Van Anda's Water Treatment Plan

Design Recommendation Presentation

Team H-4

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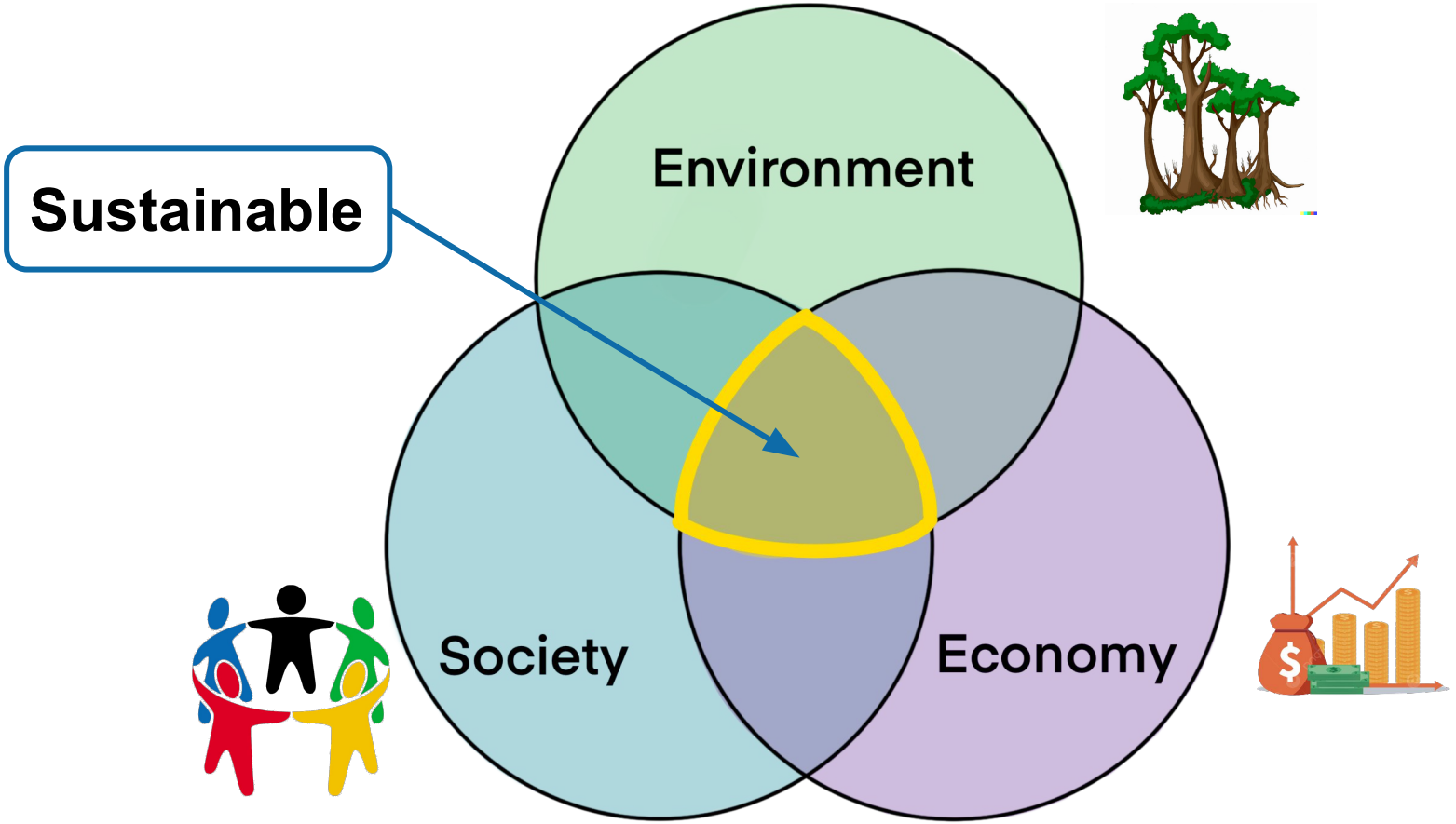
Introduction

Priest Lake

Our Goal:
To provide the Van Anda community with a *sustainable* solution to the current water crisis.



What do we mean by **Sustainable**?

Our Recommendation:

A ‘Hybrid’ Treatment Model

We propose a water treatment system which will provide water from two sources:

Rainwater Harvesting

Bottled Water Shipments

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Investigating Different Models

1: ‘Semi-Decentralized Model’

- Continues to source from Priest Lake
- Implementation involves renovating the *existing* system

2: ‘Centralized Model’

- Sources water from the mainland (Powell River)
- Involves transporting water across the Malaspina Strait

Unresolved Issues:

1: Semi-Decentralized Model

- Priest Lake remains unsustainable

2: Centralized Model

- Dependent on supply lines that are vulnerable to weather conditions.
- Expensive transportation costs

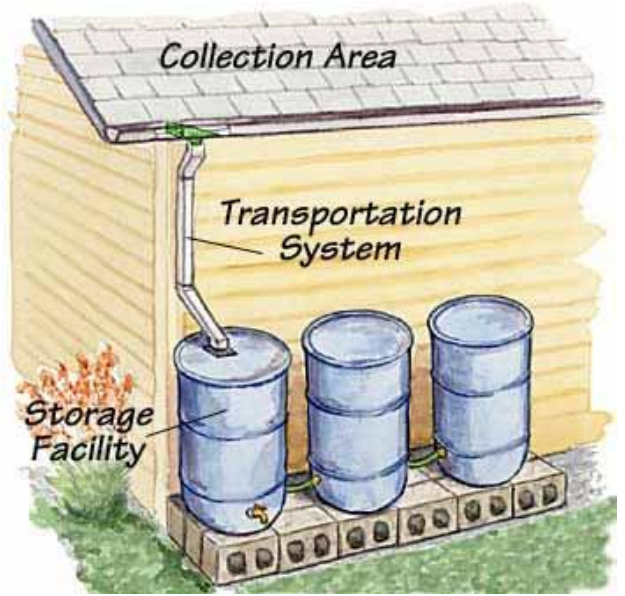
What if we could capture each's benefits whilst mitigating adverse effects?

Results from our Research

We explored some water source alternatives:

- Groundwater contamination is a problem
- Pipelines or desalination are **way** too expensive

Rainwater collection stand alone as a local water source



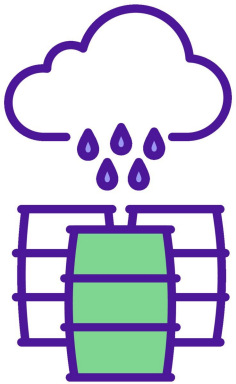
Option 3: The Hybrid Model

A combined system consisting of decentralized and centralized elements.

Rainwater Collection System:

(decentralized)

- One rainwater collection and filtration system per property
- Provides nearly a third of total water needs.



Bottled Water Shipment System:

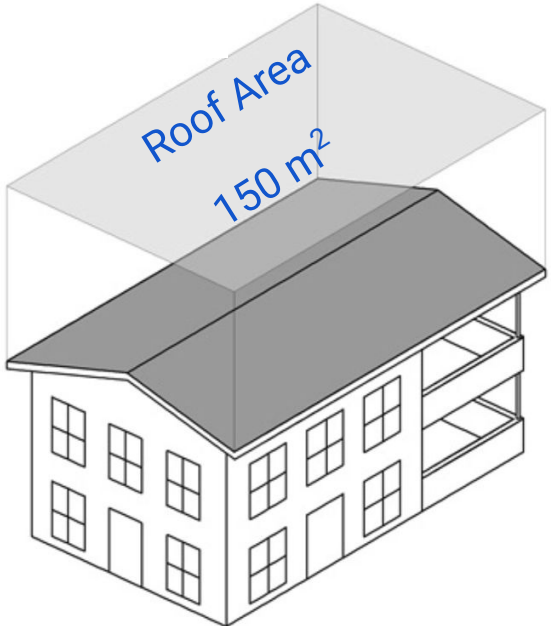
(centralized)

- Remaining water demand will be covered by bottled water.
- Volume of water imported is flexible

In an average year, rainfall is enough to supply approximately

30% of water needs in Van Anda

Collected Rain = [Avg. Roof Area] * [# of Buildings] * [Avg. Annual Rainfall]

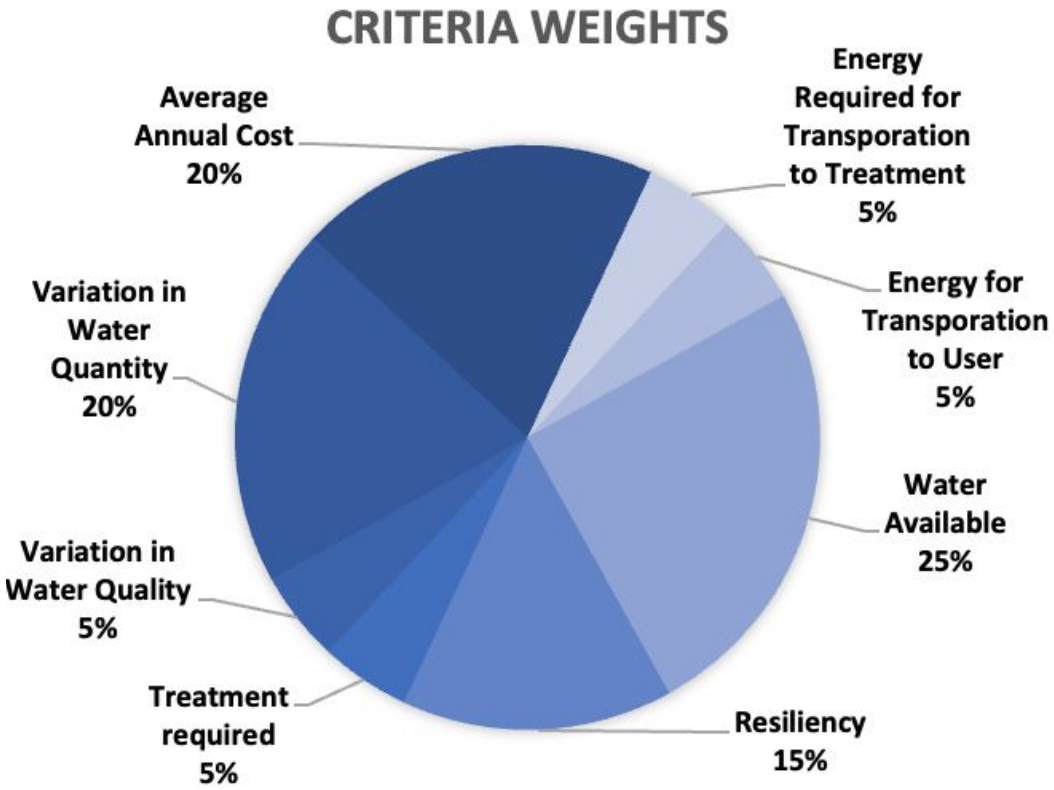


Avg Collected Rain per Year ≅ 32,132,000 L

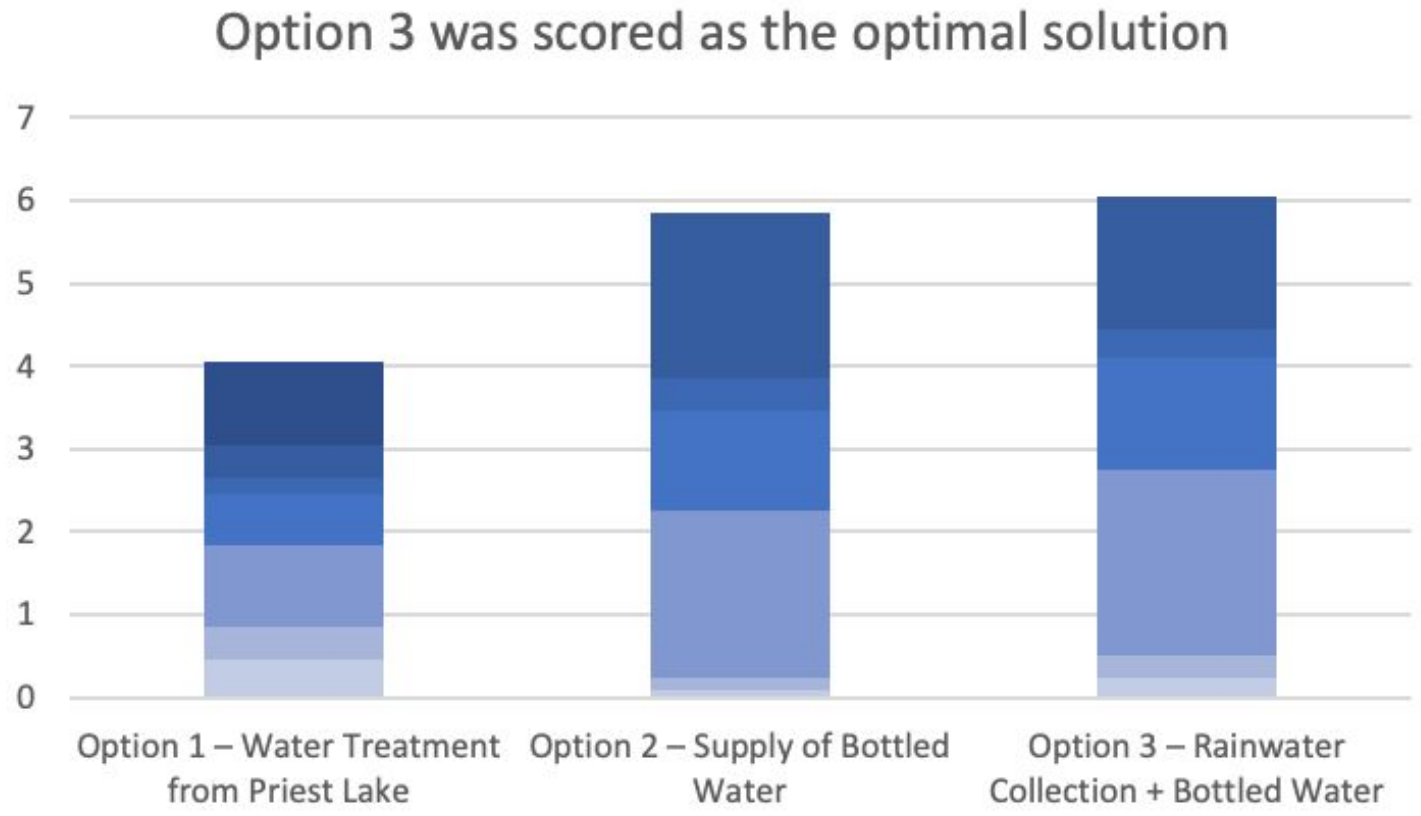
Avg Water Use per Year ≅ 110,800,000 L

(28,710,000L / 110,800,000 L) ≅ **30%**

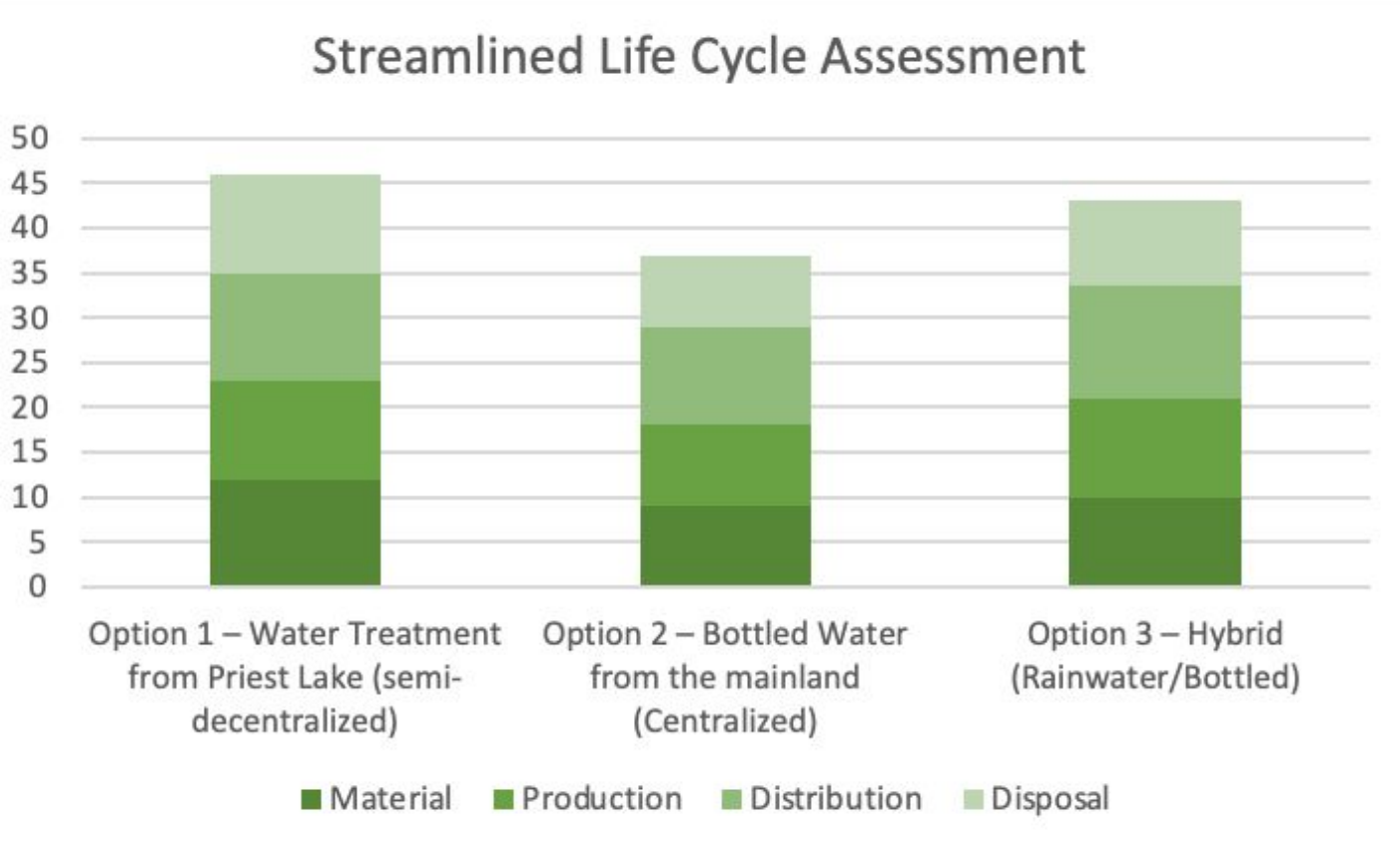
Quantitative Analysis



Quantitative Analysis



Qualitative Analysis



Final Recommendation: **Option 3**

A Decentralized Rainwater Collection model supported by Bottled Water Shipments

- Ranked above other options in the WDM in terms of sustainability.
- More resilient compared to the other options.
- Prioritizes long life and reliability.
- Minimizes expenditure.

Thank *you*.

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Cost Analysis

Based on stakeholder interviews, the prices they are paying for chlorine, and publicly available cost estimations for the transportation of water including fuel and labour costs:

- We predict it will cost ~**$200k/year** to ship in needed water.
- For a population of 300, that would be ~**$676 per capita per annum.**
- The national average for the installation of a rainwater collection system ranges from **$1000 – $3500** which varies based on catchment area and materials.
    - This upfront cost will pay itself off in **2–8 years** due to the cost savings of shipping in less water.
- Without a detailed and comprehensive analysis of the current system's state we are unable to estimate the cost of renovation.
    - Notwithstanding, the up-front costs of renovating such a system can be expected to **significantly greater** than $3500.
- Reverse osmosis filtration systems for as low as **$750**.

Rainfall Estimate

1. Average Rainfall: 957 mm per annum
    a. Publicly available data
2. Water use: ~110,000,000L
    a. From Van Anda Improvement District published data
3. Average catchment area of roof: 150m^2
    a. Estimation based on national averages
4. Number of Residences: 175
    a. From Statistics Canada’s 2016 Census
5. Other Applicable Buildings: >35
    a. From looking at Google Maps and counting applicable buildings, lower bound used

WDM

	Criteria	Weightin	Option 1 –	Option 2 –	Option 3 –
Weights and Raw	Energy required for water transport from source to	0.05	9	2	5
	Energy for water transport after treatment to user	0.05	8	3	5
	Water quantity available	0.25	4	8	9
	Resiliency of water supply	0.15	4	8	9
	Amount of treatment required	0.05	4	8	7
	Seasonal variation of water quality	0.05	4	10	9
	Seasonal variation of water quantity	0.2	2	10	8
	Average annual cost over 10 year period (including	0.2	5	3	5
	Sum of weights	**1.0**			
Caclulated Scores	Energy required for water transport from source to		0.45	0.1	0.25
	Energy for water transport after treatment to user		0.4	0.15	0.25
	Water quantity available		1	2	2.25
	Resiliency of water supply		0.6	1.2	1.35
	Amount of treatment required		0.2	0.4	0.35
	Seasonal variation of water quality		0.2	0.5	0.45
	Seasonal variation of water quantity		0.4	2	1.6
	Average annual cost over 10 year period (including		1	0.6	1
	Total		**4.25**	**6.95**	**7.5**

SLCA

Option 1 – Water Treatment from Priest Lake (semi-decentralized)

	Material	Production	Distribution	Disposal	Total
Resources used	3	3	4	2	
Energy usage	3	2	2	2	
Waste generation	3	3	4	4	
Public health	3	3	2	3	
Total	12	11	12	11	46

Option 2 – Bottled Water from the mainland (Centralized)

	Material	Production	Distribution	Disposal	Total
Resources used	2	2	3	2	
Energy usage	2	2	1	2	
Waste generatio	2	2	4	2	
Public health	3	3	3	2	
Total	9	9	11	8	37

Option 3 – Team-generated option (Rainwater/Bottled)

	Material	Production	Distribution	Disposal	Total
Resources u	2	3	4	3	
Energy usage	2	3	2.5	2	
Waste gener	3	3	4	2.5	
Public health	3	2	2	2	
Total	10	11	12.5	9.5	43

Additional Information

- Used plastic bottles can be shipped back to Powell River to hopefully be reused or recycled.
- Van Anda could enter into a future's contract with a supplier to agree to buy bottled water at a certain price to reduce price volatility.
- WDM for Option 2 and 3 are very similar as they are rather similar systems with only 30% of Option 3's water supply being different.
- Our estimates for water quantity from rainfall does not account for water tanks filling.
- Unpowered homes could have filtration capacity from purification tablets or simply use bottled water solely.
- Option 1 scored so well on our SLCA as its unreliability due to climate change was not factored in.
- A sensitivity analysis was performed with our WDM with other likely options for our weights. Option 3 scored the best on all different sets of weights that we considered as realistic, and for most of them the gap between it and Option 2 even grew.
- Malaspina Strait is the portion of the Georgia Strait between Texada Island and Powell River.