Tasmania

DEPARTMENT *of*
PRIMARY INDUSTRY
and FISHERIES

State of River Report on

Mersey River Catchment

Index of River Condition

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1. INTRODUCTION

The Mersey catchment survey was carried out by staff of the Department of Primary Industries and Fisheries and community representatives on the 4 March 1997. The survey was conducted with a view to develop a rapid Index of River Condition (IRC) using a one off snap-shot approach for 33 sites within the catchment. The methodology was designed to provide a broad picture of stream condition within the Mersey catchment.

This report grew out of the concerns of community groups for the overall condition of catchment streams within the Mersey river system particularly downstream of Parangana dam. The whole concept was developed with a view to providing a simple descriptive format that could be readily accepted by community groups and provide a rapid qualitative assessment of river condition of each site. The report is far from comprehensive but the basic presumption is that it provides enough data to illustrate the overall health of a number of sites throughout the catchment. The data that has been collected to provides a benchmark study that can be re-run, or expanded, at a later date to observe changes over time.

For the purposes of this report the 'stream condition' is defined as the physical condition of the river as directly related to a 'natural condition'. The basis of the whole process is to analyse data against a benchmark of what is regarded as an unimpacted example. Each parameter is also viewed in terms of its importance for maintaining adequate conditions to support a healthy population of instream fauna.

This report is a first in a program being developed by Department of Primary Industry and Fisheries staff that is designed to provide rapid analysis of environmental conditions of Tasmanian streams. This type of survey has also been adopted by some mainland states and provides valuable information on the state of rivers.

2. SITES

Field data collection for IRC parameters occurred at thirty three sites within the catchment. Thirteen were on the mainstream Mersey River, and twenty on tributary streams (Figure 1). Faunal data was collected separately and at an earlier period by DPIF staff under a separate protocol at twenty four corresponding sites (see Figure 7).

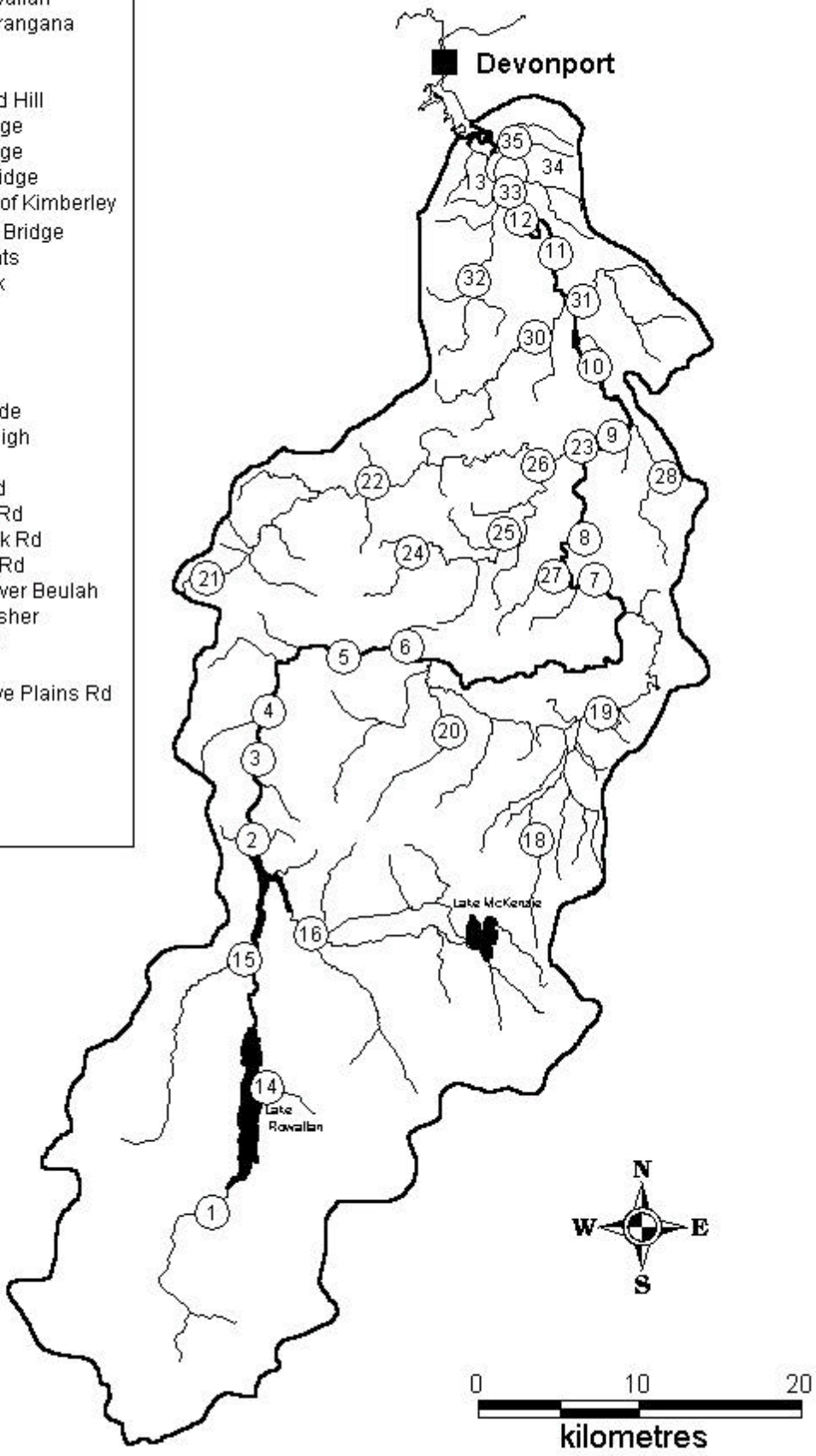
3. METHODOLOGY

This technique is a modification of the methods adopted by the Queensland Department of Primary Industries 'State of the Rivers' studies and the 'Index of Stream Condition' developed by the Victorian Department of Conservation and Natural Resources. It involves the use of a 'snap-shot' approach, that is, a one off survey of river condition at a number of sites along the length of a target stream.

The aim is to achieve an understanding of current conditions within a system which can be used as a bench-mark for future comparisons. This is achieved through gathering information on current physical and ecological conditions of the stream system that will detect impacted reaches within the catchment and provide a baseline against which future assessments of river condition can be compared. The overall format, therefore, is designed not only to provide rapid assessment of river condition, but also as a long term tool for monitoring change within the catchment.

Figure 1: Mersey River Index of River Condition Catchment Sites

1 Mersey, Above Rowallan
2 Mersey, Below Parrangana
3 Mersey, Olivers Rd
4 Mersey, Liena Rd
5 Mersey, Dogs Head Hill
6 Mersey, Union Bridge
7 Mersey, Kellys Bridge
8 Mersey, Dynans Bridge
9 Mersey, Upstream of Kimberley
10 Mersey, Merseylea Bridge
11 Mersey, Lovetts Flats
12 Mersey, Farrel Park
13 Mersey, Shale Rd
14 Fish River
15 Arm River
16 Little Fisher
18 Lobster Rt, Caveside
19 Lobster Rt, Chudleigh
20 Sassafras Ck
21 Dasher, Claude Rd
22 Dasher, Paradise Rd
23 Dasher, Bridle Tack Rd
24 Minnow, Paradise Rd
25 Minnow, Above Lower Beulah
26 Minnow, Above Dasher
27 Garden of Eden Rt
28 Coilers Ck
30 Redwater Ck, Native Plains Rd
31 Parramatta Ck
32 Marine Ck
33 Caroline Ck
34 Bonneys Ck
35 Kings Ck



This procedure requires the assessment of data gathered from field and office sources. These assessments are based on a range of inputs that are placed into rating categories. A number of indicators may be recorded and these values will be combined under one group category to provide a sub-index value. Sub-index values are weighted on a scale of between 0 and 10. These scores are then combined to supply an overall environmental condition rating for each site. The final assessment of site and catchment condition is subjective in nature and findings must be viewed with this in mind.

3.1 Objectives

a) to create an index of condition for all observed parameters (i.e. quality rating).
b) to develop a system to determine overall site condition and incorporate this into a factor of river condition.
c) to base stream condition on physical parameters which detect departure from a condition of an estimated 'norm' or 'natural' condition.
d) to produce a standardised, easily replicated format that is transferable to other systems.

Full descriptions of all physical aspects of each site are necessary to observe changes (improvements/degradation) in sites if subsequent studies are undertaken at a later date, and as optional input into the analysis of stream condition.

3.2 Parameter ratings

Parameters scoring is based on a 5 point rating scale wherever possible. Ratings are based on the difference between the current value of the indicator and what it would be under unimpacted conditions. Victorian authorities justify the use of a 5 point scale by stating that higher ratings would be unrealistic given the current state of knowledge. With less than 5 points there are problems as the category size becomes too large.

Table 1. Example of a 5 point scale for indicator measurements.

Category	**Numerical value (Rating)**
Essentially natural	4
Near natural	3
Some modification	2
Major modification	1
Highly modified	0

3.3 Sub-index headings

The methodology is broadly based on the following sub-indices:

1) Physical form;
2) Streamside zone;
3) Water quality;
4) Aquatic life;
5) Instream values.

Each sub-index represents a composite of one or more parameter measurements, and the sub-indices are combined to provide a single rating of site condition.

Through field measurements a number of indicators may be recorded and these values will be combined under 1 group category to provide a sub-index value. Sub-index values are weighted in a scale of between 0 and 10.

Table 2. The sub-index parameters and their associated indicator categorise.

Sub-index	**Indicator**
Physical form	Overall disturbance
Streamside zone	Width of streamside zone Density of native species Tree height Vegetation type
Water quality	Turbidity Conductivity
Aquatic life	SIGNAL
Instream values	Streamside cover Coarse woody debris (snags) Detritus Macrophytes

3.3.1 Physical form

This parameter was singularly categorised as an overall rating for a site reach. Six disturbance categories were available (extreme, very high, high, moderate, low and very low) one of which was selected for each site. All categories were present in this assessment. The categories were largely based on physical aspects of streamside vegetation.

3.3.2 Streamside zone

Width of streamside zone
This was regarded as the average distance from waters edge at base flow to any cleared or developed land. The streamside zone is the interface between the aquatic and terrestrial environment. This parameter is largely designed to determine how much vegetation is present from the river bank to when some form of disturbance, such as clearing, occurs. Of course the streamside zone may be extensive therefore anything over 40 m should be recorded. The size of the streamside zone is important to determine how much of a buffering effect it is having from adjacent developed land.

Density of native species
The amount of native species present provides a rating of how near to natural the site may be. The presence of exotic species may also be undesirable depending on the quantity and/or the particular species.

Tree height
This parameter is regarded as a rough indicator of disturbance. Taller trees indicate long term stability potentially from fire or logging.

Vegetation type
This rating is based on the assumption that natural succession in vegetation occurs whereby the final position is that of pure rainforest (highest rating).

3.3.3 Water quality

Water quality parameters were collected for this study on the same day as the habitat analysis. A parallel study specifically designed to obtain a broader picture of water quality within the catchment was also conducted by DPIF staff. Results from this study, which are presented in part according to the guidelines listed below, are detailed in a separate report.

Turbidity Guidelines For Tasmanian Rivers
Turbidity in water is caused by;

- suspended matter such as clay, silt, fine organic and inorganic matter.
- soluble coloured compounds.
- and microscopic organisms.

Turbidity is an expression of the optical property of the water that causes light to be scattered rather than transmitted in a straight line through the sample. It is a useful measure of the amount of sediment being transported in the river and high turbidity readings often indicate active erosion or stream disturbance.

Turbidity is often related to flow and can vary dramatically with time, so classification of a river using turbidity should be based on the average of many readings taken over a wide range of flows. For this study this was not possible therefore data analysis is rather subjective for the purposes of this report. Table 3 gives some idea of what readings represent good or bad conditions.

Table 3. Turbidity values for Tasmanian streams.

Mountain	Valley	Plain	Rating
< 5	< 10	< 15	4
< 7.5	< 12.5	< 17.5	3
< 10	< 15	< 20	2
< 12.5	< 22.5	< 30	1
> 12.5	> 22.5	> 30	0

* Values are in Nephelometric Turbidity Units (NTU's).

Conductivity Guidelines For Tasmanian Rivers
The Electrical Conductivity measured in water provides an indication of the amount of dissolved salts and hence salinity. The following table is a rough guide to what constitutes a high or low conductivity value with respect to dissolved salts. In Tasmania, most of our lowland rivers will generally fall within the range of 100 -500 µS. In the upper catchment most readings will be between 20 - 100 µS.

Table 4. Conductivity values for Tasmanian streams.

Mountain	Valley	Plain	Rating
< 20	<50	< 100	4
20 - 60	50 - 100	100 - 250	3
60 - 90	100 - 300	250 - 450	2
100 - 150	300 - 500	450 - 750	1
>150	>500	>750	0

* All expressed in µS cm^{-1} (microSiemens per cm).

A full evaluation for water quality for the whole catchment has been conducted by DPIF staff under a separate format and will be summarised in a separate report.

3.3.4 Aquatic Life

Aquatic invertebrates are good indicators of river health. Preliminary invertebrate data for a number of sites within the catchment were collected by DPIF staff. From the available invertebrate data a scoring system based on a sensitivity grade for Family level information can be determined to ascertain the health of a particular site. The conversion factors and comments for the appropriate grades are listed below.

Table 5. SIGNAL values for faunal data based on Chessman (1995).

SIGNAL value	Rating	Comment
>7	4	Excellent
6-7	3	Clean water
5-6	2	Doubtful, mild pollution
4-5	1	Moderate pollution
<4	0	Severe pollution

The SIGNAL (Stream Invertebrate Grade Number Average Level) value is a simple biotic index based on a sensitivity grade for families of common invertebrate fauna to pollution in rivers. The index is calculated by summing the grades for all the families present at a site, the total is then divided by the number of families at the site which gives an average grade per family. Analysis of specific Tasmanian data has lead to Tasmanian River Health Officers recommending the use of the original scale (Chessman, 1995) rather than the new national scale (Chessman, 1997, in draft). This information is also being incorporated into a model that is being developed by DPIF staff for the Mersey catchment that is part of the Monitoring River Health Initiative. This model creates an objective evaluation of the environmental quality of streams and rivers based on macroinvertebrates. Results obtained for this model will be detailed in a separate section.

3.3.5 Instream values

Stream cover/shading
The indicators for this section are categorised as follows:

* canopy cover
* vegetation overhang
* root overhang
* bank overhang
* man-made overhang

The data collected for this section provides an assessment of available habitat in the form of shelter and shading for aquatic life. Overhanging trees may also provide a direct food source in the form of leaf and insect fall into the stream.

Coarse woody debris (snags)
Instream woody debris can represent a very important habitat for aquatic animals. It provides a refuge for many animals, food source for many macroinvertebrates, and is important for spawning for some fish species (e.g. Blackfish). The rating scale is based on the proportion of available (maximum to minimum) snags. The rating assumes that the greater the proportion of snags available, the more habitat there is for instream fauna.

Detritus
The detrital rating is specific to the data collected from within the particular study catchment at the time of sampling. The rating scale is based on the proportion of available (maximum to minimum) detritus. The rating assumes that the greater the proportion of detritus available, the more habitat and food there is for instream fauna.

Macrophytes (instream vegetation)
The macrophyte rating, as with the detrital and snag rating, is specific to the data collected from within the particular study catchment at the time of sampling. The rating scale is based on the proportion of available (maximum to minimum) macrophytes. The rating, within the limited assessment range (0 - 14.4% of reach), assumes that the greater the proportion of macrophytes available, the more habitat there is for instream fauna. This is only appropriate for lower quantities of instream vegetation. Extensive cover may indicate high levels of nutrients in the stream. This can lead to depletion of dissolved oxygen with detrimental effects on aquatic fauna.

Bed aggradation and degradation.
No practical results were obtained to use bed stability as a parameter.

4. RESULTS

4.1 Overall site condition

The final environmental rating for each site was determined by combining all the sub-index values from the sources indicated above. For sites including faunal data the overall value of the Index of River Condition (IRC) combined 5 sub-index values. For sites with physical data only, (faunal data not included) the IRC value combined 4 sub-index values.

Table 6 illustrates the condition categories associated with the appropriate rating scores for the range of values that may be obtained for each individual site. This data can then be used to produce an overall environmental value for a site. This is a rather generalised category that supplies a descriptive condition for a site. A full list of site conditions is presented in Appendix 1.

Table 6. IRC rating categories for individual sites.

Condition	**Very poor** **Highly modified**	**Poor** **Major modification**	**Moderate** **Some modification**	**Good** **Near natural**	**Excellent** **Essentially natural**
Total score habitat & fauna	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50
Total score habitat only	0 - 8	9 - 16	17 - 24	25 - 32	33 - 40
Environmental rating	0	1	2	3	4

Table 7. Environmental rating for all streams and combination of streams in the entire catchment (corresponds to an average value). Ratings correspond to values illustrated in Table 6.

	Numerical value (Rating)			
Category	**Sites upstream Parangana**	**Mersey R. downstream of Parangana**	**Mersey R. Tributaries downstream of Parangana**	**Average for all catchment sites**
Physical form	4	2	1	2
Streamside zone	3	1	1	1
Water quality	3	2	2	3
Aquatic life	4	3	3	3
Instream values	0	0	0	0
Overall IRC with fauna values	**3**	**2**	**2**	**2**
Overall IRC without fauna values	**3**	**1**	**1**	**2**

Total site values in Table 7 are separated between sites with and without fauna values due to the incomplete faunal data set. To compare these two separate categories under one parameter would provide an upwardly biased representation of information favouring sites with fauna data.

The data in Table 7 illustrates the average value score for each independent sub-index and overall IRC value for the combined sites within the catchment. These values are highly dependant on site selection and the result may be skewed towards higher or lower values dependant on site information. Nevertheless, the available data illustrates some interesting trends. Overall, the lowest ratings are for the tributary streams below Parangana while the highest ratings are for the less disturbed higher catchment sites, as would be expected. Of all the values water quality and aquatic fauna rate well, while physical form (overall disturbance) and streamside zones rate poorly (except in the higher catchment streams), and, instream values rate badly in all areas.

4.2..Mainstream Mersey River Sites

The IRC results for the mainstream Mersey River for sites with fauna data are represented in Figure 2, and sites without fauna data in Figure 3. The data in both these figures illustrate a gradual increase in overall condition with sites up the catchment. The site at Liena bridge has a reduced condition rating due to the lack of streamside zone, high proportion of exotic streamside vegetation species and very high disturbance rating. The lower rating for the site below Lake Parangana is due to the presence of young regrowth vegetation, reduced streamside zone and lack of instream values. All sites illustrate low instream values, this may indicate that this is a natural state or further analysis of the rating system may lead to changes in these parameters. Mersey River at Shale road was rated for physical form as extremely disturbed but its overall site condition is kept high by the highest rating of all sites for instream values.

Site locations and associated ratings are illustrated in Figure 4 (sites with fauna data) and Figure 5 (sites without fauna data). The information illustrated in Figure 5 indicates the variable nature of habitat quality along the Mersey River which is clearly site dependent. Inclusion of water quality through the invertebrate indicator scaling (Figure 4) illustrates a more obvious decline in condition with sites down the catchment.

Figure 2. Mainstream Mersey River I.R.C. sites and values (including fauna data)

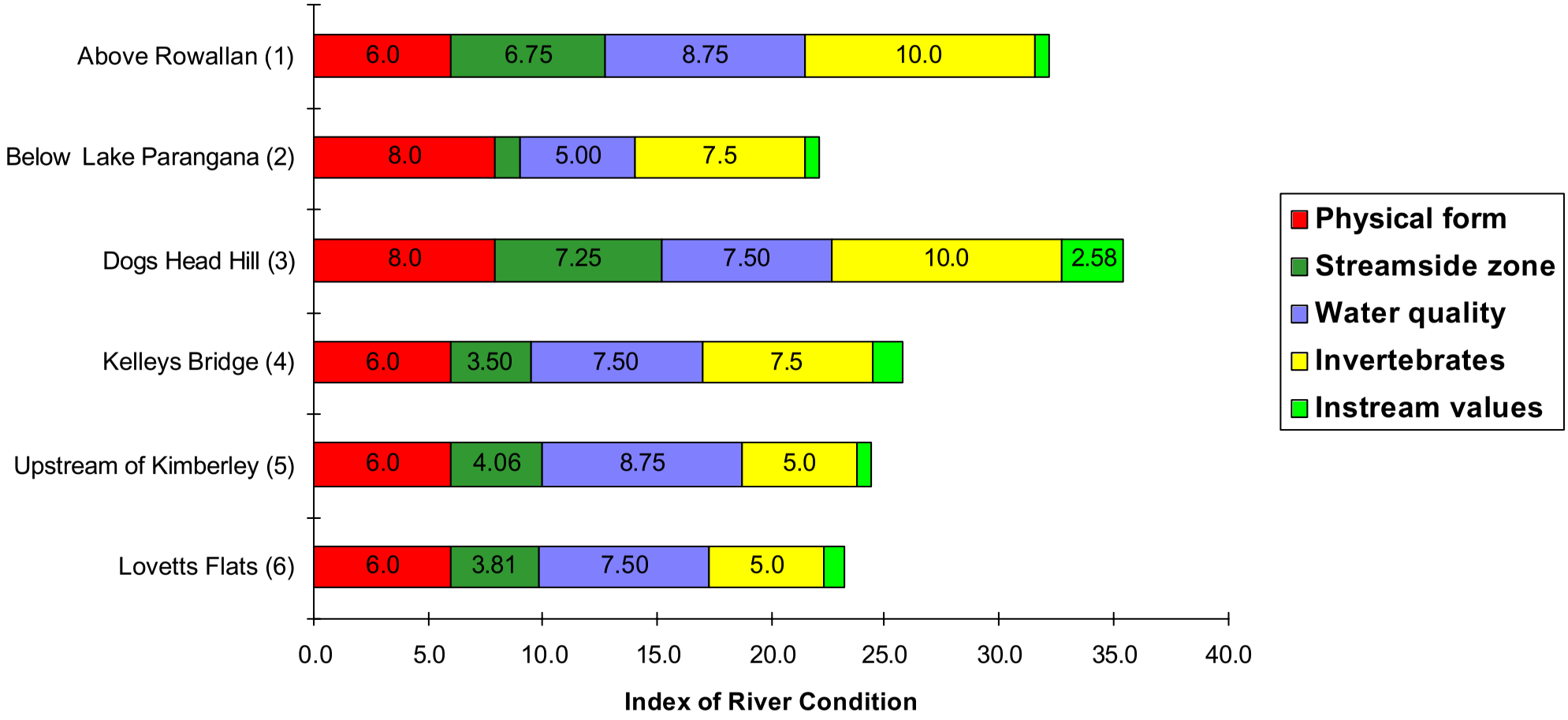


Figure 3. Mainstream Mersey River I.R.C. sites and values (without fauna data)

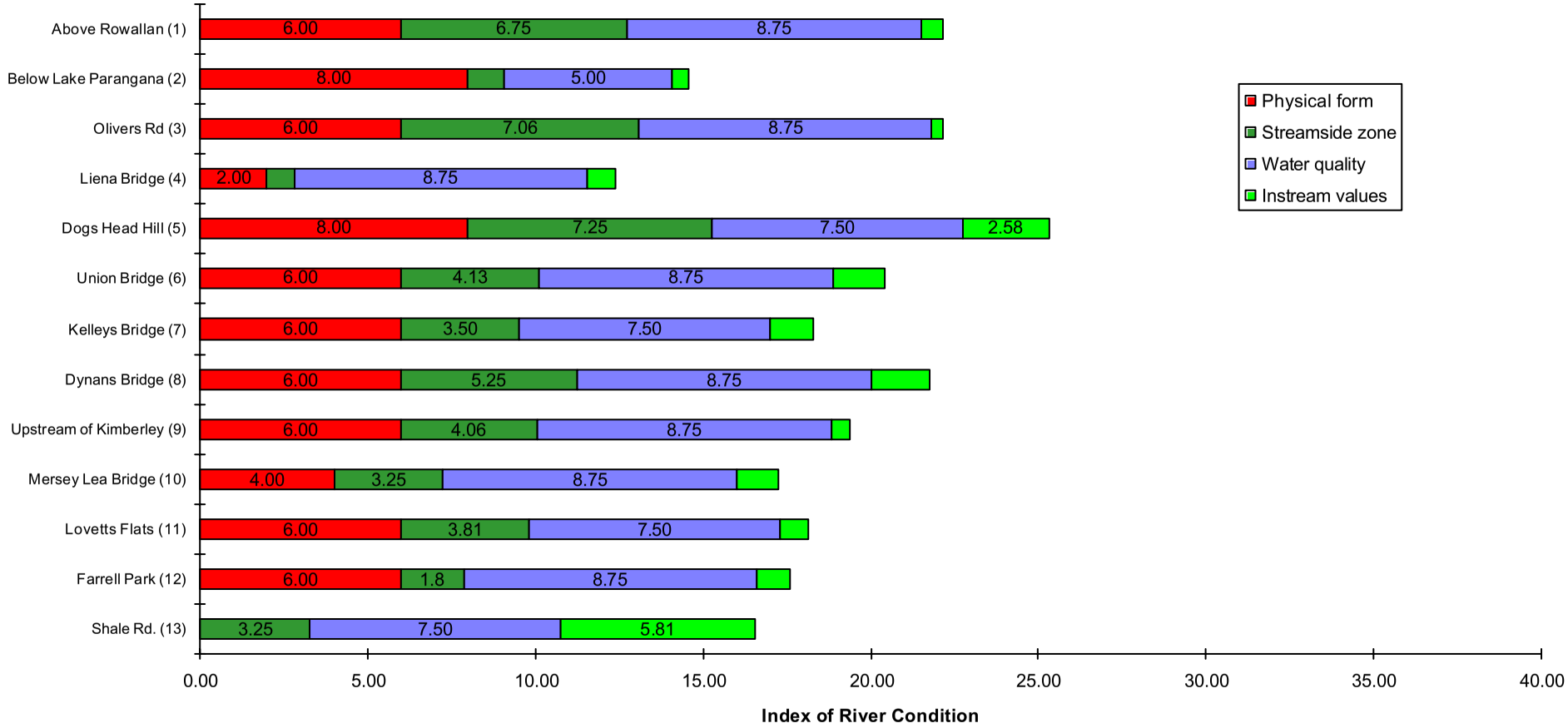


Figure 4. Site assessment: Mersey River Catchment
Physical habitat and biological ratings

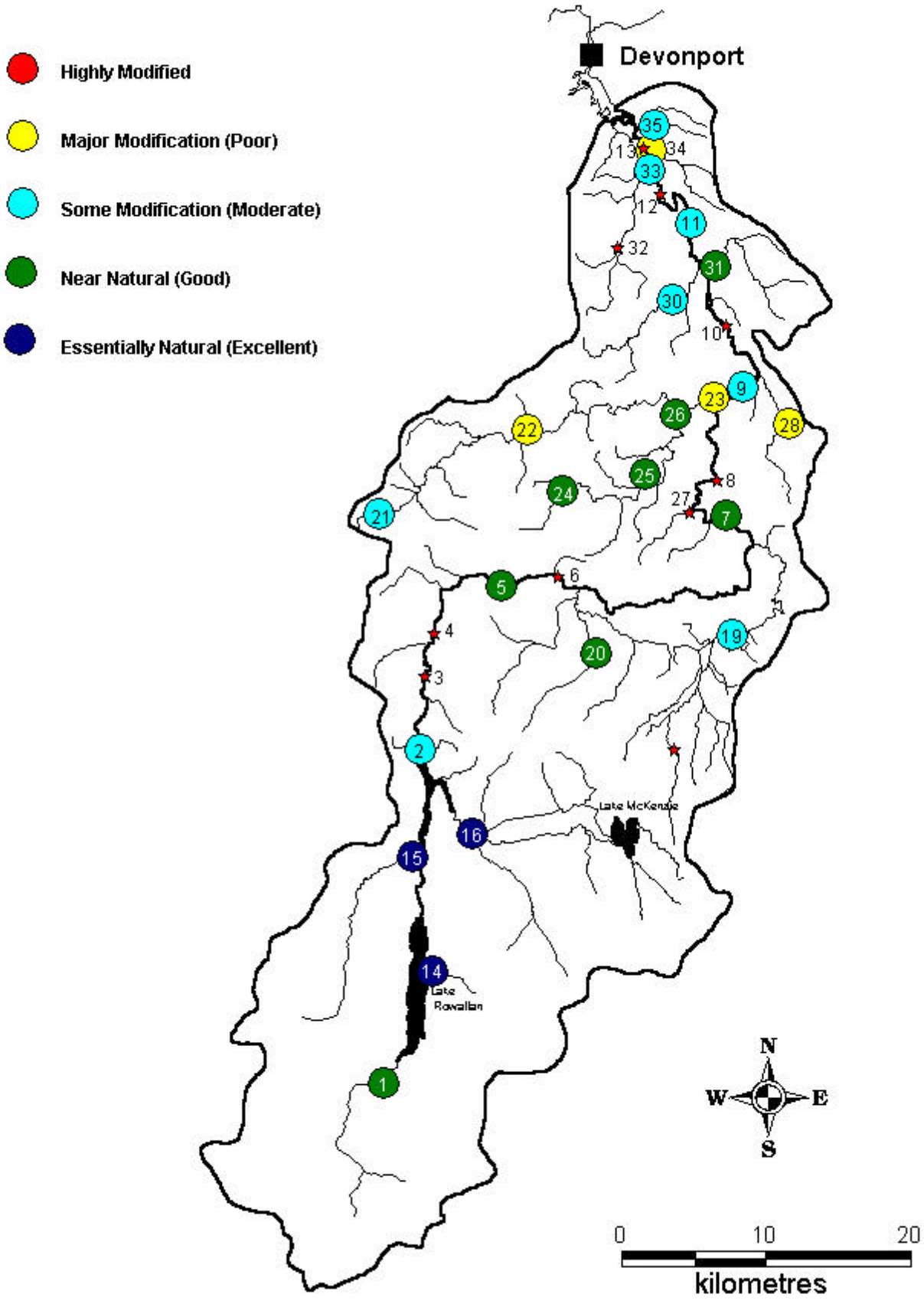
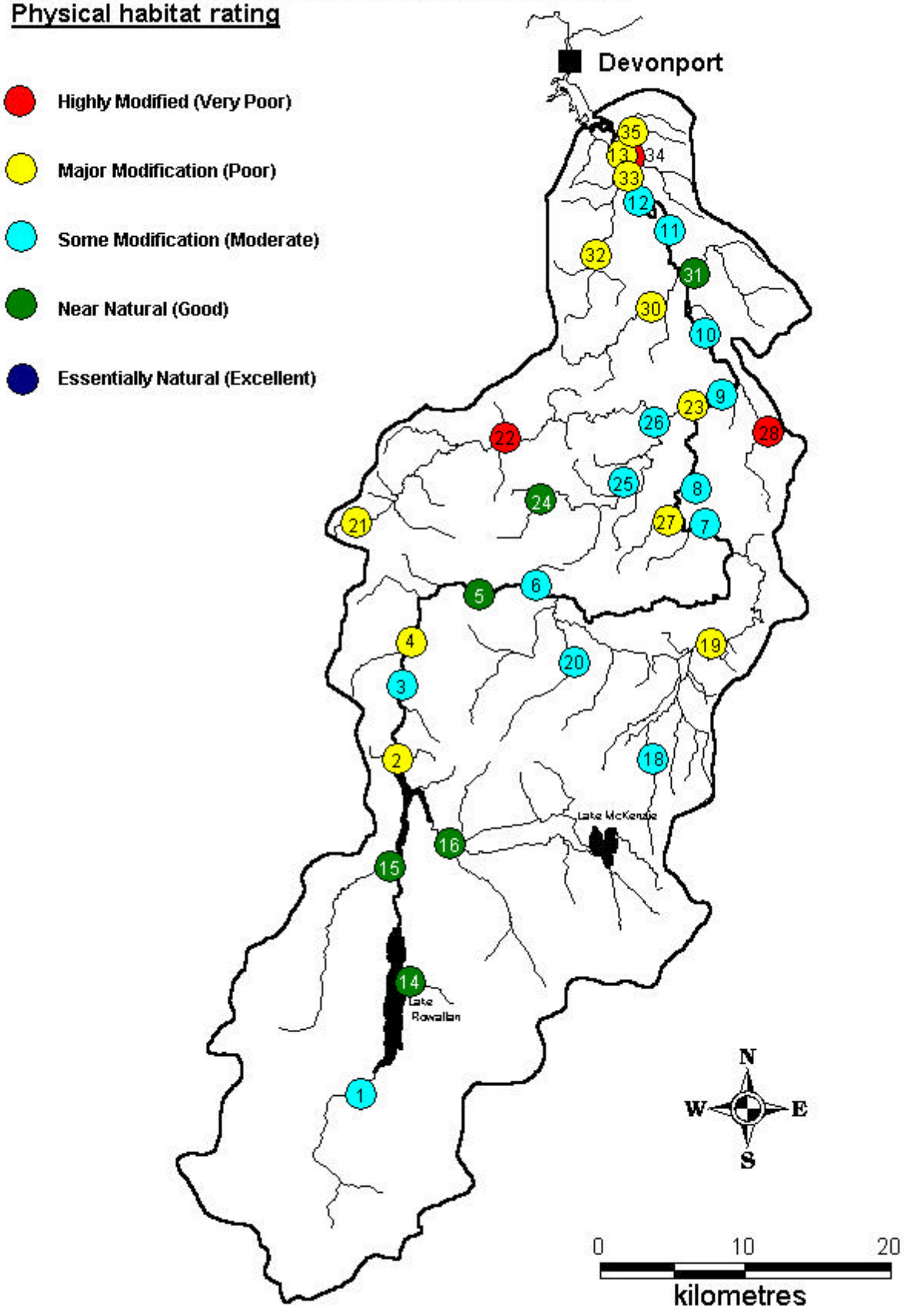


Figure 5. Site assessment: Mersey River Catchment
Physical habitat rating



4.3 Mersey River Tributary Sites

The IRC results for the Mersey River tributary streams are provided in Figure 6. Only 2 out of 17 tributary sites did not have available fauna data, therefore, indexing was not separated as with the mainstream data. The results clearly illustrate the higher quality upper catchment tributaries (Fish, Arm and Little Fisher Rivers). The only other comparable sites are the Minnow River and Parramatta Creek.

Minnow River is situated amongst extensive native vegetation, Parramatta Creek is detailed below. The lowest rating is for Caroline Creek largely due to poor water quality, streamside zone and instream values. Caroline Creek had the worst rating of water quality of all sites.

In most cases the lack of streamside condition seems to be the over-riding factor that drags ratings down (e.g. Lobster Rivulet, Dasher River, Coilers, Bonneys, Redwater and Marine Creeks). The lack of physical form for Dasher River, Coilers and Redwater Creeks and Lobster rivulet at Chudleigh is also dragging condition factors down for these streams. In nearly all sites instream values rate poorly. Water quality rates consistently high throughout all the Mersey River catchment except at Bonneys Creek where this rating was for a highly modified condition (extreme low rating).

Parramatta Creek
Some detail is spent here on Parramatta Creek. The site selected for this creek was indicative of how fickle site selection can be. The actual site is above the road bridge and consists of high quality vegetation and overall stream condition. Directly below the bridge a complete change is evident. Erosion is extensive, exotic weeds are abundant and general condition is low. This highlights the need to target sites in accordance with the objectives of the particular program. In this case several sites may be required for selection to encompass the range of conditions available. Therefore, the condition rating for Parramatta Creek is quite high when it may have been expected to be quite low. This also contrasts with the results of the AUSRIVAS study which found the site, as dictated by faunal parameters, to be severely impacted. It was found that site selection for this study was below the road bridge in the heavily modified zone.

4.4 Faunal data (SIGNAL index)

The application of faunal scores is an important aspect of assessing instream health. Faunal data collected in a parallel study is presented in a separate report that details a model designed to analyse river health within the catchment (report on the AUSRIVAS model for the Mersey catchment). This study does not utilise the AUSRIVAS model but concentrates in presenting data in the form of a SIGNAL rating. For the purposes of this study, sites have been separated and rated accordingly with and without SIGNAL scores. This was necessary due to the fact that only 24 out of the 33 total sites had faunal parameters available for analysis. Nevertheless, due to the rapid time frame required to obtain results the number of sites with faunal data was more than expected.

Figures 4 and 5 illustrate the spread of values throughout the catchment. Ratings for the SIGNAL scores are illustrated in Figure 7. SIGNAL scores vary throughout the catchment from 5.11 (Doubtful, mild pollution) to 7.33 (Excellent). This equates to a rating scale of 2 (moderate conditions) to 4 (excellent conditions). Of the 24 sites 5 illustrated a rating of essentially natural (excellent water quality), 11 illustrated a rating of near natural (clean water) and 8 illustrated a rating of some modification (doubtful water quality, mild pollution). The lowest ratings for the Mersey, Dasher and Minnow Rivers was in each case at the lower end of each catchment, as would be expected through the accumulating effect of pollutants downstream. Of the single tributary sites the lowest ratings were for Marine, Redwater, Sassafras Creeks and Garden of Eden Rivulet. These creeks are associated with intensive farming.

Figure 6. Tributary I.R.C. sites and values (with fauna data where available)

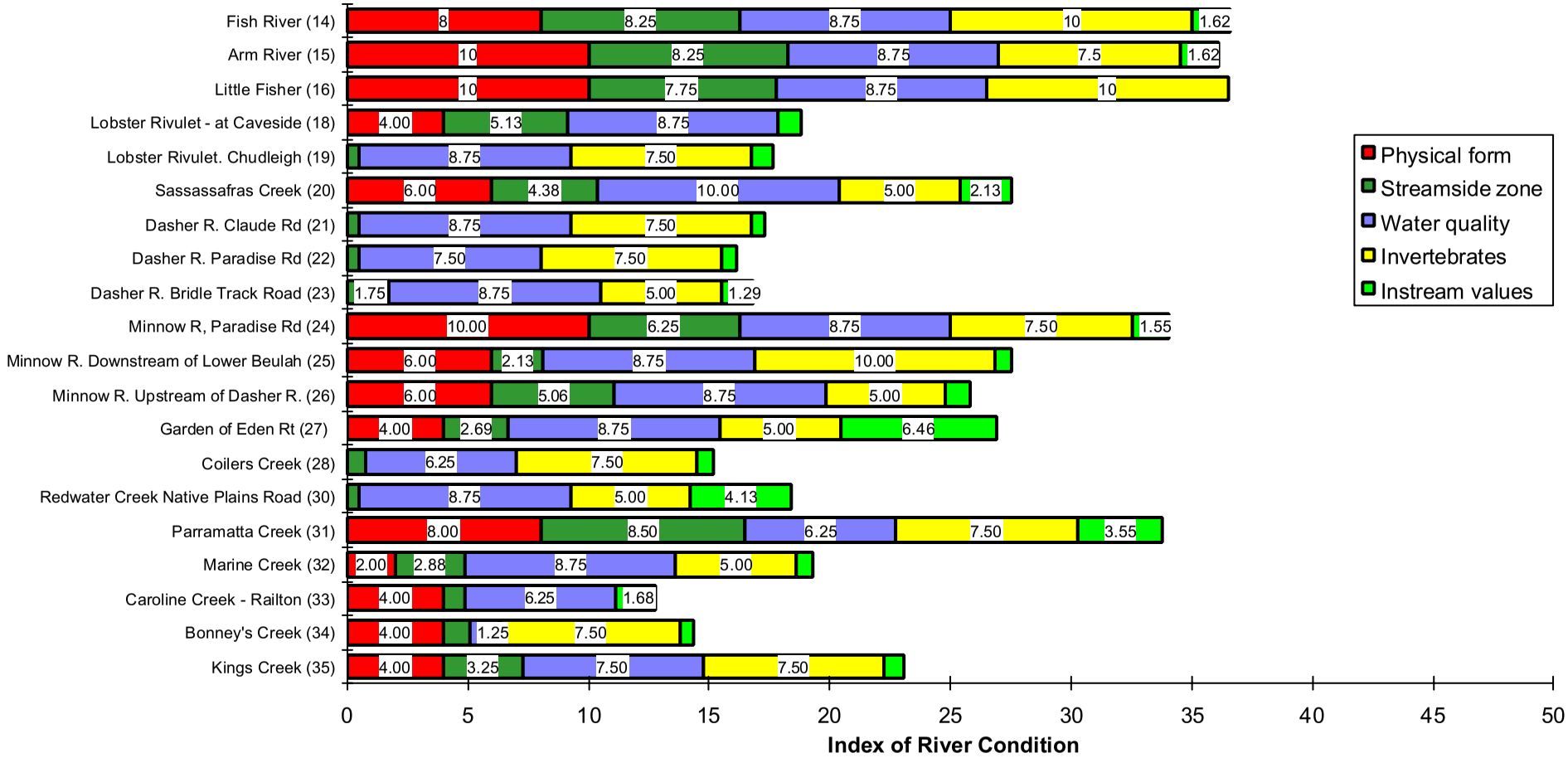
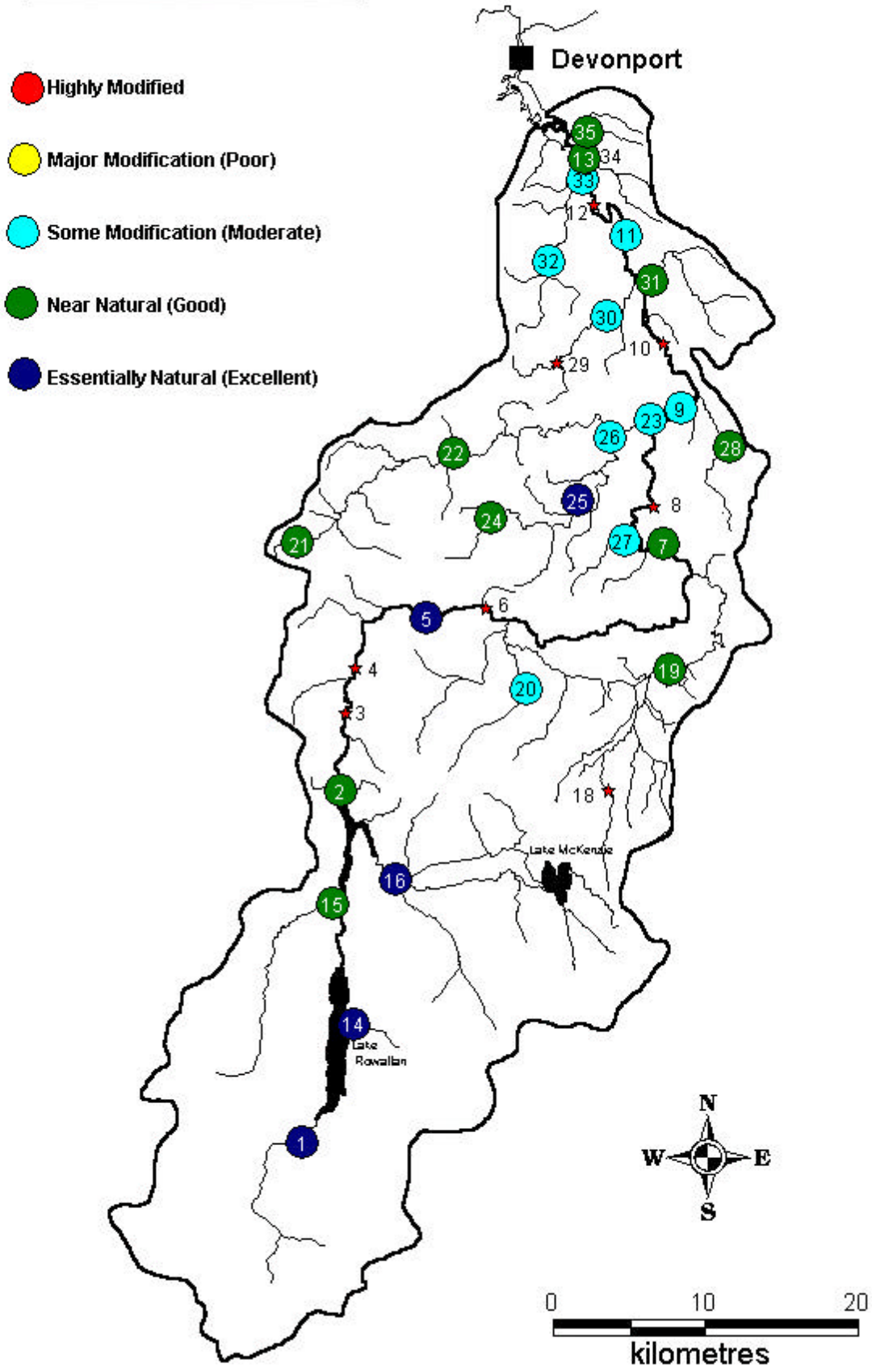
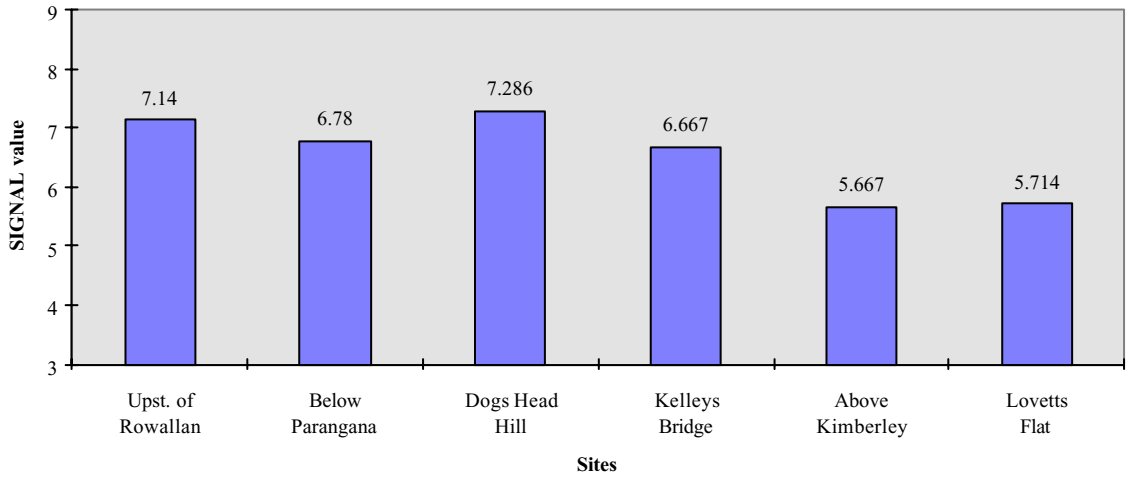


Figure 7. Site assessment: Mersey River Catchment
Biological (SIGNAL) rating



There is also an obvious decrease in SIGNAL ratings progressively down the mainstream Mersey River catchment. This is illustrated in Figure 8. Actual SIGNAL scores are presented here. The lower rating at the site below Lake Parangana dam is most likely due to the direct influence the dam is having on this zone, which may not be a result of lower water quality, but rather an effect of no recruitment of invertebrates from upstream, or conversely it may be a result of stable long term low flows.

Figure 8. Mersey R. Faunal ratings (SIGNAL) throughout the catchment.



Ward and Stanford (1983 in: Travnichek and Maceina, 1994) proposed that biotic diversity below a dam would be less compared to river sections above the dam, but, diversity would increase downstream of the dam eventually simulating a natural system. This is supported through the findings of this study whereby, as mentioned above and through the evident trend in Figure 8, number of taxa groups were in the order of 50% lower in the downstream sites as compared with the upstream sites. The further away from the dam downstream, the less the influence of the dam becomes and the greater the influence of other factors. Similarly, the catchment health and water quality studies found that, overall, Mersey river sites seem reasonably healthy in terms of aquatic fauna. The trend illustrated within the catchment health study parallels the findings of the SIGNAL scores as illustrated in Figure 8.

4.5 Rating of stream length

At this stage it has been decided that there is not enough data available to estimate the condition of overall stream length. Information is expressed as site specific only. Rating stream length could be simply achieved through specific selection of further sites within the catchment if a follow-up survey was to be conducted in the future.

5. DISCUSSION

The Index of River Condition assessment protocol has effectively illustrated the condition of specific sites within the middle and lower Mersey River and its catchment. A broad range of sites within the catchment were chosen to provide a suitable description of the variation in conditions that are present. Time constraints for this project limited the number of sites that could be assessed and it has become clear that a greater number and selection of sites would be necessary to expand this procedure to encompass catchment condition rather than purely site specific condition.

In general, it has been shown that there are a range of factors that strongly influence site condition, including land use and riparian management practices, water quality and water quantity (flow). It is clear from a comparison with several sites above Lake Parangana that

sites in the middle and lower Mersey and its catchment tributaries have moved away from a natural state.

5.1 Mainstream Mersey River

The available information indicates that the sites on the mainstream Mersey River are moderately impacted. It is likely that these impacts have occurred due to intensive land practices such as farming and forestry. Site condition is also heavily influenced by the presence of non-native species in the stream-side zone, including Crack willow, which was shown to be well established in the Mersey River.

Willow was identified at seven of the 13 sites, and the streamside zones were dominated by this species at two sites (Mersey and Mersey Lea Bridge and downstream of the train bridge at Latrobe). The impacts of Crack willow on the river system include the following:

- runoff patterns are altered due to a lack of understorey;
- instream habitat is altered; and
- canopy cover inhibits primary production.

The second two factors primarily affect streams of a small width, such as headwater streams.

Information from sites indicated that there is regrowth of minor species (natives) and some exotic species occurring in the gravel beds, and encroaching onto the old river bed. This growth and encroachment is likely to be due to a reduction in the quantity of water in the river, particularly in the reduction of flushing flows through the system since impoundment.

5.2 Tributaries of the Mersey River

As with the mainstream of the Mersey River, tributary sites are apparently impacted by land practices such as farming and forestry and, in certain areas, mining practices. There is no indication of impacts through modified flow regimes. However, these smaller streams are heavily influenced by riparian practices. Issues and impacts include the following:

- severe erosion due to destruction of streamside zones;
- uncontrolled stock access;
- choking of waterways from exotic species;
- pollution inputs, and
- forestry practices including extensive plantations with no natural streamside zones and limited understorey.

6. CONCLUSION

Final assessment of data sets for the Index of River Condition has clearly illustrated that it is a useful tool in assessing river condition at selected sites within a catchment. It has proven a practical means of illustrating the deviation of a site away from its predicted natural state. This is evident through comparison with several sites above Lake Parangana in areas that are largely unimpacted. Nevertheless, it would be unreasonable to assume that sites should be returned to as near a natural state as possible for this does not necessarily mean health of a site would be improved. Unless a site is severely impacted it may not be appropriate, reasonable or practical to attempt to return it to a near natural condition. Rather, management options to improve the overall condition would be appropriate. These may include:

- streamside zone management to allow the regeneration of an appropriate buffer strip of native species;
- stream bank protection by limiting stock access; and
- the assessment of pollution sources within the catchment.

This project set out to illustrate the condition of specific sites within the lower Mersey catchment and to this end the results indicate that this has been suitably achieved. Data collection for this study provides a baseline of information that can be used for comparative purposes to observe changes within the catchment over time. Suggestions as to how the quality of individual sites could be improved are beyond the protocol of this study and would need to be addressed under a separate format.

7. ACKNOWLEDGEMENTS

The author would like to thank Sonia Anderson of the HEC for assistance in field data collection and community liaison, staff of Freshwater Systems for some technical input, staff of the Department of Primary Industries and Fisheries for assistance in preparation of this report and field data collection and all members of the community groups who provided valuable support in obtaining field data.

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APPENDIX 1. Sub-index and overall IRC ratings and associated values for all catchment sites.

MERSEY CATCHMENT SITES ABOVE LAKE PARANGANA

Summary of sub-index	Sub-Index Parameters	Physical form		Streamside zone		Water quality		Aquatic life		Instream values		ISC (with aquatic		ISC (without	
		Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating
Arm River		10.00	4.00	8.25	4.00	8.75	3.00	7.50	4.00	1.62	0.00	36.12	4.00	28.62	3.00
Fish River		8.00	3.00	8.25	4.00	8.75	3.00	10.00	4.00	1.62	0.00	36.62	4.00	26.62	3.00
Little Fisher (B)		10.00	4.00	7.75	3.00	8.75	3.00	10.00	4.00	0.00	0.00	36.50	4.00	26.50	3.00
Little Fisher River		8.00	3.00	8.13	4.00	10.00	3.00	0.00		0.32	0.00			26.45	3.00
	Average	9.00	3.50	8.09	3.75	9.06	3.00	9.17	4.00	0.89	0.00	36.41	4.00	27.04	3.00
	Condition	Good		Good		Good		Excellent		Very poor		Excellent		Good	
MERSEY RIVER SITES															
Mers. U/S Rowallan.		6.00	2.00	6.75	3.00	8.75	3.00	10.00	4.00	0.65	0.00	32.15	3.00	22.15	2.00
Mersey R. Below Lake Parangana		8.00	3.00	1.06	0.00	5.00	2.00	7.50	4.00	0.52	0.00	22.08	2.00	14.58	1.00
Mersey R. - Olivers Rd		6.00	2.00	7.06	3.00	8.75	3.00	0.00		0.32	0.00			22.14	2.00
Mersey R. Liena Bridge		2.00	0.00	0.81	0.00	8.75	3.00	0.00		0.84	0.00			12.40	1.00
Mersey R. at Dogs head		8.00	3.00	7.25	3.00	7.50	3.00	10.00	4.00	2.58	1.00	35.33	3.00	25.33	3.00
Mersey R. Union Brdge		6.00	2.00	4.13	2.00	8.75	3.00	0.00		1.55	0.00			20.43	2.00
Mersey R. at Kellys Bridge		6.00	2.00	3.50	1.00	7.50	3.00	7.50	4.00	1.29	0.00	25.79	3.00	18.29	2.00
Mersey R. - Dynans Bridge		6.00	2.00	5.25	2.00	8.75	3.00	0.00		1.74	0.00			21.74	2.00
Mersey R. Upstream of Kimberley		6.00	2.00	4.06	2.00	8.75	3.00	5.00	2.00	0.58	0.00	24.39	2.00	19.39	2.00
Mersey R. Merseylea Bridge		4.00	1.00	3.25	1.00	8.75	3.00	0.00		1.23	0.00			17.23	2.00
Mersey R. Lovetts Flats		6.00	2.00	3.81	1.00	7.50	3.00	5.00	2.00	0.84	0.00	23.15	2.00	18.15	2.00
Mersey R. Farrell Park		6.00	2.00	1.88	0.00	8.75	3.00	0.00		0.97	0.00			17.59	2.00
Mersey R. Shale Rd.		0.00	0.00	3.25	1.00	7.50	3.00	0.00		5.81	2.00			16.56	1.00
	Average	5.38	1.77	4.00	1.46	8.08	2.92	7.50	3.33	1.46	0.23	27.15	2.50	18.92	1.85
	Condition	Poor		Poor		Moderate		Good		Very poor		Moderate		Poor	
MERSEY CATCHMENT TRIBUTARY SITES BELOW LAKE PARANGANA															
Lobster Rivulet - at Caveside		4.00	1.00	5.13	2.00	8.75	3.00	0.00		0.97	0.00			18.84	2.00
Lobster Rivulet. Chudleigh		0.00	0.00	0.50	0.00	8.75	3.00	7.50	4.00	0.90	0.00	17.65	2.00	10.15	1.00
Caroline Creek		2.00	0.00	2.88	1.00	8.75	3.00	5.00	2.00	0.65	0.00	19.27	2.00	14.27	1.00
Sassassafras Creek		6.00	2.00	4.38	2.00	10.00	3.00	5.00	2.00	2.13	1.00	27.51	3.00	22.51	2.00
Minnow Creek		10.00	4.00	6.25	3.00	8.75	3.00	7.50	4.00	1.55	0.00	34.05	3.00	26.55	3.00
Minnow R. Downstream of Lower Beulah		6.00	2.00	2.13	1.00	8.75	3.00	10.00	4.00	0.65	0.00	27.52	3.00	17.52	2.00
Minnow R. Upstream of Dasher R.		6.00	2.00	5.06	2.00	8.75	3.00	5.00	2.00	0.97	0.00	25.78	3.00	20.78	2.00
Dasher R. Claude Rd		0.00	0.00	0.50	0.00	8.75	3.00	7.50	4.00	0.58	0.00	17.33	2.00	9.83	1.00
Dasher R. Paradise Rd		0.00	0.00	0.50	0.00	7.50	3.00	7.50	4.00	0.65	0.00	16.15	1.00	8.65	1.00
Dasher R. Bridle Track Road		0.00	0.00	1.75	0.00	8.75	3.00	5.00	2.00	1.29	0.00	16.79	1.00	11.79	1.00
Coilers Creek		0.00	0.00	0.75	0.00	6.25	2.00	7.50	4.00	0.65	0.00	15.15	1.00	7.65	0.00
Parramatta Creek		8.00	3.00	8.50	4.00	6.25	2.00	7.50	4.00	3.55	1.00	33.80	3.00	26.30	3.00
Redwater Creek - Garden of Eden Road		4.00	1.00	2.69	1.00	8.75	3.00	5.00	2.00	6.46	3.00	26.90	3.00	21.90	2.00
Redwater Creek tributary U/s npr.		0.00	0.00	0.50	0.00	8.75	3.00	5.00	2.00	4.13	2.00	18.38	2.00	13.38	1.00
Caroline Creek - Railton		4.00	1.00	0.88	0.00	6.25	2.00	0.00		1.68	0.00			12.80	1.00
Bonney's Creek		4.00	1.00	1.06	0.00	1.25	0.00	7.50	4.00	0.52	0.00	14.33	1.00	6.83	0.00
Kings Creek		4.00	1.00	3.25	2.00	7.50	3.00	7.50	4.00	0.84	0.00	23.09	2.00	15.59	1.00
	Average	3.41	1.06	2.75	1.06	7.79	2.65	6.67	3.20	1.66	0.41	22.25	2.13	15.61	1.41
	Condition	Poor		Poor		Moderate		Good		Very poor		Moderate		Poor	

APPENDIX 2.

FIELD DATA SHEETS USED FOR THE MERSEY RIVER 'INDEX OF RIVER CONDITION' SURVEY

Rapid River Condition Assessment
Department of Primary Industry and Fisheries

This technique or methodology is a modification of the methods adopted by the Queensland 'State of the Rivers' studies by the Department of Primary Industries and the 'Index of Stream Condition' developed by the Victorian Department of Conservation and Natural Resources. It involves the use of a 'snap-shot' approach, that is, a one off survey of river condition at a number of sites along the length of a target stream.

The aim is to achieve an understanding of current conditions within a system which can be used as a bench-mark for future comparisons. This is achieved through gathering information on physical and ecological conditions of the current stream system that will provide data on problem areas and provide a baseline for future comparative work to observe rates of change.
The format is designed as a standard to provide current condition information and a method that can be utilised in follow-up surveys.

It is broadly based on the following parameters:

1) Physical form;
2) Riparian zone;
3) Water quality;
4) Aquatic life; and
5) Instream values.

Aspects of hydrology, water quality and aquatic life can only be obtained by technical staff.

Objectives
a) It will be necessary to create an index of condition for all observed parameters (i.e. quality rating).
b) From all applied index data it will be necessary to develop a system to determine overall site condition and incorporate this into a factor of river condition.
c) Stream condition must be based on physical parameters with deteriorating condition departing from an estimated 'norm' or 'natural' condition.
d) Data collection must be of a standardized form that can be easily replicated.

Full descriptions of all physical aspects of each site is necessary, not necessarily to include in final analysis of site condition, but to observe changes (improvements/degradation) in sites if subsequent studies are undertaken at a later date.

Aquatic Insects
Aquatic invertebrates may be good indicators of river health. Preliminary invertebrate data has already been collected from a number of sites and analysis of indicator species will be incorporated into the final data set at a later date.

Note:
This methodology is based on "physical stream condition" and is currently under review and is open to modification and expansion.

Indicator ratings

All field data obtained will be subjected to a rating scale to determine overall condition of the system.

Indicators are based on a 5 point rating scale (other than in 2 exceptions). Ratings are based on the difference between the current value of the indicator and what it would be under unimpacted conditions. Victorian authorities justify the use of a 5 point scale by stating that higher ratings would be unrealistic given the current state of knowledge. With less than 5 points there are problems as the category size becomes too large.

Example of a 5 point scale for indicator measurements

Category	Numerical value
Essentially natural	4
Near natural	3
Some modification	2
Major modification	1
Highly modified	0

Through field measurements a number of indicators may be recorded and these values will be combined under 1 group category to provide a sub-index value. Sub-index values are weighted in a scale of between 0 and 10. (eg. on a 0 to 4 rating multiply sub-index value by 2.5)

FIELD NOTES

All data is to be collected from within the boundaries of the stream bank, that is, to the minor flood level or, bank full level, or top of levee bank.

At each site an approximate 100 meter length of stream is to be assessed, greater lengths are allowed where necessary, but must be recorded..

Stream bank designation - for example, left bank refers to the left side when facing upstream.

In channel measurements - for substrate parameters only - to be recorded within the streamwashed channel.

A number of data collection techniques require brief explanations and are detailed below.

Unless otherwise specified all parameter estimates are to be recorded for the full length of the site (e.g. 100 m).

MAJOR STREAM HABITAT TYPE KEY

RIFFLE	Depth 0.1 - 0.3 m; gradient 1 - 3 deg; Moderate currents.
RUN	Depth >0.3m; gradient 1 - 3 deg; small but distinct and uniform current; surface unbroken.
POOL	Depth >0.5 m; where stream widens or deepens and current declines.
BACKWATER	Depth <0.3 m; a reasonable size (>20 % of channel width) cut-off section away from the main channel course.

AGGRADATION		DEGRADATION	
Nil	no evidence of aggradation	**Nil**	no evidence of degradation
Slight		**Slight**	
Moderate	accumulations of material at obstructions, bed tending to flat, same size material on bed as bars, evidence of minor overbank siltation.	**Moderate**	steep bed, absence of alluvial material, narrow low flow course, bank erosion, evidence of recent minor deepening.
Heavy		**Heavy**	
Extreme	high width/depth ratio, flat bed, channel largely blocked, overbank siltation evident, adjacent water logging.	**Extreme**	low width/depth ratio, evidence of recent severe deepening, bare banks, bank erosion, possible erosion heads.

Aggradation = is the accumulation or deposition of stream bed materials.

Degradation = the downcutting or erosion of a stream into its bed materials.

RIVER CONDITION INDEX - FIELD DATA SHEETS
Sheet - 1

SITE INFORMATION (100 METER SITE LENGTHS - PLEASE SPECIFY OTHERWISE)

River:-		
Site location:-		
Date:-	Time:-	
Map name/number:-		
Grid reference:-	Easting-	Northing-
Catchment area:-		
Discharge:-		
Elevation of site:-		

NB:- please fill only the appropriate sections above e.g. elevation, discharge, etc. unnecessary)

Water Level at Time of Sampling	
Completely dry	
Isolated pools, no flow	
Low flow/low level	
Moderate < water mark	
Normal - near water mark	
High > water mark	
Flood > bankfull	

Site selection
Choose 100 m sites that incorporate representative pools, riffles, and runs (WHERE POSSIBLE). If a proportion of a mpool or run is used this must be indicated as such. If more than 100 m is necessary to encompass all habitats, this is acceptable, as long as the estimated length is recorded.

Site Sketch

Sketch: Show location of survey, access points, landmarks and key features such as roads, bridges and buildings. Also show the key features about the stream environs and its location. Indicate the direction of flow. The sketch should be adequate for quickly finding the site again for future follow-up surveys. Also include a diagrammatic representation of the sequence of pools riffles and runs including the estimated length and average width of each.

AVERAGE WIDTH OF STREAM:-

DATA FOR RIVER CONDITION INDEX
Sheet 2

RIPARIAN VEGETATION

Vegetation Cover	Left Bank % Cover	Right Bank % Cover
OVERSTOREY		
Trees >30 m		
Trees 10-30 m		
Trees <10 m		
UNDERSTOREY		
Woody shrubs		
Rushes and sedges		
Herbs/non-woody shrubs		
GROUND COVERS		
Grasses		
Ferns/Bracken		

Vegetation Type	Left Bank % Cover	Right Bank % Cover
Rainforest		
Mixed forest (rainf. with euc. overstorey)		
Wet sclerophyll (euc. overst., thick underst.)		
Dry sclerophyll (pred. euc.)		
Titree		
Willow		
Gorse/Blackberries etc.		
Grass (eg. farmland)		

Proportions of vegetation COVER of overstorey, understorey and ground cover to be separate. All of vegetation TYPE to equal 100 %.

AVERAGE WIDTH OF RIPARIAN ZONE	Left Bank	Right Bank
> 40 m		
30 - < 40 m		
20 - < 30 m		
10 - < 20 m		
5 - < 10 m		
< 5 m		

The Riparian zone is the interface between the aquatic and terrestrial environment. This parameter is largely designed to determine how much vegetation is present from the river bank to when some form of disturbance, such as clearing, occurs. Of course the riparian zone may be extensive therefore anything over 40 m should be recorded. The size of the riparian zone is important to determine how much of a buffering effect it is having.

DENSITY OF NATIVE RIPARIAN SPECIES	Left Bank	Right Bank
95 - 100 % cover		
85 - 94 % cover		
65 - 84 % cover		
40 - 65 % cover		
0 - 39 % cover		

DATA FOR RIVER CONDITION INDEX	Sheet - 3

AQUATIC HABITAT

Assessment is made in terms of the % cover of the surface area within the selected site.

SUBSTRATE PARAMETERS (within channel)													
Percent. Class (A to F)	**POOL** (Numbered if several at site)				**RIFFLE** (Numbered if several at site)				**RUN** (Numbered if several at site)				**Percent class examples**
	1	2	3	4	1	2	3	4	1	2	3	4	**(A) 0 - 5**
Bedrock													**(B) 5 - 25**
Boulders (>300 mm)													**(C) 25 - 50**
Lge Cob. (140-300 mm)													**(D) 50 - 75**
Sm. Cob. (20-140 mm)													**(E) 75 - 95**
Gravel (1-20 mm)													**(F) 95 - 100**
Sand/silt (<1 mm)													

SUBSTRATE PARAMETER EXAMPLES					
Sand/silt	Gravel	Small Cobble	Large Cobble	Boulders	Bedrock
Raw sugar	20 cent piece	Softball	Human Head	Greater than head	

1 mm 20 mm 140 mm 300 mm

COARSE WOODY DEBRIS		Cover %
None	No snags are visible at the measurement site.	
Few	Some visible branches in stream. Debris cover 10% or less of stream bed.	
Moderate	Visible branches and trees that have been relocated to be adjacent to the stream banks. Surface area of debris 30% or less of stream bed.	
Numerous	Large trees present all the way across the stream. Surface area of debris cover 30 to 50% of stream bed.	
Abundant	Numerous debris with surface area 50% or more of the stream bed. Large trees may be present right across the stream.	

DETRITUS - FINE DEBRIS												
Percent. Class (A to F) as with substrate parameters.	**POOL** (Numbered if several at site)				**RIFFLE** (Numbered if several at site)				**RUN** (Numbered if several at site)			
	1	2	3	4	1	2	3	4	1	2	3	4
Detritus (eg. leaf packs)												

INSTREAM VEGETATION Macrophytes	Proportion (%) for representative reach											
	POOL				**RIFFLE**				**RUN**			
	1	2	3	4	1	2	3	4	1	2	3	4
Submerged												
Floating (eg. strapweed)												
Emergent (eg. bullrushes)												

Water Chemistry (to be recorded by DPIF Staff)					
	Temperature	**Conductivity**	**Diss. Oxyg.**	**Turbidity**	**pH**
Parameter:-					

DATA FOR RIVER CONDITION INDEX **Sheet - 4**

(Please place a tick in the appropriate boxes)

BANK STABILITY		Left Bank	Right Bank
Stable	erosion resistant soils, no undermining, usually gentle batter, good vegetative cover, no significant damage to bank structure or vegetation.		
Limited erosion	good vegetative cover, some minor isolated erosion, no continuous damage to bank structure or vegetation.		
Moderate	banks held by discontinuous vegetation, some obvious damage to bank structure and vegetation, generally stable toe.		
Extensive	little effective vegetation, recent bank movement, mostly unstable toe.		
Extreme	evidence of rapid unchecked erosion, little effective vegetation, unstable toe.		

AGGRADATION (Refer to explanatory sheet)	Left Bank	Right Bank	DEGRADATION	Left Bank	Right Bank
Nil			**Nil**		
Slight			**Slight**		
Moderate			**Moderate**		
Heavy			**Heavy**		
Extreme			**Extreme**		

OVERALL DISTURBANCE					
Extreme	**Very high**	**High**	**Moderate**	**Low**	**Very low**

COMMENTS:.....

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APPENDIX 3

RESUME

Mersey River Catchment Index of River Condition

This project was developed through community concern over the condition of waterways within the Mersey River catchment. It is one aspect of a broad scale study initiated by the Mersey River Working Group encompassing catchment hydrology, faunal studies, water quality and environmental flows that will provide a holistic view of overall catchment condition. This part of the project is generically termed Index of River Condition (IRC). It is a habitat based approach that is designed to provide a generalised view of stream condition at specific locations within the catchment. It has been conducted in conjunction with two seperate on ground studies by staff of this department, one which describes general water quality throughout the catchment, and the second which analyses river health through monitoring macroinvertebrate assemblages.

The project was run through full community involvement with initial field training exercises followed by short term intensive field surveys of 33 sites within the Mersey River catchment (Figure 1). Community participation provided a means of gaining rapid results, although short term rapid training prior to the field exercise is essential. For future studies upgraded training and quality checks would need to be addressed. Initial site selection, data analysis and final reporting was required by professional staff.

This methodology is in its infancy in Tasmania and is the first trial using this new technique, although it has been adopted by several mainland states. It is clearly not a quantitative process, but rather provides a qualitative assessment of catchment conditions. The project adopted most of the concepts behind the Victorian development of an Index of Stream Condition (CEAH, 1995). It is expected that data parameters and overall methodologies will be extensively reviewed and modified for future studies.

This procedure requires the assessment of data gathered from field and office sources. These assessments are based on a range of inputs that are placed into rating categories. A number of indicators may be recorded and these values will be combined under one group category to provide a sub-index value. Sub-index values are weighted on a scale of between 0 and 10. These scores are then combined to supply an overall environmental condition rating for each site. The final assessment of site and catchment condition is subjective in nature and findings must be viewed with this in mind.

The sub-index parameters were chosen for ease of use and applicability to the Tasmanian environment. Modifications to ratings and parameter selection were made where necessary and on the advice of professional staff. With further refinement of index parameters this list will be expanded for future studies. The sub-index parameters are as follows:

Sub-index	**Indicator**
Physical form	Overall disturbance
Streamside zone	Width of streamside zone Density of native species Tree height Vegetation type
Water quality	Turbidity Conductivity
Aquatic life	SIGNAL
Instream values	Streamside cover Coarse woody debris (snags) Detritus Macrophytes

The overall aim of the procedure is to determine the deviation of a site away from an estimated condition of naturalness. The lower the rating, the further from a natural state a site will be and therefore the higher the impact of specific streamside activities. The following categories and associated ratings were adopted:

Category	Numerical value (Rating)
Essentially natural	4
Near natural	3
Some modification	2
Major modification	1
Highly modified	0

Many of the category rating scales were based on Victorian procedures and modified to suit the Tasmanian environment through professional judgement. Thirty three sites within the Mersey catchment were analysed for a habitat condition rating. Each site has associated with it a set of sub-index categories (as illustrated above) which are totalled to provide an overall environmental condition rating. Overall ratings which broadly categorise all sites into one condition value are listed as follows:

	Numerical value (Rating)			
Category	**Sites above Parangana**	**Mainstream Mersey R.**	**Mersey R. Tributaries**	**Average for all catchment sites**
Physical form	4	2	1	2
Streamside zone	3	1	1	1
Water quality	3	2	2	3
Aquatic life	4	3	3	3
Instream values	0	0	0	0
Overall IRC with fauna values	3	2	2	2
Overall IRC without fauna values	3	1	1	2

The above information is condensed to provide an overall rating for the entire catchment. The information is not as robust as site-by-site data but it does provide a quick assessment of broad scale catchment condition. As would be expected sites above Parangana, which are largely unimpacted, rate well with high condition factors. The mainstream Mersey River sites seem moderately impacted with aquatic life rating the highest (i.e. near natural). The tributary streams rate consistently the lowest
(i.e. modified condition) with aquatic fauna again rating highly. Combining all lower catchment sites illustrates a reduced rating indicating some modification to this part of the system, as would be expected. Figure 2 illustrates site-by-site conditions for all streams, also indicating a reduction in condition factor down the catchment. Clearly, site-by-site information provides a more detailed analysis of the range of conditions encountered within the catchment.

Several discrepancies in, and obvious improvements to, the methodology became clear during field trials and analysis of data sets. Data analysis indicated that:

* sites selected represented a suitable range of conditions within the catchment but a greater number would be required in any future design.
* habitat parameters selected for this process were adequate but should be expanded for any future studies.
* the instream values sub-index consistently rated low for nearly all sites, this may be a result of the site specific nature of these parameters. Appropriate modifications to suit specific parameters may be necessary in future.

* the rating scale seems to adequately assess the condition of a site, with suitable modifications and tightening of target parameters, accuracy should only increase.
* certain parameters were either not recorded, or insufficient time was available to collect full data sets (e.g. faunal data). Data analysis has highlighted the need to maintain consistency when collecting field data.
* initial training of field workers was brief but essential and would need to be repeated by professional staff for any untrained individuals.

Summary of Condition factors for catchment streams

The overall condition rating for the entire catchment was determined to be that of a moderately impacted environment.

Mersey River

The mainstream Mersey River sites below Lake Parangana encompass a range of environmental condition ratings (12.4 to 25.3, this does not include faunal data). There is also an evident decline in stream condition down the catchment. The overall condition rating for the majority of sites in the river suggests 'some modification' is evident. Of the sub-index parameters water quality consistently rated well through all sites as did the aquatic life (except in 2 of the lower catchment sites). Streamside zone ratings were generally low ('some' to 'major' modification), while physical form rated largely as 'some modification'.

Tributary streams

The Mersey River catchment tributary sites below Lake Parangana also encompass a broad range of environmental condition ratings (6.8 to 26.5, this does not include faunal data). Over half of the sites have rated as having 'major' or 'high modification' with the remaining rating as 'some modification' except 2 sites (upper Minnow Creek and Paramatta Creek) which both rate as 'near natural'. Of the sub-index parameters water quality rated consistently high (near natural) except at Bonney's Creek where a 'highly modified' rating was recorded. Of the streamside zone parameter nearly half the sites rated very low (highly modified), a similar result was obtained for physical form. Faunal ratings varied between 'essentially natural' and 'some modification'.

Upper catchment streams

Four sites above Parangana dam were analysed as unimpacted examples for comparative purposes. All sites rated highly, that is, 'near' to 'essentially' natural for all sub-index parameters other than instream values. This highlights the need to incorporate unimpacted 'control' sites to illustrate the deviation that exists between impacted and unimpacted regions. It also aids in assessing the usefulness of all parameters and any anomalies that may occur in data sets.

REFERENCE

Centre of Environmental Applied Hydrology (CEAH) and ID&A Pty. Ltd., (1995) Development of an Index of Stream Condition, report prepared for the Waterways Unit of the Department of Conservation and Natural Resources.