Tremco Incorporated Vegetated Roof & Rainwater Harvest System

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Tremco North Building Renovation

- Vegetated roof and rainwater harvesting as part of a total renovation of the entire building
  - Built in 1969
  - High operating costs
  - Need for an active demonstration of the RPM ‘Building Solutions Group’ family of products
  - Desire to have a LEED certified building

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Green on Green Retrofit

- Retrofit Highlights:
  - Vegetated roof
    - Approximately 9,000 sq ft
    - Engineered growing medium absorbs most of the water
    - Stormwater reuse for irrigating plants keeps it out of sewer system
    - Insulating quality helps moderate building temperature
    - 46 species of plants / 16,000 plants

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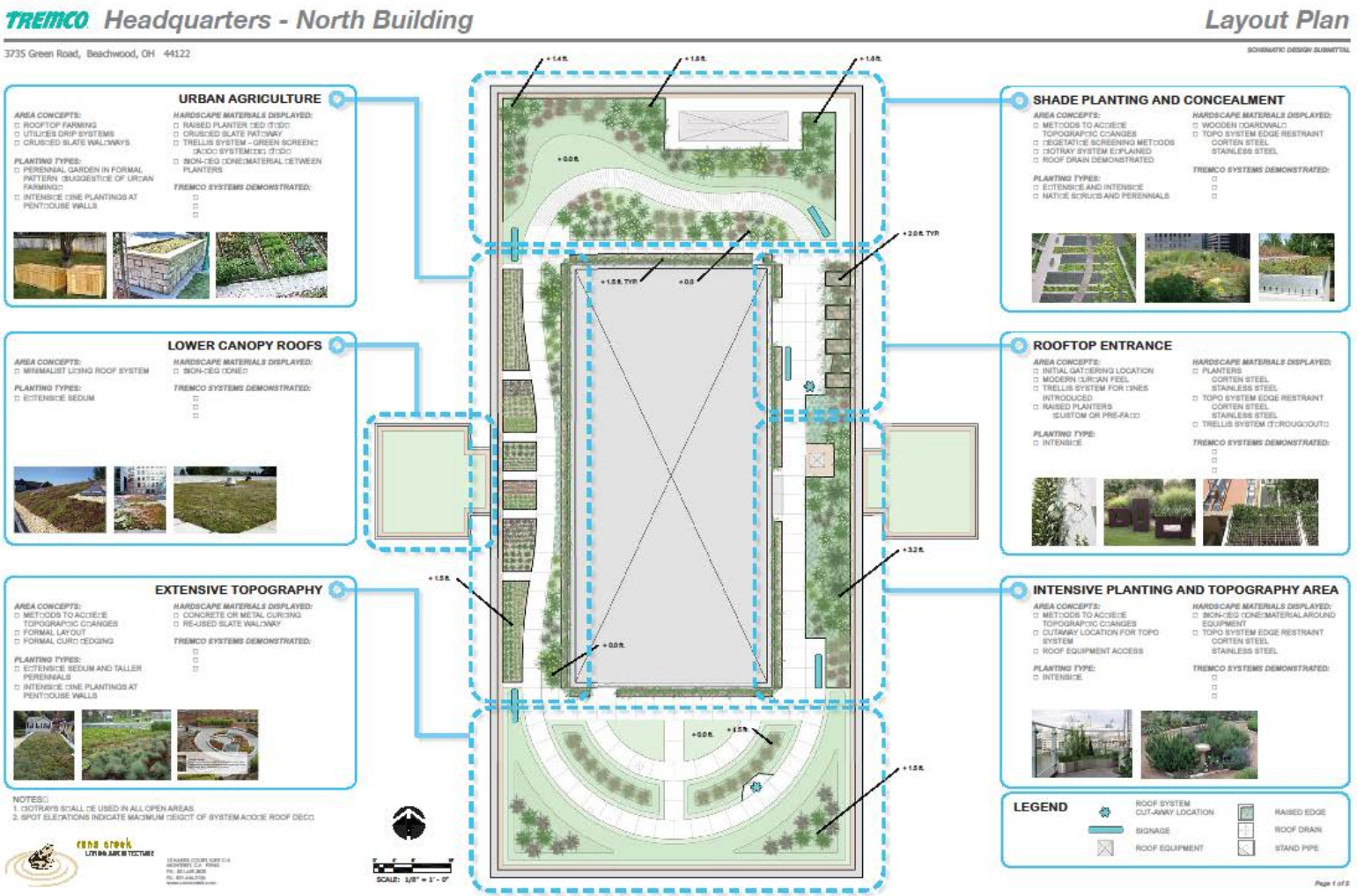
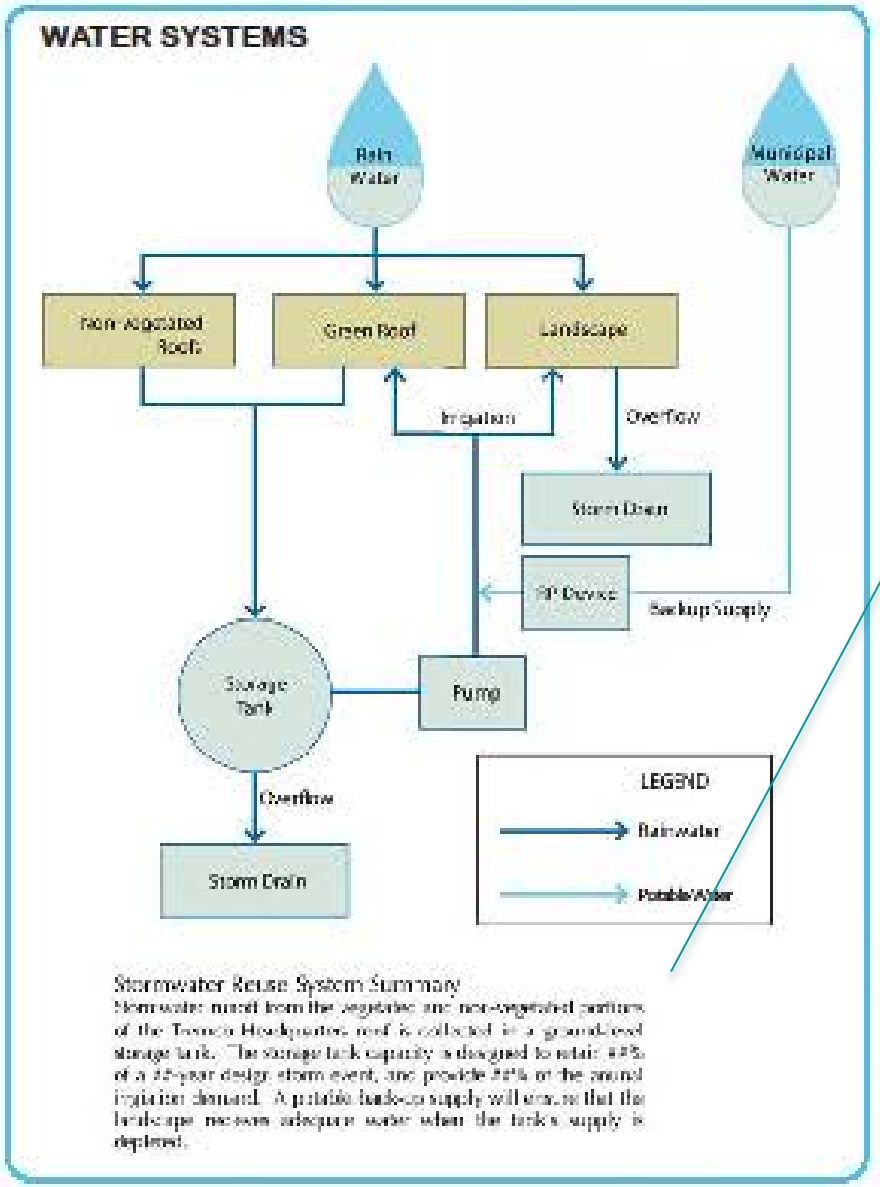
Vegetated Roof Concept





Stormwater Reuse System Summary

Stormwater runoff from the vegetated and non-vegetated portions od the Tremco Headquarters roof is collected in a ground-level storage tank. The storage tank capacity is designed to retain 75% of a 20 year design storm event and provide 100% of the annual irrigation demand. A potable back-up supply will ensure that the landscape receives adequate water when the tank's supply is depleted.

Plants, Irrigation & Stormwater Capture

Which Decision Came First

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How Much Water

Plant Palette

- Urban Agriculture
- Native meadow
- Sedum groundcover areas
- Native shade concealment area
- Over 200’ linear ft of living walls

Where and How to Capture

- Parking lot surface!
- Available area for cisterns
- Available area for pumps, vault for initial capture and other equipment

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Plant Palette Water Needs

- Typical Transpiration Ratios
  - Water processed for sufficient CO_2 uptake for photosynthesis
  - C3, C4 and CAM
  - ET Rate calculation
    - Irrigated area (sf) X ET Rate (inches) x 0.6233 = Water in gallons
- The Challenge of Life on a Roof
  - Shallow growing media
  - Aggregates to aid in drainage
    - Store water AND heat
- Irrigation Challenges
  - Sub-surface drip

Water Capture Design

- Asphalt pavement
  - 50,000 sf; 1” rain per hr. = 31,000 gph
  - Petroleum, salt and particulate issues
- 15,000 gal storage Vault in parking lot
  - 15 hp, 500 gpm pump
  - High and low level controllers tied to automated building management system
- Captured water moves to 6 cisterns
  - Rosedale particulate filter/strainer holds back particulates from cisterns
- 6 – 2,000 gal cisterns store water for use on the roof utilize gravity to move water from one to the other

Irrigation

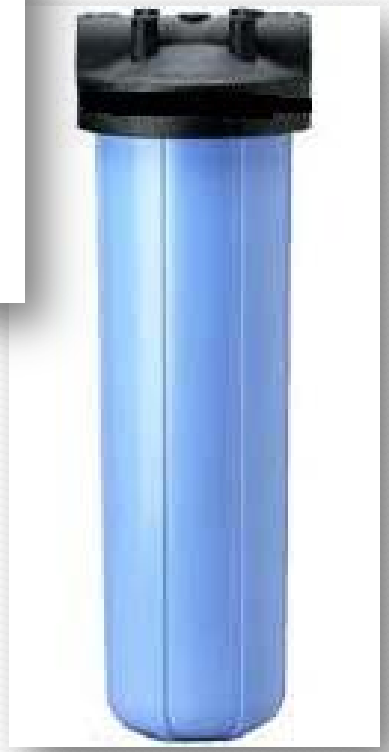
- Cistern water moves to the roof via pump
  - 1.5 hp; 20 gpm; 60’ head
- Hunter Controllers
  - 9 zones
  - Multi zone run times
    - Avoids cycling pump on and off
  - Solar synch
- KISSS Lo Flo Subsurface irrigation system
  - 0.5 gpm emitters
  - Capillary mat helps move water into surrounding soil
- Water runs through 2 Pentek OAD 20BB filters
- All tied into the automated building management system

Captured stormwater moves from the parking lot storage vault through this particulate strainer/filter and into the cisterns.

Double Cartridge Filtration

Stormwater is pumped to the roof from the cisterns and flows through two Pentek OAC-20BB cartridges.

- *Oil adsorbing cartridges*
- *Filters out 90% of total hydrocarbons*
- *Modified cellulose-based filter media*
- *20” long*
- *High flow rate/low pressure drop*



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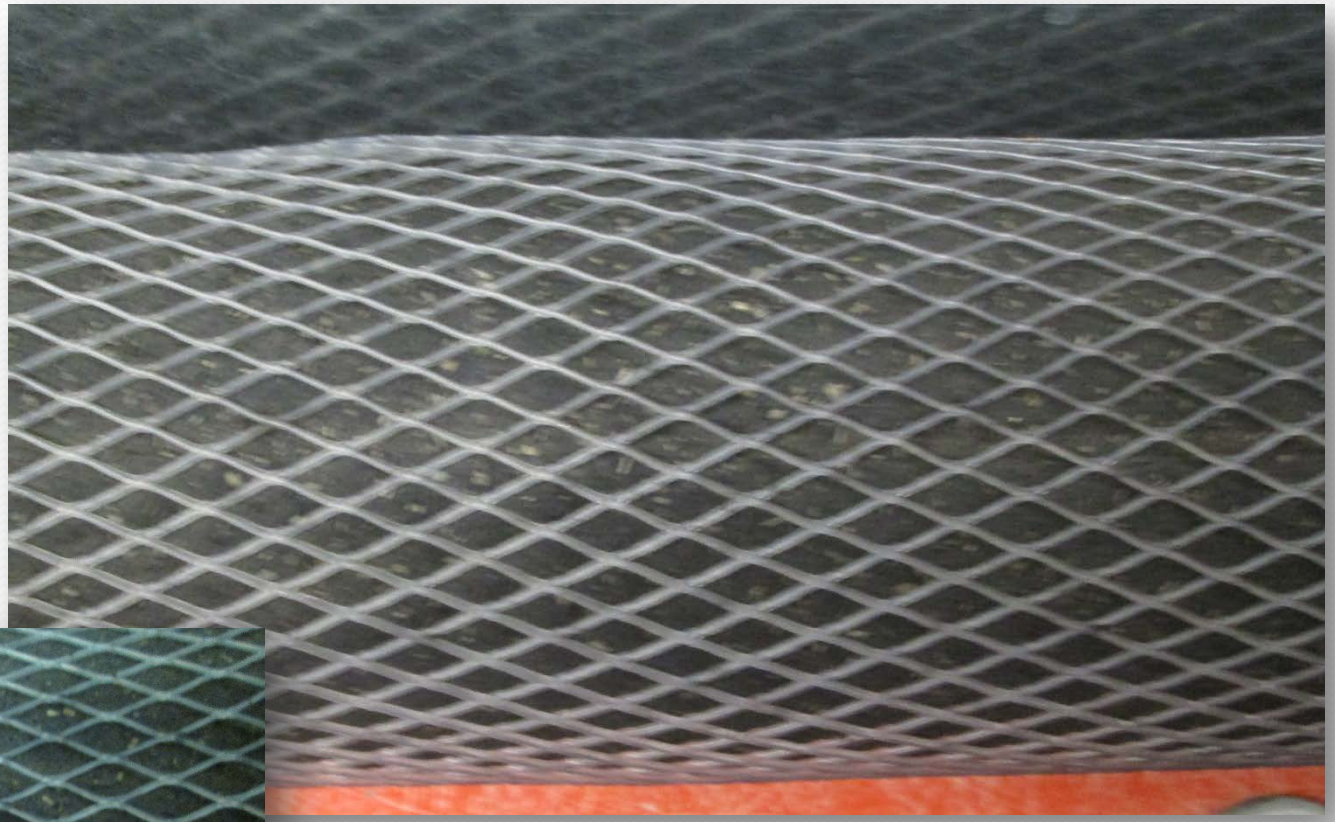

Used Oil Adsorbing Cartridge… typically replaced once a month during the summer.

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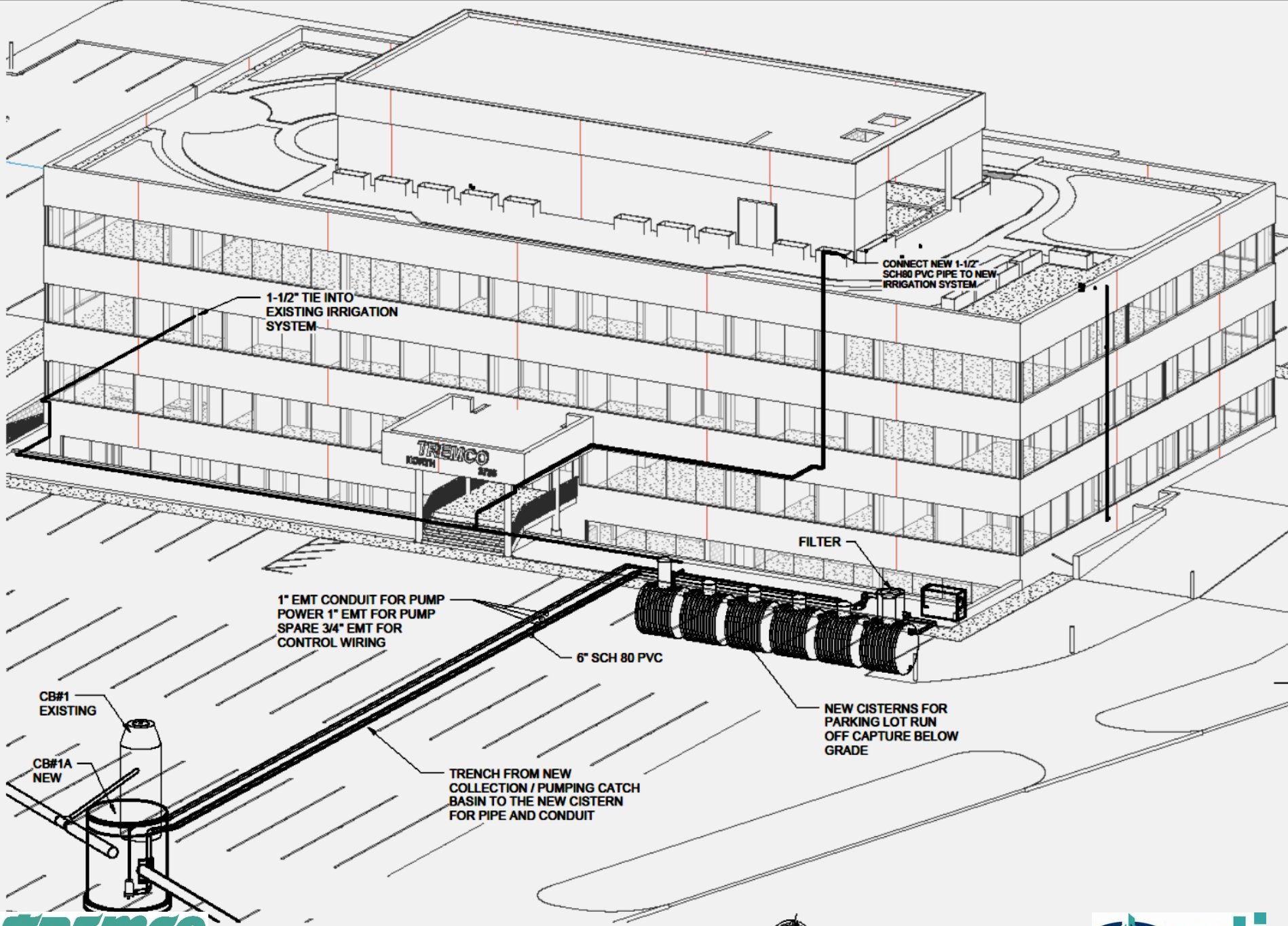

1 3D RAIN WATER HARVESTING

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Constant Monitoring

There is an ongoing effort to monitor the amount of available water in the cisterns. While alarms will sound if the water level is less than 10% of needed capacity, monitoring helps to alert the manager to the potential need for potable water.

	Inches	1=28 gallons	Cell DX6		
Day	Depth	Gallons Per Cistern	Total Gallons	Days of Rain	Solar Sych %
Week of 6/4					
Monday					
Wednesday	62	1736	10416	1	53% (R) 51% (G)
Friday	53	1484	8904	0	62% ® 70% (G)
Week of 6/11					
Monday	42	1176	7056	0	90%(R) 85%(G)
Wednesday	36 3/4	1029	6174	1	73% ® 75% (G)
Friday	16	448	2688	0	81%(R) 83%(G)
Week of 6/18					
Monday	67	1876	11256	1	73%(R) 66%(G)
Wednesday	62	1736	10416	0	58%(R) 61%(G)
Friday	58 1/2	1638	9828	1	88%(R) 81%(G)
Week of 6/25					
Monday	41	1148	6888	0	78%(R)73%(G)
Wednesday	39	1092	6552		65%(R)70%(G)
Friday	37	1036	6216		91%(R)81%(G)
Week of 7/2					
Monday	38.75	1085	6510	1	78%(R)76%(G)
Wednesday	65	1820	10920	2	76%(R)76%(G)
Friday	61	1708	10248	1	60%(R)60%(G)
Week of 7/9					
Monday	61	1708	10248	1	90%(R)93%(G)
Wednesday		0	0		

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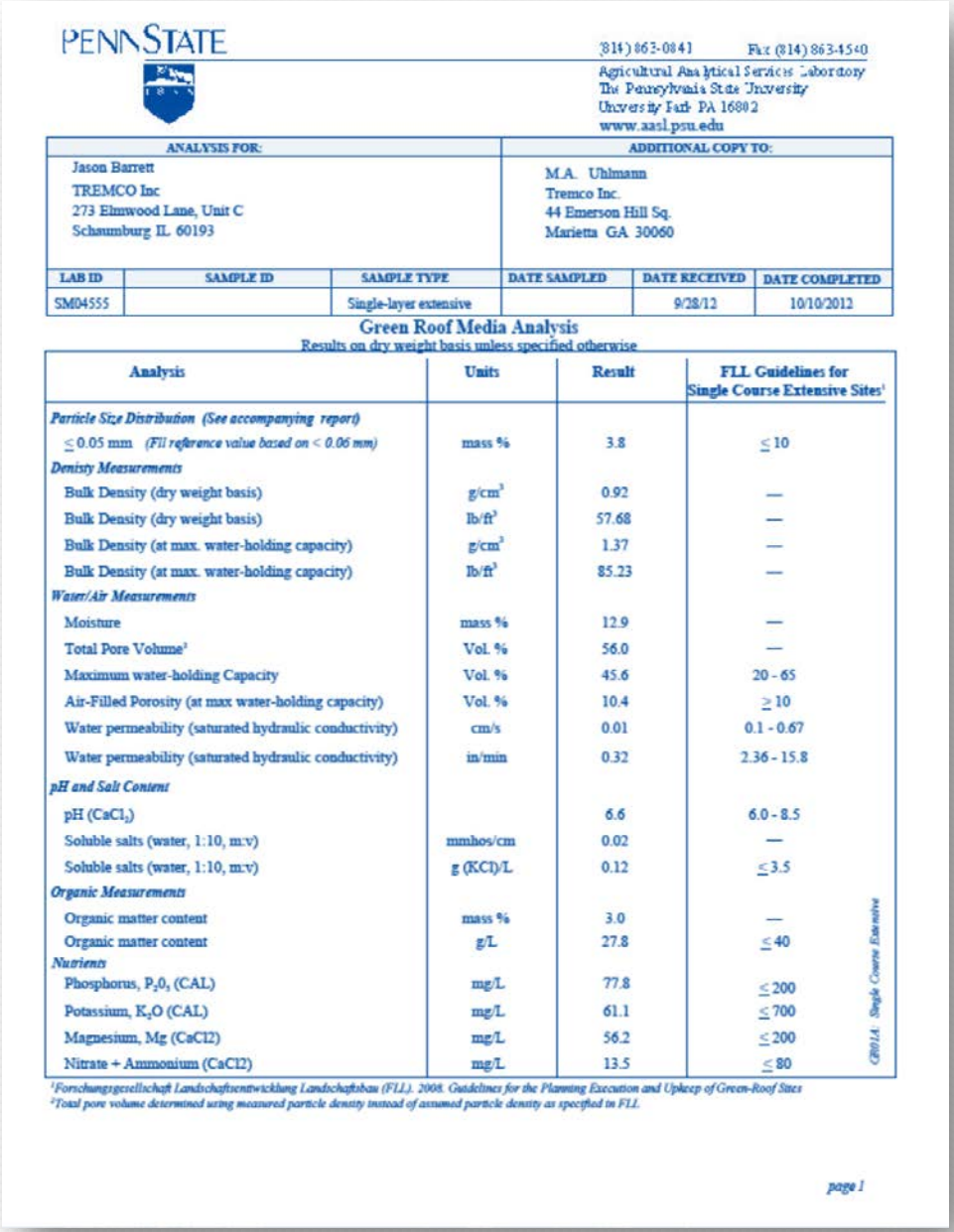
Annual Testing

The water coming into the irrigation system is tested yearly to monitor for petroleum, metals, ph. and other containments. The growing media is also tested on a yearly basis. This test allows the staff horticulturist to monitor air porosity, nutrients levels, ph., metals, contaminants and other valuable information leading to prescriptive and corrective maintenance protocols.



PENNSTATE

(814) 863-0841 Fax (814) 863-4540

Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
www.aasl.psu.edu

ANALYSIS FOR:	ADDITIONAL COPY TO:
Jason Barrett TREMCO Inc 273 Elmwood Lane, Unit C Schaumburg IL 60193	M.A. Uhlmann Tremco Inc. 44 Emerson Hill Sq. Marietta GA 30060

LAB ID	SAMPLE ID	SAMPLE TYPE	DATE SAMPLED	DATE RECEIVED	DATE COMPLETED
SM04555		Single-layer extensive		9/28/12	10/10/2012

Green Roof Media Analysis

Results on dry weight basis unless specified otherwise

Analysis	Units	Result	FLL Guidelines for Single Course Extensive Sites[1]
Particle Size Distribution (See accompanying report)			
≤ 0.05 mm *(Fll reference value based on < 0.06 mm)*	mass %	3.8	≤ 10
Density Measurements			
Bulk Density (dry weight basis)	g/cm³	0.92	—
Bulk Density (dry weight basis)	lb/ft³	57.68	—
Bulk Density (at max. water-holding capacity)	g/cm³	1.37	—
Bulk Density (at max. water-holding capacity)	lb/ft³	85.23	—
Water/Air Measurements			
Moisture	mass %	12.9	—
Total Pore Volume[2]	Vol. %	56.0	—
Maximum water-holding Capacity	Vol. %	45.6	20 - 65
Air-Filled Porosity (at max water-holding capacity)	Vol. %	10.4	≥ 10
Water permeability (saturated hydraulic conductivity)	cm/s	0.01	0.1 - 0.67
Water permeability (saturated hydraulic conductivity)	in/min	0.32	2.36 - 15.8
pH and Salt Content			
pH ($CaCl_2$)		6.6	6.0 - 8.5
Soluble salts (water, 1:10, m:v)	mmhos/cm	0.02	—
Soluble salts (water, 1:10, m:v)	g (KCl)/L	0.12	≤ 3.5
Organic Measurements			
Organic matter content	mass %	3.0	—
Organic matter content	g/L	27.8	≤ 40
Nutrients			
Phosphorus, P_2O_5 (CAL)	mg/L	77.8	≤ 200
Potassium, K_2O (CAL)	mg/L	61.1	≤ 700
Magnesium, Mg (CaCl2)	mg/L	56.2	≤ 200
Nitrate + Ammonium (CaCl2)	mg/L	13.5	≤ 80

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[1] *Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL). 2008. Guidelines for the Planning Execution and Upkeep of Green-Roof Sites*

[2] *Total pore volume determined using measured particle density instead of assumed particle density as specified in FLL*

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Original outlet pipe for stormwater cut to receive vault and fittings.

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Completed installation of vault with 6 cisterns waiting for installation.

Six 2,000 gal cisterns installed.

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The Idea of Saving Water

The daily effort to manage water from a limited resource has made a change in attitudes regarding water. No other effort could have affected such a change in habits.

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The Team

J. William Jensen, PE, Consultant

ATIGROUP
Energy & Systems Solutions

RMS
RAINWATER MANAGEMENT SOLUTIONS

KISSS
Kapillary Irrigation Sub Surface Systems

Hunter®
The Irrigation Innovators