Council Briefing Agenda

Date:	Thursday, 12 November, 2020
Time:	10:30 am
Location:	Council Chamber Forum North, Rust Avenue Whangarei
Elected Members:	Her Worship the Mayor Sheryl Mai (Chairperson) Cr Gavin Benney Cr Vince Cocurullo Cr Nicholas Connop Cr Ken Couper Cr Tricia Cutforth Cr Shelley Deeming Cr Jayne Golightly Cr Phil Halse Cr Greg Innes Cr Greg Martin Cr Anna Murphy Cr Carol Peters Cr Simon Reid

For any queries regarding this meeting please contact the Whangarei District Council on (09) 430-4200.

Whangarei District Council

2.1. Innovating Streets – Rose Street to Vine Street

Meeting: Council Briefing

Date of meeting: 12 November 2020

Reporting officer: Tracey Moore (Senior Landscape Architect)

1 Purpose

To provide an update on the Waka Kotahi / NZTA Innovating Streets for People (Innovating Streets) Pilot Programme - Rose Street to Vine Street Project.

2 Background

Whangarei District Council were successful in a funding application for the Waka Kotahi / NZTA - Innovating Streets Pilot Programme, to deliver a tactical urbanism street project. Tactical urbanism projects make temporary or semi-permanent physical changes to urban streets, in advance of future permanent upgrades. Tactical urbanism can deliver a transformational change, at low cost, with little disruption to the local business community.

The Whangarei Complete Streets Master Plan proposes Vine Street to be better connected to both the Rose Street Bus Hub and the city centre, with defined crossing points. The Rose Street bus hub is on the edge of the city centre with pedestrian links that are not obvious or legible. Key connection points are visually and physically blocked by carparks. Workers and carpark users also approach the city centre via Vine Street to Quality Street, crossing randomly between traffic and creating safety issues.

Once installed the semi-permanent pedestrian crossing, planters, seating and painted footpath will be monitored and evaluated to determine whether they will become permanent, relocated or removed entirely.

3 Discussion

As ‘Innovating Streets’ is a pilot programme between Waka Kotahi / NZTA and local government, we attend webinars and online workshops with the agency and share information and experiences with other councils participating around New Zealand.

We are having ongoing conversations with public transport users, the business community, internal and external stakeholders:

- Businesses on Quality Street and part of Vine Street are supportive of a semi-permanent pedestrian crossing on Vine Street, despite the loss of 5-6 carparks, and would like to be involved during implementation
- Public transport users at the Rose Street Bus Hub have participated in a survey about their experience of moving between the bus hub and their destination
- Youth Advisory Group who would like to be involved in the installation
- Future Leaders group who would like to be involved in the installation

- We will meet with Positive Aging and Disability Advisory Groups next to obtain their comments before finalising locations and design

A tube traffic count was installed on Vine Street to determine the speed and volume of vehicular traffic. After the semi-permanent pedestrian crossing and speed humps are installed and during the monitoring & evaluation phase, this will occur again to determine whether traffic speeds have reduced on Vine street. We are working closely with the Roading Department to ensure all roading and traffic management standards are met during the design phase and installation.

We have used CCTV 'people counting software' on Vine Street to provide data on pedestrian movement over Vine Street. Again, this will be updated following implementation of the semi-permanent pedestrian crossing to confirm, or otherwise, whether it is located in the optimum place before future, permanent infrastructure is installed.

Tactical urbanism elements that have been proposed are:

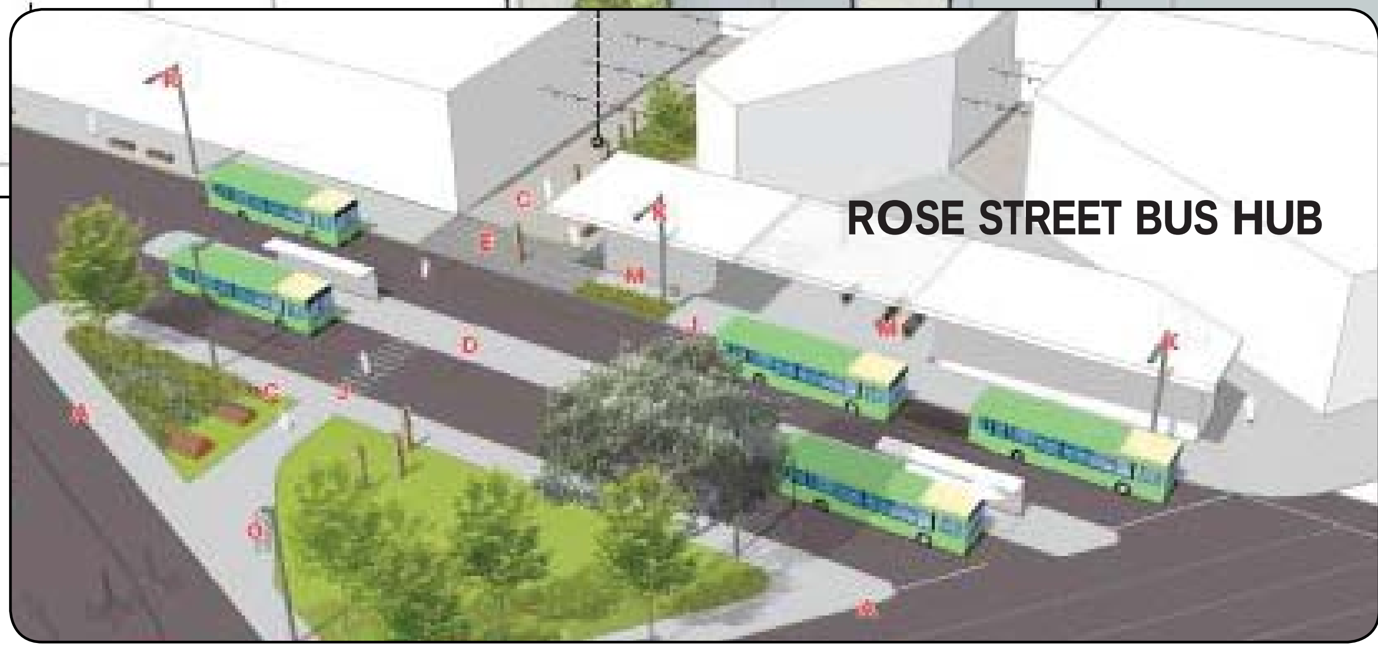
- Semi-permanent pedestrian crossing and speed humps either side of the crossing
- Painted footpath – to be co-designed with the community
- Planters – Off-the-shelf planters with in-built bench seating and recycled 900mm diameter steel pipes at various heights located to create a cohesive route from Vine Street into the city centre.

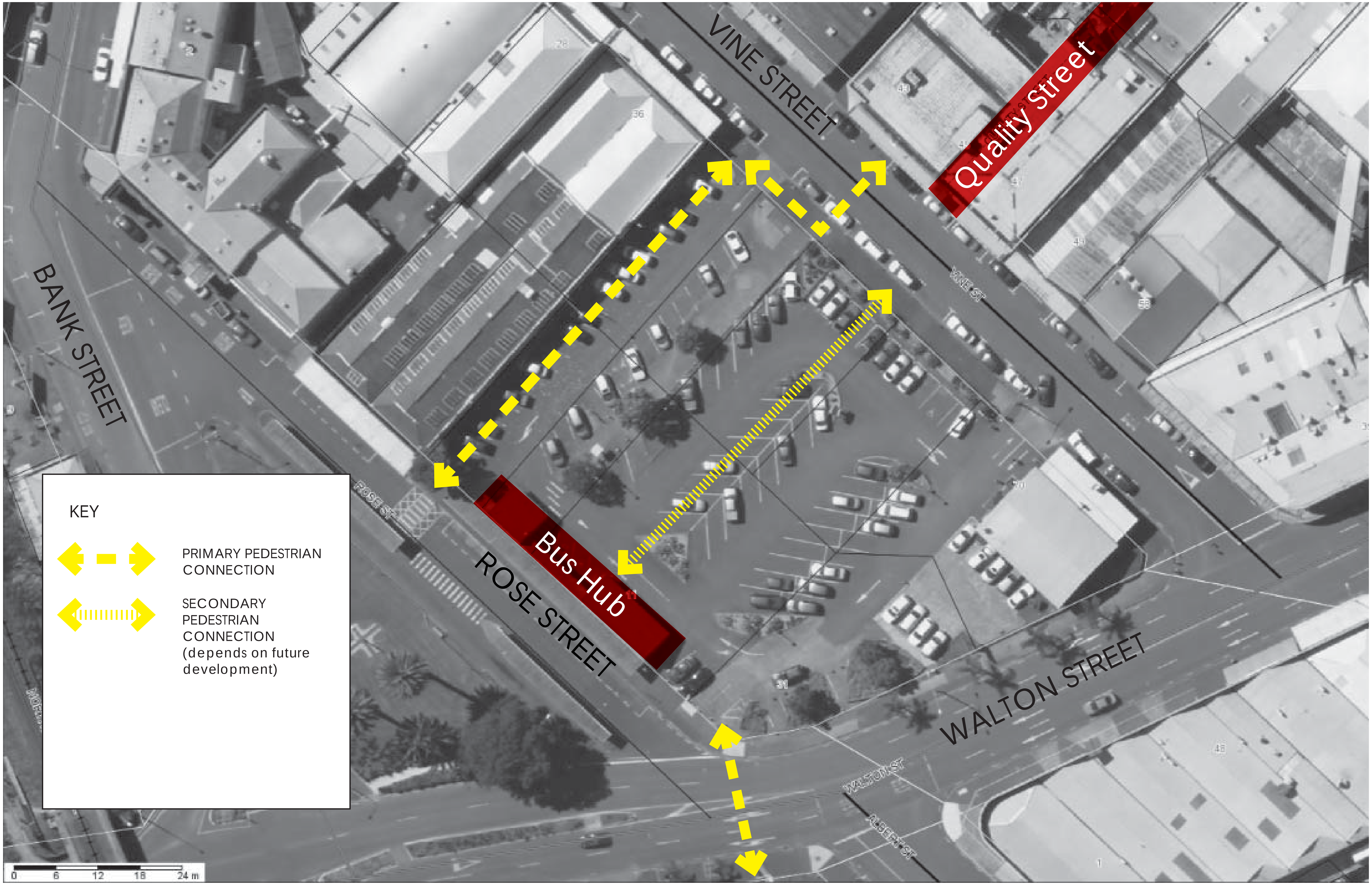
4 Attachment

Briefing on Innovating Streets – Rose to Vine

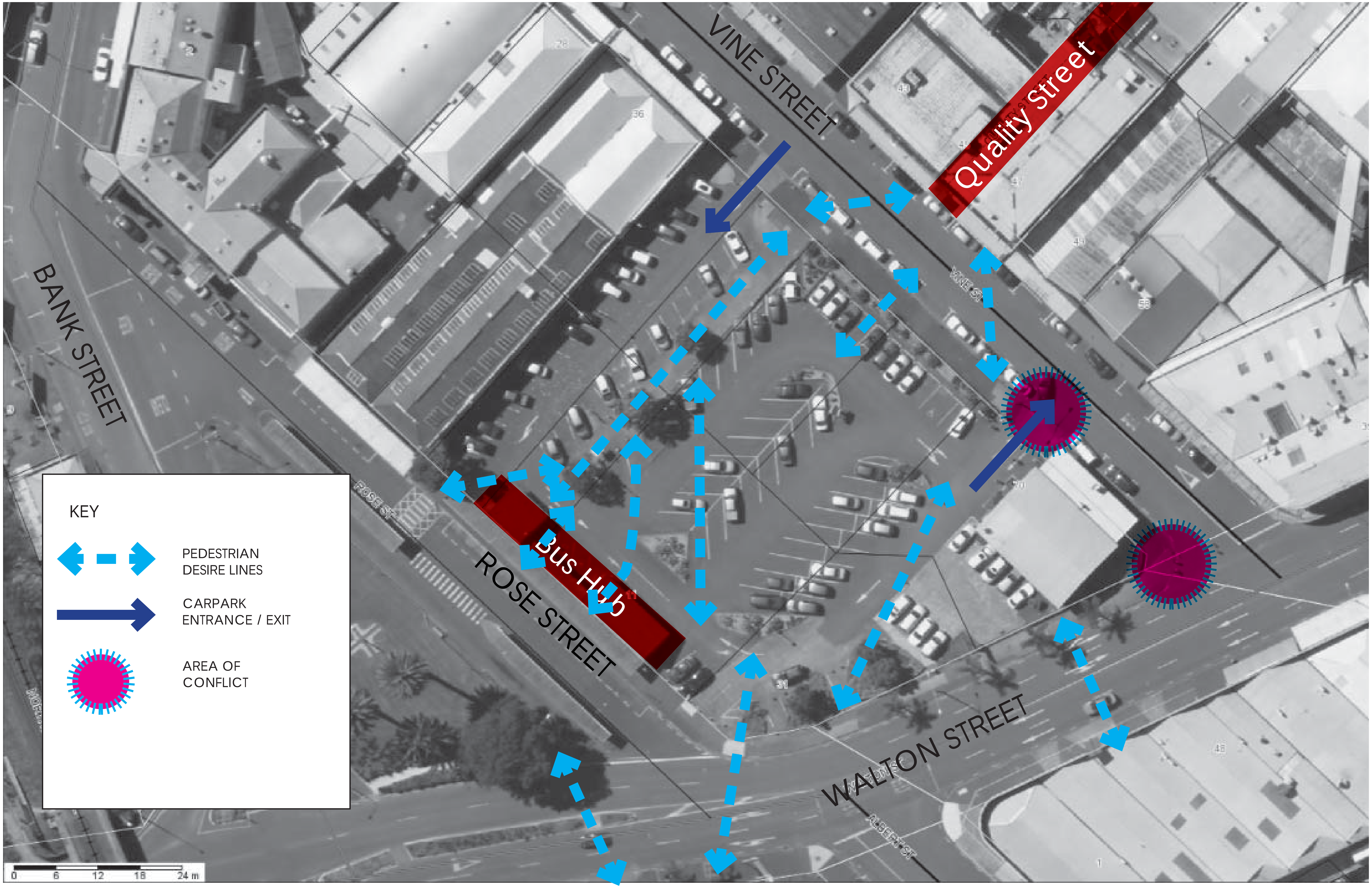
LOCATION PLAN


lan.
Pedestrian crossing
Rain gardens to
north side
Pedestrian crossing
Connection to Cameron St
Plan | 1:1
QUALITY STREET
BANK STREET
VINE STREET
WALTON STREET
VINE STREET

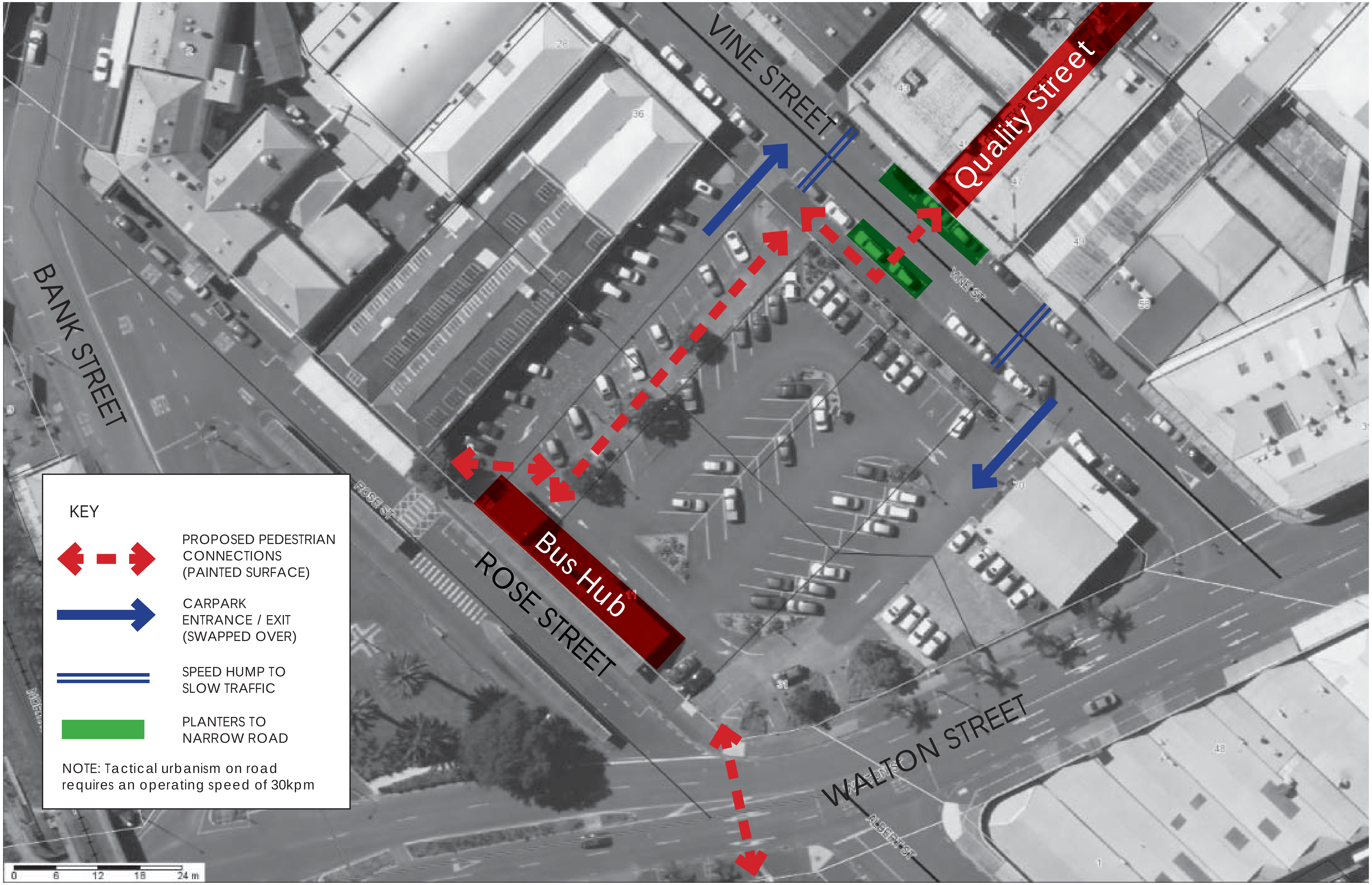

ROSE STREET BUS HUB



WCSMP - PROPOSED PEDESTRIAN CONNECTIONS



CURRENT PEDESTRIAN / VEHICLE MOVEMENTS



PROPOSED CONCEPT DESIGN (DRAFT)

ROSE STREET BUS HUB & TOWN BASIN BUS & VISITOR FACILITIES

Opportunity to *collaborate, combine resources* and engage one consultant to design a universal bus shelter, instead of designing and delivering these facilities in isolation.

Positive outcomes

- Aligns with the Whangarei Complete Streets Master Plan (WCSMP)
- Consistent & cohesive design within the city core
- Visual connection between bus facilities
- Include a design element unique to Whangarei
- Modular structures
- Can be implemented at any time
- Could be used as shelters elsewhere
- Cost savings - design & fabrication, ongoing maintenance
- Feels and is safe for users
- Encourages people to use pubilc transport
- Safe & legible pedestrian connections to the city core. Can incorporate wayfinding signage

Welcome visitors to the city

- Rose St bus hub is located on the main vehicular entrance into the city and has a signficant visual presence along this route
- Town Basin is the drop off point for visitors using either tourist buses & cruise ship shuttle buses

COMMS

- Ongoing contact with business community
- Ongoing contact with youth groups
- Rose St Bus Hub users - on street survey
- Media release with proposed concept design
- Facebook & newspaper
- Provide update to councillors
- Seek volunteers for installation (early 2021)

DESIGN

- Tube traffic count installed on Vine St - data received
- CCTV footage with pedestrian movements - data received
- Prepare pedestrian crossing design with specs from Roading - ongoing
- Meet / liaise with DAG, PAG, Blind Low Vision NZ
- Rose St Bus Hub upgrade - continue meeting with Roading & NRC to ensure consistency in design of bus shelters (Rose Street & Town Basin)
- Internal stakeholders workshop - ongoing

IMPLEMENTATION

Timeframe

- Early 2021 (after busy Christmas period for businesses)

Planters

- Recycle steel pipes into round planters
- Off-the-shelf planters with bench seating
- Planting & ongoing mainteance

Painted surfaces

- Road - only allowed on streets with 30km operating speeds
- Paths - can be painted - check visually impaired, non slip
- Pattern co-designed with community

Road crossing

- Semi permanent speed humps & raised pedestrian crossing

Volunteers / event during implementation

- YAG and Future Leaders groups would like to be involved
- Quality Street hospitality keen to be involved

2.2. Rainwater Tanks and Town Supply

Meeting: Council Briefing
Date of meeting: 12 November 2020
Reporting officer: Andrew Venmore (Manager Water Services)

1 Purpose

This agenda looks at the case for rainwater tanks to supplement the water supply for the Whangarei Water Supply Area.

2 Background

Whenever droughts occur and water restrictions are imposed, the question of rainwater harvesting by individual households as a supplementary water supply is often raised. Many cities and large provincial areas have faced droughts and undertaken options analysis, yet very few have chosen to encourage the use of rainwater tanks in urban areas. The reason is that in most cases the level of resilience provided by rainwater tanks is a lot less than that which can be achieved by other sources.

Where other water sources are available, these can often be developed at far less cost than installing rainwater tanks and usually provide a much greater and more reliable water supply. However, all supplies have limitations and where no alternative supplies are available, rainwater harvesting may prove beneficial.

3 Discussion

The rainwater tanks in urban areas can be used for three different purposes; Water Supply, Stormwater Detention, and Emergency Water Supply. An individual tank can usually only be used for one of these purposes. A Stormwater Detention tank needs to be empty, an Emergency Water tank needs to be kept full and a Water Supply tank needs to be used regularly to be of benefit.

For the purpose of the agenda, we are only considering a tank used for water supply or Rainwater Harvesting (RWH). This agenda looks at how rainwater harvesting could be used to supplement the town supply in a situation where some customers would have both a connection to the town supply, and a rainwater tank.

The rainwater tank would only be used for non-potable uses such as watering gardens or cleaning vehicles and driveways. These activities can account for 20-30% of the average household's water use and do not necessarily require the high standard of treated water provided by Council. Where rainwater tanks are used for outside water use only, a $5m^3$ tank is often chosen. This being a reasonable size without being too unsightly. It is also between 20-30% of a normal household tank of $22m^3$. The cost of purchasing, installing and fitting out a new $5m^3$ rainwater tank system has been calculated at around $7,000, see attached report.

One of the key benefits suggested for rainwater tanks in the Whangarei Water Supply area is to mitigate the impacts of a drought. This is discussed below.

3.1 Improving Drought Resilience

Whangarei District Council (WDC) has good water supplies and in normal years, there are no issues with water availability. However, in extremely dry years and with the potential for climate change, there is a need for greater resilience. The Wairua River has been identified by Council as the preferred option for supplementing current supplies. A consent has been granted to take water from the river, which will provide an additional 10,000m^3 per day above the capacity of the existing Poroti water treatment plant. This is the equivalent of an additional dam with storage capacity of around 2,000,000m^3. The cost of developing the Wairua River source and upgrading the Poroti water treatment plant is in the region of $30 million and will provide water for over 13,000 new residential households. This will be sufficient for the Whangarei water supply area for the next 50 years at current predicted growth rates.

If all those new households were to install a 5m^3 tank, the total additional storage achieved would be 65,000m^3 or 3.25% of the capacity provided by the Wairua/Poroti upgrade. This also equates to less than three days summer usage by the City. The cost of installing 13,000 tanks would be in the region of $90 million. However, as the rainwater tanks provide only a fraction of the required capacity the Wairua/Poroti upgrade will still need to proceed.

These findings related to the viability of rainwater tanks are supported by a GNS report for the Wellington Region which showed similar conclusions. The report states that… *"studies commissioned by Greater Wellington Regional Council indicate that installation of rainwater tanks for non-potable uses (toilet flushing and outdoor usage) would be unlikely to make a significant contribution to reducing demand in Wellington City during dry summers; and furthermore would be difficult to justify on economic grounds as installation costs greatly outweigh savings in water charges."* This report can be found on the GNS website link here https://www.gns.cri.nz/static/pubs/2013/SR%202013-016.pdf.

Notwithstanding the limitations of rainwater tanks highlighted above, there are some practical concerns which need to be considered when determining their effectiveness. Firstly, they all need to be functioning correctly and be full at the start of a drought. Research by the Institute of Sustainable Futures in Australia found that of over 7,000 tanks studied nearly 50% of the tanks were not working. The research found that … *"up to half of tanks are not functioning. The pump is busted, the pipes clogged, the first flush mechanism isn't working, or other problems have caused a malfunction that is yet to be addressed."* An article about this research can be found here https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/news/rainwater-outdoor-taps-only.

For a rainwater harvesting system to provide benefits, it needs to be adequately maintained and the tanks and pumps replaced when required. Failure by households to adequately maintain their rainwater systems in perpetuity may significantly reduce their expected benefit. One of the reasons that tanks fall into disrepair and are not used is cost and this is discussed in more detail below.

Assuming the tanks are operating, residents need to use the tank water instead of the town supply for outdoor usage. However, if a drought is extended and tanks run low the residents need to avoid the temptation of refilling their tanks from the town supply and negating any savings. Residents with water tanks may consider that water saving messages or water restrictions do not apply to them and potentially end up using more water than those on the town supply. This would not be an issue unless they run low and top up their tanks. Policing this would be extremely difficult, and this could lead to water restrictions becoming less effective. Ultimately, WDC will still need to ensure we have the capability to provide water to all properties during an extended drought. The installation of rainwater tanks will not reduce the size and capacity of the infrastructure needed to achieve this.

Some reasons that people may choose to install rainwater tanks are to save money, to benefit the environment or for emergencies. These are discussed below.

3.2 Cost of rainwater systems

As most people are aware, the cost of water is not the water itself, it is the cost of capture, treatment and delivering it that we pay for. The town supply currently costs $1.97 (excl GST) per m^3, but how much does a m^3 of rainwater cost to irrigate the garden or wash the car? A report by Power and Process Chemistry (attached) compares the costs and power requirements of rainwater tanks and WDC supplies. Using the same sized tanks as discussed above, the report concludes that over the 25 years expected life of a rainwater tank, the cost of water per m^3 for rainwater tanks is $10.49 (excl GST). These costs include the costs to maintain the tank and all associated equipment, the power for the pump, testing of the backflow preventer and replacement of the pump once. This is 4 times more than the town supply average cost over 25 years of $2.52 (excl GST) per m^3.

3.3 Power usage for tanks

The report by Power and Process Chemistry found that the operational energy intensity of a rainwater tank pump was 1.10kWh/m^3. The report calculated that the operational energy intensity of the WDC water supply network averaged 0.43kWh/m^3 over the last three years. This includes the power demands to treat and pump the water around the network. This means that on average it takes 2.5 times more power to provide rainwater from a tank than it does to provide water from the town supply. As WDC is a large power user, we get a more favorable rate than most domestic customers. The report calculates that over the lifetime of a tank, the cost of pumping for rainwater harvesting is $0.45/$m^3$ compared to $0.11/$m^3$ for the town supply. Consequently, the cost of power for a rainwater tank pump to provide 1m^3 of water is 4 times more expensive than that for Council to provide it.

3.4 Environmental Impact

As shown above, where a small domestic pump is used, the power demand is 2.5 times greater than that required to produce town water. A report by the Environmental Agency in the UK found that, on average rainwater systems had a carbon footprint 1.4 times greater than mains water supply. The study concluded that… *"Buildings using rainwater tanks or treated greywater typically increase greenhouse gas emissions compared to mains water".* They also suggested that… *"decision makers should review the current situation where rainwater and greywater systems are essentially universally encouraged"*. This information can be found here
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291745/scho0610bsmq-e-e.pdf

Plastic storage tanks account for a large portion of the carbon footprint of rainwater systems and these tanks also represent unique challenges for future end of life disposal.

3.5 Rainwater for Emergency

In an emergency situation, when the power is disrupted, or particularly after an earthquake when the town supply infrastructure could be damaged, stored rainwater would be very beneficial. Emergency tanks do not need to have pumps and can be smaller than the tanks discussed above, depending on the length of emergency that is being planned for. Ideally, an emergency tank should be full at the start of an emergency so use of the water in the tank below an emergency level is not encouraged for everyday activities. In these situations, a tank as small as 200 litres may be beneficial. These supplies are likely to be of poor quality and would need to be treated or boiled before consumption. They would be useful for toilet flushing, non-consumptive hygiene and clothes washing when no other source of water is available.

3.6 Conclusion

The use of rainwater tanks to supplement the town supply within the urban area is of limited benefit. Rainwater tanks provide only a very small additional storage and will not reduce the cost of infrastructure required by Council in the future. The cost of water supplied from rainwater tanks is greater than that from the town supply and the environmental impact is also greater. It would be difficult to justify requiring residents to install and use rainwater tanks in the urban area when the cost of the water from tanks is more than the cost of the water provided by Council.

4 Attachments

1. Energy Intensity of Rainwater Harvesting System versus Reticulated Mains Water Supply – Power and Process Chemistry

Making process chemistry work for you

Whangarei District Council

Energy Intensity of Rainwater Harvesting System versus Reticulated Mains Water Supply

Prepared for:

Whangarei District Council

Andrew Venmore – Water Services Manager

Report No. R20012.2.1

Revised Report – 28 October 2020

Revision History

Report Number	Status	Date of Issue	Details of Change
R20012.1.0	Final	15/09/2020	Final report incorporating water usage and power usage data from WDC water treatment plants and pump stations.
R20012.2.0	Revised	16/10/2020	Update to Version 1.0, including new information on RWH system equipment lifecycle costs, and corrected data for water network power usage.
R20012.2.1	Revised	28/10/2020	Additional information on lifecycle cost of dedicated RWH systems. Correction to position of backflow preventer in Fig. 2.

Report Prepared By

HUGH FALLON (BENG), CONSULTANT – WATER CHEMISTRY, POWER & PROCESS CHEMISTRY LTD

Contents

Executive Summary

This report compares the Operational Energy Intensity of a typical domestic/residential Rainwater Harvesting (RWH) system to the Operational Energy Intensity of the reticulated potable water provided by Whangarei District Council (WDC). This report also compares the equipment lifecycle cost of the RWH system per cubic meter of water delivered to the cost per cubic meter of potable water provided by WDC.

Operational Energy Intensity

The Operational Energy Intensity of the proposed RWH system is 1.10 kWh/m^3 of rainwater delivered, where the consumption of rainwater is 50 cubic meters per annum and the primary use of the rainwater is for irrigation of gardens and other landscaped areas, and for other outside washing and cleaning purposes, e.g., cars, windows, driveways, etc.

The Operational Energy Intensity of the reticulated potable water provided by Whangarei District Council was 0.38 kWh/m^3, 0.41 kWh/m^3, and 0.49 kWh/m^3 for the 2017/18, 2018/19 and 2019/20 financial years respectively, where the Council's financial year runs from July to June. The higher Operational Energy Intensity value for the 2019/2020 financial year was due to the extended drought during the first half of 2020, and reflects the increased use of pumped river water as the supply to WDC's drinking water treatment plants, rather than the usual gravity flow from the storage dams.

The Operational Energy Intensity of the proposed RWH system is therefore 2 to 3 times that of WDC's reticulated water supply.

Based on a 2009 study (Beacon Pathway Limited), the Operational Energy Intensity of reticulated water supply for two other District/City Councils of similar geographic extent and topography to Whangarei District Council was reported in the range 0.39 – 0.44 kWh/m^3. If Whangarei District Council's power usage in the 2019/20 financial year is atypical, as is assumed due to the extended drought event during that financial year, then the Council's Operational Energy Intensity of reticulated water supply compares favourably to that of its peers.

RWH System Lifecycle Costs

The cost per cubic meter of rainwater over the assumed 25-year lifecycle of the proposed RWH system is calculated as $10.04/m^3. The pumping cost per cubic meter of rainwater delivered is $0.45/m^3, based on the RWH system Operational Energy Intensity of 1.10 kWh/m^3 and an average electricity unit cost over the life of the RWH system of $0.41/kWh.

The total cost per cubic meter of rainwater delivered over the lifetime of the RWH system is therefore $10.49/m^3.

By comparison, over the 25-year lifecycle of the RWH system, the average cost per cubic meter of reticulated water from the WDC network is calculated as $2.52/m^3. Therefore, when annual water consumption is relatively low, as per the 50 m^3/annum rainwater usage in this assessment, it is greatly more cost-efficient for a residential customer to take water from the Council's reticulated supply than to install and operate a RWH system, notwithstanding the advantages that a RWH system can present in providing a short-term supply of water during a civil emergency or drought event.

Over the 25-year lifecycle of the RWH system, WDC's pumping cost per cubic meter of potable water delivered to a residential property is $0.11/m^3. This is one-quarter of the $0.45/m^3 pumping cost for the proposed RWH system.

All costs shown are exclusive of Goods and Services Tax (GST).

1 Operational Energy Intensity of Domestic Rainwater Harvesting System

1.1 Typical Rainwater Harvesting System

A typical domestic rainwater harvesting (RWH) system is shown in Figure 1. A system consists primarily of a water storage tank and fixed-speed pump. Coarse and fine filters and other debris-management devices can be installed at the inlet and outlet of the storage tank to limit the build-up of natural vegetation material (leaves, etc.) that could otherwise accumulate in the rainwater guttering and within the tank itself.

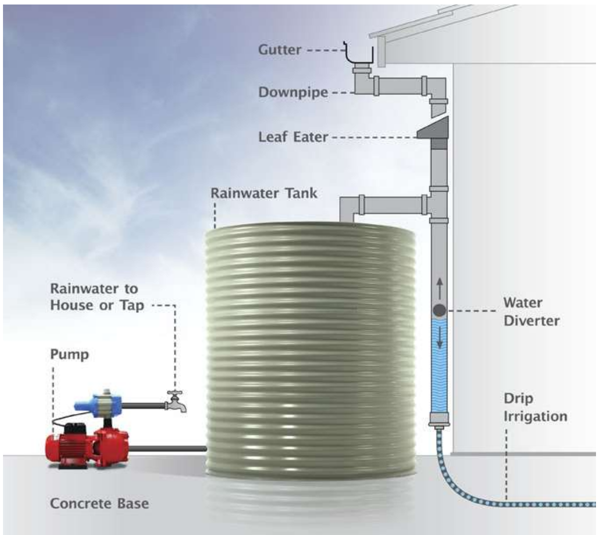


Figure 1: Typical domestic rainwater harvesting system (image from Just Water Pumps, Australia)

1.2 Rainwater Usage

Whangarei District Council water usage data shows that the average domestic consumption of reticulated water in the 2020 financial year was 162.5 m^3 per household.

In a typical household, the breakdown of water usage is as follows[1]:

[1] Northland Regional Council. Source: https://www.nrc.govt.nz/environment/water/caring-for-our-water/saving-water.

- Bathroom (25%)
- Toilet (30%)
- Kitchen and laundry (25%)
- Outdoors (20%)

For this study, rainwater for outdoors use is assumed to be 30% of total annual consumption. This higher value (relative to the national average) provides a more conservative basis for calculating the cost of the RWH system per cubic meter of rainwater delivered. The RWH system would therefore replace 162.5 m^3 x 30% ≈ 50 m^3 of annual water demand from the reticulated mains water supply.

Table 1 shows the typical water consumption rates in litres per minute (LPM) for different home devices and appliances. Since the purpose of the RWH system is for outdoors use, and particularly for sprinkler-type irrigation, the average water consumption rate when the RWH system is in service is taken conservatively to be 11.5 litres per minute, the average of the range shown for a lawn sprinkler.

Typical Domestic Water Consumption Rates	
Device / Appliance	**Usage Rate (LPM)**
Standard tap	4 – 8
Standard shower head	12 – 16
Washing machine	12 – 18
Dishwasher	12 – 18
Toilet	6 - 8
Garden hose	15 - 20
Lawn sprinkler	8 - 15

Table 1: Typical water consumption rates (LPM) for different home devices and appliances

1.3 RWH Water Storage Tank

Dwellings in rural areas that use rainwater to meet all household water consumption have storage tank capacities based on the average per person water usage of 250 litres per day[2], equivalent to 230 m^3 per annum[3]. A useful rule-of-thumb for sizing rainwater storage tanks is to allow for at least 10% of the annual water consumption, which allows for a reasonable turnover rate of stored water while providing

[2] http://www.wdc.govt.nz/WaterandWaste/Water/Pages/WaterConservationTips.aspx
[3] Based on an average 2.5 occupants per dwelling in the Whangarei District Council area. Source: Statistics New Zealand, Census of Population and Dwellings 2013 and 2018.

6 weeks reserve during low-rainfall periods. Using the above figures, this would equate to an installed storage tank capacity of at least 23 m^3; the closest standard tank size (in plastic) would then be 25 m^3.

A similar approach is taken for the sizing of the storage tank for the RWH system. For 50 m^3 annual usage, the recommended size for the storage tank would be 5,000 litres (10% of 50 m^3).

The RWH water storage tank can be installed below-ground or at ground level. The two most common materials of construction are concrete and plastic (ideally UV-stabilised, food-grade polyethylene). For this study, the simplest and most cost-effective RWH storage tank installation is assumed, i.e., an above-ground, plastic tank.

It is assumed the RWH storage tank remains connected to the reticulated water supply (Figure 2), to provide flexibility to the homeowner to keep the tank topped up during periods of low rainfall. The RWH system would therefore require the use of a backflow preventer on the connection from the reticulated main, downstream of the water meter as shown in the figure.

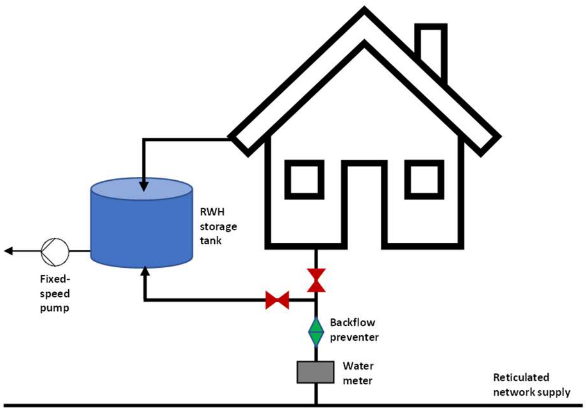
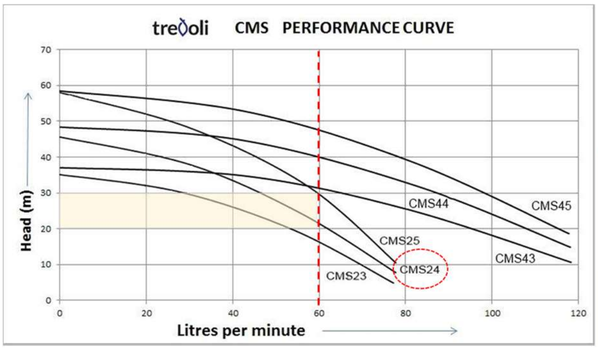


Figure 2: RWH system with connection to the reticulated water main

1.4 RWH Water Pump

For outdoor use, and to ensure adequate water flow and pressure to all parts of the property, the RWH system pump should be capable of providing 20 – 30 meters of water head. While lower than the 50 meters of water head available from the reticulated supply, a high-pressure pump is not considered necessary for the primary end-use of the RWH system, which is irrigation and outdoor washing.

The total pump capacity should be at least 5 times the average water consumption rate, to allow for multiple and simultaneous end-uses, in this case 5 x 11.5 LPM ≈ 60 LPM. Figure 3 shows the performance and technical data for one brand of water pump (Trevoli CMS24) that can meet the stated flow rate and pressure requirements.



Technical Data

Model	Power (kw)	Max Head (m)	Max Flow (LPM)	Pressure PSI	Weight (kg)	Inlet (mm)
CMS23	.55	34	60	50	10	25
CMS24	.75	45	60	60	12	25
CMS25	1.0	57	60	80	13	25
CMS43	.75	36	110	52	13	25
CMS44	1.0	48	110	68	14	25
CMS45	1.5	60	110	87	18	25

Figure 3: Performance and technical data for water pump operating at 60 LMP and 2 - 3 bar (Trevoli)

The pump in the example given has a motor power of 0.75 kilowatts (kW). The motor power can also be derived as follows. First assume that the water pump has a small, positive suction head of 2 meters and increases the water pressure by a maximum 32 meters at the full flow of 60 LPM, equivalent to 0.001 m^3/s.

The hydraulic power requirement, P_h in kW is:

$$P_h = \text{Flow } (m^3/s) \times \text{Head } (m) \times g \ (m/s^2) \ldots \text{ where g is acceleration due to gravity, } 9.81 \ m/s^2.$$

$$P_h = 0.001 \ (m^3/s) \times 32 \ (m) \times 9.81 \ (m/s^2) = 0.314 \text{ kW}$$

The electrical power requirement for the water pump, P_i in kW is:

$$P_i = P_h \div (\text{pump efficiency} \times \text{motor efficiency})$$

Typical values for domestic water pump and motor efficiencies are 55% and 80% respectively, which accounts for the frequent start-stop operating profile of such pumps. Hence,

$$P_i = 0.314 \text{ kW} \div (55\% \times 80\%) = 0.71 \text{ kW}$$

This calculated result for the electrical power requirement for the water pump motor compares closely to the 0.75 kW given for the example of the Trevoli CMS24 pump. This value of 0.75 kW is taken as the representative pump motor power rating for the proposed RWH system.

1.5 Operational Energy Intensity of RWH Pump System

The average water consumption rate when the RWH system is in service is taken as 11.5 litres per minute, or 0.000192 m^3/s. It would therefore take, on average, 5,220 seconds to pump 1 m^3 of water from the storage tank (1 ÷ 0.000192 $m^3/s \approx$ 5,220 s/m^3).

5,220 seconds is 1.45 hours, which is the average time the pump operates for each cubic meter of water delivered. The Operational Energy Intensity of the pump system is the number of kilowatt-hours (kWh) of power required to operate the pump per cubic meter of rainwater delivered, and is given by:

Operational Energy Intensity (kWh/m^3) = Pump Operating Time/m^3 x Motor Power (kW)

RWH Pump System Operational Energy Intensity (kWh/m^3) = 1.45 h/m^3 x 0.75 kW = **1.1 kWh/m^3**

The Environment Agency (UK) prepared a report in 2010 titled, 'Energy and Carbon Implications of Rainwater Harvesting and Greywater Recycling' (Report: SC090018). This report reproduces the work of Retamal et al. (2009)[4], who compared theoretical models of pump energy use for single home rainwater systems with monitored pump energy use. The pump energy models were found to provide a reasonable estimate of the operational energy use of rainwater systems. The pump model results, shown in Table 2 below, illustrate how the pump energy demand in direct feed systems varies depending on the end use being supplied.

Pump model:	Constant power model	Pump 1	Pump 2	Pump 3	units
Nominal motor power	750	500	770	890	W
Average whole house	**1.5**	**0.9**	**1.1**	**1.4**	kWh/m³
Faucets	2.9	1.8	2.1	2.6	
Toilets	2.7	1.7	1.9	2.4	
Clothes washer	0.9	0.5	0.7	0.9	
Irrigation	0.8	0.4	0.6	0.8	
Showers	1	0.6	0.8	1	
Baths	0.8	0.4	0.6	0.8	
Leaks	96.4	64	67.9	80	

Table 2: Energy intensity of home rainwater pumping by end use (Retamal et al., 2009)

[4] RETAMAL, M., GLASSMIRE, J., ABEYSURIYA, K., TURNER, A. AND WHITE, S., 2009. The Water-Energy Nexus - Investigation into the Energy Implications of Household Rainwater Systems. Institute for Sustainable Futures, University of Technology Sydney, Australia.

The Retamal analysis has two pump scenarios with a nominal motor power close to the 0.75 kW used in this study. The Retamal 'Pump 2' scenario uses a more efficient pump and so comparison will be made against the data for this 'Pump 2'.

Taking the mid-range of values for household water consumption rates in Table 1, and applying these to the calculations carried out above, the Operational Energy Intensity of each domestic household device / appliance is calculated and shown in Table 3. The rightmost column includes the Retamal et al. value (for the 'Pump 2' motor power model, i.e., 0.77 kW) for those entries where there is a direct comparison in Table 2.

Operational Energy Intensity of RWH System by End Use Pump Motor Power = 0.75 kW			
Device / Appliance	**Average Usage Rate (LPM)**	**WDC Operational Energy Intensity (kWh/m³)**	**RETAMAL et al. Operational Energy Intensity (kWh/m³)**
Standard tap	6	2.1	2.1
Standard shower head	14	0.9	0.8
Washing machine	15	0.8	0.7
Dishwasher	15	0.8	
Toilet	7	1.8	1.9
Garden hose / irrigation	17.5	0.7	0.6
Lawn sprinkler	11.5	1.1	-
Average for Whole House	**12.3**	**1.18**	**1.1**

Table 3: Operational Energy Intensity of RWH System, WDC and Retamal et al.

The Operational Energy Intensity end-use values for this study agree closely with those of Retamal et al., and the household average kWh/m^3 values are essentially the same in the two analyses. The average value of 1.1 kWh/m^3 for the Retamal assessment is the same value as for the proposed RWH system, where the primary use of the rainwater is for irrigation of gardens and other landscaped areas, and for other outside washing and cleaning. Hence, the Operational Energy Intensity of a RWH pump system in the Whangarei District Council area is specified as 1.10 kWh/m^3 when the primary application of the RHW system is for outdoor use.

2 Operational Energy Intensity of WDC Reticulated Mains Water Supply

2.1 Total Annual Reticulated Water Usage

The total annual usage of reticulated water is assumed to be the total volume produced by the seven Whangarei District Council (WDC) drinking water treatment plants. This total annual usage will include all consumption by residential, commercial, and industrial users, and any non-metered system losses due to leaks, line-flushing, etc.

Table 4 shows the total production per annum for each water treatment plant for the years 2017-2018, 2018-2019 and 2019-2020. The production year follows the Council's financial year, i.e., 1st of July to 30th of June.

Annual Supply of Water from WDC Water Treatment Plants to Reticulated Networks			
Water Treatment Plant	Total Water Treatment Plant Production (m^3)		
	Jul 2017 – Jun 2018	Jul 2018 – Jun 2019	Jul 2019 – Jun 2020
Whau Valley	3,709,213	3,436,273	3,326,446
Poroti	1,520,012	1,728,863	2,408,461
Maunu	1,384,145	1,533,402	1,245,508
Ahuroa	1,090,398	1,227,259	1,365,233
Ruakaka	1,770,547	1,707,420	1,482,006
Maungakaramea	34,509	48,507	44,629
Mangapai	10,471	12,215	12,028
TOTAL	**9,519,295**	**9,693,939**	**9,884,311**

Table 4: Annual supply of water (m^3) from WDC WTPs to reticulated networks, 2017-2020

2.2 Annual Power Usage for WTPs and Pump Stations

Table 5 shows the annual power usage in kWh for the top 10 consumers and the total power usage for all Whangarei District Council drinking water treatment plants and pump stations.

Annual Power Usage (kWh) Top 10 Consumers and Total Power Usage for all WDC Plants and Pump Stations					
Jul 2017 – Jun 2018		**Jul 2018 – Jun 2019**		**Jul 2019 – Jun 2020**	
Location	***kWh***	***Location***	***kWh***	***Location***	***kWh***
Cutforths Pumps Mangakahia Rd	974,585	Cutforths Pumps Mangakahia Rd	1,119,716	Cutforths Pumps Mangakahia Rd	1,628,788
Kamo (Forward) Boosters Whau Valley Rd	953,797	Kamo (Forward) Boosters Whau Valley Rd	951,467	Kamo (Forward) Boosters Whau Valley Rd	1,017,137
WTP Ahuroa	368,477	WTP Ahuroa	441,968	WTP Ahuroa	502,155
Water Pump, State Highway 1	228,447	Water Pump, State Highway 1	243,269	Water Pump Hatea River	425,022
WTP Whau Valley	184,523	WTP Whau Valley	189,267	WTP Whau Valley	197,798
Pump; Cnr Mackesy & Onerahi Road	148,957	Water Pump Hatea River Reed Park	177,822	Water Pump, State Highway 1	143,780
Water Pump, Tuatara Drive	68,557	Water Pump, Whau Valley Road	175,787	Pump; Cnr Mackesy & Onerahi Road	105,025
Mcleods Bay Water Plant	52,892	Pump; Cnr Mackesy & Onerahi Road	157,610	Water Pump, Tuatara Drive	76,062
WTP Maunga-karamea, Pump, Stonehaven Drive	46,373	Water Pump, Tuatara Drive	79,330	Water Pump Waitaua Rd Vinegar Hill	62,820
Water Pump Waitaua Rd Vinegar Hill	40,980	Mcleods Bay Water Plant	56,469	WTP Maunga-karamea, Pump, Stonehaven Drive	56,351
ALL SYSTEMS	**3,580,272**	**ALL SYSTEMS**	**3,996,382**	**ALL SYSTEMS**	**4,851,496**

Table 5: Top 10 annual power usage (kWh) for water treatment plants and pump stations, 2017-2020

2.3 Operational Energy Intensity of WDC Mains Water Supply

The information presented in Section 2.1 and Section 2.2 is used to calculate the Operational Energy Intensity of mains water supply for the Whangarei District Council networks. Table 6 summarises the results for each of the past three financial years (July to June).

Whangarei District Council Operational Energy Intensity of Mains Water Supply (kWh/m^3) for Past Three Financial Years			
	Jul 2017 – Jun 2018	**Jul 2018 – Jun 2019**	**Jul 2019 – Jun 2020**
Total Water Usage in All Networks, m^3	9,519,295	9,693,939	9,884,311
Total Power Usage for all WDC Plants and Pump Stations, kWh	3,580,272	3,996,382	4,851,496
Operational Energy Intensity of Mains Water Supply, kWh/m^3	0.38	0.41	0.49

Table 6: Operational Energy Intensity of WDC mains water supply (kWh/m^3)

Note from Table 6 that the percentage increase in water usage from the 2018/19 financial year to the 2019/20 financial year was 2.0%, whereas the percentage increase in power usage over the same two financial years was 21.4%. This large increase in power usage in the 2019/20 financial year was due to the extended drought during the first half of 2020, and reflects the increased use of pumped river water as the supply to WDC's drinking water treatment plants, rather than the usual gravity flow from the storage dams. This accounts for the significant increase in the Operational Energy Intensity of WDC mains water supply for the 2019/20 financial year.

2.4 Operational Energy Intensity of Mains Water Supply for Other District and City Councils

A 2009 study by Beacon Pathway Limited[5] examined the operational energy component of urban water systems and reported the Operational Energy Intensity of reticulated water supply for:

- Waitakere City Council;
- Palmerston North City Council;
- Kapiti Coast District Council; and,
- Nelson City Council.

Table 7 gives a summary of the Operational Energy Intensity information in the Beacon study, which includes both the total volume of potable water produced/used and the energy consumed.

[5] Energy-Water Relationships in Reticulated Water Infrastructure Systems, WA7090/2, Beacon Pathway Limited, 2009.

Operational Energy Intensity of Mains Water Supply for Other District and City Councils (Beacon, 2009)			
City / District Council	Total Potable Water Volume Produced / Used (m^3)	Total Energy Consumption for Potable Water Supply (kWh)	Operational Energy Intensity of Mains Water Supply (kWh/m^3)
Waitakere City Council	17,054,177	4,034,178	0.24
Palmerston North City Council	10,391,426	1,538,612	0.15
Kapiti Coast District Council	7,817,730	3,472,179	0.44
Nelson City Council	8,115,000	3,131,692	0.39

Table 7: Operational Energy Intensity for Other District and City Councils (Beacon, 2009)

Kapiti Coast District Council and Nelson City Council are considered similar to Whangarei District Council with respect to the population served and a geographic area and topography that necessitates a significant pumping requirement to supply reticulated water to all networked customers. Whangarei District Council's Operational Energy Intensity of mains water supply for the 207/18 and 2018/19 financial years compares favourably with Kapiti Coast District Council and Nelson City Council.

3 Cost per Cubic Meter of Water Delivered

3.1 Cost per Cubic Meter of Water Delivered for RWH System

3.1.1 Equipment for RWH System

The RWH system should be simple and cost-effective to install and maintain. The simplest system is an above-ground plastic tank with a fixed-speed centrifugal pump. The storage tank should be of slimline design, in keeping with the more limited space available in typical urban and semi-urban sections.

For maximum usability of the RWH system, it is assumed the RWH storage tank can be filled either with rainwater or from the reticulated mains, through use of isolation valves and a backflow preventer on the mains water connection (refer to Figure 2).

To minimise maintenance on the storage tank system, a leaf-screen device should be employed in the guttering to prevent leaves and other vegetation and debris from accumulating in the gutters. The average property floor area[6] is assumed to be 180 m^2, with an effective roof area of 200 m^2, given as 10 meters wide and 20 meters long. It is assumed that half the available length of guttering, i.e., 30 meters, is connected to the RWH storage tank.

A first-flush diverter is recommended, as is a cartridge filter unit on the pump outlet; these devices are recommended to ensure good quality water, even when the primary application of the RHW system is for outdoor use.

3.1.2 Equipment and Installation Costs

Table 8 itemises the costs for the proposed RWH system equipment. Apart from the slimline storage tank, all other equipment is essentially off-the-shelf, and can be procured from hardware stores or other irrigation, pumping and filtration providers.

[6] https://www.stats.govt.nz/news/new-homes-around-20-percent-smaller

Although a building consent is not required for a small, above-ground tank installed at ground level, the installation costs assume the use of a labourer or handyman. Electrical installation of the water pump can only be carried out by a qualified electrician.

Equipment and Installation Costs for a Rainwater Harvesting System	
Equipment Supply	
Item	**Cost (ex GST)**
5,000 litre slimline tank, polyethylene	$2,900.00
60 litre-per-minute fixed-speed pump, 0.75 kW	$550.00
Gutter guard, 30m	$300.00
First-flush diverter	$125.00
Downpipe debris diverter (used during maintenance of gutters)	$45.00
Downpipe and stormwater connections and fittings	$200.00
Backflow preventer	$250.00
Cartridge filter housing + 10-micron filter	$95.00
Valves and pipe fittings (for mains connection)	$200.00
Installation	
Tank Installation • Concrete footing • Parts and materials • Labour (12 hours at $85/hr)	$1,920.00
Pump Installation • Materials • Labour (4 hours at $110/hr)	$840.00
Total Cost for Equipment and Installation	**$7,425.00**

Table 8: Equipment and installation costs for a typical above-ground RWH system

3.1.3 Maintenance Costs

Since the proposed RWH system is for outdoor use, only basic maintenance is required, consisting of annual cleaning of the tank and guttering, and replacement of the cartridge filter (if used). These activities could be carried out for an annual cost of $60. Allowance is made for the water pump to be replaced once over the life of the RWH system (25 years). Annual testing of the integrity of the backflow preventer would be required as per Whangarei District Council policy[7], at a cost to the resident of around $80 ex GST. Amortising the cost of pump replacement over the life of the RWH system and allowing for inflation, the annual maintenance cost for the RWH system is proposed as $205 ex GST.

3.1.4 Total Lifecycle Costs

All equipment is assumed to have a lifecycle of 25 years[8], except the pump, which is assumed to be replaced once during this time. The total maintenance cost over the 25 years, including allowance for pump replacement, is therefore 25 x $205 = $5,125. Including the cost for equipment purchase and installation, the total lifecycle cost for the RWH system is $12,550 ex GST.

3.1.5 Cost per Cubic Meter of Rainwater Delivered

If 50 m^3 of rainwater is used in the RWH system each year, then the total rainwater usage is 1,250 m^3 over the 25-year lifecycle of the system.

The cost per cubic meter of rainwater over the life of the system is therefore $12,550 ÷ 1,250 = $10.04/$m^3$ ex GST.

From Section 2 of this report, the RWH pump system Operational Energy Intensity is 1.10 kWh/m^3. The unit cost of electricity for a residential customer on a typical 8,000 kWh per annum usage plan in the Whangarei area is taken as $0.326/kWh inclusive of GST, as shown in Figure 4 (Ministry of Business, Innovation, and Employment[9]). The GST-exclusive cost of electricity in the Whangarei area is therefore $0.28/kWh. This cost includes transmission and distribution charges.

Assuming a 3% per annum escalation rate in the cost of domestic electricity, the average unit cost over the 25-year lifecycle of the RWH system is $0.41/kWh. The pumping cost per cubic meter of rainwater delivered is thus 1.10 kWh/m^3 x $0.41/kWh = $0.45/$m^3$.

The total cost per cubic meter of rainwater delivered, over the lifetime of the RWH system, is $10.04/$m^3$ + $0.45/$m^3$ = $10.49/$m^3$ exclusive of GST.

[7] Whangarei District Council Policy. Backflow Prevention Policy and Code of Practice. Policy 0020.
[8] Typical manufacturer's warranty for plastic/polyethylene tanks is 25 years. http://www.bluescopesteel.com.au/index.cfm?objectID=B303F6BA-88F6-475DAEE714D5A6DE2644.
[9] https://www.mbie.govt.nz/assets/qsdep-report-15-may-2020.pdf. Includes transmission/distribution charges and GST.

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

Quarterly Survey of Domestic Electricity Prices

Nominal indicators on 15 May 2020

Modelled NZ Consumer - 22 kWh per day on cheapest low user tariff available without a fixed term contract.

Location	Lines Company	Notes	Indicators on 15-5-2020 Retail c/kWh	Lines Comp c/kWh	Energy and Other c/kWh
New Zealand			30.7	11.1	19.6
North Island					
Kerikeri	*Top Energy*	1	41.67	21.6	20.1
Whangarei	*Northpower*	2	32.60	12.1	20.5
Auckland North Shore	*Vector (Northern)*		29.69	10.6	19.1
Auckland Central	*Vector (Auckland)*	3	28.95	10.6	18.4
Pukekohe	*Counties Power*	4	31.38	12.8	18.6
Tauranga	*Powerco (Tauranga)*	5	33.45	10.6	22.8
Hamilton	*WEL Networks*		30.78	10.6	20.2
Thames	*Powerco (Thames Valley)*		32.64	11.4	21.3
Cambridge	*Waipa Networks*	6	29.31	8.7	20.6
Whakatane	*Horizon Energy (Urban)*		30.06	11.7	18.4
Rotorua	*Unison (Rotorua)*		32.67	11.4	21.2
Taupo	*Unison (Taupo)*		32.69	11.4	21.3
Gisborne	*Eastland (High Density)*		35.20	14.6	20.6
New Plymouth	*Powerco (Western A - Nth Taranaki)*		30.18	9.9	20.2
Otorohanga	*The Lines Company (Hangatiki GXP - LV High Density)*		33.53	14.4	19.1
Taumaranui	*The Lines Company (Ongarue GXP - LV High Density)*	7	33.53	14.4	19.1
Napier	*Unison (Hawke's Bay)*	8	31.71	12.0	19.7
Hawera	*Powerco (Western B - Sth Taranaki)*		33.53	11.9	21.6
Waipukurau	*Centralines*	9,10	38.07	20.0	18.1
Whanganui	*Powerco (Western A - Whanganui)*		31.26	9.9	21.3
Dannevirke	*Scanpower*	11	33.84	15.1	18.7
Masterton	*Powerco (Western B - Wairarapa)*		33.38	11.9	21.5
Palmerston North	*Powerco (Western A - Manawatu)*		30.36	9.9	20.4
Paraparaumu	*Electra*	12	29.70	11.9	17.8
Wellington City	*Wellington Electricity Lines*		28.95	9.7	19.2

Note	Type	Made by	Amount for model customer
1	Lines company discount	Top Energy	2.5 c/kWh
2	Lines trust distribution	Northpower Electric Power Trust	1.5 c/kWh

Figure 4: New Zealand domestic electricity prices, including Whangarei area, May 2020

By comparison, for rural properties that use rainwater to meet all household water consumption (average of 230 m^3 per annum, as per Section 1.3), the cost per cubic meter of rainwater delivered for a well-designed RWH system that consistently provides safe drinking water can be summarised as follows, with all costs shown exclusive of GST, and where the 25-year lifecycle cost is based on the use of above-ground, polyethylene tanks:

- 2 x 25 m^3 polyethylene water tanks, 25-year lifecycle: $6,250
- Pump, automatic flow control, 1.1 kW motor, 80 LPM flow at 50 m head: $1,200
- High-flow UV water filter system: $1,600
- System installation (tanks, pump, piping and fittings): $3,200
- Total: $12,250

Maintenance costs—for annual tank cleaning and replacement of UV water filter system consumables, and for ongoing upkeep and eventual replacement of the water pump, UV steriliser, and other fittings and devices, such as a leaf-guard, first-flush diverter, etc.—is estimated at an average $450 per annum. Total maintenance cost over the 25-year life of the storage tanks is therefore 25 x $450 = $11,250. Including the cost for equipment purchase and installation, the total lifecycle cost for the RWH system is $23,500 ex GST.

If an average 230 m^3 of rainwater is used in the RWH system each year, then the total rainwater usage is 5,750 m^3 over the 25-year lifecycle of the system.

The cost per cubic meter of rainwater over the life of the system is therefore $23,500 ÷ 5,750 = $4.09/$m^3$ ex GST.

Using the analysis from Section 2 of this report, the RWH pump system Operational Energy Intensity can be calculated as 1.50 kWh/m^3 for the overall household. The average unit cost of electricity over the 25-year lifecycle of the RWH system is estimated at $0.41/kWh. The pumping cost per cubic meter of rainwater delivered is thus 1.50 kWh/m^3 x $0.41/kWh ≈ $0.62/$m^3$.

The total cost per cubic meter of rainwater delivered, over the lifetime of the RWH system, is $4.09/$m^3$ + $0.62/$m^3$ = $4.71/$m^3$ exclusive of GST. This does not include any costs to purchase tankered water if required during extended dry periods.

3.2 Cost per Cubic Meter of Reticulated Water from WDC Network

The 2020 cost per cubic meter of reticulated water from the WDC network to a residential customer is $1.97 (ex GST). This cost includes network infrastructure depreciation and so provides for future capital costs for new plant and for network growth. A 2% per annum escalation rate in the cost of reticulated water is assumed. Over the 25-year lifecycle of the RWH system, the average cost per cubic meter of reticulated water is calculated as $2.52/$m^3$ ex GST. This compares to $10.49/$m^3$ (ex GST) for a RWH system supplying 50 m^3 of water per annum. Therefore, when annual water consumption is relatively low, it is greatly more cost-efficient for a residential customer to take water from the Council's reticulated supply than to install and operate a RWH system, notwithstanding the advantages that a RWH system can present in providing a short-term supply of water during a civil emergency or drought event.

3.3 WDC's Pumping Cost per Cubic Meter of Reticulated Water

The pumping cost per cubic meter for WDC to provide reticulated water to a residential customer is the reticulated network Operational Energy Intensity value multiplied by the average unit cost of electricity paid by WDC for their water treatment plants and pumping stations. Since the Operational Energy Intensity value for the 2019/20 financial year was an outlier, due to the extended drought during that year, it is more reasonable to take the average of the two previous financial years as the baseline value for Operational Energy Intensity. From Table 6 in Section 2.3, that average Operational Energy Intensity value is 0.395 kWh/m^3.

The unit cost of electricity (ex GST) paid by WDC for each month of the 2019/20 financial year is shown in Table 9.

Unit Cost of Electricity Paid By WDC for Each Month of the 2019/20 Financial Year			
Month	**Total Power Usage (kWh)**	**Total Electricity Cost (ex GST)**	**Electricity Unit Cost ($/kWh)**
July	436,788	$90,772.17	$0.21
August	450,118	$94,365.22	$0.21
September	387,787	$82,106.09	$0.21
October	409,888	$69,176.52	$0.17
November	430,113	$75,806.09	$0.18
December	427,283	$78,794.78	$0.18
January	434,293	$85,407.83	$0.20
February	378,002	$70,600.00	$0.19
March	388,292	$76,214.78	$0.20
April	366,033	$71,096.52	$0.19
May	378,370	$74,326.96	$0.20
June	364,530	$73,568.70	$0.20
Average Electricity Unit Cost ($/kWh)			**$0.19**

Table 9: WDC electricity unit cost for the 2019/20 financial year

The average electricity cost for the financial year was $0.19/kWh (ex GST). Assuming a 3% per annum escalation rate in the cost of electricity, the average unit cost of electricity paid by WDC, over the 25-year lifecycle of the RWH system, is $0.28/kWh, exclusive of GST.

Over the 25-year lifecycle of the RWH system, WDC's pumping cost per cubic meter of potable water delivered to a residential property is thus 0.395 kWh/m^3 x \$0.28/kWh = \$0.11/m^3. This is one-quarter of the \$0.45/m^3 pumping cost for the proposed RWH system.

3.4 Carbon Footprint of RWH System

From the previous calculations, it can be seen that the proposed RWH system uses more power per cubic meter of water delivered than water supplied from the WDC reticulated network. Hence, it might be concluded that RWH systems have a larger carbon footprint. This conclusion is supported by the Environment Agency (UK) 2010 report on 'Energy and Carbon Implications of Rainwater Harvesting and Greywater Recycling'[10], which presents the findings of a study into the energy and carbon implications of RWH (and greywater recycling) systems for residential and commercial buildings. The review was commissioned jointly with the Energy Saving Trust (EST) and National House Building Council (NHBC) Foundation.

The report concluded that the operational energy and carbon intensities of the RWH systems studied were higher than for mains water by around 40%. Buildings using harvested rainwater were found to increase greenhouse gas emissions compared to using mains water, where total "cradle-to-gate"[11] embodied and operational carbon are considered. For example, over 30 years, where an average 90m^2 house has a RWH system with a polyethylene tank, the total carbon footprint is approximately 1.25 – 2 tonnes of carbon dioxide equivalent (CO_2e). The higher end of the range is equivalent to greenhouse gas emissions from 8,000 km driven by an average passenger vehicle, or CO_2 emissions from 850 litres of petrol consumed[12].

Storage tanks account for a large proportion of the embodied carbon footprint of rainwater systems. Life-consumed plastic tanks also represent unique future challenges for disposal, as these tanks may not be suitable for recycling, or the cost of recycling may be high and may further add to the lifecycle carbon footprint of the RWH system.

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[10] *Energy and carbon implications of rainwater harvesting and greywater recycling*. Report: SC090018. Environment Agency (UK) – August 2010.

[11] A life cycle assessment covering manufacture ('cradle') to the factory gate. Transport to the consumer, operational energy consumption and disposal are not included.

[12] United States Environmental Protection Agency. Greenhouse Gas Equivalencies. https://www.epa.gov/energy/greenhouse- gas-equivalencies-calculator.

4 Summary

This report compares the Operational Energy Intensity of a typical domestic/residential Rainwater Harvesting (RWH) system to the Operational Energy Intensity of the reticulated potable water provided by Whangarei District Council (WDC).

The operating energy requirements of a simple RWH system, consisting of an above-ground, polyethylene tank and a fixed-speed, 0.75 kW water pump have been evaluated, where the consumption of rainwater is 50 cubic meters per annum and the primary use of the rainwater is for irrigation of gardens and other landscaped areas, and for other outside washing and cleaning purposes, e.g., cars, windows, driveways, etc. The typical average water consumption rate when the RWH system is in service is taken conservatively as 11.5 litres per minute. The Operational Energy Intensity of the RWH system is calculated to be 1.10 kWh/m^3 of rainwater delivered.

The Operational Energy Intensity of the reticulated potable water provided by Whangarei District Council was 0.38 kWh/m^3, 0.41 kWh/m^3, and 0.49 kWh/m^3 for the 2017/18, 2018/19 and 2019/20 financial years respectively, where the Council's financial year runs from July to June. The higher Operational Energy Intensity value for the 2019/2020 financial year was due to the extended drought during the first half of 2020, and reflects the increased use of pumped river water as the supply to WDC's drinking water treatment plants, rather than the usual gravity flow from the storage dams.

The Operational Energy Intensity of the proposed RWH system is therefore 2 to 3 times that of WDC's reticulated water supply.

Based on a 2009 study (Beacon Pathway Limited), the Operational Energy Intensity of reticulated water supply for two other District/City Councils of similar geographic extent and topography to Whangarei District Council was reported in the range 0.39 – 0.44 kWh/m^3. If Whangarei District Council's power usage in the 2019/20 financial year is atypical, as is assumed due to the extended drought event during that financial year, then the Council's Operational Energy Intensity of reticulated water supply compares favourably to that of its peers.

This report also compares the equipment lifecycle cost of the proposed RWH system per cubic meter of water delivered to the cost per cubic meter of potable water provided by WDC. All costs are reported exclusive of GST.

The cost per cubic meter of rainwater over the assumed 25-year lifecycle of the RWH system is calculated as \$10.04/m^3. The pumping cost per cubic meter of rainwater delivered is \$0.45/m^3, based on the RWH system Operational Energy Intensity of 1.10 kWh/m^3 and an average electricity unit cost over the life of the RWH system of \$0.41/kWh.

The total cost per cubic meter of rainwater delivered over the lifetime of the RWH system is therefore \$10.49/m^3.

By comparison, over the 25-year lifecycle of the RWH system, the average cost per cubic meter of reticulated water from the WDC network is calculated as \$2.52/m^3. Therefore, when annual water consumption is relatively low, as per the 50 m^3/annum rainwater usage in this assessment, it is greatly more cost-efficient for a residential customer to take water from the Council's reticulated supply than to install and operate a RWH system, notwithstanding the advantages that a RWH system can present in providing a short-term supply of water during a civil emergency or drought event.

Over the 25-year lifecycle of the RWH system, WDC's pumping cost per cubic meter of potable water delivered to a residential property is \$0.11/m^3. This is one-quarter of the \$0.45/m^3 pumping cost of the proposed RWH system.

End of Report

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Whangarei District Council

2.3. WDC 2020/21 Roading Capital Works and Renewals Programme

Meeting:	Council Briefing
Date of meeting:	12 November 2020
Reporting officer:	Greg Monteith (Capital Works and Procurement Manager – NTA)

1 Purpose

To provide elected members with detail about the WDC 2020/21 Roading Capital Works and Renewals programme

2 Background

As detailed in the attached report prepared by the Northland Transportation Alliance

3 Significance and engagement

The decisions or matters of this Agenda do not trigger the significance criteria outlined in Council's Significance and Engagement Policy, and the public will be informed via Agenda publication on the website, Council News and Facebook

4 Attachment

WDC 20-21 Capital Works and Renewals Programme

NORTHLAND TRANSPORTATION ALLIANCE
"Moving Northland Forward"

Meeting: **Infrastructure Committee 12 November 2020**

Name of item: **WDC 20/21 Capital and Renewals Programme**

Author: Greg Monteith – Capital and Procurement Manager

Date of report: 21 October 2020

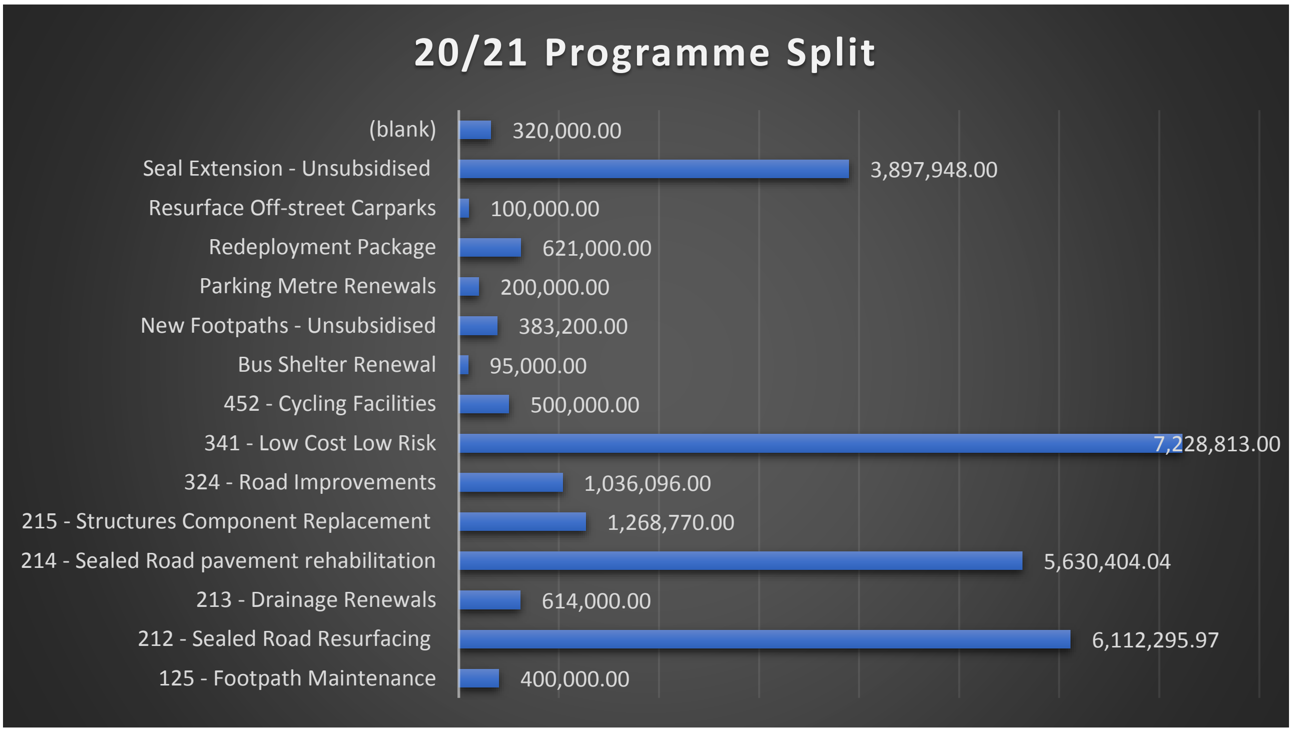
Purpose of the report

Provide Elected Members with the WDC 20/21 capital and renewal programme.

Discussion

The WDC Capital Works and Renewal programme totals $28,407,524.00. A break down per activity is set out below. With additional project detail set out later in this report.

It is noted there number of items that form part of the WDC capital budget that are not delivered through the capital and renewal team and thus not included in this report. These include heavy metalling activities, drainage renewals and traffic services renewals that our delivered through our maintenance team.



Programme Split by project

	Sum of Budget
125 - Footpath Maintenance	**$400,000.00**
Footpath Renewal	
Rose Street	
Various	

	Sum of Budget
212 - Sealed Road Resurfacing	**$6,112,295.96**
Sealing Chip seal	
MO&R Contract Management (CM) fixed cost	
South Region (67.5km) North Region (70.5km)	
Various locations - TAC 2.43km	

	Sum of Budget
213 - Drainage Renewals	**$614,000.00**
Drainage	
Various	
Various locations - Sealed Rd Pavement Rehab drainage renewal	

	Sum of Budget
214 - Sealed Road pavement rehabilitation	**$5,630,404.04**
Rehabs	
Design (next years sites)	
DICKSON RD	
KOKOPU BLOCK RD	
LIMEBURNERS RD	
MAUNU RD	
MCCARDLE RD	
MILL ROAD	
MO&R Contract Management (CM) fixed cost	
PATAUA NORTH RD	
PIPIWAI RD NTH	
REWA REWA RD	
WAIOTIRA RD	
WESTWOOD LANE	

	Sum of Budget

215 - Structures Component Replacement	**$1,268,770.00**
Bridge	
Ararua Road - Mangonui River 168b	
Hayward Road (Design only)	
Heavy Maintenance WDC bridges (Full Network)	
Marsden Point Road - Sergants 102b	
McAllister Road - McAllister O'Head R'way 117A-b	
McBeth Road - McBeths 194b (Design only)	
Mititai Road - Mangonui Rvr 171b	
Ngunguru Road - Waiotoi Bge 404b (design only)	
Nova Scotia Bridge No. 606 Upgrade	
Old Tokatoka Road Bridge No. 232 Upgrade (design only)	
Reyburn Street - Reyburn Street B6	
Rosythe Road - Rosythe No3 559b (design only)	
Scour Protection Works (Full Network)	
Takitu Road - Haha 232b (design only)	
Whananaki South Road - Whananaki Footbridge 546f (design only)	

	Sum of Budget
324 - Road Improvements	**$1,036,096.00**
Intersection	
Maunu/ Porowini Intersection	
Lighting	
District wide	

	Sum of Budget
341 - Low Cost Low Risk	**$7,228,813.00**
Associated Improvements	**$1,300,000.00**
Various sites associated with rehab sites	
Bridge	**$610,000.00**
Cemetery Road Culvert 871c	
Gillingham Road Bridge No. 395	
Grahamtown Rd Bridge No. 6 Culvert replacement	
Harris Rd Culvert No. 387 Replacement	
Mangapai Road - Moewhare Turnoff 133a	
Waiotoi Bridge No. 408	
Waiparerea Rd Culvert No. 21 Replacement	
Whangarei Heads Road	
Cycleways	**$20,000.00**
Railway Road	
Intersection	**$156,000.00**
Corks/ Gillingham Intersection	
Robert/ Walton Intersection	
Lighting	**$2,632,500.00**
District wide	

New Footpath	**$845,000.00**
Mackesy Rd	
One Tree Point Rd	
Pipwai Road	
Port Road	
Rose Street and Lwr Bank Street Ped Crossing	
Various	
Pedestrian Improvements	**$500,000.00**
Dent Street Pedestrian Crossing Upgrade	
Resilience	**$200,000.00**
Various sites associated with rehab sites	
Safety	**$304,313.00**
Cove Road	
Fishermans Point	
Ngunguru Road - Murphys Cnr	
Vinegar Hill Rd	
Whg Heads Rd	
Speed	**$400,000.00**
Various sites - Speed limit infrastructure	
Traffic Calming	**$261,000.00**
Hikurangi Township (King Street/George Street/Valley Road)	
Peter Snell Rd, Ruakaka and Corks/Station Rd, Tikipunga	
The Avenues	

	Sum of Budget
452 - Cycling Facilities	**$500,000.00**
Cycleways	
Kamo cycleway Stage 5 (Fisher Tce to Station Rd)	

	Sum of Budget
Bus Shelter Renewal	**$95,000.00**
General Maintenance	
Various	

	Sum of Budget
New Footpaths - Unsubsidised	**$383,200.00**
New Footpath	
Whangarei City Wide (Sense of Place) c/o from 19/20 - Not a roading project	

	Sum of Budget
Parking Metre Renewals	**$200,000.00**

	Sum of Budget
Redeployment Package	**$621,000.00**
New Footpath	
Gillingham Rd	
Ngunguru Rd from Whg Falls to (or close to) Ngunguru Rd path	
One Tree Point Rd	
Tauraroa Rd, Maungakaramea	

	Sum of Budget
Resurface Off-street Carparks	**$100,000.00**

	Sum of Budget
Seal Extension - Unsubsidised	**$3,897,948.00**
Seal Extension	
Attwood Road	
Brooks Road	
Franklin Road	
Massey Road	
Nook	
Ody Road	
Tahunatapu Road	
Future sites TBC (Future Designs)	

	Sum of Budget
Bus Terminal	**$320,000.00**
Public transport	
Rose Street Bus Terminal	

Report Approval

Approved by:

Calvin Thomas - NTA Manager
21st October 2020