1 Introduction

We all need clean water to survive, yet is increasingly becoming scarce on the planet. While architects and engineers have gotten much better at how to reach Net Zero Energy (NZE) with buildings, Net Zero Water (NZW) remains more of a mystery. The critical issue with "water neutral" as it stands is the term, and related terms, are ambiguous. Different private firms, towns, or water utilities define it differently; as a result, the phrase is in danger of losing any meaning it might have, and becoming little more than a way to market products. This report intends to define the "Net Zero Water" term for our semester project and explains in depth the tasks completed and in progress, for 50% interim design submission, to achieve NZW system for Mehran University of Engineering and Technology.

The first section of the report discusses the site location of our project. A site map is attached to understand the location of the project. The second section refers to the details of data requirement, sources, applicable authorities and code, and regulations.

The third section of the report discusses the design criteria and detailed calculation to estimate the water budget and amount of water reuse for the Jatoi hostel building, MUET Jamshoro. All the input data to calculate water budget was readily available through our contacts. Few assumptions were imperative to take for the calculations, and those are (a) rainfall data of Hyderabad was used as there is no gage station in Jamshoro city, (b) fixture rates are not taken from the regional authority, it is based upon Capital Development Authority, Islamabad. The complete design for Net Zero Water (including rainwater harvesting, water conservation and wastewater treatment and reuse).

The fourth section of the report explains the sustainability rating system for this project. We are implementing "Living Building Challenge, Water Petal." The intent of the Water Petal is to realign how people use water and to redefine "waste" in the built environment so that water is respected as a precious resource. The water petal encompasses the Net Positive Water Imperative which defines that site water utilization and discharge must work in amicability with site hydrology and its environment. 100% of the site's water needs should be provided by caught precipitation or closed loop system with treatment process as needed to maintain water quality that will be used for indoor or outdoor activities. The calculations for net zero water has been completed for the interim design stage, and it will be further refined for the final submission.

This report provides a brief overview of the cost analysis (BOQs) for plumbing work, water treatment plant and rainwater harvesting. This is the initial estimate, and detailed cost analysis will be submitted with final design report.

2 Site Description

This report sets out the basis for interim design and schematic for water and wastewater infrastructure of Jatoi Hostel in Mehran University of Engineering and Technology (MUET), Jamshoro. The project is located about 18 kilometers from Hyderabad. The hostel building has approximately 20,000 sq.ft of covered area and 25,000 sq.ft of landscape area in its territory. Climatic conditions are arid; days are hot and dry while nights are cooler. The majority portion of precipitation happens in monsoon season (June to August) with an average rainfall of 7.00 inches. However, in recent years, there have been several rainfall events that have exceeded the average rainfall in the region. The historical precipitation data for the study region have been provided in Appendix. The only source of freshwater for the study area is from Karachi Canal that is roughly 3km away, and ground water is not favorable for indoor and outdoor usage. The existing stormwater infrastructure is conventional, consisting of the downspout at the roof, which collects rainwater and discharges it into existing municipal drainage system.

2.1 Site Maps

Known location of primary water source overlaid on the aerial photo concerning site area is shown below. The map also provides an overview of open space availability that can be used for gray/black water reuse for irrigation purposes.

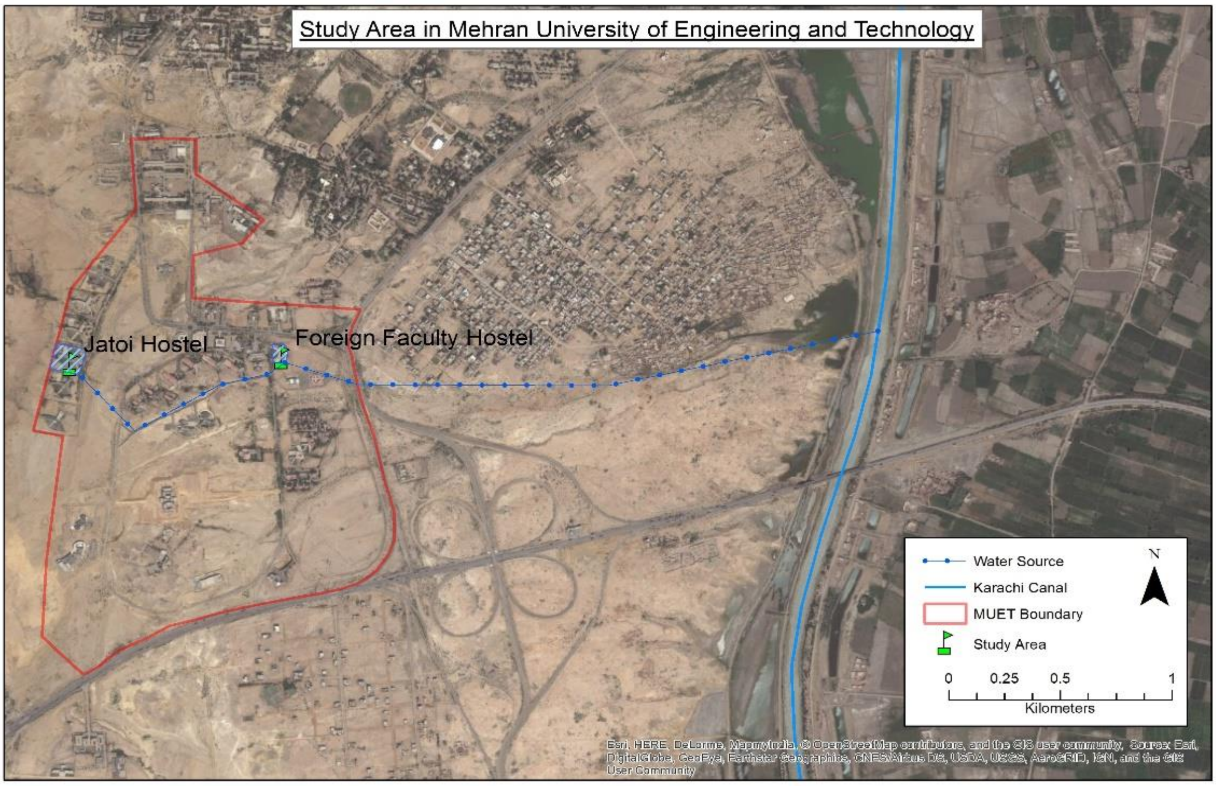


Figure 1. Study area location map

3 Data Requirements

The initial data requirements for this project was to get the total numbers of a resident at the hostel building. This information was gathered with the help of a formal resident and current exchange student from MUET at U of U, named Azizullah Ghafar. He was the primary source for reconfirming the total number of students from hostel administration. The next step was to get the type of fixtures and their flow rates for accurate estimation of the water budget. This information was collected from Capital Development Authority (CDA), Islamabad and local builders. Lastly, the rainfall data was collected from Pakistan Metrological Department by the help of a Dr. Rasul Bux Mehr (Faculty Member at MUET). Due to unavailability of rain gauge station at the project site, nearby city's (Hyderabad) precipitation data was used for all the calculation purposes and rainfall data is provided in Appendix 1.

3.1 Applicable Authorities & Approvals

The requirements of the relevant local authority shall be adhered to where no applicable standards or guidelines are provided then local standards, international standards, and best practice shall be adopted.

Should conflicts arise during the design out of discrepancies between codes, standards and other documents, the more stringent requirement shall apply. Local authority requirements will usually prevail to ensure compliance and ease of obtaining approvals. Where differing or conflicting standards are used, a unified approach shall be adopted to avoid errors or discrepancies arising from differences in approach, methodology or criteria.

3.2 Services Layout Drawings

The proposed water and wastewater network layout in hostel building has been provided for ground floor which is assumed to be replicated in rest of the building. For conceptual design stage, a typical layout is provided will be modified as the project moves to the detailed design stage. The drawings are attached in Appendix 2.

3.3 Regulations and Codes

Due to unavailability of local codes and regulations related to our project, mostly international standards and regulation will be applied to carry out all the work. For plumbing work, "International Plumbing Code" (IPC) will be followed. A copy of IPC is attached as Appendix. For rainwater harvesting, "Ontario Guidelines for Residential Rainwater Harvesting Systems" will be used as regulatory guidelines. The copy of this code is also attached in Appendix. Finally, for gray water reuse, "Guidelines for the Reuse of Gray Water" by Prepared by Hawaii State Department of Health Wastewater Branch.

4 Net Zero Calculations

4.1 Rainwater Harvesting and Conservation

4.1.1 Indoor Water Usage

The estimation was done by using "LEED Indoor Water Use Reduction Calculator v. 4". The input and assumptions are given as below:

- Total Number of Students = 167 (Male)
- Percentage of males expected to use restrooms with urinals are = 100%
- Number of annual operational days = 365
- For the Baseline case, Urinal and Toilet flush rate of 1 gpf and 1.6 gpf respectively were used.
- **The Baseline case annual flush volume becomes 1,194,718 gallons/year.**
- It was assumed that all the fixtures were installed after 1995. This results in maximum water consumption to 1,433,661 gallons/year.
- Instead of using regular toilets flush and Urinal, Low Flow Water Closet and non-water urinals were recommended and low flow fixtures for kitchen, showerhead and public lavatory faucets.
- **The design case annual flush volume is equal to 814,665.40 gallons/year. The design case value was used to estimate the cistern size.**

The details calculations are provided as Excel worksheet "Annual Indoor Demand" in Appendix 3.

4.1.2 Determine the yield from the rainfall

The total yield from the rainfall was calculated from the information provided for the roof top area and monthly rainfall data. Runoff coefficient is taken as 0.95. The total indoor demand was divided by the number of days for every month to calculate the monthly indoor demand. The analysis results are provided in Appendix 4.

4.1.3 Outdoor Water Usage

Table 1. Initial monthly outdoor water demand

Week	Date	ETOS Grass Total (in)	Rain (in)	Monthly Landscape ET, ETL (in)	Irrigation demand (in)	Irrigation demand (ft^3)	Irrigation demand (gal)
1	May	4.89	0.14	3.91	5.39	11,227.86	83,990
2	June	8.32	0.96	6.65	8.13	16,946.67	126,770
3	July	5.90	1.10	4.72	5.17	10,766.67	80,540
4	August	5.81	1.42	4.65	4.61	9,613.81	71,916
5	September	4.58	1.09	3.66	3.68	7,662.86	57,322
	Total for Growing Season	**29**	**5**	**24**	**27**	**56,218**	**420,539**

Table 2. Final monthly outdoor water demand

Week	Date	ETOS Grass Total (in)	Rain (in)	Monthly Landscape ET, ETL (in)	Irrigation demand (in)	Irrigation demand (ft^3)	Irrigation demand (gal)
1	May	4.89	0.14	1.81	2.39	4,968.93	37,170
2	June	8.32	0.96	3.08	3.03	6,305.31	47,167
3	July	5.90	1.10	2.18	1.55	3,219.91	24,087
4	August	5.81	1.42	2.15	1.04	2,174.81	16,269
5	September	4.58	1.09	1.69	0.86	1,796.98	13,442
	Total for Growing Season	**29**	**5**	**11**	**9**	**18,466**	**138,135**

The detail calculations for outdoor water usage are attached in Appendix 5.

4.1.4 Calculate the cistern size from yield and indoor water usage

From the yield (runoff from the precipitation) and indoor and landscape water usage, cistern size was calculated as shown below:

Table 3. Cistern size calculation for indoor and outdoor water usage

Year 1				
Month	Yield	Demand	Cumulative Storage	Municipal Makeup
	(gal)	(gal)	(gal)	(gal)
January	710.60	13,838.15	-13128	13128
February	3,197.70	12,498.98	-9301	9301
March	2,013.37	13,838.15	-11825	11825
April	3,316.13	13,391.76	-10076	10076
May	1,302.77	51,008.30	-49706	49706
June	2,131.80	60,558.78	-58427	58427
July	22,265.47	37,924.76	-15659	15659
August	33,516.63	30,106.86	3410	0
September	6,158.53	26,834.12	-17266	17266
October	2,605.53	13,838.15	-11233	11233
November	1,065.90	13,391.76	-12326	12326
December	1,065.90	13,838.15	-12772	12772
Year 2				
Month	**Yield**	**Demand**	**Cumulative Storage**	**Municipal Makeup**
	(gal)	**(gal)**	**(gal)**	**(gal)**
January	710.60	13,838.15	-13128	13128
February	3,197.70	12,498.98	-9301	9301
March	2,013.37	13,838.15	-11825	11825
April	3,316.13	13,391.76	-10076	10076

May	1,302.77	51,008.30	-49706	49706
June	2,131.80	60,558.78	-58427	58427
July	22,265.47	37,924.76	-15659	15659
August	33,516.63	30,106.86	3410	0
September	6,158.53	26,834.12	-17266	17266
October	2,605.53	13,838.15	-11233	11233
November	1,065.90	13,391.76	-12326	12326
December	1,065.90	13,838.15	-12772	12772

The cistern size based on these calculations comes out to be ***3,410*** gallons and details are given in Appendix 6.

4.1.5 Rainwater Harvester:

Rainwater Harvester program was used to determine the performance of the system. The inputs and assumptions for the program are provided below:

Inputs:

- Rainfall Event = Hyderabad Daily
- Roof Area = 20,000 sq ft
- Capture Factor = 0.95
- Cistern Volume = 3,410 gallons
- Cistern Cost = $ 8,000
- Consistent Daily Usage = 446 gallons/day

Assumptions:

- Water Cost = 0.0055 $/gallons
- Sewer Cost = 0.0017 $/gallons
- Backup Water Supply is unchecked

Results:

- Total Water Capture = 51%
- Usage Replaced = 77%
- Annual Water Usage = 124,716 gallons
- Annual Water Savings = $898
- Overflow Frequency = 23%
- Dry Cistern Frequency = 27%
- Payback Period = 9 years

4.1.6 Optimal Cistern Size

The optimal size of the cistern is the one which increases the storage size, usage replaced, annual water usage and annual water savings. Alongside, it should decrease the cost, overflow frequency, dry cistern frequency and payback period. It is selected as tradeoffs among some contributing factors. For this analysis, "50" simulations were done by using Rainwater Harvester program. Results were analyzed to produce a Pareto-optimal surface consisting of 5 parameters which include storage size, cost, dry cistern frequency, and overflow frequency. The result of the analysis is shown in Figure 2. From the analysis, the optimal size of the cistern is selected as **3,000 gallons**.

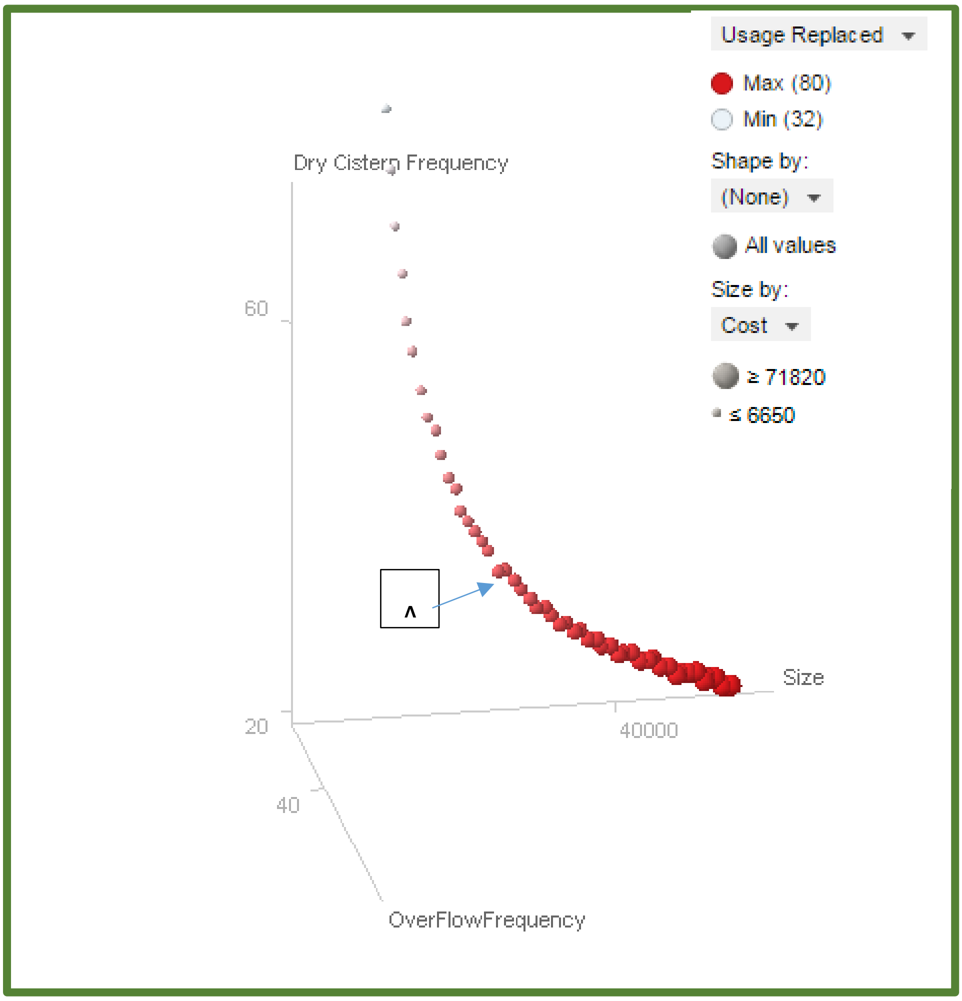


Figure 2. Optimization of Cistern Sizing

Explanation of Figure: Size of the cistern is plotted on the x-axis, overflow frequency on the y-axis and dry cistern frequency on the z-axis. Cost is presented as the size of the symbol, which means that small circle represents a low cost and large circles represent a higher cost. User replaced (Water delivered from the cistern) is plotted as a color, which means that the redder the color is, the more water is supplied by the system and vice versa. The optimal size of the cistern is where the curve changes i.e. Pareto-optimal surface. It is shown as point "A" in the Figure.

Results with Optimal Cistern Size:

- Total Volume Capture: 54%
- Usage Replaced = 80%
- Annual Water Usage = 124,812 gallons
- Annual Water Savings = $ 1003
- Overflow Frequency = 26%
- Dry Cistern Frequency = 32%
- Payback Period = 8 years

4.1.7 Whole Life Cost

General Cost Analysis (Cistern):

The life cycle cost of the cistern was done based on the optimized cistern size of 3,000 gallons. Type of Cistern is plastic, Primary use is outdoor, the height of the building is two stories, and some fixture unit per story is assumed as 40. The level of maintenance is chosen as a medium, and the discount rate is 5.5%. The total capital cost for the cistern is $8,060. Regular maintenance cost is $980 per year. Corrective maintenance cost is $130 after every three years and $198 after every five years for periodic maintenance and pump replacement respectively. And the present value of this cost is $29,587. Present value takes into account time value of money and the discount rate. Cash flows are given under discounted cost per year.

Life Cycle Assessment (Cistern):

Before doing LCA, it is important to understand that every method calculates capital and operational costs with different methods and using different rates. Some assumptions and modifications were made on the LCA calculator to align its values according to the values calculated in the previous steps. They are discussed in detail below:

- **Input and Assumptions:**

Roof area was directly entered instead of writing the length, width, and height of the building. Irrigation area is taken as zero, as it is not required for the project. In Part A, the analysis was done to calculate the indoor demand for toilet flushing by using “LEED Indoor Water Use Reduction Calculator v.4”. The number of people taken was 167. And also a low flush toilet and no water urinals were used to compute the indoor demand. However, this sheet lacks the capability to add two different types of system. In this sheet, the low flush toilet was used, but the number of people is adjusted in a way so that total indoor toilet demand becomes almost equal to the demand that was used for the section 4.1. Also, the cistern volume was manually added to 3,000 gallons, which corresponds to the optimized design of the cistern. The details calculations for whole life cycle and life cycle assessment are provided in Appendix 7.

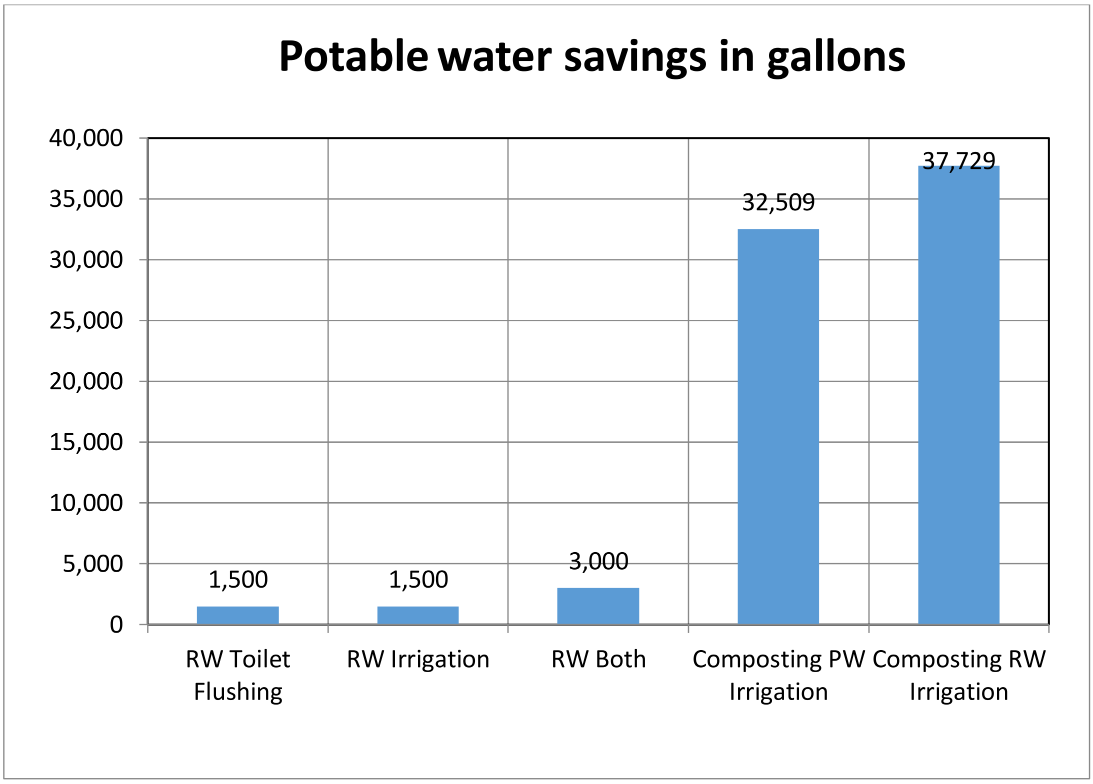


Figure 3. Potable water saving in gallons

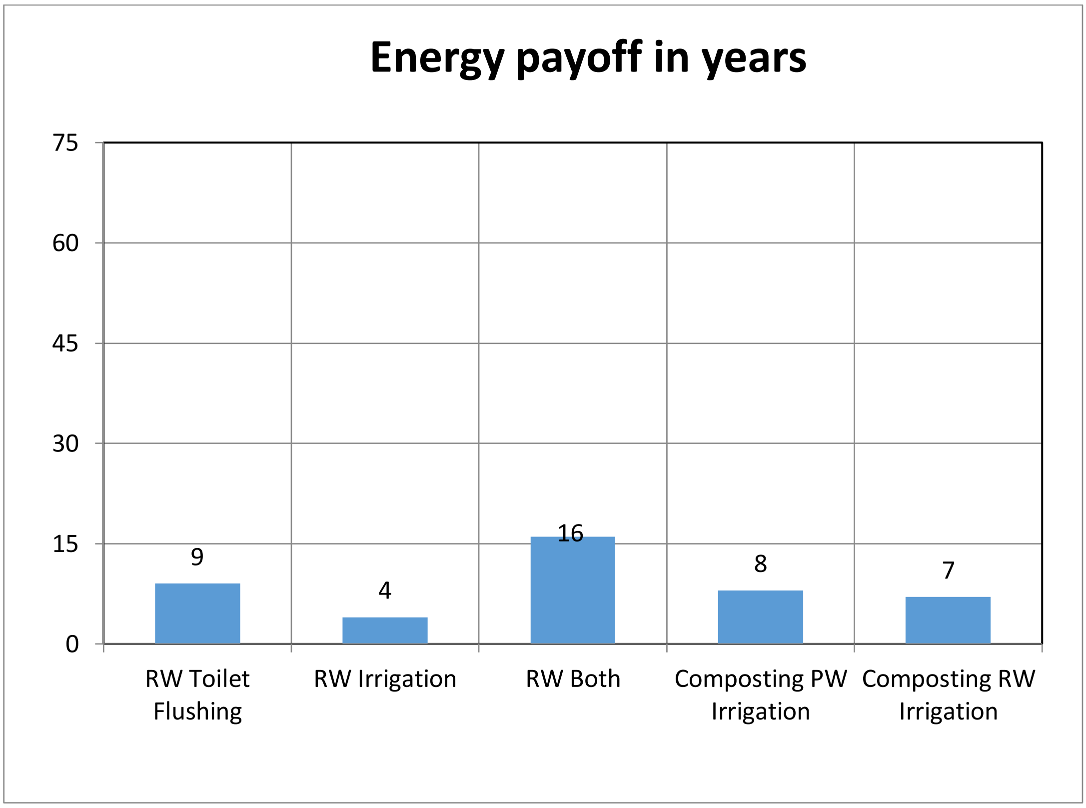


Figure 4. Energy Payoff for the cistern is 20 years

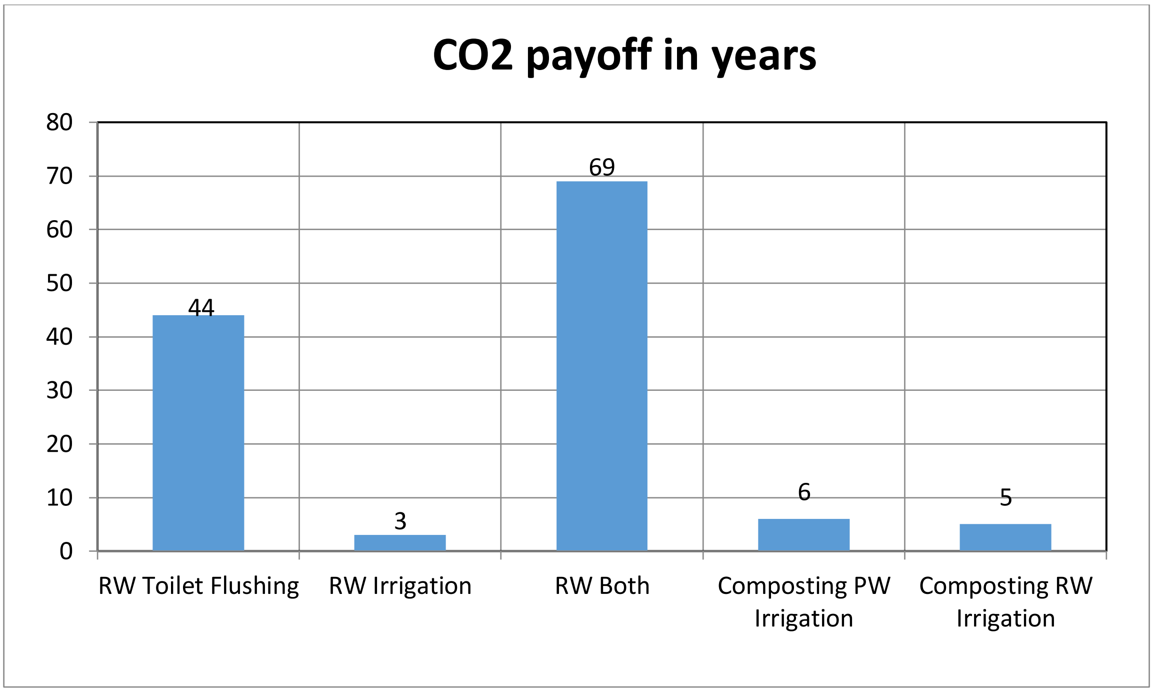


Figure 5. CO_2 Payoff for the cistern is 44 years

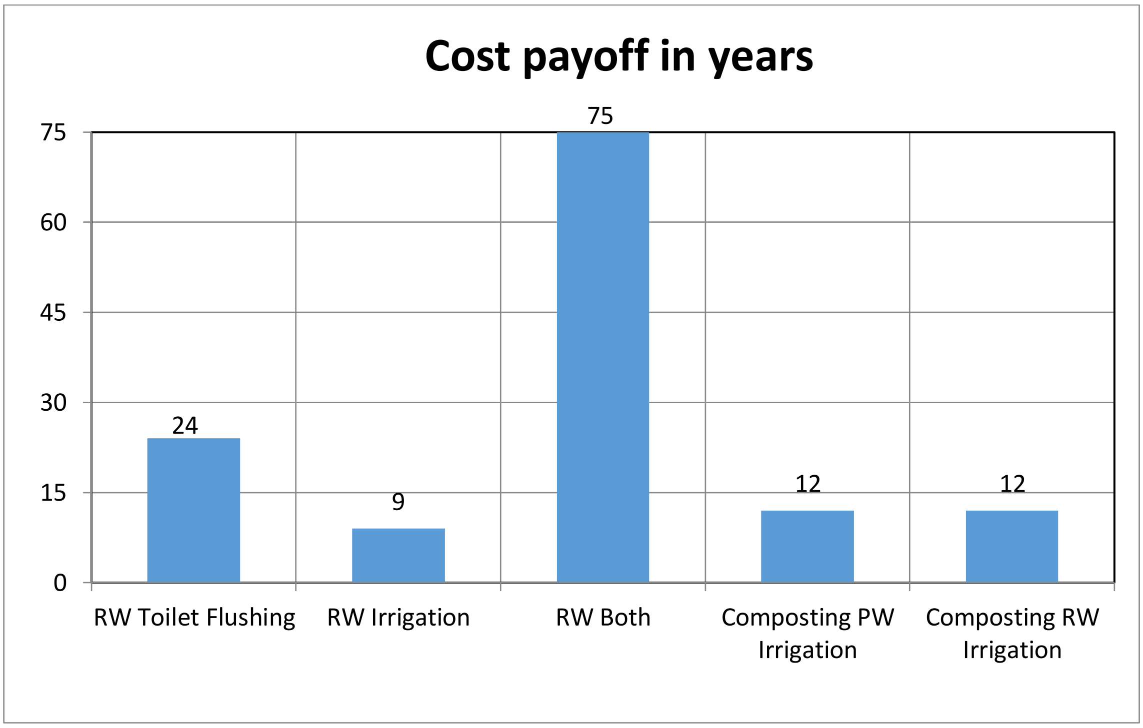


Figure 6. Cost Payoff for the cistern is 24 years

4.2 Water Treatment

Flow diagram of the water treatment process:

In this project, the main goal is to make the building net zero regarding water. That can be achieved only with the help of water reuse. Here in the building two types of water being generated, gray water and black water. Where black water needs more purification, gray water needs less purification. The logic behind this is simple. Black water contains all the solid biological waste that being generated from the toilet, and the gray water is the relatively pure water generated mainly from the sink or after a shower. Again it is expensive to treat a large volume of water up to the potable water grade. So we will treat only that much water up to the potable grade which is needed. Again black water is the direct sewage water and has a higher biological demand and contamination level. So that we are not mixing that water with the gray water which has far less biological demand and contamination level. To do so, we are maintaining two separate pipelines for gray water and black water.

As per the water budget calculation 2000gallon of water per day need to be treated where 200 gallons of water will be consumed as drinking water. So 200 gallons of water should be treated as the potable water grade, and the rest of 1800gallon of water will be treated as a non-potable grade. Here for the treatment mechanism activated sludge system has been chosen to make sure rapid and low power intensity system. The area of the treatment plant will be around 17000ft2. There are three main sections of this treatment process for black water. Mechanical treatment, Biological treatment, and the disinfection. On the other hand, Gray water will receive only the mechanical treatment and the disinfection.

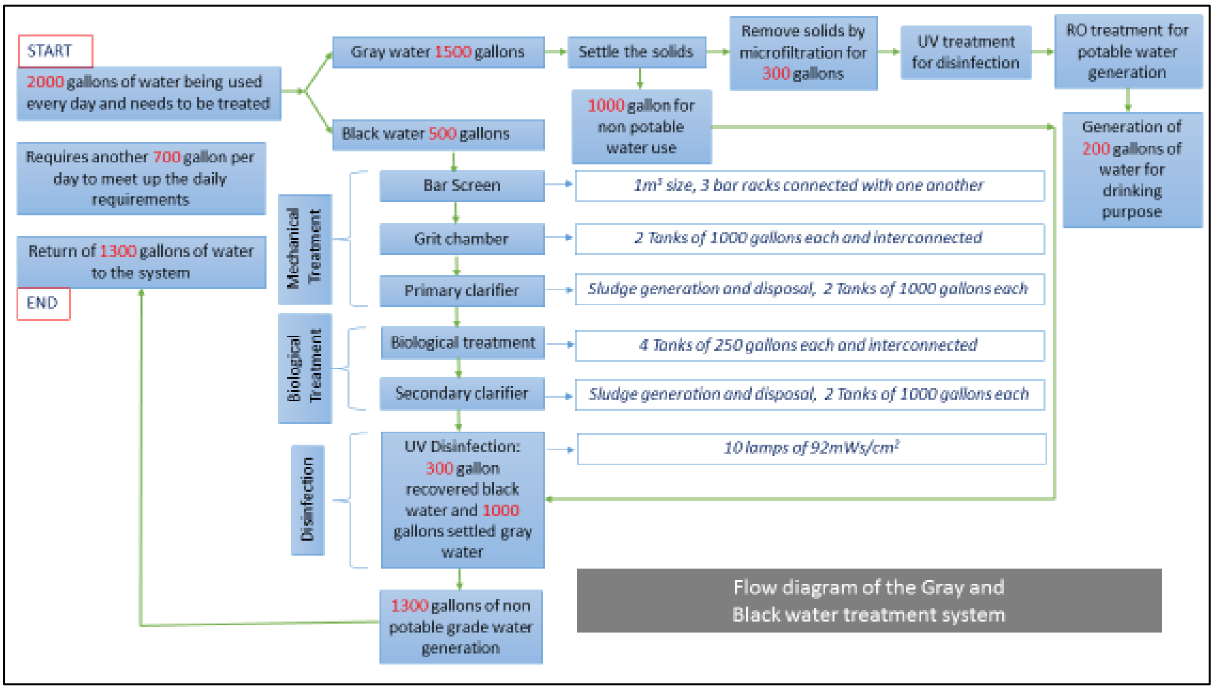


Figure 7. Water treatment process flow diagram

4.2.1 Gray water treatment steps

- Settle the solids: Here a tank of 2000 gallon will be used for the solid settling. For the gray water, most of the solid waste will be removed by this system. The heavy solids will be accumulated at the bottom of the system, and the relatively fresh water will be settled at the top. From the bottom, solids will be removed, and from the top, relatively clear water will pass to the next step for the microfiltration.

- <u>Removal of solids by microfiltration:</u> Next step is the microfiltration. The main reason for this microfiltration is to make sure that there are no solid particles remains in the water. As the ultimate target is to purify this water up to the potable grade so that no remaining solid particle is not acceptable.

- <u>UV treatment:</u> The main purpose of this UV treatment is the disinfection. Only two bulbs are required for 300 gallons of water. This bulb is the similar kind of bulb that will be used after the black water treatment.

- <u>RO treatment</u>**:** Reverse osmosis the final stage of the purification to ensure the optimum water quality to declare that as the potable water. Separate RO system will be used here for this purpose.

4.2.2 Black water treatment steps:

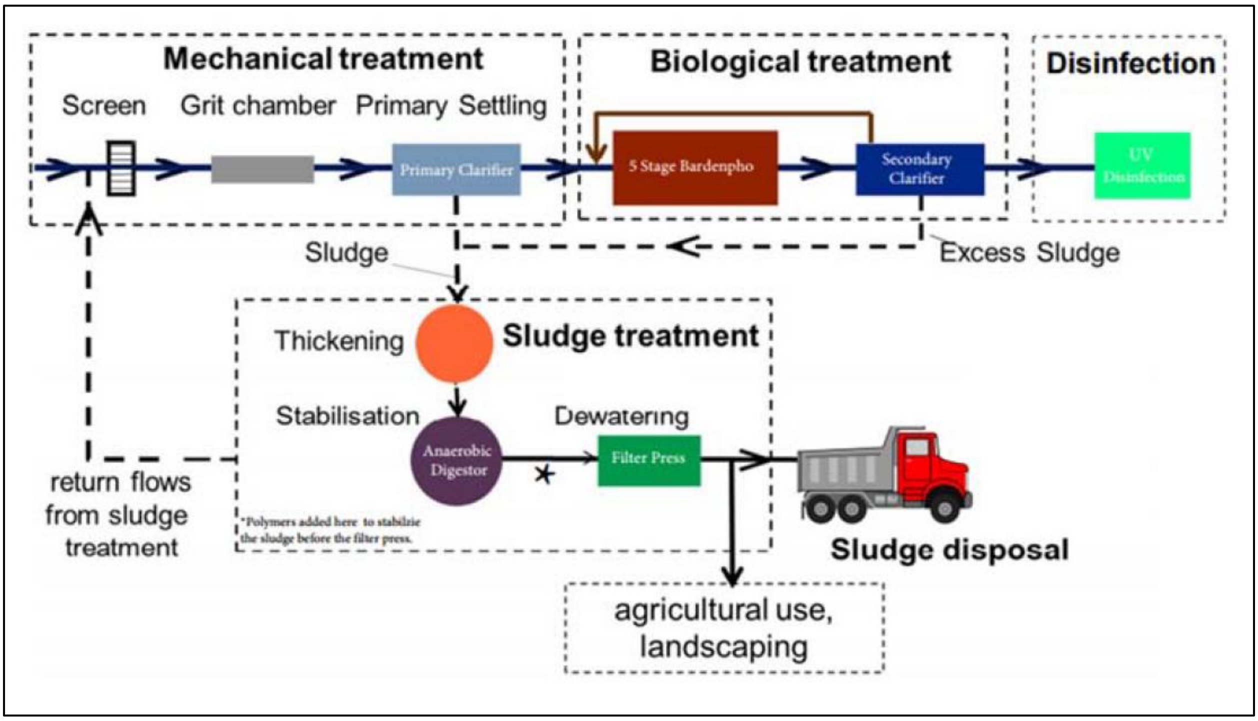
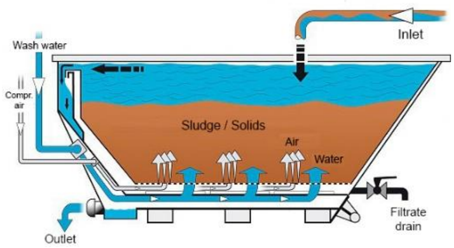


Figure 8. Gray water treatment flow diagram

- Bar Screen: Influent from the sewer district must first bypass some mechanical treatment. For that bar, the screen is a mechanical filter that removes an assortment of large solids from the wastewater before further treatment. Also, this process removes non-digestible materials and fragments biodegradable particles into smaller pieces. Mechanically cleaned bar racks will be used to reduce operating costs and improve screening capacity of the plant. The continuous belt type will be used, as it can remove fine and coarse solids, and will be continuously self-cleaning. In our project, the main concert will be the biological waste generated from the toilets. The 1m2 size of 3 bar racks is connected with one another in our system.

- Grit Chamber: Aerated grit chambers are utilized to settle larger solids that would damage subsequent treatment systems, including egg shells, coffee grounds, sand, and glass particles. The wastewater enters the grit chamber after it has passed through the bar screen, and is designed to facilitate the settling of solids by inhibiting flow. But typically there should not be any objects like egg shell or other non-degradable plastics in our system. So again the main target will be to reduce the biological waste form the system. Two tanks of 1000 gallons each are connected with one another in our system.



- <u>Primary clarifier</u>**:** Following the pretreatment process, wastewater is pumped into the sedimentation tanks, also known as the primary clarifiers. The main objective is to further remove additional solids, and skim any grease on the surface of the tank. Given the extended detention time, suspended solids will readily settle, and the tanks are equipped with mechanically driven scrapers that continuously drive the collected sludge towards the center. This is the last step in the mechanical treatment. 2 tanks of 1000 gallons each are connected with each other in this system. By product of this step is the sludge generation. This sludge can be used as the fertilizer in the field. By selling this fertilizer in the field, we can reduce the payback time for the whole project.

- <u>Biological treatment</u>**:** This step is used for the removal of Biological oxygen demand (BOD), nitrogen and phosphorus from the waste water. Four conjugative tanks in the following sequence: Anaerobic, aerobic-anoxic and aerobic are arranged to reduce the biological oxygen demand of the system. The interesting fact about this system is that with the BOD removal this system is also capable of reducing the nitrogen and phosphorus from the system. Four tanks of 250 gallons each are connected.

- <u>Secondary clarifier:</u> It is needed after biological treatment to further reduce solids and BOD by settling and concentrating mixed liquor suspended solids (MLSS). The water is then pumped to disinfection, where it is treated for microorganisms and discharged. This is the last step of biological treatment. There should not be any visible clump formation in the water by this step. Most of the biological solids should be removed by now. Only to kill any possible microorganisms, UV disinfection is applied. Again like the primary clarifier two tanks of 1000gallons are connected with one another for the final sludge removal. Like the primary clarifier here also the generated sludge can be used as fertilizer.

- <u>UV disinfection</u>: Ultraviolet (UV) disinfection inactivates microbes, which increases the quality of the discharged effluent. No sludge will be produced, which will reduce the amount of waste generated by the plant. Also, no residual chlorine is required in the effluent (this is only required for water treatment facilities). UV disinfection is also a safer alternative to chlorine and will result in space savings and reduced contact time. Ten lamps of $92 mWs/cm^2$ are used here in our treatment system for the final water disinfection.

In our on-site treatment plant there will be 2000 gallon of water received every day, and after treatment, there will be 1300 gallons of water back to the system. So that means 700 gallons of water will be needed from outside source like rainwater harvesting and central pipelines will be needed to meet the daily requirement.

4.2.3 Initial Cost Estimate – Wastewater Treatment

DESCRIPTION	QUANTITY	TOTAL COST
SCHEDULE A - MOBILIZATION & SITE PREPARATION		
Equipment Mobilization	LS*	$3,500.00
Labor Mobilization	LS	$2,500.00
Site Marking & Safety Signs	LS	$1,000.00
TOTAL SCHEDULE A		**$7,000.00**
SCHEDULE B - PLUMBING WORKS		
Excavation and backfilling for all Pipes Works	LS	$5,000.00
PPR Water supply pipes	LS	$8,000.00
UPVC Sewrage pipes	LS	$9,500.00
All pipe specials such as bends, junctions, elbows, tees, etc.	LS	$2,250.00
Valves and flow meters	LS	$6,000.00
Testing & commissioning the entire installation	LS	$2,000.00
TOTAL SCHEDULE B		**$32,750.00**
SCHEDULE C - WATER TREATMENT PLANT		
Oil & Grease trap	EA*	$4,750.00
Equalization tank	EA	$15,000.00
Sand Filter & Activated Carbon filter	EA	$9,500.00
Chlorinator	EA	$7,500.00
Sludge holding tank	EA	$5,750.00
Filter press	EA	$4,000.00
Piping and Cabling	EA	$8,500.00
Final treated effluent tank	EA	$10,000.00
TOTAL SCHEDULE C		**$65,000.00**
SCHEDULE D - RAINWATER HARVESTING COMPONENTS		
3,000 Gallon Cistern	EA	$15,000.00
Sump with Transfer Pump	EA	$7,000.00
Gutter with Gutter Screens	LF	$6,500.00
Prefilter	EA	$1,250.00
Insulated Enclosure & Isolation Valve	EA	$750.00
Booster Pump with Controls	EA	$6,000.00
Bag Filter	EA	$100.00
2" Backflow Preventer, RPBA	EA	$650.00
Automated Valve	EA	$150.00
6" Storm Drain Pipe	LF*	$1,500.00
2" Pressurized Rainwater Pipe	LF	$2,375.00
TOTAL SCHEDULE D		**$41,275.00**
SCHEDULE E -FINISHING		

DESCRIPTION	QUANTITY	TOTAL COST
Clearing spaces and cleaning	LS	$3,000.00
TOTAL SCHEDULE E		**$3,000.00**
	TOTAL - ALL SCHEDULES	**$149,025**
	CONTINGENCY (20%)	**$29,805**
	Sales Tax @8.7%	**$2,593**
TOTAL ESTIMATE INCLUDING SALES TAX		**$181,423**

*LS is lump sum; EA is each and LF is labor force

5 Evaluation Measure

5.1 Living Building Challenge

The Living Building Challenge is an endeavor to significantly increase present expectations from a worldview of doing less harm to one in which we see our part as steward and co-maker of a genuine Living Future. The Challenge characterizes the most exceptional measure of manageability in the assembled condition conceivable today and acts to quickly reduce the crevice between current breaking points and the end-amusement positive arrangements. Living Building Challenge gives structure to plan, development and the advantageous relationship amongst individuals and all parts of the group.

5.1.1 Water Petal

The expectation of the Water Petal is to realign how individuals utilize water and to reclassify "squander" in the fabricated condition with the goal that water is regarded as a valuable asset. Shortage of consumable water is rapidly turning into a significant issue the same number of nations around the globe confronted extreme deficiencies and traded off water quality. Indeed, even locales that have kept away from the dominant part of these issues to date because of a chronicled nearness of plentiful crisp water are at hazard: the effects of environmental change, profoundly unsustainable water utilize designs, and the proceeded with the drawdown of real aquifers forecast huge issues ahead.

5.1.2 Water Petal Documents Requirement

This section list all the documents required for claiming “I05 NET POSITIVE WATER” petal.

105-1: Water Narrative

A narrative shall be provided, fully describing water system design and compliance with the Imperative. The narrative, written by the water engineer or designer, shall include the following:

- A summary of the site hydrology and project systems. These calculations are presented in Section 2.
- A description of the pre and post-development hydrology of the site, and how the project works in harmony with natural water flows. (Not applicable)
- A detailed description of how 100% of project water needs are being met from on-site sources, including contributing system(s) and major components, their function and

location, and the water treatment method(s). These calculations are presented in Section 4.1 and 4.2

- A detailed description of the stormwater, grey water and black water treatment and management system(s), their major components, and their function and location. These calculations are presented in Section 4.2.

I05-2: Annual Water Balance Diagram

An annual water balance diagram is showing general water flow and balance of project and site. This diagram is presented below in Figure 9.

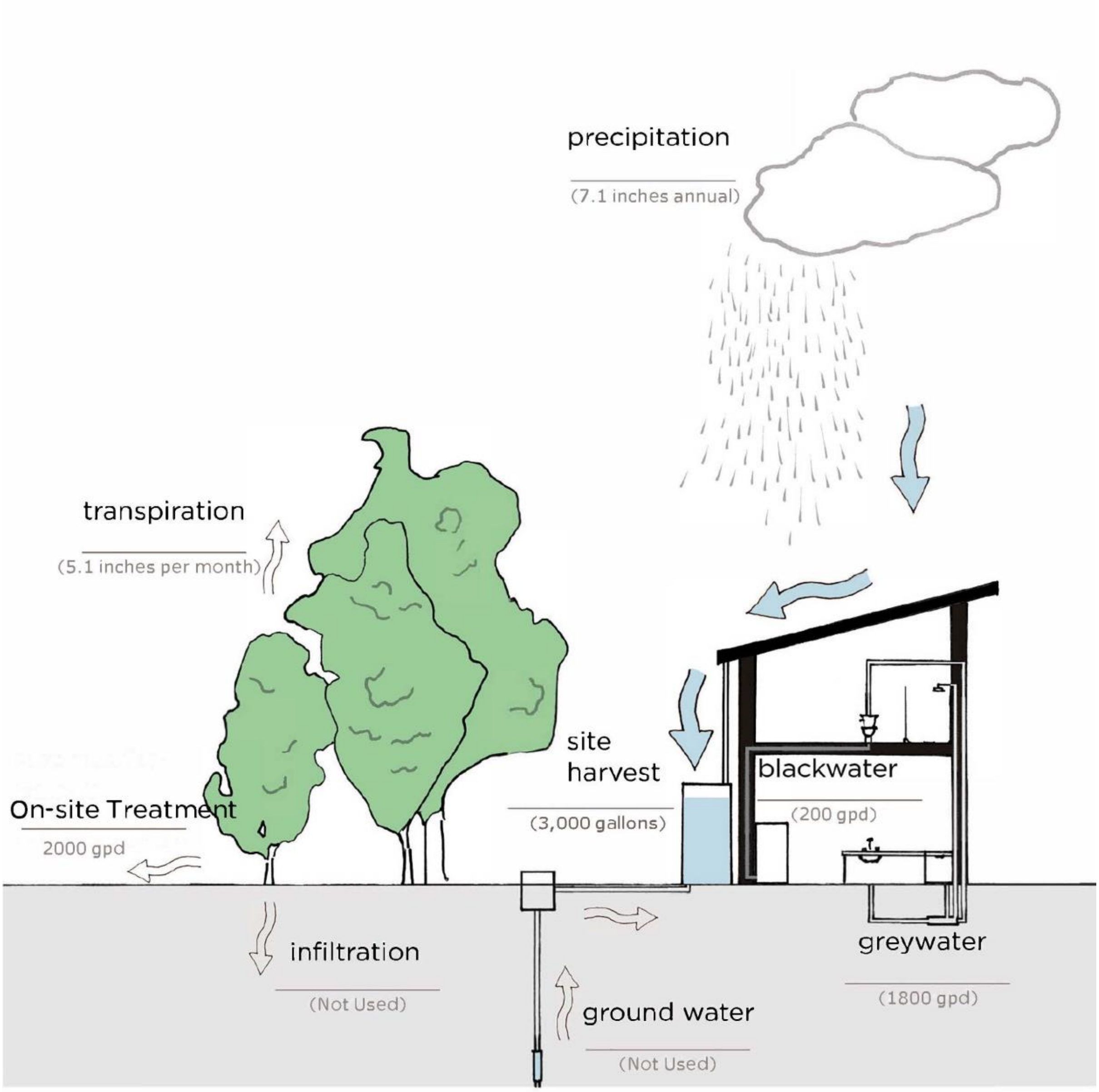


Figure 9. Annual Water Balance Diagram

105-3: Water Supply and Use Table

Total actual water use from monthly readings throughout the 12-month occupancy period from the meter(s) or other on-site tracking systems that clearly record the amount of water used from each applicable supply source. This document is presented in Figure 10.

Instructions:

Fill out green and white cells as they pertain to the project. Customize supply and use sources as needed.

Living Building Challenge 3.0 Water Supply and Use Table		Project Name:	MUET Net Zero Water											
Performance Period	Performance Month	1	2	3	4	5	6	7	8	9	10	11	12	
	Actual Month & Year (fill in name/year)	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Month Year	Annual Total
	Water units (fill in)	*gallons per month*												
Water Supply	Rainwater	748	3366	2119	3491	1371	7231	23437	35281	6483	2743	1122	1122	88513
	Natural Condensate	-	-	-	-	-	-	-	-	-	-	-	-	
	Ground/Surface Water	-	-	-	-	-	-	-	-	-	-	-	-	0
	Reclaimed Greywater	58812	53121	58812	56915	90407	97007	79286	72641	68341	58812	56915	58812	809880
	Reclaimed Condensate	-	-	-	-	-	-	-	-	-	-	-	-	
	Municipal Potable Water (if allowed by exception)	-	-	-	-	-	-	-	-	-	-	-	-	0
	Other (describe)	-	-	-	-	-	-	-	-	-	-	-	-	0
														0
	Total Actual Water Supply	59560	56487	60931	60406	91778	104238	102723	107921	74824	61555	58037	59934	**898394**
Water Use	Domestic water*													0
	Process water*													0
	Irrigation**					37170	47167	24087	16269	13442				138135
	Other (Total)	64693	58433	64693	62606	64693	62606	64693	64693	62606	64693	62606	64693	761712
														0
	Total Actual Water Use	64693	58433	64693	62606	101864	109773	88780	80962	76049	64693	62606	64693	**899847**
Modelled	Modelled water supply	59560	56487	60931	60406	91778	104238	102723	107921	74824	61555	58037	59934	898394
	Modelled water use	64693	58433	64693	62606	101864	109773	88780	80962	76049	64693	62606	64693	899847
	Predicted delta	-5133	-1946	-3762	-2201	-10085	-5536	13943	26959	-1225	-3139	-4569	-4759	-1453

Figure 10. Water Supply and Use Table

105-4: Stormwater Calculations

Stormwater calculations by the project engineer demonstrating Imperative requirements for working in harmony with natural water flows, based on a minimum of a 10-year storm event. These estimates are presented in section 4.1.2.

105-5: Bio solids Disposal Documentation (This documentation will be provided at 100% submission)

Evidence of appropriate use of bio-solids and liquids within a 100-mile radius of the project.

105-6: Photographs (This documentation will be provided at 100% submission)

Photographs of the systems, particularly portions that will be hidden from view at the time of audit due to completion of construction.

1-05: Exception Documentation Summary Table (Not applicable)

- 105-a: Narrative Statement
  The signed narrative statement is making a clear case that the project is eligible for the exception and how it has met requirements.
- 105-b: Meter Data & Calculations
  Meter data and calculations as needed to show compliance with Exception requirements.
- 105-c: Design Documentation
  Design documents, such as project manual excerpts, drawings or cut sheets, showing how the project meets Exception requirements.
- 105-d: Appeals Documentation
  Documentation of the team’s effort to comply with requirements despite regulatory barriers.