Manapouri Power Scheme

Waiau River Landscape Assessment

Report submitted to the

Waiau River Working Party

prepared for

Electricity Corporation of New Zealand Limited

by

Boffa Miskell Limited

August 1995

1. Introduction

In September 1994 Boffa Miskell Limited was commissioned to prepare a visual landscape assessment of the lower Waiau between the Mararoa Weir and Blackmount. This study was dependent upon assessing the effects of controlled flows at the Mararoa Weir. Due to the unusual weather conditions in the spring and summer, controlled flows were not feasible and the study was delayed. In May 1995 Boffa Miskell was instructed to broaden the study to include a greater range of controlled flows and to consider issues of wider landscape significance.

This report is the result of investigations conducted between September 1994 and July 1995. The work on assessing the effects of controlled flows occurred in May, June and July 1995.

The aim of these investigations is to assist Electricity Corporation of New Zealand (ECNZ) to meet its statutory obligations under the Resource Management Act 1991 (RM Act) when applying for Resource Consents for the Manapouri Power Scheme.

Landscape is not defined in the RM Act. Neither are a number of other concepts central to this investigation. Consequently a glossary of terms follows this introduction. The report then sets out the study methodology before focussing on the findings which in turn lead to a number of conclusions.

Acknowledgments

The study team wish to acknowledge the assistance they received from a wide range of sources including:

- Electricity Corporation of New Zealand Limited
- Southland Regional Council
- Department of Conservation
- Southland Fish and Game Council
- Members of the Waiau Working Party

2. Extracts from the Resource Management Act 1991 (RM Act) and Glossary of Terms

The purpose of this study is to provide technical information required as part of ECNZ's obligations under the RM Act when applying for resource consents.

The following sections (5-8) are taken from Part II, Purposes and Principles of the RM Act.

5. Purpose-(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while-

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

6. Matters of national importance-In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:

(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:

(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

7. Other matters-In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to-

(a) Kaitiakitanga:

(b) The efficient use and development of natural and physical resources:

(c) The maintenance and enhancement of amenity values:

(d) Intrinsic values of ecosystems

(e) Recognition and protection of the heritage values of sites, buildings, places, or areas:

(f) Maintenance and enhancement of the quality of the environment:

(g) Any finite characteristics of natural and physical resources:

(h) The protection of the habitat of trout and salmon.

*8. **Treaty of Waitangi**-In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).*

Of particular relevance to this study are S6a, b and d and S7c, e and f.

Environment and Amenity Values are defined in the RM Act (S2).

Environment

"Environment" includes-

(a) Ecosystems and their constituent parts, including people and communities; and

(b) All natural and physical resources; and

(c) Amenity values; and

(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters:

Amenity Values

"Amenity Values", means those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes:

Landscape

Landscape is not defined in the RM Act. Indeed 'landscape' is something of an elusive phenomenon. In this study it is treated as both a physical and a perceptual resource.

Physical Resource

Landscape is the composite physical expression of the interplay between physical, biological and cultural processes. Each area has its own unique landscape character and identity which reflects the particular mix and emphasis of its formative processes.

Perceptual Resource

Each landscape takes on value when it is perceived and experienced. The values people place on any area are subjective. Inevitably, the combination of multiple values contained in any landscape and the differing responses of each individual means that the issue of landscape assessment is one fraught with difficulties. However many values ascribed to landscape are widely shared in the community, or are supported by research findings, or are already formally recognised by the community (eg. through reserve status).

It is not a straight forward exercise to relate this definition to the terminology of the RM Act. However, the concept of a perceptual resource appears to be consistent with the RM Act definition of environment and amenity values. A recent landscape study for the Canterbury Regional Council identified a number of ways in which regionally outstanding landscapes may be valued.

1 Natural Science

Natural features and landscapes that are of at least regional importance for reasons of the rarity or representativeness of their particular landform and landcover. A natural feature may be a landscape feature or an element/component of the landscape. Under S6(b) geology and soils are elements of particular focus, as flora and fauna values are also considered elsewhere in the Act.

2 Legibility

Landscapes (or natural feature) of regional significance that clearly express past natural and cultural processes. Some may have strong historical connotations and a distinctive sense of place. Others may be particularly expressive examples of major geological processes.

3 Transient

Natural features and landscapes of regional significance that provide a predictable or regular experience of dimensions of nature, other than landform or landcover, eg. concentrations of wildlife, exceptional climatic or weather phenomena.

4 Aesthetic

Landscapes (and natural features where applicable) that are of high aesthetic value determined on how memorable they are, on their naturalness, on their composition (coherence) and on other important aesthetic factors.

5 Shared and Recognised

Natural features and landscapes which are highly valued by the general public, for example as reflected through writing and painting or through popular tourist locations. The presence of existing protected sites is also likely to reflect shared and recognised values.

6 Tangata Whenua

Natural features and landscapes recognised as having particular regional importance to tangata whenua.

Boffa Miskell Ltd and Lucas Associates (1993)
Canterbury Regional Landscape Study Volumes 1 and 2

Aesthetic Quality

The RM Act makes two references to aesthetic values.

1. The definition of "amenity values" in S2 refers to "those natural and physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes"; and

2. In the Fourth Schedule (S2(d)) persons undertaking an assessment of effects on the environment are required to assess "any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual or cultural or other special value for present or future generations".

Traditionally aesthetic coherence and value have tended to equate to 'visual quality'. However, an emphasis on visual quality alone can diminish the meaning of landscape. It is not some superficial aesthetic. Landscape is clearly more fundamental than this, reflecting social values and community aspirations.

A useful working definition of aesthetics is:

> 'pertaining to the quality of human perceptual experience (including sight, sound, smell, touch, taste and movement) evoked by phenomena or elements or configurations of elements in the environment'

In other words aesthetic quality is the significance given to a landscape determined by the landscape's physical properties coupled with the cultural values of the person experiencing the landscape.

Terms used to explain the aesthetic qualities of landscape include vividness and coherence.

A **vivid** landscape is a striking landscape that remains long in the memory.

A **coherent** landscape is one that visually 'hangs together'. Unity and harmony are other words that convey the same meaning.

Natural Character

RM Act S6 refers to the preservation of the natural character of rivers and their margins. Natural character is not defined in the RM Act. However, it does appear probable that the degree of natural character in any landscape derives from the extent to which its character is an expression of nature rather than culture. In the Canterbury Regional Landscape Study mentioned above, 'natural landscapes' were defined as 'landscapes whose character derives mainly from natural elements, natural patterns or natural processes'. This is a 'liberal' interpretation of natural, but one that has found support in case law.

All these aspects of landscape will be of significance in studying the effects on the Waiau River of the Manapouri Power Scheme.

3. Study Method

The study approach had four com

1. *Client and stakeholder disc*

An approach was recommen skell and accepted by ECNZ. This was discussed with a wi iau Working Party members who made a number of sugg ere incorporated into the study methodology.

They also discussed their pe ts on the significance of the Waiau landscape which prov elpful in building up a picture of both the river and the qualitie valued.

Informal discussions with int during site investigations provided further information.

2. *Literature review*

Working Party documentatic d including technical studies, Waiau Watch and other mor scape reports of the area.

Landscape acts as an impor of many of the issues described in detail in Waiau Working p documents. However, it is not appropriate or necessary to terial contained in these studies apart from a few key points ect bearing on the conclusions and recommendations cont port. The recreation, historical and Maori reports in particu r understanding of how the Waiau River landscape is perceive and valued. The geological and hydrological studies provide derstanding and structuring the site investigations reported rs. Reference is made to these studies in the relevant secti

Reviewed material is listed ed on in Appendix 1

3. *Site investigations and p record*

Nine days were spent on t days in familiarisation and the identification of suitable ph wpoints; one day preparing landscape descriptions, an otographing the controlled flows. To gain an overview of the riv reaches were flown by fixed-wing aircraft.

The use of photographs taken under various controlled flows has been an important component of the study.

Twenty four viewpoints were identified as suitable. These included all the locations from which the general public can view the river plus a number of other spots where access was known to be used by anglers and others. Finally, where a reach of river had no coverage, access across private land was arranged with the land owner.

Identical photographic panoramas were taken at each location for a range a controlled flows at the Mararoa Weir - 0, 11, 18, 25, 50, and 100 cumecs (originally a 14 cumec flow was planned, however when this was measured accurately by NIWA it was found to be 18 cumecs. A further 14 cumec flow was arranged and photographed from selected locations. This flow was found by NIWA to be 11.1 cumecs). Despite these difficulties it was considered that the data generated by the six sets of photographs are adequate to illustrate or predict the likely effects of any controlled flows below 100 cumecs.

A further complication in the analysis of controlled flows resulted from the variation in the tributary flows between the various investigations. The contribution from tributary flows becomes increasingly significant as one moves down river. It is necessary to keep this in mind when assessing the findings.

Only one flow could be photographed each day. This was because the river takes time to adjust to each new flow and photography could only occur during daylight hours (ideally 9.30am - 3.30pm). It took at least five hours to work through the twenty four viewpoints.

Weather conditions were rarely ideal with low cloud and fog persisting along the river from Mararoa to Clifden on several occasions. This disrupted the order in which viewpoints were photographed which in turn meant that some photographs were taken directly into the sun, making analysis difficult. Nonetheless the photographs have proved invaluable and have provided the basis of a graphic analysis in which all flows are overlayed.

4. Analysis and evaluation of findings

A range of techniques are used to evaluate the significance of the different controlled flows and to relate this information to the wider picture. An attempt has been made to be as transparent as possible in this assessment so that readers can measure their own responses against the reports findings.

4. Site Investigations

Landscape Context

These investigations focus on the Waiau River and in particular the predicted effects of Mararoa Weir controlled flows. However, to appreciate the effects these flows may have on people's appreciation and enjoyment of the river it is necessary to consider the wider landscape context.

Landscape Context of the Lower Waiau

The lower Waiau flows through two landscape units identified in the report "Landscape and Ecology in Southland District" prepared for Southland District Council by Boffa Miskell Ltd as a background paper to the Proposed District Plan.

The northern part of the river from Mararoa Weir to Black Mount is in the Te Anau Basin Unit. This is a spacious landscape between the Fiordland National Park to the west and the Takitimu Mountains to the east. The basin has a complex geological history, which is not entirely understood. This complexity shows through in the variety of landforms, river and vegetation patterns and present day uses of the area. Its climate is strongly influenced by the Fiordland mountains with the rivers having played an important role in shaping the terrain of the basin. Wetlands are a feature of this landscape.

The Blackmount Redcliff Road parallels this stretch of the river south to Redcliff Creek, before turning east away from the river to cross over the Black Mount shoulder. This stretch of road is part of the Southern Scenic Route and as such is popular with tourists. The only point at which the river can be reached by car is at the Mararoa Weir. There are pedestrian/4WD access points near Excelsior and Redcliff Creeks. There are very few views of the river from anywhere along this stretch of the Southern Scenic Route.

South of Black Mount the river flows through the Lower Waiau Unit. This landscape unit includes the farmland of the Waiau Valley from the Monowai - Black Mount area down to the coast. The Waiau Valley is a broken landscape with hills and steep valleys in the north, extensive terraces and terrace escarpments for much of its length, rolling limestone country around Clifden extending south towards Tuatapere and a wider more expansive valley south of Tuatapere.

The bulk of the valley is intensively farmed; although there are remnants of tussock, shrubland and bush particularly in the north. More extensive forest remnants occur to the west of the river. Tuatapere is the main settlement of the area. It grew as a timber town, based on the native forests of Waitutu and the Longwoods. A forest remnant, Tuatapere Domain, forms an attractive riverside

reserve in the town. Clifden, Monowai and Blackmount are other small settlements. Monowai is a village associated with the power station.

The Southern Scenic Route follows State Highway 99 north to Tuatapere and Clifden. These two locations give good views to the river. Elsewhere, the river is in the middle distance when viewed from the highway south of Tuatapere and near to the Wairaki River confluence mid-way between Clifden and Blackmount. A number of minor roads and access tracks approach close to the river. The most significant is at Monowai where minor roads give views or access to the river river crossing at the Monowai Suspension Bridge.

Between Monowai and Clifden there is limited vehicle access with Motu Road on the true left bank and the Lillburn Monowai Road on the true right providing the most convenient access.

In summary the Waiau River is integral with, and has played a crucial part in the formation of the Waiau Valley. However, because the river is entrenched below extensive terraces or confined to narrow gorges, it is a river that is rarely seen by the general public apart from the crossings at Monowai, Clifden and Tuatapere. The river is rarely seen from the Southern Scenic Route. This inconspicuousness puts added importance on the few locations where the river can be experienced by the general public.

The Lower Waiau River

Waiau Working Party report E1 (River Reach analysis of the Waiau River, Southland, from Mararoa Weir to Te Waewae Bay) describes the river in detail. Brierley identified 11 reaches. A description of their key characteristics is contained in Appendix 1 (mapped in Figure 1).

Physical descriptions of the river reaches will not be repeated here apart from the reaches north of Monowai for which some additional detail is necessary. There are three distinctive stretches of river landscape between the Mararoa Weir and Monowai Power Station.

Mararoa Dam to Whare Creek

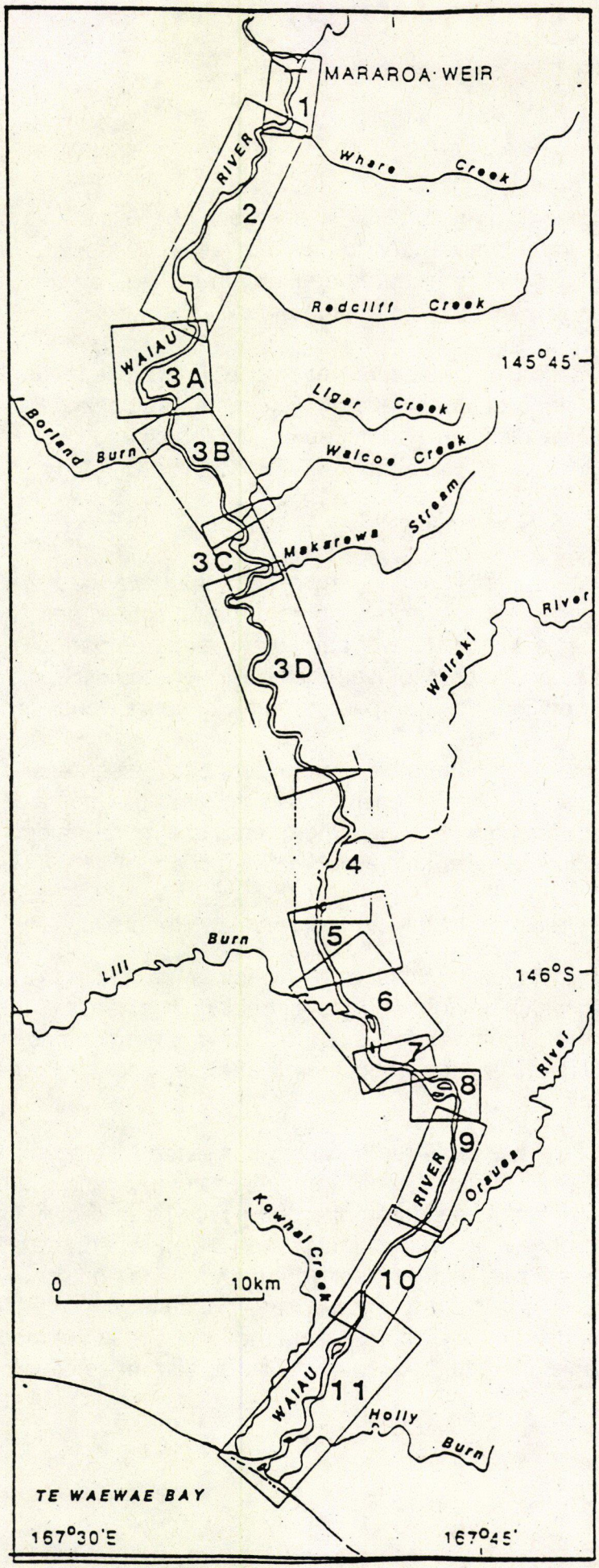
Single stem, gently meandering, entrenched river bed stretching for 2 kilometres. Scrub (bracken, gorse etc) and some trees (including remnant beech) adjacent to the river particularly on steep banks. Willows immediately adjacent to river above Whare Creek. Surrounding country highly modified-mostly in pasture but with some woodlots.

At low flows the watercourse meanders between extensive shingle banks but with some more extensive pools eg. near the mouth of Exelsior Creek. Downstream from here the watercourse has more braided characteristics but is still confined within a well-defined channel.

Whare Creek to Black Mount (4km below Redcliff Creek)

The characteristics of this major stretch (9 km) of the river are 1) the braiding within boulder and gravel banks; 2) extensive riffles; 3) strong meandering form; 4) vegetated islands and promontories within river bed. These characteristics reflect the broader, less contained nature of the river along this stretch.

Much of the western (true right) bank is formed by the lower slopes of Paddock Hill. This hill is covered in beech forest and is a major landscape feature. There is a significant eroding face near Redcliff Creek which is visible from a number of points in the valley. Where the adjacent land on the western bank is less steep it is in shrubland and scrub. On the eastern side the land is in pasture, scrub and woodlots with extensive conifer plantations south of Whare Creek and Little Creek. Immediately along the river banks there is rough pasture, scrub and areas of willow.



River Reach Map Sheet Index

Brierley, Gary J (1992) (E1) " River reach analysis of the Waiau River, Southland, from Mararoa Weir to Te Waewae Bay" Report submitted to the Waiau Working Party

Figure 1

ıunt (4km below Redcliff Creek) to Monowai Confluence

ĸilometre stretch of river is more confined with a single channel. It ıowing but with some shallow pools and riffles. The Monowai has a small delta into the main channel. For much of this stretch the entrenched with forested banks or nearby terrace faces. On the ınk there is scrub and bush. On the east are the commercial gs of Black Mount Forest.

ınd its tributaries are expressive of the highly dynamic nature of this . The present rivers and creeks under moderate flows appear to be ven the scale of their valley surrounds eg. Redcliff Creek. For much .iau Valley the presence of a major river is only apparent because of ;ing, terrace faces and occasional distant glimpses of water. The e and Clifden crossings coupled with the river valley 'impression' lsewhere are all that the majority of passing tourists will experience. ı the river is a relatively minor component of the wider landscape.

se visiting the river itself, the significance of the landscape context is depend on the activities pursued. For example a fisher may be very ɪ on the water and almost oblivious to the wider surroundings. People .ing by the river however, may be very conscious of their surroundings. us Working Party reports suggest that many regular visitors and residents Waiau Valley see the river as an important component of the landscape.

ʌıı limited exceptions, eg. the river at the Monowai suspension bridge, the river and its context are likely to be viewed and experienced as one landscape. Nonetheless, this study now focuses on the waters themselves to better understand the contribution that controlled weir flows make to the character and quality of the Waiau River.

Controlled Flows

As described in an earlier section of this report six controlled flows were assessed at 24 locations. These locations are shown in Figure 2 and photographs 1-24.

The photographic viewpoints were chosen because either they were thought to be representative of a stretch of river and/or they were a significant point from which the public can experience the river.

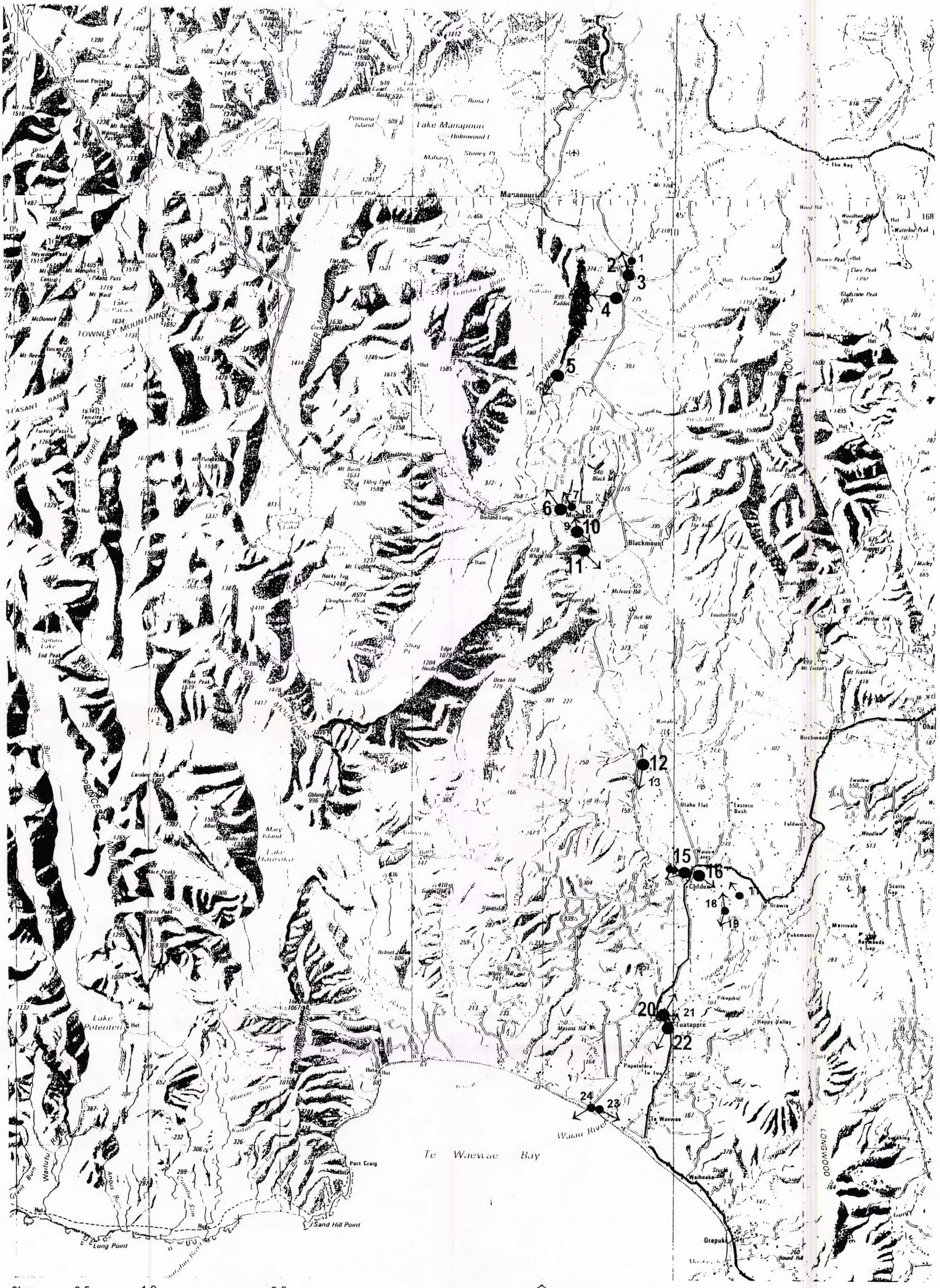
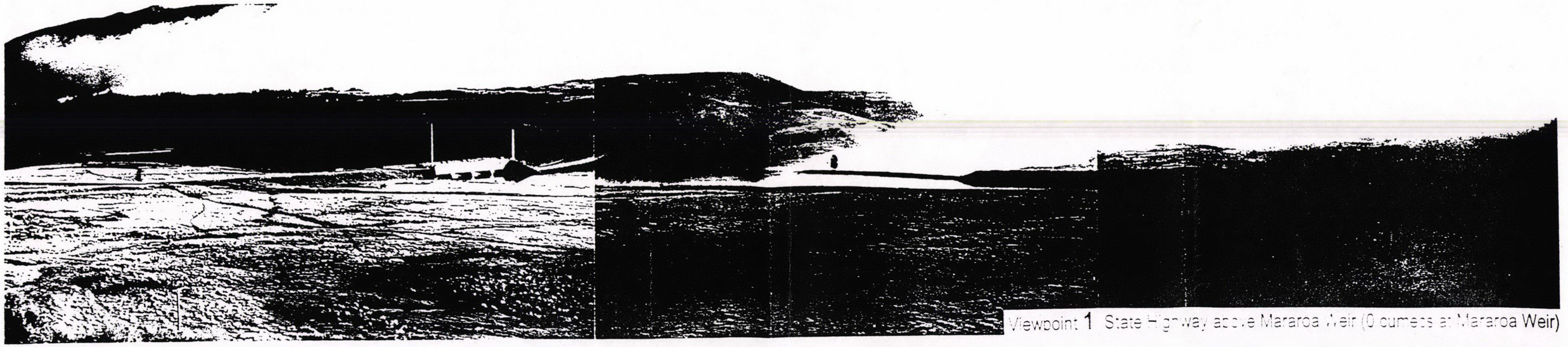


Figure **2** **Photo Viewpoints**

Department of Survey and Land Information Map Licence NL 097071/1:
Crown Copyright Reserved NZMS 262 Sheet 16 1:250,000



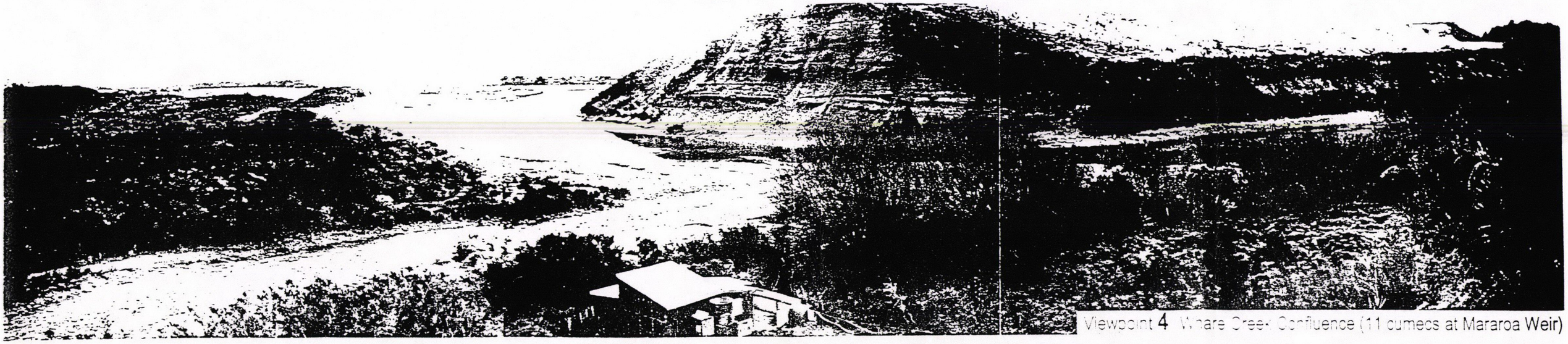
Viewpoint 1 State Highway above Mararoa Weir (0 cumecs at Mararoa Weir)



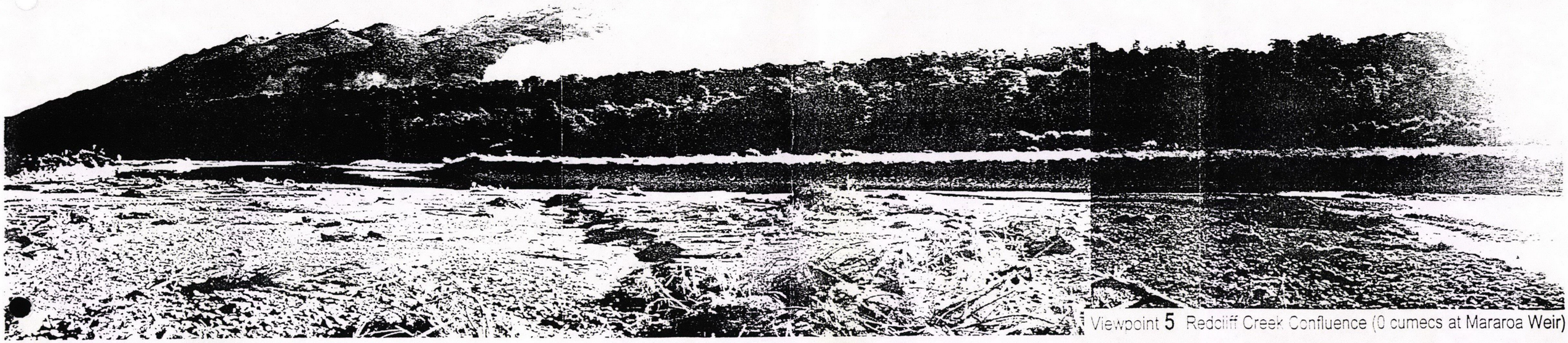
Viewpoint 2 Bridge below Mararoa Weir (0 cumecs)



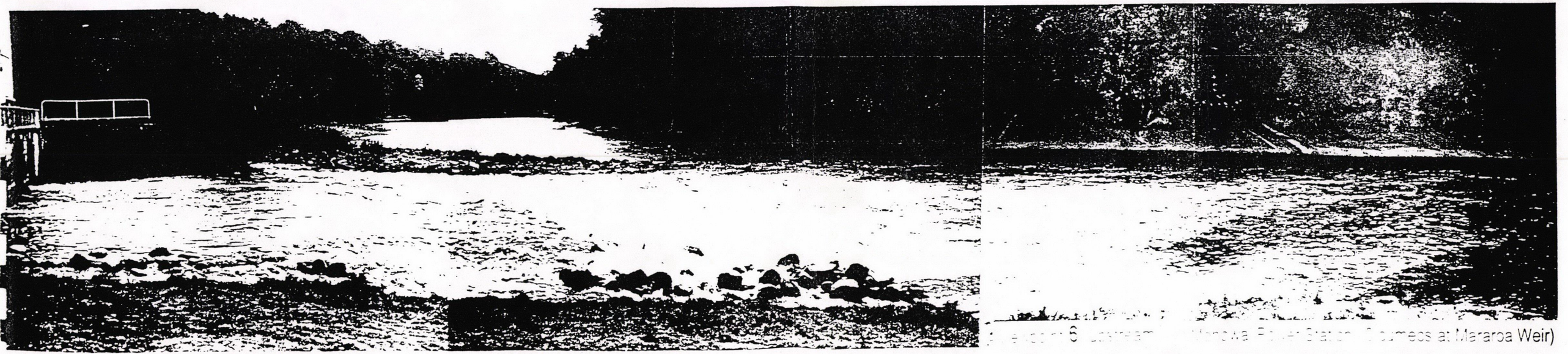
Viewpoint 3 Bridge below Mararoa Weir (0 cumecs)



Viewpoint 4 Mhare Creek Confluence (11 cumecs at Mararoa Weir)



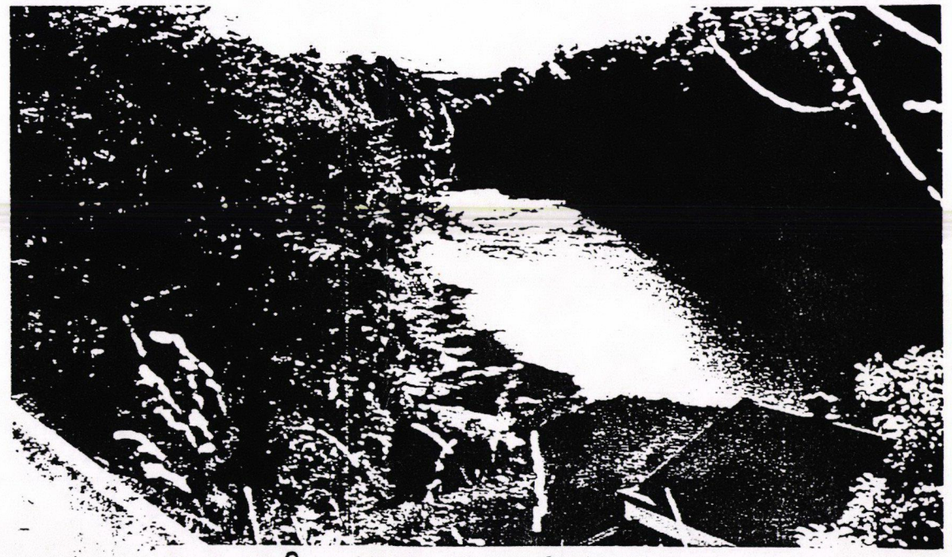
Viewpoint 5 Redcliff Creek Confluence (0 cumecs at Mararoa Weir)



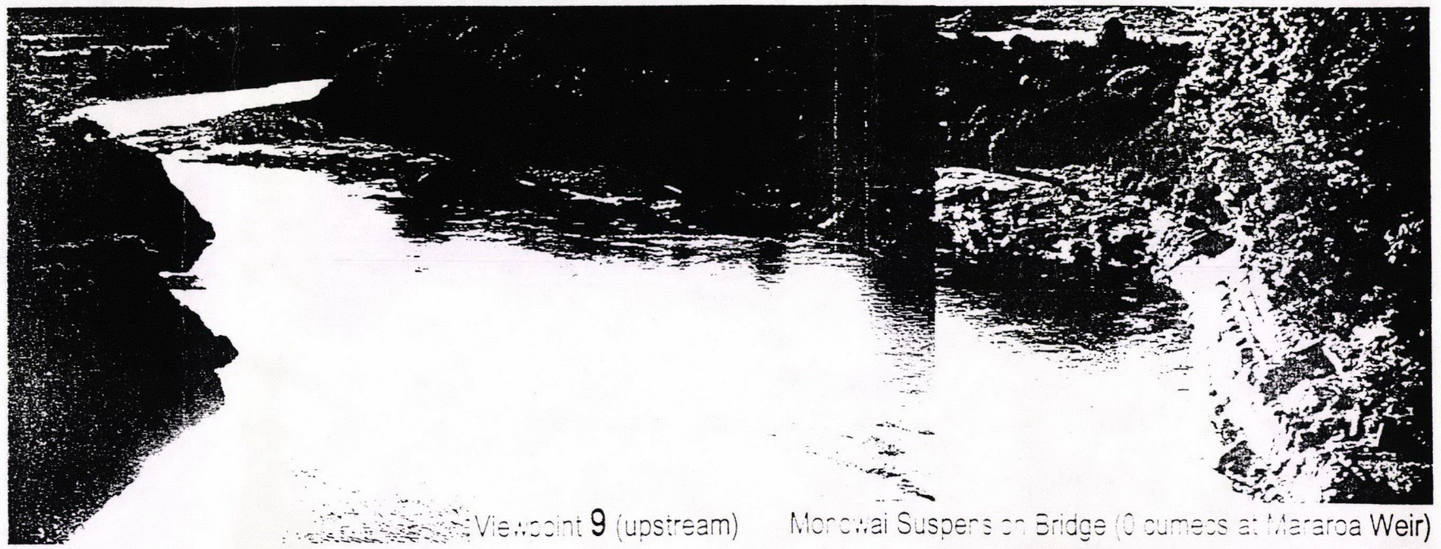
Viewpoint 6 [illegible] Manapia Power Station (0 cumecs at Mararoa Weir)



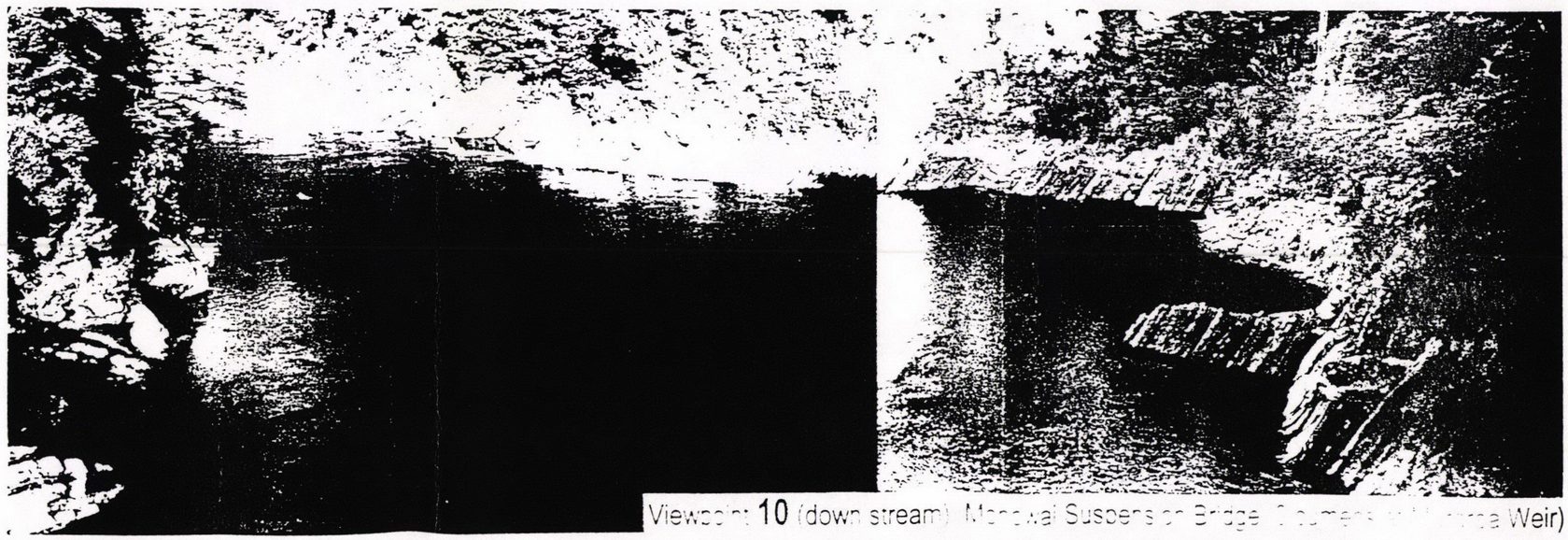
Viewpoint 7 downstream)
Monowai Suspension Bridge (0 cumecs at Mararoa Weir)



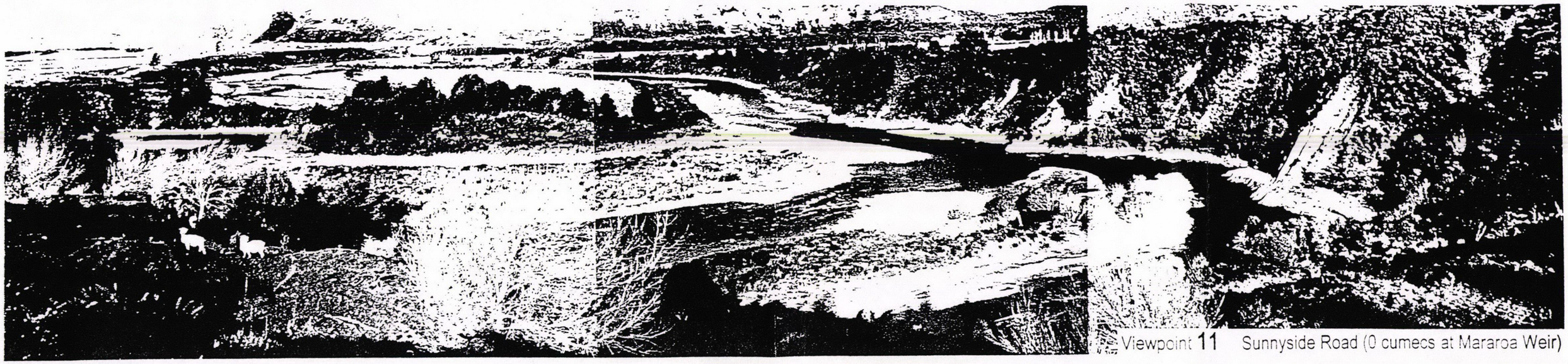
Viewpoint 8 Monowai Power Station (0 cumecs at Mararoa Weir)



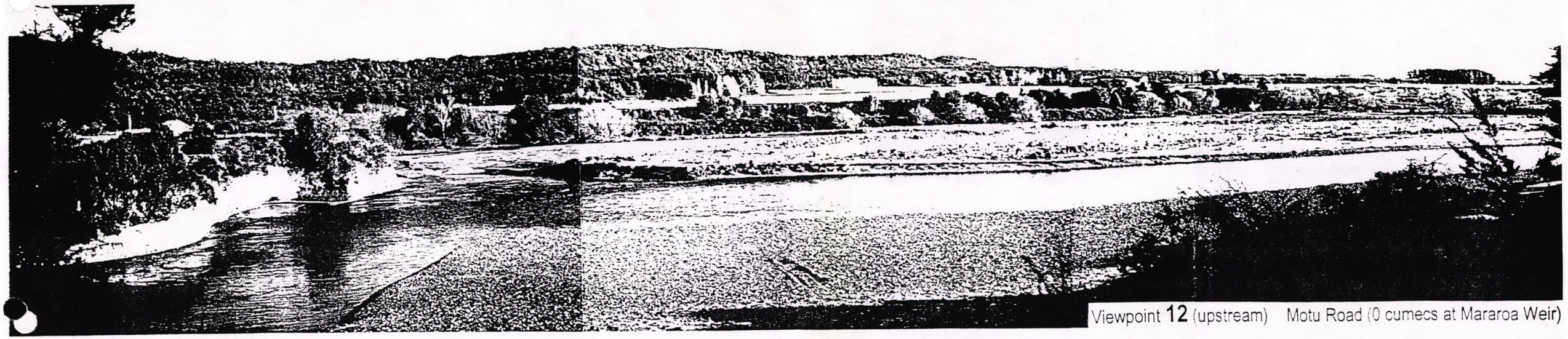
Viewpoint 9 (upstream) Monowai Suspension Bridge (0 cumecs at Mararoa Weir)



Viewpoint 10 (down stream) Monowai Suspension Bridge (0 cumecs at Mararoa Weir)



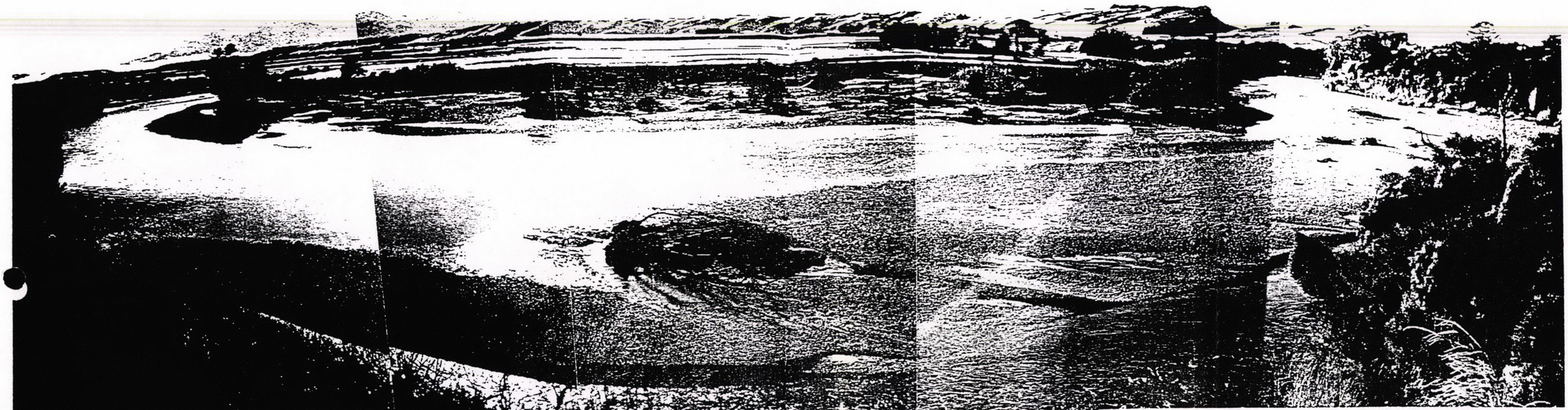
Viewpoint 11 Sunnyside Road (0 cumecs at Mararoa Weir)



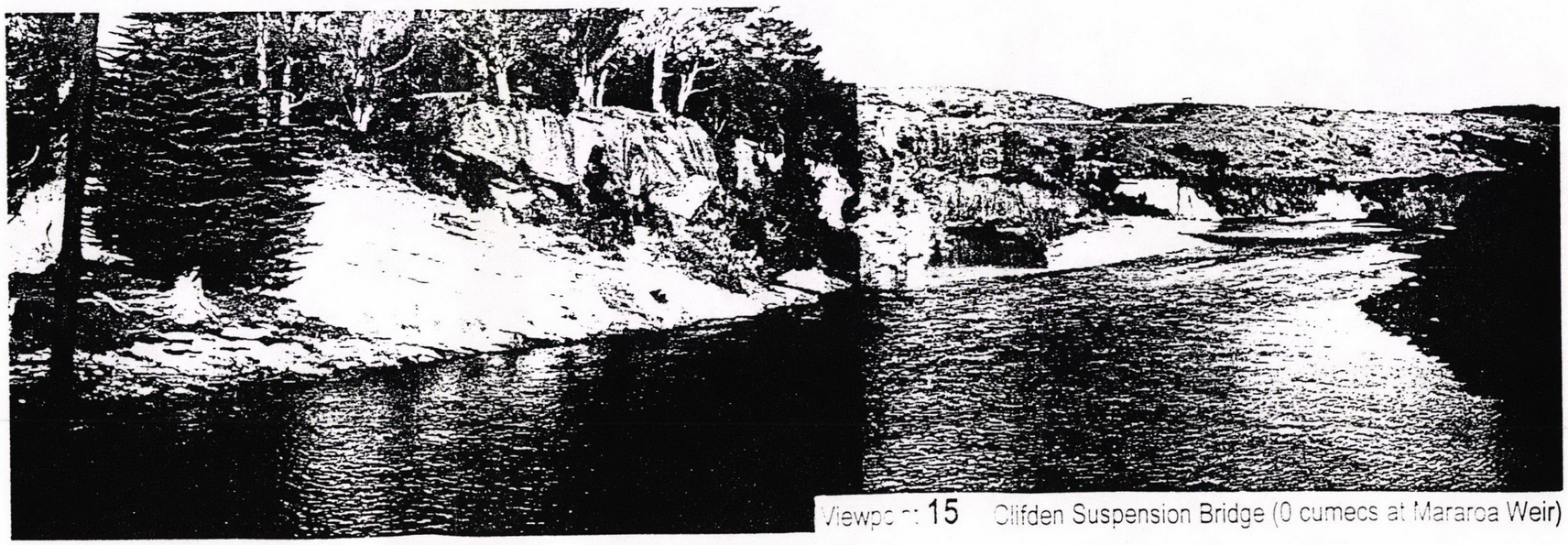
Viewpoint 12 (upstream) Motu Road (0 cumecs at Mararoa Weir)



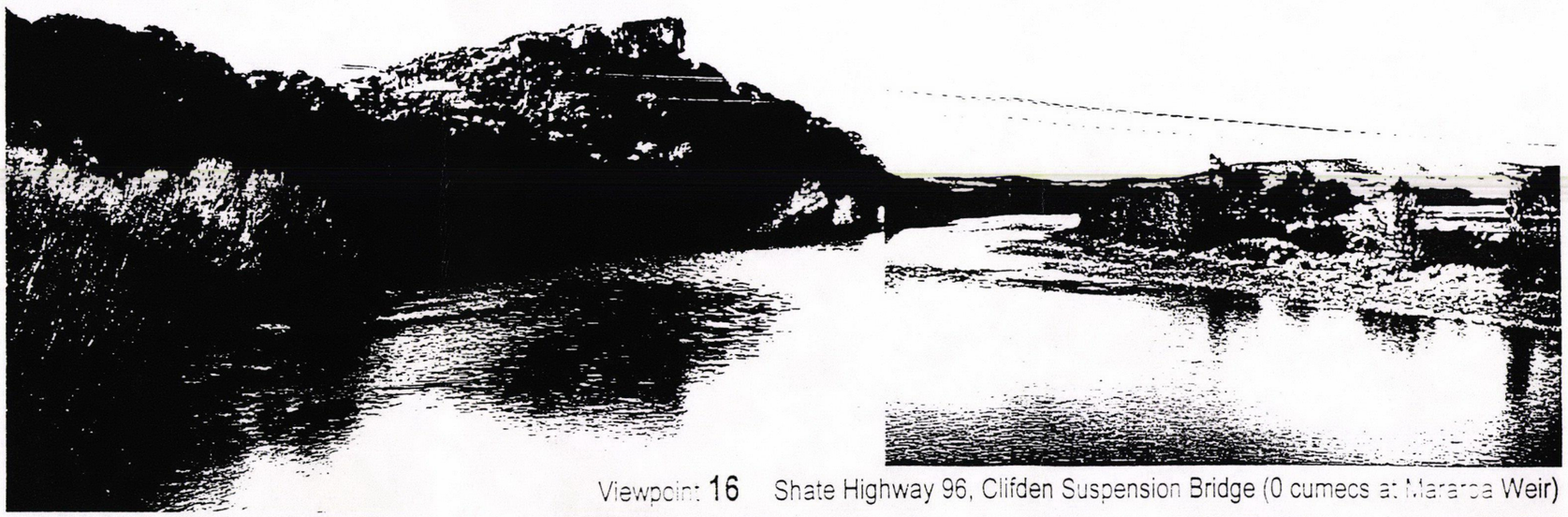
Viewpoint 13 (downstream) Motu Road (0 cumecs at Mararoa Weir)



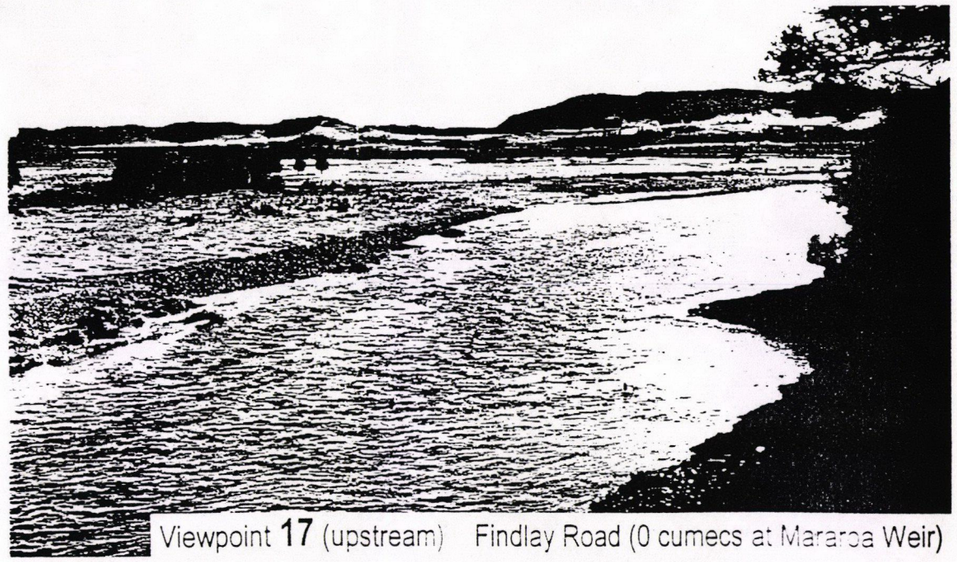
Viewpoint 14 Lillburn Valley Road (0 cumecs at Mararoa Weir)



Viewpoint 15 Clifden Suspension Bridge (0 cumecs at Mararoa Weir)



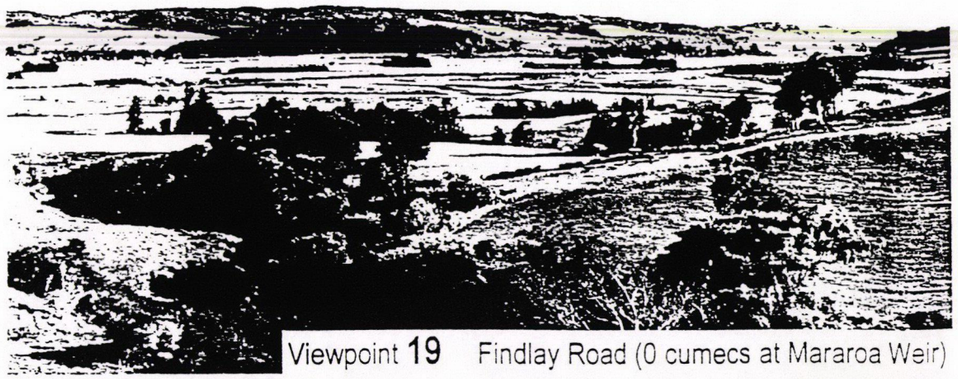
Viewpoint: 16 Shate Highway 96, Clifden Suspension Bridge (0 cumecs at Maranoa Weir)



Viewpoint 17 (upstream) Findlay Road (0 cumecs at Maranoa Weir)



Viewpoint 18 (downstream) Findlay Road (0 cumecs at Maranoa Weir)



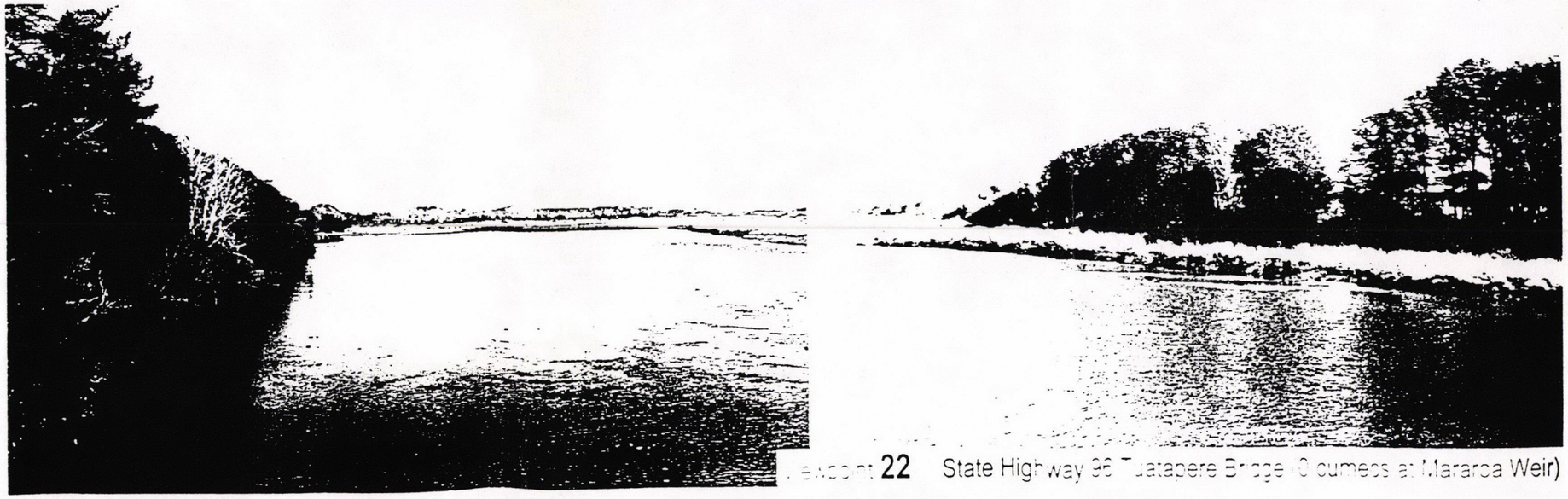
Viewpoint **19** Findlay Road (0 cumecs at Mararoa Weir)



Viewpoint **21** (upstream)
State Highway 96 Tuatapere Bridge (0 cumecs at Mararoa Weir)



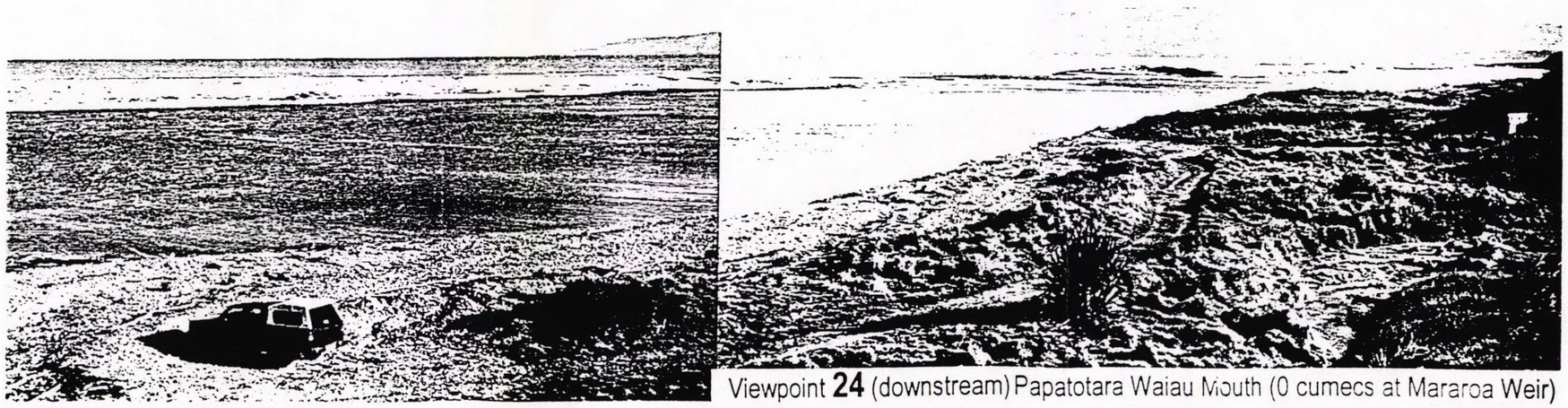
Viewpoint **20** Tuatapere Domain (0 cumecs at Mararoa Weir)



Viewpoint **22** State Highway 96 Tuatapere Bridge (0 cumecs at Mararoa Weir)



Viewpoint **23** (upstream) Papatotara Waiau Mouth (0 cumecs at Mararoa Weir)



Viewpoint **24** (downstream) Papatotara Waiau Mouth (0 cumecs at Mararoa Weir)

Following detailed analysis a 'short-list' of twelve viewpoints was chosen. These provide a comprehensive picture of the effects of different flows. Table 1 lists the reasons for excluding viewpoints from the shortlist.

Table 1

Viewpoint	Reason for excluding viewpoint from shortlist
1	Above weir - little variation visible
7	View down river from Monowai Power Station - shows similar effects to photo 6
8	View from on hill above Power Station - similar to photo 6
9	Monowai Suspension Bridge up river into sun. Photo 10 is from same location looking down river
13	Motu Bush road down river. Similar changes to photo 12
15	West of Clifden gives good view but access to viewpoint difficult and shows similar effects to photo 15
17,18	Viewpoint across several paddocks on private land. Controlled flows having relatively little effect on river changes
19	Distant view from Hagen Road. No obvious changes to river's appearance
21	Up river from Tuatapere bridge - similar to photo 20 and directly into sun
23,24	Changes in appearance result from tidal effects in lagoon rather than controlled flow changes

The twelve short-listed viewpoints are now analysed in figures 3-14. Note: reference to cumec flows on the viewpoint sheets (0-100cumecs) relates to the controlled flows at Mararoa weir on that day, **NOT** to the flow at the photographic viewpoint. The latter flow can be estimated using the table of flows provided on each sheet. This table records the cumec flows or river levels at Mararoa weir, Sunnyside, Clifden and Tuatapere.



25 cumecs controlled flow, 16 June 1995

Viewpoint 3 ***Bridge below Mararoa Weir (downstream)***

Naturalness Fairly low. View from bridge below Mararoa Weir Ford crossing in foreground with extensive boulders. View to pleasant riparian vegetation beyond.

Changes under different flows Very significant changes. Zero flow results in small pools and a trickle of water with gravel and boulders dominant. At 100 cumecs the river extends from bank to bank and 90% of the in-river rocks are covered. There is a distinct difference in appearance between 11 and 18 cumecs resulting from flows across the gravel on the true left side of the river. Further benefit is slight until above 50 cumecs.

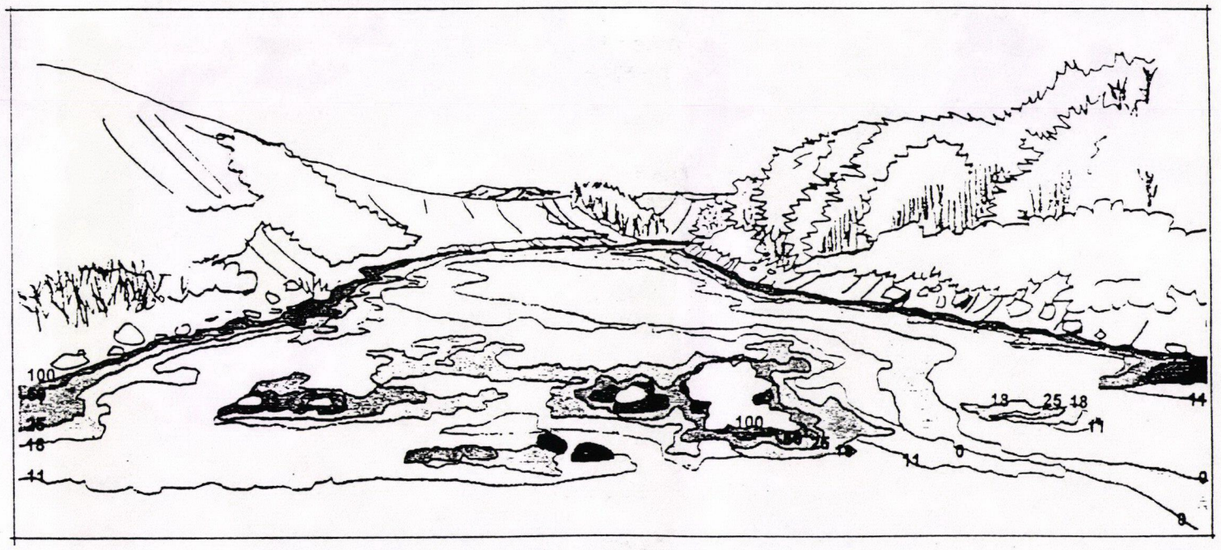
Tributary Flows not applicable

Water area differences Based on a simple measure of the extent of water between the vegetated banks - 11 cumecs results in 40% ± of the appearance of a full river but still appears to flow around the boulders. The 18 cumec results in 60-70% cover and flows through the boulders. There is then a gradual increase to 95% under 100 cumec flow.

Elements The appearance of a sinuous stream within the wider river bed is lost between 11 and 18 cumecs. At 18 cumecs the river flows across the width of the bed. Only above 50 cumecs do the in-river boulders lose their visual dominance and by 100 cumecs the obvious water depth and speed of flow is taking on the proportions of a large river. The gravel fringe along the river banks is partially lost above 50 cumecs and in-river gravel slugs lost above 25 cumecs flow.

Users This is one of the few points with reasonable access. The river is not signposted from the sealed road however its presence is clear to those travelling from Manapouri south. Access suggests family parties may use this area for picnicking, etc. In low flows fish are visible below the weir.

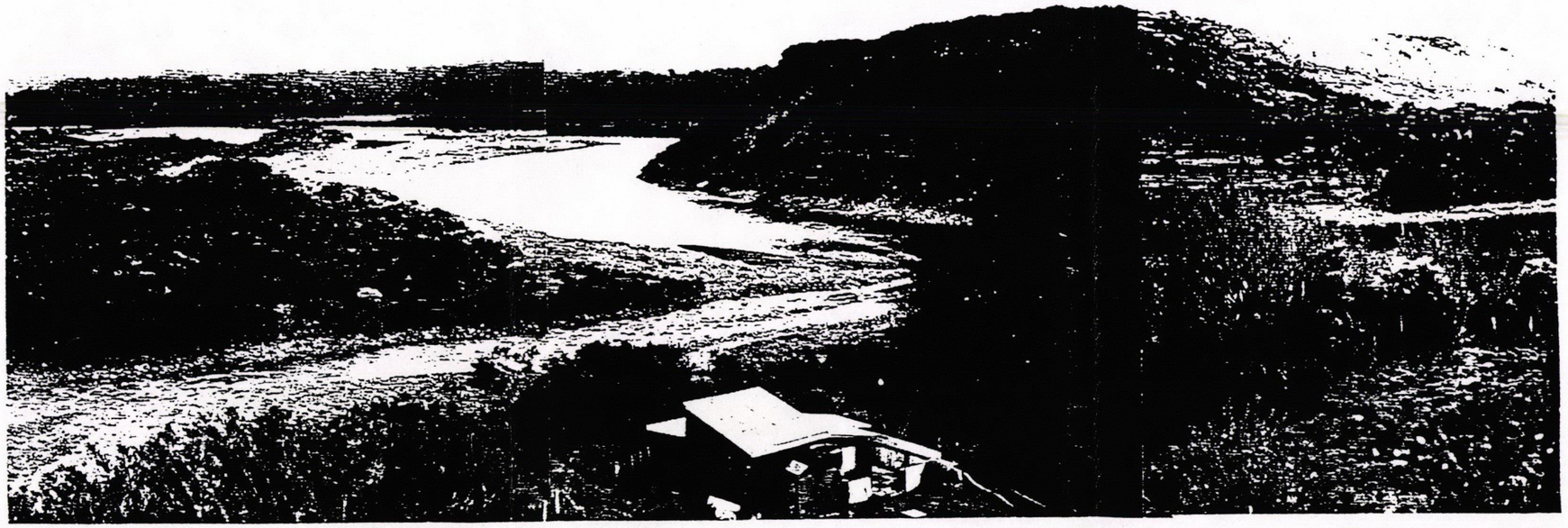
Comments With the current disposition of gravel and boulders etc, there is a distinct benefit in the 18 cumec flow over the 11 cumec flow. However, the river bed is not static and will be modified in each flood flow. Therefore it is important not to place too much emphasis on details of the situation when photographed. Modification of the river bed could have a significant effect on the benefits gained under different flows.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	60.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 3 Bridge below Mararoa Weir

Figure **4**



25 cumecs controlled flow, 16 June 1995

Viewpoint 4 *Whare Creek Confluence*

Naturalness

High. Bush clad mountains in national park and major river terrace exposures are dominant.

Changes under different flows

Very significant changes from a small sluggish river set in a gravel bed at zero flow to a substantial swift flowing braided river at 100 cumecs. River develops a second channel around the small island between the 18 and 25 cumec flows. Even at 100 cumecs extensive in-river gravels and boulders and still visible.

Tributary Flows

Similar tributary flows apart from 50 cumec flow where both Excelsior and Whare Creeks were substantially higher.

Water Area Differences

Extent of water. Benefits of 11 and 18 cumecs flows over 'zero' flow are minor. Above 25 cumecs river begins to take on braided appearance. Illustrated 'zero' flow contributes 50% ±, 11 and 18 cumecs <55%, 25 cumecs 60%, and 100 cumecs 80% coverage of river bed.

Elements

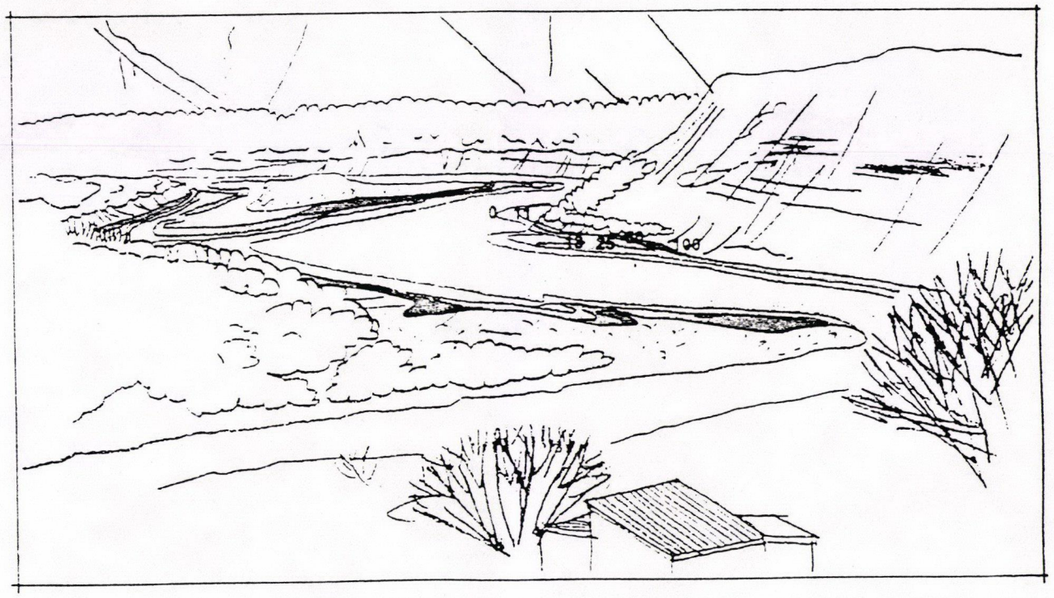
This is a braided stretch of river as it leaves the confined upper reach. A greater extent of exposed river bed is therefore to be expected. Exposed fringe of gravel exists to 100 cumecs. Braids creating in-river island occurs above 25 cumecs. The speed of river flow appears to increase above 50 cumec levels.

Users

Access is across unsigned paddocks. Users are likely to be restricted to fishers and the occasional knowledgeable in-river users.

Comments

Very few people other than fishers are likely to experience this stretch of river. It is not visible from public roads. The river appears to be modified (ie. artificially controlled flows) until at least a 25 cumec flow occurs. Given the knowledge and interests of those using this reach of river, the recognition that the river is controlled is unlikely to be significant.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	60.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 4 Whare Creek Confluence

Figure **5**



50 cumecs controlled flow, 9 June 1995

Viewpoint 5 ***Redcliff Creek*** *Confluence (downstream)*

Naturalness Medium high - high with bush etc on true right bank, but pasture and extensive broom etc on true left bank.

Changes under different flows These are relatively minor with the Redcliff Creek 'delta' dominating the foreground. The major change is in the depth and speed of the mainstem particularly at >50 cumecs.

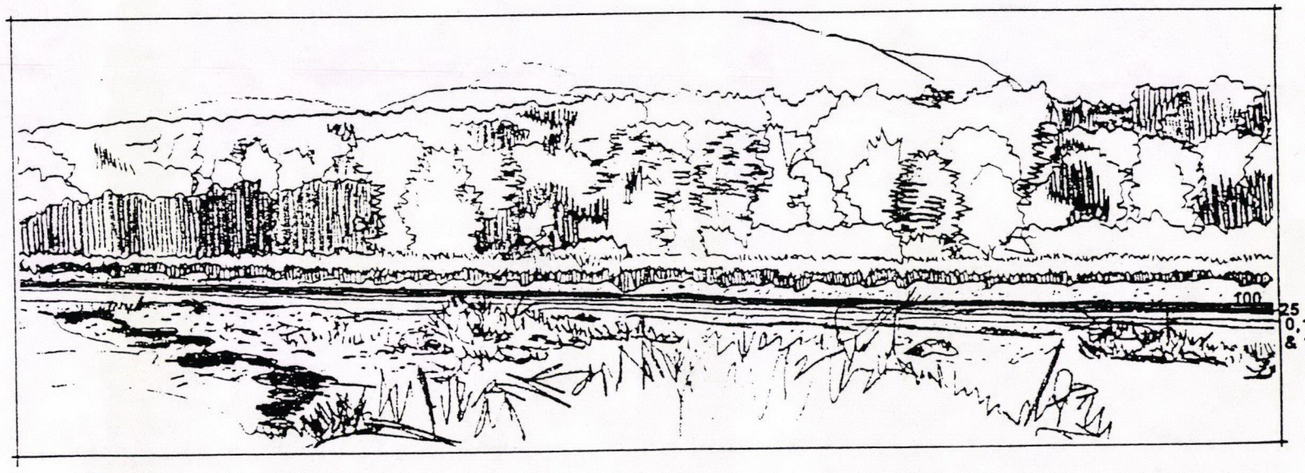
Effects of tributary flows The contribution of tributaries to the 50 cumec flow was substantially greater than other flows. Note that by the Monowai Power Station the 50 and 100 cumec flows were essentially the same suggesting that an additional 50 cumecs had entered the Waiau between the Mararoa Weir and the Monowai confluence.

Water area differences There is a visible doubling of visible water between the zero and 100 cumec flows with incremental changes as the flow increases. No obvious thresholds are discernible. Even under 100 cumecs a substantial area of exposed gravel is clearly dominant. The 50 and 100 cumec flows give the impression of a substantial swift flowing river at this point.

Elements The gravel braiding and Redcliff Creek delta are dominant elements and very expressive of a dynamic river of variable flow. This is emphasised by the flood debris. The views out to the Takitimus and Fiordland further reinforce this impression. Limited bank vegetation suggests that flows greater than those photographed are relatively frequent occurrences.

Users Access is via a private track through paddocks. It is only likely to be used by fishers and others with specific in-river interests.

Comments In this upper unconfined braided section (Whare Creek to Redcliff Creek) the river landscape clearly displays the characteristics of a dynamic river. With substantial flows in Redcliff Creek access was difficult and the local farmer commented on major changes to the creeks course in the last storm. The transportation of boulders at the height of the flood sounded "like a bulldozer working on the road outside the house". Similar processes will operate on the mainstem and frequent changes in river course are probable.
There is little difference in appearance between the '0' and '25' cumec flows.
The fishers perception is likely to be largely coloured by the ability to gain access along the river. Access across the river would be dangerous in the higher flows.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 5 Redcliff Creek Confluence

Figure 6



Viewpoint 6 *Monowai Power Station (upstream)*

25 cumecs controlled flow, 16 June 1995

Naturalness High apart from presence of Power Station. Approach through village and past penstocks etc reduces the sense of an unmodified gorge landscape.

Changes under different flows Minor changes. With 50 and 100 cumec flows the tailrace water appears to join a substantial river while at less than 25 cumecs the river and tail race flows are not dissimilar. The visual changes on the rock face opposite are very small.

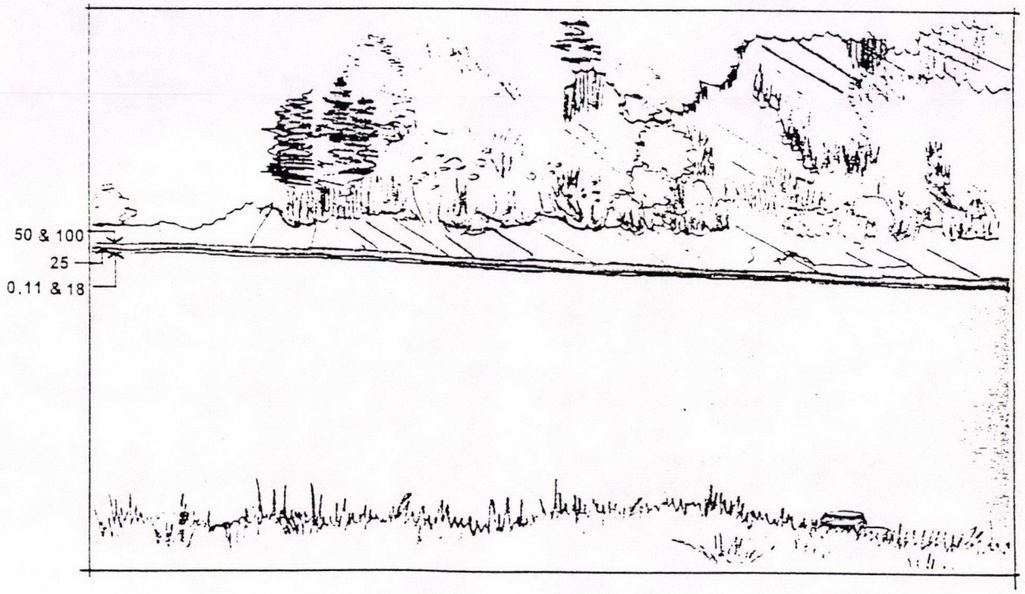
Effects of tributary flows The Monowai flow is similar throughout (19.7-22 cumecs). 50 and 100 cumec flows are very similar by the time they reach Monowai as a result of different tributary flows. ie. much higher on the 50 cumec day. Tributary contribution significant.

Water area differences The differences between the zero and 25 cumec flows at the weir have all but been lost by the time the river reaches this point. The width of the river coupled with the steepness of the banks makes any difference, even when directly comparing photographs, virtually indiscernible. The 50 and 100 cumecs flows are noticeably greater (but see notes on tributary flows above).

Elements In the low flows (<25 cumecs) the tail race water descends into the Waiau creating riffles well into the river. The Waiau flow is more dominant under the 50/100 cumec flows. The 'peninsula' of rocks that jut out into the river north of the tailrace illustrate this difference.

Users Most casual visitors will be attracted by the power station, which can be reached by vehicle. This location is not as scenic as the suspension bridge gorge which is more likely to attract those seeking a more natural setting. It is not unreasonable to assume that many visitors will be unaware of the subtle differences in flows under 50 cumecs.

Comments This is an attractive area in which the river is an important component. The appearance of the river in its gorge varies little between flows. Direct comparison of the photographs confirms that under the 50/100 cumec flows dominance of the mainstem is apparent. This is unlikely to be of significance to the visitor.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 6 Monowai Power Station



18 cumecs controlled flow, 15 June 1995

Viewpoint 10 Monowai Suspension Bridge (downstream)

Naturalness High. Viewpoint is on suspension bridge, however this structure adds to the historical atmosphere and does not detract from the naturalness of the scene.

Changes under different flows Minor - due to steepness of the river banks

Effects of tributary flows The 50 cumec flow is greater than the 100 cumec flow - swollen by tributary flows. Tributary contribution significant.
Measurements at Sunnyside (1 kilometre downstream) were as follows:

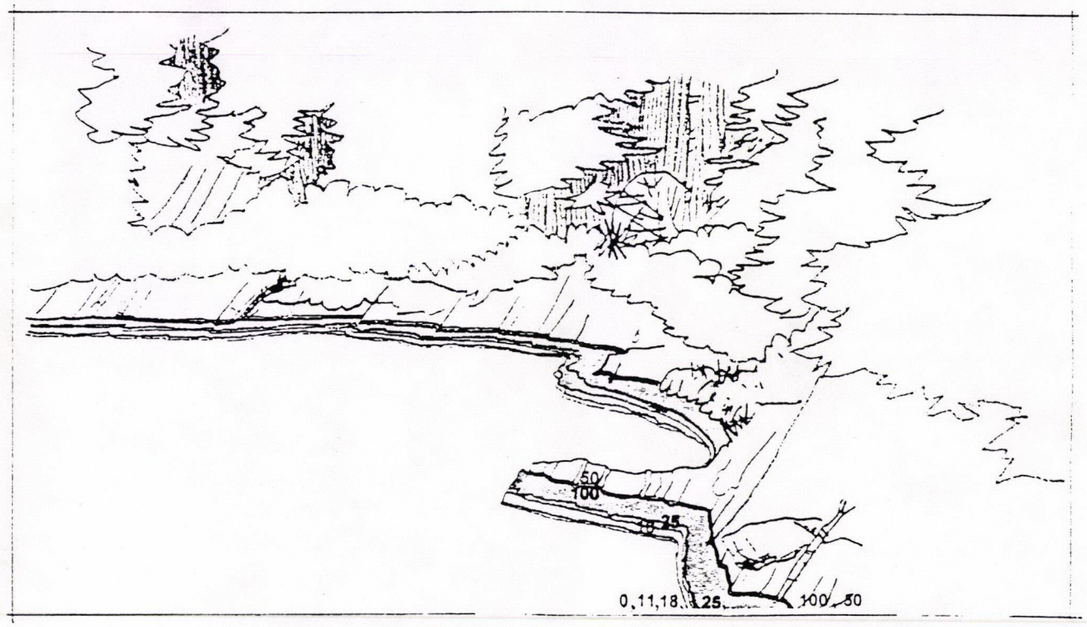
Flow at Mararoa	*Flow at Sunnyside*
0	49.0
11	57.3
18	50.0
25	62.3
50	196.0
100	177.0

Water area differences As a % change in water area the differences are very minor between controlled flows - less than 5%.

Elements The inclined rock strata, a fascinating natural feature of the gorge, are more exposed in the low flows. The river in the 50/100 cumec flows takes on the oily swirling power of a large river in a confined reach. The river appears tranquil in the 0 - 25 cumec flows.

Users The main viewers will be residents and visitors passing through to Monowai, the Borland and Sunnyside Road. Opportunities to stop vehicles are limited and most views will be fleeting as the vehicle slows or briefly stops on the bridge. Access is not easy for those people visiting the river for fishing, picnicking, etc.

Comments Very little difference will be experienced by the casual visitor. Many people are likely to appreciate the tranquillity of the lower flows with their reflections of bush, and interesting rock exposures. The 50/100 cumec flows display an impressive power which can be appreciated from the security of the bridge.

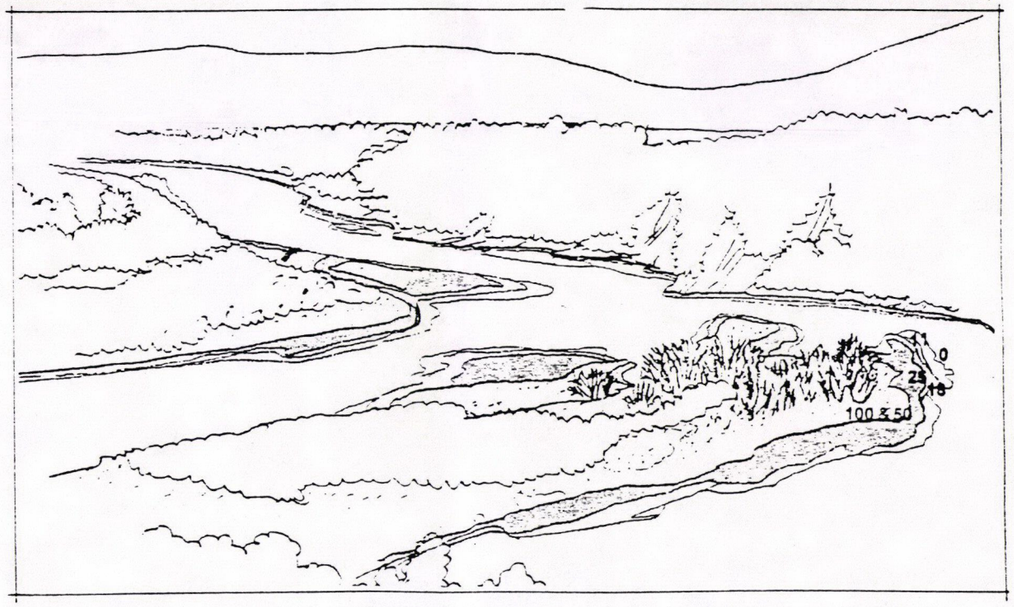


Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	86.0	92.0	202.0	181.0

Viewpoint 10 Monowai Suspension Bridge (downstream)



0 cumecs controlled flow, 14 June 1995)



Viewpoint 11 *Sunnyside*

Naturalness

Fairly high. The river itself appears natural although exotic trees are dominant. The wider landscape is heavily modified farmland.

Changes under different flows

In these photographs there is little difference between the 0 to 25 cumec flows. The 50 and 100 cumec flows do give the impression of a larger, faster flowing river.

Effects of tributary flows

the flows measured at Sunnyside were:

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	49.0
11	57.3
18	50.0
25	62.3
50	196.0
100	177.0

Water area differences

The increase in water area is very minor between zero and 25 cumec flows (5% ±). A further increase of 10% ± occurs with the 50/100 flows.

Elements

The most apparent change is from a small river meandering through a rock and gravel bed in the 0-25 cumec flows while the 50/100 flows spread across the width of the bed.

Users

This viewpoint required crossing an electrified fence although glimpses are possible along Sunnyside Road. There are a number of cribs on the opposite bank which suggests this is a popular fishing spot.

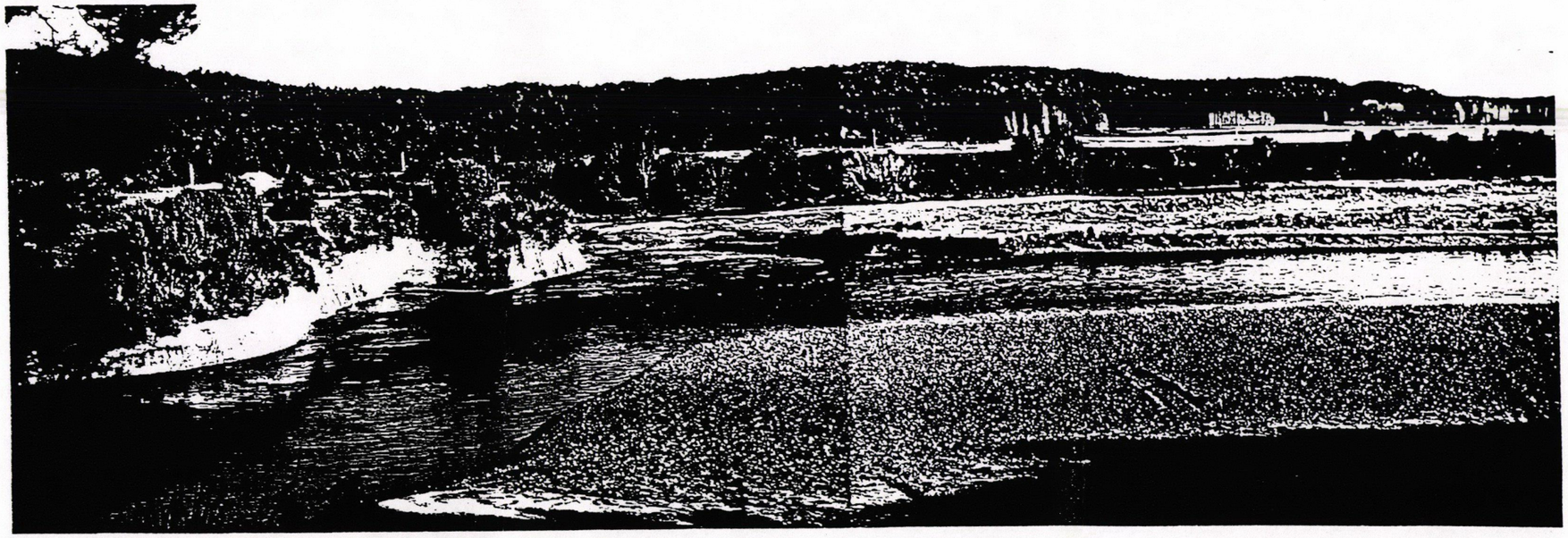
Comments

Only those very familiar with the river would be aware of the differences between flows. The most likely people to use these reaches are anglers.
Caution: the contribution of controlled weir flows of less than 25 cumecs has very little effect on the flow south of Monowai.

Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.50m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 11 Sunnyside Road

Figure 9



0 cumecs controlled flow, 14 June 1995

Viewpoint 12 ***Motu Road (upstream)***

Naturalness

High, although far (true right) bank is farmed. The viewpoint is an area of native bush and distant views are also to mountains and bush.

Changes under different flows

Minor. Only the extent of the gravel bank in the foreground is substantially changed.

Effects of tributary flows

The river under 0-25 cumec flows appear similar as do the 50-100 flows. Therefore the tributary contribution is substantial.

Water area differences

The upper two flows make a 25% difference in the apparent width of the river compared with the lower flows.

Elements

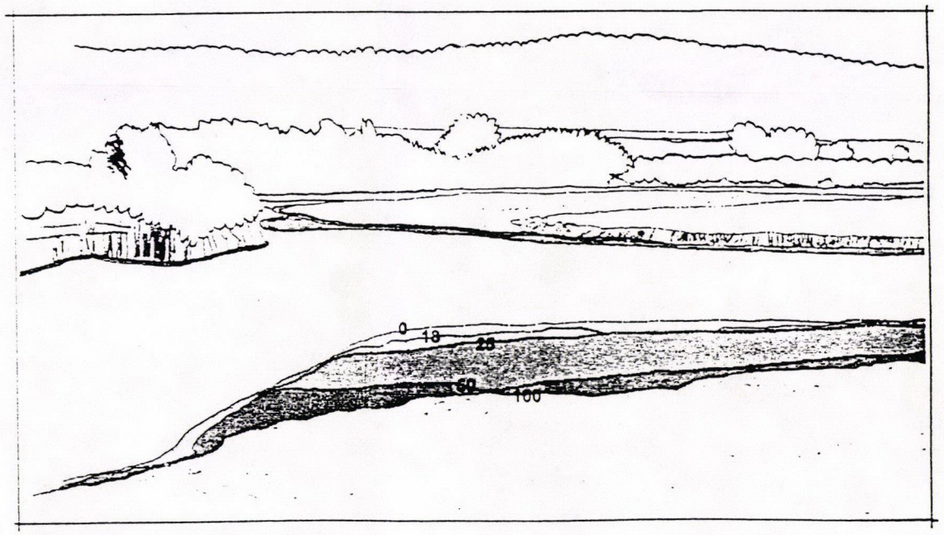
No obvious change is apparent on the far bank, however the greater flows do obscure parts of the gravel foreground. The riffles visible in the low flows are lost in the high flows, replaced by a greater speed and strength of flow.

Users

Fishers, picnickers, naturalists, etc may visit this area which has good unsealed access to the river and adjacent bush reserve.

Comments

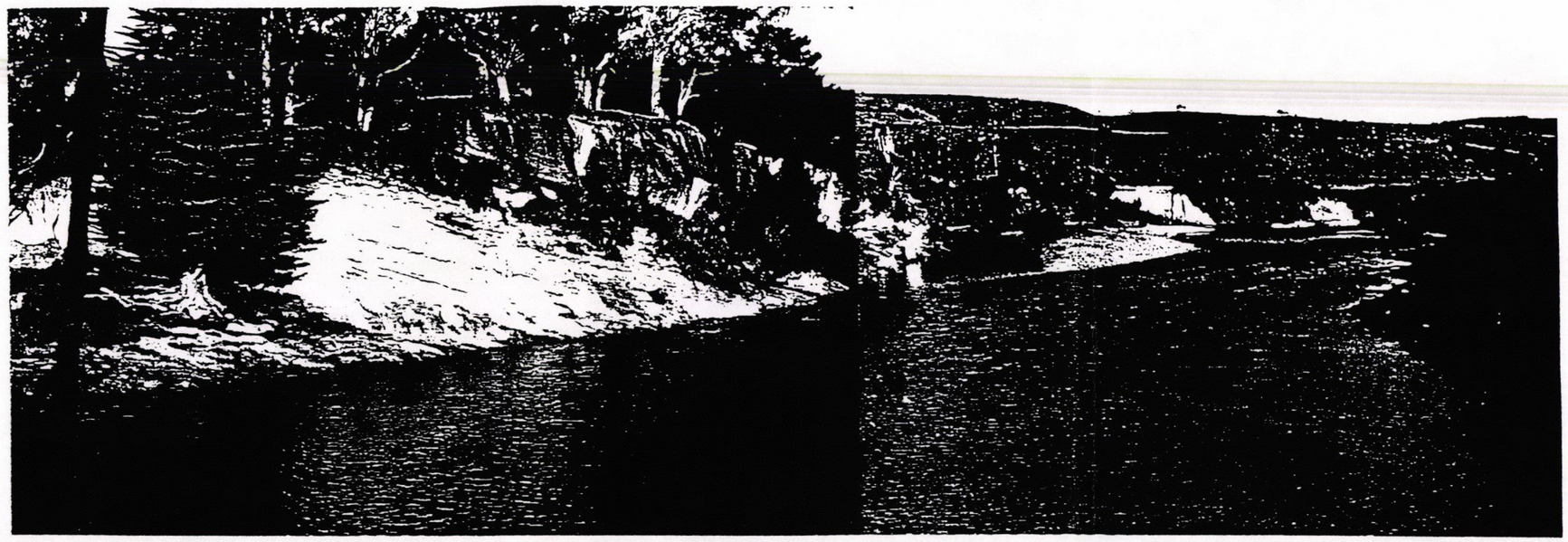
Few visitors are likely to experience any significant difference in the landscape between the high and low flows investigated. Clearly even the 50 and 100 flows are low compared with the flows that deposited the sand and gravel banks and eroded the cliff face.
Caution: the contribution of controlled weir flows of less than 25 cumecs has very little effect on the flow south of Monowai.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden river levels	0.88m	0.9m estimated	0.935m	1.07m	1.30m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 12 Motu Road (upstream)

Figure **10**



0 cumecs controlled flow, 14 June 1995

Viewpoint 15 *Clifden Suspension Bridge*

Naturalness

Medium-high. Although in a modified environment viewed from the suspension bridge and close to dwellings and roads the limestone outcrops and river still dominate and give a sense of naturalness.

Changes under different flows

There is little difference between the 0 to 25 cumec flows - also between the 50 and 100 cumec flows.

Effects of tributary flows

River heights measured at Clifden were:

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	0.88m
11	0.9m
18	0.935m
25	1.07m
50	1.60m
100	1.48m

Tributary contribution considerable.

Water area differences

The increased water area is approximately 10% between highest and lowest flows.

Elements

A greater extent of gravel and grass banks exposed under the low flows is the only obvious difference. Also under low flows more of the unusual rock formations are visible which may be seen by some as a benefit.

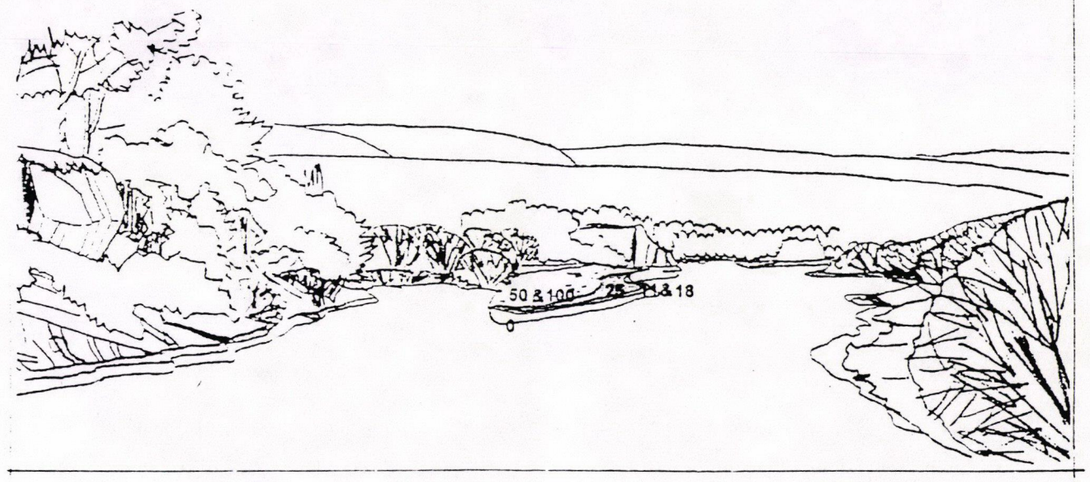
Users

Large numbers of visitors view the river, the bridge and the surrounding limestone landscape from this viewpoint. It provides good access to the true left bank of the river upstream.

Comments

The knowledgeable visitor who is familiar with the river under different conditions will recognise the difference in flows. The casual viewer will not.

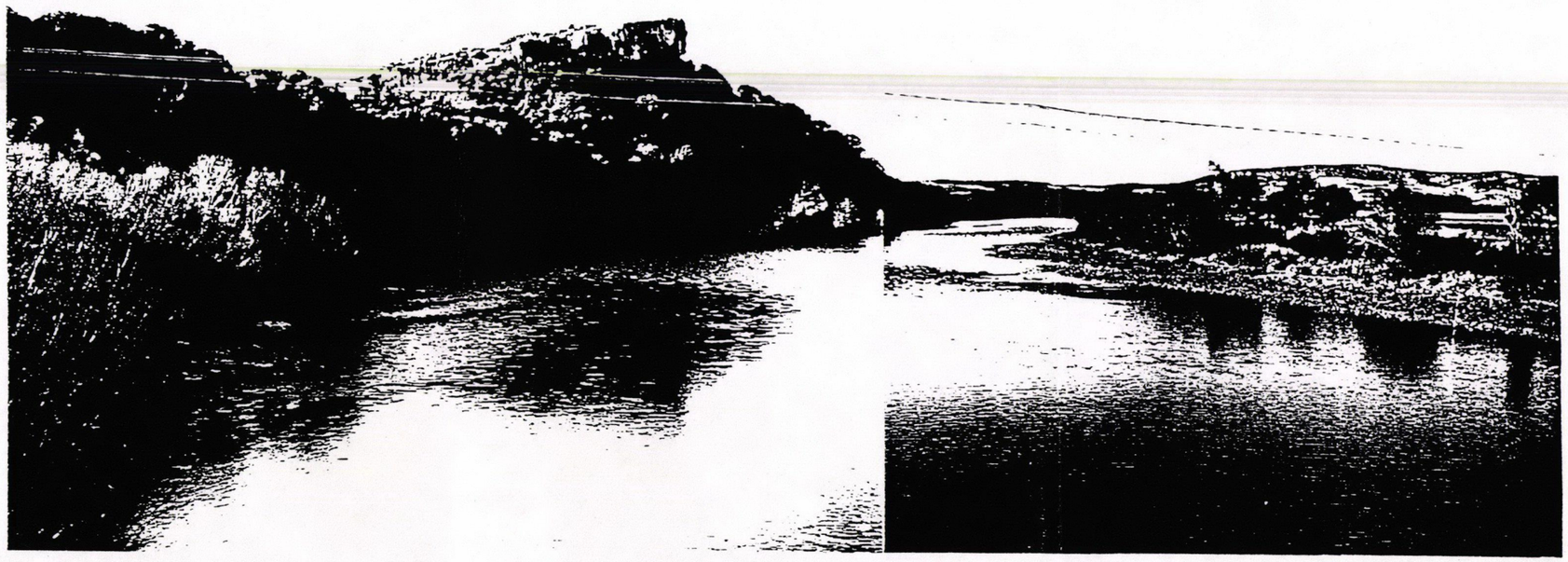
Caution: the contribution of controlled weir flows of less than 25 cumecs has very little effect on the flow south of Monowai.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	60.0	62.3	196.0	177.0
Clifden (river levels	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Figure **11**

Viewpoint 15 Clifden Suspension Bridge



0 cumecs controlled flow, 14 June 1995

Viewpoint 16 ***State Highway 96 Clifden Bridge***

Naturalness

Medium-high. Although viewed from the State Highway the river appears natural partly due to the impressive limestone outcrops and associated bush cover.

Changes under different flows

Minor - despite the substantial differences in flows (see below). It requires a keen eye to detect the differences.

Effects of tributary flows

River heights measured at Clifden were:

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	0.88m
11	0.9m
18	0.935m
25	1.07m
50	1.60m
100	1.48m

Tributary contribution considerable.

Water area differences

The increased area of shelving bank on the true right bank may reduce the river width by 5% ±.

Elements

The river feels bigger with higher flows reflecting the apparent speed of flow rather than its width. A small gravel bank is exposed under the lower flows.

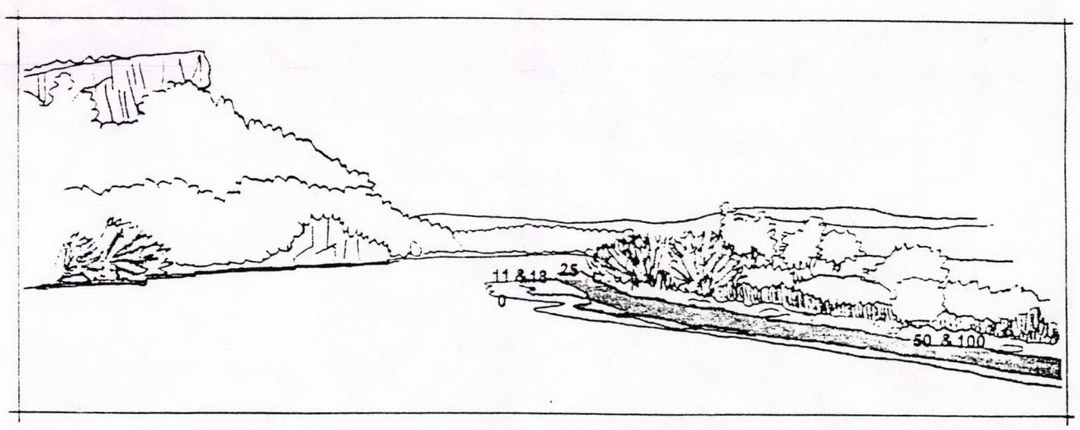
Users

Many viewers, mostly passing through on the State Highway. Those that do stop are likely to view the river and the limestone outcrops as a very aesthetic combination. The differences in flow are not readily apparent.

Comments

Differences between flows in this range are unlikely to affect peoples experience and enjoyment of the area. Only those very familiar with this area are likely to be aware of the differences. These may be farmers alongside the river and regular fishers, jet boaters, etc.

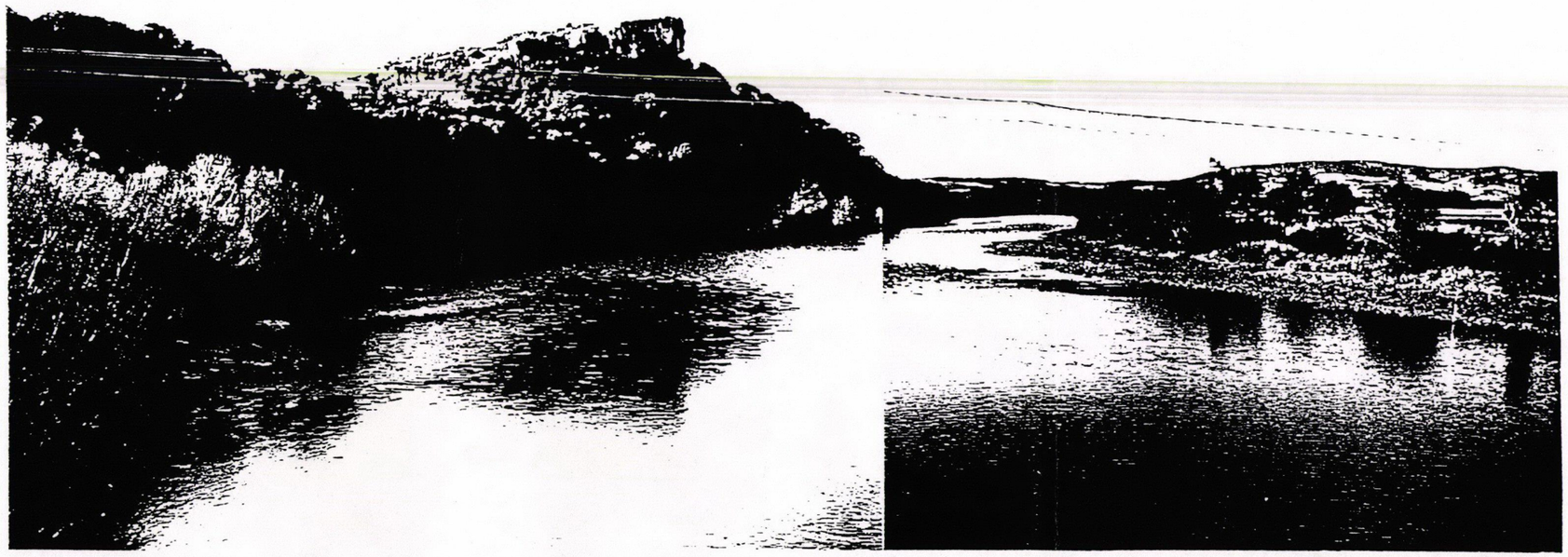
Caution: the contribution of controlled weir flows of less than 25 cumecs has very little effect on the flow south of Monowai



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	60.3	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	88.3	92.0	202.0	181.0

Viewpoint 16 State Highway 96 Clifden Bridge

Figure 12



0 cumecs controlled flow, 14 June 1995

Viewpoint 16 ***State Highway 96 Clifden Bridge***

Naturalness

Medium-high. Although viewed from the State Highway the river appears natural partly due to the impressive limestone outcrops and associated bush cover.

Changes under different flows

Minor - despite the substantial differences in flows (see below). It requires a keen eye to detect the differences.

Effects of tributary flows

River heights measured at Clifden were:

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	0.88m
11	0.9m
18	0.935m
25	1.07m
50	1.60m
100	1.48m

Tributary contribution considerable.

Water area differences

The increased area of shelving bank on the true right bank may reduce the river width by 5% ±.

Elements

The river feels bigger with higher flows reflecting the apparent speed of flow rather than its width. A small gravel bank is exposed under the lower flows.

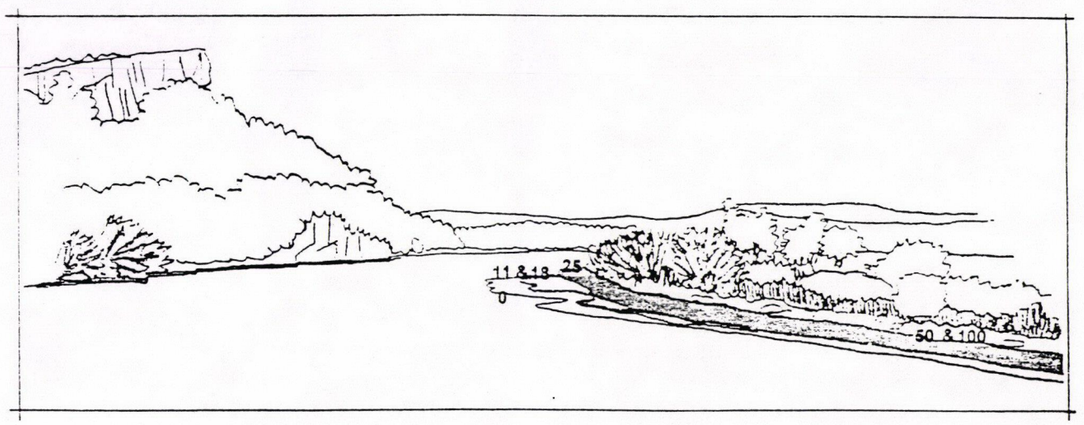
Users

Many viewers, mostly passing through on the State Highway. Those that do stop are likely to view the river and the limestone outcrops as a very aesthetic combination. The differences in flow are not readily apparent.

Comments

Differences between flows in this range are unlikely to affect peoples experience and enjoyment of the area. Only those very familiar with this area are likely to be aware of the differences. These may be farmers alongside the river and regular fishers, jet boaters, etc.

Caution: the contribution of controlled weir flows of less than 25 cumecs has very little effect on the flow south of Monowai.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	60.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	88.0	90.0	202.0	191.0

Viewpoint 16 State Highway 96 Clifden Bridge

Figure 12



25 cumecs controlled flow, 16 June 1995

Viewpoint 20 Tuatapere Domain

Naturalness Medium-high. The river appears natural although the proximity of Tuatapere, the State Highway and the Domain reduce the natural character of the wider landscape.

Changes under different flows Substantial differences between the 0-25 cumec flows and the 50/100 cumec flows resulting from the exposure of a gravel bank opposite the viewpoint.

Effects of tributary flows

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	71
11	91.4
18	66
25	92
50	202
100	181

Tributary contribution considerable.

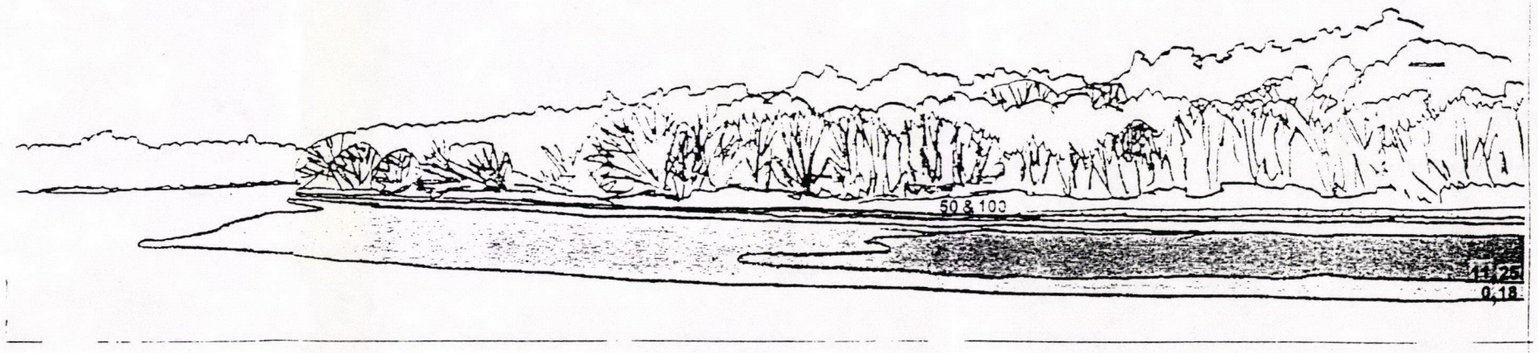
Water area differences Under the two high flows the river is approximately 20% wider where it covers the gravel bank exposed in the low flows. Further up and down river this is not the case.
Caution is necessary. Even with the high flows the water is very shallow above the gravel bar and minor course adjustment could result in a significant change of appearance.

Elements The covering of the shingle bar opposite the viewpoint makes a substantial visual difference, but it is the increased velocity and strength of the river close to the near bank which is the major difference.

Users Large numbers of locals may experience the river from this location. There is a sealed access to the Domain from the State Highway.

Comments The visitor to the Domain is likely to view the river as a component of the wider landscape. Frequently this will be a setting for activities which will be the focus of attention. There is a clear difference between the low and high flows. The low flows are perceived as less dangerous and more inviting to water based family activities. Views of the gravel and boulder bottom are very attractive. The swirling power of high flows is impressive but less inviting for in-river activities.

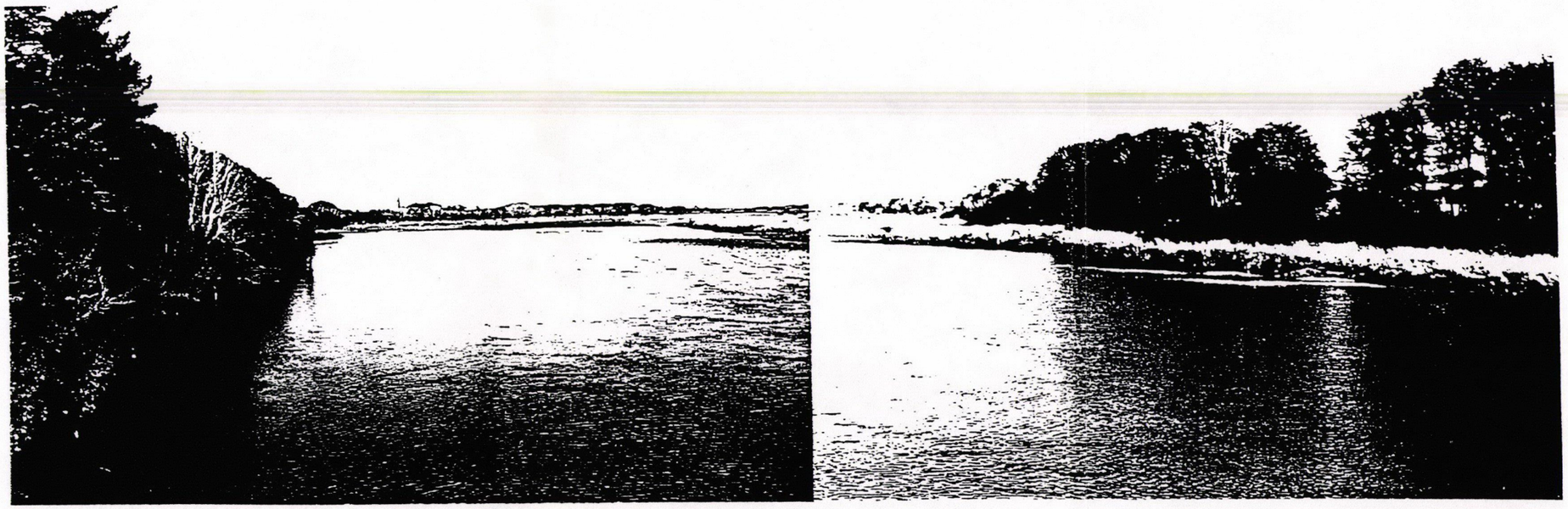
Caution: The contribution to the total flow of controlled weir flows of less than 25 cumecs has very little effect on the appearance of flows south of Monowai.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.0	50.0	62.3	196.0	177.0
Clifden river levels	0.86m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	191.0

Viewpoint 20 Tuatapere Domain

Figure **13**



0 cumecs controlled flow, 14 June 1995

Viewpoint 22 ***State Highway 96 Tuatapere Bridge*** *(downstream)*

Naturalness Medium-high

Changes under different flows very minor

Effects of tributary flows

Controlled Flow at Mararoa	*Flow at Sunnyside*
0	71
11	91.4
18	66
25	92
50	202
100	181

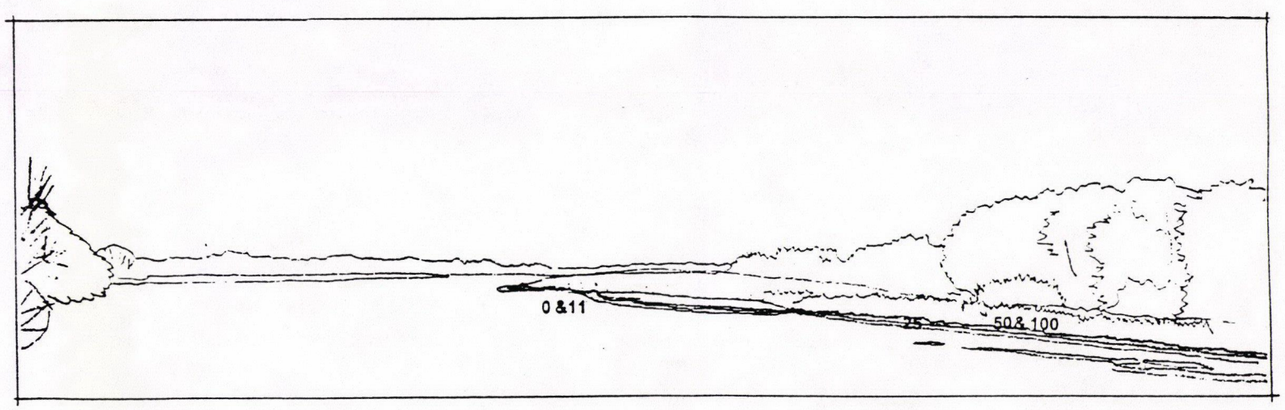
Tributary contribution considerable.

Water area differences less than 5% between highest and lowest flows.

Elements Some minor gravel banks exposed under the low flows.

Users Large numbers of Tuatapere residents, travellers passing through.

Comments Some locals and regular visitors will be aware of the differences between high and low flows although these do not necessarily relate to flows at the Mararoa Weir. At the low flows photographed, the river is attractive particularly where the coloured pebble bottom is visible. Higher flows are impressive with the movement of the water a significant element.
Note: these comments only relate to the photographed flows, ie. high flow approximately 200 cumecs. Low flow 66 cumecs.



Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

Viewpoint 22 State Highway 96 Tuatapere Bridge

Figure **14**

Commentary on Results of Photographed Flows

The photographs are an accurate record of the river on the six survey days in June and July. However, they should be analysed with great care. Differences in weather conditions. the time of day on which photographs were taken and most critically, differences in tributary flows all influence the significance that can be placed on the results.

Ideally, all flows should have been photographed in similar weather conditions, at the same time of day, and with identical, low, tributary flows. This was not feasible for the following reasons:

1. very variable weather conditions making photography difficult - fog was a problem on several days

2. timing difficulties resulting from generation requirements and lake level operations

3. variable rain in tributary catchments particularly affecting the day of the 50 cumec controlled flow

4. no continuous dry periods coincided with the study period. Therefore no flows were witnessed that equate to the minimal flows that have affected the river in the past.

Points 1 and 2 should be born in mind when assessing qualitative aspects of the river under different flows. To enable a fair comparison it is necessary to ignore the effects of different weather conditions. In particular water takes on a different appearance when sparkling in the sun and reflecting the blue of the sky.

Points 3 and 4 are critical if attempting to draw general conclusions from an analysis of the photographic record. The following flow table is attached to each sheet to assist in this analysis.

Table **2**

Location	0 cumecs	11 cumecs	18 cumecs	25 cumecs	50 cumecs	100 cumecs
Mararoa Weir	0	11	18	25	50	100
Sunnyside	49.0	57.3	50.0	62.3	196.0	177.0
Clifden (river levels)	0.88m	0.9m estimated	0.935m	1.07m	1.60m	1.48m
Tuatapere	71.0	91.4	66.0	92.0	202.0	181.0

This table shows a number of features that are significant when interpreting the photographs.

The tributaries contributed least to river flow on the day of the 18 cumec flow and most on the day of the 50 cumec flow. If the Monowai flow of 20.5 cumecs is excluded, the contribution to the 18 cumec Waiau flow from tributaries between Mararoa and Sunnyside is **11.5** cumecs and **126.3** cumecs on the 50 cumec flow day.

The following table sets out the tributary contributions between Mararoa and Sunnyside, for the Monowai tributary flow and for tributary flows between Sunnyside and Tuatapere.

	Tributary Flow Contribution					
	0	11	18	25	50	100
Mararoa to Sunnyside	27.1	26.3	11.5	15.3	126.3	57.4
Monowai	21.9	20 (est)	20.5	22.0	19.7	19.6
Sunnyside to Tuatapere	22.0	34.1	16.0	29.7	6.0	4.0

Note: Original readings were kindly provided by NIWA, Dunedin.
No attempt has been made to verify or analyse the figures in this table.
They are simply mathematically derived and are taken at face value. They do not account for hydrological complexities.

It is apparent from these figures that:

- There were major variations between tributary flows on different photographic days.
- The greatest variations between tributary flows occurred in the upper catchments (above Sunnyside). The flow on the day of the 50 cumec controlled flow was significantly greater than on other days.

If it is valid to take the lowest tributary flows from the reaches above and below Monowai recorded on any of the six days then a composit low flow of approximately 35 cumecs at Tuatapere would result. The lowest flow photographed in this study was 66 cumecs. **Note:** Occasional flows of less than 20 cumecs have been recorded at Tuatapere (see Working Party Hydrological Reports)

Photographs reflect river conditions in June and July 1995. Many of the observations are based on quite subtle differences in river depth, etc. It must be recognised that the river is constantly changing. With each flood, the bed load will alter, new channels and banks will form and there may be substantial local changes to the character and appearance of the river. The photographs are indicative of the river's appearance and should be analysed on that basis.

5. Findings

It is clear from the preceding section that caution is necessary when attempting to extrapolate from the controlled flow photographs to the rivers appearance in different flow conditions and at different times. Nonetheless, certain observations have general validity.

- Controlled flows have different effects dependent upon the characteristics of the reach. Theoretically the greatest visual changes should occur where there are large gravel or mud banks on the edges of a single channel river. In strongly braided reaches, variable flows are less pronounced. In steep-sided and confined reaches level changes may have little impact on appearance.

- The effect of different controlled flows generally reduces as one moves downstream.

- Tributary flows are very significant to the appearance of the mainstem in all but the upper-most reaches when controlled flows are relatively high (eg. greater than 25 cumecs).

- The landscape effects of controlled flows less than 25 cumecs will be minor below Sunnyside unless tributary flows are low (eg. less than 30 cumecs at Sunnyside). The benefit of a controlled flow over a zero flow is greatest near to the weir.

- The distance downstream that low flows are perceived to have adverse effects is dependent upon the controlled and tributary flows and the 'expectation' of the viewer.

- The river reaches where landscape effects will be most significant are from the weir to Sunnyside, at Clifden and at Tuatapere. This reflects both the level of physical change and the level of access to the river.

- Three distinctive reaches between Mararoa weir and Monowai are identified.

    - The first reach is confined and its upstream end is dominated by the control structure, road bridge, etc. This is true even under 100 cumec flow. With the present bed configuration there is slight visual benefit below the bridge of flows above 11 cumecs. This is a subtle difference and the same effect could be gained by minor adjustments to the river bed. The river bed is artificial and it is not clear how changeable it is under current or proposed flows.

- The second reach from Whare Creek to Redcliff Creek is braided and little landscape difference is apparent between 11 and 25 cumec flows. The riverbed was noticeably fuller under 50/100 cumec flows. Access to the casual visitor is very limited and anglers will be the major users, along with adjacent farmers. The contribution from tributary flows significantly affects the appearance of the river.

- The third reach to Monowai is confined and enters the gorge landscape above the Power Station. Access to this reach is difficult. At Monowai the visual differences between flows recorded in this study were very minor.

- Flows from the Monowai Power Station were very similar throughout the field investigations. With controlled flows below 25 cumecs and with low tributary flows, the Monowai contribution is significant.

- The power station at Monowai is the focus of interest at that location. For many visitors the significance of the river may be less as a result. In the gorge, flow variations are less apparent.

- The Monowai suspension bridge area is a focus of interest for many visitors. The photographed flows do not show a substantial variation although at the higher flows the river takes on the 'feel' of a big river.

- At Clifden very little change is noticeable between the flows although the gravel and mud banks and rock outcrops become increasingly prominent elements as the flow is reduced. At the photographed flows this did not result in significant adverse effects.

- At Tuatapere Domain there are clear differences in the flows below 100 cumecs and those above 200 cumecs, but the differences between the low flows photographed are barely noticeable.

These findings from the site investigations and photographic record need to be considered in the wider context. Both as the river relates to the broader landscape and as the river is likely to be experienced by different people. The following observations are drawn from the review of Waiau Working Party reports, other reports, video footage provided by T. McClelland and from discussions with Waiau Working Party members and others.

- The Waiau River landscape is very attractive. Much of its value is a consequence of its relationship to other nationally and regionally outstanding landscapes - its position in the foreground to Fiordland and the Takitimu mountains viewed from the Southern Scenic Route and its physical linkages to the exceptional landscapes of its catchment.

- The river and immediate river valley is not outstanding on a national basis but within it are landscapes and natural features that are arguably outstanding at the regional and local level eg. the Clifden area, the Monowai Gorge.

- The pre and post control rivers have very different characteristics and qualities.

- The pre-control Waiau was a massive river which was generally bank full in all confined reaches. With a mean flow of several hundred cumecs it would have had a different appearance from an equivalent flood flow in the present river. The oily swirling dark characteristics of the original river is replaced with a choppy brown river in flood flows. High lake spill flows may result in a similar appearance to the original river.

- Despite the change in appearance the post-control river still retains many of the elements, patterns and processes that give it a natural character. These include processes such as erosion and deposition reflecting variable flows; elements such as the water itself and surrounding vegetation; and patterns that reflect the level of confinement, eg. braiding. The area immediately below the Mararoa Weir lacks natural character particularly during low flows.

- The use, enjoyment and experience of the river reflects the intentions, aspirations and prior experience of the individual. For analysis purposes it is reasonable to group those 'using' the river into:

  1. residents - urban and rural - particularly those whose livelihoods are directly affected by the river;

  2. regular visitors with specific river interests eg. whitebaiters, anglers, family picnicking; these groups often also have a locational preference, eg. crib users.

  3. passing tourists for whom the river is an incidental component of the wider landscape experience;

  4. those with spiritual or nostalgic feelings or environmental concerns for the river who may or may not visit.

- The focus of interest for these broad groups will be different. For example, spatially, tourists are likely to focus on the Tuatapere, Clifden and Monowai areas. Anglers may have an activity focus eg. the fishability of the river and base themselves at a particular crib. The following table is an attempt to illustrate the geographical areas of interest to different user groups.

River Reach	Resident R - Rural U - Urban	Visitors	W - Whitebaiters B - Birdwatchers A - Anglers J - Jet Boats P - Picnics	Tourists - Major - Minor - Occasional
Mararoa		P		occasional
Whare - Monowai	R	A		-
Monowai	R	P.A		minor
Sunnyside-Waikaki	R	A		-
Waitaki - Clifden	R	A		-
Clifden	R	P		major
Clifden - Tuatapere	R	A.J		-
Tuatapere	U	A.J.P		minor
Tuatapere to coast	R	W.B.J		occasional

Note: 1. Anglers visit much of the river particularly the upper reaches
2. Spiritual, nostalgic or general environmental concerns are likely to apply to the whole river.

- The use, enjoyment and experience of the river is partially dependent upon a range of 'non-river' variables such as weather, knowledge, and disposition of the person involved.

6. Conclusions

None of the controlled flows photographed would be equivalent to the grandeur of the pre-control river. Any of the controlled flows would enhance the present situation, particularly north of Monowai where a flow of 11 cumecs has a substantially beneficial effect.

Based on these investigations it is apparent that for the reaches above Monowai the greatest benefit from controlled flows occurs with the first 10± cumecs released and that there is a diminishing return above that.

Controlled flows of less than 25 cumecs are most significant for the river reaches between the weir and Monowai.

Clifden and Tuatapere are the most significant locations further down river because they are readily accessible.

Anglers will be the main beneficiaries down river to Monowai as access is severally restricted and there is little to attract casual visitors.

Tributary flows are very variable and have a significant effect on the appearance of the river particularly when river flows are low.

A controlled flow of 11-18 cumecs at the Mararoa Weir would be very beneficial, enhancing the landscape of the Waiau River, particularly north of Monowai.

With the tributary flows at the levels experienced during these investigations there is little landscape benefit in increasing controlled flows above 18 cumecs.

In very low tributary flow conditions, a greater controlled flows may be beneficial to the river landscape further downstream, eg. Clifden and Tuatapere, however these conditions were not experienced during these investigations

The landscape benefits of different flows in the river have different effects in different reaches. To give the Waiau River a 'big river' feel would require very substantial flows. Based on these investigations flows greater than 100 cumecs would be required upstream of Monowai, and at least 200 cumecs at Tuatapere.

Different flows eg. recreation flows, flushing flows and flood flows will have landscape benefits, introducing greater variety and providing major amenity benefits for specific interest groups eg. jetboaters.

Minimum acceptable flows for amenity purposes are very difficult to determine. A flow of more than 10 cumecs will result in a major improvement to amenity south to Monowai. At Sunnyside a flow of 50 cumecs (the lowest experienced in

these investigations) retains amenity values. A 70 cumec flow at Tuatapere retains amenity values. Lower flows at these locations may also be effective in maintaining amenity values but were not experienced.

A flow of approximately 10 cumecs at the Mararoa Weir, 50 cumecs at Sunnyside and 70 cumecs at Tuatapere is adequate to retain the natural character of the river. (Note: the landscape adjacent to the weir structure is not 'natural'). Lower flows may also retain natural character but these were not experienced.

Occasional flows lower than those mentioned in the previous paragraph are likely to be seen as reflecting the natural dynamics of the river. This is not to say that all groups will necessarily find this acceptable, however it is unlikely to be considered to have adverse effects by the passing tourists and visitors.

For those that remember the Waiau as it once was and wish to see it regain its former majesty, none of the controlled flows will be adequate. Several hundred cumecs would be desirable.

The river is adjusting to a new equilibrium, with bankside vegetation extending towards the water. Over time the controlled river will establish a new identity which will be valued differently from the pre-control river yet will have importance and take on meaning to new generations. Peoples' memories of what the river once was will gradually begin to fade.

Based on this investigation it is reasonable to conclude that for several reaches the proposed controlled flow regime will be a substantial improvement on a 'zero' base flow - in terms of natural character and amenity values.

Appendix 1

Background material provided by ECNZ included:

- Anderson, Margaret; Southland Regional Council (1992) (R1) "Report on Tourism and Recreation in the Waiau Catchment" Waiau River Working Party - Recreation Task Group.
- Boffa Miskell Limited (1993) "Landscape and Ecology In Southland District" Southland District Council
- Boffa Miskell Limited and Lucas Associates (1993) "Canterbury Regional Landscape Study, Vol.1 and 2"
- Brierley 94 notes that "river character is largely determined by the history of flood events" (p11). This suggests that variation in the low-flow (as in the proposed 10-14 cumec minimum flow) has little effect on wider issues of river character.
- Brierley, Gary J (1992) (E1) " River reach analysis of the Waiau River, Southland, from Mararoa Weir to Te Waewae Bay" Report submitted to the Waiau Working Party

No.	Reach Name	Description and Characteristics
1	Duncraigen Reach	Duncraigen Reach is 2.2km long, down stream of Mararoa Weir to a point immediately upstream of the confluence of the Waiau with Whare Creek • single channelled, almost straight reach • virtually no alluvial or valley flats. • gravel bars restricted to small alternating lateral bars • no within-channel deposits
2	Redcliff Reach	14.3km long, from just upstream of Whare Creek confluence to about 4km downstream of Redcliff Creek confluence, adjacent to Blackmount Forest. • valley setting opens up, extensive valley flats • increased extent of alluvial flats and active gravel surfaces • channel divides into 4 or 5 channels downstream of Redcliff Creek - as a result, capacity limit of Waiau exceeded with concomitant within-channel sedimentation • terraces exceedingly prominent on left bank of Waiau - right bank pinned against foothills of Paddock Hill • top of reach is broadly sinuous with compound point bar features • many large, dissected islands noted adjacent to contemporary channel • island development noted (created by the side channels) • several topographic levels evident in this braided configuration
3	Blackmount - Mangapiri Reach	Longest of the river reaches extending from 46.1 - 81.5km from the mouth of the Waiau River. • a laterally constrained single channel, which flows within an imposed broadly sinuous course • within-channel sedimentation restricted to 2 large compound point bars. • occasional lateral bars associated with tributary channel confluences and small mid-channel bars associated either with bedrock steps or local valley widening • This reach is made up of 4 subreaches, Blackmount, Monowai, Waicoe, and Mangapiri.
4	Wairaki Reach	This reach extends for 8.2 km from a large point bar 2km upstream of Wairaki confluence to a bank-attached compound bar just downstream of Broadlands Bush. • wider valley with extensive and complex terrace sequences • river is pinned against bedrock adjacent to Motu Bush (known as Motu Reach) • terraces generally fragmentary • concomitant increase in area of alluvial flats and active channel zone • alluvial flats are fragmentary and switch from valley side to valley side • discrete sediment inputs from Wairaki River & Dean Burn (resulting in reduced flow competence - has exceeded the capacity of the channel to transport all its sediment • within-channel sedimentation • flow divides around a series of complex bars and riffles with dissection of bank-attached compound bars by chute channels • reach appears to represent a 'sedimentation zone' in a wandering gravel bed river • characterised by pronounced lateral instability in the channel

		• flow concentrated into a single channel immediately downstream of Broadlands Bush
5	Motu Reach	A short, single-channelled, almost straight reach which is pinned between extensive terraces of Otahu Flat and Motu Bush. 2.4km reach extending from 35.5 to 37.9km upstream of the Waiau Mouth. • extensive valley flats (up to 4.5km wide) • no evident alluvial flats or within-channel sedimentation • channel highly stable • sandy mudstone evident in banks downstream and horizontally-bedded outwash gravels located atop the bedrock base in places
6	Lill Burn Reach	Extends for 7.4km, from 28.1 to 35.5 km from the mouth of the Waiau River • constrained by bedrock -confined banks • valley flats extensive and alluvial flats laterally extensive • distinct downstream variability in the character of within-channel sedimentation • wide terraces (4-5m above channel), extend on both sides of valley • outwash materials are the predominantly channel-marginal and valley-flat materials. Bedrock downstream • straight, single channelled configuration, side and chute channels become more prominent downstream
7	Clifden Suspension Bridge Reach	1km long reach. 27.1-28.1km from Waiau River mouth. • bedrock constrained reach with prominent limestone cliffs on both river banks • outwash terraces are notable marginal to the bedrock • single channel, no alluvial flats • no within-channel sedimentation
8	Downstream O'Clifden Reach	This reach is 5.4km long and extends from 21.7-27.1km upstream of Te Waewae Bay. • lowland setting, with gentler valley-marginal slopes • fewer high terraces • gravel bar patterns similar to those in Redcliff, Wairaki and Lill Burn reaches. (single channel to a flow divided around mid-channel bars). • tight freely-migrating channel. • lateral and bank-attached compound bars upstream in reach • within-channel sedimentation on bedrock bars downstream further • bedrock base of both banks downstream
9	Hagen Road Reach	4.3km reach between 17.4-21.7km from Te Waewae Bay • extensive valley flats (about 4km wide) • limited alluvial flats (<300m) • roughly straight, single channelled configuration • at least 3 continuous pronounced terraces on right bank, while left bank is Papa bedrock • no within-channel sedimentation is evident
10	Orauea Reach	Extends for 5.5km from 11.9-17.4km from the mouth of the Waiau River • river has a moderately straight configuration, predominantly single-channelled • valley is moderately broad (upper terraces extending over approx. 5km width) • terraces curved and fragmentary and appear to be paired and non-eroding • within-channel sedimentation • a mid-channel bedrock step also featured (a sandstone bank in Papa bedrock) • channel confined by bedrock with terraces atop in upper part of reach • a series of flood channels roughly parallel to channel featured • bar types restricted to alternating lateral bars • channel itself relatively stable
11	Tuatapere Reach	This reach extends for 11.9 river kilometres from just downstream of the bridge in Tuatapere to Te Waewae Bay • only true 'lowland' reach in this study area • terraces set back further from river and lower • bedrock observed at two locations within this reach • active gravel bars more evident • Quite a wandering gravel-bed river reach where flow is divided into two or more channels, which are laterally unstable. In other sections flow is within a single channel • relatively steep reach (approx. 0.0017) for a lowland basin

• Brierley, Gary J; (1994) "Tributary river reach analysis of Waiau River catchment, Southland" Final report submitted to Waiau River Working party as part of the project entitled "Tributary reach analysis of Waiau River" School of Earth Sciences, Macquarie University, NSW, Australia

- Brierley, Gary J with Fitchett, Keith (1994) (E3) "Channel Adjustments along Waiau River, 1946-1992: Assessment of the Impacts of Flow Regulation" for the Waiau River Working Party

- Corry, S and Puentener, R; (1993) (I1) "Tikanga Maori Cultural, Spiritual and Historical Values of the Waiau River". a report for the Iwi Task Group of the Waiau River Working Party.

- Day, Delyn (1993) (R2) "Historical Review of the Waiau River and Coastal Area" for the Waiau River Working Party

- Jowett, I.G. (1993) "Minimum Flow Requirements for Instream Habitat in the Waiau River, Southland, from the Mararoa Weir to the Borland Burn - NZ Freshwater Miscellaneous Report No.46" NIWA Freshwater, Christchurch

- Kearsley, G. W (1994) (R3) "The Waiau River Recreation Survey" Waiau River Working Party, Southland Regional Council.

- Kirk, R.M and Shulmeister, Dr.J (1994) (C1) "Geomorphic Processes and Coastal Change in the Lagoon System, Lower Waiau River, Southland" report to the Waiau River Working Party

- Riddell, D.C (1991) (H5) "Hydrological Data Summary" Southland Regional Council. For the Waiau River Working Party.

- Riddell, D.C; Freestone, H; & Nutting, S; (1993) (H2) "Waiau River Hydrology" report to the Waiau River Working Party

- Southland Regional Council; (1992) "Waiau River Working Party - Recreation Task Group - Report on Tourism and Recreation in the Waiau Catchment" Researcher: Margaret Anderson, Dunedin Tourism Enterprises, Dunedin

The SRC 92 report refers to Egarr and Egarr 1981, who in their New Zealand Recreational River Survey wrote the following for the Waiau River from Mararoa to Monowai.

Location: The Waiau River, upon leaving the diversion dam below the Mararoa, flows south through scrub and tussock country to the Monowai confluence.
Section end location: NZMSI, S158/695759
Maps: NZMS18, Sheet 24 Invercargill, NZMSI, Sheet S149 Manapouri; S158 Monowai
Length: 27km
Average gradient:: Slight

Recreational use and scenic description: Below the diversion dam there seems to be a certain amount of seepage so that water lies in the old river bed even in late summer, with a perceptible flow in winter and spring. However, it is shallow and seldom deep enough for recreational use. The bed is stony with wide beaches or rocks with crumbling banks clothed in coarse tussock and matagouri scrub. A number of small creeks flow into the river along the left bank and these add to the flow sufficiently to create moving water by the time the Waiau reaches the Monowai junction. The tussock country with some beech forest is somewhat akin to the upper Mararoa River which is to be preferred. This section of the river was used a lot until the dam was built. The main side creeks are Whare Creek and Redcliff Creek but neither is of sufficient size for boating, being steep and stony with normally only a trickle of water. At Monowai the river banks change dramatically from high, crumbling shingle to a narrow rocky gorge. There is insufficient flow to create rapids but there is a large quiet pool near the road bridge to Monowai which is used for splashing about and swimming in summer.

Scenic value: Uninspiring
Recreational value: Insignificant

In the main body of the SRC report it is noted that:
the river immediately below the Mararoa Weir was the least used for recreation and most activity took place around the pool at the base of the weir, at Jencho Creek and at the mouth of Exelsior Creek. The use was linked to access points along the river.

Scenic Values

The Lower Waiau region contains a number of different landscapes, from the mountains near the lakes to the sea, and including pastoral as well as bush. While not as spectacular as the upper parts of the catchment, the scenic value is still high and the landforms are very interesting examples of glacial and river action. The western side of the river is mostly in the Fiordland National Park, with bush covered mountains and river flats, while the eastern side is a mixture of forestry and farmland with the Takitimu Mountains in the background. The variety and constant change of view adds to the interest for travellers on the Southern Scenic Route.

There has been a tendency to write off as less scenic any area that is not spectacular by comparison to the fiords and lakes, but to the visitors these areas have their own interest and value (p25).