BEFORE THE KAIPARA DISTRICT COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of a private plan change request by Mangawhai Central Ltd to the Kaipara District Plan ("Plan Change 78")

STATEMENT OF SUPPLEMENTARY EVIDENCE OF JAMES STUART DUFTY (ENGINEERING - WATER SUPPLY)

18 DECEMBER 2020

Counsel instructed:
Ian Gordon
Stout Street Chambers
Level 6, Huddart Parker Building
1 Post Office Square
Wellington 6011

Solicitors acting:
JR Welsh / SJ Mutch
ChanceryGreen
78 Jervois Road
Auckland 1011

1. INTRODUCTION

1.1 My full name is James Stuart Dufty. My qualifications and experience are as set out in my evidence in chief dated 6 November 2020.

1.2 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2014) and I agree to comply with it. I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

1.3 The purpose of this supplementary evidence is to clarify and provide further detail regarding matters raised at the hearing and/or the conclusions in my evidence in chief.

2. SUMMARY OF EVIDENCE

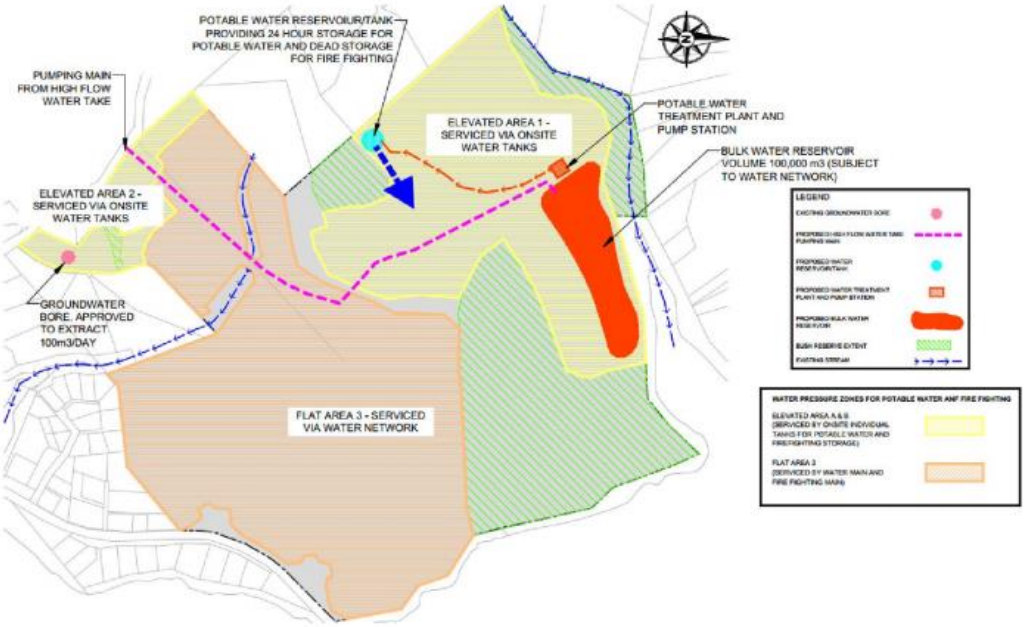
2.1 In my opinion there is no engineering-based reason for Plan Change 78 ("PC78") not to be approved.

2.2 As outlined in my evidence in chief and Water Supply Report,[1] a water reticulation network (including an onsite reservoir) is proposed as part of the PC78 development. Based on available pressure from a reservoir located on the ridge (see Figure Two), there is sufficient pressure within the water reticulation network to service Subzone 3A, Subzone 1 (Retail/Commercial), Subzone 7 (Service Zone) (which are all contained within the "Bowl") and the lower area of Subzone 3B (also known as the "Flank") based on a max finished ground level of circa 14m (see Figure One and Two below).

[1] *Mangawhai Central Water Source for Potable Water Reticulation Report*, McKenzie and Co Consultants Ltd (6 September 2020) [See Appendix H to the s42A Report]. See also the related report: *Mangawhai Central Potable Water and Fire Fighting Network Design Options Report,* McKenzie and Co Consultants Ltd (24 September 2020) [See Appendix H to the s42A Report].

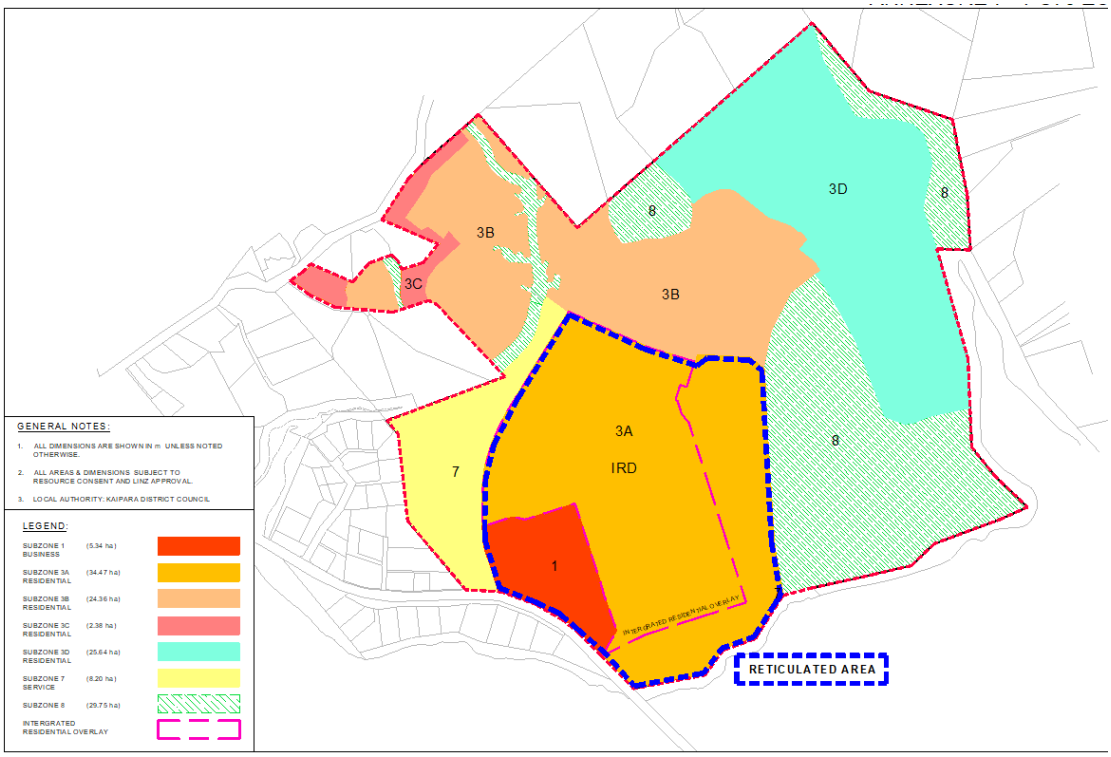
Figure One

Figure Two



2.3 Due to possible lot sizes within the IRD area of Subzone 3A, this subzone is expected to rely on a water reticulation for potable water. The water reticulation is intended to cover the entire Subzone 3A and can also be used to service the Subzone 1 Business area. This area is outlined in section 3 of this evidence (the “Reticulated Area”) and illustrated in Figure Three below. Residential land outside the “Reticulated Area” can be supported by rainwater collection, which is standard practice in Mangawhai. It should be noted that a significant portion of the Subzone 1 Business area has already been consented based on rainwater harvesting only. This has been assumed to be connected into the reticulated network as part of this scenario (representing a conservative approach with respect to reticulated network demand).

Figure Three



2.4 Based on Mr Munro's evidence, and concept masterplan which was used to test the approximate yield of the development, the "Reticulated Area" is assumed to have a residential yield of approx. 620 lots. This assumes the yield is inclusive of 200 retirement units associated with a retirement village.

2.5 Applying the Watercare standard daily use per residential property, the assumed 620 lots within the "Reticulated Area" have a total daily demand of 343m^3.

2.6 The retail/commercial area (Subzone 1 Business) within the "Reticulated Area" has a daily demand of 54m^3.

2.7 Applying Watercare standard water usage rates, without any water saving and/or rainwater harvesting, the total daily demand for the "Reticulated Area" is 397m^3. This is equivalent to an annual demand of approximately 145,000m^3.[(2)]

2.8 As outlined in Mr Williamson's evidence there are multiple options for the supply of potable water. The onsite solution outlined in Mr Williamson's supplementary evidence has shown that a supply of 400m^3 can be provided daily, based on two case study onsite high-flow water takes and a 100,000m^3 reservoir. Based on Mr Williamson's hydraulic

2 MCL's annual demand of 145,000 m^3 is calculated from 397 m^3/day x 365 days per year.

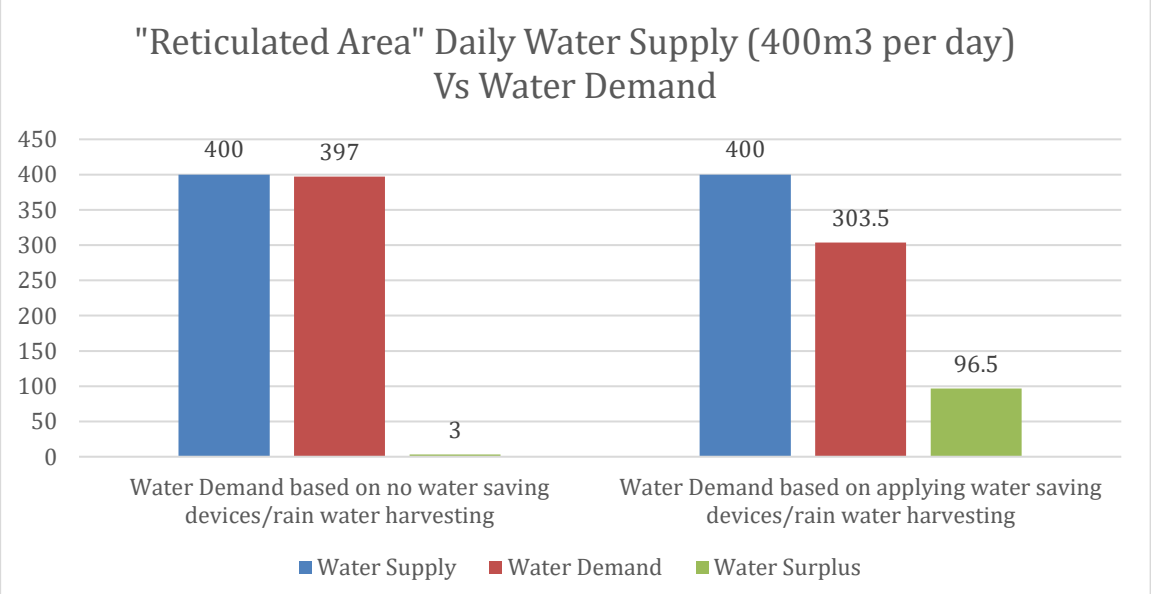
modelling, the reservoir is extremely unlikely to run dry throughout the year (i.e. it can provide a reliable source of potable water).

2.9 Based on the daily 400m^3 supply, this can sufficiently accommodate the daily demand from the "Reticulated Area" of 397m^3, without using any water saving devices and/or rainwater harvesting within these subzones. This would also have a surplus of 3m^3 per day. This is equivalent to 1 standard water truck delivery (10,000L) every 3.5 days to the other assumed lots during the dryer periods.

2.10 However, in accordance with the proposed PC78 text (including additional amendments recommended by me in this supplementary evidence) a pro-active/innovative and sustainable approach is proposed to water supply. For all residential lots within the "Reticulated Area", high quality water saving devices and supplementary rainwater harvesting tanks are proposed to be required in order to reduce both absolute daily water demand and demand for reticulated water. All other PC78 residential lots (outside the "Reticulated Area") are also proposed to be required to implement water saving devices.

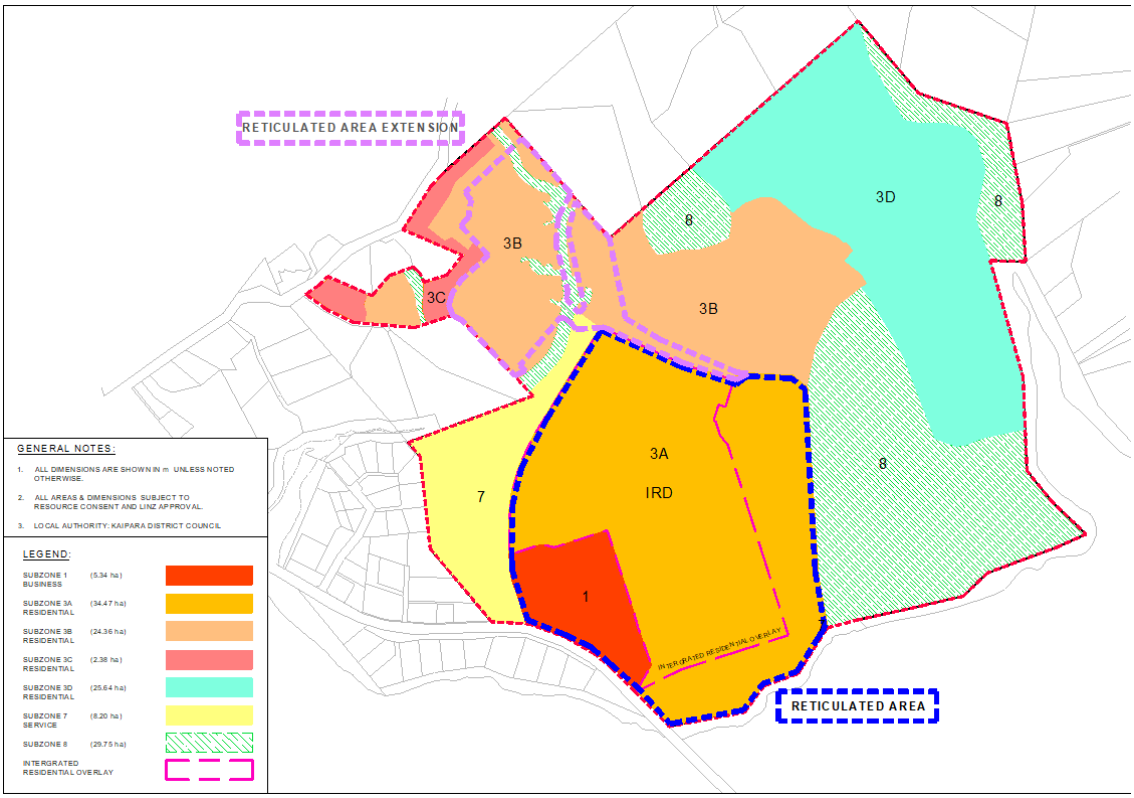
2.11 Based on the proposed installation of water saving devices within the "Reticulated Area" the daily demand significantly reduces to 303.5m^3 (see Figure Four). This would provide a daily surplus of 96.5m^3. This daily surplus is significant. The daily surplus of 96.5m^3 allows approx. 10 water tank (10,000L) deliveries daily throughout the drier seasons. Given that there would be approx. 380 houses within the PC78 area that can be assumed to be on water tanks under this scenario (i.e. outside the "Reticulated Area") this would allow each of those lots to receive 3 deliveries through the drier period (December to March).

Figure Four



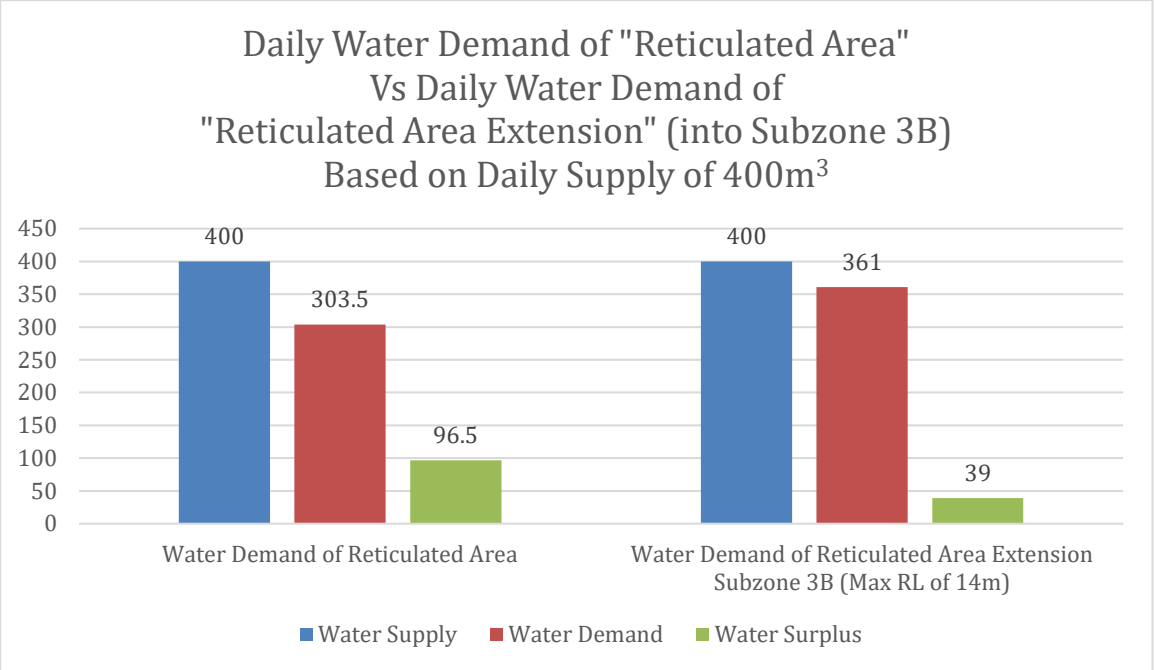
2.12 Alternatively, the surplus daily water allows the reticulation to be extended to lots outside the “Reticulated Area” (Subzone 3A and Subzone 1). The potential additional areas as identified in the Water Source Report based on suitable water pressure include the lower area of Subzone 3B, also known as the ‘Flank”, based on a max finished ground level of circa 14m.This is shown as the Reticulated Area Extension in Figure Five below.

Figure Five



2.13 These additional lots (circa 120 lots) that could be serviced by the reticulation network have an additional daily demand of 57.6m^3, taking the total daily demand if extended to the lower Subzone 3B (Flank) area to 361m^3. This still has a surplus daily demand of 39m^3. This surplus is equivalent to approx. 4 water tank deliveries (10,000L) daily throughout the anticipated drier season (December-March) for the assumed remaining 260 lots which are to be reliant on roof water collection. This is approx. 1.8 deliveries per household over the drier season (see Figure Six below for comparison).

Figure Six



2.14 Based on the surplus water available when using water saving devices the entire PC78 development is basically self-sufficient and would unlikely require any water tankers from external catchments to provide water during the drier periods.

2.15 When projecting water use for the development, the worst-case scenario needs to be taken into account. Rainwater harvesting is promoted/required and will reduce the water demand from the reticulated network. However, this has not been included in the projected 160L per person/day demand which has been forecasted for the entire year. This is a very conservative approach as in reality through the wetter months the rainwater harvesting tanks will be able to provide sufficient water for the toilet and laundry, meaning the reservoir draw down is significantly less than what has been modelled.

2.16 It should be noted that the current Chapter 16 assumes water tanks for the entire development including the 500 Residential lots. Based on the analysis I have undertaken, the development enabled by Chapter 16 would require delivery of water from elsewhere during the drier months

3. RETICULATED AREA

3.1 The “Reticulated Area” (Subzone 3A and Subzone 1) identified in Figure Three is proposed to be connected to a water reticulation network.

3.2 Based on Mr Munro’s indicative masterplan for the development it has been assumed that the area Subzone 3A and Subzone 1 area consists of the following:

(a) Retirement Village consisting of 200 units;

(b) Approx. 420 Residential lots; and

(c) Commercial/retail area.

3.3 These assumptions have been used to determine water demand for the "Reticulated Area" (as outlined below). These numbers are subject to resource consent.

4. WATER SUPPLY (INCLUDING GROUNDWATER SURPLUS SUPPLY)

4.1 As outlined in Mr Williamson's supplementary evidence, considering an onsite water take scenario - including a 100,000m^3 reservoir - the water take case study onsite can reliably provide a daily water supply of 400m^3/day across the project to support the proposed water reticulation.

4.2 In addition, MCL has a consent to extract groundwater (100m^3 per day). This supply is seen as a secondary supply that may be used (once treated) to top up the reservoir as and when needed, (because the 400m^3 per day supply outlined in Mr Williamson's supplementary evidence is sufficient for the proposed "Reticulated Area").

Firefighting supply

4.3 For completeness, below I provide a summary regarding firefighting water supply:[3]

(a) Within the Reticulated Area, firefighting water is intended to be provided via hydrants on the reticulated network. A *separate* firefighting water reservoir providing "dead storage" will be located on the elevated ridge above the "Bowl" area of PC78. The water reservoir will only be used for emergencies for firefighting. This tank has been approved as part of the supermarket/main street consent.

(b) Outside the Reticulated Area, firefighting supply will be provided by properties' onsite primary water tanks, as is currently widespread throughout Mangawhai.

5. WATER DEMAND PER RESIDENTIAL HOUSEHOLD

5.1 As outlined in Watercare standards[4], a typical demand estimation of a daily water consumption is 220L/person/day.

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[3] Firefighting water is addressed in detail in *Mangawhai Central Potable Water and Fire Fighting Network Design Options Report,* McKenzie and Co Consultants Ltd (24 September 2020) [See Appendix H to the s42A Report].

[4] Watercare, The Auckland Code of Practice for Land Development and Subdivision, Water and Wastewater code of Practice for Land Development and Subdivision, 2019, Chapter 6 Water

5.2 Watercare design residential occupancy allowances for 2-4 bedroom houses is 3 people (see Table One below).

Table One

Table 6.1.a - Design residential occupancy allowances

Number of bedrooms (Notes 1 and 2)	*Occupancy for design purposes (i.e. people)*
1	*2*
2-4	*3*

5.3 Watercare design for a typical demand estimation for retirement village single bedroom units is 1.5 people per unit.

5.4 Applying the standard Watercare design inputs, this provides a daily demand per residential household of 660L/per house. (220L/person/day x 3 people).

5.5 Applying the standard Watercare design inputs for retirement village units, this provides a daily demand per residential household of 330L/per house (220L/person/day x 1.5 people).

6. STANDARD WATER DEMAND FOR THE "RETICULATED AREA"

6.1 Based on Mr Munro's evidence and concept masterplan which was used to test the approximate yield of the development, the "Reticulated Area" is assumed to have a residential yield of approx. 620 lots. This assumes the yield is inclusive of 200 retirement units associated with a retirement village.

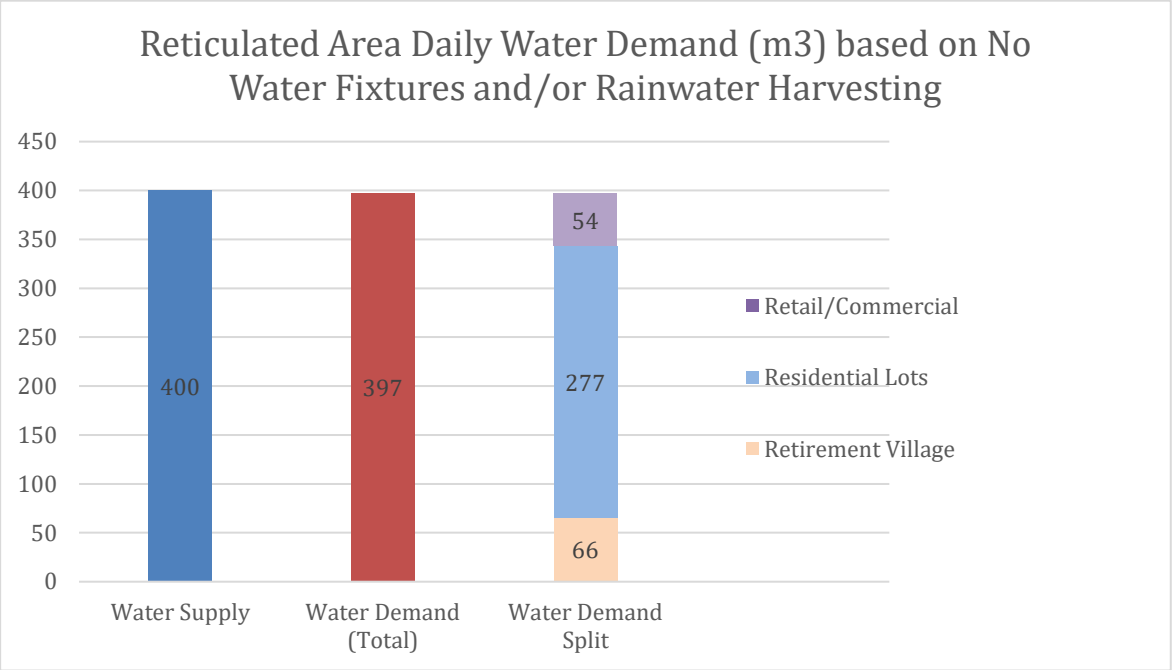
6.2 Applying the Watercare standard daily use per residential property, the assumed population of 620 lots within the "Reticulated Area" has a daily demand of 343m^3.

6.3 The retail/commercial area in Business Sub-Zone 1 is also proposed to be serviced by the reticulated network. The retail/commercial area has a daily demand of 54m^3.[5] It should be noted that approx. 26m^3 of the assumed retail/commercial demand has been consented based on rainwater harvesting for potable water. Despite this, the 26m^3 has been allowed for in the water demand calculations (representing a conservative approach with respect to reticulated network demand).

[5] *Mangawhai Central Water Source for Potable Water Reticulation Report*, McKenzie and Co Consultants Ltd (6 September 2020) [See Appendix H to the s42A Report].

6.4 Applying Watercare standard water usage rates, without any water saving and/or rainwater harvesting, the total demand for the "Reticulated Area" inclusive of commercial/retail is 397m^3 (see Figure Seven below).

Figure Seven



6.5 A 400m^3 (400,000 litres) daily supply can support circa 200 retirement village units (330L/per unit x 200 units = 66,000 litres) and 420 residential houses and the proposed retail/commercial area.

6.6 This design demand does not allow for any supplementary rainwater harvesting or water saving devices which are used to reduce residential demand. These options are outlined below, which show the reduction of actual demand and the availability of suitable surplus water for top ups of water tanks from the proposed reservoir if and when needed.

6.7 It is noted that the 220L/per person/per day is a conservative approach for calculating demand per household. As outlined in a 2017 Watercare document[6], it was concluded that the actual average daily usage (demand) per person is circa 160L/day.

6.8 In summary, by applying no water saving devices or rainwater harvesting, a 400m^3 daily supply can service the "Reticulated Area".

7. STANDARDS TO REDUCE WATER DEMAND OF RESIDENTIAL LOTS

7.1 As outlined in my evidence in chief, PC78 is promoting/requiring water saving fixtures

[6] Auckland Water efficiency strategy 2017 to 2020, Residential Water Use, page 12, 160 L/per person/per day.

and rainwater harvesting tanks. Many developments are starting to incorporate water saving devices and rainwater harvesting tanks where the focus is on providing a sustainable approach to water supply.

7.2 There are strict Australian/New Zealand standards that identify and control the quality of water saving devices. The Water Efficiency Labelling Scheme (WELS) is a standard that identifies and classifies the effectiveness of water efficient products.

7.3 The New Zealand Green Building Council (NZGBC) is a non-profit membership organisation that promotes better buildings. The NZGBC uses Homestar, an independent comprehensive, national environmental rating tool for assessing the health, efficiency and sustainability of houses. As outlined in the Homestar Technical Manual[7], the overarching objective of the Homestar rating tool is to improve the performance and reduce the environmental impact of new and existing New Zealand dwellings.

7.4 *TP58 On Site Wastewater Systems – Auckland Council* (TP58) documents the effectiveness of using water saving fixtures with respect to daily water demand.

8. WATER EFFICIENCY LABELLING SCHEME (WELS)

8.1 The PC78 development proposes to use water saving devices/fixtures in line with the Water Efficiency Labelling Scheme (WELS). *AS/NZS 6400:2016, Water efficient products – Rating and labelling* outlines the objectives of the Water Efficiency Labelling Standards scheme (WELS):

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-032, Water Efficient Products, to supersede AS/NZS 6400:2005.

This Standard forms a basis for the rating and labelling of a range of products under the mandatory Water Efficiency Labelling and Standards (WELS) scheme, as required by the Australian Water Efficiency Labelling and Standards Act 2005 (Cth) (the WELS Act) and, in New Zealand, the Consumer Information Standards (Water Efficiency) Regulations. This Standard has been updated to reflect changes to the WELS Act and to remove ambiguities and superseded and conflicting requirements.

The objectives of the WELS Scheme are to encourage the development and marketing of water efficient products and to enable consumers to clearly identify and purchase water efficient products.

8.2 The WELS standards ensure any water saving device being sold complies with Australia/New Zealand standards. The label (see an example at Figure Eight below) is also designed to help purchasers make informed choices about water efficiency

[7] Homestar v4 Technical manual, Aims and Objectives of Homestar, page 8.

products. This Standard also provides rules that can be enforced at building consent stage on developments that are pursuing a sustainable approach to water use on residential lots.

Figure Eight

9. HOMESTAR STANDARD (WELS)

9.1 Homestar uses WELS (Water Efficiency Labelling Scheme) for determining the effectiveness of water reduction in residential houses.

9.2 The Homestar technical document focuses on water savings fixtures as a key component to the sustainable approach of water design and focuses on effective ways to reduce water demand in residential houses.

9.3 The higher the Homestar rating (points), the more efficient the water saving device is. Below (Figure Nine) are extracts from the Homestar Standards based on Water Fixtures in relation to the WELS rating.

Figure Nine

Points are awarded as per the following categories:

(1) Showers	0 points	0.5 points	1.5 points
WELS Star Rating	1 Star	2 Star	3 Star
Flow Rates (L/min)	≤ 16	≤ 12	≤ 9

(2) Lavatory equipment	0.3 points	1 point	1.5 points
WELS Star Rating	3 Star	4 Star	4.5 or more Star
Flow Rates (L/flush)	6.0 L closet pans with matching 6/3 L cisterns. Avg. flush volume more than 3.5 but not more than 4.0 L/flush.	4.5 L closet pans with matching 4.5/3 L cisterns. Avg. flush volume more than 3.0 but not more than 3.5 L/flush.	Avg. flush volume not more than 2.5 L/flush. Council approved composting toilets achieve 1.5 points.
Notes: For dual flush toilets, flow rates are to be calculated from the average of 4 half flushes and one full flush. Points can then be awarded based on the information in this table.			

(4) Main kitchen sink and main bathroom hand-basin taps	0.3 points	0.6 points	1 point
WELS Star Rating	4 Star	5 Star	6 Star
Flow Rates (L/min)	≤ 7.5	≤ 6	≤ 4.5

(5) Dishwashers	0.2 points	0.3 points	0.5 points
WELS Star Rating	3 Star	4 Star	5 and 6 Star
Flow Rates (L/wash)	Variable based on model type.	Variable based on model type.	Variable based on model type.
Notes: • Dishwashers with unknown WELS ratings will be allowed 0.2 points provided they are less than 3 years old. • Where a dishwasher is not provided in the dwelling, the points will be deemed Not Applicable.			

9.4 To ensure water saving devices are compulsory within the development, provisions can be placed on the development to ensure all residential units are using devices in line with the Homestar rating. These devices would be required to be shown at Building Consent stage.

10. TYPICAL WATER USE PER HOUSEHOLD

10.1 Typical breakdowns of residential household water use are shown in Figure Ten below, based on a Watercare Report, 2017.[8]

Figure Ten

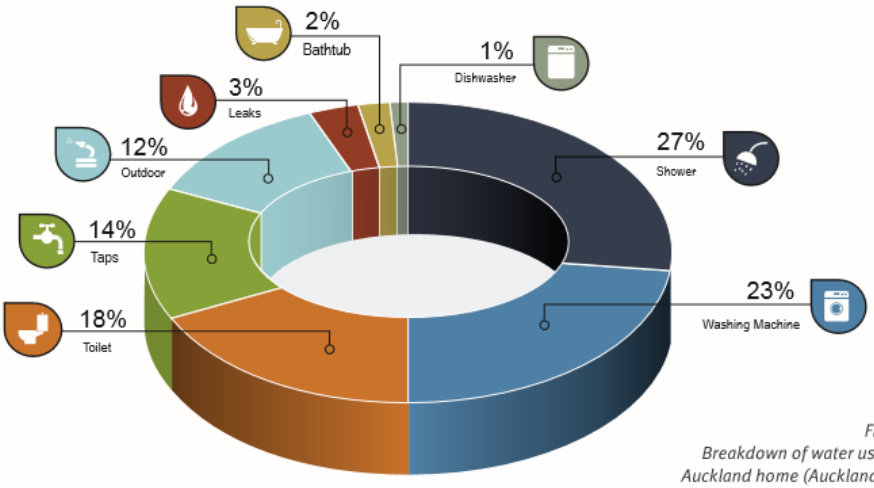


Figure 8
Breakdown of water use in an Auckland home (Auckland water use study, BRANZ 2008).

10.2 It is noted that toilets and laundry water usage equate to circa 40% of daily demand per household. Based on a conservative 660L/per household/per day, this is equivalent to 265L/per household/per day (88 L/per person/day).

11. REDUCTION IN DAILY WATER DEMAND USING WATER SAVING DEVICES

11.1 It is not uncommon for residential houses to use water saving devices to reduce water demand. This is a typical approach for houses when designing onsite wastewater systems (disposal fields) to reduce the actual daily demand which in turn reduces the footprint of the disposal field. Disposal fields are not proposed as part of the PC78 development, however the approach of water saving fixtures, as highlighted in TP58 (On Site Wastewater Systems), reinforces the effectiveness of water saving fixtures with respect to daily water demand reductions.

11.2 As outlined in TP58, the effectiveness of the reduction in water demand is dependent on the number of water saving fixtures in place. See the below Table Two (from TP58) for water reduction based on water saving devices:

[8] Watercare, Auckland Water Efficiency Strategy 2017 to 2020.

Table Two

Table 6.3: Flow Allowance Reduction Calculations for Household Flows

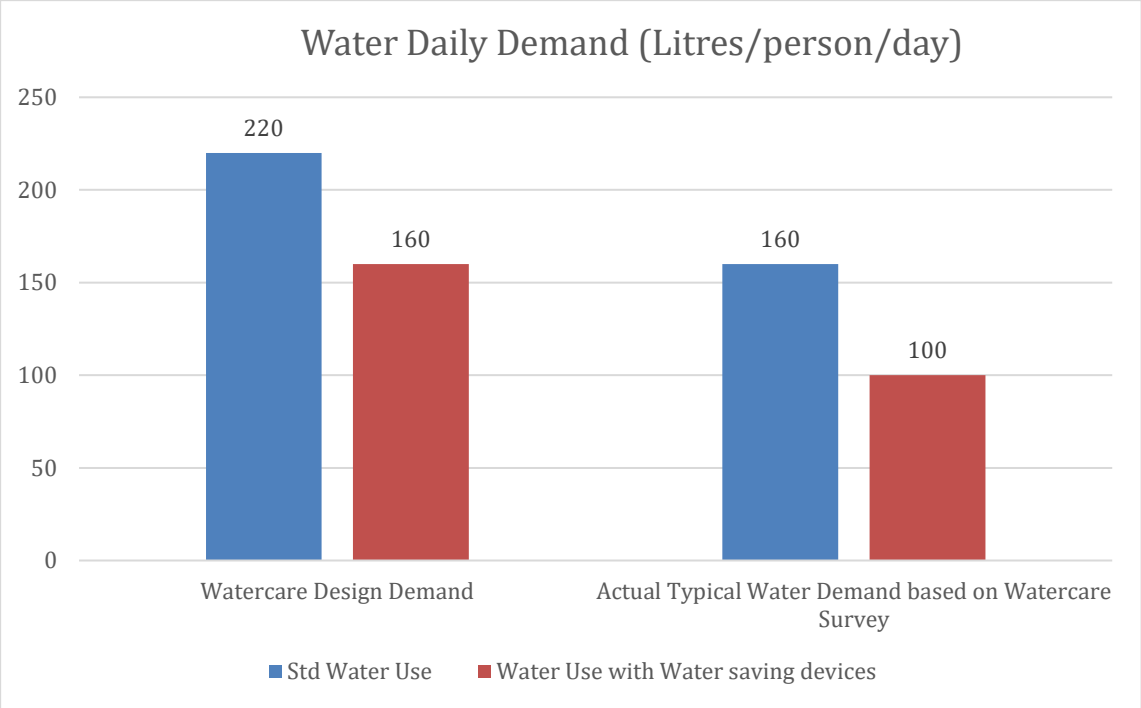
FLOW ALLOWANCE Litres/Person/Day	CALCULATION	JUSTIFICATION
B. Standard Fixtures 180 – 200 L/p/d		Toilet use flow volume based on 5 flushes/d @ 11 litres/flush l(L/f) s 11 L/f x 5 f/p/d = 55L/p/d (Toilet use only)
C. Household with 11/5.5 or 6/3 litre flush 160 L/p/d	180 L/p/d – 22 L/p/d = 158 L/p/d	**Dual flush 11/5.5 L flush** 1flush x 11 litres plus 4 flushes x 5.5 litres = 33l/p/d OR 22 litres less per person per day
D. Household with 6/3 litre flush and Water Reduction Fixtures *145 L/p/d*	180 L/p/d – 37 L/p/d = 143 L/p/d	**Dual low flush 6/3 litre** 1 flush x 6 L plus 4 flushes x 3 L = 18 L/p/d OR 37 litres less per person per day
E. Household with Full Water Reduction Fixtures *120 L/p/d*	145 L/p/d – 26 L/p/d = 119 L/p/d	**Dual low flush PLUS water reduction valves** etc having an 18% reduction from water saving devices is 26 L/p/d giving a total % reduction from 180 L/p/d to 120 L/p/d of 35% (made up of 20% for 6/3 toilets and 15% for water reduction fixtures)

11.3 TP58 shows a reduction in daily demand per person of up to 60L-80L/per person/day when applying water saving fixtures to the household. This takes the original conservative Watercare design demand from 220L/per person/day to 160-140 litres/per person/day. Furthermore, if this water reduction was applied to the actual current Watercare demand based on household surveys, which is 160L/per person/day, it would further reduce this to 100L-80/per person/day.

11.4 Figure Eleven below is a graph showing the reduction of water demand when applying water saving devices based on Watercare Design Demand and Actual Demand[9].

[9] Water Demand Reduction as per TP58 is 80-60L/per person/day. The conservative 60L/p/d has been adopted for reducing water demand based on water reducing devices

Figure Eleven



11.5 The above results do not consider rainwater harvesting which would further significantly further reduce water demand on a daily basis (see section 13 below).

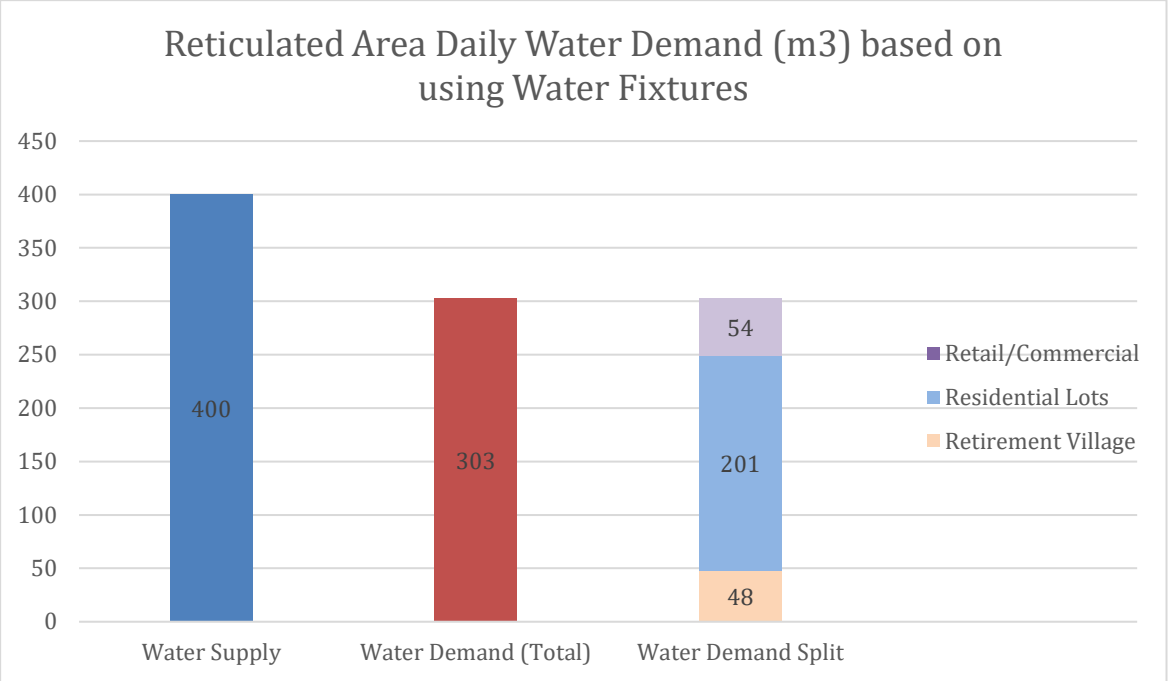
12. WATER DEMAND FOR THE RETICULATED AREA WHEN USING WATER SAVING DEVICES

12.1 Given the effectiveness of water saving devices as shown above, it is recommended that the entire PC78 development uses water saving fixtures which reduces daily water usage and allows contingency on lots that are solely reliant on rainwater harvesting.

12.2 Based on the proposed installation of water saving devices within the "Reticulated Area" the daily demand significantly reduces to 303.5m^3[10] based on 160L/per person/day (see Figure Three and paragraphs 12.3 to 12.4 below). This would provide a daily surplus of 96.5m^3 (See figure Twelve below). This daily surplus is significant. The daily surplus of 96.5m^3 allows approx. 10 water tank (10,000L) deliveries daily throughout the drier seasons. Given that there would be approx. 380 houses within the PC78 area that can be assumed to be on water tanks under this scenario (i.e. outside the "Reticulated Area") this would allow each of those lots to receive approx. 3 deliveries through the drier period.

[10] 420 Residential lots x 160l/p/d x 3 persons (201.5m^3) + 200 Retirement Units x 160l/p/d x 1.5 persons (48m^3) + Retail/Commercial demand (54m^3).

Figure Twelve



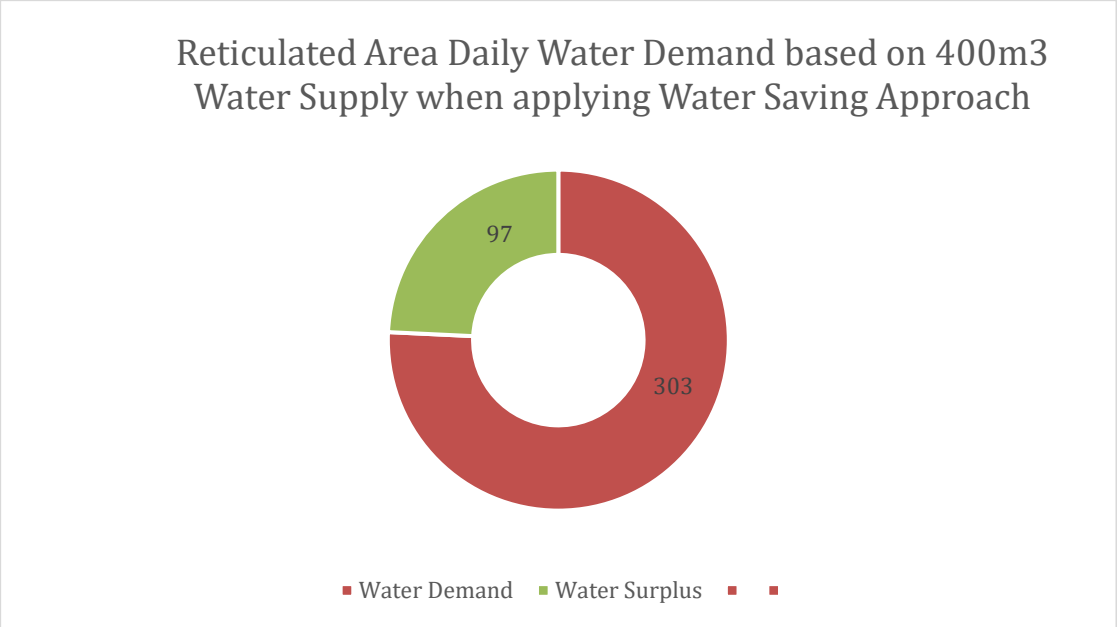
12.3 Using water saving fittings and devices the daily use of the residential property and retirement village units has reduced to 249m^3.[11]

12.4 For a conservative approach the retail/commercial area is assumed to remain at a daily demand of 54m^3.

12.5 This reduction in daily demand provides a significant amount of surplus water available based on a 400m^3 daily water supply as per Mr Williamson's supplementary evidence (see Figure Thirteen below).

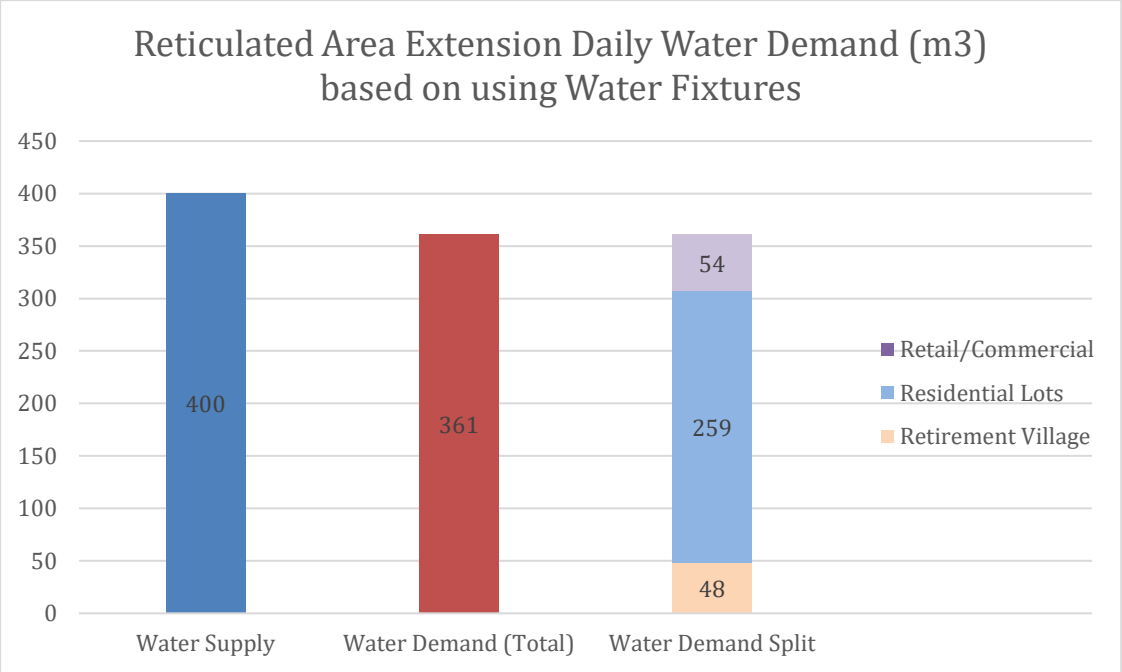
[11] 420 Residential lots x 160l/p/d x 3 persons (201.5m^3) + 200 Retirement Units x 160l/p/d x 1.5 persons (48m^3).

Figure Thirteen



12.6 Alternatively, the surplus daily water allows the reticulation to be extended to lots outside the “Reticulated Area”. The potential additional areas as identified in the water source report based on suitable water pressure include the lower area of Subzone 3B, also known as the ‘Flank”, based on a max finished ground level of circa 14m (shown on Figure 5). These additional lots (circa 120 lots) that can be serviced by the reticulation network have an additional daily demand of 57.6m^3, taking the total daily demand if extended to the lower Subzone 3B (Flank) area to 361m$^{3.}$ (See Figure Fourteen). This has a surplus daily demand of 39m^3. This surplus is equivalent to approx. 4 water tank deliveries (10,000L) daily throughout the anticipated drier season (December-March) for the assumed remaining 260 lots which are to be reliant on roof water collection. This is approx. 1.8 deliveries per household over the drier season.

Figure Fourteen



13. SUPPLEMENTARY WATER HARVESTING ON LOTS WITHIN THE RETICULATED NETWORK

13.1 Supplementary Rainwater harvesting is a very effective way to reduce the daily demand of any household that is connected to a water reticulation network.

13.2 Supplementary[12] rainwater harvesting tanks typically vary from 500L to 5,000L. They are typically sized based on roof area vs monthly mean rainfall and are installed to capture the rainwater from the roof areas and collect it in tanks. Below at Figure Fifteen are typical images of supplementary rainwater tanks of different sizes used to supplement toilet/laundry water demand.

[12] Supplementary Rainwater harvesting tanks are tanks supplementing lots connected to a reticulated network.

Figure Fifteen[13]

13.3 The Homestar technical document focuses on rainwater harvesting as a supplementary rather than primary source being a key component to the approach of water design and also focuses on effective ways to reduce water demand in residential houses. Rainwater harvesting promotes the supplementary reuse of the collected rainwater to be plumbed into the toilet and laundry facilities within the residential house.

Rainwater Reuse

Up to three additional points are awarded where the rainwater harvesting system is plumbed for use within the dwelling and the rainwater harvesting system can meet the water demand of the uses it is plumbed to. The Water Calculator will automatically determine the percentage of water demand the rainwater harvesting system can satisfy and will pro-rata points accordingly.

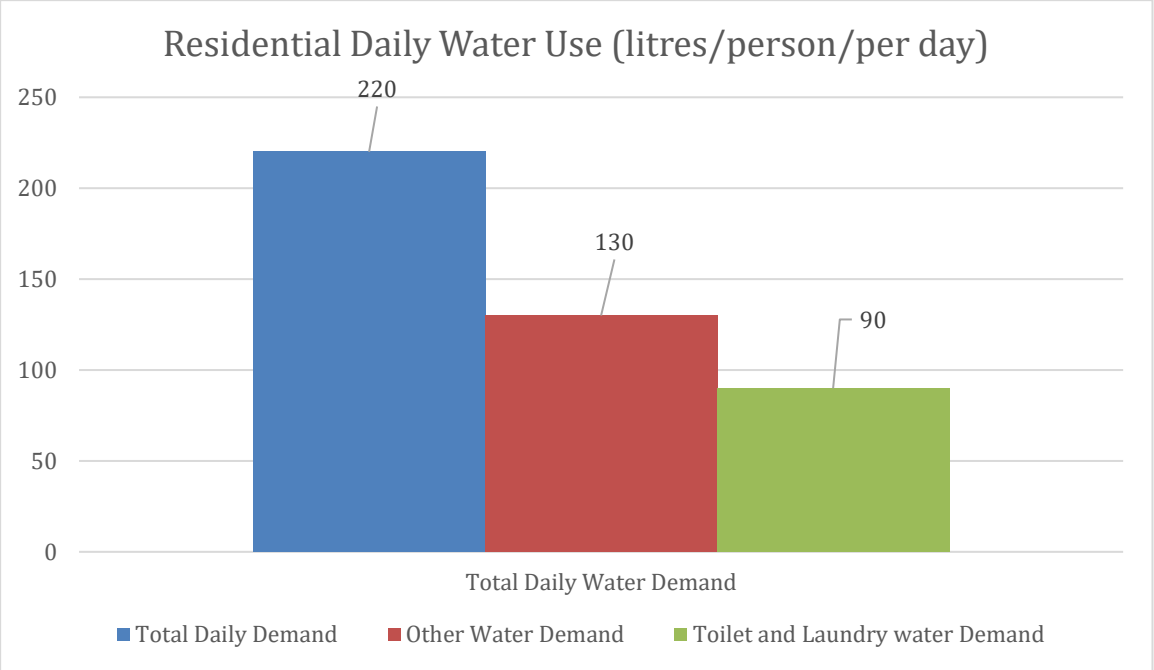
Points are awarded as follows:

(1)	Where rainwater is plumbed to a minimum of one toilet OR laundry facilities inside the dwelling, OR	Up to 1.0 point
(2)	Where rainwater is plumbed to a minimum of one toilet AND laundry facilities inside the dwelling, OR	Up to 2.0 points
(3)	Where rainwater is plumbed to a minimum of one toilet AND laundry facilities AND the hot water system inside the dwelling.	Up to 3.0 points

13.4 Again, it is noted that toilet and laundry water usage equate to circa 40% of daily demand per household (see Figure Sixteen below).

[13] Size and type of tanks shown are Promax Plastic Slimline tanks 3000L ($3m^3$) & Tanksalot Corrugated Slimline Tank 5000L ($5m^3$).

Figure Sixteen



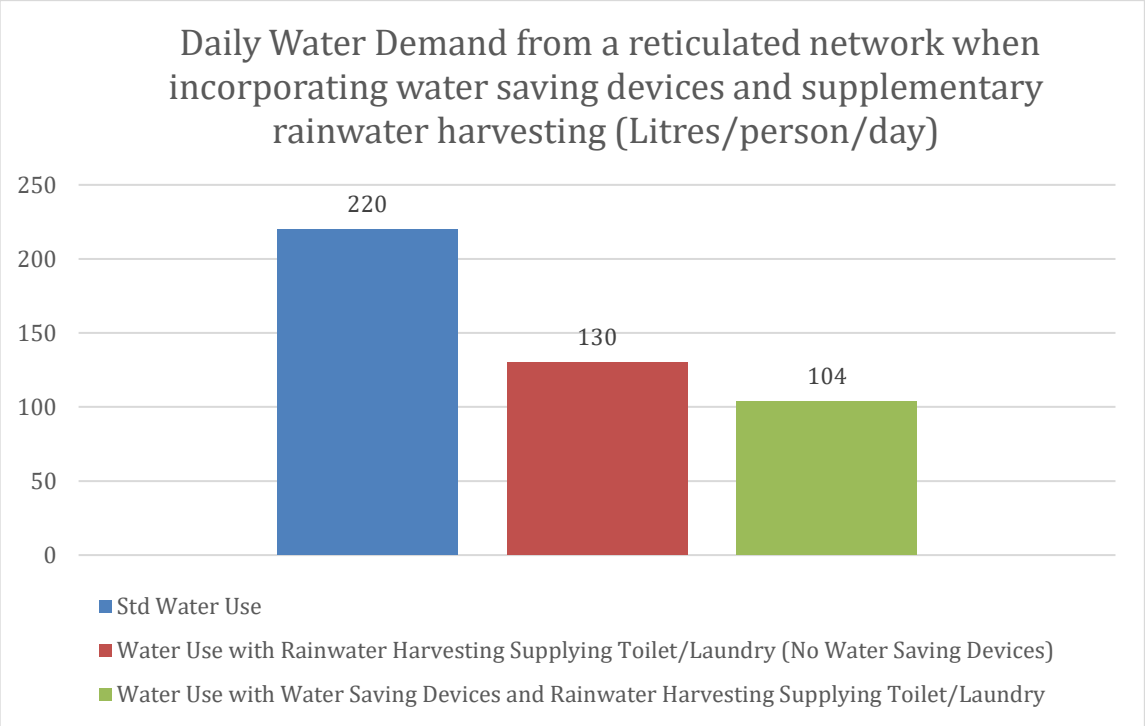
13.5 By supplementing the need to provide reticulated water to the toilet and laundry (40% of daily demand, 90L/per person/day), rainwater harvesting is therefore a very effective tool to reduce water demand from a water reticulation network, in particular during the wetter months. Based on a conservative 220L/per person/per day, and allowing for 40% of the daily demand to be provided via rainwater harvesting, the daily demand via the water reticulation reduces from 220L/per person/per day to 130[14] L/per person/per day (this excludes water saving devices).

13.6 Furthermore, if supplementary rainwater harvesting is used for supplying water for the laundry/toilet, water saving devices/fixtures can also be used to further reduce the demand on the water supply from the reticulated network. As per TP58 (Table Two), water saving devices have a further reduction of approx. 26L/pp/day, which would result in a daily demand of 104L/pp/day[15] when relying on supplementary water tanks to supply water to the toilet and laundry and also using water saving devices throughout the rest of the household.

13.7 Below at Figure Seventeen is a graph showing the reduction in water demand when considering supplementary rainwater harvesting and water saving devices vs the standard Watercare demand calculation.[16]

[14] 220L/pp/day – 90L/pp/day = 130L/pp/day.
[15] 220L/pp/day – 90L/pp/day = 130 L/pp/day. 130L/pp/day x 18% =24L/pp /day. 130L/pp/day – 24L/pp/day = 106L/pp/day.
[16] Graph is based on tank never running dry.

Figure Seventeen



13.8 Depending on the rainwater harvesting tank size and available roof area, it could be expected that at some point the rainwater harvesting tank would run dry. If so, the daily demand required from the reticulated network would increase as the toilet and laundry supply would be reliant on the reticulated network.

13.9 When projecting water use for the development, the worst-case scenario needs to be taken into account. As such the use of rainwater harvesting has not been included in the projected 160L/per person/day which has been forecasted for the entire year. This is a very conservative approach as in reality through the wetter months the rainwater harvesting tanks will be able to provide enough water for the toilet and laundry demand.

13.10 From an engineering perspective it is feasible to install sufficient primary rainwater tanks on a 350m^2 (Subzone 3A) lot. Nevertheless, 350m^2 lots are limited to the Subzone 3A, where a reticulated network is proposed. All other lots proposed are a minimum 500m^2 which are suitable for primary rainwater collection for potable and firefighting requirements.

13.11 Finally, I also note that rainwater harvesting helps to attenuate stormwater runoff, and to reduce “first flush” contaminants (sediment) from roofs entering the receiving environment. In addition, reducing potable water usage also reduces wastewater discharges.

14. CONCLUSION

14.1 In this supplementary evidence I have clarified and provided some additional detail regarding matters raised at the hearing and/or addressed in my evidence in chief.

14.2 As outlined, when projecting reduced daily water demands allowing for supplementary rainwater harvesting tanks and/or water saving devices, a conservative approach has been taken when determining the reduction of demand.

14.3 I am satisfied that development of the site as proposed by PC78 is feasible from a water engineering perspective and that there are no engineering constraints that preclude the site's development as proposed.

14.4 I recommend the following additional provisions be included in PC78:

(a) Any residential lot connected to the proposed water reticulation network is required to rainwater harvest in line with the Homestar standard with a minimum Homestar rating of 4.

(b) All residential lots are required to comply with the following:

1. minimum 4 Star WELS shower head
2. minimum 5 Star WELS washing machines
3. minimum 4 Star WELS toilets
4. minimum 4.5 star WELS dishwasher
5. Minimum 5 star WELS kitchen and bathroom tapware

14.5 Overall, there are no potable water issues precluding the granting of PC78.

James Dufty
18 December 2020