BACK TO TAKANINI - PIPES? WHERE WE'RE GOING, WE DON'T NEED PIPES

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ABSTRACT

Auckland Council, in partnership with multiple developers and landowners, is in the process of constructing the innovative Takanini Strategic Stormwater Corridor ("TSSC", McLennan Park wetlands upgrade and Artillery Drive tunnel. This radical stormwater management intervention by Auckland Council is facilitating the development of over 100 Ha of flood prone Special Housing Area (SHA), the Takanini SHA. The TSCC is a man-made stream of 25-50m width that provides attenuation and conveyance for the 1% AEP event with additional attenuation and treatment being provided at the McLennan Wetlands. Attenuated and treated flows are then discharged to the Pahurehure Inlet via the Artillery Drive Tunnel.

In 2015, the Takanini SHA area was extended to include an additional 16 Ha at Mill Road to provide 264 residential lots. The Mill Road site straddles two stormwater catchments; the Papakura Stream catchment and the Pahurehure Inlet catchment. Successful development of the site relies on the ability to pass post development flows downstream. This is not possible for the Papakura Stream portion of the site due to a lack of downstream infrastructure and downstream flood risk. Through close collaboration with Auckland Council, AR & Associates designed the site such that post development flows from the entire site pass to the Pahurehure Inlet catchment via the TSSC. The predevelopment flows to Papakura Stream remain.

The entire site was raised by approximately 750mm and the orientation changed to facilitate the catchment boundary adjustment and make the land less vulnerable to flooding by providing resilience and freeboard. The loss of floodplain storage due to infilling was not an issue as the TSSC channels and associated downstream infrastructure was designed to cater for floodplain storage and conveyance for the 100-year ARI.

The volume of imported material was kept to a minimum due to the costs and availability of fill. The resulting site profile was very flat, and this together with the need to provide groundwater recharge and SMAF mitigation, lent itself well to a water sensitive urban design ("WSUD") approach. Local stormwater runoff is managed through swales, recharge pits and infiltration, resulting in a largely pipe-less, integrated solution. This approach also responded to other project drivers such as urban design, landscaping and roading. The WSUD approach also facilitates the critical requirements for ground water recharge of the underlying peat soils to prevent settlement.

As the downstream infrastructure is not yet operational, the site had to consider the implementation of temporary drainage solutions. This included the incorporation of a greenway corridor that will operate as a temporary stormwater attenuation area and will connect to and mimic the TSSC concept once it comes online. The greenway provides amenity, improved ecological habitat and a public park that includes a playground and cycleway for the wider community.

The Takanini Strategic SHA Extension Development at Mill Road exemplifies effective adaptation of a water sensitive design approach and 'outside the box' thinking to suit local topographical, geotechnical and flooding constraints, while responding to specific project urban design drivers.

This paper discusses the design process, the implementation and lessons learned as well as customer feedback from key stakeholders including the developer and Auckland Council, who will ultimately be the asset owners of these WSUD features within the development. The paper also touches on a disconnect between the resource consent phase undertaken by the developer and the building consent phase undertaken by the future lot owners. All too often the best intentions and the innovation of the resource consent stage is lost in translation to the building consent phase. This particular development has attempted to try and bridge this gap with some success.

KEYWORDS

Low Impact Design, LID, Stormwater, Integration, Landscape Architecture, Urban Design WSUD, WSD, Stormwater Management, Infiltration, Collaboration

PRESENTER PROFILE

Andrew Nell, Senior Associate, AR & Associates Ltd- Andrew has approximately twenty three years professional experience with projects for both the private and public sectors throughout New Zealand and overseas. Andrew experience covers a wide range of fields primarily in the urban land development and infrastructure markets within New Zealand.

Andres Roa is the Founding Director of AR & Associates. Andrés has more than 20 years professional experience with projects for both the private and public sectors throughout New Zealand and overseas. Andrés' experience covers a wide range of fields and in recent years has focused on integrated engineering design and WSUD.

Lisa Dowson is the Green Infrastructure Senior Associate at AR & Associates Ltd. Lisa has over a decade of public sector stormwater experience primarily in the flood mitigation and catchment planning space. She has a particular interest in stream restoration and water sensitive design approaches to stormwater management.

1 INTRODUCTION

The wider Takanini area has long been identified as a growth area and was initially Structure Planned in 2000. In 2014, the development of over 100 Ha of flood prone land was approved in principal through the zoning of a Special Housing Area (SHA), the Takanini SHA. The area lies in close proximity to key transport connections, which makes this SHA well-suited to accommodate some of the significant growth anticipated for Auckland.

Auckland Council, in partnership with multiple developers and landowners, is in the process of constructing the innovative TSSC, McLennan Park wetlands upgrade and Artillery Drive tunnel. This radical stormwater management intervention by Auckland Council is facilitating development of the Takanini SHA by managing the widespread flooding issues in the area. The TSSC is a man-made stream of 25-50m width that provides attenuation and conveyance for the 1% Annual Exceedance Probability ("**AEP**") event with additional attenuation and treatment being provided at the McLennan Wetlands. Attenuated and treated flows are then discharged to the Pahurehure Inlet via the Artillery Drive Tunnel.

In 2015, the Takanini SHA area was extended to include an additional 16 Ha at the corner of Walters and Mill Roads to provide 264 residential lots, called the Takanini Strategic SHA Extension (SHA Extension). The SHA Extension site straddles two stormwater catchments; the Papakura Stream Catchment to the north and the Pahurehure Inlet Catchment to the south. This is shown in **Figure 1** below.

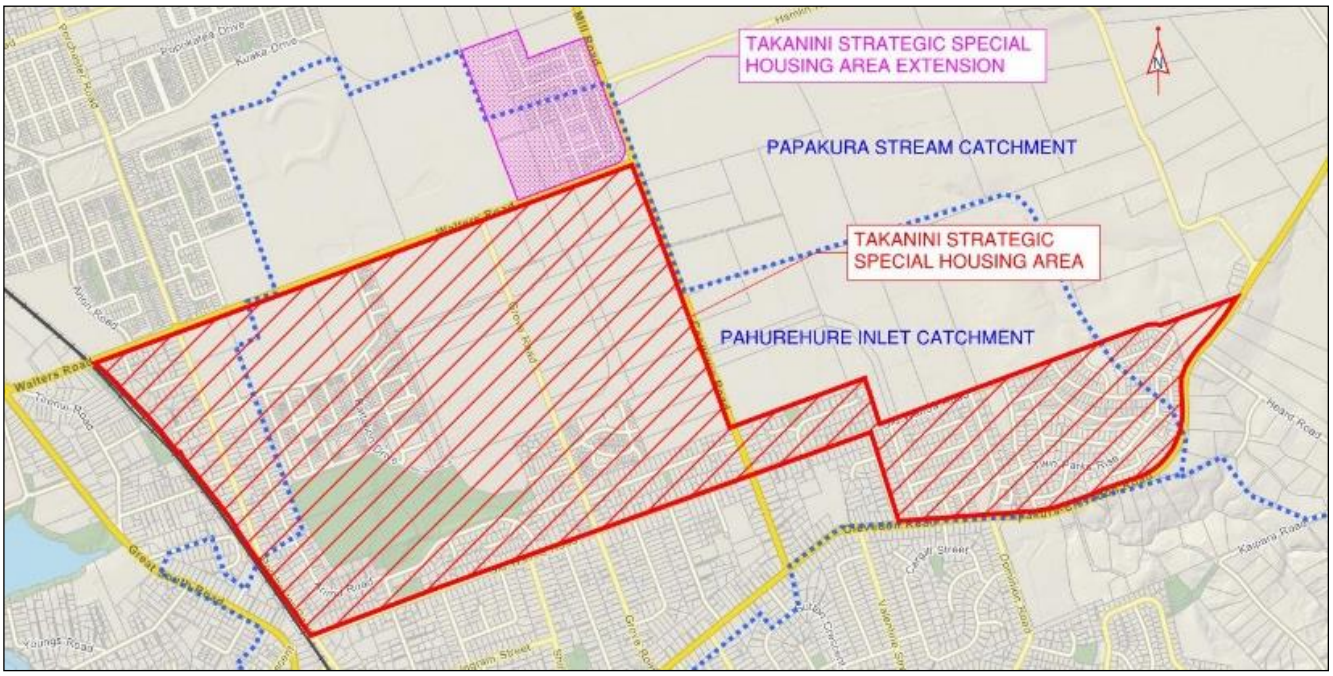

Figure 1: SHA and Catchment Boundaries

Successful development of the SHA Extension site relied on the ability to pass post development flows downstream. It was not possible to pass flows forward into the Papakura Stream catchment due to a lack of downstream stormwater infrastructure and significant downstream constraints and flood risk in the existing urbanised Takanini Township. Instead, stormwater flows from the SHA Extension will be passed into Council's TSSC channel.

Through close collaboration with Auckland Council, AR & Associates designed the site such that post development flows from the entire site pass to the Pahurehure Inlet catchment via the TSSC. The predevelopment flows to Papakura Stream remain.

It is noted that all stormwater infrastructure provided within the SHA area for the development was undertaken and funded by the applicants at the time of undertaking the development. The culvert under Walters Road, which allows the SHA area to discharge to the downstream infrastructure, was subjected to an Infrastructure Funding Agreement ("IFA").

2 CATCHMENT DESCRIPTION AND CONTEXT

2.1 CATCHMENT DESCRIPTION

The wider Takanini Strategic SHA catchment area is predominantly flat, with the existing land use typically pastoral. A number of farm drains are constructed throughout the catchment in an effort to drain the flat land.

The catchment area is predominantly underlain by peat soils to varying depths but typically in excess of 10m. Peat soils are generally relatively permeable but can also display low permeability. The groundwater table in these peat soils varies seasonally and is typically less than 500mm below ground level in the winter and up to 2m below ground level in the summer months. Perched water tables can also be encountered in the peat soils in this area.

No streams or watercourses were present on the SHA Extension site although a number of drains and channels had been excavated over the years to manage stormwater within the rural context of the catchment.

There is no formalised drainage across the catchment with small dissected natural intermittent streams and farm drains connecting to roadside table drains. The existing natural streams in the region are very short and have little to nil baseflow during the summer months (Draft Central Papakura ICMP, 2007).

Extensive modelling by Auckland Council and the legacy Papakura District Council of the wider catchment has been previously undertaken. The vast majority of the wider Takanini Strategic SHA is shown to be inundated in a 1% AEP storm event to a depth of 300 to 500 mm. This is shown in Error! Reference source not found. below.

Due to the entire SHA area, and much of the wider catchment area, being predicted to be inundated in the 1% AEP storm event, development of the area is currently restricted. To enable development in these areas and to mitigate the existing flooding issues within wider area, Auckland Council has proposed and is progressing a significant stormwater conveyance scheme known as the Takanini Stormwater Conveyance Corridor ("**TSCC**") and is shown in Error! Reference source not found. below.

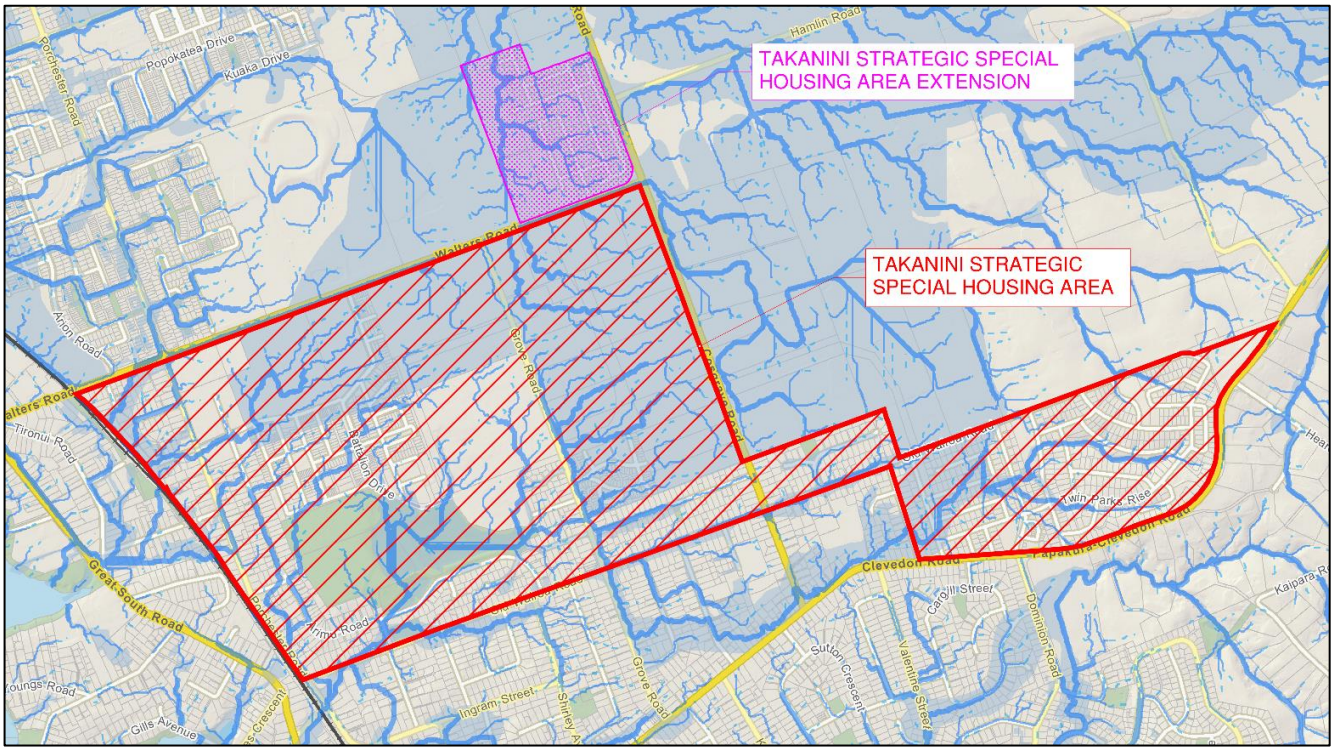

Figure 2:- Extend of Flooding in the Wider SHA

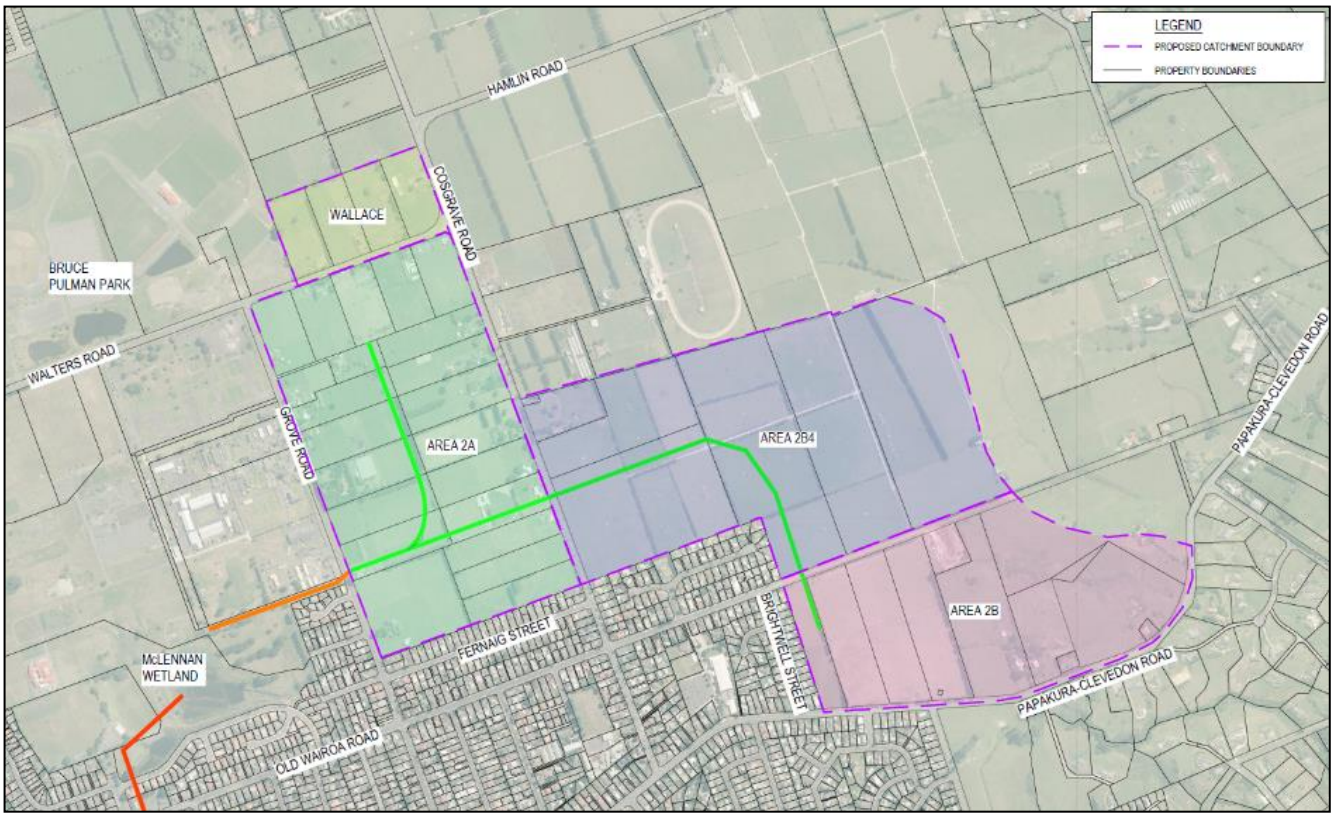

Figure 3:- Takanini Stormwater Conveyance Corridor

3 TAKANINI STRATEGIC SHA EXTENSION SITE DESCRIPTION

The SHA Extension is located at the north western corner of Mill Road and Walters Road. The land use typically comprised 2ha lifestyle blocks with relatively low impervious area coverage and was used for low intensity pastoral grazing.

No significant natural features have been identified for the Site. There were no identified streams or other water bodies associated with the SHA Extension area and a minor farm drain had been constructed along the eastern boundary of 180 Walters Road. Gradients were very gently sloping over the whole of the site with the land falling towards the north-northwest.

The Council's GIS system confirms the site gradient, showing overland flowpaths within the site flowing in a north westerly direction and exiting the site along the northern boundary and continuing to flow north. In addition to the overland flowpaths originating within the site, the GIS system also identified overland flowpaths originating in Bruce Pulman Park ("**BPP**") and entering the site along the western boundary. This is shown in Error! Reference source not found. below.

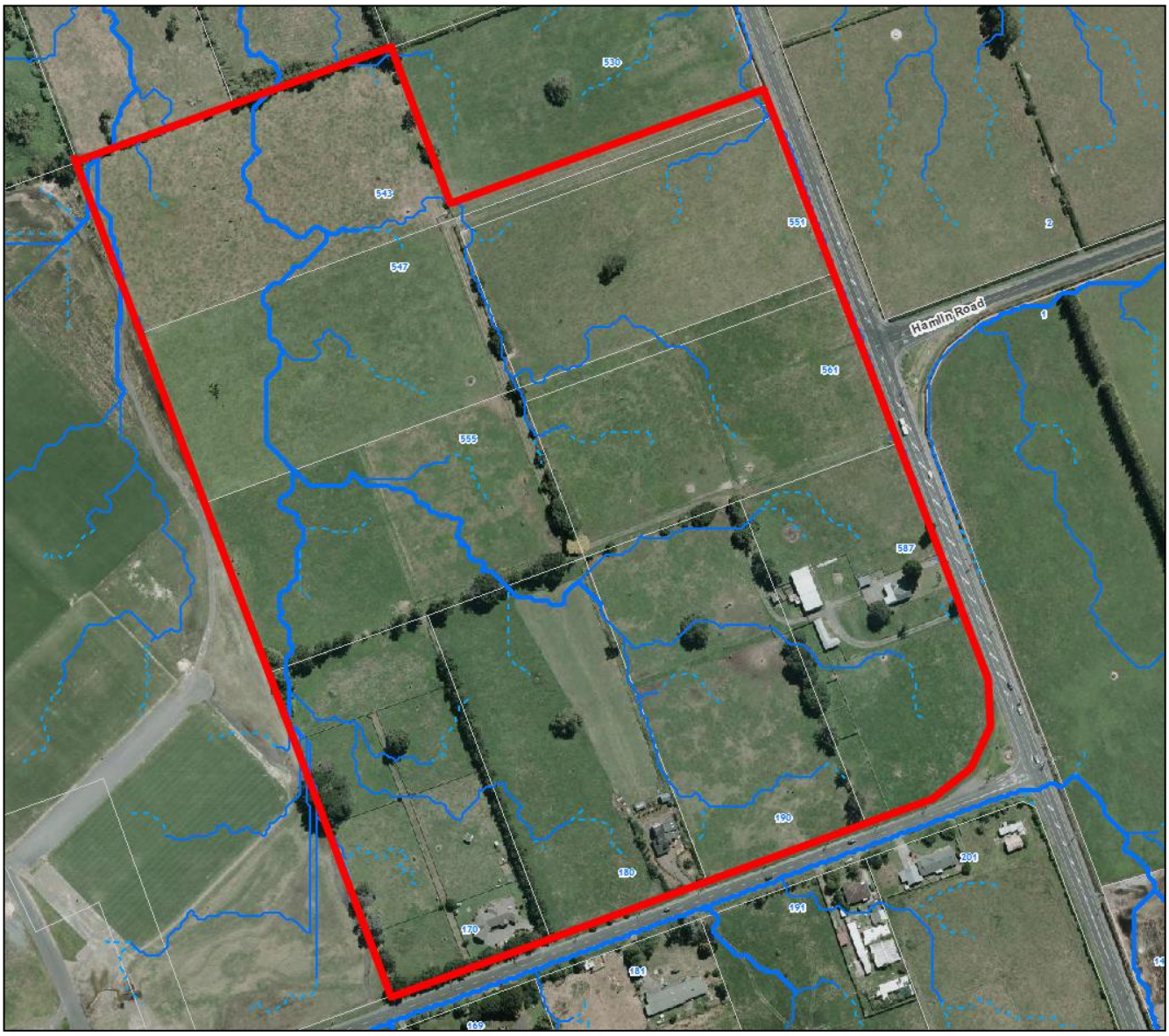

Figure 4:- Existing Overland Flowpaths on the site

The SHA Extension site originally discharged to the Papakura Stream Catchment. However, due to the lack of downstream stormwater infrastructure, existing flooding in the downstream Takanini township and flow constraints within the Papakura Stream itself, it was not possible to discharge development flows to the Papakura Stream Catchment.

As the SHA Extension lies at the boundary of both the Papakura Stream and Pahurehure Inlet catchments, there was a unique opportunity to change the topography of the site and redirect development flows southwards to Council's TSSC stormwater channel.

Discussions with Council resulted in agreement for the design of the TSSC to be amended to include the SHA Extension in its catchment. A small amount of flow could not be directed to the TSSC, which was designed to maintain predevelopment flows to the Papakura Stream catchment. This is shown in Figure 5 below.

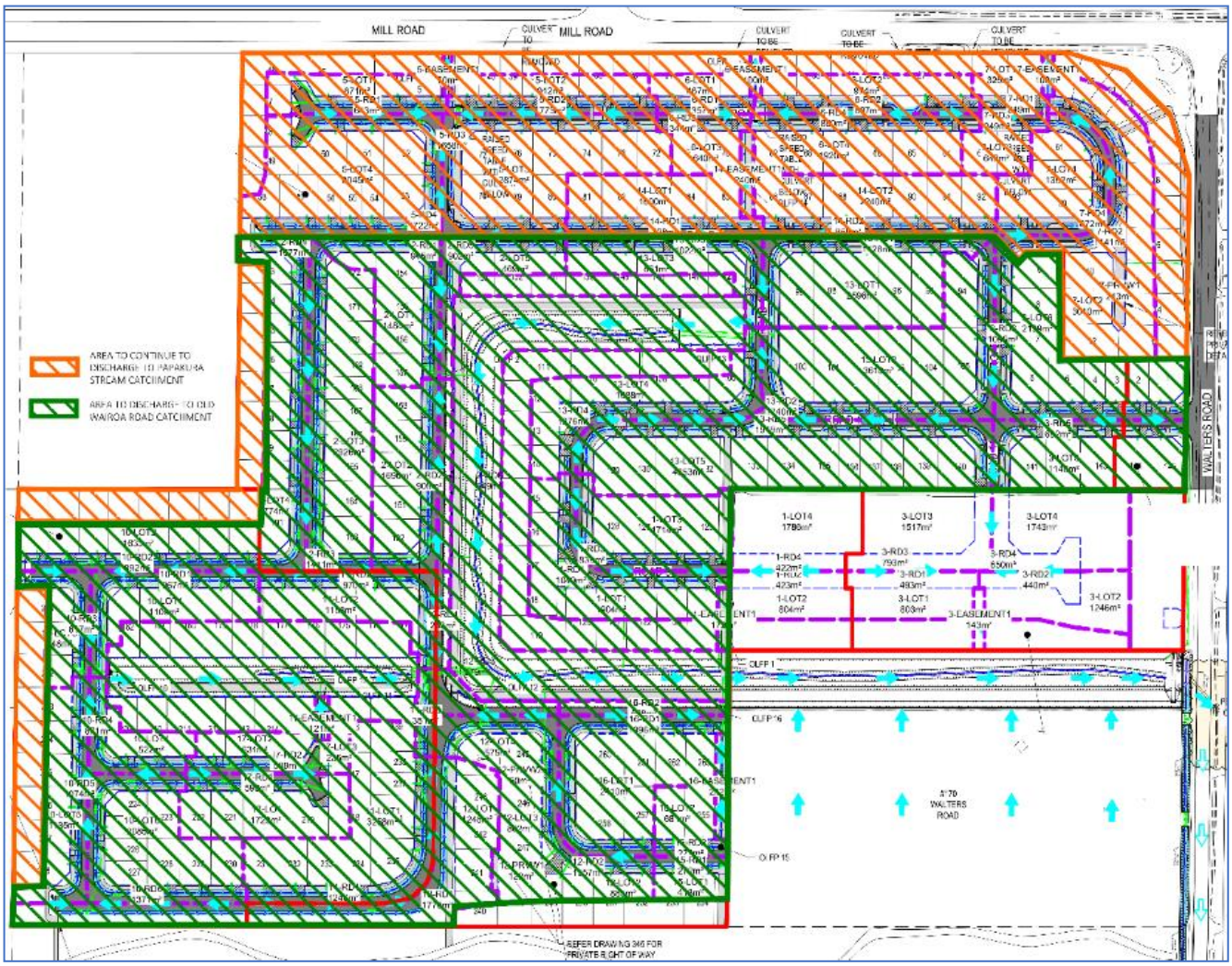

Figure 5:- Post Development Catchment areas

The lack of existing infrastructure, flat nature of the site, and the anticipation, and design allowance by Auckland Council, that the SHA Extension site would be developed in such a way that resulted in re-directing stormwater from a northerly flow to a southerly flow, provided the developer of the SHA Extension site with an opportunity to provide a unique solution to stormwater management.

While traditional advice and preference is to maintain existing hydrology and hydraulics, the expectation to divert the flow introduced a complexity to the design solution that was no longer purely engineering. In order to divert the flow as discussed here, the flat nature of the site required a significant change to the topography to achieve the required falls. The only option available to achieve this outcome was to import sufficient bulk fill to the site to change the overall topography and grade of the site.

This importation of material was a significant cost to the project and a balancing exercise was required to achieve the best practicable option of the project. The need and desire to achieve good environmental and stormwater outcomes was carefully considered with the economic outcomes for the project.

While stormwater management outcomes could readily be achieved by lifting the ground levels, it was necessary to be cognisant of the relationship and interaction of the development with the wider community as well as the immediate neighbours to the site.

3.1 KEY STORMWATER MANAGEMENT ISSUES/OPPORTUNITIES

Paramount to the stormwater management consideration was the need to manage the existing overland flow and flooding issue in the wider context of the area. Furthermore, groundwater recharge was also a significant design consideration for the stormwater management.

3.1.1 LONG TERM STORMWATER MANAGEMENT SOLUTION

The overall plan is to discharge the stormwater from the development to the TSSC via a double-barrel culvert under Walters Road.

But Council's infrastructure timeframes were slower than site development timeframes, therefore we needed an interim solution to manage stormwater adequately while waiting for TSSC and associated infrastructure to become operational.

3.1.2 INTERIM STORMWATER MANAGEMENT SOLUTION

The proposed development of the SHA area initially considered a staged approach to integrate with the programme for the construction of the TSCC. However, it was apparent that the programme for this major piece of stormwater infrastructure was still very much a work in progress and in order to provide certainty to the development programme, Pakenham investigated an alternative, temporary option to allow the development to progress ahead of the TSCC.

This interim (temporary) stormwater management solution involves providing peak flow attenuation within the SHA Extension site within a centrally located green corridor; and the conveyance of the 10% AEP in a temporary open channel within the existing northern berm of Walters Road.

This system discharges to the existing piped network within Walters Road. When the piped network reaches capacity, the open channel on the southern side of Walters Road overflows to the overland flowpath within the McLennan development and ultimately to the McLennan wetland. This schematic is shown in **Figure 6** below.

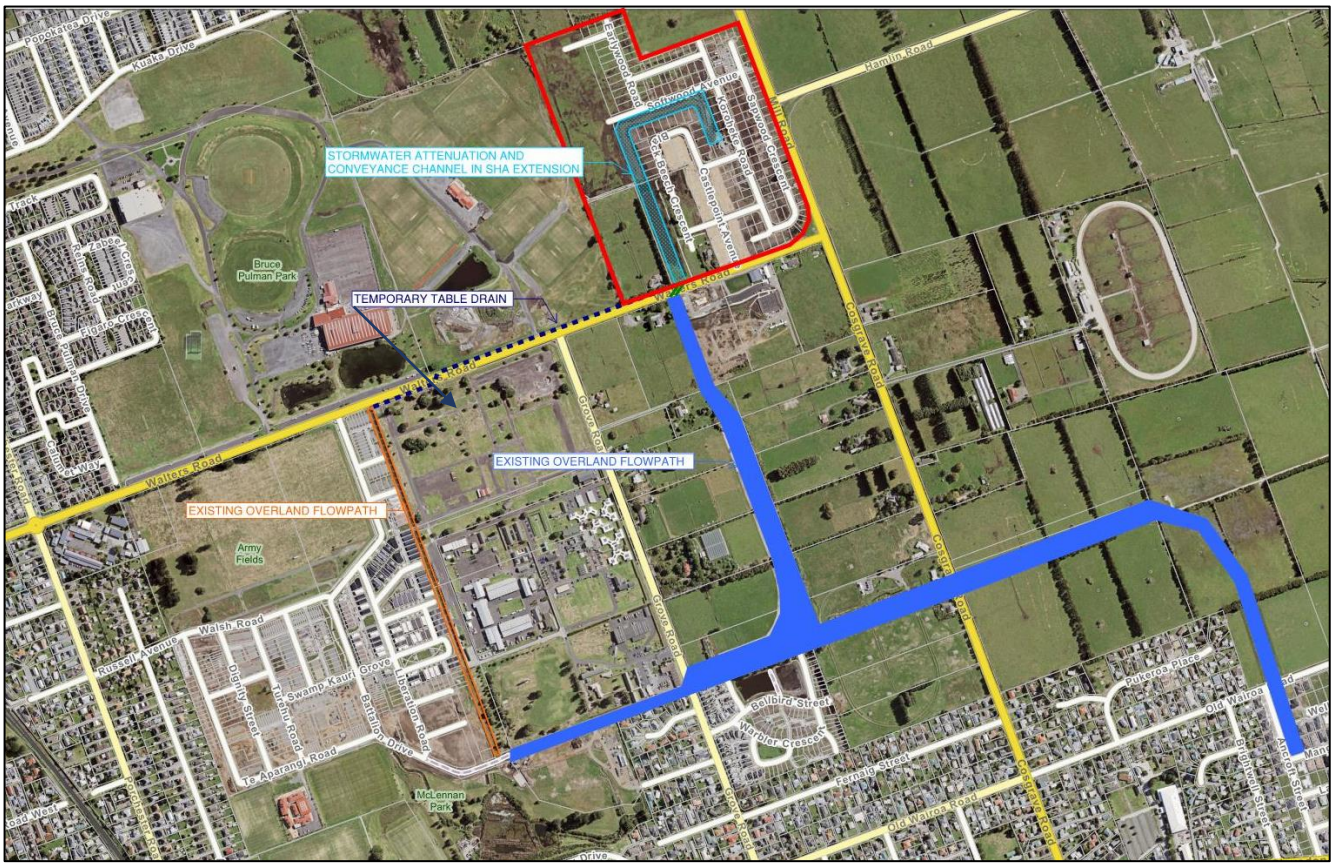

Figure 6:- Temporary and Permanent Solutions

3.1.3 FLOODING AND OVERLAND FLOW PATHS

As previously discussed, the temporary and permanent stormwater management solutions address the 10% AEP storm event for the two scenarios. The internal secondary flows and overland flowpaths are essentially unchanged for the two scenarios. However the permanent solution will allow conveyance of 1% AEP flows for the site to the TSCC, whereas the temporary solution allows for much of these flows to be temporarily contained within the onsite green infrastructure corridor and released to Walters Road at a controlled rate.

For both the temporary and permanent situation, the secondary overland flow is directed towards the proposed roads, which have been designed to convey the overland flow to the greenway channel. Where this is not feasible, overland flowpaths have been provided through lots or between lots as pedestrian links.

4 WHY PIPELESS

Why minimise the pipes is a question that many may ask, when the tried and trusted approach is to put the stormwater in a pipe under the ground.

Firstly, the very flat nature of the site meant that the pipes would be correspondingly flat. This would require larger pipes to convey the flow expected. Furthermore, a piped system also relies on a receiving pipe network, which doesn't exist in the immediate vicinity of the SHA Extension site.

In additional, the nature of peat soils is such that it is susceptible to settlement and this causes a number of issues with the construction of drainage lines, including the risk of dips in the pipes, reverse grades, etc. To avoid this, drainage lines are installed at steeper than

minimum grades in peat soils and as such, significantly more fill would be required to be brought into the site to provide a topography that could accommodated steeper lines.

The fill material brought to site amounted to approximately 100,000m^3 to achieve a maximum fill height of approximately 1m along the northern boundary of the SHA Extension site. Realistically it may have required this to be of the order of 2m to 3m to achieve a suitable grade on a piped network, resulting in a fill volume in excess of 300,000m^3. This would have been prohibitively expensive but also would have resulted in a development that did not sit well with the wider context of the surrounding area. Visually it would have resulted in a significantly negative effect on neighbouring properties.

In short, here was a fantastic opportunity to go back to basics and implement a water sensitive design that still achieved the stormwater management requirements but also complemented the overall design outcomes for the development.

5 WHEN IT ALL GOES WRONG

Of course, it's not all plain sailing when one "bucks the trend". Significant challenges existed in the design and implementation of this pipeless stormwater management approach. The biggest challenge being education. Most people don't ever think about their stormwater until the pipe blocks and the water suddenly has nowhere to go. The mentality of "out of sight, out of mind" is quite prevalent when it comes to stormwater management.

We were fortunate that Auckland Council's Healthy Waters department and Auckland Transport's Stormwater Engineers were very positive and supportive of the proposed approach. However, they required significant discussions, demonstration and agreement as to how the system would be maintained on an on-going basis.

Through the resource consent process, it was proposed and agree that the swales within the road berms would be maintained by the individual lot owners. This was ensured by the inclusion of a consent notice on all the titles, which sets out the requirement for this to be undertaken, as well as a guideline of the level and frequency of maintenance of the swales.

However, there is still a disconnect between the Resource Consent phase and the Building Consent Phase. With all the good intension and provisions to ensure that the end user of the lots are aware of their obligations to manage and maintain the swales, there was still a need to protect these stormwater features during the house building phase.

Most people would not expect to find a pipeless stormwater system in a built up urban environment. This applies to the tradesmen who construct these houses. The relatively small lot sizes means that the house sizes are maximised for the lots. This results in very little space being available on the site for building materials, parking, skips bins etc. Traditionally these are stored on the road berms. Clearly this was not an option for this development and Pakenham Group took it upon themselves to include an information pack with all sale and purchase agreements for the properties that explained the uniqueness of the stormwater system and the need to keep the swales and berms clear of building material, parked vehicles and other obstructions.

In addition, Pakenham also employed a site superintendent to monitor the builders and provide them with guidance and information in this regard. When the first builders arrived on site, many undertook their building operations in the traditional way with materials and cars stored and parked in the swales. However, it quickly became the accepted norm that these areas were to be kept clear at all time. With the exception of bits of timber, and other minor rubble, the swales are now kept clear of all building materials.

6 CONCLUSION

A unique pipeless solution to address various site constraints including downstream flooding, flat grades, and the lack of a reticulated stormwater network, is under construction at the Takanini Strategic SHA Extension site at the corner of Walters and Mill Roads in Takanini.

The need for a pipeless system was primarily driven by the need to minimise the amount of material to be imported to the site to achieve an alternative discharge catchment of the site.

This in itself raised a number of question and concerns to address, particularly around the management of surface flows in shallow swales. The concerns included:

- how to ensure that the swale profile was maintained and manage well into the future;
- managing surface flows across roads where pipes could not be installed;
- secondary overland flowpaths; and
- vehicle crossings, parking bays and pedestrian crossings within the swale.

Much of this was overcome by the developer undertaking more physical works than would typically be done by a developer. This included construction of all vehicle crossings to the profile of the swale. They also employed a site superintendent to monitor the buildings during the house construction to ensure that the swale profile was not damage, or where it was, that is was reinstated to the required profile.

Secondary overland flows were managed across road in the form of fords, which act as traffic calming too.

The ability for this proposed stormwater solution to work has primarily been due to the innovative approach that the developer was willing to take for the stormwater management on the site but most importantly too was the willingness of Auckland Council's Heathy Waters and Auckland Transport's Stormwater engineers to consider this approach. Their main concerns related to the users of the road networks and in particular the pedestrians. Acceptance of some water in the pram crossing and that people generally don't mind the sole of their shoes getting wet meant that there was some relaxation of the requirements of the SW Code of Practice.