PRISONS, PLANTING AND FLOOD PROTECTION

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ABSTRACT

This paper describes the Department of Corrections Flood Protection Improvements at Rimutaka Prison.
The Department of Corrections (Corrections) in collaboration with the New Zealand Defence Force (NZDF) commissioned the construction of a stormwater channel to divert an unnamed stream channel around the perimeter of the Rimutaka Prison facility and through land owned by NZDF. Corrections' primary driver was to prevent reoccurrence of flooding damage within the prison, while NZDF's key driver was the potential for environmental enhancement and restoration of the area. With the two different drivers, the project required strong collaboration between all parties to be successful.

The project consisted of 1,200m of new stormwater channel with part of the channel consisting of an environmental channel with several wetland areas and a weir to attenuate flows to restrict the downstream water volumes received to pre channel flows. The channel was designed to screen debris arriving at the prison and to provide a 100 ARI level of protection. In addition, an NZDF driver was to increase water quality and provide a natural habitat for fish species. The channel was located across both NZDF and Corrections land, between an operational prison site, an active live-firing military range complex and demolitions range that is used for training with explosives, and also for emergency disposal of explosive items discovered in the community, such as old 'souvenir' munitions or improvised explosive devices. Access to both sites is strictly controlled for safety and security reasons.

During construction the $2.8M project encountered several unforeseen factors including; poor ground conditions, bomb squad call outs, adverse weather, variation disputes and a police arrest. Both Corrections and NZDF required specific site protocols to be followed at all times, making the already dynamic project truly unique.

KEYWORDS

Stormwater, low impact design, ecological restoration, prison and defence force works.

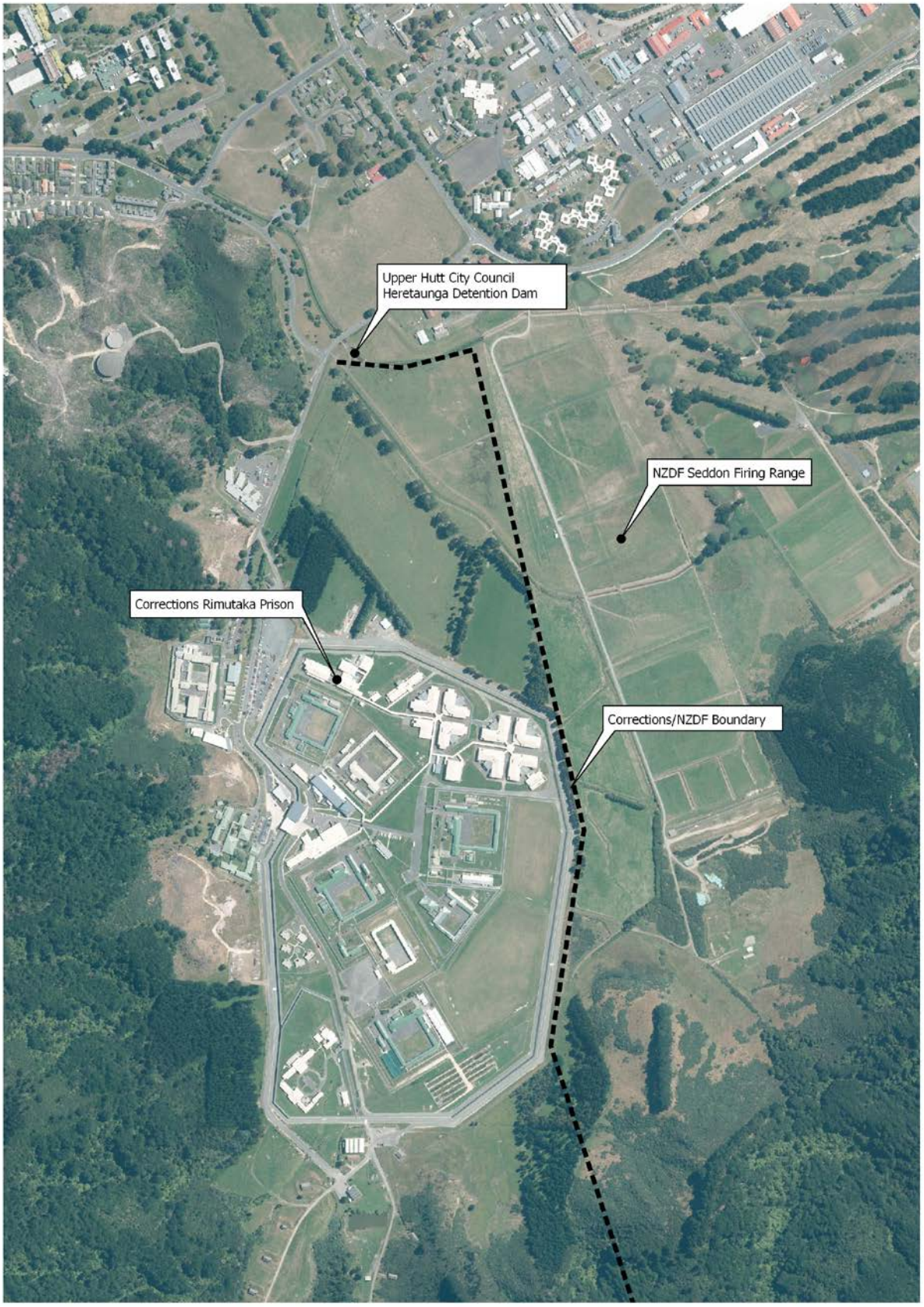
1 INTRODUCTION

The Rimutaka Prison is a Department of Corrections (Corrections) facility located in a valley at the end of the Freyberg Road extension, Upper Hutt. The existing prison site has been developed over the years and the natural water flow over the site has been extensively modified. Through extensive development of the catchment, the stream from the upstream Kuku Valley catchment formed a series of open channel sections through the center of the prison complex. In previous major flood events, the stormwater system could not cope with stormwater flows and water flooded various critical parts of the prison causing significant damage. Flood events in 2009 damaged the gatehouse. As result of the increasing flooding Corrections sought an engineered flood protection solution to increase the level of protection to the prison.

The Rimutaka Prison and New Zealand Defence Force's (NZDF) Seddon Firing Range share a common boundary as shown in Photograph 1. The likely engineered stormwater solution would require close collaboration with NZDF as there was likely to be insufficient room within Corrections land to accommodate the flood protection solution required to provide a new level of service.

Both the Corrections and NZDF sites have unique land uses that bring with them particular challenges. The flood protection solution would need to recognise these land uses and access restrictions.

Figure 1: Aerial of Rimutaka Prison and NZDF Seddon Firing Range



2 STAKEHOLDER DRIVERS

Early project stakeholder discussions confirmed that the key stakeholders Corrections, NZDF and Upper Hutt City Council (UHCC) had quite differing drivers but for the project to be successful, a common solution meeting all parties' drivers would need to be found.

2.1 DEPARTMENT OF CORRECTIONS' DRIVERS

In 2009 an intense storm event flooded Corrections Rimutaka Prison's new gate house and car park with water and silt. The prison itself was not affected but the perimeter fence suffered damage. The flow of the storm water also undercut security fence foundations on the west and eastern side of the prison. This could have created a breach in security had the fence been damaged further.

The objectives of the project were to reduce the risk of future flood damage to Rimutaka Prison as experienced in 2009.

2.2 NZDF DRIVERS

NZDF have a driver to improve the terrestrial and aquatic environment around the Seddon Firing Range and have prepared a Trentham Ecological Restoration Plan (TERP) which sets out potential future improvements. Undertaking improvements in the drainage of the area provides the ideal opportunity to also make habitat improvements through adopting the principals of the TERP.

The TERP vision is to: *establish an aquatic pathway from the Trentham Hills to the Hutt River, alive with native fish and birdlife, and providing a living record of the vegetation sequence that once existed. A place that enhances peoples living environment and where people learn how natural ecosystems function through working on a project in their back yard.*

However, the NZDF project drivers were not solely ecological. During periods of wet weather the drainage channels that drain the Seddon Firing Range back up as a result of sedimentation blocking the receiving water body. This had an operational impact on the land use as the backing up of these drains caused flooding to parts of the range and posed a risk of blocking access to the NZDF adjacent Demolitions Range. NZDF were wanting this situation on their land to be improved as a result of the works.

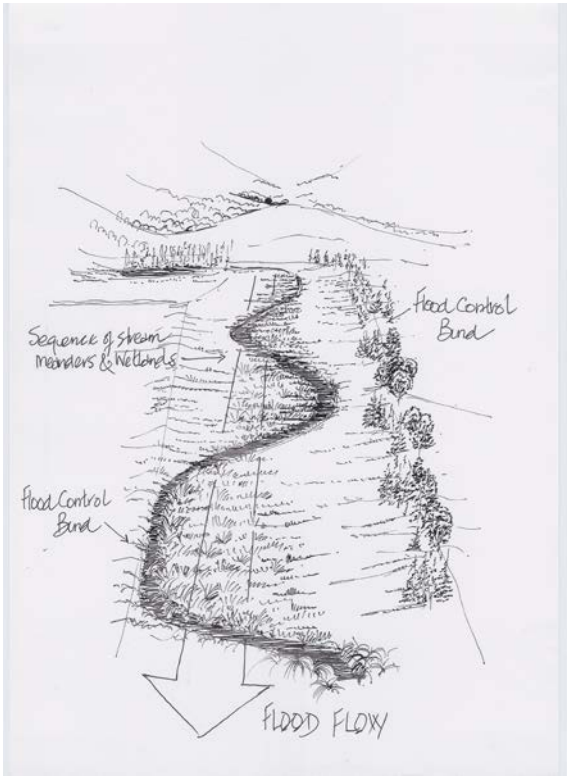


Figure 2: Trentham Ecological Restoration Plan (prepared by Groundtruth Ltd)

2.3 UHCC DRIVERS

Upper Hutt City Council (UHCC) own and maintain a number of key flood protection assets immediately downstream of Rimutaka Prison and the Kuku Valley catchment. The Heretaunga Flood Retention Dam and flood control structure area was constructed following a flood in 1976, and is located at the junction of the stream with Freyberg Road (refer Figure 1). This structure has flood gates that can be shut via telemetry in the event of a major flood event. This causes water to pond behind a stopbank, flooding the lower prison land and NZDF land by storing water and avoiding a damaging flood peak through residential areas. When the peak storm flow has passed, the water can then be released slowly to avoid a damaging flood peak.

The downstream watercourse is known as the Heretaunga Drain and is managed by UHCC down to the confluence with Pinehaven Stream at Whitemans Road near the Silverstream Railway Station. Downstream of Pinehaven Stream it is known as Hulls Creek and managed by Greater Wellington Regional Council.

The UHCC has responsibility for the Heretaunga Drain and requires that it is kept clear of obstructions to flood flow. Given UHCC's flood protection responsibility the Council's drivers for the project were that while it was

post project was to be consistent with that being experienced previously. This was to ensure that the new flood protection solution did not change the time of concentration by passing water forward more quickly thereby adversely affect the Heretaunga Drain's operation or the frequency of its operation.

3 CATCHMENT CHARACTERISTICS

3.1 HYDROLOGY

A desktop investigation of the hydrology of the catchment upstream of Rimutaka Prison was carried out in order to calculate the flows expected at the perimeter of the prison and how these might be managed. This involved the calculation of 100-year average recurrence interval (ARI) flows expected from the sub-catchments.

3.2 SUB CATCHMENT FLOW ESTIMATES

A rainfall runoff model was used to estimate design peak flows from each sub-catchment and the combined routed flows around the prison perimeter. The Rational Method was used to calculate the 100-year ARI design peak flow from each sub-catchment and the parameters of the rainfall runoff model were adjusted until the model generated similar peak flows on the hydrograph. The results of this process are given in Table 1, while sub-catchment characteristics are given in Table 2 and the adopted RORB parameters are shown in Table 3. Water Resources Explorer New Zealand (WRENZ) Flood Frequency values have also been included in Table 1.

The Rational Method was selected for use in establishing RORB parameters because it is better suited to smaller catchments while the WRENZ Flood Frequency method, while providing a useful comparison, is not considered ideal for catchments less than 10km^2. Design rainfall for the site was obtained from HIRDS v3.

Figure 3: Layout of the sub-catchments draining to Rimutaka Prison

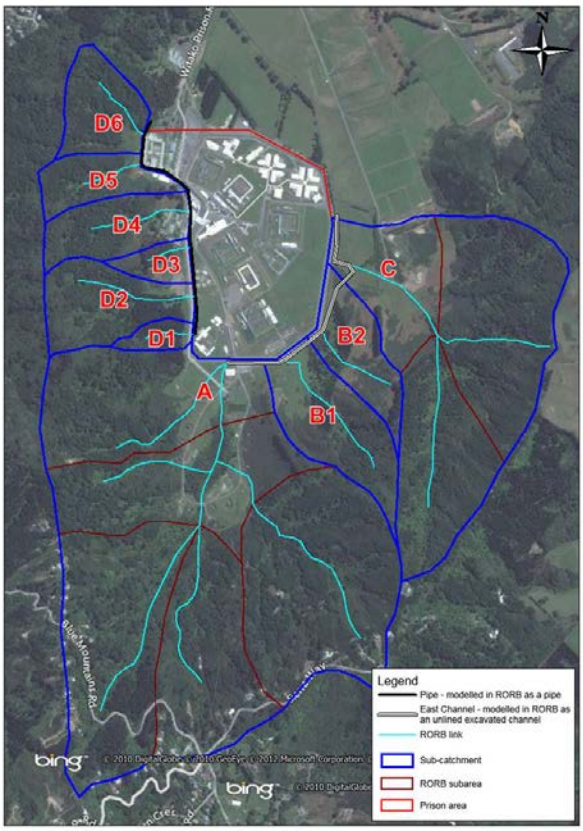


Table 1: Sub-catchment 100-Year ARI Flow Estimates (m3/s)

Sub-catchment	Rational Method[1]	RORB	WRENZ Flood Frequency[2]
A	10.4	10.4	10.1
B1	1.5	1.4	1.7
B2	1.0	1.1	1.2
C	6.4	5.1	5.6
D1	0.2	0.3	0.4
D2	1.3	1.2	1.5
D3	0.3	0.5	0.5
D4	1.0	1.1	1.2
D5	0.7	1.0	0.9
D6	0.9	1.2	1.1

Table 2: Sub-catchment Details

Sub-catchment	Area (km^2)	Main Stream Length (km)	Rational Method Runoff Co-efficient[3]	Estimated time of concentration (minutes)[4]
A	1.396	1.35	0.35	20
B1	0.145	0.69	0.35	10
B2	0.093	0.42	0.35	10
C	0.610	1.01	0.35	10
D1	0.022	0.23	0.35	10
D2	0.119	0.57	0.35	10
D3	0.031	0.21	0.35	10
D4	0.096	0.48	0.35	10
D5	0.069	0.28	0.35	10
D6	0.087	0.33	0.35	10

Table 3: RORB Parameters

	k_c	Initial Loss (mm)	Continuing Loss (mm/hr)
Parameter Value	1.9	3.0	2.0

The routed sub catchment flows were calculated during the option development (refer to Section 4.2.1).

3.3 MODIFIED ENVIRONMENT

The Rimutaka Prison site and the upper area of the Seddon Firing Range are relatively isolated from the nearby Upper Hutt suburbs. To the west and south of the area the land slopes up into predominantly native forest (including rimu, totara, punga fern) with a smaller amount of exotic trees (including eucalyptus, pine and gorse).

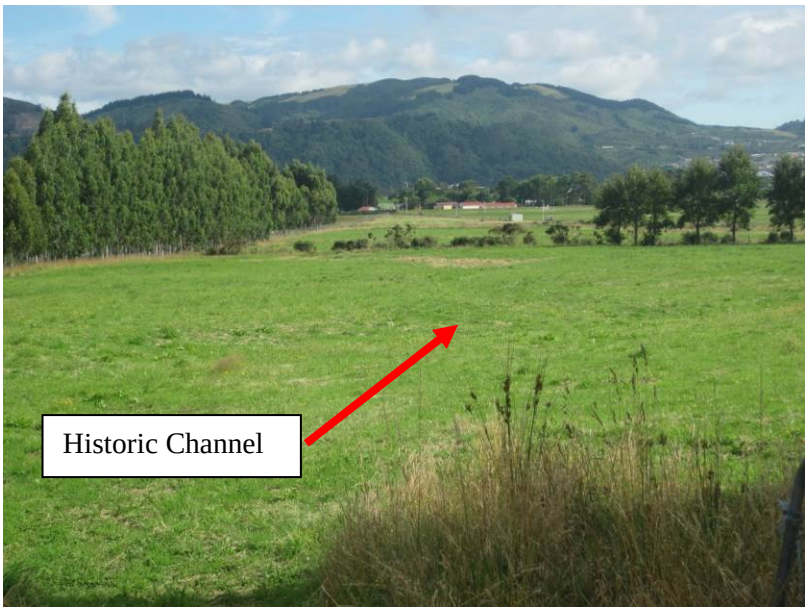
[1] Used when catchment areas are less than 0.5km^2. This method is not applicable for large catchments (New Zealand Water Environment Research Foundation).

[2] Available at http://wrenz.niwa.co.nz/webmodel/. This is based on the Flood Frequency method by Pearson & McKerchar (1989). This method is not considered ideal for catchments less than 10km^2.

[3] A runoff coefficient of 0.35 has been assumed as this represents woodlands with average to below average infiltration.

[4] These are rounded values to match the rainfall event durations provided by HIRDS v3.

Photograph 2: View of NZDF site looking towards Seddon Firing Range



A number of intermittent streams flow onto the area of the works around the prison. The stream system is characterised by on-going relatively low flows with occasional very high flow events that can result in considerable scouring and erosion of sections of the stream bed. The streams had been modified over time and the engineering of water channels as straight drainage channels is likely to have exacerbated erosion, resulting in on-going cutting down of watercourses at their head to re-established natural flow gradients.

The catchment runoff was largely directed through the prison site in a series of open channels and piped sections which were not capable of carrying the full 100 year ARI flow. Some of the catchment flows were also controlled around the prison by two main channel systems:

- From the eastern hills via a series of streams and open drainage channels; and
- From the west via an open channel in the road.

There is also an existing highly modified watercourse with NZDF land (along the Seddon Firing Range). The Seddon Firing Range Stream was diverted into the drainage channel alongside the range road sometime in the past 100 years. Photograph 2 shows the original stream alignment as a visible depression.

There is very little in the way of native vegetation in the drainage channels in this area except toward the upper reaches where occasional species including mahoe were present and where the stream emerges from remnant kahikatea swamp forest. The Seddon Firing Range Stream channel is susceptible to bed erosion in the upper reaches, resulting in a perched culvert and necessitating gravel removal. While fish passage is currently blocked by the perched culvert kokopu were observed in a pool below this culvert. Clear identification was not possible but they appeared likely to be either short-jawed or giant kokopu[5].

The presence of fish in the upper catchment was not well understood, although it was expected that eels may be found in these watercourses. Fish data in the lower catchment is recorded in a publication on Hulls Creek dated August 2007[6]. The weir at the Heretaunga Drain forms a barrier and is therefore likely to prevent fish passage to stream sections in the upper catchment.

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[5] Trentham Ecological Restoration Plan - June 30 2010, p9.

[6] http://www.gw.govt.nz/assets/council-publications/Hulls%20Creek%20Water%20Quality%20Investigation%20Screen%20Version.pdf

4 PROPOSED FLOOD PROTECTION SOLUTION

4.1 OPTIONS CONSIDERED

The Rimutaka Prison and NZDF's Seddon Firing Range share a common boundary. As part of the project for Corrections, discussions were held with NZDF on the proposal to construct a shared channel capable of providing flood protection to the prison while providing a solution that was consistent with the NZDF drivers of ecological improvements.

An optioneering stage was undertaken to determine what options could provide the 100 year ARI level of protection. These were focussed around:

- A new channel solely on Corrections land
- A new channel on both Corrections and NZDF land

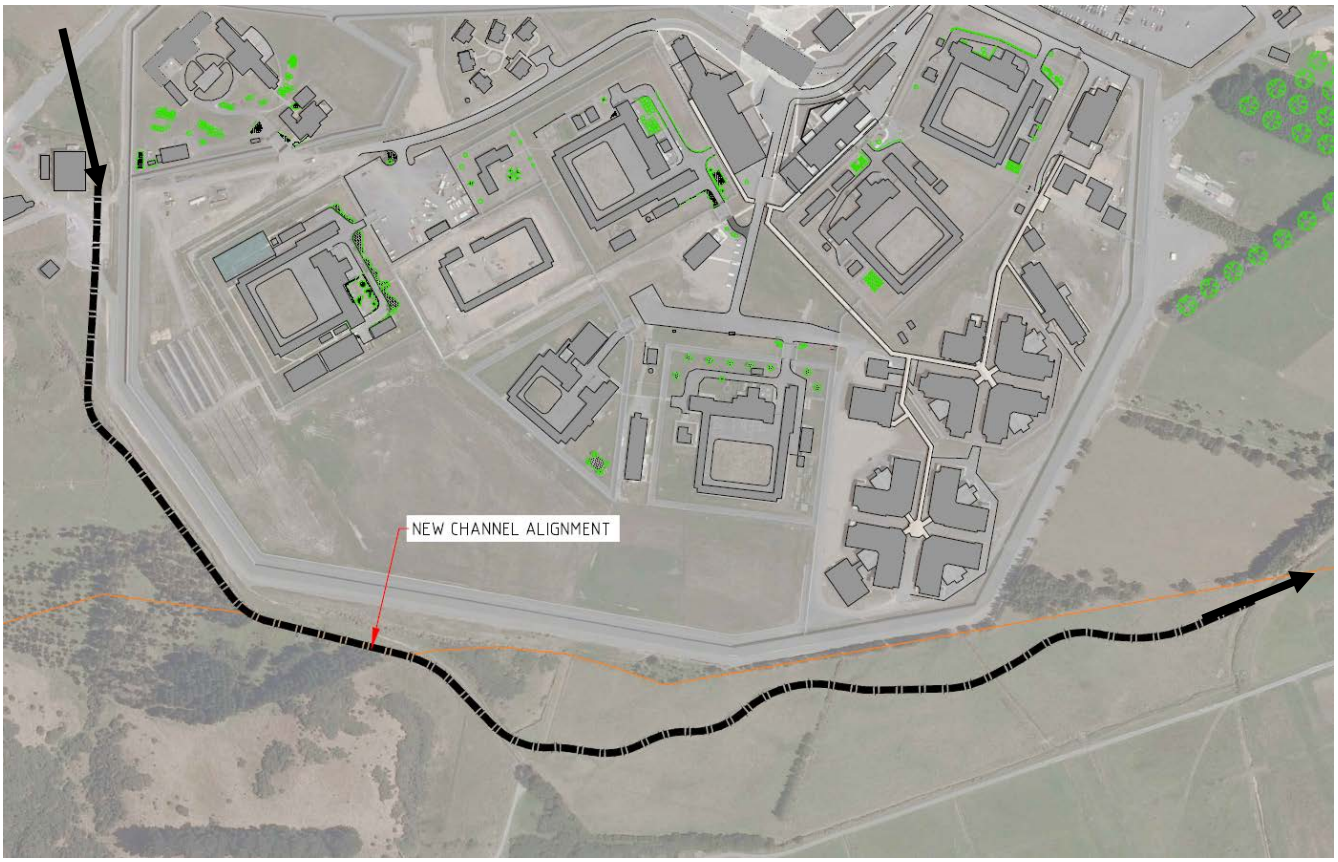
This exercise concluded that in order to provide the 100 year ARI level of service the new channel would need to encroach on NZDF land. This was due to there being insufficient available Corrections land to accommodate the required channel width.

Given that the adjoining land owned by the NZDF would be required to help address the problem of flooding, both parties agreed to find a suitable solution to solve what was considered to be a wider problem. There was also an opportunity to not only create emergency flood paths and stormwater storage for Corrections but to also provide increased ecological values by improving waterway flows and habitat for NZDF. To facilitate the solution, a memorandum of understanding was drafted and signed by both parties that agreed long term maintenance and access issues.

4.2 PROPOSED OPEN CHANNEL

The preferred solution was to construct a new diversion channel around the prison perimeter which effectively reinstated the old stream alignment shown in Photograph 1 back to its original alignment with the additional flows from the prison and Kuku Valley Stream. The new channel alignment is shown in Figure 4.

Figure 4: New Channel Alignment through Corrections and NZDF land



4.2.1 DESIGN FLOW

The channel was designed to take the 100 year ARI allowing for climate change to 2090 as well as potential to collect water from an adjacent catchment should Corrections wish to construct another related flood protection project in the future. A minor increase in overall flow was also allowed for to accommodate potential future development within the prison site.

Using the rainfall runoff model in RORB the design flows from each sub-catchment were routed around the prison perimeter. Sub-catchments A, B1, B2, and C as shown in Figure 2 were to be diverted around the eastern edge of the prison, while sub-catchments D1 through to D6 were diverted around western edge.

The impact of climate change on peak flows was considered for the year 2090. This was done using the function within HIRDS v3 that allows climate change to be accounted for by specifying temperature differences. A temperature increase of 2.1 degrees was used for the year 2090 (as recommended in the MfE Coastal Hazards and Climate Change Guidance Manual). The adjusted rainfalls were then used in the RORB model to generate new peak flows as given in Table 4.

Figure 5: Routed flow estimate locations

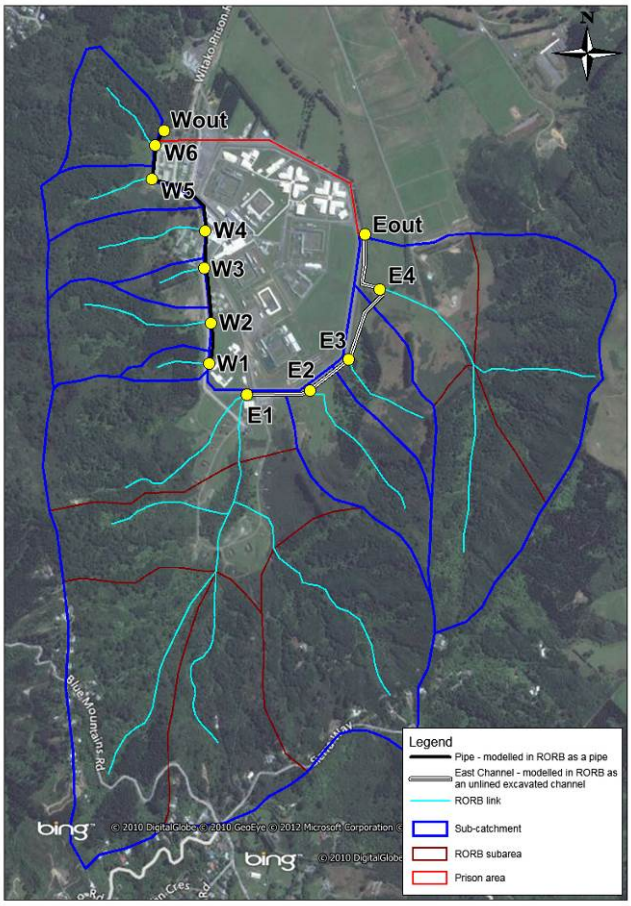


Table 4: Routed Peak Flow Estimates for 100-year ARI Event Including Climate Change Effects for 2090

Location	Flow (m^3/s)
E1	12.2
E2	13.4
E3	14.3
E4	19.8
E out	19.5
W1	0.4
W2	1.8
W3	2.2
W4	3.5
W5	4.5
W6	5.8
W out	5.8

In order to provide the required 100 ARI levels of service for Corrections, the required channel was designed to accommodate 19.5m^3/s as shown Table 5 (E out).

4.2.2 CHANNEL CHARACTERISITICS

The channel design included diverting the flow of the intermittent streams arriving at the prison boundary into one new open drainage channel around the perimeter of the prison, constructing a flood retention area with bunds and constructing a debris trap area. The approximate length of the channel is 1,200m.

The channel follows the periphery of the eastern side of the prison site, and then traverses the adjoining NZDF property. A debris trap area was constructed at the upstream end of the new perimeter channel at the rear of the prison site to reduce the amount of debris entering the channel from the steep upstream catchment.

The channel alignment is shown in Figure 4 and follows the perimeter of the prison for approximately 500m and then follows the natural ground profile onto the adjoining NZDF land. The proposed channel structure commences as a standard trapezoidal channel until the lower reaches where is becomes an environmental channel comprising a low flow channel with a planted ecological area bounded between two bunds approximately 50m apart. The proposed low flow channel will meander to increase its sinuosity thereby reducing the potential for erosion and also creating protected habitat for fish. The channel then flows into the Heretaunga Retention Dam.

Parts of the construction site were located within the ricochet zone of the adjacent Seddon Firing Range. This meant that no heavy civil design structures could be located within the lower reaches of the stream. Therefore the design focussed on earth bunds to provide the required level of service.

The design, including the bunded flood detention area, accommodates a 100 year ARI flood event. The design philosophy for the channel was for the time of concentration to the downstream Heretaunga Retention Dam to not be shorter along the new channel than along the previous flow path through the prison. The previous time of concentration to the downstream Heretaunga Retention Dam was calculated and allowance made to retain flow during flood events that mimicked previous flow based on eye witness accounts and documentation of previous flooding occurrences.

The typical cross section Figure 6 shows that the drainage channel is typically 2m wide at the base, and approximately 12m across at its height, with a 1V:3H slope. The channel was designed to have a freeboard allowance of 0.5m on the prison land side, and 0.3m on the NZDF land side in a Q100 flood event. This was to preferentially direct water away from the prison in a storm event greater than 100 year ARI.

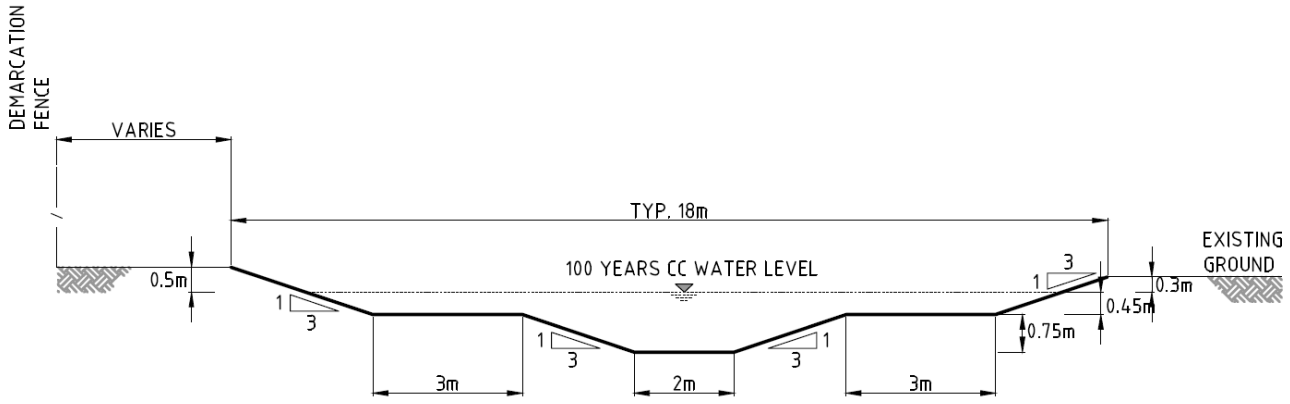


Figure 6: Typical Cross Section of new channel

The purpose of the retention area was to mimic the performance of the previous system to satisfy UHCC's project driver of not greatly altering the catchment time of concentration. The volume of storage created on the new detention area matched the volume of water captured when the prison carpark previously flooded. A 1m x 4m box culvert was installed to allow up to a 2 year ARI to pass before flood detention occurs. The retention area is shown in Photograph 3.

Photograph 3: Taken standing on the bund and box culvert looking upstream to the flood retention area

4.2.3 NZDF CHANNEL WORK

As the diversion channel alignment through NZDF land was confirmed, NZDF also requested the designer look to not only provide habitat improvement in the area but to also address drainage issues within the Seddon Firing Range (outlined in Section 3.2). This further aligned the drivers between the two parties.

4.2.4 ALIGNMENT WITH THE NZDF RESTORATION PLAN

Of relevance to the proposed stormwater upgrade is the Trentham Ecological Restoration Plan (TERP) prepared by NZDF. This plan seeks to establish a formal restoration project on the upper slopes to the south of the Trentham Military Camp on land owned by the NZDF. The intention of the restoration plan project is to achieve greater biodiversity; contribute to fish habitat corridors and enable fish passage; and encourage a culture of sustainability within NZDF and the local community, all without compromising or impacting on neighbouring land or flood management.

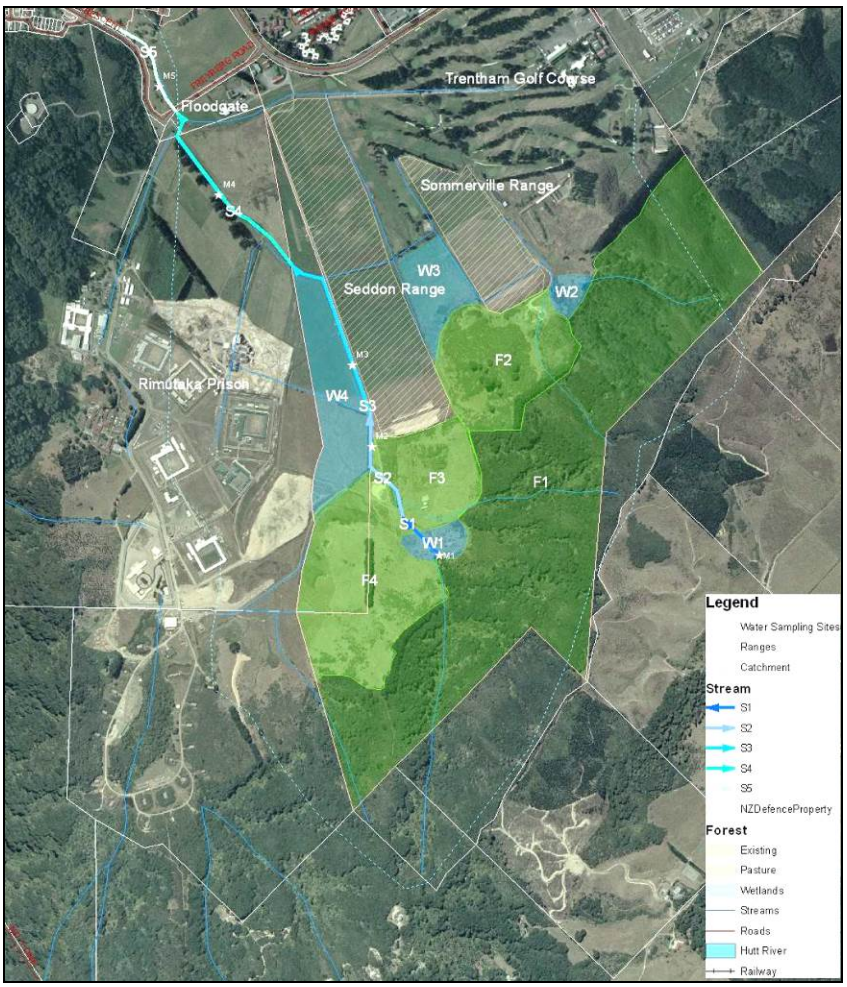
The area of land included in the restoration plan that overlaps with the new channel is area W4 as shown in Figure 7.

As outlined previously, the construction of the channel incorporated the restoration of a historic waterway that had been drained and diverted sometime in the previous 100 years. The project supported TERP by cutting and remove gorse from the area and providing a range of eco-sourced wetland species that can tolerate occasional dry periods including Carex species, rushes, and Flax (Phormium tenax). These were propagated from the Rimutaka Prison nursery. In the future Corrections may provide prisoner labour for planting activities, which is likely to focus on Corrections land.

In order to obtain the resource consent to work within an existing waterway (connecting the new channel at either end) a five year planting plan was provided that detailed the areas that would be planted and in the planned stages to generate maximum ecological improvement. The planting was to be undertaken with eco-sourced plants grown by the adjacent Rimutaka Prison nursery. This was a good local source of appropriate plants for the new wetland that not only provided the ecological improvements but assisted with the prisoner rehabilitation programme.

The flood protection solution was in keeping with the objectives of the TERP. Within the W4 area, the restoration plan included flood control bunds and a meandering stream as indicated in the concept sketch in Figure 2.

Figure 7: Trentham Ecological Restoration Plan project area



4.3 CONSENT REQUIREMENTS

The following resource consents were required for the works:

- Water permit to divert a number of unnamed intermittent tributaries of the Heretaunga Drain into an open drainage channel; and
- Land use consent to construct and maintain a culvert and associated structures in the bed of unnamed tributaries of the Heretaunga Drain; and for the disturbance of the beds of unnamed tributaries of the Heretaunga Drain

The land parcels affected by the proposed works were designated for Rimutaka Prison and Defence purposes under the Upper Hutt City District Plan. Consequently, resource consents were not required from Upper Hutt City Council. However, an Outline Plan for the works was submitted in accordance with s176A of the Resource Management Act.

4.3.1 FISH RELOCATION

One resource consent condition was to capture and relocate fish from waterways which were potentially affected by the earthworks. This work was undertaken in accordance with the approved fish relocation plan.

The total catch was four shortfin eels (Anguilla australis) from 350mm to 500mm in length, and three large banded kokopu (Galaxias fasciatus) from 200mm to 275mm in length. All fish were in good condition and were successfully relocated to suitable habitat in the upper stream, upstream of the boundary of the prison. All but one of these fish were caught in fyke nets in reaches two (Photograph 4). This area provided good quality habitat due to the presence of pools (0.4 to 0.6m deep), abundant riparian cover of grasses and

Juncus, and an associated small area of wetland. Fish records were uploaded to the NZ Freshwater Fish Database.

Photographs 4 and 5: Habitat where large banded kokopu (pictured) was caught and relocated upstream

4.4 SCOPE OF PHYSICAL WORKS

To improve the flood protection at Rimutaka Prison a contract was prepared by Corrections for the construction of the following infrastructure:

- Installation 1,200m of stormwater channel including a floodplain and weir to attenuate downstream flows;
- Several wetland areas providing water quality enhancements and provide a natural habitat for fish species;
- Stabilisation of the ground with clover to allow for future native planting in accordance with the TERP.
- 250m of rock rip rap installation.
- Installation of three large box culverts.

5 CONSTRUCTION CHALLENGES

The construction of the channel commenced in March 2014 and concluded in November 2014 at a cost of approximately $2.8M. Although there were works within the security fence at Rimutaka Prison, the majority of the flood protection works were associated with the construction of the flood protection channel, wetland and associated box culverts. Throughout the construction there were challenges associated with the unique nature of the prison and adjacent firing range and demolition range.

5.1 SITE ACCESS AND SAFETY PROTOCOLS

The channel was located on land between an operational prison site, an active live-firing military range complex and demolitions range that is used for training with explosives, and also for emergency disposal of explosive items discovered in the community, such as old ‘souvenir’ munitions or improvised explosive devices. Access to both sites is strictly controlled for safety and security reasons.

Prior to commencing on site, the contractor was required to have all staff inducted by Corrections and have passed Ministry of Justice security checks. Identification and evidence of security approval were required to be carried at all times. Other site protocols required for working in the area included:

- Access to the site required controlled issue of access keys for NZDF land that were to be signed in and out each day. The placement of plant at the end of each day was strictly controlled. All plant need to be disabled, parked only in designated areas away from the prison and out of sight;
- Parts of the construction site were located within the ricochet zone of the adjacent Seddon Firing Range. This meant that no work could occur during planned bookings of the firing range. These included

military exercises and club and national competition events (e.g. Ballinger Belt). This also meant that no plant and only selected materials could be stored within this area of the site;

- The site office location had to be carefully determined. The location of the site office needed to be clear of the cell phone blocking system that Rimutaka Prison operates, as well as the ricochet zones.
- Use of the Demolitions Range for emergency demolitions could occur at any time and as a result NZDF required three contact numbers for site staff onsite to clear the site at zero notice. An NZDF radio was also carried on site by the contractor for use in-case of such an event, due to the cell phone blocking service.

5.2 CONSTRUCTION CHALLENGES ENCOUNTERED

The biggest construction challenge was that the work was largely being carried out during wet weather. Programme delays, particularly consenting delays meant the majority of the earthworks had to occur during autumn. Careful planning and staging of the works enabled the contractor to largely continue other aspects of the contract without requiring access to the particularly wet areas.

As the project was recreating a channel along an old channel alignment, areas of poor ground particularly wet ground and peat were encountered. The contract required the construction of the flood protection bunds by using appropriate excavated on-site material. Analysis of early construction test pits concluded that the silts present onsite were unsuitable for that channel bund construction if solely used. Consequently a bund design solution was developed that involved installing geotextile matting with AP65 anchor boxes. This proved successful and provided a bund design that has sufficient resistance to scour.

During construction, NZDF required the use of the Demolition Range for live detonations over a period of two days. It was understood that this was a training exercise but given the live detonations, the contractor was required to clear the site within the 300m danger area measured from the Demolition Range's concrete pad.

Construction activities surrounding the prison security fence can have a significant effect on the operation of the prison. During early construction activities, the distraction that the contract staff created through normal activities was enough cover for a person who was seen to approach the fence and throw over an item of contraband. Police attended the site, arrested the person and recovered the item.

Photograph 6: Community planting on the lower channel

5.3 POST CONSTRUCTION REGENERATION

Approaching two years after the first planting has been undertaken, the smaller grasses and wetland species have started to establish well.

Photographs 7 and 8: Showing the NZDF land before and after channel construction and planting

6 CONCLUSIONS/RECOMMENDATIONS

This paper describes the Department of Corrections Flood Protection Improvements at Rimutaka Prison. The solution required close collaboration between NZDF and Corrections and resulted in the construction of 1,200m of new stormwater channel including a temporary storage area via a weir to attenuate downstream flows and protect Rimutaka Prison as well as several wetland areas providing water quality enhancements and provide a natural habitat for fish species.

The early engagement with both parties to understand the some common opportunities worked well. The solution provided the 100 year ARI flood protection that Corrections sought and by locating the channel within NZDF land and adopting the philosophy of NZDF's environmental restoration plan a win-win was obtained.

Although construction of the $2.8M project encountered several unforeseen factors, the end result was a higher standard of flood protection for the prison, and the beginnings of an ecosystem which, through NZDF, future prisoner rehabilitation programmes and community volunteers can provide a corridor for native flora and fauna to thrive.

ACKNOWLEDGEMENTS

The project was funded by Department of Corrections with NZDF providing a significant portion of the land corridor required.

The planting and restoration work was coordinated and undertaken by volunteers from the Trentham Ecological Restoration Project www.naturespace.org.nz/groups/trentham-ecological-restoration-project.

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