BAY OF PLENTY REGIONAL COUNCIL
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Kaituna Rediversion Project - Operations and Maintenance Manual

Bay of Plenty Regional Council
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Contents

Introduction

About the Manual

This Operations and Maintenance Manual (the Manual) has been produced for the Kaituna River Re-diversion and Te Awa o Ngatoroirangi / Maketu Estuary Enhancement Project (the Project).

The Manual contains the key information needed to operate and maintain the Project, and to ensure requirements of the resource consents (67958-AP) are met. It provides:

- An overview of the Project and assets
- Operational procedures for the gates
- The flow regime operating rules
- Inspection and maintenance requirements
- Ongoing consultation requirements.

The resource consents (condition 26.4) state that the objectives of the Manual are:

(a) To ensure that procedures are in place to:

(i) Operation the re-diversion to maximise ecological outcomes, and

(ii) Manage the flow regime and discharges such that adverse effects attributable to the Project are minimised.

(b) To specify how erosion control works will be maintained

(c) To specify how the diversion control structure is to be controlled to ensure the Project does not increase the flood levels in Maketu Township above those that existed prior to the Project.

The Manual has been provided to the Regional Council Rivers and Drainage Manager, so the culvert operational procedures are included in the Council's Flood and Warning Manual (condition 26.7).

Roles and responsibilities

The table below gives the key personnel/organisations that are responsible for the Project.

Aspect	Organisation	Contact Person	Title	Responsibility
Owner	Bay of Plenty Regional Council (BOPRC)	Bruce Crabbe	Rivers & Drainage Manager	Overall oversight
Operations and Maintenance	Bay of Plenty Regional Council	Kerry Smith	Area Engineer	Day-to-day operations and maintenance Gate alarms
Flood Duty Managers	Bay of Plenty Regional Council	Graeme O'Rouke Mark Townsend Peter Blackwood Pim de Monchy Roger Waugh	Flood Duty Officers	Gate closing/ opening during flood situations Gate alarms

Aspect	Organisation	Contact Person	Title	Responsibility
Telemetry	ControlTech	Karam de Lacy	Technical Director	Ricardo system - telemetry
Stakeholders	Western Bay of Plenty District Council	EJ Wentzell Peter Watson	Utilities Manager Reserves & Facilities Manager	Hazard Management Reserves/Property
	Maketu Coastguard	Shane Beech	President	Coastguard mooring
	Waterhouse Partnership	Butch Waterhouse	Company owner	Commercial mooring

Terminology

Figures 1 through 3 define the terminology given to assets in this Manual. The following terminology also applies:

Terminology	Definition
Downstream	Means water on the Maketu Estuary side of the gates
Gates	Also interchangeable with 'Slide gates' or 'Penstock gates'
Upstream	Means water on the Kaituna River side of the gates
MVD-53	Moturiki Vertical Datum

Consultation

As part of development of this Manual, a meeting was held with Western Bay of Plenty District Council Parks and Reserve and Roading staff on 22 January 2020. A separate meeting was held with the Utilities Manager (2 March 2021) to discuss operation of the gates and specifically flood measures. There is agreement between the parties regarding operational measures.

There is an ongoing requirement to meet with the District Council's Utility Manager as follows:

Condition 26.11

The consent holder shall meet with the Utilities Manager of Western Bay of Plenty District Council at least once per year to review the operation of the OMM in relation to flood management within Maketu Township.

Condition 26.12

The Consent Holder shall keep minutes of the meeting required by condition 26.11 of this resource consent. The minutes shall record:

(a) The names of those that attended the meeting;

(b) Main topics of discussion, and

(c) Any agreed outcomes.

The Consent Holder shall forward a copy of these minutes to the Regional Council within 20 working days of the meeting being held.

Figure 1 Project Arrangement

Figure 2 Salinity block arrangement

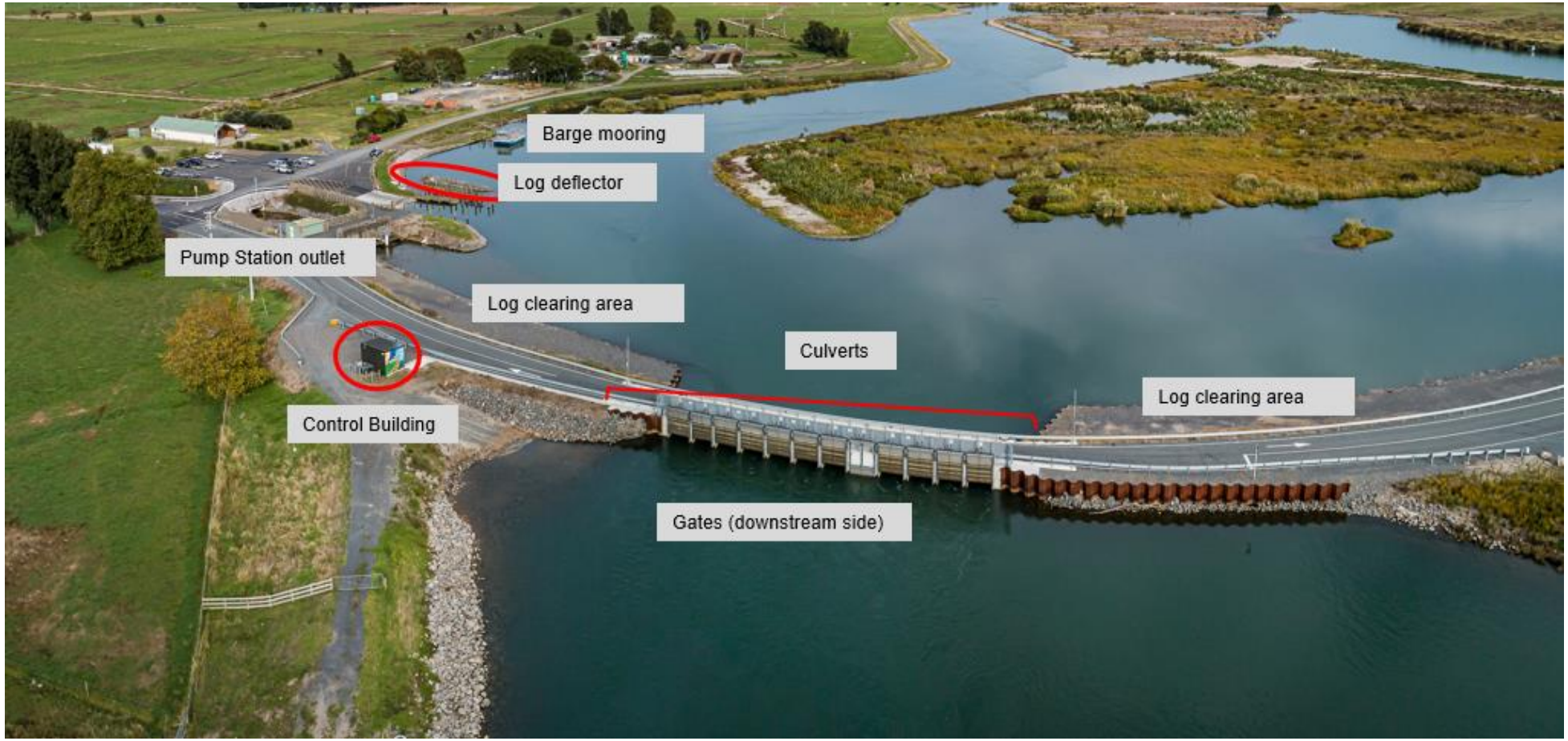

Figure 3 Diversion arrangement

Part 1:
Project assets

1.1 Introduction

The purpose of this section is to provide essential information needed to understand the assets that make up the Project.

1.2 Project assets

The following items are the responsibility of the Regional Council. Appendix 1 contains the as-builts for the gates.

A full set of the as-builts (and QA documents) are available on Council's computer network under Objective ID:fA1426285.

Table 1 Regional Council assets

Project asset	Asset description	Ownership / Maintenance responsibility
Diversion channel - Inlet - Channel - Left bank - Outlet	Entrance to diversion channel, rock rip rap Approx 600 long channel Soft edge of channel with access track End of diversion channel, no physical structures	BOPRC ownership & maintenance
Diversion channel stopbank south side	*Not part of this project as forms part of the Kaituna Catchment Control Scheme*	
Kaituna River bank riprap	Rock riprap from barge mooring to public boat facilities	BOPRC ownership & maintenance
Public boat facilities - Log deflector - Rock bund - Boat safety signage	Wooden log deflector and bund (crest at RL1.1) to protect jetty and boat ramp area	BOPRC ownership & maintenance
Waka ama posts	x2 posts for mooring Maketu Hoe Waka boat	BOPRC ownership & maintenance
Salinity Block	Saline block from construction linking Ford Road to Ford Island. 10 m wide easement for Ford Land Holdings Ltd constructed as engineered fill. Northern side of block in rip rap	BOPRC ownership & maintenance
Salinity Block moorings - Waterhouse jetty - Coastguard - Timber fences - Compound	29.1 m long timber jetty with 5 m long by 4 m wide timber vehicle platform with gate 15 m long by 4.8 m wide aluminium pontoon with 15 m long gangway with gate x2 timber security fence down rock slope Gravel parking area, x2 storage containers, security fencing, security lighting. Automatic gates by others	BOPRC ownership Waterhouse maintenance Coastguard maintenance Waterhouse and Coastguard maintenance

Project asset	Asset description	Ownership / Maintenance responsibility
	Leases held with B. Waterhouse and Maketu Coastguard	
Mooring basin	River area at end of salinity block moorings required to be maintained with a water depth of no less than 1m at mean spring low tide	BOPRC maintenance
Ford Island Erosion protection	Rip rap: Erosion zone 1 (northern side), 2 (southern end) and 3 (southern side)	BOPRC ownership & maintenance
Ford Road Drain culvert crossing	*Not part of this project as forms part of the Kaituna Catchment Control Scheme*	
Log clearing areas	Southern and northern log clearing areas either side of the culverts with lockable access gates	BOPRC ownership & maintenance
Diversion Control Structure - Culverts	- Culverts are consecutively labelled 1–12 starting from the right hand side (i.e. most right hand side Culvert is #1 and nearest to the control building). - Rip rap apron	BOPRC ownership & maintenance
- Gates and operating system	- 12 slide gates located on the downstream face of the culverts. Each gate is operated by hydraulic motor driven spindles. Hydraulic fluid supply and return is from a common Hydraulic Power Unit (HPU) located within the control building. Refer Section 1.3.1 for further details. - Gates are consecutively labelled 1–12, starting from the right hand side, to align with their respective culverts.	
- Gate Control Building	- Concrete block control building situated on the Southern bank near gate 1. - Houses the HPU, electrical and control systems and telemetry equipment. The control building also contains a set of spare parts for the gates and a copy of this O&M Manual complete with drawings.	
- Electrical and Control systems	- Electrical supply is from a step down transformer located behind the control building. This is owned/maintained by PowerCo. - The gates are normally automatically operated via Programmable Logic Controller (PLC) within the control building but are also operable remotely manually and locally manually. - The telemetry system is a RiCardo system, supplied and serviced by ControlTech.	
- Warning lights and siren	x4 warning lights with two warning sirens on poles that automatically go when gates are being raised or lowered	
Power transformer behind Control Building	*Note: the transformer is owned by PowerCo and access provided via an easement over Council land*	
Stilling wells	Kaituna River upstream of culverts: concrete well with PVC cable duct to control building	BOPRC ownership & maintenance

Project asset	Asset description	Ownership / Maintenance responsibility
	Fords Cut downstream of culverts: concrete well with PVC cable duct to control building	
Fords Cut	South bank - *Not part of this project as forms part of the Kaituna Catchment Control Scheme*	
Te Pa Ika wetland including plantings	Approximately 20 ha wetland Post and wire fence along Fords Road, gate at Maketu Spit end	BOPRC ownership & maintenance
Te Pa Ika culverts	x4 culverts allowing water movement from Fords Cut to wetland with timber drop boards	BOPRC ownership & maintenance
Papahikahawai Island bridge	Wooden pedestrian bridge approx. 40m long with rip rap at abutments	BOPRC ownership & maintenance
Papahikahawai Island Shoreline	Cheiner edge along length of south side of island	BOPRC maintenance
Navigational markers	Diversion channel - 5 knot signs Installed as per harbourmaster recommendations	BOPRC ownership & maintenance

Western Bay of Plenty District Council (WPOPDC) are responsible for the following assets:

Table 2 District Council responsibility

Asset	Asset description	Ownership / Maintenance responsibility
Fenced Compound	Ex construction compound with wire mesh fence	WBOPDC ownership & maintenance
River bank area	x1 Picnic table	
Public Boat ramp	2 lane concrete boat ramp	
Public Jetty and piles	Timber jetty Timber piles on the eastern side of the boat ramp	
Car park and swale	Sealed carpark with stormwater swale	
Ford Road	Legal road reserve. Details in RAMM database	

The following are not part of the Project:

- Ford Road Drain including the timber crib walls
- Barge mooring
- Waka ama container and boats.

1.3 Description of plant

1.3.1 Gates

The slide gates control the flow of water from the Kaituna River to the Maketu Estuary. Each of the 12 gates are identical in their design, comprising a gate leaf that slides inside a gate frame fastened to the downstream face of the concrete culverts. A set of drawings for the gates are included in Appendix 1 for reference.

Normal gate operation will be under (near) balanced head conditions (i.e. upstream water level is approximately equal to downstream water level) once the upstream water level starts to exceed the downstream water level by a nominal set point. The gates are designed to be operable up to a maximum differential head (=upstream water level minus downstream water level) of 1.6 mWC (metres of water column ie. measures hydrostatic pressure) in an extreme event for the flood protection of the Maketu township. The maximum design head results from the combination of rising limb of flood in the Kaituna River in combination with the rising tide in the estuary.

Full details of the gate operation are in Appendix 2.

Part 2:
Health, safety and environmental

2.1 General

PLEASE READ BEFORE CARRYING OUT ANY WORK/ACTIVITY ON THE EQUIPMENT SUPPLIED

The equipment has been designed and constructed to be safe for its intended purpose in compliance with relevant Health and Safety legislation. All persons concerned with the off-loading, handling, storing, installation, operation, maintenance, removal or disposal of the equipment must however comply with relevant statutory Health and Safety legislation and any regulations or requirements specific to the particular site.

It is essential that, before any work activity is carried out, that a risk assessment is made by the responsible person to identify the safety measures needed to minimize the health and safety risks. The site conditions and location of the equipment could give rise to additional hazards (e.g. drowning hazards), which must also be considered. These activities must be managed, supervised and carried out by competent persons who have had appropriate experience, training and instruction. Work personnel must be equipped with the necessary work equipment.

For day-to-day operation workers must wear steel cap boots and hi-vis vests. For maintenance activities, PPE requirements are to be included in any required JSA.

Certain maintenance activities may require that the equipment is appropriately isolated, locked off at source and de-energised (if applicable) to prevent inadvertent start up or electric shock.

2.2 Notification

Before taking the gate electrical or hydraulic or telemetry system offline for any reason, the following personnel shall be notified:

- Bay of Plenty Regional Council Flood Duty Officer -see Appendix 4 for names and contact details

2.3 Operating system isolations

2.3.1 Electrical isolations

Electrical isolations are available at the following points:

Figure 4 Electrical isolation points – Distribution board

Table 3 Isolation point identification

ID	Isolation point	Description
1	Motor Starter Circuit Breakers	Isolates motor starters which in turn isolates the electric motors on the pumps. Isolation does not affect the Control system.
2	Change over switch	Used to select the power source either set to ‘Mains’, ‘Off’ or to ‘Gen’ (Generator). When set to ‘Off’, isolates all power downstream of the distribution board.
3	Main Switch	On/Off control for Mains power supply
4	Generator Switch	On/Off control for generator power supply
5	Step-down transformer (not shown)	Any/all isolation to be arranged with and provided by PowerCo (Transformer Owner). Isolation of the control building will not affect the Coast guard power supply.

2.3.2 Hydraulic system isolations

Following isolation of the electrical system, any/all remaining hydraulic system pressure must be relieved from the header lines before work can commence on the gates and their operating systems.

This is achieved by:

1 Opening the connecting balancing valve between the supply and return header pipe on the HPU, as depicted below in Figure 5.

2 Check/confirm that the pressure gauge on the HPU has returned to zero following opening of the balancing valve before commencing any work on the hydraulic system.

3 Lock the valve in the fully open position to prevent accidental system energisation.

Note: The hydraulic system will naturally balance over time due to leakage of hydraulic fluid from the high pressure header through each of the gate control valves to the low pressure header. This however SHOULD NOT replace the above steps for any/all hydraulic and gate maintenance.

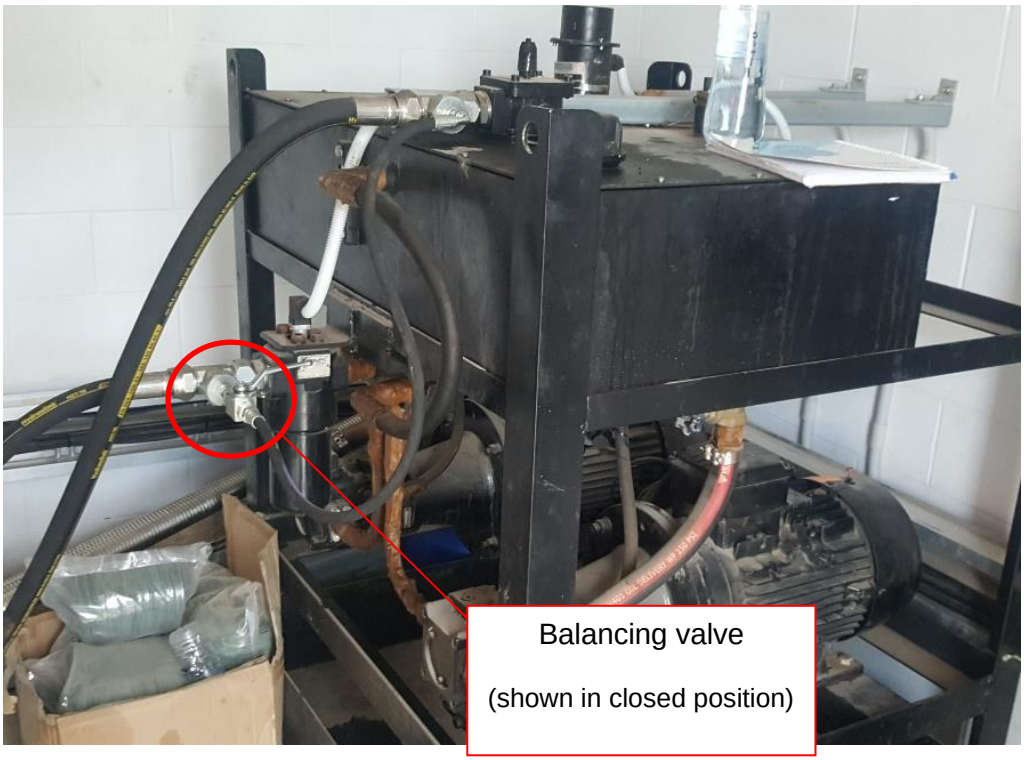

Figure 5 Hydraulic system pressure equalising valve - HPU

Note: Hydraulic pressure equalisation can also be achieved by a second balancing valve between the two header lines at Gate 12 as depicted in Figure 6 (Valve with BLUE HANDLE). The valve handle is normally removed and stored inside the control building to prevent tampering by unauthorised personnel. Access to this valve is limited by the security fence and there is no lock-out facility available on the valve. As such, the bypass valve at the hydraulic pack shall be used in preference of this valve.

Figure 6 Hydraulic system pressure balancing valve – gate 12

2.3.3 Oil spills

In the event that there is an oil leak that may enter water call the Regional Council pollution hotline on 0800 884 883.

A bucket with absorbent material to be used for spills can be found in the Control Building.

2.4 Slide gates

IMPORTANT- LIFTING EQUIPMENT AND LIFTING POINTS:

It is BOPRC's responsibility to ensure that a competent person thoroughly examines any lifting equipment at regular intervals and prior to use. This includes the requirement for any statutory examinations and test certification, subsequent to the date of supply. Any safe working loads indicated on the lifting eyes or lifting beams should not be exceeded. Lifting equipment may have been designed/sized for the particular unit(s) supplied and should not be used on units for which they were not intended.

Always use designated/marked lifting points.

Some units may indicate points from where the unit must not be lifted which must be observed.

For lifting vertically, a lifting tackle should be attached to the main frame. Always attach to the frame by means of suitable lifting eyes/shackles and never use hooks directly onto the unit. Units must never be lifted inverted. The approximate weight of the unit (less any associated operating gear), is indicated on the rating plate (or CE plate) and should be used as a guide for the selection of suitable lifting equipment of adequate safe working load (SWL) capacity.

IMPORTANT-WORK ACTIVITY UNDER RAISED DOORS:

Slide gates must be adequately physically secured before any work is carried out directly adjacent, or underneath, or when anyone is required to pass under or through the unit aperture.

Reliance should not be placed on the operating gear/spindle arrangement or solely on the transit stop to secure the slide gate.

Spindle nuts can be subject to wear, particularly those immersed in the liquid where grit and debris can cause rapid or excessive wear. This can result in the threads being unable to support the weight of the door.

THE DOOR COULD FALL/DROP WITHOUT WARNING

Wear should be minimised by the use of recommended lubricants (see maintenance section) and by carrying out inspection and maintenance at appropriate intervals. Your attention is drawn to the important note above prior to conducting any inspection or maintenance activities.

2.5 Temporary traffic management

Due to the width of the culvert crossing, a road closure will typically be required to carry out major maintenance on the gates or when there are emergency situations. Small maintenance tasks, depending on their nature, may be achieved by opening one of the various fence panels for access to the gates.

Road closure will require a current Traffic Management Plan (TMP). **The plan needs to be resubmitted every 12 months to Westlink.**

Before a closure is to take place the Site Traffic Management Supervisor (STMS) needs to drive site clearing anyone who is fishing off the cut. If closure is going to take less than an hour the STMS is to brief the public explaining what is happening and keeping clear communication with them as to when it will be open again.

Table 4 includes the TMP equipment required and this is stored in the control building.

Table 4 Minimum TMP Equipment for road closure

Item	Quantity
Road Closed Ahead sign	1
Road Closed sign	1
Residents only sign	1
Sign Stand	3
Sign Base	3
Cones	10

Part 3:
Regime to maximise ecological outcomes

The consent conditions (condition 26.4(a)) require that the re-diversion be operated to maximise ecological outcomes and to manage the flow regime and discharges such that the adverse effects attributable to the Project are minimised.

When set to 'AUTO' mode, the gates will operate automatically as the result of a difference in water levels between the upstream and downstream sides of the culverts.

Water level is measured by two hydrostatic pressure transducers installed in stilling wells on the upstream and downstream sides of the culvert structure. The gates automatically operate to maximise the flow of river water into the estuary, and close to prevent water flowing from the estuary to the river when river levels are low. Setting the gates to operate this way, based on the tides, maximises the potential ecological outcomes by maximising the volume of freshwater.

The culverts were designed and installed to ensure fish passage other than when the gates are closed.

Regular ecological and water quality monitoring is undertaken to gauge the health of the estuary. Results to date have confirmed an increase in this health. Nevertheless, this will be closely monitored, and in the event deleterious signs are seen the flow regime will be altered.

The ecological monitoring includes:

Parameter	Requirement	Condition
Water quality	Once within two years of Stage 1, then annually for five years after Stage 1 (Jan-Mar). From Stage 1, three times per year	Condition 32.1 – dissolved oxygen, temperature, salinity Condition 32.4 – nitrogen, phosphorus, salinity, bacteria
Shellfish	From Stage 1, three times per year Annually from Stage 1 for five years	Shellfish flesh – bacteria Pipi survey, core samples
Ecology Flora	Transect 9, 10 and 11: No less than one month prior to Stage 1, within six months of Stage 1, then annually for five years. Transect 1-6: within six months of Stage 1, then annually for five years.	Condition 34.1 – terrestrial and wetland vegetation
Ecology Flora	Prior to Stage 1, then six monthly got two years.	Condition 34.5 – vegetation composition and spatial extent
Sediment & algae	Once prior to Stage 1 commissioning, once within two years of Stage 1, once within five years of Stage 1.	Condition 35 – survey of algae & sediment

Part 4:
Flow regime operation

4.1 Day to day operations

As described in section 2.3.1.

Everyday operation of the gates is programmed to operate automatically as the result of a difference in water levels between the upstream and downstream sides of the culverts.

Water level is measured by two hydrostatic pressure transducers installed in stilling wells on the upstream and downstream sides of the culvert structure. The gates automatically operate to maximise the flow of river water into the estuary, and close to prevent water flowing from the estuary to the river when river levels are low.

4.2 Power outages

All network scheduled power outages are notified to the Accounts Payable at BOPRC who then auto-forward these as required. Scheduled outages are notified to:

- Pim de Monchy, Coastal Catchments Manager
- Duty Flood Manager
- Rivers and Drainage team – Kerry Smith (Area Engineer), Jason Rive (Works Foreman) and Arty Rangihika (Works Coordinator).

If the gates are open when the power is cut there is a risk they will stay open longer than appropriate allowing large back flows from the estuary to the river.

If necessary, the gates are to be closed remotely by the Flood Duty Manager.

There are provisions for a back-up electrical supply (in the event of mains power failure) via connection of a portable diesel generator.

4.3 Flood operation

In a flood situation, where gates need to be closed, the gates need to be operated manually (either remotely or on site). A description of the flood requirements is set out in detail in the Flood Warning Manual provided in Appendix 7 and summarised here.

A gates closure decision matrix is used to determine how many gates need to be closed in a flood situation. The matrix is based on four components:

1 EcoConnect Software: forecast sea state data offshore from the Kaituna River mouth.

2 Sea level at the Kaituna River mouth: transformation of the EcoConnect forecast sea state data.

3 Kaituna River Flow Forecast Data: generated from the BOPRC Non-Linear Reservoir Flood Forecasting System.

4 Trigger Level Decision Matrix: combine the forecast River Flowrate and the River mouth Sea State Level to determine whether a critical water level will be exceeded within the Maketu Estuary just offshore of Maketu Village.

The critical estuary flood level adjacent to Maketu at which flooding of the township begins has been determined at 1.6 m (MVD-53). The gates should be closed before the Maketu critical level is reached. Gate closure details for 1.4 m and 1.5 m (MVD-53) critical levels are presented below.

Table 5 Gate closure decision matrix for critical peak water level of 1.4 m at Maketu township

Kaituna River Flow (m^3/s)	Maximum Water Level at River Mouth (m MVD-53)				
	1.1	1.2	1.3	1.4	1.5
100	Open	Open	Open	Open	Open
300	Open	Open	Open	Open	Close Nine
400	Open	Open	Open	Open	Close Nine
500	Open	Open	Open	Close Nine	Close Nine
600	Open	Open	Open	Close Nine	Close All
700	Open	Open	Close Nine	Close Nine	Close All
800	Close Nine	Close Nine	Close Nine	Close Nine	Close All

Table 6 Gate closure decision matrix for critical peak water level of 1.5 m at Maketu township

Kaituna River Flow (m^3/s)	Maximum Water Level at River Mouth (m MVD-53)				
	1.1	1.2	1.3	1.4	1.5
100	Open	Open	Open	Open	Close Nine
300	Open	Open	Open	Close Nine	Close All
400	Open	Open	Open	Close Nine	Close All
500	Open	Open	Close Nine	Close Nine	Close All
600	Open	Open	Close Nine	Close All	Close All
700	Close Nine	Close Nine	Close Nine	Close All	Close All
800	Close Nine	Close Nine	Close Nine	Close All	Close All

Table 7 Water level and flow at the Tauranga Eastern Link (TEL) Bridge, Fords Cut and Kaituna River mouth.

Kaituna River Flow (m^3/s)	Water Level (m MVD-53)								
	TEL			Fords Cut			River Mouth		
	-1.0 m	1.1 m	1.5 m	-1.0 m	1.1 m	1.5 m	-1.0 m	1.1 m	1.5 m
100	1.00	1.47	1.75	0.26	1.17	1.54	0.14	1.15	1.53
300	2.54	2.60	2.68	1.41	1.63	1.84	1.23	1.50	1.75
400	3.01	3.04	3.08	1.81	1.92	2.04	1.64	1.77	1.93
500	3.40	3.42	3.44	2.13	2.19	2.26	1.99	2.06	2.15
600	3.74	3.75	3.76	2.40	2.43	2.48	2.28	2.33	2.38
700	4.04	4.04	4.05	2.64	2.66	2.70	2.53	2.57	2.61
800	4.30	4.31	4.32	2.85	2.86	2.90	2.75	2.77	2.81

If communications are out and data cannot be obtained when on site (for example in the middle of a storm event), take a conservative approach to closing the gates. Manual water level readings can be taken from the staff gauges (where the stilling wells are) upstream and downstream of the gates and the tide height gauge at Park Road, Maketu.

4.3.1 Gate closure duration

The table below is based on a coincident and non-coincident peak scenario with the peak river flood level occurring at the same time as the peak river mouth sea state situation. A conservative approach should be taken and the 1.4 m scenario applied as per the Flood Warning Manual.

Level scenario	Duration of gate closure for Critical Level of 1.4 m	Duration of gate closure for Critical Level of 1.5 m
Coincident River Flood and River Mouth Peak Level	Close at least two hours before peak sea state time Open seven hours after peak sea state time	Close at least two hours before peak sea state time Open six hours after peak sea state time
Non-Coincident River Flood and River Mouth Peak Level	Close three hours before peak sea state time Open seven hours after peak sea state time	Close three hours before peak sea state time Open six hours after peak sea state time

Part 5:
Non-gate inspections and maintenance

This section covers inspection and any maintenance requirements associated with all other parts of the Project except for the gates.

5.1 Inspection requirements

Inspections of the project area should be carried out at the following intervals:

- Three monthly during the Contractor's Defects Liability Period this is until 30 March 2022 for the gates.
- Six monthly thereafter.
- After significant weather events such as when the water level at the Fords Cut level recorder exceeds 2.8 m (Chart Datum).

Detailed check sheets are provided in Appendix 5 to aid the inspections. If there are no problems with an item it should be given a tick, otherwise a brief description of the issue should be given and anything considered urgent highlighted. Photos should be taken of particular concerns.

A table is provided at the end of the check sheets so that any work that is required can be entered with more detail, photos and a priority.

It is anticipated that the inspections will be carried out on foot except for those of the Te Pa Ika Wetland and Papahikahawai Island, which can be carried out by drone. An inspection by boat or foot may be considered if a drone inspection shows any areas requiring a more careful investigation.

Inspections inside the culvert barrels have not been included as a routine. It is considered that these would only be required if it is suspected that debris has become jammed in a barrel or has caused some damage to a gate frame. These inspections should be carried out at slack tide.

If a close inspection of gate seals and frames is required, it could be carried out by boat at slack tide or from a man cage suspended from the road level. Any blockage of the road will require works to be undertaken in accordance with traffic management plan requirements.

Sections of the project works will revert to Western Bay of Plenty District Council following completion of the Defects Liability Period, as given in the table below. During the Defects Liability Period the Contractor will be responsible for any maintenance and repair work (except for plantings). The responsibility will revert to the District Council following this period.

Table 8 Items reverting to Western Bay of Plenty District Council control

Item	Contractor's Liability Period (from April 2020)
Ford Road	24 months

5.2 Maintenance

The maintenance requirements for most of the project works are typical of any stopbank system with rock rip rap protection; only those structures/features specific to this project are discussed below. The required frequency of this maintenance can only be determined after a period of operation of the river diversion.

5.2.1 Erosion protection works

The resource consent conditions require that all structures are maintained in a sound condition and that any maintenance works be carried out as soon as reasonably practicable.

All erosion control works (rock work) that are part of the protect are included in the maintenance inspection check sheets.

The only rock used shall be free of contaminants and any mud, soil, clay or other soluble debris.

Maintenance works shall not increase the scale of the protection works without first confirming any resource consenting requirements.

If maintenance works are required on the protection works around Ford Island, prior notification of the works (nature of the works and timing) shall be provided to the property owner (will be either Ford Land Holdings Pty Ltd or Western Bay of Plenty District Council).

5.2.2 Timber jetties

The District Council is responsible for the public jetty and B. Waterhouse for the commercial jetty.

Any marine growth should be water blasted off the decks, bearers and braces as needed. The required frequency for this cleaning will be determined by the rate of growth. Special attention should be paid to the condition of the decks and non slip geogrid. Rubbing strips should be replaced if damaged.

5.2.3 Log deflector and rock bund

It may be necessary from time to time to clear debris from these two structures. This could be carried out using a long reach excavator from the shore or by using a boat. If possible, the debris could be moved towards the southern log clearing area where is can be lifted out of the water. A site specific safety plan would be required for this work.

5.2.4 Boat ramp

The District Council is responsible for the public boat ramp

The boat ramp should be water blasted down to low tide level to remove marine growth and clear any build up of sediment from the grooved surface. If there is significant damage to the grooved surface it should be repaired using standard concrete repair techniques.

5.2.5 Slide gate area

The area between the protective fence and the slide gate frames should be water blasted to remove any accumulated debris and moss. Care should be taken to remove any debris that lands on the slide gate seal area.

5.2.6 Gates

See Appendix 6.

5.2.7 Log clearing yards

Any accumulated debris or logs around the culvert inlets should be removed by using a long reach excavator from the log clearing yards. Occasionally it may be necessary to access the debris from Ford Road. This would require a traffic management plan. The debris should be loaded onto the clearing yards or directly into trucks for removal from site. Standard operating and safety procedures should be applied. Any damage to rip rap caused by the work should be repaired.

5.2.8 Salinity block and moorings

There are two leases and licences held over the salinity block compound and moorings. The lease agreements contain a number of maintenance requirements.

Item	What	Who/When
Compound containing Coastguard container, Waterhouse container/diesel tank, Automatic gate	Maintenance is the responsibility of the leases as the assets are owned by them The compound area is to be kept by the leasees in a clean and tidy condition	
Compound Fence	The top of the ground beam forming the fence foundations should be water blasted when similar work is being carried out to remove any build up of material around the base of the fence posts or in the gate track to improve drainage and reduce the rate of corrosion.	Leasees As required
Timber fences	Water blasted to clean off any marine growth as required.	Leasees As required
Coastguard gangway, pontoon and gate	The Coastguard are to undertake inspections of the pontoon and forward the inspection information to BOPRC: Anodes - monitored and replaced before they are completely dissolved Antifouling - monitored for growth and reapplied once heavily fouled Hinge bolting arrangement on the gangway abutment - monitored for wear Rubbing strips on the pontoon end (underside) of the gangway - monitored for wear	Annual 2 yearly Annual Annual
Waterhouse vehicle platform, wooden jetty and gate	The lessee is responsible for all maintenance of the facilities	

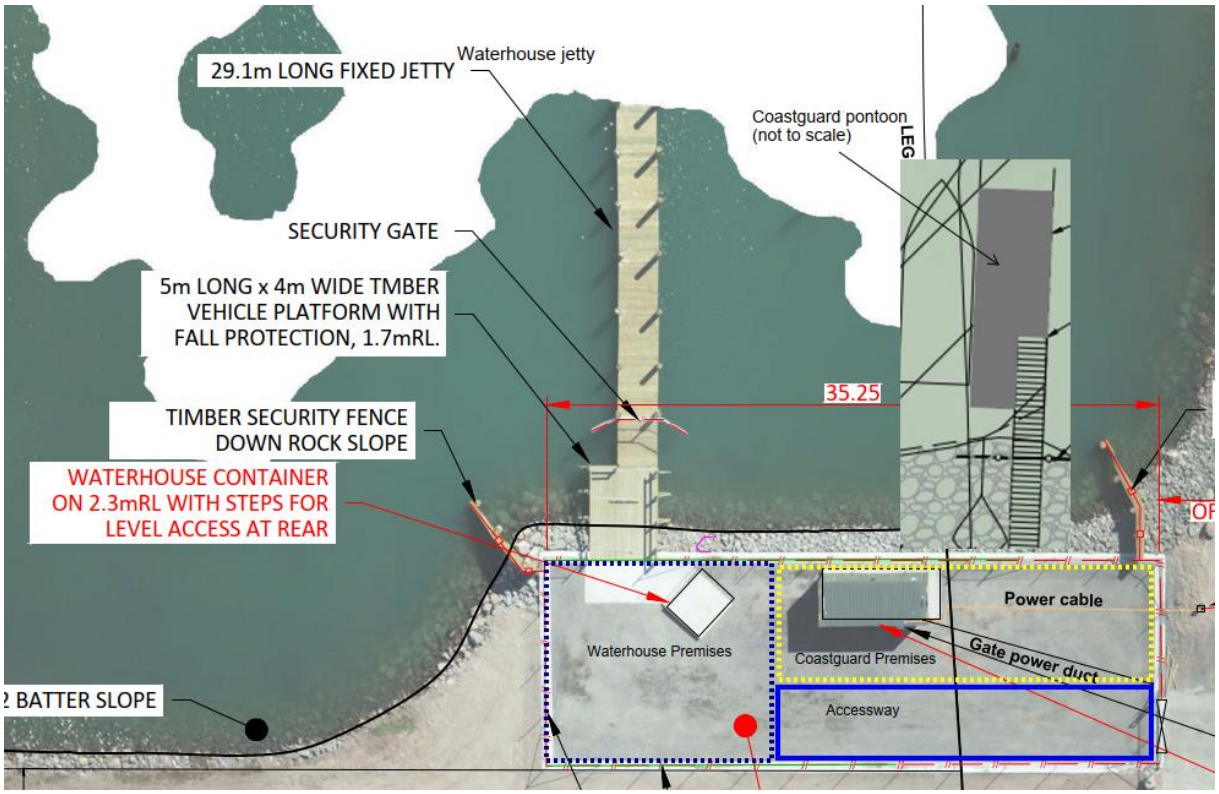

Figure 7 Waterhouse and Coastguard facilities including compound area.

Part 6:
Diversion structure: Inspection, maintenance and testing requirements

6.1 Summary

Appendix 6 contains the list of inspections, testing and maintenance requirements in the form of a checklist. In summary, checks are required at the following intervals:

Item	Weekly	3 monthly	6 monthly	Annual	Other
Gates	X	X	X	X	2 yearly
Gate hydraulic system	X	X		X	
Electrical and control systems	X	X			5 yearly
Telemetry				X	

6.2 Lubricants and oils

For the gates the following are RECOMMENDED LUBRICANTS:

For general lubrication under normal operating conditions it is recommended that Rocol Saphire 2 (or equivalent) is used for greasing spindle threads, door nuts (or yoke sleeves) and thrust housings.

For seawater applications or modulating applications in seawater, it is recommended that Rocol Tuffgear Universal (or equivalent) is used.

The spindle thread and nut should be cleaned and lubricated in accordance with the lubrication recommendations below for modulating applications.

For the Gate Hydraulic System

The pump is fitted with a pressure line oil filter plus a return line filter fitted to the reservoir lid. The pressure filter element can be replaced by removing the bowl from the head. The return filter element can be replaced by removing the cover plate. Filter replacement intervals vary dramatically depending on running time, ambient conditions and temperatures. Filter clogging switches are fitted to warn of the need for replacement.

6.3 Spare parts

A list of spare parts is provided in Appendix 3.

Part 7:
Other

7.1 Process for investigating complaints

Where a complaint or enquiry has been received related to the operation of the project the following process is to be followed. Complaints/enquiries could come via email, phone (e.g. pollution hotline) or in writing.

Details of complaint/enquiry

Where possible the following details should be obtained:

- Name, phone number and email address
- Date of incident or contact with Council staff member
- An explanation - the what, when and why of the complaint/enquiry.

Timeframes for resolving complaints

When receiving complaints/enquiries, aim to acknowledge within two working days and respond or resolve within 15 working days. If more time is required to respond this should be communicated to the party.

Assessing complaints

A written record is to be made documenting the nature of the complaint, any findings and any action proposed to be taken. Any outcomes should be communicated back to the complainant.

7.2 Stakeholder engagement

A meeting is to be arranged with Western Bay of Plenty District Council on an annual basis to review operation of the gates in relation to flood management at Maketu township.

Appendices

Appendix 1:
Drawings

Part	Drawing No	Title
Gates		*All drawings by Penstocks*
	18116-01-01_Sht 1	2500x2500 F35S Penstock
	18116-01-01_Sht 2	2500x2500 F35S Penstock
	18116-01-02	Workshop Assembly
	18116-01-03_Sht 1	Frame Weldment
	18116-01-03_Sht 2	Frame Weldment
	18116-01-04_Sht 1	Gate Weldment
	18116-01-04_Sht 2	Gate Weldment
	18116-01-05	Stem Detail
	18116-01-06	Side Seal Retainer Bar – LHS
	18116-01-07	Cross Seal Retainer Bar
	18116-01-08	Frame Front Headrail Weldment
	18116-01-09	Headrail Infill Pressing
	18116-01-10	Bronze Thrust Nut
	18116-01-11	Bronze Limit Nut
	18116-01-12	Non Rising Steam Thrust Washer
	18116-01-13	Cover Guide Strip
	18116-01-14	Spacer Guide Strip
	18116-01-15	Invert Infill Strip
	18116-01-16	Frame Gasket
	18116-01-17	Frame Invert Rail Pressing
	18116-01-18	Frame Invert Seal Angle Pressing
	18116-01-19	Frame Cross Rail Pressing
	18116-01-20	Side Rail Pressing
	18116-01-21	Frame Channel Pressing
	18116-01-22	Gate Stiffener Pressing
	18116-01-23	Gate Top Stiffener Pressing
	18116-01-24	Gate Vertical Stiffener
	18116-01-25	Headrail Front Channel Pressing
	18116-01-26	Upper Frame Anchor Plate
	18116-01-27	Invert Seal Retainer Bar
	18116-01-28	Headrail Mounting Plate
	18116-01-29	Compensating Plate SS F14
	18116-01-30	Thrust Nut Pressing
	18116-01-31	Left Plate Weldment
	Hydraulic Schematic	
Electrical Supply	D000	Single Line Diagram
	D005	Main Switchboard Layout
	D006	Control Panel Layout
	D050	24VDC UPS Power
	D051	PLC & Touch Screen
	D101	Gate 1

Part	Drawing No	Title
	D102	Gate 2
	D103	Gate 3
	D104	Gate 4
	D105	Gate 5
	D106	Gate 6
	D107	Gate 7
	D108	Gate 8
	D109	Gate 9
	D110	Gate 10
	D111	Gate 11
	D112	Gate 12
	D201-1	PMP-1 Pump 1
	D201-2	PMP-1 Pump 1
	D202-2	PMP-1 Pump 1
	D202-2	PMP-1 Pump 1
	D300	Hydraulic Protection & Duty
	D301	Flashing Lights & Sounder
	D302	E Stop
	D400	LT-01 Up Stream Level
	D401	LT-02 Up Stream Level
	D500	Equipment List
Culverts	3934527-SE-015	General and concrete notes
	3934527-SE-016	General arrangements
	3934527-SE-017	Precast concrete culvert units
	3934527-SE-018	Precast concrete retaining wall units
	3934527-SE-019	Miscellaneous
	3934527-SE-020	Scour apron details
	3934527-CA-045	Sheet pile plan and sections
	3934527-CA-051	Sheet pile and culvert as-built information
	T6766-1	Hynds shop drawings
Control Building	3009026-071	Nominal layout and building services plan
	3009026-072	Nominal section
	3009026-101	General notes Sheet 1
	3009026-102	General notes Sheet 2
	3009026-107	Service trench and drainage, Typical sections and details
	3009026-111	Slab plan and equipment layout
	3009026-112	Roof framing plan and roof plan
	3009026-116	Slab reinforcing plan
	3009026-121	Exterior elevations Sheet 1
	3009026-122	Exterior elevations Sheet 2
	3009026-123	Control building sections
	3009026-126	Wall reinforcing elevations Sheet 1
	3009026-127	Wall reinforcing elevation Sheet 2
	3009026-131	Floor slab sections and details Sheet 1
	3009026-132	Floor slab sections and details Sheet 2
	3009026-133	Floor slab sections and details Sheet 3
	3009026-141	Blockwork wall section Sheet 1

Part	Drawing No	Title
	3009026-142	Blockwork wall sections Sheet 2
	3009026-151	Roof framing sections and details Sheet 1
	3009026-152	Roof framing sections and details Sheet 2
	3009026-156	Door details Sheet 1
	3009026-157	Louvre details Sheet 1
Ford Road drain crossing	417786-T-S-D041	As-built plan
	13957 Sheet 1	Aerial plan
	13957 Sheet 2	General arrangement
	13957 Sheet 3	Internal unit
	13957 Sheet 4	Long Section
	13957 Sheet 5	Typical culvert detail
	13957 Sheet 6	Side elevation
Boat Ramp	145630 00 4100	Locality Plan
	145630 00 4101	General Notes
	145630 00 4102	General arrangement plan & long section
	145630 00 4110	Typical Cross sections
	145630 00 4120	Typical Details - Sheet 1 Precast concrete details
	145630 00 4121	Typical Details - Sheet 2 Precast concrete connection details
	145630 00 4122	Typical Details - Sheet 3 cast insitu reinforcement / concrete details
	145630 00 4123	Typical Details - Sheet 4 Surface treatment
	145630 00 4124	Ramp extension details
Log deflector	3934527-CA-036	Log deflector typical detail
Public Jetty	3934527-CA-039	Jetty Plan
	3934527-CA-039	General arrangements and details
Ford Road & carpark	417786-T-S-D042	Car park final contour
	417786-T-S-D042	Final contour south of culverts
	417786-T-S-D042	Final contour salinity block
	417786-T-S-D042	Car park
	417786-T-S-D042	Underground services
	417786-T-S-D042	Guard rails south of culverts
	417786-T-S-D042	Final contour north of culverts
	417786-T-S-D042	Guard rails north of culverts
Pontoon	DR-190904-001	General details
	200-02-09	Gangway skid detail
Waterhouse jetty	3934527-CA-028	Jetty and pontoon sections
	3934527-CA-031	Vehicle platform
	3934527-CA-032	Waterhouse jetty
	3934527-CA-020	Timber pile depths and levels

Appendix 2:
Plant and gate operation

1 Description of plant

1.1 Gates

Each gate comprises:

- A 2.5 m x 2.5 m square sliding leaf for the isolation of the culvert openings. The leaf comprises a flat skinplate supported by horizontal structural steel members welded to the downstream face of the skinplate. The leaf seals on all four sides, on UHMWPE (top and side seals) or EPDM seals (bottom seal) fitted to the gate frame.

The gate leaf is unpainted, 2205 Duplex Stainless steel.

- A gate frame in which the gate leaf slides and hydraulic motors are mounted to.

The gate frame is painted, 2205 Duplex Stainless steel, fixed to the downstream face of the culverts by 2205 epoxy grouted studs. The frame is sealed against the culvert faces via grout between the positioned frame and culvert.

In the interests of longevity, the frame includes added corrosion protection by way of proprietary coating by Carboline, containing a priming layer, two over coats and a top coat of anti-fouling for a total dry film thickness of 350 micron. Details of the paint mix can be found in Appendix 3.

- A 2205 duplex operating spindle (protected by Hypalon bellows), driven by a hydraulic motor, which translates the gate leaf up and down the gate slots. The spindle is greased on assembly and topped up with grease car of an automatic lubricator located under the top gate girder, with grease line entering the thrust nut. The automatic lubricator requires yearly top up or replacement. The spindle is protected from debris by a hypalon bellow.

1.2 Hydraulic system

A single Hydraulic Power Unit (HPU) is located in the control building and provides pressurised oil to a common supply header that in turn supplies each of the 12 gates with high pressure oil. The HPU is fitted with 2 x 100% variable displacement pumps, suitable for operating up to six (6) gates at any one time at the maximum design head differential.

Each penstock is driven via hydraulic motor connected to the supply header that drives a reduction gearbox and non-rising spindle. The hydraulic motor and gearbox assembly are mounted on top of the gate frame.

Oil supply to each hydraulic motor is by spring return solenoid valve, allowing control of any one gate at a time or any combination of gates up to six (6) simultaneously in an opening or closing time of approximately 10 minutes.

The solenoid control valves are fitted with an emergency rotary manual override, plus a pressure compensate flow control to regulate the penstock speed irrespective of how many gates are being operated.

The hydraulic system is filled with a biodegradable water/Glycol solution.

Each coil has an LED plug to indicate which valve is energised. In the event of an electronics system failure, if the AC motors can still be started, the gates can still be opened and closed using the manual override knobs on each end of the directional valve. Turn the knob fully clockwise to energise the valve. Turn the knob fully counter-clockwise to stop.

WARNING: Operating the gates using the manual override also overrides the gate limit switches that normally stop the gate operating once they have reached either their fully open or fully closed positions. Accordingly, Operators must manually stop the gate from moving. Failure to manually stop the gate may lead to damage of the gate and possibly gate frame.

A Pressure relief valve is included at the hydraulic pack for protection of the drives from overload. Isolating check valves on each pump will allow one motor/pump to service all 12 gates in an emergency, at reduced speed.

When the power pack is turned on, system pressure will rise to 110 bar and will maintain this pressure whether the gates are working or not.

The hydraulic oil reservoir is fitted with a 1kW, 240 V single phase heater and an adjustable thermostat. The thermostat should be set to 20°C. and a permanent power supply provided. An over temperature switch is fitted to the oil reservoir set to 60°C. This is incorporated into the system shutdown to prevent overheating in case of a systems failure.

1.3 Summary of Design Parameters

Table 9 Summary of design parameters

Item	Description	Unit	Value
1	**Gates**		
1.1	Sealing Height	m	2.5
1.2	Sealing Width	m	2.5
1.3	Maximum design head on sill		
1.3.1	*On seating direction*	m WC	1.6
1.3.2	*Off-Seating direction*	m WC	1.6
1.4	Materials		
1.4.1	*Gate Leaf*	-	2205 Duplex Stainless Steel
1.4.2	*Gate Frame*	-	2205 Duplex Stainless Steel, painted
1.4.3	*Gate Spindle*	-	2205 Duplex Stainless Steel
1.5	Gate stroke	m	2.5
1.6	Operating Speed		
1.6.1	Raising	mm/min	250
1.6.2	Lowering	mm/min	250
2.0	**Hydraulic System**		
2.1	Normal operating pressure	Bar	110
2.2	Pressure relief valve setting	Bar	120

Item	Description	Unit	Value
2.3	Maximum number of gates operable at any one time under maximum design head on sill	-	6
2.4	Oil type	-	Fuch Plantohyd 46 (Biodegradable oil)
2.5	Motor size	kW	2 x 15 (fitted with VSD)
2.6	Pump duty	-	2 x 100%
2.7	Pump type	-	Variable displacement

2 Gate operation

2.1 General

This section describes gate operation from the following points:

1 Power Supplies
2 Gate Controller Settings
3 Automatic Gate Operation
4 Equipment
5 Manual, local, control board operation
6 Manual, local, HMI operation
7 Manual, local (at Gate) operation
8 Manual, remote, operation (Ricardo System)
9 Hydraulic Sytem
10 Electrical
11 Trouble Shooting

The following extracts are taken from the Contractor's O&M submissions.

If any tight spots should be encountered when opening or closing the gates, do not try to overcome these by exerting an abnormally high force, because this could cause damage to the spindle or nut. In such cases the first priority should be to determine and clear the cause of any obstruction.

Note: the risk of this potential problem will be minimised if the maintenance recommendations are carried out (Refer Appendix 6).

The life of a gate unit will be prolonged if minimum force to achieve the leakage requirements is utilised at the fully closed position. DO NOT alter settings of torque limiters, pressure relief valves or limit switches.

2.2 Power supplies

A full set of electrical drawings are provided in Appendix 1.

The gates electrical supply is normally from a 400V mains connection to the transformer located outside the control building.

Provisions for a back-up electrical supply (in the event of mains power failure) is available via connection of a portable diesel generator (DG) plugged into the socket on the control room wall (Figure 1 refers). Connection of the DG is via a penetration through the control room wall directly beneath the socket.
This allows the DG to remain connected to the socket without having to have the control room doors remain open beyond the initial connection.

The socket is 125A, V = 400 V, 5 pin configuration – see Figure 1. Max portable DG size is 86.6kVA. Portable diesel generator size can range between 20-80kVA, on the basis that the DG plug matches the socket.

Portable diesel generators are available for hire through:

- ControlTech, Whakatane & Mount Maunganui, 07 219 0661 or Karam de Lacy 027 4993 944
- NES Hire – Power & Pump Solutions, 25b Newton Street, Mount Maunganui, 0800 999 582 – 24/7 service and call out
- Edgecumbe Hire, 3 Ngaio Place, 07 304 8279 or 027 630 0045

The change the supply from mains to DG:

- Rotate the ‘Main Switch’ on the distribution board from the on position (red ‘I’ symbol) to the off position (green ‘O’ symbol).
- Rotate the selector switch (blue in colour) from ‘Main’ to ‘Gen’ position.
- Rotate the ‘Generator’ switch on the distribution board from the off position (green ‘O’ symbol) to the on position (red ‘I’ symbol).
- Start the diesel generator.

Note: The gate controller has a battery pack connected allowing it to stay online for up to eight hours after a loss of power to the site. The battery pack is only for the control system and will not start the pumps.

Figure 1 Portable Diesel Generator socket.

2.3 Gate controller settings

Figure 2 summarises the gates settings, available through the HMI.

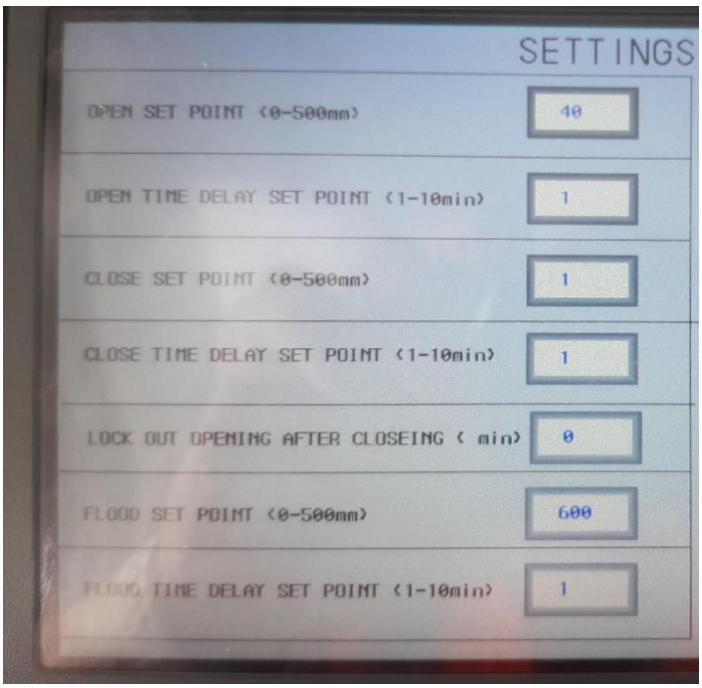

Figure 2 Gate Settings

2.3.1 Automatic gate operation

The gates are normally left in Automatic mode.

When set to 'AUTO' mode, the gates will operate automatically as the result of a difference in water levels between the upstream and downstream sides of the culverts.

Water level is measured by two hydrostatic pressure transducers installed in stilling wells on the upstream and downstream sides of the culvert structure. The gates automatically operate to maximise the flow of river water into the estuary, and close to prevent water flowing from the estuary to the river when river levels are low.

The gates are <u>not</u> programmed to operate in the event of a flood however, will raise an alarm once a predetermined flood level is reached so that an operator can take manual control of the facility.

2.3.2 Operating sequence

When the system is left in automatic mode on an open condition the siren and flashing lights will operate for 30 seconds.

1 The Hydraulic pump will then run for 10 seconds to build up pressure.

2 Once the above start-up delays have passed, Gates 1,3,5,7,9,11 will open.

3 Once these gates have reached the fully open position Gates 2,4,6,8,10,12 will open.

If any gate is **NOT AVAILABLE**, or **FAULT**, the control system will skip the unavailable/ faulted gate and continue operating the remaining gates. An alarm indicating the fault will be raised.

A gate will **FAULT** if it fails to open within **GATE FAULT SET POINT (1-600s)**.

The **GATE FAULT SET POINT** is currently set to 16 minutes.

When closing the sequence will operate in reverse order.

2.3.3 Open condition

When the upstream level is greater than **OPEN SET POINT** for **OPEN TIME DELAY SET POINT**.

- The OPEN SET POINT is the water level difference between upstream and downstream.
    - +ve values means that the upstream level is greater than the downstream level resulting in flow from the river into the estuary.
    - -ve values means that the upstream level is less than the downstream level which will result in flow from the estuary into the river (and is to be avoided).
    - The current setting is 40 mm. This range is adjustable between the ranges of 0-500 mm via the HMI.
- OPEN TIME DELAY SET POINT is the minimum time at which the OPEN SET POINT must be reached or exceeded before the gates will open. This is to avoid multiple start/stops in quick succession while the water conditions are stabilising.

- This time delay is adjustable on the HMI between a range of 1-10 minutes.
- Current setting is 1 minute.

2.3.4 Close condition

When the downstream level is greater than **CLOSE SET POINT** for **CLOSE TIME DELAY SET POINT**.

- The CLOSE SET POINT is the water level difference between upstream and downstream.
  - +ve values means that the upstream level is greater than the downstream level resulting in flow from the river into the estuary.
  - -ve values means that the upstream level is less than the downstream level which will result in flow from the estuary into the river (and is to be avoided).
  - The current setting is 1 mm. This range is adjustable between the ranges of 0-500 mm via the HMI.
- CLOSE TIME DELAY SET POINT is the minimum time at which the CLOSE SET POINT must be reached or exceeded before the gates will open. This is to avoid multiple start/stops in quick succession while the water conditions are stabilising.
  - This time delay is adjustable on the HMI between a range of 1-10 minutes.
  - Current setting is 1 minute.

2.3.5 Flood alarm

When the upstream level is greater than FLOOD SET POINT for FLOOD TIME DELAY SET POINT. The flood alarm will be triggered.

Note: This function only raises an alarm to alert operators of the flood level. This DOES NOT result in operation of the gates.

- The FLOOD SET POINT is the water level difference between upstream and downstream.
  - +ve values means that the upstream level is greater than the downstream level resulting in flow from the river into the estuary.
  - -ve values means that the upstream level is less than the downstream level which will result in flow from the estuary into the river (and is to be avoided).
  - The current setting is 600 mm. This range is adjustable between the ranges of 0-500 mm via the HMI.

- FLOOD TIME DELAY SET POINT is the minimum time at which the FLOOD SET POINT must be reached or exceeded before the gates will open. This is to avoid multiple start/stops in quick succession while the water conditions are stabilising.
    - This time delay is adjustable on the HMI between a range of 1-10 minutes.
    - Current setting is 1 minute.

2.3.6 Automatic sequence interlocks

The automatic sequence will not operate if any of the following conditions are true:

- Level sensor failure. In the event of a level sensor failure, an alarm will be raised alerting operators.
- GATE CONTROL not in AUTO
- Both hydraulic pumps FAULT or NOT AVAILABLE
- All gates NOT AVAILABLE

2.4 Equipment

2.4.1 Audible sirens

Two (2), pole-mounted audible sirens are located on the upstream side of the culvert structure, one at each end of the culverts.

The sirens operate for 30 seconds prior to operating the gates in AUTO mode.

The sirens will operate when the hydraulic pump is started from any manual operation.

The siren will only operate for 30 seconds.

The sirens will be silenced between SILENCE SIREN FROM to SILENCE SIREN TO. This is 7pm to 7am. The gate control system will require adjustment for daylight savings time at the appropriate times of the year.

2.4.2 Visual sirens

A set of four (4) amber rotating visual sirens are located on the upstream side of the culvert structure.

The visual sirens will run 30 seconds prior to operating the gate in AUTO mode and for the full duration the gate is operating in AUTO mode. The lights will turn off when the gates have completed their full stroke.

The visual sirens will operate when the hydraulic pump is running from any manual operation.

2.4.3 Hydraulic pumps

Auto duty select

The DUTY HYDRAULIC PUMP will change from PUMP 1 to PUMP 2 and vice versa every 50 RUN HOURS.

The DUTY HYDRAULIC PUMP will change from PUMP 1 to PUMP 2 and vice versa if the DUTY HYDRAULIC PUMP is FAULTED or NOT AVAILABLE.

Manual duty select switch

The MANUAL DUTY SELECT switch sets the Hydraulic pump that will operate when the gates are operated manually from the push buttons.

Manual-Off-Auto switch

AUTO- Default position, the DUTY HYDRAULIC PUMP will start 30 seconds prior to operating in the gate in AUTO mode. This is to allow the hydraulic pressure to build up.

MAN- The pump will run.

OFF-The pump will not run.

2.4.4 Interlocks

The hydraulic pump will not operate if any of the following interlocks are activated this will stop the operation of the gate.

- ESTOP
- VSD fault
- Hydraulic filter blocked
- Hydraulic oil Low

2.5 Manual, local, control board operation

The gates can be operated locally from within the control building using the control switches. This operation is independent of the PLC control system, allowing gate operation if there is a PLC failure. The switches mirror the HMI control however, have precedence over the HMI if both are being used simultaneously.

2.5.1 Manual-Off-Auto switch

AUTO- Default position, gates will operate the automatic sequence or controlled manually from the HMI or Remote telemetry.

OFF- The gate will not function (this is not an isolation, isolate both hydraulic pumps before working on the system)

MAN- Will run the duty hydraulic pump. Gate will operate from the UP-OFF-DOWN switch. Will not run from HMI/SCADA.

2.5.2 Up-Off-Down

UP- The gate will operate up when the AUTO-OFF-MAN is in the MAN position

OFF – Stop the gate when the AUTO-OFF-MAN is in the MAN position

DOWN- The gate will operate down when the AUTO-OFF-MAN is in the MAN position

2.5.3 Indicator lights

UP -Will illuminate when the gate has reached the maximum up position as measured by the inductive proximity sensor.

DOWN-Will illuminate when the gate has reached the maximum down position as measured by the inductive proximity sensor.

2.5.4 E-Stop

ESTOP- Will stop the hydraulic pumps from operating when pushed.

2.6 Manual, local, HMI operation

The gates will only function from the HMI or remote telemetry if the gate AUTO-OFF-MAN switch is set to MAN. The NOT AVAILABLE indicator on the HMI will flash yellow on the HMI if the gate is not set to AUTO.

2.6.1 Home page

Control mode switch

AUTO- The system will function in the automatic sequence. Refer to section- 1. Automatic operation.

MANUAL- The system will not automatically function. Gates can be manually operated from the HMI or remote telemetry.

Indicator lights

UP- Illuminates when the gate has reached the maximum up position as measured by the inductive proximity sensor.

DOWN- Illuminates when the gate has reached the maximum down position as measured by the inductive proximity sensor.

The indicator light turns off when the gate is between the two proximity probes.

NOT AVAILABLE- Will flash if the AUTO-OFF-MAN switch is not set to AUTO.

2.6.2 Local HMI control

LOCAL-When pressed, a pop up will load to control the gate from the HMI. When the AUTO-OFF-MAN switch is set to AUTO.

The LOCAL button illuminates when the gate is being controlled locally.

The local pop up has 4 buttons to control the gate AUTO, UP, DOWN, OFF.

When the AUTO-OFF-MAN switch is set to OFF, the local HMI control is reset to AUTO.

2.6.3 **Levels**

RIVER LEVEL- The height of the water on the upstream side of the culvert is measured by the hydrostatic level sensor. The level sensor is located within a stilling well located in the log clearing area, approximately opposite the control building. The level sensor is hard wired into the gate controller.

ESTUARY LEVEL- The height of the water on the downstream side of the culvert is measured by the hydrostatic level sensor. The level sensor is located within a stilling well located on the true right hand bank, approximately 50m downstream of the gates. The level sensor is hard wired into the gate controller.

RIVER LEVEL MINUS ESTUARY LEVEL- Upstream level minus downstream level- The difference between the RIVER LEVEL and the ESTUARY LEVEL. This should be 0 at the peak tide and minimum tide. To calibrate refer to section 2.6.5 Settings page.

2.6.4 **Hydraulic pump**

STATUS- Displays the status of the pump either RUNNING, AVAILABLE, NOT AVAILABLE, FAULTED

RUN HOURS- Displays the motor run hours

MOTOR CURRENT- Displays the motor current

2.6.5 **Settings page**

The SETTINGS button Navigates to the settings page where the control set points can be changed. This page is protected by a password (ENG).

OPEN SET POINT (0-500mm)

OPEN TIME DELAY SET POINT (1-10min)

CLOSED SET POINT (0-500mm)

CLOSE TIME DELAY SET POINT (1-10min)

FLOOD SET POINT (open set point -500mm)

FLOOD TIME DELAY SET POINT(1-10min)

GATE FAULT SET POINT (1-600s)

SILENCE SIREN FROM

SILENCE SIREN TOO

CALIBRATE LEVEL- **Calibration Method**

Read the upstream and downstream value of the depth of water from the gauges installed in the river. Add 500 to it. Enter the corresponding values at RIVER LEVEL, ESTUARY LEVEL and press calibrate.

Depth of water in the stilling well = 500 + gauge reading

Calibration logic

The hydrostatic level sensors are installed in the stilling well. Our measurement range is the height of the tank from its inlet level. Low level is the stilling level inlet. The depth of the water inside the stilling well is measured using an aluminium staff corresponding river.

Example - This is the gauge at the Riverside it reads 1140 so the new calibration value for the riverside should be 1140+500=1640 - level is measured on the gauge.

RESET PUMP 1 RUN HOURS

RESET PUMP 2 RUN HOURS

2.6.6 Alarm page

Navigates to the alarms page where the following alarms events are listed, acknowledged and reset. A pop-up page will also appear on an alarm event. The date and time are of the fault are included in all alarm pages.

- Flood alarm
- Gate x Fail to open
- Gate x Fail to close
- Hydraulic alarms
- Pump x VSD fault
- Pump x fail to start
- Pump x Isolated
- Level sensor x failure
- Estop activated
- Phase failure
- Phase rotation failure
- Surge protector replace.

2.7 Manual, local (at Gate) operation

The gate can be operated locally once the hydraulic pumps have been started. This type of operation would typically be used for testing and inspection or if there is a malfunction of the electrical system and the gate needs to be operated.

To raise the gates manually:

1 Open the fence panel of the gate(s) requiring operation.

2 Go to the switchboard inside the control building. Set the hydraulic pump to ‘MAN’ and select one of the pumps.

MAN- Will run the duty hydraulic pump. Note: When selected to manual the sirens will not activate unless also set into manual mode.

3 Back at the gates, rotate the hydraulic motor control ports to affect operation. Start with both control ports screwed close.

   (a) Open the LHS control port by turning the knob clockwise to raise the gate

   (b) Open the RHS control port to raise the gate

4 Close the respective control port by turning the knob counter-clockwise to stop gate operation.

Note: The limit switches will not stop the gates when operating in this mode and therefore it is advisable that the gates are slowed down towards the end of their stroke. Each gate is fitted with mechanical stops which will prevent the gates from over travel. When the gate stops moving, close all control ports.

To return the gates to control from the gate controller, (1) shut down the pumps and then (2) return both left and right knobs of the hydraulic motor control ports to their fully open position. At the gate switchboard, return the selector switch back to ‘AUTO’ for the affected gate.

2.7.1 E-Stop

ESTOP- Will stop the hydraulic pumps from operating when pushed.

2.8 Manual, remote, operation (Ricardo System)

The gates can be monitored and controlled remotely using the Ricardo system that ControlTech manage for BOPRC. Staff have full access to the site where the information is kept.

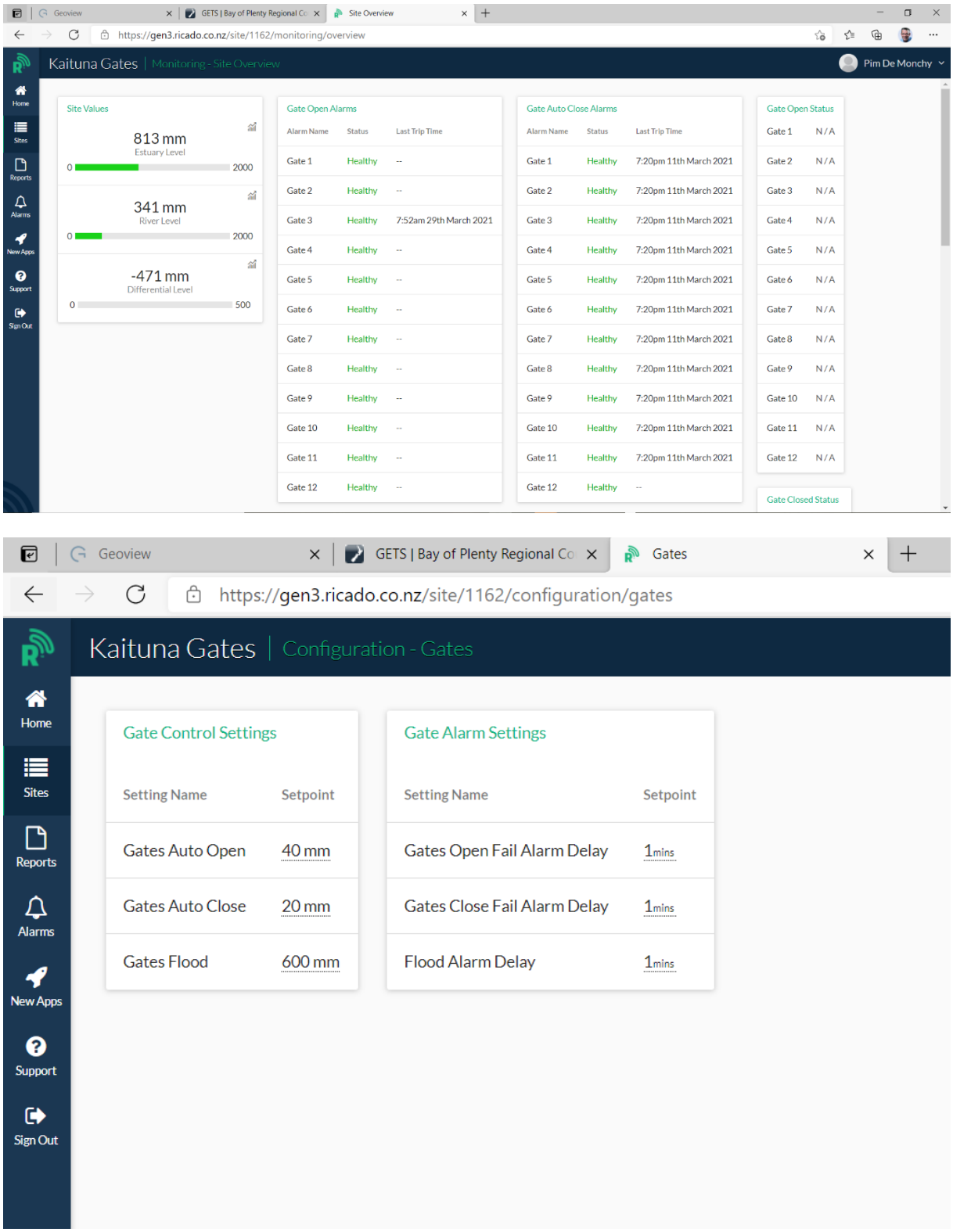

Figure 3 Screen shots from Ricardo system

The default is that the gates are left in automatic mode. The expectation is that a flood raises an alarm that alerts Flood Duty Managers that there is a flood, to assess the situation and take full manual control – see Part 5 and Appendix 7. In addition, if there are issues with the gates, they can be operated remotely.

Flood Duty Managers and Kaituna Catchment Rivers and Drainage Operations staff receive text messages whenever there is an alarm. Alarms are to be responded to by Rivers and Drainage staff as appropriate.

2.9 Hydraulic system

A copy of the hydraulic schematic can be found in Appendix 1.

Hydraulic power unit and controls operate from one through to 12 gates independently, or up to six (6) gates simultaneously in an opening or closing time of approximately 10 minutes.

Each penstock is driven via a gearbox from a hydraulic motor. The hydraulic system is filled with a water/Glycol solution. The supplier is Fuchs Oil NZ ltd. The oil type is Fuchs Plantohyd 46. A small amount of top-up oil is kept in the control building. A datasheet for the oil can be found in Appendix 3.

The motor is fitted with a solenoid operated directional valve with emergency rotary manual override, plus a pressure compensate flow control to regulate the penstock speed irrespective of how many gates are being operated.

Each coil has an LED plug to indicate which valve is energised. In the event of an electronics system failure, if the AC motors can still be started, the gates can still be opened and closed using the manual override knobs on each end of the directional valve. Turn the knob fully clockwise to energise the valve. Turn the knob fully counter-clockwise to stop.

A pressure relief valve if fitted to the pump discharge manifold to protect the gate drives from overload. Isolating check valves on each pump will allow one motor/pump to service all 12 gates in an emergency, at reduced speed.

When the power pack is turned on, system pressure will rise to 110 bar and will maintain this pressure whether the gates are moving or not.

The hydraulic oil reservoir is fitted with a 1KW 240 V single phase heater and an adjustable thermostat. The thermostat should be set to 20°C and a permanent power supply provided. An over temperature switch is fitted to the oil reservoir set to 60°C. This is incorporated into the system shutdown to prevent overheating in case of a systems failure.

COMMISSIONING OF THE SYSTEM AFTER DRAINAGE

IMPORTANT: Unless BOPRC staff have been trained in hydraulics, the following shall only be undertaken by a contractor such as Hydraulink.

Ensure the suction line isolation valves are turned fully counter-clockwise, then remove the hand wheels and attach loosely to the valve body. This will prevent accidental closing of the valves which would lead to catastrophic pump failure.

Ensure the AC motor is turning in the correct direction by ‘jog’ starting the motor (there is an indicating arrow on the fan cowling).

If possible, pre-fill oil lines to eliminate air. If this cannot be done then, after initial running, the power unit should be switched off for a few hours to allow any trapped air to escape from the oil. To flush the main pressure and return header pipes there is a connection between the two lines at the far extremity from the power pack. Run one motor/pump for 5-10 minutes to flush the pipes of air, then switch off and let the system rest so that air bubbles can dissipate from the oil in the reservoir. Close the shut off valve or remove the link hose (carefully). A little more air will be flushed through when the gates are cycled. Once all 12 gates have been cycled, once again switch off the pumps and allow the oil to settle.

The power unit will have been factory tested. The pressure relief valve has been set and no further adjustments are normally required.

2.10 Electrical

KaitunaRiver Diversion Gate Electrical-I/O Schedule

Revision:2

Date:08/05/2019

Rev.	Type	Address	Equipment tag	Equipment name	Description	Note
0			CPU-01	CP1L-EM40DR-D 1	OMRON CP1L PLC	
0	DI-	0/00	G1-ZSO	Gate 1	Prove open	Normally closed prox
0	DI-	0/01	G1-ZSC	Gate 1	Prove close	Normally open prox
0	DI-	0/02	G1	Gate 1	Auto	
0	DI-	0/03	G2-ZSO	Gate 2	Prove open	Normally closed prox
0	DI-	0/04	G2-ZSC	Gate 2	Prove close	Normally open prox
0	DI-	0/05	G2	Gate 2	Auto	
0	DI-	0/06	G3-ZSO	Gate 3	Prove open	Normally closed prox
0	DI-	0/07	G3-ZSC	Gate 3	Prove close	Normally open prox
0	DI-	0/08	G3	Gate 3	Auto	
0	DI-	0/09	G4-ZSO	Gate 4	Prove open	Normally closed prox
0	DI-	0/10	G4-ZSC	Gate 4	Prove close	Normally open prox
0	DI-	0/11	G4	Gate 4	Auto	
0	DI-	0/12	G5-ZSO	Gate 5	Prove open	Normally closed prox
0	DI-	0/13	G5-ZSC	Gate 5	Prove close	Normally open prox
0	DI-	0/14	G5	Gate 5	Auto	
0	DI-	0/15	G6-ZSO	Gate 6	Prove open	Normally closed prox
0	DI-	0/16	G6-ZSC	Gate 6	Prove close	Normally open prox
0	DI-	0/17	G6	Gate 6	Auto	
0	DI-	0/18	PMP-01	Hydraulic Pump 1	Auto	
0	DI-	0/19	PMP-01	Hydraulic Pump 1	Running	
0	DI-	0/20	PMP-01	Hydraulic Pump 1	Fault	
0	DI-	0/21	OIL-JB	Hydraulic alarm	Hydraulic Fault	
0	DI-	0/22	AL-01	Intruder alarm	Control room	Normally closed
0	DI-	0/23	CP-01	UPS	Low battery	Normally closed
0	DO-	0/00	G1-SV-O	Gate 1	Open solenoid	
0	DO-	0/01	G1-SV-C	Gate 1	Close solenoid	
0	DO-	0/02	G2-SV-O	Gate 2	Open solenoid	

Rev.	Type	Address	Equipment tag	Equipment name	Description	Note
0	DO-	0/03	G2-SV-C	Gate 2	Close solenoid	
0	DO-	0/04	G3-SV-O	Gate 3	Open solenoid	
0	DO-	0/05	G3-SV-C	Gate 3	Close solenoid	
0	DO-	0/06	G4-SV-O	Gate 4	Open solenoid	
0	DO-	0/07	G4-SV-C	Gate 4	Close solenoid	
0	DO-	0/08	G5-SV-O	Gate 5	Open solenoid	
0	DO-	0/09	G5-SV-C	Gate 5	Close solenoid	
0	DO-	0/10	G6-SV-O	Gate 6	Open solenoid	
0	DO-	0/11	G6-SV-C	Gate 6	Close solenoid	
0	DO-	0/12	PMP-01	Hydraulic Pump 1	Run relay	
0	DO-	0/13				
0	DO-	0/14	FL-1	Flashing Light	Run relay	
0	DO-	0/15	RS-1	Rossini Sounder	Run relay	
0			**I/0-1**	**CP1W-40EDR 1**		**24 Digital Input 16 Digital output**
0	DI-	1/00	G7-ZSO	Gate 7	Prove open	Normally closed prox
0	DI-	1/01	G7-ZSC	Gate 7	Prove close	Normally open prox
0	DI-	1/02	G7	Gate 7	Auto	
0	DI-	1/03	G8-ZSO	Gate 8	Prove open	Normally closed prox
0	DI-	1/04	G8-ZSC	Gate 8	Prove close	Normally open prox
0	DI-	1/05	G8	Gate 8	Auto	
0	DI-	1/06	G9-ZSO	Gate 9	Prove open	Normally closed prox
0	DI-	1/07	G9-ZSC	Gate 9	Prove close	Normally open prox
0	DI-	1/08	G9	Gate 9	Auto	
0	DI-	1/09	G10-ZSO	Gate 10	Prove open	Normally closed prox
0	DI-	1/10	G10-ZSC	Gate 10	Prove close	Normally open prox
0	DI-	1/11	G10	Gate 10	Auto	
0	DI-	1/12	G11-ZSO	Gate 11	Prove open	Normally closed prox
0	DI-	1/13	G11-ZSC	Gate 11	Prove close	Normally open prox
0	DI-	1/14	G11	Gate 11	Auto	
0	DI-	1/15	G12-ZSO	Gate 12	Prove open	Normally closed prox
0	DI-	1/16	G12-ZSC	Gate 12	Prove close	Normally open prox
0	DI-	1/17	G12	Gate 12	Auto	

Rev.	Type	Address	Equipment tag	Equipment name	Description	Note
0	DI-	1/18	PMP-02	Hydraulic Pump 2	Auto	
0	DI-	1/19	PMP-02	Hydraulic Pump 2	Running	
0	DI-	1/20	PMP-02	Hydraulic Pump 2	Fault	
0	DI-	1/21	E-STOP	E STOP	Activated	
0	DI-	1/22	MSB-01	Main switchboard	Phase failure	Normally closed
0	DI-	1/23	MSB-01	Main switchboard	Surge arrestor failure	Normally closed
0	DO-	1/00	G7-SV-O	Gate 7	Open solenoid	
0	DO-	1/01	G7-SV-C	Gate 7	Close solenoid	
0	DO-	1/02	G8-SV-O	Gate 8	Open solenoid	
0	DO-	1/03	G8-SV-C	Gate 8	Close solenoid	
0	DO-	1/04	G9-SV-O	Gate 9	Open solenoid	
0	DO-	1/05	G9-SV-C	Gate 9	Close solenoid	
0	DO-	1/06	G10-SV-O	Gate 10	Open solenoid	
0	DO-	1/07	G10-SV-C	Gate 10	Close solenoid	
0	DO-	1/08	G11-SV-O	Gate 11	Open solenoid	
0	DO-	1/09	G11-SV-C	Gate 11	Close solenoid	
0	DO-	1/10	G12-SV-O	Gate 12	Open solenoid	
0	DO-	1/11	G12-SV-C	Gate 12	Close solenoid	
0	DO-	1/12	PMP-02	Hydraulic Pump 2	Run relay	
0	DO-	1/13				
0	DO-	1/14				
0	DO-	1/15				
0			**I/0-2**	**CP1W-40EDR 1**		**24 Digital Input 16 Digital output**
0	DI-	2/00	PMP-01	Hydraulic Pump 1	Isolated	
0	DI-	2/01	PMP-02	Hydraulic Pump 2	Isolated	
0	DI-	2/02		Hydraulic system	Filter out block	
0	DI-	2/03		Hydraulic system	Filter in block	
0	DI-	2/04		Hydraulic system	High temp	
0	DI-	2/05		Hydraulic system	High level	
0	DI-	2/06		Hydraulic system	Low level	
0	DI-	2/07				
0	DI-	2/08				

Rev.	Type	Address	Equipment tag	Equipment name	Description	Note
0	DI-	2/09				
0	DI-	2/10				
0	DI-	2/11				
0	DI-	2/12				
0	DI-	2/13				
0	DI-	2/14				
0	DI-	2/15				
0	DI-	2/16				
0	DI-	2/17				
0	DI-	2/18				
0	DI-	2/19				
0	DI-	2/20				
0	DI-	2/21				
0	DI-	2/22				
0	DI-	2/23				
0	DO-	2/00				
0	DO-	2/01				
0	DO-	2/02				
0	DO-	2/03				
0	DO-	2/04				
0	DO-	2/05				
0	DO-	2/06				
0	DO-	2/07				
0	DO-	2/08				
0	DO-	2/09				
0	DO-	2/10				
0	DO-	2/11				
0	DO-	2/12				
0	DO-	2/13				
0	DO-	2/14				
0	DO-	2/15				
0			**I/O-2**	**CP1W-AD041 1**	**4 Point Analogue Expansion Module**	

Rev.	Type	Address	Equipment tag	Equipment name	Description	Note
0	AI-	3/00	LIT-01	Level transmitter 1	Up river level	
0	AI-	3/01	LIT-02	Level transmitter 2	Down river level	
0	AI-	3/02	PIT-01	Pressure transmitter 1	Hydraulic pressure	
0	AI-	3/03	Spare			

2.11 Telemetry

The telemetry system is managed by ControlTech who should be contacted if there are any issues.

ControlTech	Karam de Lacy	027 4993 944
22 Gateway Drive, Whakatane	karam@controltechltd.nz	07 219 0661

2.12 Trouble shooting

SYMPTOM	CAUSE	REMEDIAL ACTION
LEAKAGE (Most Fluid Control is not designed to be drop tight, the maximum leakage rate, under normal operating conditions (up to 6 m on seat head) is 1.25 litres per minute per metre	Paint/mastic/concrete or foreign matter on seal face.	Carefully remove with fine emery cloth.
	Loose or unevenly adjusted wedges.	Wedges are factory set, but can loosen in transit. Seek advice/instructions from Penstocks NZ on wedge adjustment in order to re-instate seal tolerance as outlined in 4.1.
	Fixing bolts loose.	Re-tighten bolts.
	Frame distortion/poor installation/leakage through grout behind frame.	Complete re-installation may be necessary.

SYMPTOM	CAUSE	REMEDIAL ACTION
NOISE – Bang when gates start lifting .	Withdrawal of door from tightly wedged condition.	Normal – No action required.
NOISE – High pitched squeal (penstocks and weirs only).	Spindle thread not lubricated.	Check threads, clean and lubricate.
	Spindle guides out of alignment and rubbing as spindle rotates.	Check spindle guides for correct alignment and re-align.

SYMPTOM	CAUSE	REMEDIAL ACTION
WON'T OPEN	Transit stop/device still in position.	Remove transit stop (after reading Section 2).
WON'T OPEN – Spindle turns but won't raise	Operating nut is missing or stripped threads. Or drive dogs in actuators/gearboxes have not engaged.	Replace nut in the case of missing nut or stripped threads. Check thrust housing is correctly assembled and drive dogs/keys are correctly engaged.
WON'T OPEN – Excessive force required rocks, weirs	Spindle thread not lubricated, misaligned spindle, guides, footplate or pillar.	Clean and lubricate threads. Re-align spindle, guides, footplate, pillar.

SYMPTOM	CAUSE	REMEDIAL ACTION
WON'T CLOSE (penstocks only)	Obstruction in the invert (or possibly between wedge faces on penstocks).	Raise door and remove obstruction.
	Wedges/adjusters not correctly adjusted.	Re-adjust/reset wedges/adjusters.
WON'T CLOSE – Actuator cuts out on torque whilst closing	Obstruction in the invert (or possibly between wedge faces on penstocks). Wedges/adjusters not correctly adjusted.	Raise door and remove obstruction. Re-adjust/reset wedges/adjusters.
	Limits/Torque switches incorrectly set.	Re-set switches correctly and re-test.

SYMPTOM	CAUSE	REMEDIAL ACTION
SPINDLE **FLEX–** penstock and weirs only	Loose spindle guides/guide caps.	Ensure spindle guides are correctly aligned and tighten fixings.
	Spindle guides/guide caps out of alignment or missing or incorrectly spaced.	Check spindle guides for correct alignment and positioning. Re-position/re-align.
	Excessive effort applied on closing.	Reset actuator limit and torque switches.

Appendix 3:
Equipment manuals and spare parts

Equipment warranties:

Pontoon only. Valid for 10 years from practical completion. Issued by Pacific 7 Ltd.

Key specifications

- Bellows
- Bevel gear actuators
- Gearbox grease
- Gearbox test sheet
- Hydraulic Fluid
- Level-Temperature switches
- Paint specification
- Variable Speed Drive
- Water Level Transducers

Spare parts

The following spare parts are provided under the Contract:

ID	Part or Drg Number	Description	Manufacturer	Qty	Storage Location
1	Drg. 18116-01-05_Rev 3	Spindles	Penstocks NZ Ltd.	3 of	Control building
2	Drgs. 18116-01-13 to 15	Gate Seals	Penstocks NZ Ltd.	3 sets	Control building
3	SD58A12500A2155B176C140B276C240	Spindle Bellows	Bellowflex Australia Pty Ld.	12 of	Control building
4		Pump and two seal kits			Control building
5	NKP-43	*Water level sensors* River sensor cable Upstream of gates 47 m Downstream of gates 10 m		1	Control building

If maintenance schedules are adhered to there is usually little need for spare parts.

Appendix 4:
Emergency contacts

Aspect	Organisation	Contact person	Title	Phone
Owner	Bay of Plenty Regional Council	Bruce Crabbe	Rivers & Drainage Manager	021 756 032
Operations and Maintenance	Bay of Plenty Regional Council	Kerry Smith	Area Engineer	027 586 6479
Flood Duty Managers	Bay of Plenty Regional Council	Graeme O'Rouke Mark Townsend Peter Blackwood Pim de Monchy Roger Waugh	Flood Duty Officers	021 190 9523 027 222 0298 027 550 4934 021 649 818 029 368 9519
Telemetry	ControlTech	Karam de Lacy	Technical Director	027 4993 944
Stakeholders	Western Bay of Plenty District Council	EJ Wentzell Peter Watson	Utilities Manager Reserves & Facilities Manager	021 655 672 0274 902 543
	Maketu Coastguard	Shane Beech	President	027 539 2930
	Waterhouse Partnership	Butch Waterhouse	Company owner	0274 791 520
Generator hire	ControlTech Whakatane & Mount Maunganui			07 219 0661 or Karam de Lacy 027 4993 944
	NES Hire – Power & Pump Solutions, 25b Newton Street, Mount Maunganui			0800 999 582
	Edgecumbe Hire, 3 Ngaio Place			07 304 8279 or 027 630 0045

Appendix 5:
Inspection checklists

INSPECTION CHECKLIST Date ……

Inspected by …….. File …….

Checked by ……..

This checklist is to be used to aid regular inspections of the re-diversion. The gate control systems have a separate inspection programme.

See Figures 1 to 3 of the Operations and Maintenance Manual for the identification of each part of the project referred to in the sheets.

A sheet has been included at the end to summarise the maintenance work required and give it a priority.

Location	What to look for	Observations
Waterway		
Diversion Inlet	Loss/movement of rip rap	
	Erosion of banks	
	Debris accumulation	
	Channel marker condition	
Diversion Channel (right bank)	Loss/movement of rip rap	
	Damage to grass berm	
	Debris accumulation on berm	
Stopbank	Crest condition, rutting, pot holes etc.	
	Settlement of crest	
	Vegetation cover	
	Overlay condition, shape, ponding, pugging, grass cover	
	Damage to batters	
	Boundary fence condition	
	Security gate condition	
	Access ways to berm	
	Pipe penetration area, signs of leakage, settlement	
	Pump shed area	
Diversion Channel (left bank)	Erosion / slumping of bank	

Location	What to look for	Observations
	Rutting, ponding, scouring in berm	
	Vegetation cover	
Diversion Channel Outlet	Erosion at left bank	
	Erosion/damage at right bank rip rap transition	
Old River Channel	Damage/movement of rip rap on south side of Ford Island	
	Condition of plantings on south side of Ford Island	
	Scouring/slumping of right bank	
	Vegetation cover of right bank	
	Accumulation of rubbish/debris	
Boat Ramp Area		
Barge mooring	Erosion/slumping around mooring area	
Rock Bund	Damage to rock/shape	
	Debris accumulation	
Log Deflector	Debris accumulation	
	Damage to pole connections	
	Damage to rubbing strips	
Public Jetty	Debris accumulation	
	Damage to timber work	
	Damage to rubbing strips (both sides)	
	Missing bolts/nuts	
	Condition of geogrid	

Location	What to look for	Observations
	Condition of access path and abutment	
Boat ramp	Accumulation of debris	
	Damage to concrete	
	Condition of poles on right side	
River bank	Rip rap condition between barge and boat ramp	
	Vegetation/grass condition	
Pump Station Crossing	Surface	
	Rubbish/debris	
	Crib wall condition	
	Access to stilling well	
	Handrail condition	
Picnic Area	Rip rap condition	
	Erosion / scouring	
Ford Road Drain Crossing	Batter condition	
	Signage	
	Guardrail and gate condition	
	Pavement	
Ford Rd Drain outlet	Erosion, sedimentation	
Ford Road Drain (between crossings)	Rip rap condition	
	Vegetation	

Location	What to look for	Observations
	Screen load out area	
	Rubbish/debris	
Carpark	Pavement condition	
	Swale drain/culvert	
	Plantings	
Compound	Fence/gate condition	
	Drainage	
Control Gates		
Gate control building	Leaks	
	Damage to doors	
	Damage to ventilators	
	Drainage	
	External light	
	Generator connection	
	Transformer	
	Graffiti	
Culverts	Debris accumulation upstream	
	Rip rap adjacent to outlet	
	Debris in downstream, right bank corner	
	Concrete cracking, spalling, rust stains	

Location	What to look for	Observations
	Surface drainage	
	Debris in fence area	
North log clearing area	Gate condition	
	Surface	
	Erosion, scouring	
	Debris/rubbish	
	Rip rap condition	
South log clearing area	Gate condition	
	Surface	
	Erosion, scouring	
	Debris/rubbish	
	Rip rap condition	
Upstream stilling well	Damage	
	Staff gauge	
Downstream stilling well	Damage	
	Sensor junction box	
	Staff gauge	
Gate fence	Damage	
	Lock condition	
	Hinge condition	

Location	What to look for	Observations
	Corrosion	
Gates	Visible damage	
	Operation as expected, noises when moving	
	Condition of spindle bellows	
	Condition of hoses, damage, leaks	
	Visible seal leaks	
Ford's Cut		
	Erosion of true left bank	
	Rip rap condition on right bank	
	Visible bars in channel	
	Outlet into estuary, erosion, sedimentation	
Salinity Block		
Compound fence	Damage	
	Netting condition	
	Post corrosion	
	Foundation cracking, spalling, rust stains	
	Slide gate condition	
Timber fences	Damage	
	Graffiti	
	Missing nuts/bolts	
Rip rap	Condition in mooring area	

Location	What to look for	Observations
	Condition along access track edge	
Compound	Surface shape, drainage	
	Surface condition	
	Weeds etc.	
Waterhouse jetty	Erosion around piles	
	Damage to structure	
	Handrail condition	
	Deck condition	
	Missing nuts/bolts	
Coastguard pontoon	Security gate	
	Gangway, condition	
	Gangway movement	
	Pontoon condition	
	Pontoon movement	
	Pile damage	
	Ground beam condition	
light	Condition	
	Pillar box	
Mooring basin	Sedimentation, erosion	
	Debris accumulation	

Location	What to look for	Observations
Wetland area	Slumping, scour	
	Vegetation	
Ford Island access	Security gate condition	
	Track surface, shape	
	Boundary fence condition	
	Farm gate condition	
	Vegetation	
	Debris	
Ford Island north	Erosion protection condition	
	Picnic area, vegetation Drainage	
Ford Road		
River edge	Erosion, slumping	
Pavement	Pavement damage	
	Signage	
	Guardrail condition	
	Salinity block carpark area	
Fence	Wetland fence condition	
	Rock vehicle protection	
	Dumped rubbish	
Te Paika Wetland		
Culverts to Fords Cut	Erosion at inlets	

Location	What to look for	Observations
	Erosion at outlet	
	Erosion and slumping of access track	
Culvert to river	Inlet clear	
estuary edge (drone)	Erosion	
	Debris/rubbish	
Papahikahawai Island		
Gate	Condition	
Bridge	Damage	
	Abutments, scouring	
	Handrail condition	
	Deck	
Shoreline (drone)	Chernier erosion	
	Inlet erosion, sedimentation	

Maintenance work required **Date:**

Location	**Issue** (include photos)	**Work required**	**Priority**

Appendix 6:
Maintenance checklists

Kaitauna gates & controls inspection checklist

Item	What to look for	Date checked	Checked by	Comment
Gates				
Weekly	General check of security fence and gates for signs of vandalism			
	Check no obstructions caught on gates			
	Check bellows in correct position			
3 monthly	Clean the gates by hosing down with clean water to remove any grit or debris.			
	Clean the staff gauges on each side of the culvert so that they are legible			
	Check for any leakage between the unit and concrete wall and the general soundness of the surrounding civil structure. Make good any faults.			
	Check tightness of all fixing bolts/nuts including foundation bolts (only requires visual inspection from the top).			
	Complete a full cycle of all gates and note any unusual observations and/or noises			
	Whilst in the fully open/extended position, check that there is no damage or excessive wear to the sealing surfaces. Consult Penstocks New Zealand Ltd for advice on repair to damaged seals.			
	Normal wear on the seals on penstock units may be overcome by adjustment of the wedges or adjusters. Seek advice from Penstocks New Zealand Ltd on the adjustment of the factory set wedges or adjusters.			

Item	What to look for	Date checked	Checked by	Comment
	Check all components for corrosion damage. Painted units should be checked for signs of corrosion or damage to the paint system and repaired in accordance with the repair scheme for the original paint system (in accordance with the paint manufacturer's instructions). Seek advice from Penstocks New Zealand Ltd regarding any components which show any signs of excessive corrosion.			
	Remove bellows to inspect spindle. Check any operating gear for damage (including rounding over of threads), wear and freedom of movement. Inspect spindle grease for signs of debris and metal filings. Clean the spindle threads by hosing down with clean water.			
	Check and record auto-greaser level.			
	Check that machine guarding originally supplied with the unit remains in position and is securely fixed.			
Annually	Resubmit Traffic Management Plan to Westlink for road closures	Every February		
	Replace automatic greaser (Pulsarlube E, available from SAECOWilson). Refer Appendix 3 for datasheet.			
	Check system operating pressure with 6 gates operating simultaneously.			
	Check spindle condition by removing clamp on either top or bottom of bellows to get access to the spindle.			
	Check bellow condition for UV damage, splitting/tearing, other.			

Item	What to look for	Date checked	Checked by	Comment
	Remove gearbox top cap and check for signs of water. Top up with Biomultis EP Grease as required. Refer Appendix 3 for datasheet			
2 yearly	Check all fixing bolts/nuts under water by using for example a camera on a pole			
Gate Hydraulic System				
Weekly	Check hoses for any chafing, cracking or splitting, signs of perishing			
	Check oil level, top up as necessary			
	Check visually for any oil leaks			
	Check for oil leaks at the gates and inside the control building at the HPU			
Every 3 months	**Check oil filter** The pump is fitted with a pressure line oil filter plus a return line filter fitted to the reservoir lid. The pressure filter element can be replaced by removing the bowl from the head. The return filter element can be replaced by removing the cover plate. Filter replacement intervals vary dramatically depending on running time, ambient conditions and temperatures. Filter clogging switches are fitted to warn of the need for replacement.			
	Check reservoir for signs of water			
Annually	Check correct operation of pressure relief valve.			
	Check and record gate operating pressure with no less than 6 gates operating simultaneously.			
	Take an oil sample for lab testing			

Item	What to look for	Date checked	Checked by	Comment
	Check Pressure Relief Valve (PRV) function and setting			
	Record pump operating hours			
Electrical and Control Systems				
Weekly	General visual inspection confirming adequacy of equipment condition and connections.			
	Check water level pressure transducer reading on HMI with visual water level site gauge. Recalibrate if necessary.			
Every 3 months	Check calibration of pressure transducers with level gauge.			
	Check functionality of visual and audible sirens			
5 yearly	Perform full battery discharge test to ensure battery backup capacity.			
	Electric motor insulation tests.			
Telemetry system				
The telemetry system is part of the wider Council system throughout the region that is managed by ControlTech. Contact ControlTech directly if there are any issues.				
Annually	Cross check of the functionality of the system by Rivers and Drainage team when checking the function of the gates to make sure that what is coming up on mobile phones and on the Regional Council environmental data portal is representative of what is happening on site.			

Appendix 7:
Flood warning manual instructions

Note the information that follows is an extract from section 12 of the Flood Warning Manual. The section number from the Flood Warning Manual has been used.

Flood warning manual instructions

Kaituna rediversion

The Kaituna rediversion has returned fresh water flow into the top end of the Maketū Estuary. To maintain a fresh water estuary the following should be ensured:

- Saline high tide flows must be prevented from entering through the Kaituna rediversion gates. This has been automated.
- Kaituna River flows during flood events can enter the Maketū Estuary though the Kaituna rediversion gates. The exception to this is shown in Table 2 below. This operation will be operated by the Duty Flood Manager.

In order to calculate the maximum water level at the Kaituna River mouth, the following standard operating procedure should be utilised.

Kaituna rediversion gates closure decision matrix

Table 2 Standard Operating Procedure

INPUT DATA	1	Significant Wave Height	H*s*	Obtain H*s* from EcoConnect Seagram at time X	
	2	Storm Tide	ST	Obtain ST from EcoConnect Seagram at time X	
	3	River Flood Flow	Q*f*	Obtain River Flood Flow from HydroTel at time X	
SHALLOW WATER TRANSFORMATION	4	Wave Setup at River Mouth for river flow of 50 m^3/s	WS_{50}	Calculate using: Wave Setup = 0.042 H*s*	
	5	Adjust Wave Setup (WS_{50}) for River Flood Flow	WS*r*	**Go to table 3*** (Flood Manual) Find the intersection of ST and Q*f* to get the Percentage Adjustment. Apply this % to WS_{50}	
	6	River Mouth Storm Tide plus Wave Setup Level at Flood Flowrate	WL*r*	Calculate Using: ST + WS_{50} +/- WS*r*	

GATES CLOSURE	7	Gate Closure Decision Matrix		Take Q*f* and WL*r* and apply to ***Table 4**** (Flood Manual)	

*NB: This table is reproduced from Kaituna Rediversion Gates Operations Manual (A3422746).

*Table 3 ** *Percentage change in Wave Setup for 1% AEP events for increasing Kaituna River flows relative to Wave Setup for river flow of 50 m^3/s.*

Storm Tide (m)	% change in wave setup (relative to wave setup for Kaituna river flow of 50 m^3/s)					
	Kaituna at 100 m^3/s	Kaituna at 200 m^3/s	Kaituna at 300 m^3/s	Kaituna at 400 m^3/s	Kaituna at 500 m^3/s	Kaituna at 600 m^3/s
0.77	1.6%	-9.2%	-16.2%	-53.0%	-68.6%	-89.7%
0.89	-2.3%	-9.2%	-15.7%	-52.1%	-68.1%	-79.6%
0.99	-0.8%	-7.6%	-14.1%	-37.2%	-50.1%	-72.2%
1.08	2.5%	-5.4%	-11.7%	-18.4%	-28.1%	-65.4%
1.15	5.4%	-3.6%	-9.3%	-3.3%	-11.8%	-59.4%
1.22	8.0%	-1.8%	-6.5%	9.8%	0.6%	-52.6%
1.27	9.1%	-0.6%	-4.3%	16.7%	5.2%	-47.0%
1.33	9.5%	0.4%	-1.4%	21.1%	4.3%	-39.2%
1.37	8.9%	0.9%	0.8%	21.1%	-1.1%	-33.3%
1.42	7.0%	1.2%	3.5%	17.0%	-14.2%	-24.9%
1.46	4.5%	1.2%	5.9%	9.9%	-30.6%	-17.4%

*NB: This table is reproduced from Table 3.2, NIWA Kaituna Wave Modelling V02 (A3263774).

*Table 4** *Gate closure Decision Matrix for critical peak water level = 1.40 m at Maketū township.*

Kaituna River Flow (m^3/s)	Maximum Water Level at River Mouth (m MVD-53)				
	1.1	1.2	1.3	1.4	1.5
100	Open	Open	Open	Open	Close Nine
300	Open	Open	Open	Close Nine	Close All
400	Open	Open	Open	Close Nine	Close All
500	Open	Open	Close Nine	Close Nine	Close All
600	Open	Open	Close Nine	Close All	Close All
700	Close Nine	Close Nine	Close Nine	Close All	Close All
800	Close Nine	Close Nine	Close Nine	Close All	Close All

*NB: This table is reproduced from Kaituna Rediversion Gates Operations Manual (A3422746).