“Bridging the Divide – A story of integrating transport, stormwater and amenity in Auckland’s new Super City”

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This paper presents an investigation, which forms part of a planning assessment, resulting in an integrative restorative water urban design solution for the Omega Pond. This public asset forms part of the quantity and now quality management asset for urban discharges into the Alexandra Stream, Auckland, New Zealand. The overall project is known as the Te Ara Alexandra project and encompasses the integration of a major public cycle-way project with stream restoration, wetland enhancement and stormwater infrastructure improvements. It has set a standard by which a new model that amenity, parks and water sensitive urban design managers can draw upon. The project and subsequent construction, has been driven by an Integrated Stormwater Catchment Management Planning process that is considered best practice for the new Auckland Council Super City.

The objective and rational of this project was to:

- Define and develop a design to establish a treatment efficiency function for the pond as it previously only performed a stormwater detention function.
- Investigate how the ponds water quality function might be formalised and/or enhanced;
- To incorporate the development of amenity features and improvements where possible in any proposed design;
- To include and support the objectives of the cycle-way strategy;
- The use of low impact design and other on-site mitigation methods for new development or re-development for the purposes of reducing contaminant discharge at source, to manage stream erosion and to protect stream health.

The method for the development of the detailed design and integrative planning documents includes:

- Conducting assessments of the receiving environment through sampling and recording,
- Undertake GPS topographical survey of the pond and assets,
- Developing models of stormwater flows and contaminants loads,
- Conducting consultation with other stakeholders to indentify and include wider objectives,
- Utilising LIDAR (Light Detection and Ranging) data, a 3D computer model was developed,
- Cycle-way design plans were incorporated into stormwater designs and a single set of design drawings developed for tendering.

This project is a shining example of how stormwater and transport practitioners can bridge often divergent philosophical approaches. The fundamental scheme design for the cycle-way project had not included a linkage through the area of the existing pond and because of input from the stormwater team, additional access was achieved, which opened up the cycle-way to a much wider community catchment base. The outcome being improved performance of a public asset, enhanced public amenity of the open space area and an optimised cycle-way design. The result of this investigation, assessment and design has been the construction of a $350,000 transport, amenity and water sensitive urban design asset.

In conclusion sound planning and design processes have underpinned this project. In particular the following conclusions are relevant:

- Overcoming often divergent views between council entities regarding use of riparian reserves and stormwater assets has been key,
- Blending stormwater, amenity, transport and environmental objectives has meant getting the best bang for your buck,
- Identification of design elements through the planning phase of the project has been core to the successful design,
- Linking design elements back to planning objectives throughout the design process is imperative.

KEYWORDS

Integrated catchment management planning, water quality, cycle-way, integration, bio-engineering.

PRESENTER PROFILE

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Rowan Carter is a Senior Stormwater Catchment Management Planning Specialist at Auckland Council. He has spent much of that time scoping stream restoration projects, many of which have required integrated approaches in order to maximise the potential of each project.

1 INTRODUCTION

Successful Integrated Catchment Management Planning includes establishing the connectivity between catchment issues and the other landuse driven complexities, such as transportation development, to ensure that multiple benefit solutions are achieved. This has been achieved through the planning and construction phases of the Te Ara Alexandra project.

The Te Ara Alexandra Project encompasses the integration of a major public cycle-way project with stream restoration, wetland enhancement and stormwater infrastructure improvements. One component of this wider catchment project involves enhancing Omega Stormwater Pond, located adjacent to the Alexandra Stream, North Shore City, Auckland, New Zealand (see figure 1a).

This integrative design project was born during the development of the Oteha Stormwater Catchment Management Plan (CMP) process. An Australian equivalent being Urban Stormwater: Best Practice Environmental Management Guidelines (CSIRO 1999)

The CMP identified a number of enhancement and optimisation opportunities within the Alexandra Stream corridor, including:

- Contaminant management and removal,
- Erosion management and remediation,
- Ecological enrichment,
- Amenity enhancement, and;
- Improvement to public access.

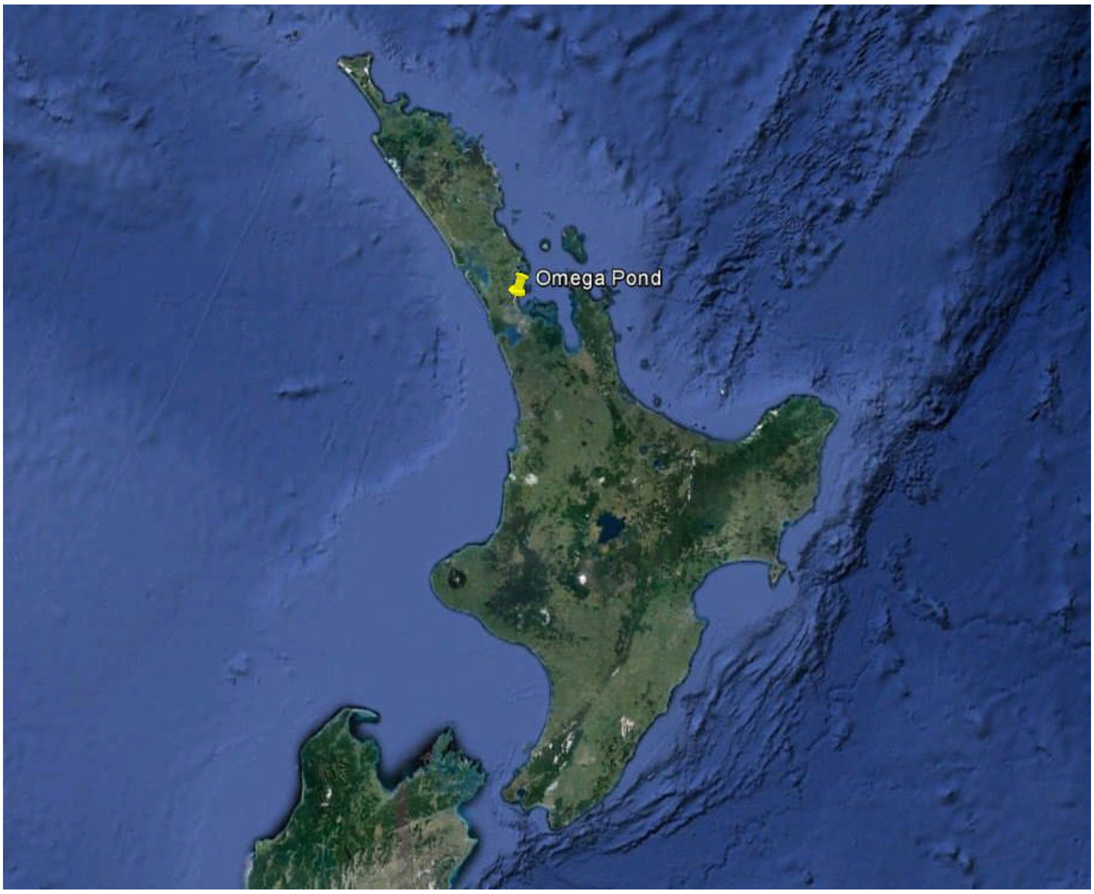

Figure 1a: Location of the Project Site in the North Island of New Zealand

1.4 CATCHMENT/PROJECT CONTEXT

The Omega Pond is located within the Alexandra Stream catchment which drains a 270 Ha area and flows in a south-north direction for approximately 5 km (mostly within reserve land) from the headwaters in the Unsworth Reserve through to it's confluence with the Oteha Stream at Bush Rd, Albany (refer figure 1b).

The Oteha Stream ultimately discharges into the Lucas Creek estuary; a low energy depositional environment in the upper Waitemata Harbour. Sediment quality monitoring in the estuary has shown increasing levels of heavy metals such as zinc and copper. For this reason, priority has been placed on managing sediment and associated contaminants in this and other contributing stormwater catchments.

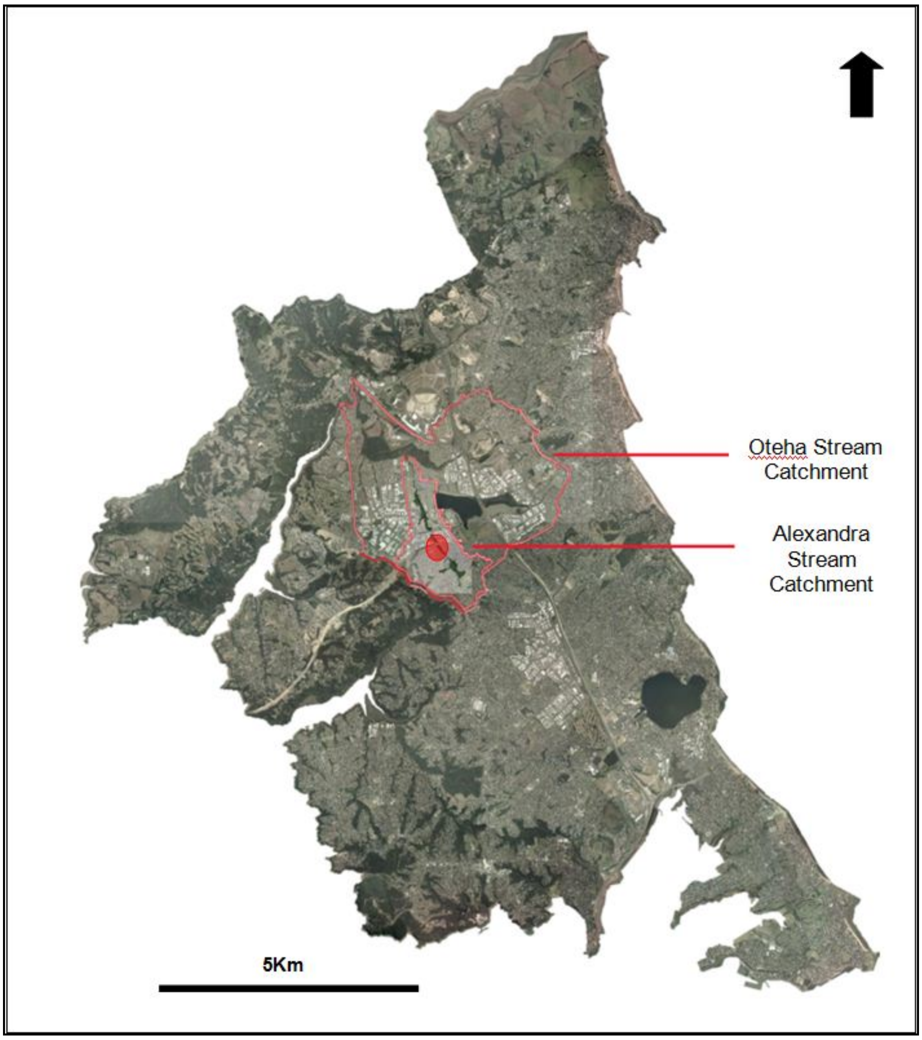

Figure 1b: North Shore Area Showing Oteha and Alexandra Catchments with Omega Pond (red circle).

The Alexandra Stream corridor is almost entirely within a thin strip of reserve land. The upper main corridor is surrounded by residential development (see figure 2), which has resulted in alteration of the form of the stream through piping, culverting and the creation of stormwater control ponds.

The land use adjacent to the upper-middle section of the stream is dominated by industrial/commercial development. This is where the majority of contaminants are being generated in the catchment. Adjacent land use in the lower section of the stream is composed of a mixture of reserve, residential and education land. Present land use within the Alexandra Stream catchment comprises of 30% low density residential, 21% open space, 16% pasture, 16% road, 11% industrial, 4% commercial, 3% bush and 0.5% high density residential. Vegetation covers 12% (34ha) of the catchment.

The topography of the Alexandra Stream has been altered by earthworks carried out to create the Rosedale Treatment Plant. The southern catchment has the steepest gradient rising to excess of 80 m within the Unsworth Heights area. The eastern and western parts of the catchment are gently sloping and rise to approximately 40 m in elevation. The general shape of the catchment can be described as long and thin.

The Oteha Valley Stormwater Catchment Management Plan states that a veneer of silty alluvium overlies inter-bedded mudstones and sandstones of the Waitemata Group (East Coast Bays Formation). The mudstones and sandstones in this area are completely to highly weathered to depths of 10 m to 12 m, comprising soft to firm silts and sands with minor clay. A thin iron mineralised 'hard pan' occurs in places between the alluvium and the underlying weathered Waitemata Group soils.

Alexandra Stream shares some of the natural character of Oteha Valley Stream. It has a well formed channel in the lower main section with remnant totara trees supporting the stream banks. The lower-middle section of the stream borders the Rosedale treatment ponds. This section is zoned for recreation and includes a substantial wetland area known as the Alexandra Lower Wetland.

1.4.1 PROJECT SITES

The Alexandra Lower Wetland was one of a number of sites that were earmarked for enhancement during the development of the catchment management plan. These enhancement projects include riparian weed management and planting, erosion mitigation, flood plain modification to encourage contaminant removal, a stormwater swale for contaminant removal, a stormwater pond upgrade and the provision of an off-road recreational and commuter 'share with care' cycle path. The parcel of projects was termed the Te Ara Alexandra Project.

Six main project sites were selected for detailed investigation, options assessment and design along the length of the Alexandra Stream (see Figure 2). They include:

1. Alexandra Wetland
2. Omega Pond and Omega Reserve
3. Rook Reserve Swale
4. Barbados Wetland
5. Rook Reserve Reach (re-vegetation)
6. Unsworth Ponds Upgrade

These opportunities aligned with stormwater management objectives derived from the North Shore City legacy Council's (NSCC) stormwater strategy 2004 and further endorsed through the combined catchment integrated catchment management plan for the area. These objectives included the following:

- To provide mitigation measures to enhance ecological values,
- To improve public access within the stream corridor,
- To ensure sediment control requirements are met,
- To minimise quantities of zinc and copper entering the receiving environment,

- To recognise and protect heritage and cultural values of the stream and environment,
- To manage stream erosion,
- The use of low impact design and other on-site mitigation methods for new development or redevelopment to reduce contaminant discharge at source, manage stream erosion and protect stream health,
- Protection against future stream bank erosion and damage to native vegetation,
- Maintaining and/or enhancing amenity and ecological values by retaining existing native riparian vegetation where practicable, implementing new planting and ongoing weed management,
- Protection and enhancement of existing wetland's and its/their associated natural treatment capability by restoring and maintaining in a more natural condition;
- Enhancement of general stream ecology by other means where appropriate, for example by habitat enhancement,
- Minimising in-stream works as far as practicable,
- Encouraging current and future community involvement in stream management,
- Mitigation of the effects of erosion at Council outfalls, and
- Removal or mitigation of man-made barriers to fish.

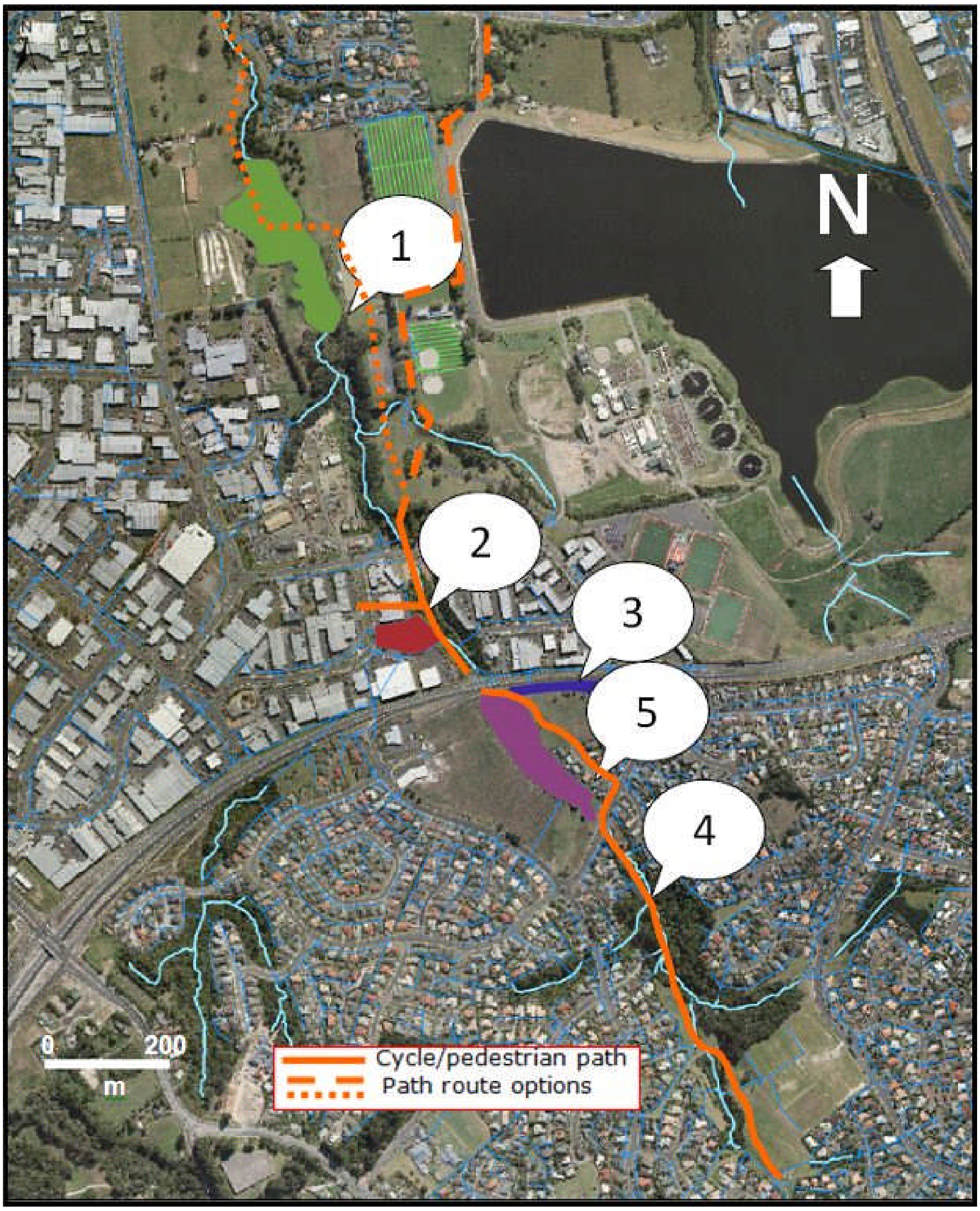

Figure 2: Map of Alexandra Stream Enhancement Project areas

The planning phase for these projects started in 2009. Most of the cycle-way has now been constructed along with the work at Omega Pond. Rook Reserve re-vegetation and Barbados wetland improvements are near completion, with further construction of the cycle-way and stormwater projects proposed over the 2012/13 and 2013/14 construction seasons.

1.5 INTEGRATION OPPORTUNITY

In 2009, discussions held with the North Shore City Council's Transport division highlighted an integration opportunity. Transport objectives aimed at providing commuter and recreational cyclist off-road routes had identified the Alexandra Stream reserve space for this purpose. Collaboration in planning and design phasing resulted in shared project objectives and a collective, strengthened project rational.

The integrated management of stormwater goes beyond simply focusing on runoff rates, volume and flooding. It requires a wider scope of consideration including the incorporation of built environments such as transport networks, public spaces, and buildings. In Victoria revised clause 56 (for residential subdivision) of the Victoria Planning Provisions came into effect on the 6th October 2006. These provisions serve to implement the principles set out in Melbourne 2030 – planning for sustainable growth to deliver more sustainable built environments. Essentially this supports the integration of water management with transport and neighborhood networks including subdivision construction management.

The Te Ara Alexandra Project encompasses the integration of a major public cycle-way project with stream restoration, wetland enhancement and stormwater infrastructure improvements. It therefore is an example of how sustainable objectives can be tangible outputs from integrated projects and has parallels with initiatives in Australia.

2 THE OMEGA POND SITE AND PREWORKS SITUATION

Omega Pond is located at 33 Omega Street, Albany, adjacent to the Upper Harbour Highway (refer figure 3).

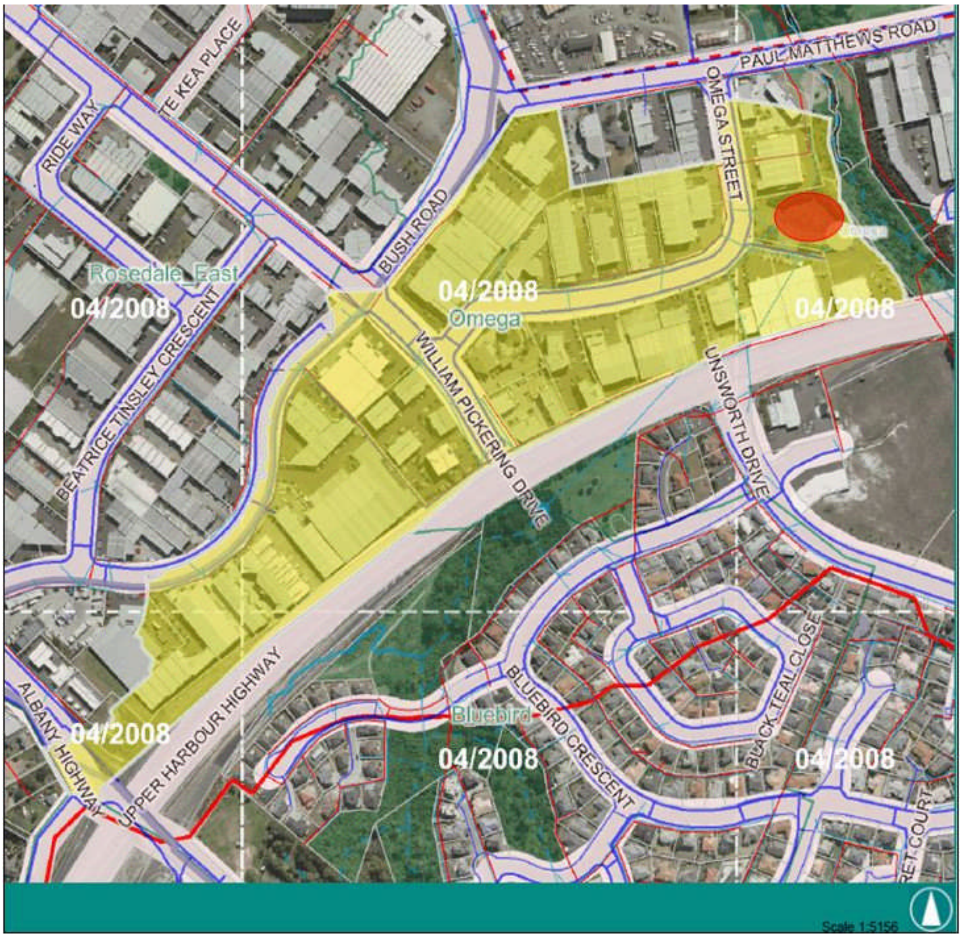

Figure 3: Omega Pond Catchment Area Map and Location (red circle).

The Omega Pond was designed as an extended detention dry pond and was constructed in 2000 by Neil Construction as part of the Unsworth Views and North Harbour Industrial Estate development. A design report prepared by Bruce White (source: Auckland Council Omega Pond) states that the Pond was designed to manage stormwater run-off from a 100 year 6 hour summer storm event, the critical rainfall event for flooding in the lower catchment area. It serves a small industrial catchment within the Oteha Valley Stormwater Catchment of approximately 174,000 m^2.

2.1 WHY THE OMEGA POND SITE WAS SELECTED FOR IMPROVEMENT WORKS

The Omega Pond site was selected for investigation as part of the CMP process because of the potential to improve the water quality function of the Pond. The wider catchment has been identified for improved contaminated management as the loadings are considered high and the marine receiving environment has the potential for accumulation of containments of concern.

The potential of the Omega Pond to be more than a stormwater asset was clear from the beginning of the project. The number of viewing shafts from adjacent commercial business and Omega Street indicated any increase in amenity would naturally benefit the surrounding area (refer figure 3). These amenity opportunities were further confirmed through a landscape contextual analysis undertaken as part of this project. Furthermore many of project objectives had the potential to be achieved through implementing improvements at the site including:

- To provide mitigation measures to enhance ecological values,
- To improve public access within the stream corridor for commuter and recreational purposes,
- To minimise quantities of zinc copper and other contaminants entering the receiving environment, and
- Encouraging current and future community involvement in stream management.
- Improve habit value and ecosystem services function.

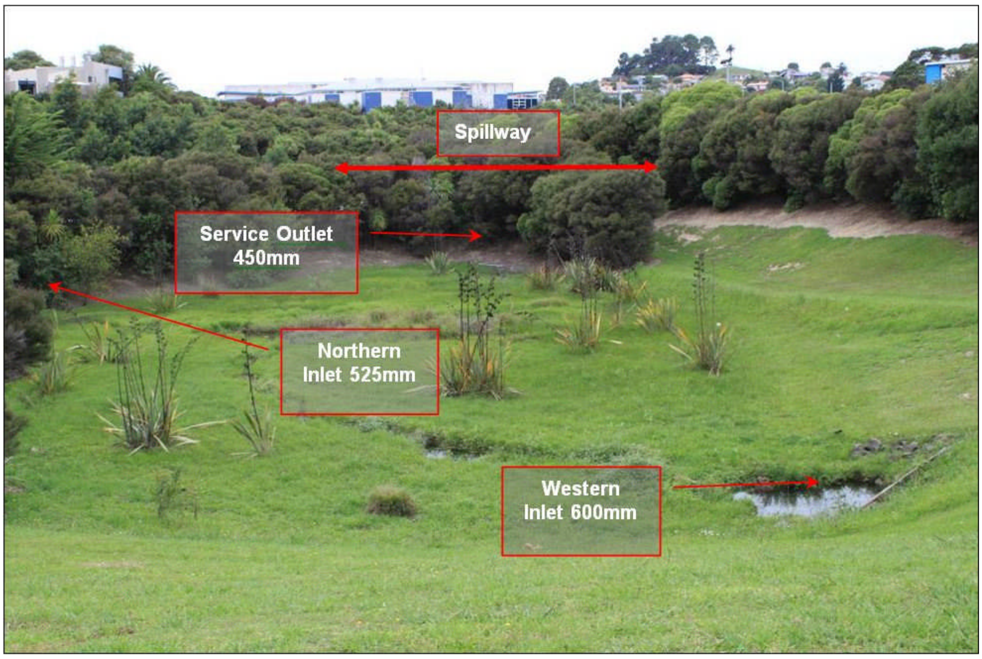

Figure 4: Showing Pre Works Omega Pond (facing East)

2.2 NETWORK CONFIGURATION

There are two public stormwater lines discharging to the pond. A 600 mm diameter pipe conveys stormwater quality flows into the west side of the pond (refer figure 4) while high flows from that sub-catchment are diverted to the Alexandra Stream. The second inlet is a 525 mm diameter pipe that enters the northern end of the pond. There are three outlet structures serving the pond; a service outlet structure and low flow outlet pipe. in addition to a secondary high level service outlet. An emergency spillway to the Alexandra Stream takes the form of an amoured broad crested weir.

2.3 DEPOSITED SEDIMENT VOLUME AND COMPOSITION

While functioning as a detention pond, the ponds effectiveness had been reduced by the large volume of the deposited sediment which had filled the pond to the invert level of the service outlet and reduced the available storage volume. This build up on the bed of the pond had resulted in wetland type vegetation colonising the surface. The outcome being that the pond was functioning as a dry detention pond but had wetland type features.

Prior to physical works Omega Pond contained approximately an average of 250 mm of deposited sediment. This was measured using probes and the use of RTK GPS survey technology. Using this data a sediment depth model was built in AutoCAD Civil 3D in order to calculate the volume of deposited sediment in the Pond. This was undertaken using existing LiDaR but also through refining the digital terrain model with additional infill GPS survey points to produce the sufficient resolution for modeling.

Figure 5: Showing Test Pits Dug into Accumulated Sediment

The result of this analysis was that there was a calculated of volume sediment of 290 m^3 deposited sediment.

Sediment testing was undertaken to determine the nature of any contamination. The results of the sediment testing for typical anthropogenic inputs (zinc, copper, lead, VOC) due to previous and current landuse, indicated the deposited sediments did not contain significant concentrations of tested contaminants. The deposited sediments were therefore suitable for disposal at a managed cleanfill site under national guidelines.

2.4 WATER QUALITY VOLUME

The water quality volume (WQV) required to treat the upstream catchment was determined in accordance with Auckland Regional Council (ARC) Technical Publication 10 (TP10). The ARC

Technical Publication No. 108 'Guidelines for stormwater runoff modelling in the Auckland region' were used to calculate the design water quality volume discharge for the catchment. These results being supported by current and future flows (maximum probable development) documented in the Oteha Valley Stormwater Catchment Modelling Report, 2008.

Water Quality Volume was calculated using the maximum probable development (MPD) of 90% imperviousness as the catchment is a zone 2 Stormwater Management Area (SMA) with business landuse. The existing imperviousness was calculated to be 88% using Council GIS layers. This data and associated parameters formed the basis for the developed design.

2.5 CHOSEN DESIGN OPTION

After a detailed options analysis including cost estimation it was concluded that the most feasible, effective and appropriate option was the construction of a wetland with a kidney shaped forebay at the north side of Omega Pond. This would improve the sediment removal efficiency, dissolved contaminant removal and amenity values of Omega Pond. The constructed wetland would consist of a forebay with a volume of 485 m^3 and a vegetated wetland area with an equivalent volume of 378 m^3. This would allow Omega Pond to capture approximately 54% of suspended solids as well as quantities of copper, zinc and hydrocarbons.

3 PROJECT PHILOSOPHY AND INTEGRATION

The over arching Te Ara Alexandra Project is supported by some key environmental data and assessments that have identified restoration opportunities. These include a complete stream and asset assessment undertaken by an engineer and ecologist in 2004. This involved physically walking the entire length of the Alexandra waterway assessing all built and natural structures including:

- Stormwater outfalls,
- Cascades and waterfalls,
- Stream morphology,
- Riparian features,
- Erosion and stability.

Part of this process involved considering the existing ecosystem services and how they might align with regulatory requirements and/or guidelines for the management of contaminants. This resulted in the identification of the Omega Pond as a potential restoration works site in 2004 along with a number of semi-modified wetlands including the Barbados Wetland (upstream) and lower Alexandra Wetland (downstream).

Other related benefits such as amenity improvement and social engagement, economic development, ecological enhancement, cultural sensitivity, educational components, etc. were also considered early in the project development and this involved rigorous dialogue with other Council departments including and in particular the Transport Department.

A traditional stormwater management approach might have excluded many of these enhancement opportunities because they would have been considered outside the scope of the standard stormwater management envelope. However, the objectives and outcomes sought of the project go beyond simple flood, erosion and/or water quality to include quadruple bottom line outcomes.

3.1 THE CHANCE FOR INTEGRATION

As outlined a holistic approach goes beyond simply stormwater management and must consider objectives of other stakeholders. The NSCC Transport section had at the time of the preparation of the Omega Pond options, developed designs for a cycle-way that followed the Alexandra Stream corridor, being part of Transport's Strategic Cycling Plan. Because of the open dialogue between the departments at the time it was soon understood that both parties had projects planned that could be modified to provide mutual benefits. The immediate benefits being:

- Combine planning resources to work towards achieving overlapping project objectives.
- Take advantage of the opportunity to maximise cost savings.
- Minimising disruption to the environment and the community.
- Chance to combine design resources and technical expertise.
- Combined tendering to reduce redundancy and ensure project success.
- Combine technical skills and resources.

As a consequence of these identified benefits a planning and design group was established with members from the stormwater planning, transport planning/projects and the key design and consenting consultancy resources. This led to sharing the management and optimisation of project budgets, swapping of key information sets and modification of design.

One of the methods of integrated project management for the wider project involved establishing a joint computer file folder storage arrangement. This meant that reports and data could all be located in a single location on Council drives, so reports and studies which would otherwise not be known about, were made available and accessible to all parties involved. A good example of this was the landscape design plans for the cycle-way and stream restoration projects.

3.2 PROPOSED CYCLE-WAY ALIGNMENT "WIN WIN"

The key objective of the "share with care" cycle-way was to provide an off-road commuter and recreational cycle route that would connect a significant residential population upstream with a key employment area and recreational reserves downstream. The alignment of the cycle-way interacts with several of the stormwater projects planned for the Alexandra Stream corridor and there has been considerable integration between the two planning teams to ensure the best stormwater and transport outcomes might be attained. One of these touch points was the alignment from Paul Mathews Drive through to Rook Reserve under State Highway 18. During the course of a site walkover with the Transport Team a number of feasibility issues were identified. These included stormwater consenting, land ownership and most significantly linkages of the cycle-way to adjacent feeder systems.

It was suggested that the alignment be moved from the eastern side of the Alexandra Stream (which was along the existing walking track) to the western side of the watercourse, adjacent to Omega Pond (see Figure 6). This new route made access to Omega Street possible. Because the landownership and access through the Pond reserve did not immediately seem to be feasible from a transport planning perspective it was discounted. However, the Pond design option at the time included a bund through the middle of the Omega pond separating a proposed constructed wetland from a kidney shaped forebay at the north side of the pond.

An elevated cycle-way along the Omega Pond bund alignment would provide an ideal access route from Omega Street to the main cycle-way alignment along the stream. This in effect would put the community in better contact with the environment through this new cycle route selection, incorporate enhanced amenity, reduced possible runoff caused by the cycle-way, and thereby reduced the environmental footprint of the cycle-way (refer figure 6).

Figure 6: Original cycle-way alignment in red, proposed change in green and access through the Pond in yellow

The design development phase of this project has been inclusive and iterative. In order for this process to be successful it required open collaboration, active communication and a willingness to share contracts, outputs, budgets etc.

3.2.1 TENDERING AND DESIGN

The design of the cycle-way was prepared in association with the pond remedial designs with two design teams bringing together a single set of drawings and schedules for Council approval and tender documents. The design needed to meet the operational and performance requirements of Stormwater and the specifications Transport had set for the cycle-way.

The Stormwater Department organised partial funding for this side link into the cycle-way as the cycle-way Project initially had only planned an alignment to pass by the pond. However, Transport provided a substantial proportion which supported the raised boardwalk component and access paths. Consequently this provided the potential to let the physical works contract for all the required works including pond upgrade, plantings and boardwalk construction. This provided economy of scale with associate cost and time savings.

Figure 7 shows the overall plan of the Omega pond and the cycle-way. The pond geometry is the dominating feature of the design with the cycle-way design effectively draping over the proposed contour.

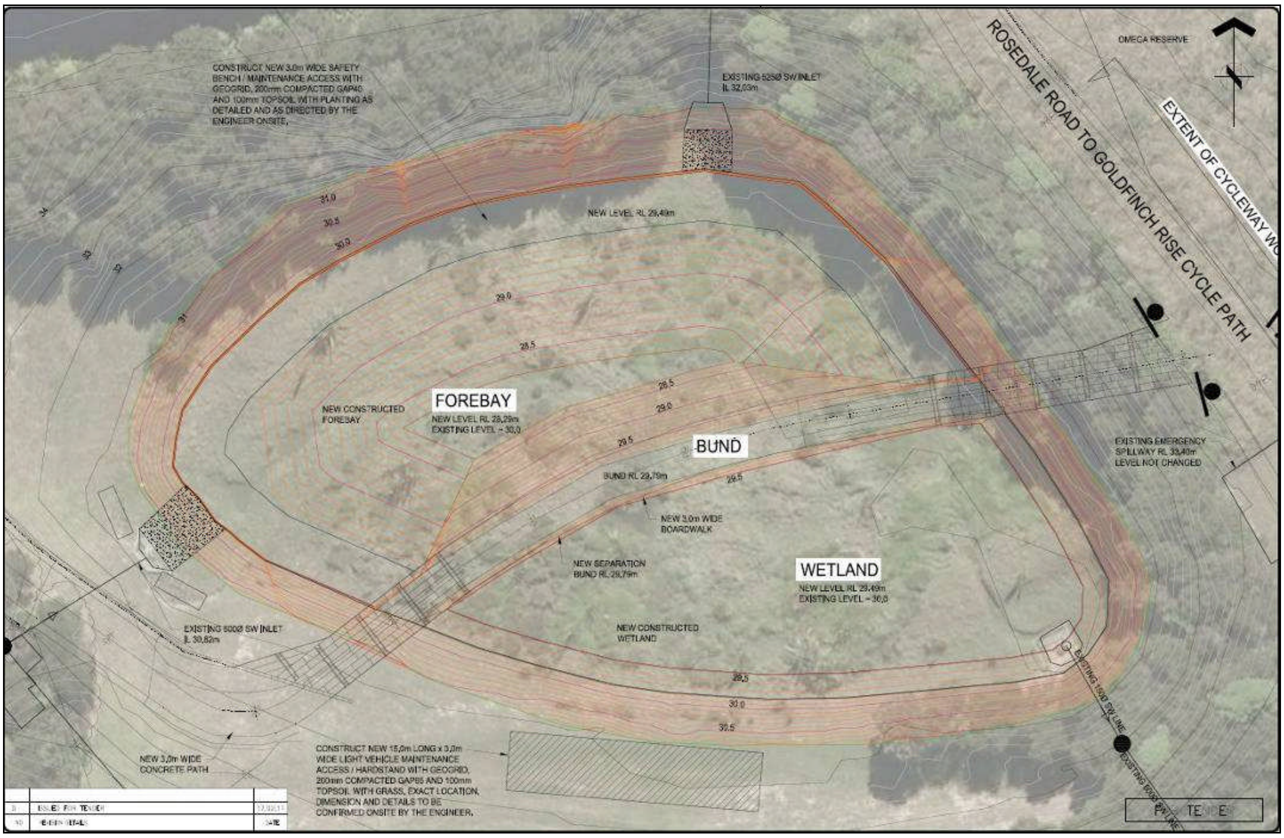

Figure 7: Showing Design Layout of Omega Pond and Cycle-way Alignment

3.2.2 FUNDAMENTAL DESIGN SHIFT- PERVIOUS PAVING

Although this paper focuses on the integration around the Omega Pond, the influence stormwater technical input had on the design of the cycle-way at a more fundamental material level may have been of equal or greater significance. Because of the total area to be developed, from largely grassed pervious surface to impervious concrete, the cycle-way project ran the risk of needing to mitigate any increases in stormwater volume required through the consenting process. This would have added additional cost and also technical complexity to the project. Because Stormwater raised this risk to Transport and together recognised the significance, an alternative design was investigated.

Stormwater planning staff suggested the use of pervious concrete to be used in the areas where slope allowed and alternative materials such as loose, hoggin material could not be used. Through previous research and trialing a local manufacturer had developed a pervious concrete recipe into production. The simple outcome was one of the largest pours of pervious paving in New Zealand at the time (refer figure 8a/b).

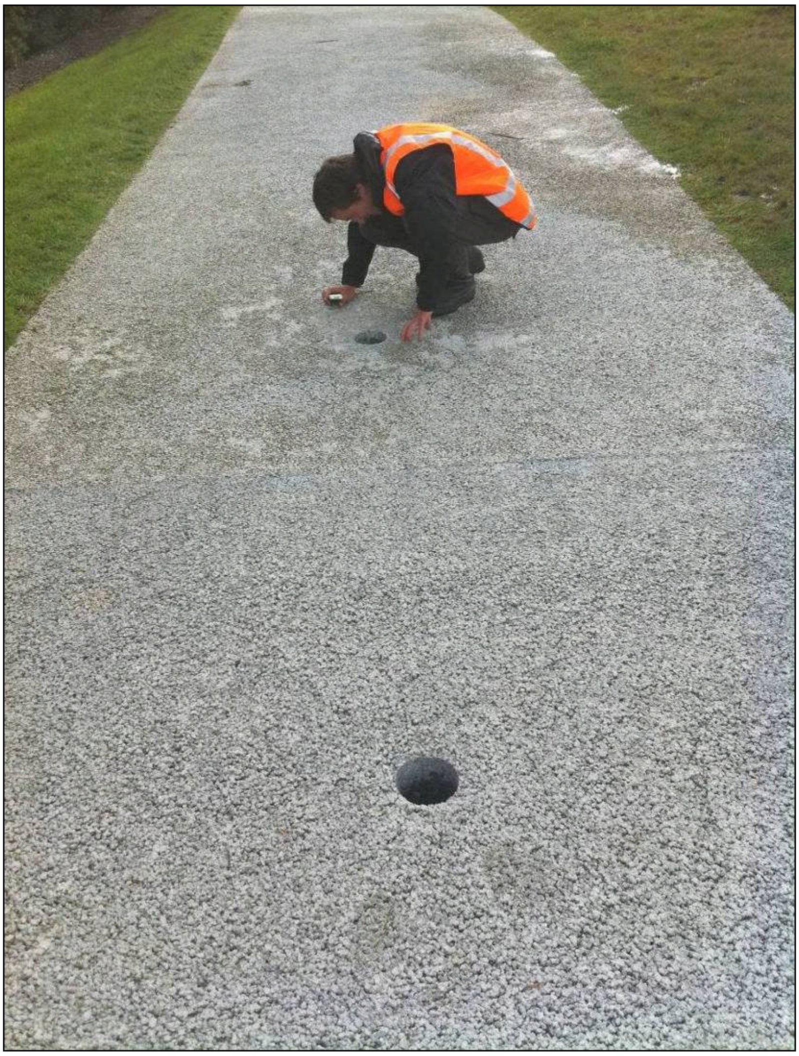

Figure 8a: Showing example Section of Pervious Paving

Figure 8b: Showing test pit in Pervious Paving

4 THE BUILT OUTCOME

The final design and works for the Omega Pond and cycle-way included the following elements:

- The construction of a 3 m wide share with care pathway and timber boardwalk from Omega Street, across Omega Pond, to link with the proposed Goldfinch pathway.
- Abutment walls, drainage and terramesh retaining walls associated with cycle-way.
- The removal and disposal of sediment and underlying material to create a pond forebay and wetland within an existing temporary detention dry pond
- The construction of a clay bund between the forebay and wetland.
- Planting of the wetland, bund and pond perimeter with wetland plant species.
- Extension of the existing rip rap from the pond inlets to the forebay edge.
- The construction of a wetland planted safety bench and dual maintenance accessway around the perimeter of the deep water forebay.
- Upgrade of existing low level and high level service outlets.
- The construction of a maintenance access way to the pond for heavy vehicles.
- Supply and installation of all cycle-way rails and pond and cycle-way signage.
- Interpretative signage on the boardwalk explain the function of the forebay/wetland.

The deep water forebay (refer figure 9) incorporated a 3 m wide planted safety bench which was designed to accommodate a long reach digger for the digging out of the accumulated sediments over time. This planted bench is anticipated to improve the amenity and water quality treatment function of the Pond.

Figure 9: Omega Pond Showing Construction of Deep Water Forebay

Figure 10: Cycle-way Developed on top of the Seperation Bund.

The raised cycle-way follows the clay separation bund (refer figure 10) between the forebay and wetland. Because of the temporary detention function of the Pond the deck level of the cycle-way was in the order of 2.8 m above the normal operating water level. The planted bund will eventually be thickly vegetated with flax and over time blend into the wetland pond setting. The wetland area is considerably shallower than the deep water bund being 600 mm at its deepest point it has been designed to act as both a freshwater habitat and as a water quality enhancement area.

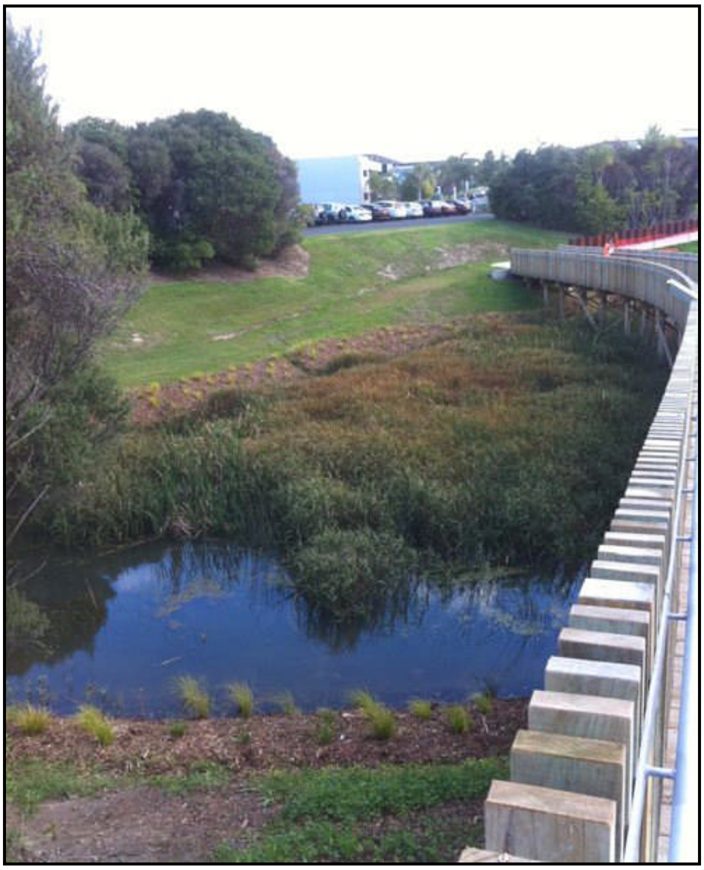

Figure 11: Omega Pond showing Stage 1 Wetland Plantings before Infill Planting

5 CONCLUSIONS AND LEARNINGS

The integration between Auckland Transport and the Auckland Council Stormwater Unit has been a key success of this project. Identifying opportunities for integration is often the most significant issue to resolve when attempting to meet the objectives of the public and wider stakeholders.

The alignment of the cycle-way has significantly benefited from the technical advice the collaboration with the stormwater department. The original alignment would not have provided access for the catchment of people on the western side of Alexandra Stream including Bush Road, William Pickering, Ride Way and Beatrice Tinsley Crescent. It now does.

The public money spent on stormwater treatment devices often results in only limited benefits which in general do not include recreational amenity and/or access. This project is an example of how integration can benefit the community and the environment.

The mitigation design of the Pond from temporary detention dry pond to deep water forebay and wetland has significantly improved contaminant removal, retained the erosion mitigation function of the original design and provided valuable wetland habitat with both ecological and amenity benefits.

Staff turnover has led to difficulties in project integration due to lack of continuity and lapses in understanding of project objectives. Having documented agreement on project objectives and responsibilities at the outset of the project would have helped in providing this continuity.

There were some differences in opinion between what Stormwater and Transport believe is amenity value. This was particularly relevant in regards to the style of boarding to be used on the cycle-way over bridge which was specified to be constructed with solid boarding. However, during the construction phase the positive relationship with Transport resulted in a request from Stormwater for a less solid finish which was adopted.

Auckland Transport is particularly supportive of off-road cycle-ways that meet the criteria for external funding from the New Zealand Transport Authority. The preferred path width is therefore 3m. The benefits of financial assistance for projects such as these needs to be weighed up against the impact a wider path may have on amenity and the environment, particularly in sensitive locations such as stream reserves.

To investigate avenues and establish process for integrated planning, open communication between stormwater and transport departments needs to be encouraged for the future. This is particularly relevant in the current Auckland environment where geographic barriers and organisation boundaries resulting from the new ‘super city’ council structure need to be overcome.

Sharing contracts between Auckland Council departments (or other council controlled organisations) can be a cheaper and more efficient method of design and construction. This was demonstrated by the single built contract let for both the cycle-way and the Pond works.

Integrated projects like this one require planning staff to be closely involved in the design component to ensure consistency and integration of design components with the project objectives. In order to maximise the benefits of a stormwater project, a holistic approach is required. This involves unlocking the overall potential of a stormwater project early in the planning process through the identification of related ecological, amenity, other social and cultural issues.

5.1 AUSTRALIAN CONTEXT

Best practice in the Victorian requires that SWMP must identify actions to improve the environmental management of urban stormwater and protect the environmental values and beneficial uses of receiving waters, while identifying key risks to the catchment. (Urban Stormwater: Best Practice Environmental Management Guidelines CSIRO 1999).

The Catchment Management Plan developed for the Oteha Catchment, which Alexandra is part of, serves largely to meet these same objectives and the Te Ara Alexandra shows a commitment to best practice and has demonstrated beyond requirements cooperation and coordination between agencies. This is driven by the need to management from catchment discharges to the stream receiving environment but also largely by opportunities that present themselves for improved ecological and stormwater quality outcomes as a component of an infrastructure project.

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