THREE RIVERS PROJECT

Water Quality Monitoring & Management

Final Report

Executive Summary

European Union Cohesion Fund

M.C.O'SULLIVAN - Consulting Engineers
Carnegie House, Library Road
Dun Laoghaire, Ireland
Phone Number: +353 1 202 0870
Fax : +353 1 202 0707

Introduction

This report marks the completion of the Three Rivers Project, a government initiative to develop catchment based water quality monitoring and management systems for the Boyne, Liffey and Suir catchments. This three-year project was sponsored by the Department of the Environment and Local Government (DOELG) and by the constituent Local Authorities with support from the European Union Cohesion Fund. The Project was carried out on behalf of the government by a group of consultants led by M.C.O'Sullivan and Co. Ltd. (MCOS) under the guidance of a single Steering Group and an Operational Management Group for each catchment.

Prior to the start of the Project, water quality in the rivers of these catchments deteriorated since general monitoring of water quality first began in the 1970s. The main cause of deterioration is excessive inputs of nutrients, mainly phosphorus, from a variety of human activities such as sewage disposal and agriculture.

The Project has delivered a monitoring and management system which will be the basis for halting this deterioration in water quality and restoring good water quality in the Boyne, Liffey and Suir river systems.

The Three Rivers Project commenced in September 1998. Field teams composed of MCOS environmental staff (environmental and agricultural scientists, and engineers) and Local Authority (L.A.) laboratory and sampling staff were deployed in each of the catchments to implement the Project on the ground. The field teams were responsible for gathering data, implementing water monitoring programmes and the design and implementation of special investigations/ pilot studies into the impact of agricultural, urban drainage and forestry activities on water quality and nutrient loads.

These teams were supported by a Project Manager and Technical Support Team based in MCOS Dublin. Two Project Co-ordinators (Boyne/Liffey and Suir) provided an interface between the Client and the Consultant Team.

The consultant field teams concluded their work in the catchments in November 2001. The monitoring programmes which commenced in January 2000 continue to be operated by the Project Laboratories under the direction of the Project Co-ordinators.

In addition to MCOS, the consultant group was composed of J.G. Quigg and Company (GIS development), Conservation Services Ltd. (biological monitoring) and HR Wallingford Ltd. (initial design of monitoring systems). National experts, including Teagasc Research and Advisory Service, provided additional advice on specific aspects of environmental management.

Project Output

Catchment Management Systems have been developed for the 3 catchments consisting of 5 main elements:

The Project Management System will be the basis for restoring good water quality.

An inventory of Risk Characteristics and Pressures - identifying landuse characteristics and activities that have the potential to generate nutrients (pressures), physical characteristics that present a risk in terms of nutrient runoff and waters that are sensitive to nutrient pollution due to their use and ecological importance.

A Monitoring Programme - to determine current water quality, quantity and nutrient loadings, identify likely pressures influencing water quality and to audit the success of management measures.

A Programme of Management Measures - aimed at managing nutrient impact from all sectors of the community.

A Plan for implementing management measures.

A dedicated **Geographical Information System** (GIS), "Catchment Envisage", to assist in the implementation, auditing and review of the management system.

1. Inventory of Risk Characteristics and Pressures

The main landuse activities in the three catchments are agriculture (75 to 91%), urban development (1 to 7%) and forestry (3-11 %).
"Activities" that pose potential risk of nutrient losses to the surface water environments include:

Regulated point discharges such as Municipal/Urban Wastewater Treatment Plants (MWWTP) and licensed discharges from industry.

Other point discharges from farmyards, septic tanks, urban drains and sewer over flows which are difficult to pin point.

Diffuse discharges primarily associated with runoff from landuse activities such as agriculture and forestry mainly due to inappropriate/excessive application of mineral fertilisers, slurries or sludges.

Generally the potential risk of nutrient loss to surface waters will increase as the density/ intensity of these activities increase.

An inventory of all MWWTP and licensed discharges to surface waters in each of the catchments has been compiled and mapped.

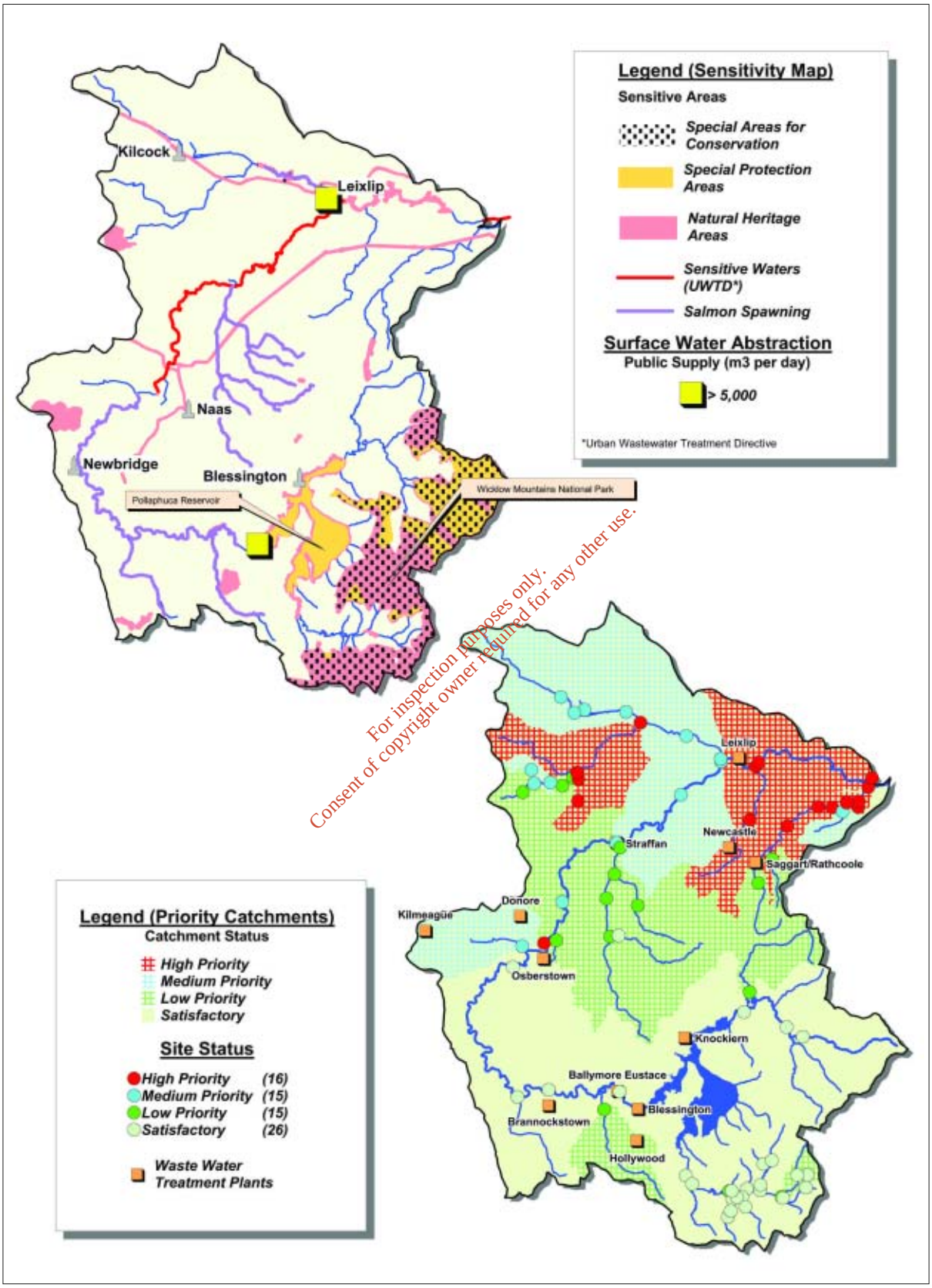
"Risk Maps" have been produced, which identify areas that have higher potential to generate nutrient loss than other areas due to their physical characteristics (slope, soil characteristics, rainfall etc.) and the type and intensity of landuse activity.

"Sensitivity Maps" have been developed, which identify river stretches or water bodies considered particularly sensitive to nutrient pollution due to their "beneficial use" for water abstraction, fisheries resources and amenity or because of their ecological importance.

"Priority Catchments" have been identified based on poor biological water quality, elevated MRP (Molybdate Reactive Phosphate, a form of nutrient most available to aquatic plants) concentrations, and MRP loads, i.e. the amount of phosphate produced per hectare per year from each sub-catchment.

The Sensitivity Map and Priority Catchment Map for the Liffey catchment are shown in **Map 1**.

Project monitoring data and investigations in pilot study areas indicate that agricultural landuse/activities export approximately two-thirds of the total phosphorus load to each of the catchments while "regulated" point discharges (MWWTPs and licensed discharges) contribute approximately one quarter of the total load. The remaining phosphorus load is generated by unsewered populations (3 to 8%) (e.g. septic tank users), urbanised areas (1 to 10%) and forestry and peat land (3 to 7%). The contribution of phosphorus from "background sources" such as rainfall and natural processes of soil erosion etc. are included in these figures.



Map 1 Sensitivity Map and Priority Catchments (Liffey)

2. Monitoring Systems

The Project has established comprehensive monitoring systems comprising physico-chemical and biological (water quality) and hydrometric (water quantity) networks in the three catchments.

These monitoring systems:

Identify the areas and sectors generating high nutrient losses so that management strategies to minimise losses can be targeted effectively.

Facilitate the calculation of nutrient losses from catchment areas and,

Enable continual review of water quality in the river systems.

Water quality monitoring networks include biological monitoring based on the EPA macro-invertebrate "Q Index" at between 52 and 70 sites in each of the catchments on an annual basis. Physico-chemical monitoring (focusing on nutrients) is carried out on a weekly basis at 75 to 85 sites in each catchment. In addition, monitoring is carried out on a daily basis (using automatic samplers) at key locations, for example at the bottom of pilot sub-catchments and at the freshwater limit of each of the 3 main channels.

The Project has established two new, dedicated laboratories at Trim, Co. Meath to operate the monitoring networks in the Boyne and Liffey catchments and at Clonmel to operate the Suir network. Each Project laboratory has a resident staff of a chemist, laboratory technicians and dedicated sampling technicians. Over 25,000 water samples have been analysed in the laboratories in the past two years. The laboratories participate in a number of laboratory inter calibration schemes including the EPA Interlab, Aquacheck and CSL.

Hydrometric Monitoring on the Kings River.

Significant improvements to the hydrometric (water quantity) monitoring infrastructure were undertaken by Local Authorities in each of the catchments on behalf of the Project. The number of hydrometric stations has now increased by 120 to 140% in each of the catchments. Water levels are recorded on a weekly basis at the majority of stations and on a daily basis at key locations using automatic recorders. River flows are calculated by the EPA on behalf of the Project from these water level records, using verified rating curves. Accurate knowledge of water levels and flows allows the calculation of pollution loads, the prediction of the effects of new discharges to, or abstractions from, rivers, and can also facilitate flood forecasting by other Agencies.

Valuable databases of biological and physico-chemical water quality and water flows have been compiled in easily accessible formats for each of the three catchments. Knowing the concentration of the nutrient in the water and the flow of water at a certain point, the amounts of nutrient entering the river upstream of that point can be calculated. Effective management measures can now be implemented to limit nutrient inputs based on sound background data, collected in a scientific manner.

The Project has delivered the structures and mechanisms to carry out this comprehensive monitoring system into the future.

Water Quality in the Three Rivers Catchments

Baseline water quality data in the three catchments was established at the start of the Project using data collected from existing monitoring programmes.

The physico-chemical baseline quality was established from Local Authority monitoring data from 1995-97 while the biological baseline quality was established from EPA monitoring data from 1996 (Suir catchment) to 1998 (Liffey catchment). Using the comprehensive datasets gathered from the Project monitoring networks, the Project team has been able to track the changes in water quality in each of the catchments over the intervening years particularly in relation to the amount of phosphorus (P) and nitrogen (N) in the river systems and the resultant biological quality (Q Index).

These nutrients (particularly phosphorus) are important because in elevated amounts they can cause excessive algal and weed growth, which in turn will remove oxygen, vital for fish and other creatures, from the water during the hours of darkness. The Q Index, based on pollution sensitive and pollution tolerant communities living on the bottom of a watercourse, provides a longer-term picture of the effects of water quality on the ecosystem of the river. Based on this Q Index "Biological" water quality is split into 4 classes, "unpolluted", "slightly polluted", "moderately polluted" and "seriously polluted".

Map 2 shows current (2001) biological water quality at each of the Project monitoring sites. However, because the Project monitoring network is focused at the downstream ends of tributary catchments and in areas of poor water quality, the assessment of the overall water quality in the catchments may be "conservative".

Management measures recommended by the Project are only now being introduced and the full effect of these measures are not yet apparent in water quality in the catchments. In many cases, particularly in relation to dealing with diffuse sources of nutrient pollution, the benefits of management measures will take some years to be reflected in water quality.

River Boyne

In the Boyne catchment, biological quality improved over the lifetime of the Project.

Out of 54 comparable monitoring sites, (Baseline year and 2001), 29 improved, 24 remained the same and only 1 site deteriorated. In terms of phosphorus concentrations (measured as MRP), 24 out of 29 comparable sites improved over the Project lifetime, however 67% of sites are still above the Project P concentration criteria of 0.03mg/l MRP. Nitrogen levels have also fallen at 86% of sites during this time. Therefore the overall picture on the Boyne is that water quality is improving, but there is still much work to be done before it is returned to "good" quality. **Figure 1** shows the % of phosphorus (P) inputs to the river system from various activities. Agriculture is the largest producer of P accounting for 63% of the catchment total, with sewage and industrial discharge sources accounting for 25% and septic tanks for 8%.

River Liffey

Biological quality deteriorated over the Project period with an increase in monitoring sites classed as moderately and seriously polluted, particularly on the tributaries, though quality in the main channel improved significantly at a number of locations.

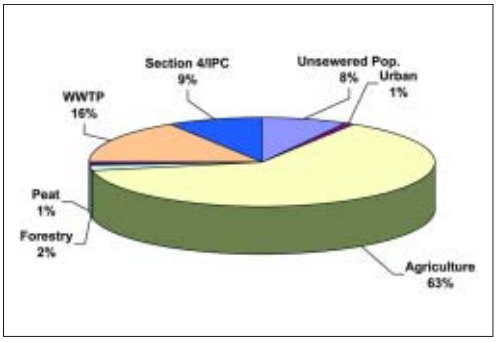


Figure 1 Sectoral TP Loads - Boyne

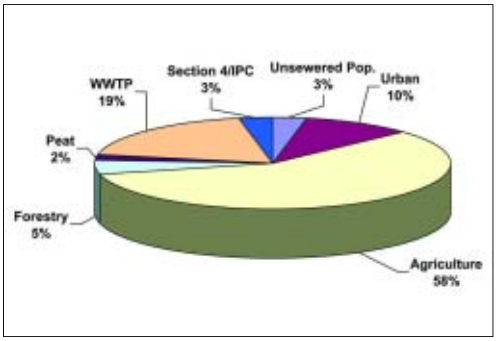


Figure 2 Sectoral TP Loads - Liffey

In terms of MRP, water quality improved (i.e. MRP concentrations decreased) over the Project lifetime, particularly on the main channel where 10 out of 11 comparable sites improved. These improvements are largely due to the upgrading of Leixlip and Osberstown Wastewater Treatment Plants. Nitrogen levels have also fallen throughout the catchment over the Project period. On balance, the overall picture is that water quality in the Liffey has remained relatively stable. **Figure 2** shows that P inputs from agriculture, accounting for 58% of the total is the largest source, with sewage and other discharges contributing 22%. Urban drainage is also a significant factor producing 10% of the total.

River Suir

Biological quality deteriorated slightly over the Project period in this catchment with a decrease in monitoring sites classed as "unpolluted". Although the majority of monitoring sites maintained their quality classification, quality increased at 15% of sites and decreased at a further 15% over the Project period.

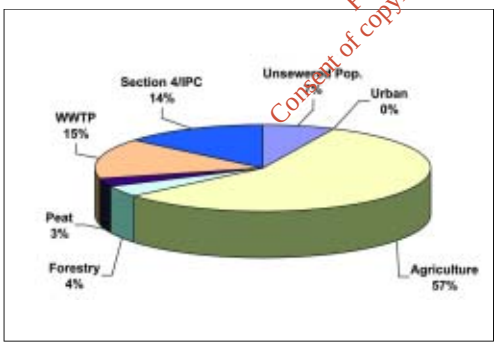


Figure 3 Sectoral TP Loads - Suir

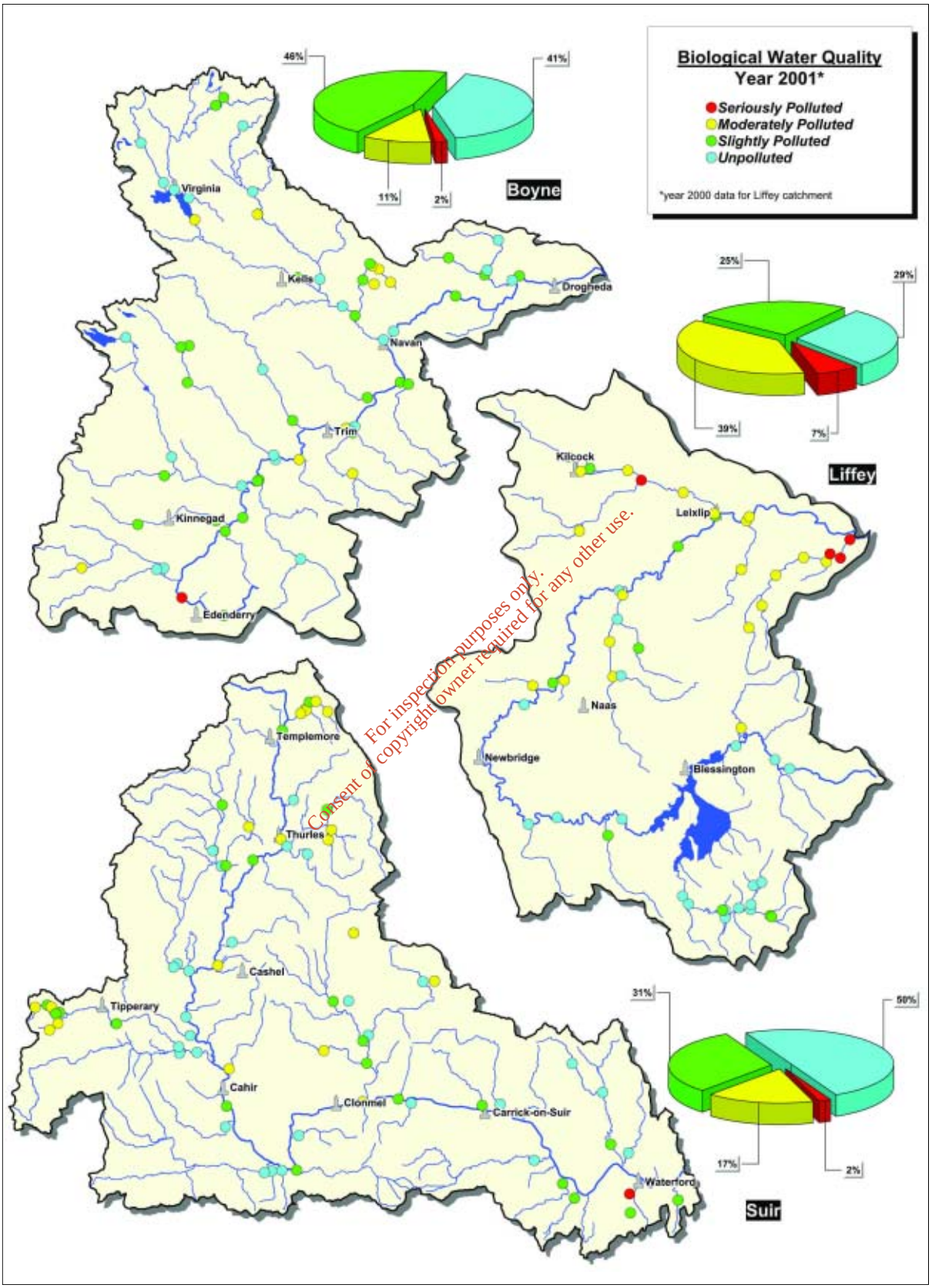
There was no obvious pattern to these changes. MRP concentrations increased at the majority of monitoring sites over the Project lifetime indicating worsening water quality, though nitrogen levels fell at over three-quarters of sites. Overall, water quality in the Suir has declined. **Figure 3** shows the sources of nutrients contributing to this decline. P from agriculture, at 57% is the largest source, with sewage and other discharges contributing 29%. Septic tanks add a further estimated 7% of P to the river system.

Compliance with Phosphorus Regulations

The Phosphorus Regulations (1998) require water quality to be of a certain standard by 2007. A comparison of current water quality at the Project monitoring sites with their 2007 interim target, gives an indication of the intensity of management measures required in order for the Regulation targets to be met in the 3 catchments. The Regulations require each monitoring site to pass its target for *either* MRP *or* Q-rating. The Water Framework Directive (WFD) may require that both criteria be met at each monitoring site. In 2001, 80% of Project monitoring sites in the Suir and 79% of sites in the Boyne achieved P-Regulation target standard. There were no biological monitoring results for the Liffey catchment in 2001, but monitoring data from 2000 shows only 60% of sites would achieve the Regulations target. Compliance with indicative WFD criteria however, is much lower in all three catchments.

	% COMPARABLE WATER QUALITY SITES					
	Boyne (48 sites)		Liffey (50 sites)		Suir (69 sites)	
	2000	2001	2000	2001	2000	2001
Pass Q criteria ONLY/Fail MRP	23	27	12	-	16	17
Pass MRP criteria ONLY/ Fail Q	25	6	20	-	14	29
Pass Both (WFD Compliant)	25	46	28	-	35	34
Pass P Regulation Objective (Either/or)	73	79	60	-	65	80
Fail P Regulation Objective (both)	27	21	40	-	35	20

Table 1 *Compliance with P-Regulation targets*



Map 2 Three Rivers Water Quality (Biological)

Special Investigations

Special investigations were carried out in 8 pilot study areas to examine the impact of specific activities on water quality and test the effectiveness of management measures to reduce such impacts in a number of these. Intensive water quality and hydrometric monitoring programmes were carried out in these areas to generate information on the risk of nutrient loss from specific activities and where possible to quantify that loss.

Medium Intensity Agriculture

Five areas where medium intensity agriculture is the dominant landuse were investigated; the Yellow (Blackwater) and Annesbrook (Moynalty) Rivers in the Boyne catchment and the Clonmore, Ara and Dawn (including Ballyshonnock Lake, which is an important water supply for Waterford City) Rivers in the Suir Catchment.

Detailed surveys of agricultural practices in these areas highlighted a number of "risk factors" in terms of protecting water quality. These included high animal stocking rates, poor management of farmyards and lack of storage for slurry and manures leading to the spreading of slurries at inappropriate times and on unsuitable lands. Background levels of phosphorus in the soils in these areas were generally within acceptable agronomic levels. The Project established that the direct runoff from poor fertiliser spreading practices (either slurries or chemical fertilisers) and poor farmyard management are likely to be the most significant contributors to poor water quality in these areas.

Forestry operations can have negative impacts on water quality

Low Intensity Agriculture and Rural Housing

A study of the Clonshanbo River in the Liffey catchment was carried out to pin-point the source of nutrient inputs in this catchment which is dominated by low intensity agriculture and rural housing development. This complex study indicated that the primary sources of nutrients were agriculture (poor farmyard management and fertiliser usage) and phosphorus stored in river sediments. Because the catchment is relatively flat, water flow is slow and soil and sediments washed off the land during wet weather stay on the bed of watercourses. This phosphorus is then released to the water from the sediments with rising temperature in summer months leading to eutrophic conditions. No elevated phosphorus levels were found in the groundwaters which feed the river system in summer months when rainfall is low. While contamination of groundwater from septic tanks attached to rural housing in the area was not detected, contamination through direct discharges from septic tanks to watercourses can not be ruled out.

Urban Drainage

This study investigated the impact of urban drainage on water quality in the Camac River in the Liffey Catchment. The middle and lower reaches of the river are heavily urbanised and drainage from the M50 and N7 Naas Road also discharge to this river. The principle source of nutrient contamination was found to be the Municipal Wastewater Treatment Plant at Saggart (currently being decommissioned and diverted to the city sewage system) which accounted for up to 50% of the phosphorus inputs to the river. Mis-connections of foul sewage to surface water drains is another major source. A quarter of the phosphorus input was attributed to general urban runoff which could be minimised to a large extent by the implementation of Sustainable Urban Drainage Systems (SUDS) in these areas. This would involve source control systems (filter strips, ponds, swales etc.) to slow the rate of runoff and intercept pollutants.

Forestry Operations

A study was conducted of the Kings River in the upper Liffey Catchment to determine the impact of forestry operations on water quality. Mature commercial forestry development dominates landuse in this catchment. Clear felling, thinning and replanting operations were carried out during the study period but no fertiliser was applied. Project investigators found that in general the operators complied with the Code of Best Forest Practice. Monitoring results suggest that the forestry operations did not have an overall detrimental impact on nutrient concentrations in watercourses. However, due to logistical difficulties in deploying automatic water samplers (ASs) extensively throughout this catchment, investigations were based primarily on weekly grab samples. A further study using ASs is recommended before a direct relationship between forestry operations and nutrient losses can be ruled out. Absolute control of nutrient inputs to this upland catchment is required as, due to the high rate of rainfall and runoff, even a small increase in nutrient concentrations could have a major impact on the Pollaphuca reservoir, which the Kings River enters. This reservoir is the major source of drinking water for Dublin city.

Relationship between flow and nutrient concentrations

In general, monitoring results from the Project auto-samplers deployed in special investigation areas indicated that the concentration of nutrients in watercourses increases as flows increase, suggesting that diffuse discharges (e.g. runoff from the land) and unregulated discharges (such as farmyards, urban drainage and sewer overflows) are a major source of nutrients in most catchments. Reliance on regular one-off grab samples for measuring nutrient loads, particularly in "flashy catchments" (i.e. catchments where there is a rapid runoff of rainfall), can lead to a serious under estimation of the load discharged, by missing out the peak conditions.

3. A Programme of Management Measures

While the onus for ensuring that water quality in our rivers and lakes meets legislative requirements rests with Local Authorities and statutory bodies, the responsibility for implementing management strategies to reduce nutrient inputs lies with all sectors of the community.

A suite of Management Measures **(Table 3)** has been proposed by the Project to minimise nutrient losses from all significant activities carried out in the three catchments and include:

Capital Investment (upgrading of WWTPs, improvements in farmyard infrastructure and storage, Sustainable Urban Drainage Systems).

Statutory Measures (licensing and regulations, planning control, Bye-laws, cross compliance in grant aid/subsidies, "Polluter Pays Principle").

Voluntary Agreements and Schemes (Codes of Good Practice, Rural Environmental Protection Scheme (REPS).

Public Awareness/Environmental Education programmes aimed at all sectors of the community.

Balancing ponds, like this one, can prevent pollution, flooding, and also provide habitats for animals and birds.

A number of measures, (e.g. cross compliance and the implementation of "Nitrate Vulnerable Zones") will require strong political will at a national level to ensure implementation. In addition, some existing regulations need to be reviewed in the light of more stringent environmental objectives required under new legislation. Manpower and financial resources must be made available to L.A. and other bodies to implement these measures. Regular auditing and review of the implementation and effectiveness of measures is essential to continually improve water quality.

As agriculture is the main landuse activity in the three catchments particular emphasis has been placed on developing/refining agricultural management practices to minimise detrimental impacts on the freshwater environment. In conjunction with Teagasc, the Project has "refined" existing Best Farm Management Practices and successfully implemented Best Farm Management Plans on 157 farms in 4 pilot sub-catchments. Innovative practices developed by the Project include:

"Hydrological risk assessment" of land for the application of nutrients,

Nutrient management planning on a field by field basis and,

Linking of slurry storage capacity to hydrological risk and field by field nutrient requirements (subject to the provision of a minimum capacity).

Good farmyard management is an essential part of "Best Practice" and on many of the farms participating in the pilot programme a small change in management practices or farmyard infrastructure would result in significant improvements towards protecting the environment.

The pilot studies in sub-catchments dominated by urban and forestry developments have added to our understanding of the potential impacts of such activities and have helped in the development of management measures and recommendations to minimise losses from these sources.

A number of successful awareness initiatives aimed at encouraging public participation have been delivered by the Project including "The Happy Fish Campaign" aimed at primary school children, a Project website, information leaflets, seminars, field trips and pilot studies to publicise Best Farm Management Practices, and an information leaflet aimed at the owners of septic tanks.

4. Implementation Plan

Under the current government structures, the responsibility for the implementation of these Catchment Management Systems will fall substantially on Local Authorities within the context of the wider River Basin District (RBD) to be formulated under the Water Framework Directive. The Project has proposed a catchment/regional management structure to guide and oversee the implementation of the various management strategies. This *Management Structure* includes:

A **Management Committee** drawn from the L.A. responsible for water bodies in the catchment/region, with responsibility for prioritising strategies, securing funding and auditing implementation:

An **Implementation Group** drawn from the L.A., statutory bodies and "stakeholder" groups (e.g. farm organisations, industry bodies) with responsibility/accountability for implementing measures including "Codes of Good Practice".

An **Expert Group** of specialists to advise in specific disciplines.

A **Support Team** composed of a GIS specialist and an environmental and agricultural scientist to assist the Implementation Group and Management Committee.

The Project provides a blueprint for the implementation of management measures at catchment and sub-catchment level. There are a limited amounts of manpower and financial resources available to tackle problems with water quality.

The Project advocates a targeted stepwise approach to determining the appropriate management measures to be implemented in any particular area to achieve the most effective use of these limited resources. The approach is based on:

Identifying major risk characteristics and pressures at catchment scale.

Identifying Environmental Quality Objectives/Standards (EQO) for each waterbody based on its use and ecological sensitivity.

Monitoring water quality and quantity to identify areas/water bodies not achieving their EQO and to identify activities and land areas having a detrimental impact on water quality.

Prioritising the implementation of management measures based on the following criteria:

1. Current Water Quality - (both physico-chemical and biological) with priority given to areas where poor water quality and/or high nutrient load is identified *(aimed at achieving compliance with Phosphorus Regulations, Nitrates Directive and Water Framework Directive).*

2. Sensitivity of Water Resource - priority given to areas of "beneficial use" or ecological importance, with high sensitivity to pollution *(aimed at protecting specific water resources).*

3. Risk Characteristics - priority given to "high risk" areas where intensification of existing activities or new activities may lead to deterioration in water quality in the future *(forward planning aimed at avoiding problems in the future).*

Where the source of nutrient inputs can be identified, implement the appropriate management measure from **Table 3**.

Where the source cannot be identified, implement on the ground investigations to determine the most likely cause.

Assess planning applications in relation to Risk Map and target management measures in high risk areas when resources are available.

Priority sub-catchments have been selected by the Project in the three catchments based on current water quality and nutrient loads from each sub-catchment. **Table 2** shows the Priority Catchments selected by the Project.

CATCHMENT	SUB-CATCHMENT	MAIN MANAGEMENT ISSUES
BOYNE	Boyne main channel, Knightsbrook	MWWTP, Agriculture
	Mattock/Devlin's, Moynalty	Agriculture
	Skane, Clady	MWWTP's
LIFFEY	Main Liffey channel d/s of Leixlip, Camac	MWWTP's, Urbanisation
	Griffeen	MWWTP's
	Main Lyreen	Agriculture, Urbanisation
	Upper Lyreen from source to Lyreen Br.	Agriculture
SUIR	Ara, Suir d/s of Thurles, Outeragh, Suir d/s Cahir	Agriculture, MWWTP`s
	Black Stream (Cashel)	MWWTP
	Clover	Agriculture, Septic Tanks
	Blackwater (Kilmacow), Clonmore, Clashawley	Agriculture
	St Johns (Provisional)	Industrial, agricultural, urbanisation

Table 2

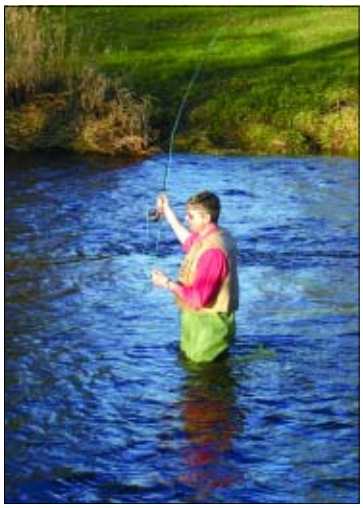
Local Authorities can further refine this selection based on additional criteria detailed above and any additional information. The implementation of management measures should be phased in terms of achieving short, medium and long term objectives and be related to manpower resources and the capital investment available.

The Project has compiled "Management Sheets" for each sub-catchment of the river systems that identify the specific management measures appropriate to address pressures in the individual sub-catchments.

5. Catchment Management Tool - Catchment Envisage GIS

The Project has delivered a customised Geographical Information System (GIS), based on MS Access and MapInfo, designed for managing and presenting data at a catchment scale. The system is now operational in 18 Local Authorities in the Three Rivers Project area.

The system comprises of remote stand-alone modules to capture and manage data relating to water monitoring, "pressures", farm surveys etc, and a central system to manage and analyse data collected from these sources. The central system allows a manager to review the monitoring or survey results against background layers of catchment characteristics such as soils and topography, to easily produce pre-formatted maps for reports, and to exchange data with the relevant government agencies. Catchment Managers can generate full Nutrient Management Plans (NMP's) and Best Farm Management Plans using customised modules. Data for initial and detailed farm surveys can be stored and analysed on the system facilitating annual auditing and updating of farm plans and recommendations. A number of pre-formatted maps and reports are provided and there are also the facilities for Catchment Managers to define outputs, and save these as part of the users default system. Development of this GIS was undertaken in conjunction with the Local Government Computer Services Board (LGCSB).



Increasing water quality benefits everyone

Key Recommendations

The Project makes the following key recommendations in relation to facilitating effective and efficient river catchment management in the future, based on the experience gained over the course of the Project:

1. Responsibility for catchment management should be co-ordinated by a single management structure which is representative of all significant stakeholders in the catchment. This structure must be adequately resourced, and authorised, to implement existing and new legislation aimed at protecting water resources. In addition, the presence of Field Operatives on the ground helps to raise public awareness and deters polluters.

2. A step-wise approach to identify pressures on water quality and appropriate management measures is recommended for the efficient use of available resources within the 3 catchments. There may also be merit in considering this approach on a national scale.

3. The Project Monitoring Programme should be integrated with L.A. and EPA monitoring to provide an integrated Programme aimed at the protection of all water bodies.

4. The Project automatic samplers at key locations in the catchments should continue as an essential part of this programme and additional automatic samplers should be installed on a temporary basis in flashy catchments and locations particularly sensitive to eutrophication.

5. The intensive monitoring programmes in the agricultural pilot catchments should be continued to evaluate the effectiveness of the management measures implemented in those areas.

6. The recommended upgrade of the hydrometric network should be completed and primary responsibility for the hydrometric networks, transferred from the L.A. to the EPA, with the exception of OPW and ESB stations. Resources must be allocated to the EPA to allow this.

7. A National Dangerous Substance Monitoring Network should be established and supported by an accredited laboratory, capable of analysis to legislative detection limits. In addition, National Dangerous Substances Protocol should be established to deal with the taking, handling, analysis and reporting (of these samples).

8. The Urban Wastewater Treatment Regulations should be reviewed in relation to achieving Environmental Quality Objectives/Standards required under the Water Framework Directive and the Phosphorus Regulations.

9. Monitoring requirements for all MWWTP and licensed discharges should be adequate to allow the calculation of the nutrient load discharged by the facility **(Technical Summary Part 4, Table 43)**. Existing discharge licences should also be reviewed, and new applications assessed, with respect to achieving Environmental Quality Objectives/Standards in receiving waters. This should also include the review of Section 16 discharges to foul sewer in areas of poor water quality.

10. Local Authorities should adopt and implement the "Polluter Pays Principle", with respect to applications for discharge licenses.

11. Best Farm Management Plans (BFMP) as implemented by the Three Rivers Project should be adopted as a standard for farming throughout the catchments, and should be audited on an annual basis by an accredited planner.

12. The implementation of "Cross Compliance" principles in relation to payment of subsidies, grant aid etc. would be an appropriate method for ensuring adoption of BFMP on a catchment basis.

13. Participation in REPS (Rural Environmental Protection Scheme) should be encouraged throughout the catchments. The criteria for participation should be revised to include a wider range of farming enterprises or a similar scheme developed to attract large or high intensity enterprises. REPS plans should be assessed yearly by independant, accredited planners, who in turn, should also be audited and re-accredited on regular basis.

14. Public Awareness programmes should be adequately resourced and implemented on an ongoing basis to engender ownership among all sectors of the community of both the problems and solutions in relation to protecting water resources.

15. Gaps were identified in a significant number of data sets required for determining Risk Characteristics, Pressures and Sensitive Waters (see Technical Summary). It is recommended that data gathering programmes be funded and executed at a national level to fill these gaps.

Table 3 summarises specific management strategies appropriate to the defined pressures in order to maintain and improve water quality and environmental management of water resources.

Conclusion

The Three Rivers Project provides a blueprint for the implementation of catchment or river basin monitoring and management systems. The project has delivered dedicated physico-chemical, biological and hydrometric monitoring systems in the three catchments with the infrastructure to support these systems. Key pressures in each of the catchments have been identified and a suite of management measures formulated to address each of these issues. Priority catchments have been identified for immediate implementation of management measures and a stepwise approach developed for continually updating management priorities in these catchments, and there may be merit in extending this approach to other catchments in the River Basin Districts (RBDs). A customised catchment management GIS has been delivered and deployed to manage and analyse catchment data and to facilitate auditing, revision and updating of management plans.

The success of the management programme is totally dependant on the implementation of the measures proposed. This requires the commitment of the Government and Local Authorities to achieving the degree of phosphorus reduction required in each of the catchments. This commitment needs to be backed up by the allocation of adequate manpower and financial resources at catchment and regional level.

With this commitment, the recommendations of the Three Rivers Project will be a key factor in delivering Ireland's commitments under the Water Framework Directive in relation to the reduction of phosphorus inputs.

What next?

The EU Water Framework Directive (WFD) was adopted in 2000 and advocates an integrated approach to managing all water bodies including surface waters, groundwaters and transitional and coastal waters. This Directive will act as an umbrella for all legislation aimed at protecting water resources in the future. Waters will be managed at River Basin District (RBD) level (a collection of river catchments). River Basin Management Plans must be prepared by 2009 and "good status" achieved for all water bodies by 2015. The River Basin Management Projects currently being commissioned by the DOELG are a key step towards the implementation of the WFD in Ireland. The Liffey and Boyne catchments will be incorporated into the Eastern River Basin District while the Suir catchment is included in the South-Eastern River Basin District.

The Three Rivers Project wishes the River Basin Management Projects every success over the coming 4 years.

POLLUTION SOURCE	KEY MANAGEMENT MEASURES
	Regulated Point Discharges
MUNICIPAL WASTEWATER DISCHARGES	• Review Urban Wastewater Treatment Regulations (UWTRs) in the light of Phosphorus Regulations and Nitrates Directive requirements • Increase frequency and extent of Discharge Monitoring and determine nutrient load discharged • Revise Discharge Limits to achieve environmental quality objectives in receiving waters
TRADE & INDUSTRIAL DISCHARGES	• Upgrade, maintain and audit the performance of **All** plants • Increase frequency and extent of Discharge Monitoring and determine nutrient load discharged • Revise Discharge Limits to achieve water quality objectives in receiving waters • Implement waste prevention strategies by applying Best Available Technology to reduce nutrient load at source • Implement "Polluter Pays Principle" to encourage reduction at source
	Unregulated Point Discharges
URBAN DRAINAGE	• Planning Control - Zoning, Building Regulations, licensing of discharges • Source Control - of contaminated runoff eg. bunding, correct miss-connections • Implement Sustainable Urban Drainage Systems (SUDS) in new developments and retrofit in existing developments • Emergency Response to manage accidental spills
SEPTIC TANKS	• Planning Control – appropriate siting, level of treatment, quality of construction • Education of owners in proper use and maintenance
	Diffuse Discharges (including farmyards)
AGRICULTURE	• Implement Best Farm Management Plans (BFMP) on **All** farms • Encourage participation in Rural Environmental Protection Scheme (REPS) • Implementation by the Government of "cross compliance" between direct payment schemes and environmental farming practices • Implementation of Legislative Control – Water Pollution Act (Section 12s, Agricultural Bye-laws) and Waste Management Act (spread lands) • Environmental Awareness programmes promoting the uptake of "Codes of Good Practice" in farming.
MUNICIPAL & INDUSTRIAL SLUDGES	• Develop and implement sludge management plans under the Waste Management Act at a catchment level • Implement Nutrient Management Plans (NMP) for all lands on which the spreading of sludge is authorised • Auditing of waste licenses and NMP with respect to spreadlands • Development of a "spreadland" module for a catchment Geographical Information System to enable efficient tracking and auditing of sludge spreading.
FORESTRY	• Implement, monitor and audit Code of Best Forestry Practice • Monitor the impact of forestry activities on water quality using automatic samplers • Implement Water Pollution Act where impact is shown
PEAT EXTRACTION	• Implement engineering solutions to minimise the release of sediments from drainage and extraction activities • Develop and implement a Code of Best Practice for extraction activities in consultation with L.A., EPA and Fisheries Boards

Table 3 *Key Management Measures*

THREE RIVERS PROJECT PARTNERS

THE THREE RIVERS PROJECT PARTNERS

The Three Rivers Project is sponsored by the Department of the Environment and Local Government, with 85% financial support from the European Union Cohesion Fund.
The project is jointly administered by Meath County Council, Kildare County Council and Tipperary (S.R.) County Council.

The overall project is managed by a Steering Group, which consists of representatives of the following organisations:

Environmental Protection Agency

Department of the Environment and Local Government

Central Fisheries Board

Kildare County Council

Meath County Council

Tipperary (S.R.) County Council

The project is being carried out in partnership with the following constituent Local Authorities in the catchment :

Cavan County Council

Cork County Council

Drogheda Borough Council

Dublin City Council

Fingal County Council

Kildare County Council

Kilkenny County Council

Limerick County Council

Louth County Council

Meath County Council

Offaly County Council

South Dublin County Council

Tipperary (NR) County Council

Tipperary (SR) County Council

Waterford City Council

Waterford County Council

Westmeath County Council

Wicklow County Council

Other participating agencies are :

Bord na Móna

Coillte

Department of Agriculture and Rural Development

Dúchas

Eastern Regional Fisheries Board

Electricity Supply Board

Forest Service

Geological Survey of Ireland

Irish Cattle Traders and Stockowners Association (ICSA)

Irish Creamery Milk Suppliers Association (ICMSA)

Irish Farmers Association (IFA)

Local Government Computer Services Board

Office of Public Works

Southern Regional Fisheries Board

Teagasc

The Three Rivers Project is 85% funded by the European Union Cohesion Fund

THREE RIVERS PROJECT

Water Quality Monitoring & Management

BOYNE CATCHMENT

Meath County Council
(Environment Section)
County Hall
Railway Street
Navan Co. Meath

Telephone Number: 046-9021581
Fax Number: 046-9021463
E-mail: info@meathcoco.ie

LIFFEY CATCHMENT

Kildare County Council
(Environment Section)
St Mary's
Naas Co. Kildare

Telephone Number: 045-873838
Fax Number: 045-873848
E-mail: secretar@kildarecoco.ie

SUIR CATCHMENT

South Tipperary County Council
(Environment Section)
Emmet Street
Clonmel Co. Tipperary

Telephone Number: 052-34456
Fax Number: 052-24355
E-mail: secretary@southtippcoco.ie

www.threeriversproject.ie

This report was printed on fully recycled paper

M.C.O' SULLIVAN - Consulting Engineers