MERSEY RIVERCARE PLAN

2 - DASHER - MINNOW

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Natural Heritage Trust

Helping Communities
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DEVONPORT

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Tasmania
DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

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Mersey Catchment Vision 2020 in Essence

- Excellent & elevated surface water quality
- Equitable sharing of water between environment & industry.
- Effective control of weeds & pests.
- Enhanced & exceptional native biological diversity.
- Economically & environmentally sustainable land management.
- Enterprising & enthusiastic catchment communities.
- Extraordinary natural recreational and social amenities & opportunities.

Executive Summary

The philosophy behind the Rivercare Plan arises primarily from the River Styles™ methodology (Fryirs & Brierley, 1998[1]) and from the Australian Stream Rehabilitation Manual (Rutherfurd, 1999[2]).

These approaches require as input:

- The vision and goals sought by the community responsible for the river system
- Past, current and target conditions
- Defined natural assets and problems threatening these assets, and the trajectories of both

This information enables priority setting for action, based on both the communities' aspirations and the current biophysical and ecological regime of the system.

The Mersey Rivercare Plan develops specific actions for high priority places throughout the catchment, and provides a framework to assess the priority of locations not covered in detail.

It sets out a framework that awards highest priority to areas where the river system is intact, with important assets, and lowest to areas that are degraded, have little impact on other areas and are lacking important defined assets.

This is achieved by analysing at three scales (subcatchment, reach and project), using six ranked categories (conservation, strategic, linked, unlinked, rehabilitation only, low recovery potential). Priorities are allocated within this cascade, with the reach scale generally being the most important: ie. if two projects were being compared for funding priority, a strategic reach in an unlinked sub-catchment would be higher priority for works than an unlinked reach in a strategic sub-catchment.

This Rivercare Plan is a fully defensible, strategic investment plan for rehabilitation of the Mersey River system in its entirety and is based squarely on the communities' aspirations as outlined in the Vision statements. The priorities as are set out in Tables 5 - 9 and investment should be based on these rankings, in conjunction with the text that accompany the tables.

However, it is important that these guidelines are not interpreted rigidly, and that local communities' enthusiasm and dedication are rewarded with support from the Mersey Catchment Steering Committee: after all, unless there is voluntary participation in these rehabilitation activities nothing will happen.

Feedback from the catchment community has indicated that they are generally focused on investing in reaches in poorer condition as it is these areas that worry them.
Thus the combination of the Plan with the implementation activity of the catchment community, should result in a balance between a 'top-down' strategic approach, and a 'bottom-up' self-interest approach.

[1] Fryirs , K and Brierley, G (1998), The use of River Styles and their associated sediment storage in the development of a catchment based river rehabilitation strategy for Bega/Brogo catchment, south coast NSW, Macquarie Research Ltd, Sydney

[2] Rutherfurd, I, Marsh, N., Jerie, K., 1999, Australian Stream Rehabilitation Manual, Land and Water Resources Research and Development Council, Canberra.

1. Vision for stream and riparian management

The vision for riparian conditions sought for the catchment has been expressed as a series of policy statements that cover the range of issues found in the system[3]. Together, they clearly state the communities' view of what the river system should look like in the future.

Continuous improvement policy statement

This overarching policy statement refers to all aspects of the natural resource management strategy.

The Mersey Catchment Steering Committee (MCSC) seeks to attain continuous improvement in all measures of catchment health from present conditions.

Riparian Soils

The soil lining the banks and forming floodplains is an asset susceptible to loss by bank erosion and flooding. This has both ecosystem and production impacts: erosion in one place will degrade natural values in lower reaches (including the estuary) and also reduce the productive assets where the erosion occurs

The MCSC seeks to protect soils resources throughout the catchment and encourages appropriate vegetative cover and channel works to reduce the impact of scour on riparian soils.

Riparian Vegetation

In most cases, native riparian vegetation should be protected where it is in good condition, rehabilitated where degraded and revegetated where absent. This includes:

- Diverse vegetation with understory species, acting in a functional sense (erosion control, bank stability, filter and buffer strips) and as habitat for the stream, the riparian zone and as 'wildlife corridors'
- Aquatic vegetation in streams and in wetlands
- Willows are considered a threat to the natural values of the catchment and will be replaced with diverse and effective native vegetation where prudent to do so. Exceptions to this are areas where they perform a critical role in erosion control or where replacement cannot be guaranteed
- Other exotic weeds will be replaced with diverse and effective native vegetation where possible, but these areas generally have a lower priority than willows
- There is an ambivalent attitude to silver wattles due to their short life and habit of falling into the stream and causing erosion

The MCSC recognises that riparian rehabilitation will need to protect and rehabilitate native vegetation wherever feasible, and will reduce the impact of riparian weeds-willows in particular-but recognises that this is an on-going process, and that any woody vegetation is better than none in most circumstances.

[3] These policies were developed at the Riparian Working Group forum Your Future River, on 16 December 1999 at the Sheffield Senior Citizens Club

Aquatic and Riparian Fauna

In most cases, native aquatic and riparian fauna should be protected and habitats rehabilitated to encourage their recolonisation. This will largely be achieved through other actions such as revegetation and structural works. However, in some cases, populations of native animals (invariably herbivores) has exploded, causing an ecosystem imbalance.

The MCSC recognises that riparian rehabilitation will need to protect and rehabilitate habitats for native aquatic and riparian fauna, but will seek to discourage animals that have become 'pest species', such as brush tail possums and native hens.

Floodplains

It is recognised that floodplains have natural as well as productive functions. In natural situations, while active in floods, they:

- convey much of the water, reducing the effective power in channels
- act as 'cleansers', trapping and settling sediment
- are a source of food and habitat to aquatic life

However, many floodplains and their associated channels have changed, the channels are enlarged and the protective riparian and floodplain vegetation has been cleared for production: intensive cropping and grazing. This compromises their natural functions by:

- concentrating flow in the channel and increasing effective power to scour banks and streambeds
- allowing increased erosion on floodplains due to lack of vegetative cover, thus changing the floodplains from net sinks to net sources of sediment
- reduces available habitat to aquatic life

The MCSC recognises that riparian rehabilitation will need to tread a line between the natural and productive functions of floodplains, and will seek to rehabilitate the riparian and associated zones to a level that is consistent with the productive uses of floodplains.

Wetlands

Wetlands are considered assets due to their flow buffering capacity, their biodiversity and a means of monitoring 'catchment health'. However, it is recognised that wetlands in productive land are often regarded as boggy places that reduce productivity and are thus drained. This has occurred in the past at a sub-catchment scale, and will probably continue at a farm level.

The MCSC recognises the natural values of wetlands and will seek to define:

- those areas that are considered critical to catchment health
- indicators of wetland importance to help guide land managers in decision-making when considering drainage

It will not seek to impose a blanket ban on wetland drainage, but will seek landowner co-operation in the use of environmentally appropriate management practices.

Woody Debris

Large woody debris (LWD) is recognised as an integral component of aquatic health and stability. It provides food and habitat to aquatic life, in some cases structure and stability to channels.

It can, however, exacerbate erosion and channel change, and represent a danger to navigation.
The MCSC recognises the ecosystem value of large woody debris and will seek to retain LWD in streams, and allow realignment of pieces that are causing either erosion or are a danger to navigation.

Public and private infrastructure

In general, infrastructure must be protected, however:

- siting of either public or private infrastructure such as bridges, irrigation intakes and pumps, dams and roading can have detrimental effects on the river systems:
- ill-advised protection works can further degrade the stream
- protection works to alleviate flooding for townships and cropping lands can destroy natural values

The MCSC recognises that siting and protection works must be carried out in accordance with an overall rivercare plan, and that works must be approved by the appropriate river management body.

Clean Water

Degradation of water quality takes many forms and may impact on either aquatic ecosystems or human health, or both.

The MCSC will seek to:

- identify the nature and sources of ongoing pollution
- identify sources of regular, but intermittent pollution
- encourage reduction or elimination of both types of pollution as per the 'Continuous Improvement Policy'

The MCSC recognises that water quality will need to be monitored consistently and regularly.

2. Natural Assets

To help set priorities and target conditions sought for rehabilitation, a clear understanding aquatic and riparian ecological needs is required. However, in many cases these needs are poorly understood. To overcome this limitation, we have taken the approach of seeking to improve habitat conditions and water quality for riparian and aquatic species that are considered sensitive or under threat.

The most sensitive species can be regarded as indicators for other species. Ensuring that conditions are suitable for their survival and reproduction, will probably ensure that the more robust species are looked after as well.

Aquatic species known to occur in the catchment, their habitat preferences and threats are listed in Table 1.

Of these, Australian Grayling, River Blackfish, Giant freshwater lobster and the water snails Beddomiea spp are considered under threat or have disappeared from part of their original habitat. In addition to this, the Grey Goshawk is known to prefer riparian vegetation, particularly where blackwood is dominant.

These populations and habitats that house them are all considered assets.

Thus the habitats sought for protection and rehabilitation are:

Shaded tributaries with intact native vegetation, especially where it contains Blackwood
- Shaded pools, especially with undercut banks and snags
- Intact pool/riffle sequences with small gravel bars
- Snags throughout the catchment, but particularly in mid-size streams
- Intact riparian vegetation
- Marshes and wetlands, both riparian and landlocked

The major problems threatening these habitats are:

- Channelisation increasing flow velocities and leading to erosion
- Clearing riparian vegetation, or allowing stock access
- Channel expansion by either bed or bank erosion contributing sediment and turbidity downstream and drowning habitat diversity
- Marsh and wetland drainage
- Stream channel damage from sand and gravel extraction
- 'Cleaning out' river sections resulting in loss of suitable instream habitat
- High nutrient levels: human wastes, erosion and runoff
- Aerial spraying over or near waterways, leaching through permeable sediments
- Effluent run-off from agricultural practices eg: dairies
- Fish barriers requiring fish to leap more than 150 mm
- Introduced aquatic or riparian weeds out competing native species

Table 1: Known aquatic species in the Mersey catchment

Name	Comments	Species
Australian Grayling	Listed as Vulnerable under the Threatened Species Protection Act (1995), it occurs in clear, gravelly streams with a moderate flow. Prefers deep, slow flowing pools. Threats: habitat loss, overfishing	Prototroctes maraena
Blackfish	This species is dependant on snags in the river for habitat, food and reproduction. It has disappeared from the lower reaches.	Gadopsis marmoratus
Climbing Galaxias	The largest of the Tasmanian galaxias, they inhabit headwaters of clear bouldery streams with riffles and cascades, under stones. Juveniles large schools live in lake margins, near tributary mouths	Galaxias brevipinnis
Mud galaxias	Live in marginal swamps and ditches with no noticeable flow. Threatened by drainage and marsh reclamation practices	Galaxias cleaveri
Jollytail	Juveniles form a substantial part of the whitebait runs. They tolerate a wide range of habitat conditions, but prefer the lower reaches of coastal streams and rivers, in still or slow moving water.	Galaxias maculatus
Sandy	Occupying both fresh and salt water, they are threatened by loss of instream habitat; stream channel damage from sand and gravel extraction; loss of riparian vegetation; Channelisation leading to increased flow velocities	Pseudaphritis urvillii
Tasmanian Smelt	Lower reaches of coastal streams probably in slow flowing water with cover provided by logs and aquatic plants. Threatened by loss of instream habitat and predation from introduced species	Retropinna tasmanica
Spotted mountain trout	Riverine populations prefer lower elevation quiet streams in pools with log debris, overhanging banks and boulders.	Galaxias truttaceus
Tasmanian Whitebait	Were once the basis for commercial fishery and still form a large component of the whitebait run. Prefer lowland estuarine reaches of rivers with suitable spawning habitat	Lovettia sealii
Shortfin eel Long finned eel Brown trout	Likely to be throughout catchment, but status unknown Likely to be in the catchment, but status unknown A very popular introduced recreational fishing species, it was introduced in the late 1800's and has naturalised, spawning on seasonally inundated gravel (20mm) point bars.	Anguilla australis A. reinhardtii Salmo trutta
Rainbow trout	Another popular introduced recreational fishing species, requiring cool well oxygenated water, with adequate cover and shelter. Spawn in gravel.	Salmo trutta
Invertebrates		
Giant freshwater lobster	Listed as Vulnerable under Tasmania's Threatened Species Protection Act 1995, they are the largest freshwater invertebrate in the world. Due to over fishing, their slow growth and low reproductive rates, plus their sensitivity to degraded habitat, severe population declines have been recorded over most of their distribution	Astacopsis gouldi
Freshwater lobster	Lives throughout the catchment, preferring undisturbed smaller streams with pools, undercut banks and instream debris.	Astacopsis franklinii
Yabbie	Naturalised in farms dams? Presently only reported in one dam	Cherax destructor
Dragonflies and damselflies Caddisflies Mayflies and Stoneflies	This very diverse and abundant group of species These three groups of species form the basis for much of the macroinvertebrate communities throughout the catchment. They figure prominently in undisturbed habitats and are indicator species for degrading water quality and habitat	Odonata spp Trichoptera Ephemero-ptera and Plecoptera
Freshwater snail	Rare species found generally in the upland streams	Beddomeia spp

3. River Styles™

A River Styles analysis has been carried out by Guy Lampert, Macquarie Research Ltd[4]. It is a catchment-framed survey of river structure and function that provides a template on which this study is based. All references to River Styles, the four category condition rating, and the management prioritisation are derived from this River Styles analysis.

The aims of the river style assessment are:

i) to characterise, map and describe river styles within the Mersey catchment;

ii) to assess the downstream patterns of river styles and their primary controls throughout Mersey catchment;

iii) to assess the geomorphic condition of rivers in the Mersey catchment;

iv) to discuss the geomorphological basis for river rehabilitation issues within Mersey catchment, using a catchment-based prioritisation framework.

3.1 River Styles in the Mersey Catchment

The river style analysis of the Mersey catchment covers the main streamlines downstream of Parangana dam. These are the Mersey River trunk, Dasher and Minnow Rivers, Lobster Rivulet, Mole, Sassafras, Marakoopa/Overflow, Coilers, Redwater, Caroline, Parramatta, Bonneys and Figure of Eight Creeks.

Ten river styles have been identified in the Mersey catchment which have divided into three broad categories, Confined Valley, Partly Confined Valley and Alluvial Valley. These are briefly described below (for full descriptions and maps, see Lampert, 2000):

Confined Valley River Styles:

- Headwater: these are low order streams with relatively steep gradients. They are completely bedrock confined and sediment storage is usually limited to gravel and boulders. On basalt geologies, headwater river styles have more gentle gradients and display a lower variety of morphologic features. eg, Upper Dasher
- Gorge: this river style is also characterised by being entirely bedrock bounded. It is common throughout the catchment especially along the Mersey and Dasher Rivers. The confined nature of this river style results in high stream powers, giving the stream the capacity to transport large boulders during high magnitude events. eg, Alum Cliffs

[4] Lampert, G (2000) River Styles in the Mersey Catchment, North West Tasmania. School of Earth Sciences, Macquarie Uni, Sydney

- Confined with occasional floodplain: river styles have the characteristics of the gorge river style for much of their stream length. However, isolated pockets of floodplain intervene with some regularity. These pockets are usually associated with areas of increased valley width or with the confluence of a tributary.

Partly Confined Valley With Occasional Floodplains River Styles

- Bedrock controlled discontinuous floodplains: this river style is common along sections of the Mersey River and is also found in middle to upper sections of tributary streams. It is characterised by the channel being bounded by bedrock on one side and a discontinuous floodplain on the other. The high degree of bedrock control means that the position of the channel is relatively stable. eg, Mersey River at Kelly's Bridge
- Planform controlled discontinuous floodplains: river styles occur in valleys that display some regularity in width. This permits the channel to adjust from valley side to valley side, producing floodplains that are discontinuous. Bedrock control is variable, such that the channel in locations is able to meander across the valley floor. eg, Coiler Creek

Alluvial Valley River Styles:

- Intact: is characterised by an alluvial valley fill and no defined channel. The fill is generally composed of fine sediment such as silt and organics. eg, Upper Caroline Creek
- Channellised fill: this river style is the product of the channelisation of an Intact fill. The cause of the channelisation can be for the intentional drainage of wetlands for agriculture or the retreat of a headcut initiated from a disturbance (eg. a road crossing or sediment extraction). eg, Caroline Creek
- Meandering gravel bed: this river style is common in middle to lower reaches of many of the stream lines in the Mersey catchment. Here valley widths are consistently wide enough for floodplains to be continuous along both sides of a channel with moderate to high sinuosity. Gradients are relatively low, making these sites areas of medium to long term sediment accumulation. eg, Dasher River downstream Claude Road bridge
- Low sinuosity gravel bed: is found only along sections of the Mersey River, such as the Merseylea area. It is characterised by a low sinuosity channel bounded by broad floodplains and terraces. The floodplains exhibit considerable evidence of past channel changes suggesting that the river in these areas is prone to avulsion. eg. Merseylea
- Tidal: Due to the lack of a well developed coastal plain in the Mersey catchment, this river style is essentially comprised of the estuary. The estuary is highly bedrock confined, formed through the drowning of the earlier river valley when sea level rose after the last Glacial Maximum., and supports relatively small areas of tidal mud flats.

3.2 River condition in the Mersey Catchment

River condition is a broad reflection of the degree of human impact on a system and indicates the extent which differing reaches have been displaced from an intact, naturally functioning state. Changes to river structure and function have significant impacts for habitat availability and viability and a range of other considerations (e.g. channel/floodplain relationships, river stability and sediment supply).

The categories that will be used to describe the geomorphic condition of rivers in the Mersey catchment are summarised in Table 2.

Table 2: Categories of geomorphic condition

Condition	Characteristics
Near Intact	Geomorphically unaltered from pre-disturbance state. Riparian vegetation is often largely unchanged.
Minimally Impacted	Geomorphic structure is largely unchanged from the pre-disturbance state, but vegetation cover and composition may be significantly altered.
Moderately Impacted	The type, extent and rate of processes are somewhat altered from the pre-disturbance state, but overall the system functions in a similar way. The river has not fully adjusted to prevailing conditions and is experiencing ongoing changes.
Degraded	Considerable geomorphic alteration to the functioning of the system when compared with the pre-disturbance condition. Type, extent and rate of processes are radically altered. The prospects for the river to return to a pre-disturbance condition are limited.

4. Priorities

The general approach to priority setting was discussed with the Riparian Working Group and comprises:

- Look after areas in good condition first, as this represents the best value for money
- Attack 'strategic' or causative problems next, as these contribute to degradation of other reaches. Generally fix problems that are easy to fix first, then the harder problems.
- Ensure that some reaches with a high public profile, capable of demonstrating effective investment, are treated very early in the project
- Work with streams that have committed groups first
- Only those reaches where a maintenance agreement has been struck will receive public funding

This fits in well with the priority setting in River Styles (The River Styles Approach to Management Prioritisation).

The cost benefits in protecting what is in good condition rather than rehabilitating degraded areas is obvious. However, working with committed individuals and groups is the only way that work will be implemented: community motivation and education are critical to any long term plan.

Thus the priorities set throughout this section should be regarded as strategic priorities, but the implementation of works should be guided by the enthusiasm of the local land managers and community, given a championing role by the Mersey Catchment Steering Committee.

Priorities are set at three levels, all reflecting the desire to retain and enhance assets, to abate their threats and to work with committed communities.

4.1 Sub-catchment priorities

The first level allocates priorities on a sub-catchment level (Table 3: Priorities at a sub-catchment level and the map: Mersey sub catchment and reaches). It indicates those regions having assets that are worthy of protection, what the major threats are, and the trajectory of those assets or threats.

This is an indicative, rather than prescriptive, level. This focuses on catchments that should be given priority for works to retain assets that are still in good condition, as it is more cost-efficient to prevent degradation before it happens, rather than working to repair assets that are already degraded. The sub-catchment level further considers that habitats in reaches are linked, and that it is better to expand good reaches rather than work on isolated assets[5].

In terms of final ranking, this scale of priority setting helps to order reaches within the categories, rather than the other way around.

[5] see, for instance, Rutherfurd (1999)[2]

Table 3: Priorities at a subcatchment level

Sub catchment/reach	Assets	Threats	Trajectory
Conservation			
Minnow Catchment	Mostly good reaches	Erosion	Deteriorating
		Willows	Deteriorating
		Plantation forestry	Stable
	Slightly impaired aquatic biology	Pine riparian zone	Stable
	Giant Freshwater Lobster	Loss of habitat, fishing	Deteriorating
Strategic			
Dasher Catchment	Some good upper reaches	Clearing, stock access	Stable
	Trout recruitment and native aquatic fauna	Loss of pool habitat, riparian vegetation	Deteriorating
	Water quality	Sheffield STP, instream erosion	Deteriorating

4.2 Reach priorities

The second scale of the priority setting process examines the reaches within each sub-catchment or segment of the river.

A total of 103 reaches were defined in the catchment using the River Styles analysis (Lampert, 2000). These were defined using unique combinations of River Style, Condition and Management Prioritisation. Note that in this context, condition refers to geomorphic condition, (see page 10, rather than a summary of overall condition. Thus a reach can have degraded water quality, but still be classified as intact.

These are categorised and listed in:

- Table 4: Conservation reaches
- Table 5: Strategic reaches
- Table 6: Linked reaches with high to medium recovery potential
- Table 7: Unlinked reaches with medium recovery potential
- Table 8: Reaches with rehabilitation potential
- Table 9: Reaches with low recovery potential

Map 3: Dasher, Minnow and Middle Mersey Rivers shows the location of reaches, the presence or absence of willow and native vegetation, each in three categories of density. Where streams are mapped, but lacking colours that represent vegetation, it usually means that there is no woody vegetation in the riparian zone:

Conservation reaches

Most conservation reaches are confined valley river styles with bedrock control and are already protected either in formal reserves, or in State Forest under the Forest Practices Code (FPC). These need no further work to ensure that they remain in good condition, with their assets protected, except keeping an eye on forestry operations for adherence to the FPC.
Exceptions to this are reaches wholly within private land, or spanning public and private land.
In the highest priority catchment where this occurs-the Minnow-three reaches are in private hands: MN 2, 3, and 8.

Water quality and aquatic biology in the Minnow are only slightly, and it is one of the best remaining habitats for the Giant Freshwater Lobster. MN 3 has scattered willows which will need management.

These reaches thus fall into the highest priority for protection, with effort required to contact the owners and ensure that threats are managed to protect the assets.

The Dasher has one reach (D6) fully in private hands, two (D4 and D5) that are roughly half on private land, and two (D15 and D16) mostly on public land. The first three reaches have isolated to medium density willows within essentially intact native riparian communities. They are also threatened by sedimentation from upstream. Comments for protection are the same as for the Minnow reaches.

Table 4: Conservation reaches

Stream	Reach ID	Condition	Protected	River Style	Reach Lgth (km)
Minnow River	MN2	Intact	No	Gorge	1.8
	MN3	Minimal impact	No	Valley confined, occasional floodplain	1.1
	MN4	Intact	Y	Gorge	5.2
	MN7	Intact	Y	Valley confined, occasional floodplain	2.7
	MN8	Intact	No	Meandering gravel bed	2.6
	MN10	Intact	Y	Meandering gravel bed	0.5
	MN11	Intact	Y	Valley confined, occasional floodplain	0.9
	MN13	Intact	Y	Valley confined, occasional floodplain	0.8
	MN14	Intact	Y	Headwater	6.1
Dasher River	D4	Intact	Y (some)	Gorge	1.5
	D5	Intact	Y (some)	Valley confined, occasional floodplain	8.1
	D6	Intact	No	Meandering gravel bed	1.7
	D15	Intact	Y (most)	Valley confined, occasional floodplain	3.2
	D16	Intact	Y (most)	Headwater	1.5

Strategic reaches

These reaches (Table 5) are not in near-intact condition, but rehabilitating them leads to benefits either up or downstream, thus fixing them gives a good cost efficiency. They will generally expand the area of good reaches, or prevent problems threatening other reaches that are in near-intact condition.

The Minnow (MN 5, 6, 9 and 12) has the bulk of these reaches, and all but one are privately owned.

The exception (MN12) runs through a second generation pine plantation in State Forest. This was converted to plantation prior to the FPC being enacted, and has been planted and harvested fully into the riparian zone. The second generation has been planted, but the riparian zone has not been rehabilitated and is now full of weeds. Water quality appears to be compromised with turbidity.[6]

Rehabilitation requires weeding (pines and blackberries) and perhaps strategic replanting. This would return the upper Minnow River to near intact condition.

MN9, less than half a kilometre long and with a river reserve on the south bank, is eroding where it emerges out of the bush and has no riparian vegetation. It is the worst reach in the catchment and links near-intact reaches both up and downstream.. As such, it gets a top priority for rehabilitation. Fencing, perhaps with active revegetation and some instream structures to speed rehabilitation are needed to help stabilise the banks.

MN 6 is another short reach with scattered willows in good riparian vegetation, is minimally impacted and should be quite cheap to rehabilitate. It will need fencing. MN 5 is moderately impacted, with medium density willows. Rehabilitation and fencing would complete the whole Minnow down to MN1, which only needs fencing. Details are presented in Map D5.

Table 5: Strategic reaches

Stream	Reach ID	Condition (impacted)	River Style	Reach Lgth (km)
Minnow River	MN5	Moderate	Meandering gravel bed	3.3
	MN6	Minimal	Meandering gravel bed	0.8
	MN9	Moderate	Meandering gravel bed	0.5
	MN12	Moderate	Valley confined, occasional floodplain	3.2

Linked reaches with high to medium recovery potential

These reaches (Table 6) link to intact or near intact reaches, usually upstream. As such, if they are in reasonable condition, they can be relatively easy to repair: seed and sediment supply from upstream allow rapid recovery.

MN 1-a short reach at the base of the Minnow is intact geomorphically, linked to good upstream reaches, but is quite depauperate in native vegetation. Fencing to restrict stock access should see good recovery of the native vegetation

[6] Mersey River Study Committee, 1997., Mersey River Experimental Study, Technical Reports incorporating State of River reports.

Table 6: Linked reaches with high to medium recovery potential

Stream	Reach ID	Condition (impacted)	River Style	Reach Lgth (km)
Dasher River	D2	Minimal	Low sinuosity gravel bed	1.6
	D3	Minimal	Low sinuosity gravel bed	0.3
	D7	Minimal	Meandering gravel bed	2.9
	D14	Minimal	Bedrock controlled, discontinuous floodplains	1.4
Minnow River	MN1	Minimal	Valley confined, occasional floodplains	0.7

Four reaches of the Dasher River (D14, D7, D3 and D2) are linked, with good recovery potential, but as stream condition deteriorates downstream, these four reaches are probably ranked in order of condition as listed.

D14 is bedrock controlled; contains the upstream willow outliers of the Dasher (including some on a minor tributary); and has reasonably intact native vegetation: it should be easy to rehabilitate.

D7 is somewhat isolated; only linked to a good reach downstream. It has quite heavy willow infestation and only scattered native vegetation; is threatened by upstream sediment (although substantial amounts of sand settle out prior to this reach) and nutrient, and has quite impaired aquatic biology. If upstream erosion and sediment delivery can be limited, the reach has a good chance of geomorphic recovery. Riparian recovery will be more difficult.

This section of the river (along with others discussed elsewhere) has high phosphorous levels, and very high E coli counts. The invertebrate sample data6 indicate that degradation may be due more to habitat conditions than water quality. Nevertheless, improving the performance of the Sheffield STP and limiting sediment delivery to the stream will aid riparian recovery.

The lower reaches (D3 and D2), while linked to reasonable upstream reaches, have heavy infestations of willows with difficult access, are evidencing lateral migration, impaired invertebrate populations and water quality. These would get the lowest priority for rehabilitation of the four reaches. Note that channel movement threatens bridge infrastructure: works have been implemented and will continue to be whenever deemed appropriate by the land manager. Much of the willow removal will need to use the more invasive techniques (W3 and W4), but this will not be appropriate in the areas of restricted access and where there are remnants of native vegetation. Here, the best technique would be W1: Stem Injection. Of the different sub-techniques, use of the poison hammer would be best.

Unlinked reaches with medium recovery potential

Reaches (Table 7) not downstream of intact reaches, and in poorer condition, are more difficult to rehabilitate. The flow regime may inhibit recovery, input of sediment from upstream may drown habitat complexity, pollution may be impacting, and the seed supply for natural regeneration scarce. These reaches commonly have on-site problems as well.

Table 7: Unlinked reaches with medium recovery potential

Stream	Reach ID	Condition (impacted)	River Style	Reach Lgth (km)
Dasher River	D11	Moderate	Meandering gravel bed	1.6
	D13	Moderate	Meandering gravel bed	5.6

Two Dasher reaches (D13 and D11) are still in reasonable condition, but due to their isolation from other good reaches, are more difficult to rehabilitate.

D13 is a long (5.6 km) and varied reach, starting at the confluence of O'Neills Creek near Gowrie Park and running down to Patawalonga Rd. Localised bank erosion has infilled some pools and the riparian zone has only scattered native vegetation, with the odd willow. O'Neills Creek has high woody debris loading, with bank undercutting toppling mature trees. This area is a good case study for snag re-alignment: placing snags in the banks and stream to reduce bank-toe scour and provide log sills to mimic natural bed control. Some rock riffles will be needed as well. Willows are a high priority for removal (as they are isolated) using W1 or the less invasive W3 techniques. As most of the reach has some remnant vegetation, fencing alone should aid riparian recovery.

A funding proposal that covers reaches D13 - D5 has been developed by Mt Roland Rivercare Catchment Inc, based on discussions with various riparian experts. Proposed works are presented in Maps D1-D4. These show the location of fencing, revegetation activities, instream works and willow removal. Detailed designs for structures need to be developed.

As D11 is very similar to D13, but only 1.6 km long, the same comments apply.

Reaches with rehabilitation potential

These reaches (Table 8) are, in general, moderately impacted or degraded, expensive and/or risky to fix. As with previous sections, the reaches are presented in a loose order of priority for rehabilitation.

Four reaches of the Dasher River (D1, D8, D10 and D12) are classified as either degraded or moderately impacted. The more degraded reach D9 is considered here as well.

The downstream reach (D1) is choked by willows, aggrades due to excessive sediment supply from upstream, is naturally an avulsive channel and has had considerable channel work performed to reduce flooding and to protect infrastructure. Works for this reach are included in the Merseylea's Rivercare plan

Apart from Kings Creek (the creek that runs through Latrobe), it has the lowest OE score6 in the catchment, and is equal lowest with Parramatta Ck's P1 reach for OESIGNAL. This indicates a site impacted due to both water quality and lack of habitat.

D8 and D10-both in a moderate condition-are separated by the most degraded reach in the Dasher River (D9): all three are meandering gravel bed reaches. Running through floodplains, this river style naturally meanders quite tightly and would always have active, but localised, bank erosion. The channel would have been quite small (although there are few field remnants displaying this) densely

vegetated with titree, and floodwaters would have been mostly carried on the floodplain-unlike now-protecting the channel from the force of floods.

Riparian vegetation clearance, unrestricted stock access, channel straightening and woody debris removal have led to active bed lowering, bank erosion, channel expansion and the consequent increased stream power and excessive sediment transfer. This has destroyed habitat complexity and infilled pools.

In D10, substantial sections of the reach have been rip-rapped over the last twenty years. Together with channel straightening, this has increased the power of the reach tremendously and is probably the cause of D9's active degradation.

The Dasher rivercare plan calls for intensive instream works in D9, which will need to be very carefully designed. Active and intensive revegetation will be needed to help stabilise the banks, and the use of woody debris is strongly encouraged.

Sampling at the Paradise Road bridge falls into the same category as D1 for aquatic health, but is seemingly less impacted by water quality, although the data for this are sketchy6.

D12 requires fencing and revegetation only, and this is scheduled in the Dasher Rivercare Plan.

Table 8: Reaches with rehabilitation potential

Stream	Reach ID	Condition (impacted)	River Style	Reach Lgth (km)
Dasher River	D1	Moderate	Low sinuosity gravel bed	0.9
	D8	Moderate	Meandering gravel bed	5.5
	D10	Moderate	Meandering gravel bed	2.8
	D12	Degraded	Meandering gravel bed	1.7

Reaches with low recovery potential

Only one reach is considered to have low recovery potential (D9).

Table 9: Reaches with low recovery potential

Stream	Reach ID	Condition (impacted)	River Style	Reach Lgth (km)
Dasher River	D9	Degraded	Meandering gravel bed	2

4.3 Works priorities

The third level of priority setting is generic, but is applied at the ground level, where works are contemplated. The preceding analysis provides a strategic framework to prioritise where effort is directed within the entire catchment. This level allows prioritisation within that framework, and can direct effort to areas where no detailed analysis has been carried out.

Transparency and accountability are required in any devolved grant scheme using public money, such as contemplated for the Mersey catchment. Criteria for allocating money need to be clear and unambiguous public policy statements.

Applications for works will come from individuals and groups to work on their own properties. These need to be assessed on-ground, ranked for merit and value for money, monies allocated, and works carried out accurately. This is particularly difficult in rivers, where causation is often difficult to trace, ecological processes are poorly understood and the potential for poor outcomes is high.

These issues are taken into account in Table 9. The MCSC will need to set a minimum level of funding allocation to the high priority works: say 45% to top priority works and 30% to second priority works, with the remainder being spent on third priority or lower works.

Table 9: Priority framework for works

Works to protect assets	Top	Second	Third
Reaches	Conservation Strategic	Linked high/moderate recovery	Unlinked high/moderate recovery
Channel features	Deep pools Snags	Stable undercut banks	5 - 20mm gravels
Habitat (for)	Rare/threatened spp as defined in legislation	Very sensitive genera as defined in Waterwatch manual Native fish	Sensitive genera as defined in Waterwatch manual Trout spawning areas
	Intact native veg	Damaged native habitats without weeds	Scattered native habitats without weeds
Works to manage threats	**Top**	**Second**	**Third**
Geomorphic	Active headcut	Bed erosion	Bank erosion only
Riparian vegetation	Isolated willows in native vegetation	Isolated upstream willows	Damaged native habitats with weeds
Water Quality.	Scheduled premises: STP's, industry	Orchards	Intensive agriculture
Managing impacts from:	Work to identify significant sources of pollution	Areas with poorly operating septic system	Floodplain cropping Stormwater
Infrastructure			Bridges

The table can be used in a variety of ways:

- as an educational tool in public brochures
- to communicate policy priorities of the MCSC in a simple and brief way
- in assessing application for works from community members
- in allocating funds to works
- in communicating progress to stakeholders

For on-ground assessment of potential projects, the table is used by comparing the conditions met at the site with the priorities. The highest priority conditions dictates which category the project falls into for funding purposes and with some further modifications, the data on the form can be used to summarise the entire project's progress

5. Indicators of progress

To demonstrate that implementation of the Rivercare Plan is spending public monies well, there need to be valid indicators of progress. Rutherfurd (1999) recognises five types of objectives that can be measured to evaluate progress (Table 11).

Table 10: Types of objectives for evaluation (after Rutherfurd (1999)

Objective type	Generic objectives	Typical measures
1. Execution outputs	To successfully complete our plan of works.	Did you build three structures and 500 m of fencing, and complete 2 ha of revegetation; as per our plan?
2. Survival outputs	To install works that will withstand expected natural events.	Did the structure survived its design flood (eg 10 year flood)? Did the vegetation survive the summer?
3. Aesthetic outcomes	To produce a more attractive environment To promote recreational use.	Does the reach looks better than it did before. Has the number of recreational users doubled?
4. Physical/ structural outcomes	To improve habitat by increasing physical and hydraulic diversity.	Is the reach more stable? Does it have more varied hydraulic habitat, narrower, coarser bed material, reduced velocity? Are there more snags?
5. Ecological outcomes	To improve the population size, diversity and sustainability of plant and animal communities.	Has the mean population size of a range of macroinvertebrates has increased over 5 years? Have platypus have returned to a reach from which they were absent?

Wherever in-stream works are to be carried out - for instance in the middle Dasher - surveys with set reference points should be set up to assess the effects of structures on bed levels and bank retreat.

Measuring ecological outcomes can be expensive, and require validated scientific techniques. Furthermore, there is always doubt about why the outcomes being measured are present.

Nevertheless, two sets of indicators could be used to assess progress:

Water quality parameters: standard chemo/physical tests taken at above town water intakes, above and below sewage effluent outfalls and any other sites routinely tested. There could be value in setting up standard sites below intended intensive works such as the middle Dasher.

Selected biological parameters: macroinvertabrate sampling at established sites, done in both spring and autumn on a two or three year return period and analysed using both the OE and OESIGNAL protocols. These tests are fairly quick and easy, but do require expertise for reliability and consistency. As threatened species' ecological requirements are being used as surrogates for full ecological understanding quantitative assessment of population distribution and density of, say blackfish with standard effort electrofishing, or Astacopsis with new techniques may be appropriate.

Appendix 1

Sub Catchment descriptions

This sub-catchment priority framework analysis splits the five areas defined by the Mersey Catchment Steering Committee into finer subcatchments and areas with similar issues. Not all areas are real subcatchments, as they are sometimes grouped on issues rather than watershed divides.

The main Mersey River is treated as a series of linked reaches within this analysis.

Refer to the Riparian and Rivercare Background Report for detail on each of the sub-catchments.

1. Dasher/Minnow Catchment

Bounded by watershed divides to the south (Gog Range and Mt Roland), to the west (along Staverton Rd), to the north (to Redwater Ck boundary, from Kimberley Lookout through the Sheffield area, along Stoodley Rd and Sun Ridge) and down to the Mersey River to the east.

The catchment can be divided into:

- The Mt Roland reserve
- Plantations (Gog and Paradise) and forestry on the northern slopes of the Gog Range
- Extensive private plantations and native forestry in the non-basalt lower areas of both the Dasher and the Minnow
- The remainder of the catchment has large rolling hills-often intensively dammed to provide irrigation water and many with basalt soils-plus floodplains along the Dasher, all cleared for cropping and grazing.

Status

- Mersey Forest District Forest Management Plan

The Dasher has high E. coli and impaired invertebrate biology (in the lower reaches) linked to water quality degradation, although both native fish and trout have healthy populations.

The Minnow has slightly impaired invertebrate biology (in the lower reaches) linked to habitat degradation.

Some riffles, willow removal and riparian rehabilitation have been implemented

Appendix 2

Field Trip Notes

Mt Roland Catcment Rivercare Inc, Dasher River, 13th Jan 2000

Present: Astrid Ketelaar, Daniel Sprod, Guy Lampert, Arthur Ford, George Kelly

Attended some of the time: David Klye, Dale Padman

Summary

The Dasher River can be divided into 8 sections:

Section 1, Headwaters to Gowrie Park, relatively intact

Section 2, Gowrie Park to Patawalonga Rd, Good native veg seed source, minor bank and bed erosion

Section 3, Patawalonga Road to Careys Road, some erosion in fairly cohesive soils

Section 4, Careys Road to Claude Road, channel re-alignment, extensive bank stabilisation works, bank and bed erosion still occuring, little channel variation.

Section 5, Claude Rd to Treloars boundary, degraded, extensive stabilisation works required

Section 6, Treloars boundary to Duck Marsh, relatively stable with some native veg

Section 7, Gorge section, relatively intact with some willows

Section 8, Gorge to Mersey junction, lots of willows

Some disagreement between the consultant team and River Engineer on the use of timber versus rock, with the team preferring timber where possible with the aim of creating minor adjustments, which can be easily modified as opposed to rock structures which are designed as permanent fixtures.

The Mt Roland Rivercare Group have done extensive consultation and planning with landowners, council, DPIWE and all adjacent landowners are aware of the proposed river works. A survey has been conducted to aid research into landowner's attitudes and planned works and results compiled.

Expert assistance and advice has been sought through David Klye and David Wright on options for addressing problems.

Follow Up

Arthur Ford and George Kelly will mark 1:10 000 maps current conditions and planned works. Information to be transferred to mapinfo ASAP, by Astrid.

Astrid, Research willow hybridising and potential threat, through Neil Parker and Peter Harrison

Astrid: Research John Cunningham, willow control methods

Pass on recommendation to DA from David Klye re ragwort control

Stop 1, O'Neills Creek, near confluence with Dasher

Some stumps have recently fallen over in O'Neills Creek causing bank erosion.

Recommendation is to stand the stumps up in their original location and fence and revegetate the area.

There is good native veg in this area and no willows. Eucs, Tea-tree. At Dasher confluence the resilient "cathead fern?" is present

Stop 2, George Kelly's property, upstream from Febeys Road.

Some bank erosion, and some rock armouring attempted. Native veg establishing easily where stabilisation of bank has occurred. Stock access restricted in places. Good native veg , for seed source, mainly Tea-tree.

Recommendation is to fence out a bit wider, say 5m, and spot spray pasture. Then scrape the top off sprayed area and scatter seed or plant seedlings.

Stop 3, Patawalonga Road, at Dasher River Bridge (Residential Estate)

Rock armouring of eroding bank: described by David Klye as text book solution.

Recommendation is to finish rehabilitation works now that bank has been stabilised by revegetating the banks

Stop 4, 100m upstream from Careys Road bridge

High eroding bank, threatening pump intakes.

Vegetated on eroding side, and fenced with blackberries growing in riparian zone on opposite lower bank.

Recommendation is to use rootball groins? to deflect water away from eroding bank. Opposite bank will need revegetating. Also construct small rock riffle downstream to slow water down. There was some dispute as to whether a riffle is necessary. The result may be increased flooding and/or channel widening.

Stop 5, Careys Road bridge (Everinghams Creek junction)

Previous bridge washed out '98? New bridge constructed higher and narrower. Western bridge wing wall requires protecting from further erosion. Some Rocks have been positioned to attempt to deflect the flow and reduce velocity. (Council will contribute to cost ?)

Recommendation is to construct a spillway in conjunction with the previous stop's recommended riffle. Also use some logs to further deflect the water. There was some dispute as to whether a riffle is actually required here

From here to Claude Road bridge the landowner (Dale Padman) on the Eastern bank has done extensive willow removal and subsequent bank stabilisation works, and flood mitigation, using rock. The bank is fenced, although very little native vegetation has been allowed to establish. The owner considers the establishment of native vegetation on the bank a high risk and potentially increasing maintenance with regard to his rock stabilisation work. The majority of the western bank will be fenced and revegetated.

Stop 6, Lockwoods Road bridge

Eroding bank on Western side upstream of bridge. Currently fenced but little vegetation. Lots of shingle and not very co-hesive soil. Difficult to stabilise.

Recommendation is to construct a riffle and fence further back from edge of bank and revegetate.

Stop 7, Large Eucalypt (E. ovata?) being undercut, downstream of Lockwoods bridge

The alluvial soil on this flood plain was deposited when stream velocity was slower. Now velocity has increased with subsequent bed erosion and tree roots have reduced effectiveness in stabilising the bank as the bed drops below their effective stabilising range.

Recommendation is to construct riffle downstream of tree and rock armour under tree roots.

Stop 8, Eroding western bank upstream of farm bridge on Padmans'.

Bed lowering and bank erosion in non cohesive soils. Landowner has used logs and earth fill on eastern bank to reclaim land which is now stabilised. He is concerned that further stabilisation works may jeopardise this.

Recommendation is to build two small demonstration riffles

From the small farm bridge downstream the Dasher takes the form of a stone lined drain with very little bed variation. The landowner built a series of small weirs to improve water offtake points, however he was told to remove these by the water management officer in the early 1990's? In hindsight these small weirs would have improved the bed variation. Riparian vegetation on the eastern bank is good for a section approx 200m, linking with adjacent bush block managed for light grazing.

Stop 9, Claude Road bridge, exposed telecom cable

A Telstra cable was buried approx and has become exposed over the last 3 to 4 years. The group estimate that the bed has dropped 1m in the last 15-20 years.

Telstra will pay for works recommended by Rivercare group to protect cable. Plan to do works end of Feb 2000.

Recommendation is to build a riffle between bridge and cable. Bury cable. Extend riffle V to the bridge and reduce erosion potential of banks near bridge. Initially it was suggested that the riffle be built over the cable, however the landowner wants to control stock access, and requested riffle be situated 3m downstream which is probably a better site. Riffle will reduce velocity upstream to 100m and decrease bed erosion in this area.

From this site downstream for approx 2km there is extensive bed and bank erosion and excessive deposition of gravel and sand sourced from local bank erosion in some areas. The channel has expanding to accommodate extra sediment in some areas and stabilisation will be difficult. There is some good native veg on the northern bank for approximately 1km of this section. Levee banks have been constructed in some areas using gravel from the river bed, and this has further exacerbated bank erosion.

The group plans to restrict stock access on both banks (there is some fencing already) and revegetate where there is currently some remnant native vegetation. Off-stream water will be provided where necessary. They also intend to batter the banks in some places.

Recommendations; Stabilising the banks is the highest priority for this section, and controlling the release of sediment overall, with the emphasis on low cost options using vegetation in conjunction with fencing to restrict stock access. It is further recommended that trials be carried out to place existing on site timber at strategic positions to deflect flow off the banks, promote bed scour and to improve habitat. Over time it is envisaged that as the banks stabilise, the amount of loose sediment in the channel will gradually become locked up within channel and channel marginal morphologic features, and an appropriate bed structure with a range of flow conditions will evolve.

It is planned to do a more detailed analysis and recommendations for this section using 1:10 000 maps.

The last approx 500m of this section before Paradise Road on C. Treloars property is relatively stable. There is little in the way of native vegetation, however, bank and bed erosion are minor. The adjacent flood plains are regularly inundated. Some rock armouring is planned for a section of bank erosion on the northern bank.

Recommendation: While the bank and bed appears stable at the moment, further strengthening is recommended by restricting stock access where applicable and revegetating the riparian zone to a minimum width of 5m. (currently cropping into point bars). Planned upstream works may destabilise this area?

From Paradise Bridge to Duck Marsh the riparian vegetation and channel morphology are similar to George Kelly's section. (reach 2) Banks are relatively stable with Tea-tree dominating the majority of the riparian vegetation. Stop 10 is a major problem in this section.

Stop 10, B. Febey's 180 degree turn

Accelerated bend migration is occurring on this site. The landowner has attempted some rock armouring using cement and rock. The landowner's intention is to stabilise banks with willows if funding for alternative options not sourced.

Recommendations

Option 1. Radical channel re-alignment to reduce angle of meander. Fencing and revegetating new channel alignment. There will be off-site impacts while the river re-adjusts itself, with adverse impacts.

Option 2. T-jacks with revegetation. May not be successful if the bend is too acute.

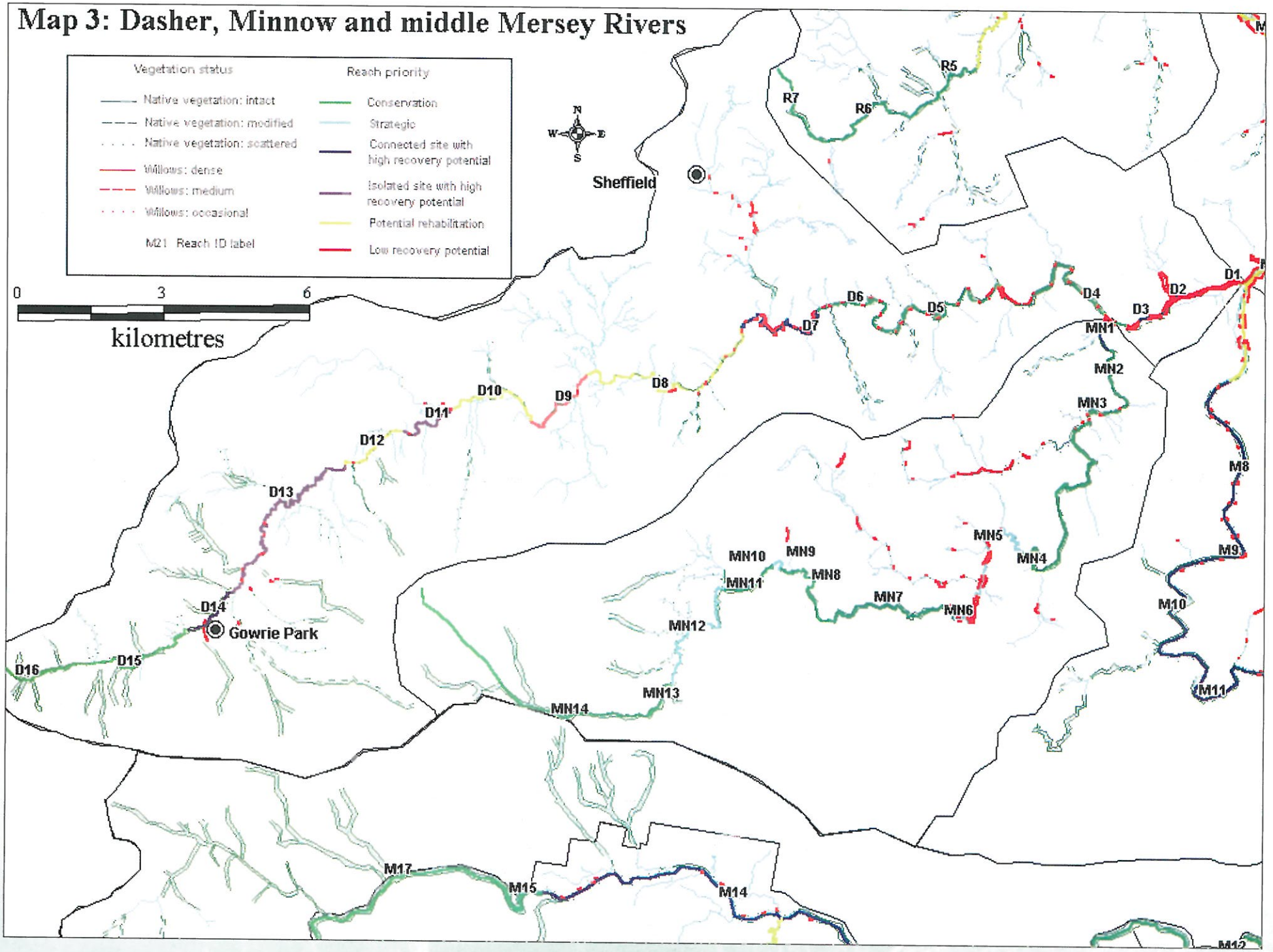
Option 3. Negotiate with landowner to revegetate with natives only.

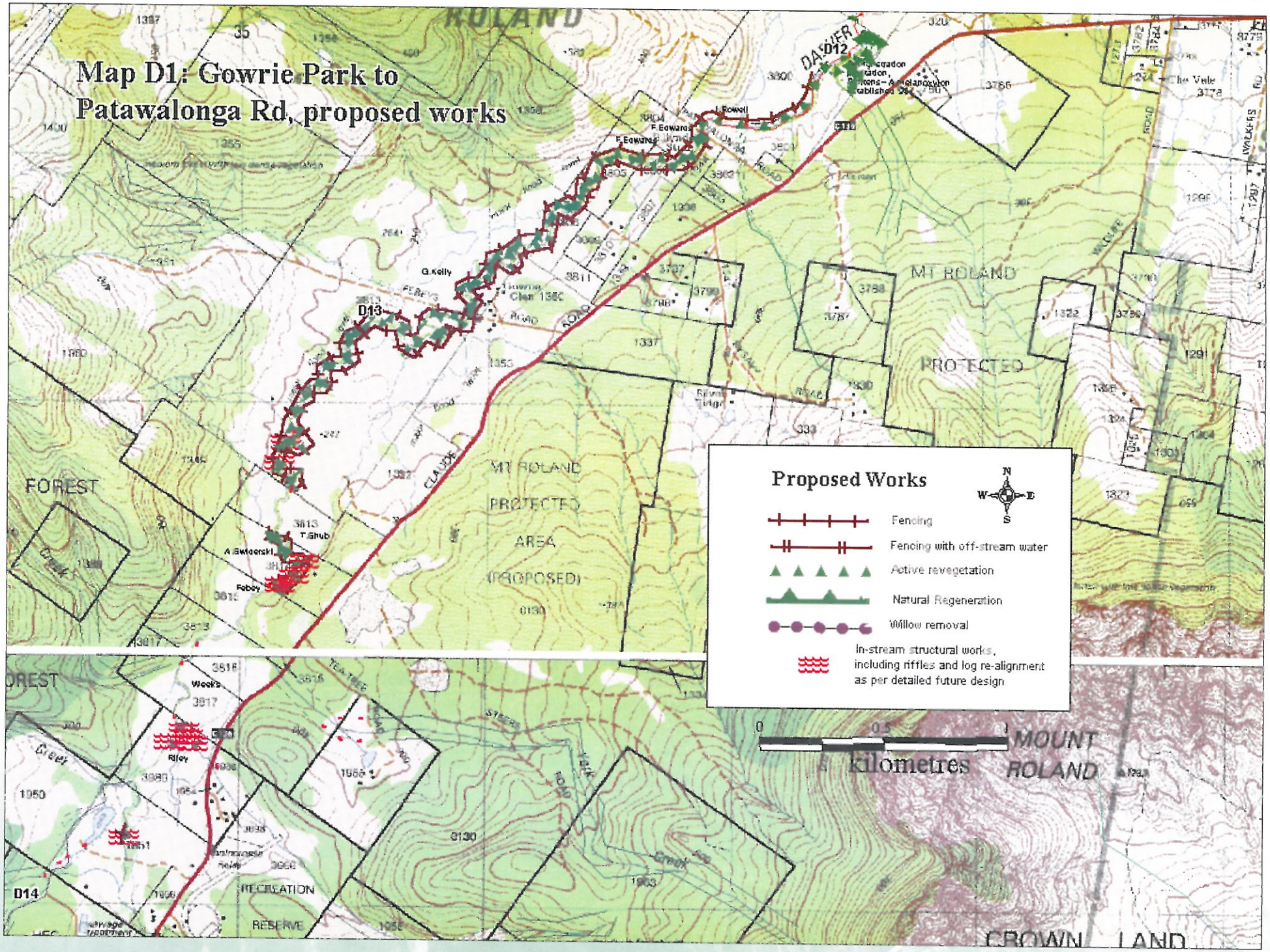
Stop 11, Duck Marsh

The Duck Marsh area is a drained Tea-tree swamp. Constructed levee banks have reduced inundation however; flooding is still a regular occurrence. There is excess sediment in this section although channel widening has not occurred to the same extent as the 2km "difficult" section. There is good riparian vegetation on one side and bed variation in the channel. Willows are present but small.

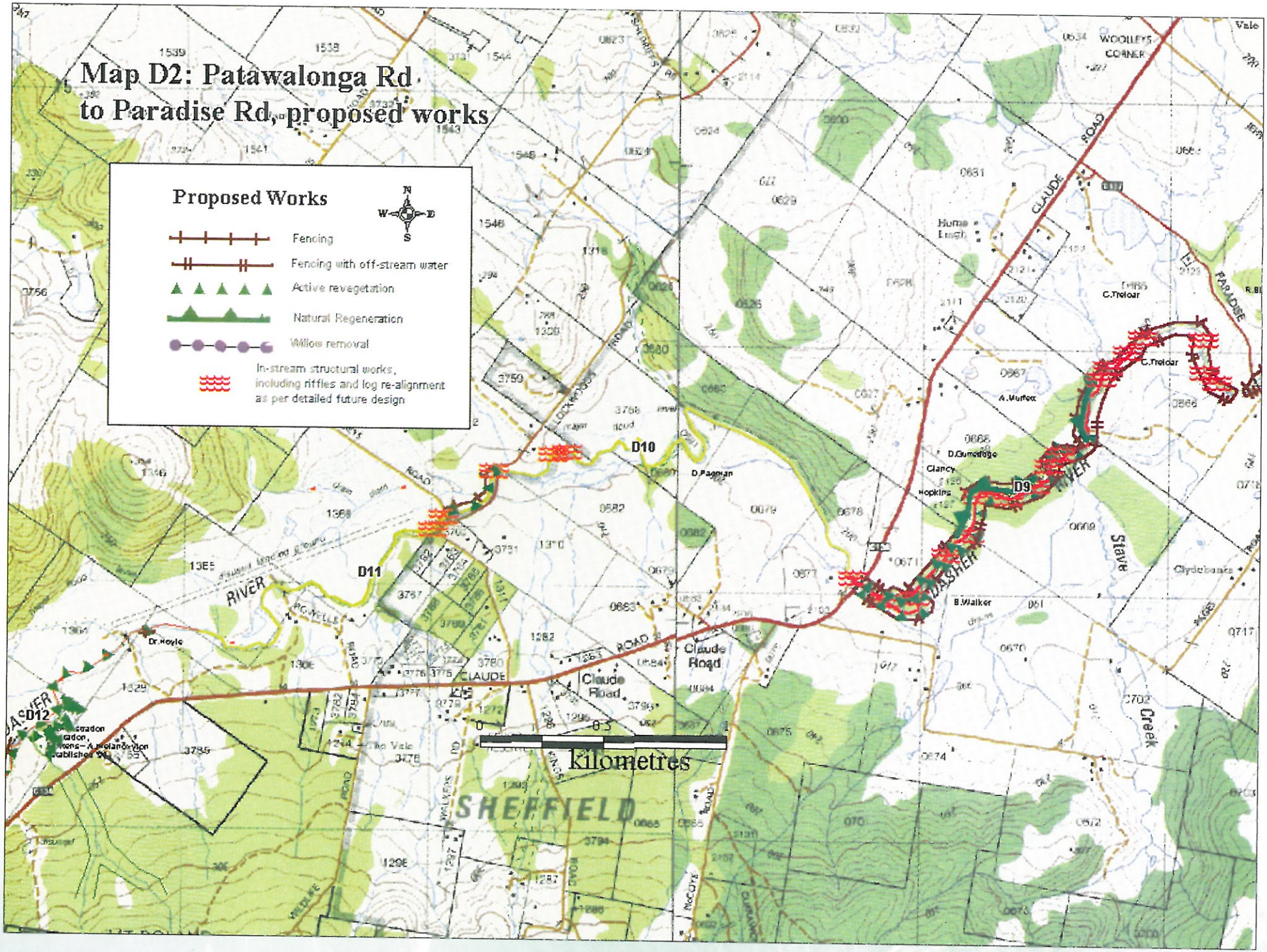
From Duck Marsh to Minnow River junction the Dasher River flows through a gorge and is considered relatively intact. From the confluence with the Minnow River to the confluence with the Mersey River the riparian vegetation is dominated by willows. To protect the bridge across the Dasher at Armistead, shingle has been moved and vegetation from an old channel cleared. The site requires further stabilisation by revegetating the eastern bank with tussocks and tea-tree. The vegetation in the old channel will need to be maintained at a reduced level.

Map 3: Dasher, Minnow and middle Mersey Rivers



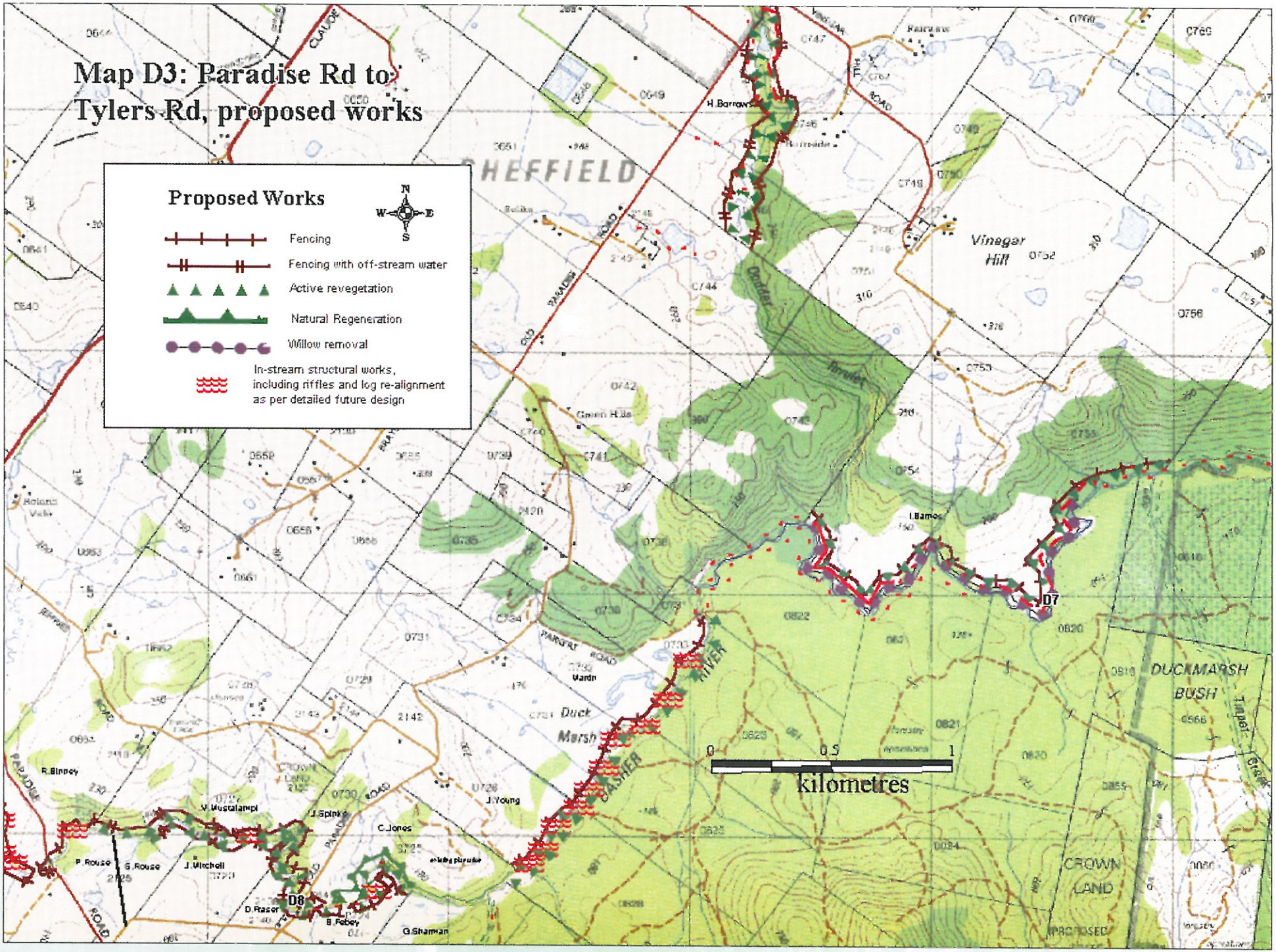

Map D1: Gowrie Park to Patawalonga Rd, proposed works
D12
D13
D14
MT ROLAND PROTECTED AREA (PROPOSED)
FOREST
MT ROLAND
PROTECTED
RECREATION RESERVE
CROWN LAND
MOUNT ROLAND
Proposed Works
N
W
E
S
Fencing
Fencing with off-stream water
Active revegetation
Natural Regeneration
Willow removal
In-stream structural works, including riffles and log re-alignment as per detailed future design
0
0.5
1
kilometres

MAP D1

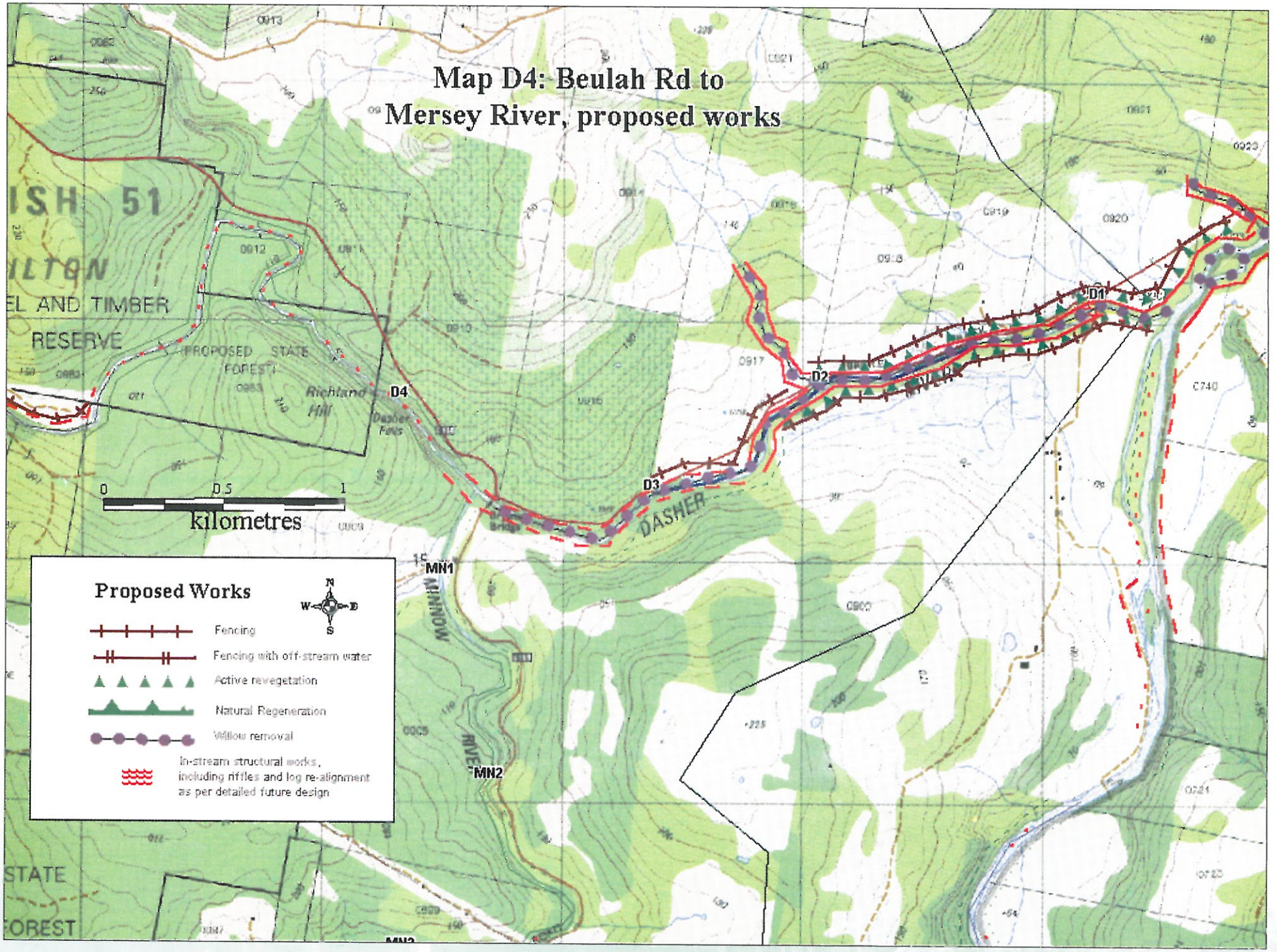

Map D2: Patawalonga Rd to Paradise Rd, proposed works
Proposed Works
Fencing
Fencing with off-stream water
Active revegetation
Natural Regeneration
Willow removal
In-stream structural works, including riffles and log re-alignment as per detailed future design
N
W
E
S
D10
D11
D12
D9
Claude Road
CLAUDE ROAD
LOCKWOODS ROAD
PARADISE ROAD
WOOLLEYS CORNER
CLAUDE RIVER
Stave Creek
SHEFFIELD
0
0.5
1
kilometres

MAP D2

Map D3: Paradise Rd to Tylers Rd, proposed works



Map D4: Beulah Rd to Mersey River, proposed works



LOWER DASHER & MINNOW RIVERS

Lower Dasher and Minnow Rivers

Vegetation status

- Native vegetation: intact
- Native vegetation: modified
- Native vegetation: scattered
- Willows: dense
- Willows: medium
- Willows: occasional

M21 Reach ID label

Reach priority

- Conservation
- Strategic
- Connected site with high recovery potential
- Isolated site with high recovery potential
- Potential rehabilitation
- Low recovery potential

D1 D2 D3 D4 D5 D6 D7 D8 D9

MN1 MN2 MN3 MN4 MN5 MN6 MN7 MN8 MN9 MN10 MN11 MN12 MN13

M8 M9 M10 M11

0 1.5 3

kilometres

UPPER DASHER RIVER

Upper Dasher River

Vegetation status

- Native vegetation: intact
- Native vegetation: modified
- Native vegetation: scattered
- Willows: dense
- Willows: medium
- Willows: occasional
- M21 Reach ID label

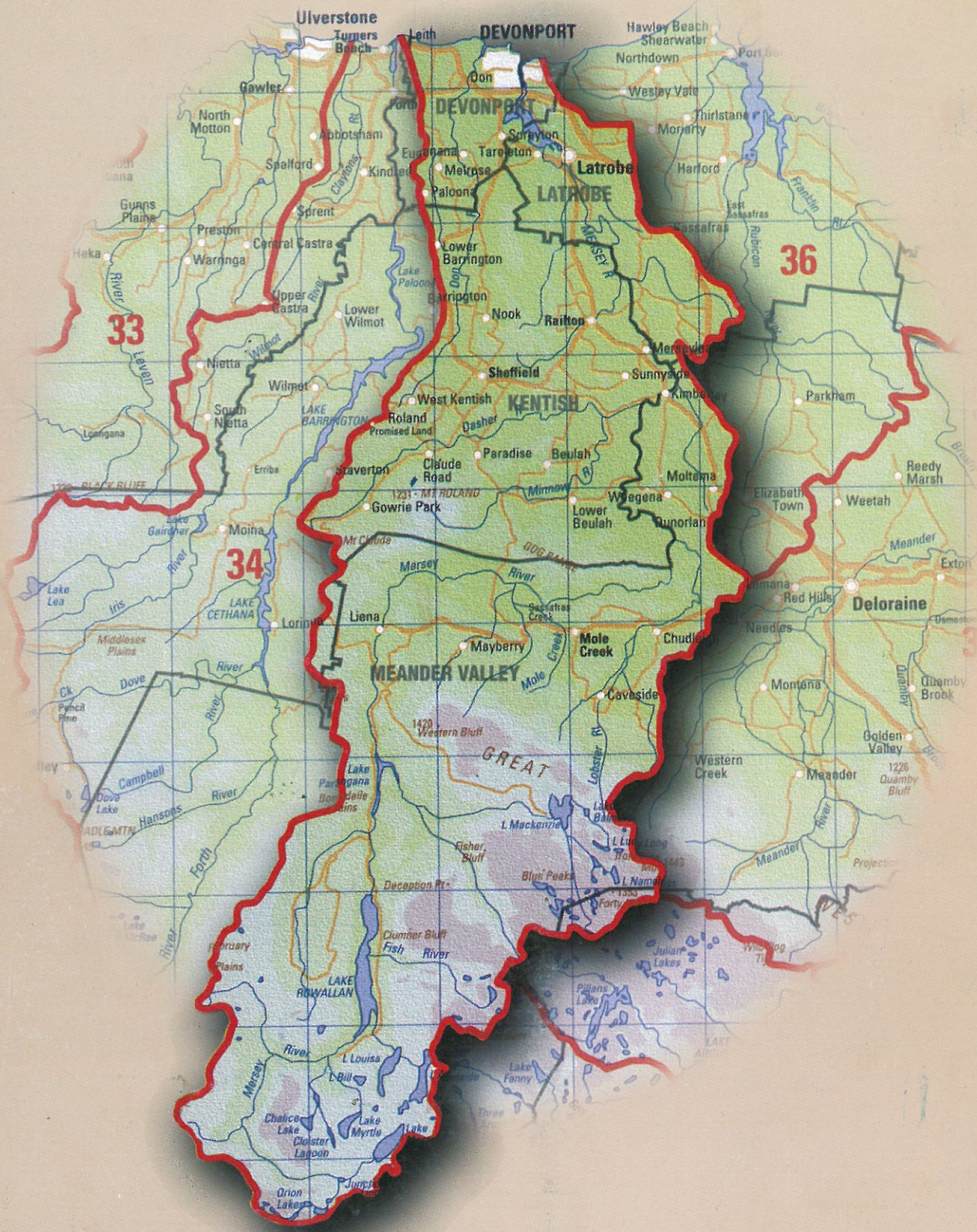
Reach priority

- Conservation
- Strategic
- Connected site with high recovery potential
- Isolated site with high recovery potential
- Potential rehabilitation
- Low recovery potential

D9 D10 D11 D12 D13 D14 D15 D16 MN14

KENTISH 51 ROLAND SHEFFIELD CROWN LAND MOUNT ROLAND MOUNT CLAUDE FOSSEY MOUNTAINS

0 2 4 kilometres



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