A NEW APPROACH TO COOPERATIVE PROJECT DEVELOPMENT: A STORMWATER PERSPECTIVE

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ABSTRACT

The proposed MacKays to Peka Peka Expressway has seen a new approach to project alliancing, with the Alliance extending to cover not just owner/constructor/designer, but also the local District Council. Another unusual aspect is that, unlike the more usual alliance of a design/construction phase project, this alliance's first task is to develop the concept, prepare a Scheme Assessment Report and AEE, and take the Project through an EPA process for designation and consenting. This has resulted in challenges and successes, as different drivers and standards are merged, and differing responsibilities are addressed.

This paper outlines the structure of the Alliance and how the project will be delivered with a particular focus on stormwater issues. It explores how the various relationships work, relative to the responsibilities of the different parties in this respect between the stormwater engineer, ecologist and Council asset manager. It looks at some of the issues around standards and how these have been addressed, and draws together some thoughts and learning from the experience of putting together such a cooperative venture.

KEYWORDS

Alliances; stormwater; cooperation; ecology, stormwater and council relationships.

PRESENTER PROFILE

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1 INTRODUCTION

1.1 PURPOSE

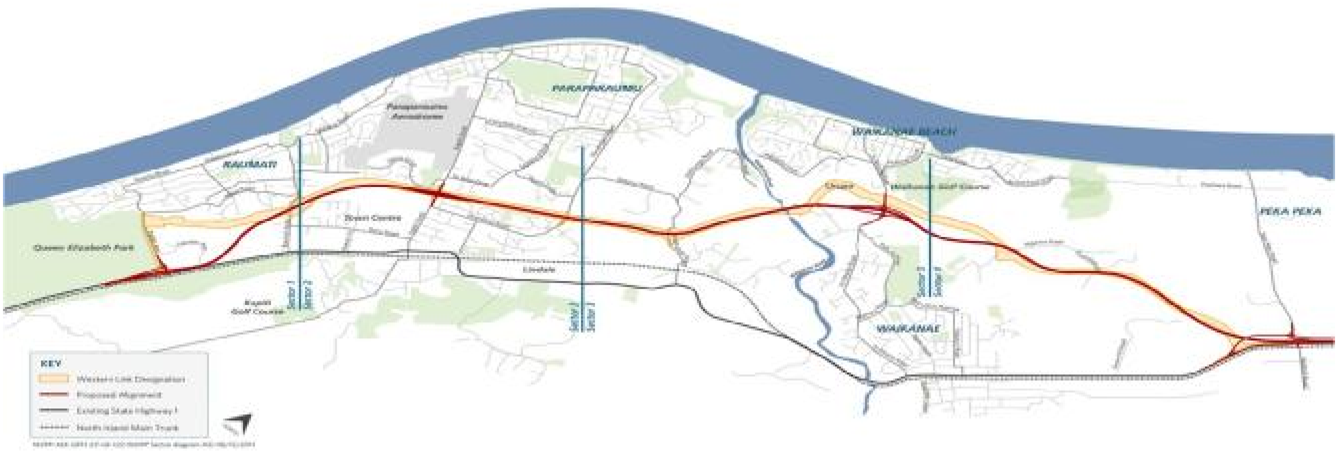
This paper will outline the features that make the M2PP Alliance a unique project and how this influences the relationships involved with the stormwater design. It will outline some of the benefits, challenges and contrasts in order to draw lessons that are applicable to not just large and/or Alliance projects – all from the perspective of a Council asset manager, an ecologist and a stormwater design engineer.

1.2 THE PROJECT

In 2009, the Government identified seven 'Roads of National Significance' (RoNS), and set priority for investment in these as New Zealand's most important transport routes. The MacKays to Peka Peka (M2PP) project is one of eight sections that make up the Wellington Northern Corridor RoNS.

The project consists of approximately 16km of four lane median divided Expressway from the Raumati Straights in the south through to Peka Peka in the north (refer Figure 1). It involves construction of a new carriageway off line from the existing SH1, essentially bypassing Paraparaumu and Waikanae town centres, and includes a new bridge over the Waikanae River as well as a number of interchanges and local road crossings.

Figure 1: Project extents schematic.



As well as the Waikanae River the project will involve crossing of 14 other large streams and drains and numerous other smaller drains together requiring 8 bridges (the three largest being 180, 140 and 60m long), several large span box culverts and many smaller box and pipe culvert crossings.

Of the 16km of Expressway, 3.8km of it is across low lying floodplains i.e. 24% of the Expressway is across flood prone land. It threads its way past many wetlands including the large and regionally significant Te Harakeke wetland (located north of Waikanae Golf Course shown in Figure 1).

The key stormwater issues the project faces are around understanding the effects and mitigation of these, particularly with respect to:

- **Increased flood levels (from loss of floodplain storage, increased flow rates and culvert sizing);**
- **Worsening water quality (from Expressway discharges);**
- **Loss or changes to stream and wetland habitats (from bridges and culverts); and,**
- **Changes in the groundwater regime effecting stream and wetland habitats (from land drainage or the road embankment).**

1.3 PROJECT STATUS

The project falls under the Environmental Protection Authority's (EPA) jurisdiction and at the time of writing, is expected to go to a Board of Inquiry (BoI) for statutory approvals instead of applications being made to the traditional resource consenting authorities i.e. regional and district councils.

The preliminary design, scheme assessment, consultation, preparation of technical reports and the application to the EPA have been completed and the project is due for lodgement with the EPA in March/April 2012.

The next stages include the EPA/BoI process, detailed design, costing with construction planned for 2013.

1.4 WHAT IS AN ALLIANCE?

The M2PP project is not a traditional design/consent/construct contractual framework. It is being delivered under an Early Alliance contractual model and so is a significantly different framework under which the design is carried out. In order to make observations on elements of the stormwater design it is first necessary to briefly understand just what an Alliance actually is.

Simply put, an Alliance is when the owner, consultant and constructor enter into a contract that promotes collaborative work with an integrated project team where the disparate commercial and organisational interests are aligned with outcomes for the project.

That is, decisions are made on a "best for project basis" and not each entity pursuing it's own interests, including some decisions that may not be necessarily even be "best for owner". Each member provides a representative to a Project Alliance Board that is responsible for controlling the delivery of the project. Generally, the decisions of the Board are to be unanimous and best for project.

While more traditional delivery models have the owner, consultant and constructor sit on each side of the contract, in an Alliance there is much more sharing of the "pain" and "gain". A key feature of an Alliance model is the Total Out-turn Cost, or TOC, that is a figure that the Alliance signs up to as the cost to deliver the project. Usually completing the project under this triggers bonuses and over triggers penalties for all parties – hence the "pain" and "gain". Coming with "pain" and "gain" are also various limitations in liability and disputes.

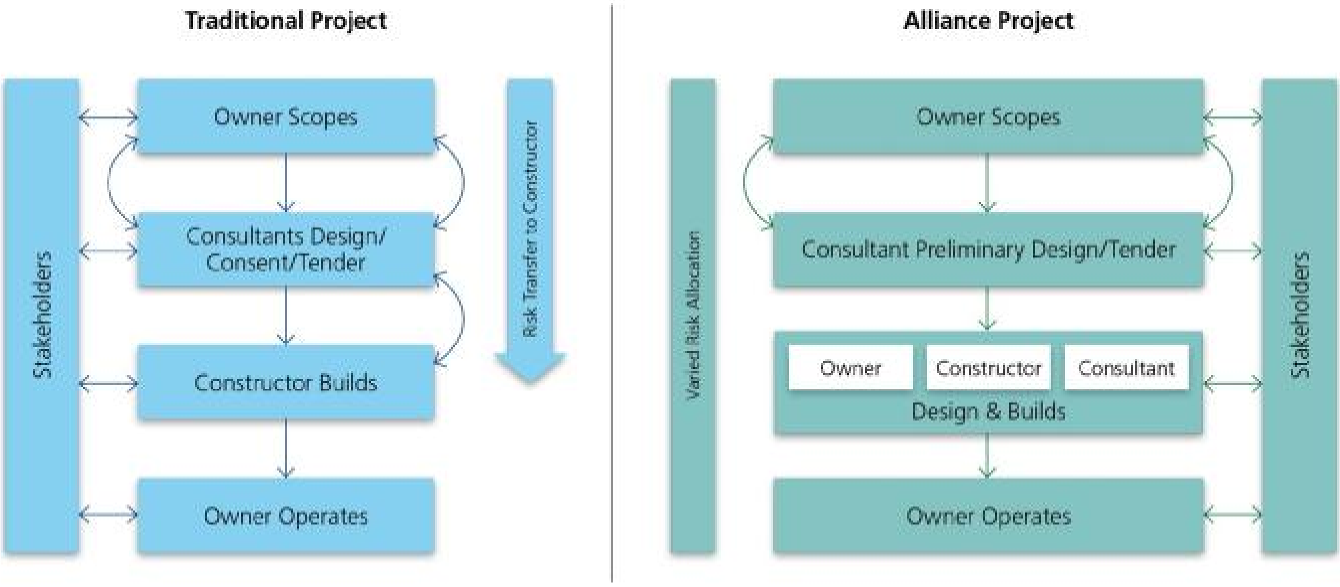
Certainly not all projects suit the Alliance model and they generally favour the larger projects. An Alliance can be appropriate when the project has the following features:

- **Large scale;**

- High cost;
- Tight programme;
- High need for flexibility and innovation;
- Significant stakeholder issues; and,
- Benefit can be gained by reallocating project risks.

However, there are several philosophies and lessons that can be taken from an Alliance and applied to small projects. Figure 2 shows a general comparison of an Alliance structure against a more traditional model.

Figure 2: Traditional project and Alliance project delivery structure.



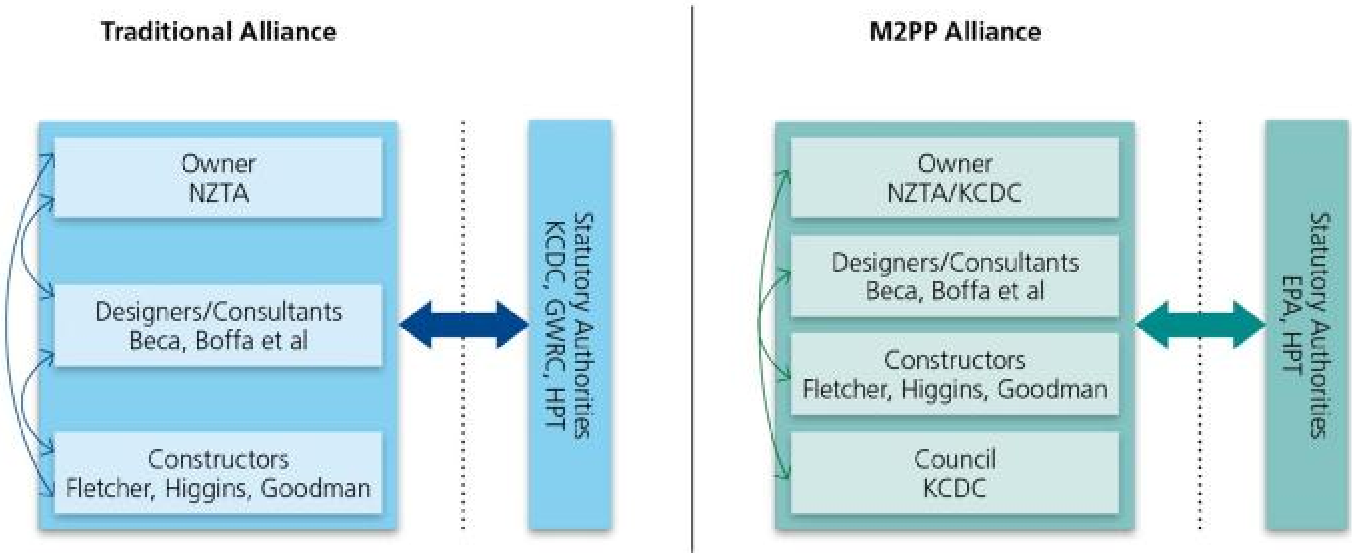
2 M2PP ALLIANCE STRUCTURE

2.1 A UNIQUE ALLIANCE

The M2PP Alliance is unique from other Alliances because it includes the constructors (Fletcher and Higgins) and a territorial local authority (KCDC) from the earliest of stages of the project. Particularly, they were included before the project was fully defined and scoped but also before the technical investigations and design commenced for resource consents.

The uniqueness of the M2PP Alliance fundamentally changes how designs, including stormwater, are prepared at this stage of a project. The comparative structure and interactions are shown in Figure 3. Other Alliance projects to date have been formed after the projects scoping, definition, preliminary design and consenting has been completed with the Alliance formed for the detailed design and construction stages. This uniqueness provides benefits as well as generating challenges and these are discussed in later sections.

Figure 3: Traditional Alliance and the M2PP Alliance relationship structure.



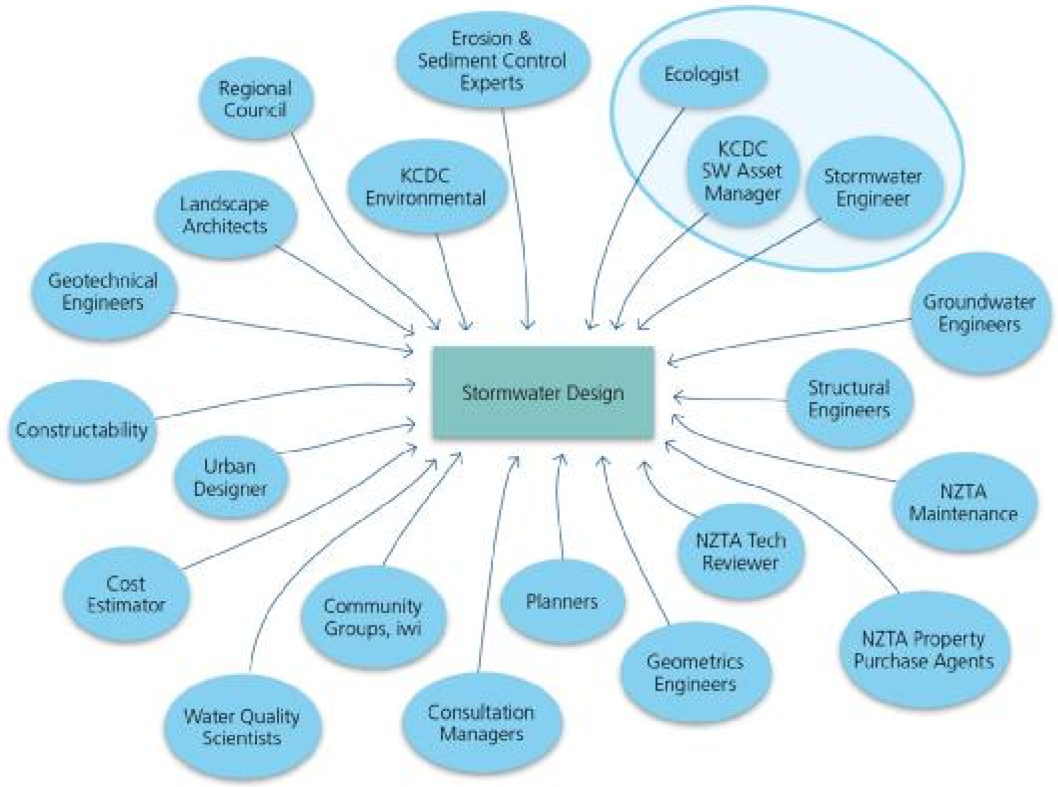
2.2 STORMWATER DESIGN RELATIONSHIPS ON M2PP

Stormwater design involves a complex web of relationships with multiple other engineers, scientists, designers and planners; various constructors; the owner or client; regulatory organisations and a wide range of community stakeholder groups. The larger the project the more numerous and inter-woven these relationships become. For M2PP, the inputs that go into shaping the design outlined, if somewhat simply, in Figure 4. However, not all of these relationships need be examined in order to highlight how this Alliance model impacts on the stormwater design process.

This paper focuses on three of the most important relationships: the stormwater engineer, the ecologist and the council asset manager. The roles of each are briefly outlined in the following sections.

These three areas interface across a wide range of stormwater issues and in some detail. Because of this, the wider benefits and challenges are discussed at a higher level with specific project examples given that illustrate some of these issues to a lesser or greater extent.

Figure 4: Typical stormwater design relationship web. This paper focuses on the ecologist - stormwater engineer – KCDC Asset Manager cluster.



2.3 ROLE OF THE STORMWATER ENGINEER

The stormwater design engineer was responsible for carrying out the stormwater design such that it is suitable for consenting and engineering purposes. That is, understanding effects and determining measures to avoid or mitigate these as well as documenting the design for NZTA's scheme assessment process and associated cost estimation.

At this stage the key driver was about understanding, and determining mechanisms for handling, the effects of the project on flooding and water quality.

A significant aspect of the role was to engage with the stormwater related stakeholders such as KCDC, Greater Wellington Regional Council, DoC and the local community.

2.4 ROLE OF THE ECOLOGIST

In essence, the main responsibility of the M2PP Ecologist was to ensure that the Expressway appropriately considered and took into account potential effects on watercourses, wetlands and related ecosystems. For stormwater this focused on the freshwater watercourses and wetlands but also did touch on some sensitive marine areas as an ultimate receiving environment.

The key driver for the ecologist to date has been to ensure that the Alliance has sufficient information on these ecosystems so that they could be appropriately protected from the adverse effects of development, but also to work with the stormwater engineer to achieve positive environmental outcomes where these could be worked into the design concept. This extended to run-off and the sediment that comes with it.

Again like the design engineer, the ecologist needed to cover ecology from a statutory and community interest perspective, communicating with similar stakeholders and community organisations involved with restoration initiatives within the Kapiti District e.g. Friends of Waikanae River etc.

2.5 ROLE OF KCDC'S STORMWATER ASSET MANAGER

KCDC's stormwater asset manager's role was to ensure the Council adopted Guiding Objectives were adhered to and communicate KCDC's stormwater management principles so that they were understood and integrated into the expressway design, such that it was compatible with the management of adjacent urban and rural areas. This included providing interpretations of how KCDC standards should be interpreted and applied; providing extensive background knowledge of local stormwater issues; providing direct KCDC input into the decision making and design process indicating KCDC preferred methods; and reviewing designs, outcomes and effects.

Due to KCDC having the dual role of representing the community as well as being a member of the Alliance it was decided that KCDC would not front the public consultation aspects of the project, however, they have been heavily involved in consultation with Greater Wellington.

3 BENEFITS

Having KCDC in the Alliance and a strong ecological input from the start of the project has resulted in many benefits to the project, the most significant being:

i. Access and Application of Local Knowledge

A direct result of KCDC being part of the Alliance is that their staff are much more accessible to the designers. KCDC staff have local knowledge of existing stormwater assets and issues that the project will need to interface.

Importantly, they were also in the position of using this knowledge to the project's advantage. Often with traditional projects, in order to obtain all the relevant information, it is incumbent on the designers to know what questions to ask. This is further complicated by the opportunities to ask such questions generally being restricted by budget, programme or how busy the Council staff happen to be. However, having the KCDC Stormwater Asset Manager present in almost all of the project evaluation workshops means this local knowledge is proactively applied in shaping the early decision and design work. This directly avoids rework saving time and effort.

KCDC has built and maintains stormwater models for almost all of the catchments that the Expressway crosses. These are powerful and efficient tools that KCDC bring to the Alliance that directly benefit not only the project but also KCDC itself. Not only does the Alliance avoid the need and expense of building expensive duplicate models (with a risk of contrary results), but KCDC will in return have their models updated and refined with the Expressway included, thus avoiding significant expense.

The Alliance not only determined it was best to use KCDC's models but also to engage KCDC's incumbent modelling consultants to carry out the work. This brought considerable additional local knowledge and experience to the benefit of the Alliance. This allowed the engineers most familiar with the models to bring their experience to bear and contributed to KCDC's trust in the results that the Alliance was producing. This is also a good example of "best for project" in that Beca would have benefited financially if they had

carried out the modelling however, it was a better result for the project in terms of cost and time, if another consultant did the work.

The Expressway was overlaid in the model, catchments amended and the hydrology re-run. The Alliance's hydrologist prepared discharge hydrographs (using Infoworks to model swales and wetlands) of the runoff coming from the Expressway for input into KCDC's models. An iterative testing process then started with testing the effects of the discharges and refining the levels of attenuation to offset any effects. One specific example of this was where one particular wetland was increased in size to offset an increase in the 10%AEP flood levels in the receiving watercourse that is part of the Wharemauku Stream storage area (refer section 5.2).

The KCDC asset manager will also benefit from a much greater and in-depth understanding of the design and decisions made about this significant item of new infrastructure planned for their district.

ii. Coordination and Interpretation of KCDC/NZTA Standards

Both NZTA and KCDC maintain their own stormwater management practices and guidelines and these both follow a similar principle of best practice stormwater management. However, there are different conceptual approaches applied, different definitions of design standards, and different preferred solutions. Where differences do occur the fact that KCDC is a member of the Alliance means that their interpretation has much greater sway than it would otherwise. It has also enabled agreement to be achieved from all parties regarding the selection of stormwater management practices to be used. There are several examples of this as outlined below.

Firstly, KCDC's standard of "hydraulic neutrality" has been adopted by Alliance as a fundamental principle underpinning the design. Other projects have sometimes walked a finer line on this issue leaving it to the designers to make the determination of significance of effects and therefore the selection and extent of mitigation measures to apply.

NZTA's standards generally assume that attenuation is not required if a project is located in the bottom half of a catchment. However, KCDC's "hydraulic neutrality" requirement does not recognise this and has resulted in the creation of several smaller offset storage areas been included were other comparable projects may not have done so. Examples of this are the three storage areas (each approximately 1500m^3 in volume) in the northern part of the project that protects rural land that is already subject to flooding, from a small increase in flood levels. If KCDC were not part of the Alliance it would be likely these areas would not have received full mitigation on the grounds that the environmental effects were not significant to warrant mitigation and that land disturbance involved with doing so would be greater than the effects of increased flood levels during relatively infrequent events.

On the other hand, this application of hydraulic neutrality to the project has removed the need to test future catchment development scenarios as hydraulic neutrality applied to other developments in the wider catchment accounts for any effects they would have on flooding that could otherwise be "seen" at the Expressway.

KCDC also has slightly different design rainfall figures than the HIRDs database. The HIRDs rainfalls are all slightly higher than KCDC's rainfalls (which are based on a specific NIWA and SKM study that included regional analysis of the district). Table 1 shows a

direct comparison of a range of storm rainfall depths. This led to the question of which rainfalls should be used for design.

Table 1: Comparison of rainfall depths (with mid estimate climate change to 2090) at the Waikanae River.

Storm	Duration	KCDC Rainfall (mm)	HIRDs V3 Rainfall (mm)	HIRDs Greater by (mm)
1% AEP	10mins	165.6	172.0	6.4
	1hr	43.1	52.3	9.2
	24hrs	18.2	21.8	3.6
10% AEP	10mins	12.1	13.4	1.3
	1hr	28.7	31.6	2.9
	24hrs	110.2	113.8	3.6
50% AEP	10mins	8.4	9.1	0.7
	1hr	20.0	21.0	1.0
	24hrs	76.0	80.7	4.7

HIRDs gives a greater resolution at low times of concentration than interpolating isohyet charts and this is needed for the long, narrow, ribbon like Expressway. Therefore, it was agreed that HIRDs would be used for the Expressway runoff modelling and KCDC's hydrology for the wider existing catchment modelling. This results in some inbuilt conservatism as the HIRDs rainfalls are higher than KCDC's rainfalls.

When it comes to design return periods, KCDC standards differ in how they treat overdesign events. KCDC uses a 1.5 x 1%AEP storm to test overdesign scenarios. NZTA generally does not go beyond a 1%AEP storm, other than for structural design loadings on bridges where a 0.04%AEP storm is used. The 1.5 x 1%AEP has been adopted by the Alliance and run in the models (additional to the 0.04%AEP storm).

Another example is the adoption of KCDC's requirement for "natural" treatment and drainage devices such as wetlands, swales and fish passage in culverts. Adopting these for the project allows the solutions to be much more consistent with Kapiti practices, landforms and ecological features. KCDC places significant importance on the natural environment and as a consequence the role of the project ecologist becomes more reinforced in informing and influencing the engineering design as the project management can see more tangible benefits in directly addressing one of the Alliance member's key concerns.

iii. Ecological Guidance Comes More to the Fore

For an ecologist, these projects usually require assessment to be carried out on end-of-pipe options after design and function objectives have been achieved, whereas M2PP has allowed consideration of wider benefits that take into account other factors such as the utilisation of planted wetlands to enhance habitat and provide ecological benefits. Additional levels of protection were also able to be applied to those areas with known high ecolgoical values. Also, streams have been assessed based primarily on our interpretation of their ecological habitat and corridor values and their stormwater functions, as opposed to restricting modelling to hydraulic considerations of flows only.

The adoption of many of KCDC's stormwater practices and objectives (refer point .iv below) has resulted in the relationship with the project ecologist becoming much more important and integrated in the stormwater design, leading to a solution that is more in balance with the aquatic environment both in terms of native planting and habitat enhancement of swales, culverts, stream diversions and wetlands and also from the perspective of enabling fish passage at culverts.

Another benefit of this approach was the promotion within the wider engineering design team of the need to specially consider those streams with more ecologically significant or sensitive downstream environments as requiring an additional 'one-above' level of treatment (i.e. swales plus treatment wetlands). Linked with this was the understanding from both Council and engineers of the importance of the numerous ecosystems along the way, i.e. in the sense of these areas providing habitat for indigenous vegetation and fauna, but also the importance of retaining, respecting and considering opportunities for enhancing them. In most areas, this has worked well and should result in some habitat improvements more consistent with what would have been there historically.

Also, this approach has also resulted in flexibility in the location of stormwater treatment and flood storage solutions – in those areas where space is tight, alternative options were agreed, often with improved outcomes for existing ecological features. In some examples, stormwater treatment features were moved to allow better connections for existing and new ecological features. Similarly, flood storage areas were located to complement existing ecological features.

Typically, projects are designed from an engineering and stormwater perspective, with ecological involvement and assessment often coming as an afterthought as a necessity to obtain regional consents. The approach adopted on M2PP has resulted in almost all of the ecological impacts associated with the loss and modification to freshwater systems being mitigated largely within the existing alignment through a combination of stream and riparian restoration and flood storage planting. This has not been achieved at the expense of the stormwater issues such as flooding. Following the construction of new stream diversions, culverts and the establishment of riparian planting, the project is expected to result in improved freshwater habitat connections to a large number of waterbodies traversed/passed by the Expressway actually improving habitat for existing and future freshwater species over and above the current situation.

iv. Better Integration of KCDC Objectives

KCDC being in the Alliance effectively means that a significant stakeholder is included in a much more fundamentally influential manner than would have resulted with any level of standard consultation practices that are a feature of more typical projects. This allows their objectives to carry much more weight within the project both in guiding towards an outcome and whether or not that outcome is acceptable to them. Overall, and not just

for stormwater, their driver could be summarised as obtaining the best possible outcome for the community and make sure the design delivers a balanced approach to their community.

KCDC and NZTA agreed guiding objectives as part of KCDC joining the Alliance and the stormwater/environmental related ones were:

That the Project is designed and constructed in a manner that:

- **conforms to the Kapiti Coast District stormwater requirements and associated best practice, in particular the Stormwater Management Strategy and the policy of on-site hydraulic neutrality;**
- **ensures the hills to coast stormwater flow (both surface and groundwater) is not impeded;**
- **ensures the natural flows in wetlands are not impeded;**
- **minimises the loss of dunes and wetland landscape through which it passes, including any remnant native vegetation;**
- **provides a high quality of natural environment where the project crosses streams, wetlands and the Waikanae River and avoids culverting and closing in of streams;**
- **ensures that adverse effects on the environment and amenity of the Waikanae River corridor are avoided, mitigated or minimised;**
- **avoids, mitigates or minimises adverse impacts on local flora and fauna, particularly in areas currently protected or covenanted for their natural systems and ecological values;**
- **avoids, mitigates or minimises any adverse amenity, environmental, archaeological, waahi tapu and visual impacts in a manner representative of internationally accepted best practice, including but not confined to the NZTA's best practice statements on urban design and planning.**

These have resulted in all of the significant streams, in terms of size and ecological value, being crossed with bridges as opposed to culverts. However, this is not to be interpreted that all watercourses are being bridged, as there are many open channel "farm drains" along the route where it is much more appropriate to culvert these. All being in the same team has enabled a balanced outcome to be achieved.

Another example is the on-site "hydraulic neutrality". That is, the Expressway must not significantly increase flood levels through infill of flood plain storage, increased runoff peak flow rates or by way of culvert / bridge sizing. This has led to extensive attenuation of peak flows across the project (ranging from 80% to as low as 8% of pre-Expressway peak flows) and the inclusion of several hundred thousand cubic metres of offset storage along the route. The planting of indigenous wetland species into some of these off-set storage areas has a dual role in meeting both the above Objectives. Further specific examples are discussed in Section 5.

As the stormwater design has been prepared in close coordination with KCDC staff it has enabled flexibility to incorporate improvements or solutions to existing stormwater issues. The project has termed these "opportunistic solutions" i.e. it is not the purpose of

the works to improve of fix these issues but if it could be simply done then it was. For example, investigations found that an area of residential properties that suffer from regular flooding as they don't have a positive drainage outlet could be improved with a connection into the new Expressway drainage and so this was included. Similarly, new hydraulic connections between flood storage areas or existing drains will lead to habitat improvements.

The integration of KCDC's objectives and opportunistic solutions has resulted in the overall lowering of predicted flood levels across parts of the District and not just in the immediate location of the Expressway. However, benefits to KCDC do not only come in the form of improvements to flooding out in the field but also the tools and knowledge the Asset Manager uses become more detailed and refined including a better picture of the overall state of environment.

Also an important role of KCDC's Stormwater Asset Manager was to review the Stormwater Effects Report prior to it being submitted to the EPA. This allowed for a much more efficient process rather than awaiting a formal submission at the BoI and then having a potentially non supportive submission (with respect to stormwater). Even before this review KCDC's involvement throughout the project has allowed their understanding of the issues that the design faces to be much more fully developed than just reviewing the consent application and seeking flaws. This also carries significant benefit to the project from a consenting risk perspective.

4 CHALLENGES

Having KCDC in the Alliance and a strong ecological input during the early stages of the project has also resulted in some challenges for the project, some of the most significant being:

i. Effective Stormwater Management Needs Space

One of the main challenges for the project comes from basic principle that adequately managing the Expressway's stormwater requires a great deal of land. This is an issue on many long, narrow, ribbon-like roading projects. However, in this instance it is also exacerbated by the low-lying/flat nature of the land and associated high water tables. These two factors in particular have resulted in the historical formation of lots of wetlands in the vicinity of the route, many of which have high ecological values having survived intensive urban development.

While spatial constraints and generally swampy ground is not an overly unique feature to this project, it does take on an increased emphasis with KCDC being part of the Alliance. They have a strong focus on the freshwater environment being all too aware that around 90% the pre-European wetlands that were so prevalent across the Kapiti District, have been lost as a result of historical land development, swamp draiange vegetation removal associated with farming.

Because of these constraints, and the sensitive nature of the ecological areas, there was a real risk that some of these areas may be compromised as a result of the Expressway works and the lack of viable alternative options for stormwater management. Further the ribbon-like nature of the Expressway with its narrow designation and the many watercourse crossed means with is little land available for off-set whether stormwater storage or habitat off-set of streams and wetlands by way of ecological mitigation.

As a result adopting KCDC's requirements for hydraulic neutrality and "natural" stormwater treatment features, large areas of land are needed for new treatment wetlands and new flood offset storage areas (upwards of 250,000m^2 in total). This generates considerable design, property purchase, funding and ongoing maintenance issues that need to be taken into consideration.

While high groundwater can be useful in constructing viable wetlands (i.e. keeps them wet) it works against the designer when storage is needed. High groundwater acts to limit the available vertical flood storage tending to result in a much larger footprint. There are also maintenance and planting restrictions.

In some instances, the form that an off-set storage area takes is determined principally by the ground water level at that location. That is, when the existing ground level is lowered and the groundwater level is high, then the only viable alternative is to plant the areas as wetland (note these areas are different to a treatment wetland in that these areas do not have a specific treatment functions and so do not require areas of permanent standing water). This has resulted in some very large wetland areas on the project. While ecology is not the primary reason for creating these new wetlands it has resulted in a definite "double win" for the project and wider District. That is, significant areas of land are being returned to native wetland as a result of their requirements for permanently maintaining flood protection for the road. However, such aspects also serve to further complicate the assessment of environmental effects, in that for these areas need to be carefully assessed to avoid potential double (or triple) counting of benefits but still do so in such a manner that related design disciplines could rely on them for some form of mitigation i.e. first and foremost the wetlands and storage areas are for water quality and flood management purposes but they also have ecological, amenity and landscape and visual benefits that need to be accounted for.

ii. A Question of Groundwater

As noted above, one of the controlling parameters for the large offset storage areas is groundwater level. More specifically, it is understanding how the level varies with time i.e. its seasonal fluctuation. Groundwater monitoring over a long period of time is crucial in building this understanding. There are many existing piezometers (Greater Wellington's and KCDC's) but many new ones are required in order to gain the resolution and coverage along the route. Prior to detailed design, at least one full year's worth of data will have been collected from numerous locations along the route. There will also be data from many existing piezometers in the district that cover a much longer period than this.

Designing the new treatment wetlands so that they operate within the range of the existing groundwater regime makes a treatment wetland viable (as the permanent water level is controlled and maintained by an outlet). However, the target is shifted for the offset storage areas in that keeping the new finished ground level above the highest groundwater level would result in land that could be returned to pasture or used for other community needs such as sports fields. As noted above, on this project keeping clear of the highest groundwater level is not often practical resulting in areas that are almost ready made for reinstatement as native wetlands to enhance ecology and minimise landscape and amenity issues associated with such large, temporarily inundated areas.

However, it is not just a question of an interface between the groundwater, ecology and stormwater aspects. In some instances there is no practical alternative and the local groundwater needs to be drained down. While local residents may benefit with drier properties in the long-term, this also brings an increased risk of ground settlement as the water is lowered. Where drawdown is adjacent to existing wetlands then the risk is an ecological one where even a small change in the hydrological regime could result in significant undesirable ecological changes in that wetland. In order to better understand these influences and test for effects, 3D groundwater modelling has been undertaken and will be updated and refined on an ongoing basis throughout the duration of the project.

iii. Time

One of the reasons the Alliance was formed was to fast-track the design and consenting to deliver the project as quickly as possible. This has generated significant programme tension for the team. There is only so fast a project can go and there is not a bottomless budget available to bring more resources to bear. There have been various solutions all contributing to how the programme and cost was managed in the Alliance. From a stormwater perspective, some of the measures taken to manage this included:

- Joint walkovers of the site with the stormwater engineers, ecologist and stormwater asset manager to make knowledge sharing targeted and as efficient as possible;

- Using KCDC's stormwater models as design tools. This avoids the time and costs involved with building new models and allows flexible and iterative problem solving to be carried out relatively swiftly;

- Contracting KCDC's incumbent modelling consultants, to run the models for the Alliance;

- Using stormwater engineers who recognise that the watercourses are not just drains for stormwater but have intrinsic ecological significance (to a varying degree). Similary, the recognition of the importance of wetlands and wetland hydrology. This may sound obvious but in practice it meant that relationship between the ecologist and the stormwater engineer was already some way towards being aligned even before the project commenced and it only became stronger as the design proceeded; and,

- Having a focus on regular communication and openness in order to foster trust between the ecologist, stormwater engineer and the KCDC Asset Manager that each will look out for the other's interests during the course of the design. When ideas and concepts came up there was no reluctance to test the waters in order to get buy in and refinements to result in a workable solution. Refer examples in Section 5.

Another less obvious aspect of time and cost is the strain that the project presented to KCDC's resources. Being involved in such a large scale project puts their own resources and budgets under some strain. They still need to perform their day-to-day management of Kapiti's stormwater network while also diverting significant attention to the numerous M2PP project site visits, workshops, queries, reviews not to mention just keeping tabs on progress.

iv. What is next?

Some of the challenges remain to be resolved by the Alliance that could have flow on effects to the stormwater design. Some also await the Alliance in later stages of the project. A selection of these are:

- What will the TOC design bring in terms of pressure to reduce project risks and/or costs?

- What is KCDC's role for later stages of the Alliance? KCDC will be submitting to the BoI on the project and as such need to keep this part of their role independent of their work in the Alliance to date. Further, what will KCDC's role become post consenting when they would traditionally perform a regulatory/inspection role on construction projects (from a building consent/drainage permit standpoint). In recognition of this NZTA provided funding to cover expenses incurred by KCDC as a result of having to obtain extra resources to carry out essential normal duties that would have normally been done by staff tied up in the Alliance process.

- In a non-alliance situation Council would submit and provide enough evidence to try and ensure that the conditions of consent would be sufficient to ensure the project outcomes are in the best interests of the community. Council still requires these best interest outcomes however it is hoped that the Alliance process will alleviate concerns such that the Councils submission will be in full support (with respect to stormwater).

- How will the ongoing and long term maintenance requirements be met.

5 EXAMPLES

5.1 KAKARIKI STREAM FLOOD OFFSET STORAGE AREA

The Kakariki Stream (refer photograph 1) flood offset storage area is an example where the ecological and stormwater aspects overlap and work in concert with each other (and other landscape and visual).

The Kakariki Stream runs from the steep slopes of the hills west of SH1, through Waikanae township before passing Nga Manu Nature Reserve and flowing into the regionally significant Te Harakeke wetland. The catchment above the proposed Expressway crossing is 618ha in area with native bush covering the upper catchment and a mix of urban and rural land in the lower catchment. The Kakariki Stream forms an important part of an ecological corridor being developed by the community to enhance the long-term habitat linkages from Kapiti Island to Te Harakeke wetland and Nga Manu Nature Reserve from there to the Tararua Ranges and beyond.

At the location of the proposed Expressway, the stream is deeply incised with partially restored native riparian vegetation . The planting along the Ng Manu access road was carried by Nga Manu staff and local community interest groups.

The pastoral land between Ngarara Road and Nga Manu on the true right bank of the Kakariki Stream is low lying and prone to flooding. Nga Manu's access is also regularly cut off by flooding from the Stream (refer Figure 5).

The Expressway passes through the floodplain and fills in storage as a result. In order to mitigate the increase in flood levels that this causes, off-set storage needs to be provided. Modelling determined the volume require was 25,000m^3. It was then proposed to locate this volume on the land that currently floods. This requires the existing ground level to be lowered by 500mm giving an area of 50,000m^2. The high groundwater table in this peat dominated area means that reinstating this area back to pasture is no longer an acceptable solution, given the frequent inundation/ponding expected and the inability of pasture grasses to cope with such inundation. However, this same high groundwater table means reinstatement as a native planted wetland becomes much more feasible and desirable given the proximity of Nga Manu, Te Harakeke and other smaller wetlands and

the Kakariki Stream. While potentially more expensive to plant in the short-term, mass planting of native wetland species that can adapt to seasonal variations in water levels will have some long-term habitat benefits for both indigenous flora and fauna, potentially enhancing connections with surrounding ecolgocial areas. In addition, within the wider off-set storage area several existing farm drains will be re-created (including one 400m long diversion) with a more natural stream form (meanders, riparian planting, improved connections to the Kakariki Stream etc) that is in context with the new wetland area.

The combination of stormwater and ecological needs has provided a complementary solution that will result in a significant area of land being retired from farming and returned to wetlands which will improve habitat for indigenous flora and fauna while delivering hydraulic neutrality in terms of flood effects. The overall landscape and visual amenity of this area will also be improved as a result of this solution.

Photograph 1: Kakariki Stream with floodplain in the foreground, Naga Manu Bird Sanctuary in the mid-ground and Waikanae township and Tararua ranges in the background.

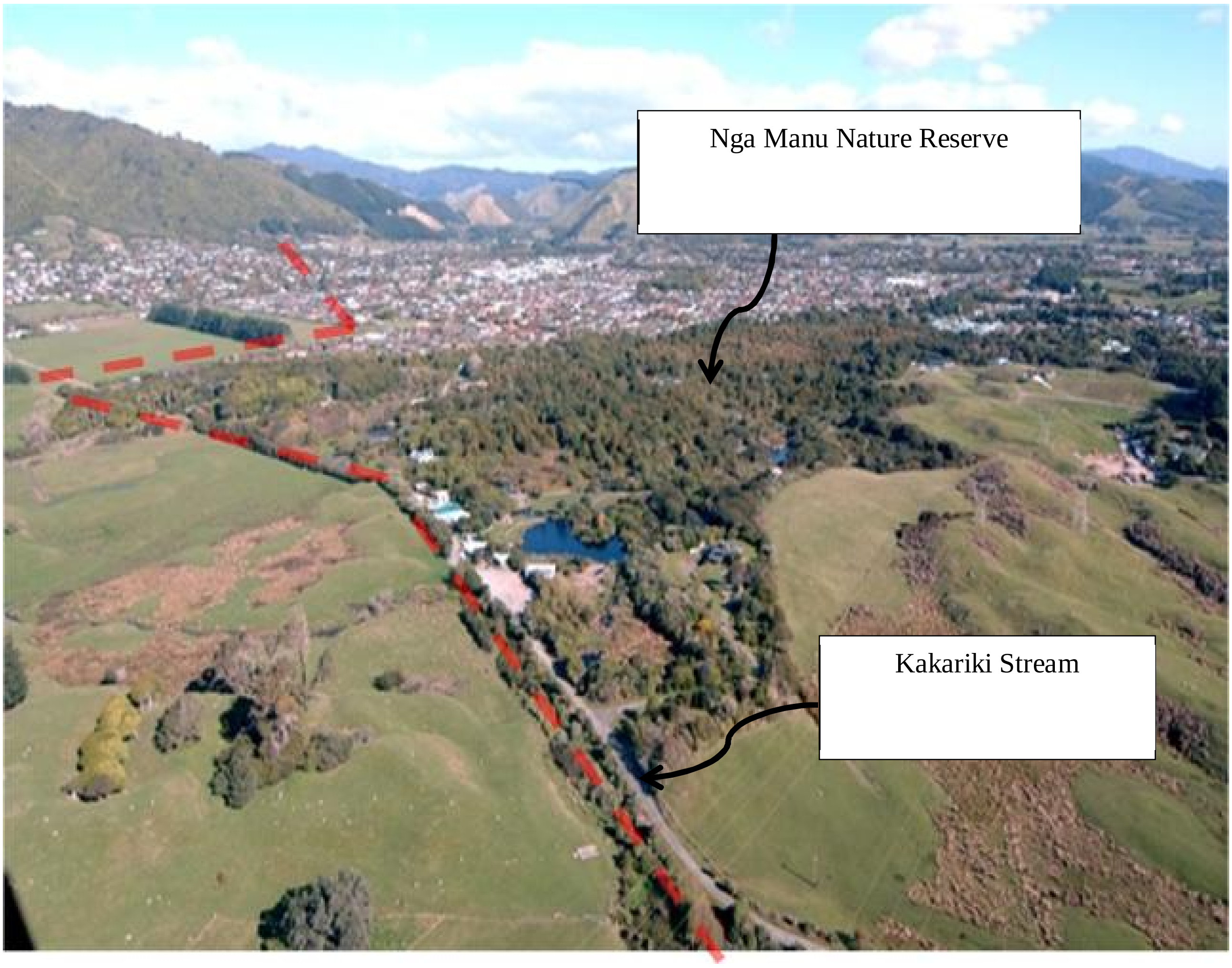
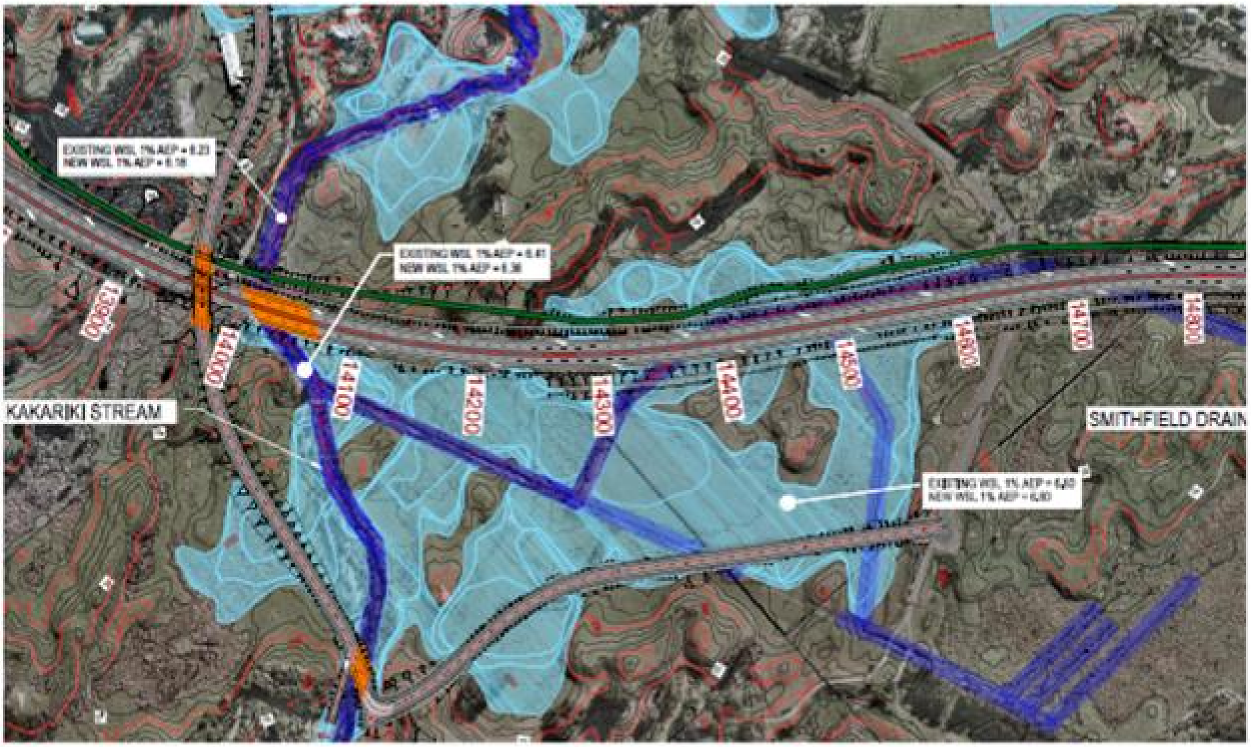


Figure 5: Part of an M2PP flood map prepared for the AEE showing the Kakariki Stream, 1%AEP floodplain, proposed Expressway and a local road crossing the floodplain (Nga Manu is located just off the bottom of the picture).



5.2 WHAREMAUKU STREAM FLOOD OFFSET STROAGE AREA

The Wharemauku Stream (refer photograph 2) flood offset storage area is another example where the ecological and stormwater aspects overlap and work complement each other. However, this example also includes integration with KCDC's town centre flood storage requirements and also the complexity of drawing down the groundwater to provide the required volume and the potential risk of resulting ground settlement.

The Wharemauku Stream catchment has a mixture of residential and commercial properties sited on the coastal plain, with an upper catchment of rural farm land and forestry blocks. Most of the stormwater from Paraparaumu township drains to the Wharemauku Stream. The upper catchment comprises steep hill country with shallow clayey soils, in contrast to the flat coastal peat and dune areas of the lower catchment. The groundwater is relatively high throughout the flat, peat areas of this catchment. The area of the Wharemauku catchment upstream of the proposed Expressway is approximately 1,000ha. The Wharemauku Stream is the main watercourse through Paraparaumu town centre and is fed by many tributary watercourses that generally all come together in the area downstream of the town centre.

Just upstream of the Paraparaumu Airport, the stream passes through a narrow gap in a line of high sand dunes. This gap functions to control flood flows in extreme storms so that flood water spills out into farmland upstream. This large open area is zoned as KCDC flood storage and is integral to KCDC's flood management for the Wharemauku catchment.

The existing Wharemauku flood storage area is also an integral part of KCDC's future town centre planning. KCDC has advised that any town centre development plan for this area will take into account its effects on peak flows and flood storage. KCDC is currently

working through the planning for the future town centre. However, any solution that is arrived at by the Alliance needs to be integrated and give a good fit with the solution that KCDC determines.

Photograph 2: Shows the Wharemauku Stream and floodplain with Paraparaumu town to the left and Raumati in the background.

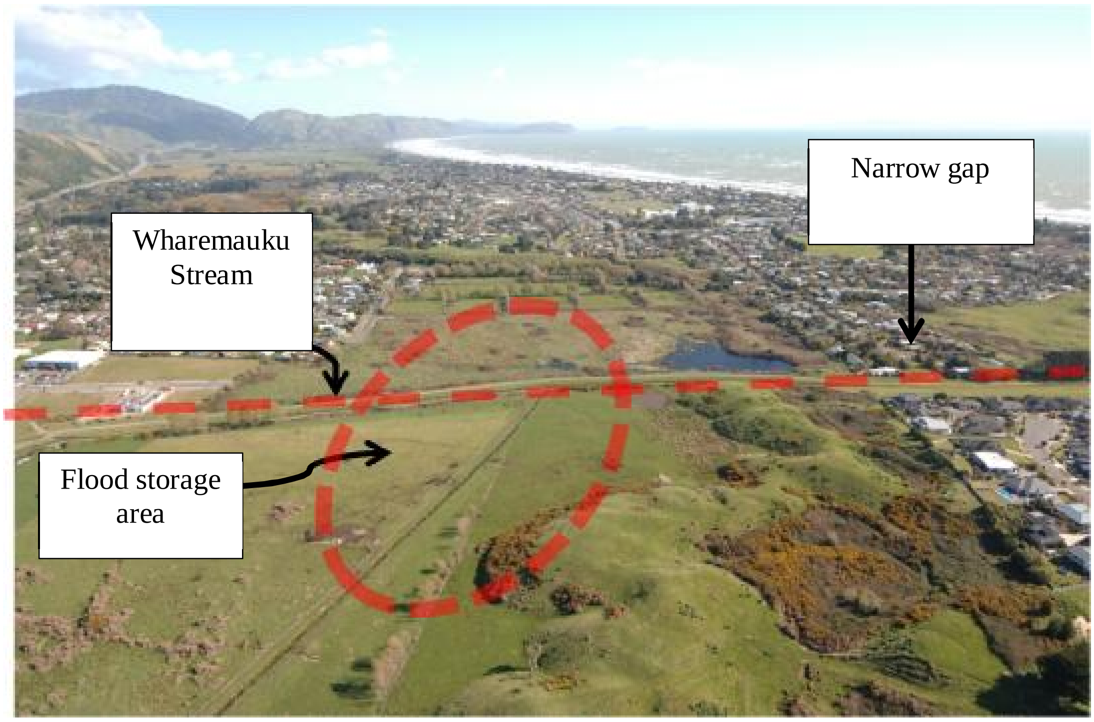
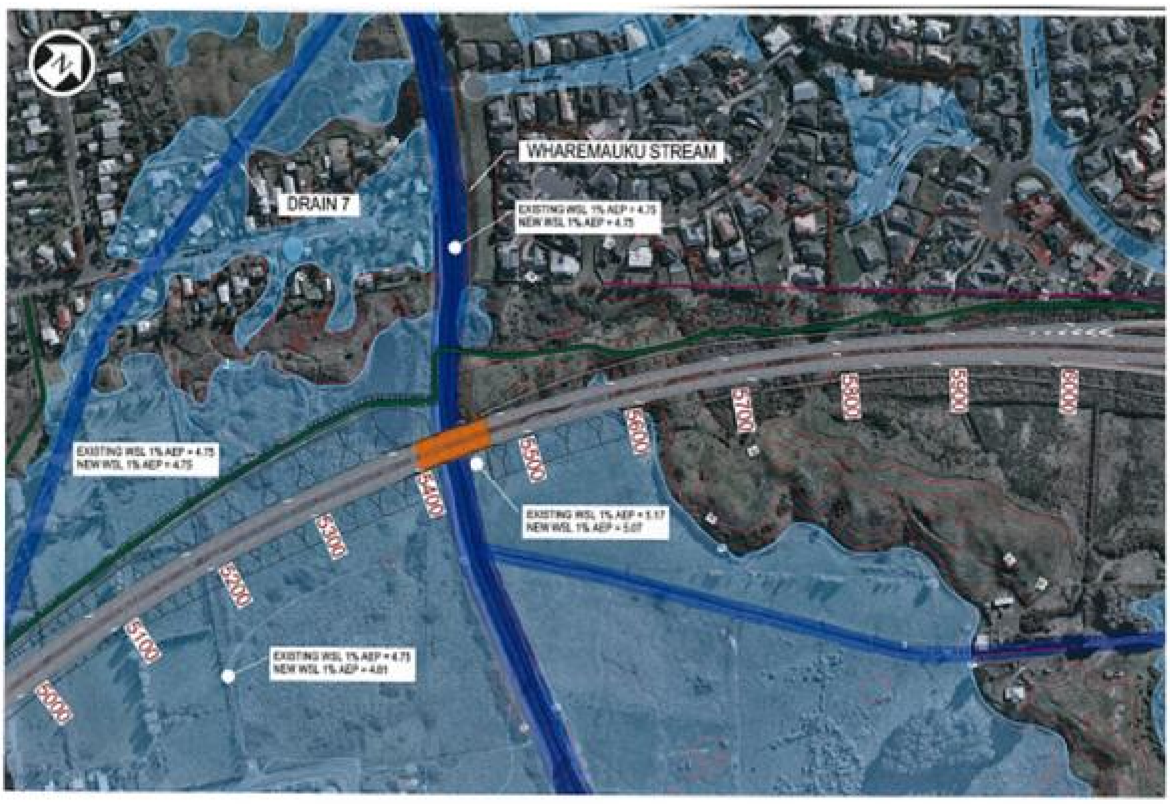


Figure 6: Part of an M2PP flood map prepared for the AEE showing the Wharemauku Stream, 1%AEP floodplain, proposed Expressway and a local road crossing the floodplain.



Again, in this location the Expressway passes through the floodplain and fills in storage. In this example, the volume required is 76,000m^3 and with the high groundwater this translates into a 105,000m^2 storage complex. In this location the only available area to provide this offset is within the existing flood footprint. However, the groundwater is very close to the surface and to provide such a large volume the groundwater needs to be drained down. Given the close proximity of residential dwellings in the same area, the level of acceptable draw down needed to be determined after careful consideration involving groundwater modelling by geotechnical engineers. The potential for settlement could then be addressed.

Similar to the Kakariki example, the high groundwater table in this location means that reinstating this area back to pasture is no longer viable but reinstatement as a native planted wetland would be a better outcome. Similar to at Kakariki Stream, this will provide new native habitat for indigenous flora and fauna consistent with pre-European vegetation in this area.

The flood storage solutions in the Wharemauku Stream area are consistent with what KCDC have determined will be appropriate for the storage offset involved with any future town centre development. Also as a result of the off-set flood storage location being so close to a large urban population there is excellent potential for additional public amenity enhancements in this area (walking and cycling tracks, boardwalks, wildlife viewing areas etc) to be incorporated into the designs and long-term development of this wetland area.

Overall, the Alliance approach to this project has resulted in the potential for the development of a very large complex of indigenous wetlands across the length of the route that delivers on stormwater, ecological, KCDC stakeholder and community amenity needs.

6 CONCLUSIONS

The Alliance model requires intense and close coordination between participant organisations and demands a “best for project” approach. The M2PP Alliance is unique as it includes a territorial authority, KCDC, within the Alliance. These two characteristics have led to many benefits and challenges. To date some these have been:

- **Results in better access and application of local knowledge;**
- **Improved coordination of design standards and interpretation of these;**
- **KCDC standards have additional weighting that comes with a seat on the Alliance board has resulted and a more balanced stormwater design in terms of community interests and ecological values;**
- **KCDC’s objectives were easier to include in the project and KCDC has received more direct benefit than if they had been on the outside looking in;**
- **Improved ecological and community outcomes being achieved; and,**
- **Overall, a better more balanced design has resulted.**

The challenges have been:

- **Stormwater management using "natural" devices such as wetlands and offset storage can need a lot of land;**

- **Understanding the groundwater regime and the impacts the works will have on this is crucial in designing wetlands;**

- **Time and costs are more intense on an Alliance and need to be carefully managed; and,**

- **There remain many more challenges still to come for the Alliance.**

Overall, the Alliance model has facilitated a collaborative approach that has streamlined the preparation of the submission to the EPA. Through the involvement of KCDC and an ecologist at the front-end of the project agreement has been achieved on the form of mitigation measures. This has involved a good mix of both the modelling, practical engineering concepts about flood management and water quality designs, practical council operational experience and ecology.

Finally, there are aspects of the Alliance culture that can be simply applied on other projects irrespective of size. Some worth considering are:

- **"best for project" does not have to be just an Alliance concept. Any project can benefit from considering this concept;**

- **Local knowledge is invaluable on all projects particularly if applied early;**

- **If possible work in stakeholders aims in determining a particular solution;**

- **Design of streams, drains and wetlands need to be approached from a balanced perspective. Stormwater design is only one aspect. Groundwater conditions, ecological values and council/community objectives can have as much an influence on stormwater designs as rainfall, runoff and flow management.**

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