

Section E : Rules for Methods for Wairau Floodplain River Floodways

Within the Wairau Floodplain Floodways, Council or persons nominated by Council, shall be permitted to carry out the activities detailed in Section D under the following conditions.

E1 Permitted Activities

1.1 *Gravel or Sediment Removal from above River Water Level*

(i) *Extraction procedures*

- (a) Gravel and other sediment extraction will take place only within the defined fairway of the river. Berms will not be disturbed for gravel extraction.
- (b) Extraction is only from the Wairau River from Tuamarina to Jefferies Road, Lower Wairau River above Ferry Bridge, Wairau Diversion and Taylor River.
- (c) No gravel extraction plant will be operated in water.
- (d) Gravel will be extracted in layers from the inside of bends, working from the waters edge towards the land and with a perceptible slope rising away from the watch edge.
- (e) The excavation will take place from the downstream end of the gravel beach, working upstream, with particular care to avoid re-entrant areas with upstream access to the river flow.
- (f) No secondary braids and flow patterns will be opened up, either by extraction, tracking, or other redirection to river flow, with the consequent danger of reducing flow in the main channel.
- (g) Holes or piles of gravel in the fairway will not be created. Vertical faces will not exceed one metre in height.
- (h) Except for working piles, gravel will not be stockpiled within the fairway. Gravel stockpiles can be made within designated berm areas. Gravel stockpiles will be outside the designated floodway area.

(i) The extraction of gravel will only be carried out during the hours of 7.30am - 5pm from Monday to Saturday. No gravel will be extracted on public holidays or between the periods 24 December to 3 January inclusive.

(ii) *Access*

Access from public highways to the gravel extraction sites across private land must be agreed by the land owner. Access for the public to public areas will remain open - except for reasons of safety.

(iii) *Signposting*

Where the operation will cause an unusual danger to the public, signposts will be erected on tracks on the edge of danger zones..

(v) *Reject Material*

Oversize boulders or other sediment initially removed from the river fairway, but later considered unsuitable for use, shall be spread in holes or hollows on the berms or spread evenly back in the channel.

This reject material will not be left in piles in the floodway.

(vi) *Taylor River*

For the Taylor River gravel extraction will not be lower than 0.5 metres above normal (winter) water level, and again with a perceptible slope rising from the water edge.

(vii) *Wairau Diversion*

Gravel extraction will not be carried out in the Wairau Diversion below Rarangi bridge in the whitebaiting months of August, September, October and November.

(viii) *Limits*

Gravel extraction is not to exceed the following limits for the combined Wairau, Lower Wairau and Diversion 150,000m³/year; and for the Taylor 10 000m³ over the whole 10 year period to 30 June 2004.

(ix) *Nesting Birds*

No extraction within 500 metres of the sites of colonial nesting birds, during October-November.

(x) *Record of Extraction*

Extractor to retain records of all gravel or other sediment removal from the floodway.

Reason

Gravel extraction is an important feature of river floodway management. Gravel and other sediment buildup reduces waterway capacity. Too much gravel removal can cause bank instability.

Gravel in the river can and does build up at a rate that reduces the rivers ability to carry flood water.

The gravel is a valuable resource, required for building and roading.

Removal of gravel is thus necessary and desirable, but if it is not managed can cause problems with the river flow alignment, bank stability, water quality and appearance, as well as disturbance to bird and fish life, and recreational river use.

1.2 *Gravel or Sediment Removal by Dredging*

- (i) This applies to the Taylor, Lower Opawa and Lower Wairau Rivers.
- (ii) This dredging will be carried out no more than once a year per river reach. Fish and Game Council and Department of Conservation will be consulted prior to dredging will take place.
- (iii) Dredging shall be carried out by mobile excavator working from the waters edge and up to a water depth of 2 metres.
- (iv) Excavated material may be retained in the floodway by spreading in hollows on the berms or against the stopbank.
- (v) Temporary stockpiling of excavated material on the berms within the floodway until dry is allowed.
- (vi) Dredging shall not be carried out in the Wairau River below Ferry Bridge, or in estuarine areas between 1 August and 30 November in any year.

Reason

Removal of built up gravel and sediment from the deep narrow channels of the Lower Opawa, Taylor and Lower Wairau Rivers must be carried out below water level.

Excavation of this material, will be carried out as infrequently as practical and then only following consultation with identified interested parties.

1.3 *Diversions and Channel Shaping of gravel bed River Fairways*

Conditions of Shaping Gravel Beds

- (i) Shaping will take place only to gravel beds within the defined river fairways of the Wairau, Lower Wairau above Ferry bridge, Wairau Diversion, Taylor, Waihopai, Omaka and Fairhall Rivers.

NB: This includes mechanical opening of the Wairau Bar, and Wairau Diversion.

(ii) *Diversion Procedures*

- (a) Diversion works shall be carried out by working from downstream to upstream, in such a way that water is not diverted until the final break through is made. In this way operation of machinery in moving water is to be minimised and the effects of water discolouration also minimised.
- (b) Existing redundant channel shall be left open at the downstream end. Every effort will be made to carry out the works in a way that fish stocks are not entrapped.
- (c) The Nelson Marlborough Fish and Game Council and the Department of Conservation shall be informed of the proposed works, at least one week prior to work starting.

(iii) *Fairway Shaping Works*

Channel shaping works by bulldozing up banks shall be carried out only where it is required to carry out urgent repair works.

Reason

Diversions in gravel riverbeds are sometimes necessary to get the river flow back onto the desirable alignment. This can occur after floods or freshes have moved gravel or as temporary works to allow repairs or capital works to be implemented. The diversions do not deplete the river of water and have no long term effect on fish and wildlife, and very little short term effect. Because any diversion is in gravels, and much of the works occur out of the water there is not a serious siltation problem.

Channel shaping works for immediate bank repair or channel enlargement are not commonly carried out. However, when it is necessary it must be carried out quickly and notification procedures are inappropriate.

1.4 *Tree and Scrub Removal and Control*

- (i) Trees and scrub can be removed or controlled by chemical or mechanical means.
- (ii) Mechanical removal or control can be carried out by bulldozer or tractor and slasher. The work shall be contained to areas above water level, and machinery shall not be operated in flowing water. Removal of trees overhanging or partially in water shall be by machinery operated on the river bank or mounted on boats or barges. The material shall be removed from the floodway or burnt.
- (iii) Chemical removal or control can only be carried out by a registered chemical applicator recognised by the Pesticides Board. All spray application shall be carried out in accordance with the Agrichemical Users Code of Practice (published by the NZ Agrichemical Education Trust), and in accordance with the Code of Practice contained in the Rivers Environmental Handbook..

Spraying of chemicals may take place at any time throughout the year, subject to suitable climatic and seasonal conditions.

- (iv) Tree and scrub removal shall only be carried out in accordance with the “Code of Practice”. This code is being developed by Council in consultation with the Department of Conservation and the Nelson/Marlborough Fish and Game Council and is contained within the Rivers Environmental Handbook.

Reason

The control of vegetation is necessary to stop river channels being clogged with vegetative growth, thus impeding the channel flood carrying capacity. The maintenance of a clear (vegetation free) fairway or channel is fundamental to the flood control objectives.

If proper channel maintenance is carried out, only routine spray control will be necessary. Mechanical removal of vegetation is only required where major regrowth has established and continued unchecked.

The control of exotic aquatic weeds is necessary to allow unobstructed passage of flood and drainage water, access to a water body and for continuation of aesthetic values.

Mechanical clearance of aquatic weeds is necessary where the water flow is too fast for successful chemical control or special environmental constraints apply.

Chemicals have been used extensively for weed control for many years, and if used in a controlled way provide an efficient and effective means of weed control with little adverse environmental effect.

A Grass Carp trial is currently in progress. If successful grass carp may well be an alternative environmentally acceptable means of weed control in specific locations.

1.5 *Placement and Recovery of Rock Rip Rap, Concrete or Masonry Rubble and Gabions*

Conditions of Placement and Recovery

- (i) Rock, the preferred material, may be placed against river berm edges, training banks or stopbanks, and excavation adjacent to these edges and banks may be carried out for the purpose of placing the rock. The rock can be placed into flowing water down to and below minimum bed level.

Rock from damaged or redundant structures may be recovered from the river bed.

- (ii) Concrete or masonry rubble may be used as a substitute for rock. In these situations, any exterior reinforcing steel will be cut flush with the surface of the concrete and then removed from the site.
- (iii) Gabions or other stone filled wire mesh structures may be used as a substitute for rock.
- (iv) Motor vehicle bodies, old machinery and scrap iron shall not be used for bank protection works.
- (v) Except in urgent situations, placement of rock rip-rap in estuarine areas will not take place between 1 August and 30 November in any year.

Reason

The placement of rock, or similar solid material, for repair or construction of training banks, is necessary to prevent bank erosion. Pre placing to a stable depth, slope and thickness is desirable.

Damage to structures mean the movement of rock which can be retrieved from the riverbed much more cheaply than carting in new rock.

1.6 *Tree Planting*

Conditions of Tree Planting

- (i) Willow or poplar trees may be planted or maintained on river banks as edge protection to prevent bank erosion.
- (ii) Willow trees will be a blend of Matsudana hybrid tree willow, and purplea hybrid shrubby and osier willows. Except for the Wairau River, there will be no plantings of "crack" willow or "golden" willow.
- (iii) Trees will be ripped or dug into the ground, and release sprayed during their first year of growth.
- (iv) From time to time after reaching a mature size the trees can be lopped and layered along the bank edge with tiebacks to anchors, as appropriate.
- (v) Trees may be planted, or allowed to self germinate on areas of the floodway berm where flood berm velocities have the potential to scour the surface. This tree planting will not occur in areas where waterway capacity is of prime importance.
- (vi) Trees may be planted for aesthetic purposes and to provide cover for fish. In areas where waterway capacity is of prime concern such aesthetic tree planting will be of spaced, single stem trees, set back several metres from the waters edge.
- (vii) Methods of planting and control are as for B3.1.4 and B3.1.7.
- (viii) The choice of planting material will be based on the guidance of the Rivers Environmental Handbook.

Reason

Willow and poplar tree planting is an effective and efficient means of bank protection against erosion.

1.7 *Driving and Construction of Piled Retards*

Conditions of Piled Retards

- (i) As edge protection for the gravel bed river fairways of the Wairau, Lower Wairau (upstream of Ferry bridge), Waihopai and Omaka Rivers piled retards may be used in conjunction with tree planting.

- (ii) Piles may be made of driven rail irons or timber, or "cruciforms" of trestles of willow poles. Horizontal whalings will be of wire cable or tree limbs. Piles will be driven to 70% of their length.
- (iii) Piled retards will not be used for channel training purposes in the main channel.

Reason

In the early years of growth trees have not got the strength to withstand river attack. Piled retards protect river banks and encourage gravel and sediment deposition to consolidate the bank line. The piled retards are built on the river bank, or will soon become part of the bank and so pose little hazard to boats.

1.8 *Tree shrub and vegetation removal, maintenance and control*

Conditions of Vegetation Planting and Control

- (i) Trees and other vegetation removal may be carried out on river berms where it will increase the capacity of the floodway or is desirable for environmental reasons and will not adversely effect the berms stability. Removed vegetation will be replaced with grass, lucerne or similar low ground cover.
- (ii) Plant pests may be controlled where the control is necessary for floodway hydraulics, and to prevent smothering of other preferred vegetation.
- (iii) Plant pests may be sprayed or mown. Chemical sprays shall be applied by a registered chemical applicator and only chemicals approved by the Ag. Chem. Bd. shall be used. Sprays shall be applied with care, and special care taken where banks are located in private property or adjacent to crops. Adjacent landowners shall be notified when chemical spraying is carried out on stopbanks.

Reason

Floodway berms carry a significant portion of major flood flows. Berms also provide a buffer and keep high velocity water away from stopbanks. Berms must not be allowed to scour and form active channels of high velocity water. Trees and other vegetation must be carefully controlled to maintain waterway capacity at non scouring velocities.

Many plant pests are present in the floodways. Plant pests inhibit the effectiveness of tree bank protection works or conversely can reduce waterway capacity. Some pests, such as Clematis Vitalba, are too widespread to eradicate. Control of noxious weeds can only be carried out within economic limits. The Council also has some responsibility as a "good neighbour" to control pests on its own lands, especially where they adjoin highly productive private land.

1.9 Removal of Guide Banks

Conditions for Removal

- (i) Existing wing or spur banks may be fully or partially demolished or reduced in height where it is desirable to improve the waterway capacity of the floodway.
- (ii) Removal of guide banks, and their replacement with more permeable tree works, will be carried out as staged works as trees develop to an adequate size.

Reason

Guide banks can be in the form of training banks, wing banks, cross banks, or spur banks. Guide banks have primarily been built to reduce the intensity of flood flows on to the berms.

Waterway capacity has been found to be of prime importance in some areas of the floodway. High guidebanks prevent the flood berms being fully utilised by flood flows and in these areas guide banks need to be partially removed and replaced with more permeable tree plantings.

1.10 Berm Reshaping

Conditions for Berm Shaping

- (i) Vegetation may be removed, topsoil stripped, and gravel holes filled to reshape berm areas to provide a shape less likely to scour and more likely to lead berm flow back to the main channel or fairway.
- (ii) Berm shaping may remove natural high areas of the berms and so increase waterway capacity.
- (iii) Reshaped berms will be resown with grass, or planted with other vegetation as is desirable for the hydraulics of the floodway.

Reason

Berms have been formed by river flows. In some places old channels exist near, or head towards stopbanks or other river control structures. Reshaping berm areas can reduce the likelihood of bank or berm erosion. Conversely banking on high areas may impair the hydraulic efficiency of the berms and reduce the waterway capacity.

1.11 Tracks for Inspection, Construction Purposes

Conditions for Track Construction

- (i) Tracks may be constructed or maintained to facilitate access to the river floodway.
- (ii) Vegetation may be removed and gravel laid.
- (iii) Gates with locks will be provided through fences, in cases of private land.
- (iv) Tracks shall be suitable for light vehicle traffic but may be capable of carrying heavy construction traffic. The tracks will preferably be located on top of the stopbanks.

Reason

Council needs access to inspect, maintain, construct and repair river works. In times of flood it is imperative that easy access along stopbanks is available for inspection, monitoring and emergency repairs such as sandbagging.

1.12 Public Access

Conditions for Public Access

- (i) Public access to the river will be provided across floodway land owned or managed by Council
- (ii) At time of high fire hazard or for other management reasons, or on areas leased for farming operations, public access to the river will be restricted to foot access. Access to or through forestry areas will be restricted.
- (iii) Stiles, gates, tracks and signposts will be provided as appropriate. On the Lower Opawa and Taylor Rivers specialised recreational structures may be required (such as bridges), and will be subject to separate resource consent. Any consent application shall contain full structural details and hydraulic calculations to show that the structure will not have an adverse effect on flood levels or on natural water flow, or create a navigational hazard.

1.13 Stopbank Construction, Reconstruction and Maintenance.

Conditions for Stopbanks

- (i) New stopbanks or raised stopbanks as listed in section B2 shall be constructed using relatively impermeable sandy silt (or gravelly sandy silt) and compacted to normal engineering standards. Top width shall be at least 3.5 metres and batter slopes no steeper than 2 horizontal to 1 vertical. The same dimensions shall apply to reconstruction of inadequate stopbanks.
- (ii) Repair, maintenance or reconstruction of stopbanks on essentially the same alignment or to essentially the same height may be undertaken.
- (iii) Stopbank foundation remedial works in the form of impermeable cut off impermeable trenches, or permeable toe drains may be undertaken.

Reason

Stopbanks are vital structures for controlling the direction of flowing flood water. Stopbanks need to be maintained.

1.14 Repair of Culverts and Floodgates

Conditions for Repair of Culverts and Floodgates

- (i) Culverts and floodgate structures may be repaired or reconstructed in their original location.
- (ii) Gates in excess of 1200mm diameter will be removed or replaced with side hung gates to allow easier fish passage.
- (iii) Gates up to 900mm in tidal areas will be replaced with light weight top hung gates (fibre glass or similar).
- (iv) Provision for passage of fish at all tidal sites nominated by the Department of Conservation will be made.
- (v) Temporary coffer dams can be constructed and maintained during culvert maintenance or replacement, but must be removed at the completion of culvert maintenance.

The Department of Conservation will nominate those gates important for the passage of native fish.

Reason

The repair of culverts through stopbanks is essential. However, it is appreciated that fish and whitebait passage through floodgates can be improved in some cases. To do this as the opportunity exists, flood gates will be replaced using side hung or lighter fibreglass gates as appropriate.

E2 Controlled Activity

Grazing

Standard Conditions of Grazing

The preferred grazing stock is sheep. Goats and deer shall **not** be grazed on floodways, they cause damage to river control plantings and/or stopbanks. Cattle may be permitted on berms in circumstances where they are desirable for vegetation control. Stock shall be adequately fenced to prevent damage to planting, vegetation, banks, river edges and water contamination. Fencing shall be temporary by post and wire construction, or electric fences.

Matters Over Which Control is Reserved

In considering applications for grazing the Council may reserve its control and may impose conditions in respect of the following matters :

- (i) type and number of stock grazed;
- (ii) the time and period of grazing;
- (iii) fence location and standard.

Reason

Grazing of berms can be beneficial to flood control in that vegetation such as grass and shrubs are kept low. However, uncontrolled grazing can cause damage to willow plantings, stopbanks and river edges, and movement of stock into the river can cause contamination.

E3 Non-complying Activities

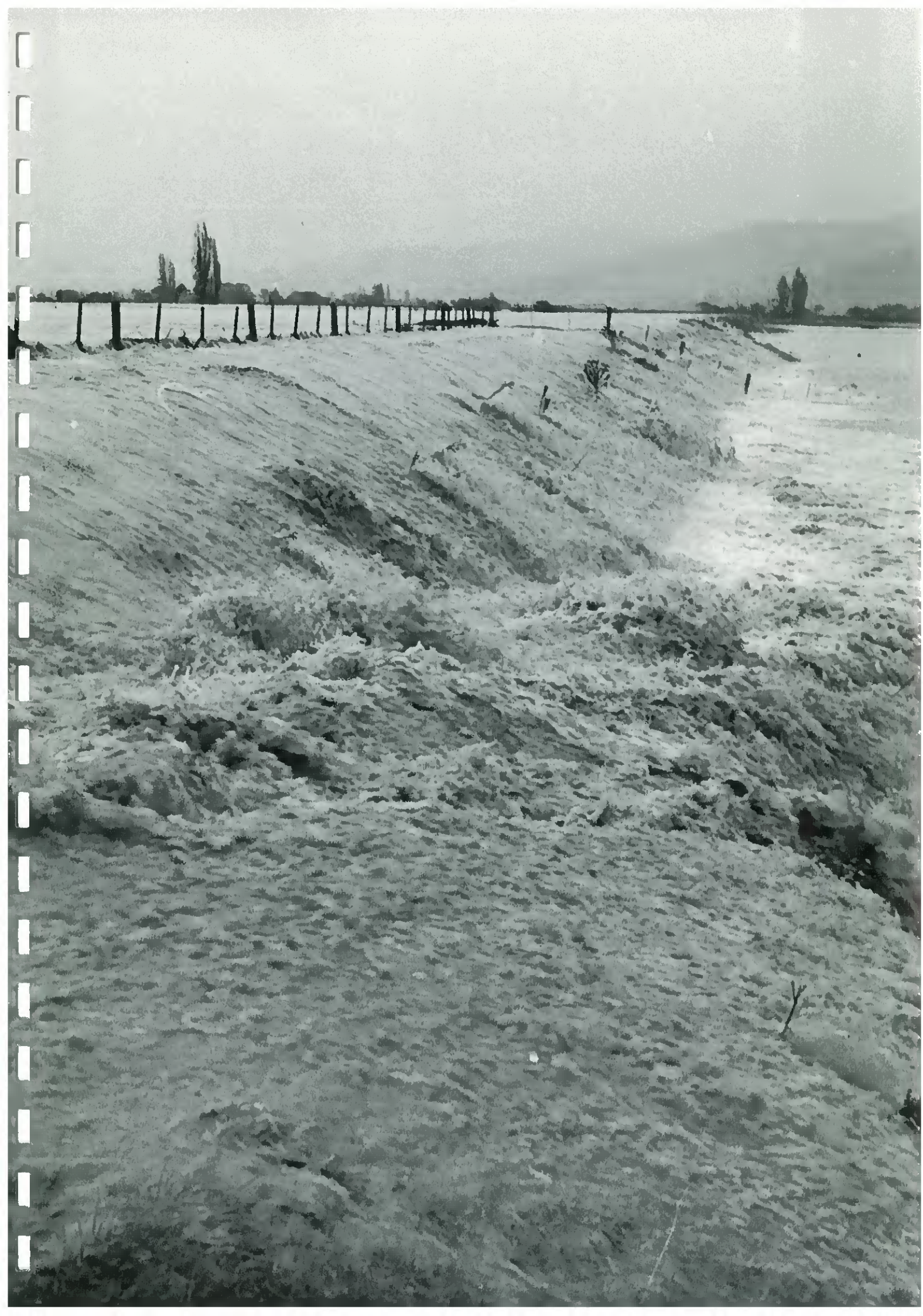
All activities not listed as Permitted or Controlled in this plan are non-complying and will require a resource consent. Council has retained discretion over all matters relating to non-complying matters.

All activities listed as Permitted activities but being carried out by persons other than Council.

Activities not listed as Permitted or Controlled Activities and carried out by any person.

Council will retain discretion over all matters, including notification, relating to non-complying activities.

Photograph : Floodwater overtopping stopbank at Blind Creek, Tuamarina - 10 July 1983



Section F : Wairau River Above Waihopai Confluence

F1 River Control Activities on the Wairau above Waihopai Confluence

F1.1 Description of Issue

1.1.1 1960 Wairau Valley Scheme

The Wairau Valley Scheme (Davidson (1959)) proposed works on the Wairau above Waihopai confluence to limit bank erosion. The proposed works were to limit the river channel to 600m width, and thus allow 1500 hectare of shingle waste to be reclaimed from the river. It was noted that 250 hectare of farmland had been eroded away in the previous 20 years. The Scheme report did not state the degree of flood protection this 1500 hectares of potentially reclaimed land would have, nor its likely productive capacity.

The river works were mainly tree based with bands of trees in an echelon pattern being planted to contain the river and cruciforms to block off unwanted braids. Rock work was used in places of more severe attack. The works were successful to the degree of generally limiting the active channel from 850 metres width to 750 metres, still well short of the planned 600 metres. However, generally the tree work was too weak to sustain major attack from the river and a considerable amount of tree based river works were swept away. The work turned progressively to more rock work, and in 1974 at the completion of the original 15 year scheme, a new scheme was proposed.

1.1.2 1974 - 1982 Wairau River - Waihopai Confluence to Wye Confluence

The 1974 "Wairau River - Waihopai to Wye River" scheme report of Thomson and Pascoe (1974) recommended that strong rock lined banks were required to hold the river to a 600 metre width. It was anticipated that these banks would also force a meander pattern in the river.

Some seventeen separate rock lined banks, each typically 1.5 km long were constructed on alternating sides up the river. This banking was not continuous stopbanking, but open ended stopbanks usually linking back to terraces or cross banks at their upstream ends. The banks were built to a design level of the September 1970 flood. This flood is now considered to be of a 7 year

return period event, though at the time it was considered to be 3500m³/sec and exceed a 20 year return period event.

An amount of 9 tonnes of rock per lineal metre of bank was the design rock quantity. Maintenance was discontinued of the tree planting work of the 1960's.

The economic analysis of these works by Orsman and Pedersen of the MAF (1974) presumed that the river control works would provide a protection standard of between 50 and 100 year return period to the most vulnerable overflow areas and allow development of waste areas on the river margins.

This economic analysis proposed that :

- (i) 890 hectare of developed land would be fully protected to allow more intensive development.
- (ii) 1130 hectare of undeveloped land would receive full flood protection allowing it to be fully developed.
- (iii) 800 hectare of river channels could become rough grazing.

The works have protected the already developed land (i), and there is now some 700 hectares of rough grazing (iii). However, only 220 hectare of the proposed 1130 hectares (ii) have been developed. This latter facet was to have been the major economic benefit of carrying out the river control works. The fact that these areas of former riverbed land have not been developed is indicative that the MAF (1974) report was overly optimistic in its predictions. It is not a criticism of the farmers of the area.

These river control works further reduced the active channel width to typically 700 metres, though it is clearly still a braided river with typically 3 braids at any cross section compared to 5 braids in 1958.

It should be noted that the 1974-1982 period was a very quiet period from a flood viewpoint, and the apparent moderate success of the works during construction was not indicative of longer term trends.

1.1.3 Flood Damage Repair 1983 - 1991

The 1983 floods caused considerable damage to these rock lined banks, and indeed regular damage has occurred in many floods including quite moderate floods since.

Flood damage repair subsidy money was available to repair the rock banks damaged in the 1983 floods. From 1986 to 1991 the finance for repair of rock banks has been from the 1986 Wairau follow up scheme.

This repair work consisted of topping up and replacing rock on the banks. Typically 20 tonnes of rock per metre was used to strengthen or replace the original 9 tonnes. The rock was also costing more per tonne as good rock was becoming more difficult to obtain from the quarry.

In present day terms the rate of expenditure on flood damage repairs in the 1983-89 period averaged \$350,000 per year (Ticehurst (1989)). This was the same as the annual expenditure in the 1960-1973 and 1974-1982 capital works programmes.

Each of the seventeen rock lined banks had substantial flood damage expenditure on it in this period. For the repair of one bank Wadsworth (1986) carried out an economic analysis and recommended that intensive irrigation of the protected land was required to make the bank restoration works economic.

1.1.4 Current Situation

Over the last 3 years there has not been money available to carry out repairs and maintain the rock lined banks.

The Nelson Marlborough Regional Council adopted a interim strategy of repairing the upper ends only of damaged banks, where more land is protected. Several lengths of bank at the bottom end have washed away, but little damage to developed farm land resulted.

Even so, repairs did not keep pace with flood damage, and there are several lengths even at the top end of banks where the bank is completely washed away, or the rocks stripped from them. These weak areas were clearly inadequate to cope with a significant flood.

Recently, in June 1993, a significant flood occurred of 3100m³/sec size (as measured at Tuamarina). This is similar in size to the 1970 flood and has an expected return period of one every seven years. This flood, the largest since 1983 floods, eroded out 250 metres of rock bank in each of two places. These sections were known to be weak, despite fairly recent expensive works. In fact, the areas eroded were at the very top end of the rock banks, where return banking was required and the river has hit at a more severe angle. The flood waters then rampaged across areas of farmland behind the banks causing erosion and gravel deposition and destroying fences.

Other areas known to be weak suffered some minor damage but were not eroded away, simply because the main river braid was not attacking the bank at that time. The river is clearly braided and the main braid is just as likely to be in the middle of the channel, as on the far side, as attacking a particular rock lined bank.

Ticehurst (1989) estimated that \$1.1 million dollars was required to restore the obvious flood damaged areas. Significant further moneys would be required to upgrade lengths of original low standard rock banks. This would now be greater following the June 1993 flood. Flood damage will be a continuing and on-going cost.

It appears that an annual expenditure of \$350,000 is required to maintain the rock lined banks to the protection standard perceived in 1982. The current river works rate charged on the protected landowners is approximately \$10,000.

The banks are not really part of a comprehensive river control scheme. Each bank, in effect, directly protects typically 150 hectares of land directly behind it. This land is usually owned by less than a handful of farmers, sometimes only one. Each bank has little effect on the other side of the river, or on land further downstream.

Priorities for carrying out further works in the area are not clear, for potential works can include :

- Lengths of damaged bank not under current river attack.
- The bottom end of damaged banks where only small areas of land behind would benefit.
- Lengths of banks of original low standard rock where the river is threatening to attack.
- Areas where the river has outflanked the banking system and is attacking where there is no rock lined bank at all.

It has already been pointed out in Section D2.2 that there is no clear off site benefit on the main Wairau floodplain downstream in terms of reduced sediment deposition effects there.

Landcorp (1993) has carried out an economic assessment of continuing further river control works in this area and makes the following conclusions :

- "(i) In today's terms \$10 million* has been expended on river control works. This total exceeds the current market value (\$2.25 million) of the protected land by some \$7.75 million.
- (ii) It is my opinion that the benefits described in the 1974 agricultural economic report on which approval for the river control scheme was gained have in the main not occurred. This could be a reflection of the general economic climate during the period or simply an overestimation of the expected benefits.
- (iii) In my view addressing the revenue in Gross Margin terms derived from the protected area would only justify a maintenance expenditure on River Control structures of between \$30,000 - \$50,000 annually.
- (iv) The alternative way of looking at economic expenditure levels in this area is to simply assume that if no expenditure occurs and the protection level declines then the income earning level of the protected land may decrease. In the majority of cases the least productive land is the most at risk. If over a number of years 50% of the productive land is eroded away the effect is a reduction of approximately \$100,000 of Gross Margin income on an annual basis."

It should be noted that the Council is now a unitary authority with responsibility for constructing and maintaining the Northbank Road and other roads. The Council may have to carry out river bank erosion protection works from time to time to protect the road from river attack and erosion.

1.1.5 Feasibility of Preventative Works

The wide braided Wairau is capable of attacking banks in any location. Individual strong points of river works may soon be outflanked as the river channels move about and attack another place.

The tree based works of the 1960's were spread over the length of the river but were too weak to control the river. The rock lined open ended stopbanks of the 1970's and 80's require \$350,000 a year or more to maintain.

A programme of bank protection works cannot be devised to spend \$30,000 to \$50,000 per year - the amount advised by Landcorp as justifiable. This would simply result in one or two repair jobs a year done to a satisfactory standard while the rest of the banking system fell apart.

* Ticehurst (1989) assessed \$10 million dollars expenditure in 1989 terms, and this figure was used by MacNabb. Cost indexed to 1993 the expenditure would be \$12 million.

Willow and other vegetation lodging and subsequently growing in the main channel can form islands which then divert the braids to attack the banks. Removal of willow tree and other obstructions is a practical river preventative control method that is of advantage to the whole community.

1.1.6 Summary

Bank protection works in this area have been both by a low cost tree planting approach, or high cost rock lined banks approach. Both have failed and/or are far too expensive to economically maintain. It is not economically feasible to carry out a programme of preventative bank protection works on a community wide basis in this area.

Clearing of islands or individual willow trees or other obstructions is a practical river control method.

Other desirable work may be repair of flood damaged banks that have significant areas of developed land directly behind. In these situations if the local landowner is keen to carry out such work, and is prepared to contribute, the Council should also make a contribution in recognition that previous river control works have encouraged land development and subdivision and the farmer now has more to lose than previously. The Council also has to protect the Northbank Road from river attack, and if this is required a joint response with a benefitting landowner may be appropriate.

F1.2 Objective:

- | | |
|------|--|
| (i) | To prevent obstructions by willow trees or other debris forming islands in the fairway which could divert braids against the river banks |
| (ii) | To carry out flood damage repair works on an as practical and economic basis |

F1.3 Policies

- (i) *To remove willow growth or other obstructions lodging in the braided fairway.*
- (ii) *For non programmed works where the landowner(s) on a tributary desire river works to a higher standard than proposed by Council, then jointly funded works may be carried out with Council contribution of up to 50%.*
- (iii) *Council would at its discretion contribute up to 50% of relevant protection/production tree planting on the river flats at risk from river attack.*

F1.4 Rules for Activities on Wairau above Waihopai

As for Section G2.

Section G : Wairau Tributaries Outside Floodplain

G1 River Control Activities on Wairau Tributaries

G1.1 Description of Issue

In Section D2.2 and D2.3 it was indicated that the activities on the Wairau tributaries had little effect on the main Wairau Floodplain and were of different communities of interest. Nevertheless it was desirable that the Council supported and carried out works on the tributaries as part of an overall package, but to a different standard and different funding mechanism.

A summary of works to date on the tributaries under the Wairau Valley Scheme have been described by Carr, Fitzgerald and Ticehurst (1993). Generally the works consisted of channel cleaning, channel dozing, tree planting and rock bank protection work on the outside bends. Minor stopbanking has been carried out in places.

Out of the ordinary works were

- A 2km diversion to carry floodwater directly to the Wairau in the Hillersden area.
- Continuous rock lined training banks on the Waihopai and Omaka Rivers.
- Channel straightening and relocation on the Tuamarina and Are Are Streams.

The work on these tributaries is complicated by being poorly defined as what work is to be done to achieve what standard of river control. The standard achieved and the expenditure committed in some cases has been in excess of the 1960 Wairau Valley scheme intentions. With the government subsidy, the expenditure has also been considerably in excess of rating money from the areas.

The improvement in standard of protection that has been achieved has clearly been substantial in several cases, but less so in other areas. This improved standard of protection is difficult to determine. In some areas a 10 year return period standard was aimed for, but in other areas greater or lesser standards have been achieved.

On some of the tributaries e.g., the Tuamarina, the land holdings are often small and river works in one location can affect many landowners. These are truly community works where it is essential for the Council to have the authority to carry out works.

The works are now by and large at a maintenance stage. Annual river works rates charged on the area benefiting is approx. \$60,000.

Works such as channel clearing are relatively cheap and can have a benefit to ratepayers over extensive lengths of each tributary. Even on a low budget therefore, it is feasible to devise a programme of works that is to the benefit to the community of interest, and predominantly paid for by this community.

It is not practical to prepare a ten year programme of activity for each tributary. It is practical to prepare an annual programme of work. The preparation of an annual programme of work would be best carried out on advice of the benefiting ratepayers of the area. The benefiting ratepayers would be able to assess the standard of river control works they desire, the extent of river activities required and the amount that should be spent. The "standard" of protection in these non stopbanked rivers will be qualitative rather than quantitative.

G1.2 Objectives

- (i) To carry out regular river activities and maintenance on the tributaries outside the Wairau floodplain with the intention of maintaining clear stable channels as far as practical and economic.
- (iii) To carry out flood damage repair works on these tributaries on an as practical and economic basis.

G1.3 Policies for Wairau Tributaries Outside the Main Floodplain

- (i) *These tributary watercourses of the Wairau are not stopbanked systems that will be maintained to a defined standard. Any activity concerned with significant new work (methods) will be to an annual plan submitted separately for resource consent. Maintenance and regular flood damage repair will be carried out as allowed under the rules as set out in G2.*
- (ii) *To use the annual rate intake from the relevant tributary benefitting areas as a guide to the scale of activity to be carried out.*
- (iii) *To liaise with local residents/advisory groups representing various communities of interest in carrying out these tributary activities.*
- (iv) *To provide a policy for non programmed works that where the affected landowners on a tributary, desire river works more extensive or to a higher standard than proposed by Council, then jointly funded works may be carried out, with Council contribution of up to 50%.*

G1.4 Possible Future River Control Activities

1.4.1 Background

In the previous section it was shown that it was a policy of the Council to carry out maintenance and flood damage activities on the various Wairau tributaries, but it was not possible to list and describe other possible concerns and propose methods to be adopted.

Nevertheless, it is worthwhile to flag significant concerns and possible Council policies and methods that may be required on the Omaka and Tuamarina rivers in the future.

1.4.2 Omaka River (Upstream of Hawkesbury Road Bridge)

(a) Situation

Upstream of Hawkesbury Road bridge for several kilometres the Omaka river is a steep gravel bed river within a 700m wide valley floor contained by a steep terrace on one side and hills on the other. River control works such as tree planting and rock lined training banks have helped confine the river to a single channel of typically 20m width.

This channel is only large enough to carry normal flows up to minor floods. Floods spill out over the valley floor, and major floods can occupy much of the flats out to the terrace or hillside.

The valley slope is sufficiently steep that such floods can scour and erode on these flats, with the potential for the river to break out of its existing channel and form a new channel in an old river braid across the flats.

This land is now being viewed as potential viticultural land. Landowners developing these valley flats for such grape growing are taking a significant risk with the river in its current state. Current river control works even if well maintained, are inadequate to prevent breakout. The channel is simply too small.

The landowners, or some of the landowners, may request Council to improve river control works to decrease this risk.

(b) Possible Solution

A defined standard of protection appropriate for grape planting and subdivision would best be achieved by a stopbanked river system. Within the stopbanks would be a 50m width cleared fairway, flanked by a buffer of 15m of willow plantings on each side to provide bank protection. The total floodway width would be 100 metres.

The existing rock lined training banks in some places and established willows in others should be of significant value in carrying out such a work.

A significant difficulty may be obtaining agreement from the landowners as to on whose land the river floodway should be located. Some recent subdivisions have sought to define legal land ownership boundaries so as to constrain the river as narrow as legally acceptable. Land clearance close to this boundary edge has, on occasions, subsequently followed.

A policy of establishing esplanade reserves for natural flood hazard mitigation purposes in further subdivisions would be desirable.

1.4.3 Tuamarina River : Para Swamp

(a) Situation

The Wairau Valley Scheme envisaged that water levels in the Tuamarina river at its confluence with the Wairau would be reduced by 2 metres or more by the river control works on the Wairau. This would then result in the draining of the Para Swamp.

This lowering of Wairau and Tuamarina levels has not eventuated and will not eventuate. Draining of the Para Swamp is no longer a feasible nor desired option.

Department of Conservation (1993c) have made a submission requesting that the Para Swamp be retained, and suggesting that further river control works should be carried out to retain it and develop it as a wetland. This is not contrary to other river objectives, and should be supported by the Council. More investigation of the concept is required. A joint proposal between D.O.C. and Council may be suitable.

G2 Rules for Activities in Tributary Watercourses Outside the Main Floodplain and Wairau above Waihopai Confluence

For tributaries outside the Wairau Floodplain, Council or persons nominated by Council, shall be permitted to carry out the activities detailed in Section F and G1 under the following conditions.

G2.2 Permitted Activities

2.1 Channel Bed Maintenance

Conditions for Channel maintenance

Shaping

- (i) Shaping will take place only to gravel beds within the defined river fairways of the Wairau
- (ii) *Diversion Procedures*
 - (a) Diversion works shall be carried out by working from downstream to upstream, in such a way that water is not diverted until the final break through is made. In this way operation of machinery in moving water is to be minimised and the effects of water discolouration also minimised.
 - (b) Existing redundant channel shall be left open at the downstream end. Every effort will be made to carry out the works in a way that fish stocks are not entrapped.
 - (c) The Nelson Marlborough Fish and Game Council and the Department of Conservation shall be informed of the proposed works, at least one week prior to work starting.

(iii) *Fairway Shaping Works*

Channel shaping works by bulldozing up banks shall be carried out only where it is required to carry out urgent repair works.

Reason

Build up of gravel is a natural process that causes the river to move across the flood plain. This movement is no longer acceptable to the community, and channel works are necessary to retain the location of the river. In streams channel works can cause temporary water quality problems.

2.2 *Repair or Maintenance of Rockwork*

- (i) Rock that has been moved or damaged may be reinstated or replaced in its original position.

Reason

Rockwork is used in streams only in very vulnerable spots. Reinstatement of damaged rock work is often urgent and if replaced as the original, will not cause problems. New rockwork could cause adverse effects by changing the river pattern and will be subject to specific resource consents.

2.3 *Vegetation Control*

Conditions for Vegetation Control

- (i) Vegetation in the main channel, overhanging the main channel or impairing flood flows may be removed.
- (ii) Willow plantings of Matsudana hybrid and/or purpurea shrubby or osier willows can be undertaken.

Reason

Willow and other vegetation within the channel can cause turbulence and encourage the erosion of banks. Willow and other growth in the channel or overhanging the flood channel impedes flood flows and is a factor in causing the river bed levels to increase with consequent additional damage to banks and surrounding land.

Willow trees can be desirable as bank edge protection.

2.4 *Gravel or Sediment Removal*

Conditions of Gravel and Sediment Removal

- (i) Gravel and other sediment may be extracted from the Wairau River up to its confluence with the Rainbow, the Waihopai River from SH 6 bridge up to Craiglochart bridge, and the Omaka River for 1 kilometre upstream from the Hawkesbury Road bridge.
- (ii) Extraction shall be carried out as in Section E1.1. It is to be noted that for "defined fairway" read "natural active channel".
- (iii) Gravel extraction from the Waihopai River shall not exceed 10,000m³/year; and for the Omaka River 10,000m³ over the 10 year period up to 30 June 2004.

Reason

Gravel extraction from wide braided rivers can proceed without detriment to other river users. Upper limits are specified to minimise potential conflict with nesting birds on these extensive lengths of braided rivers. Larger quantities may be extracted but will require separate resource consents.

2.5 Control of Plant Pests*Conditions for Plant Pest Control*

- (i) Plant pests may be controlled where the control is necessary for floodway hydraulics, or to prevent smothering of preferred vegetation.
- (ii) Plant pests may be sprayed or mown.
- (iii) Chemical sprays shall be applied by a registered chemical applicator and only chemicals approved by the Agricultural Chemical Board shall be used. Sprays shall be applied with care, and special care taken where stopbanks are located on private property or adjacent to crops.
- (iv) Adjacent landowners shall be notified prior to chemical spraying on stopbanks.

Reason

Many plant pests are present in the floodways. Plant pests inhibit the effectiveness of bank protection works and can reduce waterway capacity. Some plants, such as *Clematis vitalba*, are too widespread to eradicate. The Council also has some responsibility as a "good neighbour" to control plant pests on its own land, especially where they adjoin highly productive private land.

2.6 Stopbank Maintenance or Reconstruction*Conditions for Stopbank Management*

- (i) New stopbanks or raised stopbanks be constructed using relatively impermeable sandy silt (or gravelly sandy silt) and compacted to normal engineering standards. Top width shall be at least 3.5 metres and batter slopes no steeper than 2 horizontal to 1 vertical. Similar dimensions shall apply to reconstruction of presently inadequate stopbanks.
- (ii) Repair, maintenance or reconstruction of stopbanks on essentially the same alignment or to essentially the same height may be undertaken.
- (iii) Stopbank foundation remedial works in the form of impermeable cut off impermeable trenches, or permeable toe drains may be undertaken.

Reason

Stopbanks are vital structures for controlling for direction of flowing flood water. Stopbanks need to be maintained.

G2.3 Non-complying Activities

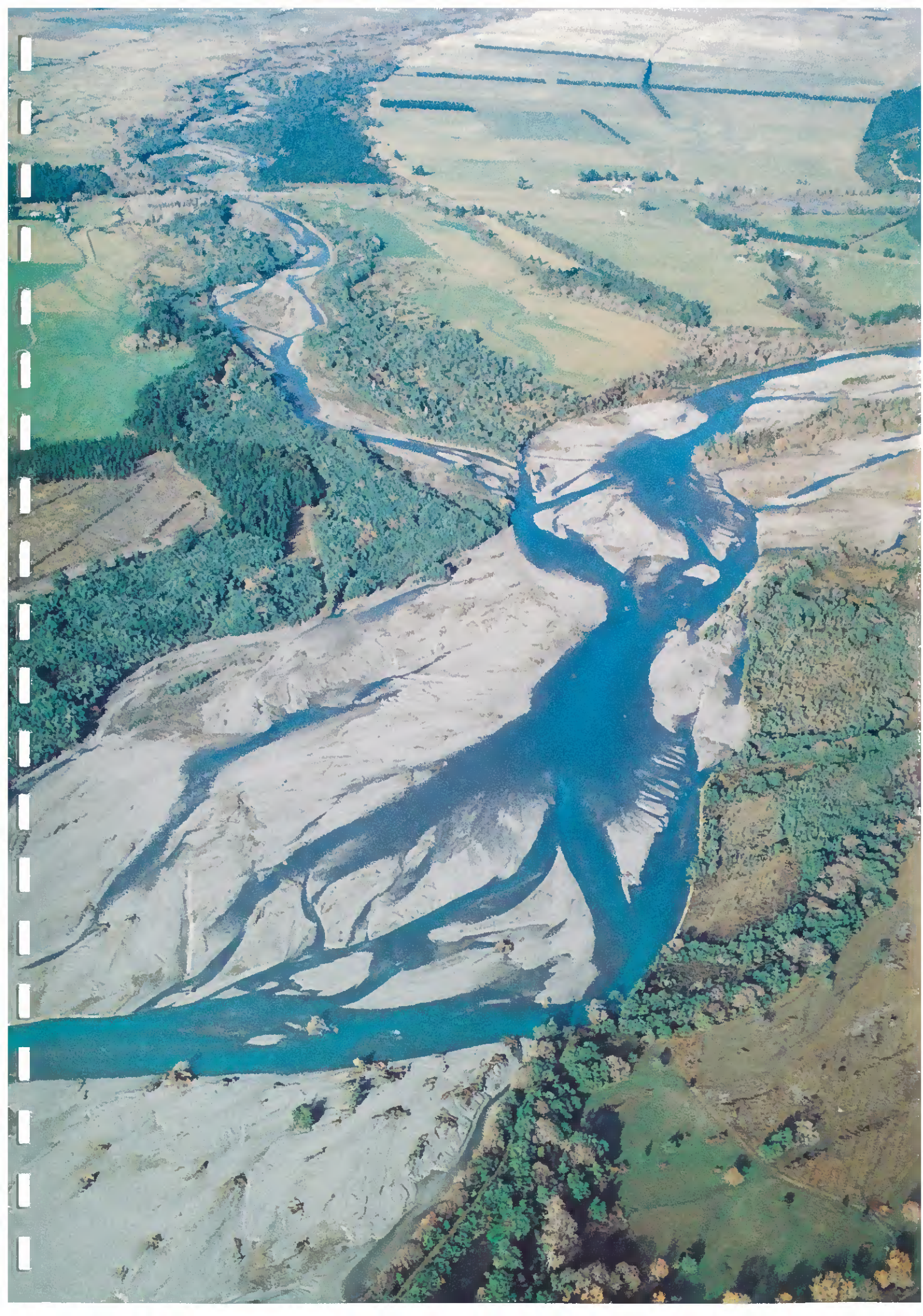
All activities not listed as Permitted in this plan are non-complying and will require a resource consent. Council has retained discretion over all matters relating to non-complying matters.

All activities listed as Permitted activities but being carried out by persons other than Council.

Activities not listed as Permitted Activities and carried out by any person.

Council will retain discretion over all matters, including notification, relating to non-complying activities.

Photograph : Confluence of Waihopai and Wairau Rivers, normal flow conditions, July 1993



Section H : Environmental Matters

H1 Impact of River Control Activities in the River Floodways on the Environment

H1.1 Description of Issue

River control works to provide flood and erosion protection can affect other environmental river matters as listed in Sections 6 and 7 of the Act. The matters in the Wairau river floodways system that this plan needs to make provision for are :

- Natural character of river margins, and indigenous flora.
- Public access for recreational use and amenity.
- Maori cultural values.
- Trout, salmon, whitebait and other fauna habitat and ecosystems.
- Groundwater recharge.
- Desired land use of floodway land by landowner.

The river control works can be both to the advantage and disadvantage to those various other environmental aspects.

From previous reports and discussion with Department of Conservation, Fish and Game Council staff, and the Community Panel that was set up, no environmental/river control issue appeared sufficiently serious to warrant specific investigation. The discussion herein is drawn principally from previously written documents, especially evidence for the Draft Wairau Local Water Conservation Notice (1986).

The impact of river control works on the river was not considered an issue in that Conservation Notice hearing concerned with the recognition of the amenity values afforded by the Wairau River in its natural state. The issues identified at that Hearing, principally dealt with impacts of water abstraction from the Wairau River, and have further been examined by Whale (1992) in a Nelson Marlborough Regional Council staff discussion paper.

H1.2 Objectives

- (i) To provide for, and where appropriate enhance, ecological and environmental river values and give consideration to cultural and social concerns, consistent with works and controls required for flood protection activities and consistent with the already highly modified floodway system
- (ii) To provide access to, promote and where appropriate enhance recreational use of Council floodway land, consistent with works and controls required for flood protection activities

H2 Policies and Reasons for Policies

H2.1 Natural Characteristics of River Margins

2.1.1 Policies

- (i) *In suitable locations and where not in conflict with river control requirements to plant and maintain native and other vegetation on Council owned floodway land.*
- (ii) *To liaise with other interested parties wishing to develop wetland and other areas on Council owned floodway land where not in conflict with river control requirements.*

2.1.2 Reasons and explanation for Policies

- (i) River works require careful control of vegetation in floodways. Heavy tree growth in floodways holds back the flow and reduces its waterway capacity. Clearing of trees from the floodway is a common river control task. In narrower river channels like the lower Wairau, or the lower Opawa, bushy, overhanging willow can cause serious reduction in flow capacity, with serious implications for overtopping of banks. Conversely some trees are desirable to prevent bank and berm erosion. They are particularly required where river velocities are higher, for example the Wairau river above Tuamarina. Willow trees have an advantage in their strong root systems and quick growth from cuttings. However, excessive growth, particularly where it overhangs far into the main channel, will reduce the flow capacity.

Control of the amount and type of vegetation in floodways is therefore an important part of river control, and not something that can be left to nature. Indeed, the planting of willows on river banks for river control works has now gone on for so long that willow trees can be considered as the natural riparian character. If specific native or other vegetation is desirable for aesthetic wildlife, fishery or other environmental reasons this can be achieved in some places, including the requirement to be managed and maintained.

- (ii) The area of wetlands on the Wairau floodplain river margins has been substantially reduced by drainage and river control works, but there are opportunities to enhance the Para Swamp on the Tuamarina river (in partnership with other organisations) which are not in conflict with river control policies. These are also opportunities to develop Bothams

Bend back channel downstream of Tuamarina bridge and on other areas of floodway berm land. Recently, a private landowner, with Council consent, has developed a wetland area on the floodway berm of the lower Opawa.

H2.2. *Public Access for Recreational Use and Amenity*

2.2.1 Policy

- (i) *To develop (Council) management plans to facilitate recreational access on Council land.*

2.2.2 Reasons and explanation for Policy

- (i) **Recreational activities** within the Wairau river system include rowing, boating, fishing, canoeing, rafting, jetboating, water skiing, mini power boats, and swimming as on the water activities. The adjacent floodway berms provide access for the carrying out of these activities, but also provide an environment for picnicking, game bird hunting, walking, bicycling, horse riding. The control and use of the on the water activities in the navigable river reaches of the Lower Opawa and Lower Wairau is with the Council's Harbourmaster under the Harbours Act.
- (ii) **A major study was carried out by Robertson (1986) and published by the Marlborough Catchment Board entitled "Recreational Use of Marlborough Rivers"**. The study detailed the various activities and river locations of recreational use. It noted that recreational use of rivers was an important part of outdoor recreation. The report recommended that recreation areas continued to be preserved and enhanced. Furthermore, that the Wairau local authorities allow in their plans to preserve, enhance or develop its recreational facility.
- (iii) **The river works carried out under the Wairau Valley Scheme have considerably improved the access for recreational use**, especially over the large area of floodway land that are owned or managed by Council as river control reserve, or esplanade reserve or other reserve. Prior to the scheme access was generally limited to bridge sites.

Nevertheless, both Robertson (1986) and the Community Panel (See Appendix III) identified lack of access over Council owned floodway land as a significant conflict, for there are large areas of floodway land that are commercially leased for farming operations. Walking access to river recreational interests is seen to be a desirable activity not in

conflict with river control or usually commercial leasing interests. In future, foot access to the river across Council owned floodway land should be provided where it is not in conflict with fire hazard.

- (iv) **Council owns**, or manages crown reserve land, over a considerable area of floodway berm land. This land is under a variety of titles e.g. legal road (unformed), river control reserve, marginal strips, esplanade reserves, freehold titles etc.

For much of this land there is no automatic of legal public access for this depends on the title under which it is held. Substantial areas of the land have recreational values, in particular :

- The Taylor floodway berms through Blenheim provide a valuable and appreciated recreational facility. This is land owned by the Council. The community panel indicated that it would like to see such Council owned floodway given a high priority for recreational use.
- The Taylor floodway upstream of Doctors Creek confluence is considerably in excess of waterway capacity requirements and there is significant opportunity for various recreational uses on the floodway berms.
- Lower Opawa land that the Council would buy in the future for berm shaping works could also be developed for recreational use, especially recreational walkways and cycleways and recreational boating.
- Spring Creek floodway berms in its lower reaches can be developed to provide good access to this valued fishery.
- The floodway berms of the south bank of the Wairau between Tuamarina and Renwick bridges which provide for a variety of recreational use.
- The mouth of the Wairau Diversion which provides for fishing and other recreational use.

H2.3 Maori Cultural Values

2.3.1 Policy

- (i) *Will consult with iwi from time to time regarding river floodway activity concerns and resource consent processes.*

2.3.2 Reasons and explanation for Policy

The partnership established by the Treaty of Waitangi provides the framework for consultation for rivers management issues.

Consultation with iwi in the preparation of this plan took place at a hui at Omaka Marae 2 August 1993. The Iwi have particular concern of the ecological values of the Lower Wairau, and were concerned at the potential effect of siltation on this ecology. As the siltation is being affected by the flow regime of the Lower Wairau - altered since the construction of the Wairau Diversion in 1963 - they wished to see a flow control structure constructed at the head of the Wairau Diversion. Such a flow control structure they hoped would be a simple shingle bank that would divert all flows up to moderate floods down the Lower Wairau so as to flush out the deposited silt.

The siltation of the Lower Wairau is a concern, as outlined in D8.1.1 and the need for a control structure is discussed in D8.3. It is recommended that it is premature to make decisions on a flow control structure at this stage and though it may certainly be required in the longer term. Further monitoring and analysis is required.

The iwi are also concerned at the ecological values of the Vernon Lagoons, lower Opawa and Lower Wairau tidal estuaries, which should be improved by maintenance of a direct mouth opening (Ref D8.1.5).

H2.4 Trout, Salmon, Whitebait and other Fauna Habitat and Ecosystems

2.4.1 Policies

- (i) *To provide for the replacement of floodgates on culverts in strategic locations with side hung floodgates that provide better passage for whitebait and other fish.*
- (ii) *To develop an Environmental Handbook that will specify rules by which river control methods are carried out so as to minimise detrimental effect on fish habitat, and other environmental concerns.*

2.4.2 Reasons and explanation for Policies

- (i) The Wairau river is recognised as being regionally important for **brown trout**. Aspects of habitat concerns adequate water depth for fish passage, avoidance of high water temperatures, adequate invertebrate fauna as food, and sufficient habitat area.

River control works on the Wairau between Tuamarina and Renwick bridges have trained the river to be less braided and provide overhanging trees beside some of the channel. At low flow it is almost a single thread channel river in this reach, which at times has low flows.

With a more single thread channel condition the water is typically deeper. This provides better fish passage up and down river and also keeps temperatures cooler so more suitable for fish as hot summer days. The rock riprap banks and planted willow trees provide good cover for the fish. The reduction in braiding may have reduced riffle feed area but the river channel seems generally preferable for fish habitat.

Trout and salmon spawning is a particular factor that can be affected by river channel activities in localised spawning areas in the months of May to September.

- (ii) **The Wairau (Vernon) Lagoons** are recognised by the Department of Conservation as of national ecosystem value, in their Draft Conservation Strategy (1993a) and in Department of Conservation (1993b) Issues and Options Paper on the area. The ecology of the Wairau Lagoon is described by Knox (1983). Knox recognised that salinity, tidal water level regime, water temperature and tidal flushing were aspects affecting the lagoons ecology, that in turn was influenced by the effectiveness of the Lower Wairau river mouth bar.

Guide walls on the bar have been constructed for over 100 years, with the last one built by the Marlborough Catchment Board in 1961, being particularly effective in keeping a direct open mouth. Such a direct open mouth achieves a more consistent salinity level, a regular water level change and flushing of both the lagoons and lower Wairau/Opawa estuaries. Not only is this condition the accepted state for over 30 years, but both Knox (1983) and Cawthron (1992) imply that this has desirable features.

- (iii) The lower Wairau, Wairau lagoons, Wairau Diversion, Rose's Overflow and Lower Opawa, and drains or minor watercourses leading into these rivers through floodgated culverts, **provide habitat for whitebait species.**

Floodgates can impede the passage of migrating fish.

The higher river flood levels require that floodgates be put on drainage outfalls to prevent the backflow of flood waters. In low lying areas the gates have a dual function of preventing tidal variations of natural river levels being transmitted back up the drains. This has had the effect of allowing cultivation of land at or near sea level, both from the point of view of actual water level as well as saline intrusion in the drains.

Environmental groups could consider that it is expecting too much to farm high value crops in very low lying areas, but to return to natural drainage in all but flood situations would require a serious political decision, as well as posing considerable operational problems.

Better provision for whitebait could be achieved by maintaining the already reduced native vegetation and facilitating whitebait passage by replacement of top hung floodgates with side hung floodgates at strategic culverts.

- (iv) **Spring Creek**, with its constant cool flowing water and riparian vegetation provides a valuable fishery. River control maintenance works, or its proposed outlet work changes need to be carried out with maintenance of existing habitat as an essential part of the design of the work, especially fish passage arrangements through a floodgated culvert.

H2.5 Groundwater Recharge

2.5.1 Policy

To continue to abstract water from the Waihopai river into Gibsons Creek for the purpose of benefitting groundwater levels and other riparian values.

Note: The amount of water to be abstracted from the Waihopai and control of the water in Gibsons Creek are concerns to be addressed in the Wairau/Awatere Resource Management Plan.

2.5.2 Reasons and explanation for Policy

- (i) The Wairau aquifer is of tremendous importance to the Wairau floodplain. Changes to groundwater recharge and groundwater levels due to river control works are therefore of potentially great significance.

The reduction in groundwater recharge due to river works in the upper and lower Conders area in the 1910's that blocked the Waihopai and Wairau from the Opawa was contentious.

In 1960 the Wairau Valley Scheme made provision for an abstraction of 2.8m³/sec from the Waihopai into Gibson's Creek and the upper Opawa so as raise groundwater levels in the area and for other riparian benefits. This still continues today, though the abstraction is usually in the range of 0.5m³/sec to 1.5m³/sec. The degree to which this recharges the groundwater aquifer depends on the siltation pattern and its removal in Gibson's Creek and the Upper Opawa.

This is the most economic method of recharging the aquifer providing there is adequate water available from the Waihopai.

- (ii) The Wairau between Wratts Road and Waihopai confluence is the major source of groundwater recharge to the very important Wairau aquifer. In this reach significant river control works to narrow the channel have been carried out since 1966. Measurements of flow losses to groundwater have been carried out on several occasions over the last 20 years (as shown in Figure D9). These measurements show that losses to groundwater are reasonably steady at 7m³/sec between Waihopai confluence and Wratts Road. This is irrespective of size of flow in the river or river control works in this period. Variations of ± 1.5 m³/sec in the measurements is likely to be primarily due to difficulties of gauging the river with underflows in gravel beaches in places and tributary flows from Northbank Streams and Southbank drains. These may also be as underflow. There is no evidence to show that the river control works over the last 20 years have affected groundwater recharge.

H2.6 *Desired Use of Floodway Land by Landowners*

2.6.1 Council Policies

- (i) *For Council to purchase private land in the floodways where the degree of river control activity is in conflict with the landowners land use expectations.*

- (ii) *To facilitate Council access across private floodway land for flood monitoring purposes and emergency flood repairs.*

2.6.2 Reasons and explanations for Policies

- (i) A significant proportion of floodway land is in **private ownership**. For some floodways the desires of the landowner to farm his land is in conflict with Council's needs to shape the floodway berm to be hydraulically efficient, and/or strictly control vegetation for hydraulic efficiency or erosion protection purposes.

This particularly applies to the Lower Opawa floodway which is predominantly owned by private landowners. Council owns some land in the upper reaches and there is also some short lengths of esplanade reserve. The proposed berm shaping works of Section D8.5.2(b)(iii) and controls in keeping the floodway berms in short grass will seriously effect the expectation of the landowners.

It also applies to the Wairau floodway between Tuamarina and Waihopai not already in Council ownership, where strict controls on vegetation are required for channel hydraulic efficiency and stopbank erosion protection reasons, and to parts of the Upper Opawa.

- (ii) Fencing of the land across stopbanks or berms on private land **inhibits Council access** for inspection, maintenance and repair of river works. In major floods the safety of the stopbank cannot be observed, and it is more difficult to carry out emergency sandbagging if necessary. Regular inspections and maintenance work and moderate flood monitoring is also more difficult.

H3 Monitoring and Environmental Outcomes

H3.1 Scope of Monitoring

Monitoring is required to measure the effectiveness of the river control works to prevent flooding and erosion, and the effects of these works on the environment. A range of activities needs to be monitored. These activities range from aspects solely concerned with the flood control effectiveness (e.g. flood levels) to behaviour of the environment of which flood control works are only one of several influencing factors (e.g. instream values in rivers).

Monitoring of the effectiveness and effects of river control activities is part of a broader Council responsibility. The following discussion of items to be monitored (4.2 → 4.7) is in general order from specifically of value to assess the effectiveness of river control works, through to aspects in which effects of river control measures is only one of the several requirements for Council to carry out monitoring. (This does not imply any order of priority).

H3.2 Monitoring of Flood Events

The performance of the river channels in a flood event is of prime importance. Marking and measurement of flood levels, observation of the flood during the event, aerial and land based photographs are required for all major floods. Lesser floods also should be monitored from time to time partly because they can physically be measured more accurately and partly because higher floods occur only infrequently (by definition) and the constantly changing river conditions need assessment.

Inspection of stopbanks, bank erosion protection works, floodgated culverts, is required during and after flood events. Specialist studies are required that measure water pressure in the foundation of stopbanks of uncertain structural integrity.

H3.3 River Bed Surveys

A programme of river cross sectional surveys is required to determine changes to the river bed from sediment erosion/deposition or deliberate removal (gravel extraction). Typically every river would be resurveyed every 5 years. In the flow division area of the Wairau below Tuamarina, and other areas of gravel extraction, more regular resurvey is required perhaps even annually. For more stable rivers such as the Upper Opawa, a 10 year resurvey is adequate. This river bed survey also includes resurvey of the Wairau above Waihopai confluence, where gravel build up would ultimately affect the lower floodplain.

Aerial survey of the systems to record changes to the river pattern, stopbank and vegetation changes is required every approx. 4 years.

The Council has appropriate computer technology to hold, store and analyse this river bed cross sectional record.

H3.4 Flood Hydrology

A network of continuous water level recorders at the suitable sites of Tuamarina (Wairau), Dicks Road (Lower Wairau), Borough Weir (Taylor), Taylor Dam (Taylor), Hutcheson Street (Taylor) is the basis for flood hydrology. Regular gauging of high flow is required to determine the relationship between water level and flood flow at the recorder site. This also changes from time to time with changes to riverbed level through sediment deposition/erosion. This flood hydrology measurement needs to be integrated with low and other flow measurement.

H3.5 Lower Wairau River Mouth

The river control works to achieve a direct mouth opening not only affect flood levels but has an impact on a range of environmental factors in the important Wairau estuary area including the Vernon Lagoons, Lower Wairau and Lower Opawa (as discussed in detail in D8.1.5). A continuous water level recorder has been re-established in the Wairau estuary as a base for monitoring work. From time to time specific studies measuring salinity levels, water quality, flow circulation, gauging flows etc (as was done by Cawthron (1992)) will be required to analyse the environmental outcomes of a range of affected aspects.

H3.6 Groundwater Recharge

The Council has a regular programme to gauge flow losses to groundwater down the Wairau river and whether those change with time and if so, could be due to river control works. Occasional gauging of the Omaka and Upper Opawa will also be required from time to time. This work is within a much broader monitoring and analysis of the groundwater resource and of its use.

H3.7 Instream Flow Values and Habitat

The Council is currently setting up a programme to monitor instream flow values for a variety of reasons of which the impact of river control works is but one. Instream flow values include habitat for native and exotic fish, bird habitat and other fauna and flora associated with the river environment. A summary paper by Whale (1992) identifies issues and values in this area and provides a basis for establishing a programme to monitor instream and habitat. Also refer to Section D7.

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