INNOVATIVE WASTEWATER TREATMENT DESIGN AND CONSTRUCTION: GISBORNE WASTEWATER TREATMENT PLANT

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ABSTRACT

An innovative wastewater treatment plant has been designed and constructed for Gisborne.

Innovation started in the planning stage when an ambitiously different resource consent was sought. In 2002 a review group was set up to look at appropriate solutions to Gisborne's wastewater treatment problems. The group was responsible for making some significant consensus decisions including selecting the biological trickling filter (BTF) process, choosing a wastewater treatment plant (WWTP) site, and shepherding the agreed wastewater scheme concept through a successful consenting and designation process.

The relationship between Gisborne District Council and CH2M Beca during the design stage resulted in a number of technically satisfying solutions including a BTF without primary sedimentation, an industrial separation scheme, energy efficiency, sacrificial sheetpiles to reduce liquefaction, rainwater reuse, design for commissioning and staging UV disinfection.

HEB Construction continued in the close relationship vein. Large scale use of PE lining to corrosion-protect concrete and GRP pipes, manholes and pump stations has rarely been seen in New Zealand. Add to that the aluminium BTF dome and on-site welding of the trickling filter media and the project is truly unique.

The project was completed on-time – in spite of unexpected hurdles along the three year journey – and under the agreed budget of $40m proving that innovation and collaboration impacts directly on the financial outturn of design/construction projects.

KEYWORDS

Innovation, wastewater treatment, design, construction, Gisborne District Council

1 INTRODUCTION

Gisborne's wastewater has been a contentious issue since before the current ocean outfall was installed in 1964. Prior to the outfall, wastewater was dealt with in a number of different ways. Two surf-zone outfalls were in use at Midway and Kaiti beaches. By 1964 these short outfalls were largely undersized. Other parts of the city were served by a night-cart collection system followed by landfill disposal. Neither of these disposal methods was satisfactory in dealing with Gisborne's wastewater.

Around 1964 the local authority decided to deal with all of Gisborne's wastewater in one place. As a result, the current ocean outfall was constructed off Midway beach. The 762mm internal diameter concrete pipe stretches 1.7km out into Poverty Bay. At the end it has a 189m diffuser section initially with 22 operating ports. The Gisborne outfall was innovative in its time as it was the first post-tensioned, precast concrete segmental outfall in the world.

The outfall was the only wastewater disposal method in Gisborne from 1964 to 1990. All wastewater and solids were discharged to Poverty Bay. In 1990 a milliscreening plant was constructed at the end of Stanley Road. The

1mm aperture, rotating drum milliscreens were operated continuously from 1990 until they were decommissioned at the opening of Gisborne's new WWTP at the end of 2010.

2 BACKGROUND TO CONSULTATION

For many years, Gisborne District Council has been considering what future form of wastewater treatment was appropriate for the city, including, as it does, a high number of large primary procuring industries with strong trade wastes, and a high proportion of Maori residents with strong views on the discharge of human sewage to Poverty Bay. Balancing the opinions of Tangata Whenua, the wider community interests, capital and operating costs and affordability has not been easy for elected members.

The preferred scheme, based on a wide range of options study, was for a new secondary treatment plant for human sewage with high strength wastes separated out and managed through trade waste controls. However, when consents were sought for this Scheme, there was significant opposition from key stakeholders, so the Council put the consent application "on hold" and formed a Wastewater Adjournment Review Group (WARG) to further explore options for a long-term solution.

This group eventually returned with a recommendation for:

- Biological trickling filters (BTF) to transform the human waste to biomass
- Clarification of the biomass followed by UV disinfection
- New treatment plant sited on Gisborne Airport land
- Separation Scheme for major industrial discharges

A 35-year consent and designation for the new WWTP site was granted based on this core concept design in mid-2007. A project budget of some $25m was identified by the Council and CH2M Beca was appointed in October 2007 as engineering advisors and project manager to implement the consented scheme.

3 DESIGN SOLUTIONS

The first task for CH2M Beca was to prepare a Pre-design Report and Total Project Out-term Cost (TOC) estimate for the consented scheme, with the new BTF treatment plant at the Airport site with associated transfer pipelines and pump stations, and full industrial separation scheme.

A condition and capacity assessment of the existing Stanley Road screening facility and outfall pump station determined that both needed to be replaced and then decommissioned. The resulting TOC of over $80m (for completion of the full scheme in 2012) was well over the budgeted cost. In April 2008, Council requested the Gisborne District Council / CH2M Beca project team revisit the consented scheme concept and produce a scheme at a greatly reduced cost.

A range of options, including two new WWTP sites much closer to the existing Stanley Road outfall, and with staged implementation of treatment processes, were investigated and cost estimates prepared on the same TOC basis (Johnston-French et al. 2009). The preferred Scheme, with a TOC of $45m comprised:

- A new WWTP at the north end of Banks Street including milliscreens for both domestic sewage and separated industrial wastes and a single BTF tank loaded at 0.8kgBOD/m^3.day (double the loading rate for the consented concept)
- Two new influent pump stations for domestic sewage and separated industrial wastes
- A new outfall pump station for both waste streams combined

- Extensions to both trunk interceptors and new rising main to the existing outfall

Provision was made for UV disinfection, secondary clarifiers and a second BTF (although only the UV disinfection was included in the TOC of $45m).

In adopting this revised concept, Council decided to apply for a variation to the existing consent and a new designated site for the WWTP. It set up a Wastewater Management Committee (WMC) which, in a similar manner to the WARG, worked through the second consultation process and variation hearing to agree a suitable set of conditions for the new consent, which was eventually issued, without appeals, in June 2009.

The plant layout for Banks Street, the process flow diagram (including options for upgrading or expansion) and the new Industrial Separation Scheme and trunk network changes are shown in Figures 1, 2 and 3.

Figure 1: Gisborne WWTP Plant Layout

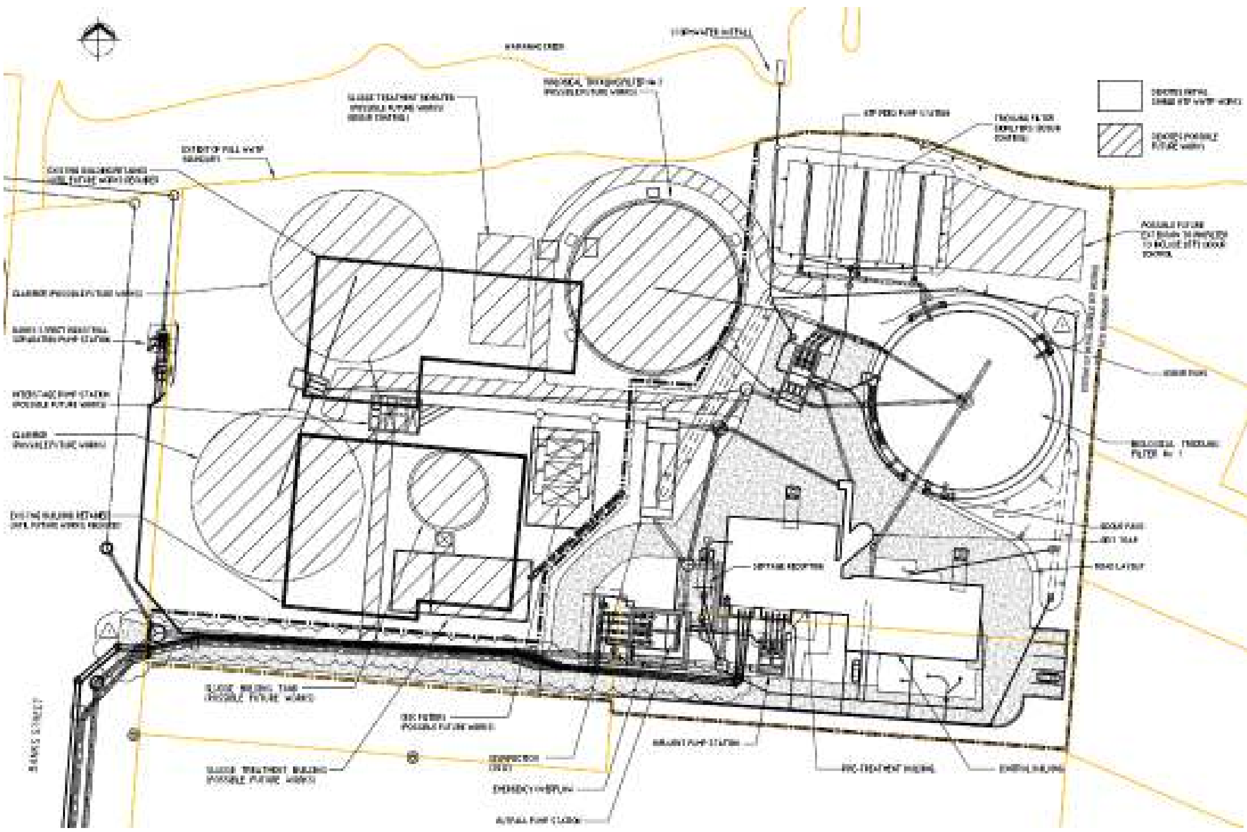


Figure 2: Gisborne WWTP Process Flow Diagram

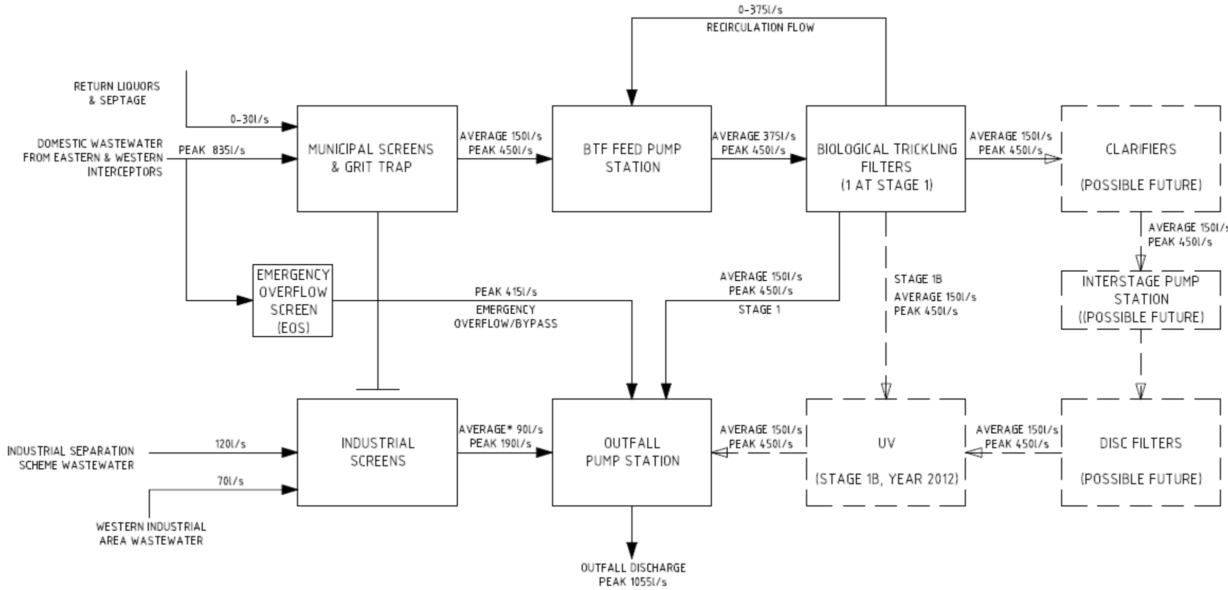
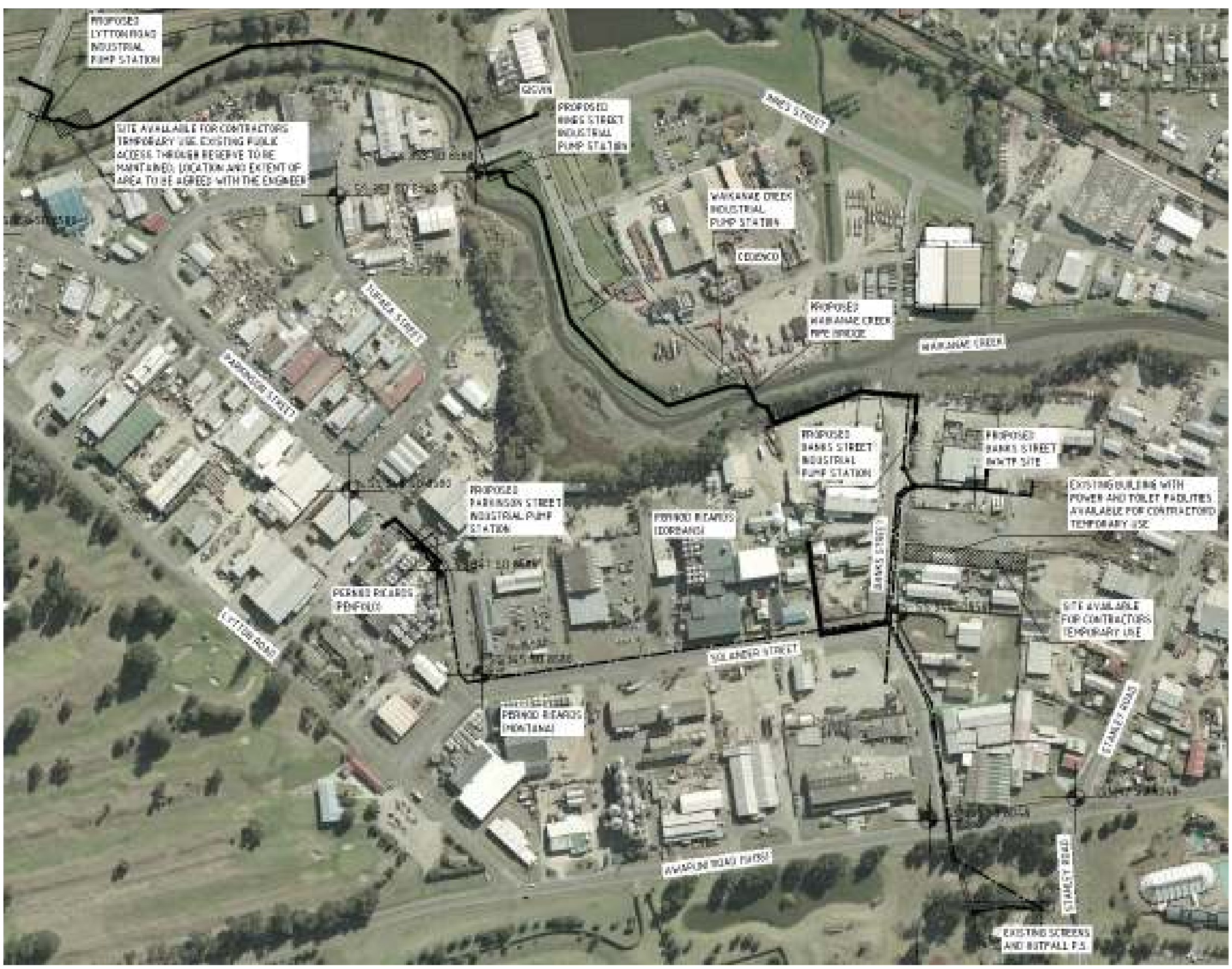


Figure 3: Industrial Separation Scheme



Detailed design for the revised scheme started in July 2009 and the construction contracts were tendered and then awarded by December 2009.

3.1 EXCLUDING PRIMARY SEDIMENTATION

Conventional trickling filter plants include two stages of primary treatment - screenings/grit removal and primary sedimentation.

Screening wastewater is essential before a BTF process. Typically fine screens between 0.25 – 2.5mm aperture are used to remove the solid material from a waste stream. These solids, if not removed from the waste stream can cause blockage in the media bed. Large, solid particles can easily get caught in the media bed because of the tortuous path that the bed creates. Over time these caught particles will trap other material. The build-up then creates preferential flow paths through the media, creating a dead spot within the media bed and reducing treatment capacity. Microorganisms also grow on these blocked clumps. Over time, as more material builds up, the microbes will have less access to oxygen and anaerobic conditions will prevail. This causes the release of hydrogen sulphide, methane and other odorous compounds. Regular flushing of the media can help prevent dead spots forming within the media bed. However, once a dead spot has formed the only way to remove it is to take out the surrounding media and clear it by hand. This is a difficult process as it is hard to determine where dead spots are within a media bed, which may be thousands of cubic metres in total volume.

To minimise the risk of dead spots occurring in the media bed, CH2M Beca chose to use structured crossflow media in the BTF. Structured media provides definitive flow paths for wastewater through the filter. The crossflow lattice promotes easy flow and good distribution while preventing areas where water or solids can pond.

Gisborne's WWTP before the upgrade consisted of 1mm rotating drum milliscreens. These screens had been operating since 1990 and they were coming to the end of their functional life. To address this problem, a new milliscreening plant was included as part of the new treatment plant works with screen apertures of 1mm. This would ensure good capture of solids before the BTF.

As well as screening, the new WWTP included grit removal. Characterising Gisborne's wastewater had shown that a large amount of grit was present in the system. A number of pump stations had to be regularly emptied of grit. This high level of grit was most likely due to the age and condition of Gisborne's wastewater network and sandy soils, as well as the high ground water level around Gisborne. A vortex grit chamber and grit classifier were used to remove grit from the wastewater before it reached the BTF. Not removing grit can lead to a build-up of fine debris in places of the treatment plant that are not designed to have grit. Most common places would be the inter-stage pump stations and the floor of the BTF. Accessing the pump stations for cleaning is a simple operation but accessing underneath the BTF is difficult. For this reason grit removal facilities were installed.

The second stage of primary treatment that is common in BTF plants is a primary sedimentation tank. Typically PSTs are used to settle solid particles that pass through screens and grit removal before flow reaches the BTF. The main reason is to lower the organic load to the BTF. Small, particulate organic particles are removed in PSTs. Removing these particles before the BTF allows the BTF to be smaller in size as the organic load is less. Removing solids in a PST provides an opportunity to anaerobically digest the sludge and create some energy from biogas.

Drivers for solids removal from wastewater in Gisborne are different than most other places. The process of having a BTF tank without primary sedimentation is largely unique to New Zealand. The first BTF plant built in New Zealand without PSTs was at Hastings WWTP. However, the Hastings plant was different to Gisborne because it had random pack plastic media.

Meeting cultural concerns was the primary driver for not installing PST tanks in Gisborne. The resource consent process and liaison with Tangata whenua indicated that transportation of solid human waste removed from a PST is offensive, particularly when transporting the waste past local marae, burial grounds and places of ancestral significance. Allowing this waste to be treated by the BTF provides a chance for biotransformation of the waste. The small organic particles and the dissolved organics are both transformed by organisms in the BTF into biomass. This biomass, while still solid particles, is less culturally offensive.

The use of structured media without PST tanks is very unusual internationally although there is increase interest in replacing PSTs with only fine screens ahead of BTFs (Almeida and Chernicharo, 2011). It provides a good technical solution to a culturally significant issue.

3.2 INDUSTRIAL SEPARATION

Trade waste bylaws were introduced to large processing plants in Gisborne in 1996. The bylaws meant that, at the time of WWTP design, the industrial waste did not need to be treated to the same level as municipal waste. This was also true culturally because industrial waste does not contain human waste and does not need as much treatment to restore its mauri. Industrial wastes often have high biological oxygen demand. By stopping industrial waste from going through the treatment plant the design load is reduced, which reduces the size of treatment units.

Consent was granted to discharge BTF treated municipal waste and screened industrial waste to Poverty Bay. This allowed for an industrial waste separation scheme. The original proposal was to retain the existing milliscreening building at Stanley Road and upgrade the facilities to treat industrial waste. However, when it became apparent that Stanley Road was not a viable option, the revised idea was to treat all industrial waste at the Banks St site.

Regular consultation meetings were arranged by GDC with industrial partners. A number of smaller industrial operations were excluded from the scheme due to their location. Most of the big industries involved food processing of seasonally dependant crops. The main issue for concern for most of Gisborne's industries was construction during their peak season. These issues were addressed by council and the final scheme saw 4 terminal pump stations collecting waste from the major industries. These pump stations discharged directly to the headworks of the industrial milliscreens at the new WWTP.

This is one of the only times in New Zealand's history that a significant industrial separation scheme has been carried out as part of a new WWTP construction. The separation work was tendered as a separate contract to the WWTP, but contractors were given the choice of tendering both contracts in the hopes that both contracts complete by one contractor would be cheaper than two contract's completed separately. In the end HEB Construction won both contracts because they were able to provide the lowest price for both packages.

3.3 ENERGY STRATEGY

A significant portion of operational costs in wastewater treatment operations can be attributed to energy consumption. In addition, energy prices continue to rise reflecting the risks associated with the security of electricity generation and transmission in New Zealand. It was therefore important to consider energy consumption and generation options in the wastewater treatment design process to mitigate the impact of energy costs on future operations, and identify and implement energy generation options to offset these costs if possible.

Key energy strategies developed for Gisborne WWTP include:

- Ensuring that the pump selections provided the most efficient operation over the duty range to which they operate. Special consideration was given to the normal duty range of operation (e.g. the low flow pumps in the Influent and Outfall Pump Stations), where small gains in efficiency in this operating range are exaggerated by the significant length of time that the pumps operate in this range. If the pumps operate at slightly less efficiency at very high flow rates, this may have less impact on overall energy costs because operation in this range is rare and intermittent.

- Incorporating comprehensive monitoring systems that measure flow, pressure and energy use so that changes in the pump operating characteristics can be detected early, thereby preventing operation away from the pump's best efficiency point.

- Installation of an inter-stage pump station between the BTFs and possible future clarifiers so that the clarifiers can be constructed above ground water level. This would present significant construction cost savings. Energy used in the Stage 2 pump station is offset by additional energy that would be required in Stage 1 to pump the water high enough to gravitate through future clarifiers.

These strategies helped reduce on-going operational costs at the plant and minimise whole-of-life construction and operation costs.

3.4 DEALING WITH LIQUEFACTION

Liquefaction has been a highly relevant topic in New Zealand of late with the recent earthquakes in Christchurch. The earthquakes brought large amounts of silt to the surface in some areas and caused the ground to slump in other areas. This was all due to liquefaction.

Gisborne's WWTP is located close to the beach and is also close to Waikanae Creek, which meant the ground water table was high. This means that the site is susceptible to liquefaction under a seismic event. Ground surveys showed deep sand layers down to 10-15m, with an underlying clay base.

Geotechnical and structural engineers analysed the site to find a way of preventing structures either sinking or floating during a seismic event. Deep structures like pump stations are usually held in the ground by a weight of concrete that exceeds the upwards force on the structure or by creating nibs around the base of the structure to provide extra ground bearing area on the structure.

Gisborne's design was different to the conventional way of dealing with deep structures. The three deep pump stations in Gisborne were supported in the ground by a ring of "sacrificial" sheet piles. The piles were 12-15m in length and were driven into the ground at the periphery of the pump station excavation (see Photograph 1). This process is common with deep excavations but it was unique in Gisborne because the sheet piles are permanently keyed into the clay layer beneath the sand layers. The idea was that groundwater would be cut off from entering the excavation as it could not permeate underneath the pump station through the clay layer. The sheet piles were left in the ground and had a design life as long as the concrete in the pump station. Concrete for the pump station walls was poured against the sheet piles as external formwork, incorporating them as part of the finished structure. The pump station and sheet piles could then act as one unit under a seismic event. Resistance of the sheet piles on the surrounding ground would prevent the structure rising or sinking if the material turned to liquid. Preventing groundwater from easily entering the space beneath the pump station will also help the structure remain stable during a seismic event, as well as assisting in groundwater control during construction.

Photograph 1: Sheetpiling to Outfall Pump Station

The construction process showed that this idea should work well with no ground water entering the excavations from below and only small amounts through the sheet piles.

3.5 RAINWATER REUSE

Wastewater treatment plants can be high water users. Water supplies were required at Gisborne WWTP for screen washing, biofilter damping and site wash-down hoses. Early in the design it was clear that the industrial area of Gisborne was one of the major water users in town. Adding more pressure to the area's water supply was not on GDC's agenda.

However, sustainability was on GDC's agenda. Areas or processes that could be optimised to minimise energy or resource use were. One such example was the rainwater reuse system. To reduce the WWTP's water demand a rainwater collection system was installed. Rainwater was collected from the roofs of both buildings and channelled to a storage tank. The system included a first flush diversion system so material caught in gutters could be flushed out before entering the storage tank.

Rain in Gisborne during summer is sometimes infrequent so the storage tank had to be topped up by town supply. Wash-water for the site was drawn out of the storage tank, providing the WWTP water needs and decreasing reliance on town water supply. This strategy is uncommon among WWTPs in New Zealand and will save GDC a part of their valuable resource for years to come.

3.6 DESIGNING FOR COMMISSIONING

Because of the complicated connections between the new WWTP, the industrial separation scheme and the existing sewer trunk network, the project team finalised the cut over and commissioning methodology before finalising the design and contract works. Some of the cut overs were permanent with no "fall-back" position once the changeover was made, and these required contingency plans should the switch not go as planned.

The commissioning for the WWTP was particularly important as at no stage did Gisborne District Council want to discharge un-milliscreened sewage to the bay. As designed, there are a number of internal plant bypasses to allow unit processes to be taken offline for maintenance and, by using these bypass options intelligently in the commissioning methodology, the various stages of treatment could be progressively dry tested, "clean water" tested and then "brown water" tested before being brought fully into the treatment train. This somewhat "back-to-front" approach to design in foreshadowing how the plant would be commissioned was an innovative solution to maintaining effluent quality through the handover period and proved very effective in removing commissioning issues, risks and glitches.

3.7 STAGED CONSTRUCTION UV INSTALLATION

The original consented concept design for the Airport site included secondary clarification and UV disinfection, but the revised lower cost scheme postponed both the second BTF (hence increased the BTF loading rate) and final clarification along with all the associated sludge dewatering and load-out facilities. Space and hydraulic capacity has been provided for future installation of these unit processes if they are decided necessary and affordable.

The UV plant must, under the consent variation, be installed December 2012 and the plant design allows this to be simply "plugged in" between the BTF and final outfall pump stations to provide disinfection of the treated domestic sewage flow before it combines with the milliscreened industrial effluent. Monitoring of the BTF effluent for 12 months after commissioning will enable the most suitable UV system to be identified and then installed. The WMG is now actively involved in the monitoring of the BTF operations and the degree of biotransformation of human sewage that is achieved at the higher loading of 0.8kgBOD/m^3.day.

4 CONSTRUCTION SOLUTIONS

4.1 LINING CONCRETE WITH POLYETHYLENE (PE)

Concrete corrosion was identified as a major risk item for the treatment plant structures. Previous experience at the Stanley Road milliscreening plant and on the two main interceptors has shown that inadequately protected concrete is susceptible to sulphide attack and will corrode in wastewater environments. Fixing the concrete surfaces or retro-fitting corrosion protection has proved to be difficult and costly.

CH2M Beca has had previous experience with PE lining at other New Zealand treatment plants, originating at the Timaru milliscreening plant in the mid-1980s. The international market for PE lined concrete is strong but the New Zealand market is still developing. At the time of lining there was only one PE lining supplier/welder in New Zealand. While the limited market did not provide great price competition the PE supplier was willing to provide technical assistance at the design and construction stage.

For the contractor it was their first use of PE lining. Before lining work started there was a meeting between the contractor and PE lining supplier/welder to be trained in PE lining installation. This was also a chance to agree the extent of PE lining required and details around concrete penetrations, pipe penetrations, penstocks, roof joints and wall joints.

Installation went relatively smoothly. The contractor learnt early on that PE lining changes shape when left in direct sunlight because of its high thermal expansion coefficient. There were one or two examples of the expanding lining pulling out the nails with which it had been fixed to the formwork. At one stage the project had exhausted PE lining supplies in New Zealand and there was a delay until more could be brought in. Once these issues had been addressed there were very few problems.

Welding and testing PE lining proved challenging. Welding can only be done in dry conditions so the frequent rain in Gisborne hampered progress. Tents were erected over the pump stations to allow work to progress in the rain. Some welding in small channels was also required, which meant wearing correct equipment and following appropriate procedures for working in confined spaces. Testing the welding was largely achieved by filling up adjacent chambers and spotting leaks. Thorough visual inspections were required where water testing could not be achieved.

The overall PE lining process was a learning experience for the contractor, supplier and wastewater construction industry in New Zealand. Successful completion of the project has shown that New Zealand does have PE lining capability and is able to deliver good results on a large scale.

4.2 USING GLASS REINFORCED PLASTIC (GRP)

Pipe material selection for the Gisborne WWTP went through a number of iterations before a solution was reached. PE pipe was considered the most cost effective pipe for long runs of small diameter pressure pipe. PE pipe was used in a number of places in the Gisborne wastewater scheme for connecting industrial separation pump stations to the treatment plant. Larger diameter pipes, however, were not available in PE.

Pipes of 800NB and 900NB were required to intercept flow from Gisborne’s existing western and eastern trunk sewers and convey this to the new WWTP. The two interceptor pipes were both gravity flow but a new segment of 700NB rising main was needed to connect the plant to the outfall. Most pipe materials were considered for these pipes but, being wastewater, the pipe material had to be able to withstand likely chemical attack. This was especially relevant to the large diameter pipes collecting wastewater from Gisborne’s entire network.

The final decision for large gravity pipes came down to a choice between PE lined concrete or GRP. The rising main options were PE or GRP. Both options were allowed in the tender process, with a final decision to be made on price.

HEB Construction made a decision to go for the GRP option, with pipe supplied by Maskell. However, in addition to the use of GRP pipe, HEB proposed to construct all the manholes (see Photograph 2) and industrial pump stations in GRP. All up this amounted to over 1000m of GRP pipe, 23 manholes and four industrial waste pump stations.

A major consideration before switching manhole and pump station material was ensuring that GRP chambers would not float out the ground or sink during a seismic event. This was mitigated by providing a nib on the GRP chambers halfway up the body that could have concrete or crushed aggregate placed on top of it to prevent floatation during liquefaction.

Installation of GRP chambers appeared much easier and quicker than a concrete equivalent. The GRP chambers were delivered from factory to site with stub pipes already “welded” in place. Installation involved excavating a hole and placing the GRP chamber in it. Most of this work can be done from the surface so allows people to work safely outside of the excavation. Pipe laying is similar to concrete with socket and spigot joints. Joining pipe to chambers is simply another socket/spigot type connection. If changes are required then the GRP can be cut and repaired on-site with new sheets of GRP.

Photograph 2: Fabricated GRP Manhole

4.3 BIOLOGICAL TRICKLING FILTER

Designing a biological trickling filter (BTF) is nothing new as they have been around since the early 1900s. However, due to updates in technology there were some 'never seen before in New Zealand' aspects to the Gisborne BTF.

4.3.1 FILTER MEDIA

Media for microorganisms to grow on is the most integral part of a BTF. Various forms of filter media have been trialled over the years including rocks, iron slag and corn cobs. More recently plastic has been used because it is able to be moulded into shapes that have a high surface area to volume ratio and allow easy drainage through the media bed.

Filter media selected for use in Gisborne through a competitive international tendering process was structured plastic media. This was the first large scale use of structured plastic media in New Zealand since the Christchurch BTFs were constructed in the late 1970s. Over 5,000m^3 of media was required for the Gisborne BTF. The supply contract for Gisborne media was won by SuperChill Australia. In the past SuperChill had supplied structured plastic media for cooling towers in Australia and the Pacific so it was relatively new for them to be supplying media for a BTF. The media was shipped from Germany in sheets of corrugated plastic 2.4m long by 0.6m wide. When the individual sheets arrived on site they needed to be electro-fusion welded together. SuperChill had sourced two welding machines from overseas and brought them to New Zealand specifically for this job. The individual sheets were welded into bales measuring 2.4m by 0.6m by 0.3m. Each bale took approximately 7-10 minutes to weld and the overall welding process was completed in around 1600 manhours over 6 months. An unusual feature of the SuperChill media, and an advantage over other media, was its specific surface area ratio of 125m^2/m^3 volume – some 25% greater than other competing media options.

Installation of the media bales was completed by hand. The bales were lifted into the BTF tank and placed from the centre outwards. Bales were trimmed with a chainsaw to ensure there were no gaps between bales or the tank wall. Every second layer was placed perpendicular to the layer beneath it to ensure flow would be dispersed well. Care had to be taken during installation and cutting so small pieces of media did not fall into the media bed. This was to avoid possible sources of clogging in the future. The installation process was completed by 3-5 workers in 2-3 weeks.

4.3.2 BTF COVER

Often it is beneficial to leave trickling filters open to the air for free air ventilation and this is common in areas of low population density. Temperature differences between ambient air and wastewater can create natural drafts through the media bed, providing air to the microorganisms. Such conditions are preferable as they prevent the need for forced ventilation and the power requirements associated with that.

Gisborne's BTF was to be built in the middle of an industrial area and in relatively close proximity to one of Gisborne's most popular surf beaches. Temperature differences in Gisborne over winter were also not high enough to promote natural air flow through the media. Both of these situations lead to the decision to cover the BTF and provide a forced ventilation system. This would keep smells in and allow sufficient air flow all year round.

Cover material was left to the main contractor to choose. HEB Construction had initially tendered for a GRP cover that has been used in New Zealand before and is similar to existing BTFs at the Christchurch WWTP and the old (now decommissioned) BTFs at Mangere WWTP in Auckland. However, during the tender negotiation stage a geodesic aluminium cover was presented as an alternative that would provide a significant cost saving. It would also be the first significantly sized aluminium cover used at a wastewater treatment plant in New Zealand. The cost saving was approved by GDC and an aluminium cover was secured through an American company, Temcor.

Construction of the 32.5m cover went ahead rapidly. The cover arrived on-site as a large jigsaw puzzle. A small team of fixers set about putting the pieces together. From start to finish the cover took less than two weeks to complete. Once put together the next thing was to place the cover on top of the tank. This was achieved by a 220 tonne crane from Tauranga, show in Photograph 3. Lifting the cover in place went remarkable smoothly and is a testament to HEB Construction's control of the workplace and their ability to build round tanks.

Photograph 3: Crane lifting BTF cover in place

5 PLANT OPERATION 9 MONTHS ON

Gisborne District Council has been sampling flows before and after the BTF as part of their resource consent required monitoring programme. Average removal results for operation between March and September 2011 are shown in Table 1.

Table 1: Gisborne BTF Sampling Results

Parameter	Before BTF (Ave)	After BTF (Ave)	Average Removal
Enterococci	$7x10^5$ cfu/mL	$7x10^4$ cfu/mL	1-log Reduction
TSS	222 mg/L	163 mg/L	30% Removal
TOG	29 mg/L	14 mg/L	50% Removal
BOD	255 mg/L	101 mg/L	60% Removal
COD	425 mg/L	187 mg/L	56% Removal

Figure 4 shows the BOD concentration before and after the plant from January to September 2011.

Figure 4: BOD Sampling Jan – Sep 2011

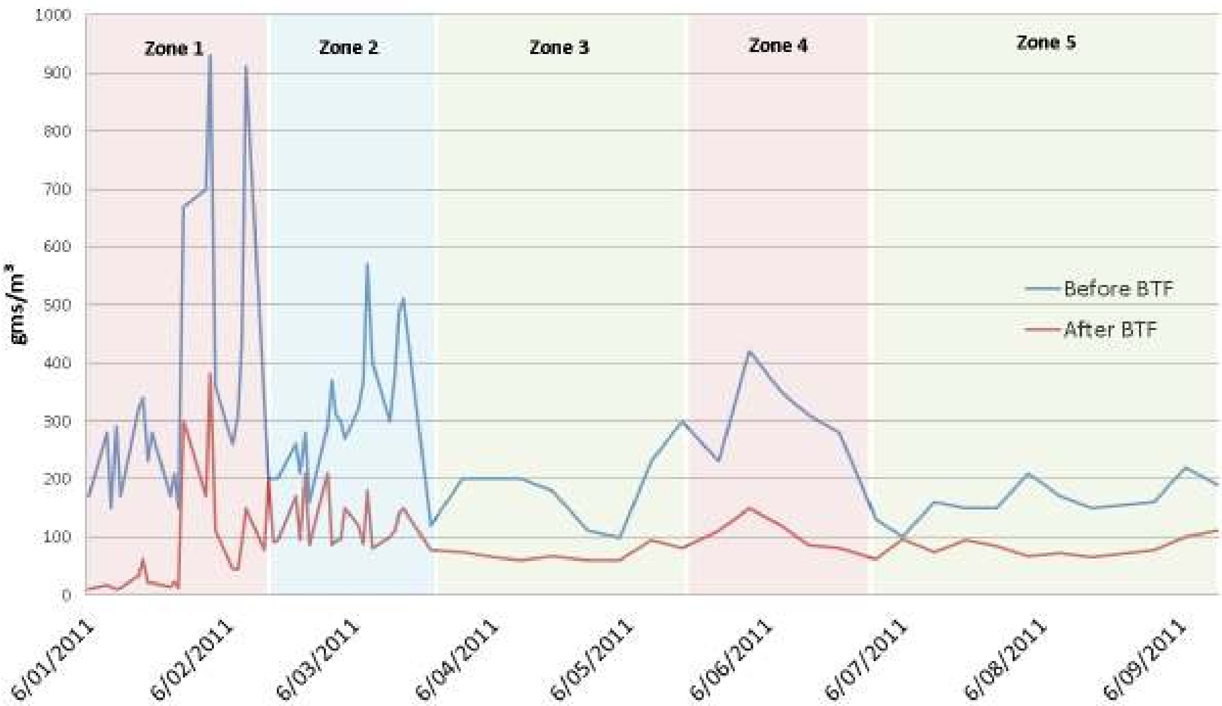


Figure 4 reflects five distinct periods of operation since the BTFs were commissioned. During January 2011 the main domestic interceptors in Gisborne were diverted to the new plant. However, the final industrial waste streams were not separated from this flow until mid-February 2011. This period is indicated as 'Zone 1' in Figure 4. This zone has some extremely high BOD concentrations that were well in excess of design values. After industrial flows were removed there appears to be a settling period as the BTF flushing cycle is established and biofilm normalises. This is indicated by 'Zone 2'. 'Zone 3', from late March through to mid-May, is a period of stable operation with concentrations around design values. This period was interrupted from mid-May to late-June when the industrial milliscreens were out of operation. 'Zone 5' from late-June to mid-September shows another period of good operation where the plant appears to be operating well.

6 CONCLUSIONS

The Gisborne Wastewater Project is a good example of the old maxim "good things come to those that wait". Over the decades, the patience and energy of many stakeholders and successive councils – elected members and staff – was tried as the different parties tried to resolve the positions of "no more treatment" all the way through to "full" land based treatment and no discharge to the sea. However, through meaningful consultation and a full understanding of the different options, a compromise was reached – the BTF-based treatment plant with industrial separation scheme was developed, consented and delivered. The result was a long-term benefit to the community and cost savings now and in the future.

The Gisborne Wastewater Treatment Plant was officially opened on 22 March 2011, after being successfully commissioned a week before the new consent deadline of 31 December 2010. Results from operation so far show around a 60% reduction in BOD, a 56% reduction in COD and a 1-log reduction in Enterococci.

The project was completed on-time – in spite of unexpected hurdles along the three year journey – and under the agreed budget of $40m proving that innovation and collaboration impacts directly on the financial outturn of design/construction projects.

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Photograph 4: Site Aerial Photo