions on compliance or non-compliance also depend on the condition of the waterway in previous years, as follows:

- If the waterway was previously non-compliant, then the 90% confidence interval must be below the target before compliance is inferred.
- If the waterway was previously compliant, then the 90% confidence interval must be above the target before non-compliance is inferred.

Estuary targets

The SCCP Action Plan is mainly aimed at reducing extremes in condition such as phytoplankton blooms or low-oxygen events. Therefore, rather than the 'typical' condition that is reflected in median values, Estuary targets were based on 90th percentiles for chlorophyll-a and nutrients (high values are undesirable) and 5th percentiles for oxygen (low values are undesirable) (Table 7.3).

Table 7.3 Target chlorophyll (90th percentile), dissolved oxygen (5th percentile), total nitrogen and total phosphorus (90th percentile) concentrations for the Swan-Canning estuary

Estuary	Chl. –a (µg/L)	Surface DO (mg/L)	Total N (mg/L)	Total P (mg/L)
Lower Swan-Canning	3.55	82.1	0.509	0.058
Middle Swan	8.75	75.1	0.790	0.110
Upper Swan	19.98	81.2	1.009	0.119
Middle Canning	11.67	49.1	0.790	0.190
Upper Canning	39.00	15.4	1.330	0.300

In the estuary, compliance is based on monitoring in the low flow period in **summer/autumn**, when there is less variation in climate and the risk of blooms and low oxygen is highest. For the middle and upper parts of the system, data from one of the routine monitoring sites are selected, and combined with similarly obtained data from the previous two years. A slightly different approach is used in Swan-Canning basin, where samples are obtained from a site randomly selected from a grid of sites. Both approaches provide about 60 samples, from which the relevant percentile, and the 90% confidence interval around that percentile, are calculated. Compliance/non-compliance is assessed in the same way as for the catchment targets.

Understanding the ecosystem

The Environmental Performance and Progress Reporting project provides information on the current condition of the estuary and catchment streams, and changes over time. Out of this has come process understanding, and insight into ecological function. Algal distributions over time, depth and space are measured, so that algal activity can be related to rainfall, flow, nutrients and other variables. The monitoring program was developed in such a way that understanding has grown of nutrient delivery locations, rates and changes over time, for example, the importance of base flow over storm flow, the relative importance of different sub-catchments, and the influence of urban drains versus rural streams for nutrient delivery.

Informing stakeholders and the community

The community is informed about the state of the Swan-Canning system through web-based information on water quality that is updated on a weekly basis, and through informed through brochures, annual reporting and community talks. The website provides for community feedback.

Project objectives

The objectives (and therefore the associated tasks) of this project are as follows:

1. Collect data on nutrient concentrations and water quality parameters in the estuarine portions of the Swan-Canning River System which are sufficient to detect trends in nutrient concentrations over time.
2. Document phytoplankton species succession throughout the year. Provide health warnings and alerts where appropriate for phytoplankton blooms
3. Develop an understanding of the annual variability in phytoplankton communities in response to environmental factors.
4. Provide a response capability for the Swan River Trust in the event of pollution incidents and algal bloom activity.
5. Report against catchment and estuarine targets set for the program.
6. Support the development of models and decision support tools.

7. Provide reports and information to the SRT, WRC and community on water quality issues in the SCRS based on data collected over the last six to seven years.
8. Provide support to community and catchments groups within the constraints of the budget.
9. Provide data for research on basic biogeochemical processes conducted as part of the SCCP program.
10. Provide support to the Swan Regional Strategy.

7.3.2 Inputs

Action Plan funding for Environmental Performance and Progress Reporting is shown in Table 7.4. Although essentially one project, it is funded as three separate components, as follows:

- Environmental Performance and Progress Reporting.
- Water Quality and Quantity Measurement. This is essentially staffing support for the continuous and non-continuous stream flow monitoring of tributaries to the Swan and Canning Rivers, the weekly sampling of the Swan and Canning Rivers, and the maintenance and calibration of instruments and laboratory equipment.
- Logistical Support supplies the SRT vessel (boat) and staff support for water sample collection (in the rivers and catchment), including preparation of sample collection bottles and chain of custody forms.

Table 7.4 Funding for the different components of Environmental Performance and Progress Reporting

Year	Environmental Performance & Progress Reporting	Water Quality and Quantity Measurement	Logistical Support	TOTAL
99-00	$606,564	$55,240	-	$661,804
00-01	$568,125	$56,000	-	$624,125
01-02	$429,340	$108,476	$51,068	$588,884
02-03	$450,593	$108,455	$72,357	$631,405
03-04	$450,000	$108,480	$62,157	$620,637
TOTAL	**$2,503,622**	**$436,651**	**$185,582**	**$3,126,855**

7.3.3 Outputs and Outcomes

1999/2000

The following activities were completed:

- Sampling and Analysis programs were developed;
- Staff were recruited and trained.
- QA program and QC procedures were implemented.
- Database ('WIN' database) development continued.
- Reporting schedules were defined and delivered.
- All samples were collected as planned, and analysed.
- Catchment sites were surveyed and status of gauging documented.

- Partnership agreements were made with SRT depot and Swan Goldfields (SGA) Agricultural Region office of the Department of Environment region, for support in matching projects.
- A public information brochure series 'River Science' was started. These educational brochures target members of the community seeking further understanding of the science behind the Action Plan, and are a resource for extension groups such as the Swan Catchment Centre.

2000/2001

Routine monitoring program

- The routine water quality monitoring progam was carried out as planned.
- The involvement of SGA staff in estuarine work was negotiated.
- There was a full-scale response to a *Microcystis* bloom in February 2000 (including issuing of health warnings), demonstrating a broad skill base applied to incident response from sampling, toxicity determination, incident response management, information management and reporting.
- Phytoplankton identification and enumeration skills and general knowledge on algal biology and ecology developed to very high proficiency levels. The WRC laboratory responsible for identification and analyses (the Phytoplankton Ecology Unit) has become well known throughout Australia.

Data management

Backlogs in important data sets were eliminated. Some data still require validation and input but the database is current, and is an efficient process for analysing and regular reporting that has been refined and taught to all staff. Information requests for the Action Plan program were met.

Reporting and publications

- Information was prepared for the SRT Annual Report and SCCP Annual Progress report.
- Draft technical reports were prepared on long term water quality trends in both Swan and Canning Rivers and catchment.
- Planned community educational documents such as River Science have all been completed and most printed and released to the public.
- Technical information and River Sciences have been put on the SRT website for Internet access.

Other activities

A fish stress biomarker study was established through an ARC linkage study with Dr Monique Gagnon at Curtin University, and was extended to 2002.

2001/2002

Routine monitoring program

The routine water quality monitoring program was carried out. Operation of auto-samplers at Ellen Brook, Mill St and Walyunga was partly covered by a WRC project. Catchment sampling by SRT staff was supervised and coordinated, and audit of flow measurement activities was undertaken.

Data management

- Data management is now streamlined with good QA and verification procedures, but will always be critical and time consuming task.

- Analysis and interpretation of water quality data was completed, and weekly updates provided for the SRT web site.
- Development of management targets for the catchment and estuary was completed, including data collection requirements for comparison against targets.

Reporting and publications
Information was prepared for the SRT Annual Report (including information on Progress indicators) and SCCP Annual Progress report.

Advice
Ongoing advice to SRT, community groups, local government and internal WRC branches on a wide range of issues of relevance to the SRT and the Swan-Canning catchments and estuaries.

Additional activities
The Fish stress biomarker study with Dr Monique Gagnon (Curtin University) was completed.

2002/2003

Routine monitoring program
The routine water quality monitoring program was carried out as planned. There was also a full scale response to a *Karlodinium* bloom and fish kill from about May through to following year, involving considerable additional sampling, and phytoplankton identification from the whole Phytoplankton Ecology Unit staff, and substantial toxicity testing and information gathering from national and international sources. Samples were sent to Tasmania and USA. Considerable effort was required from all staff to support the SRT in meeting media requests and deadlines.

Although the focus of work remained on nutrient-based effects on water quality, there was increasing emphasis on the impact of non-nutrient contaminations from the catchment on the estuary (these issues were identified but not initially funded as part of SCCP Action Plan). A full scale response was initiated to putative contamination from the Bayswater area of the Swan, potentially related to the fish kill. Contamination from industry and acid sulphate drainage were both suspected causes at the same time as publicity on CSBP contamination in groundwater was in the press. Considerable additional sampling and reporting was required by staff over several months, with the intense effort required due to the high media profile. Considerable support was also provided to Department of Environment staff over a drain contamination issue that arose at Brookdale.

Data management
Data verification and data management was kept up to date. Weekly and monthly water quality and phytoplankton reports were prepared, including posting of weekly water quality reports to the SRT website.

Reporting
- Input was provided to the Action Plan annual report, and to the SRT Annual Report (including information on Progress indicators).
- Presentations of trends and results of monitoring were made at the Australian Marine Science Association and Australian Society of Limnology conferences.

Publications
The following River Science brochures were completed and submitted in draft form to the SRT for publication approval:

- River Science 3. Algal blooms in the Swan-Canning Rivers: Patterns causes and history.
- River Science 4. Nitrogen and phosphorus cycles.
- River Science 7. Setting Targets: measuring the success of the Swan-Canning Cleanup Program.
- River Science 8. Seasonal Nutrient Dynamics in the Swan Estuary, 1995-2000.
- River Science 9. Seasonal Nutrient Dynamics in the Canning River 1995 - 1998.
- River Science 10. Nutrient limitation.
- River Science 11. Estimating nutrient loads in the rivers and drains of the Swan-Canning catchment.

The following technical reports were produced:

- Water Quality in the Canning Estuary 1994-1998.
- Water Quality in the Swan Estuary 1994-2000.
- Water Quality Targets for the Swan-Canning Estuary.
- Nutrient fractions in tributaries of the Swan-Canning Estuarine System (1987-2000): Seasonal and Flow variation.

Draft State of Catchment reports based on assessment of group's needs (to be made available as hard copy and posted on the web, with information included on trends, loads and targets) was submitted to the SRT for review.

2003/2004

Routine monitoring program
The routine water quality monitoring program was carried out as planned. Event sampling and fish kill response monitoring (*Karlodinium* bloom) was also carried out.

In the five years from 1999 to 2004, there has been an apparent improvement in water quality entering from the catchments, in that the number of sites meeting the short-term targets for nitrogen has increased from 12 to 15, and from 13 to 15 from phosphorus. However, this is probably due to a series of dry years, and therefore decreasing catchment runoff. There has been no evidence of any change in phytoplankton abundance in the estuary.

Data management
Data verification and data management was kept up to date, and weekly reports of Water quality posted to the SRT website.

Reporting
- Input was provided to the Action Plan annual report, and to the SRT Annual Report (including information on Progress indicators).
- Presentations of trends and results of monitoring were made at the Australian Marine Science Association and Australian Society of Limnology conferences.
- Catchment report cards were completed (after extensive community consultation).

Publications
There were extensive delays in receiving publication approval from the SRT, which slowed the release of River Science brochures. River Science no. 3 and no. 4 were returned from the SRT in July 2004. River Science 7, 8 and 9 have been printed. River Science 10 was still awaiting approval in July 2004. River Science 11 is undergoing review and update of catchment load numbers. A draft has been completed of River Science 20, Macrophytes in the Swan-Canning Estuary.

Technical reports and support completed/provided:

- Catchment Report Cards (returned from SRT in June 2004 after review).
- Preparation of papers and presentation for the Drainage Forum (see Section 2.2.2).
- Development of sampling plan for non-nutrient contaminants.
- Negotiation and workshopping with Swan Catchment Council in developing collaborative projects for regional strategy to provide leverage funding for SCCP investment.
- Completion of Bayswater contamination report.
- Completion of Brookdale drain report ready to go on web.

Constraints / Opportunities for improvement

Routine monitoring program
This is now routine and well organised. The Aquatic Science Branch supervises and coordinates catchment sampling by SRT staff, and audits flow measurement activities undertaken by SGA staff. Audits are important for quality control, and have not been as regular as planned. Quality assurance is an issue that will be revisited. Instrument maintenance is still a major work load but costs coming down with better care of instruments.

Flow data are in poor shape due to insufficient discharge measurements, especially during high flows. Gauging sites are also physically crumbling due to lack of resources for maintenance. Furthermore, only 15 of 31 sub-catchments of the coastal plain are sampled: many important urban sub-catchments are not monitored. The project will need to work through these issues in the 2004/2005 financial year. Capital will be requested from WRC for urgent gauging station repair.

The decline in flow data quality is becoming a bigger issue each year. Poor flow data are affecting modelling capability (see Section 7.5) as well as status and trends measurement. SRT may need to provide modest funding for infrastructure upgrades. This cost was originally budgeted in the SCCP program but was returned as a saving in the first year of the program at the request of the SRT.

Data management
Data management process is streamlined with good QA and verification procedures, but will always be a critical and time consuming task.

Reporting to Stakeholders, advice to community groups
Formal technical reporting has been reduced in favour of web reporting and River Science brochure style reporting. More complete technical reporting will be important at the end of the first five years collection of data: a synthesis report is due in 2004/2005. Modest additional funds have been requested (back to original project allocation).

Process understanding conceptual models have been developed. The focus for the next year is to work through the phytoplankton data to develop a more sophisticated understanding of phytoplankton response to changes in catchment nutrient delivery. More fine-scale understanding of physical processes may also be useful: for example, water quality monitoring is weekly, but information (modelled or measured) on the daily movements of the salt wedge (surface and bottom waters) may be important in understanding *Karlodinium* blooms.

River Science brochures on 14 topics have been printed, but long delays (sometimes over a year) have been experienced in getting publication approval from the SRT. The River Science brochures are in demand, and some issues are in their second print run.

Advice has been provided to SRT, community groups, local government and internal WRC branches on a wide range of issues of relevance to the SRT and the Swan-Canning catchments and estuaries.

Assistance has been provided to catchment groups, primarily relating to monitoring programs: training in sampling techniques and guidance in sampling design, particularly assisting the groups to ask the right questions. Additional training using a procedures manual developed by Aquatic Sciences Branch will continue next year, hopefully with matching NHT2 funding. To that end the Aquatic Sciences Branch has been liasing with the Swan Catchment Council and Swan Catchment Centre to better understand their programs and to develop a coherent monitoring and evaluation framework for the Swan-Canning. Many of the community groups would like the Aquatic Sciences Branch to take the lead so that only meaningful data are collected.

7.3.4 Status of Action Plan recommendations

The Environmental Performance and Progress Reporting project addresses the following recommendation:

Recommendation 8.1 *Adopt recommended water quality targets for the freshwater tributaries (Table 8) of the Swan-Canning system for the year 2005 and use this to assess performance of the Action Plan.*

Recommendation 8.2 *Prepare water quality targets and a compliance table for the estuarine and tidal portions of the Swan-Canning system for nutrients, dissolved oxygen, chlorophyll and phytoplankton cell counts.*

Recommendation 9.1 *Implement a monitoring program and report on: all water quality data and compliance against targets annually; water quality trends at intervals of 3 years; success of catchment management actions over five years; data against goals and objective targets.*

Recommendation 10.1 *Coordinate reporting to the community and ensure that there are opportunities for community feedback on implementation of the Action Plan.*

Table 7.5 Status of Recommendation 8.1, 8.2, 9.1 and 10.1

Rec'n No.	Status	Outputs & Outcomes
8.1	Achieved	**Outputs** Total nitrogen and total phosphorus targets have been adopted, refined, and a statistically rigorous basis for compliance have been determined.
8.2	Achieved	**Outputs** Statistically rigorous targets for total nitrogen and total phosphorus, dissolved oxygen and chlorophyll have been developed, and a statistically rigorous basis for compliance have been determined.
9.1	Achieved	**Outputs** A comprehensive, quality assured monitoring program for water quality in the estuary (20 sites) and catchments (15 sites) has been implemented. Compliance is reported weekly. 5-yearly synthesis report due in 2004/2005.
10.1	Achieved	**Output** Data from the water quality monitoring program are placed on the Swan River Trust's 'Algal Alert' website every week, and the community is kept informed.

7.3.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for the Environmental Monitoring Program are provided below (Table 7.6).

Table 7.6 Gaps/key issues for the Environmental Monitoring Program

Project	Key Issues / Gaps
Environmental Monitoring Program	• Money hasn't been spent on infrastructure (eg. Gauging stations) • No Research & Development budget as all R&D funds were used up with Centre for Water Research model development. • Haven't measured or technically assessed the catchments • Uninformed about on-ground works activities from Action Area 1, so monitoring of these works limited • The (DoE's) Aquatic Science Branch doesn't have the opportunity to give presentations to the SRT Board, or Catchment Officers Support Network (COSN) - and would like to.

7.3.6 Future plans by project staff

Future plans identified by project staff for the Environmental Monitoring Program are provided below (Table 7.7).

Table 7.7 Future plans for the Environmental Monitoring Program

Project	Future
Environmental Monitoring Program	• Continue existing program • Review sites, variables etc (underway) • Add light (PAR), improve turbidity* • Review targets (underway) • Infrastructure upgrade, improved maintenance • Synthesis Report (scoping) • Expand SCCP estuary and catchment program to include non-nutrient contaminants and ecosystem health indicators, • Increased source identification • Support the development of partnerships that will reduce monitoring duplication • Include community monitoring programs, Water Corp, LGA • Moreton Bay EHMP as possible cooperative model • Through Regional Strategy Development

7.3.7 Sources of information

ANZECC/ARMCANZ, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment & Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand.

DoE, 2003. *Assessment of Water, Sediment and Fish Quality in the Bayswater drains and adjacent Swan River, April/May 2003*, Department of Environment.

DoE, 2003. *Summary Report – Water and Sediment Quality in Brookdale Drains 2002-2003*, Department of Environment, November 2003.

Donohue, R. and Jakowyna, B, 2000. *Swan-Canning Cleanup Program: Trends in total phosphorus and total nitrogen concentrations of tributaries to the Swan-Canning Estuary, 1987 to 1998 (Western Australia)*, Swan River Trust Report No. 6.

Donohue, R. and van Looij, E., 2001. *The derivation of percentile quality criteria for the Swan-Canning estuary; a binomial approach*. Swan River Trust, Swan-Canning Cleanup Program Report SCCP 24.

Donohue, R. and van Looij, E., 2003. *Water Quality Targets for the Swan-Canning Estuary*. Swan River Trust, Swan-Canning Cleanup Program Report No. 29.

Jakowyna, B., 2002. *Swan-Canning Cleanup Program: Nutrients in tributaries of the Swan-Canning estuarine system (1987-2000): seasonal and flow variations*; Swan River Trust, SCCP Report No. 26.

King, K., 2003. *Sampling Guidelines for the Swan and Canning River Catchment Water Quality Monitoring Program SWEC5*. Internal document.

King, K., 2003. *Sampling Guidelines for the Swan and Canning River Catchment Water Quality Monitoring Program SWEC12*. Internal document.

King, K., 2003. *Sampling Guidelines for the Swan and Canning River Catchment Water Quality Monitoring Program SWEE7*. Internal document.

River Science Series:

- Water and Rivers Commission, 2000. *Water Quality monitoring is a vital part of the SCCP Action Plan. Swan River Trust, River Science Issue 1*.
- Water and Rivers Commission, 2000. *'Summer surprise' The Swan River blue-green algal bloom, February 2000. Swan River Trust, River Science Issue 2*.
- Water and Rivers Commission, 2000. *Algal blooms in the Swan-Canning Rivers: Patterns, causes and history. Swan River Trust, River Science Issue 3*.
- Water and Rivers Commission, 2004. *Nitrogen and Phosphorus cycles. Swan River Trust, River Science Issue 4.*
- Water and Rivers Commission, 2000. *Sources of nutrients to the Swan and Canning rivers. Swan River Trust, River Science Issue 5*.
- Water and Rivers Commission, 2000. *The delivery of nutrients to the Swan and Canning rivers has changed over time. Swan River Trust, River Science Issue 6.*

- Water and Rivers Commission, 2004. *Developing targets for the Swan-Canning Cleanup Program. Swan River Trust, River Science Issue 7.*
- Water and Rivers Commission, 2002. *Seasonal Nutrient Dynamics in the Swan Estuary, 1995-2000. Swan River Trust, River Science Issue 8.*
- Water and Rivers Commission, 2002. *Seasonal Nutrient Dynamics in the Canning River Estuary, 1995-98. Swan River Trust, River Science Issue 9.*
- Water and Rivers Commission, 2000. *Oxygenating the Swan and Canning Rivers. Swan River Trust, River Science Issue 13.*
- Water and Rivers Commission, 2000. *1998/1999 Canning River Oxygenation Trial, Swan River Trust. River Science Issue 14.*
- Water and Rivers Commission, 2000. *Report on the 1999/2000 Swan Barge oxygenation trial, Swan River Trust, River Science Issue 15.*
- Water and Rivers Commission, 2001. *Phosphorous in the Canning - 1999-2000 Phoslock™ trials, Swan River Trust, River Science Issue 17.*
- Water and Rivers Commission, 2000. *Report on the 1999/2000 Canning River oxygenation project, Swan River Trust, River Science Issue 18.*
- Water and Rivers Commission, 2001. *Aquatic plants in the Canning River, Swan River Trust, River Science Issue 19.*

Swan River Trust, 2000. *Swan-Canning Cleanup Program: Nutrients in Tributaries to the Swan-Canning Rivers and Estuarine System (1987-1998): Status and Trend, Internal report.*

Thomson, C.E., Rose, T. and Robb, M., 2001. *Seasonal Water Quality Patterns in the Swan River Estuary, 1994-1998.* Technical Report, Swan River Trust, Western Australia.

7.4 Sediment Nutrient Cycling

7.4.1 Situation

During the development of the SCCP Action Plan, considerable research was conducted on the triggers of algal blooms. As a result of that work, the sediments were identified as a major source of phosphorus (in the form of phosphate) and nitrogen (in the form of ammonium), especially during the summer. Measurements of the rate of sediment nutrient releases was therefore identified as a key information gap to be addressed in the Action Plan.

Measurements of the nutrient fluxes from sediments (and comparisons with other known nutrient inputs to the Swan-Canning system) was required to develop an understanding of key biogeochemical processes controlling nitrogen and phosphorus cycling within the system. These data were also needed for computer models of ecological processes, to test different management scenarios and changing circumstances. Furthermore, measurements of phosphorus release rates and the factors controlling nitrogen cycling processes (nitrification and denitrification) were required for developing remedial techniques (oxygenation, sediment remediation): the application of the oxygenation and modified clay techniques required this type of information to determine the dosage rates.

The Australian Geological Survey Organisation (AGSO, now known as Geosciences Australia) was selected to conduct these measurements. AGSO have established an Urban and Coastal Impacts Group which applies their expertise in marine

geochemistry and sediment chemistry to coastal areas of concern to managers. They have developed techniques using automated benthic chambers which sit on the sediment surface and allow the measurement of phosphorus release and the rate of nitrification and denitrification. The methodology used for measuring sediment nutrient fluxes involved a combination of benthic chamber incubations, intact sediment core investigations, mapping of surficial sediment and co-analysis of long term water quality data sets.

7.4.2 Inputs

The Action Plan funding for the Sediment Nutrient cycling project is shown in Table 7.8. AGSO determined this project to be of national significance and so costed the work without the multipliers that usually apply: all overheads and some salary components were contributed, and this is also shown in Table 7.8. The Swan River Trust provided considerable logistic support during the three field trips undertaken.

Table 7.8 Funding for Sediment Nutrient Cycling project

Year	Action Plan	Other funding sources	TOTAL
99-00	$70,000	>$60,000[1]	
00-01	$88,251	>$52,500[2]	
01-02	$79,205	>$20,000[3]	
TOTAL	**$237,456**	**>$132,500**	**>$369,956**

[1] *Estimated $50,00 from AGSO, $10,000 from WRC plus SRT logistic support*
[2] *Estimated $50,00 from AGSO, $2,500 from WRC plus SRT logistic support*
[2] *Estimated $20,00 from AGSO plus SRT logistic support*

7.4.3 Outputs and Outcomes

AGSO fielded a team (5 to 6 personnel) plus portable laboratories and associated equipment for 2 to 3 week periods in February/March 2000, March 2001 and September 2001, and investigated a range of waterway conditions at nine sites. The sites comprised two in the upper estuary, one in Perth Water, three in Melville Water, and three in the Canning River. Much of the analyses was done on-site by the team chemist so that subsequent chamber deployments could be determined and as much data as possible was obtained during the field program. It also proved possible to add additional sites in the Canning River to test the effectiveness of Phoslock™ within the budget, due to operational efficiencies, additional support provided by the DoE's Aquatic Sciences Branch, and considerable cooperation and logistic support from SRT depot staff.

The overarching objective of this work was to assess the effects of water column oxygen status on sediment-nutrient processes - notably the effect of changes on oxygen status (oxic to sub oxic to anoxic and vice versa) on nitrogen speciation, denitrification efficiency and phosphate release. The effects of Phoslock™ and oxygenation treatments on phosphorus and nitrogen fluxes from sediments were also measured (see Sections 6.3 and 6.4)

1999/2000

Prior to the field trip, a Project plan and AGSO proposal was provided. The field trip occurred as planned, but exceptional summer river flows and massive exchange in the estuary (following the wettest January on record) delayed the field program and provided a number of logistic difficulties due to currents and sediment movement. The field trip was successfully completed, but a flood condition was sampled rather than a typical summer condition. The data obtained were nonetheless valuable.

An interim report from the field program was provided.

2000/2001
Prior to the field trip, a Project plan and AGSO proposal was provided.

The March 2001 field program was successfully completed. An interim report from the field program was provided, and an annual report.

2001/2002
Prior to the field trip, a Project plan and AGSO proposal was provided.

The September 2001 field program was successfully completed. 60 chamber deployments were achieved overall in the project for both the Swan and Canning under a range of conditions, depths and substrates. An interim report from the field program was prepared, and a final report with nitrogen and phosphorus cycles, and conceptual models, was prepared:

- Geoscience Australia, 2002. Benthic Fluxes and Nutrient cycling in the Swan Estuary. (*full citation to be determined)*

Overall, the study provided important information on the release of nutrients from sediments to trigger and sustain algal blooms and the replenishment of sediment nutrient levels when algal blooms collapse. The study concluded that the sediments of the Swan-Canning system have little capacity to retain phosphorus and are less efficient at removing nitrogen than those of other Australian estuaries. When oxygen levels in the water near the riverbed decrease as a result of salinity stratification or (in the case of the Canning River) thermal stratification, phosphorus retention and nitrogen removal is reduced even further. Thus, nutrients in the sediments are readily available to trigger and sustain algal blooms, and become even more available under the conditions in the estuary and tidal rivers typical during summer and autumn. It also means that as phytoplankton die and sink to the bottom, the nutrients are released and again become available to trigger and sustain further algal blooms. In this way nitrogen and phosphorus are recirculated many times before finally being lost from the system.

A key finding of this project concerned denitrification rates in the sediment of the Swan-Canning system. Denitrification is a key process by which nitrogen inputs to a waterway can be removed, as follows:

- Nitrogen inputs are incorporated into organic material (algae), and when this decomposes the nitrogen is released as ammonia;
- Certain types of oxygen-requiring bacteria covert the ammonia to nitrate (‘nitrification’); and
- Certain types of bacteria convert the nitrate to nitrogen gas (‘denitrification’), which is loss from the system.

Denitrification is an important loss process in estuaries. However, if nutrient enrichment causes too much build up of organic matter in the sediments, the decomposition of this organic matter can consume so much oxygen that it blocks denitrification, because the ammonia released can’t first be converted to nitrate. This threshold appears to have been reached in the Swan-Canning system: the work undertaken by AGSO found that the ability of the Swan-Canning system to remove nitrogen through denitrification was much lower than in other estuaries in Australia, such as Wilson Inlet in the southwest of Western Australia, and Port Phillip Bay in

Victoria. The inference from this finding is that the Swan-Canning system may have little capacity to cope with further nitrogen inputs before serious water quality problems occur.

7.4.4 Status of Action Plan recommendations

The Sediment Nutrient Cycling Project addresses the following recommendation:

Recommendation 9.2 *Investigate nitrification-denitrification and carbon cycles in relation to estuarine sediment nutrient cycling.*

Table 7.9 Status of Recommendation 9.2

Rec'n No.	Status	Outputs & Outcomes
9.2	Achieved.	**Outputs** ***Environmental*** A comprehensive and scientifically rigorous study of benthic nutrient cycling processes was carried out. Sediment nutrient release rates were determined at a range of sites throughout the Swan-Canning system, under a range of seasonal conditions. **Outcomes** ***Environmental*** Knowledge and understanding of sediment nutrient cycling processes have been greatly increased. Data have been generated that will improve computer models of ecosystem processes, and therefore their ability to predict the impacts of various environmental scenarios. This will aid future decision-making. Dosing rates for river intervention techniques (oxygenation, Phoslock™) could be determined, and their performance optimised.

7.4.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for the Sediment Nutrient Cycling project are provided below (Table 7.10).

Table 7.10 Gaps/key issues for the Sediment Nutrient Cycling project

Project	Key Issues / Gaps
Sediment Nutrient Cycling	No specific issues or gaps.

7.4.6 Future plans by project staff

Future plans identified by project staff for the Sediment Nutrient Cycling project are provided below (Table 7.11).

Table 7.11 Future plans for the Sediment Nutrient Cycling project

Project	Future
Sediment Nutrient Cycling	Not identified (Project completed?).

7.4.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Water and Rivers Commission, 2004. *Nitrogen and Phosphorus cycles. Swan River Trust, River Science Issue 4.*
- Fredericks, D.J., Palmer, D.W., Smith, C.S. & Heggie, D.T, 2004. *Benthic Fluxes and Nutrient Cycling in the Swan Estuary*. Geosciences Australia. Report No. 2002/03.

7.5 Decision support model expertise

7.5.1 Situation

The SCCP Action Plan acknowledges the role that catchment models and estuary models can play in environmental management. Models serve to synthesize all available knowledge and process understanding, and then used to inform and assist in decision making. Models are particularly useful for predicting what will happen under scenarios or circumstances that cannot be determined experimentally, for example, to determine if a catchment management technique will be more effective if applied to one location rather than another. Gaps in knowledge and the relative importance of those gaps can also be highlighted: for example, monitoring can be improved by identifying the most effective times and locations to collect samples.

Development of catchment models involves taking available data for flow and nutrients in a spatial sense and matching it to land use. Estimates of nutrients and flow can also be made from land use and placement of point sources. These data in combination with process understanding incorporated into models allow for development and testing of catchment management scenarios.

For this Action Plan project, the Large Scale Catchment Model (LASCAM model) developed at the University of Western Australia's Centre for Water Research (CWR) was identified for use to provide the catchment water balance to drive salt and nutrient losses and feed into an estuarine model to predict impacts on water quality. For the estuarine model, the combined hydrodynamic and ecological (ELCOM/CAEDYM) model that was being developed by CWR at that time was meant to capture current system understanding especially in relation to ecological processes. The intention was that the use of the catchment model and estuarine model would lead to additional process understanding, and the ability to estimate estuarine response from both improvements and deterioration in the catchment.

The Decision Support Model Expertise project was undertaken by the Aquatic Science Branch of the Water and Rivers Commission (WRC). The objectives of this work were as follows:

- Investigate catchment models which may be applicable to the Swan-Canning system, including LASCAM (a process model, i.e. a model that simulates the processes happening in a catchment) and CSIRO's Catchment Management Support System (CMSS, a logic framework model that relies on parameters for runoff characteristics from different soil/land use types).
- Investigate estuary models which may be applicable to the Swan-Canning system, including ELCOM/CAEDYM.
- Calibrate and validate the ELCOM/CAEDYM estuary model for application to Swan-Canning estuary (to be undertaken at the DoE).
- Implement catchment models at the CWR and WRC; and
- Develop catchment and estuarine modelling expertise at the WRC. The State Government through the SRT and SCCP has invested considerable funds in developing these CWR models, and to realise the value of this investment the WRC needed to develop in-house ability to understand and use them.

7.5.2 Inputs

Action Plan funding of the Decision Support Model Expertise project is shown in Table 7.12. The Western Australian Department of Agriculture also supplied $5,000

additional funds in 2000/2001 and an unknown (i.e. not documented) amount of support in 2001/2002.

Table 7.12 Funding for Decision support model expertise project

Year	Funding
99-00	$85,325
00-01	$136,422
01-02	$117,494
02-03	$126,764
03-04	$121,473
TOTAL	**$587,478**

7.5.3 Outputs and Outcomes

1999 to 2001

- Catchment modeller appointed to the project in August 1999.
- Available catchment models reviewed and reported on.
- Swan Spatial model reviewed and reported on.
- There were considerable delays in getting land use GIS data (historical, current and predicted land use) from the Department for Planning and Infrastructure.
- Commenced negotiation with the CWR on model delivery.
- Provided advice to SRT in contract negotiations and conflict resolution.
- Additional outputs in 1999/2000:
    - Implementation of an empirical travel time equation for inorganic phosphorus using a GIS.
    - Modelled re-establishment of salinity following the Jan 2000 flood and *Microcystis* blue-green algal bloom in the lower estuary.
- Additional outputs in 2000/2001:
    - Estuary modeller appointed in September 2000
    - CMSS and NEXSYS purchased.
    - All available literature on nutrient export rates reviewed and collated.
    - CMSS used to model Ellen Brook and Southern River catchments.
    - LASCAM applied to Ellen Brook catchment (at CWR).

2001/2002

- Agreement on estuary scenarios that will be modelled with ELCOM/CAEDYM by CWR.
- Agreement on LASCAM modelling tasks which will be completed before the end of the collaborative project.
- Scenario calculator presented to Ellen Brook catchment group.
- Collation of data for input to ELCOM/CAEDYM modelling completed.
- Additional outputs:
    - Estuary modeller developed a rainfall runoff model to enable the implementation of the catchment model. His model out-performed an existing (AWBM2000) rainfall-runoff model.

2002/2003

- Received final report from CWR (in Oct 2002): An integrated ecological model of catchment hydrology and water quality for the Swan-Canning

estuary. Volume 1 – Estuary Modelling, and Volume 2 – Catchment modelling.

- The version of the ELCOM/CAEDYM model delivered with the final report did not work.
- Collaborative project with the CRC for Catchment Hydrology to implement EMSS ('2nd generation' version of CMSS; a logic framework model with some processes included) on the Swan-Canning coastal catchments established.
- Second catchment modeller appointed to the Aquatic Sciences Branch in January 2003.

2003/2004

- The estuarine modelling component could not be completed for two reasons:
  - The CWR did not deliver a working version of ELCOM/ CAEDYM until November 2003 (over a year after the first version was delivered).
  - WRC's Estuary modeller left DoE in January 2004.
- Calibrated SYMHYD (EMSS Hydrological model) on all gauging stations in Swan-Canning coastal catchment.
- Implemented EMSS on all SCCP catchments. There were serious problems with the EMSS model:
  - The terrain analysis software does not work in areas of little slope and artificial drainage, such as the Swan coastal plain. The CRC has been requested (and paid) to develop an input module so Swan coastal plain sub-catchments and drainage can be input, but this work has not been completed yet.
  - The underlying hydrological model SYMHYD does not give good results in WA. DoE's catchment modeller working on this at present.
- Scenario modelling for urban development proposed in the Southern River Structure Plan.
- Report prepared on results of LASCAM modelling for Southern River.
- Re-designed sub-catchments for LASCAM modelling of the whole SCCP area.
- Assessment of the MUSIC model on Ellen Brook and Mill St MD catchments.
- Additional outputs:
  - Presented the LASCAM modelling in Southern River catchment to the chair of the SRT, Charlie Welker (November 2003).
  - Increased collaboration with the CRC for Catchment Hydrology. Christian will modify the SYMHYD model which is the hydrological driver for EMSS, MUSIC and SEDNET.
  - New modeller started work with the Aquatic Science Brach modelling group in December 2003.

Constraints / Opportunities for improvement

No testing of ELCOM/CAEDYM was carried out on the Swan estuary because a working version of the model wasn't delivered until November 2003, and a key staff member left in January 2004. Staff continuity is an issue in all workplaces, but particularly so in modelling work: it takes time for personnel to become familiar with a complex model, and considerable expertise can be lost when key staff members leave.

The quality of modelling outputs also depends strongly on the quality of the input data used in the model. For this reason the following issues need addressing:

- Water quality and flow data need to be of better quality.
- The importance of groundwater (quality and quantity) needs to be better quantified.
- More of the urban catchments need to be monitored for water quality and/or flow.
- Spatial data is of variable quality and availability.

The LASCAM model will be calibrated for use in all sub-catchments by the end of 2004. This will offer an important tool for optimising catchment management techniques, and predicting the effects of future land use (as has already been done for the proposed Southern River development). It also offers the opportunity to examine the possible effects of climate change.

With respect to estuarine modelling, the ELCOM/ CAEDYM model is complex, user-unfriendly, and requires a lot of effort to make it work. Alternative models need to be investigated.

7.5.4 Status of Action Plan recommendations

The Decision Support Model Expertise project addresses the following recommendations:

Recommendation 9.3 *Complete development and validation of estuary and catchment models and use them to model system fluxes of nutrients including carbon.*

Recommendation 9.4 *Develop decision-support systems to predict and demonstrate the consequences of changes to the catchment or the estuarine system, to optimise management practices.*

Recommendation 9.5 *Develop expertise within the Water and Rivers Commission in the application of WAERF estuarine process and decision-support models.*

Table 7.13 Status of Recommendations 9.3, 9.4 and 9.5

Rec'n No.	Status	Outputs & Outcomes
9.3	Partially achieved, and ongoing	**Outputs** The catchment model LASCAM has been developed and validated. A useable estuary model has yet to be developed.
9.4	Partially achieved	**Outputs** LASCAM has already been used as a decision support tool to predict the effect of land development in the Southern River catchment.
9.5	Partially achieved	**Outputs** In house expertise in catchment models has been developed.

7.5.5 Gaps / Key issues identified by project staff

Gaps/key issues identified by project staff for the Decision Support Modelling project are provided below (Table 7.14).

Table 7.14 Gaps/key issues for the Decision Support Modelling project

Project	Key Issues / Gaps
Decision Support Modelling	DATA • The catchment and estuary models are both constrained by the available data • the catchment model LASCAM requires (time series) meteorological data; spatial data for land use inputs; including land management practices and remediation strategies that have been implemented; flow and water quality data for calibration STAFF • models are complex to run - we wouldn't be using LASCAM without Christian Zammit (staff member) • difficult to find and keep modellers ESTUARY MODELLING • not as advanced as we would have liked • we will be considering other models, such as CSIRO's

7.5.6 Future plans by project staff

Future plans identified by project staff for the Decision Support Modelling project are provided below (Table 7.15).

Table 7.15 Future plans for the Decision Support Modelling Project

Project	Future

Decision Support Modelling	Catchment modelling
	• Fill data gaps
	  o temporal (lost data)
	  o spatial (ungauged catchments)
	• Examine the seasonality of nutrient delivery to the estuary
	• Examine the impact of changing climate
	
	Estuary modelling
	• Determine the response of the estuary to changed nutrient and flow inputs
	  o algal response
	  o sediment nutrient stores
	• Simulate point source pollution events
	• Simulate the impact of climate change

7.5.7 Sources of information

- SCCP Evaluation Project Pro Formas.
- Two interviews with Water and Rivers Commission modelling personnel.
- Kelsey, P. and Zammit, C., 2003. *LASCAM modelling of the urban development proposed in the Southern River -Forrestdale-Brookdale-Wungong structure plan. Vol 1: report*. Water and Rivers Commission.
- Kelsey, P. and Zammit, C., 2003. *LASCAM modelling of the urban development proposed in the Southern River -Forrestdale-Brookdale-Wungong structure plan. Vol 2: Annexes*. Water and Rivers Commission.

8. General community survey and targeted surveys

8.1 Overview

The overall success of the SCCP Action Plan will ultimately depend on changes in peoples' attitudes and behaviour: this is why the Action Plan has a strong emphasis on the involvement and education of the community.

As one means of determining how well key Action Plan messages are reaching the community, the following surveys were undertaken:

- A broad-scale survey, to ascertain the level of **awareness** of the SCCP Action Plan within the general community, the level of **knowledge** about the causes of algal blooms and what individuals can do to help, and what interviewees were doing to help (**action**). Questions were also included to determine the **barriers** preventing people from taking actions.
- Targeted surveys of people involved in specific SCCP education/awareness raising activities. These surveys were intended to assess participant's level of **knowledge** before and after involvement in the activities, what they were doing differently as a result, and any **barriers** preventing them from taking action. The targeted surveys were also intended to compare the effectiveness of the various activities in achieving their specific 'teaching messages', and included some questions from the general community survey to see if the level of **awareness**, **knowledge** and **action** about the SCCP Action Plan and algal blooms differed from results for the general community survey. Four main SCCP activities were surveyed (Table 8.1).

The methodology and survey questionnaires were predominantly developed by Market Equity in consultation with EWT members that had specialist expertise in community education and awareness (Wendy Yorke, Marion White, Nancye Ganaway and Kelly Exell); with additional input from Oceanica and the EWT. Dr. Doug Mackenzie Mohr also made some suggestions in the early stages of development.

Community survey

The community survey comprised a stratified random design, and involved a telephone survey of residents living in one of four geographic areas:

- People living in the Perth metro area who have a particular relationship with the Swan or Canning River – i.e. they live very close, or they use the river directly and regularly;
- Other people living in the Perth metro area who have also been exposed to various mass communications through the SCCP;
- People living in peri-urban areas just outside the metro area, who represent small land-holders (esimated 10,000 population);
- People living in rural areas within the catchment, covering areas represented by Gingin, Toodyay, Jarrahdale and other rural areas between these boundaries and Perth city (not covered by the other samples).

The total sample size was 400, and aimed for a minimum sample of 200 Perth metro residents (in total) and between 50 and 100 residents in each of the other locations.

These surveys sought to determine issues such as awareness of the SCCP, awareness of threats to the health of the Swan and Canning Rivers, perceptions of the current health of these rivers, whether people believe they have an individual responsibility to protect the rivers, awareness of behaviours necessary to reduce nutrient flow into the rivers and self-reported behaviours that result from SCCP education.

SCCP Action Plan Program participant survey

These target surveys focused on identifying the impact of the different education and awareness programs on attitudes and behaviour, and addressed the specific elements of the program itself.

Telephone surveys were conducted with SCCP program participants from the last 4 years, using contact lists provided by the individual project managers. Sample quotas were determined by the size of the contact lists supplied.

Table 8.1 SCCP activities, and sample sizes used in targeted surveys

SCCP Program / Activity	Total No.of Program Participants	Sample no. used for Survey
Corporate Care Day	150	50
Great Gardens Seminar	6000	100
Heavenly Hectares Seminar	3000	100
Property Planning Workshop	900	100
Swan River Action Kit Activity	300	50

The results of each type of survey are discussed below. Some review comments provided by Dr. Doug Mackenzie-Mohr, one of the Expert Reference Panel members, are also included.

8.2 General Community Survey: Results

A key point to note about the General Community survey is that, ideally, the results should be compared against a 'baseline' survey (using the same questions) that was undertaken before the Action Plan was implemented. This issue was raised by Expert Reference Panel member, Dr Doug McKenzie Mohr. In the absence of any suitable 'control' area that the survey results for Perth could be compared against, and in view of the fact that the Action Plan is a 20+ year program, Dr McKenzie Mohr suggested that the 2004 survey results be set as the baseline.

Top line findings of the awareness, knowledge and behaviour of respondents surveyed within the general community are provided below.

8.2.1 Awareness

- **Importance of rivers:** The Swan River and Canning Rivers are personally important to 95% of the respondents. This feeling is backed up by actions such as observing the appearance of rivers and speaking about the rivers to family and friends. Walking or cycling around the river/s was reported as the main reason for visiting the river; with boating or skiing the next most common. Fishing, prawning, rowing, and windsurfing were also mentioned but to a much lesser degree. There is high usage of Swan River (59% use once or more every 2-3 months), but lower usage of Canning River (22% use once or more every 2-3 months).
- **Awareness of responsibility:** Most respondents (82%) believe they should be involved in keeping the rivers healthy. The three most commonly identified actions to help keep the rivers healthy involving Perth residents were: picking up litter, being fertilise wise and not putting chemicals into drains. Other

responses given as to ways in which individuals could contribute were: being water wise, learning how to keep rivers healthy, using environmentally friendly products, reducing boat use, reporting environmental abuse and educating others.

- **Perceptions of Swan River health:** Almost all respondents (97%) felt they could make comment on the health of the Swan River. Most people felt that the Swan River was in average condition (44%); with a fairly even distribution of others who felt the river was either in a poor (20%) or good (33%) condition. Only a small proportion of residents felt that the river was in excellent condition (3%).
- **Perceptions of Canning River health:** It was evident that respondents felt more familiar with the Swan River condition than the Canning River. Only 63% of the people interviewed felt they could comment on the health of the Canning River. Of those that made comment, approximately half of the people rated it in average condition (49%), with approximately one quarter of people rating it as either poor (24%) or good (25%). Similar to the Swan River, only a small proportion of respondents felt that the river was in excellent condition.
- **Main information sources:** There is a strong awareness of the problems facing the rivers that are covered by the media (algal blooms & pollution) but little awareness of other issues. A small proportion of residents have received information via the radio, displays at public events or by mail. Approximately one fifth (18%) of residents hadn't seen, heard or read anything.
- **Awareness of SCCP**: There is good awareness of SCCP by name (47% of residents had heard the name). There is some awareness of the broad SCCP aims (such as keep the rivers healthy), but little knowledge of its objectives to reduce algal blooms or nutrients, and little supporting behaviour.

8.2.2 Knowledge

- **Problems facing the rivers:** The five most commonly identified problems facing the Swan and Canning Rivers include (in order): 1. Algal blooms; 2. Pollution; 3. Excess nutrients; 4. Litter and general rubbish; and 5. Fish deaths. Other less common problems identified included (also in order): Increased recreational use; foreshore damage/erosion; runoff from drains; and decreased river flow.

8.2.3 Behaviour

- **Actions around the river:** Picking up rubbish was the most often cited river friendly behaviour, perhaps indicating a poor understanding of the issues (nutrients are more important). 57% of people stated that it is something that they should be doing for the rivers. In addition, 31% of residents reported undertaking no specific action.
- **Actions around the garden:** The message about being 'fertilise-wise' appears to be reaching residents and influencing behaviour. Over half the residents (54%) reported being fertilise wise with their gardens. Other behaviours that SCCP wish to promote have limited uptake. There is a poor understanding of the importance of stormwater drains in river health—only 8% have actively kept drains cleared. Of those that have done river friendly actions around the home/garden, it is unlikely that the majority had the river in mind when they did it – stormwater drains were largely ignored. About half of the people interviewed claimed to have reduced their lawn size (49.6%), but it is difficult to know it this was done with the rivers in mind. There is good use of slow release fertilisers (47.3%).

- **Actions around the workplace:** There is very little activity around the workplace to ensure the health of the rivers—86% had taken no specific actions.
- **Other actions:** 10% of respondents reported attending a public event that promoted healthy river or participated in a catchment activity.
- **Current involvement:** Most people see the need to assist in keeping the rivers healthy; they enjoy the surroundings, visit regularly, but they are not participating in programs and have a limited knowledge of the issues. The vast majority of people have not participated in Cleanup programs. There is little perception that volunteer work in the catchment is something people should be doing —7% said it is something they should be doing. Very few people have participated in catchment activities (only 8.3%) or attended a training seminar (only 1.3%).
- **Willingness to act:** Many people reported that they are willing to become more involved or modify their behaviour, and recognise the need. Also people are open to information and guidance on home based river friendly practices. But this information is currently not reaching the target audience. For example, 94% of people reported they are willing to use council facilities to dispose of chemicals appropriately, but would rarely do so.
- There is willingness to become involved:
  - 50.7% are willing to be involved in a catchment activity.
  - 58.3% are willing to be involved in a public event promoting healthy rivers.
  - 94% are willing to use a council tip for chemicals.
  - 55.4% are willing to reduce lawn.
  - 66.4% are willing to replace plants with natives.
  - 74.7% are willing to reduce fertiliser use.
  - 81.5% are willing to switch to slow release fertiliser.
  - 47.3% are willing to assist in water quality monitoring.
  - 46% are willing to attend a training seminar.
  - There is a high percentage of people not doing anything different after attending a program—some are using less fertiliser.
- **Main constraints:** A lack of time is the major factor impeding participation. This is likely to require a combination of finding appropriate times for programs (e.g. weekends), and creating a sense or urgency and importance, or high appeal. In addition, it was also recognised that SCCP is competing with other demands and priorities for residents.

8.3 Targeted Surveys: Results

Top line findings of the awareness, knowledge and behaviour of respondents surveyed that have participated in one of the SCCP's education based programs are provided below.

8.3.1 Corporate Care Day

- Corporate Care Day (CCD) participants did not recall any specific topic that they learnt about. The most frequent recall made was that planting trees helps reduce nutrients.

- There is a high overall satisfaction with the CCD activities. It was considered a useful activity as it raised awareness about the problems with the river and participants learnt about planing trees.
- The CCD was considered useful for learning about the rivers, the problems the rivers face, and how planting tress can assist to keep them healthy.
- Some participants are being fertilise wise and using environmentally friendly products after attending CCD, however 40% are not doing anything differently.
- There is awareness of some key SCCP objectives, but little recall of supporting aims such as reducing nutrient levels in the rivers.
- When asked what activities the respondents thought they could be doing to help keep the river healthy, the most common responses were: be fertilise-wise, pick up litter in and around the rivers. Volunteer work in the catchment and using environmentally friendly products were also identified.
- CCD participants identified some key problems facing the rivers, such as: algal blooms, excess nutrients, litter, pollution, drain runoff, habitat loss, effects of increased recreational use and fish deaths (in order).
- 72% of participants recalled learning about nutrients and using less fertiliser.

8.3.2 Great Gardens Workshop

- Great Gardens Workshop (GGW) participants learnt river friendly practices that related predominantly to their garden; such as considering local conditions, planting native plants, being fertilise and water wise.
- Participants found the learning of river friendly fertiliser practices a useful outcome of the GGW.
- The main self-reported behavioural changes relating to the GGW include fertilising their gardens less often, using mulch/compost, using slow release fertiliser, less water and planting native plants. Eighty percent of participants reported changing their behaviour to some degree.

8.3.3 Heavenly Hectares / Property Planning

- Heavenly Hectares (HH) participants recalled learning topics such as local gardening conditions and planting native plants, creating a land management plan, being fertilise wise, best practice and principles of land management and other issues.
- There was a high overall satisfaction with the HH seminars and all participants said they would recommend it to others.
- HH participants found the activity useful as there was a practical outcome in which they learnt environmentally friendly land-use practices, the importance of soil testing, tree planting, and weed planting and other topics.
- A range of behavioural changes were reported following attendance at a HH seminar, including: revegetation, planting native plants, reducing fertiliser use and using slow release fertiliser, using perennial pasture and other actions. Approx. 1/3 of participants reported undertaking no specific action.
- Of the participants that attended a HH seminar, 44% of respondents attended a Property Planning Workshop (PPW). For those that did not attend the PPW, main reasons given were: no time (46%), and already know enough to manage their property (38%).
- HH participants thought the key actions they should be undertaking to protect the rivers were: be fertilise wise; avoid putting chemicals and waste in

stormwater; be water wise; practice better land use management; plant native plants in the garden and learn more about how to keep the rivers healthy.

- Key topics learnt by the PPW participants included creating a land management plan; local gardening conditions and planting native plants, best practice and principles of land management; planting trees helps reduce nutrients.
- Approximately 72% of PPW participants reported a behaviour change of some kind, although no participants reported implementing their property plan.
- Only 7% of PPW participants reported having finished their property plan. Fifty-six percent reported being almost completed or half-way; with 37% of participants reporting not, or just, starting.
- Almost all PPW respondents thought that they should be contributing to the health of the rivers; with the majority of suggestions claiming they should be fertiliser wise.
- PPW respondents recalled that reduction in fertiliser use would help reduce the occurrence of algal blooms.

8.3.4 Swan River Action Kit

- Swan River Action Kit (SRAK) participants recalled the key topics covered to be understanding the river systems; their history; helping to keep the rivers healthy; and local gardening conditions and planting local plants. There was a wide range of other miscellaneous issues raised.
- SRAK participants found it useful to become aware of the problems facing the rivers and how to assist in minimising those problems.
- The most common self-reported behaviour by respondents was the use of environmentally friendly production; and 32% of respondents reported no specific actions.
- SRAK participants who do become more active after participating (38%) typically reported working individually in self initiated activities.
- SRAK participants reported they could best help keep the rivers healthy by using environmentally friendly products; picking up litter around the rivers; undertaking volunteer work in the catchments; being fertilise and water wise; and avoiding putting waste and chemicals into stormwater.
- SRAK participants identified the main river problems to be caused by: excess nutrients; pollution; litter and general rubbish; loss of habitat and foreshore damage; algal blooms; increased population pressures and many other miscellaneous issues.

8.3.5 Project discussion

It is important to note that in order to draw significant conclusions about the effectiveness of the different education programs based on the survey results, that statistical analyses on the responses by interviewees is required. It is recommended that the SRT statistically analyses the data collected from these surveys to ascertain the effectiveness of the different projects. Until this is done, only qualitative comments on the survey results the can be made.

- **Usefulness:** In general, the majority of respondents from the different education projects rated that the activity that they attended was quite, or very, useful. For all projects except the Corporate Care Day, over half of the ratings were reported as ‘very useful’.

- **Knowledge improvement:** In general, over half (50-64%) of the respondents reported improving their knowledge about the related project or activity topics by "a small amount". A smaller number of participants reported learning a medium amount (16-20%); and only a very small proportion ever reported learning "a large amount" (2-9%). Corporate Care Day participants reported the highest proportion of no improved knowledge (30%); followed by the Swan River Action Kit (22%) and the Heavenly Hectares seminar.
- **Awareness of SCCP:** There is good awareness of SCCP by name (47% of residents had heard the name). There is some awareness of the broad SCCP aims (such as keep the rivers healthy), but little knowledge of its objectives to reduce algal blooms or nutrients, and little supporting behaviour.
- **What is striking about the results obtained for the targeted surveys is the extremely similar responses provided across all programs.** Essentially identical responses have been given about (for example): the usefulness of programs; and levels of knowledge and ability gained; across all projects; and in similar proportions. Similarly, the responses to the question "what could you be doing to help keep the river healthy" are the same as for the general community – being fertilise-wise; picking up rubbish, and being water-wise. No higher level of understanding appears to be evident with these respondents than in the general community (as indicated from the community respondents).
- **The very 'generic' responses that were provided by the project participants raises the concern that the projects themselves may not be delivering sufficiently focussed or detailed enough information to their participants.**

8.4 Survey limitations

It is important when considering self-reported behaviours – such as the community and targeted surveys – to note that respondents commonly "over-report" their actions and behaviour. Particular caution about the survey findings must be heeded when the questions address socially desirable actions – such as their behaviour as a function of river health – as the likelihood of participants presenting themselves in a socially desirable light is considerably increased.

Dr. Doug Mackenzie-Mohr provided the following review comments regarding the survey information, and in particular identified the respondent answers that should be considered with reservation.

Respondents have likely over-reported their behaviour (to ensure the health of the river) concerning the following issues:

- Actions around the garden;
- Actions around the workplace; and
- Actions around the river.

Their willingness to engage in inconvenient actions, such as disposing of chemicals at the landfill; attend a public event, and reduce the amount of lawn in the garden percentages are not believable. Public events are notoriously poorly attended and reducing lawn size requires such significant expenditures of effort that it unlikely that anywhere close to 55% would actually engage in this activity.

It is hard to know whether the awareness levels of SCCP are simply due to reasonable guesses as to what the Swan-Canning Cleanup Program is meant to do.

Knowing that the Swan and Canning are both rivers, and that the purpose of the project is their cleanup, it would be surprising if respondents did not report “keep the rivers healthy” and “improved water quality of the rivers.” Accordingly, claims that the various initiatives have reached a penetration level of 60% understanding the primary goals are likely unfounded.

There is literature that suggests that when humans purposely participate in a program they are likely to skew their view of the program to justify their participation in it.

The surveys provide useful information, but the information addressed in the survey is primarily descriptive and as a result there is little information on barriers/benefits to specific activities.

9. Literature review of selected case studies

9.1 Background

A literature review was conducted of current initiatives to manage nutrients in the waterways and catchments of South-East Queensland, the Glenelg-Hopkins Region of Victoria, and in Lake Taupo and its catchment in New Zealand. These three initiatives cover a range of water bodies from turbid, tropical coastal waters to a clear, temperate freshwater lake, and their approaches to nutrient management range from a voluntary, collaborative approach to one based more on regulation. Importantly, the Expert Reference Panel involved in the evaluation also included three members who have been directly involved in these three programs, thereby allowing a more complete analysis than is readily obtainable from documentation.

This literature review was not intended to provide an in-depth comparative analysis of the different approaches to nutrient management adopted in each of the case-studies. Rather it was a high-level desk-top review of key documents, and its intent was to provide a broad overview of the different institutional arrangements and the underpinning policy and planning framework adopted to achieve the desired environmental, social, cultural and economic outcomes. While the focus of the report is on approaches to nutrient management in waterways, in all the case-studies, nutrient management is being undertaken within the broader context of integrated catchment management

It is not suggested that any of these models for nutrient management should be adopted for the Swan-Canning River System. Rather, the purpose of undertaking a review of these three different case-studies was to use the experiences, findings and challenges to inform the review of the Swan-Canning Clean-Up Program. Lessons can be learnt from the experiences of these (and other) case-studies by identifying and analysing some of the critical factors that need to be taken into consideration in developing and pursuing future initiatives to manage nutrient enrichment in the Swan-Canning River System.

Key findings of the literature review are presented below, with the caveat that the literature review needs to be reviewed by those members of the Expert Reference Panel who were directly involved in the studies. Once this is done, and corrections made, the literature review will be provided to the SRT.

9.2 Moreton Bay Waterways and Catchments, South-East Queensland

9.2.1 The issues

Moreton Bay, the Sunshine and Gold Coasts and their river systems have undergone extensive alteration over the last 200 years since the start of European settlement. Land-use changes and vegetation clearance have resulted in significant changes in hydrology and sediment delivery. Water quality has declined as a result of sediment and nutrient inputs from wastewater discharges, stormwater run-off, and disturbance of acid sulphate soils, and there has been a loss of aquatic biodiversity. The river estuaries are highly turbid and the lower Brisbane River does not meet national standards for primary contact activities. The major river systems have been highly regulated through the construction of dams and weirs. Since 1994, outbreaks of a toxic cyanobacterium, *Lyngbya majuscula*, have been occurring in Moreton Bay.

The region has one of the fastest growing populations in Australia, and the rapid increase in population is expected to result in 75 km² of bushland, agricultural land and other rural land being converted to housing and other urban purposes, each year.

9.2.2 The approach

The Moreton Bay Waterways and Catchments (Healthy Waterways) Partnership was established in 2001 to facilitate the implementation of the *South-East Queensland Regional Water Quality Management Strategy*, which represents the first comprehensive and integrated program for the protection and restoration of the ecological health of South-East Queensland's waterways and catchments. The *Regional Strategy* was developed by State agencies and Local Government, industry and community stakeholders working in close co-operation in response to significant regional water quality issues (nutrients, fine sediments and, to a lesser extent, toxicants) which had arisen as a result of activities and point and non-point source discharges. The collaborative approach to the development of the *Regional Strategy* was a key characteristic of the process and continues with the work of the Partnership. The *Regional Strategy* is a combination of continuing local initiatives and new management actions developed directly by stakeholders in response to consistent robust scientific information; and agreed by consensus through a voluntary peer pressure/peer support process rather than a "command type" regulatory approach. The Partnership operates through a hierarchy of consultative, participatory, advisory, planning, decision-making and regulatory processes to achieve the Healthy Waterways Vision. The Partnership represents a whole-of-government/whole-of-community organizational approach to understanding, planning for and managing the waterways and catchments of South-East Queensland, and is increasingly being recognised both nationally and internationally as a successful model of integrated catchment management.

Consideration of the discharge of treated wastewater from wastewater treatment plants provides an example of the process by which stakeholders agree on environmental values, environmental goals, water quality objectives and management actions. Wastewater treatment discharges were identified as an issue by stakeholders and scientific studies were commissioned to investigate treated wastewater nitrogen plumes in Moreton Bay. The findings from these studies indicated that Bramble Bay (western Moreton Bay) was experiencing chronic algal blooms with chlorophyll-a concentrations between 4-5 µg/L. A water quality objective to achieve mean chlorophyll-a concentrations of <2 µg/L in Bramble Bay by 2007 and sustain it until 2020 was identified to achieve the environmental goal of minimising algal blooms, thereby helping to restore the intrinsic environmental value of aquatic ecosystems. Modelling indicated that to achieve chlorophyll-a concentrations of <2 µg/L, nitrogen would need to be reduced to 5 mg/L at most of the treatment plants contributing to the plumes. The economic and social impacts were considered through a formal cost-benefit analysis and advice from community, industry and government stakeholders. Stakeholders considered all the information and agreed that: 5 mg/L nitrogen in treated wastewater discharge was technically feasible, costs of implementing the management actions (some $100 million) were acceptable, given the benefits that will accrue, and management actions will be implemented before 2007. The sustainable point source nitrogen load to southern Bramble Bay via the Brisbane River needed to achieve this objective is estimated to be 1,900 kg d-1. Management actions will reduce the nitrogen load in the Brisbane River from 4,800 kg/d in 1997 and to 1,900 kg/d in 2007. The load is predicted to rise to 2,100 kg/d in 2020 as population increases and further load reduction is likely to be required.

9.2.3 Some of the lessons learnt

Some of the key lessons the Partnership has learnt are:

- Large-scale planning processes take time, including an initial gestation period, during which few tangible results may be apparent. This period involves getting the scope of the project right and building the community involvement processes.
- It is important to develop an effective process for inter-agency interactions.
- Local political leadership can play a key role in obtaining and maintaining the support and funding and in dealing with bureaucratic issues.
- The key role of the Commonwealth Government in providing seed funding and the social/political imprimatur to bring stakeholders together.
- It is important to include scientific, industry and community representatives on decision-making committees, where they can interact directly with politicians and government officers.
- The project must be grounded within the established regional planning framework – ideally through a catchment-based approach.
- A common vision must be developed early in the process to maintain focus and momentum.
- The importance of the delivery of good information by scientists speaking effectively with "one voice" and the community confidence that results from getting this process right.

9.2.4 Future challenges

Most of the improvement made to date are attributable to reductions in point source pollutants (wastewater treatment plants). Future improvements will require reductions in diffuse sources, which are much harder to achieve. The view is that unless significant improvements are made in restoring riparian vegetation and preventing contamination of surface water and groundwater run-off from urban development, it will be difficult to maintain these improvements. The focus for future implementation will therefore need to be upstream and to address non-point source catchment management issues. The challenge will be to build on previous achievements through ongoing effort over a sustained period (i.e. many years).

An audit of the Partnership undertaken in 2003 also identified that the major challenges for the Partnership in the future will be to focus on the implementation of effective actions, while maintaining a solid research program. Furthermore, the external audit also identified that while the Partnership is demonstrably successful and has been responsible for delivering tangible results, there was a need to guard against:

- Creeping complacency.
- A failure to refresh initiatives.
- Getting the balance wrong between effort on capability building and implementation.
- A lack of responsiveness to new demands.
- Being overtaken by new events.
- A failure to engage with old stakeholders and start engaging with new stakeholders.

Some other key issues identified by the External Audit which will need addressing in the future included:

- Ensuring that governance arrangements continue to provide for adequate and appropriate ownership by, and accountability to, key stakeholders without involving processes that unduly delay action and divert resources from the achievement of the overall objectives.
- Capacity building for community-based stakeholders who are experiencing increased difficulties participating in Partnership initiatives and other regional natural resource management planning initiatives.
- Careful consideration of the balance of resource allocation between Secretariat Programs (e.g. science and management) as the focus on implementation increases.

9.3 Glenelg-Hopkins Catchment, Victoria

9.3.1 The issues

Over the past 200 years, the Glenelg-Hopkins catchment has been substantially altered through activities such as clearing of native vegetation to create agricultural land, drainage of wetlands, and water extractions for agricultural and urban needs. Dryland sheep and cattle grazing have traditionally been the main industries within the Glenelg-Hopkins Region (over 2 million hectares). Over recent years there has been a trend towards an increase in the area covered by Blue Gums for timber production, increases in raised-bed cropping, and on a smaller scale, horticulture and viticulture industries such as grapes, herbs and cut-flowers have shown significant growth.

Compared to other regions in Victoria, the water-bodies of the Glenelg-Hopkins Region are generally not considered to have serious nutrient problems, nor are serious algal bloom problems common in recreational water-bodies and reservoirs. However, between 1929 and 2000, algal blooms have been recorded at 20 sites in the Glenelg-Hopkins Region and some sites have experienced more than one bloom over the years. Major threats to waterways in the region are considered to include pollution from farming activities, salinity, erosion and over-use of water resources. In terms of degradation of water quality, the most significant issues relate to sedimentation, high salinity, low dissolved oxygen and elevated nutrient levels.

9.3.2 The approach

In 1997, Catchment Management Authorities were established as the primary caretakers of river health in Victoria to create a whole-of-catchment regional approach to the management of biodiversity, land and water resources in partnership with other government agencies, industry and the community. The Glenelg-Hopkins Catchment Management Authority was selected as an example of the implementation of the Victorian Catchment Management Framework. Strong emphasis has been placed on the development of Regional Catchment Strategies as a means of identifying priority actions and determining expenditure. The Regional Catchment Strategy is a statutory document which represents the primary planning framework for the region, and ties together a suite of sub-strategies and action plans addressing issues such as water quality, biodiversity, vegetation etc. These Strategies are progressively being linked to statutory land-use planning instruments, environmental regulations, and land-use and development control and environmental management in urban and rural areas. Victoria is widely considered to be at the leading edge in

the preparation of Regional Catchment Strategies and the administrative arrangements to plan and manage at a catchment-level. The Glenelg-Hopkins Catchment Management Authority represents an example of the implementation of the Victorian Catchment Management Framework.

The Draft Regional River Health Strategy has adopted an assets based approach, whereby all the environmental, social and economic assets (or values) are identified and prioritised for each of the region's 32 sub-catchments, and a risk-assessment undertaken to determine the major threats and risks to the most valuable assets. The priority actions identified in the Draft Regional River Health Strategy are based on maintaining these assets, protecting high value reaches, enhancing river reaches in good condition and protecting river reaches from damaging developments. The Draft Regional River Health Strategy assesses and integrates all river health issues throughout the region to ensure that actions provide multiple benefit outcomes.

During the development of the Draft Regional River Health Strategy a number of Regional River Health Targets were determined, based on the assets and the proposed actions in each sub-catchment. These include:

- Outputs which represent the on-ground works (e.g., "Increase length of fencing in priority sub-catchments where permanent ecological vegetation classes are present by 239 km in Glenelg Basin and by 16 km in Portland Coastal Basin").
- Outcomes which represent the condition change (e.g. "Reduction in nutrient levels and increases in number of sites compliant with State Environment Protection Policy – 11% reduction in total phosphorus entering the waterways" over a time-frame of 1-30 years).
- Aspirational Targets which represent the long-term goals (e.g. "Improve techniques for the management of nutrients and reduce levels in waterways in the Glenelg Hopkins Region by fully implementing the Nutrient Management Plan. Reduce the input of total phosphorus to regional waterways by 54.5%").

A *Nutrient Management Plan* is one of a number of plans that underlie the Strategy, and it identifies the incremental costs of nutrient reduction ($\$ kg^{-1} year^{-1}$) in the Glenelg-Hopkins Region to provide a guide to the cost effectiveness of each of the potential nutrient reduction activities, which enables a ranking of the relative priorities which should be afforded to each activity.

Community partnerships are a key feature of the Strategy. Over the 2002-2003 period, the Glenelg-Hopkins CMA implemented 417 projects for on-ground works under the Community Partnership Projects scheme, an expenditure of $1.92 million equating to $3.8 million combined contribution (Glenelg-Hopkins Catchment Management Authority 2003b). Over this period: 520 km of protective fencing were erected, 479 km of land were direct seeded, 506,520 seedlings were planted, 1,510 ha of revegetation was undertaken; and 240.6 km of waterways were protected.

The Nutrient Reduction Target for the Glenelg-Hopkins *Nutrient Management Plan* is to reduce the nutrient loading entering the local waterways by 54.5% total phosphorus over the next 30 years, which will be achieved by the implementation of the priority activities of the whole plan at an estimated annual equivalent cost of $4.95 million.

9.3.3 Some of the lessons learnt

In a recent paper on catchment management and water policy in Victoria, Christine Forster, Chair of the Victorian Catchment Management Council, identified some of the key lessons that have been learnt over the 15 years that Victoria's community-based catchment management framework has developed. These include:

- Integrated catchment management is about partnerships, co-operation and collaboration. It is important to acknowledge that these take time to become established and often need to be re-established with changes in agency staff. The catchment management framework develops considerable social capital which needs to be valued.
- Considerable effort needs to be made at the establishment phase to set the accountability framework required for ongoing operations. Appropriate monitoring and evaluation frameworks should also be established early on.
- Administrative efficiency was one of the original objectives of the Victorian Catchment Management Framework which has yet to be met. The transaction costs are high as multiple funding sources have separate requirements and integrated projects often need to be separated out into separate components for reporting processes, making it difficult to optimise resources. The majority of Catchment Management Authority investors (State and Commonwealth) have been brought together in the Regional Catchment Investment Plan process to assist with the development of integration.

The Glenelg-Hopkins Catchment Management Authority's own internal review processes have also identified the need for clarification and consistent communication of Agency roles and responsibilities. There is a high level of recognition of the Glenelg-Hopkins Catchment Management Authority (CMA) as an entity, but this does not appear to be converted into a high level of understanding of the specific roles and responsibilities of the CMA. This creates confusion amongst the catchment audiences regarding the respective roles and responsibilities of the CMA and different agencies. Without a greater co-ordination of communication, different agencies are also likely to communicate to similar audiences in inconsistent ways, which dilutes the overall message. This has been identified as a key issue that needs to be addressed in order to improve the co-ordination of natural resource management activities.

9.3.4 Future challenges

Developments in the Victorian Catchment Management Framework

The Victorian Catchment Management Framework has faced a number of challenges and changes over its first decade – including legislative changes, increased responsibilities, changed funding arrangements, changing programs and departmental changes. A recent White Paper Securing Our Water Future Together (Victorian Government 2004) sets out changes that will in principle lead to an improvement in integration and co-ordination in water resource management, but the enhanced responsibility ascribed to CMAs will require additional capacity within the CMAs and rigorous governance, accountability and adaptive management frameworks.

Establishing an Integrated Framework for Planning and Communicating

The CMAs have a primary co-ordination and strategic planning role in natural resource management within the catchment, and there are a range of other government agencies with responsibility for different components of catchment natural resource management. Consequently planning of activities within a region is

often relatively fragmented and there are inherent overlaps which can lead to duplication of activities and cause confusion among catchment audiences. While it is acknowledged that this is improving, with the Regional Catchment Strategy focussing on creating a framework for the co-ordination of activities, this will not be achieved without specific mechanisms and protocols being established for greater co-ordination of activities and the linking of priority activities

Relationships with Local Government

There has been wide variation in the extent and effectiveness of the interpretation of the Regional Catchment Strategies in planning schemes though local strategic planning policy. Similarly, Regional Catchment Strategies do not adequately identify the means of implementing the Strategies through planning tools. Effective partnerships and communication are needed to overcome these difficulties. It is important that Local Government and CMAs are included in the development of strategies and that there is effective referral of planning permit application to CMAs.

9.4 Lake Taupo, Central North Island, New Zealand

9.4.1 The issues

Historically, the Lake Taupo Catchment was covered in tussock grassland and native forest. Since the mid 1800s there have been major changes in land-cover in the catchment, including: a loss of tussock or shrubland and indigenous forest; an increase in plantation forests; and an increase in areas used primarily for pastoral agriculture. Over the last 50 years there has been intensification of rural land-use in the catchment - more farmland has been developed, sheep, beef and deer farms have intensified, some dairying has also developed. In 1997, a Ministry of Agriculture and Forestry report indicated considerable potential for dairy expansion in the Lake Taupo Catchment, raising concerns about the potential longer term impacts of further land-use intensification on the Lake. In addition to the growth in agriculture in the catchment, urban settlement close to the Lake has increased.

Over the mid 1990s, scientific information began to indicate that the clarity of Lake Taupo's open waters was declining - minimum winter water clarity decreased from 12 m in the 1970s to 10 m in 1998-1999 and to approximately 7 m in 2002 (see references in Environment Waikato 2004a, b, c). Dissolved nitrogen levels were also found to be higher than in the previous 20 years - mean concentrations of nitrate in the surface 10 m of Lake Taupo increased from 0.31 mg m^3 prior to 1986 to 2.36 mg m^3 between 1988-1991. There has been an associated increase in chlorophyll-a (phytoplankton growth) in the Lake's surface waters over the last decade and increased growths of nutrient-dependent macrophytes, blooms of filamentous green algae and algal slimes (diatoms and other algae) in the sheltered waters near lake-shore settlements. In addition, blooms of potentially toxic algae were reported for the first time on record in 2001 and 2003, resulting in health warnings being issued for some areas of the Lake.

Scientific measurement and modelling has indicated that ~94% of the manageable nitrogen reaching the Lake is from pastoral farmland (primarily from animal excretion and defecation, with relatively little coming from the direct application of fertiliser.

Ironically, Lake Taupo has the highest levels of riparian protection of any developed water-body in the Waikato Region, because land-owners have undertaken extensive works to reduce soil erosion (a major issue). However, this has not been sufficient to

counter increases in nitrogen leaching from agricultural land and wastewater systems.

9.4.2 The approach

The principal framework for managing natural and physical resource in New Zealand is the Resource Management Act, which is widely considered to provide a precedent-setting comprehensive legal framework for establishing environmental management objectives and standards that are based on environmental considerations as well as on social and economic factors. Regional Council's are the environmental management agencies with primary responsibility for management of water quality, and have a specific function under the Act in terms of the control of the use of land for maintaining and enhancing water quality in water-bodies. In October 2004, after 4 years of discussion and consultation with project partners (Local Government, Central Government and Maori) and stakeholders from the Taupo Catchment, the Waikato Regional Council released the Lake Taupo Catchment *Draft Variation* to the Proposed Waikato Regional Plan outlining its proposed approach to the management of land-use change and nutrients entering Lake Taupo to protect the overall health of the Lake.

The target for the protection of Lake Taupo water quality is to reduce the manageable sources of nitrogen (pastoral farming, urban run-off and sewage) to the Lake by 20% to maintain water quality at its current level. In recognition that actions to protect the Lake will have far-reaching implications for the people and economy of the Taupo District and further afield, it is proposed that actions will be implemented over a 15-year time-frame.

The Waikato Regional Council has adopted a mix of policy approaches in the Draft Variation, including:

1. Encouraging voluntary change in behaviour and land-use from existing and future land-owners.
2. A regulatory approach involving nitrogen capping of nitrogen to prevent further increases in nitrogen leaching from pastoral and urban land.
3. Sharing of costs to achieve a 20% reduction in nitrogen from pastoral and cropping land. Financial incentives are funded by local, regional and national communities.

The Draft Variation includes land-use and wastewater treatment and disposal rules to control nitrogen entering the Lake from the surrounding catchment, such as livestock stocking rates, and fertiliser standards.

The total cost for taking action to protect water quality in Lake Taupo by managing nitrogen entering the Lake is estimated at NZ$143.3 million (at 2003-2004 values) over 15 years.

9.4.3 Some of the lessons learnt

The importance of long-term relationships was identified as a key lesson for the successful management of Lake Taupo. Consultation and communication about the effects of nitrogen on Lake Taupo began in 2000. Waikato Regional Council, Taupo District Council, Central Government, Tuwharetoa Maori Trust Board, Taupo Lake Care and the wider community have worked extensively to find the best solutions for both the Lake and the community. Throughout this process of change the stakeholders have sought to build long-term relationships. A number of factors have been important in establishing and continuing these relationships:

- Acknowledgement of the role of Ngati Tuwharetoa as kaitiaki and principal land-owner.
- A willingness to meet with the community "at their place" to address questions and concerns.
- Responsiveness to provide new information to clarify issues.
- Providing consistent messages while also acknowledging uncertainty in scientific information.
- Involving those sectors of the community facing the greatest change at a science, economic and policy level with sufficient time to cover all issues to their satisfaction.
- Acknowledging and incorporating local and traditional knowledge.
- Articulation of a long-term vision for the community and the Lake which values the natural resources and the community aspirations.

9.4.4 Future challenges

Future challenges are identified as follows.

- There are still considerable issues to resolve in determining nitrogen allocations to land owners.
- Will a 20% Reduction in Nitrogen Inputs to the Lake be Sufficient? The 20% reduction is based on robust scientific information that is currently available, but is nonetheless an estimate. A recent independent review of the available information suggests that a 20% reduction is at the conservative end of the range of estimates (20-80%) of the necessary reduction in manageable nitrogen to maintain the Lake's current water quality.
- Public understanding of the issues facing Lake Taupo. A recent re-survey of Taupo residents to determine the effectiveness of communication tools and public awareness and involvement identified that while in general the key issues were well understood by the community, there were apparent gaps in understanding of the long-term nature of Lake Taupo's groundwater system (which implies a considerable time-lag between management actions and environmental improvements) and confusion over the main causes of Lake Taupo's water quality problems.

9.5 Common factors contributing to success

None of the three case studies is without challenges, but there was a suite of key attributes that are central to the frameworks that have been developed for managing nutrients. These were as follows:

- Appropriate statutory frameworks.
- Strong leadership and co-ordination.
- Strong and consistent political and agency commitment.
- Strong co-operative and collaborative stakeholder partnerships.
- Close links between management agencies and Local Government.
- Clear identification of roles, responsibilities and accountabilities.
- Integration of environmental, social, cultural and economic considerations and integration across jurisdictions and science/policy/implementation.
- Commitment to an adaptive management framework.

- High levels of stakeholder and broader community ownership and involvement.
- Effective management of conflict between different stakeholders.
- Funding over and above agency budgets and targeted investment.
- Compatible and comprehensive incentives and disincentives.
- Specific and measurable performance indicators.
- Enforceable management actions.
- Auditing of environmental outcomes.

Appendix A

Report provided by Dr Doug McKenzie-Mohr on the SCCP Action Plan's Communication and Education components

Comments on the Communication and Education components of the SCCP Action Plan provided by Dr Doug McKenzie-Mohr.

As requested, I am confining my comments to communication/education aspects of the evaluation. More specifically, I'll comment on three portions: 1) education - communication components of the Cleanup Program, 2) problems, issues and observations regarding the community survey report, and 3) case studies from elsewhere.

As you'll see from my comments the approach that I would take to facilitating awareness building and behavior change is quite different from what has been done so far. Further, the approaches that I am advocating are far more likely to bring about significant and lasting changes in behavior. While I am suggesting significant changes in approach please do not interpret my comments as not supportive of what has been done to date. The commitment that has been shown with respect to improving river quality is really quite remarkable. As I see it, my role is to assist in improving future efforts, hence most of comments will hopefully be seen as constructive criticism.

Education/Communication Components of Cleanup

In my initial feedback I stressed the importance of identifying the perceived barriers and benefits to each activity that is related to river health. Without this information it is very difficult to develop effective programs. Barrier and benefit research has to be collected at the level of specific activities as the primary literature indicates that the barriers and benefits are unique for each activity that we might promote (e.g., reduced fertilizer use, proper disposal of HHW, etc.). To date, this essential first step to effective social marketing has not been addressed in any meaningful way. That is, there in no indication in the documentation provided that the barriers and benefits are known to specific activities that have been and/or will be promoted. To conduct this type of research, it is necessary to conduct focus groups and interviews both with householders / businesses / farmers who are engaged in the activity as well as those who are not. The focus groups and surveys should be composed of items that will measure potential barriers and benefits for each specific activity (usually you can only address 2-3 activities in one focus group or survey). Regarding the survey, you need to have at least 15 participants for each barrier and benefit that you have identified in order to conduct multivariate statistics, such as discriminant analysis or logistic regression (for example, if you have identified 20 barriers and benefits, you will need at least 300 participants who are preferably equally divided between active and inactive). It is important to use multivariate statistics as they provide the opportunity of not only identifying which barriers and benefits distinguish between those who are active and inactive for a specific activity, but also the relative importance of these barriers and benefits. For example, several years ago I wrote and analyzed a national telephone survey in Canada that investigated the barriers and benefits to three activities related to reducing CO2 emissions. One of the activities that we explored the barriers and benefits to was tire inflation. Of all the barriers that we explored to tire inflation, the discriminant analysis revealed that only three barriers really mattered (in order of importance these were: 1) forgetting to check your tires, 2) having a tire gauge, and 3) having the requisite knowledge to know how to check and inflate your tires). Beyond these three barriers none of the remaining barriers were anywhere near as important. As you can quickly see, having this information is very meaningful with respect to designing programs. Knowing, for example, that individuals who don't check their tires forgot on an ongoing

basis to engage in this activity suggests the use of prompts to overcome forgetting. Indeed, some vehicles now have a warning system that prompts a motorist when their tires are under inflated – conveniently addressing the most important barrier.

The absence of this type of careful preliminary research is a major limitation of the entire Swann-Canning Cleanup program. In lieu of knowing the actual barriers and benefits, program designers across your many initiatives are simply guessing as to what they are. To stress how important this is, each time I deliver a workshop I ask participants to guess what the three most important barriers are to tire inflation. I have now delivered workshops for over 20,000 program planners and no one has ever guessed all three, let alone in there correct order. Further, most folks don't get more than one right. What this suggests is that the vast majority of behavior change programs that make-up the Swan-Canning program are being delivered in a knowledge vacuum. To overcome this, I would suggest the following:

1. The activities to be promoted are prioritized in terms of importance. That is, from the perspective of the vitality of the watershed which activities impact water quality most significantly?
2. Next, focus groups are conducted with the target groups for the behavior change. These focus groups are divided, as with the telephone survey, into those who are active and inactive.
3. Building on the information gleaned from the qualitative focus groups, telephone surveys are conducted to quantitatively identify the barriers and benefits for the most important activities. These surveys must make use of multivariate statistics, as descriptive statistics, upon which past survey work has relied, is incapable of prioritizing barriers and benefits.
4. Funding for behavioral change initiatives is tied to the extent to which specific initiatives address barriers and benefits.
5. Funding is also provided for pilots prior to broad scale implementation and behavioral change and/or demonstrable changes in river quality are the required evaluation measures.

Moving to a community-based social marketing approach to fostering behavioral changes requires a fundamental rethinking of how to facilitate behavioral changes on the part of those involved in delivering these programs. In reviewing the materials that you provided I found frequent examples of pamphlets and the like being prepared as a route to bring about changes in awareness and behavior. While such approaches may change awareness and attitudes (though nowhere near as well as the personal conversations that would occur in the workshops) they have little likelihood of changing behavior. They are based on the mistaken assumption that attitude and awareness changes lead to changes in behavior (see the first chapter of my book, Fostering Sustainable Behavior, for a fuller discussion of this approach). Ideally, those individuals who are struck with the task of delivering these types of programs should attend a workshop on community-based social marketing so that all involved understand the limitations of information-intensive programs in facilitating behavioral changes and that there are far more effective alternatives. Further, changes in the funding guidelines, as set out above, can have a significant impact upon the uptake of these approaches. These changes in guidelines are unlikely to come about unless those directing the program understand the inherent challenges in facilitating behavior change. If possible, you might consider coordinating both those that are directing the program as well as those who design and deliver the initiatives going to the introductory community-based social marketing workshop that I am delivering in Perth on April 30th. Alternatively, there is an executive session breakfast session being held

on the morning of April 28th that might be appropriate for some of the executive (I can provide further information on this and contact information if you wish).

Community Survey Report

Below are a variety of micro-level comments on the surveys.

- What was the participation rate for the "General Community Survey"? Without knowing the participation rate it is impossible to judge whether the results can be easily generalized back to larger population from which the sample was drawn.
- The question dealing with "Actions aground the garden – slide 19" is likely to have led respondents to over report their behavior (to ensure health of the rivers). This question suggests to the respondent that taking action is socially desirable and therefore increases the likelihood of participants presenting themselves in a socially desirable light. The same is true with respect to Actions around the Workplace (slide 20) and Actions around the River (slide 18). It would also be helpful to have frequency information with respect to these actions.
- Regarding fertilizer use (slide 23) is the lower percentage for young adults an artifact created by fewer owning homes or have apartment owners been excluded from the analysis?
- Social desirability is also very likely influencing the self-reports in slide 21. A good indication of the social desirability of these actions is found in the high number of respondents who report a willingness to engage in inconvenient actions, such as disposing of chemicals at the landfill.
- For slide 22, the responses should be correlated with the presence/absence of a garden – if this wasn't done already.
- The willingness to attend a public event and reduce the amount of lawn in the garden percentages are not believable. Public events are notoriously poorly attended and reducing lawn size requires such significant expenditures of effort that it unlikely that anywhere close to 55% would actually engage in this activity.
- It is hard to know whether the awareness levels shown in slide 28 are simply due to reasonable guesses as to what the Swan-Canning Cleanup Program is meant to do. Knowing that the Swan and Canning are both rivers, and that the purpose of the project is their cleanup, it would be surprising if respondents did not report "keep the rivers healthy" and "improved water quality of the rivers." Accordingly, claims that the various initiatives have reached a penetration level of 60% understanding the primary goals are likely unfounded.
- Slide 30 is perhaps the most important slide in this set. It clearly demonstrates that the vast majority of resident have not participated in Cleanup programs. Further, it suggests that alternative approaches, such as the case study presented below would reach far greater numbers of residents. I'd like to discuss this with you in further detail, perhaps while I am in Perth.
- Slide 35 – As before it would be good to know the participation rate. Further, for all of these surveys the use of a refusal surveys would have been beneficial (if we meet in Perth or chat on the phone I can discuss with you how refusal surveys work – you can find a brief introduction to them in the second chapter of my book)
- Slides 38-40 – Hard to know what to make of these findings without having information on participation rates. If the participation rate was high this is a non-issue. However, if many people elected not to participate then it is likely that the participants would be more enthusiastic about the program than those

that refused to do the survey. This comments applies to the evaluations of the other workshops as well.

- Slide 44 – It is disturbing that the participants had such low recognition of one of the key messages of the Corporate Care Days.
- Slide 42 – It is surprising that a larger percentage of households are not engaging in the suggested behavioral changes. Again, see the results in the case study below that are much more promising.
- Slide 52 – Need to know the participation rate in order to be able to interpret these numbers
- Slides 54-56 – Need to be interpreted with caution. There is a literature that suggests that when humans purposely participate in a program they are likely to skew their view of the program to justify their participation in it.
- Slide 57 – It would be useful to know the frequency of these actions
- Slide 67-72 – Same comment as for slides 54-56. This comment also applies to the property-planning workshop.
- Slide 104 – Useful to know frequency of the activities

The surveys provide useful information, but the information addressed in the survey is primarily descriptive and as a result there is little information on barriers/benefits to specific activities.

Case Studies

Many of the behavioral change approaches currently make use of workshops as the primary delivery vehicle for facilitating change. The inherent challenge with workshops is that they are time intensive both to organize and to attend. As a consequence of the inconvenience of attending these sessions, it is unlikely that the Cleanup Program will ever obtain significant penetration into the residential/commercial/farmer sectors unless alternative approaches are explored. One of the most promising alternatives involved door-to-door visits in which trained staff walk through a residential community and approach each individual household and speak to them about behavioral changes that they can make to foster improvements in water quality. The specific strategies that are utilized in these visits should be based upon the barrier and benefit research discussed earlier. This approach is being tested this summer with respect to reducing outdoor water, pesticide and fertilizer use in Bend, Oregon (contact Tim Hester <thester@resourceoregon.org>. Door to door approaches have been used very successfully in a variety or programs (see the attached information on Durham and Halton Region in Southern Ontario, Canada). The best known of these programs is an initiative designed and run be a friend of mine, Glen Pleasance. I served as an advisor on this multi-year initiative. This specific approach can be readily adapted to deal with not only water use, but also water quality. If you'd like, can discuss this in more detail over the phone with you or, perhaps, while I am in Perth. Here is an abbreviated version of the case study description from my website:

Durham Region is located on the north shore of Lake Ontario, on the eastern border of Toronto. In 1995 Durham Region began developing initiatives to help their customers reduce water consumption. Durham Region has a population of over 531,000 citizens, and between 1990-1994 the population grew at a rate of 2.4% annually, while water consumption increased at the alarming rate of 6% annually. Durham Region recognized its potential water supply problem and consequently set out to reduce the water consumption of its 118,000 metered regional water customers. By reducing the water consumption of its citizens, costly water plant expansions could be avoided. Residential water consumption represents 62% of the total water consumption in Durham, and for this amount to be significantly reduced a program that encompassed a variety of

strategies had to be developed. Some of these strategies involved residential toilet replacement, lawn and garden watering reduction, and general water efficiency information. All of these initiatives helped contribute to the success of the Water Efficient Durham program. Glen Pleasance, Durham Region's water efficiency coordinator, decided to use a non-coercive approach to changing water related behavior. Residents had to understand that despite their close proximity to Lake Ontario (one of the largest bodies of freshwater in the world) it was essential that everyone reduce the amount of water they used for their lawn and garden, as well as the amount of water consumed by everyday household appliances and fixtures like toilets. Pleasance decided to utilize community-based social marketing in facilitating these changes. This approach, which relies heavily upon personal communication, gave summer student employees the opportunity to communicate effectively with residential water customers. Also, if customers had questions or concerns they could easily be answered. After conducting extensive public consultations to determine where Durham Region should concentrate its water efficiency efforts, specific initiatives were developed. These initiatives included implementing a Water Fixture Replacement Program (WFRP) to replace 7,500 toilets in 5,000 homes over a two year period, establish a Water Efficient Demonstration Garden, institute an Odd/Even Day Lawn Watering Bylaw, develop initiatives to reduce the Summer Peak Consumption (which exceeded 50%), publish a 60 page Householder Guide to Water Efficiency, develop a workshop for the Industrial, Commercial and Institutional (IC&I) water customers as well as an accompanying assessment guide to enable participating organizations to identify new efficiencies in their water use.

Summer Water Consumption: Excessive lawn watering is a significant challenge for many water efficiency programs. Only by changing behavior can water usage be reduced. Community-based social marketing strategies are well suited as the face-to-face communications employed are more likely to change participants long-term behavior compared to simply providing information through brochures or bill-stuffers. By using non-coercive techniques a relationship can develop between the participant and the program employee, which allows open communication to take place.

The Pilot Program: In 1997 Durham Region ran a pilot program in the town of Ajax aimed at reducing lawn watering. The university students who were employed, utilized community-based social marketing methods to reduce the amount of water consumed by participants. Their photo identification, and Water Efficient Durham T-shirts and hats easily identified them. The students approached residents in pairs when it seemed appropriate, as they did not want to inconvenience the residents. The focus was on developing a trusting and helpful relationship with residents. The students gave the residents a brochure on water efficiency and they talked to them about ways to reduce their water consumption. The students stressed that lawns only need one inch of water, including rainfall, a week to remain healthy. This helped residents realize that much of their watering was unnecessary. The first intervention was followed by five more, each allowing the residents to develop a more trusting relationship with the students. The students visited two hundred homes over a ten-week period. There were four different study areas, and the students observed the water habits of each area from bicycles for fourteen hours each day. The four areas under study were: a control area, a traditional mail-out area, Master Gardeners providing landscape assessments, and students meeting residents face-to-face. By far the most successful of these areas was where students interacted with residents; they achieved an observed 26% reduction in watering. In this area the summer peak of those homes was reduced by half. Clearly, the community-based social marketing methods employed by the students significantly reduced the peak summer water consumption of these homes, which resulted in the 1998 program expansion. In 1998 the program expanded to nine hundred homes in six

communities: Pickering, Ajax, Whitby, Oshawa, Port Perry, and Uxbridge. These neighborhoods were chosen because they each had a history of high summer water use. Due to the success of the student interventions relative to other approaches utilized in 1997, only the student interactions with residents were utilized in 1998. The students contacted each household six times. During these interventions they gave residents hose washers, a rain gauge, lawn care and gardening brochures, the Household Guide to Water Efficiency, and a tag for the outdoor faucet that acts as prompt to remind people to conserve their water. The Household Guide to Water Efficiency is a sixty-page book that gives residents a plethora of opportunities for indoor and outdoor water conservation. The students would then ask the residents to reduce their water consumption by whatever means they preferred. The students stressed that residents use the rain gauge to measure the amount of irrigation they applied. Generally, one inch of water (including rainfall) is sufficient for most turf. The rain gauges were used to determine this amount. The final goal was to get residents to make a written commitment to a series of water efficient behaviours, including watering a maximum of one inch of water per week. Given the importance of restricting watering to no more than one inch per week, residents were asked to make a written commitment toward achieving this goal. Written commitments, are more likely to be effective than those that are made verbally (see Chapter 3 in Fostering Sustainable Behavior for more information on commitments). Written commitments were obtained from eighty-eight percent of the households and this program also achieved a 26% reduction in outdoor water use. The program cost $88 per household for a total of $80,000. This program achieved its goal by giving residents both the information and tools that they required to reduce their lawn watering. In 1999 Durham Region focused on the Water Fixture Replacement Program, but in 2000 they decided to employ the summer students again. The students worked in two neighborhoods, one in Whitby (350 homes) and one in Oshawa (700 homes). One change in this study was that the monitoring was done by means of bulk metering, instead of the observations done previously by the students. This method allows community water use to be monitored unobtrusively assuring that residents are not changing their behavior just because they are being scrutinized. Monitoring is accomplished by reducing water supply to one water main and using an insertion meter and data logger to measure water flow to the homes. Once temperature and precipitation data are overlaid, irrigation can be quantified. By comparing the study area to a control area, the student's impact can be measured. Compared to the 1998 study, in the 2000 study the students only did four interventions per household. The first intervention was aimed at introducing the students and the program to the resident. The students gave the participant two brochures, one brochure provided information on Durham Region's Water Efficient Demonstration Garden, and the other provided general water efficiency information. The second intervention stressed the program's main goal, which was limiting lawn watering to one inch per week, including rainfall. The students also gave participants rain gauges and lawn-watering brochures. During the third visit residents were given a water reminder tag for their outdoor faucet (see the graphics database to view this reminder) and the Household Guide to Water Efficiency. On the final visit, the students would ask the resident for a public written commitment to limit his/her irrigation to one inch per week. Eighty-two percent of residents agreed to the written commitment and water consumption was reduced 32% compared to the control area. This equals a reduction of two hundred and fifteen litres of water per household per day. The cost of the program was also reduced to forty-five dollars per household. In 2001 students recruited volunteers to help spread the success of the program to 3000 homes, compared to the 1000 homes reached in 2000. This method is known as social diffusion because it relies on educated volunteers to communicate the benefits to their circle of friends. Unfortunately, the students were not able to recruit enough volunteers, and it took more effort to recruit volunteers than to have the students do all of the front line contact themselves. The students then reverted back to

their face-to-face contact with the three hundred households that were being bulk-monitored, homes that were not included in the 2000 study area. In the summer of 2001 the control and study areas from the 2000 program were bulk-monitored again to determine what portion of the 32% irrigation reduction was sustained through the following summer; the participants were not told about this monitoring. The 32% irrigation reduction was maintained only on weekends, not on weekdays. Part of the reason for this confusing result was that the summer of 2000 was wetter, whereas the summer of 2001 was considerably drier and hotter than average. Some of the innovations in Durhamís 2002 program included the students knocking on doors in the study area as opposed to relying solely on casual contact (i.e., approaching people that are outside doing yard work or watering). The students also used Palm Pilots to record each contact made with homeowners and track the actions from each meeting. Previously, the students would spend up to 25% of their time simply transcribing and inputting the results each day. These innovations enabled the students to triple the 2000 CBSM program coverage area to almost 3,000 homes and reduce the cost per household to $24 (the cost in 2000 was $45 per household). A summary of the interventions used in 2002 is provided below.
Intervention #1: Conducted between June 15th and July12th. Students gave participants a program introduction and completed a baseline questionnaire. The students then provided homeowners with a rain gauge, recording card, and fridge magnet. Coverage of intervention #1 was close to 100%.

Intervention #2: Conducted from June 30th to July 13th. Residents were given the Region's sixty page Household Guide to Water Efficiency and a hose bib reminder tag (which can be viewed in the graphics database at this site). Students discussed the various indoor and outdoor water savings opportunities contained in the book. By flipping through the book the students would identify areas of interest to the resident. The guide often stimulated long conversations with residents on conserving water. The Guide also helped to build upon concepts introduced during the first intervention. The hose bib tag, with its "1 Inch Per Week," "Odd/Even Watering," and "Water in the Morning" reminders was a visual prompt to reinforce those irrigation habits that conserve water.

Intervention #3: Conducted between July 13th and July 28th. Focused on water efficient gardening. Students distributed the Region's two brochures introducing and listing the plants from its water-efficient demonstration garden. Residents were encouraged to visit the Region's garden and to choose water-efficient plants for their own gardens.

Intervention #4: Conducted from July 28th to mid August. Final intervention. Involved the distribution of the Commitment Form. The Commitment Form is a written social contract completed by the resident in the presence of the students, listing a series of water savings actions. The most important commitment (limiting irrigation to a maximum of 1" per week including rainfall) received a 90% commitment level. This level of support corresponds well with the quantified peak demand reductions of 27%.

Results: A measure is said to be cost-effective if the costs associated with implementing the measure are less than the costs associated with not implementing it. Water saved as part of an irrigation reduction program will help to defer the need for water supply infrastructure expansion. The greater the amount of water saved, the longer the deferral, and the greater the economic value to the municipality. To calculate the economic value, it is first necessary to estimate the unit cost associated with expanding or constructing new water supply infrastructure. Actual costs and construction schedules of infrastructure expansion programs vary from municipality to

municipality. As such, there is not a single value that accurately reflects the unit cost of expanding water supply for all areas. There is, however, a guideline that allows these costs to be estimated, whereby these costs can then be compared to the costs associated with implementing water efficiency measures to determine approximate cost-benefit ratios. A report in the AWWA Journal concludes that the unit cost of water treatment infrastructure alone is about $0.265 per L/d. Information in the City of Toronto's 1996 Water Supply Joint Study supports this value, and also goes further to suggest that the cost associated with treatment plant expansion alone accounts for approximately 40% of the total cost of water treatment and distribution infrastructure expansion (e.g., expanding water mains, pumping stations, valves, reservoirs, etc.). The unit cost of providing water treatment and distribution infrastructure is, therefore, approximately $0.66 per L/d (i.e., $0.265 per L/d divided by 40% = $0.66 per L/d). Because it is expected that reducing peak demands will allow water suppliers to defer rather than eliminate infrastructure expansion, the present value of this cost must be determined. Using a discount rate of 4.5% (to account for compound interest) and an assumed deferral period of 10 years, the approximate present value unit cost of infrastructure expansion (supply) is reduced to about $0.40 per L/d (i.e., saving $0.40 today is equivalent to saving $0.66 in 10 years). Based on this methodology, municipal irrigation reduction measures must be implemented for less than $0.40 per L/d of water savings to be cost-effective (i.e., to cost less than the alternative solution of expanding water supply infrastructure). It is important to remember, however, that to apply this cost-benefit methodology the water savings must be maintained from year to year (a water treatment plant, for example, can provide water on an ongoing basis, therefore, water savings from an efficiency program must also be maintained). The approximate cost-effectiveness associated with implementing the different levels of municipal irrigation reduction measures is calculated using the estimated cost of delivery on a Region-wide basis and an avoided cost of supply of $0.40 per L/d. In 2000 the cost to deliver the water efficiency program was $45 per home, compared to $24 in 2002 when the program was delivered more efficiently. The water savings in 2000 were 186 L/d while in 2002 it was 250 L/d, for unit cost savings of $0.242 and $0.096, respectively (cost per home/water savings per home). It is expected that the cost of program implementation would be somewhat less per capita if completed on a Region-wide scale. Both programs, however, are more cost-effective than expanding water treatment/distribution infrastructure. The data collected during the summer of 2002 indicates that the Control Area continues to use more water for irrigation than either the 2000 or the 2002 study areas. The irrigation savings achieved in the 2000 study area have reduced slightly over time, but are generally being maintained (87% of savings originally achieved in 2000) even though there have been no subsequent interventions in the area. The irrigation savings achieved in the 2002 Study Area are in line with the original savings achieved in the 2000 study area even though the summer students implementing the CBSM program were required to cover a significantly greater number of households during the period. Both the 2000 and the 2002 CBSM programs are more cost-effective at meeting growing peak day water demands than the construction of new infrastructure.

Appendix B

Case studies of successful behaviour change programs provided by Dr Doug McKenzie-Mohr

WATER EFFICIENT DURHAM

OUTDOOR WATER CONSERVATION PROJECT

JUNE – SEPTEMBER 2002

MAPLE DURHAM
28 RICE DRIVE
WHITBY, ONTARIO
L1N 7Z1
905-666-1046

CONSULTANT

AMBROSE SAMULSKI
MAPLE DURHAM
28 RICE DRIVE
WHITBY, ONTARIO
L1N 7Z1
905-666-1046

FACILITATORS

SUSAN SAMULSKI
VALERIE FIELD

PROJECT LEADERS

CHRIS WEBDEN
JONATHAN OLDMAN

TEAM INTERVENORS

JAMIE KING
LAURA LABINE
JASON VECENTE
SARAH ROGERS

CHAPTER 1

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Since 1997, Maple Durham has participated in delivering Outdoor Water Reduction programs for the Works Department of Durham Region, specifically the projects involving Community Based Social Marketing (CBSM). In 2001, the Region decided to study the effectiveness of incorporating the concepts of Social Diffusion into administering the CBSM protocols. That study concluded that the current restrictions surrounding a summer based water reduction campaign would not adequately be served by using the principals of Social Diffusion. The previous water reduction programs employing CBSM of 1997, 1998, 1999 and 2000 had a high degree of success in achieving reductions in peak water demand in the neighbourhoods covered by these programs. Similar programs were attempted by Halton Region and in their programs, similar reductions were achieved with modifications to Durham's approach. The purpose of the 2002 study was to achieve greater cost effectiveness per household while maintaining similar water reductions as in previous years. In this study, approximately 3000 homes were selected in both Ajax and Pickering and a proactive approach was incorporated.

Recruitment of the summer team of students was similar to previous years and the criteria for selection is described in the report. Returning students make up part of the team each year and they are involved in the selection process of new team members. Training was conducted over an initial 3-day period at Durham College using a team of trainers, past team members and resource people. Training was shared with the team from Halton Region and included 3 field trips as part of the program. The team then conducted an inventory of the homes selected in both municipalities and started entering the data into a spreadsheet database for use in Palm hand held computers. All team members were supplied with Palm M505 computers including "Data Viz" and "Documents to Go" software. The team was trained in the use of these units as well as downloading the information collected to a central computer for analysis.

The students then started the series of interventions. The initial contact with the residents included a baseline survey with 9 0r 10 questions directed at determining their current lawn and garden practices. The students also handed out the rain gauges, a refrigerator magnet and hose washer. The rain gauge was accompanied by an explanation of the importance of the "1 inch per week" guideline which is one of the main messages of the reduction program. The second intervention consisted of distribution of the Household Guide to Water Efficiency and the hose tag reminder. The hose tag serves as a prompt for the key messages of the interventions. The residents were introduced to one or more key sections within the Household Guide during this intervention. The 3rd intervention included distribution of the literature on Water Efficient Gardening and the Water Efficient Plant List. The final intervention involved the presentation of the commitment form. One area of Ajax had the interventions combined into 3 rather than four to determine if there was a significant difference incompletion rates of the commitment forms.

A total of 82% of both Ajax and Pickering residents completed the baseline questionnaire. Only 9% indicated that they measured the amount of water they used to water their lawns and gardens. A minority of residents, 29% indicated that they observed the Odd/Even bylaw while 76% indicated that they considered weather and climate when

they watered. A majority 62% said they preferred to water in the evenings and 61% indicated that they watered their lawns and gardens between 1 to 3 times per week. Only 25% said they considered water efficiency as a criterion for plant selection. Forty three percent indicated that they never sprinkled water onto paved areas. Very few, 7% practiced any type of water recycling activities.

The total number of houses selected for interventions in both cities was 2741 after several were deleted for numerous reasons such as being unoccupied. Of these 81% were deemed to be active which meant that they the team was able to personally contact the resident on more than 1 occasion. 2120 commitment forms were distributed to the homes and 82% or 1742 were completed. The results of the commitment form items are as follows:

1. 83% committed to no more than 1 inch per week
2. 88% agreed to leave their grass length at more than 21/2 inches.
3. 88% would leave their grass clippings on their lawn as mulch.
4. 93% indicated that they would avoid unintentional watering of paved areas.
5. 86% committed to watering only in early morning and evenings.
6. Only 24% agreed to collect rainwater for irrigation purposes.
7. 73% committed to watering on cool calm days.
8. 75% agreed to consider water efficiency as a criterion for plant selection.
9. 84% committed to observing the Odd/Even bylaw.

A comparison of information collected during the baseline survey as compared to the commitment form indicated the following changes in practices:

1. There was an increase of 73% in residents willing to follow the 1 inch per week guideline.
2. The number of people willing to leaver their grass grow to the longer length of 21/2 to 3 inches increased by 51%
3. The number of residents willing to leave grass clippings on the lawn increased by 39%
4. 50% more people agreed to avoid unintentional watering of paved areas.
5. Only 9% more were willing to water only in early morning or evenings.
6. The numbers indicating a willingness to use rain barrels increased by 21% from the very low level of 3%
7. There was an increase by 51% in the numbers willing to select water efficient plants in the future.
8. The numbers willing to observe the Odd/Even bylaw increased by 55%

Historical data of the previous CBSM projects indicated that there were similar increases in commitment to water efficient practices in this year as compared to other years. It was interesting to note that the results of the baseline survey have changed over the last 5 years. This can be attributed to the ongoing media campaign and promotions by the Region in the area of building awareness of water efficient practices. For instance, the practice of leaving grass to grow longer was practices by 37% in 2002 compared to 21% in 2000. Increases were seen in the area of practicing water efficient gardening (up by 3%), practicing grass cycling (up by 14%), avoidance of unintentional watering (up by

24%) and watering the lawn no more than 1 inch per week (up by 6%0 over the same two year period.

There was no significant difference between the areas receiving 3 rather than 4 interventions. Both areas achieved similar results in the numbers completing the commitment forms. The number of students involved remained at 6 in 2002 but the number of houses approached with the CBSM program increased to close to 3000. This is a substantial increase in efficiency over the past 4 years.

CHAPTER 2

INTRODUCTION

For most municipalities across North America the dramatic summertime increase in water consumption by residential customers has become a key concern. High summertime water consumption coupled with higher standards for water quality and costs associated with best available technologies for water treatment have made the cost efficient supply of potable water to rapidly expanding populations a difficult challenge. Most water utilities have relied on traditional resources, such as media advertising, bill inserts and public announcements to disseminate their water conservation messages. The response to these traditional public campaigns has been less than satisfactory in reducing peak summertime water demand. In countries such as Canada, where freshwater resources are abundant, the perceived need to conserve water is lower than in countries or states where water scarcity has long been a political and economic issue.

In response to the shortcomings of traditional public education about water use and conservation, a more successful approach has been sought out by a number of municipalities. Recent research has shown that changes toward environmentally sustainable behaviour are best achieved through comprehensive, community-based social marketing programs (McKenzie-Mohr 1996). Community-based social marketing (CBSM) combines the findings of social psychology with the experience of product marketing to encourage environmentally related behavioural changes. McKenzie-Mohr (1996) has suggested that the relationship between attitudes and behaviour is complex,

and that desirable environmental behaviours do not necessarily follow a change in attitude toward environmental issues. Researchers such as Prose (1996), Cobern, Porter, Leeming and Dwyer (1995), and McKenzie-Mohr (1996) have shown that enduring behaviour changes are intrinsically motivated and that performing a desired behaviour frequently precedes the change in values and attitude.

Community-based social marketing focuses on the factors that lead individuals to change their behaviour. Until recently marketers of social and environmental change assumed that education and information will lead to altered attitudes, then behaviour change. Gail Savina of King County Local Hazardous Waste Management program aptly points out that the bottom line for marketing environmental behaviour change is that "information by itself is not sufficient to change behaviour." Savina (1997) cites McKenzie-Mohr's (1996) work and suggests that,

> "Outreach programs that begin by designing brochures, planning workshops or setting up site visits are starting at the wrong end of the process. In the majority of cases, handing someone a brochure has little impact on what they do. Because they are working backwards, these projects fail to address all the barriers besides information that stand in the way of behaviour change."

Community-based social marketing begins with a clear objective and accurate identification and assessment of the target audience. Savina (1997) relates a well-known story about Gloria Steinem's foray into the environmental field that illustrates the importance of this planning step. While on a geology field trip Steinem was reported to have come across a snapping turtle making its way toward a road. She promptly picked

up the turtle and put it back onto the riverbank, thinking she had saved it from further struggle and potential hazard. Later, her professor informed her that the turtle had probably spent a long time, perhaps a month, making its way up the road to lay her eggs. The critical message communicated in the story is, "*always ask the turtle*" (Savina, 1997). Effective CBSM invests a substantial effort into researching the behaviour of the group and its various socio-environmental contexts, motivations, attitudes and barriers to better behaviour. Knowing your audience – what they do and why they behave the way they do – is the key to developing successful strategies for marketing environmental change.

Determining barriers to the desired behaviour change is an important activity in CBSM. This involves viewing the obstacles from an insider's perspective. Barriers to change and the motivation to behave differently may be personal, social or external and frequently vary within groups of individuals. Differences with and between identified groups are largely attributable to demographic, environmental, cultural and individual psychological factors. Common barriers include lack of knowledge about a practice or problem; negative beliefs about the importance, difficulty or convenience of a practice; friends, neighbours and peers not performing the behaviour; the change being viewed as expensive or alternatives as limited (Savina, 1997). The central challenge in developing a CBSM strategy is to identify and overcome the most important, common and changeable of the barriers. Community-based social marketing thus makes use of incentives, disincentives, prompts, reminders and social influences to convince people to perform the behaviour first. The overall behaviour change is broken into increments that

include small, easy to perform activities such as changing hose washers to prevent leaks. Small incremental changes are easier to accommodate than those perceived as large or sudden. Changes in attitudes and values regarding environmental issues often follow, as the new set of behaviours become a habit.

Prompts used in CBSM projects are typically products that are used to gain the trust of subject group members and frequently overcome barriers. For example, in Durham Region's 1997 pilot project, many residents found it inconvenient to water early in the morning when they were getting themselves ready for work and children off to school. The 1998 summer project addressed the barrier by offering a discount coupon for sprinkler timers. Residents were offered something of value and the product being promoted offered a technical solution to the inconvenience barrier. As with traditional, product marketing, the items used as prompts in CBSM projects must be appropriate to both the audience and the message being delivered. They must be perceived to have some value as a gift and they must work as promised. Traditional marketing of consumer products has shown that bad experiences with an item generally lead to its failure in the marketplace. A prompt that is poorly executed, inappropriate, or otherwise unsatisfactory can jeopardize the probability that an individual will make greater commitments to change later on. For example, it is imperative that information about lawn care is communicated prior to asking residents to commit to displaying grasscycling signs. Appropriate prompts, such as the rain gauge, provide a simple way for residents to ensure their lawns receive no more than an inch of water per week. It is also important that any information distributed be as accurate as possible in order to avoid dissatisfaction and

mistrust. An individual will be more likely to permanently change his or her behaviour if the perceived benefit of doing so increases proportionately with the level of commitment. The key to any successful social marketing endeavour is placing the consumer at the center of an initiative. This requires project organizers to involve the consumer in the research in order to identify salient needs, values and barriers.

Social influences play a significant role in encouraging sustainable behaviour. According to social psychologists, behaviour is heavily influenced by the social context in which it occurs. People typically encounter many different personal, social, political and economic situations in any given day and tend to alter both language and behaviour to suit the type of social interaction (Burling, 1992). This is no less significant when considering an environmentally-related behaviour. Individuals have a tendency to compare themselves to their neighbours and adjust their behaviour to fit the community norm. Most people feel the need to behave consistently within a particular context lest they be perceived as untrustworthy or outside the immediate social group (Colehour and Fruse1997, McKenzie-Mohr 1996). Community-based social marketing makes use of this type of social motivator to encourage individuals to perform environmentally desirable activities. This may include strategies such as convincing a few residents to display lawn signs or posters publicly proclaiming their involvement and support of the issue or program. The pilot study for Durham Region's Water Efficiency program (1997) identified the display of grasscycling lawn signs as an important influence on nearby householders, thus indicating participants' willingness to make a small commitment.

Gaining a commitment from a householder to perform a particular activity is a strong motivator for undertaking further desirable behaviours. Studies have shown that an individual who agrees to a small commitment will be more likely to agree to greater commitments in the future. A voluntary behavioural change leads to alterations in an individual's self-perception. Therefore, intrinsically motivated behaviour tends to be more permanent than coerced or externally regulated behaviour (McKenzie-Mohr, 1996).

Colehour and Frouse (1997) describe a four-step process for achieving environmental behaviour change that includes increasing awareness, obtaining commitment, habit and maintenance. With respect to commitment, these researchers recommend the following:

> "Nurturing commitment requires finesse. Don't try to push too hard, too fast. Easy, simple-to-perform tasks must parallel the communications and marketing message…If an individual makes a commitment and then cannot find ways to perform desired actions, he or she will revert to old habits and newly instilled motivations will fade away."

A successful CBSM project must place importance on achieving long-term behaviour changes. To do this the strategy should include a variety of reinforcement techniques. A climate protection CBSM project in Germany and Austria, known as the Nordlicht campaign reported a high degree of success and placed substantial emphasis on feedback as a means of encouraging permanency of the desired behaviour. For example, project organizers reported the successes of the program back to the target audience in a variety of ways, relating this technique with long-term performance of the new behaviour (Prose,

1996). Colehour and Frause (1997) stress the importance of continuing to stimulate environmental awareness, commitment and habit for extended periods. "New circumstances, new information and competitive messages seeking still other changes in one's motivations will constantly bombard these individuals. You've got to stay with them if you want to keep them hooked." This is one of the driving principles of the CBSM as practiced in Durham Region.

While the strategies and techniques of CBSM have enjoyed significant success in health-related fields for a decade or more, their application to the environmental projects is a relatively new, increasingly popular way to facilitate behaviour changes. Community-based social marketing campaigns are popular because they emphasize results. The depth of audience research, tailored message content, interpersonal contact between field workers and subject group members, commitment, and feedback all contribute to the success of CBSM projects in the environmental field. However, Beverly Schwartz, director of social marketing at the Academy for Educational Development in Washington D.C. warns: "social marketing campaigns are also tricky. They must be conducted with sensitivity and care, or they will alienate the very people they intend to reach," (1995).

In 1992, the City of Kamloops, British Columbia, initiated a project to reduce water waste during the summer months. The project focused on education and public awareness. It included displays at local stores, garden centers and special events. An in-school education program for grades 6 and 7, as well as mass media advertising, contests, prizes, financial incentives, and disincentives. Water efficient garden displays

(xeriscapes) were created to encourage planting of low water requirement vegetation. A group of students biked around the town and spoke directly to residents about minimizing water waste and observing the odd/even bylaw. The Kamloops project reported a 15% reduction in peak water consumption, noting the greater success of the bicycle team, the in-school program and the xeriscape displays.

In 1995, the City of Santa Rosa, California, also initiated a project to reduce water consumption. The city offered rebates on the purchase of high-efficiency washing machines. They also paid for the material and labour costs of installing low-flow water efficient toilets. Since the implementation of the program the city has been able to reach over 18 000 residents, and replace over 40 000 toilets; helping them reduce water usage by 1 million gallons per day, by 2001. (ci.santa-rosa.ca.us)

The city of Toronto also has a program to help initiate water conservation. For $15, residents can buy a pail full of water reduction items as part of their Peak Pail Program. The pail comes filled with various water saving utensils such as an automatic water timer, a hose washer, hose repair couplings, a trigger hose nozzle, and a rain gauge. The pails are on display throughout the city and are available for purchase at numerous retail outlets. (www.city.toronto.on.ca)

In Durham Region there has been a water efficiency project being implemented for the past six summers. In 1997, Maple Durham was hired by Durham Region to design and implement a water efficiency pilot project. The objectives of the project were to identify

and evaluate the best combination of CBSM techniques and interventions capable of achieving a 10% reduction in summer peak water consumption. Maple Durham hired six environmental science and technology students from Durham College and Trent University to research, design, and implement the pilot project. That summer the students spent six weeks in the field talking with residents, giving them rain gauges, and educating them on how to reduce the amount of water they use during the hot summer months. At the end of the six weeks 71.8% of the residents committed to reducing outdoor water use by completing and signing commitment forms.

Due to the success of the pilot project Maple Durham has continued to work in neighbourhoods throughout the Durham Region in an effort to reduce water consumption. In the summer of 1998 the project was expanded to include more homes, and more interventions were used. Each intervention included the presentation of a pamphlet or a small gift such as a hose washer and was designed as an increment intended to build toward greater commitment to reduce water consumption. In 1999 and 2000, CBSM was employed as the foundation for a summer-long project to reduce water consumption. Each year reductions in water consumption were observed, and the study areas were expanded to increase efficiency and cost effectiveness.

In 2001 Maple Durham decided to change their technique and attempted to reduce water consumption using a form of social diffusion. Social diffusion research has sought to understand and make use of the social networks that exist within a community. Maple Durham's goal was to enlist a block leader, or 'maven', and make it their responsibility to

spread the idea water conservation around the neighbourhood. The idea was that each person educated by the maven about water conservation, would in turn tell others, who would in turn tell others, essentially spreading the concept of water conservation throughout the neighbourhood. Unfortunately, at the end of the summer when it came time to commit only 4% of homes visited agreed to commit to the target behaviours. In previous studies conducted by Maple Durham in excess of 79% of the residents signed commitment forms and there is evidence in these studies that they followed through on their commitments to water efficiency. It appears that the mavens were unprepared or unwilling to follow through with the responsibility entrusted to them. Since the results were far below expectations the use of social diffusion was abandoned until further developmental work could be completed. A longer term commitment to bringing on mavens and connectors to play a more effective role is required.

Community-based social marketing was re-adopted in 2002. Maple Durham hired 6 post-secondary to comprise the Water Efficient Durham (W.E.D.) team. Their responsibilities included approaching residents and discussing specific issues related to water conservation such as: lawn care, xeriscaping, indoor water conservation, rainbarrels, redirection of drain spouts, hose washers, water recycling, the odd/even watering by-law, and proper watering times.

The students were given uniforms consisting of a t-shirt, hat, and photo I.D. nametags. The t-shirt featured “removing mountains of water” caricature depicting a summer peak for water based on lawn watering demand, and the front featured a Water Efficient

Durham embroidered logo. The had featured the same embroidered logo, and was used both as protection from the sun, and to increase visibility. Uniforms were worn in the intervention areas to identify the students as a trustworthy source of information in the community, and to increase project visibility.

One of the chief goals of the 2002 project was to reach 3000 homes, almost doubling the amount of homes reached in previous summers. In order to accomplish this goal, the W.E.D. team adopted a more aggressive form of CBSM. Following the example set by Halton Region in 2001, who used telemarketing to spread the idea of water conservation and achieve a reduction in peak summertime consumption, the W.E.D. team decided to go door-to-door with their information instead of relying on casual contact, as had been done in previous years. This allowed a greater amount of residents to be reached in the same amount of time. Some concerns were raised about how effective this new approach would be, would it be too intrusive, would it affect the residents' acceptance levels of the team of students, and would there be an ultimate difference in levels and patterns of water usage?

The study was conducted in two areas, one in Ajax and the other in Pickering, each with approximately 1500 homes each. By conducting the project in two different areas the W.E.D team was also able to compare the relative acceptance of the CBSM interventions in two separate neighbourhoods, further increasing the economies of scale.

The students visited each household at least four times throughout the summer. The group members provided a new tool and information at each intervention. This way, major behavioural change is broken into smaller, manageable requests that over time generate large change with little or no perceived inconvenience or discomfort to the resident. Students approached households throughout the afternoon and early evening (1:00pm-8:30pm).

The first intervention consisted of a rain gauge and a questionnaire, which was used to provide baseline data on the watering behaviours of the residents. In the second intervention a hose tag prompting appropriate behaviours, and a Household Guide to Water Efficiency were handed out. The third intervention included two pamphlets that described ways to garden and landscape using plants and flowers that require little or no watering maintenance. In the final intervention a commitment form was handed to residents, and they were asked to check which of 9 water efficient behaviours they were willing to commit to in the future.

By using an active CBSM approach the 2002 W.E.D. team was able to reach more people, educating them on the effects of water waste. The main goal of the project was to achieve long-term behavioural changes that would lead to a reduction in the amount of water used outdoors during the summer. A reduction in water consumption will not only save each household hundreds of dollars on their utility bills, but will also save Durham Region millions of dollars on water infrastructure in the long-run. Because CBSM eliminates barriers by providing residents with tools, prompts and information, residents

are educated and hopefully convinced to adopt and engage in environmentally sustainable behaviours. These behaviours in turn reduce the amount of water consumed by the household, and help reduce the peak water consumption experienced during the hot summer months.

CHAPTER 3

METHOD DEVELOPMENT:

RECRUITMENT

The Water Efficient Durham (WED) team was selected IN May 2002. It was based on the size of the study areas and modifications and recommendations from previous WED projects. It was pre-determined that approximately 3000 homes in Ajax and Pickering would be receiving the water reduction program in 2002, necessitating the hiring of approximately 6 team members. The 2002 WED team consisted of two experienced group members from previous years and five new members recruited through the John Howard Society and the YMCA Employment Centre. New group members were recruited based on university education and program of studies and a strong interest in environmental issues as well as on the criteria established during the 1997 project evaluation. In addition, selection was also based on the following skills, abilities, and characteristics.

- Maturity, confidence and well developed interpersonal skills
- Ability to communicate and provide information in a convincing and non-threatening manner
- Experience in public relations
- Ability to understand and practice social marketing methods and techniques learned in the training seminars
- Above average academic standing

- Strong environmental interests and participation in related clubs or organizations
- Knowledge of basic horticultural and regional water policies
- Flexible and resourceful team players
- Ability to work shifts and weekends
- Excellent writing skills
- Experience using database, spreadsheets, word processing software and personal palm organizers
- Physically fit and comfortable working outdoors

TRAINING

Two previous WED team members facilitated community-based social marketing (CBSM) training and skills development for the 2002 Durham Region and for the Halton Region WED team. New members from both groups attended all sessions held during the three days of extensive training from June 5th to 7th. Training topics included:

- CBSM concepts and techniques
- Team building
- Water efficient lawn care by horticulturist, Chris Jones
- Water efficient gardening techniques at Mason-Hogue Gardens and tour
- Discussion of previous WED projects and water metering by Glen Pleasance and Bill Gauley
- Discussion of Halton Region water reduction program
- A visit to the Region's Water Efficient Demonstration Garden in Whitby

Group members met for 1-2 hours bi-weekly thereafter to reinforce and fine-tune concepts and techniques learning during the training sessions.

INTERVENTION AREAS

Durham Region chose intervention areas based on water consumption data and an increasingly limited water supply capacity. Initially, the areas selected contained almost 3000 homes in each town and subsequently the study areas were redefined for approximately 1500 homes in both Ajax and Pickering. Before interventions commenced, WED team members organized the neighborhood study areas into manageable groups and identified street names and house numbers for each area. A total of 1457 households in Ajax and 1284 households in Pickering were scheduled for the 2002 series of interventions (See Appendix I for Maps). The breakdown by municipality and street is as follows:

Intervention Area: Number of Active Households - Ajax

Ajax 1	Dakin Dr.	
	Hufton Cr.	
	Large Cr.	
	Mullen Dr.	
	Pearce Dr.	
	Rotherglen Dr.	
	TOTAL	**328**

Ajax 2	Carrick Dr.	
	Coughlen Dr.	
	Gurr Cr.	
	Marshall Cr.	
	TOTAL	**169**

Ajax 3	Barrett Dr.	
	Brennan Dr.	
	Daniels Cr.	
	Delaney Dr.	
	TOTAL	**223**

Ajax 4	Bowers Dr.	
	Brockman Cr.	
	Delaney Dr.	
	Hobson Cr.	
	Tipton Cr.	
	Tresher Ct.	
	TOTAL	**204**

Ajax 5	Brockelsby Dr.	
	Carnelly Cr.	
	Chatfield Cr.	
	Radford Dr.	
	Stockbridge Cr.	
	TOTAL	**304**

Intervention Area: Number of Active Households – Pickering

Pickering 1	Amberlea Dr.		**Pickering 2**	Aspen Rd.	
	Graceland Ct.			Millbank Rd.	
	Lamour Rd.			Parkside Dr.	
	Napanee Rd.			Pebble Ct.	
	Nipissing Ct.			Pebble St.	
	Otonabee Dr.			Sprucehill Rd.	
	Seguin Dr.			**TOTAL**	**267**
	TOTAL	**333**			
Pickering 3	Boyne Dr.		**Pickering 4**	Aspen Rd.	
	Driftwood Ct.			Cricket Ln.	
	Eramosa Cr.			Highview Rd.	
	Highview Dr.			New St.	
	Saugeen Dr.			Sprucehill Dr.	
	Sturgeon Ct.			Strouds Ln.	
	TOTAL	**167**		Stonepath Cl.	
				Una Rd.	
				Woodruff Cr.	
				TOTAL	**294**

Total Ajax: 1228
Total Pickering: 1061
Total Study Area: **2289**

PROPERTY VALUE – DESCRIPTION OF HOMES

The two study areas in the 2002 WED project are comparably different from each other. In Ajax detached properties were relatively small (~25,000 sq ft.) and ranged in value from $170,000 to $190,000. The neighbourhood was fairly well established (~15 yrs) and was not overly maintained as sparse shrubbery and medium sized trees provided little shade. Three convenience stores were located in the area and were at times busy nodes in the community. Conversely, the newer detached homes in Pickering were situated on large lots (~ 40 sq ft) in quite cul-de-sacs. Typical values are in excess of $300,000. Well-manicured lawns and landscaped gardens were common and often residents were contacted outside while tending to their yards. Based on casual observations, the study

areas in Ajax were frequently home to young single income families whereas double income middle-aged residents were more apparent in Pickering. Language barriers were infrequent overall but occurred most often in Ajax. These residents, notably, displayed a great interest in the aesthetics of their property and widely practiced water efficiency.

PALM PILOTS

To stay current with technology and become more efficient in gathering data and the manipulation of data, the 2002 WED project piloted the use of personal palm organizers to record data instead of traditional hard copy methods utilized in previous years. Each student was supplied with a *M505 Palm Pilot®* hand-held computer along with *DataViz Documents to Go®* software for easy uploading onto computer spreadsheets. Within each study area the personal palm organizers were specifically programmed by street and house number for fast accessibility and to record data easily. Each week the students uploaded the raw data collected in the field onto Microsoft Excel spreadsheets to secure data and to note the progress of the project over the summer. Hard copy notebooks were also readily on hand in case of a technical failure with the palm organizers, however none resulted. Appendix II shows how the palm organizers were programmed and the resulting spreadsheets saved to hard disk.

Team members attended a brief hands-on training session given by one member on the usage and operation of the Palm. Members were given a lesson on the general usage of a Palm organizer, but additionally the team was shown how to utilize “Documents to Go”. The team was also taught how to synchronize the data collected from the Palm with that already present in the Excel spreadsheet on a remote computer. All members tackled these tasks with ease and the entire training process lasted less than an hour.

The personal palm pilot organizers were a complete success in terms of cost effectiveness and time efficiency for CBSM. The palm pilots took 3 hours and 2 students to program compared to 10 hours and 6 student researchers to create traditional recording notebooks. Baseline and commitment form questionnaires were programmed into the personal organizers, which eliminated the need of hard copy surveys that are expensive to print, and tedious and time consuming to tally residents' responses. In addition, it is easy to calculate and compare the success rate of each intervention with the palm pilot. This too eliminated the need of traditional methods of recording, manual counting and calculation of data. Furthermore, the palm pilots can be reused and reprogrammed for future CBSM projects.

Personal Palm Organizers Compared to Traditional Hard Copy Recording

	Personal Palm Organizers	**Traditional Hard Copy Recording**
Time to Create/Setup	3 hrs	10 hrs
Number of Employees required for Setup	2	6
Ease of recording data in the field	• Point and click • Quantitative and qualitative recording • Continual automated update	• Numerous pages to flip through • Hand writing can be messy and hard to read • Qualitative recording
Ease of tallying Questionnaire	• Effortless • Minimal Errors	• Time consuming • Tedious • Frequent common errors • Printing expenses
Ease of calculation to record the progress of each intervention	• Effortless • Minimal Errors	• Time consuming and tedious • Frequent common errors

INTERVENTIONS

Progress in intervention methodology has been made based on previous WED projects as well as other municipality water efficiency projects such as Halton Region. The WED project has been in effect since 1996 and has had a tremendous success rate each year of the number of homes that have committed to save water. Each year the WED project has slightly modified the delivery techniques from previous methodologies in order to try to achieve maximum coverage and cost effectiveness while maintaining 80% compliance from residents to commit to outdoor water efficiency.

The 2002 WED project looked at studies from other municipality's water efficient projects for ideas and recommendations to adopt in order to increase efficiencies. Halton Region Water Efficiency programs had a good response rate of residents committing to water efficiency from water metering by using a more direct approach of CBSM. As a result of their success, the WED team used a more proactive approach rather than a passive approach by increasing its coverage to 3000 homes compared to 1500 in previous years with 4 interventions.

Shifts were arranged in order to avoid knocking on doors early in the morning or during the evening dinner hours. Moreover, in past projects overlapping interventions was sometimes necessary due to the inability of the WED team to reach residents during a previous intervention. Such practices were modified slightly in the 2002 project. Students varied the times of the day that they approached homes where they had not reached personal contact with the resident. After four attempts, if the resident had still

not been contacted, then the intervention was dropped off in their mailbox with a brief note that described what they were receiving and the WED team will hopefully meet with them during the next intervention (Appendix III). Additionally, throughout the summer the WED team documented anecdotal comments and concerns about the success of the project. Furthermore, local newspaper and television coverage ran local advertisements to inform residents of the program and to remind them of key water efficient practices.

BASELINE DATA

Baseline data for the 1998 project consist of survey data collected from residents in the intervention areas. The survey questions (ten in Ajax; nine in Pickering – Appendix IV) were directly related to the key messages delivered to households throughout the summer. For instance, one question asked residents whether they watered their lawns and, if so, whether they measure the amount of water their lawn receives. The corresponding first intervention consisted of a rain gauge and recording card that the students distributed to residents to overcome the barrier of over watered lawns. During this intervention WED representatives explained why early morning or evening watering is preferable to watering at peak sun times. Commitment form statements corresponded to questions on the survey to facilitate evaluation of the project.

After careful consideration and recommendations from the WED team and residents in the Ajax study areas, a revised, more comprehensive baseline questionnaire was used in the Pickering study areas and will be used for analysis of data.

Intervention 1:

Introduction, Baseline Questionnaire, Rain gauge and Recording Card, Refrigerator Magnet

Between June 15th and July 12th, the 2002 WED team conducted the first intervention by knocking on doors in each of the neighbourhoods in Ajax and Pickering. The students introduced themselves and explained the objectives of the project. Group members informed residents that they would be stopping by throughout the summer to provide them with information and materials related to water efficiency. Residents were given a rain gauge and a recording card to monitor how much water their lawn receives each week.

The WED team informed residents that lawns only need up to 1 inch of water per week including rainfall and instructed where the best location for optimal results would be in their yard and sometimes installed the tool for the resident. The WED team also supplied residents with a refrigerator magnet to constantly remind them about outdoor water efficiency. The homeowner was then asked to fill out a short questionnaire to help determine the neighbourhoods' views about water efficiency and tailor the program to the residents' needs. Upon completion of the survey, general questions and comments were discussed about the project and the resident was reminded that the WED team would be back to give them more tools to help them conserve on outdoor water consumption. The first intervention was completed after 4 weeks with close to 100% coverage of the areas.

Intervention 2: Household Guide to Water Efficiency, 2nd Ed. and Hose Tag Watering Reminder

The WED team approached residents' from June 30th-July 13th and distributed the 2nd edition of the Household Guide to Water Efficiency during the second intervention. This high quality comprehensive manual produced by the Durham Region Works Department used social marketing-based techniques to convey information about water use and tips for reducing water waste in and around the home.

Project representatives gave the resident a brief summary of the contents to encourage interest and highlighted points of significance in the manual. The section highlighted often depended on the householders expressed interest in a topic and the guide facilitated frequent lengthy conversations with residents. The Household Guide expanded upon ideas and techniques introduced in the 1st intervention about healthy lawn care and served as a graphic reinforcement for the concepts related to water efficiency. The booklet also contained a section on planning water efficient gardens. A sample of the guide may be found in Appendix V.

The WED team also distributed a Hose tag watering reminder to residents specifically noting three key messages about water efficiency:

- Make sure the lawn receives no more than one inch of water per week, including rainfall
- Reminder of the odd-even watering by-law
- Watering is best in the early morning and evening

The tag were placed on outdoor faucets to serve as a vivid reminder of the appropriate watering behaviours. This type of CBSM prompt is intended to reinforce new behaviours

by placing a graphic reminder at the location where the behaviour typically occurs. A sample of the hose tag may be found in Appendix VI. The 2nd intervention was completed with nearly 100% coverage of the areas, the majority of which had personal contact.

Intervention 3: Water Efficient Gardening pamphlet and Water Efficient Plant List

WED programs in the past have noted that respondents' lack of knowledge as a barrier to choosing water efficient plants. The 3rd intervention was carried out between July 13th and July 28th and consisted of two pamphlets. The first pamphlet, Water Efficient Gardening, highlighted the Durham Region demonstration garden at Rossland Rd. and Garden St. in Whitby. Residents were verbally invited to visit the garden to see its variety and aesthetic quality. The second pamphlet, Water Efficient Plant List, (Appendix X) provided the name and description of many plants, shrubs and trees that do not require regular watering. The brochure was designed as a check-list for customers to take to one of the participating garden centres located on the back of the pamphlet to aid in purchasing the desired water efficient species.

Intervention 4: Commitment Form

Obtaining a resident's written commitment to perform or avoid certain behaviours increases the likelihood that the residents will follow through and behave consistently with their publicly declared commitment. The Community Based Social Marketing technique has been shown to be successful in a number of studies (Cobern, et al. 1995; McKenzie-Mohr 1996; Prose 1996) where it officiates and represents the culmination of smaller commitments and intervention prompts leading up to it. Results from the WED project over the years support the proposition that written commitments are effective in

encouraging water efficient behaviour. In the 1997 pilot showed the necessity of selling the commitment. A more assertive approach is required to obtain written commitment to water efficient behaviours. While many residents were openly and actively supportive of the project goals, the official nature of asking residents to sign a document represents a higher level of commitment. Selling the commitment included reminding the resident about the desired water efficient activities and elaborating on their simplicity and advantages. Social influence techniques, such as pointing out high participation rates in the neighbourhood and explaining how a resident's participation helped achieve the project goals, were often asked. The success of this approach is indicated by the approximate 82% completion rate of the collected forms.

The final intervention was conducted by knocking on residents' doors from July 28th until mid-August. Respondents were given the commitment form (Appendix VII) and asked to check off the activities they would commit to practicing in the future. The activities corresponded to the survey questions asked at the beginning of the project such as watering early in the morning and no more than one inch per week for lawns. During the two weeks scheduled for this intervention, residents were asked to fill in a card stock commitment form, checking off which commitments they agreed to completing in the future. Once responses from the commitment form were quickly referenced and recorded into the personal organizers, respondents were able to keep a copy of their commitments and encouraged to place this in a visible location (i.e. the refrigerator) to remind the household of their commitment to outdoor water efficiency. Had residents' been unable to be reached on the fourth visit during this intervention, the WED team dropped off the

commitment form in their mailboxes with a note explaining its significance and instructions for it to be picked up by the team. This crucial intervention received 90% compliance, which shows the success of the water efficiency program.

Interventions in Study Area: Ajax 5

Each study area in Pickering and Ajax received all tools and prompts distributed by the WED team, however one study area in Ajax received only 3 interventions instead of 4 interventions given out in the rest of the study areas. In area 5 in Ajax, interventions 1 and 2 were combined together in that residents were asked to complete the baseline questionnaire, as well as given:

- a rain gauge and recording card,
- water reminder magnet,
- the Household Guide to Water Efficiency,
- a hose tag watering reminder.

The corresponding 3rd and 4th interventions were distributed individually at the same times that the other study areas received the prompts and tools. The purpose of the difference in number of interventions carried out was to determine if the same effectiveness of water reduction could be achieved with fewer contacts by the WED team.

CHAPTER 4

QUESTIONNAIRE: BASELINE

Household Water Use Questionnaire: Establishing a Baseline
Intervention One

The Household Water Use Questionnaire (Appendix ?)

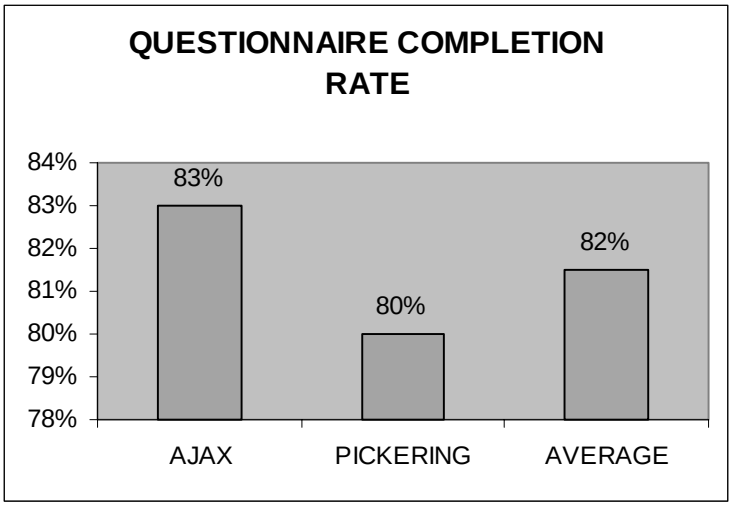
was conducted as part of the first intervention. A total of 10 questions were asked in Ajax and a total of 9 questions were asked in Pickering (one question was omitted and others were slightly reworded to avoid ambiguity). Three of the questions required a "yes" or "no" response while the remaining questions required the respondents to choose from four options. The survey was designed to provide a baseline for evaluating the effectiveness of the project. Each of the items on the commitment form corresponds to the options available on the commitment form (fourth intervention). Later comparison of the two data sets provides a measure of commitment to change various water use behaviours.

Results show that residents in both areas tend not to measure the amount of water used outdoors, or observe (or have knowledge of) the odd/even by-law, but do tend to water in the evening. Most householders water several times a week but a large percentage water less than once a week or not at all. The majority of residents in both areas do not use any method of water recycling. The vast majority of householders seldom or never all water to land on paved areas.

The completion rate, that is the sum of questionnaires completed within the region, was excellent in both Ajax at 80% and Pickering at 83%.

For a complete listing of all data collected on the Palms throughout the duration of the project please refer to the Appendix.

FIGURE 4A

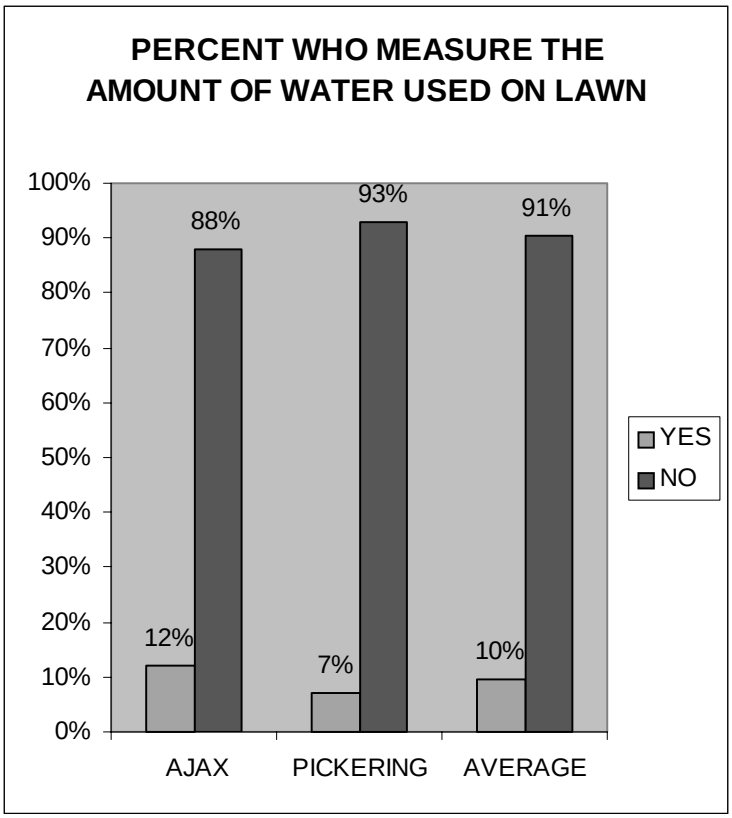


The histograms on the following pages detail the breakdown of responses in both Ajax and Pickering and show the average response over the total area.

Question 1

The first survey question asked if the resident measured the amount of water used on the lawn or garden. Percentages varied little between Ajax and Pickering. On average, across both areas, approximately 10% measure the amount of water used on their lawn and gardens and 91% do not.

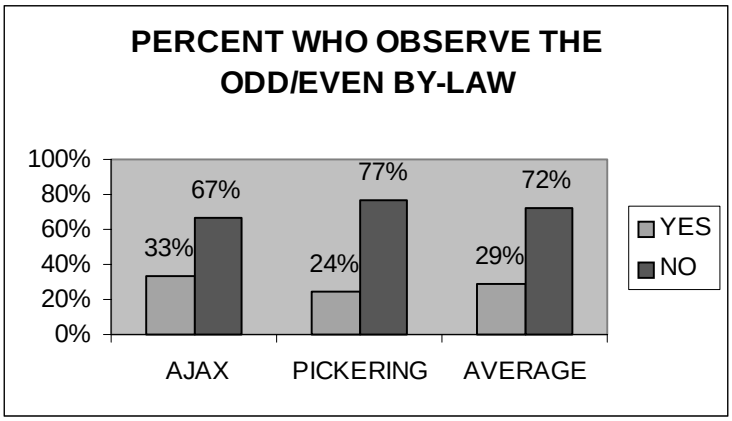
FIGURE 4B



Question 2

Residents were next asked if they observed the odd/even by-law. Seventy-two percent admitted they did not observe the by-law while 29% claimed they observed it. It was observed that this result occurred due to the fact that a large number of residents either did not know of the by-law or they believed the by-law to be in effect only during summer drought periods or when publicly announced.

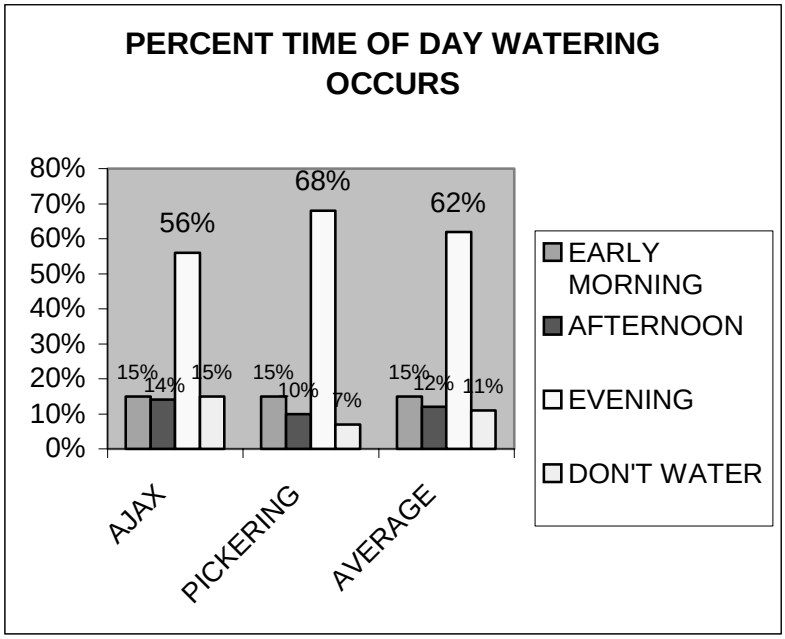
FIGURE 4C



Question 3

The promotion of early morning, or evening as the best time for watering lawns and gardens was a project goal. Question 3 provides a baseline for evaluating components of this objective. Residents were asked what time of day they most often watered their lawns and gardens.

FIGURE 4C

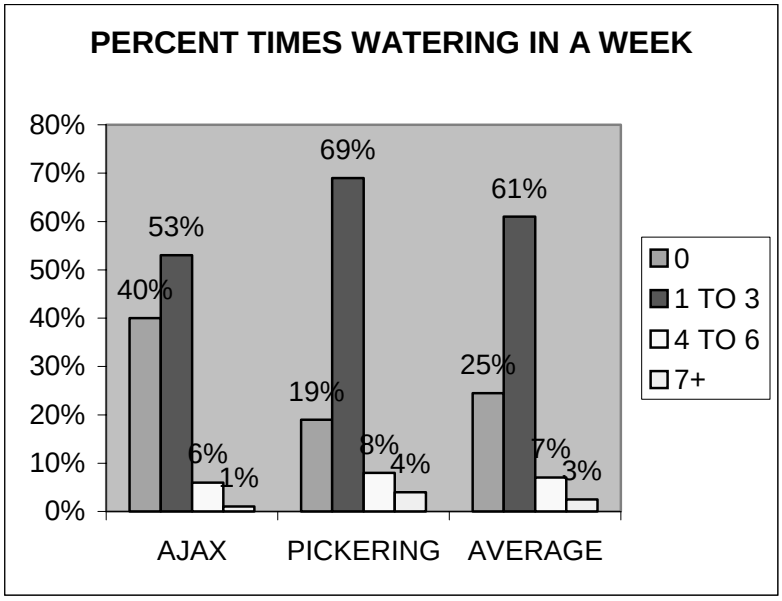


Most residents water their lawns and gardens in the evening. Respondents frequently offered justification for this activity, mostly related to work schedule and convenience. An average of 11% claim to not water their lawn at all. 15% claim to water their lawns in the early morning and a minority of respondents water their lawns in the afternoon. (See figure 4D)

Question 4

Residents were next asked how frequently they watered their lawn and gardens. Only 2.5% admitted to watering on a daily basis, while 7% claimed they watered 4 to 6 times a week. 61% of residents water 1 to 3 times a week, and 24.5% claim they do not water their lawns at all. (See figure 4E)

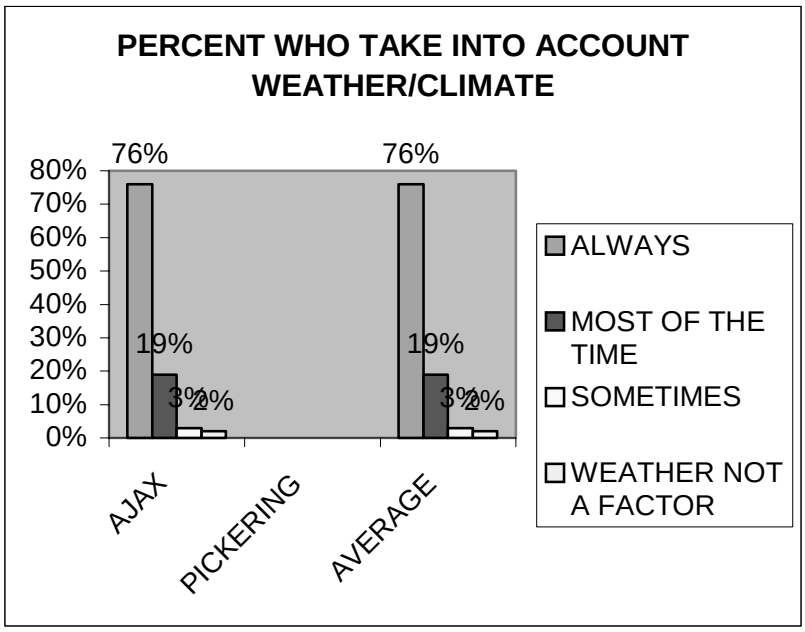
FIGURE 4E



Question 5

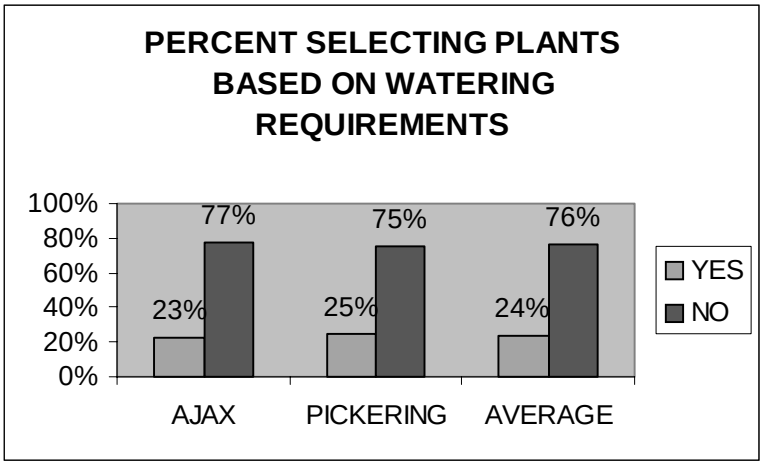
When asked if they take the weather into account when watering, 76% of residents replied that they always take the weather into account. 19% claimed they take the weather into account most of the time, and 3.2% said they sometimes take the weather into account. Because 'always' received such a high response rate, this question was left off of the Pickering questionnaire.

FIGURE 4F

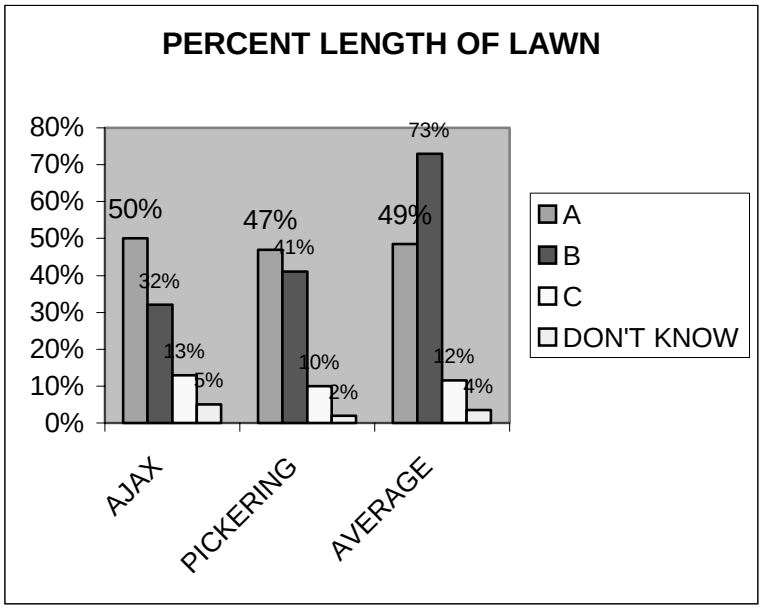


Question 6

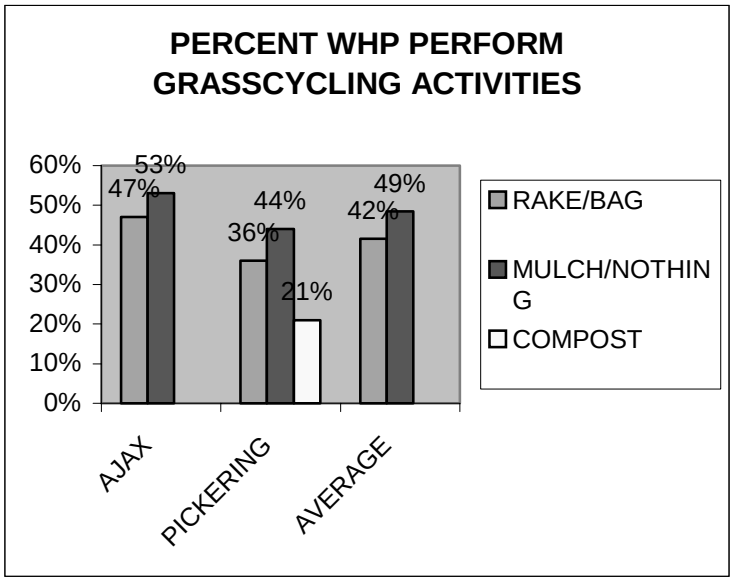
Figure 4G:



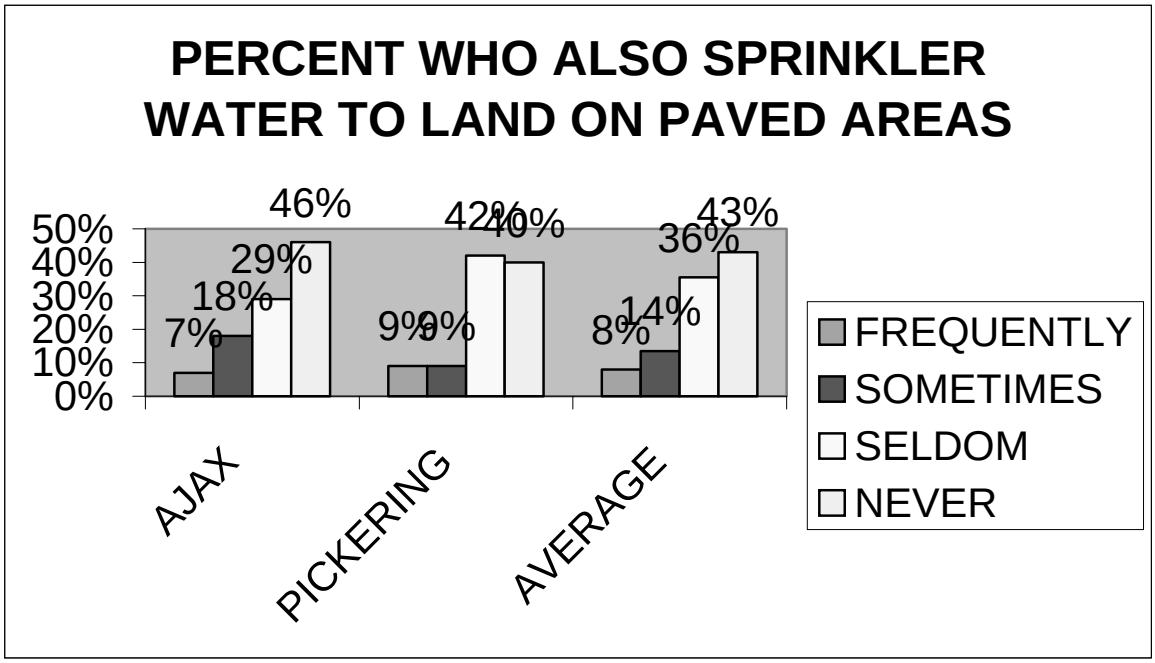
Question 7


PERCENT LENGTH OF LAWN
80%
70%
60%
50%
40%
30%
20%
10%
0%
50%
32%
13%
5%
47%
41%
10%
2%
49%
73%
12%
4%
AJAX
PICKERING
AVERAGE
A
B
C
DON'T KNOW

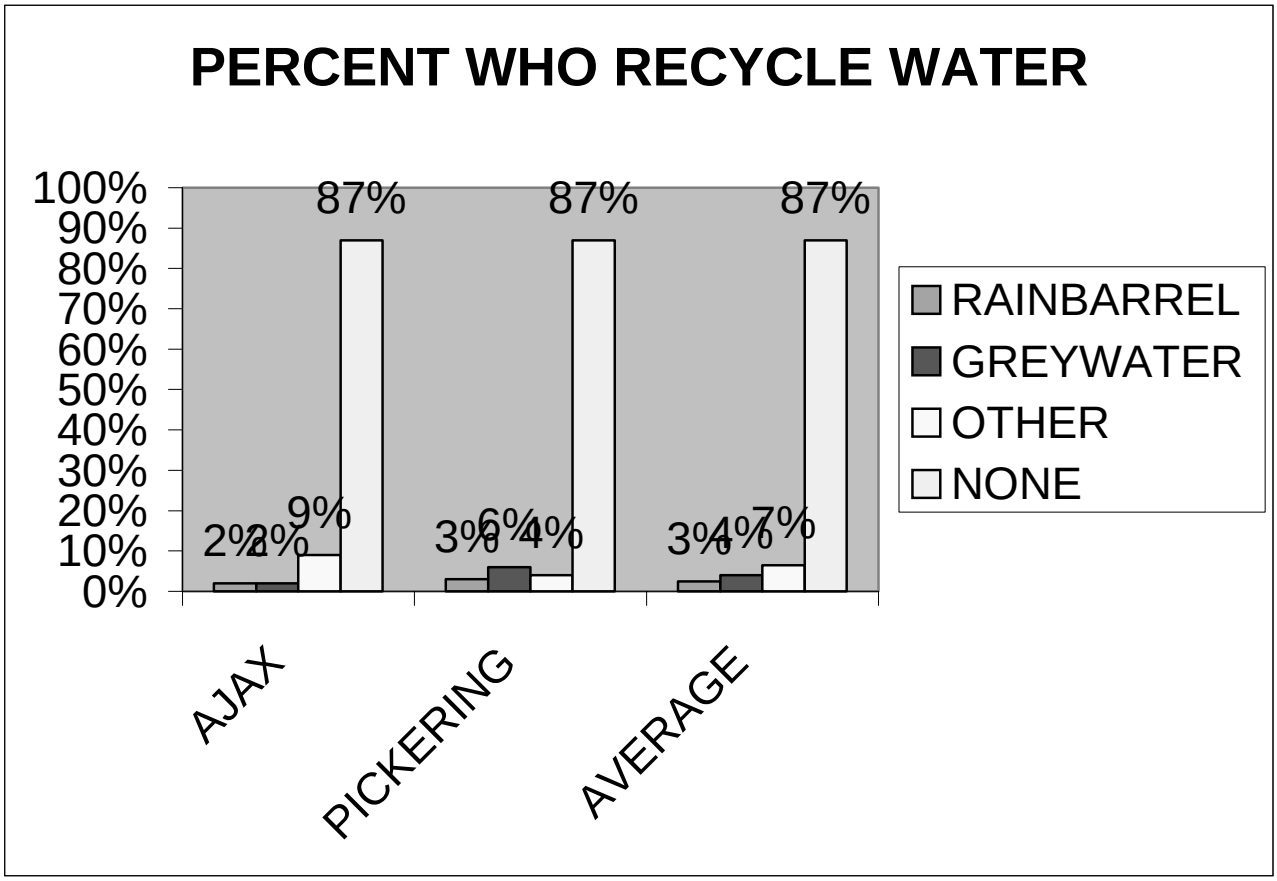
Question 8


PERCENT WHP PERFORM GRASSCYCLING ACTIVITIES
60%
50%
40%
30%
20%
10%
0%
47%
53%
36%
44%
21%
42%
49%
AJAX
PICKERING
AVERAGE
RAKE/BAG
MULCH/NOTHING
COMPOST

Question 9


PERCENT WHO ALSO SPRINKLER WATER TO LAND ON PAVED AREAS
50%
40%
30%
20%
10%
0%
7%
18%
29%
46%
9%
9%
42%
40%
8%
14%
36%
43%
AJAX
PICKERING
AVERAGE
FREQUENTLY
SOMETIMES
SELDOM
NEVER

Question 10


PERCENT WHO RECYCLE WATER
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
87%
87%
87%
2%
2%
9%
3%
6%
4%
3%
4%
7%
AJAX
PICKERING
AVERAGE
RAINBARREL
GREYWATER
OTHER
NONE

CHAPTER 5

COMMITMENT

Commitment Form Responses

In order to determine the effectiveness of the series of interventions, the residents were asked to complete commitment forms. There were nine statements on the commitment form and residents were asked to select the practices to which they were willing to commit. There were 1742 forms collected by the Water Efficient Durham (W.E.D.) team by the end of the project. The following charts summarize responses to the commitments by neighborhood area as well as the Regional total. There were 2120 commitment forms distributed and 1742 were returned resulting in an 82% completion rate. The high rate of commitment by the residents may be attributed to a high level of motivation developed as a result of the interventions.

Of the 1059 active homes in Ajax, 850 completed commitment forms. Likewise, of the 1061 active homes in Pickering, 892 completed commitment forms.

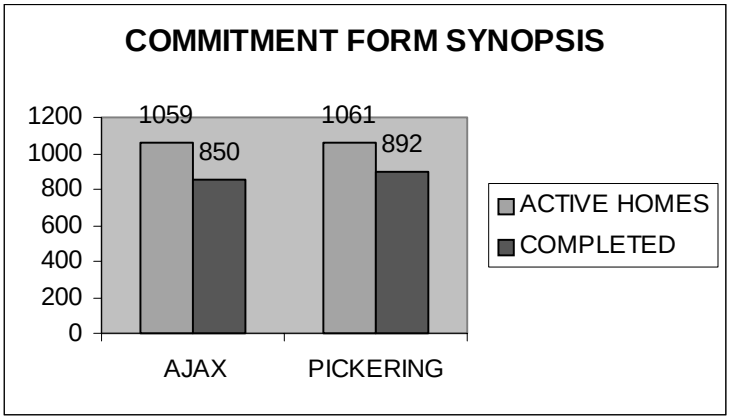
The number on the x-axis of each chart corresponds to the following nine commitments.

1. Make sure the lawn receives no more than one inch of water per week, including rainfall.
2. Leave the grass 2.5 to 3 inches long.
3. Leave grass clippings on your lawn.
4. Avoid unintentional watering of paved areas (i.e. driveway and sidewalks).
5. Water only early in the morning or in the evening.
6. Collect water in a rainbarrel for use during dry weather.
7. Wait for calm, cool days to water your lawn.
8. Select plants based on their watering requirements
9. Observe the odd/even watering by-law.

Commitment Form Synopsis

Categories compared include the number of active homes, and the number of completed commitment forms. Active homes included households where initial contact was made in either intervention one or two, and a questionnaire was completed. If contact could not be made during the first 4 visits in intervention one, then the questionnaire was administered during intervention two. The following graph (figure 5A) compares these categories for the two study areas included in the 2002 project.

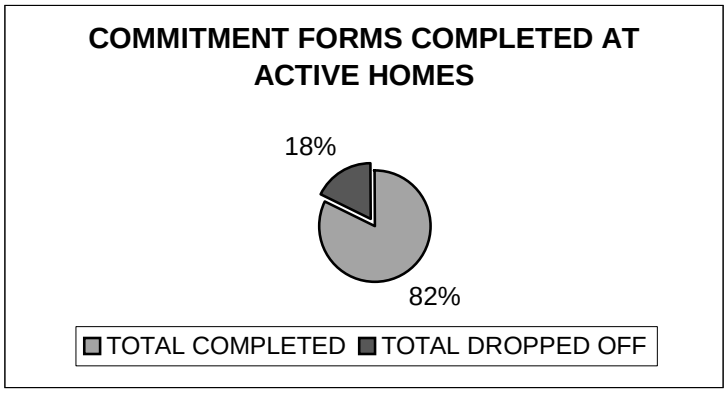
FIGURE 5A



Active homes were defined as those homes where a resident adult was contacted personally by a team member at least on one occasion during the summer intervention period.

Total number of households selected by Region	2741
Total number of active households	**2120**
Total homes for sale	31
Total homes not interested	76
Total homes inactive	345
Total homes de-selected in Ajax 2	169
Percentage of homes active	2120/2741 = 77%
Updated percentage of active homes (not including Ajax area 2)	**2120/2604 = 81%**
Total commitment forms distributed	2120
Percent of commitment forms completed	1742/2120 = 82%

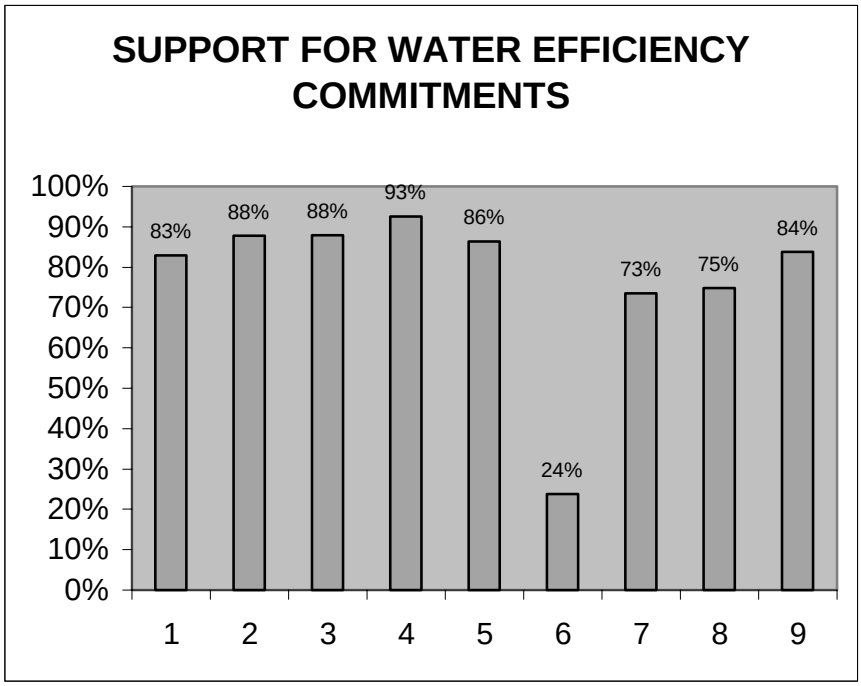
FIGURE 5B



Total Region Commitment Form Results

Of the 2120 commitment forms that were handed out 1742 of them were completed. Avoiding watering paved areas, early morning/evening watering, leaving grass 2.5 to 3 inches long, and grasscycling commitments all received very strong support (>85%). Watering no more than one inch per week (83%) and observing the odd/even watering by-law (84%), each received a moderately strong committal rate. The strong support shown for watering no more than an inch per week, including rainfall, is particularly notable since this commitment is the central focus of any outdoor water reduction campaign. Waiting for calm, cool days (75%) and selecting plants based on watering needs (73%) each received moderate response. Rainbarrel use showed little support with only 24% of residents willing to purchase and use these items. (See figure 5C)

FIGURE 5C



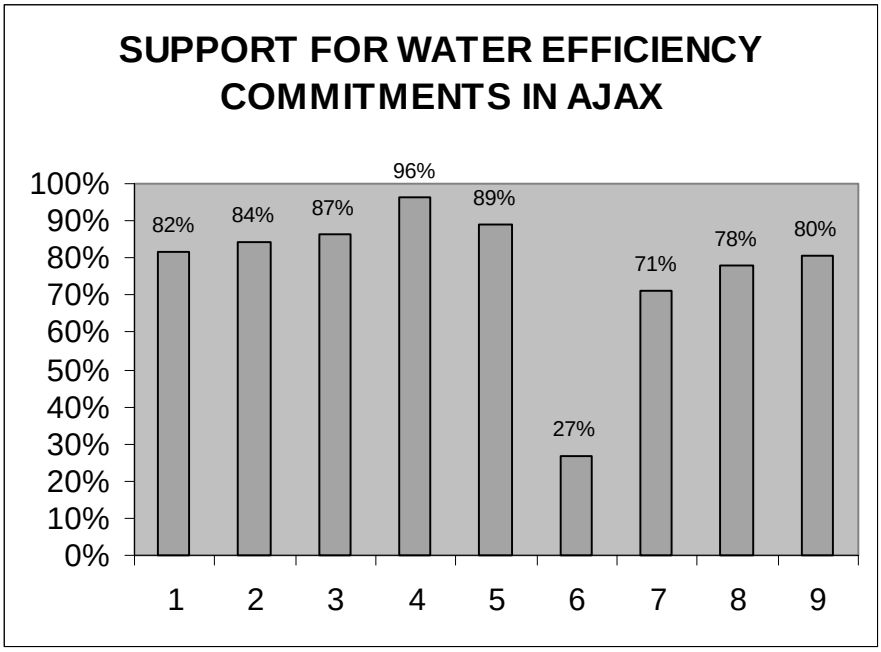
Commitments:

1. Make sure the lawn receives no more than one inch of water per week, including rainfall.
2. Leave grass 2.5 to 3 inches long.
3. Leave grass clippings on your lawn.
4. Avoid unintentional watering of paved areas (i.e. driveways and sidewalks)
5. Water only early in the morning or in the evening.
6. Collect water in a rainbarrel for use during dry weather.
7. Wait for calm, cool days to water your lawn.
8. Select plants based on their watering requirements.
9. Observe the odd/even watering by-law.

Ajax Commitment Form Results

In Ajax 1059 homes received commitment forms, and 850 were completed and collected, resulting in an 80% completion rate. Leaving grass clippings on the lawn, avoiding unintentional watering of paved areas, and watering only in the early morning or evening all attained the highest level of support (>85%). Watering only an inch per week, leaving grass 2.5 to 3 inches long, and observing the odd/even watering by-law all received between 80% and 85%. Waiting for calm, cool days gained 71% commitment rate, and selecting plants based on their water requirements received 78%. Using a rainbarrel had the lowest support rate with only 27% of respondents willing to commit. (See figure 5D)

FIGURE 5D



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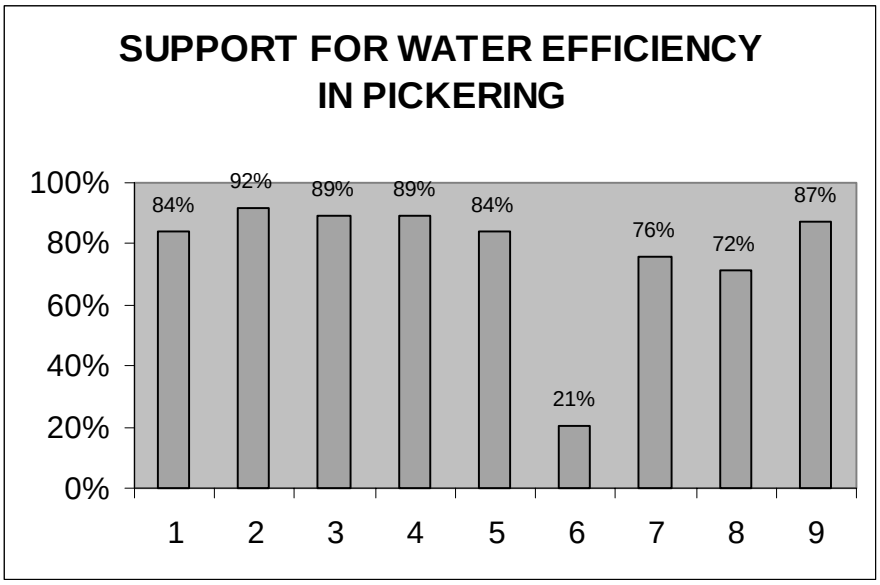
6. Collect water in a rainbarrel for use during dry weather.
7. Wait for calm, cool days to water your lawn.
8. Select plants based on their watering requirements
9. Observe the odd/even watering by-law.

Pickering Commitment Form Results

In Pickering 1061 homes received commitment forms, 892 of which were completed and collected, resulting in an 84% completion rate. Leaving grass 2.5 to 3 inches long attained the highest level of support with 91.51% of households willing to commit. Between 85% and 90% of households pledged to leave grass clippings on the lawn, avoid unintentional watering of paved areas, and observe the odd/even watering by-law. Making sure the lawn only receives an inch of water per week, and watering only in the early morning or evening, each received a commitment rate between 80% and 85%.

Waiting for calm, cool days to water gained a 75% commitment rate, and selecting plants based on their water requirements acheived a 72% commitment rate. Using a rainbarrel received the lowest rate of commitment, with only 21% of households willing to use one. (See figure 5E)

FIGURE 5E



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8. Select plants based on their watering requirements.
9. Observe the odd/even watering by-law.

CHAPTER 6

COMPARISON OF BASELINE AND COMMITMENT FORM

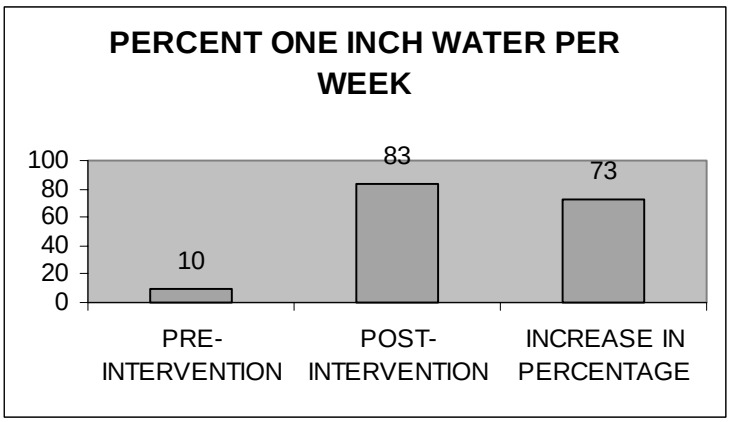
Comparison of Survey and Commitment Form Results

A comparison of survey and commitment form results was made to provide an indicator for the acceptance level of each of the corresponding items on the forms. The average of all the two areas was used to compare results of the nine water efficient activities surveyed, promoted, and commited to at the end of the summer. The nine water efficient activities include:

1. Make sure the lawn receives no more than one inch of wate per week, including rainfall.
2. Leave the grass 2.5 to 3 inches long.
3. Leave grass clippings on your lawn.
4. Avoid unintentional watering of paved areas (i.e. driveways and sidewalks)
5. Water only early in the morning or in the evening.
6. Collect water in a rainbarrel for use during dry weather.
7. Wait for calm, cool days to water your lawn.
8. Select plants based on their water requirements.
9. Observe the odd/even watering by-law.

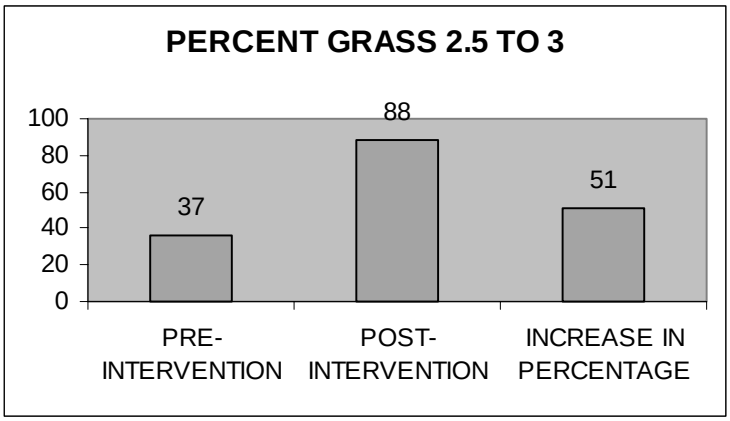
At the beginning of the project only 10% of questionnaire respondents said they measured the amount of water they used on their lawn and garden. Following project interventions, 83% of respondents in the study area committed to ensuring that no more than an inch of water (including rainfall) would be used on the lawn and garden. The percentage of households who were willing to comply with the request to use no more than an inch of water per week increased by 73%. (See figure 6A)

FIGURE 6A



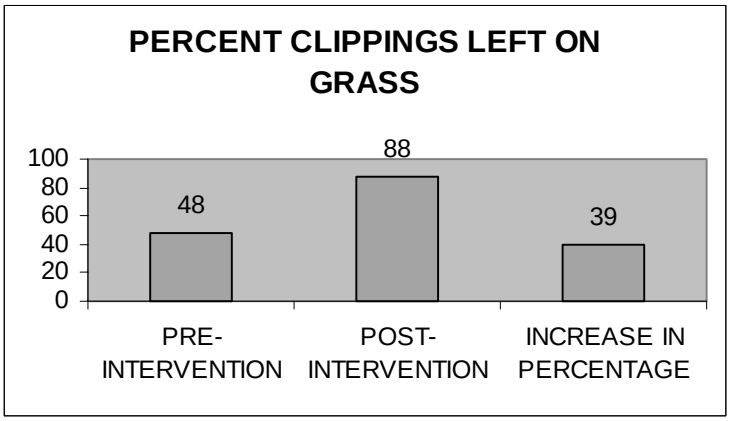
During the first and second interventions residents were encouraged to leave their lawn between 2.5 and 3 inches in length, in order to ensure adequate shade cover for the soil. At the beginning of the summer 37% of residents were leaving their lawn this length. At project conclusion 88% of households committed to leaving their lawns between 2.5 and 3 inches in length. These results show a 51% increase in the number of residents who will let their lawn grow longer. (See figure 6B)

FIGURE 6B



Residents were also encouraged to leave their lawn clippings on the lawn, which would act as mulch and feed the soil. 48% of those questioned were in the habit of doing this at the beginning of the summer, but after the interventions 88% of households committed to doing this in the future. This represents a 39% increase in the number of residents who will leave their lawn clippings on their lawns instead of bagging them. (See figure 6C)

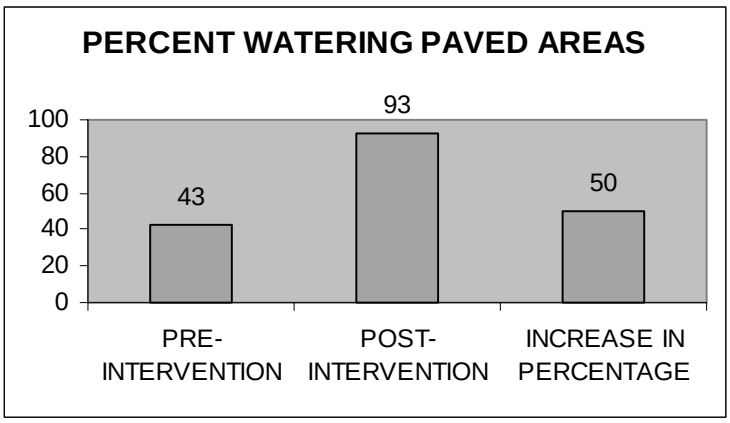
FIGURE 6C



At the project commencement 43% of questionnaire respondents claimed they never allowed water intended for the lawn to land on paved areas. Following interventions 93% agreed to avoid unintentional watering of driveways and sidewalks. This shows a

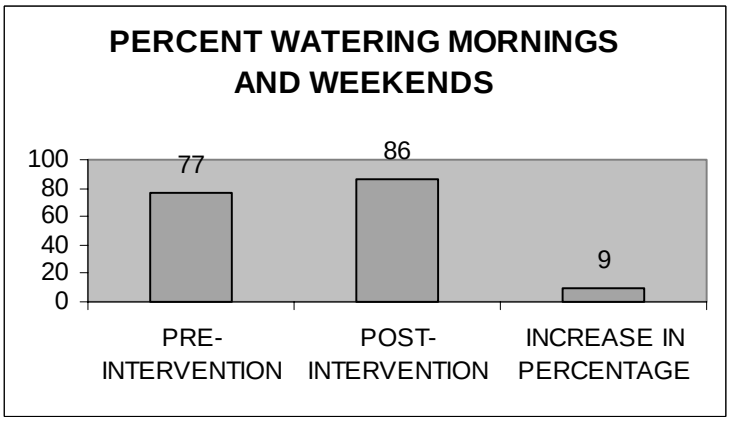
50% increase in the number of residents who will avoid watering paved areas. (See figure 6D)

FIGURE 6D



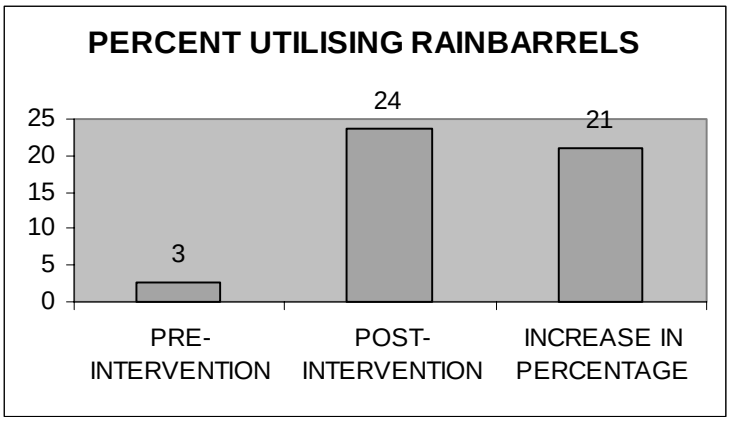
The results for early morning and evening watering were far less dramatic. The results of the questionnaire show that 77% of residents were in the habit of watering either in the early morning or in the evening. At the end of the summer 86% of households committed to watering only in the early morning or evening. Convenience is the major determinant of the time of day that residents water their lawns. The percent increase in the number of residents who will water in the early morning or evening is only 9%. (See figure 6E)

FIGURE 6E



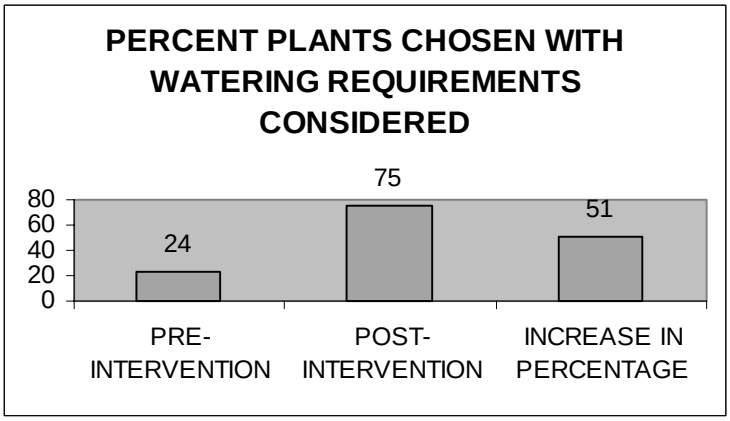
Results for use of rainbarrels to reclaim water showed an increased of 21%. Residents frequently commented that the cost of the rainbarrel (usually between 50 and 100 dollars) was a major determinant preventing them from purchasing and using the device. Many remarked however, that if the region were to hand them out, or offer a rebate program they would be willing to place one in their yard. (See figure 6F)

FIGURE 6F



Water efficient gardening showed a moderately high level of acceptance. Many residents showed an interest in the concept and the information and prompts were well received. The results of the initial questionnaire showed that 24% of residents already took watering requirements into account when choosing their plants. At the end of the summer 75% of residents committed to keeping water efficient plants in mind when doing their shopping the following spring, resulting in a difference of 51%. (See figure 6G)

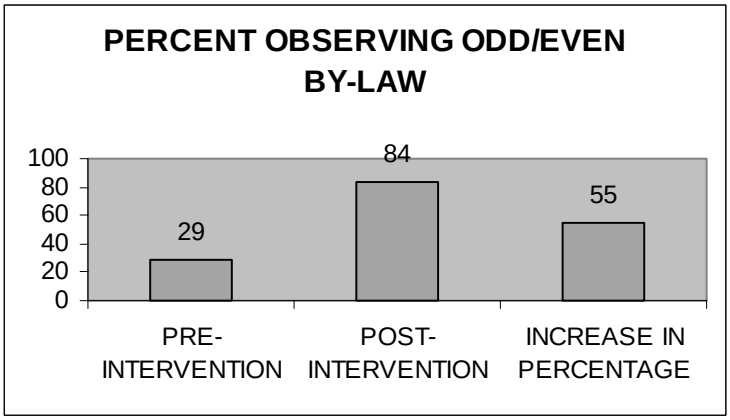
FIGURE 6G



73% of respondents to the commitment form committed to waiting for calm, cool days before watering their lawn. Once explained, most residents understood why it was important to not water on hot, windy days. There was no corresponding item in the initial survey for this item so a comparison is not provided.

Observation of the odd/even by-law increased by 55%. 29% of respondents in the initial survey claimed they already followed the practice, and 84% of respondents committed to following it in the future during the final intervention. Awareness of the by-law is probably a limiting factor for this item. Most residents claimed to be unaware of the by-law during the initial intervention, but were more than willing to abide by it once they were made aware. (See figure 6H)

FIGURE 6H



Of the nine items compared in the survey and commitment forms, limiting watering to one inch per week showed the most substantial increase. Rainbarrel usage showed the least amount of improvement, which is consitent with the results of previous years. The rest of water conserving activities all enjoyed moderate increases ranging between 35% and 55%.

What is most important, however, is the significant number of residents who committed to watering their lawns with only an inch of water per week because it is this practice that will have the most dramatic effect on the summer water consumption peak.

CHAPTER 7

HISTORICAL ANALYSIS (SINCE INCEPTION OF PROJECTS IN 1997)

Each year, a comparison between the baseline questionnaire and the final commitment form was carried out to determine whether ongoing personal contact with residents had an impact on the completion rate of the commitment form and whether or not the residents actually changed their habits (or at least committed to change their habits). The baseline survey data of each of the study areas was compiled and the survey answers were compared to the level of commitment for each of the items in the final commitment form. For the last number of years, the WED team noticed that the level of commitment (as indicated on the commitment form) compared to the initial indication of practicing water efficiency (as indicated on the baseline survey) had risen. This comparison was again carried out for this year's study.

Water Early Morning or Evening

Watering only early morning and evening is a useful way to decrease evaporation due to peak daylight times of the day. When the team asked residents the baseline questionnaire in the 1998 WED study, 89% of residents admitted that they water only during these times. 94% of residents committed to watering early morning or evening early morning or evening; a 5% increase. In the 2000 study, this number increased by 7% and in the 2002 study, this number increased by 9%. It is evident that the message as presented by the WED team is being embraced by a higher percentage compared to the baseline survey and this can imply a better method of delivering this particular intervention.

While residents generally indicate that they already water only at these times and a high percentage indicate this in the baseline survey, it is important to reinforce this practice and try to "convert" the relatively small percentage that do not. This is a reasonably easy concept to promote because many prefer to water their lawns before they go to work or after they come back and some also have either in-ground watering systems or utilize timers. Some residents indicate that they do not water their lawns or gardens at all. Ultimately this would be the best measure of success because this implies that the residents practice water all levels of efficient gardening and have selected right plants and have acclimatized their lawns to occasional drought periods.

Practice Water Efficient Gardening

As indicated above, water efficient gardening is a great way to conserve on outdoor water usage. In 2000, only 21% of respondents indicated on the baseline survey that they choose plants based on their water efficiency. On the commitment form, 79% of respondents agreed to buy water efficient plants in the future for an increase of 58%. In 2002, 24% of residents indicated that they plant water efficient gardens and 75% agreed

to commit to practice water efficient gardening in the future for an increase of 51%. Data for 1998 was not available.
A possible reason for a higher percentage indicating that they already practice water efficient gardening is that people are becoming more educated about the concept of xeriscaping. The Region has invested some resources in their water efficient garden in Whitby and has passed out information in many of the garden centers on plant selection based on their water efficiency. These efforts are paying off and one may predict that the numbers adopting this practice will increase over the next few years as the information gets out. The information about water efficient plants was delivered late in the interventions and after the residents had already planted their gardens. Water efficient plants can be more costly than water loving plants (which are readily available at most mass market locations) and choosing these plants and flowers may be require more study on removing these barriers to adoption.

Leave Grass 2.5 to 3 Inches Long

There is an increase in both the baseline responses and post intervention commitment for the 2000 and 2002 in the number of residents who leave their grass 2.5 to 3 inches long. In 2000, 21% of respondents admitted that they leave their grass longer and 37% in 2002. At post intervention, 82% in 2000 committed to leaving grass2.5 to 3 inches long whereas 87% in 2002 agreed to commit. Again data for 1998 was not available.
There was an increase from 21% to 37% in residents who were already leaving their grass longer. This can be attributed to several factors and one important one could be the Region's campaign to encourage this practice through their advertising and lawn sign campaign. It is encouraging to see the number of people willing to commit to this practice increase by 5% to 87% from 2000 to 2002.

Grass cycling

Grass cycling has become more widely practiced in the Durham Region. Since 1998, there has been a steady increase in the number of respondents who practice grass cycling. In pre-intervention 34% of respondents in 1998 agreed to practice grass cycling. In 2000, 35% of residents practiced grass cycling. But, in 2002, 48% of respondents admitted that they grass cycle. Similar results in the post-intervention show that residents agree to commit to grass cycling.

Possibilities for the increase in the number of respondents who practice grass cycling could be due to Durham Region's "grass cycling" advertising and lawn sign campaigns and due to the composting promotions as well. The Region does not pick up grass clippings and dispose of them as frequently as they used to in previous years.

Unintentional Watering of Paved Areas

Results indicate that again residents are becoming more environmentally and waste conscious when asked about unintentional watering. During the baseline questionnaire in

1998, nineteen percent indicated that they avoid unintentional watering of paved areas. This number increased to 37% by 2000 and again to 43% in 2002. After the interventions, the commitment levels were in the 95% range for both years

People who do not water paved areas admitted that they are saving money as well as that they are more environmentally and waste conscious. Some respondents said that they could more easily manipulate their sprinkler systems than in the past with newer sprinkler designs so that they were more likely to adjust the spray to not land on paved areas of their property.

Some of those respondents that would not commit, indicated that they have awkward architecture and landscaping and therefore could not easily prevent water from landing on paved areas. Others remarked on how inexpensive water is in the Durham Region but they also agreed that there were other issues, such as run off, rather that just water cost

Lawn Receives Up to 1 inch of Water Per Week

A rain gauge is an effective tool for residents to monitor the amount of sprinkler water and rainwater that lands on their lawn. Responses varied little from year to year between pre and post intervention. Each year, very few respondents admitted that they monitor the amount of water that their lawn receives (around 10% each year). However, in post-intervention (after receiving a free rain gauge) between 86% to 92% of respondents each year agreed to use a rain gauge to monitor their future watering.

The rain gauge is one of the most critical prompts or tools used by the WED team and the use of this gauge is reinforced during many of the summer interventions. This gauge has been supplied at many gardening centers across the Durham Region (for free) in other Regional promotions. It remains a popular item with most of the residents in the intervention areas.

Observe the Odd-Even Watering By-law

Most respondents do not realize that the odd-even watering by-law is in effect all year round. Since this project commenced in 1997, there is a low compliance to this by-law initially but there is a willingness to commit to following this by-law by close to 90% in most years by the end of the interventions.
People may be unaware of the by-law because the Region does not regularly enforce it. Many believe that it is only in effect during periods of drought. This is especially true for new residents who have recently moved to Durham from other municipalities.

Water Recovery Practices

Water recovery may be a historical practice however; in today's 'convenient' society this practice is sometimes neglected or forgotten about. In both 1998 and 2002, approximately 4% of respondents when asked the baseline questionnaire admitted that they use water recovery practices such as using a rain barrel to collect water. Only

approximately 22% would commit to using a rain barrel in the future. In 2000, however, a number of residents, mostly elderly respondents in south Oshawa admitted that they use water recovery practices. However, an astounding 89% of residents agreed to use a rain barrel because that year the WED was in stewardship with Friends of the Second Marsh and respondents were informed that they could purchase a rain barrel for a subsidized price.

Barriers that the WED team encountered about why residents did not like to use rain barrels was that they feared that they were not child proof, were a nesting ground for mosquitoes they were too costly and many homes have rain spouts that are directly connected to the sewer systems. The West Nile virus scare of the summer of 2002 is likely to persist next year and may be difficult to overcome.

HISTORICAL ANALYSIS (SINCE INCEPTION OF PROJECTS IN 1997)

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While residents generally indicate that they already water only at these times and a high percentage indicate this in the baseline survey, it is important to reinforce this practice and try to "convert" the relatively small percentage that do not. This is a reasonably easy concept to promote because many prefer to water their lawns before they go to work or after they come back and some also have either in-ground watering systems or utilize timers. Some residents indicate that they do not water their lawns or gardens at all. Ultimately this would be the best measure of success because this implies that the residents practice water all levels of efficient gardening and have selected right plants and have acclimatized their lawns to occasional drought periods.

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Lawn Receives Up to 1 inch of Water Per Week

A rain gauge is an effective tool for residents to monitor the amount of sprinkler water and rainwater that lands on their lawn. Responses varied little from year to year between pre and post intervention. Each year, very few respondents admitted that they monitor the amount of water that their lawn receives (around 10% each year). However, in post-intervention (after receiving a free rain gauge) between 86% to 92% of respondents each year agreed to use a rain gauge to monitor their future watering.

The rain gauge is one of the most critical prompts or tools used by the WED team and the use of this gauge is reinforced during many of the summer interventions. This gauge has been supplied at many gardening centers across the Durham Region (for free) in other Regional promotions. It remains a popular item with most of the residents in the intervention areas.

Observe the Odd-Even Watering By-law

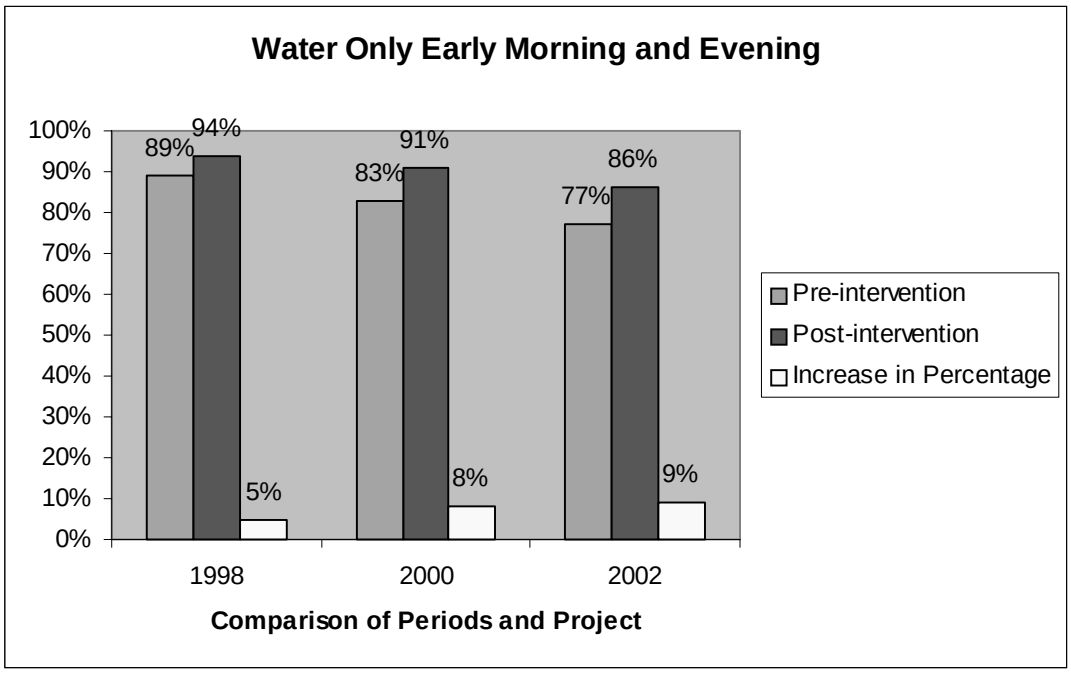
Most respondents do not realize that the odd-even watering by-law is in effect all year round. Since this project commenced in 1997, there is a low compliance to this by-law initially but there is a willingness to commit to following this by-law by close to 90% in most years by the end of the interventions.

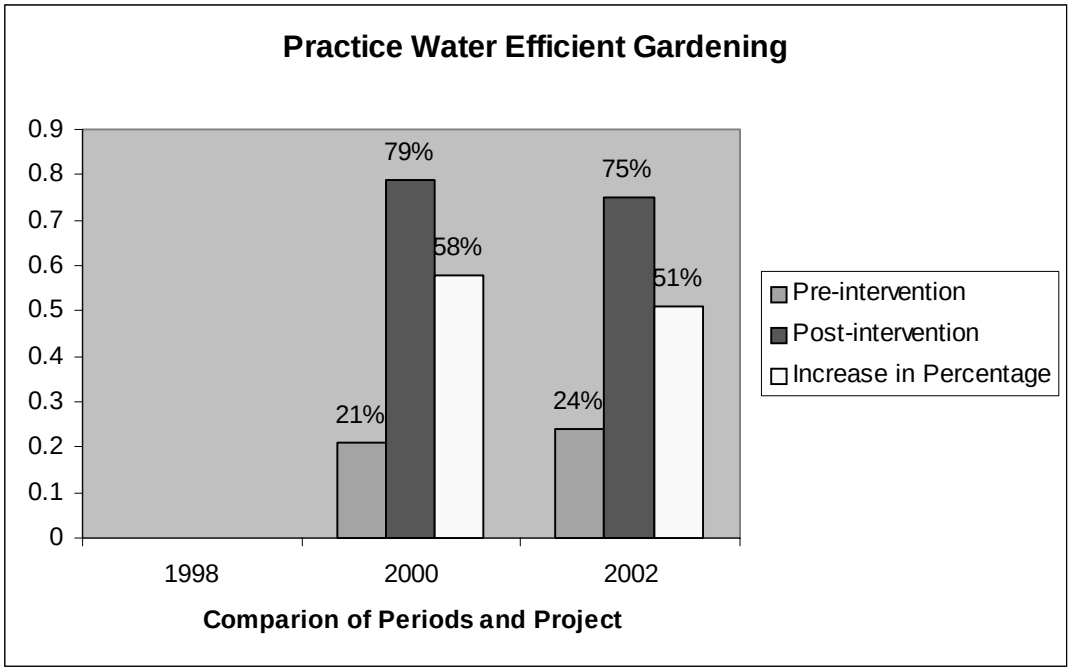
People may be unaware of the by-law because the Region does not regularly enforce it. Many believe that it is only in effect during periods of drought. This is especially true for new residents who have recently moved to Durham from other municipalities.

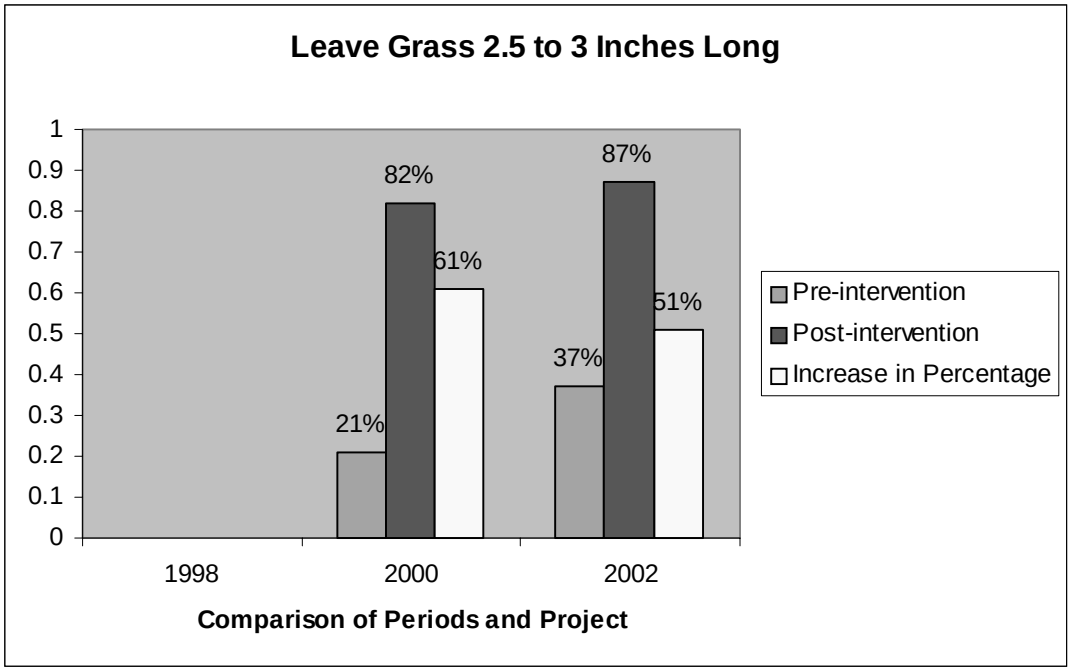
Water Recovery Practices

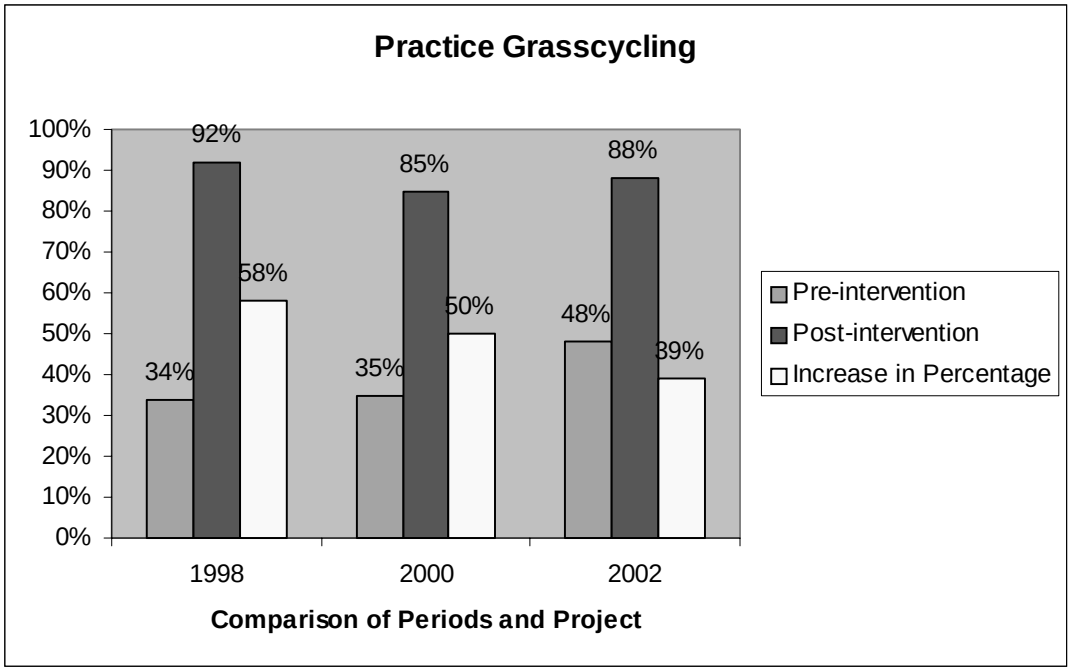
Water recovery may be a historical practice however; in today's 'convenient' society this practice is sometimes neglected or forgotten about. In both 1998 and 2002, approximately 4% of respondents when asked the baseline questionnaire admitted that they use water recovery practices such as using a rain barrel to collect water. Only approximately 22% would commit to using a rain barrel in the future. In 2000, however, a number of residents, mostly elderly respondents in south Oshawa admitted that they use water recovery practices. However, an astounding 89% of residents agreed to use a rain barrel because that year the WED was in stewardship with Friends of the Second Marsh and respondents were informed that they could purchase a rain barrel for a subsidized price.

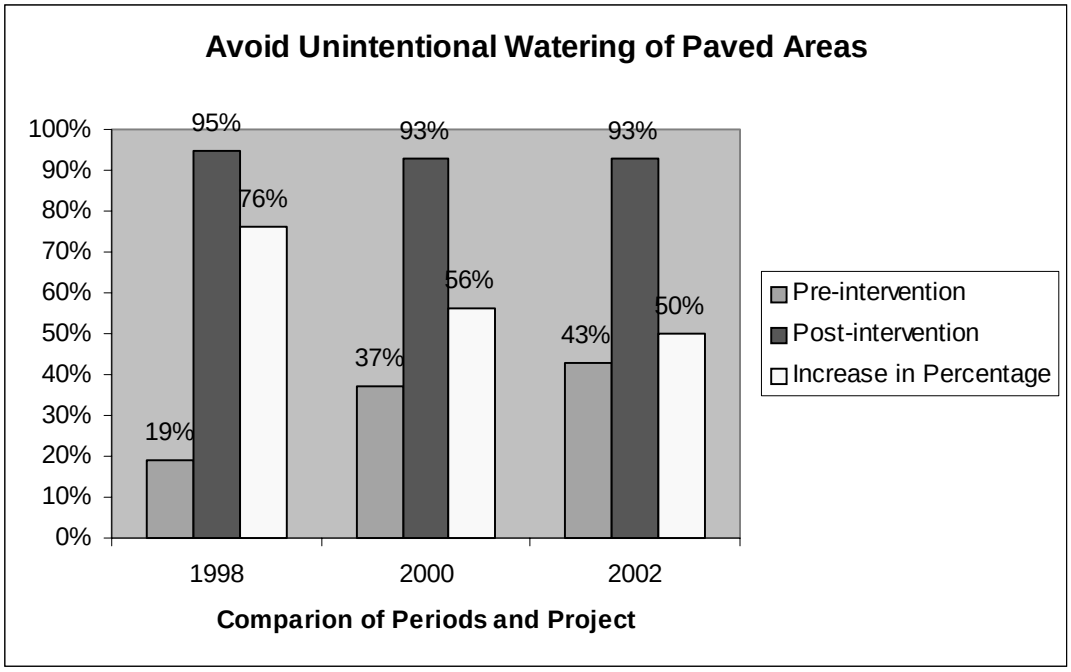
Barriers that the WED team encountered about why residents did not like to use rain barrels was that they feared that they were not child proof, were a nesting ground for mosquitoes they were too costly and many homes have rain spouts that are directly connected to the sewer systems. The West Nile virus scare of the summer of 2002 is likely to persist next year and may be difficult to overcome.

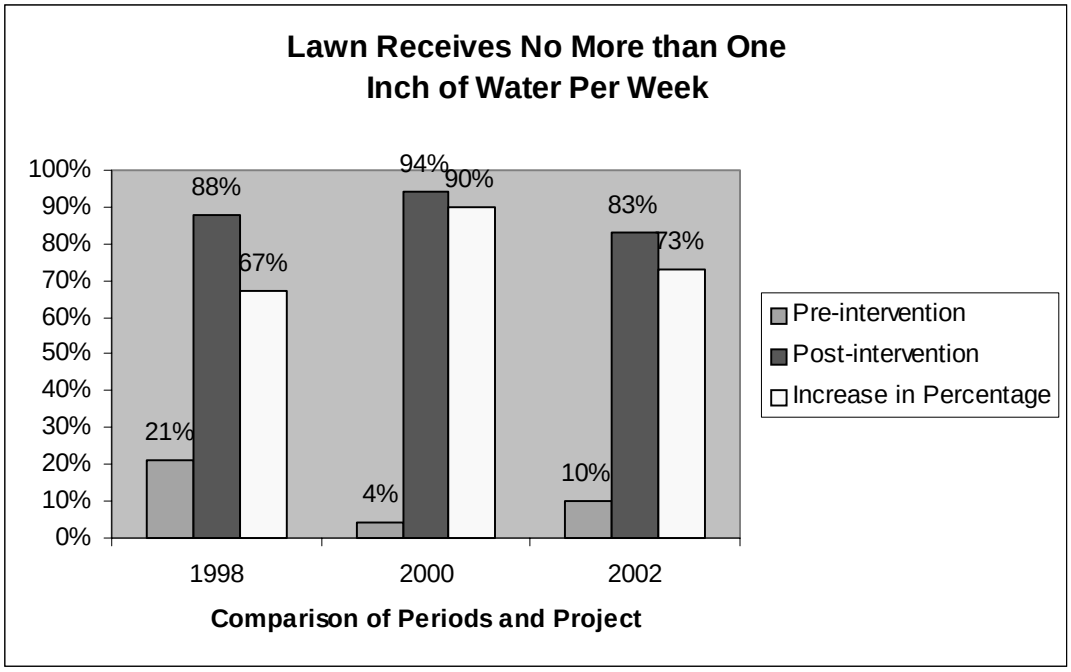


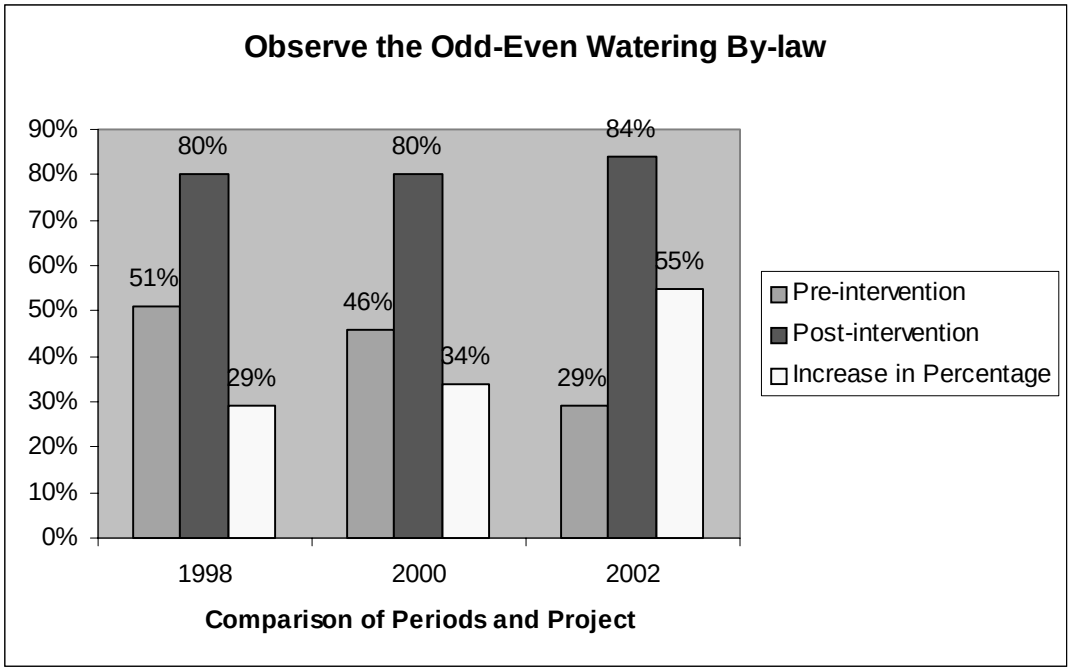

Practice Water Efficient Gardening
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
79%
75%
58%
51%
21%
24%
1998
2000
2002
Comparion of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage

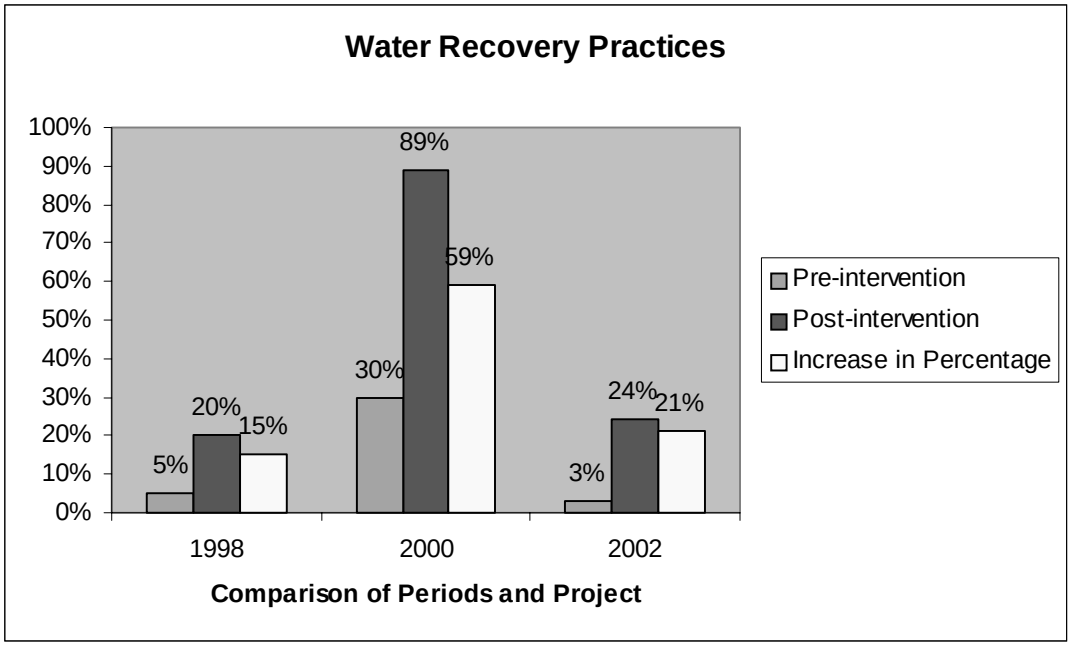

Leave Grass 2.5 to 3 Inches Long
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
82%
87%
61%
51%
37%
21%
1998
2000
2002
Comparison of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage


Practice Grasscycling
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
92%
85%
88%
58%
50%
48%
39%
34%
35%
1998
2000
2002
Comparison of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage


Avoid Unintentional Watering of Paved Areas
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
95%
93%
93%
76%
56%
50%
43%
37%
19%
1998
2000
2002
Comparion of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage


Lawn Receives No More than One Inch of Water Per Week
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
88%
67%
21%
94%
90%
4%
83%
73%
10%
1998
2000
2002
Comparison of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage


Observe the Odd-Even Watering By-law
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
80%
51%
29%
80%
46%
34%
84%
29%
55%
1998
2000
2002
Comparison of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage


Water Recovery Practices
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5%
20%
15%
30%
89%
59%
3%
24%
21%
1998
2000
2002
Comparison of Periods and Project
Pre-intervention
Post-intervention
Increase in Percentage

CHAPTER 8

COMMENTS AND DISCUSSIONS

COMMENTS AND DISCUSSIONS ON 2002 WED PROJECT

1. There was competition between telemarketers and intervenors in the field causing some residents to feel overwhelmed and upset. For example, telemarketers soliciting residents to purchase energy at a fixed cost were frequently spotted in the same area as WED intervenors. Residents repeatedly complained to intervenors about the annoyance and frustration they experienced with door to door telemarketers and that was part of the reason they were reluctant to take part in the study.

2. Communication ability and confidence when talking to residents improved over time. Intervenors were better able to read people and become accustomed to their reactions and this was used to modify their approach. The delivery became more concise, relaxed and measured and residents responded positively to this. Unnecessary, redundant or confusing information was deleted and therefore less time was required at the door.

3. Language usage (i.e. deleting technical words only WED intervenors would comprehend) and pace of the delivery were important. Intervenors were sometimes asked to slow down or clarify what they were saying.

4. Investing more time in the introduction emphasized the purpose of the study and the role of intervenors. People were curious about the project and the more they knew about it, the more willing they became to take part.

5. Appearance of a home (i.e. well maintained lawn vs. unkempt) said a lot about how the owner would respond and was a major factor when deciding on an approach. The approach was adjusted to recognize these and other differences.

6. Giving the rain gauge to residents first rather than the questionnaire made them more responsive. They were more willing to answer the questions once they had been presented with something free than those who were presented with the rain gauge second.

7. Residents appreciated prompts intended to reduce water waste, such as rain gauges, hose tags, the Household Guide to Water Efficiency and pamphlets. Some residents asked intervenors for extra rain gauges to pass onto family and friends or for different parts of the house. These are valuable tools for any CBSM venture.

8. The Household Guide to Water Efficiency was well received by residents. The layout and quality of the book were major factors and they felt it appealed to different learning types. As well, bright colors made them less likely to misplace it. Residents were more likely to keep it and refer to it later if intervenors opened it and discussed with them the different landscaping ideas and general water efficient practices. It also gave residents a good idea of where their tax dollars went. The team liked the book and became more committed to the project ("I handed books to my family and friends and they were all thankful").
9. The use of palm pilots increased efficiency and made the intervenors appear more professional. These palm pilots also allowed for more personal interaction while entering data than the old system where everything was hand written. The information from the palm pilots was readily compiled and the progress of an intervention was easily monitored.

10. The point of contact usually varied with each intervention and there was difficulty making sure the message was delivered to the same person. If it wasn't, it was hard to insure the information was being passed on to the individual who was likely to foster or encourage behavioral change within that household.

11. A checklist of water efficient plants simplified the plant selection process. Many commented on the quantity of important gardening information that was presented and expressed interest in visiting Durham Region's Water Efficient Demonstration garden in Whitby.

12. The signature on the commitment form increased the apprehension of respondents. Many were hesitant to sign because they thought it would be a monitored commitment. Once intervenors explained it is a self-commitment, residents were more responsive.

13. People were less willing to take part in commitments that involved time and money (i.e. the cost of a rainbarrel is $100+). This is consistent with the concept of barrier removal in CBSM.

14. The commitment form was another chance to educate people about water efficient practices, reinforce some of the important messages and answer any questions they may have had.

15. The demographics of Ajax included a lot of non-English speaking people. When approached by intervenors, some were intimidated and less receptive to the project.

Training
(Comments by the WED team)

1. Incorporating two WED teams (one from Durham, one from Halton) during training provided more interaction and presentation of ideas.

2. Role-playing and games were effective in simulating situations encountered in the field.

3. Presenters were knowledgeable and provided useful information to intervenors.

4. Variation in speakers and topics kept training interesting.

5. Training in xeriscaping practices increased the knowledge and resources of intervenors. Trips to water efficient gardens where this technique was implemented were essential before interacting in the field.

6. Meetings before each intervention were important in order to keep the team motivated. New techniques and difficult situations encountered were discussed to better prepare intervenors for the field.

Recommendations

1. Presentation of the questionnaire as part of the initial training will give intervenors additional experience, confidence and practice so they are more comfortable when entering the field.

2. The WED team should be sensitized to delivery strategies when dealing with residents who do not have English as their first language. It is very important to consider demographics which are constantly changing.

3. Getting residents to sign the commitment form proved to be problematic yet this is an important part of CBSM. In the future, more training sessions prior to the commitment form intervention would be helpful. Techniques used to place residents more at ease should be revisited and residents should be more willing to commit.

4. Most residents were unaware of the year round implementation of the odd/even by-law. The WED team should be used in conjunction with other media to enforce the message (i.e. newspaper ads).

5. The project should be started earlier than in the planting season (before May 24). The pamphlets listing water efficient plants and useful techniques for water efficient gardening could be grouped with the rain gauge and questionnaire. Residents could then use this information when choosing their plants early in the planting season.

6. Efforts should be made to capitalize on the goodwill and sensitized population of previous water reduction campaigns. Verifying questionnaire and commitment form answers when possible ensures results are accurate (i.e. checking the grass length of a home, whether they mulch or not, etc.).

7. In order to reinforce the water efficiency message in subsequent years to make the project more effective, it may be desirable to "piggy-back" new initiatives such as pesticide reduction, waste diversion or energy efficiency with the water efficiency prompt.

8. In past years it was clearly demonstrated (in Port Perry) that a community exposed to CBSM and sensitized to environmental issues are extremely open and very likely to adopt other related initiatives. (In Port Perry, for example, replacing 20L toilets with 8L).
9. In some cases, non-residents are present during intervention times (i.e. baby-sitters, housekeepers, etc.). Attempt to establish and make note of times when actual residents could be contacted (i.e. weekends, evenings).

10. Attempts should be made to identify the point of contact at every address (i.e. husband, wife). In future interventions, attempts should be made to contact the same person or insure the person present passes on the information to the individual who was likely to foster or encourage behavioral change within that household. This may be accomplished by making a note in the palm pilot.

11. The requirement of residents to sign the commitment form was relaxed. This may impact on level and nature of commitment. In future projects, care must be taken to establish sufficient timelines to ensure the signatures are actual commitments.

12. The use of palm pilots was an excellent addition to this year's project. Keeping running totals from the beginning increases the efficiency of the team and this efficiency far exceeds the original capital outlay. For next year a "real time" access to information is suggested. This will enable us to have continual progress reports and shorten the turn around time for modification to our approaches.

13. Lawn and garden care were grouped together in the questionnaire but some residents frequently watered their garden and never watered their lawn. The questions should be separated into their own categories for more accurate results.

14. 2002 was one of the hottest summers on record with close to a month of no significant precipitation. It is difficult to ascertain the effectiveness of a CBSM project unless the climatic variations are taken into account. It is recommended that meteorological data be correlated with effectiveness of water reduction campaigns. Attempts should be made to correlate the effectiveness of interventions (i.e. the number of houses approached, the number of commitment forms signed) on a hot, humid day versus a cooler day.

15. Many residents requested information about rainbarrels. This information should be implemented at the beginning of the project in the form of a list of rainbarrel suppliers and possible rebates, discounts or incentives.

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CHAPTER 9

APPENDICES

APPENDIX 1:

WATER EFFICIENT DURHAM

Is Promoting Outdoor Water Conservation

Sorry that we missed you!!

We are volunteers on behalf of **Durham Region** promoting outdoor water conservation.

We are giving away **FREE** tools and information on how you can conserve your outdoor water use:

- ***Rain Gauge:*** **Measures the amount of rain and sprinkler water your lawn receives. Your lawn only needs 1" of water per week.**
- ***W.E.D. Fridge Magnet and Hose Tag-*** **To remind you of appropriate times to water your lawn.**
- ***Pamphlets*** **- Healthy Lawn Care,**
  -Plant Lists that are water efficient

We will be back in your neighbourhood throughout the summer to provide you with more information and tools.

We hope to see you next time!

Appendix II
AJAX VERSION:

- Do you measure the amount of water used on your lawn or garden (including rainfall)? (YES / NO)
- Do you observe the odd-even watering by-law? (YES / NO)
- What time of day do you usually water your lawn/garden? (EARLY MORNING / AFTERNOON / EVENING / DON'T WATER)
- How many times do you water your lawn in an average week? (0 / 1-3 / 4-6 / 7+)
- How often do you take into account the weather/climate when watering? (ALWAYS / MOST OF THE TIME / SOMETIMES / WEATHER NOT A FACTOR)
- Do you select plants based on their watering requirements? (YES / NO)
- What length do you leave your lawn when cutting it (in inches)? (1.5 – 2.5 / 2.5 – 3.5 / 3.5 + / DON'T KNOW)
- What do you do with your grass clippings? (RAKE / BAG / MULCH / NOTHING)
- How often does your sprinkler water land on the house, driveway or other paved areas? (FREQUENTLY / SOMETIMES / SELDOM / NEVER)
- Which of the following water recycling methods do you use? (RAINBARREL / GREYWATER / OTHER / NONE)

PICKERING VERSION:

- How many times do you water your lawn/garden in an average week? (0 / 1-3 / 4-6 / 7+)
- What time of day do you usually water your lawn/garden? (EARLY MORNING / AFTERNOON / EVENING / DON'T WATER)
- Do you measure the amount of water used on your lawn/garden (including rainfall)? (YES / NO)
- Are you aware of the odd-even watering by-law - if so do you observe it? (YES / NO)
- How often does your sprinkler water land on the house, driveway or other paved areas? (FREQUENTLY / SOMETIMES / SELDOM / NEVER)
- Do you select plants based on their watering requirements? (YES / NO)
- What length do you leave your lawn when cutting it (in inches)? (1.5 – 2.5 / 2.5 – 3.5 / 3.5 + / DON'T KNOW)
- What do you do with your grass clippings? (RAKE / BAG / MULCH / NOTHING)

Which of the following water recycling methods do you use? (RAINBARREL / GREYWATER / OTHER / NONE

HOUSEHOLD WATER USE QUESTIONNAIRE
-Pickering Sectors-

1. **How many times do you water your lawn/garden in an average week?**

a) 0 b) 1-3 c) 4-6 d) 7+

2. **What time of day do you usually water your lawn/garden?**

a) Early morning b) Afternoon c) Evening d) Don't water

3. **Do you measure the amount of water used on your lawn/garden (including rainfall)?**

a) Yes b) No

4. **Are you aware of the odd-even watering by-law - if so do you observe it?**

a) Yes b) No

5. **How often does your sprinkler water land on the house, driveway or other paved areas?**

a) Frequently b) Sometimes c) Seldom d) Never

6. **Do you select plants based on their watering needs?**

a) Yes b) No

7. **What length do you leave your lawn when cutting it (in inches)?**

a) 1 – 2 b) 2 – 3 c) 3+ d) Don't know

8. **What do you do with your grass clippings?**

a) Rake b) Bag c) Mulch/Nothing d) Compost

9. **Which of the following water recycling methods do you use?**

a) Rainbarrel b) Greywater c) Other d) None

HOUSEHOLD WATER USE QUESTIONNAIRE

1. **Do you measure the amount of water used on your lawn or garden (including rainfall)?**

a) Yes b) No

2. **Do you observe the odd-even watering by-law?**

a) Yes b) No

3. **What time of day do you usually water your lawn/garden?**

a) Early morning b) Afternoon c) Evening d) Don't water

4. **How many times do you water your lawn in an average week?**

a) 0 b) 1-3 c) 4-6 d) 7+

5. **How often do you take into account the weather/climate when watering?**

a) Always b) Most of the time c) Sometimes d) Weather not a factor

e) Don't water

6. **Do you select plants based on their watering requirements?**

a) Yes b) No

7. **What length do you leave your lawn when cutting it (in inches)?**

a) 1.5 – 2.5 b) 2.5 – 3.5 c) 3.5 + d) don't know

8. **What do you do with your grass clippings?**

a) Rake b) Bag c) Mulch d) Nothing

9. **How often does your sprinkler water land on the house, driveway or other paved areas?**

WATER EFFICIENT DURHAM (WED'S) OUTDOOR WATER REDUCTION COMMITMENT FORM

Please check the appropriate box beside each of the water conservation practices that you and your family agree to follow in the future.

- ❑ I agree to monitor the rainfall my lawn receives and not to water my lawn if it has rained over 1 inch per week

- ❑ I agree to observe the odd/even watering by-law and avoid any unintentional watering of paved areas (i.e. driveway and sidewalks)

- ❑ I agree to water only early in the morning or in the evening and on calm, cool days

- ❑ I agree to not cut the grass shorter than 2.5 to 3 inches long.

Street and House#	Intervention	Tools and Info Given	Comments
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		
	1		
	2		
	3		
	4		

Outdoor Residential Water Reduction Programs
Do they Really Work???

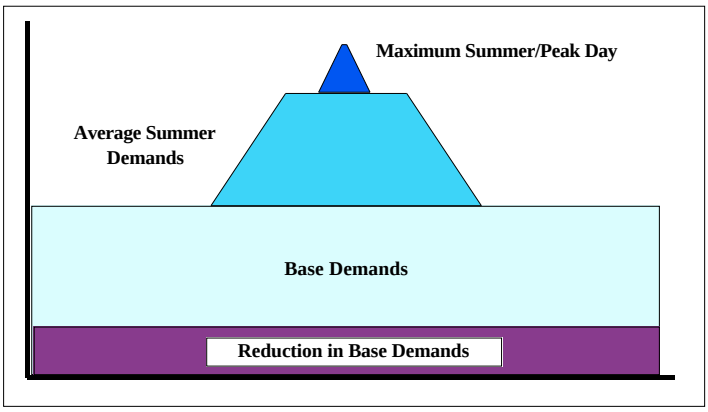
Cassandra Bach – Water Efficiency Coordinator
Regional Municipality of Halton, Ontario

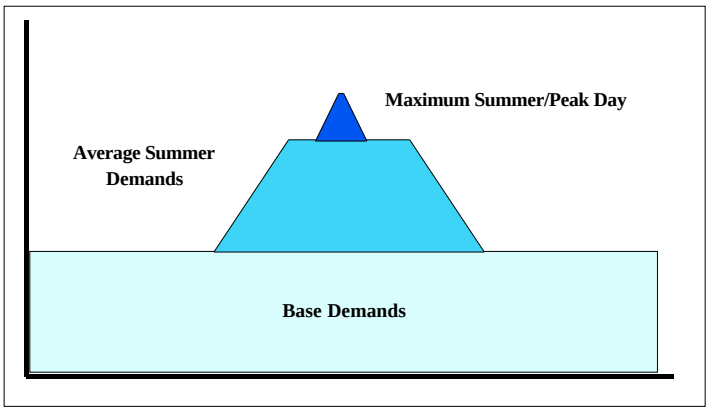
The Canada Mortgage and Housing Corporation and the Canadian Water and Wastewater Association sponsored a monitoring study initiated to determine the effectiveness of municipal peak day water demand reduction programs. The Ontario Regions of Durham, Halton, and York participated in the study with the hope of obtaining quantifiable data to evaluate their peak day reduction programs. Veritec Consulting Inc. was contracted to design and conduct the monitoring, and to analyze the results. Each municipality implemented a different method of reducing peak day – outlines of their programs along with the results of the monitoring study are discussed in this paper.

Peak Day

Peak day refers to the single day each year where water demand is at its maximum. Although there is only one actual peak day, there are a number of 'peak-like' days each year, usually occurring after a number of hot dry days. The demands on these days are often up to 50% greater than average annual day demands. Since many components of the water supply infrastructure must be designed to accommodate peak day demands, this water is the most expensive water for a municipality to provide. The system must be built to supply the demand for those 20 or so days where the demand on the water treatment facilities is greatest due to irrigation. Those days account for insignificant revenue even though the cost of providing the water is the greatest.

Diagram 1: Demand Pyramid





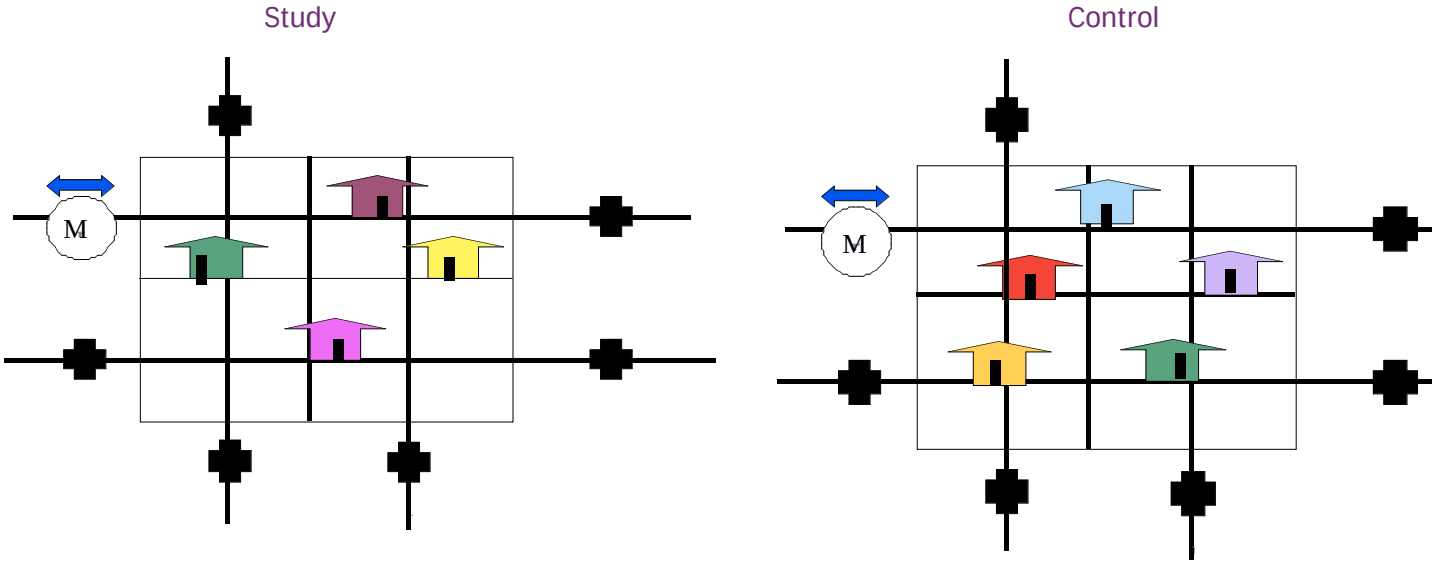
This diagram illustrates the distribution of demands on water treatment facilities. The base demands represents the average annual day, the average summer day represents the increase during the summer due to irrigation and other outdoor activities, and the peak day represents the few days of the year where the demand on the water treatment facilities is the greatest and may even be at or near plant capacity.

When considering an outdoor water reduction program it is not in the municipality's best interest to affect average day because it will result in a decrease in revenue. This is illustrated in diagram 1 where a slice of the base demands is removed and the result is in fact a reduction in peak day, but it is accompanied by the decrease in revenue as well.

The benefits of implementing a peak day program are reduction in the strain on existing infrastructure, service a greater population with same infrastructure, and the deferral of infrastructure expansions. All capital deferrals that would occur if peak demands were reduced should be considered before deciding on the details of a program. In order to analyze the potential for water efficiency a net present value analysis can be carried out. For example the present value of spending $1 in 10 years is $0.64 today.

The monitoring for this study was done by means of bulk metering in neighbourhoods where the water supply was isolated. The challenge in attempting to reduce peak day is that all of the water use is behavioural. The opportunity to achieve permanent savings is not available outside as it is in the home with programs that replace toilets and other fixtures. As well, people tend to modify their behaviour when they are aware of the fact that they are being monitored, this is known as the *Hawthorne Effect*, and that is why it is important to monitor water reduction program participants without their knowledge. The method of monitoring through bulk metering allows the community to be monitored without their knowledge because it is done through the watermain. Valves are closed such that the neighbourhood is supplied by a single watermain. An insertion flow meter is installed in the water main and a data logger periodically records the demands, e.g., every 5 minutes. The size of the community is determined by layout of the infrastructure. The data logger is left in the watermain for some months during the study period.

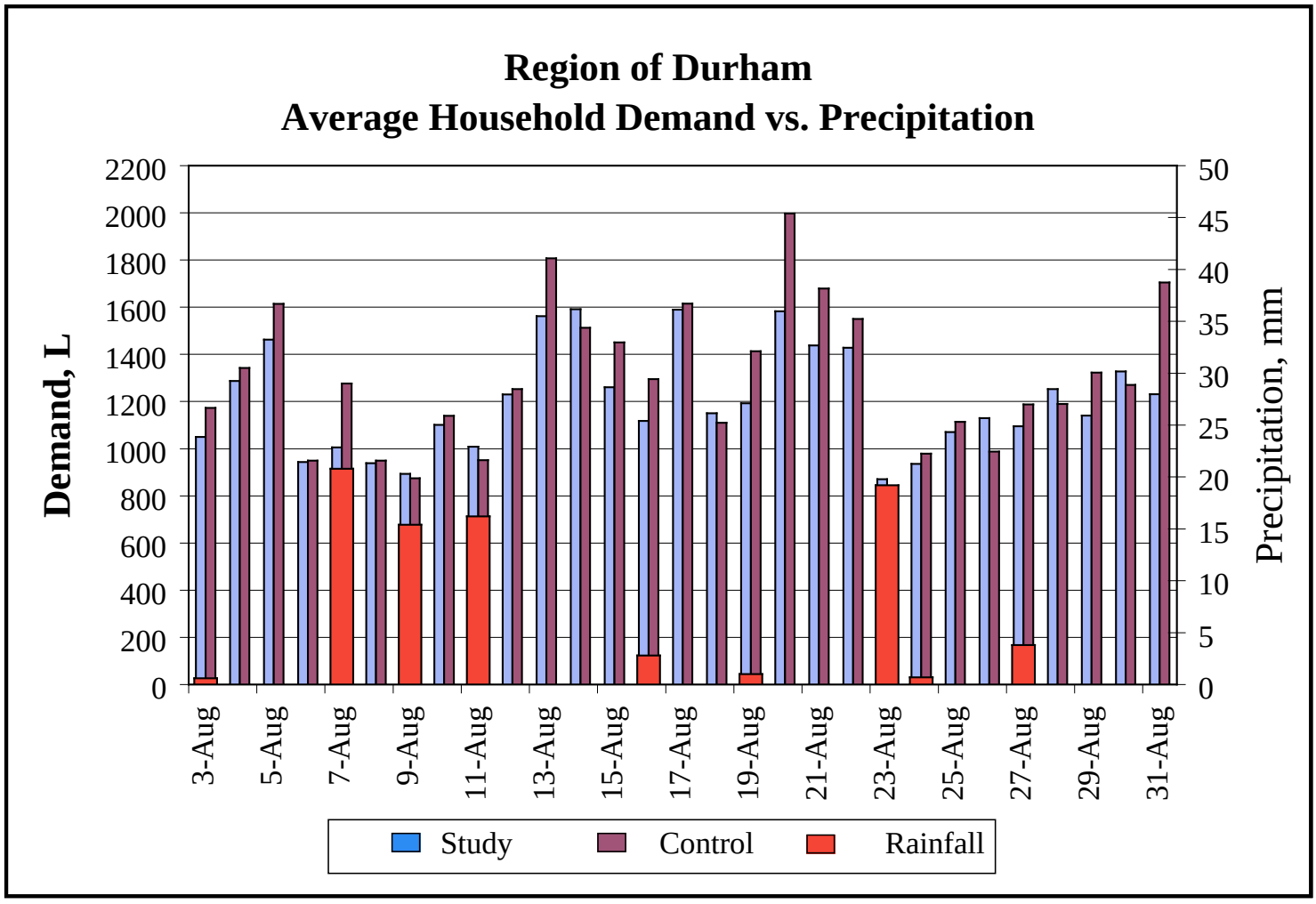
Diagram 2: Bulk Metered Area



This diagram illustrates how the community is isolated in order to monitor the water demands.

It is important when carrying out this type of a study to include both a study community and a control community. The study and control areas must be similar in demographics, property age and size in order to allow for an accurate comparison. For the purpose of this study, the size of the study and control areas was each about 500 homes. The use of a control area made it possible to discriminate between changes in demand due to weather or media (including storm warnings or widespread City of Toronto ad campaign) versus changes in demand due to the peak day reduction measure.

Graph 1: Household Demand Data



This graph illustrates two important things, the first is that lawn watering does not always decrease following a rain event and second, notice that although peak demand days occur in both the study and control groups, in the study group they are significantly lower.

Each municipality developed their own peak day reduction pilot program, which they implemented throughout the summer months concurrently with the monitoring. Baseline data was obtained for non-irrigation months for comparison and the percent reduction in irrigation demand and litres per household saved were calculated. Thus from this information the success and cost effectiveness of each program at addressing peak day demand could be evaluated.

York Region

York Region employed a consultant and used the traditional drop off delivery method to distribute a rain gauge and flyer to each household. They then returned at a later date to provide a reminder outdoor hose tag, which reminded residents of the program. This program cost approximately $22 per household and achieved water savings of 3 litres per household per day. This amounted to a 1% reduction in irrigation demand. This is a minimal decrease in irrigation, however it was determined that there was very little irrigation occurring in York to begin with which nearly eliminated the potential for savings. This information in itself was useful to York Region and was unknown before but identified through the monitoring program.

Durham

Durham employed a more aggressive program based on community based social marketing techniques, which involved marketing the program through personal contacts. Durham Region also employed a consultant to run the program. They supplied their residents with educational material and rain gauges while also communicating with them through personal contact. Students were in the community on a daily basis to talk to the homeowners about their outdoor water use while also providing knowledge on how to decrease their consumption. The cost of this program was approximately $44 per household and it achieved water savings of 215 litres of water per household per day. This equated to a 32% reduction in irrigation demand.

Halton

Halton chose to employ a less intense version of Durham's program in that they still used community based social marketing, but they were not in the community at extensively. Halton ran the program 'in house', which lowered the cost of the program. They combined personal contact with both mailed letters and delivered educational material and rain gauges. They communicated with the residents through the use of a survey in order to open a discussion with residents regarding outdoor water use and to identify ways for them to decrease their consumption. Halton's program cost approximately $18 per household and achieved water savings of 220 litres per household per day. This amounts to a 45% reduction in irrigation demand.

Cost of Savings

Table 1: Comparison of Cost of Savings Peak Day Reduction Program

Municipality	Cost per Household	Savings per Household	Cost of Savings	Ratio of Cost of Supply to Cost of Savings
York	$4.60	3 L/d	$1.53 per litre	1:4
Durham	$20	215 L/d	$0.09 per litre	4:1
Halton	$12	220 L/d	$0.05 per litre	8:1

The ratio was determined using the approximate present value capital costs associated with supplying a L/d, the present value was estimated at $0.40 based on AWWA and City of Toronto using a present value analysis for a 10 year capital works deferral and a discount rate of 4.5%, *AWWA Journal, March 1997, Volume 89*

A comparison of the cost of *saving* a litre per day with the cost of *supplying* a litre per day of water for each municipality based on the expected costs of implementing a region wide program shows that Durham Region was successful at reducing irrigation demands in a cost-effective manner with a supply cost to savings ratio of 4:1. Halton Region was even more successful at running a cost-effective program with a ration of 8:1 due to the fact that they used Regional staff to implement the program. York Region's program demonstrated that the traditional method of program delivery could prove unsuccessful; the cost of supplying the water actually cost less than the program itself at a ratio of 1:4. This unexpected result demonstrates the importance of running a pilot program before implementing a program region-wide.

These are only three methods of delivering peak day reduction programs. There are many other programs that municipalities use to attempt to change residents' water use habits. All of these programs need to be tested in a scientific way. Some examples include:

- Voluntary watering restrictions
- Mandatory watering restrictions
- Odd/even lawn watering restrictions
- Bill stuffers
- Sprinkler Timers

Year 2001

The next step and perhaps an even more critical component to this study is to determine the sustainability of savings. If the savings achieved only last for one year and the program needs to be implemented on a yearly basis or if increasing effort (and costs) are needed each year to produce the same results then it may be cheaper to *supply* the water than to *save* the water. However, it is not expected that all of the savings will be lost. Durham and Halton will be monitoring both the study and control areas again in 2001 to determine *savings* sustainability. If some of the savings are lost a bill stuffer or reminder letter will be distributed to the study communities in an attempt to reclaim at least a portion of the savings from last year.

Household Guide to Water Efficiency

In addition to testing the sustainability of the water savings from last year Halton will be testing the Canada Mortgage and Housing Corporation *Household Guide to Water Efficiency*. As an additional test last year, after all irrigation had ceased, the *Household Guide to Water Efficiency* was distributed to the residences in the study community. After a period of time had passed the data was gathered from the data loggers and the study was again compared to the control. It was discovered that when the guide was distributed following the summer program the homeowners achieved a 5.9% reduction in their water consumption based on their established baseline water consumption.

This year Halton Region will again partner with the Canada Mortgage and Housing Corporation to determine the effectiveness of the *Household Guide to Water Efficiency*. The program will employ the same monitoring techniques and evaluate different delivery methods of the guide. The first study community will simply receive the guide through the traditional drop off method. The second will receive a phone call alerting them that they will be receiving the guide and a follow-up call to discuss it and answer questions. The third study community will receive the more extensive marketing method of community based social marketing through a program based on both Durham's and Halton's methods used in 2000. The findings should prove very useful in that they will demonstrate the effectiveness of traditional distribution methods versus different levels of personal contact. This type of valuable information could potentially change the way municipalities' implement many types of program in which we seek to change residents' behaviours.

Contacts for more information about this study:

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Appendix C

Comments on Draft Forum Debrief Report provided by Professor Neil Gunningham

Review of Expert Reference Panel Forum Debriefing Report and related material.

Neil Gunningham

While most of my comments are prompted by the Debriefing Report and the SCCP Preliminary Evaluation Report, I begin with two broader contextual points

- The large majority of the nutrients which contribute to blue-green algae blooms in the Swan-Canning come from agricultural activities in the Ellenbrook catchment. Yet very little attention has been given to, nor resources devoted to addressing this problem. Instead, attention has concentrated on other solutions, including retrofitting and technical and remedial solutions that are almost invariably more expensive and far less effective, than addressing the problem at source. This is a policy failure of profound significance. (For elaboration, contact my colleague Simon Gordon (simon.gordon@anu.edu.au).
- The large majority of purported solutions to the challenges confronting the Swan-Canning have relied upon voluntary mechanisms, yet in many circumstances the gap between the public interest (in cleaning up the Swan-Canning) and private interests is too large for voluntarism alone to have more than a marginal impact. Again, the failure to recognize this fact has had profound policy implications. If policy-makers continue to repeat the mantras and mistakes of the last 20 years, then the Swan-Canning will continue to deteriorate, and current policy failings will be exacerbated. For elaboration see Gunningham and Sinclair "Non-Point Pollution, Voluntarism and Policy Failure: Lessons from the Swan Canning" *Environment and Planning Journal* April 2004..

Comments on Panel Forum Debriefing Report

Although I was unable to participate in the forum I can readily concur with many of the recommendations and have a few specific comments

Re recommendation 1, the Panel is surely correct in emphasizing that the mandate of the Trust is not sufficient to achieve a 'catchment focus'. The importance of addressing the nutrient problems caused by non-point source agricultural pollution (nitrogen and phosphorus) from the Ellenbrook catchment, is crucial in this context. Re recommendation 2, addressing "the efficacy of various management approaches/techniques and the socio-economic costs of implementing those management approaches/techniques," again brings into focus the importance of engaging with nutrient discharges from Ellenbrook, since this could likely be done far more cost-effectively than the various technical and remedial measures contemplated to date.

Consistent with my brief as a member of the Expert Reference Group, most of my comments below are concerned with Action Area 2. However, as regards Action Area 1,

I strongly endorse the recommendation of the Panel to assess "the importance of involvement of commercial and intensive farming properties in the SCCP, and engagement of this sector in the Farm Management Plan project".

Re Action Area 2

I note the overall aim is to "use statutory mechanisms (including regulations, by-laws, town planning schemes and statements of planning policy) to modify land-use practices and prevent or relocate polluting activities." Yet in my view very little has so far been achieved in these terms. The Panel is undoubtedly correct that:

- "Area 2 has been the least successful Action Area overall" …
- there is a need (recommendation 6) for "economic and regulatory mechanisms to encourage catchment, wetland and river foreshore management for nutrient reduction."
- "Statutory Mechanisms are at the core of the Action Plan and yet the weakest link".

It is particularly surprising that the Department of Planning and Infrastructure, having been allocated $140,000 to identify how and what statutory mechanisms can be used to modify existing and future land-use patterns, and prevent or relocate polluting activities within the Swan-Canning catchment, has failed to do so.

But what should such measures involve? The work of my own team from the Australian National University would suggest the following approach; (more fully developed in the final report of our 3 year study, to be released shortly). Much of it resonates with comments made in the forum but it is necessarily more developed and detailed than the forum discussions.

Building a policy strategy

In brief we argue for phased approach to policy implementation, one, in particular, that builds on the above analysis and based on the policy evaluation criteria of effectiveness, cost-effectiveness, equity and political acceptability. This would entail the introduction of a 'Phase I' based on persuasion and positive incentives, and in the event of demonstrable failure, a 'Phase II' based on compliance and negative incentives.

Phase I: Persuasion and positive incentives

- First, establish targets based on specification standards and process standards.
- Second, establish catchment-wide performance benchmarks for water pollution.
- Third, publicly announce that a failure to meet the targets specified above within a specified timeframe will trigger a shift from positive incentives (Phase I) to negative incentives (Phase II).
- Fourth, target measures at agricultural enterprises located in pollution hot-spots.

- Fifth, develop an environmental farm plan (EFP) with the following characteristics: (i) the capacity to be tailored to the circumstances of different agricultural sectors and different soil types; and (ii) identifies four or five key context specific improvements in diffuse water quality management, and includes soil testing.
- Sixth, develop a code-of-practice which identifies key physical changes for pollution abatement: (i) identify key best practice landscape changes for delivering pollution abatement, in particular managing water run-off; (ii) accommodate different land and soil types; (iii) make it transparent to second/third party observers.
- Seventh, provide a variety of positive incentives for landholders to adopt the EFP and landscape code of practice, including: (i) education workshops and free on-site advice; (ii) financial subsidies; and (iii) official recognition to participating farmers.
- Eighth, introduce a system of auctioned grants for the voluntary improvement of landscape management practices, with landholders having an opportunity to tender, on a competitive basis, by outlining proposed management actions.
- Ninth, modify planning policies to restrict future agricultural development in hot-spots. Offer compensation to those farms with the highest risk profile.
- And tenth, explore the viability of a financial subsidy for environmental preferred fertilisers, such as slow release fertilisers.

Phase II: compliance and negative incentives

- First, Phase II would only come into operation in the event that Phase I initiatives had demonstrably failed to achieve the water pollution abatement targets.
- Second, in this event Phase I initiatives would be extended to all agricultural enterprises, not just those located in pollution hot-spots.
- Third, positive incentives in the targeted areas (that is, pollution hot-spots) would be supplemented or replaced with the more interventionist measures described below.
- Fourth, an environmental general duty to the land would be imposed. This duty would be deemed to be discharged by compliance with the EFP/code of practice.
- Fifth, mandatory specification standards would be imposed regarding landscape changes (for example, buffer zones).
- Sixth, a levy or sliding charge would be imposed on those farms that do not adopt *and comply with* the EFP and code-of-practice initiatives.
- Seventh, annual self-audit check-lists would be extended to include mandatory reporting on rates of fertiliser consumption.
- And eighth, a system of land use permits would be introduced restricting activities in pollution hot-spots to low impact production, along with adequate compensation.

Land Use and Planning Controls

As to the specific issue of planning controls and land use planning, the approach I have so far taken (largely complementary but substantially more detailed than the Forum approach), is summarized below.

Modifying the prevailing land use patterns (that is, to shape the location and type of farm activities that take place) across an entire catchment or sub-catchment. The virtue of this approach is that it takes account of a range of geographical, geophysical and biophysical factors. Policy instruments best suited to target land use patterns include planning law, subsidies for changes in the type of farm activity, and mandatory changes in land use (usually associated with financial compensation). In principle, planning law could play a substantial role at state, regional and local levels in discouraging or prohibiting environmentally inappropriate land uses. For example, national or at state level planning "enables the government to coordinate a response to a particular matter of environmental concern and require a consistent approach, applying common standards throughout the state".

In practice, however, this potential has not been realised. In Western Australia, the focus of state planning law has been comparatively narrow, and does not address agricultural water pollution. And although local planning schemes could be a powerful instrument in reducing non-point source pollution (by aligning the identification of pollution hot spots with zoning powers to restrict or ban agricultural production in these high-risk areas), they can only apply prospectively and therefore cannot address existing uses. This means that local planning restrictions can only be used to address greenfield sites, or where property changes ownership and the existing use provisions no longer apply. Internationally, planning law has not been a prominent feature of non-point source pollution abatement policy strategies for the agricultural sector. In summary, planning processes are of limited value given that in many areas, activities are already taking place that are environmentally inappropriate and the planning system, given its prospective nature, provides no mechanism for dealing with them.

If planning laws are demonstrably insufficient to change existing land use patterns, what other policy options are available? One possibility is to offer subsidies targeted to farmers in pollution hot spots to adopt different, less polluting agricultural activities. This might be achieved by using a range of criteria, such as soil type, proximity to sensitive waterways, or vulnerability to erosion. However, such financial compensation needs to be carefully considered. In particular, where farmers are expected to provide an ongoing management role, lump sum payments although initially attractive do not provide an ongoing incentive. In such cases, compensation (or rather, future oriented payments) could take the form of an environmental service fee whereby payment is forthcoming when defined environmental improvements have been achieved.

Mandatory controls are an alternative to subsidies. Although such an approach has not yet been used within Australia to address non-point source water pollution, it has been used in a related area, namely native vegetation clearance controls. In theory, at least, the

concept of permits could be extended to cover a range of land use patterns relevant to non-point water pollution, such as restricting unauthorised actions in highly nutrient sensitive areas. The challenge of applying mandatory controls to achieve the desired changes in land use patterns is that is arguably even more politically sensitive than that of clearance controls, given that the changes require either a fundamental change of production activity, or, more ambitiously, a complete ban of agricultural production. On the other hand, because changes in land use patterns are only likely to impact on farms in pollution hot spots, the overall number of affected properties will be less than for clearance controls that potentially apply to all farms.

Light Industry

Regarding the Light Industry Project, I concur with the Panel view that there is a lack of on going funding support, lack of resources, lack of coordination and lack of clarity on roles and responsibilities. Over and beyond this, it is important to emphasise that voluntary initiatives (the Cleaner Production initiative) have had a very disappointing uptake and should not be relied upon as primary tools of policy. The ANU research team position (Gunningham and Sinclair) is as follows.

Pollution prevention and control for light industry

What should an effective and efficient environmental strategy for light industry involve? In this context, we argue that there are four overriding concerns. First, there must be a range of instruments that target the different motivations for complying with environmental law. Second, motivating enterprises to comply with environmental law is necessary but not sufficient to achieve compliance. Third, solutions must be tailored to the specific circumstances of light industry. Fourth, it will be necessary to develop mechanisms that are effective in addressing the principle obstacles to the improved environmental performance of light industry. In particular, many enterprises in light industry are ignorant of the negative environmental consequences of their actions and are not even aware that unauthorized releases of liquid industrial waste are doing environmental harm, many have no incentives to change their attitudes or improve their environmental practices, and even where enterprises in light industry do express a desire to achieve environmental improvement, they are unsure how to do so.

Information and education

A necessary underpinning to any other strategy is the effective provision of information and education. Ignorance of their polluting impact and a lack of skills, and expertise to do something about it, are major obstacles to better environmental performance by light industry. Only when enterprises are aware of their environmental impact, know of more environmentally responsible means of behaving, and know of their legal responsibilities, are policy-makers in a position to ask business to “do the right thing”. Yet many well-intentioned efforts by government and industry to provide education and training have failed to get their message across and have had minimal impact. Past experience

internationally suggests that much depends on how this information is presented, to whom it is presented, and who presents it.

In Western Australia, considerable success has been achieved by a government / industry partnership under which the Motor Trades Association (MTA) is funded to engage directly with its members on environmental matters. But even if education and training are well targeted and presented, it is unlikely that they will be enough in themselves to achieve widespread behavioural change because a number of other motivational pressures described above, may militate against voluntary action.

Positive incentives

Since most SMEs do not have any apparent concern with, or short-term self-interest in improving their environmental performance, they are unlikely to do so in the absence of incentives to encourage and reward such behaviour (or to discourage breaches of the law as described in the following section). In principle, positive economic incentives might be expected to work well since SMEs, including light industry, "are the companies most likely to respond to the potential financial benefits inherent in many incentive options". Unfortunately, for reasons we have explored elsewhere, the scope for introducing such instruments in relation to SMEs is very limited.

Regulation

Three regulatory instruments have particular merit. First, self-inspection and self-audit has considerable potential in the context of light industry. Briefly, this entails an enterprise manager applying a pre-set checklist of measures (usually tailored to different industry sectors) to determine if their premises are achieving a basic level of environmental good practice. In order to minimise the burden involved, and motivational fatigue, the list is confined to a limited range of issues (for example, the top four pollution issues in a particular sector). Such an approach is well suited to reducing water pollution from light industry, since most such pollution is caused by simple acts of disposal, rather than complex production arrangements. Successful participants should then be encouraged to adopt further cleaner production initiatives.

Second, given that many in light industry do not perceive a self interest in improving their environmental performance, the threat of enforcement against recalcitrants is an important underpinning not just for individual strategies such as self-audit, but also to education, training and suasive instruments more generally. As noted above, this is a glaring policy gap that, with the advent of the unauthorised discharge regulations, has only recently been addressed. Many of those interviewed, particularly local government officials, concurred that credible enforcement was fundamentally important. However, it remains to be seen how well the unauthorised discharge regulations will work in practice. At a minimum, state government must provide significant support.

Third, an approach which encapsulates a more geographical and community based regulatory response has been developed in Victoria through the vehicle of the

Neighbourhood Environmental Improvement Plan (NEIP). NEIPs are designed to foster local community involvement in and control over environmental issues relevant to their neighbourhood. The concept of NEIPs would seem readily applicable to the problem of SME water pollution in the Swan-Canning. As such, it has very considerable promise.

In summary, a package of policy instruments would include:

Information and education – based on simple but effective messages that are easily understood, and are industry and task specific; industry ownership and commitment by engaging them in the formation of educational material; trusted people, especially industry associations, to disseminate the information, ideally face-to-face, including to owner/managers, spouses (where appropriate) and staff; and the engagement of third parties (customers, suppliers, professionals) to reinforce the pollution prevention message.

Positive incentives – provide targeted subsidies for environmental audit and technological assistance.

Self-inspection and self-audit - develop a self-audit check-list specific to key industry sectors, keep it simple, arrange for collection and collation of completed check-lists, provide oversight through peer review, industry association desk-checks and/or randomised audits by regulators, and provide an incentive by threatening inspections for those they do not complete and return self-audit check-lists.

Inspection and enforcement - based on unauthorised discharge regulations, including delegated power to local government to enter premises, seize equipment, issue infringement notices (on the spot fines), *and* improvement notices, with the Department retaining the right to prosecute continued breaches.

Neighbourhood Environment Improvement Plans – empower local communities to develop geographically based environmental improvement plans, and engage light industry at the local level through their participation in such plans.

The Role of Economic Instruments

My colleague Simon Gordon has produced two working papers on this theme which are summarized below.

Three innovative economic instruments in particular appear to warrant consideration.
The first two of these instruments are aimed at increasing the adoption of best management practices (BMP) by agricultural non-point source polluters. The first, a system of auctioned grants for the voluntary improvement of management practices is based on the current underlying beliefs regarding the property rights for non-point source emissions. The second, a system of BMP incentive charges, is based on the principle that the non-point source polluters should pay for their emissions. The third economic

instrument to be examined is a system of emissions offsets targeted at managing future increases in urban residential non-point emissions.

Auctioned BMP payments

Typically, cost share programs aimed at increasing adoption of BMPs on farms are based on a simple fixed-rate payment from the government to a landholder for the landholder to undertake an agreed management action. Adopting this form of grant delivery is most efficient where the potential improvement in water quality and the opportunity cost of delivering these improvements are homogenous.

Where sites are heterogeneous, targeted grant delivery is likely to deliver a more cost-effective outcome. Such a system takes into account the differences between farm types and differentiates payments according to the opportunity cost of undertaking a management action and the expected improvements in water quality that it will provide. Targeting grant delivery comes at a cost, however. This occurs due to the clear presence of information asymmetry. Non-point source polluters have a far better idea than the government as to how various management changes will affect their production plans and profits. Under these conditions the government needs to expend resources to have landholders reveal information about these impacts.

Auctions (or competitive tendering) are one mechanism that can elicit the required information from farmers. In addition, auctions may be designed to accommodate variability in water quality improvements from one site to the next. Competition between bidders for BMP payments and the ability of the government to compare the environmental and cost-effectiveness of each bid also provides for a more cost-effective solution.

The first step in developing such a scheme involves linking the impact that various management practices would be expected to have on emissions of nitrogen and phosphorus. This is necessary so that the relative improvements in water quality from actions undertaken from one site to the next can be compared. In the case of Ellen Brook it appears that these links are uncertain and cannot be made with a great degree of confidence. While the difficulties in establishing the links between management actions and water quality should not be understated, for the purposes of examining how a system of auctioned BMP payments could operate it is assumed that these links are known.

The next stage of a system of auctioned BMP payments would involve an assessment of individual sites within the Ellen Brook catchment to determine which management actions would be most suited to each site and what the likely impact on water quality of undertaking these actions would be. Landholders would then identify the actions they would be prepared to undertake and prepare an agreed management plan as the basis of their bid.

Following the preparation of the management plan, landholders would be asked to submit a sealed tender for the level of payment they require from the government if they are to

undertake the proposed management action. It is envisaged that cost-sharing provisions could also be included in the scheme whereby individuals may propose to undertake some of the costs of changing their management practices. This would not only alleviate the public cost of undertaking the management change but would also improve the competitiveness of their bid. Furthermore, tenders could also be made collaboratively with neighbouring properties for actions that may cross farm boundaries.

Once all tenders have been received, the government would then access each tender in terms of its cost and the anticipated impact on pollution levels. Funds would be provided for those activities that are considered to provide the greatest per dollar improvement in water quality.

BMP incentive charges

Under a system of BMP incentive charges, non-point source polluters face variable charges based on their management practices. Actions that result in high levels of emissions face the highest charges while farms demonstrating BMPs would be exempt. Assuming that incremental improvements in management practices may be made, a series of charge levels could be placed between these two extremes.

The first stage in establishing these charges would be to determine what management actions are going to be required under the system. Using BMPs as an end point, a schedule of what may constitute a reasonable time-path from current to best management practices could be prepared.

The chosen path from current to best management practices may end up involving several broad progressive management changes. For instance, the first step may be that all farms undertake soil testing. An interim step may involve the provision of fertiliser setback areas, while a final step could entail the revegetation and fencing of all waterways.

Once these steps have been agreed to a series of charges may be attached. For instance, the charge for farms who have undertaken none of these steps could be $x/year. Farms who have undertaken step one may pay a lower charge equal to $y/year. Charges would get progressively lower as more of the BMP steps were completed until farms that are deemed to be undertaking BMPs would pay no charge at all.

The imposition of these charges would be expected to face significant opposition from farms and farm groups. There are a number of options available to reduce both the opposition from farm groups and the resultant transaction costs. First, the introduction of charges can be phased in gradually in recognition of the potential magnitude of management changes that may be required. Second, charges could be increased gradually with fees capped at a maximum amount so as not to endanger financial viability in the short term. Finally, once administrative costs have been covered, revenue raised through the collection of charges could be recycled back to affected industries to reward those farms that have made the greatest management changes. Alternatively, part of the revenue could be recycled back to the affected industry (to reduce opposition) and part could be used to fund public environmental works in the Ellen Brook catchment.

Urban non-point source emissions offset bank

In the Swan-Canning an offset scheme could be designed so that increases in non-point source emissions from urban residential development were offset by less costly reductions in agricultural non-point source emissions. This not only would allow urban developers to meet their obligations of 'no net increase' in nutrient emissions but would also help to fund reductions in non-point source pollution from agricultural sources.

The first stage in establishing an offset scheme is the development of legislation that would prohibit new urban residential development unless either: a) all non-point source emissions are eliminated on site; or b) any increase in emissions from the development is offset through equivalent emissions reductions elsewhere in the Swan-Canning. The decision on how to reduce emissions would be made by the developer based on comparing the costs of doing so on site with the costs of arranging for other emitters in the system, such as agricultural non-point sources, to undertake equivalent reductions.

Offsets are typically undertaken on a bilateral basis, whereby the developer conducts their own search for the appropriate off site action and negotiates the terms of the offset contract with the other party. The costs associated with making bilateral offset transactions can be high, however, and threaten to erode much of the potential cost-savings associated with the offset. These costs can be reduced through an offset banking system.

In an offset banking system, government or approved private organisations undertake actions to reduce emissions. Based on the outcomes of these actions, a 'bank' of emission reduction credits is built up. Similar to the operation of the bilateral offset scheme the developer is presented with two options if they are to comply with the offset legislation. First, they can eliminate the emissions from the development by implementing on site management actions. Alternatively, they can allow the emissions from their development to increase unabated and purchase an equivalent amount of emission reduction credits from the offset bank.

Offset banks offer a number of advantages over bilateral offset schemes. First, they significantly reduce transaction costs per unit of emissions reduction. Second, they may achieve reductions in emissions more effectively. Large projects, which may offer greater per dollar reductions in emissions than a number of small projects, may be undertaken by the owner of the offset bank to generate emission reduction credits. Third, they provide for greater environmental certainty without slowing down applications for urban residential development.

It is important to note that the efficient operation of the offset bank is predicated on the ability of the government (or an approved private business) to estimate both the emissions loadings from new urban residential developments (the 'debits') and the 'credits' generated by emissions reductions from projects conducted by the owner of the offset bank. Where emissions cannot be directly measured, it is necessary to use emission proxies.

Drain Licensing

- On drain licensing, my colleague Simon Gordon (simon.gordon@anu.edu.au) has undertaken a comprehensive analysis which is summarized below.

Rather than simply focusing on individuals causing non-point source pollution upstream, policymakers could focus on downstream pollution by licensing the main drains into which the nutrients from elsewhere in the catchment ultimately flow. This approach would have two crucially important consequences. First, it would transform hundreds of thousands of non-point and small point sources of pollution into a large point source, and second, and in consequence of this, it would enable the imposition of performance standards that, where practicable, are generally preferable to using other, less direct and less flexible types of standards. The performance standard in question could be a maximum permitted pollutant load (calculated to weigh most heavily, those pollutants, such as phosphorus, that cause most damage to the river system) or be based on maximum permitted nutrient concentration levels.

Under this approach the drain manager (or at least the main drains manager) would be made responsible for all pollution flowing into the drains over which it has control. This would provide the drains manager with a strong incentive to reduce the impact of urban non-point source pollution that has entered the drains for which it is responsible. This could be achieved either through undertaking drain rehabilitation and nutrient stripping projects or through the imposition of obligations on urban non-point polluters, commensurate with the amounts of nutrients they discharge. By doing so, the drainage manager would pass on most of its own charges in a manner that would both satisfy the 'polluter pays' principle, and, more important, create incentives for those best capable6 of achieving the greatest reductions in nutrients discharges (non-point source polluters themselves), to do so.

Adopting such an approach in the Swan-Canning is not without considerable problems, however. First, the drains manager may be constrained in its efforts to build nutrient stripping wetlands both by the physical location of the drains and by the fact that it is often considerably more expensive to remediate than to reduce the amount of pollution at source. Second, it is uncertain whether it is currently feasible to convert groups of non-point sources into point sources in the Swan-Canning. Third, for main drains performance standards to operate effectively it is essential that the main drains manager has a mandate that enables them both to undertake catchment level pollution abatement, such as nutrient stripping wetlands, and impose obligations on urban non-point source polluters. The system that currently exists in the Swan-Canning is far removed from this model.

Final Comments

My broader point is that many of the issues which are crucially important under Action Area 2 have been considered by the ANU research team, which has engaged in three year project involving a broad based analysis and a number of concrete recommendations.

However notwithstanding the paucity of information and analysis from other sources, and the relevance of our work to the future of the SCCP, our draft report has generated remarkably little comment from any of the major stakeholders. It is as if the regulatory, economic incentives and planning aspects have been put in the ‘too hard’ basket, and left for another day. I hope the current exercise will to some extent redress the balance.

Neil Gunningham 28 January 2005.