

Memorandum

To: Otago Regional Council

From: Claire Hunter, Mitchell Daysh Limited

Date: 28 March 2023

Re: Otago Regional Council - Review of LVAMP-Related Conditions – Clutha Hydro Scheme

INTRODUCTION

In response to Otago Regional Council's (Council) Notice of a Review of Conditions on Resource Consents Associated with the Clutha River Hydro Electricity Scheme (Clutha Scheme)– Clyde and Roxburgh Dams dated 23 August 2022 (Review Notice), I have been asked by Contact Energy (Contact) to assist in revising the conditions specified in the Review Notice which, relate to the preparation of the Landscape and Visual Amenity Plans (LVAMP), to address the issues with these conditions as identified in the Review Notice.

BACKGROUND

The three conditions that the Review Notice has stipulated are subject to review (or proposed new conditions added within the scope of those conditions¹) are:

- Condition 17 of consent 2001.385.V3 relating to the LVAMP for the Kawarau Arm of Lake Dunstan;
- Condition 18 of consent 2001.386.V4 relating to the LVAMP for the Manuherekia River; and
- Condition 8 of consent 2001.398.V2 relating to the LVAMP for the Manuherekia River.

The historical background to these conditions and how they were developed through, and imposed by, the Environment Court in its various decisions between 2005 and 2007 is set out in **Appendix A**.

The reasons for undertaking the Clutha Scheme Review as expressed in the Review Notice are as follows:

"The consent conditions relating to the Landscape and Visual Amenity Management Plan (LVAMP) are not effective in avoiding, or mitigating, adverse effects on the environment as a result of the exercise of the consents. The current consent conditions relating to the LVAMP as written have resulted in the inadequate management of adverse effects namely those outlined

¹ Section 129(1)(a) and (d) of the RMA.

below and there is not clear direction in the current conditions that allows for appropriate monitoring of the LVAMP and the actions contained within."

The adverse effects considered to not to be effectively avoided or mitigated by the current Clutha Scheme conditions of consent are in relation to landscape and visual amenity effects **only**, in particular:

- Driftwood accumulation and the particular visual impact it has from the Old Cromwell Precinct, the Jackson Lookout the Junction Lookout, including the lake margins around Cornish point;
- Lagarosiphon within Lake Dunstan;
- A change in flow regime and how the presence of less attractive sediments, algae, aquatic weeds and terrestrial weeds will be monitored and managed during periods of low lake levels;
- Driftwood, Lagarosiphon and sediment accumulation and obstruction on the use of the Old Cromwell jetty, the Cromwell boat ramp; and
- Future lower Manuherekia River gravel extraction works on visual amenity and the maintenance of the swimming hold immediately downstream of Shaky Bridge.

The scope of the Consent Review is therefore limited to concerns about the effectiveness of the LVAMPs to avoid or mitigate adverse effects on visual amenity and landscape as listed above.

Dr Lieffering, an Independent Commissioner, engaged by the Council identified a number of issues with the mechanics of the LVAMP related conditions. These issues are briefly summarised below:

- The conditions lack clear performance or environmental standards;
- The current structure of the consent is unlawful on the basis that it leaves the management of actual or potential adverse effects for a subsequent decision making process;
- There is no specificity in terms of who Contact must consult with in preparation of the LVAMP, nor how Contact is to address feedback received on the draft LVAMP, and the condition could be improved to require Contact to provide a summary of the consultation/feedback and identify how that feedback has been incorporated into any revised LVAMP and/or why such feedback has not been incorporated; and
- The original Commissioner's and the Environment Court's decisions acknowledge that there will be changes to landscape and visual amenity values over the next 35 years of the Clutha Consents, but they are not necessarily adverse. It is therefore not clear what aspects of landscape and visual amenity matters the LVAMP is trying to address.

PROPOSED CONDITIONS

To address the concerns raised in the Review Notice and by Dr Lieffering in particular, I have developed, along with relevant experts (Mr Foster and Mr Coombs) and legal input, and through engagement with, and feedback from, relevant parties, a revised set of conditions relating to the

preparation, delivery and implementation of the LVAMP conditions. As the conditions apply to two geographically separate locations, being the Kawarau Arm and the Manuherekia River, two sets of conditions have been drafted. These are attached as **Appendix B and Appendix C** to this memorandum.

Reports prepared by Mr Foster and Mr Coombs in support of the framework from a technical perspective are also attached to this response (refer **Appendix D and Appendix E**)

Kawarau Arm / Bannockburn LVAMP Conditions – Appendix B

The overarching objective of the draft revised LVAMP conditions is to create a sufficiently detailed framework for identifying and responding to adverse effects caused by the operation of the Clutha Scheme. By providing clarity about where and how areas will be monitored, detail on the mitigation actions to be implemented in response to the identification of adverse effects and clarity about reporting, Contact seeks to provide the Council and the community with confidence that where unanticipated adverse landscape and visual amenity effects within the specified areas arising from the Clutha Scheme are identified, they will be mitigated to an acceptable level.

The conditions require that the LVAMP is produced on a five yearly basis. The first of the LVAMPs prepared under this revised framework would therefore be scheduled to occur on or about 1 July 2025. A revised LVAMP using this framework is therefore expected to be replaced in 2026, 2031, 2036 and 2041.

To address the concerns raised in the Review Notice regarding lack of certainty and the deferral of the LVAMP “approval” process to another process, Condition 1 sets out the parameters against which any future plan shall be approved by the Council². Condition 1 provides a clear checklist approach to LVAMP approval, rather than a deferred decision-making requirement. The “approval” measures are that:

- The LVAMP has been prepared by a suitably qualified and independent landscape architect;
- Includes clear actions, methods and a monitoring programme to achieve the purpose of the plan(s); and
- Meets the obligations that are now clearly set out in subsequent conditions.

Condition 2 sets out the area that the LVAMP should apply to, by reference to a clearly mapped boundary area. The intent of the mapped boundary areas is to ensure that there is no dispute or uncertainty about what area the LVAMP applies to and where the mitigation actions are to apply to (the subject locations). The intent is also to ensure there is a clear understanding of which entities have which responsibilities for the activities which the LVAMP applies to.

² I note that an earlier draft of the conditions sought that the plan be ‘certified’. However, Contact was concerned that this approach differed to that which is set out within its existing consent obligations which require the “approval” rather than the Certification of the Council.

Conditions 3 and 4 sets out the purpose of the LVAMP as it applies to the Kawarau Arm and Bannockburn Inlet areas. Within the Kawarau Arm the purpose of the LVAMP is to identify areas and the actions to address landscape and visual amenity effects arising from driftwood accumulation, terrestrial weed management and planting. Within the Bannockburn Inlet the purpose of that part of the plan is to address the landscape and visual amenity effects arising from any consent obligation on Contact to remove sediment from within the inlet.

Condition 5 then sets out the matters that the LVAMP must address. These are summarised below:

- It requires the LVAMP to describe the existing landscape and visual amenity values of the subject locations, including context of how these values fit within the consented environment. This is intended to provide clarity about what effects of the Clutha Scheme in the subject locations are anticipated and accepted as part of the consented environment, and which are not and should be addressed specifically through the LVAMP.
- The condition then requires the LVAMP to describe the mitigation actions that have been undertaken in the preceding term of the earlier LVAMP, and then to identify the priority areas and annual work requirements for the life of the revised LVAMP.
- The condition also requires details of the monitoring, timelines and milestones associated with implementing the LVAMP mitigation actions.
- The LVAMP is also required to include a section which describes the likely actions that will be undertaken by Contact following a high flood flow event – this may include an inspection of the flooded areas and further removal of driftwood should that be a necessary requirement following the event.
- The LVAMP is also to include a terrestrial weed management and planting programme to be implemented as appropriate.
- The LVAMP shall also set out the ways in which Contact will work with Land Information New Zealand as the owner of the lake bed to assist in the management of aquatic weeds.
- The LVAMP is also required to contain a section of the consultation undertaken with stakeholders in its preparation.

Condition 6 seeks to establish a clear framework under which consultation with key stakeholders is to occur during the drafting of the LVAMP. It clearly sets out the parties to which the draft LVAMP is to be provided, including Kāi Tahu Papatipu Rūnaka and the Lakes Dunstan Charitable Trust. It requires that the draft LVAMP is provided to these parties at least 90 calendar days prior to the final version being submitted to the Council for certification. Condition 7 requires that the feedback received on the LVAMP is clearly outlined in its drafting, alongside a clear explanation of where any comment has not been incorporated or addressed by Contact in the finalisation of its LVAMP and the reasons why. Condition 8 is to provide for an unlikely event whereby the stakeholders listed in the conditions do not or do not wish to provide comments on the draft LVAMP. It enables Contact to continue to finalise the LVAMP for submission to the Council in such circumstances.

Condition 9 has been proposed to enable Contact to undertake urgent works or activities following a high flow event. These actions may be outside the prescription of the LVAMP and this condition seeks to acknowledge that Contact may have to implement additional or unforeseen actions for landscape and visual amenity purposes following such events.

Condition 10 requires that the LVAMP is implemented.

Condition 11 then sets out the ongoing reporting requirements to provide transparency to the Council and the community as to how the LVAMP is being implemented on an annual basis. An annual report is required to be submitted by Contact, with the intention being that this reporting will confirm whether the LVAMP is effective in meeting its purpose (refer to Conditions 3 – 4). A copy of this annual report will also be provided to key stakeholders.

This review requirement is important in my view as it will ensure Contact is maintaining responsibility for implementation of the LVAMP, and by confirming the LVAMP is effective in meeting its purpose, it does not obligate the Council to review and risk deferring their decision making powers to another process.

Manuherekia River LVAMP Conditions – Appendix C

The proposed condition framework for the Manuherekia River LVAMP is similar to that which is explained above. A clear difference is Condition 3 which sets out the purpose of the Manuherekia River LVAMP. In this location the purpose of the LVAMP is to identify the areas and the actions to address landscape and visual amenity effects arising from the excavation of sediment within the Manuherekia River under Contact's existing consent conditions. It is also to set out the actions that will be undertaken to maintain or improve the landscape and visual amenity of the Linger and Die area within the Alexandra Reaches of the Scheme.

The remaining conditions are similar to those explained above.

CONSULTATION WITH KEY STAKEHOLDERS / INTERESTED PARTIES

Contact Energy has sought to engage with the following key stakeholders / interested parties on the development of the proposed LVAMP conditions:

- Aukaha
- Lakes Dunstan Charitable Trust
- Central Otago District Council
- The Department of Conservation
- Otago Regional Council
- Fish and Game Otago

This process has been genuine and robust. The early draft condition framework was shared with the abovementioned stakeholders in late 2022. This was followed with face-to-face meetings, follow up emails and calls to discuss the conditions and any suggested improvements. During this time Contact received useful feedback which has significantly aided in the preparation of the final LVAMP framework.

Specifically, this feedback resulted in a number of amendments being made to the conditions which are attached to this memorandum, including:

- The development of the two sets of conditions – one for each LVAMP area (Kawarau Arm and Manuherekia);
- A clear requirement to prepare the LVAMP having appropriate regard to best practice in undertaking landscape and visual assessments;
- A clear requirement for the conditions to ensure that the LVAMP sets out the rationale for the identification and selection of areas for landscape works to be focussed on;
- A requirement for any terrestrial weed removal to do so being mindful of the impact it may have on cultural and wider biodiversity values (i.e. the clearance will be targeted and planned, rather than the removal of areas which may be dispersed with indigenous vegetation or provides potential habitat for indigenous species);
- A requirement that planting undertaken for the landscape and visual amenity purposes is completed using indigenous vegetation species where this can be practicably achieved;
- A requirement to submit the annual summary report to stakeholders as well as the Council;
- Other more minor grammatical changes such as the amendment of “shall” to “must”.

Several stakeholders requested changes which were beyond the scope of the review and the purpose of these conditions. This related to areas such as ecology and recreational use. As set out in **Appendix A**, the conditions which are the subject of this review relate to the landscape and visual amenity effects arising from the operation of the Scheme. These matters were noted by Contact and discussed with stakeholders directly.

In February/March 2023 the revised conditions incorporating the above changes were recirculated to all parties and further comments were sought by Contact. Contact received positive feedback that the framework addressed the majority of the stakeholders concerns with the current LVAMP conditions. Where any further changes were sought as a result of this latest round of consultation, these were only minor typographical or clarifications to the revised framework. Where appropriate these further minor changes have been incorporated into the conditions attached to this memorandum.

EFFECTIVENESS OF THE PROPOSED CONDITIONS

In my opinion the revised LVAMP conditions will be effective in addressing the issues that have been raised by the Council in its Review Notice. The revised framework seeks to ensure that the following outcomes are achieved:

- The LVAMP applies to a specific location – there is no uncertainty as to where it applies by the reference to a map.
- Each LVAMP has a clear purpose and seeks to comprehensively address the specific landscape and visual amenity issues that may be occurring within the specific locations which can be practicably remedied by Contact in accordance with a responsive management approach. For example, it is the accumulation of driftwood within the Kawarau River arm which needs to be addressed, as opposed to the removal of lake weed (which is managed by LINZ) or sediment which, was an anticipated environmental outcome of the consent, or is to be managed via a separate consenting obligation.
- The role of third parties is better defined including how their feedback will be incorporated into the preparation of the final LVAMP.
- The matters that the LVAMP must address are clearly defined as well as the ongoing monitoring requirements.
- There is a clear annual review process which means that the effectiveness of the LVAMP in achieving its purpose is clearly known to the Council and the community.



APPENDIX A

Historical Background

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Kawarau Arm and Manuherikia Landscape and Visual Amenity Management Plans

Introduction

1. Contact's consenting applications were filed on 30 March 2001.
2. They went to hearing before a panel of independent commissioners chaired by John Matthews, then a Barrister based in Christchurch and subsequently a Master/Associate Judge of the High Court. The hearing occurred between 14 October 2002 and 27 February 2003, and the decision was released 10 September 2003.
3. There were multiple appeals of the Commissioners' decision. The principal Environment Court hearing occurred between 7 March and 14 April 2005 before a Panel chaired by Judge Jackson. The Court's interim decision was released 21 July 2005 (C102/2005). A second substantive hearing occurred in January 2007 and was the subject of a second interim decision (C34/2007). That hearing related solely to Alexandra flooding issues and the conditions to manage same, and the decision was released 29 March 2007. A final decision confirming grant of consents was issued on 24 May 2007 (C67/2007).
4. While the Environment Court made some comments about the language of the conditions in its 2005 decision (refer paragraphs 192 and 193) it did not address the substance of what they required. Prior to and between the Environment Court hearings, Contact had lengthy discussions/negotiations with ORC on the wording of conditions which resulted in several consent memoranda being filed. As part of those discussions/negotiations, the landscape and visual amenity plan conditions the subject of review were revised by consent. The revised version formulated by Contact and ORC reflected the Court's directions.
5. Comparing the conditions imposed by the Environment Court with those imposed at first instance, the principal changes were:
 - Insert provision for ORC approval;
 - Make provision for the Plans to include programmes of action and timelines for those actions;

- Require the Plans to incorporate both a monitoring and a remediation component;
 - Provide for broader consultation regarding the Plans than just ORC and CODC.
6. The three conditions now the subject of review by ORC relate to the Landscape and Visual Amenity Management Plan applying in the Kawarau Arm (condition 17 of ORC consent 2001.385.V3) and to the Landscape and Visual Amenity Management Plan applying in the Lower Manuherikia River, immediately upstream of its confluence with Lake Roxburgh (condition 18 of ORC Consent 2001.386.V4 and condition 8 of ORC Consent 2001.398.V2).
7. The ORC material related to the consent condition review notice cites the following landscape and visual effects as not being effectively avoided or mitigated by the current conditions of consent:
- Driftwood accumulation and the particular visual impact it has from the Old Cromwell Precinct, the Jackson Lookout, the Junction Lookout, including the lake margins around Cornish Point;
 - Lagarosiphon within Lake Dunstan;
 - A change in flow regime and how the presence of less attractive sediments, algae, aquatic weeds and terrestrial weeds will be monitored and managed during periods of low lake levels;
 - Driftwood, lagarosiphon and sediment accumulation and obstruction on the use of the Old Cromwell jetty, the Cromwell boat ramp; and
 - Future Lower Manuherikia River gravel extraction works on visual amenity and the maintenance of the swimming hole immediately downstream of Shaky Bridge.

Kawarau Arm

8. Throughout the re consenting process that, as above, took some 6 years to finally resolve, the visual effects of sedimentation of the Kawarau Arm were not a significant issue. The focus was much more on the impact of sedimentation on the operation of irrigation intakes servicing viticulture and horticultural interests on the terraces above the Arm.
9. The Commissioners at first instance accepted their argument on that issue and imposed conditions in that regard. Contact appealed those conditions (as did several

irrigators), but the issue was settled prior to the Environment Court's 2005 hearing, and all of the irrigator appeals were withdrawn.

10. A subsidiary issue identified by the Commissioners was public safety hazards, because of evidence the Commissioners heard of the quicksand-like qualities of the sand bars accumulating in the Kawarau Arm. Thus, at page 154, the Commissioners commented:

[203] Sedimentation of the Kawarau Arm raises public safety issues, such as the quicksand nature of the silt deposits both near to shore and on bars accessible to recreational boat users. The sand bars also pose a safety hazard to some craft.

11. Putting aside the Bannockburn Inlet and the Lowburn Inlet, the sedimentation of which was a specific issue addressed by specific conditions that are not the subject of review, the Commissioners described sedimentation in the Kawarau Arm (at page 146) as follows:

[140] In the Kawarau Arm of Lake Dunstan, on the evidence presented to us, the lake will undergo a transition to a morphology more like that of an alluvial river. A semi-braided channel will develop with '*point bars*' growing off the insides of bends and possible '*medial*' bars or islands growing in mid-stream if the channel is wide enough.

[141] The bars built up by floods will become beaches or islands. With time the raised beaches or islands will grow above the level of the main channel and will vegetate.

[142] This suggests the following valley patterns could develop within the various reaches of the Kawarau Arm. It must be noted, however, that even though a relatively stable pattern will emerge with time, the channels will move in floods so that, for example, the taking of water by irrigators will be adversely affected in that the points of contact with sufficient water will shift.

12. There are more specific descriptions of the predicted landscape of each lake reach from Ripponvale down to the confluence at Cromwell in the following paragraphs.
13. In the Environment Court, Peter Foster gave evidence for Contact on the sedimentation process generally, which included the following description:

Visual Aspects of Sediment Accumulation

7.78 I now wish to turn my attention to the landscape that is likely to develop in Lake Dunstan with the type of sediment accumulation I have described. I will begin with the Kawarau arm of Lake Dunstan, and then describe the landscape that is expected to develop at the confluence and in the Cromwell to Clyde dam reach in the long-term.

7.79 The reach that has been most affected by sediment accumulation to date is from Ripponvale to Bannockburn. Figure 7.15 shows part of this reach prior to lake filling.

Refer Figure 7.15

- 7.80 Figure 7.15 shows the reach in front of the Pipeclay Gully slide area. The river channel is approximately 80 to 100 m wide and alluvial bars can be seen at the rivers edge and at the bend near the centre right of the photo.
- 7.81 Since Lake Dunstan was filled, sandy-gravel point bars and medial bars have appeared upstream of the tipping face in the Kawarau arm of Lake Dunstan, Figure 7.16 is a photo showing such a sand bar upstream of Bannockburn Bridge.

Refer Figure 7.16

- 7.82 The bar indicated in Figure 7.16 was formed during floods when the flow over the topset reach was fluvial in character. Bars are now emerging and appear as islands in the lake under normal flow conditions. Owing to the large sediment supply and the frequency of flood flows from the Shotover, this pattern of bars is liable to remain active. The bars may shift position and be slow to vegetate. At this stage, wind erosion of the bars may occur, but it is likely to be relatively minor due to the fluctuation in lake levels submerging the bars. Fluctuations in reservoir level will also vary the visibility of the emergent bar features.
- 7.83 With time, the Kawarau arm will continue to accumulate sediment, mainly on point bars and the active channel will narrow down. The point bars will eventually rise high enough to trap overbank sediment and vegetation, probably willows, will grow. At this point wind erosion is not likely to be an issue. Ultimately, the reach should stabilise with an alternate-bar, possibly semi-braided character. Figure 7.17 shows an aerial view of the Ripponvale to Bannockburn reach of Lake Dunstan.

Refer Figure 7.17

- 7.84 Figure 7.17 has the Kawarau flow entering at the top left corner and shows the head of Lake Dunstan extending down to the Bannockburn inlet at the bottom right of the figure. The arrows show the flow direction from upstream to downstream. In Figure 7.17, it is possible to see both lateral and medial islands upstream of Bannockburn inlet forming in the reservoir.
- 7.85 I have examined aerial photos downstream of the Shotover delta in the Kawarau River to see if there were already examples of the fluvial landscape that is expected to develop in this reach of Lake Dunstan. The area of most interest is in the 7 km reach downstream of the Shotover confluence with the Kawarau as indicated in Figure 7.18.

Refer Figure 7.18

- 7.86 Figure 7.18 shows a plan of the area, including the Shotover River delta and a reach just downstream of the Rastus Burn. In the latter area, there are a number of bars in the Kawarau River and a semi-braided fluvial landscape already exists.
- 7.87 An aerial view of the 3 km reach downstream of the Rastus Burn Delta is shown in Figure 7.19.

Refer Figure 7.19

- 7.88 Figure 7.19 shows vegetated medial bars downstream of the Rastus Burn Delta, and partially vegetated meander points bars further downstream. The main river channel is narrower than the bank to bank distance, which is in the order of 200 to 300 m in

the aerial photo. Such a fluvial landscape should eventually develop in the Kawarau Arm of Lake Dunstan.

14. Mr Foster's Figures 7.15-7.19 are attached.
15. Mr Graeme Martin's evidence for ORC agreed with Mr Foster's characterisation of the sedimentation process and its likely effects in visual terms.
16. Frank Boffa gave visual evidence for Contact cross referencing Mr Foster's evidence and noting the Commissioners' findings in the following terms:

In their decision, the Commissioners considered that the visual impact of the sand/gravel bars in the Kawarau Arm would be detrimental both before they were dry and following their colonization with woody weeds such as willow, briar, gorse and/or broom. The formation of sand/shingle bars along with the colonisation of these areas with woody weeds is to a large extent part of the wider Kawarau River landscape. Figure 27 shows an aerial photograph of the upper reach of the Kawarau Arm I took on 10 October 2004. The medial sand bars are clearly evident in this view. Figure 27 also shows ground level views of some of the point bars that are developing in the Kawarau Arm in the vicinity of the Bannockburn Bridge. During my December site visit I walked out on to one of the sand bars and found that I could safely and readily walk over it without sinking into what has been referred to by some submitters as "quicksand". My footprints are evident in one of the photographs on Figure 27.

17. Mr Boffa's view was that the Kawarau Arm would transform over time but this was more in the nature of a change rather than adverse effect. Commenting on the Commissioners' condition specifically at paragraph 4.10, Mr Boffa said:

With respect to the Kawarau Arm, the Commissioners imposed a condition (19) that within 2 years of grant of consent the holder is to prepare a Landscape and Visual Amenity Management Plan for the bed of the Kawarau Arm of Lake Dunstan. The plan is to describe how the effects on landscape and visual amenity values are to be managed. I am not clear whether it is intended that this condition excludes the Bannockburn Inlet, which is subject to a separate condition. Assuming it does, I support the principle of the Landscape and Visual Amenity Management Plan is so far as it relates to vegetation management, public access and recreation within the changing bed of the Kawarau Arm. I do not see the need or appropriateness of removing sediment or modifying the "naturally" occurring sand bars in the Kawarau Arm of Lake Dunstan. I understand Contact Energy have accepted this condition.

18. The Environment Court's 2005 decision reflected that evidence. After acknowledging the effect of the Clutha Hydro Scheme dams on trapping sediment, including the

consequences as described by Peter Foster that with time "*the lake transitions to a morphology more like that of an alluvial river, with "point bars" growing off the inside of bends and possible "medial" bars or islands growing in mid-stream if the channel is wide enough. This can create a meandering or semi-braided channel pattern*" the Court stated:

[105] Since Lake Dunstan is not a storage dam, the sediment filling the dam will cause no particular problems for generating electricity. However, the character of parts of the lake will change quite radically. The Kawarau arm will over the next few years look like a large powerful braided river with sandbars which trees, shrubs and weeds will colonise over time."

[107] Other consequences of the change in character of the Kawarau arm are:

- the outlook of rural and urban (Cromwell) residents will change - within five years the latter will be looking down onto a semi-braided river rather than a lake;
- recreational opportunities will be changed - in particular the launching ramp and jetty at Cromwell will become more difficult to use.

As to the latter, Contact has volunteered a condition directing dredging of a channel from the jetty to the river if the jetty becomes silted up. That should be inserted into the resource consent.

[108] Dealing with the outlook issues is more difficult. Cross-examination of Mr Boffa by Mr Todd showed that Mr Boffa was not of the opinion that siltation of the Kawarau arm would cause the natural character or visual amenity of the Kawarau arm to be worse, merely to change. It is not obvious to us that substituting a fast-moving braided river with medial bars and islands for a slow-moving one (which is what the Kawarau arm of the "lake" was) is necessarily a detraction in amenities. Any larger sandbars will be colonised with plants - probably willows - quite quickly. The experts compared this area with the Kawarau River much further upstream - in the Rastus Burn area immediately below the Shotover confluence, and the willows there are not unattractive."

19. As above, the ORC review of issues a reviewed condition needed to address includes reference to Lagarosiphon. This was a particular issue in the re-consenting hearings.
20. The Environment Court for instance quoted Dr Greg Ryder's evidence for Contact (at [109]), as follows;

After lake filling, Lagarosiphon rapidly colonised sheltered, stable, shallow areas with fine substrates. This was not surprising as it was known to be well established in the Clutha River/Mata-au above and below the location for Lake Dunstan ... The speed of colonisation is attributable mainly to the downstream drift of plant fragments but also boating activity, and the relatively small fluctuations in lake levels. Higher fluctuations,

such as occur at Lake Hawea, appear to preclude colonisation. In Lake Dunstan, Lagarosiphon forms an essentially [a]monoculture at 1-4 m depth, particularly in areas such as immersed valley heads and ridges, and in sheltered embayments. The weed is a nuisance species in terms of amenity and recreational values of the lake, and presents a risk as a source of material for colonisation of other water bodies via boats. The presence of Lagarosiphon in the lake is thought to limit the extent of native macrophyte species.

LINZ (Land Information New Zealand - the Crown agency responsible for ownership of the lake bed), report that Lagarosiphon in Lake Dunstan is controlled by aerial application of a herbicide with diquat as the active ingredient. LINZ report that control levels achieved with this method have been very good (LINZ 2004a,2004b). The spraying programme has the full support of the Lake Dunstan Management Committee. The programme demonstrates that it is possible to control the spread of Lagarosiphon and its effects on lake amenity values. Similar management programmes are being undertaken [elsewhere] in the Clutha River/Mata-au Catchment (e.g., Lake Wanaka Lagarosiphon Management Team).

21. ORC sought and the Commissioners imposed obligations on Contact to manage lagarosiphon. Contact appealed those conditions and the Environment Court upheld Contact's point, rejecting the relevant conditions: see paragraphs [109]-[113]. The basis of the Environment Court's rejection was its acceptance of the economic evidence Contact led that lagarosiphon reduced the positive benefits of the lake as a recreational resource, rather than creating an adverse effect.
22. The independent planning review of the conditions for ORC suggested that any review of the conditions on account of lagarosiphon be limited to measuring and monitoring, possibly for that reason.
23. The notice of review, and the internal ORC report underpinning it does not, however, indicate an intention to confine the review in that manner.

Lower Manuherikia

24. During the first instance hearing of Contact's consenting applications, the principal issue debated in relation to the Lower Manuherikia was about exacerbation of flood risk. ORC contended in its staff report that Contact should be taking steps to remove sediment accumulation in the Lower Manuherikia, because it exacerbated flood risk. That led to a technical debate. One of the then landowners (Harrison-Lee) in the Galloway area, which is historically flood prone, called hydrological evidence that the area where sediment ought to be removed should be extended upstream. Contact

(through Peter Foster) disputed the extent to which accumulating sediment was contributing to flood risk at all.

25. In terms of visual effects, the Commissioners summarised the position at page 182/paragraphs 89-97, as follows:

- [89] Dr Macpherson's (CODC) view was that sedimentation in the Lower Manuherikia, created a significant adverse effect due to loss of amenity. He produced a number of historical photographs from a collection at the Alexandra Museum to support his view that by 1956, when the Roxburgh Dam was commissioned, the Manuherikia in the vicinity of Alexandra was an attractive, clean, gravelly, braided river, used extensively for swimming and as a fishery. In the years since then the stretch of the river which flows past this township has turned into a muddy, flood-prone backwater with low amenity values.
- [90] The river now has the appearance of a stagnant backwater, characterised by muddy sandbanks, weeds, eroding banks protected by riprap, and driftwood. This is on Alexandra's back door, only a few metres from the Warehouse car park. The comparison to pre-dam conditions is striking.
- [91] Pre-lake the Manuherikia River, while far from natural, had considerable amenity value to the people of this community, and it was used for and valued as a recreation resource. That is no longer the case. The disamenity caused by Lake Roxburgh is a future effect, as the loss of amenity continues into the future.
- [92] Some local residents also expressed concern about visual and landscape issues associated with these gravel accumulations and the generally unkempt nature of vegetation along the river margins, which in places is covered with broom, gorse and rank grass growth.
- [93] Mr Knox (Contact) completed site assessments of the extent to which views of the gravel accumulation may adversely affect the natural character and appearance of the area, and to examine visual amenity aspects of the river vegetation in the vicinity.
- [94] In Mr Knox's opinion, the gravel accumulations close to the confluence of the Manuherikia River and Clutha River do not adversely affect the natural character or visual amenity values of the area. In his opinion the gravel banks, recently cleared of willow, appear as natural elements resulting from processes which occur commonly in rivers.
- [95] He said that the surrounding land has modified riparian vegetation close to the river margins. Further away from the riverbank, on the western side, the hill is dominated visually by the houses and suburban streetscape above River Street. On the eastern bank there is a mixture of open modified pastoral vegetation and horticultural land use. In this setting, the gravel banks within the river do not adversely detract from the natural character or visual amenity values of the area.
- [96] In terms of visual amenity values, the riverbank vegetation appears to be typical of similar riparian situations throughout New Zealand. In his opinion improvements could be made to replace some of the existing vegetation and open up access. These improvements should reflect its importance as an amenity area associated with the nearby suburban areas.

[97] Mr Robinson said in his closing submission that while Contact is dubious (essentially for the reasons set out in Mr Knox's evidence) whether the visual amenity of sediment aggradation at the confluence is any worse than it has been at times in the past, it is happy to prepare a visual and amenity plan for the confluence, and to implement it, in much the same way as for the Kawarau Arm. No one should be under the illusion, however, that this will be a one-off "fix". As Mr Foster pointed out in his evidence, the Manuherikia River is likely to drop more sediment wherever it has been removed from.

26. In the Environment Court, Mr Boffa's evidence for Contact largely agreed with the Commissioners: see paragraphs 6.2, 6.3 and 6.8 in particular:

[6.2] At Alexandra, where the Clutha River and the Manuherikia River converge, sedimentation has occurred creating a backwater effect and sediment beaches in the lower reaches of the Manuherikia River. In their decision, the Hearing Commissioners considered that sedimentation in the lower Manuherikia had created significant adverse effects in what was, prior to the construction of the Roxburgh dam, "an attractive, clean, gravely braided river used extensively for swimming and fishing" and is now "a muddy, flood prone backwater with low amenity values". I note that I have viewed old photographs of the lower Manuherikia River, which appear to show the area was modified, presumably by past mining and sluicing activities.

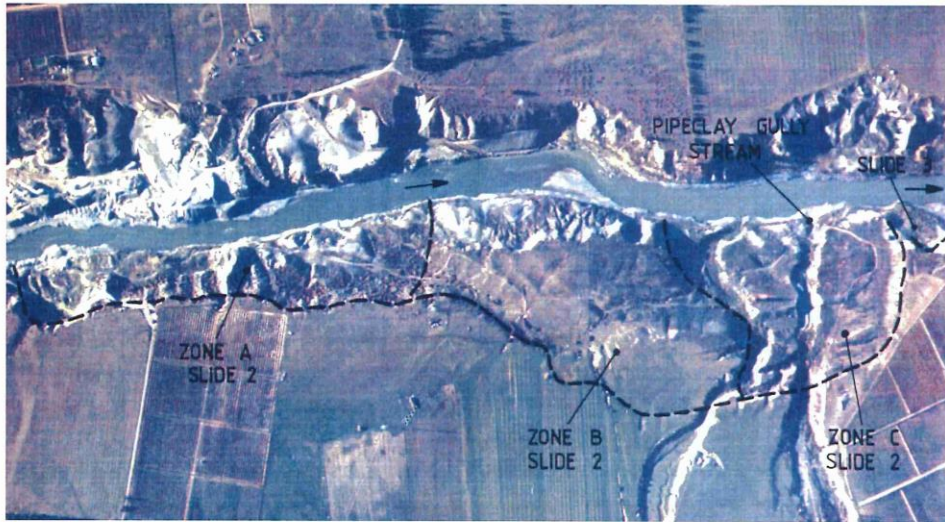
[6.3] I have recently visited the lower Manuherikia River on several occasions and I tend to agree with the Commissioners assessment that the lower section of the Manuherikia River, namely from between its confluence with the Clutha River to the Little Valley Road bridge, currently appears as a backwater, characterised by muddy sandbanks, weeds and unkempt vegetation along the river margins and the adjacent road embankments. In its present condition, the area has low visual amenity values and appears to provide limited recreational opportunity in terms of access or facilities....

[6.8] In my opinion, the lower Manuherikia offers considerable scope and opportunity for enhancement and the creation of amenities that will meet the environmental expectations and technical requirements of both the consent holder, Council and the community. In landscape terms, I consider the area can be integrated as a meaningful and attractive part of the Alexandra Township. In its current state the lower Manuherikia appears to be a wasteland and a lost opportunity.

27. The Environment Court noted specifically at paragraph 190 of its first interim decision that the area from the Little Valley Bridge down the Manuherikia, past the Linger and Die area to the confluence with the Clutha River was one of the areas the Court had

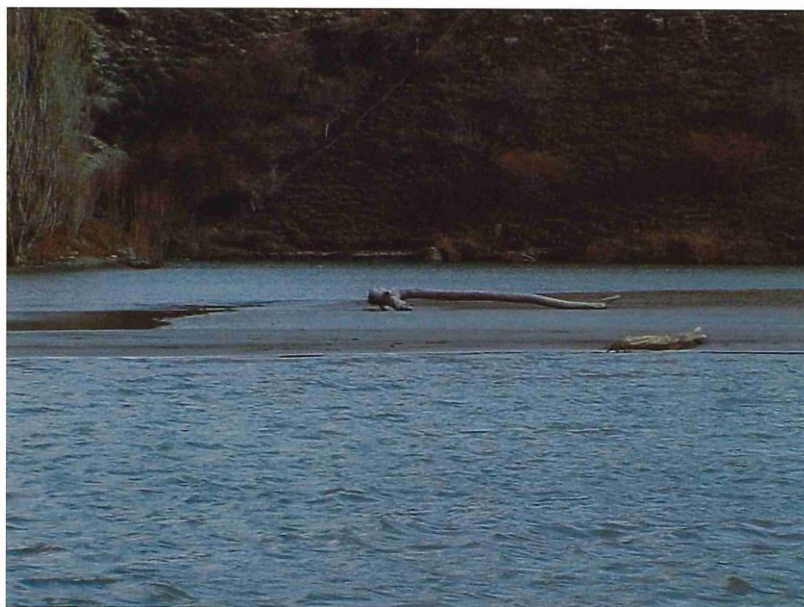
found where some landscape improvement is desirable, it did not comment on the nature of the effects anticipated, or required it to be managed.

28. Because the conditions imposed an obligation on Contact to remove sediment from the Manuherikia riverbed, the landscape effects of that sediment removal are effects of Contact's activities that Condition 8 of Consent 398 requires be managed through the landscape and visual amenity management plan. That particular effect does not appear to have been discussed either in the Commissioners' decision or in the Environment Court's first interim decision.



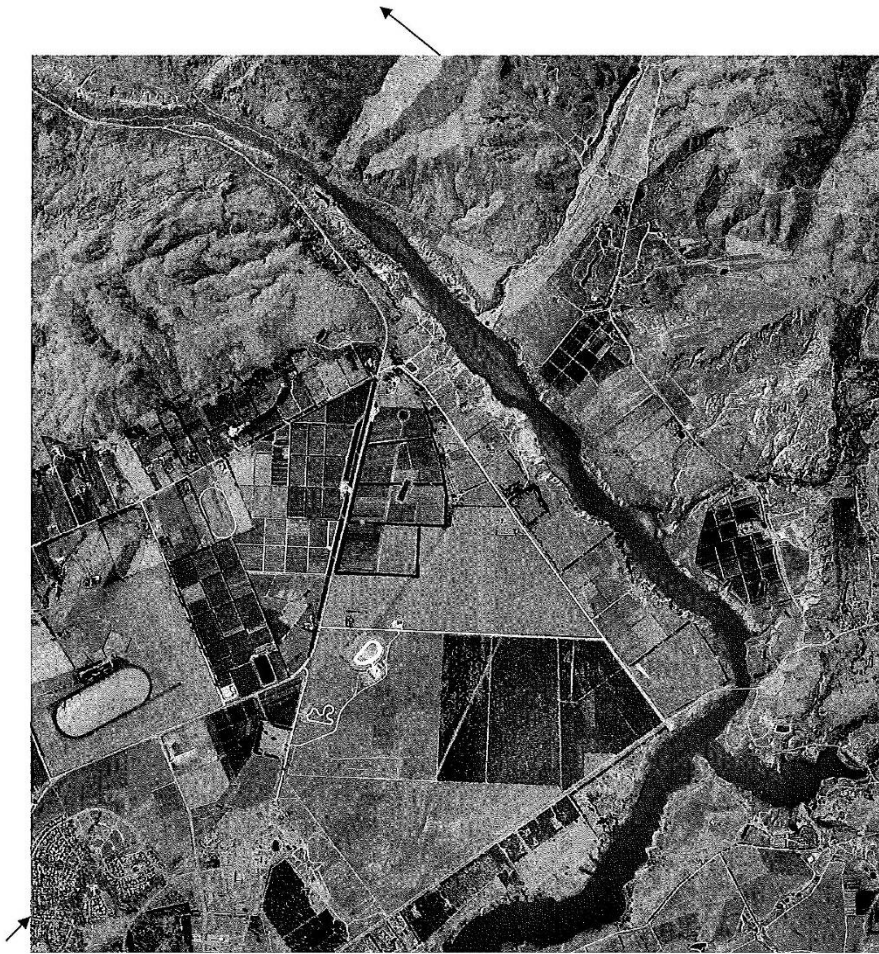
Kawarau River at Pipeclay Gully

Figure 7.15



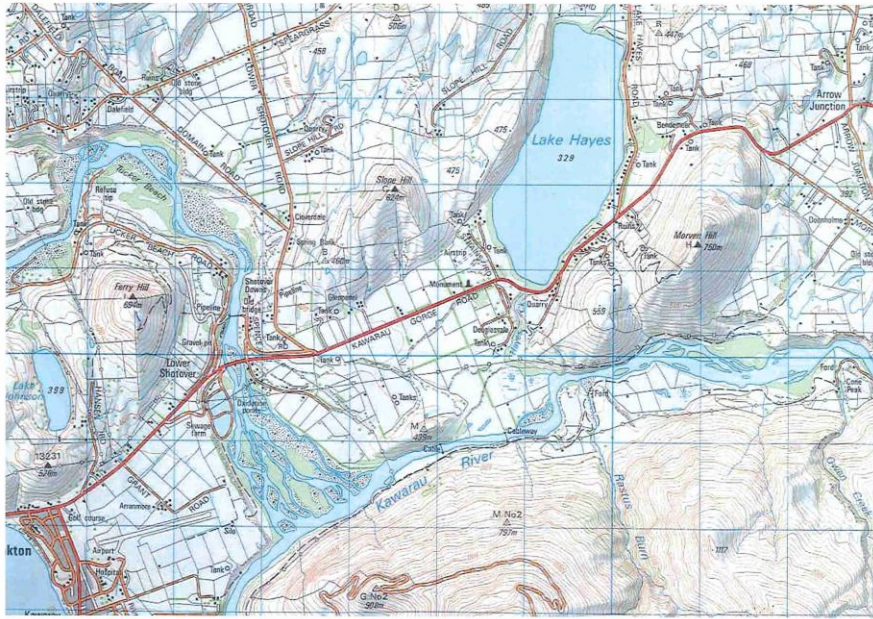
Sandbar Upstream of Bannockburn Bridge

Figure 7.16



Kawarau Arm of Lake Dunstan

Figure 7.17



Kawarau River in the Vicinity of the Shotover

Figure 7.18



Kawarau River Downstream of Rastus Burn Delta
Figure 7.19



APPENDIX B

LVAMP Conditions for Kawarau Arm
and Bannockburn

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
1	<p>No later than 1 July 2025 and five yearly thereafter, the Consent Holder must submit to the Consent Authority a Landscape and Visual Amenity Management Plan (LVAMP) for approval that it:</p> <ul style="list-style-type: none"> a. Has been prepared by a suitably qualified and independent landscape architect; b. Includes actions, methods, and monitoring programmes to assist in achieving the purpose of the Plan set out in Conditions 3 and 4 below; and c. Meets the information requirements in, and gives effect to, the matters set out in Conditions 2 – 8 below. <p>A copy of the final LVAMP must also be provided to Kāi Tahu Papatipu Rūnaka, and all other parties who were consulted with in accordance with Condition 6.</p>	<p>Minor changes to wording for clarity and consistency. Copy of final LVAMP to go to stakeholders also.</p> <p>Certification has been amended to “approval” as this is consistent with Contact’s remaining condition obligations so it makes sense for consistency purposes.</p>
2	<p>The LVAMP shall apply to:</p> <ul style="list-style-type: none"> a. Kawarau Arm and Bannockburn Inlet as shown in Map A. 	
3	<p>Within Kawarau Arm part of Map A the purpose of the LVAMP shall be to identify areas and the actions to address landscape and visual amenity effects arising from the Consent Holder’s activities including, but not limited to:</p> <ul style="list-style-type: none"> a. Areas where and the extent to which driftwood will be removed; b. Areas where and the extent to which terrestrial weeds will be removed; c. Areas where and the extent to which planting will be undertaken, including the use of indigenous species where appropriate. 	

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p><i>Advice note:</i> <i>The identification and selection of the areas will be set out within the LVAMP in accordance with Condition 5. Generally, these locations will be focussed on areas where the transition within the lake/river system has reached an equilibrium i.e. so that actions can be meaningful and not potentially lost in the next high flow. In some instances however the areas and actions that will be undertaken will focus on areas affected by high flow and flood events (i.e remedial actions).</i></p>	
4	<p>Within the Bannockburn Inlet, as shown on Map A, the purpose of the LVAMP shall be to identify actions to address the landscape and visual amenity effects arising from the Consent Holder’s activities involving the excavation of sediment in accordance with Condition 12 of consent 2001.385.V3, or any subsequent versions.</p>	<p>We have changed the structure of this condition slightly based on the feedback. There was confusion around the gravel extraction being controlled via these conditions so have said you will undertake actions to remediate areas which are subject to these activities – differs slightly to the above which specifies actions rather than areas.</p>
5	<p>The LVAMP must include:</p> <p>a. A summary of:</p> <p>i. the existing landscape attributes and values within the locations shown on the Map at an appropriate scale relative to the purpose of the LVAMP set out in Conditions 3 – 5 and having regard to best practice landscape and visual assessment guidelines;</p> <p>ii. the river processes/geomorphology (including sediment levels) as relevant, including the environment anticipated under the existing hydro scheme consents;</p>	<p>Made amendments to a number of these to ensure actions are clear and certain. Changes include:</p> <ul style="list-style-type: none"> • Requirement to prepare the LVAMP having appropriate regard to best practice in undertaking landscape and visual assessments; • Requirement to include in the LVAMP clear rationale for the identification and selection of the areas for works to be focussed on; • To require the plan to set out clear actions that are anticipated to be required following high flow events – trigger of which is consistent with existing consents which require Contact to undertake a survey;

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p>b. Identification and quantification of the changes in landscape and visual amenity by referring to any sediment and photographic surveys (undertaken by the consent holder) or any other relevant information (which must be appended);</p> <p>c. A description of the actions that have been undertaken by the consent holder to maintain landscape and visual amenity within the locations identified in Condition 2 within the period June 2024 and December 2025;</p> <p>d. Identification and rationale for the selection of the proposed areas and actions;</p> <p>e. A description of and a framework to address actions that are to be undertaken by the Consent Holder on an annual basis until the next iteration of the LVAMP in order to address landscape and visual amenity effects of the consent holder’s activities within the area subject to the Plan;</p> <p>f. A description of the actions that will be undertaken as soon as is practicable by the Consent Holder within the relevant locations identified in the LVAMP following a flood event exceeding 800 cumecs in the Kawarau River measured at the Chards Road site (Site No.75262);</p> <p>g. Inclusion of a terrestrial weed management programme including identification and rationale for weed selection and removal, also taking into account potential effects on cultural and/or wider biodiversity values arising from disturbance and removal of weeds in certain locations. Where practicable and appropriate, any replanting shall be undertaken with indigenous species;</p>	<ul style="list-style-type: none"> • Requirement for any terrestrial weed removal to do so being mindful of the impact it may have on cultural and wider biodiversity values (i.e. clearance will be targeted and planned, rather than a large area which may be dispersed with indigenous vegetation or provides potential habitat for indigenous species and mahinga kai / mahika kai); • Any replanting proposed shall be undertaken with indigenous species where this is practicable and appropriate to do so (i.e. taking into account climate, soil and other variables which may affect the planting requirements for certain sites);

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<ul style="list-style-type: none"> h. Maps and/or other visual imagery (photos) supporting the proposed actions to be undertaken by the Consent Holder; i. Details of the monitoring, timelines and milestones associated with implementing the actions set out within the plan and reporting to the Consent Authority to ensure the purpose of the LVAMP is being met; j. Details of the opportunities for the Consent Holder to work with Land Information New Zealand as the owner of the bed of Lake Dunstan with responsibility for management of aquatic weed, to assist it with aquatic weed management; k. A summary of the consultation undertaken in accordance with Condition 6, including any feedback under Condition 7. 	
6	<p>At least 90 calendar days prior to submission of the final LVAMP (being 1 July 2025 and five yearly thereafter) to the Consent Authority for approval, the consent holder shall submit a draft of the LVAMP for review and comment to:</p> <ul style="list-style-type: none"> a. Kāi Tahu Papatipu Rūnaka. b. Central Otago District Council; c. Land Information New Zealand; d. Department of Conservation; e. Lake Dunstan Charitable Trust; f. Otago Fish and Game; and 	The timeframe for consultation has been extended in response to comments.

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p>g. Any other recreational groups or users of the lake or its margins as identified by the Consent Holder.</p> <p><i>Advice note: In the event that any of the organisations change their name and/or become known/operate as a different entity in the future but have the same or similar functions, this obligation will continue to apply to those new entities.</i></p>	
7	<p>The Consent Holder must provide to the Consent Authority at the time the final LVAMP is submitted in accordance with Condition 1, the following:</p> <ul style="list-style-type: none"> i. Documented evidence that the draft LVAMP was submitted to the parties listed in Condition 6; ii. Any feedback received from the parties listed in Condition 6; and iii. An explanation of whether any comment has or has not been incorporated into the LVAMP and the reasons why. 	
8	<p>If any party listed in Condition 7 does not provide comments on the LVAMP within a 45 calendar day period, the Consent Holder may continue to finalise the LVAMP for submission to the Consent Authority for approval as if all obligations of Conditions 6 and 7 are satisfied.</p>	
9	<p>Following a flow event exceeding 800 cumecs within the Kawarau River measured at Chards Road site (Site No.75262), the Consent Holder is able to undertake any urgent actions to address landscape and visual amenity effects not otherwise specified in the LVAMP in response to the high flow event.</p>	<p>This has been added to enable Contact to undertake urgent works or activities following a high flow event – any amendments here are anticipated to only seek to “do more” in response to a flood, rather than change the final LVAMP on an as needed basis.</p>

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
10	The Consent Holder must implement the actions set out within the approved LVAMP in accordance with the specifications of the plan.	
11	<p>On an annual basis following the approval of the LVAMP the Consent Holder must prepare a Summary Landscape and Visual Amenity Monitoring Report. The summary report must include:</p> <ul style="list-style-type: none"> a. A description of the works and actions completed by the consent holder in the previous twelve months in accordance with the LVAMP; b. Where aspects of the LVAMP have not been implemented within expected timeframes, the report must include the reasons why, and the reasonably practicable measures that have been undertaken by the Consent Holder to address the failure to meet those milestones; c. Any other relevant actions undertaken by Consent Holder during the previous 12 months; d. Any relevant Rūnaka and community engagement that the Consent Holder has undertaken; e. A review of the effectiveness of the LVAMP in meeting its purpose. <p>The Summary Report must be submitted to the Otago Regional Council on an annual basis by 30 June each year following approval of the LVAMP. The Summary Report must relate to the activities undertaken in accordance with the approved LVAMP during the preceding year up to and including 31 December. Compliance with this condition can be achieved by incorporating the Summary Report into an overarching compliance report which covers the Consent Holder's</p>	<p>A copy of this report will be provided to stakeholders.</p> <p>This can be submitted as part of any other annual reporting prepared by the consent holder.</p>

Kawarau Arm and Bannockburn – Proposed Landscape and Visual Amenity Management Plan Revised Conditions Framework

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p>existing consented obligations in terms of reporting to the Consent Authority on an annual basis.</p> <p>A copy of the Summary Report must also be provided on an annual basis to Kāi Tahu Papatipu Rūnaka, and all other parties who were consulted with in accordance with Condition 6.</p>	



Digital map data sourced from Land Information New Zealand (LINZ). Licensed under the Creative Commons Attribution 4.0 International licence <https://creativecommons.org/licenses/by/4.0/>. It is made available in good faith but its accuracy or completeness is not guaranteed. Landpro accepts no responsibility for incomplete or inaccurate information. If the information is relied on in support of a resource consent it should be verified independently.

ISSUED 28.03.23

C:\12\5\1\data\SERVER\2008R2\22642-Kawarau Arm Contour Marking_5949\CAD\22642_01_PL.dwg Plotted: 28.03.2023



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Client
CONTACT ENERGY LTD

NOTES
 - All dimensions shown are in metres unless otherwise shown
 - Copyright on this drawing is reserved
 - Check any electronic data against the hardcopy plan to ensure it is the latest version
 - If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only, final dimensions and areas may vary on final survey

KAWARAU ARM LANDSCAPE AND VISUAL AMENITY PLAN

Rev.	Date	Revision Details	By	Surveyed	Signed	Date	Job No.	Drawing No.
-	-	-	-	LP		2018	22642	01
				Drawn	Signed	Date	Scale	
				NKA		11.22	1:20000 @ A3	
				Designed	Signed	Date	Datum & Level	Rev.
				NKA		11.22	LP2000 & MSL	-



APPENDIX C

LVAMP Conditions for Manuherehia

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
1	<p>No later than 1 July 2025 and five yearly thereafter, the Consent Holder must submit to the Consent Authority a Landscape and Visual Amenity Management Plan (LVAMP) for approval that:</p> <ul style="list-style-type: none"> a. Has been prepared by a suitably qualified and independent landscape architect; b. Includes actions, methods, and monitoring programmes to assist in achieving the purpose of the Plan set out in Conditions 3 - 4 below; and c. Meets the information requirements in, and gives effect to, the matters set out in Conditions 2 – 8 below. <p>A copy of the final LVAMP must also be provided to Kāi Tahu Papatipu Rūnaka, and all other parties who were consulted with in accordance with Condition 5.</p>	<p>Minor changes to wording for clarity and consistency. Copy of final LVAMP to go to stakeholders also.</p>
2	<p>The LVAMP shall apply to the section of the Lower Manuherekia River shown in Map A.</p>	
3	<p>The purpose of the LVAMP shall be to identify the areas and actions to address landscape and visual amenity effects arising from the Consent Holder’s activities involving the excavation of sediment from the river bed in accordance with Condition 7(d) of 2001.398.V2, or any subsequent versions; and in the Alexandra reaches and including the Linger and Die area.</p> <p><i>Advice note:</i></p>	<p>Have sought to clarify this condition to ensure that it is clear that actions will be undertaken within the areas that have been the subject of authorised gravel extraction activities under existing consents. This condition does not seek to authorise new gravel extraction type activities.</p> <p>An advice note has also been added to provide guidance as to where priority areas are likely to be.</p>

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p><i>The identification and selection of the areas subject to the LVAMP will be set out within the LVAMP in accordance with Condition 4. Generally, these locations will be focussed on areas within the landscape where the transition within the river system has reached an equilibrium i.e. so that actions can be meaningful and not potentially lost in the next high flow. In some instances however, the areas and actions that will be undertaken will focus on areas affected by high flow and flood events (i.e. remedial actions).</i></p>	
4	<p>The LVAMP must include:</p> <ol style="list-style-type: none"> a. A summary of: <ol style="list-style-type: none"> i. the existing landscape attributes and values within the Lower Manuherekia River (Map A) at an appropriate scale relative to the purpose of the LVAMP set out in Condition 3 and having regard to best practice landscape and visual assessment guidelines; ii. the river processes/geomorphology (including sediment levels) as relevant, including the environment anticipated under the existing hydro scheme consents; b. Identification and quantification of the changes in landscape and visual amenity by referring to any sediment and photographic surveys (or other relevant material) undertaken by the consent holder (which must be appended); c. A description of the actions that have been undertaken by the consent holder to maintain landscape and visual amenity within the locations 	<p>Made amendments to a number of these to ensure actions are clear and certain. Changes include:</p> <ul style="list-style-type: none"> • Requirement to prepare the LVAMP having appropriate regard to best practice in undertaking landscape and visual assessments; • Requirement to include in the LVAMP clear rationale for the identification and selection of areas for works to be focussed on; • To require the plan to set out clear actions that are anticipated to be required following high flow events – trigger of which is consistent with existing consents which require Contact to undertake a survey; • Requirement for any terrestrial weed removal to do so being mindful of the impact it may have on cultural and wider biodiversity values (i.e. clearance will be targeted and planned, rather than a large area which may be dispersed with indigenous vegetation or provides potential habitat for indigenous species);

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p>identified in Condition 3 within the period June 2024 and December 2025;</p> <p>d. Identification and rationale for the selection of the proposed areas and actions;</p> <p>e. A description of and a framework to address actions that are to be undertaken by the Consent Holder on an annual basis until the next iteration of the LVAMP in order to address landscape and visual amenity effects of the consent holder’s activities within the areas subject to the Plan;</p> <p>f. A further description of the actions that will be undertaken as soon as is practicable by the Consent Holder within the relevant locations identified in the LVAMP following a recorded event exceeding 350 cumecs as measured at the Ophir site (Site No.75253);</p> <p>g. Inclusion of a terrestrial weed management programme including identification and rationale for weed selection and removal, also taking into account potential effects on cultural and/or wider biodiversity values arising from disturbance and removal of weeds in certain locations. Where practicable and appropriate, any replanting shall be undertaken with indigenous species.</p> <p>h. Maps and/or other visual imagery (photos) supporting the proposed actions to be undertaken by the Consent Holder;</p>	<ul style="list-style-type: none"> Any replanting proposed shall be undertaken with indigenous species where this is practicable and appropriate to do so (i.e. taking into account climate, soil and other variables which may affect the planting requirements for certain sites);

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<ul style="list-style-type: none"> i. Details of the monitoring, timelines and milestones associated with implementing the actions set out within the plan and reporting to the Consent Authority to ensure the purpose of the LVAMP is being met; j. A summary of the consultation undertaken in accordance with condition 5, including any feedback under condition 6. 	
5	<p>At least 90 calendar days prior to submission of the final LVAMP (being 1 July 2025 and five yearly thereafter) to the Consent Authority for approval, the Consent Holder shall submit a draft of the LVAMP for review and comment to:</p> <ul style="list-style-type: none"> a. Kāi Tahu Papatipu Rūnaka; b. Central Otago District Council; c. Land Information New Zealand; d. Department of Conservation; e. Otago Fish and Game; and f. Any other recreational groups or users of the Lower Manuherekia River or its margins as identified by the Consent Holder. <p><i>Advice note: In the event that any of the organisations change their name and/or become known/operate as a different entity in the future but have the same or similar functions, this obligation will continue to apply to those new entities.</i></p>	The timeframe for consultation has been extended in response to comments.

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
6	<p>The Consent Holder must provide to the Consent Authority at the time the final LVAMP is submitted in accordance with Condition 1, the following:</p> <ul style="list-style-type: none"> i. Documented evidence that the draft LVAMP was submitted to the parties listed in Condition 5; ii. Any feedback received from the parties listed in Condition 5; and iii. An explanation of whether any comment has or has not been incorporated into the LVAMP and the reasons why. 	
7	<p>If any party listed in Condition 5 does not provide comments on the LVAMP within a 45 calendar day period, the Consent Holder may continue to finalise the LVAMP for submission to the Consent Authority for certification as if all obligations of Conditions 5 and 6 are satisfied.</p>	
8	<p>Following a flow event exceeding 350 cumecs within the Manuherekia River measured at the Ophir site (Site No. 75253), the Consent Holder is able to undertake any urgent actions to address landscape and visual amenity effects not otherwise specified in the LVAMP in response to the high flow event.</p>	<p>This has been added to enable Contact to undertake urgent works or activities following a high flow event – any amendments here are anticipated to only seek to “do more” in response to a flood, rather than change the approved LVAMP on an as needed basis.</p>
9	<p>The Consent Holder must implement the actions set out within the approved LVAMP in accordance with the specifications of the plan.</p>	
10	<p>On an annual basis following the approval of the LVAMP the Consent Holder must prepare a Summary Landscape and Visual Amenity Monitoring Report. The summary report must include:</p>	<p>Have added a requirement to submit the summary report to stakeholders also.</p>

Manuherekia River – Proposed Landscape and Visual Amenity Plan Revised Conditions Framework – Consent 2001.398.V2

28 March 2023

Condition Reference	Landscape and Visual Amenity Management Plan	Explanation of Key Changes Following Consultation Feedback
	<p>a. A description of the works and actions completed by the consent holder in the previous twelve months in accordance with the LVAMP;</p> <p>b. Where aspects of the LVAMP have not been implemented within expected timeframes, the report must include the reasons why, and the reasonably practicable measures that have been undertaken by the Consent Holder to address the failure to meet those milestones;</p> <p>c. Any other relevant actions undertaken by Consent Holder during the previous 12 months;</p> <p>d. Any relevant Rūnaka and community engagement that the Consent Holder has undertaken;</p> <p>e. A review of the effectiveness of the LVAMP in meeting its purpose.</p> <p>The Summary Report must be submitted to the Otago Regional Council on an annual basis by 30 June each year following approval of the LVAMP. The Summary Report must relate to the activities undertaken in accordance with the approved LVAMP during the preceding year up to and including 31 December. Compliance with this condition can be achieved by incorporating the Summary Report into an overarching compliance report which covers the Consent Holder’s existing consented obligations in terms of reporting to the Consent Authority on an annual basis.</p> <p>A copy of the Summary Report must also be provided to Kāi Tahu Papatipu Rūnaka, and all other parties who were consulted with in accordance with Condition 5 as part of the development of the final LVAMP.</p>	

Appendix C – Map (placeholder)



APPENDIX D

P Foster - Stantec Report



**TECHNICAL NOTE ON SEDIMENTATION
LAKE DUNSTAN**

21 February 2023

Prepared for:
Contact Energy Ltd

Prepared by:
Peter Foster

Project Number:
310103821

Technical Note on Sedimentation Lake Dunstan

Revision	Description	Author	Date	Quality Check	Date
Rev 0	Draft	PF	08/11/22	HJ	08/11/22
Rev 1	Final	PF	21/02/23	HJ	21/02/23



The conclusions in the Report titled Technical Note on Sedimentation Lake Dunstan are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Prepared by:

Signature

Peter Foster

Printed Name



Approved by:

Signature

Hamish Jamieson

Printed Name



Table of Contents

ACRONYMS / ABBREVIATIONS	II
1 INTRODUCTION	1
2 PREDICTIONS FROM 2002 EVIDENCE	1
3 2022 SEDIMENTATION	3
3.1 Sediment Deposition Rates	5
3.2 NIWA Predictions (2014).....	7
4 FUTURE PREDICTIONS	8
 LIST OF APPENDICES	
APPENDIX A FIGURES PF_1 TO PF_7	1
APPENDIX B – LIST OF QUALIFICATIONS AND EXPERIENCE, INCLUDING IN RELATION TO THE CHS	1



Acronyms / Abbreviations

CHS

CONTACT

LVAMP

SMP

CHS

Contact Energy Ltd

Landscape and Visual Amenity Management Plan

Sediment Management Plan



1 Introduction

This report is a Technical Note prepared by Peter Foster a Principal Engineer (Dams) from Stantec New Zealand related to sedimentation in the Kawarau Arm of Lake Dunstan.

Peter Foster has a BE (Hons) in civil engineering from the University of Canterbury and has worked predominately in the areas of dam engineering, and hydropower operations. **Appendix B** provides a full list of Peter Foster's qualifications and experience including his experience with the CHS.

The Technical Note is divided into sections covering:

1. Predictions made in my council-level evidence dated October 2002 filed as part of Contact Energy Limited's (**Contact's**) application for resource consents to permit operation of the CHS (and subsequently in my Environment Court evidence).
2. Evaluation of actual sedimentation from 1994 to 2022 based on surveys by Eliot Sinclair and interpretations of the data by WSP (2022) *Lake Dunstan Sedimentation and Backwater Study for March 2022 Bed Survey - Kawarau Arm Update*.
3. Future Projections of sedimentation.

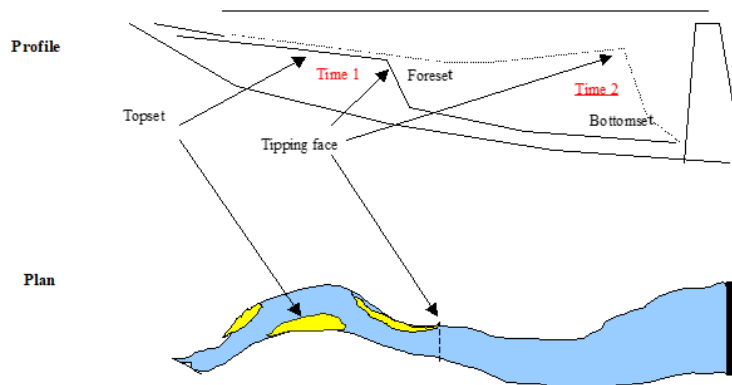
2 Predictions from 2002 Evidence

Sediment sourced from the Shotover River is transported as bedload and suspended sediment into the Kawarau arm of Lake Dunstan. Since 1994 most of the sediment has settled out in this reach but some is beginning to be deposited in the Dunstan Arm between Cromwell and Clyde Dam. Prior to Clyde Dam being built this sediment was transported down to Lake Roxburgh. The Kawarau Arm of Lake Dunstan and the Cromwell to Clyde Dam reach form a lake that is similar to Lake Roxburgh. Both are long narrow lakes and, in my opinion, a similar pattern of deposition that occurred in Lake Roxburgh from 1956 to 1994 can be anticipated in Lake Dunstan.

A stylised pattern of sedimentation into a reservoir that is similar to the Kawarau Arm and the Cromwell to Clyde Dam reach of Lake Dunstan is given in **Figure 2.1**:



Technical Note on Sedimentation Lake Dunstan 2 Predictions from 2002 Evidence



Idealised plan and profile of an elongate reservoir receiving sediment (after US Dept of the Interior, Bureau of Reclamation, 1974).

Figure 2.1

Figure 2.1 shows a plan and profile of sediment entering onto a long reservoir at two time steps. The velocity of the water entering the top end of the lake reduces compared to the velocity in the river upstream of the lake. This causes the sand and gravel materials that roll and bounce along the riverbed as bed load to settle out and form a delta. The finer suspended sediment (fine sand and silt) also begins to fall from suspension and forms an apron type deposit on the reservoir bed. Figure 2.1 shows an initial advance of the delta into the reservoir at Time 1 and the establishment of a tipping face.

With time the delta front or tipping face advances down the reservoir. As the delta advances, the “topset” reach, upstream of the tipping face, must aggrade and shallow so that there is sufficient gradient and flow velocity to move bed material to the tipping face. As this occurs the upstream section of the lake transitions to a morphology more like that of an alluvial river, with “point bars” growing off the inside of bends and possible “medial” bars or islands growing in mid-stream if the channel is wide enough. This can create a meandering or semi-braided channel pattern. Figure 2.1 shows some of these bars in the plan view of the reservoir.

The bars can grow higher with raised water levels in floods and emerge to become beaches or islands when floods recede. With time the raised beaches and islands will accumulate finer sediment as “overbank” material and will tend to vegetate as they grow in elevation and are swept by floods less frequently. The beaches and islands will grow above the level of the main channel.

In 2002 I estimated that the rate of sediment accumulation in the Kawarau Gorge and confluence to Clyde Dam could be in the range of 1.14 to 1.3 million m³/yr. Given the volume of the reservoir, I projected that the reservoir tipping face will be reaching Clyde Dam in about year 2105 as shown in **Appendix A Figure PF_1**.

Figure PF_1 shows the survey cross section numbers that are surveyed with the channel width in the upper half of the Figure and the bed section along the profile of the Kawarau Arm and Cromwell to Clyde Dam Arm of the reservoir. Bed profiles are shown for the baseline survey in 1994, and bed



profiles surveyed in 2000, which indicate some initial deposition at the upstream end of the Kawarau Arm. Projections were made as to the advance of the tipping face for years 2010, 2020, 2035, 2070 and 2105. Figure PF_1 also shows water surface profiles for a flow of 3200 m³/s downstream of the Cromwell confluence. It is expected that flood water levels will rise in the Kawarau Arm as it returns to a more riverine condition after the sediment front reaches the Cromwell confluence.

3 2022 Sedimentation

In the period 2002 to 2022 the deposition of sediment continued in the Kawarau Arm and the point and medial bar features indicated in Figure 2.1 appeared in the Kawarau Arm as shown in **Photos 3.1, 3.2 and 3.3** taken in 2010 courtesy of Peter Silvester, Contact.



Photo 3.1 Kawarau Arm near Ripponvale (looking upstream)

**Technical Note on Sedimentation Lake Dunstan
3 2022 Sedimentation**



Photo 3.2 Kawarau Arm from Ripponvale looking downstream to Bannockburn



Photo 3.3 Kawarau Arm at Bannockburn (looking upstream)



Photos 3.1 to 3.3 are in line with expectations presented in 2002.

The sediment input into the Kawarau Arm is variable and depends on flood events that drive sediment transport from the Shotover River and the turbidity of such flows. **Appendix A Figure PF_2** from WSP (2022)¹ indicates the flow in the Kawarau River at Chards Rd. The highest inflow is associated with the November 1999 flood. For the period 2000 to 2022 floods have been moderate with only a few peaks in the range of 600 to 800 m³/s.

The delivery of sediment “slugs” into the Kawarau Arm is variable both in terms of time and intensity and is significantly influenced by flood events.

Appendix A Figure PF_3 from NIWA (2011)² shows the water turbidity as measured at Ripponvale for the period January 1995 to July 2010. Turbidity is defined as the opaqueness of a fluid and is measured in nephelometric turbidity units (NTU). Figure PF_3 shows 5 events between November 1999 to December 2002 when NTU exceeded 1500, and only one such event between 2002 and 2010.

3.1 Sediment Deposition Rates

In 2002 I predicted that the sedimentation deposition rate into the Kawarau Arm of Lake Dunstan could be in the order of 1.14 to 1.3 million m³/yr, based on the deposition rate in Lake Roxburgh over a 37 year period 1956 to 1993 on the following basis:

Long term rate into Lake Roxburgh	= 1.42 million m ³ /yr
Less Upper Clutha sediment	= (0.17) million m ³ /yr
Less Other Downstream Sources	= (0.11) million m ³ /yr
Total	= 1.14 million m ³ /yr

In 1994 cross-sections were set up and surveyed to provide a base line for measuring sediment deposition in the Kawarau Arm of Lake Dunstan as well as the Upper Clutha and Cromwell to Clyde Dam Arms of Lake Dunstan. **Appendix A Figure PF_4** shows the Kawarau Arm sediment monitoring sections.

WSP (2022) lists the bed surveys in the Kawarau Arm undertaken since 1994 and the sediment deposition as presented in their **Table 3.1** below:

¹ WSP (2022) Lake Dunstan Sedimentation and Backwater Study for March 2022 Bed Survey: Kawarau Arm Update 2022

² NIWA (2011) Clutha Turbidity Monitoring Data Report 1995-2010



**Technical Note on Sedimentation Lake Dunstan
3 2022 Sedimentation**

Table 3-1: Cumulative sediment deposition volumes and average rates in Kawarau Arm.

Survey date	Sediment deposition since April 1994 (Mm ³)	Average annual rate of Sediment deposition since April 1994 (Mm ³ /yr.)	Sediment deposition since previous survey (Mm ³)	Rate of sediment deposition since previous survey (Mm ³ /yr.)
September 1999	5.69	1.05	1.8	0.51
February 2000	8.48	1.45	2.79	6.67
December 2004	14.96	1.40	6.48	1.34
July 2007	16.25	1.23	1.28	0.50
July 2009	17.56	1.15	1.31	0.65
October 2011	18.81	1.07	1.25	0.56
February 2014 (to cross-section 73)	20.52	1.03	1.71	0.73
February 2014 (Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm)	21.6	1.08	1.97 *	0.79 *
March 2016 (to cross-section 73)	21.47	0.98	0.95	0.46
March 2016 (Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm)	22.6	1.03	1.07	0.54
March 2018 (to cross-section 73)	22.30	0.93	0.83	0.41
March 2018 (Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm)	23.6	0.98	1.01	0.5
March 2020 (to cross-section 73)	22.88	0.88	0.59	0.29
March 2020 (Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm)	-	-	-	-
March 2022 (to cross-section 73)	23.68	0.85	0.80	0.40
March 2022 (Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm)	25.34	0.91	1.74 (2018-2022)	0.44 (2018-2022)

* Note: For these sediment deposition volumes, it has been assumed that the date of the lake-bed survey of the Dunstan Arm occurred at the same time as the lake-bed survey of the Kawarau Arm.

Some key points to note from Table 3-1 above:

1. The November 1999 flood, which was an unusually large event, deposited some 2.79 Mm³ as a single event and lifted the average deposition rate to 1.45 Mm³/yr from 1994 to February 2000.
2. Calculations of sediment deposition are based on surveys labelled as Kawarau Arm incl. cross-sections 35-38 and 73 in the Dunstan Arm as sediment is now being deposited downstream of the Confluence.



Technical Note on Sedimentation Lake Dunstan
3 2022 Sedimentation

3. The average rate of sediment deposition in the Kawarau arm down to section 35 in the Dunstan arm from 1994 to March 2022 has been 0.91 Mm³/yr over 28 years.
4. The average rate of sediment deposition in the 8-year period from February 2014 to March 2022 has been 0.47 Mm³/yr.

The above points demonstrate that the average deposition rates over periods in the order of 10 years can be quite variable depending on flood activity.

Appendix A Figure PF_5 shows the Thalweg³ bed level for each cross-section in the Kawarau for the period from the base survey in April 1994 to the most recent survey in March 2002 that also includes sections 34 to 38 downstream of the Cromwell confluence. Figure PF_5 shows that the tipping face has now reached the confluence with the Upper Clutha River and reasonable stable thalweg levels in the Kawarau Arm since 2018 upstream of section 80. The difference between where the tipping face would be in 2022 as made in 2002, and the position in 2022 from the latest survey can be explained by the actual deposition rate compared to the projected rate. In 2002 the deposition rate was assumed to be 1.2 Mm³/yr, whereas the actual average rate of deposition has been 0.77 Mm³/yr from February 2000 to March 2022.

WSP also updated their hydraulic model of the reservoir and recalculated flood profiles with the March 2022 survey cross-sections. Table 4-1 from WSP (2022) indicates the boundary conditions for the flows modelled at Clyde Dam.

Table 4-1: Boundary conditions for backwater analysis assuming inflows of 530, 2000 and 3200m³/s at Clyde Dam.

Flow at Clyde Dam (m ³ /s)	Headwater level at Clyde Dam (m)	Flow in Kawarau Arm (m ³ /s)	Flow in Clutha Arm (m ³ /s)
530	194.50	238.50	291.50
2000	194.83	900.00	1100.00
3200	195.10	1440.00	1760.00

Appendix A Figure PF_6 shows the backwatered water levels assuming a flow of 3200 m³/s at Clyde Dam. Figure PF_6 shows that the flood profile has been rising for this given Clyde Dam flow as the sediment front reaches the Cromwell. A prediction is also indicated for the same flow for the current consent period up to 2042.

3.2 NIWA Predictions (2014)

NIWA (2015)⁴ reported on sediment modelling and provided their predictions on the lake bed level out to year 2114 using a sediment transport model SRH-1D. Based on 18 years of data (March 1996 to February 2014), the sediment feed was assumed to be 0.98 Mm³/yr, and with a trap efficiency of 93%,

³ The thalweg is a line connecting the lowest points of successive cross-sections along the course of a valley or river.

⁴ NIWA (2015) Lake Dunstan Sediment Modelling 2015



Technical Note on Sedimentation Lake Dunstan

4 Future Predictions

giving a deposition rate of 0.91 Mm³/yr. In the NIWA modelling the trap efficiency for sediment inflows into the Kawarau Arm reduces from 91% for year 0 to 20 to 72% for year 80-100.

The overall modelling results are presented in **Appendix A Figure PF7**

Figure_PF7 shows the tipping point of deposition reaching to within 3 to 5 km of Clyde Dam in year 2114. NIWA notes that “*this is slightly later than, but roughly consistent with, the Foster and Hicks (2001) assessment which shows the tipping point reaching 4 km from the dam in 2105.*” The NIWA model also predicts that bed levels at Ripponvale are predicted to rise at a rate of 0.035 m/yr over the next 100 years.

NIWA also notes that “*We anticipate that further advancement of the sediment delta in the Dunstan Arm (after 100 years) will be fairly limited due to increasing sediment outflows from the dam. Past 100 years we would bed levels at both sites (Confluence and Ripponvale) to rise but at a rate that reduces with time.*”

Bed levels in the Kawarau and Dunstan Arms must continue to rise until, in the very long term, the slope of the bed profile approximates the natural river slope and equilibrium is obtained between sediment inflows and outflow. Determining the time to equilibrium is beyond the scope of this (NIWA, 2015) study.”

4 Future Predictions

As seen in Section 3 there is variability in sedimentation rates in shorter terms which produces uncertainty in what the actual long-term rate will be. In the NIWA (2015) study they set up a 20 year flow model that added to their 18 year time series (1996 to 2014) an additional 759 days replicated from the end of the record to 1/2/2014 to create a 20 year record. This record was replicated 5 times to create a 100-year record as shown in **Figure 5.1** below.



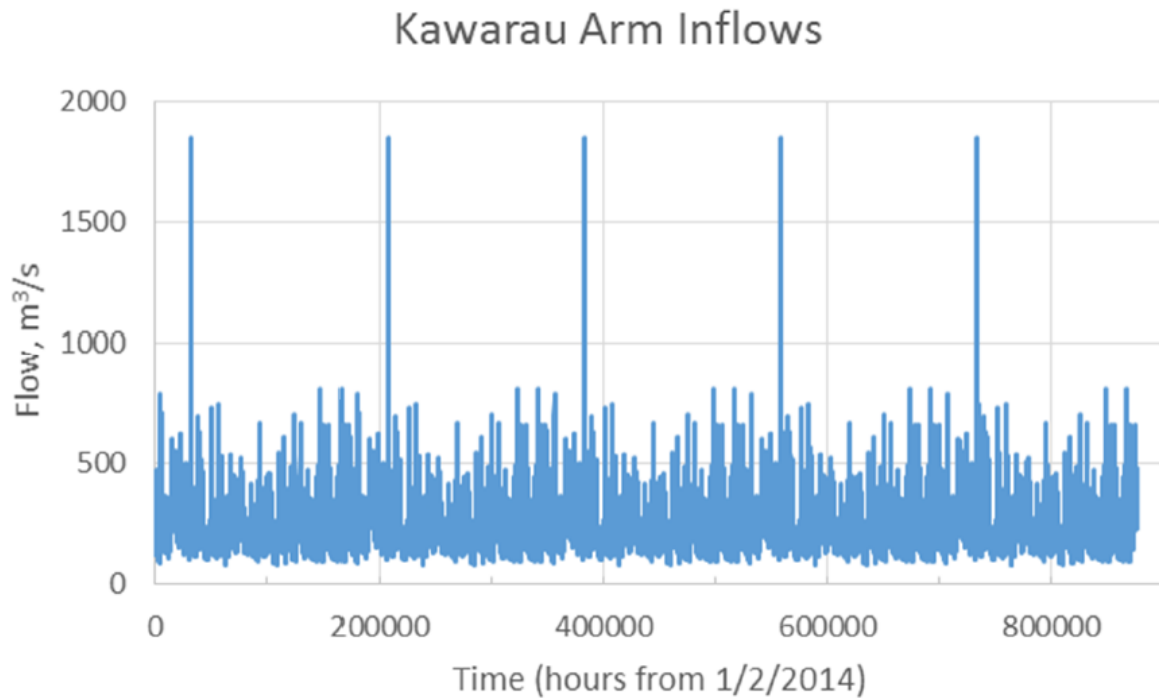


Figure 5.1

This time series has the November 1999 event, which has a return period in excess of 100 years being repeated 5 times within the 100 year period. It is possible that this may bias the predictions of both when the sediment reaches Clyde Dam and the long-term bed level changes in the Kawarau and Dunstan Arms. NIWA notes that the inclusion of this event every 20 years compensates for a lack of moderate flood events at Ripponvale in the range between 850 and 1500 m³/s, and hence the bias may be small.

The overall prediction is that there should be little change in the sediment profile in the Kawarau Arm as the tipping face has now reached the Confluence with the Dunstan Arm. The thalweg bed in the Kawarau Arm will have a slow rate of rise as coarser bed load material gets deposited. Flood levels in the Kawarau Arm for a combined flow of 3200 m³/s at Clyde Dam have been calculated to rise as sediment deposition has occurred in the Kawarau Arm and will continue to rise (predicted at 0.035 m/yr over the next 100 years) for such a flow as the sediment tipping face advances in the Dunstan Arm.

APPENDICES



Appendix A Figures PF_1 to PF_7



Technical Note on Sedimentation Lake Dunstan
 Appendix A Figures PF_1 to PF_7

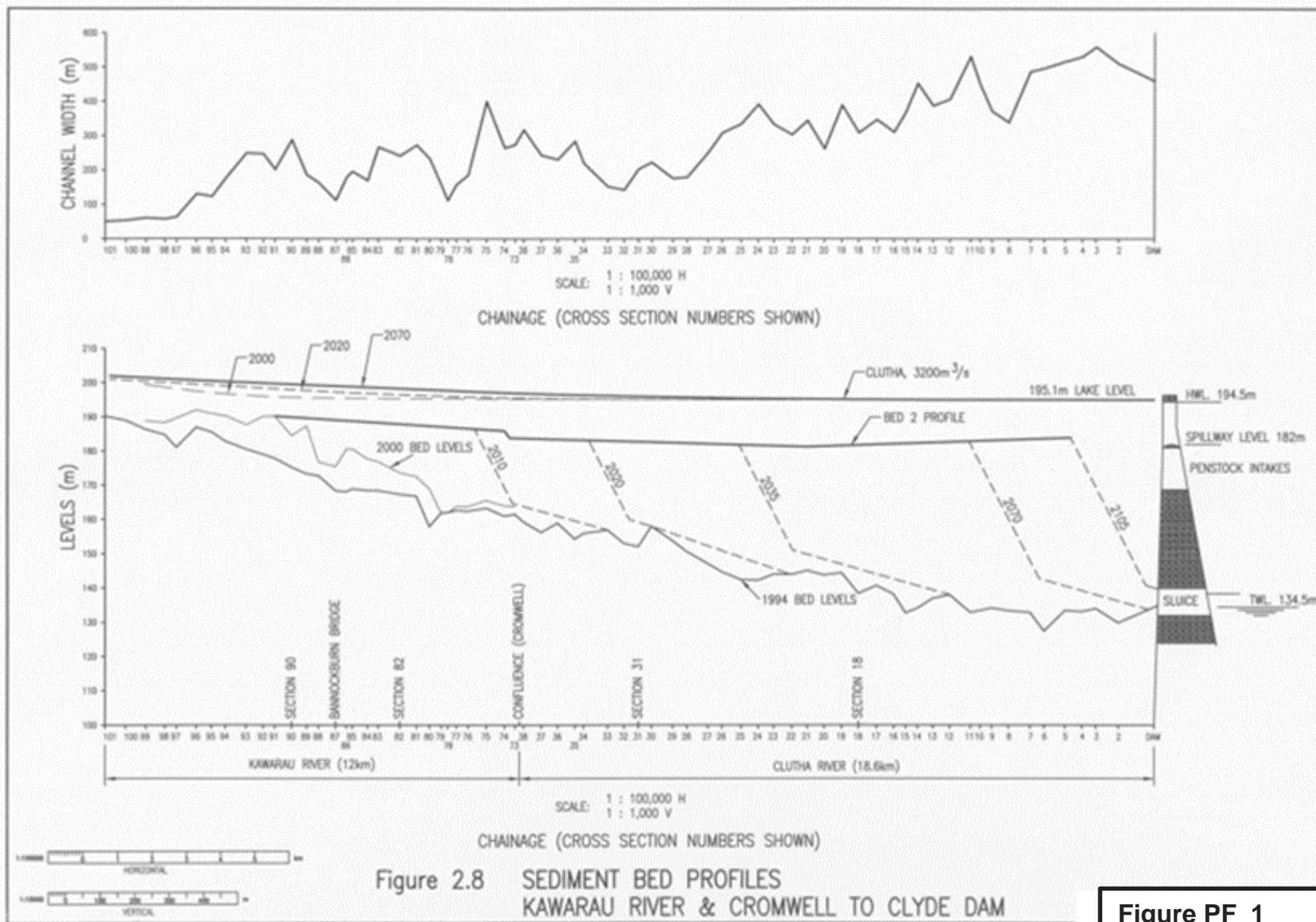


Figure PF_1

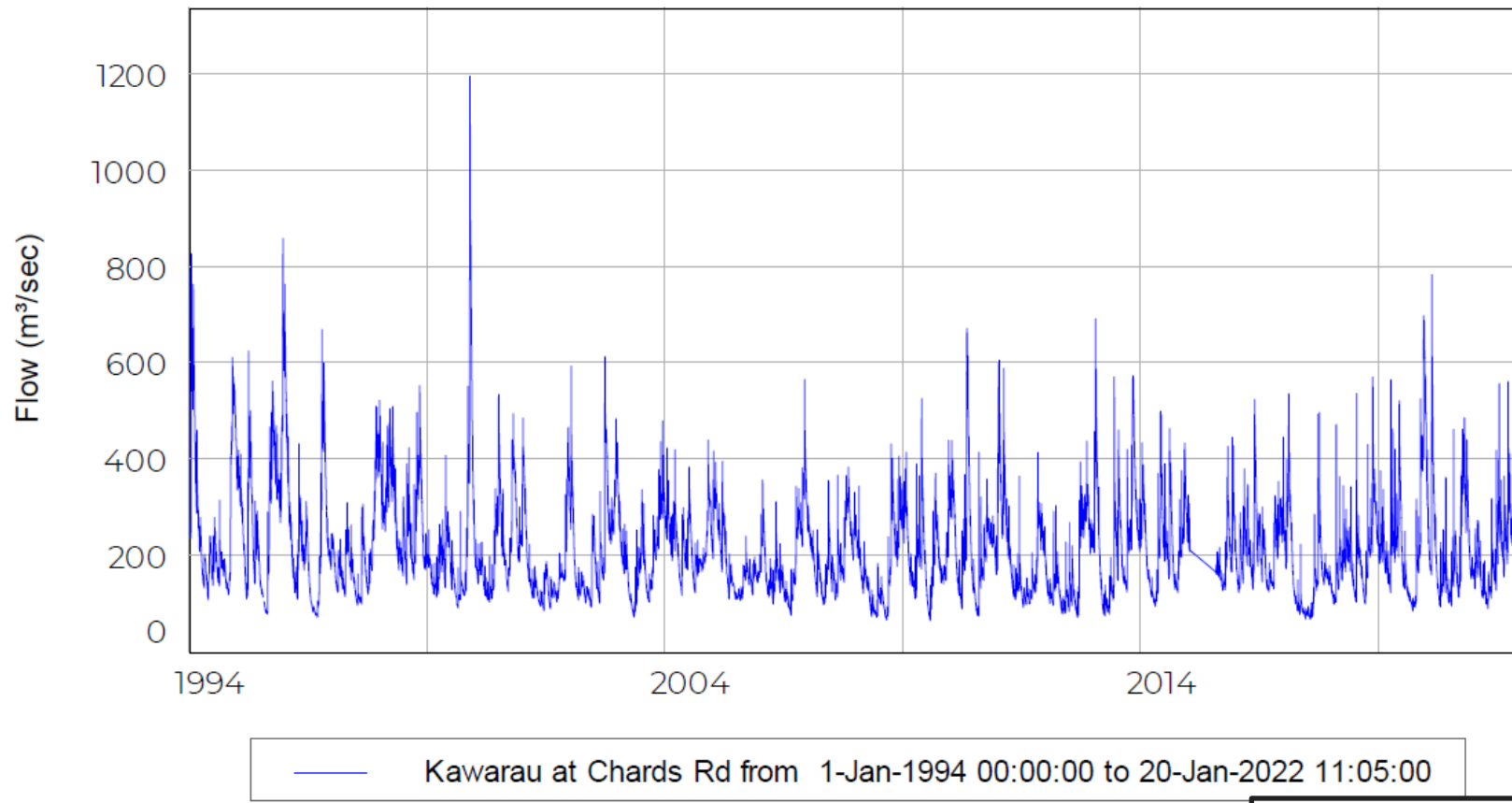
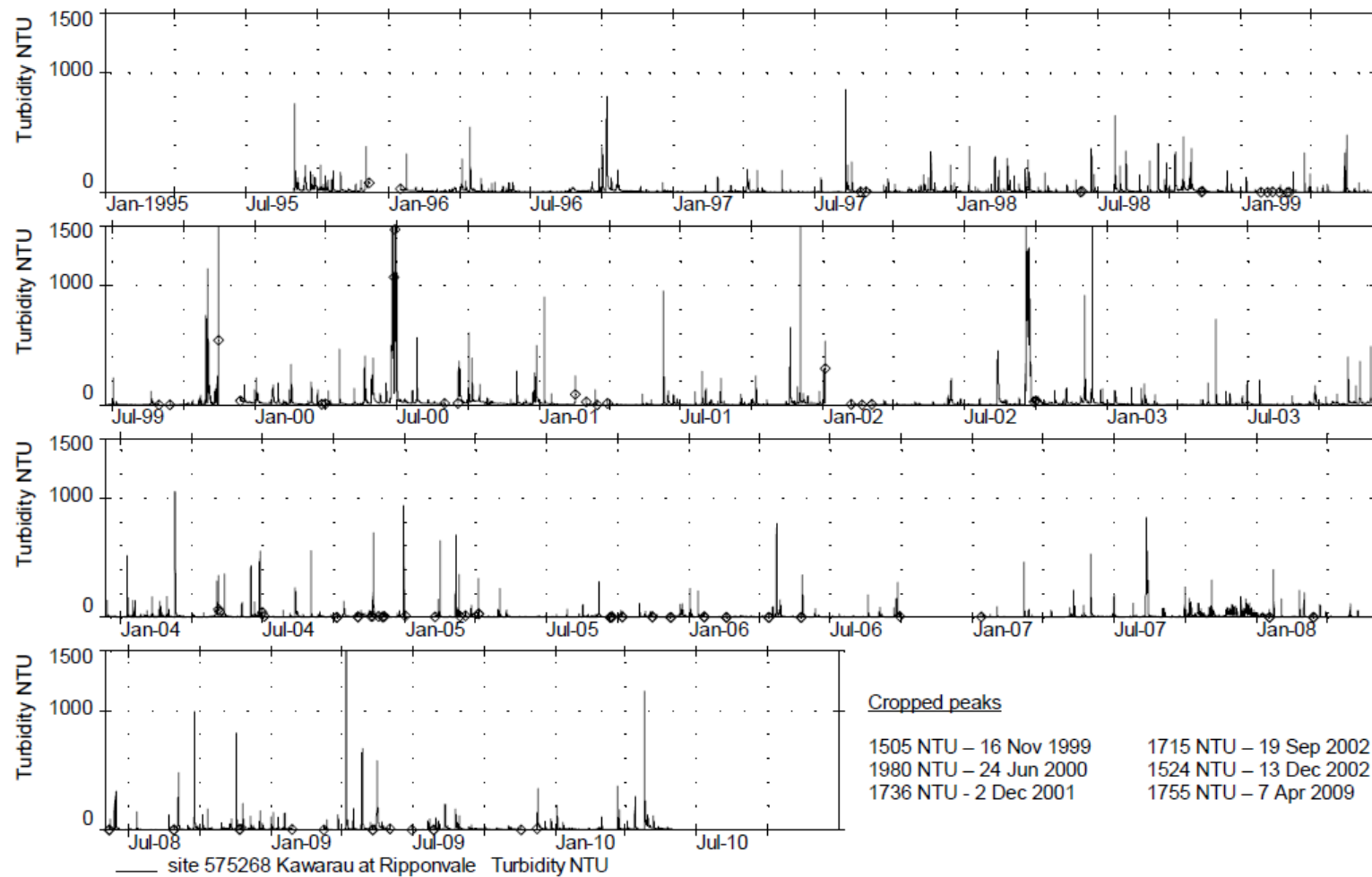


Figure 3-2: Kowarau River at Chards Road flow record (1994-2022).

Figure PF_2



Technical Note on Sedimentation Lake Dunstan
 Appendix A Figures PF_1 to PF_7

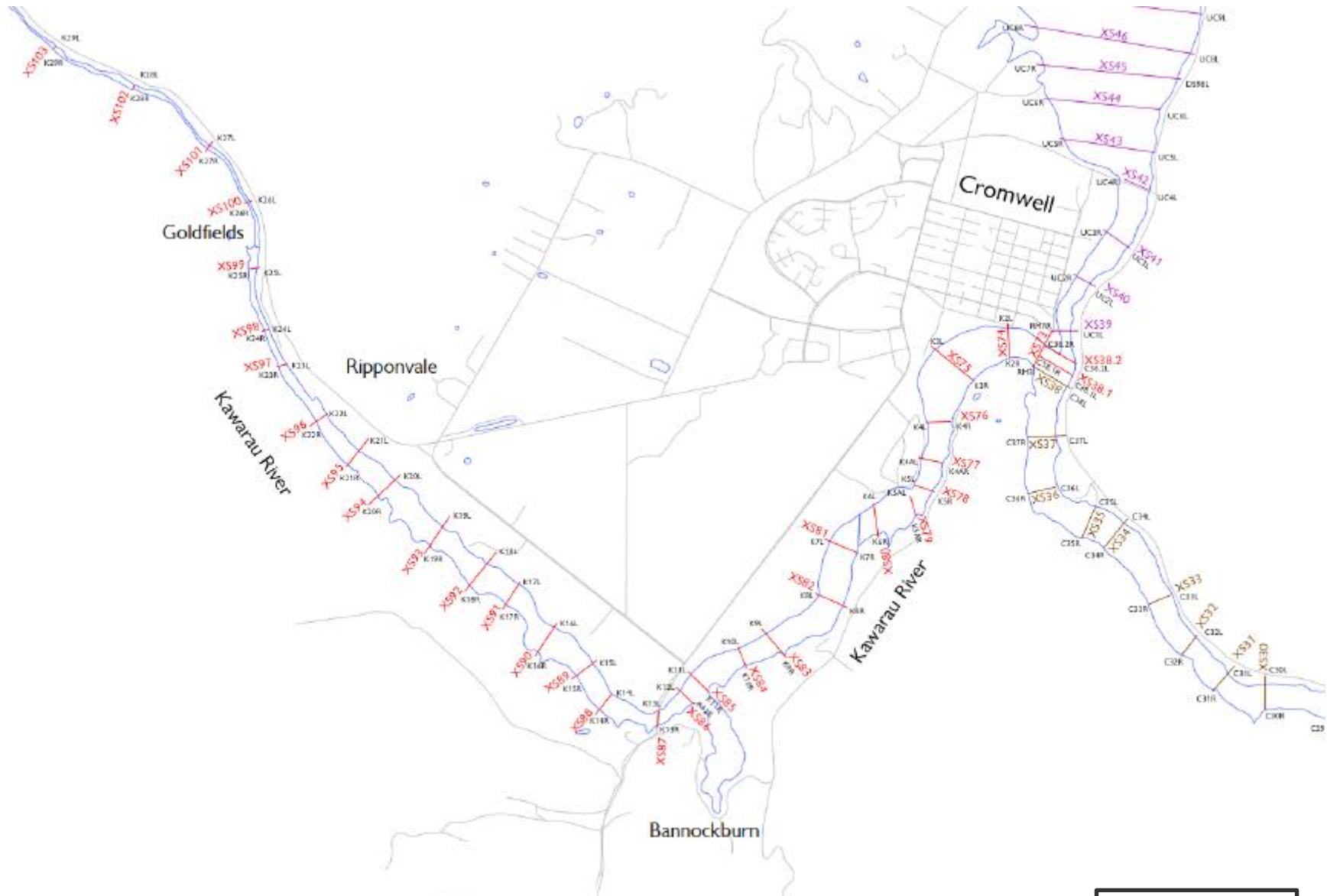


Turbidity time-series for Kawarau at Ripponvale.

Figure PF_3



Technical Note on Sedimentation Lake Dunstan
Appendix A Figures PF_1 to PF_7



Kowarau Arm Sedimentation Survey Cross-sections

Figure PF_4

Technical Note on Sedimentation Lake Dunstan
Appendix A Figures PF_1 to PF_7



Project Number: 3-53721.00
Lake Dunstan Kawarau Arm Sedimentation Study

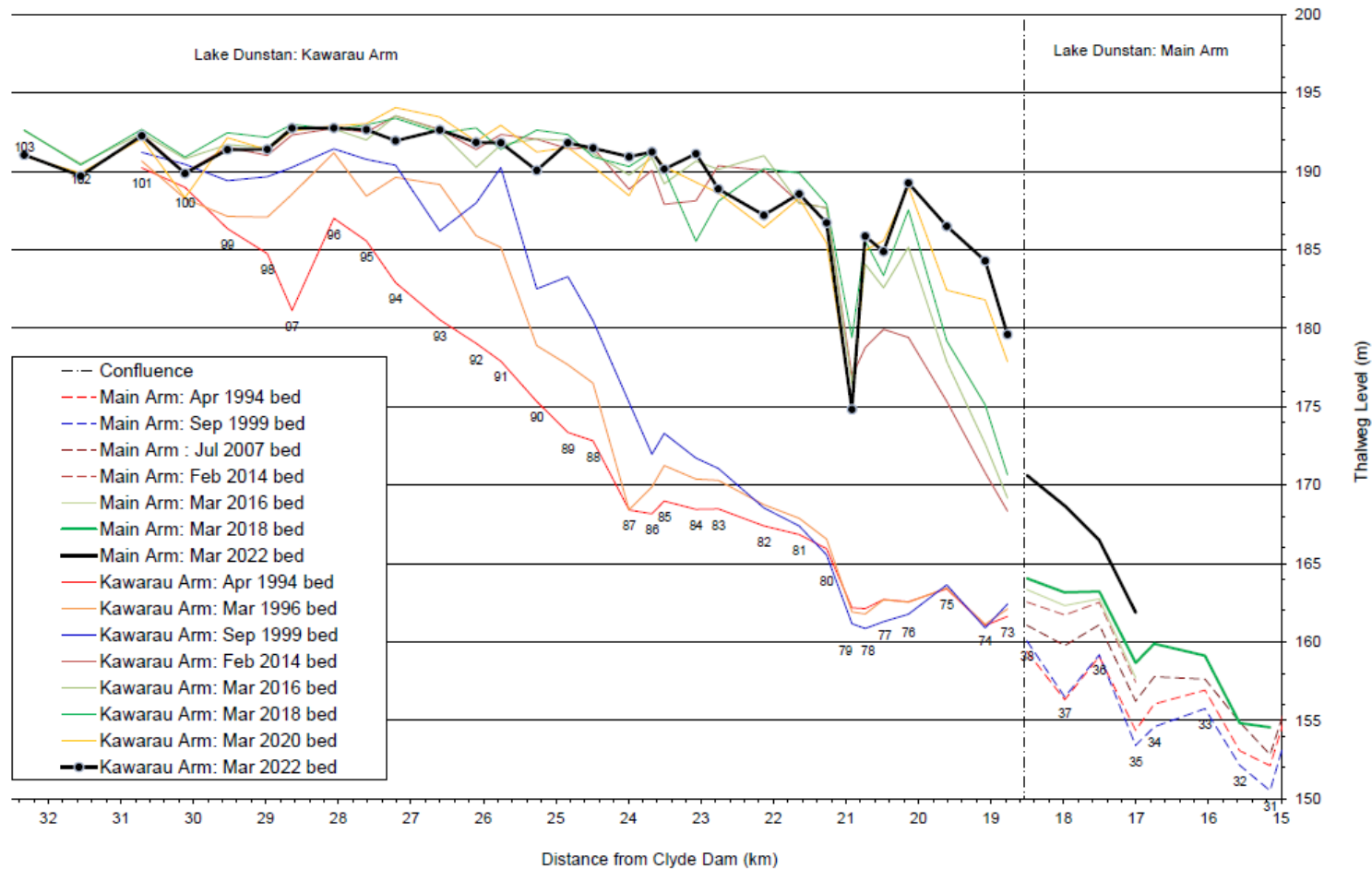


Figure 3-8: Thalweg profiles for the Kawarau Arm (Cross-section numbers are shown beneath the April 1994 Kawarau Arm and Sep 1999 Dunstan Arm survey).

Figure PF_5

Enter



Technical Note on Sedimentation Lake Dunstan
 Appendix A Figures PF_1 to PF_7



Project Number: 3-53721.00
 Lake Dunstan Kawarau Arm Sedimentation Study

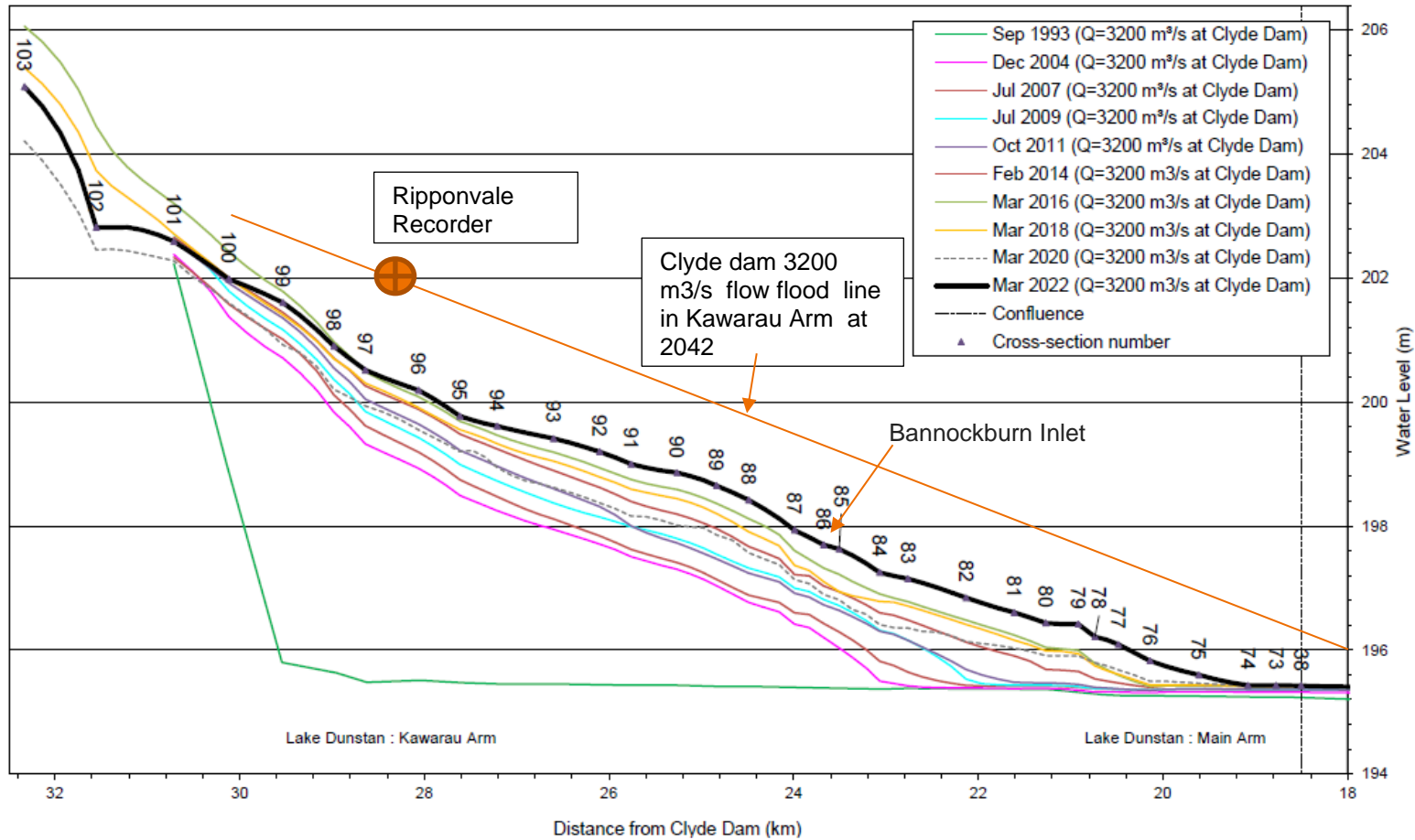


Figure 4-6b: A closer view of the predicted backwater profiles in the Kawarau Arm for the September 1993, December 2004, July 2007, July 2009, October 2011, February 2014, March 2016, March 2018, March 2020 and March 2022 lake-bed profiles, based on a flow of 3200m³/s at the Clyde Dam.

Figure PF_6



Technical Note on Sedimentation Lake Dunstan
Appendix A Figures PF_1 to PF_7

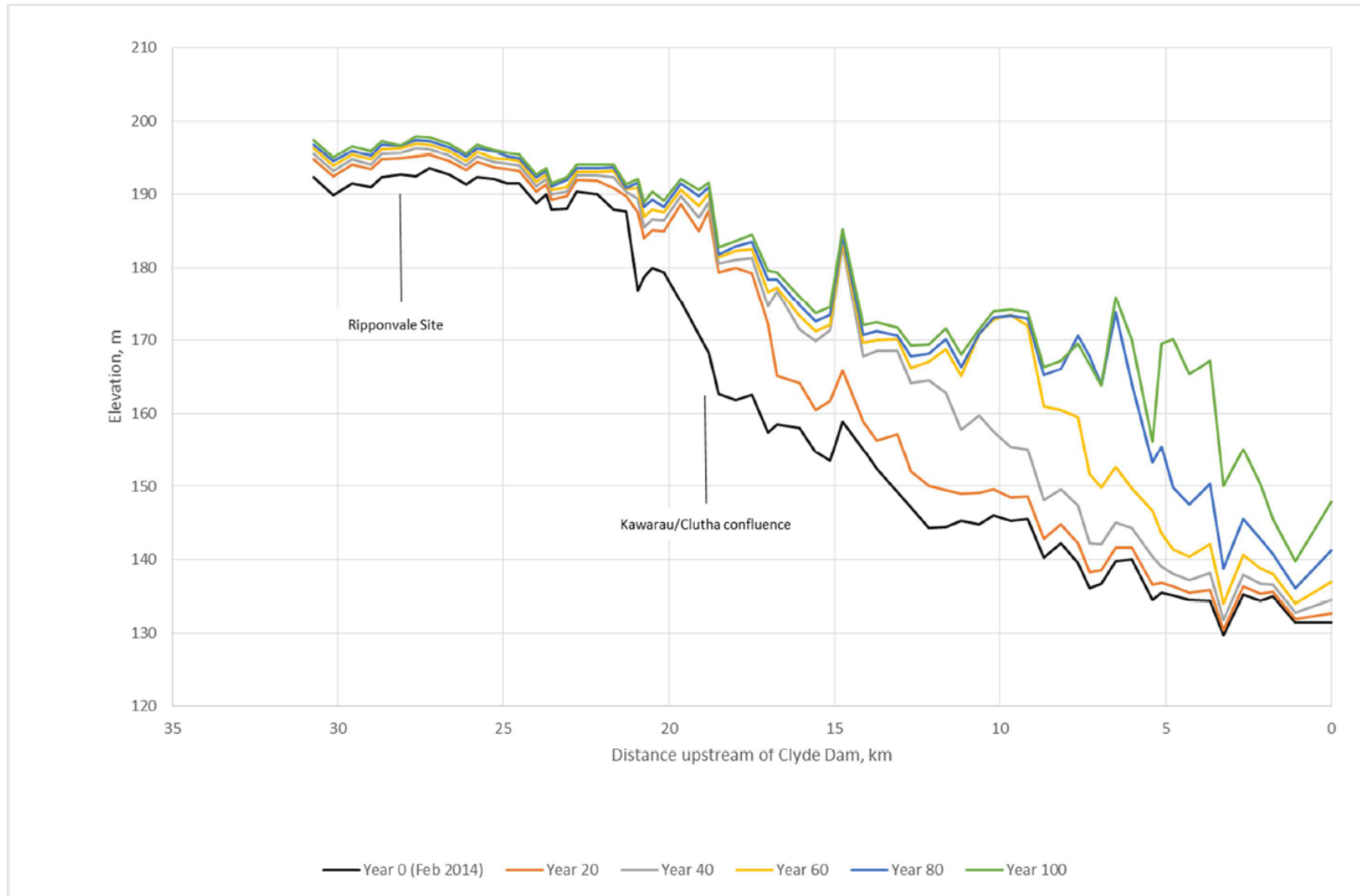


Figure 6-1: Predicted thalweg level for the Kawarau and Dunstan Arms of Lake Dunstan at year 0, 20, 40, 60, 80 and 100 from February 2014.

Figure PF_7



Appendix B – list of qualifications and experience, including in relation to the CHS

1. My name is Peter Foster. I am a Principal Engineer (Dams) at Stantec New Zealand.
1. I have a BE (Hons) in civil engineering from the University of Canterbury. I graduated in 1976 and have worked predominately in the areas of dam engineering, and hydropower operations.
2. I am a Fellow of Engineering New Zealand and a Chartered Professional Engineer. I am a member of the New Zealand Society of Large Dams, the New Zealand Geotechnical Society and the New Zealand National Society of Earthquake Engineering.
3. From 1975 to April 2002 I was employed by the Ministry of Works and Development, Works Consultancy Services and when they were privatised, Opus International Consultants. I joined MWH New Zealand Ltd (now Stantec New Zealand) in 2002 as a Senior Civil/Hydro Engineer before becoming a Principal Engineer in 2014
4. I am familiar with the Clyde and Roxburgh Dams and their reservoirs and many of the operational issues associated with the CHS in particular:
 - (a) I have had a long involvement as a consultant to the New Zealand Electricity Department, then the Electricity Corporation of New Zealand (ECNZ) and now Contact with regard to dams, reservoirs and their operations on the Clutha River.
 - (b) My involvement with Clyde Dam covers the dam site investigations, dam detailed design and construction, lake filling and operational phases of its life.
 - (c) In addition to the physical works associated with the Clyde Dam I have worked in the following areas:
 - (i) concept and detailed design for the tailrace deepening downstream of the Clyde Dam - I contributed to the report, Clyde Power Project: Environmental Impact Report on Design and Construction Proposal (December 1977), with respect to this aspect of the project; and
 - (ii) predictions of sedimentation levels and hydraulic calculation of flood levels in the Kawarau Arm and Cromwell Gorge section of Lake Dunstan, to assist the land purchase requirements associated with construction of the Clyde Dam .
 - (d) From 1986 onwards I became more involved with the landslide stability issues adjacent to what is now Lake Dunstan. I ultimately held the position of Deputy Design Manager for the landslide stabilisation works. I continued to be involved by reviewing monitoring data for the landslides when Lake Dunstan was initially filled 1998.
 - (e) In the 1990s I also began to provide consulting services to ECNZ and then Contact regarding the issues of sedimentation into Lake Roxburgh and the potential flood risk at



Technical Note on Sedimentation Lake Dunstan
Appendix B – list of qualifications and experience, including in relation to the CHS

Alexandra. I project managed and contributed to a pre-feasibility study in 1993 that looked at options to alleviate the flood risk at Alexandra. After the January 1994 flood I project managed the joint study for the Otago Regional Council and ECNZ that recommended investigation and monitoring of operational procedures to encourage sediment migration and flushing in Lake Roxburgh, and flood management strategies that account for storage within Lake Hawea. In 1995 and 1996 I also project managed and contributed to a number of joint studies that Works Consultancy Services and NIWA produced that evaluated the effectiveness of lowering flood levels at Alexandra by flushing activities in Lake Roxburgh.

- (f) I project managed and contributed to a number of studies prepared by Opus International Consultants as part of Contact's application for resource consents for the re consenting of the CHS in the early 2000s.
 - (g) I have also provided Contact with design services related to both Clyde and Roxburgh Dams. This has included annual inspection reports in accordance with procedures recommended by the New Zealand Society of Large Dams. At Roxburgh Dam I have also been involved in reassessing the Dam foundation stability and provided recommendations to upgrade the instrumentation at the Dam, project managed the design for the spillway strengthening works and the design for rock removal from the tailrace downstream of the Dam to lower the tailwater level.
5. In addition to the above, I have also provided consulting services in dam engineering and reservoir operations to clients such as Meridian Energy, Mighty River Power, Watercare Services and other dam owners in New Zealand and Seqwater and Sunwater in Queensland, Australia.
 6. I have authored or co-authored some 13 technical papers that have appeared in New Zealand and international journals and conferences. The papers relate to either the Clyde Dam, the landslide stabilisation work adjacent to Lake Dunstan, or the sediment flushing in Lake Roxburgh.
 7. My CV is as follows:



Technical Note on Sedimentation Lake Dunstan

Appendix B – list of qualifications and experience, including in relation to the CHS



PETER FOSTER

Principal Engineer (Dams)

Peter has over 35 years' experience in dam design and rehabilitation. He has specialised in dam and hydraulic structures engineering and as a result of his specialist knowledge is frequently sought after as an independent expert reviewer.

Peter has worked on major dam projects including the design of the \$1b 102m high Clyde Dam, the largest concrete gravity dam in New Zealand. This project ran for over 20 years and Peter is still providing safety inspection reviews of the dam today, exemplifying his on-going commitment to a client project. He has also worked on the design of the Ross River Dam upgrade and Wivenhoe Alliance to provide a fuse plug spillway. His on-going work in Australia continues to expose him to current practice and modern dam design work with Fairbairn and Boondooma spillway upgrade projects for SunWater being recent examples.

He is a member of the New Zealand Society on Large Dams and is a past chairman. This role required Peter to participate in many dam conferences around New Zealand and Australia and represent NZ interests at international forums. Peter has assisted ANCOLD as an expert review panel member for their Guidelines on Design Criteria for Gravity Dams (2015)

Peter makes regular trips to Brisbane to support the Brisbane dams team and has been the certifying RPEQ on 25 CSG Brine Storage dams, mentoring a local and international design team of up to 8 engineers on these works at any one time.

Since 1987, he has published 16 technical papers in New Zealand and internationally and now mentors the next generation of dam designers.

EDUCATION AND MEMBERSHIPS

- BE / BEng, Civil Engineering (Hons)
- New Zealand Society on Large Dams (Past Chairman)
- Engineering New Zealand, Fellow
- Chartered Professional Engineer – New Zealand
- Registered Professional Engineer Queensland (RPEQ)
- New Zealand National Society of Earthquake Engineering – Member
- New Zealand Geomechanics Society - Member

PROJECT EXPERIENCE

Burdekin Falls Dam Improvement Project and Dam Raise Project SunWater, 2019

Technical Lead to develop concept designs for a dam improvement project to increase flood capacity by stabilising existing dam with buttress or post-tension anchors and also to incorporate the solution into either a 2 m or 6 m raise of full supply level at the dam.

Paradise Dam Upgrade SunWater, 2019

Technical Review Panel member to review options for safety improvements at Paradise Dam to ensure a lowering of the risk profile to meet ANCOLD tolerable risk criteria.

Wivenhoe Dam Upgrade Project SunWater, 2018 to 2019

Technical Review panel member to review options for upgrading the spillway capacity at Wivenhoe dam

incorporating potential dam raise options from 0 to 4 metres for extreme floods.

Burdekin Falls Dam Upgrade SunWater, 2017 to 2018

Technical Lead to complete preliminary design of safety upgrade at Burdekin dam to improve flood capacity using post-tension cables to stabilise the dam.

Boondooma Spillway Upgrade SunWater, 2016

Design Review and Assistance to SunWater Design Team to develop tender design to protect the spillway chute from rapid rock erosion and stabilise spillway crest under extreme flood loads.

Fairbairn Spillway Upgrade SunWater, 2015 to 2018

Design Assistance to SunWater Design Team to develop concepts and detailed design solutions to enhance the stability of spillway chutes and stilling basin at Fairbairn Dam. Provision of technical advise during construction.

Warragamba Dam Raising Study Infrastructure NSW, 2014 to 2015

Assessment of options to raise the dam by 14 m to provide flood detention benefits, stability analysis, flood routing. Development of a preferred option for detailed costing.

ANCOLD Gravity Dam Guidelines ANCOLD, 2011 to 2015

Expert Review Panel Member through the period of development and finalisation for the ANCOLD Guidelines on Design Criteria for Concrete Gravity Dams.



PETER FOSTER

Principal Engineer (Dams)

APLNG Ponds

Origin Energy, 2011 to present

Certifying Engineer for design and construction of over 25 regulated ponds (3 Ponds ongoing) to store Brine and CSG associated water.

Baleh and Baram Dams Feasibility Review

Sarawak Energy Berhad (SEB), 2011 to 2012

Dam layout optioneering, spillway sizing, flood routing, and stability review for CFRD and RCC dams in height range 150 to 200 m.

Murum Dam Technical Advice

Sarawak Energy Berhad (SEB), 2010 to 2011

Technical advice on dam foundation stability, grout mix trials for 144 m high RCC dam.

Nadarivatu Hydro Project

Fiji Electricity Authority (Fiji), 2009 to 2012

Peter had a role as Owners Representative for the design and construction of the 32 metre high concrete weir structure which contains three spillway gates and a gated sluice structure.

Catagunya Dam Upgrade

Hydro Tasmania, 2007 to 2010

Peter was part of a review panel providing ongoing review services for the Catagunya gravity dam stability upgrade. He gave specialist advice on analysing the stability of the dam with post-tension cables which included the consideration of dam foundation failure mechanisms.

Lake Manchester Dam Upgrade

Brisbane City Council, 2006 to 2007

Peter was part of a review panel for the stability and flood capacity upgrade of the Manchester concrete gravity dam. He was involved in a stability review of the dam and foundations, a raised prest and post-tensioned cables to ensure stability at extreme flood loads. Peter gave specialist advice on establishing the design criteria for the upgrade.

Ross River Dam Upgrade

NQ Water, 2004 to 2006

As Design Engineer, Peter was responsible for the upgrade of the Ross River Dam. The upgrade included providing gates to the spillway and enhancing the capacity of the stilling basin. Peter was responsible for the spillway gate operating rules, the concept design for spillway gate options, the spillway blocks stability review and design of post-tensioning requirements, the hydraulic model testing of stilling basin upgrades, the design of structural upgrade for stilling basin and sidewalls as well as the seismic analysis for spillway piers. The spillway and stilling basin can now accommodate flows that are 3.5 times higher than originally designed for and the spillway stability has been enhanced with post-tension cables for extreme flood loads. The project was successfully delivered with the lake returning to full supply level in February 2008.

Wivenhoe Spillway Alliance

Seqwater, 2003 to 2005

Expert Review Panel Member through the period Peter was a member of a Peer Review Panel for Wivenhoe Alliance. The project involved providing additional fuse plug spillways, modifying spillway gates and a stability upgrade of existing spillway blocks using post-tensioned cables.

Clutha Hydro Scheme

Contact Energy 1993 to present

Peter provided annual dam safety inspections for Clyde and Roxburgh dams and reviews 3 monthly monitoring reports. Peter has a review role for Stantec annual inspections now being done by other engineers. In the period 2002 to 2004 Peter was an expert witness at Council and Environment Court hearings related to resource consent for the Clutha hydro Scheme. This included evidence related the sedimentation at lake Roxburgh and predictions related to sedimentation for the Kawarau and Dunstan arms of Lake Dunstan.

Clyde Dam

Electricity Corporation of NZ, 1977 to 1993

As Design Engineer, Peter was responsible for developing conceptual layouts for the \$1B, 102m high Clyde gravity dam as well as initial investigations, right through to the completion of the structures. Peter was involved in foundation design and remedial works, including slip joint on fault through dam foundations, together with any aspects of civil design for the dam structure. Peter also had a role as Deputy Design Manager for the landslide stabilisation works adjacent to Lake Dunstan.





APPENDIX E

B Coombs - Isthmus Report

Isthmus.

CLUTHA HYDRO SCHEME CONSENTS CONDITIONS REVIEW – LANDSCAPE REPORT

Introduction

1. In August 2022 the Otago Regional Council (**ORC**) initiated a review of the consent conditions (**Review Notice**) that relate to a suite of consents that are held by Contact Energy Ltd (**Contact**) for the Clutha Hydro Scheme (**CHS**) within the Clutha / Mata Au.
2. The Review Notice is dated 22 August 2022, and the specific conditions were:
 - Condition 17 of consent 2001.385.V3 relating to the LVAMP for the **Kawarau Arm** of Lake Dunstan;
 - Condition 18 of consent 2001.386.V4 relating to the LVAMP for the **Manuherikia River**; and
 - Condition 8 of consent 2001.398.V2 relating to the LVAMP for the **Manuherikia River**.
3. ORC identified several adverse effects from the CHS that it considered were not being adequately avoided, remedied or mitigated by these conditions of consent¹:

Landscape and visual amenity effects, in particular:

- *Driftwood accumulation and the particular visual impact it has from the Old Cromwell Precinct, the Jackson Lookout, the Junction Lookout, including the lake margins around Cornish Point;*
 - *Lagarosiphon within Lake Dunstan;*
 - *A change in flow regime and how the presence of less attractive sediments, algae, aquatic weeds and terrestrial weeds will be monitored and managed during periods of low lake levels;*
 - *Driftwood, Lagarosiphon and sediment accumulation and obstruction on the use of the Old Cromwell jetty, the Cromwell boat ramp, and*
 - *Future lower Manuherikia River gravel extraction works on visual amenity and the maintenance of the swimming hole immediately downstream of Shaky Bridge.*
4. The adverse effects identified generally relate to the preparation and implementation of a Landscape and Visual Amenity Management Plan (**LVAMP**) which was required by the conditions of consent.
 5. ORC also identified ‘*issues with the adequacy of the reporting on the LVAMP and implementation of any actions contained within the plan*’. Key matters identified in the Review Notice are²:

¹ Otago Regional Council Contact Review Notice, dated 22 August 2022. Page 4.

² *Ibid.* Page 4.

- *The LVAMP does not provide any set performance criteria or standards by which to grade compliance and to report on by the Consent Holder.*
 - *There is unclear and uncertain language and direction about consultation.*
 - *It is unclear about what adverse effects this plan should address, so it is uncertain about what the plan should contain and what should be monitored and by who.*
6. ORC sought the following outcomes from the review of the consent conditions³:
- *The consent conditions are direct, certain, enforceable and intra vires.*
 - *The adverse effects which are not currently being effectively avoided or mitigated by the conditions are addressed.*
 - *Adequate monitoring and reporting is undertaken by the Consent Holder as it relates to the LVAMP.*
7. ORC invited Contact to submit updated consent conditions in response to the Review Notice. Contact has been working towards an updated set of consent conditions since receiving the Review Notice.
8. I was not involved in the preparation of the previous CHS consent conditions or the subsequent LVAMP reports that resulted from them. In reviewing the consent conditions, I confirm that they were less specific and certain than they could have been in relation to the process and the landscape outcomes that were anticipated. In turn this affected the quality and effectiveness of the LVAMP reports that were prepared to fulfil the original consent conditions. The lack of clear, concise, and measurable consent conditions could have been partly due to the age of the conditions (mid 2000's Consents), as consent condition drafting has generally become much more specific and quantified in recent years. Landscape and visual amenity matters are also a subjective area which can lead to differing interpretations of anticipated outcomes.

Review and Involvement

9. I was commissioned by Contact in September 2022 to assist with reviewing existing LVAMP Reports and the CHS consent conditions. The first process of reviewing the latest LVAMP reports was an iterative process involving the authors of the LVAMP Report, environmental staff from Contact, other consultants and myself.
10. The first stage of the review related to the LVAMP reports that have been produced for the Kawarau Arm in response to the consent conditions, where the majority of adverse effects and issues had been identified. The LVAMP reports noted that the actions that had been completed were:
- Visual monitoring of the areas affected by the CHS (particularly the Kawarau Arm and the Lower Manuherikia); and
 - Removal of driftwood from selected areas.

³ *Ibid.* Page 5.

11. A series of review meetings were undertaken in relation to the latest LVAMP report⁴, with the objective of addressing the adverse effects and reporting matters that were identified in ORC's Review Notice. Those meetings led to the production of an updated LVAMP covering the 2019-2024 period. The list of recommended actions in the updated LVAMP includes:
- Visual monitoring / recording (continued).
 - Continue and extend the driftwood removal over a greater area.
 - Removal of terrestrial weed species and ongoing control between the lake edge and the Cycle Trail and downstream of the Cromwell Oxidation Ponds on Richards Reach.
 - Continue and extend funding of the LINZ aquatic weed program.
 - Remove terrestrial weed species and plant indigenous lake edge vegetation, in conjunction with the Mōkihi Reforestation Trust.
 - Collaborate with the Community to Co-design and undertake a project to enhance the Old Cromwell Area.
 - Sediment Management (extraction) within the Bannockburn Inlet.
 - Remove terrestrial weed species and plant indigenous lake edge vegetation within the Bannockburn Inlet.
12. The list of recommended actions within the updated 2019-2024 LVAMP is longer, more responsive and more action oriented than the previous versions which were limited to monitoring and driftwood removal. I consider that the updated 2019-2024 LVAMP goes some way towards meeting the concerns of ORC in their Review Notice⁵.
13. I was also asked to review the consent conditions that relate to the CHS, specifically in relation to the Landscape and Visual amenity matters identified above. The project team, including Contact environmental staff, consultant planner, hydrologist, lawyers and myself undertook a similarly iterative process of reviewing the consent conditions in relation to the LVAMP reports. The resulting revised consent conditions covering the following matters:
- Timing and production of LVAMP Reports (including the content – actions, methods and monitoring);
 - Location and extent of the area that the LVAMP covers;
 - Driftwood removal (expanded);
 - Terrestrial weed removal and management;
 - Indigenous planting areas and actions;
 - Sediment removal and management within the Bannockburn Inlet;
 - Landscape attribute and values identification;

⁴ Prepared by WSP, as previous versions of the LVAMP Reports have been.

⁵ The control of Lagarosiphon isn't a required action of the LVAMPs', reflecting the Environment Court decision that the presence of this aquatic weed isn't a result of Contacts' operations, but the conditions note Contacts' role in contributing to LINZ for the ongoing management of the weed.

- Landscape and visual amenity monitoring;
 - Description of actions completed;
 - Identification and prioritisation of proposed projects;
 - Recommendations for actions;
 - More direct engagement and action in relation to aquatic weed management (with LINZ);
 - Active consultation and engagement (including invitation for the provision of feedback on draft reports) with interested parties: Mana Whenua, regulatory authorities, government departments, interest groups, local community groups; and
 - An annual summary LVAMP monitoring report (including timing and process for submission and certification).
14. The review of the consent conditions has led to the development of a more comprehensive and specific set of conditions that relate directly to the matters identified in the ORC's Review Notice. The consent conditions require a much more active approach from the consent holder in not just responding to driftwood clean-up, but actively managing terrestrial weed species and an indigenous vegetation planting and management program for the areas covered by the LVAMP reports. More active management of sediment is also an outcome of the updated conditions. The conditions are time specific, achievable and respond directly to the concerns raised by ORC.
15. I have been actively involved in the drafting and review of the updated conditions that relate to the preparation and implementation of the LVAMPs. The approach taken in the updated conditions of consent is more proactive and results in the monitoring and management of a wider set of potential effects from the CHS operations. It also specifically focusses on the potential landscape and visual amenity effects of the operations. The updated conditions provide the opportunity for Contact to go 'above and beyond' where required, through the identification of new and specific projects for the enhancement of amenity in the area covered by the LVAMP.
16. In conjunction with the increased and more regular reporting and consultation obligations, I consider that the revised conditions will lead to more responsive and active management of landscape and visual amenity effects associated with the CHS.

Conclusions

17. Contact has responded directly to the Review Notice by reviewing the current version of the 2019-2024 LVAMP and the consent conditions, providing a much stronger set of conditions and recommendations that relate directly to the adverse effects of the CHS, as identified by ORC.
18. The 2019-2024 LVAMP and the revised consent conditions require an active approach from Contact in managing adverse effects and relationships with the communities that have an

interest in the CHS. In my opinion the changes in the proposed conditions appropriately address potential landscape and visual amenity effects.

19. When successfully implemented the revised consent conditions will lead to a gradual and ongoing improvement in the landscape and visual amenity values of the riverine and terrestrial environments that are covered by the LVAMP Reports, albeit that ongoing sedimentation will continue to be a feature of the CHS.

Brad Coombs

Isthmus

20 March 2023