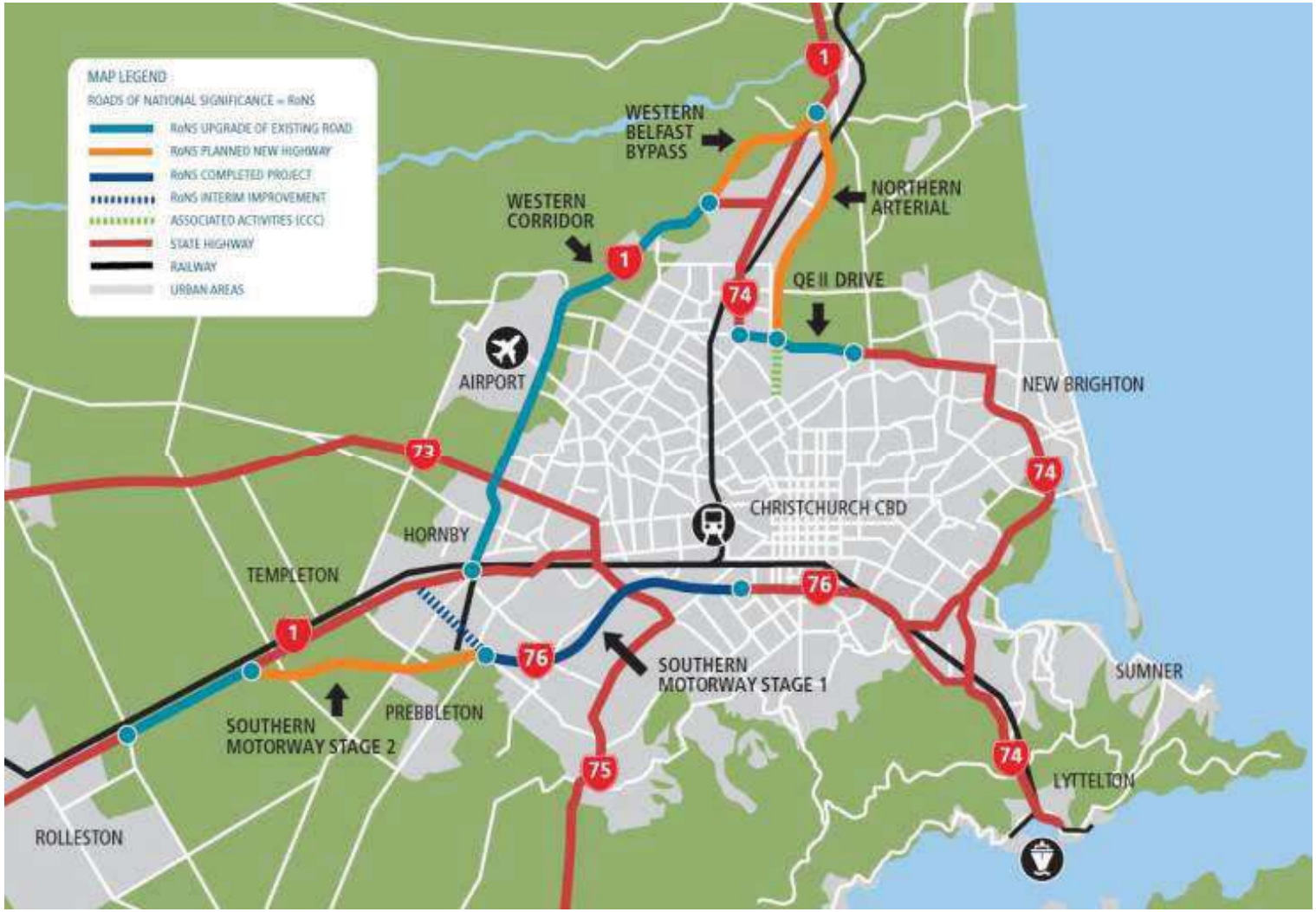

Western Belfast Bypass
– Aquatic ecology aspects &
sharing of lessons learnt
CONNECTING NATURE
CONNECTING PEOPLE

Western Belfast Bypass

- State Highway 1
- Location: Belfast, Christchurch
- Start date: May 2015
- Finish date: Nov 2017
- Client: NZTA
- Client Engineers: Opus
- Contractor: Fulton Hogan
- Aquatic Ecologist: Boffa Miskell
- Contract type: Construction only
- Works: A new 4-lane, 5km long, median divided motorway
- Extends the Christchurch Northern Motorway (SH1) to link with Johns Road (SH1), Christchurch.

Western Belfast Bypass

Fulton Hogan



Western Belfast Bypass

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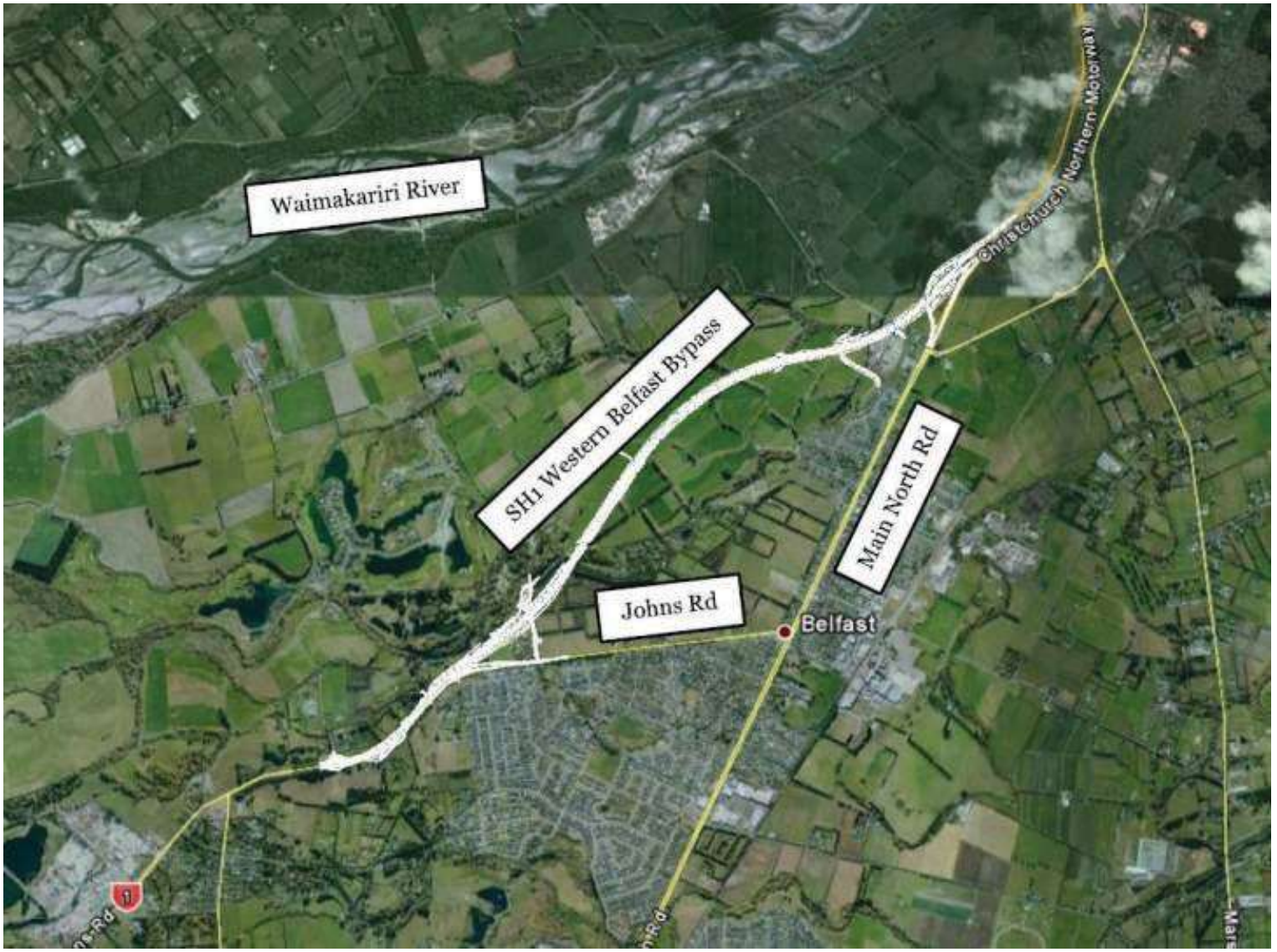

Waterbodies

Seven permanently wetted waterbodies are either in the path or directly adjacent to the WBB alignment:

- at the northern end of the WBB the base of the embankment just skirts the boundary of the Otukaikino Wetland area
- adjacent to the Stoneyhurst Sawmill on Dickeys Rd, the embankment skirts the edge of the Otukaikino Creek
- southwest of the sawmill it crosses Darroch St Drain, Horrell Drain, Whitmore Drain, and Kingsbury Drain
- near where the WBB adjoins Johns Rd the base of the embankment is near one of the lakes at The Groynes.

Throughout the Otukaikino Creek catchment 17 fish species have been recorded on the New Zealand Freshwater Fish Database.

Waterbodies

Source: Aquatic assessment of Environmental Effects: WBB, Christchurch, EOS Ecology, Feb 2014

Waterbodies

Source: Aquatic assessment of Environmental Effects: WBB, Christchurch, EOS Ecology, Feb 2014

Waterbodies


Site 3, WQ3, & SQ5
– looking upstream


Site 4
– looking downstream


Site 5, WQ4, & SQ6
– looking downstream

HORRELL DRAIN


Site 6
– looking upstream

KINGSBURY DRAIN


Site 7
– looking downstream

DARROCH STREET DRAIN


Section 1 from James (2010b) –
middle of section looking downstream

Source: Aquatic assessment of Environmental Effects: WBB, Christchurch, EOS Ecology, Feb 2014

Ecological value of waterbodies

Name	Classifications	Values
Otukaikino Wetland	Regionally Significant Wetland	Significant cultural and terrestrial
Otukaikino Creek	Spring-fed river	High ecological, cultural, and recreational
Darroch Street Drain	Waimakariri Tributary Waterways CCC Utility Waterway CCC Environmental Asset Waterway	Low ecological and cultural
Horrell Drain	Waimakariri Tributary Waterways CCC Environmental Asset Waterway	Moderate ecological and cultural
Whitmore Drain	Waimakariri Tributary Waterways CCC Environmental Asset Waterway	Moderate ecological and cultural
Kingsbury Drain	Waimakariri Tributary Waterways CCC Environmental Asset Waterway	Moderate ecological and cultural
The Groynes (Pond)	CCC Parks and Reserve Feature	Moderate recreational

Surface waterbodies

- Kingsbury, Horrell, and Darroch Street Drains all have abundant eel populations and relatively diverse aquatic invertebrate communities, despite being human-made farm drains.
- Whitmore Drain was not included in the aquatic ecology surveys for this project however, it is expected to have similar ecological value to that of the other farm drains in the area.
- The numerous dry channels also within the WBB project area are likely to have no, or limited, value for aquatic fauna.

Waterbodies – Required Works

Waterbody	Activity	Disturbed footprint
Darroch St Drain (North)	Culvert install / realignment of drain	40m / 20m
Darroch St Drain (South)	Culvert install / re-alignment of drain	20m / 10m
Horrell Drain	Culvert install / realignment of drain	50m / 100m
Horrell Drain (farm access)	Twin culvert / realignment of drain	4m / 10m
Whitmore Drain	Drain filled in	70m
Kingsbury Drain	Drain filled in & new drain to be established	220m / 220m
Sawmill Drain	Culvert install	40m

Waterbodies

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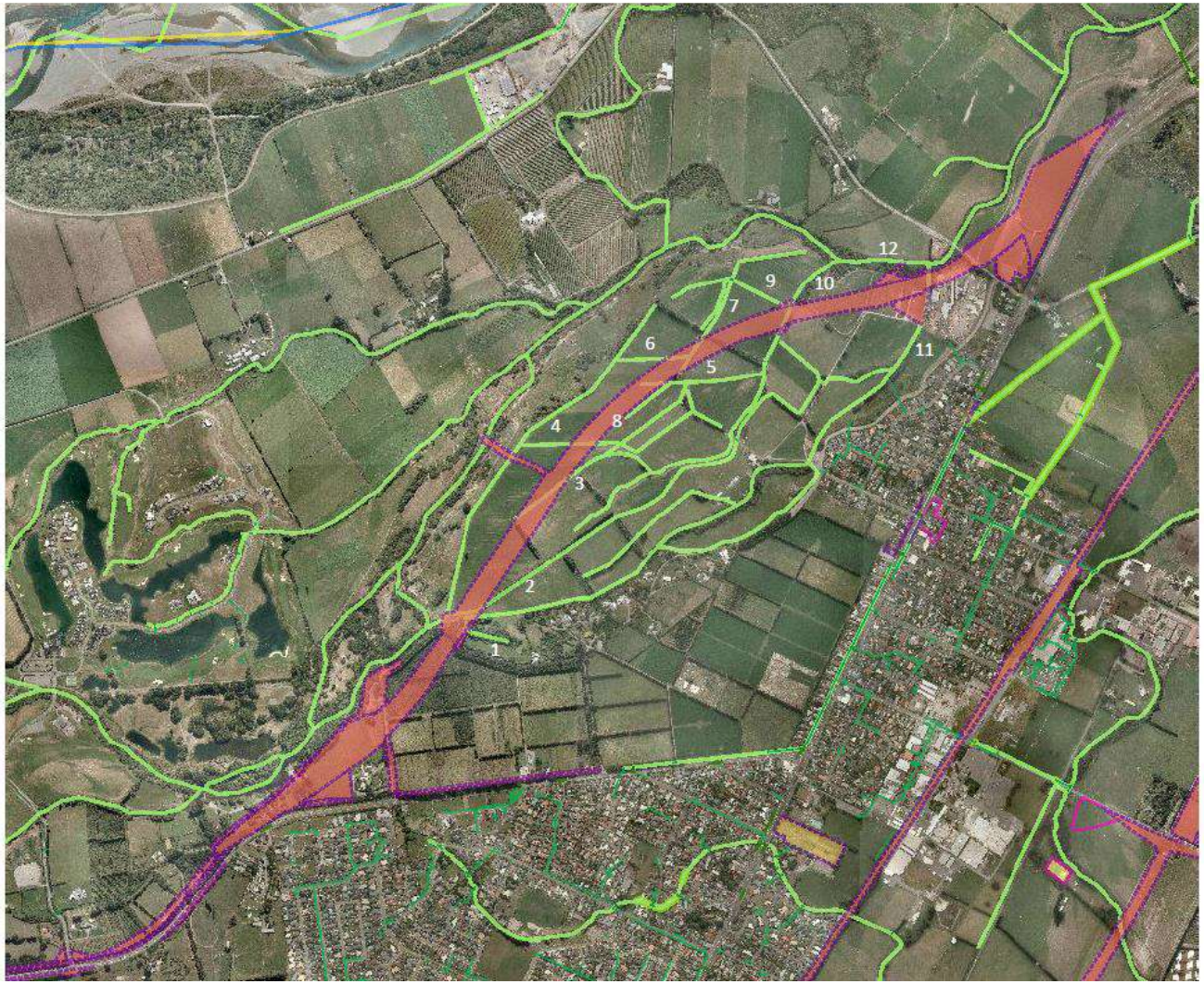
Western Belfast Bypass—Streams and Drains



Key

Designation

Drainage lines/ streams

1. Darroch St Drain
2. Griffin Drain
3. Kingsbury Drain
4. Jeffs Drain
5. Whitmore Drain
6. Rapley Diversion
7. Bayfield Drain
8. Frankish Drain
9. Bourne Drain
10. Horrell Drain
11. Darroch St Drain
12. Otukaikino Stream

Waterbodies







Statutory Requirements

Authority	Consent No.	Description
CCC	RMA92024944	New designation to allow for the construction and operation of a new section of motorway (4-lane median divided arterial road) as an extension to the existing Northern Motorway, referred to as the Western Belfast Bypass
ECan	CRC144923	Discharge permit to discharge stormwater and other contaminants into land and water
ECan	CRC144924	Land use consent - to use land to disturb excavate and erect structures in a watercourse and use land
ECan	CRC144925	Water permit - to dam and divert groundwater and surface water.
ECan	FPB125120	Flood Protection and Drainage Bylaw – To undertake earthworks near Flood protection assets.

Consent Obligations

CRC144923 –
Condition 5: Dewatering water shall be discharged onto or into land and shall not enter surface waterways unless treated.

CRC144923 –
Condition 7b: Discharges from dewatering; shall not, further than 25 metres downstream from the discharge point, result in (iii) visual water clarity greater than 20% as measured upstream and downstream of the discharge.

CRC144925 –
Condition 3: Diversion works shall be undertaken in a manner which avoids the stranding of fish in pools or channels.

CRC144924 –
Condition 13: The works shall not impede fish passage.

Management Plans

CEMP

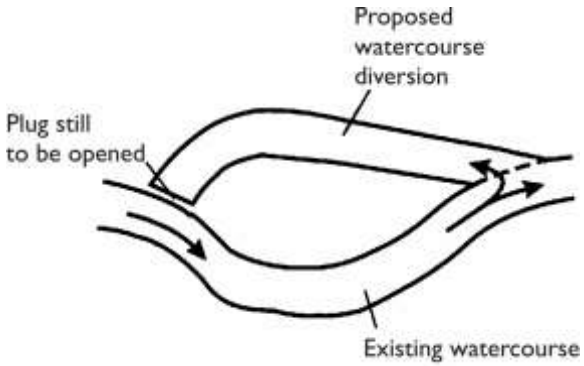
- Highlights aquatic ecology impacts and management approach.

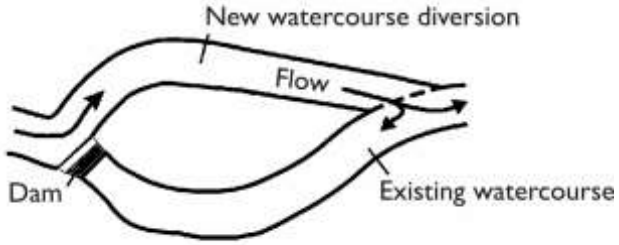
ESDCP

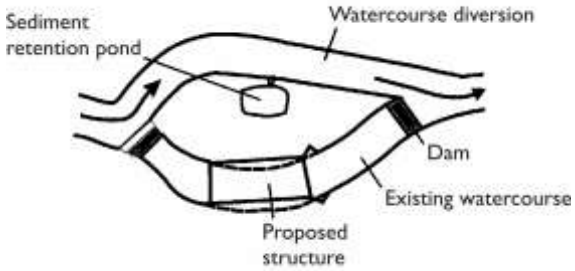
- Highlights waterways of significance and the need to protect the waterways from adverse effects of sediment.
- Highlights key construction related effects on waterways.
- Where temporary diversions are required water will be diverted in such a way as to maintain any existing fish passage.

EWDSDMP

- Mitigation measures to be adopted to address waterway form and revegetation for constructed channels, fish passage, and fish relocation from areas where the waterway will be lost.
- Identification of measures anticipated to be achieved to ensure an ecologically successful realignment of Kingsbury Drain.
- Methods to maintain fish passage during and following completion of the works along the stretches of drain affected by the works.







Waterway Diversion Principles

- The removal of fish shall be undertaken by an aquatic ecologist.
- Aquatic ecologist to be consulted during construction methodology and programming
- Dewatering should be avoided during summer (where practicable).
- Any ponded areas remaining after dewatering shall be checked for stranded fish
- Suitable fish barriers will be installed when working in waterways
- Construction of all new permanent realignment channels will be undertaken "in the dry"
- Incorporate ecologically suitable design, including provisions for fish cover, appropriate in-stream habitat complexity, and planting of ecologically sensitive riparian vegetation.
- Fish passage to be retained
- Velocities are not substantially increased due to the placement of the culvert.

Fish salvage and relocation requirements

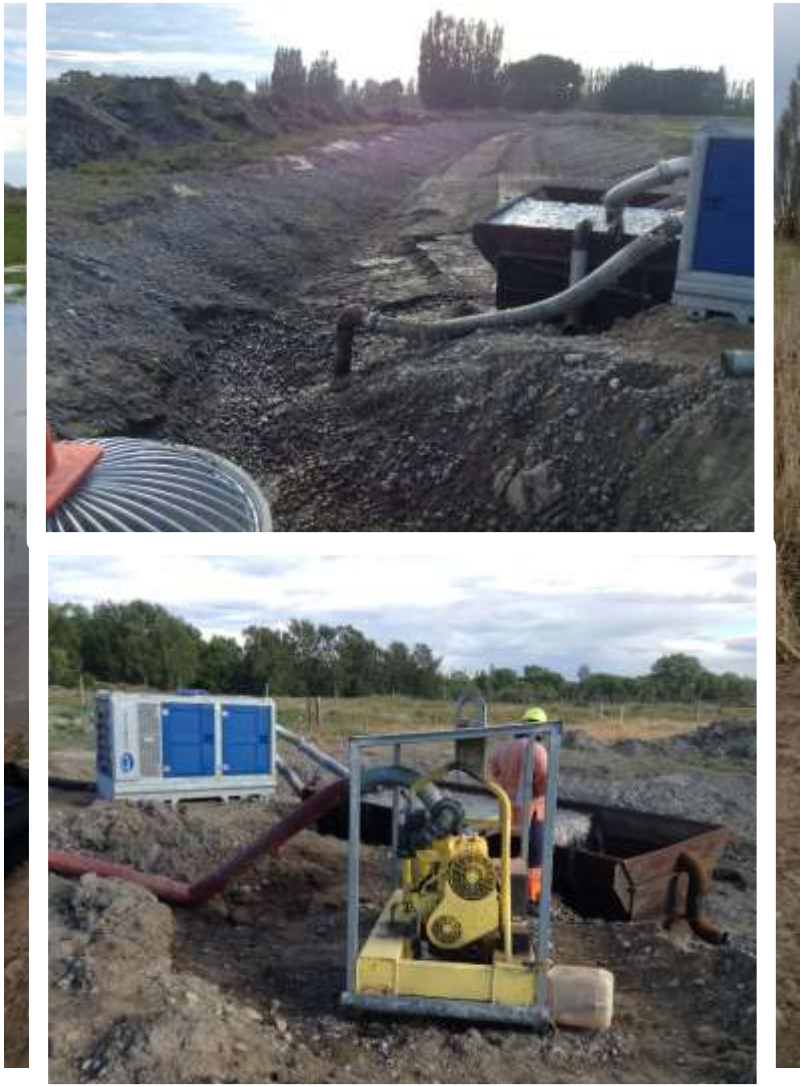
As many fish will be removed as possible from the affected waterways prior to dewatering and diversion.

Barriers will be placed within the channels at the upstream (where applicable) and downstream ends of the waterways to prevent fish recolonising the channel once it has been fished out.

Dewatering

Mitigation options:

- Ensure appropriate treatment of the discharge prior to discharge
- Minimise erosion and scour at the discharge point(s)
- Utilise the existing CCC stormwater network
- Ensure an appropriate mixing zone in the water body
- Ensure the discharge does not have a detrimental impact on flora and fauna downstream of the discharge point; and
- Minimise the volume of dewatering water discharged to surface water bodies through reuse and land-based detention and soakage.



Fish Passage (monitoring)

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Fish passage to be maintained during construction

Temporary diversions to be inspected by a qualified ecologist at regular intervals

2 hourly monitoring for all dewatering activities whilst works are taking place.

Habitat Monitoring

Constructed channels will need to present habitat of equal or better quality than the channels they have replaced.

Monitoring should occur 6 months after channel commissioning and may continue on an annual basis for four years.

Results to be compared to the pre-construction assessment completed in 2012.

If results indicate a habitat of less value, steps should be taken to improve the value.

Project success

Project success

Project success

Project success

Fish totals

Site location	Longfin eels	Shortfin eels	Eel species	Inanga	Giant Bully	Common Bully	Bully species	Total
Darroch St Drain (South)	0	0	0	0	0	0	0	0
Darroch St Drain (North)	1	25	6	0	2	0	0	34
Kingsbury Drain	1	1132	0	2	17	8	0	1160
Whitemore Drain	3	128	0	1	1	2	0	135
Horrell Drain	15	21	955	51	110	212	59	1423
Horrell Drain (Twin culverts)	3	61	0	4	0	0	82	150
Sawmill stormwater pond	0	89	0	0	0	0	0	89
Sawmill Drain	0	273	0	0	0	0	0	273
Darroch St ditch	0	7	0	0	0	0	0	7
								3271

Images (L to R) Inanga, Giant bully, Upland bully – Source: Freshwater fish fact sheets, Boffa Miskell, August 2017

Site meeting minutes

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Aquatic ecologist summary of meeting requirements 24/08/15

Meet on site at old Graynes Drive at 8:30am 24/08/15

Sign in at Safety Station/ Safety Briefing / Ecologists to be escorted onto site

Site contacts:

- Tanya Blakeley – 027 437 7183 (Aquatic Ecologist)
- Tim Toomey – 027 478 4634 (Darroch St Drain – South/Kingsbury Drain)
- Ty Coetzee – 027 534 9303 (Site engineer – Escort)
- Ash Mitchell – 027 2466 069 (Sawmill Drain / Darroch St Drain)
- Matt Taylor – 021 226 2383 (Kingsbury Drain)

Site visits required:

Darroch St Drain – Installation of culvert/diversion works (Southern end)

Date	Activity
Monday 24th August	- H&S pre-start - Installation of coffer dams (FH Drainage) - Pump out of water between coffer dams to land (using fish screen) - Sediment to be inspected by Aquatic ecologist for fish rescue - Once clearance received from ecologist, works can commence with headwall works. - Traps to be released into section of drain to be in filled (by ecologist). *Downstream works can proceed in the dry without ecologist supervision if the head wall is located where there is no flowing water* 
Tuesday 25th August	- H&S pre-start - Escorted to site - Traps to be inspected, and fish released (by ecologist). - Traps to be re-instated 
Wednesday 26th August	- H&S pre-start - Escorted to site - Traps to be inspected, and fish released (by ecologist). - Pump out of water (using fish screens), discharge to land. - Sediment to be inspected by Aquatic ecologist for fish rescue
	- Once clearance received from ecologist, works can commence with channel infill.

Kingsbury Drain – Installation of temporary culvert (works scheduled to commence 26/08/15)

Date	Activity
Monday 24th August	• Discuss methodology with ecologist on most efficient way to install 800mm culvert 

Sawmill Drain – Fill in ditch/drain with engineered fill (works scheduled to commence 07/09/15)

Date	Activity
Monday 24th August	- H&S pre-start - Discuss methodology with ecologist on most efficient way to fill in the channel.  

Darroch St Drain – Installation of temporary culvert (Northern end) (works scheduled to commence 14/09/15)

Date	Activity
Monday 24th August	- Discuss methodology with ecologist on most efficient way to install 800mm culvert 

Post construction: Habitat monitoring

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Overall, the post-construction monitoring indicates the ecological health of the constructed channels of Kingsbury and Horrell Drains is at least the same as pre-construction, baseline conditions.

The freshwater fish community found in both Kingsbury and Horrell Drain was more diverse in the constructed channels than found during the baseline survey.

In-fill planting of taller stature species recommended to increase canopy cover and stream shading in the future.

	Baseline (2012)[3]	Constructed (2017)
Habitat	**Kingsbury Drain**	**Kingsbury Drain**
Width (m)	2.25	2.50
Velocity (m/s)	0	Negligible
Macrophyte depth (m)	0.09	0.26
Substrate composition (%silt/sand:pebbles:small cobbles:large cobbles:boulders)	100:0:0:0:0	0:3:35:52:10
Fine sediment depth (m)	0.06	0.00
Water depth (m)	0.15	0.26
Habitat type (%) (riffle:pool:run)	0:100:100	0:80:20
Aquatic plant cover (% cover of stream bed)	56	46
Aquatic plant description	Watercress, duckweed, *Azolla*	Watercress, *Azolla*, water speedwell, duckweed
Riparian vegetation description	Grass and herb mix	Planted flax and *Carex*, weeds, grasses, bare earth
Macroinvertebrates		
Taxa richness	15	32
MCI[4]	65.0	74.4
QMCI	2.3	3.1
EPT[5] taxon richness (excluding hydroptilids[6])	1	3
% EPT (excluding Hydroptilids)	0.6	0.1
Fish		
Species	Shortfin eel, longfin eel[7]	**Inanga**, longfin eel, shortfin eel

Image: *A large longfin eel (At Risk, Declining) captured in Kingsbury Drain during the post construction survey.*
Source: WBB Post Construction Monitoring Memo 04-12-18 (T Blakely, K Noakes)

Opportunities for improvement






Opportunities for improvement

Opportunities for improvement

A fish screen that was blown out in a storm. Area had to be re-fished.

Silt fence used as a fish screen in stagnant water. Is this ideal?

Silt fence used as a fish screen. Is this ideal?

Silt fence, timber boards being used as a fish screen. Insert – Subcontractor salvaging eels from within the isolated work area.

Accidental discovery of fish

When handling fish you must:

- Call your Environmental Manager
- Use the Emergency Fish Salvage Kit
- Ensure hands are free of sunscreen, oils, and other chemicals
- Wet hands or gloves from the Emergency Fish Salvage Kit with clean stream water prior to picking up fish
- Collect fish in nets, where possible. A child's butterfly net works well
- Be gentle – do not squeeze fish, or hold too tightly. Don't pick fish up by gills, tails, or other appendages
- Gently place in a bucket of clean stream water
- Gently release fish into an appropriate stream or waterway nearby, as soon as possible


Upland bully

Aquatic Ecology Training

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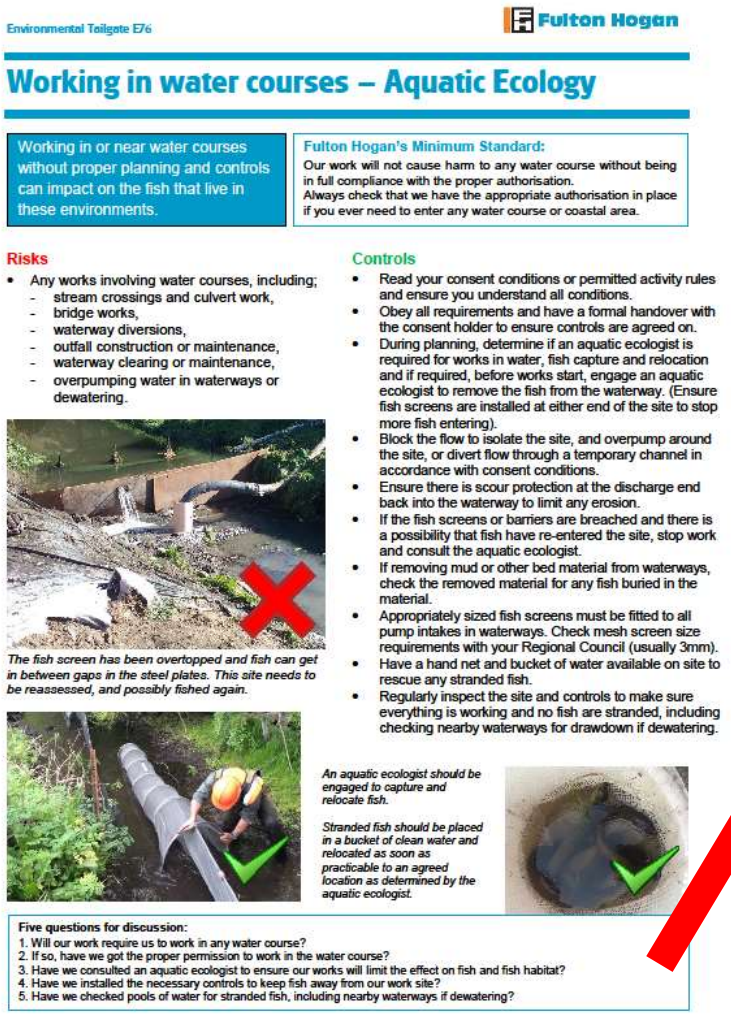

Environmental Tailgate E76

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Working in water courses – Aquatic Ecology

Working in or near water courses without proper planning and controls can impact on the fish that live in these environments.

Fulton Hogan's Minimum Standard:
Our work will not cause harm to any water course without being in full compliance with the proper authorisation.
Always check that we have the appropriate authorisation in place if you ever need to enter any water course or coastal area.

Risks

- Any works involving water courses, including;
  - stream crossings and culvert work,
  - bridge works,
  - waterway diversions,
  - outfall construction or maintenance,
  - waterway clearing or maintenance,
  - overpumping water in waterways or dewatering.

The fish screen has been overtopped and fish can get in between gaps in the steel plates. This site needs to be reassessed, and possibly fished again.

Controls

- Read your consent conditions or permitted activity rules and ensure you understand all conditions.
- Obey all requirements and have a formal handover with the consent holder to ensure controls are agreed on.
- During planning, determine if an aquatic ecologist is required for works in water, fish capture and relocation and if required, before works start, engage an aquatic ecologist to remove the fish from the waterway. (Ensure fish screens are installed at either end of the site to stop more fish entering).
- Block the flow to isolate the site, and overpump around the site, or divert flow through a temporary channel in accordance with consent conditions.
- Ensure there is scour protection at the discharge end back into the waterway to limit any erosion.
- If the fish screens or barriers are breached and there is a possibility that fish have re-entered the site, stop work and consult the aquatic ecologist.
- If removing mud or other bed material from waterways, check the removed material for any fish buried in the material.
- Appropriately sized fish screens must be fitted to all pump intakes in waterways. Check mesh screen size requirements with your Regional Council (usually 3mm).
- Have a hand net and bucket of water available on site to rescue any stranded fish.
- Regularly inspect the site and controls to make sure everything is working and no fish are stranded, including checking nearby waterways for drawdown if dewatering.

An aquatic ecologist should be engaged to capture and relocate fish.

Stranded fish should be placed in a bucket of clean water and relocated as soon as practicable to an agreed location as determined by the aquatic ecologist.

Five questions for discussion:
1. Will our work require us to work in any water course?
2. If so, have we got the proper permission to work in the water course?
3. Have we consulted an aquatic ecologist to ensure our works will limit the effect on fish and fish habitat?
4. Have we installed the necessary controls to keep fish away from our work site?
5. Have we checked pools of water for stranded fish, including nearby waterways if dewatering?

Five questions for discussion:

1. Will our work require us to work in any water course?
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Aquatic Ecology Training

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Promote awareness

Connecting Nature Connecting People

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Environmen

Minimising environme
focus for the project te
with ECan to ensure al

Around 118,000 plants, shrubs and tr
these are grown from seeds and cutti
area.

During the project more than 3,500 r
bully and inanga) have been rescued

Where the WBB passes over waterw
culverts have been designed to allow
with native species

More than 3,500 native fish have been reloca

Operation relocation

Thousands of fish are relocated away from work on the Western Belfast project

The Western Belfast Bypass (WBB) project is a NZ$940M, 5km greenfields section of State Highway 1 through Christchurch, which forms part of the New Zealand Roads of National Significance programme. The new motorway will help reduce congestion by bypassing Belfast between the Northern Motorway and SH1 at Johns Road.

The WBB alignment crosses an historic floodplain of the Waimakariri River, through what would have originally been wetlands but were drained for farmland pastures. As part of the project, four human-made perennial waterways were to be culverted, diverted, or filled in to allow for building of the new road.

Boffa Miskell (www.boffamiskell.co.nz) was commissioned by Fulton Hogan to oversee the project's aquatic ecology, including providing ecological advice on the reconstruction of new waterway channels, maintaining fish passage throughout the construction works, and carrying out the fish relocation as required by the project's ecological management plan. Boffa Miskell Aquatic Ecologist, Dr. Tanya Blakely led the team responsible for the rescue and relocation of freshwater fish from the waterways. This saw Tanya working closely with the Fulton Hogan team, so that the fish rescue works were perfectly timed with the road construction works.

The specialised technique of electric fishing was initially used to capture fish and relocate them away from the construction zone. However, electric fishing is best suited for use in faster flowing, stony-bottomed waterways. The waterways within the WBB were slow flowing with a thick layer of fine silt and sediment covering the gravel bottom. So, a variety of trapping methods were then deployed. Fyke nets (or hinaki), Gee minnow traps, and Kilwell box traps were baited with tinned cat food or raw beef, cat biscuits, and New Zealand's famous breakfast spread, Marmite.

Nearly 1,500 native freshwater fish were captured and relocated to a suitable site downstream using these methods. The majority of these fish were shortfin eels, but also included longfin eels and inanga (one of the native whitebait species), both of which are at risk with declining numbers.

Despite the enormous number of fish captured, there were still more in the waterways. So the Fulton Hogan team carefully removed the top layer of fine silt and sediment from the stream bed for Boffa Miskell ecologists to search through and rescue the fish. A further 1,700 native fish, mainly shortfin and longfin eels, were salvaged from the construction area and relocated to suitable downstream habitat.

Fulton Hogan WBB Project Manager, Ben Hayward, said the environmental successes on the project to date have resulted from all project staff being actively involved in environmental management.

"Environmental excellence isn't just a top down management drive, but rather business as usual for everyone on the project," he said. "The ownership of the project by all staff has meant that more than half of the improvement ideas raised have come directly from the field. The earthworks and drainage teams formed an excellent working relationship with both Dr Tanya Blakely and WBB Environmental Manager, Omar Seychell. On numerous occasions these teams stopped the job and got their hands dirty helping to relocate fish species that were found while conducting routine works."

Winter 2016 7

Lessons learned

1. Include ecological requirements in the landscape specification
2. Be specific with habitat features
3. Do a site walkover with the project ecologist prior to works commencing to ensure a good understanding of programming implications with fishing effort
4. Establish some aquatic ecology training sessions for the project team early on in the project
5. Have several emergency fish salvage kits on standby
6. Work with the ecologist on the best option for fish barrier screens
7. Don’t just focus on ESC with works near waterways

Lessons learned

8. Engage some key staff to get involved in the fishing and trapping efforts
9. Always include in the fishing programme some resource to ‘fishing the sediment’
10. Don’t underestimate drawdown risks when dewatering near waterways. Ensure a monitoring programme is in place and always have an emergency contingency to direct flow into surface water if levels are dropping
11. Ensure habitat monitoring requirements are realistic and undertaken during appropriate seasons
12. Acknowledge and reward good effort amongst the crews

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Thankyou