ADJUSTABLE WEIR PROVIDING FLOOD PASSAGE AND LANDSCAPING IN NEW PLYMOUTH CBD

Nicholas Keenan (MWH New Zealand Ltd),

Terry Boon (Boon Goldsmith Bhaskar Brebner, Team Architects) and

Jeff Bondy (New Plymouth District Council)

ABSTRACT

In 2008 New Plymouth District Council created a pond on the Huatoki Stream as part of a landscape revitalisation project in New Plymouth's CBD. To avoid increasing flood risk upstream, a 1.2m high by 5m wide weir that adjusts to stream flows was specified. The installation was completed in August 2009.

The pond created by the weir, while attracting people to the stream's edge, increases backwater levels during floods. To achieve high amenity in both low and high flows, the weir would need to "collapse" at a critical stream flow but be easily reinstated afterwards.

To meet these objectives, an Obermeyer weir was specified. This is a curved steel blade, hinged at the stream bed and counterbalanced by a rubber bladder of compressed air which continuously adjusts in response to a water depth sensor upstream. During a flood the bladder deflates, lowering the blade and maximising the channel capacity.

This paper discusses the logistics of specifying and installing the weir, and offers further applications for the technology locally. It demonstrates the benefits of this solution including allaying flood risk, supporting a fish pass structure, a smooth resource consent process, limiting maintenance and providing a visually dynamic signal of stream flow.

KEYWORDS

Urban restoration, amenity value, flood risk, adjustable weir

PRESENTER PROFILE

Nicholas is a civil engineer with MWH New Zealand Ltd based in Wellington where he has worked since 2005. Nicholas has been active in the surface water and rivers engineering industry, including modelling and engineering, since 1995 and has also worked in New Zealand, Australia, and Papua New Guinea on a variety of surface water related projects for local government and mining interests. He holds Bachelor of Engineering (Civil),is a Chartered Professional Engineer and member of IPENZ.

1 INTRODUCTION

This case study looks at the stormwater design outcome that became a part of an overall urban renewal project in the central business district of New Plymouth. The application of new, off-the-shelf technology provided a feasible stormwater design, complimented an overall urban design concept, and minimized flood risk to surrounding properties. The stormwater design included the low flow advantages offered by the common weir such as a flat water surface and water depth. The urban concept included interpreting historical stream usage and bringing people close to the stream's edge. Flood risk was considered to be made no worse than existing by having the weir reduce itself during high flow events and allowing the stream channel to develop full conveyance.

The Huatoki Stream has flooded in living memory but since the Huatoki stormwater detention dam was built in the 1980's the extreme peak flows from the Huatoki Stream are no longer a serious threat to property in and around the CBD. With the protection of the Huatoki Dam, and two other major stormwater detention dams in place above New Plymouth, urban renewal projects in the CBD and near the stream's edge are considered to be more feasible. The Huatoki Plaza project therefore includes a clear access to the Huatoki Stream's edge and invites people to be near it and observe a small reach of it as it has been opened out from behind buildings.

Huatoki Stream has been modified to a large extent by reclamation filling, structures, building foundations, property boundaries, culverts and bridges. The lower end of the Huatoki Stream was once a Maori canoe and Pakeha long boat beaching and landing area on an estuary and has now become a major local landmark with the iconic Len Lye wind wand structure, anchor stone carving and Puke Ariki museum, library and coastal walkway.

The use of an Obermeyer weir with its adjustable weir crest and its simple technology provides the link between the urban renewal project that incorporates the stream's edge and the need to minimize flood risk in the area. Huatoki Stream at the Plaza is tidal, shallow, has a 6m wide gravel bed. To make the stream more interesting a weir of 1.2m in height was proposed to smooth the stream surface, and to maintain a water cover over the stream bed.

Following the construction of the Huatoki Plaza and the installation of the weir in August 2009, a number of "strong flow" events have occurred in the Huatoki Stream and the weir has responded appropriately, by collapsing and redeploying automatically. The weir is programmed to respond to increases in water level just upstream by reclining onto the stream bed and so even in small flood events the weir can be observed to lie with minimal profile to the oncoming flow.

2 BACKGROUND

2.1 BRIEF HISTORY

2.1.1 NEW PLYMOUTH

New Plymouth sits at the toe of Mt Taranaki, on the west coast of the North Island of New Zealand. Moist westerly winds from the Tasman Sea push up against the sides of Mt Taranaki and deposit rainfall on the flanks of the mountain and drain to the sea.

Excerpts from NPDC, Stormwater Management, website: As New Plymouth and surrounding urban areas have grown, development within the stream catchments has meant that both businesses and residential properties are exposed to flooding during extreme rainfall events. New Plymouth experienced major floods in 1935, the 1970s and the 1980s.

The largest flood was in 1971 when 290mm (11.4 inches) of rain fell in 24 hours. Several shop windows in Devon St had to be smashed by civil defense workers to relieve pressure inside the buildings - goods were then swept into the street by the floodwaters. Homes and businesses were ruined and shops incurred hundreds of thousands of dollars in damage.

In the 1980s three major earth flood protection dams were built on the Huatoki, Waimea and Mangaotuku Streams to detain flood volumes and to limit the flows into the CBD of New Plymouth. Since that time additional flood diversion tunnels and earth detention bunds (smaller than dams) have been constructed as part of the city's flood protection scheme.

2.1.2 STORMWATER MANAGEMENT – HUATOKI STREAM

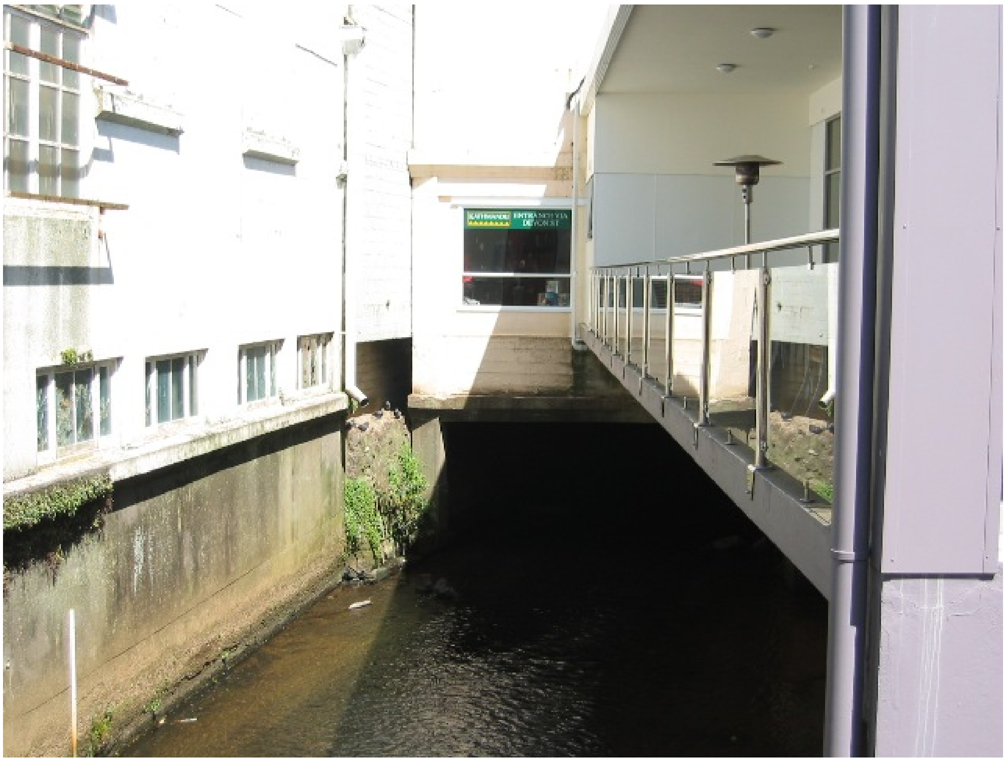
NPDC have commissioned a number of flood risk reduction strategies in the Huatoki Stream catchment as well as upgrades to culverts and primary stormwater pipelines. In 1987 the earth fill, Huatoki Dam was constructed to reduce the peak discharge of large flooding events through the CBD. The dam holds 800,000m^3 of volume and restricts outflows to 15m^3/s for storms up to 100 year ARI, 24 hours events. This compares with over 50m^3/s during the 1971 event.

A telemetry station at the Huatoki Dam was installed and connected to the Taranaki Regional Council to record water level and rainfall depth in 15-minute timesteps. This station and others around the city monitor rainfall events and compile data for the determination of flood predictions and warnings.

A detention dam or bund system on a tributary stream leading into the Huatoki Stream was constructed to delay the response of a tributary catchment during short sharp storm events, and to give the available stream capacity an initial preference to quick-response, inner city catchments.

A diversion tunnel that conveys a portion of the stream flow during high stage events was constructed near Pukekura Park to take floodwater away from open channel reaches.

Since the dam and other flood mitigation components have been in place, peak floods have not caused as much damage in the CBD. An event in 1990 had an equivalent rainfall depth and duration to the 1971 flood event but not the same widespread and damaging flood impacts on the Huatoki Stream's lower catchment.



Photograph 1: Huatoki Stream looking upstream, building to be demolished on right, November 2005

3 URBAN RENEWAL

3.1 ARCHITECTURE

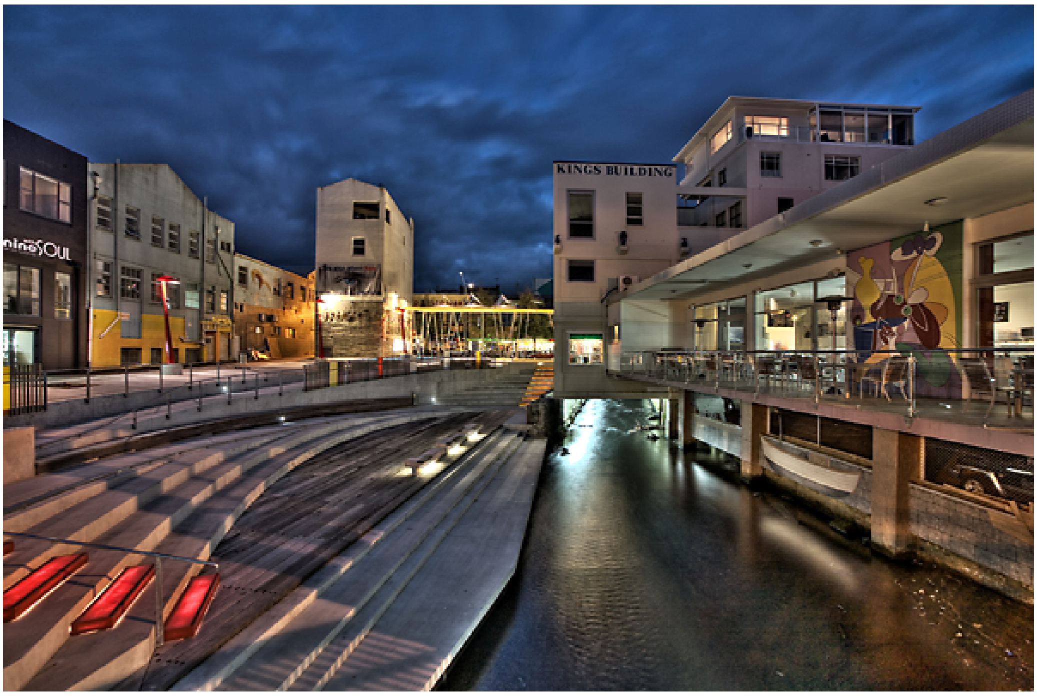
3.1.1 LANDSCAPE REVITALISATION PROJECT

The Huatoki Stream runs through part of the CBD area of New Plymouth. At the mouth of the stream is the Tasman Sea. At the foreshore around Huatoki Stream the railway line and the main road around New Plymouth cross over the stream in large concrete bridges and culverts. Alongside the stream through the CBD are placed modern features including the museum and arts gallery, and older features including carparking buildings, main road bridges, office buildings, accommodation and the rear portions of businesses including public bars and cafes.

Following many years of planning, consultation and negotiation a commercial building was purchased by NPDC and demolished to create the space for the Huatoki Plaza. This development provided an open area next to Huatoki Stream which was near to the foreshore and CBD area. The project was conceived primarily as a modern setting for social and community interaction, but the close proximity to the Huatoki Stream and its connection to the existing foreshore and to the historical estuary landing site meant that water became an important part of the overall landscape design.

3.1.2 ARCHITECTURAL CONCEPTS

The main plaza area is relatively high above the stream bed and out of flood danger, and crosses the Huatoki Stream via an existing service lane bridge that was converted into a pedestrian walkway bridge. The level of the plaza is similar to the levels of the connecting streets, whereas the normal stream flow levels are relatively low. This required the design of a range of ramps, steps and an area set aside as an amphitheatre in order for a safe approach to the water's edge.



Photograph 2: Huatoki Stream, looking upstream, development on the left, June 2009

The concept of a weir in the Huatoki Stream had a number of positive benefits to the details of the water-to-land interface. The weir created a 1m depth in the stream that was not too deep so that the bed was totally obscured or that was too much of a hazard, but deep enough so that the water surface was essentially flat along the interface with the plaza and across the stream to the opposite side, where it covers over the untidy corners where the building foundations pass through the stream bed to bedrock below.

The weir also slowed the stream flow, smoothened the surface ripples adjacent to the amphitheatre and muffled the sound of the stream to create a peaceful setting. This is in contrast to the actual site of the weir where stream flows pass over the 5m long, semi-sharp crested weir and plunge 1m onto the foundation pad and into the receiving waters of the Huatoki Stream. This can be viewed from street level vantage points at all angles by pedestrian passers-by and by people in the plaza.

The weir operates in combination with a fish pass channel that is able to be continually fed with stream flow due to the level of the weir and the water level just upstream. The fish pass channel is made up of a sloping concrete ramp with roughness elements within it that provide strong current direction signals to fish to encourage fish migration upstream and downstream. This is particularly important for juvenile native fish and the small sized inanga group of fish.

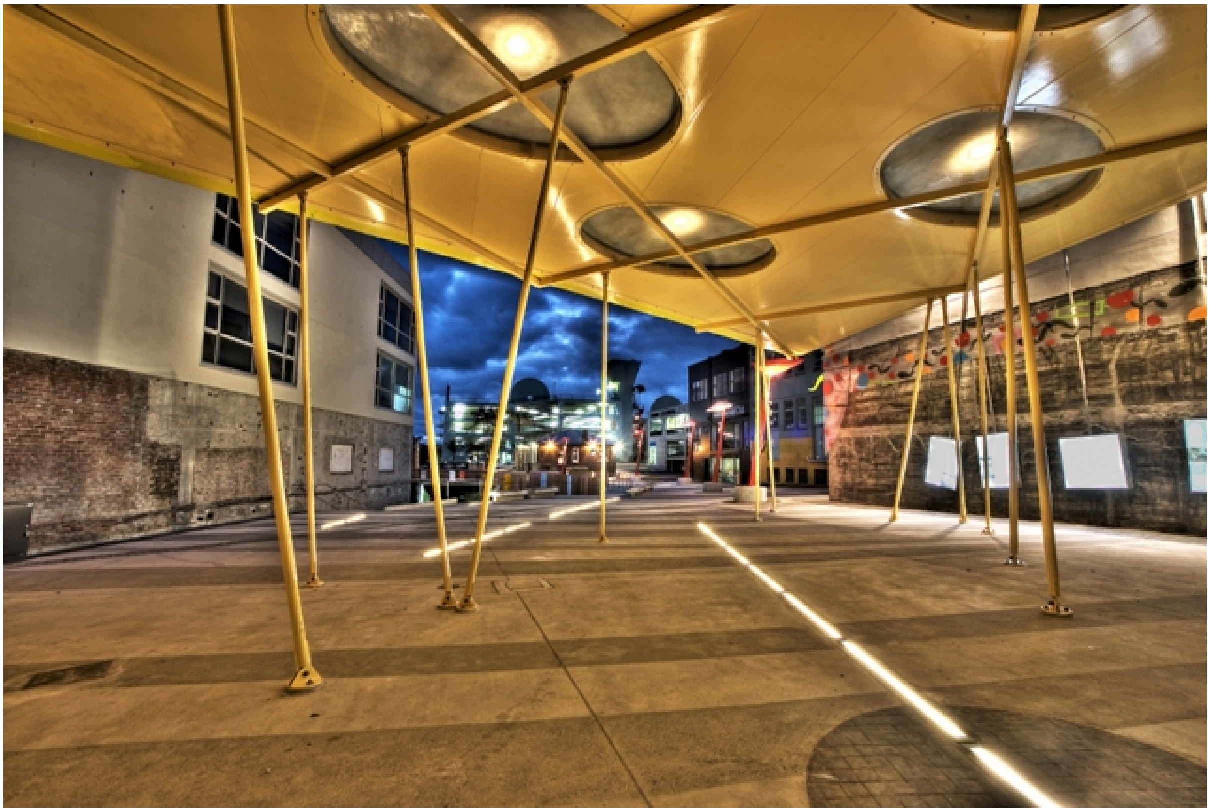
The type of weir specified for the Huatoki Stream, the Obermeyer proprietary product, is an automatic, variable-level weir and is described in engineering detail below, but it too brought sympathetic concepts to the water aspect of the Huatoki Plaza project. The first was that the weirs crest level changes in response to upstream levels detected by sensors connected to the weir's level control system. When the stream is in dry weather base flow the weir crest level is set at the designated maximum height. As flows increase, the water level at the sensor increases and this triggers a lowering response in the weir crest as it adjusts to return water levels at the sensor back to the designated level. This in turn increases the flow rate over the weir with the size and strength of the weir spill creating an intuitive, visual indicator of the stream's current behaviour. Depending on the weather and the tides, the weir and the water flow over the weir may be different from hour to hour, season to season.

The second concept that the weir product brought to the project was that it is a sophisticated weir in comparison with static weirs - automated through a sensor response mechanism, and able to change its function as the stream flow changes. Given New Plymouth and Taranaki's highly skilled, industrialized, economic sector a stainless steel, "smart" weir in the CBD as part of a modern community space development is a comfortable fit.

A third concept may be thought of in the presence of the fish pass structure with the weir. Both structures are artificial additions to the stream, as is the reclamation land all around including the stream bed, but a clear attempt has been made in the design to accommodate environmental needs (fish passage) with human needs (a pond water feature). This design points to future, normal, considerations of other species in our shared environment whenever we humans plan and act.

3.1.3 WATER FEATURE ELEMENTS

A comparison of the old Huatoki Stream at the Plaza site with the new, existing Huatoki Stream is a stark contrast in space, sound, light and ownership. The stream was boxed in by high concrete buildings on both sides that have their foundations and basement levels below the stream bed. Few people would have seen the stream at this location unless one looked out from a back room window or a carpark level. Now, a larger arc of sky can be seen from the stream and ambient light levels have risen, the light reflects off the water surface created by the weir, sounds carry across the water from a café balcony on one side to the Plaza levels on the other side and echo back. Many more people now visit the area, linger and pass through.



Photograph 3: Huatoki Plaza canopy, looking downstream, June 2009

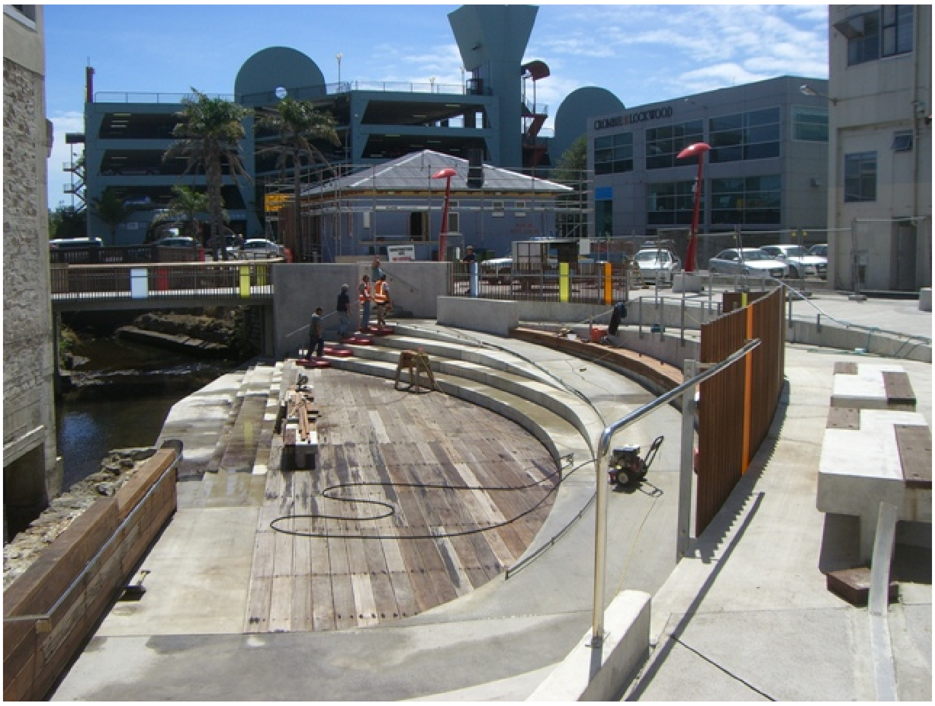
The plaza has many features to draw people to it but the weir, fish pass, pond surface and the sounds and variations in the water as it passes through these sections of the stream also add something to the overall experience. The development has enabled people to get close to the water as well as view it from above from bridges and elevated banks and footpaths.

3.1.4 AMENITY VALUE

The overall natural feature of Taranaki and New Plymouth is Mt Taranaki, the hinterland laced with rivers and the Tasman Sea. Boon Goldsmith Bhaskar Brebner Team Architecture Ltd has been strong advocates of the Mountain to Sea concept which was first expressed in their design of Puke Ariki. When a need to replace the Devon Mall was recognised the site of the Plaza became available, and the opportunity was seen to create an urban space as a meeting and performance area, and to open up as much of the Huatoki River as was practicable.

3.1.5 VISUAL ATTRACTION

It was originally conceived to include active retail spaces, such as bars, cafes, newspaper and florists and the like, but the retailers persuaded the NPDC that they should stay away from these issues. These activities were seen as essential to create a vibrant 24 hour people place. At the outset three quite different design concepts were presented and after considerable public consultation and feedback, the built design was chosen. The budget was limited and simple concrete surfaces with ground patterns, a covered area and accessible ramps introduced to allow easy movement down to the water edge. Special light fittings, seating, illuminated stores of the history of the site were designed with an element of fun in mind. The steel hand rails have timber balusters with random colourful acrylic panels included. The pond created by the weir raises the level of the water, creates reflections and interest and is successful in masking the rough foundations of the old existing adjacent building.



Photograph 4: Huatoki Stream looking downstream, amphitheatre under construction, February 2009

3.2 ENGINEERING

3.2.1 WEIR SELECTION

The Huatoki Stream between Courtney Place and the Tasman Sea is well defined between foundation walls, bridges and culverts and was a good situation to model in MIKE11 open channel software. The hydraulic model was created from over 30 surveyed cross sections that were captured as part of the Plaza development planning. The outlet of the Huatoki Stream is about 1m above mean sea level and is affected by the 3 to 4 hours of the high tidal cycle so an oscillating tidal boundary at the mouth was placed as the outlet boundary condition. Inflow hydrology was calculated from a HEC HMS runoff routing model supplied by NPDC that covered the stream and tributaries upstream of the weir site up to the Huatoki Detention Dam. The model supplied flood hydrographs of a wide range of return periods and rainfall durations.

The MIKE11 model calculated backwater curves for the existing channel and quantified the level of flood risk to buildings along the stream channel. From the modelling it was quickly apparent that a 1m high weir translated directly into an unacceptable 1m increase in top water profile for hundreds of metres upstream past many buildings and basements. For the weir to meet the conditions for approval it had to “collapse” so that the full channel capacity could be made available during flood flows and that, even in minor flood events, an increase in top water levels was not acceptable.

With these design parameters in mind, it took less than 2 hours of consideration to realize that a collapsible weir is not something that can be designed easily from first principles. Questions of materials, moving parts, collapse trigger and mechanism, stability, fouling, malfunction or jamming, robustness, reinstatement following collapse and ongoing maintenance became issues to be addressed in order to mitigate flood damage risk. Questions of how it would look and fit into an urban redevelopment were not considered.

A website search of collapsible weirs returned two general options: one - inflatable rubber products used in temporary or emergency flood protection, and in the salmon farming sector; two - the Obermeyer weir product made of steel and used in the hydropower and irrigation industries. The Obermeyer weir became the preferred option due to its application history, robustness, level control features, simple design - and looks.

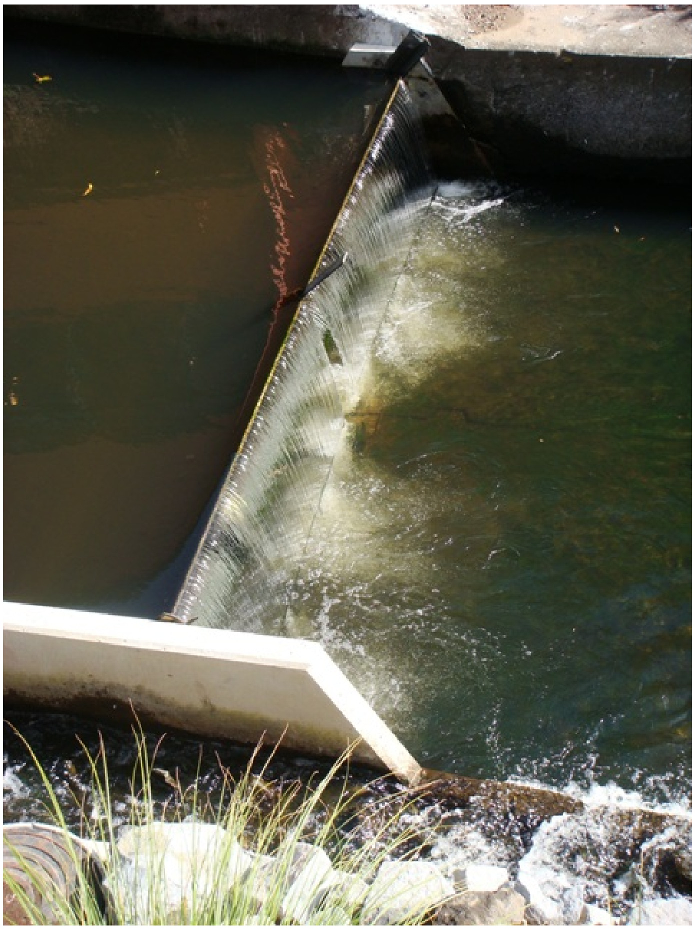
The design level of the weir crest that controlled the pond surface level was governed by the lower levels of the plaza development next to the water interface. During normal dry weather flows the pond level was to be very close to the lowest level of the amphitheatre area, and during increasing or decreasing flows the weir adjusts the crest level downward and upward to vary the channel discharge capacity to maintain the design water surface level. The Obermeyer weir provided the flexibility to meet the pond surface level at the weir location and cope with foundation levels on the stream bed.

During very large flows, the Obermeyer weir crest falls to the stream bed to create a low, snug profile while flows pass over it to the full capacity of the stream channel.

3.2.2 OBERMEYER WEIR

The Obermeyer weir consists of a curved panel of steel that spans across the flow path and is pinned with hinges to a heavy, concrete, base pad along one edge while the other edge is supported in an upright position against the flow by rubber bladders of compressed air. The bladders are constructed from high tensile strength, automotive tire technology (DuPont Kevlar) and covered with an ozone resistant polymer to protect the surface from weathering and aging. Rubber seals at the abutments and at the joins between panels complete the water tightness. For an installation close to the sea, a stainless steel weir has been chosen.

A bubbler level sensor, under the water upstream of the weir, continuously monitors water level by variations in the hydrostatic head at the sensor. The bubbler bleeds very small amounts of air continuously into the water column and detects when it becomes harder to bleed air into a higher water level. A detected rise in water level activates a release of air pressure in the supporting rubber bladders. The weir panel rotates towards horizontal about its hinge by sinking into the bladder and lowering the crest level, allowing more flow to pass over the weir crest. If the level sensor detects a fall in water level, an air compressor housed nearby the weir activates and inflates the bladder to a higher pressure, forcing the weir panel to rotate towards vertical and raise the weir crest level. In the Huatoki Stream the weir has been set to adjust bladder pressure, if need be, at 10 minute intervals.



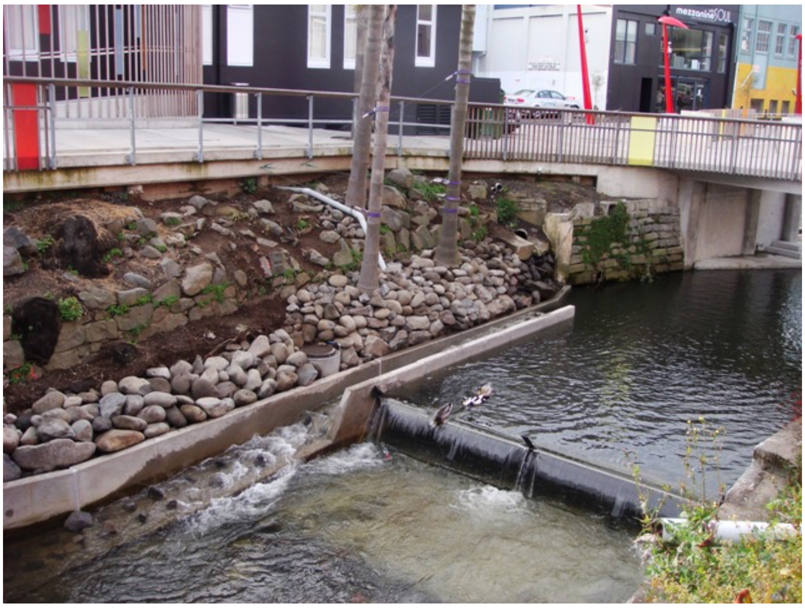
Photograph 5: Obermeyer weir in action, March 2010

In the event of a power outage, potentially during a storm event, the bubbler sensor remains active working off the pressure in the bladders and is able to either maintain bladder pressure or release air pressure from the bladder in response to rising water levels. This will cause the weir crest to either remain at its starting level or drop down without the need for power. In a large event the weir will completely drop to the stream bed without power and will stay in the prone position until power is restored to the compressor and it can inflate the bladder and lift the weir panel. It therefore has a power failure mode that does not compromise flood risk.

The compressor is able to be powered from a 12-volt solar power installation for remote sites. For Huatoki Stream the compressor has been housed under the adjacent toilet block which is above the 100 year return event flood level. The sensor and air tube are fixed, unobtrusively to a bridge abutment just upstream of the weir.

3.2.3 FISH PASSAGE

Fish pass design in New Zealand is still in a phase of trial and error, and continual modification. In laboratory conditions, NIWA have observed juvenile fish and inanga climbing ramps of up to 30 degrees slope, but have indicated much better results at slope angles of 15 degrees. NIWA have also suggested fish pass parameters based on successful climbing experiments of native fish. Observations in the field rely on surveys of fish populations of certain poor-climbing species upstream of the weir, and a comparison with populations prior to the fish pass structure, to determine if a fish pass is working.



Photograph 6: Fish pass and weir, Huatoki Stream, August 2009

The Huatoki Stream fish pass structure is 12m long by 0.7m wide and rises 1.2m to intersect with the pond surface. The flow velocity in a fish pass needs to be below 1m/s with built in opportunities for climbing fish to rest in the form of baffles and eddy zones. The weir is placed adjacent to the fish pass with the design water surface level around 100mm above the fish pass entrance level. The fish pass is always running with water and in low flow periods water would preferentially flow down the fish pass rather than over the weir crest. The ramp includes two lines of stones with a clear channel between them to indicate the current direction to the fish.

For the Huatoki Stream, the proof of the success of the fish pass is yet to be confirmed by the Taranaki Regional Council who is monitoring fish populations in the stream as part of consent conditions. The Obermeyer weir offers some flexibility if crest levels need to be slightly adjusted to improve the fish pass performance.

3.3 RESOURCE CONSENT

3.3.1 LOCAL AUTHORITY

Resource consent to construct the weir in Huatoki Stream was granted to NPDC on the basis that construction impacts would be minimized, flood risk would be eliminated and that fish passage would be incorporated into the design. The detailed specifications of the Obermeyer weir were submitted into the consent application and a full description of the role it would play in low flow conditions and in flood flow events.

3.3.2 STAKEHOLDERS AND AFFECTED PARTIES

Consultation was carried out with the main stakeholders and affected parties of the project including Iwi, the TRC, DoC, community liaison groups, the local businesses, the immediate property owners and building owners, fish and game society.

The main issues were maintaining or reducing existing levels of flood risk, incorporating fish passage, and minimizing construction impacts in the stream.

The Obermeyer weir and its specified functions satisfied the flood risk issues. The fish pass structure design, based on NIWA guidelines and current best practice, along with a commitment to undertake long term monitoring of its performance and then modify the workings of the fish pass, addressed the fish passage issues. The use of precast concrete elements where possible, a “kit-set” weir structure, stainless steel materials and speed of installation of the weir and fish pass through diversion of low flows around the worksite addressed the workings in the stream bed. When the weir was being installed, low flows were diverts through the fish pass channel, and vice versa.

3.3.3 CONDITIONS

The resource consent conditions specified a timeframe in the winter months when activity in the stream bed is prohibited due to fish spawning activity. In the long term, TRC would carry out monitoring and reporting of fish populations upstream of the weir and liaise with NPDC to modify the performance of the weir and fish pass if required.

3.4 CONSTRUCTION AND MAINTENANCE

3.4.1 LOGISTICS OF SPECIFYING

MWH initiated contact with Obermeyer Hydro Inc and provided concept plans and modes of operation. A proposal letter from Obermeyer Hydro Inc detailed the design process, cost of the structure, a programme for the design, manufacture and delivery by sea to the port of New Plymouth, and a letter of engagement from NPDC confirmed the acceptance of the proposal.

Obermeyer Hydro Inc was provided with firm dimensions and desired mode of operation and they converted this information into shop drawings for approval from NPDC. Following final approval from NPDC the drawings were finalized and the manufacture process commenced. The design process took three weeks and the manufacture of the two 2.5m span panels took 4 weeks. Delivery from Colorado to New Plymouth by land and by ship took 12 weeks. The main site contractor collected the container from the port and brought it to site.

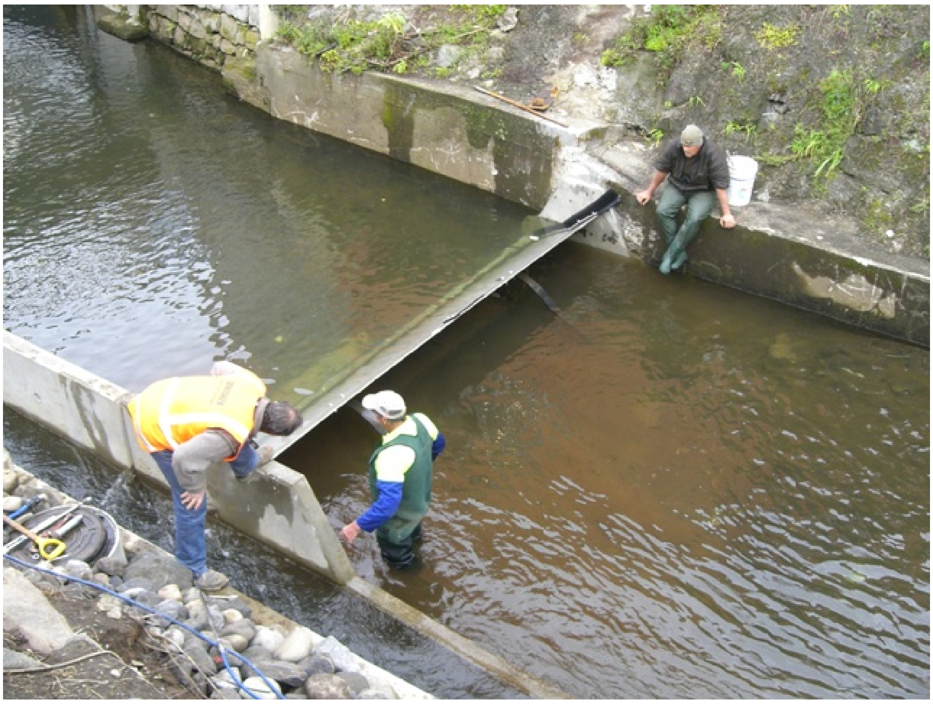
Obermeyer Hydro Inc contacted a local New Plymouth air compressor specialist who handled the specified compressor unit, and engaged them to supply and install the compressor on site.

3.4.2 INSTALLATION PROCESS

The obermeyer weir arrived in New Plymouth in a shipping container in a kit set form with instructions for installation, shop drawings and fixing specifications, connections of the compressor hosing and power, the sensor and commissioning. The on-site civil contractor for the weir and spillway works had no real problems in assembling the weir, abutment plates, hinge and fixings from the instructions and the drawings set.

3.4.3 COMMISSIONING

Commissioning of the weir included testing of the compressor unit, the level sensor and the variable weir crest level. The weir comes with manual over ride functions in the control box and a malfunction alarm that is transmitted to NPDC. The weir response to water levels is necessarily dampened by a 10 minute review and respond time step so that the compressor does not alter its settings in response to minor ripples and wind actions.



Photograph 7: Obermeyer weir being installed, July 2009

During the two or three hours of spring high tides and low stream flows the rubber compressed air bags become submerged under shallow water. When this happens the weir goes through a period of self correction at 10 minutes intervals whereby the crest rises and falls in a slow cycle. This is possibly due to the water pressure of the tide and wave depth on the bladders causing a small change in the pressure balance through the compressor. This in turn causes the weir level to rise, only to be corrected by the bubbler sensor inputs which cause the weir to drop slightly in the next time step. The effect is that the weir moves up and down slightly.

3.4.4 MAINTENANCE

The weir has been in place for just under a year to date and NPDC plan to incorporate the weir into a regular maintenance programme after assessing how the first year of service goes. An operations and maintenance manual was assembled for the weir based on Obermeyer assembly instructions and recommendations. So far, the weir has responded appropriately to flows and there have been no public complaints about the operation or the minor compressor sounds that are emitted in short bursts from the electric compressor unit at 10 minute intervals. Sediments and silts are seen to build up against the base of the weir panels near the hinges during low flow periods and it will be seen over time whether the high flows tend to flush much of the sediments away in a natural process.

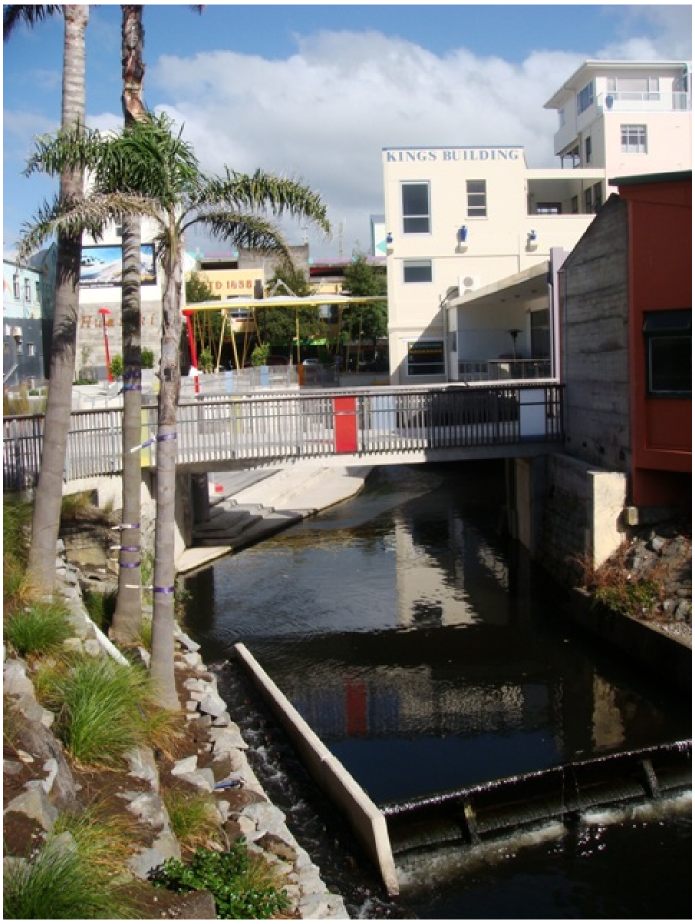
The weir traps floating litter at the weir crest during low flows and the weir plunge into the lower stream level tends to create standing eddy currents that trap floating litter. This trapping of floating litter is common in other ponds and weirs, and is routinely trawled out by NPDC before a large flow sweeps everything out to sea.

The bladders themselves appear to be tough and being hidden behind the weir cascade is an advantage in terms of tampering and worse from the public. No willful damage to the weir has occurred to date.

4 PUBLIC COMMENTS

4.1 THE PLAZA AND THE WEIR

NPDC have had general widespread satisfactory comments on the outcome of the Plaza and from before and after photos of the site it is clearly a great improvement. A small minority of ratepayers voiced a lament at the project cost and the lack of users in the area after the completion. Over time, it is possible that cafes and restaurants may become established around the periphery of the Plaza and bring vibrancy to the area. As it is, Council activities, community and radio station activities occur in the Plaza, or the Plaza is the end (recovery) point of a walk or fun run type activity.



Photograph 8: Weir, fish pass, bridge, landing and plaza, March 2010

The weir itself has not attracted any public complaints or comments due to its form or function – and NPDC officers consider this to be a satisfactory outcome. The fish pass' shape and form appear to have been accepted by the public however the function of the fish pass is still to be assessed through monitoring of fish populations and fish movements during the fish spawning season.

5 APPLICATIONS IN NEW ZEALAND

5.1 INTRODUCTION

The Obermeyer weir has advantages of simple design, low energy requirements, a safe power failure mode, robustness and simple maintenance of moving parts. The following section gives a brief applications review based on Obermeyer product literature and their web site. The New Zealand applications section below is the result of discussions and low intensity brainstorming amongst engineers, and the ideas are not necessarily fully thought-through, but are offered for discussion.

5.2 OVERSEAS APPLICATIONS

The Obermeyer Weir is used as a level-controlled spillway gate structure in irrigation schemes, channel diversions, hydropower and water supply damming, holding and catching water in stormwater detention dam sites, retro fit into existing dam structures to increase dam water levels for commercial or hydro-electric potential advantage, emergency spillway capacity on salt water barrages.

5.3 NEW ZEALAND APPLICATIONS

Unique conditions in New Zealand include a salty atmosphere in coastal areas and generally a smaller scale of project that fits New Zealand budgets and the rugged topography. Any application that involves a level control or flow control and which is currently under a manual operation regime, or if the gate is an actuated sluice gate with support frame and winch mechanism, could be handled by an Obermeyer weir.

Some specific applications that could make use of the Obermeyer include:

- Runoff capture or raw water take from a river in fresh flows over a certain stage level to top up farming or horticultural irrigation dams. Water could also be captured in known gravel areas of a river or floodplain to assist in recharging aquifers that are important to horticultural areas for example.
- Sediment control ponds where the weir could rise to trap sediment laden runoff from a coal mine or industrial "first flush" area, say, and then act as a decanter by only allowing a 50mm flow depth over the weir crest. This would discharge the pond water with the lowest suspended sediments in the water column and allow time for particle settlement to take place.
- Controlling or increasing wetland water levels for environmental reasons such as holding water in a wetland during storms so that stormwater treatment and evapotranspiration can occur, or holding small rainfall events during dry periods so that a wetland can survive. In suburban detention pond situations, a level controlled weir could provide maintenance flexibility by allowing full manual over-ride control and draw down of the pond level to flush out algal growths, weed mats, or to remove sediment deposits.
- Emergency and temporary storage of runoff in a suburban setting, to make full use of "dry", shaped stormwater detention areas such as playing fields and grass gullies, and yet spill flows before critical water storage levels are reached.
- The emergency and temporary storage of wastewater overflows in a storm event in a tank where the pipe network is surcharging. The weir could be raised to make use of off line storage behind it and lowered gradually afterwards to let wastewater back into the pipe network.

One variation to the normal application is in a coastal environment where the gate serves the dual role of passing flows towards the sea and back-flow prevention against the tide. This will require more thinking on a site-by-site basis on the level control and the protection of the foundations and bladder against waves and corrosion – as any type of gate would require on the coast.

6 CONCLUSIONS

In 2008-09 New Plymouth District Council created a pond on the Huatoki Stream as part of a landscape revitalisation project in New Plymouth's CBD under Boon Goldsmith Bhaskar Brebner Team Architecture Ltd. To avoid increasing flood risk upstream, a 1.2m high by 5m wide weir that adjusts to stream flows was specified by MWH.

To achieve high amenity in both low and high flow situations, the weir needed to “collapse” at a critical stream flow to return the stream channel capacity back to pre-weir capacity. The collapsed weir needed to automatically redeploy after a flood event.

To meet these objectives, an Obermeyer weir was specified. This is a level-controlled weir programmed to adjust its crest level in response to upstream water levels and flows.

Benefits of this solution for the Huatoki Plaza project include allaying flood risk, supporting a fish pass structure, facilitating a smooth resource consent process, limiting maintenance and providing a visually dynamic signal of stream flow.

This paper briefly discusses the logistics of specifying and installing the weir based on the experience of this project.

A number of existing overseas applications are listed, and based on the use of the product in this project, a number of potential New Zealand applications are suggested given that New Zealand has a unique coastal environment and, generally, project budgets are smaller.

ACKNOWLEDGEMENTS

New Plymouth District Council for the approving the project.

Boon Goldsmith Bhaskar Brebner Ltd for developing the design and for photos taken during the project.

Obermeyer Hydro, Inc for information on their product so that the project could become a reality. Website: www.obermeyerhydro.com

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