STORMWATER HARVESTING, AN INNOVATIVE WAY OF MEETING THE CATCHMENT WIDE NEEDS OF THE BUILT AND SOCIAL ENVIRONMENTS

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ABSTRACT

Catchment wide stormwater management objectives can incorporate harvesting and re-use, which in turn can benefit commercial and residential developments. The overall aim of the harvesting and re-use objectives is to reduce the environmental impact of large volumes of runoff entering the receiving environment. This can be a challenge for commercial developments with large roof areas and low volume of re-use demand.

This paper presents a case study for a commercial development in the Hobsonville Peninsula, which faced the challenge of accommodating large volumes of runoff from the 20ha catchment with 9.4ha of roof area. A review of an innovative approach to addressing the catchment wide stormwater management objectives was undertaken, which included the assessment of re-use demands for not only the subject site but the wider community. This assessment extended to a cost benefit analysis, for the water harvesting, which not only focused solely on the monetary aspects but introduced the social and environmental benefits that are often missed from these commercial driven assessments.

KEYWORDS

Stormwater management, stormwater harvesting, potable water reticulation, catchment objectives, cost benefit analysis

PRESENTER PROFILE

Bronwyn Rhynd is a Director of Stormwater Solutions Consulting Ltd and is an environmental engineer with broad experience in environmental and civil engineering projects. Her expertise is in the water resource area with a focus on stormwater treatment, disposal and management. Bronwyn has been involved in projects requiring project management, erosion and sediment control, flood and flow regulation, wastewater and stormwater treatment and disposal, assessment of effects for both new and existing projects.

1 INTRODUCTION

The commercial development of a Marine Industry Precinct (MIP), at the Hobsonville Peninsula, is committed to provide stormwater reuse to reduce the large volumes of runoff entering the receiving environment. This is also reflected by the development principles of the adjacent residential developments undertaken by Hobsonville Land Company (HLC). These reuse initiatives by both parties lead to the feasibility assessment and cost benefit analysis of commercial harvesting of rainwater from the Marine Industry Precinct.

To assess the feasibility of commercial harvesting of stormwater from the Marine Industry Precinct hydrological analysis has been undertaken together with rough order costing for the treatment and supply of both potable and non-potable water.

This paper presents the assessment assumptions for the hydrological analysis together with supply and demand assessments. Costs are presented for both the establishment of the system and annual costs of the operational and maintenance aspects. The comparisons of the various supply scenarios are then discussed along with legal and procedural considerations for operating the system.

2 BACKGROUND

The MIP has a large roof catchment, in the order of 9.4ha, of which the runoff can be captured for re-use purposes. The volumes on an annual basis are large therefore consideration of the re-use opportunities outside of the internal MIP water re-use demands have also been considered.

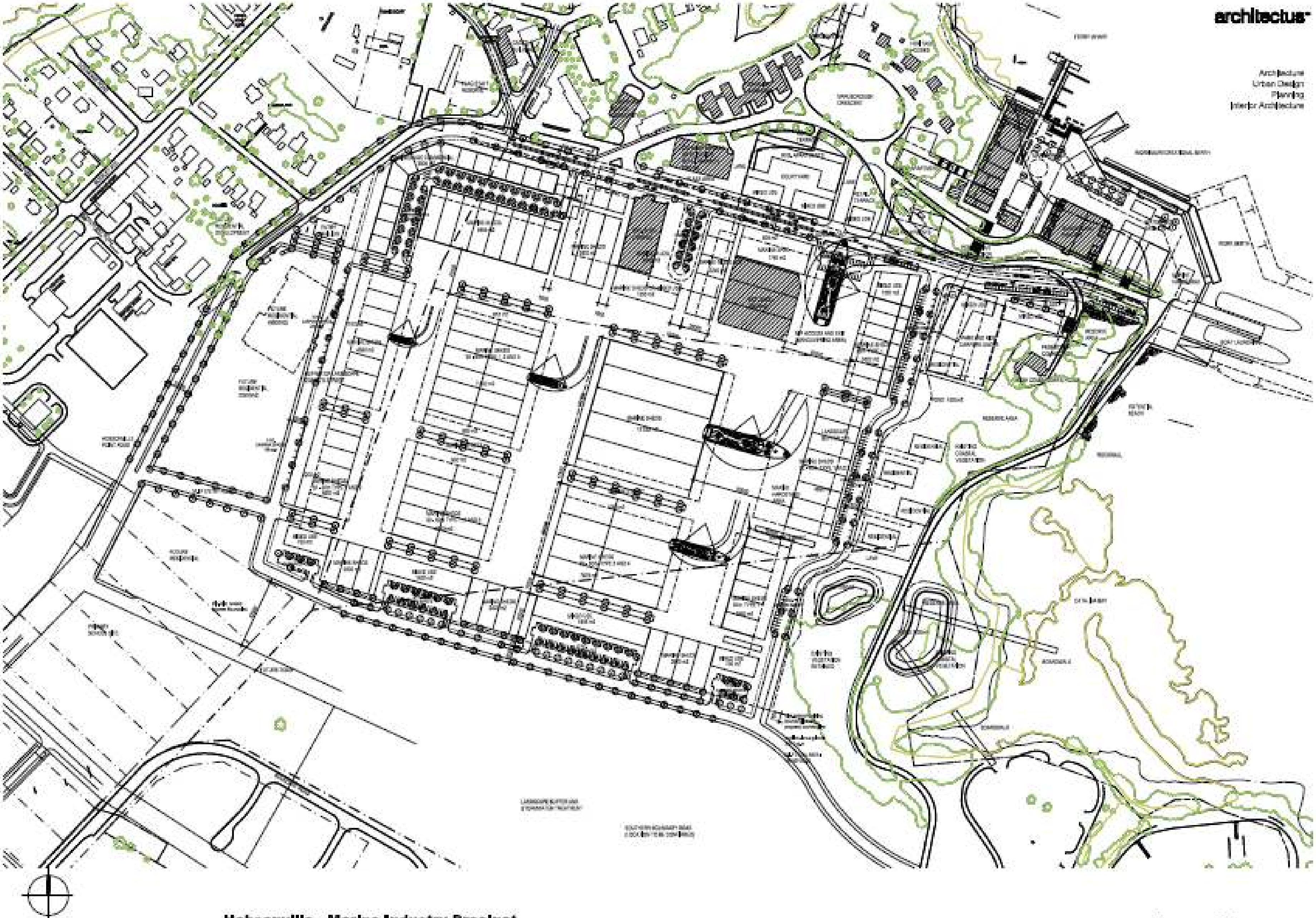
The Hobsonville Peninsula, under the HLC, will be developed for residential purposes with several of these residential subdivisions adjacent to the MIP. HLC have an objective to include rainwater re-use in the HLC areas of development. The target for the re-use is to provide 75% of the non-potable water use, e.g. toilet, laundry and garden irrigation, from rainwater harvesting. This re-use philosophy has also been adopted by Waitakere Properties Ltd (WPL) within the MIP site. Opportunities exist for the re-use of roof runoff within the MIP for non-potable use such as for toilet water, irrigation and wash down areas.

3 ASSESSMENT ASSUMPTIONS

3.1 REUSE WATER SOURCES

This commercial harvesting assessment assumes that all of the roof runoff within the Marine Industry Precinct (MIP) will be collected for reuse purposes. A total roof area of 9.4ha has been adopted in this assessment, based on the latest site plans, Figure 1.

It is to be noted that the roof runoff from the proposed residential dwellings in the vicinity of MIP could also be collected as an additional source of reuse water. However, this option has not been taken into account in this analysis due to the staging and timing uncertainty of the development at the time of writing.



architectus

Architecture
Urban Design
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Interior Architecture

Hobsonville - Marine Industry Precinct

Job no **0839**

February 2009	Prepared for **Waitakere Properties Ltd**	Drawing **SITE PLAN**	Scale 1:750 @A3	Drawing no **SK-200** Issue D

3.2 RAINFALL DATA

The rainfall data obtained from the National Climate Database, which is available from the NIWA website, has been adopted in this assessment. The daily rainfall depths recorded from 1st January 2006 to 1st January 2009 at three stations within a 10 kilometre radius of Hobsonville was deemed appropriate.

3.3 STORAGE TANK

There will be primary storage to receive runoff from the catchment, and secondary storage to store treated water prior to pumping to the receivers.

Primary storage is required to ensure that there is sufficient water available to supply the water demand on an annual basis. The supply of rainwater is reliant on the daily rainfall volumes, which are inconsistent, or variable, throughout the year. To optimise the storage volume that will compensate for long dry periods between rainfall events storage sizes ranging from $1000m^3$ to $6000m^3$, at $1000m^3$ intervals, have been analysed. In order to represent the available storage conditions at the start of a demand cycle, it has been assumed that the storage is 25% full, i.e. 75% of the volume is available for the collection of rainwater.

The secondary tank size will be selected based on the daily demand requirements to ensure sufficient supply at peak demand.

3.4 TREATMENT

Filtration processing will be provided for the non-potable supply to ensure that sediments are removed. Further treatment of Ultra-Filtration, UV disinfection and residual chlorination is required for potable water supply to meet the industry and health quality standards.

3.5 WATER LOSSES

The amount of rainfall volume that can be reused is affected by incidental water loss through the system. There are two main types of water loss, being initial loss and overflow loss, which have been taken into consideration.

The initial loss includes evaporation, spillage, and seepage, with additional loss due to the water treatment process. To simplify the assessment, a 1mm initial loss (or abstraction) has been applied to the daily rainfall depth, resulting in an overall 12% annual rainfall volume loss.

During large rainfall events, the storage tank could be filled to capacity and the runoff volume in excess of the tank maximum storage capacity will activate overflow and discharge to the stormwater network with the MIP, which in turn discharges to the downstream receiving environment. The annual overflow loss is the combined effect of the dynamic balance between rainfall volume, tank size and daily water supply and consumption. Details of the annual runoff captured and reused are presented in Section 4.4.

3.6 WATER DEMAND

The potential recipients to benefit from the commercial water harvesting include the Marine Industry Precinct (MIP) and the residential households, of the HLC development, in the vicinity of MIP. These end users can be supplied with either non-potable water (not for drinking) or potable water.

3.6.1 MIP WATER DEMAND

The water demand within the MIP is based on 1850 full time employees for non-potable re-use options for toilets, landscape areas and for industrial purposes. However, the commercial harvesting system could support a potable water supply should treatment be provided to industry and health quality standards.

The daily water consumption within the MIP estimated in this assessment is $68m^3$ and $55m^3$ for potable and non-potable demand, respectively. The details of the demand for the potable and non potable water are shown separately in Table 1.

Table 1: MIP Water Demand

Discharge points	Total Water Demand [1]		Non-Potable Demand	
	Rate	Volume	Rate	Volume
Toilet Flushing	20L/p/d	37 m^3	20L/p/d	37 m^3
Shower (1/4 occupants)	20L/p/d	9.25 m^3	-	-
Hand washing	1L/p/d	1.85 m^3	-	-
Kitchen	1L/p/d	1.85 m^3	-	-
Laundry	8L/p/d	14.8 m^3	8L/p/d	14.8 m^3
Irrigation	-	2 m^3	-	2 m^3
Washdown	1hr @ 0.5L/s	0.9 m^3	1hr @ 0.5L/s	0.9 m^3
Total	30L/p/d	68 m^3	37L/p/d	55 m^3

Notes: 1. Water will be treated to potable level.

3.6.2 RESIDENTIAL DWELLINGS WATER DEMAND

The daily demand of the residential dwellings is based on 100L/p/d of potable consumption plus 50L/p/d of non-potable uses, as per Hobsonville Land Company (HLC) estimates. For a 3 member household, the potable and non-potable demands are 450L/household/d and 150L/household/d, respectively.

The HLC identified residential developments adjacent to the MIP as potential receivers of harvested water. This assessment is based on HLC Staging Plan which indicated that approximately 470 households will be established by the year 2015 with another 330 apartments by 2018. The potable and non-potable water supply demands for these areas have been explored and detailed in Table 2

Table 2: Residential Dwellings Water Demand

Daily Water Demand	Total Water Supply	Non-Potable Supply
470 households	211.5 m^3	70.5 m^3
800 households	360 m^3	120 m^3

Notes: 1. Water will be treated to potable level.

3.7 COST

3.7.1 TOWN WATER SUPPLY COST

The Auckland Council (formerly Waitakere City Council) currently charges $1.53 per cubic metre for the town water supply (2009/2010 charges).

3.7.2 RAIN WATER SUPPLY COST

The cost of the commercial harvesting system consists of establishment (capital cost), operational and maintenance costs. These costs vary with respect to the water supply and demand. Rough order of costs has been applied to the scenarios considered and presented in Section 6.

Costs have been established for both non-potable and potable supply. Non-potable supply would require a separate reticulation system from the public potable supply, which is to be provided by an alternative supplier (public supplier EcoWater). The potable re-use supply would utilise one reticulation system, which will have a "top up" system from the public supply.

3.7.3 HLC RE-USE IMPLEMENTATION

HLC have a re-use implementation commitment the offers 75% of the annual non-potable use demand for the residential developments will be supplied by the rainfall captured from roof areas. This re-use system has a cost associated with the implementation into individual households due to the provision of individual storage tanks and non-potable plumbing. This cost is estimated to be in the order of $3.5K per household. The cost of this installation for the 470 households is $1.65M, which is exclusive of operation and maintenance costs.

3.7.4 SUSTAINABLE ADVANTAGES

There are several areas of the development of both the MIP and HLC subdivisions which have externalities that benefit from re-use of rainwater. These externalities often cannot be quantified in monetary value but rather in sustainable advantages.

The re-use of rainwater from the commercial MIP development will link the industry with the communities surrounding the site. This is a link that can create an industry-community relationship, rather than a perceived barrier.

The reuse of rainwater within the site will promote the sustainable awareness that is often removed from industrial development. The re-use of rainwater will be promoted within the site as a distinction from other industrial communities in surrounding areas.

There will be a sense of ownership from operators and their employees which will permeate to other areas of their lifestyle which in turn can benefit the wider community.

The proposal to re-use stormwater runoff is also consistent with both WPL's and HLC's philosophy on sustainable development.

4 RAINWATER HARVESTING ESTIMATION

The harvesting of rainwater from the roof catchment within the MIP has been estimated with respect to the amount that can be captured on an annual basis along with the ability to supply water to the receivers.

4.1 HYDROLOGICAL ASSESSMENT METHODOLOGY

A HEC HMS model has been set up to estimate the amount of rainwater captured during a year. This information was then used to establish various storage volume scenarios to optimise storage requirements with respect to demand for re-use water compared to the annual percentage of this water supply.

The rainfall volume was computed on a daily basis using the rainfall depths from recording stations within a 10km radius of Hobsonville. This data was obtained from the National Climate Database and is associated with three consecutive years, from 1st January 2006 to 1st January 2009.

The reuse water supply is modelled by having a constant discharge rate from the storage tank to represent the daily supply capability. The discharge rate ranges from 0.5L/s to 5L/s, at 0.5L/s intervals, which represents an average daily supply to the receivers of between 43.2m^3 and 432m^3. It is to be noted that more detail can be applied to represent daily demand peaks in future assessments.

4.2 ANNUAL RAINWATER SUPPLY CAPABILITY

MIP can supply rainwater based on the ability to capture the runoff and store the runoff within the site. The capture of rainfall has small losses due to evaporation and conveyance however there is another constraint being the storage volume. An assessment of the storage volume versus water supplied from the MIP catchment, being the roof areas, has been undertaken and presented graphically in Figure 1.

It is to be noted that there will be a potable water supply top-up system within the MIP water system to ensure 100% demand is supported annually.

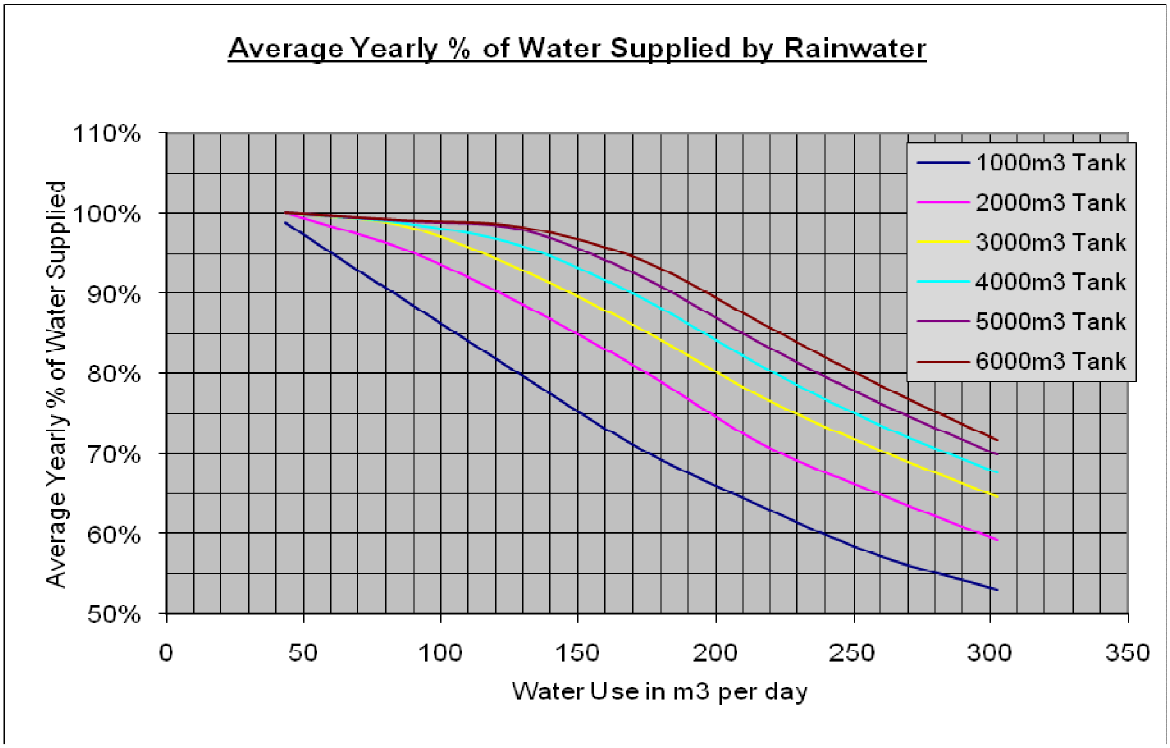

Figure 1: Average Yearly Percentage of Water Supplied by Stormwater

HLC aims to supply 75% of the non-potable water use per household from a re-use facility. Therefore the 75% annual water supply from MIP supply has been assessed based on tank size, e.g. should a 1000m^3 tank be installed with a scenario of a 150m^3 water demand then 75% of the annual water use can be supplied by the rainfall captured by the MIP.

Figure 1 indicates that the larger tank size can provide larger daily water supply rates. However, the increase of water supply is not in direct proportion to the tank size, as the total rainfall volume remains unchanged in all scenarios.

4.3 WATER DEMAND VERSUS ANNUAL SUPPLY

The water demand is based on the receiving community, therefore an assessment of the demand, both total water and non-potable, together with the percentage of rainwater supplied by the MIP on an annual basis has been undertaken. The total water demand includes both potable and non-potable demands .The outcomes are presented in Table 3.

Table 3: Daily Water Demand and Annual % Rainwater Supply

	MIP Only		MIP + 470 households		MIP + 800 households	
	Total water	Non-Potable	Total water	Non-Potable	Total water	Non-Potable
Daily Water Demand, m^3	68	55	279.5	125.5	428	175
	Annual % Rainwater Supply					
$1000m^3$ Tank	93%	96%	55%	81%	43%	71%
$2000m^3$ Tank	98%	99%	62%	89%	48%	80%
$3000m^3$ Tank	99%	100%	67%	93%	53%	85%
$4000m^3$ Tank	99%	100%	70%	96%	56%	89%
$5000m^3$ Tank	99%	100%	73%	98%	57%	92%
$6000m^3$ Tank	99%	100%	75%	98%	58%	94%

To support non-potable supply for MIP and the adjacent 800 households, a tank size in the order of $1500m^3$ is required to provide up to 75% of the annual demand volume. However, a $6000m^3$ tank can provide 75% of the annual potable demand for MIP and 470 households, which reduce to 58% once the additional 330 households, are complete and connected to the commercial harvesting system.

4.4 ANNUAL RAINWATER VOLUME CAPTURED

The rainfall that can be captured for reuse is dependent on the tank size and the daily water use, or demand. The percentage of rainfall volume captured and reused (captured/reused) in an annual basis is presented in Figure 2.

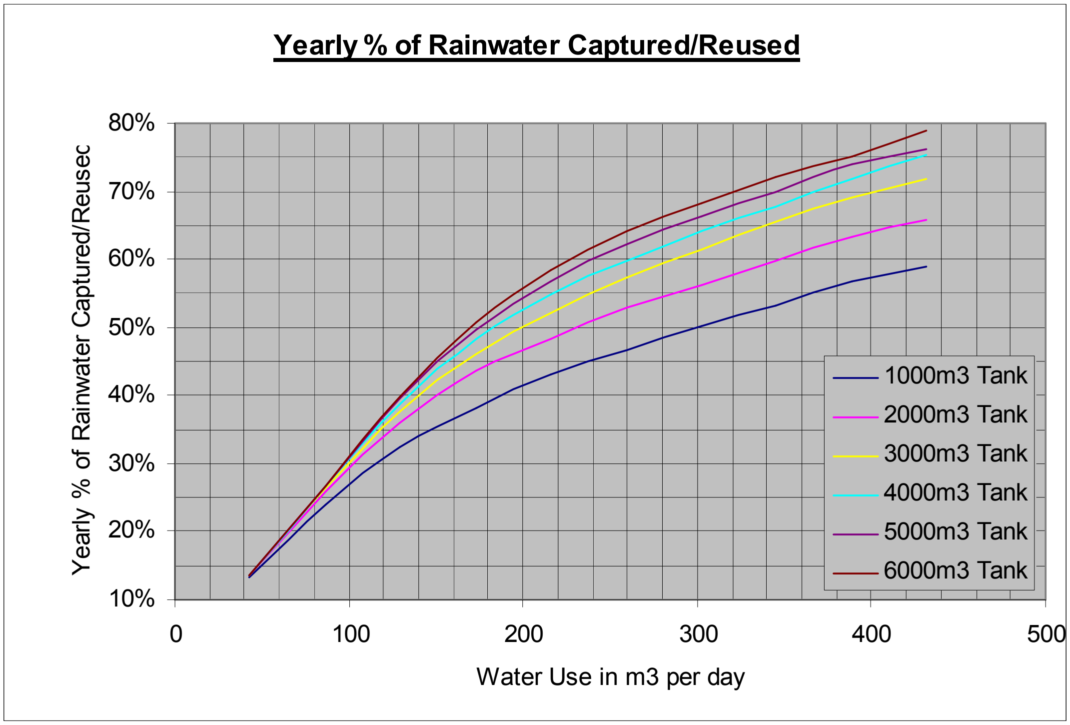

Figure 2: Yearly Percentage of Rainwater Captured/Reused

The outcome of this analysis has been applied to the water demand generated by the MIP and the nearby residential developments. Table 4 presents the percentage of annual runoff that could be used for potable and non-potable proposes.

Table 4: Annual % Rainwater Captured/Reused

	MIP Only		MIP + 470 households		MIP + 800 households	
	Total Water	Non-Potable	Total Water	Non-Potable	Total Water	Non-Potable
Daily Water Demand, m^3	68	55	279.5	125.5	428	175
	Annual % Rainwater Captured/Reused					
$1000m^3$ Tank	20%	17%	48%	32%	59%	38%
$2000m^3$ Tank	21%	17%	55%	35%	66%	44%
$3000m^3$ Tank	21%	17%	59%	37%	72%	46%
$4000m^3$ Tank	21%	17%	62%	38%	75%	48%
$5000m^3$ Tank	21%	17%	64%	39%	77%	50%
$6000m^3$ Tank	21%	17%	66%	39%	78%	52%

The larger the tank the greater the captured runoff can be utilised, however for a 6000m^3 tank only 78% of the annual runoff can be captured for reuse. This is due to the demand not matching the supply from the catchment, i.e. the rainfall incidents are naturally occurring whereas the demand is constant.

5 RAINWATER HARVESTING AND DELIVERY SYSTEM

The harvesting and delivery system proposed for the MIP water supply includes various individual components which can be grouped together and described as follows:

- Collection system: roof areas, downpipes, Pipe network leading to the water treatment centre
- Water treatment centre (Figure 3): GPT, Raw water storage – Primary storage, Filtration and treatment, Treated water storage – Secondary storage, Top up system from EcoWater supply, Delivery pumps
- Water supply: Distribution network to receivers

The collection system will be designed to Auckland Council standards for delivery of runoff to the treatment centre. This delivery system is sized to convey stormwater runoff for rainfall events up to a 100yr ARI due to the need to reduce surface water within the MIP during large rainfall events. The treatment centre has an overflow capability to discharge runoff in excess of the treatment centre holding capacity to the stormwater system.

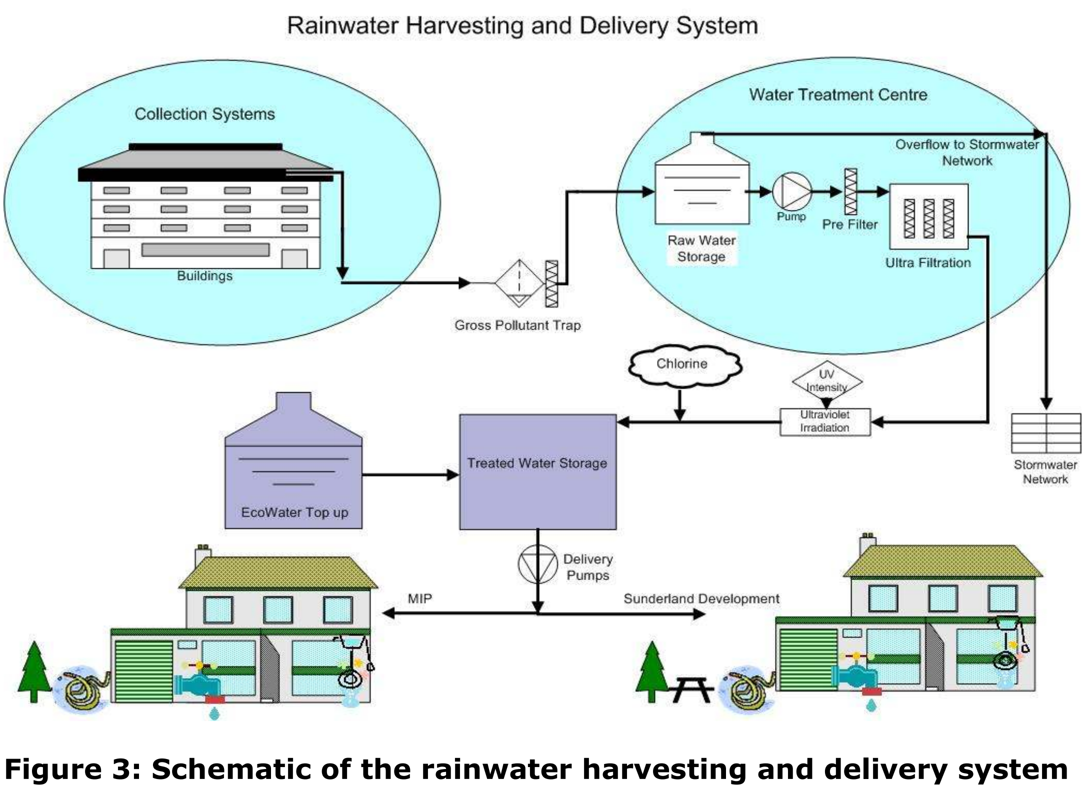

Figure 3: Schematic of the rainwater harvesting and delivery system

It is to be noted that should a non-potable system be preferred then the Water Treatment Centre would not contain Ultra filtration. The removal of sediments for non-potable water standards would be undertaken by the Pre-Filter.

6 COST ANALYSIS FOR MIP SUPPLY OPTIONS

A cost comparison of the MIP water supply has been undertaken for both potable and non-potable options for selected development options.

6.1 SCENARIOS FOR COST ANALYSIS

For this assessment a focus on the supply of potable and non-potable water to the MIP and the 470 household residential developments only will be progressed. By selecting these supply scenarios a comparison of the cost benefits can be provided without the detraction of a plethora of options. Focus on other supply options can be discussed in detail in future analysis once these options are reviewed and the principles established.

Tank size is another variation to the supply options therefore the selection of 75% annual supply by the MIP water facility has been adopted as this best represents the needs of the residential development under the requirements of the Hobsonville Comprehensive Development Plan (undertaken for HLC). Tanks sizes of 6000m^3 and 1000m^3 provide at least 75% annual supply for potable and non-potable purposes respectively. In addition a 3000m^3 tank has been selected for cost analysis to provide an understanding of the sensitivity of tank size with respect to cost.

There will be three scenarios presented for cost analysis within this report, these being supply with 1000m^3, 3000m^3, and 6000m^3 tank options.

6.2 TREATMENT AND SUPPLY COSTS

The treatment and supply costs associated with the rainwater harvesting can be divided into the establishment and then the ongoing operation and maintenance of the system.

Rough order estimation of the costs associated with the supply of water is presented in tables 5a and 5b.

Table 5a: Establishment and Operational costs

Scenarios	Non-Potable & 1000m^3 tank	Total water & 3000m^3 tank	Total water & 6000m^3 tank
Establishment Costs			
Storage (Primary and secondary tanks)	$177,250[1]	$522,200[1]	$1,037,000[1]
Treatment Plant Structure	$10,000 (10m^2)	$20,000 (20m^2)	$20,000 (20m^2)
Screening & Filtration	$7,500	$8,500	$8,500
Ultra-Filtration, UV & Chlorination	n/a	$20,000	$20,000
Treatment Pump Station	$10,000	$20,000	$20,000
Delivery Pump Station	$50,000	$95,000	$95,000
Distribution Network	$85,000[3]	$32,000[2]	$32,000[2]
Power	$5000	$5000	$5000
Total establishment costs	$344,750	$722,700	$1,237,500
Annual establishment costs[4]	$17,200	$36,100	$61,900

Notes:

1. Assumes concrete basement tank and is extra over cost of constructing a conventional on grade building floor slab.
2. Assumes extra over to reticulation for MIP i.e. connects into MIP reticulation system only.
3. Assume separate non-potable system.
4. Assumes that the recovery period is 20yrs for establishment costs

Table 5b: Operational, maintenance and total costs

Scenarios	Non-Potable & 1000m^3 tank	Total water & 3000m^3 tank	Total water & 6000m^3 tank
Operational Costs (annual cost)			
Power usage	$13,400	$17,700	$17,700
Treatment Dosage	n/a	$5,000	$5,000
Staff wages	$60,000	$60,000	$60,000
Sampling & Monitoring	n/a	$2,500	$2,500
Total annual operational costs	$73,400	$85,200	$85,200
Maintenance Costs			
Gross Pollutant Trap Maintenance	$5,000	$5,000	$5,000
Filter cleaning/replacing	$2,000	$2,000	$2,000
UV lamps replacing	n/a	$1,000	$1,000
Total annual maintenance costs	$7,000	$8,000	$8,000
GRAND TOTAL ANNUAL COSTS	$97,600	$129,300	$155,100

The level of treatment, i.e. potable quality requires more treatment, and the size of the tank increases the annual costs. Therefore the infrastructural components, being the treatment plant and tank construction, influence the costs more than the water supply demand.

Providing a potable water supply is more costly on an annual basis, however this does not include the cost of the potable water supply to be provided by EcoWater. This EcoWater supply requires another $86,000 annually, see Table 6.

6.3 TOTAL ANNUAL WATER SUPPLY COST

The MIP harvesting system can supply the MIP and the 470 household developments with a percentage of their annual demand, therefore the water supply system requires a "top up" supply from EcoWater. The "top up" demand varies for each of the review scenarios; therefore the annual cost differs, as presented in Table 6.

Table 6: Total annual water supply costs (MIP and EcoWater supply)

Scenarios	Non-Potable & 1000m^3 tank	Total Water & 3000m^3 tank	Total Water & 6000m^3 tank
Daily Demand, m^3	125.5	279.5	279.5
Annual Demand, m^3	45,810	102,020	102,020
% of annual supply by MIP	81%	67%	75%
% annual top-up required	19%	33%	25%
EcoWater annual top-up, m^3	8,700	33,700	25,500
Annual EcoWater Charge	$13.3K	$51.5K	$39.0K
System Establishment Cost	$345K	$723K	$1,238K
Establishment Cost per year (over 20 years)	$17.3K	$36.2K	$61.9K
Annual Operational Cost	$73.4K	$85.2K	$85.2K
Annual Maintenance Cost	$7.0K	$8.0K	$8.0K
Potable water demand, EcoWater	$86K	-	-
Total Annual Cost	$197K	$181K	$194K
$/m^3 total annual cost	$1.93/m^3	$1.77/m^3	$1.90/m^3

It is to be noted that any variation of the MIP stormwater harvesting system will require EcoWater top-up as the rainwater captured can only provide certain percentage of annual demand (see section 4.3), depending on tank size and size of receiving community.

The smaller tank for the MIP potable water supply is more economical than the larger tank; therefore the tank establishment costs do influence the costing comparison.

The MIP potable water supply options are more economical than having a non-potable supply from the MIP and utilising EcoWater for the potable supply. However the cost variations are not large therefore there would be some benefit in undertaking a more detailed review of the costs.

7 CONVENTIONAL SUPPLY VERSUS MIP SUPPLY

A conventional development in the Hobsonville Peninsula would rely on public water supply from EcoWater. Utilising the rainwater from the MIP will offset the town water supply costs and therefore potentially provide long term benefit to the local community.

The HLC developments aim to provide 75% of non-potable water demand which is to be supplied by rainwater captured from the roof areas. For this system to be successful a "top-up" system is required, which could be supplied by EcoWater. For this report an assessment of this system with the MIP commercial harvesting system that supplies its own independent water demands (potable and non-potable water demand) has been undertaken. This system could be considered as a variation on the conventional system.

These two conventional supply scenarios, described above, have been compared with the MIP supply scenarios to provide an understanding on the benefits of the commercial harvesting. This cost comparison is presented in tables 7a and 7b with table 7c summarising costs.

Table 7a: Annual Cost Comparison (EcoWater and 470 household tanks)

Water Supply	Conventional supply		MIP harvesting system		
	EcoWater only	470household tanks, MIP & EcoWater	Non-Potable & 1000m³ tank[3]	Total Water & 3000m³ tank	Total Water & 6000m³ tank
EcoWater Direct Supply					
Potable water per day, m^3	154	141	154	--	--
Non-Potable Water per day, m^3	125.5	--	--	--	--
Total Supply per day, m^3	279.5	141	154	--	--
Total Supply per annum, m^3	102,020	51,470	56,210	--	--
Annual EcoWater Charge	$156.1K	$33.6K	$86.0K	--	--
Total annual Cost	$156.1K	$33.6K	$86.0K	0	0
470 household Tank Supply					
Daily Demand, m^3	--	70.5	--	--	--
Annual Demand, m^3	--	25,730	--	--	--
% of annual supply	--	75%	--	--	--
EcoWater annual top-up	--	25%	--	--	--
EcoWater annual top-up, m^3	--	6,400	--	--	--
Annual EcoWater Charge	--	$9.8K	--	--	--
System Establishment Cost[2]	--	$1.645M	--	--	--
Establishment Cost per year (over 20 years)	--	$82.2K	--	--	--
Annual Maintenance Cost[1]	--	$56.4K	--	--	--
Total annual Cost	0	$138.6K	0	0	0

Notes:

1. Annual maintenance cost estimation of $120/household/annum
2. $3500/household for 470 households
3. Includes potable supply to 470 households via EcoWater

Table 7b: Annual Cost Comparison (MIP supply)

Water Supply	Conventional supply		MIP harvesting system		
	EcoWater only	470household tanks, MIP & EcoWater	Non-Potable & 1000m^3 tank	Total Water & 3000m^3 tank	Total Water & 6000m^3 tank
MIP Supply					
Daily Demand, m^3	--	68	125.5	279.5	279.5
Annual Demand, m^3	--	24,820	45,810	102,020	102,020
% of annual supply	--	93%	81%	67%	75%
EcoWater annual top-up		7%	19%	33%	25%
EcoWater annual top-up, m^3	--	1,700	8,700	33,700	25,500
Annual EcoWater Charge	--	$2.6K	$13.3K	$51.5K	$39.0K
System Establishment Cost	--	$250.8K	$344.8K	$722.7K	$1,237.5 K
Establishment Cost per year (over 20 years)	--	$12.5K	$17.2K	$36.1K	$61.9K
Annual Operational Cost	--	$32.1K[4]	$73.4K[5]	$85.2K[5]	$85.2K[5]
Annual Maintenance Cost	--	$8K	$7K	$8K	$8K
Total annual Cost	0	$55.2K	$110.9K	$180.8K	$194.1K

Notes:

1. Staff wages estimated at $30K
2. Staff wages estimated at $60K , see table 5b

Table 7c: Summary of Annual Cost Comparison

Water Supply	Conventional supply		MIP harvesting system		
	EcoWater only	470household tanks, MIP & EcoWater	Non-Potable & 1000m^3 tank	Total Water & 3000m^3 tank	Total Water & 6000m^3 tank
Overall Cost per Annum	$156.1K	$227.4K	$196.9K	$180.8K	$194.1K
$/m^3 total annual cost	$1.53/m^3	$2.23/m^3	$1.93/m^3	$1.77/m^3	$1.90/m^3

Due to the re-use commitment by HLC to provide 75% of non-potable water demand from roof runoff the comparison of 470 household tanks conventional supply to the MIP harvesting system is required. The water supply by the MIP system is more economical that the provision of tanks in individual households in the 470 household residential development.

All supply options have a higher overall annual cost than the conventional EcoWater supply. However the long term water charges by EcoWater are likely to increase over the 20 year period which has not been estimated within this costing scenario.

These costs could benefit from further refinement to establish incremental costs due to funding and operational consumables over the 20 year period.

8 LEGAL AND PROCEDURAL IMPLICATIONS

There are legal and procedural implications that will need to be addressed to ensure that a MIP water supply system can proceed. The issues that need to be addressed, however not limited to, are as follows:

- Water quality attainment
  - Monitoring and testing to ensure water quality standards are met at all times
- Guarantee of supply
  - Top up system from EcoWater will need to be established
  - Guaranteed power supply system for operation 24hours per day
- Charging structure and recovery of costs
  - Detailed cost analysis and depreciation assessment of preferred options
- Agreement between MIP and HLC to supply water
  - Legal counsel will be required
- Ownership of reticulation in public road reserves and easements
  - Private network will be established in public road reserve
  - Agreement by WCC and HLC of private network though public and privately owned land and reserves
- ICMP principles regarding communal based re-use system
  - Review of implications of re-use volumes from other water sub catchments
  - Auckland Council approval of re-use from other sub catchment applied to residential areas
- Wastewater charges
  - Review of wastewater charges with Auckland Council with respect to providing rainwater re-use

9 SUMMARY AND CONCLUSIONS

The MIP and HLC have committed to using roof runoff for non-potable purposes. HLC aim to provide 75% supply of non-potable demand within the Hobsonville development.

This cost benefit analysis presents a rough order understanding as to the application of providing either non-potable or potable supply of water to the HLC residential developments of 800 households.

The hydrological analysis undertaken shows that there is sufficient rainfall from the MIP roof catchment to support the residential development of 800 households. A water supply system has variables, such as water demand and tank storage size, which need to be optimized in order to provide an economic outcome for the system.

The tank sizes between 1000m^3 and 6000m^3 have been assessed together with the "top-up" demand from the public EcoWater supply. The outcome is that the smaller tanks are more economical than larger due to construction costs.

The cost benefit analysis has been undertaken based on rough order costs, however there are other sustainable advantages that do not hold any monetary value and provide benefits to the community. These are often over looked in costs analysis however in this instance can provide great advantage to the social health of the community.

The total supply costs include the EcoWater "top-up" that is essential for a rainwater harvesting system, due to the inconsistent rainfall recurrence of a natural phenomenon versus the constant demand from residential and commercial developments. The total supply costs are similar for both non-potable and potable options. However the tank size of 3000m^3 for both options is the most favorable. The total annual supply costs to provide potable water to the MIP and 470 household developments is approximately $181K with a 3000m^3 tank whilst the non-potable supply option with 1000m^3 tank is $197K. The cost difference is due to the volume of EcoWater supply for the potable portion of the water demand.

A comparison of individual tank supply for the 470 household developments and MIP potable supply shows that it is beneficial to have the water supply from the MIP harvesting system. The individual tank system for 470 household non-potable supply together with MIP supported by its own potable system and EcoWater providing potable to 470 households and top-up to MIP has an overall annual cost of approximately $227K. This can be compared to the MIP harvesting system to support the same residential and commercial communities, with EcoWater top up, is approximately $181K. These costs are similar however and could benefit from moving the "rough order costing" to more detailed cost analysis, at the next stage of the project.

Legal and procedural implications include the need to provide certainty to the continued water quality to industry and New Zealand Standards as well as issues of guarantee of supply. The charging and structure of the recovery of costs will need to be addressed as will any agreements between the MIP as the supplier and the HLC as the receiver of water. These implications will require legal counsel and liaison with consenting authorities.

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