STREAMLY CLEAN PROJECT REPORT

A strategy to achieve community and government endorsed Water Quality Objectives for the Upper Parramatta River Catchment

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‘Streamly Clean’ Project Report

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Acknowledgements

The commitment and involvement of the community, local government and government agency members of the ‘Streamly Clean’ project steering committee in providing direction and support is acknowledged.

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1. Executive Summary

Improvements in the health of our waterways are unlikely unless everyone who uses them or lives in their catchments accepts and understands the clear water quality goals set by government.

The Streamly Clean project in the Upper Parramatta River catchment is believed to be the first attempt in New South Wales to implement the National Water Quality Management Strategy. This nationally endorsed process allows the catchment community to select its preferred water quality goals, with the knowledge of how much it will cost to achieve them.

The Upper Parramatta River Catchment Trust is the New South Wales Government authority for Total Catchment Management in this western Sydney catchment of 110 square kilometres, an important catchment not least because it is at the headwaters of Sydney Harbour. The Trust has confirmed with the Streamly Clean project strong support for water in streams in the catchment to be of sufficiently high-quality to make them suitable for secondary recreation contact and able to meet ecosystem protection requirements. A survey indicates that clear majority of residents of the catchment support these goals and is prepared to make an additional. financial contribution to achieve them.

From October 1994 to December 1995 the Trust, through a community and government steering committee, worked with local government, government agencies and the community to determine agreed water quality goals and a strategy to achieve those goals. The process involved extensive community education, participation and development, combined with thorough analysis of water quality data.

Activities were comprehensive and included three surveys of the 70,000 households in the catchment, raising community awareness by placing signage along creek corridors, newspaper articles, community newsletters and school competitions and establishing community reference groups.

The first community survey identified past and present uses and values of local creeks. In the second, in more than 1,100 face-to-face and written survey responses, the people living in the catchment voiced a clear desire for their creeks to be cleaner and healthier. The survey found passive uses and values of creeks (ecosystem protection, passive recreation, appearance and existence value) were more important to residents, and active uses (swimming, boating and fishing) were less important. (There was, however, high support for active recreation in Lake Parramatta.)

A thorough review of water quality data for the catchment revealed a mixed variety of ‘professional’ and ‘community-based’ material. Comprehensive statistical testing and modelling enabled a valuable data set of key water quality indicators to be compiled. The data was considered sufficiently reliable to provide a broad-based assessment of water quality.

Comparison of desired and actual water quality revealed manageable shortfalls in the achievement of key water quality criteria. An integrated strategy involving the community and government was developed to achieve the community water quality goals by overcoming these shortfalls.

The final stage of the process involved the distribution of an options paper for public comment. The community was asked to confirm how it wants to use and enjoy the creeks by choosing from three alternative sets of water quality goals. Based on this integrated strategy, approximate costs of achieving each set of goals were given so residents could compare these with the resulting benefits of improved water quality.

Almost 2,000 responses were received from residents. Sixty-seven per cent favoured the highest practicable water quality goals, which would allow secondary recreation contact and meet ecosystem protection in all catchment streams, and allow swimming in Lake Parramatta. This strategy requires an eventual $25 increase in the Trust service charge of $24.70, increasing the charge by $2.50 a year for 10 years.

Twenty-eight per cent of residents supported a less expensive set of water quality goals which would require no increase in the Trust service charge. These goals were also consistent with previously-expressed community desires, but involved only partial protection of creek ecology and a longer time to achieve initial water quality improvements.

Only four per cent of residents supported a 'do nothing more' option which would see water quality continue to decline. Under this option the Trust service charge would gradually decrease as flood mitigation works are completed, but with continuing costs for maintenance. Both other options would progressively transfer more funds to water quality improvement programs as flood mitigation spending decreases.

On 15 March 1996 the Trust resolved to adopt the community-endorsed, highest practicable water quality objectives, to submit these objectives to the Environment Protection Authority for consideration as interim water quality objectives for this catchment, and to advise all councils in the catchment of this action. Should the Government endorse the water quality management strategy, approximately $41 per household a year (1996 values) will eventually be spent on a Streamly Clean Action Plan.

Involving the community in these decisions has resulted in greater understanding of why water quality is declining, and the reasons for the favoured approach. This has helped promote the strong level of community support. Most important, there is now both community and government ownership of the problem, and commitment to do something about it. This augurs well for this catchment and other catchments where water quality is declining.

Involving the community and the government in the processes for establishing water quality objectives through the Streamly Clean project gives clear and considerable benefits:

- Government and community-based water quality data has been integrated and optimally utilised
- Direct communication of broad-based community aspirations for water quality has been achieved

- Partnership opportunities have been identified and developed
- Community understanding of water quality issues has increased
- "Ownership" of the issues has been widely enhanced and there is increased commitment to do something about this.

The community-endorsed water quality objectives established by the Streamly Clean project will focus and change community and government activities to improve the creeks in the Upper Parramatta River catchment. They will also provide the 'goal posts' to monitor and report on progress.

In water quality terms the Upper Parramatta River catchment, while important, is relatively straightforward. The Streamly Clean project is a good first test of the nationally-endorsed approach to setting agreed water quality goals and objectives, and developing community and government strategies through TCM processes. It is an important milestone and a key step on the long road towards integrated and sustainable natural resource management.

2. The Upper Parramatta River Catchment and Trust

2.1 The Upper Parramatta River catchment

The Upper Parramatta River catchment is the land which drains into Port Jackson upstream of the tidal limit at Charles Street weir in Parramatta. The catchment is located at the geographic central area of the Sydney metropolitan area. *Figure 1* shows the catchment and its main creeks and suburbs. It has an area of 107 square kilometres and has played an important part in Aboriginal history and white settlement of the continent.

Since European settlement the catchment has been developed and has diversified. It has become almost completely urbanised over the past 35 years and urban landuse now accounts for 87 per cent of its area. The last vestiges of agriculture, horticulture and dairying, which were important landuses up until the 1960s, have all but disappeared and rural landuse now accounts for only one per cent of landuse. The bustling city of Parramatta is located at the bottom of the catchment, and the major centres of Carlingford, Castle Hill and Blacktown are located on its the eastern, northern and north-western boundaries respectively. The catchment includes parts of the Shire of Baulkham Hills and the cities of Blacktown, Holroyd and Parramatta.

The south and west of the catchment, formed on Wianamatta shales, has a gently undulating topography. With the exception of some large open space areas around Prospect these areas are now dominated by residential, commercial and industrial landuses. There is a large industrial area along Toongabbie Creek adjacent to the McCoy Park Basin.

The north-east of the catchment is a contrasting area of hilly and steep topography with deep incised gullies and creeks resulting from the Hawkesbury sandstone geology. The maximum elevation of this area is approximately 190 metres Australian Height Datum (AHD) at Castle Hill. This is a significant rise in elevation over a distance of only 8.5 kilometres from the elevation of only 6 metres AHD near the Charles Street weir in Parramatta.

The natural areas which once covered the entire catchment now sum only 12 per cent of total landuse. These include 14 parks, two golf courses and some attractive remaining natural and semi-natural areas of open forested land. There are also some attractive remaining natural and semi-natural areas of open and forested land in the north and south. These areas are more common in the north-east of the catchment where steeper topography has deterred development, particularly in the Darling Mills Creek sub-catchment. Cumberland and Darling Mills State Forests and the Excelsior Reserve are important bushland areas.

The catchment contains approximately 70,000 rateable properties and is home for more than 223,150 people (ABS, 1991). Major transport and infrastructural corridors cross the catchment and many important institutions and industries take advantage of its central

locality. Construction of the M2 Motorway is the latest major infrastructural development to be undertaken.

2.2 The Trust

The Upper Parramatta River Catchment Trust is a New South Wales state authority, established in 1989 under the Water Supply Authorities Act, 1987. It was established after representations by councils in the wake of widespread public concern over major floods between 1986 and 1988, which caused millions of dollars worth of damage, and distress and hardship to many people.

The Trust's area covers the Upper Parramatta River catchment above the tidal limit at the Charles Street Weir, Parramatta. It includes parts of the Shire of Baulkham Hills and the cities of Blacktown, Holroyd and Parramatta.

The Trust's charter is to coordinate flood mitigation and trunk drainage activities, improve water quality, and enhance the condition of catchment creeks and creek bank areas. The Trust is achieving this by various engineering works and community education programs. It also institutes appropriate planning controls and develops management strategies for the catchment.

A majority of the Trust's board of(12) are nominees of the four constituent councils. It has a staff of seven and is funded by a levy on all catchment properties, collected on its behalf by Sydney Water. This year the levy on a single residence is $24.70. The Trust also receives Commonwealth and State grants for flood mitigation works and currently coordinates funding for natural resources management through the National Landcare Program.

3. The 'Streamly Clean' Project

3.1 Aims

The Streamly Clean project was originally termed the Upper Parramatta River Catchment Water Quality Strategy. The project name 'Streamly Clean' was a winning entry in a student contest to develop a more 'community friendly' title. The project's aim was to establish a set of community-endorsed water quality objectives for the catchment and to develop an integrated strategy to achieve the desired standard of water quality. This aim is consistent with the National Water Quality Management (NWQM) Strategy. In fact, the Streamly Clean project is believed to be the first to comprehensively adopt the accepted nation-wide principles and policies of the strategy and produce the desired initial products and outcomes.

3.2 Procedures, main tasks and key activities

The procedures principally involved in achieving the project aim included:

- Initiating a high level of community involvement to identify and discuss desirable environmental values for the waters of the Upper Parramatta River catchment.

- Obtaining optimal agreement among all parties on what the environmental values should be and identifying the applicable water quality objectives (the numbers to be achieved) for the catchment' s streams.

- Developing a water quality improvement strategy and action plan which realistically aims to achieve the water quality objectives within an identified time.

- Achieving appropriate levels of 'ownership' by the community, local government and state agencies to ensure their continuing commitment and support for the strategy and action plan.

The project was divided into three main task areas:

- Management and coordination—managing and guiding the process to a tangible outcome, this being a recommendation to the Trust and the Government on water quality objectives for the Upper Parramatta River.

- Water quality data analyses and modelling—gathering and compiling data from all available sources, verifying it, and then managing and undertaking various analyses and modelling techniques to obtain the clearest possible picture of water quality throughout the catchment.

- Community involvement and consultation—including leading and working alongside Trust staff, local government and state agency staff, and the community to identify desirable water quality objectives and a strategy to achieve these, and developing and

implementing a comprehensive series of community involvement and communication strategies, activities and products.

Although the key tasks may be generally considered within these three main areas, other activities were undertaken within an integrated package of community involvement and technical activities. These activities aimed to ascertain the:

- Existing water quality levels.
- Desirable levels the community would wish to have.
- Differences between these existing and desirable levels (in terms of key water quality criteria).
- Options to achieve desirable water quality levels.
- Broader implications for the Lower Parramatta River.
- Estimation of likely costs of feasible options to attain desirable water quality levels.
- Verification of support from the community and government agencies for the options.
- An indication of the likely levels of commitment to meet any increased costs.
- Criteria for continuing performance evaluation and quality assurance.

3.3 Co-ordination and management

3.3.1 The 'Streamly Clean' project and the national approach

At the broadest level, project co-ordination was provided by the national framework. The NWQM strategy is a co-ordinated approach developed after years of negotiations and work by peak Ministerial councils and forums. Its policy objective is supported by Federal, State and Territory governments and is consistent with the concept of Ecologically Sustainable Development (ESD) and the Inter-government Agreement on the Environment. The objective is 'to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development'.

The commitment to ESD implies a clear predisposition to protect and enhance the quality of the nation's water resources. As policy principles, they give fundamental strategic direction and are central to the management guidelines being developed for activities which have significant impact on water quality.

The NWQM strategy recognises that satisfactory water quality will only come from sound water management. The management of water quality differs only in its time scale from most other management cycles. The classic management cycle involves:

- Goal and objective setting
- Devising action strategies
- Implementing strategies
- Measuring performance against objectives
- Revising goals and objectives.

This is illustrated by *Figure 2.* The figure illustrates the cycle which, while it may not necessarily be carried through in this neat fashion, is fairly common to management decision-making. The objective-setting part of the cycle can be described as a 'cycle of choice and

consequence'. Details of the national strategy, and the cycle of choice and consequence shown in *Figure 2*, are presented in *Appendix 1*.

The Streamly Clean project recognised and incorporated this framework and also adopted these principles from the national strategy:

- Setting community preferred water quality goals and objectives.
- Incorporating scientific input through nationally consistent water quality criteria.
- To the extent relevant, adopting nationally consistent effluent standards, promoting cleaner production and using best management practices.

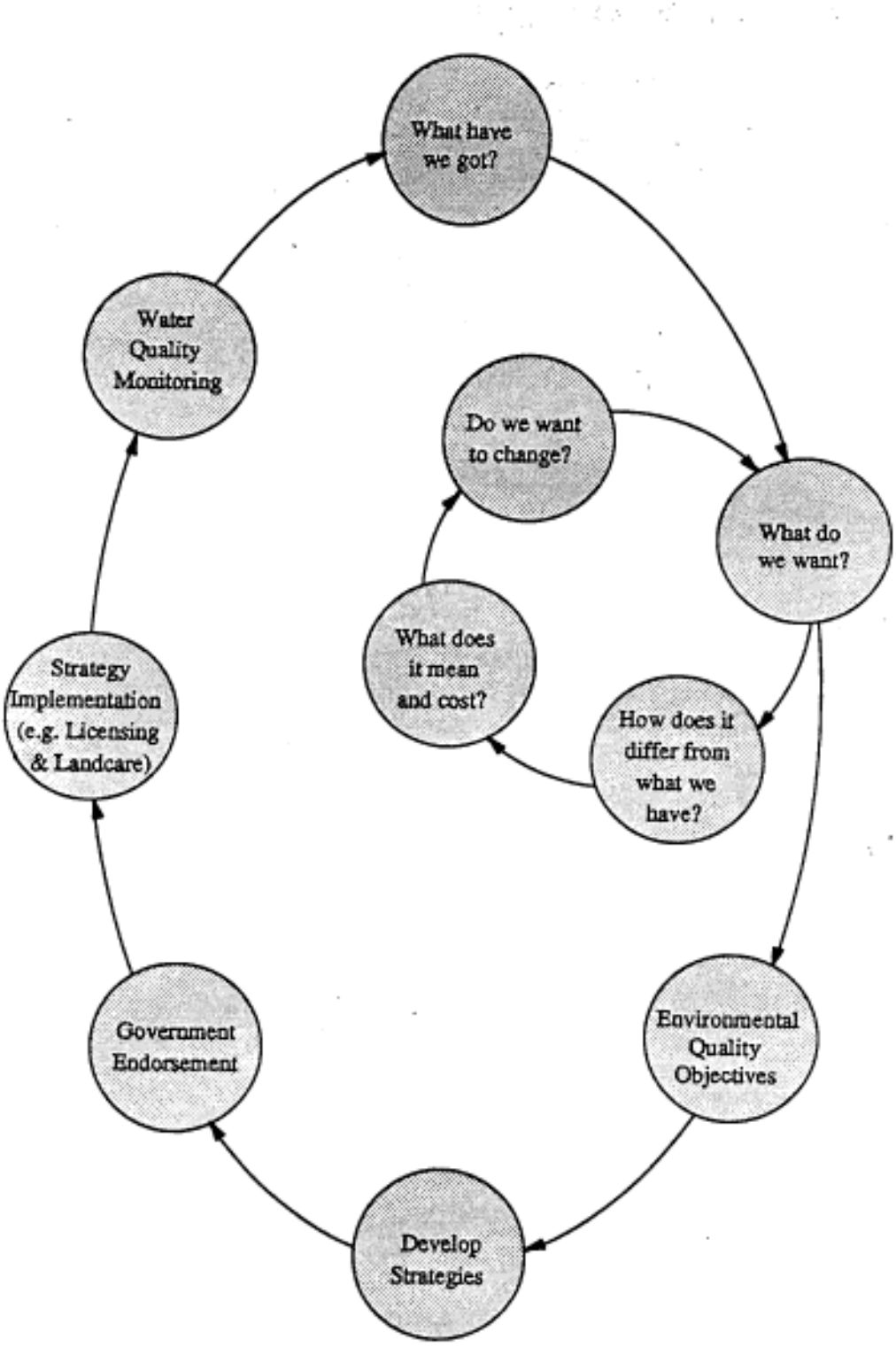


Figure 2. The Process of Setting Water Quality Objectives.

In developing appropriate strategies and action plans for the Upper Parramatta River catchment based on these national policies and guidelines, it has been important that the Streamly Clean project take into account State policies, local conditions and community needs.

3.3.2 TCM a foundation principle

Total Catchment Management (TCM) is the umbrella policy for sustainable natural resource management in NSW. The State TCM Policy began in 1984 when it was agreed more needed to be done to integrate efforts to sustain the State's land, water and vegetation resources. As a result, initiatives and sub-policies (such as the State Soils Policy and the State Rivers and Estuaries Policy) have been implemented and continue to be developed.

In 1989 TCM was strengthened by the Catchment Management Act. This landmark legislation, which was adopted with bi-partisan support, formally established TCM in the State's legislative framework. Importantly, it also brought the community into the TCM process by introducing a network of catchment management committees and trusts for the State's major catchments.

The Catchment Management Act defines TCM as:

> the co-ordinated and sustainable use and management of land, water, vegetation and other natural resources on a water catchment basis so as to balance resource management and conservation.

There are now 38 catchment management committees and trusts in almost every major catchment in New South Wales. (The notable exceptions are Sydney Harbour and the Lower Parramatta River catchment.) The aim of the committees is to coordinate community and government efforts to sustain our natural resources. The work of the people on these committees and trusts and many other TCM supporters is gradually developing a framework for achieving ecologically sustainable development, and common ground is being found for people of diverse interests to work together to overcome environmental and resource management problems. Already their work is being rewarded by early indications of better futures for waterways and catchments.

Under the Catchment Management Act catchment management committees and trusts have a broad range of responsibilities, including:

- Advising on and coordinating the natural resource management activities of authorities, groups and individuals.
- Identifying catchment needs and preparing strategies for implementation.
- Providing a forum for resolving natural resource conflicts and issues.

The New South Wales Government and the NWQM strategy recognise that community preferences in developing water quality goals can be expressed on a catchment basis co-ordinated through the agency of catchment management committees and trusts. In doing so

however, the widest possible view of 'community' is needed. Efforts must be made to ensure all who have an interest and wish to participate are able to do so.

A particularly open process was implemented for the community involvement processes in the Upper Parramatta River catchment to enable the widest possible views to be heard and considered. The Trust realised this was essential for community support for the decisions and outcomes.

The NQMW strategy provided policy directions and guidelines from a national perspective, and TCM and its component State policies and processes provided additional reference points. Through the co-ordination actions of the Trust, TCM also provided the foundation philosophy and principal for the Streamly Clean project.

Once the strategy and associated action plan are approved the TCM activities of the Trust will provide the coordination framework for implementing and delivering the programs, projects, products and services necessary to achieve the improved levels of water quality.

3.3.3 The Trust and the Project Steering Committee

The Upper Parramatta River Catchment Trust initiated the Streamly Clean project under its statutory responsibilities for mitigating the impacts of deteriorating water quality and its general responsibility for coordinating TCM in the catchment.

After the Trust endorsed the project to develop a water quality management strategy, a steering committee was formed with members representing each of the four councils in the catchment, state government agencies, and interest groups. The steering committee supervised the development and tendering processes for the consultancy brief to undertake the project and oversaw the entire process. Steering committee members are listed in *Appendix II.*

Total Catchment Management Services Pty Ltd in association with J.D. Court and Associates and GAMTRON Pty Ltd were the successful tenders and started the project in September 1994. On the recommendation of the consultancy, membership of the steering committee was immediately broadened to include three members of the catchment community.

3.4 The community involvement processes

3.4.1 Breaking the catchment into management segments

The project started by involving government agencies and local government in the collation of water quality data. The need was to obtain a sufficient understanding of the catchment to split it into logical segments. The nature of the catchment, water quality uses, and the presence of communities of common concern were all considered, in addition to water quality.

For effective and appropriate local community involvement four segments were chosen on a sub-catchment basis—Toongabbie Creek, Darling Mills Creek, Lake Parramatta (Hunts Creek down to the reservoir wall) **)** and Parramatta Park (from the junction of Toongabbie Creek to the Charles Street Weir).

3.4.2 The blueprint document

After an initial overview and analysis of the early available water quality data a document outlining the project, its proposed community involvement processes, and a summary of water quality throughout the catchment was distributed in the community. The eight page, community-orientated brochure, *Getting our creeks in better shape*, was well received and supported by press and radio coverage. Maps showing water quality appeared in all papers of the Cumberland Newspapers group circulating in the catchment, a circulation in the order of 200,000.

The brochure, which may be found at the back of this report, described the proposed approach and sought the catchment community's comments and support. It identified the four sub-catchment units for community involvement. It outlined proposed time frames, the anticipated products and outcomes expected from the process of setting water quality objectives, and suggested opportunities for involving the community.

Getting our creeks in better shape and associated publications used specially designed Icons© depicting standard uses and enjoyments under the NWQM strategy. These Icons© assisted clearer communication with the community of the range of values and enjoyments they were to consider. For the first time the condition of creeks throughout the catchment was conveyed to communities in an understandable way. To balance the 'bad news' initial ideas on plans to overcome declining water quality were proposed.

3.4.3 Community reference groups

Community reference groups were formed for each catchment segment. The role of these groups was to discuss ideas, issues and proposals for water quality management and advise the steering committee on development of the strategy and associated action plan. People able to represent community views, take a commonsense approach, work with others and make a positive contribution to the process were encouraged to join through advertisements and newspaper and radio reports. Fliers inviting people to register for a community reference group were distributed throughout the catchment. People with some familiarity of the issues affecting water quality and the ways improvements could be made were also most welcome to join. All applicants were accepted, and most of those who joined were able to continue their involvement throughout the project.

The reference groups made important contributions to the project. Although initial numbers for each group were quite low, membership grew as the project continued and generally peaked at the critical final meetings when water quality goals and cost implications were considered. Details of community reference group activities are given in Chapter *5*.

3.4.4 Streamline newsletter

Considerable use was made of the Trust's newsletter *Streamline* to communicate with the catchment community. Information was conveyed to the community every three months. Surveys were included in the newsletter, which is delivered to about 70,000 households.

3.4.5 Media liaison and support

Cumberland Newspapers, whose three regional newspapers cover the entire catchment, gave valuable support. Throughout the project, many articles about Streamly Clean and the water quality monitoring work were published, covering the aims of the project and its findings, and human interest stories arising from the community reference groups and the community surveys.

Opportunity was taken to regularly discuss the project on Radio 2CCR FM during the Trust's regular program, and the station also made regular announcements on the project and forthcoming community reference group meetings during other programs.

3.4.6 Signs

At important milestones 100 large signs were placed in parks and along paths and roads adjacent to creeks informing people each time the community was surveyed and providing information about project activities and outcomes. Signs were also put up when the recommended uses and enjoyments were finalised and the options of how to achieve them were being considered by the community.

3.4.7 School student involvement activities

Catchment-wide schools competitions

Primary and secondary pupils in all schools in the catchment were involved from the outset by inviting them to participate in competitions.

A cartoon illustration of a frog was adopted by the steering committee as project logo. Infant school pupils were asked to colour the logo in competition entry forms sent to each school and printed in local papers. Primary pupils were asked to name the frog, and secondary pupils were invited to provide a community-friendly name for the project—then still termed the Upper Parramatta River Water Quality Strategy.

Hundreds of entries were received in each category and they were of such high standard that deciding the winners was difficult. Kate Hanson (Class 1 B) Northmead Primary School won the colouring competition, Keira Bailey (Class 6B) Winston Heights Primary School won the name-the-logo prize with *Gunkfree* the frog, and Michelle Houston of Catherine McAuley Girls' High School the senior prize with *Streamly Clean* for the project title. Cash prizes of $20, $30 and *$50* were given by the Trust to each winner and were presented at special school assemblies. The local press reported the awards, providing an important early community focus on the project. *Gunkfree* and *Streamly Clean* were extensively used and were well received by the community.

A second series of student competitions was undertaken to facilitate an additional community focus on the Streamly Clean project while the Options Paper was being considered by the catchment community.

Separate competitions involving drama, photography, poster design and public speaking were held and well supported by schools from throughout the catchment. Prizes were awarded for

first, second and third winning entries and consisted of Streamly Clean shirts and caps and cash awards.

Shopping Centre Surveys

Returns from the first community survey of past and present uses and enjoyments indicated strong support for cleaning up the creeks. When options for the second survey, to identify future desirable uses and enjoyments of creeks were considered, it was agreed that a similar approach alone might produce results which did not truly reflect the full spectrum of community opinion. It was decided to undertake a series of shopping centre surveys to provide a more objective and broader indication of community-desired uses and values, and their water quality goals. On the basis of high consistency in replies between shopping centre surveys and postal returns in the second survey, the steering committee decided postal returns were a sufficiently good indicator of community views for the third survey.

Shopping centre surveys were conducted by Streamwatch students from eight high schools. They were instructed in basic survey techniques and conducted more than 300 surveys in eight shopping centres and recreation locations. Results of these surveys are in Chapter *5*.

3.4.8 Survey of current and past values and uses

An early catchment-wide community survey was undertaken in November 1994 to identify existing environmental values and uses and increase awareness. The survey provided the steering committee and each community reference group with a clearer and fuller picture of environmental values and uses of the stretches of waterways within their segments.

The survey also identified past values and uses and described significant differences between these and the present values and uses. It assisted in an understanding of why values and uses have changed over the years. Chapter *5* contains details of this survey and its results.

3.4.9 Survey of future desirable values and uses

The second catchment-wide survey in March 1995 (the survey undertaken by shopping centre interviews and delivering questionnaires to all households) was undertaken to ascertain the level of water quality which people in each segment want to protect and enjoy now and in the future, consistent with the sustainable needs of the wider catchment. As well as identifying the desirable uses and enjoyments of creeks, the survey sought to identify the level of community concern for water quality management issues compared with other environmental issues, and to gain an indication of present and potential levels of community involvement.

Almost 1,200 people were involved in the face-to-face and written surveys. Clear indications of the desirable future values and uses were obtained. Details of this survey, with its results and implications, are in Chapter *5*.

3.4.10 Release of options paper

In November 1995 a third and pivotal catchment-wide survey was undertaken to confirm a community preferred option. Each of the options presented combined a different level of water quality with financial contribution per household to achieve that level of water quality.

Detailed results of this survey are presented in Chapter *5.* Approximately 2000 surveys were returned with a clear indication of the desired level of water quality and the preparedness to pay. On the basis of this survey the steering committee recommended the preferred set of water quality goals to the Trust for adoption as the community-endorsed, integrated set of water quality goals for the catchment. The Trust then made its recommendation to government for likewise endorsement.

3.5 Water quality data management

The NWQM strategy highlights the importance of basing initial and continuing management decisions on sound water quality data and catchment assessment information. It acknowledges the general deficiency of water quality data in Australia.

Water quality monitoring should *(Policies and Principles Reference Document, NWQM strategy, p.23):*

- Guide management decisions
- Evaluate trends
- Assess effectiveness of the program
- Identify problems.

All these apply to managing the waters of the Upper Parramatta River. Unfortunately, monitoring in catchments is rarely designed to satisfy these specific purposes, but rather tends to evolve in response to a range of interests and needs over a period. This has been the case with the Upper Parramatta River catchment.

The task of analysing water quality data in the catchment was substantial, and a parallel contract was let to GAMTRON Pty Ltd and J. D. Court and Associates Pty Ltd to collect, rationalise, analyse and assess the data and to develop water quality models useful for management purposes. The contract required the data to be entered into an electronic base suitable for further analysis and for comparison with the identified water quality objectives. The results of this project are described in the complementary report *Water Quality Data Analysis and Modelling.*

Water quality is managed primarily to protect certain values or uses of the waters. These are described as the water quality goals, but the goals must be related, wherever possible, to clearly measurable levels of the indicators of water pollution. Environmental quality can be realistically managed only against these clear benchmarks and limits.

The appropriate indicators for protecting community-preferred ecosystems can be selected from the *Australian Water Quality Guidelines for Fresh and Marine Waters* developed under the National Strategy, and by the process in *Appendix I.* Using the common values in the guidelines ensures that all Australians and all Australian waters enjoy the same level of protection for similar values and uses.

For the purposes of assessing and analysing the water quality of the Upper Parramatta River catchment a set of likely goals was identified early in the Streamly Clean project and a corresponding set of water quality objectives were derived. These were based on the guidelines and the practical considerations of availability and extent for the catchment.

The detailed derivation of these objectives is described in the *Water Quality Data Analysis and Modelling* report, to which reference might be made for further understanding of the process and limitations. Key indicator (water quality objective) parameters, identified for consideration from the goals selected, should be considered in analysis of monitoring data as:

- Faecal coliform (fc) organisms for primary contact recreation for secondary contact recreation
- Dissolved oxygen as percent saturation for ecosystem protection
- Total phosphorus for ecosystem protection for primary contact recreation
- Total nitrogen for ecosystem protection for primary contact recreation
- Total ammonia (as NH3) for ecosystem protection
- Toxicants (heavy metals and pesticides) for ecosystem protection

For the many other parameters specified in the Australian Water Quality Guidelines (see appendix in *Water Quality Data Analysis and Modelling)* there are either no useable data or the parameters are not relevant to this catchment.

4. Current Water Quality in the Catchment

4.1 Collecting the water quality data

4.1.1 Sources

A survey of all possible custodians of present and historical water quality data in the catchment was undertaken initially. From these identified sources data were collected from the sources below, categorised according to methodology employed and level of operator involved. Thirty eight sites were identified.

Professional Laboratories

Department of Land and Water Conservation (formerly Department of Water Resources):

- regular physical parameters
- two locations
- since 1977

J.H. & E. S. Laxton, on contract to the Upper Parramatta River Catchment Trust:

- monthly analyses of major physical, chemical and microbiological parameters
- four locations at the outflows of major sub-catchments of the Upper Parramatta catchment
- since 1990

Sydney Water:

- wet weather sampling only on an investigation basis
- one location at the major outflow from the catchment
- since 1991

Roads and Traffic Authority (W. S. Rooney and Associates under contract using AWT Sydney Water laboratories for analyses), specialist base-line monitoring associated with the construction of the M2 Motorway:

- a full range of physical chemical and microbiological parameters, including some data on heavy metals and pesticides
- four locations in the body of the catchment during five months in 1994

Local Government

Baulkham Hills Shire Council:

- a limited range of tests (kit) of physical, chemical and microbiological parameters
- four locations in the Darling Mills Creek sub-catchment

Blacktown City Council:
- a limited range tests (kit) of physical, chemical and microbiological parameters
- three locations in the Toongabbie Creek sub-catchment

Holroyd City Council:
- a limited range tests (kit) of physical, chemical and microbiological parameters
- one location in Pendle Hill Creek

Streamwatch—high schools

These high schools have participated in the Streamwatch sampling program using kits tests for a limited range of physical, chemical and microbiological parameters since 1993:

- Catherine McAuley, Cumberland, Crestwood, Girraween, Greystanes, Marist Brothers, Merrylands, Model Farm, Muirfield, Seven Hills.

4.1.2 Sites

Thirty seven sampling stations were identified, spread throughout the upper catchment. They are identified on a diagrammatic representation of the catchment in *Figure 3* from the complementary *Water Quality Data Analysis and Modelling* report, included here for convenience.

Most of the more reliable data are grouped around the discharge end of the upper catchment, with the exception of the special purpose Road Traffic Authority monitoring.

4.2 Processing the data

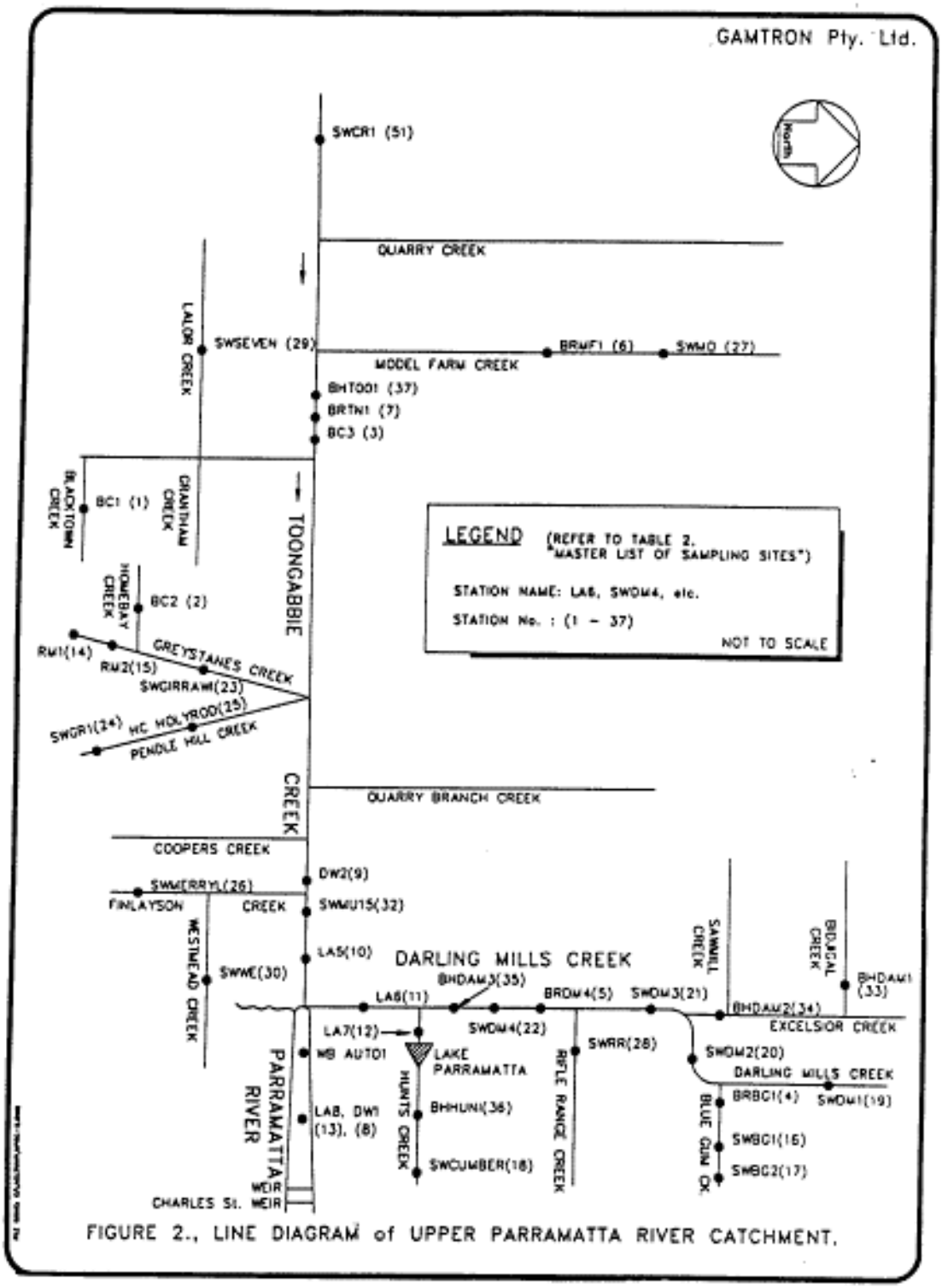


FIGURE 2., LINE DIAGRAM of UPPER PARRAMATTA RIVER CATCHMENT.

Figure 3. Line diagram of Upper Parramatta River Catchment showing water quality sample site distribution. (GAMTRON 1996)

4.2.1 Entry and normalisation

The data were entered into the electronic data base, converting to consistent units where necessary. Considerable effort was necessary to clarify the reporting units for each location. Much data was provided in electronic format, but capture to the data base used also required considerable effort. Daily and four-day antecedent rainfall data were also entered to the data base for 1979—1 995.

This data base is a valuable tool in its own right for future analysis of catchment water quality and provides a basis for design of a management of monitoring information/frameworks.

4.2.2 Statistical testing

The data was subject to statistical analysis to determine population distribution, spatial variation between stations and basic statistics.

4.2.3 Assessing methodology

An assessment has been made of the methodologies used by the various monitoring bodies for each major parameter. Generally, reliability was ranked as government professional laboratories, independent professional laboratories, council officers using testing kits and school students using Streamwatch kits.

Phosphorus, nitrogen and turbidity readings by the kit methods in particular appear to have limited value for these waters because of their lack of sensitivity in the range of concern.

4.2.4 Reduced data sets

A reduced data set was established for assessing compliance with likely water quality objectives. Total phosphorus and nitrogen data from the kit tests were removed, as were all days on which rainfall was recorded on the day or in the antecedent four days.

4.3 Identifying objectives

The water quality objectives against which the data sets have been compared for compliance are described in Section 7.2. A detailed derivation of these objectives or ‘limits’ is given in the companion *Water Quality Data Analysis and Modelling* Report.

4.4 Compliance with objectives

The general compliance of the data on a sub-catchment basis has been summarised as comparison of averages (geometric means and medians) in *Table 1.*

Table 1: **Compliance of Average Levels with Objectives**

ENVIRON VALUE →	AQUATIC ECOSYSTEMS				RECREATION
OBJECTIVE = COMPLIANCE LIMIT →	Dissolved oxygen %	Ammonia mg/L	Total Nitrogen mg/L	Total Phosphorus mg/L	Faecal Coliforms no./l00mL
type of mean →	geometric	geometric	geometric	geometric	median
TARGETS:					
a) desirable	a) 80-100%	a) 0.9	a) 0.5	a) 0.05	Primary: median <150 80%ile <600
b) tolerable	b) 60-100%		b) 0.75	b) 0.1 (lakes 0.05)	Secondary: Median <1000 80%ile <4000
CREEK ↓	↓				
Darling Mills	67	0.19	0.85	0.08	Med = 200 80%ile 420
Blue Gum	86	0.05	0.91	-	Med = 110 80%ile= 716
Hunts (Lake)	62	-	0.36	0.05	Med = 265 80%ile = 890
Toongabbie	40	0.19	1.04	0.09	Med = 282 80%ile = 483
Greystanes	109	-	-	0.05	Med = 127 80%ile = 440

It is apparent from the last column that the waters in the major sub-catchments are generally not suitable for primary contact recreation in dry weather. Median faecal coliform values of 200 and 282 for Darling Mills Creek and Toongabbie Creek respectively suggest, however, that an approximately 50 per cent reduction of bacterial loads would bring these creeks to a state which would permit swimming. It is encouraging that these two creeks appear to already be in a condition that permits secondary contact recreation.

Considering the indicators for aquatic ecosystem protection, it is apparent that the major catchments are under some stress, although it is encouraging that the extreme degradation often encountered in low-flow urban creeks (most often characterised by completely de-oxygenated water) is not apparent. Neither creek is significantly stressed by toxic ammonia. Oxygen demand stress and nutrient (eutrophic) stress is, however, apparent, in both creeks, the greatest in Toongabbie Creek.

A 50 per cent reduction in stress (measured as oxygen demanding load) would appear to be needed to bring Toongabbie Creek to a tolerable level for oxygen stress and Darling Mills Creek to a desirable level. A 50 per cent reduction in stress would also appear to be necessary to bring both sub-catchments to a desirable level for nutrient stress.

Several of the smaller tributary creeks appear to be in better condition than the main creeks for both ecosystem and recreation status. The limited data available for these indicators cautions however against drawing firm conclusions.

Compliance as a percentage of time is considered in the *Water Quality Data Analysis and Modelling* report, although it is considered less relevant for management decision purposes.

Inadequate data are available for any realistic assessment of the impact of toxins. The few data which do exist (RTA for M2 Motorway) suggest that heavy metals probably do not present a problem, but some pesticides may. This is important for protection of ecosystems and for recreational fishing in the catchment. Studies of these materials in the water column, in sediments and in the flesh of aquatic organisms are needed to establish a clearer picture.

4.5 Conclusions indicative rather than definitive

It must be stressed that the monitoring data taken as **a** whole are adequate to gain a fair indication of water quality in the catchment, but are inadequate as a basis on which to make operational decisions. In other words, the general trend of water quality for those indicators tested should be sound, taken as a whole, but the level of quality control and quality assurance is not adequate to have confidence in decisions on detail in individual sub-catchments at specific points in the water body. Management planning decisions about the degree of reduction to achieve the objectives can be confidently made, but decisions about use of waters now for primary or secondary contact in specific locations will require a greater degree of assurance than the present data set carry.

Recommendations are made in the *Water Quality Data Analysis and Modelling* report for improving the level of quality assurance and quality control for the existing monitoring framework.

4.6 Correlations

Extensive correlation between all variables was undertaken and is reported in *Water Quality Data Analysis and Modelling.* Few useful correlations flowed from the analysis, apart from the obvious ones—the various forms of oxygen, phosphorus and nitrogen anolytes correlated. Surprisingly, there appeared to be little correlation between specific pollutants and wet weather, except for those observed by eye for toxins.

A full analysis of the data set in its complete and reduced form is available electronically for study.

5. Water Quality and the Community

5.1 Background

The history of the Upper Parramatta valley is inextricably linked with its creeks and rivers. Aboriginal people centred many of their activities on the river and creeks, which the City of Parramatta recognises with its emblem of an aboriginal warrior astride the creek.

With early white settlement the importance of the river and creeks increased as the district became the food producing centre of the colony, before settlement of the Hawkesbury valley. As has commonly been the case with modem human endeavour, it did not take long for development and landuse change to affect the creek system.

By the year 1800 the colony's first woollen mill had been established on Darling Mills Creek which discharged its effluent directly into the creek. Over the next *150* years the townships, industries and agricultural industries all continued to develop. By the early 1960s Sydney had pushed well into the catchment and the Hills District became the new urban growth area. The catchment is now virtually fully developed with housing, industry and infrastructure, although several significant open space areas remain. The creeks and their associated open space areas and bushland are important areas for community recreation and respite.

5.2 Past and present values and uses

5.2.1 Aims

To provide the catchment community with an early opportunity for involvement in the Streamly Clean project and to increase awareness and discussion on water quality, a catchment-wide community survey was undertaken in November 1994.

The survey aimed to provide an indication of the various past and present environmental values (uses and enjoyments) of local creeks and provide an avenue for people to express their views on water quality issues and their management. The survey also established further community links with the project by identifying those people who wanted to receive regular communiques and those who wanted to become members of community reference groups.

5.2.2 The survey process

The survey and return forms used the specially created Icons © which depict various standard uses and enjoyments under the National Water Quality Management (NWQM) Strategy. The Icons © helped to more clearly communicate to the community the possible range of creek and waterway uses and enjoyments they might have now or had in the past.

Past and present uses included in the survey were:

- Swimming
- Playing and recreation
- Canoeing and boating
- Fishing.

Past and present enjoyments were:
- Plants and animals that live in the creeks
- Plants and animals that live along the creeks
- Looking at the creeks
- Living nearby or knowing the creeks are there.

As previously discussed, all except the last enjoyment, living nearby or knowing that the creeks are there, related to a NWQM Strategy standard. This final enjoyment, often termed 'existence value', is not listed under the national strategy, probably because the water quality parameters which relate to this value are not specific and relate to the listed values and other broader environmental values as well. National standard uses and values are described more formally in the national strategy. The terms in the strategy were replaced by those above so they could be more effectively explained to the community. The particular NWQM Strategy terms are listed below for the uses and enjoyments in the Upper Parramatta River catchment.

- Swimming (primary contact recreation)
- Playing and recreation (secondary contact recreation)
- Canoeing and boating (secondary contact recreation)
- Fishing (edible fish protection).

Past and present enjoyments were:
- The plants and animals that live in the creeks (general ecosystem protection)
- The plants and animals that live along the creeks (associated wildlife protection)
- Looking at the creeks (visual amenity and protection)

Surveys were distributed throughout the catchment to households with the Trust's newsletter *&Streamline.* The survey was published also in local newspapers. Residents were asked to return the survey by mail or fax to the Trust, or they could telephone the Trust with their response. Survey forms required residents to tick uses and enjoyments and show on an attached map the general locality of these activities. Past and present uses and enjoyments were shown separately on the form. The survey sought information on how long people had lived in the area and respondents were able to indicate whether if they wanted to receive the next survey and more information on the project, their community reference group or the Trust.

5.2.3 Survey results

The detailed results of the survey are presented for the total catchment and for each segment in *Appendix III.* This is an overview of the main findings:

One hundred and thirty survey forms were returned, representing only a very small percentage of those sent out. However this small sample was considered sufficient to provide a broad indication of community uses and enjoyments for discussion with the community reference

groups and the steering committee. The committee and the reference groups supported the general findings and there were no contrary views when the survey results were published in *Streamline* and local newspapers.

Nearly two thirds people who responded to the survey by returning the forms or by telephoning indicated they gain value or enjoyment from looking at the creeks and living nearby, knowing the creeks are there. Significantly, many of the catchment community's particular uses and values had declined markedly over the years.

In the past for example:

- More than half *(54* per cent) of those who responded once used the creeks for playing and recreation
- Almost a quarter (24 per cent) indicated they or members of their family once swam in the creeks
- More than 1 in 10 (14 per cent) said they once swam, fished, or went canoeing in parts of the catchment.

At present:

- Fewer than one-third (30 per cent) of these people use the creeks for playing and recreation
- Very few of them (2 per cent) swim in the creeks
- Considerably fewer (5 per cent) use the catchment for fishing, and canoeing (1 per cent).

The many comments in the survey make it clear that declining water quality is a prime cause of these changes. People are very concerned about the condition of the creeks and the quality of the creek water. Residents are using creeks less and obtaining fewer benefits from them because they perceive they are not as clean and healthy as they were. The survey also showed that when it came to local conservation issues the creeks were of great importance.

Approximately 60 per cent of respondents said they once enjoyed the plants and animals living in the creeks and along the creek corridors. This level of enjoyment has declined significantly. Only 38 per cent said they are now able to enjoy the plants and animals living in the creeks. Poor water quality was commonly mentioned as a main reason for this.

Residents of the catchment for up to five years accounted for 10 per cent of returns and residents for more than 10 years for 78 per cent. This differing response indicates a greater interest and concern among longer-term residents. A number of longer-term residents recounted their experiences swimming and fishing in their local creeks. Some residents described the myriad yabbies, fish and even platypus which once lived in the Upper Parramatta River catchment.

Overall response was very supportive of the Streamly Clean initiative. Many respondents asked for information and the next survey.

5.3 Desirable uses/enjoyments and likely support

5.3.1 Aims

Once the technical components of the project had identified present water quality levels in the catchment (see Chapter 4) the next step was to identify the water quality the community would like in the various catchment segments. The results of this survey were pivotal in that they would set goals for the ensuing action plan.

5.3.2 Survey procedures

Water quality goals were identified by surveying the community and asking it to identify desired uses and enjoyments. To secure more involvement a post-free return system was used. Three hundred face-to-face surveys were made by Streamwatch students trained in survey techniques and wearing specially printed Streamly Clean T-shirts and caps.

The Streamwatch students surveyed residents in shopping centres and waterway recreation areas. Seven localities, including five shopping centres, selected because they serviced communities completely within the catchment, were chosen: Stockland Mall (Baulkham Hills), Westfield (North Rocks), Northmead Plaza, the Hills shopping centre (Seven Hills), and Wentworthville shopping centre. Lake Parramatta and Parramatta Park were the two recreation areas.

The face-to-face and written surveys asked residents to identify the uses and enjoyments they would like to have available if water quality was improved. Respondents were required to tick the standard Icon © and indicate on the survey form or to the interviewer the area where they would like to enjoy or use the creeks. They were given the opportunity to indicate other uses or values, but no additional uses or enjoyments were recorded.

To help with the development of the action plan, people were asked to identify whether they or their families had changed any aspects of their behaviour for environmental reasons in the past five years. Indications of likely levels of community support for the action plan were sought by asking:

If you were aware that local resources were going directly towards improving water quality in local creeks and the river, would you be prepared to:

- Change the way you do things in the home and garden
- Do some hands-on work (say a couple of half days a year planting trees/clearing up creeks! etc)
- Support a greater ratio of existing rates and taxes being spent on local creeks and less on other issues and projects
- Contribute an extra $5 per year
- Contribute an extra $10-$20
- Contribute more than $50 per year

To confirm trends in the previous survey about the level at which people viewed creek and river pollution, residents were asked which of the following were the most important issues in their locality: household waste and garbage, creek and river pollution, loss of bushland, or litter and dumping of rubbish.

As with the previous survey, opportunity was taken for people to indicate their desire to receive further information on water quality in the area, the results of the survey and the Streamly Clean strategy as it is developed.

5.3.3 Community survey results

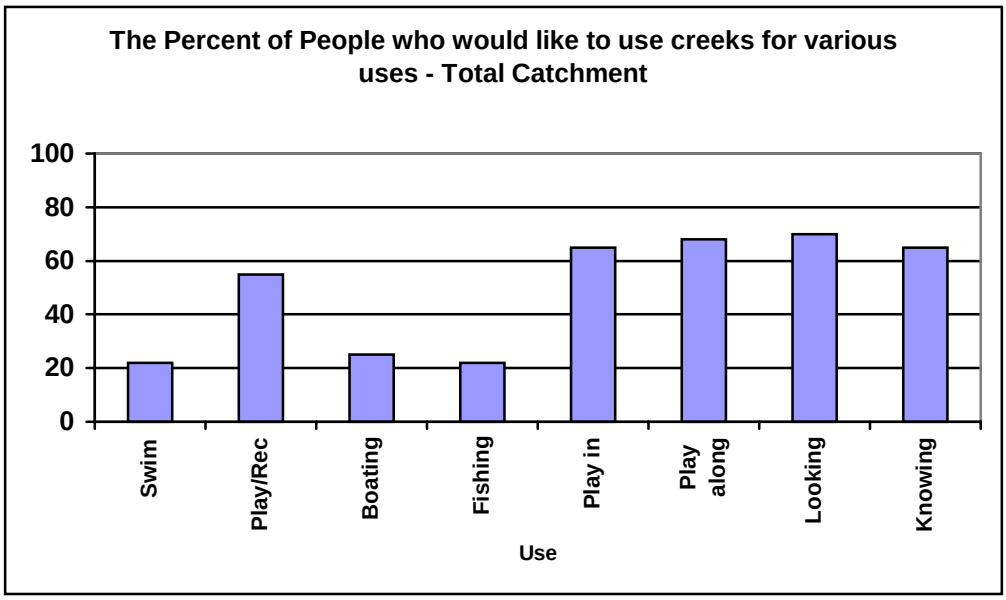
In total, more than 1,100 surveys were completed by members of the catchment community. Approximately 800 written surveys were returned using the post-free system and 300 face-to-face surveys were completed by the Streamwatch students.

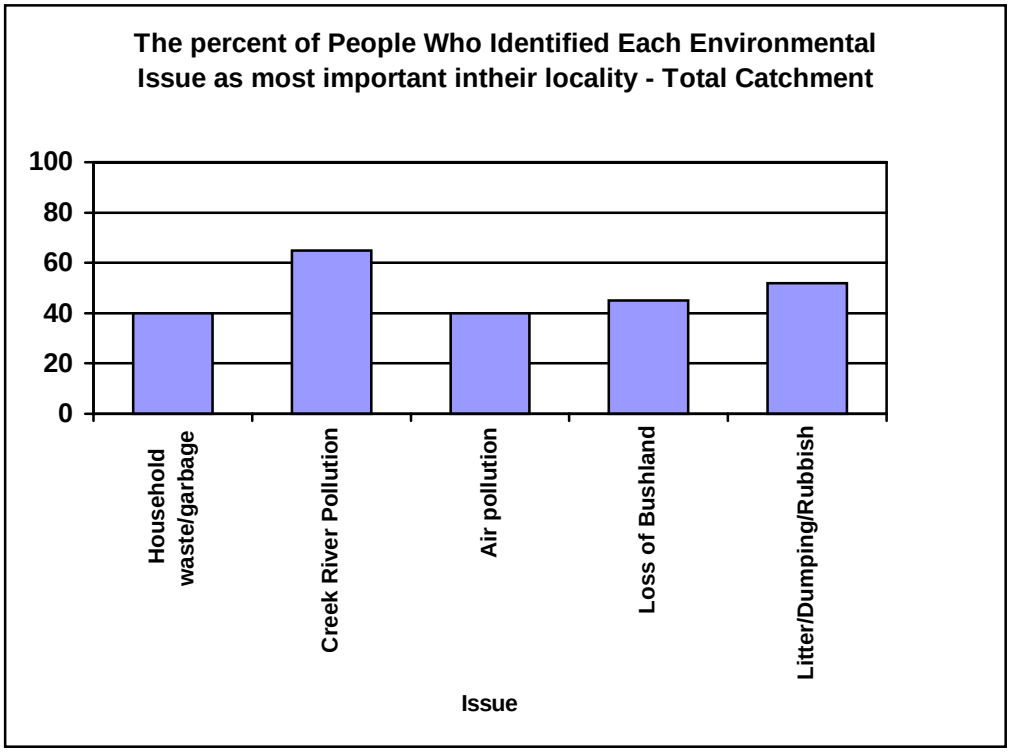
The results of the community survey of desirable environmental values for the total catchment are shown in *Figure* 4. The complete results, including those for each segment, are presented in *Appendix* IV. The figures are presented as histograms of the percentage figures of total returns. The numbers of surveys completed for each segment were: Toongabbie Creek 482, Darling Mills Creek 322, Lake Parramatta 138, and Parramatta Park 98. The main results are briefly discussed below.

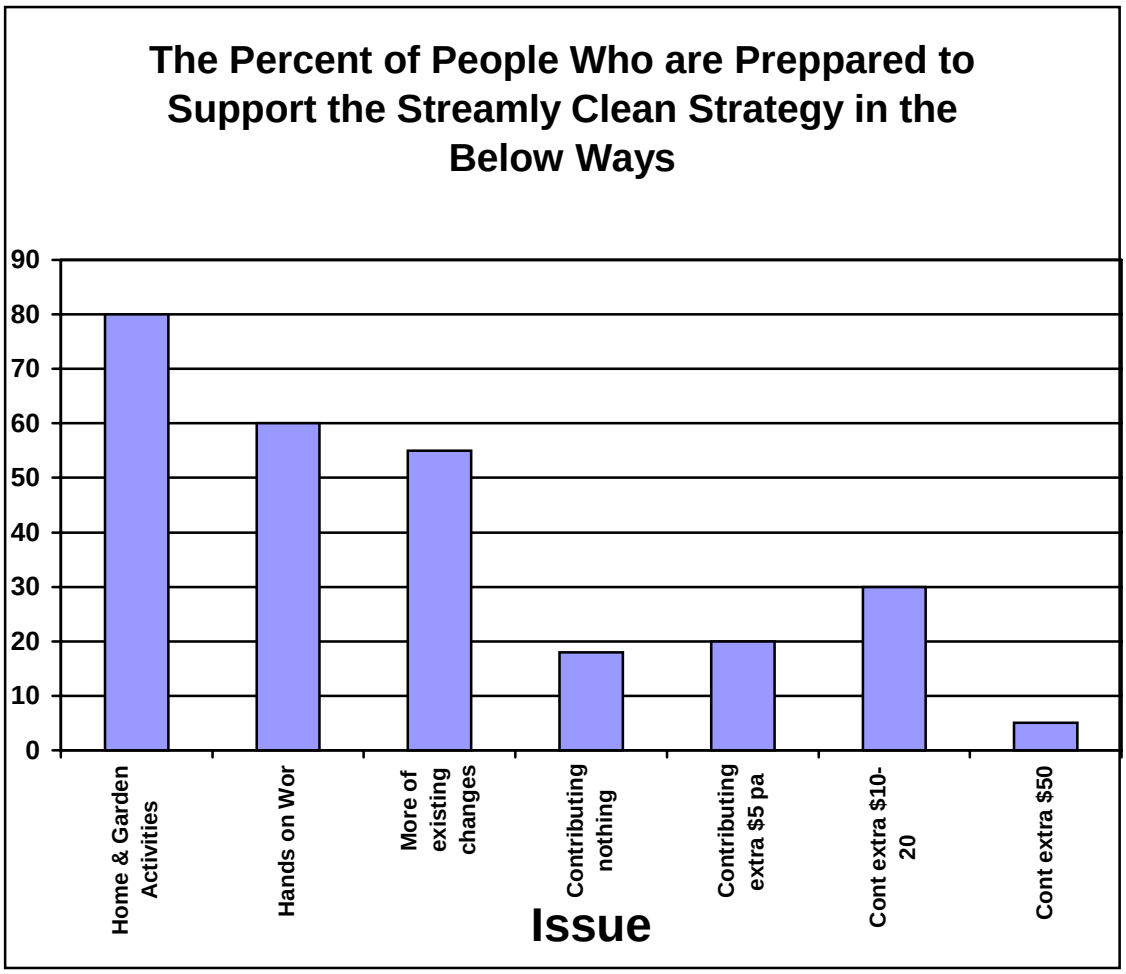
Community desired enjoyments

Eight hundred and seventeen people from the whole catchment (76 per cent of survey returns) indicated that if the water quality was suitably improved they would enjoy looking at and walking beside local creeks. This community environmental value was also unanimously most preferred in all segments with the percentage of returns ranging from 75 per cent in Toongabbie Creek segment to 83 per cent in Lake Parramatta segment.

Figure 4. Results of Total Catchment Survey of Community Desired Uses and Enjoyments and Likely Support.






The Percent of People Who are Preppared to Support the Streamly Clean Strategy in the Below Ways
90
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
Contributing extra $5 pa
Cont extra $10-20
Cont extra $50
Issue

The visual amenity of the creeks and their associated environments are obviously important, with almost eight out of ten respondents indicating a desire to share in this enjoyment if water quality is suitably improved. The existence of the creeks is important to local people, as indicated by the two thirds (67 per cent) of survey respondents who stated they would simply enjoy living near the creeks and knowing they are healthy.

The plants and animals living in and along the creeks was the next most desirable enjoyment identified in the whole catchment and within each segment. Sixty nine percent of all respondents said if water quality was suitably improved they would enjoy the plants, and 70 per cent said they would enjoy the animals living in and along the creeks. Figures were consistent throughout the catchment and differed by only up to 7 per cent, in Toongabbie Creek 74 per cent for the animals, and 76 per cent for the plants in the creek and those living along the creek corridors.

Community desired uses

Recreation is by far the most desired community use of creeks and waterways in the catchment. More than half (56 per cent) of respondents indicated that they or their families would use creeks for recreation if water quality was good enough. As with all the desired uses identified, the percentage of people desiring each use ranged very little between the four segments and the overall catchment. The percentage of respondents who desired to use the creeks for playing and recreation ranged only between 54 per cent and 70 per cent, the highest proportion of respondents from Lake Parramatta segment.

Canoeing and boating was the next most preferred use throughout the whole catchment, desired by 29 per cent of all respondents. Toongabbie Creek (27 per cent) and Darling Mills Creek (31 per cent) parallelled the results for the total catchment. Almost half of the respondents in Parramatta Park (47 per cent) and Lake Parramatta (46 per cent) however wished to use these areas for canoeing and boating if water quality was sufficiently improved.

Fishing throughout the local catchment was the next most desired use, with 26 per cent of all respondents indicating a desire to fish. Responses varied little between the segments. Darling Mills Creek had the lowest response (20 per cent), Lake Parramatta the highest *(25* per cent). This response was interesting because the previous survey indicated that few people fish in local creeks.

Twenty four per cent of respondents indicated that they would like to swim in local creeks. Toongabbie Creek (21 per cent) and Darling Mills Creek (24 per cent) segments reflected the overall catchment response. Lake Parramatta (39 per cent) and Parramatta Park *(35* per cent) segments however showed a greater interest in this potential use.

Locally important environmental issues

When asked to identify which of the issues were the most important in their locality, more respondents rated creek and river pollution as more important than any of the other five listed issues. Two thirds (66 per cent) of all respondents listed creek and river pollution as important compared with litter and rubbish dumping *(50* per cent), loss of bushland (49 per cent), household waste and garbage (41 per cent) and air pollution (40 per cent).

Between each segment there was again a high level of consistency. Generally, the percentages of respondents who rated each issue as important ranged within several percentage points of the above total catchment returns. Only a few issues in several segments varied up to 5-10 per cent from these overall figures.

Indicative community support for strategy components

A high level of support was indicated for various potential components of the Streamly Clean action plan. *Table 2* on the following page shows percentages of respondents who, when asked if they were aware that local resources were going direct to improving water quality in local creeks and the river, indicated they would be prepared to undertake certain responses. The range of percentage for the catchment segments are shown in brackets after the total catchment figure.

5.4 Broad options for meeting the community's desires

Some broad options are considered here and some initial approximate costings developed as a guide for answering the question in the 'cycle of choice and consequence', section 3.2.z, 'What does it mean and cost?' It is stressed that these are broadly identified and costed options, resting not on engineering designs but on a quick review of opportunities in the catchment and some indicative costings by comparison with similar works.

Table 2: **Percentage of respondents who indicated support on the proviso that they were aware local resources were going direct to improving local creeks and the river.**

Strategy Support	Total Catchment	Segment Range
Change the way they do things in the home and garden	80%	76%-84%
Do some hands-on work along the creeks	62%	59%-66%
Support a greater ratio of existing rates and taxes being spent on local creeks and less on other issues and projects	58%	54%-64%
Contribute an extra $5 a year in rates/taxes	23%	23%-30%
Contribute an extra $10-$20 per year in rates/taxes	33%	26%-37%
Contribute more than $50 extra a year in rates/taxes	8%	8%-12%
Contribute nothing extra a year in rates/taxes	18%	16%-19%

Again it is emphasised that the costings are developed only at the conceptual stage. Before any work is assessed or decisions are made for construction it is essential that engineering designs and firm costings are undertaken. For the purposes of testing community and authority reaction to a range of options however, these costings should expose the order of magnitude of the consequences of the choices, the essential consideration at this stage of catchment management.

5.4.1 Extent of control needed

The comparison of the existing water quality with the short list of objectives outlined in section 4.4 above and, considered in greater detail in the complementary report *Water Quality Data Analysis and Modelling*, indicate that an approximately 50 per cent reduction is needed throughout the catchment in the nutrients phosphorus and nitrogen, oxygen demand, and bacterial contamination as monitored by faecal coliforms. Various broad options are examined here for achieving this magnitude of reduction. The need for a reduction of this magnitude is encouraging because it should be reasonably achievable over a period. The question of cost is also considered in broad terms.

Nutrients and oxygen demand are caused by loss of sewage in wet and dry weather and by urban runoff. Bacterial contamination is contributed dominantly by loss of sewage in wet and dry weather. There is potential also for industrial and commercial effluents to contribute to the load but Environmental Protection Authority (EPA)-licensed sources in this catchment (quarries and swimming pool treatment plant backflush) are unlikely to contribute significant

amounts of these pollutants. Unlicensed discharges may be contributing and a scour of the catchment by EPA and council staff should be undertaken to ensure there are no undetected significant sources.

5.4.2 Reducing sewerage impacts

This consideration is based on preliminary discussions with Sydney Water on its program to manage sewerage losses. It requires confirmation and should be regarded as a tentative indication. The conclusions are those of the consultants and are not necessarily endorsed by Sydney Water.

Losses from the sewerage system can be considered in three parts for the -purposes of this report:

a) Dry-weather exfiltration (leakage) from the sewerage system on the property owners' side of the boundary trap.

b) Dry-weather exfiltration from the sewerage system up to property owners' connections (boundary traps).

c) Sewer overflows in wet weather.

In terms of responsibility a) is the property owners', and b) and c) are Sydney Water's, although ultimately all are paid for by the community.

In dry weather a) and b) are believed to be the dominant contributors to bacterial contamination. Consequently, these are the components which will need to be reduced to achieve the primary contact recreation objective in dry weather as considered in this report.

Sydney Water is developing a region-wide program to control sewer overflows which will have costs separate from those considered for dry-weather exfiltration control. Priorities for the sewer overflow program are likely to be set on a 'broader canvas' than the scale of the Upper Parramatta River catchment. Consequently, it was not judged appropriate to consider attempting to influence the priorities for this work in relation to improving wet weather sewer performance in this catchment. This timing and costing was left, for the purposes of this analysis, to be determined by Sydney Water and State agencies (EPA, Departments of Urban Affairs and Planning and Land and Water Conservation) and the Trust, as part of a wider metropolitan initiative.

Dry weather exfiltration can, however, be considered as catchment specific and is the dominant influence on dry-weather water quality. Approximately half the loss is believed to be due to a) and half to b) above. Sydney Water has technology which enables it to substantially reduce leaks on its side of the property owner connection. The figures assumed for these cost estimates are:

- A property with an assumed 20 metres of main sewer and 20 metres of on-property Sydney Water sewer

- The equivalent of 30 per cent of properties in older urban areas require treatment;
- About 75 per cent of the Upper Parramatta River catchment is older urban area
- There are 70,000 properties in the catchment
- The capital cost of one-off treatment would be amortised at 7 per cent over 30 years.

These figures result in cost of about $55 a year for each household in the catchment. This should achieve an approximately 50 per cent reduction in dry-weather bacterial loading, the target outlined above for achieving primary contact recreation quality in the whole catchment. (Contributions from pets and other domestic sources have been put aside for the moment as being less than one tenth of the total bacterial load.)

The results of the surveys and contact with community groups suggest that swimming is not seen as a particularly important use of catchment waters except in stretches such as Lake Parramatta and Parramatta Park where there is sufficient depth to swim. Consequently, another option was developed nominating Lake Parramatta as the natural swimming place for the whole catchment. To cost this option a proposal was developed for treating the sewers for dry-weather exfiltration in the much smaller Hunts Creek catchment, which discharges into Lake Parramatta. The cost was amortised as above and spread across the whole catchment. The result was a cost of about $3 a year for all households in the catchment.

5.4.3 Reducing urban runoff impacts

Considerable improvement can be achieved in urban waters by incorporating pollutant assimilation and filtration structures in drainage systems. These measures have been extensively described in urban runoff manuals. They achieve reductions primarily in the nutrients nitrogen and phosphorus, oxygen demand and litter. They can also reduce microbiological contamination, but no credit has been taken for this benefit in this assessment. Typical measures include

- trash racks to intercept litter
- wet detention basins (on-and off-stream) to trap and assimilate pollutants
- artificial wetlands to further assimilate pollutants.

All these can be developed attractively in conjunction with nature study facilities, bicycleways, picnic grounds and other opportunities for passive recreation. They have the distinct advantage over other ameliorative works of ‘showing something attractive for the money spent’, particularly if from rates or taxes.

A ‘first-pass’ set of such measures for the catchment was identified under the valuable guidance of Mr Peter Higgins of the Trust staff. Twenty-six locations where they could be applied were inspected and initial estimates of costs were made. These are outlined in *Appendix V* and would cost an estimated $8.4 million. If amortised over 30 years at 7 per cent interest the cost for each property in the Trust area is about $10 a year. An allowance for annual maintenance brings the cost to $11 a household a year.

Without undertaking detailed calculations, it was estimated these structures would achieve about one-third of the control needed to bring the catchment to an ideal level for ecosystem protection. It must be noted that much of the catchment is already at a tolerable level of quality for ecosystem protection.

It was then broadly assumed on the basis of this work that complete treatment of the catchment with such ameliorative measures would cost $35 a household a year.

5.4.4 Operational measures

A program to upgrade existing data collection and monitoring by better design and quality control was assumed to be essential for better management of catchment water quality. An allowance of $2 per household per year has been included for this purpose.

Education can reduce environmentally unfriendly practices such as littering, over-application of fertilisers in gardens, and the practice of leaving dog droppings in parks and streets. An allowance of $2 per household a year is proposed for this.

5.4.5 Combinations of options

All the above possibilities and costings were summarised and possible combinations developed. These showed a practical range of real choices for the catchment in terms of levels of water quality. No doubt other options could have been developed and there are, of course, degrees of treatment and attainment of water quality which could have been simplified for the purposes of choice.

In the subsequent discussions with the community reference groups the range of combination of options appeared to be adequate to allow useful discussion on the principal elements of the choices offered. Again it is stressed that the costings are preliminary and should be regarded as ‘order-of-magnitude’ only. An important aspect of the planned process for establishing a set of community and government endorsed water quality goals is the determination and advice of the cost implications and other changes involved in proceeding with strategies to achieve these goals.

The project steering committee considered each combination of options in detail and decided two additional components should be added:

- An extra $1 per household as an estimate of additional costs to meet enhanced surveillance of small industry by councils. It was noted that small businesses are often a source of short-duration illegal discharges of pollutants to creeks and that, because council staff are often too busy to inspect premises, extra funding for special-purpose inspectors is needed.
- A further $1 per household for rehabilitation of creek bank (riparian) vegetation in addition to that already provided for in the estimates for constructed wetlands. Although it was noted that riparian vegetation was not covered by the selected water quality indicators, its health is important for ecosystem protection and recreation use values. These funds would support a strategy to rehabilitate, plant and manage the riparian zone along the watercourses in the catchment.

The full list of cost components for possible consideration by the community is presented in the following table.

Table 3: **Cost of Alternative Goals and Action Plan Components**

Component Goal	**Cost**
1. Recreational	
a) swim in Lake Parramatta only	$3
b) swim everywhere	$55
c) Play/canoe everywhere (possible now)	-
2. Ecosystem Protection	
a) basins, wetlands, trash racks, litter - fair ecosystem protection (1/3 of ideal) plus a significant litter reduction component	$11
b) basins, wetlands, trash racks, litter - full ecosystem protection (to ideal level) plus a comprehensive litter reduction component	$35
c) education program	$2
d) extra industry inspections	$1
e) riparian vegetation strategy	$1
3. Operational Increment	
a) upgraded water quality monitoring	$2

Resolution of Arising Issues

- swimming in creeks throughout the catchment.

The community survey of desired uses and values, and advice from the four community reference groups provided the basis for the steering committee's determination of a feasible set of water quality options to present to the community for consideration.

The steering committee acknowledged that the survey showed community interest in swimming in Lake Parramatta and the Parramatta Park segments. Advice from the community reference groups was that in reality, except for Lake Parramatta, it might not be practical to encourage swimming in the catchment because there are few spots above Parramatta which are either deep enough or safe enough for swimming, regardless of water quality.

Making water quality throughout the catchment suitable for swimming would be expensive ($55 a household a year over 30 years) and would take a long time because repairs to leaking sewers throughout the catchment would be required. The steering committee decided it was

more feasible to concentrate on repairing sewers in the small Lake Parramatta segment and making it the freshwater swimming location for the catchment.

- Meeting the cost of fixing leaking sewers

There still remained the issue of who should meet the cost of repairing leaking sewers in the Lake Parramatta segment. This cost, when apportioned over the whole catchment was estimated to be $3 per household each year for 30 years.

The steering committee suggested the cost should be part of Sydney Water's Clean Waterways Program and Sydney Water advised consideration could be given to revising priorities in the program to accommodate clear community-endorsed water quality goals for Lake Parramatta developed through the Streamly Clean project processes.

The Clean Waterways Program may rehabilitate sewers in the rest of the catchment over some 20 years. Priorities for work in the entire Sydney Water area will be established on criteria including receiving-water sensitivity, size of sewage impacts compared to other sources, and the size and frequency of overflows. The standards will be determined by the EPA, government and the community.

The EPA aims to identify interim standards through a broad water quality goal-setting process. Until there are clearly defined standards Sydney Water is giving priority to areas which, like parts of the Upper Parramatta River catchment, suffer from dry-weather sewer leaks.

To help Sydney Water determine priorities for the rest of the catchment the steering committee decided to seek a clear indication of whether the community wants to swim in the upper Parramatta River or not, and this was done in the final survey. If the community did not express a strong desire to swim in other parts of the catchment, Sydney Water would be asked to give priority only to repairing sewer leaks in the Lake Parramatta sub-catchment.

5.4.6 The options presented to the community for consideration

Three water quality options were presented to the community for its consideration as a result of all these considerations:

Option A – Deferred Cost Option

(No additional financial cost arising from no extra activities to improve water quality)

Under this option:
- There would be no extra clean up of litter
- Nothing more would be done to protect creek ecology
- It would not be safe to play in and along creeks in most of the catchment and in Lake Parramatta.

The community was advised that water quality would not improve: it would in fact would get worse; and that the Trust service charge of $24.70 a household a year would most probably decrease as flood works are completed, but with the need for maintenance.

Option B – Neutral Financial Cost Option

(No additional financial cost arising from progressive transfer of current Trust service charge to water quality improvement)

Under this option:
- There would be extra efforts to clean up litter. Works and measures would be undertaken to partly protect creek ecology.
- It would be safer to play in and along all creeks
- It would be safe to swim in Lake Parramatta during dry weather.

The community was advised that water quality would improve in 7-9 years and the above water quality goals achieved in 15-20 years. It was noted that the Trust service charge of $24.70 a household a year would be unchanged in real terms.

More funds would progressively go towards water quality improvements as flood works are completed, but with the need for maintenance.

Option C – Extra Financial Cost Option

(Additional direct financial confirmation plus progressive transfer of current Trust service charge to water quality improvement)

Under this option:
- There would be extra efforts to clean up litter in and along creeks
- A comprehensive program of works and measures would be undertaken to fully protect creek ecology
- It would eventually be safe to play in and along the creeks in all areas of the catchment and in Lake Parramatta during dry weather.

The community was advised that water quality would improve in 4-6 years and the above higher water quality goals would be achieved in 20-25 years. It was noted that the Trust service charge of $24.70 a household a year would increase by $2.50 each year to a maximum $25 extra, an eventual doubling of the charge in 1996 $ values.

More funds from the existing service charge would progressively go towards water quality as flood works are completed, although some funds would still have to be spent on maintenance and monitoring of flood works.

In the past the Trust has been successful in obtaining government grants to help fund works and measures. It was explained that government grants for water quality works and measures are likely to be obtained and these would reduce the cost to the local community of achieving the water quality goals. Accordingly, contributions from catchment property owners were expected to be less than the amounts quoted.

5.5 Confirming a feasible solution

5.5.1 Aims

Once the various options for improving creek water quality were determined, the next step was to confirm which option the community wanted. As explained previously, selection of a preferred option included an integrated consideration of the degree of water quality improvement desired and the community's preparedness to contribute financially to achieving the desired water quality goals.

It was agreed that, on the basis of this survey, the steering committee would recommend the preferred set of water quality goals to the Trust for adoption as the community-endorsed, integrated-set of water quality goals for the catchment. The Trust would then make its recommendation to government.

5.5.2 Survey procedures

Seventy thousand survey forms were distributed, one to each household, in the November 1995 issue of *Streamline,* the Trust's regular newsletter.

Following on from the success of techniques used in the earlier *Community Survey of Desirable Uses and Values,* a post-free return facility was provided on the survey form to make it easier for residents to participate in this pivotal survey.

In addition, a competition was organised among schools in the catchment to encourage students and their families to participate in the survey. This additional consultation mechanism was intended particularly to provide greater opportunity for residents who do not speak or read English to participate through their English-speaking children.

Copies of the survey form and the brochure *Options for Streamly Clean Creeks,* which provided further information on the Streamly Clean project and the proposed action plan were posted to more than 500 residents who had specifically requested to be involved at this stage or who had sought additional information in the previous survey returns.

A simple survey form was designed which only required residents to tick the option of their choice, or if they preferred, to rate each option 1, 2 or 3. As with earlier surveys, standard Icons © were used to convey pictorially different water quality goals and outcomes.

As outlined previously, a separate question was asked: 'If the water quality was good enough, would you swim in suitable areas of the upper Parramatta River?'

Opportunity was also provided on the survey form for residents to seek additional information on the project and the proposed action plan.

5.5.3 Community survey results

A total of approximately 2,000 survey forms were returned and indicated overwhelming support for Option C. This option would require an increase in the Trust service charge by a maximum of *$25* a household a year to achieve the highest set of water quality goals offered. More than two-thirds of respondents (68 per cent) supported Option C only, or as their first choice.

Option B was the second highest supported option with *25* per cent of respondents indicating it as their only choice or as their first choice. This option was a middle choice which would involve no additional direct financial costs to the community, but would achieve only partial ecosystem protection.

Option A – the do-nothing-extra option – was not favoured strongly, being supported by only 7 per cent of respondents.

In response to the question on swimming in suitable areas of the upper Parramatta River, respondents who answered this question were more equivocal with 58 per cent saying yes and 42 per cent saying no.

5.6 Steering committee recommendations

The project steering committee met in early December 1995 to discuss the survey results. The committee recommended to the Trust that it adopt the water quality objectives in Option C and seek Government endorsement of those objectives by referring them to the EPA. The committee felt it should have a continuing role oversighting development and implementation of the action plan, which would implement the various works and measures required to achieve the community-desired water quality goals.

On 15 March 1996 the Trust resolved to adopt the Option C water quality objectives, submit them to the EPA for adoption as interim water quality objectives for the catchment, and to advise all councils in the catchment of this action.

5.7 The next step

The Action Plan must be developed before any specific works or measures to improve water quality are started. This will take considerable time. The Trust has agreed the water quality steering committee should be reconvened to begin to develop the action plan, and it has agreed to allocate funds in its 1996-97 expenditure estimates for the investigations which will be required.

The Trust recognised that achieving the desired improvements in water quality will take a long time – up to 25 years. Some obvious work can be done quickly to improve the appearance of local streams. Investigation, design, environmental assessment, approval, financing, construction, maintenance and monitoring of a comprehensive network of wetlands, trash racks, litter traps, creek replanting and bank stabilisation; as well as associated measures such as public education, improved monitoring and enforcement of anti-pollution controls, will however require a sustained effort by all sections of the catchment community over many years.

The related questions of how the Streamly Clean action plan is to be funded, and whether the Upper Parramatta River Catchment Trust should be responsible for its implementation will have to be deferred until the future of the Trust and catchment management arrangements for the Sydney Harbour catchment are resolved, probably by mid-1996.

6. External Considerations

The Upper Parramatta River catchment does not exist or operate in isolation from its surrounding areas and catchment, or from the broader framework of public policy and environmental management. Several aspects of this are briefly considered in this section.

6.1 Impacts on the lower catchment

All the water discharged from the upper catchment becomes the initial water of the lower catchment. This discharge will dominate the waters below the Charles Street weir until the first major tributaries, Vineyard Creek and Duck River, join the river. If swimming is not a target for the general waters of the catchment, this use in the immediately downstream waters will also be precluded.

Ecosystem protection should not be precluded if this is a goal in the catchment. Industrial usage may however be constrained in this stretch. No modelling has been undertaken to assess the likely extent of these impacts on the lower river, but it is believed to be unlikely to be significant below the Duck Creek confluence.

6.2 Policies on water quality management

The New South Wales Government has recently commenced a process to set water quality and river flow objectives for all waters within the State in accordance with the National Water Quality Management Strategy. These water quality and river flow objectives are benchmarks which are used to guide the formulation of catchment management plans, and against which the state of the environment can be assessed.

The objective setting process is being conducted in two stages:

Stage 1 is intended to produce interim objectives quickly for all waterways based on known community preferences, current scientific knowledge and a broad economic analysis. This stage is to be completed for all New South Wales rivers, estuaries, coastal marine waters and groundwaters by September 1996.

Stage 2 will involve an independent public inquiry process to confirm or modify the interim objectives. Inquiries will be preceded, where necessary, by the collection of new scientific and economic data and will involve detailed community consultation. This, of necessity, will be a much slower process and initially target sensitive/or complex catchments on a priority basis.

The Upper Parramatta River Catchment is well placed with regard to this current government initiative. On the basis of the Streamly Clean Project the Trust has been able to advise the Environment Protection Authority, which is coordinating the state-wide objective setting process, with clear and well supported water quality objectives. Moreover, these objectives have combined scientific analysis with a strong community involvement process.

The processes undertaken for the Streamly Clean project provide a "bottom-up" model based on open opportunity for comprehensive involvement by all stakeholders. This fundamental component of water quality objective setting has resulted in a considerable improvement in understanding and ownership of issues. Importantly it has allowed the community to work through the trade offs involved in selecting water quality goals and decide upon these based on a reasonable estimate of costs.

While policies on derived water quality objectives is still evolving, the Trust can adopt a policy of its own to manage water, but the status of this as it impacts on local government, state government and industry decisions is uncertain. This could weaken the implementation of such a policy.

The preferred option would be to establish water quality objectives with some statutory backing, rather than as purely policy. Environment protection, water resource management and environment planning legislation are all possible vehicles for implementation of water quality objectives.

6.3 Policies on paying for water quality

There has been much discussion in the community reference groups about funding of any options. A range of possibilities has been advanced including:

- Direct levy by the Trust on catchment households
- Levy through local councils in the catchment
- Direct allocation from State government revenues
- Grants from the State government
- Grants from the Federal government
- Starting grant from State or Federal governments with a continuing levy on catchment households
- Levy on some other catchment related usage such as the ferry to Parramatta or the M2 Motorway

This needs careful consideration in planning the next stage of consultation with the community.

7. The Proposed 'Streamly Clean' Action Plan

7.1 The recommended goals

The recommended water quality goals for the Upper Parramatta River catchment are:

For all creeks and waterways:	Aquatic ecosystem protection Associated wildlife protection Secondary recreation contact Visual amenity
For Lake Parramatta:	Primary recreation contact

In simple terms, this means that except on days immediately following heavy rain, water quality throughout the catchment should be sufficient to:

- material being visible.
- Except on days after heavy Protect and sustain the plants and animals that live in and along the creeks.
- Allow water related recreation activities (playing in and beside the creeks, bushwalking, rowing and canoeing—but not swimming).
- Enable views of the creeks without litter, rubbish and other unsightly rain, to allow swimming in Lake Parramatta.

The Upper Parramatta River catchment is highly urbanised and it is not possible with present knowledge to ensure that water quality in creeks and waterways containing large quantities of stormwater run-off for 3—4 days following heavy rain can meet the criteria for these goals.

If the Streamly Clean project is accepted by the Trust, government and the community a community education program will be promptly introduced to educate the community, and particularly young children, to stay away from creeks during these periods of dangerous flows and lower water quality.

7.2 Support for the recommended goals

The comprehensive community involvement exercises undertaken over the period of 15 months provide clear recommendations about the levels of water quality the community desires in the catchment. The recommended goals are based on:

- the results of the community survey of desirable uses and enjoyments which involved more than 1,000 community members
- the outcomes of meetings of the four community reference groups

- the results of the community survey to confirm a feasible solution, which 68 per cent of the approximately 2,000 responses supported the above recommended goals
- detailed discussion and consideration of the goals and their implications by the steering committee and the Trust

7.3 Conflicting desires and goals

Twenty six percent of all respondents indicated a desire to go fishing in the catchment if water quality was good enough. It is not recommended at this stage that fishing be pursued as goal. A decision on this use should wait for the results of the recommended monitoring program.

Twenty four per cent of respondents indicated they would like to be able to swim in local creeks. While Toongabbie Creek and Darling Mills Creek segments reflected the overall catchment response, Lake Parramatta (39 per cent) and Parramatta Park (35 per cent) segments showed greatest interest in this potential use.

The recommended option includes a goal for swimming in Lake Parramatta, but not elsewhere. Ensuring all creeks and waterways are suitable for swimming would require a several fold increase in the annual Trust service charge. It may be possible in the long-term to lift water quality so all creeks can be used for swimming, but for the purposes of the Streamly Clean program, such a goal is not considered to be sufficiently supported by the catchment community, and may be well beyond the community's capacity or willingness to fund.

7.4 The resulting water quality objectives

Adopting the process outlined above to select the water quality goals and objectives, a full set of water quality objectives was arrived at for the selected environmental values of ecosystem protection and the three levels of recreation. This process and the list is described in detail in the complementary *Water Quality Data Analysis and Modelling* report.

From this full list of objectives, a practical short list of indicators for the catchment was established for comparison with existing data sets for preliminary 'compliance' assessment as follows:

Recreation:
The indicator used for this environmental value in this catchment is faecal coliform (fc) organisms.

Primary contact recreation:
median less than 150 fc organisms/l00mL
80%ile less that 600 fc organisms/l00mL

Clarity was not assessed because of limited suitable data.

Secondary contact recreation:
median less than 1,000 fc organisms/100mL
80%ile less that 4,000 fc organisms/100mL

Ecosystem protection:
Dissolved oxygen as percent saturation:
Desirable: 100 - 80% of saturation
Tolerable: 60 - 80% of saturation

Total phosphorus:
Desirable 0.05 mg/L
Tolerable 0.10 mg/L

Total nitrogen:
Desirable 0.5 mg/L
Tolerable 0.75 mg/L

Total ammonia (as NH_3):
Limit 0.9 mg/L
Assumes a typical maximum pH of 8 and temperature of 15-20 C for the stream waters in this catchment.

The limited toxicants data was reviewed and found to be generally within the typical limits for individual compounds.

7.5 The integrated catchment wide action plan

7.5.1 Overview

To successfully achieve the improvements in water quality identified by the community the Streamly Clean Action Plan must be broad-based, and integrate community and government efforts. The Action Plan can be considered in three main areas: works, community education and involvement, and agency and authority involvement.

Assuming that Sydney Water fixes all leaks in its own sewers in the Hunts creek/Lake Parramatta sub-catchment, the preferred option will eventually see a $41 (1996 $ values) from the Trust's annual catchment service charges spent in the following way:

Works to immediately improve catchment water quality	$35
Community education and involvement	$2
Upgraded water quality monitoring	$2
Works to improve riparian vegetation	$1
Extra industry inspections	$1
	$41

7.5.2 Works

These have been explored in sections 5.4.

Effluents from the sewerage system are controlled by three types of works:

- Control of dry-weather leakage from sewer lines on householder properties. The community is unlikely to accept improvements here until Sydney Water has made inroads into control of sewerage from the structures under its direct control. It is not a first priority.

- Control of dry-weather leakage from sewer lines under Sydney Water direct control and not on householder properties. This could be a priority to reduce dry-weather bacterial contamination.

- Control of overflows (mainly in wet weather) from Sydney Water sewers. This major task is likely to proceed regionally.

Works which can be undertaken by the Upper Parramatta River Catchment Trust and local government include:

- Installation of on-stream and off-stream wet-detention basins and wetlands. A list of possibilities has been developed *(see Appendix V).*
- Installation (and maintenance) of trash racks in the stormwater system could make a major contribution to reducing litter in the streams.
- Incorporation of best management practice pollution control requirements into local government development and building consents would have a significant impact on water quality.
- Installation of environmentally friendly facilities such as bicycleways, nature study centres and picnic and sport facilities in conjunction with the artificial wetlands and detention basins.
- Modification to trunk drains to use more grass and less concrete.

7.5.3 Community education and involvement

A comprehensive and ongoing community and education program linked to programs such as Streamwatch and a Riparian Vegetation Strategy will be fundamental to the success of the Action Plan. Members of the steering committee and community reference groups should be involved in identifying key areas of endeavour and developing effective strategies to engage and sustain community commitment and support.

7.5.4 Investigation and monitoring needs

The Trust could take a lead in the coordination, redesign and improvement of the monitoring network. Measures would include:

- Redesign of sampling locations and frequency
- A program of quality assurance
- A program of intercalibration
- Some supplementation of testing in key areas
- Improvements to some kit testing methods.

The Trust could undertake and coordinate investigations and research with institutions and state agencies into these water quality issues:

- Toxic materials in sediments (proceeding).
- Toxic materials in fish and aquatic organisms (bioaccumulation).
- Establishing a catchment-specific relationship between the various methods of clarity measurement.
- Establish a set of catchment-specific measures for desirable nutrient levels in the catchment. Grant monies may be available for this purpose.

7.5.5 Agency and authority involvement

Local government can undertake or materially back these measures in support of the Streamly Clean Action Plan:

- Insisting upon best management practices when granting development consents and building approvals.
- Incorporating requirements for best management practice in local environmental plans and development control plans.
- Enforcing compliance with development control requirements
- Enforcing pollution control requirements on non-licensed premises.
- Retrofitting pollution amelioration structures jointly with the Trust.
- Supporting and undertaking community education programs.
- Maintaining pollution control devices such as artificial wetlands and trash racks.

Sydney Water can undertake or materially back these measures in support of the Streamly Clean Action Plan:

- Continued improvement in sewerage management, as outlined above.
- Continued monitoring of selected water quality parameters associated with wet weather flows.
- Assistance with, quality control of water quality testing in the catchment.
- Continued support for Streamwatch and other community involvement programs.
- Continued community education.
- A review of trade waste in the catchment with a view to reducing toxic contaminants in the inevitable sewer overflows.

The Environment Protection Authority can undertake or materially back these measures in support of the Streamly Clean Action Plan:

- Assist the Trust approach to government to set water quality objectives.
- Review of licence conditions to ensure adequate self-monitoring is undertaken.
- Assistance with, quality control of water quality testing in the catchment.
- A review with local government of likely industrial and commercial sources of water pollution in the catchment with a view to extending licensing as needed and enforcement.
- Continued community education.

The Department of Urban Affairs and Planning can undertake or materially support these measures in support of the Streamly Clean Action Plan:

- Requiring the adoption of best management practice in regional and local environmental plans.
- Integrating planning for the region with the development of a catchment management strategy.

The Department of Land and Water Conservation can:

- Continue to provide sediment and erosion control training programs for local government staff and developers
- Investigate the use of private contractors to implement sediment and soil erosion control structures.

The Department of School Education can:

- Place more resources into Streamwatch in the catchment.
- Formally recognise teacher's contribution to Streamwatch by allocating 1-2 hours per week of teacher time allowances for time spent in Streamwatch activities.

7.5.6 The Trust

The role of the Trust will be to lead and coordinate the Streamly Clean Action Plan by:

- coordinating works, education and awareness programs and agency! authority activities.
- ensuring that implementation of the Action Plan is progressively achieving the water quality goals.

Appendix I

Implementing the National Water Quality Management Strategy

Setting goals in water quality management corresponds to choosing environmental values (EVs) to be protected. This is a socio-political task which begins with community choice and proceeds through processes which assist both government and community to decide on the feasibility and achievability of the community's preferences. The final decision is one for government after considering all the factors identified by the community and its own environmental management policies.

The objectives are the water quality objectives as specified in the National Water Quality Management Strategy. The derivation of objectives from environmental values is a scientific function which, for water quality, has been set down in the *Australian Water Quality Guidelines for Fresh and Marine Waters.* These guidelines specify scientific values for key contaminants and water quality indicators which should be met to satisfy the uses and values to be protected under that specific environmental value.

There can be an element of choice in this step, but it is primarily a scientific judgment as distinct from the dominantly social judgment in deciding on the goals, that is, the environmental values to be protected for a particular body of water. Their derivation is described in the following section.

It is the catchment management process, constituting as it does the meeting ground between government and community, which provides the arena for the interaction of the social and, to some extent, the scientific dimensions in the water quality objective setting process.

The next point in the management cycle is for government, through an appropriate agency, to ratify (with such modifications as it considers appropriate) the water quality objectives recommended by the catchment communities.

Ratification might consist of introducing regulations under the environmental legislation to establish water quality objectives, or in the form of a protection of the environment policy.

Once water quality objectives have been firmly established for a body of water it will behove the 'catchment manager'- in this case the Trust, the environmental agencies and the water management agencies to develop strategies for achieving these objectives. This implies a comparison of the objectives ('What do we want?') with existing water quality ('What have we got?').

Implementation of the strategy is the next stage in the management cycle and this can be achieved either through licensing and approval of new plant under the pollution legislation, by various land management requirements which can be called up under planning or land management legislation, and by retrofitting amelioration and control structures within the catchment for control of runoff and sewage leakage and overflow.

The next phase in the cycle is a continuing water quality monitoring program designed to answer among other questions the central concern of compliance with the endorsed objectives. This then answers the question, 'What have we got?' – the last but one step in the management cycle. Comparison of the monitored status of water with the environmental quality objectives agreed before implementation of the strategy is a measure of the success or failure of the process and also a guide to modifications of the objectives which may become apparent as a result of monitoring. This closes the management loop for water quality management at large.

Selection of water quality goals and objectives

The program to set water quality objectives for the Upper Parramatta River catchment proceeded according to the principles and guidelines of the NWQM Strategy as a component of the general management strategy.

The first stage in the implementation of the NWQM Strategy process is set out in *Policies and Principles: A Reference Document* (April 1994): 'The determination of environmental values for local or regional water bodies represents the particular uses or values that the community wishes to preserve and should be the first step in the development of a water quality management program. These environmental values are matched with scientifically based water quality criteria to provide the water quality objectives. In the case of large catchments a different range of values may be given to segments of the stream or water body; however, the downstream effects on a water body would need to be considered when regional water quality objectives are set.'

Setting ambient water quality goals and objectives, the effective centre-piece of the strategy, involves two elements, described in the table below:

DERIVATION APPLICATION	SOCIO/POLITICAL CHOICE	SCIENTIFIC RELATIONSHIP
GENERAL APPLICATION	**ENVIRONMENTAL VALUES** ('Beneficial Uses') ***Box 1***	**WATER QUALITY CRITERIA or AUSTRALIAN GUIDELINES** (Indicators) ***Box 3***
	Designation in words of the values or uses to be protected (e.g. drinking water, ecosystems, protection, recreation, etc.) A menu of values is established by the ANZECC Guidelines.	The scientific levels below which contaminants should be kept to protect the corresponding value (e.g. 20 j.tg total PIL, 100 faecal coliforms/100mL, etc.) A collection of scientific values corresponding to each value is established by the Guidelines.
SPECIFIC TO WATER BODY	**GOALS** ***Box 2***	**OBJECTIVES** ***Box 4***
	The Environmental Values selected from the 'menu' for a specific water body	The scientific levels below which contaminants should be kept in the specific water body to protect the Goals chosen for that water body. Derived from the collection of criteria in the ANZECC Guidelines.

(1) Establishing a set of environmental values ('beneficial uses') (Box 1), from which a selection can be made for the specific body of waters, the selected set becoming the water quality goals for those waters (Box 2). Thus, water quality goals mean the environment values selected for a specific water body. This represents a social process which government undertakes with community consultation.

(Note that there are several sub-categories within five broad environmental values designated by the national water quality guidelines; the choice is in fact a little wider than five.)

(2) Establishing scientifically based water quality criteria (Box 3) from the national guidelines corresponding to each of the goals or selected environmental values, the most stringent of which become the water quality objectives for specific waters (Box 4) once the goals have been selected. Thus water quality objectives for a specific water body means the minimum criteria or guidelines corresponding to the selected goals. This second step is a scientific process.

The environmental values and criteria are established by the *Australian Water Quality Guidelines for Fresh and Marine Waters* prepared by ARMCANZ (Agricultural and Resource Management Council of Australia and New Zealand) and the means of setting the goals and objectives are discussed in the strategy documents.

The cycle of choice and consequence

The program of setting the water quality goals and objectives is part of the wider management process. It will be noticed in *Figure* 2 on page 10 that there is a small inner loop. This is, as it were, a 'dry run' around the management cycle as a predictive exercise in order to understand, at the point of setting the water quality objectives, their likely implications for subsequent management and likely cost. Hence, the question which will arise as soon as environmental quality objectives are proposed, namely, 'How does this differ from what we already have in our waters?'

Presuming there is some falling short of the objectives in existing water quality, a reasonable assumption given the general poor perception of water quality in Australia, the next question to ask is what does it mean to adopt the objective in terms of both effort and cost? To answer this question requires some forward prediction of likely responses of the waters to specific control measures. There is, of course, a price tag to such controls and this also needs to be estimated at least in broad terms.

At this point in the inner cycle a further question needs to be asked, mainly, 'Do we want to change?' If initial choices are seen to be outrageously expensive communities may wish to consider a lesser option. Alternatively, if initial choices appear to be very limited in terms of their cost and convenience, communities may wish to opt for a higher objective, a higher water quality, and attempt to achieve a better net water quality.

It is important that at least one cycle, and two if necessary, around this inner circle are made before water quality objectives are sent to government for ratification. There are several reasons for this. If objectives are set which turn out to be unrealistic, and unachievable within the foreseeable future, the system becomes discredited, as discussed above, and communities will lose interest in pursuing the goals and objectives or will not support them in the first place.

It needs to be appreciated that any water quality objectives which have the effect of limiting use of waters will frequently have cost implications for the parties.

Appendix II

Members of the Streamly Clean Project Steering Committee

Stephen Lees (Convenor)	Upper Parramatta River Catchment Trust
David Baggs	Excelsior Park Bushland Society
Susan Bestwick	Parramatta City Council
Bob Brimble	Holroyd City Council
Brian Chapman	Blacktown City Council
Alan Cupit	Upper Parramatta River Catchment Trust
Lawrie Doorey	Baulkham Hills Shire Council
Brigid Dowsett	Australian Conservation Foundation
Eric Hatfield	Environment Protection Authority
Peter Higgins	Upper Parramatta River Catchment Trust
Geoff Hunter	Blacktown City Council
Teresa James	Greystanes Creek Management Committee
David Leavett-Brown	Baulkham Hills Shire Council
Susan McLellan	Baulkham Hills Shire Council
Hugh Milner	Department of Land and Water Conservation
Neville Prior	Baulkham Hills Shire Council
Mike Randall	Parramatta City Council
Paul Ritchie	Holroyd City Council
Bruce Roser	Sydney Water

Appendix III

Summary Results:

COMMUNITY SURVEY OF CURRENT AND PAST CREEK VALUES AND USES

TOTAL CATCHMENT PROFILE

(Percentage of respondents in total catchment who indicated the particular use or value)

Value or Use	Past	Current
Swimming	(24%)	(2%)
Playing/recreation	(54%)	(30%)
Canoeing/boating	(14%)	(5%)
Fishing	(14%)	(1%)
Plants or animals living in	(57%)	(38%)
Plants or animals living on	(61%)	(53%)
Looking at creeks	(67%)	(62%)
Nearby/knowing	(60%)	(66%)

COMMUNITY SURVEY OF CURRENT AND PAST CREEK VALUES AND USES

DARLING MILLS SUB-CATCHMENT

(Percentage of respondents in sub-catchment who indicated the particular use or value)

Value or Use	Past	Current
Swimming	(18%)	(0%)
Playing/recreation	(62%)	(36%)
Canoeing/boating	(10%)	(0%)
Fishing	(8%)	(0%)
Plants or animals living in	(64%)	(46%)
Plants or animals living on	(72%)	(59%)
Looking at creeks	(77%)	(62%)
Nearby/knowing	(72%)	(77%)

LAKE PARRAMATTA SUB-CATCHMENT

(Percentage of respondents in sub-catchment who indicated the particular use or value)

Value or Use	Past	Current
Swimming	(48%)	(8%)
Playing/recreation	(76%)	(44%)
Canoeing/boating	(36%)	(16%)
Fishing	(20%)	(4%)
Plants or animals living in	(68%)	(32%)
Plants or animals living on	(72%)	(44%)
Looking at creeks	(80%)	(40%)
Nearby/knowing	(64%)	(44%)

COMMUNITY SURVEY OF CURRENT AND PAST CREEK VALUES AND USES

PARRAMATTA PARK SUB-CATCHMENT

(Percentage of respondents in sub-catchment who indicated the particular use or value)

Value or Use	Past	Current
Swimming	(10%)	(0%)
Playing/recreation	(60%)	(40%)
Canoeing/boating	(40%)	(0%)
Fishing	(10%)	(20%)
Plants or animals living in	(40%)	(40%)
Plants or animals living on	(40%)	(60%)
Looking at creeks	(60%)	(50%)
Nearby/knowing	(80%)	(30%)

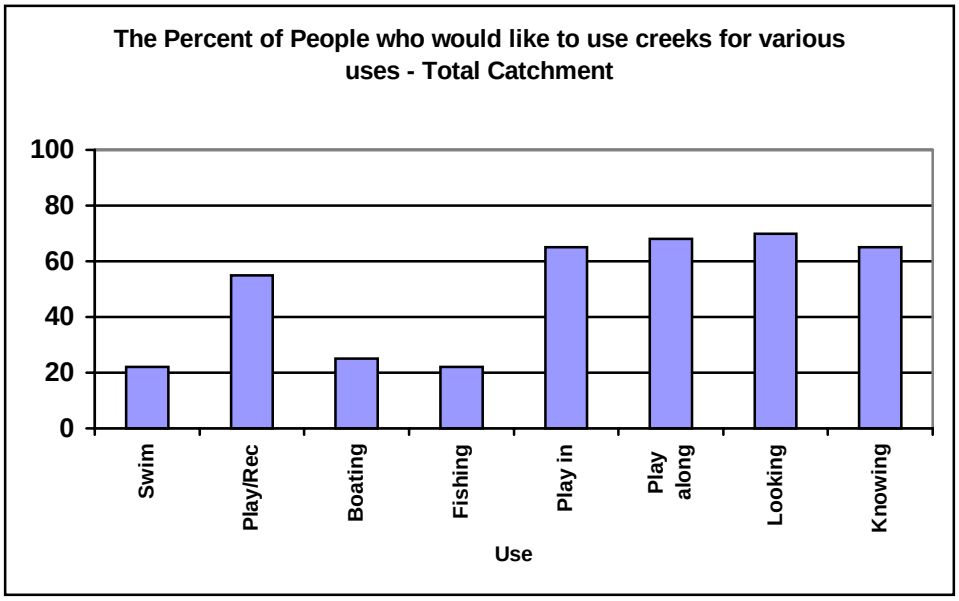
TOONGABBIE SUB-CATCHMENT

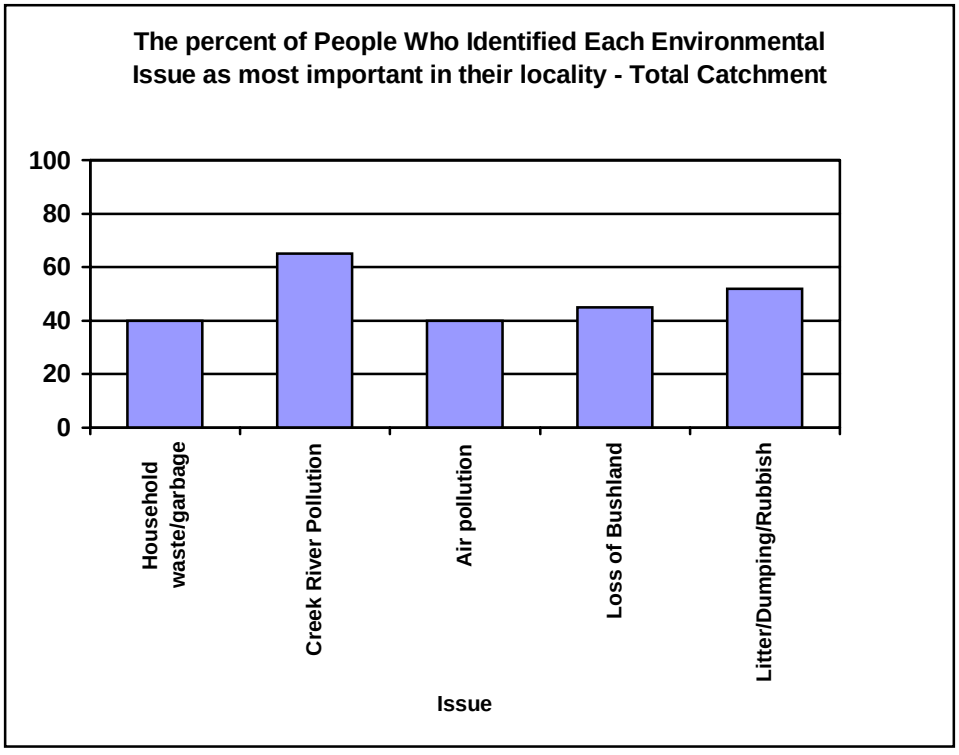
(Percentage of respondents in sub-catchment who indicated the particular use or value)

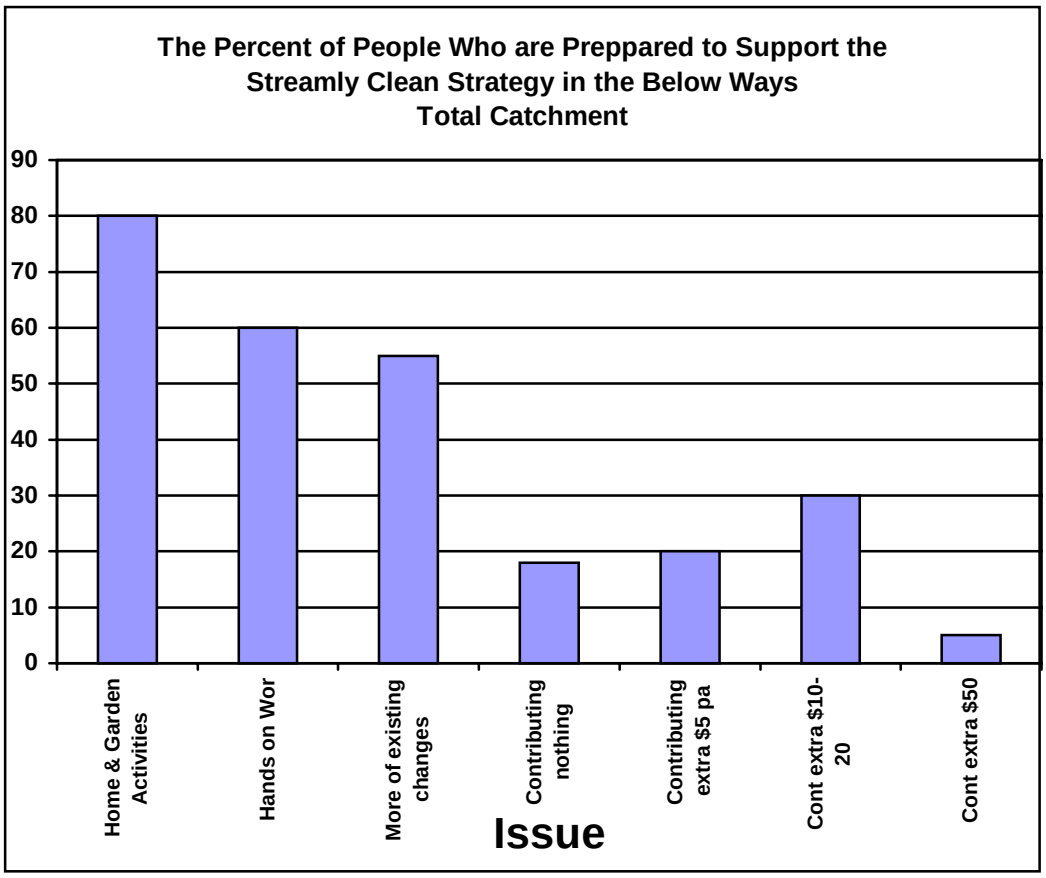
Value or Use	Past	Current
Swimming	(22%)	(0%)
Playing/recreation	(42%)	(29%)
Canoeing/boating	(14%)	(3%)
Fishing	(14%)	(0%)
Plants or animals living in	(52%)	(37%)
Plants or animals living on	(55%)	(56%)
Looking at creeks	(60%)	(66%)
Nearby/knowing	(53%)	(62%)

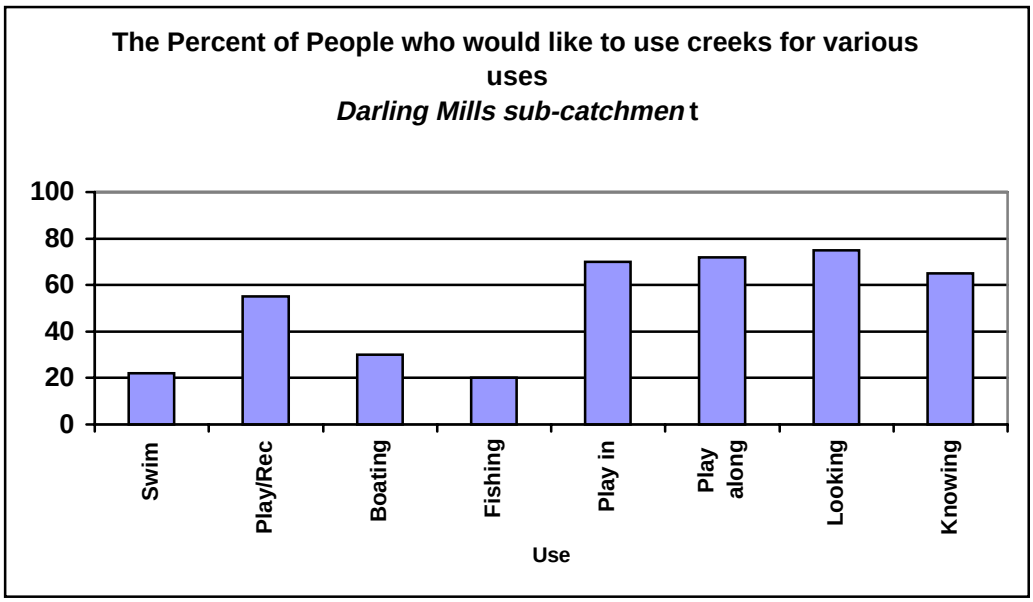
Appendix IV

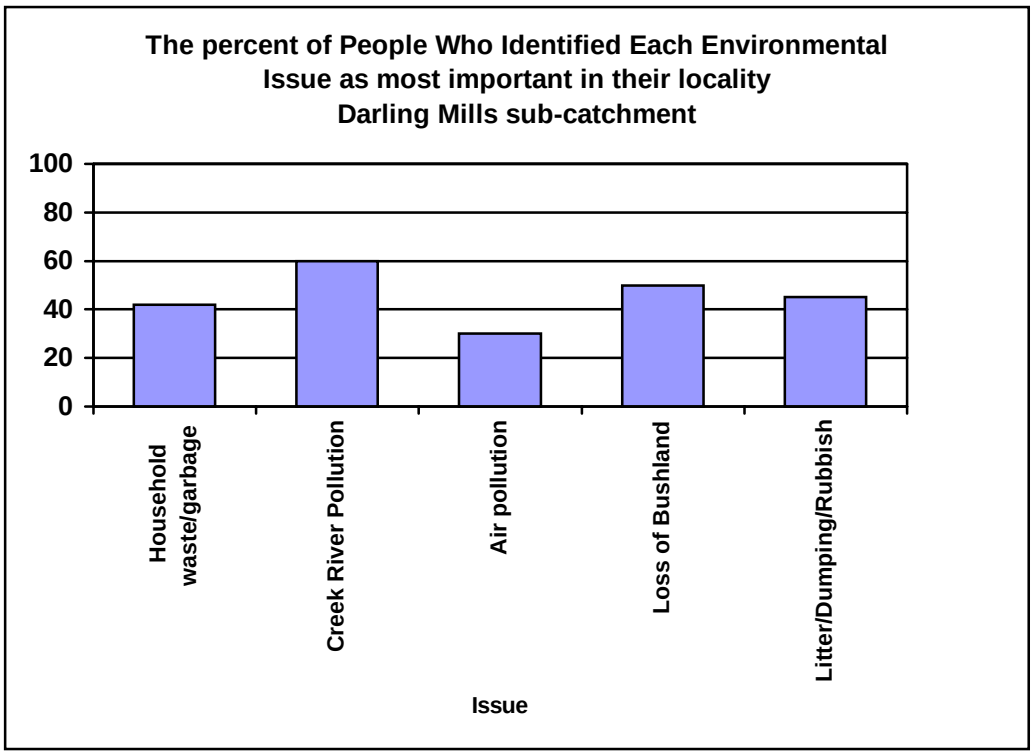
Summary Results: Community Survey of Desirable Uses and Enjoyments, and Likely Support.

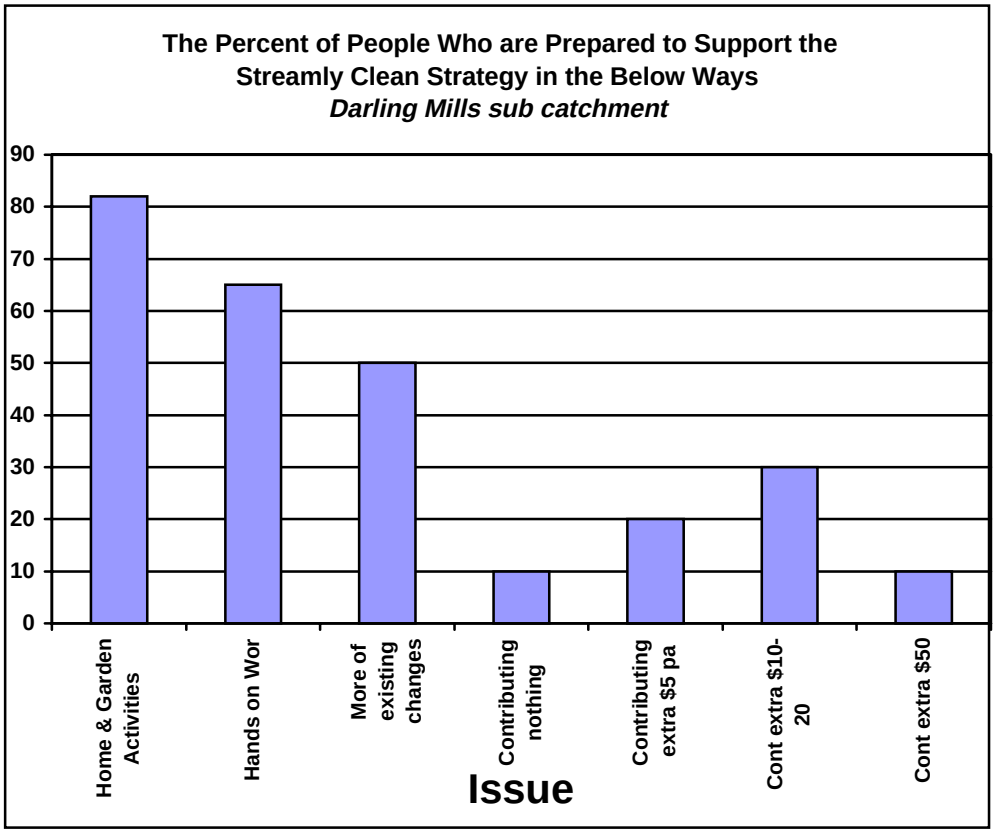





The Percent of People Who are Preppared to Support the Streamly Clean Strategy in the Below Ways
Total Catchment
90
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
Contributing extra $5 pa
Cont extra $10-20
Cont extra $50
Issue


The Percent of People who would like to use creeks for various uses
Darling Mills sub-catchment
100
80
60
40
20
0
Swim
Play/Rec
Boating
Fishing
Play in
Play along
Looking
Knowing
Use


The percent of People Who Identified Each Environmental Issue as most important in their locality
Darling Mills sub-catchment
100
80
60
40
20
0
Household waste/garbage
Creek River Pollution
Air pollution
Loss of Bushland
Litter/Dumping/Rubbish
Issue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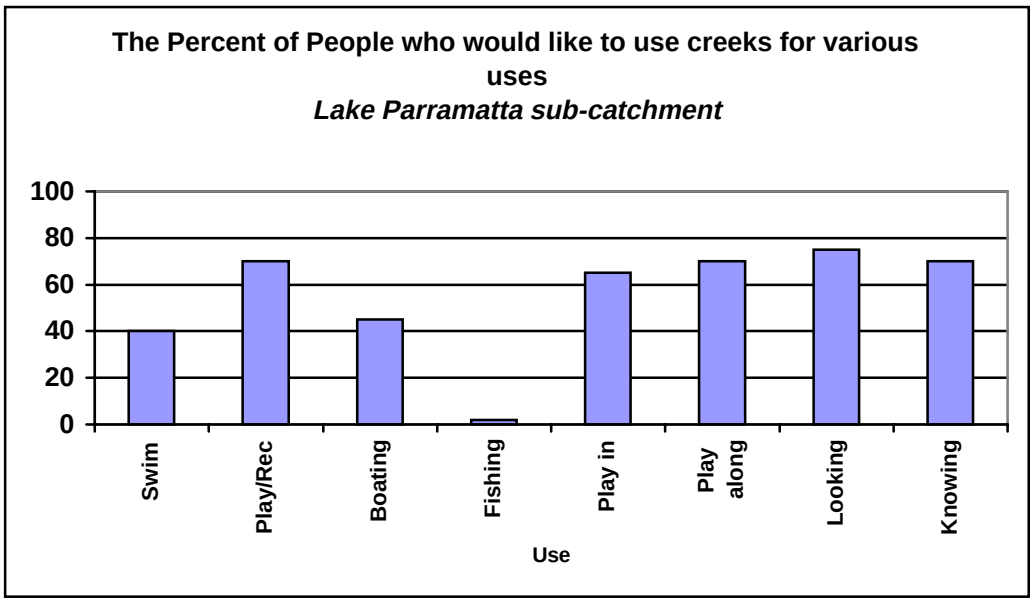
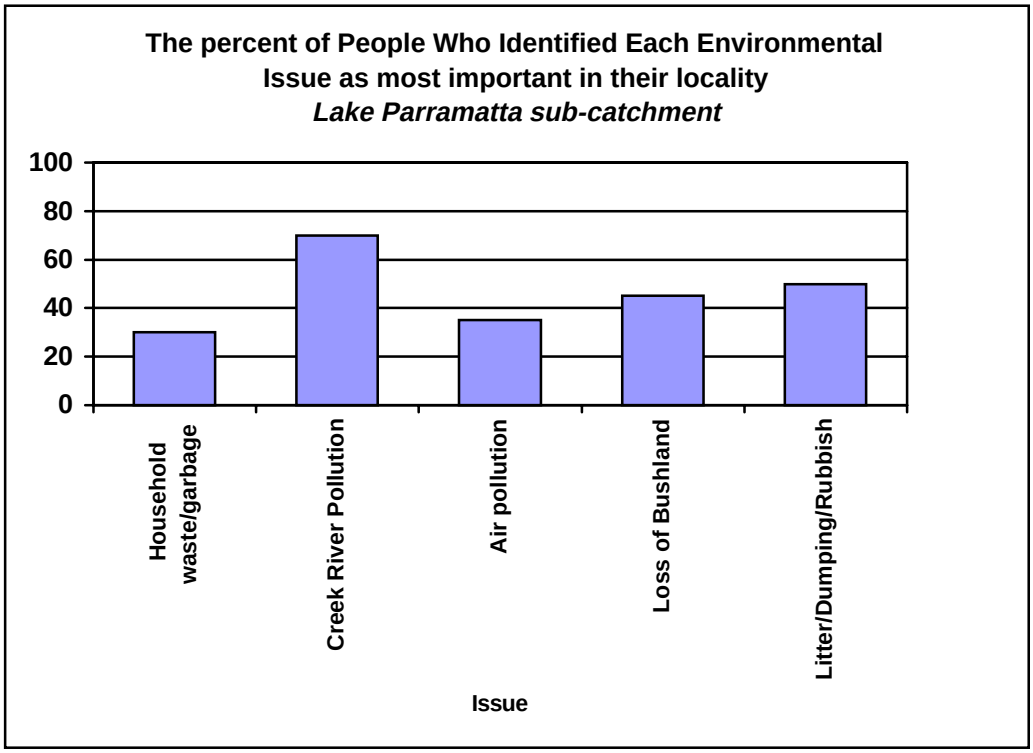
Darling Mills sub catchment
90
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
Contributing extra $5 pa
Cont extra $10-20
Cont extra $50
Issue


The Percent of People who would like to use creeks for various uses
Lake Parramatta sub-catchment
100
80
60
40
20
0
Swim
Play/Rec
Boating
Fishing
Play in
Play along
Looking
Knowing
Use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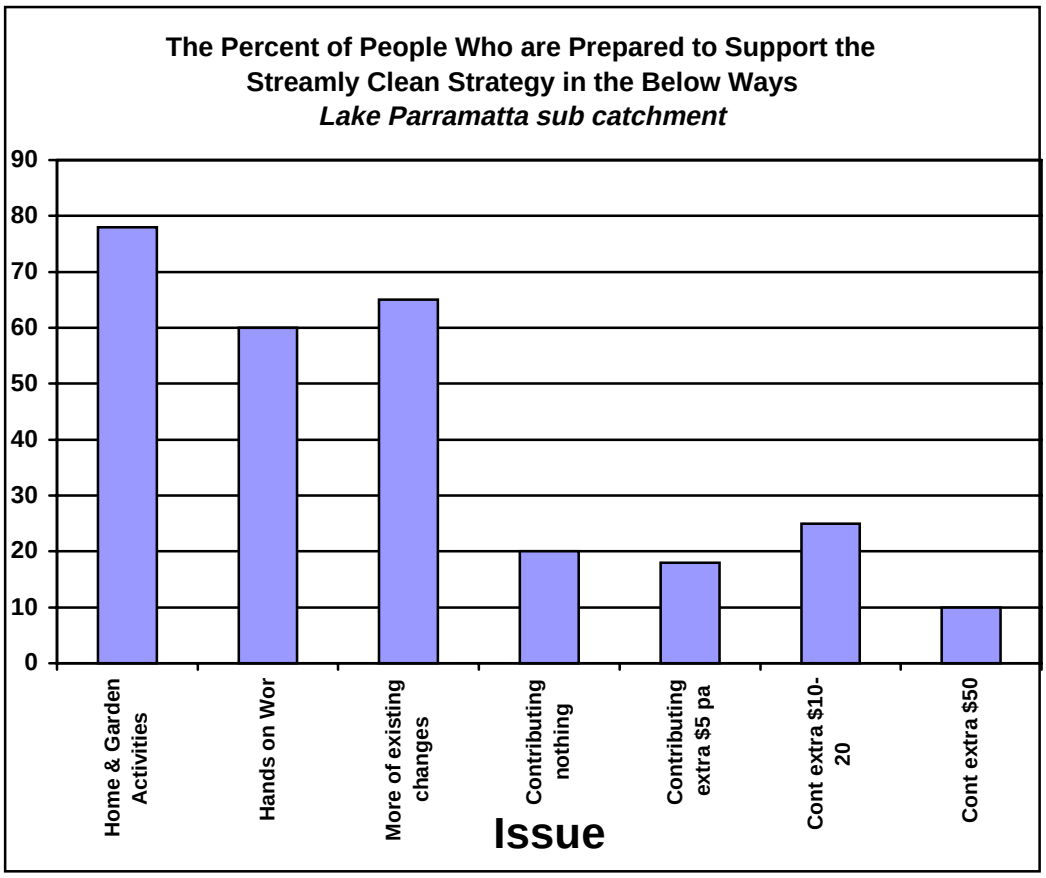
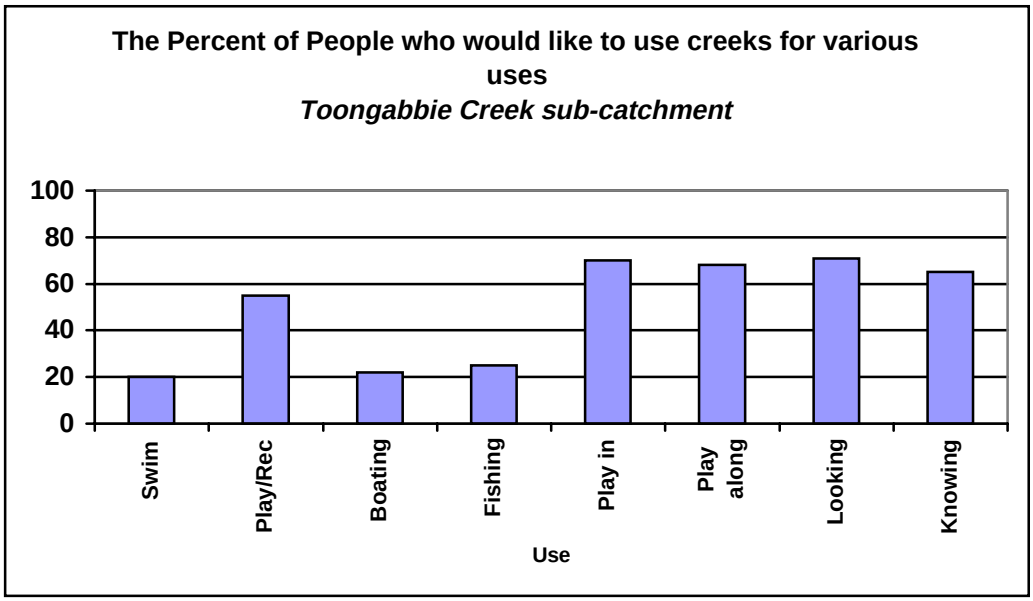
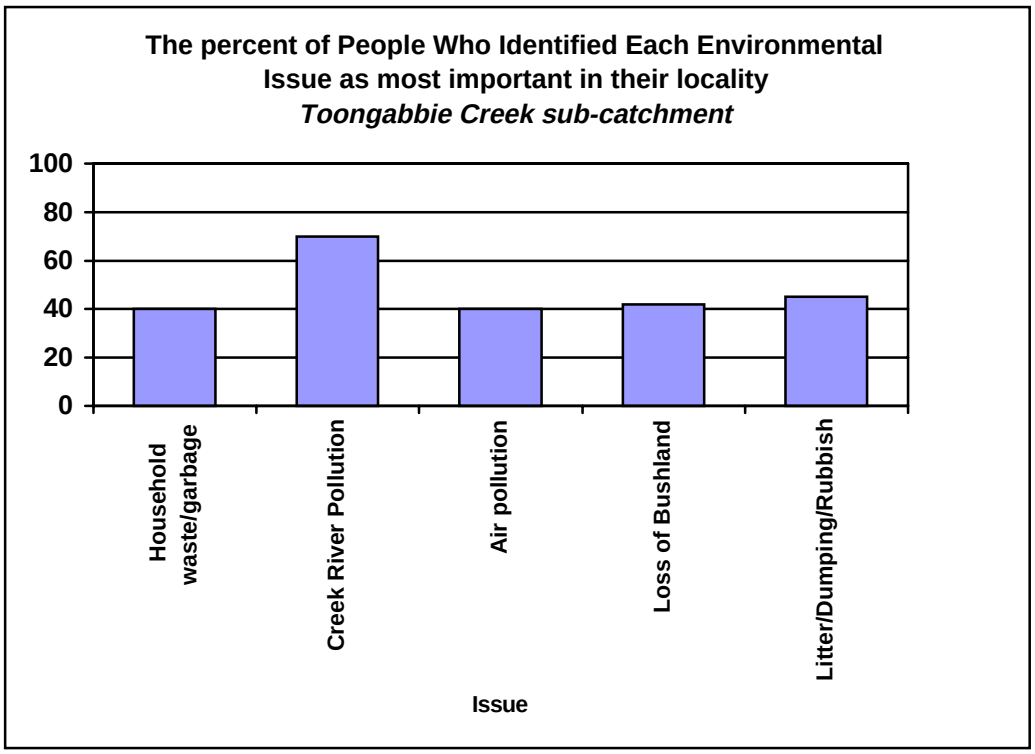
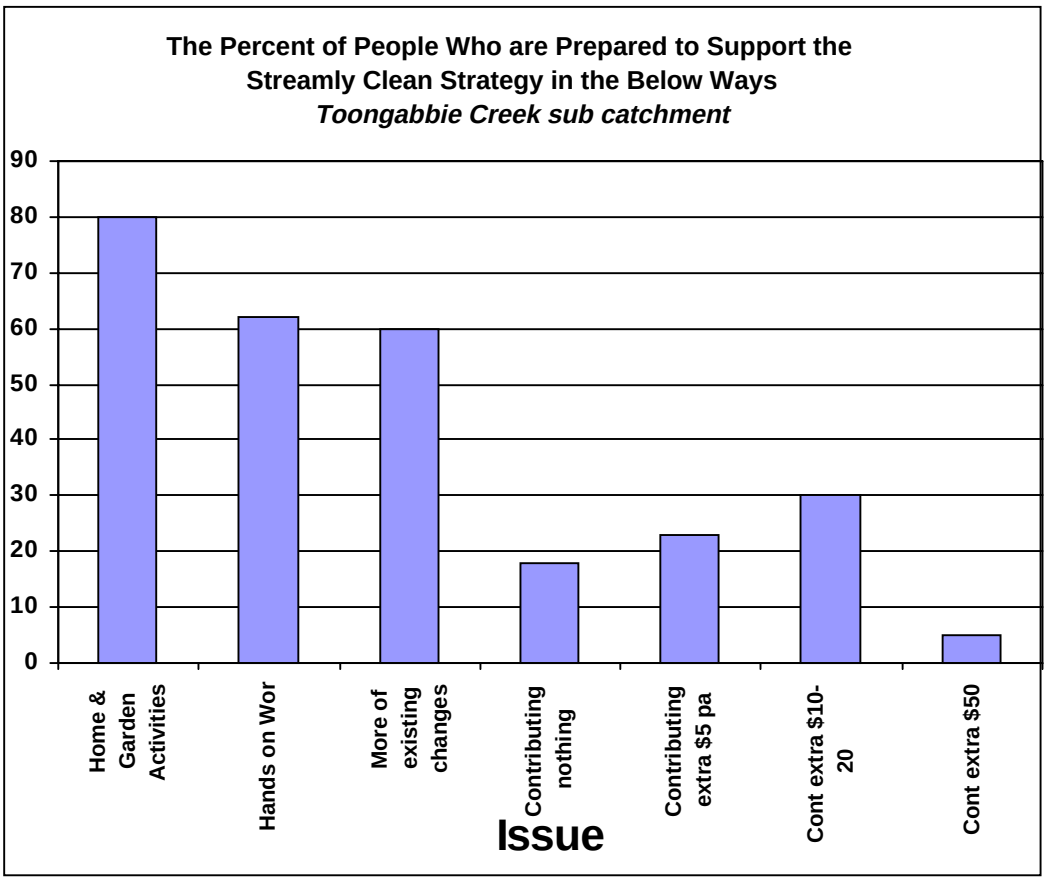
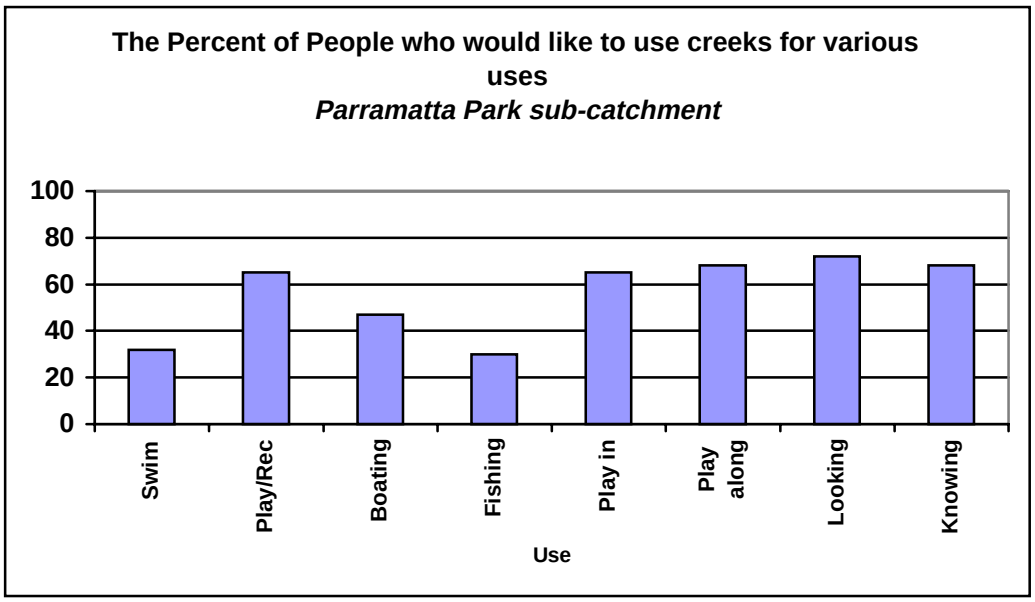
Lake Parramatta sub-catchment
100
80
60
40
20
0
Household waste/garbage
Creek River Pollution
Air pollution
Loss of Bushland
Litter/Dumping/Rubbish
Issue

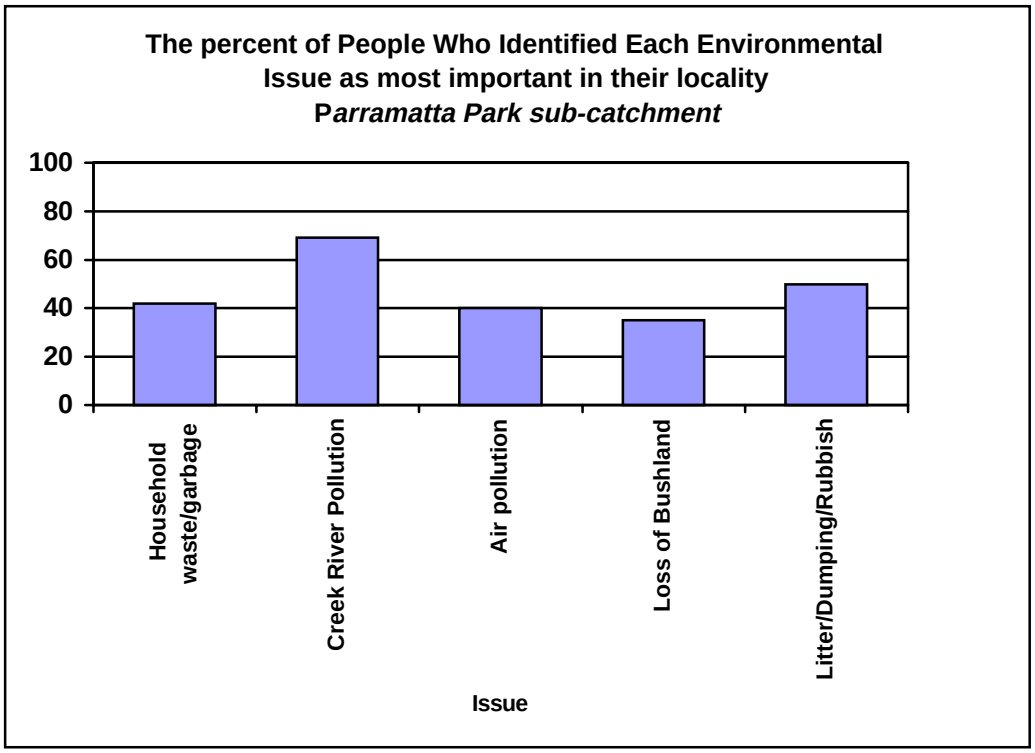

The Percent of People Who are Prepared to Support the Streamly Clean Strategy in the Below Ways
Lake Parramatta sub catchment
90
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
Contributing extra $5 pa
Cont extra $10-20
Cont extra $50
Issue

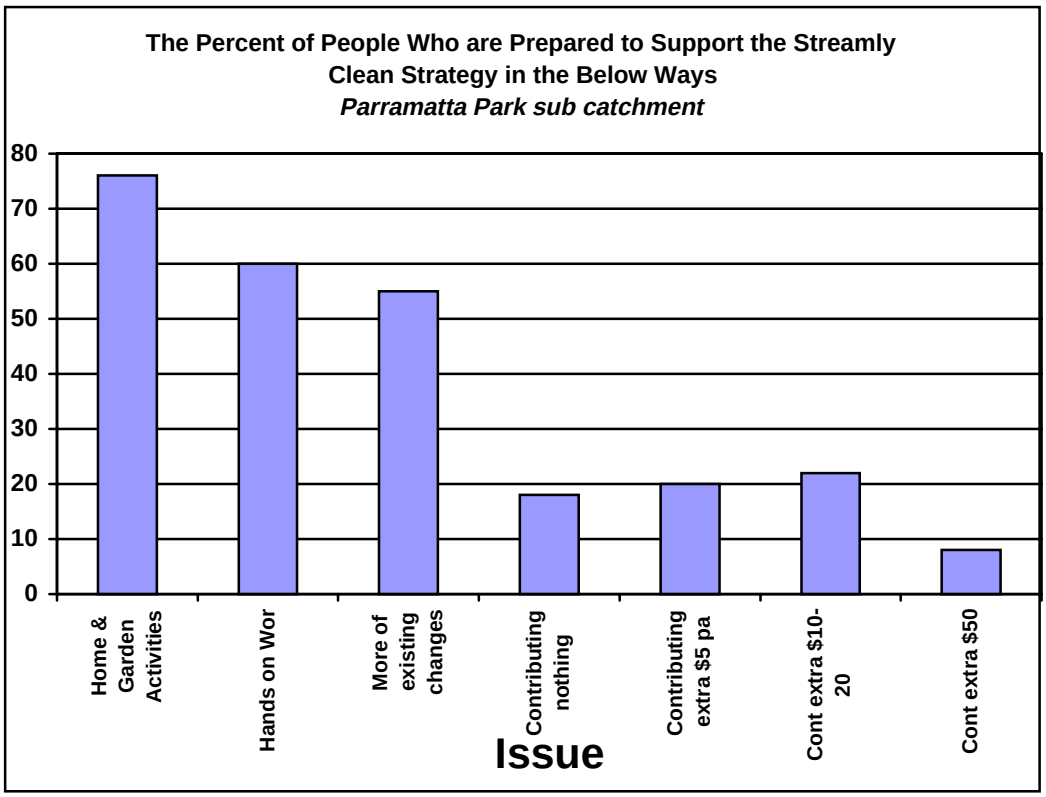

The Percent of People who would like to use creeks for various uses
Toongabbie Creek sub-catchment
100
80
60
40
20
0
Swim
Play/Rec
Boating
Fishing
Play in
Play along
Looking
Knowing
Use


The percent of People Who Identified Each Environmental Issue as most important in their locality
Toongabbie Creek sub-catchment
100
80
60
40
20
0
Household waste/garbage
Creek River Pollution
Air pollution
Loss of Bushland
Litter/Dumping/Rubbish
Issue


The Percent of People Who are Prepared to Support the Streamly Clean Strategy in the Below Ways
Toongabbie Creek sub catchment
90
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
Contributing extra $5 pa
Cont extra $10-20
Cont extra $50
Issue


The Percent of People who would like to use creeks for various uses
Parramatta Park sub-catchment
100
80
60
40
20
0
Swim
Play/Rec
Boating
Fishing
Play in
Play along
Looking
Knowing
Use


The percent of People Who Identified Each Environmental Issue as most important in their locality
Parramatta Park sub-catchment
100
80
60
40
20
0
Household waste/garbage
Creek River Pollution
Air pollution
Loss of Bushland
Litter/Dumping/Rubbish
Issue


The Percent of People Who are Prepared to Support the Streamly Clean Strategy in the Below Ways
Parramatta Park sub catchment
80
70
60
50
40
30
20
10
0
Home & Garden Activities
Hands on Wor
More of existing changes
Contributing nothing
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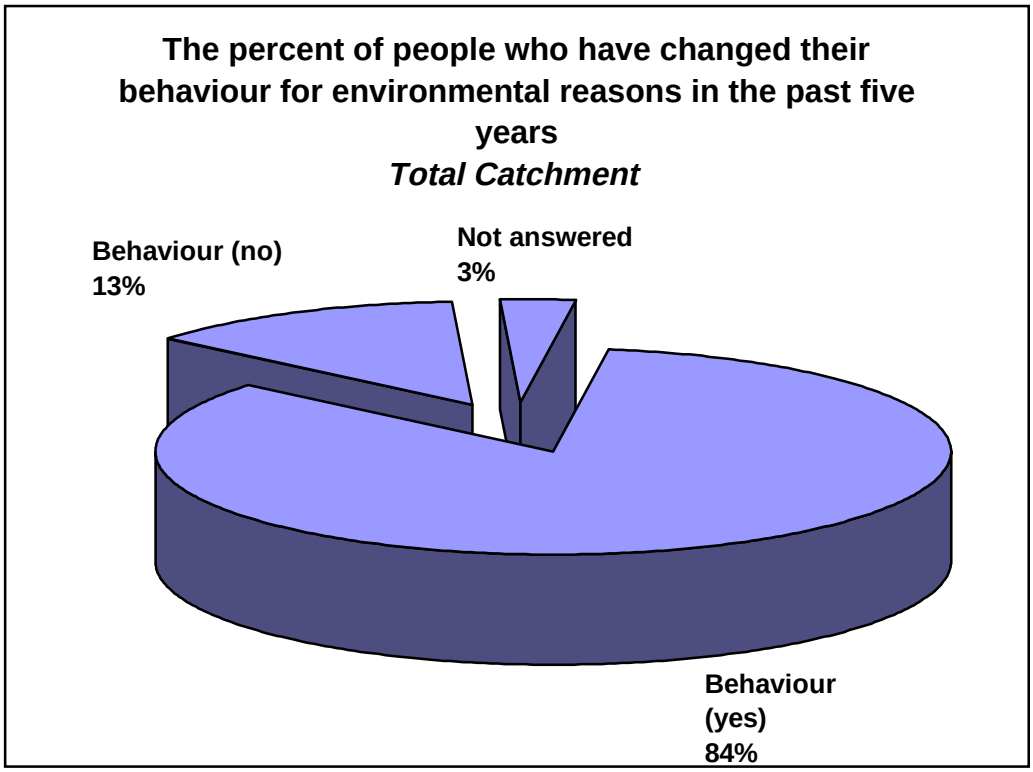
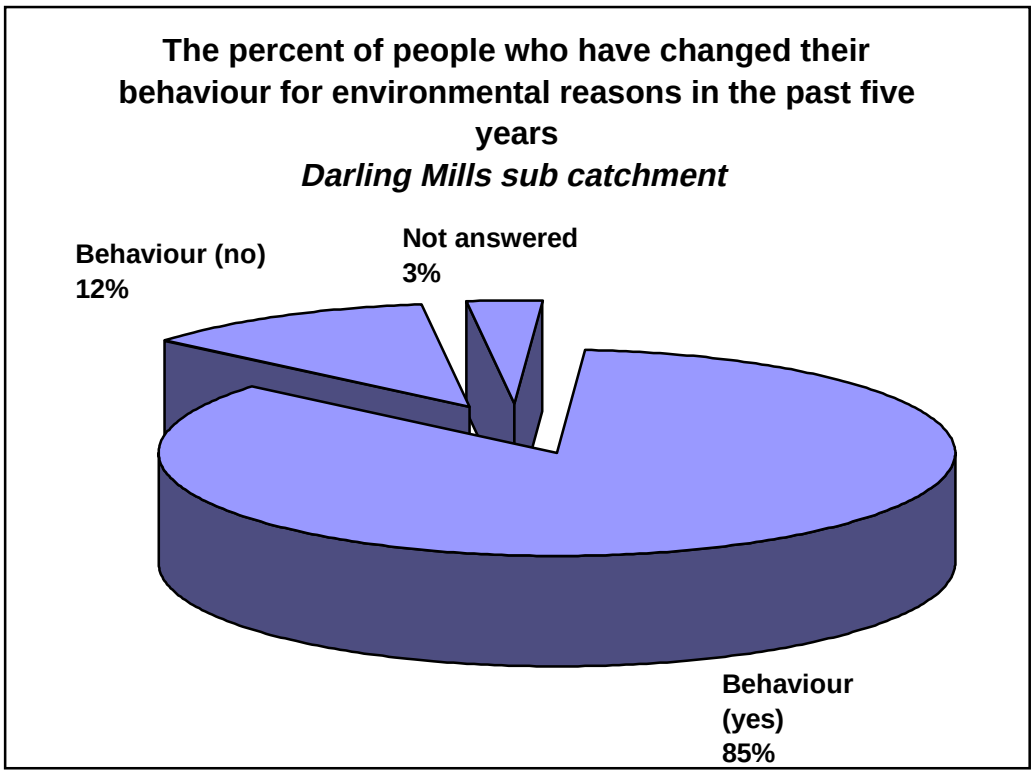
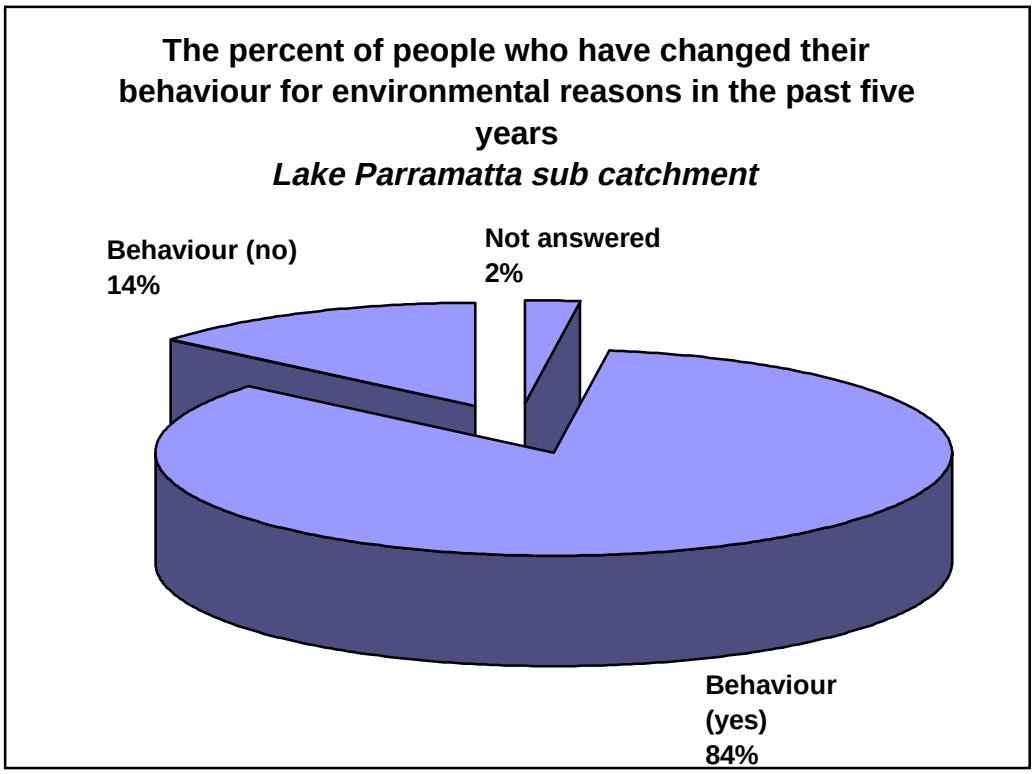
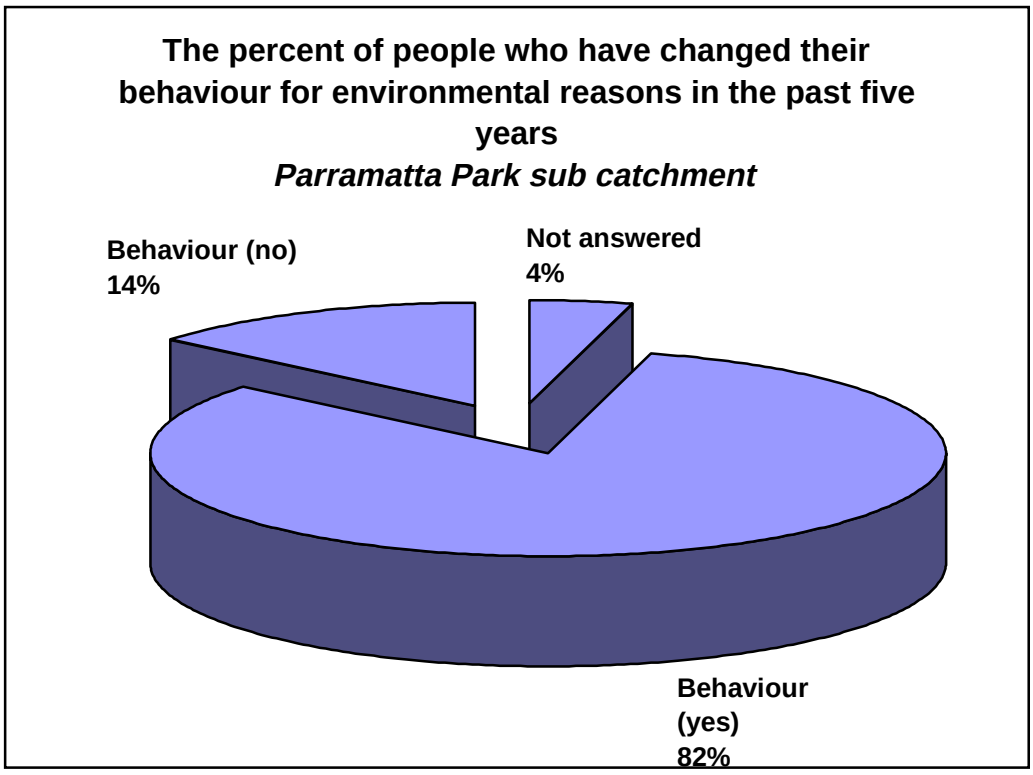
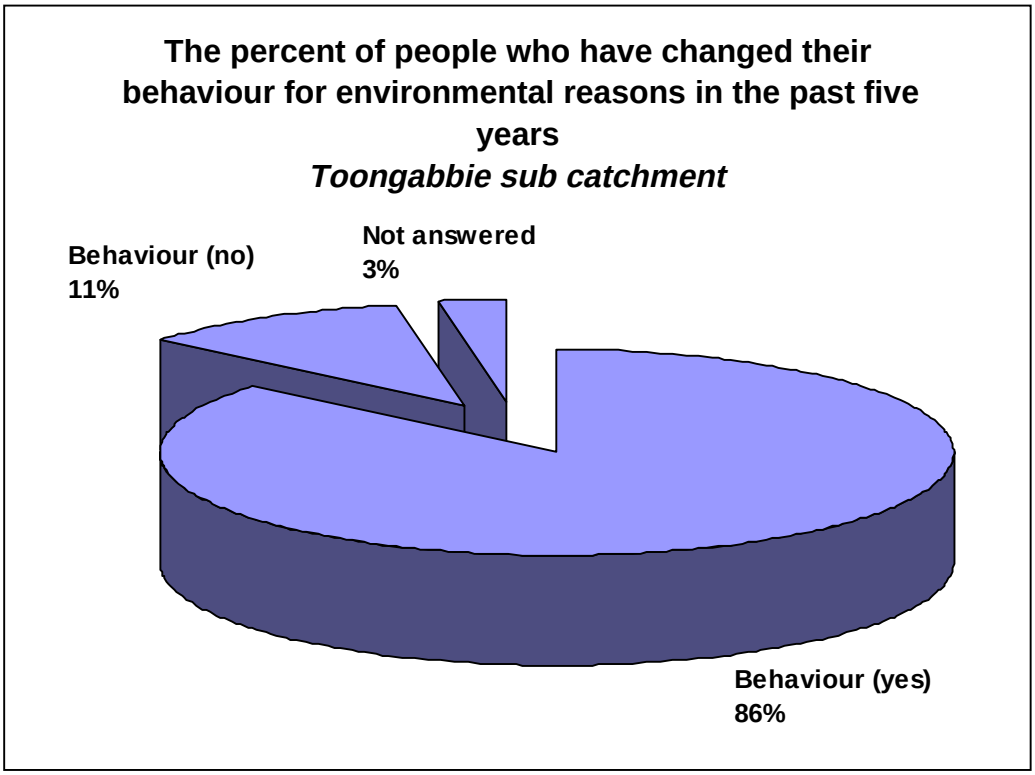
Cont extra $10-20
Cont extra $50
Issue


The percent of people who have changed their behaviour for environmental reasons in the past five years
Total Catchment
Behaviour (no) 13%
Not answered 3%
Behaviour (yes) 84%


The percent of people who have changed their behaviour for environmental reasons in the past five years
Darling Mills sub catchment
Behaviour (no) 12%
Not answered 3%
Behaviour (yes) 85%


The percent of people who have changed their behaviour for environmental reasons in the past five years
Lake Parramatta sub catchment
Behaviour (no) 14%
Not answered 2%
Behaviour (yes) 84%


The percent of people who have changed their behaviour for environmental reasons in the past five years
Parramatta Park sub catchment
Behaviour (no) 14%
Not answered 4%
Behaviour (yes) 82%


The percent of people who have changed their behaviour for environmental reasons in the past five years
Toongabbie sub catchment
Behaviour (no) 11%
Not answered 3%
Behaviour (yes) 86%

Appendix V

Proposed And Existing Water Quality Control Structures For Upper Parramatta River Catchment

	DESCRIPTION	TYPE OF STRUCTURE	STREET ACCESS	STATUS	COST ($)	MAP REF. UBD
1	Top of McCoy Park (Toongabbie Creek)	Wet Retarding basin	Edna Avenue, Toongabbie	Concept only	$2,000K	189 3 N
2	Metella Road Reserve (Greystanes Creek)	Wetland & Retarding Basin	Metella Road, Toongabbie	Approved Plans	$600K	189 13 F
3	International Park (Blacktown Creek)	Chains of Wetlands on-line	International Park	Concept only	$500K	189 1 A-F
4	Twin Gums Reserve (Lalor Creek)	Stream Stabilisation, Wetlands on-line & Basins	Vardy's Road, Lalor Park	Concept only	$2,000K needs wetland	169 8-11 J
5	Crestwood Reserve (Toongabbie Creek)	Stream Stabilisation, Existing Wetlands	Chapel Lane, Baulkham Hills	Concept only	$70K	170 4 F
6	Greystanes Creek Restoration Project (Greystanes Creek)	Stream Stabilisation, wetlands on-line, GPT	Portia Road, Metella Road and Memphis Crescent	Concept only	Wetland $2,000K	189 9 K
7	Top of Torry Burn Reserve (Quarry Creek)	Wetlands	Heather Close, Baulkham Hills	Concept only	$100K	170 6 K
8	Aiken Road (Darling Mills Creek)	Basins & Wetlands, (Gabian wall type, Sediment trap)	Aiken Road, West Pennant Hills	Concept only	$200K	171 7 M
9	End of Trent & Loyalty Roads (Darling Mills Creek)	2 X GPTs	Loyalty Road, Trent Road, North Rocks	Proposed	2 X $20K	191 1 D 171 16 F
10	At Civic Park (Pendle Hill Creek)	Wetland on-line	Civic Avenue, Pendle Hill	Completed		189 13 P-Q
11	Terminus Street, Castle Hill (Bidjigal Creek)	Gross Pollutant Trap	Terminus Street, Castle Hill	Concept only	$70K	151 15 C
12	Cross & Cary Streets (Excelsior Creek)	Gross Pollutant Trap (Pollutec)	Cross & Cary Streets	Under construction	$100K	171 9 B
13	Near James Rouse Ag. High School (Hunts Creek)	Trash Racks	Jenkin Road, Carlingford	Concept only	$20K	192 3 C
14	North Rocks Shopping Centre (Rifle Range Creek)	Trash Racks	Pembury Avenue, North Rocks	Concept only	$20K	171 15 L
15	Kings School above Lake Parramatta (Hunts Creek)	Gross Pollutant Traps, Enhance Wetlands	Masons Drive, North Parramatta	Concept only	$20K (no land acquisition assumed)	191 7 F
16	At Marsden Weir on South Bank (Parramatta River)	Trash Racks	Marsden Street, Parramatta	Concept only	$20K	373 6 E
17	At Marsden Weir on South Bank (Parramatta River)	Trash Racks	O'Connell Street, Parramatta	Concept only	$20K	373 6 C

	DESCRIPTION	TYPE OF STRUCTURE	STREET ACCESS	STATUS	COST ($)	MAP REF. UBD
18	Within Parramatta Park (Parramatta River)	Floating Booms	Fleet Street, Parramatta	Concept only	$20K	191 14 A
19	Milson Park (Finlayson Creek)	On-line Wetland & Sediment Pond/GPT	Briens Road, Wentworthville	Approved Plans	$50K	190 13 J
20	Near Leagues Club (Coopers Creek)	Trash Racks	Mack Street, Wentworthville	Concept only	$30K	210 3 C
21	Fox Hills Golf Course (Greystanes Creek)	Wetlands	Fox Hills Crescent, Prospect	Concept only	$20K (no land acquisition assumed)	189 16 G
22	DoP Basin near CSIRO (Greystanes Creek)	Wetlands within DoP detention basin	Clunies Ross Road	Concept only	$50K	209 1 D
23	Wet basin off M4 Motorway	Detention basin, wetland	Old Prospect Road	In-use, gauged	Exists	210 4 F
24	Trash-rack below shopping centre (Hunts Creek)	Trash-rack	Northam Drive, North Rocks	Concept	$70K	191 M 3
26	Wetland in annabranch (Coopers Creek)	Wetland	Hopkins Street, Wentworthville	Concept only	$200K	190 H 12
27						
28						
				TOTAL	**$8,390K**	

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Aims of water quality control structure:

- improve water quality, and
- improve aesthetic appearance of water, and where possible
- provide natural aquatic habitats, and where possible
- educate the public.

Measures for treatment of stormwaters in-system are likely to have the following effects:

- reduce the amount of floating rubbish and litter in the waterways,
- provide important habitat replacements,
- provide valuable passive recreation areas associated with waterways and active recreation areas associated with cycleways and picnic areas,
- increase associated land values,
- reduce nutrients in the waterways during dry weather flows by up to 50%,
- reduce biological contamination in the waterways during dry weather flows by up to 50%,
- provide important educational facilities for the area.

Measures for treatment of stormwaters by decreasing sewer overflows by reducing dry-weather exfiltration are likely to have the following effects:

- reduce nutrients in the waterways during dry weather flows by more than 50%,

- reduce biological contamination in the waterways during dry weather flows by more than 50%,
- increase the passive recreation amenity of existing waterways by generally improving quality,
- certain areas of the catchment will become available for active water contact ie. swimming,

The associated costs are likely to be as follows

FOR TREATMENT IN STORM WATER SYSTEM:

Based on 70,000 rateable properties in the catchment, and the total capital cost of $8.4M being amortised based on 7% over 30 years the repayments may be calculated to be as follows:

$676,120/annum
or
about $10/property/annum
for maintenance add 10%
say $11/property/annum.

FOR TREATMENT OF SEWAGE SYSTEM:

Based on 70,000 rateable properties in the catchment, and the total capital cost also amortised based on 7% over 30 years. Assuming that 30% of properties in older areas (about 75% of 70,000) require treatment to reduce dry weather exfiltration (about $3,000/treated property, includes 20 m of property sewer and 20 m of main sewer).

ie. 70,000 x 75% x 30% x $3,000 = $ 47,250,000

The repayments may be calculated to be as follows:

$3,720,000/annum
or
about $55/property/annum.