Rainwater Harvesting in Environmental Education and Peacebuilding

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New Mexico Science Teachers and
Environmental Education Association of New Mexico
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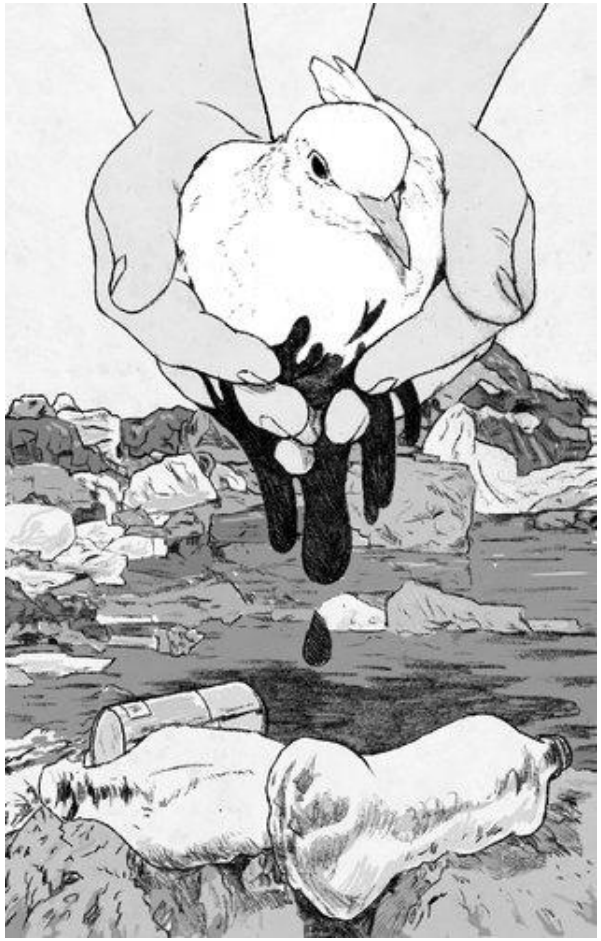
Description

- This informal lunchtime discussion will explore with how rainwater harvesting can be used as in environmental education locally and in environmental peace building globally.
- Participants will learn how these activities are being used to create bridges of communication between students in Israel and Palestine.
- Participants will be encouraged to share their experiences and ideas about how rain water harvesting can be used as a focus for STEM activities.

Environmental Peacebuilding:

A People-to-People Movement

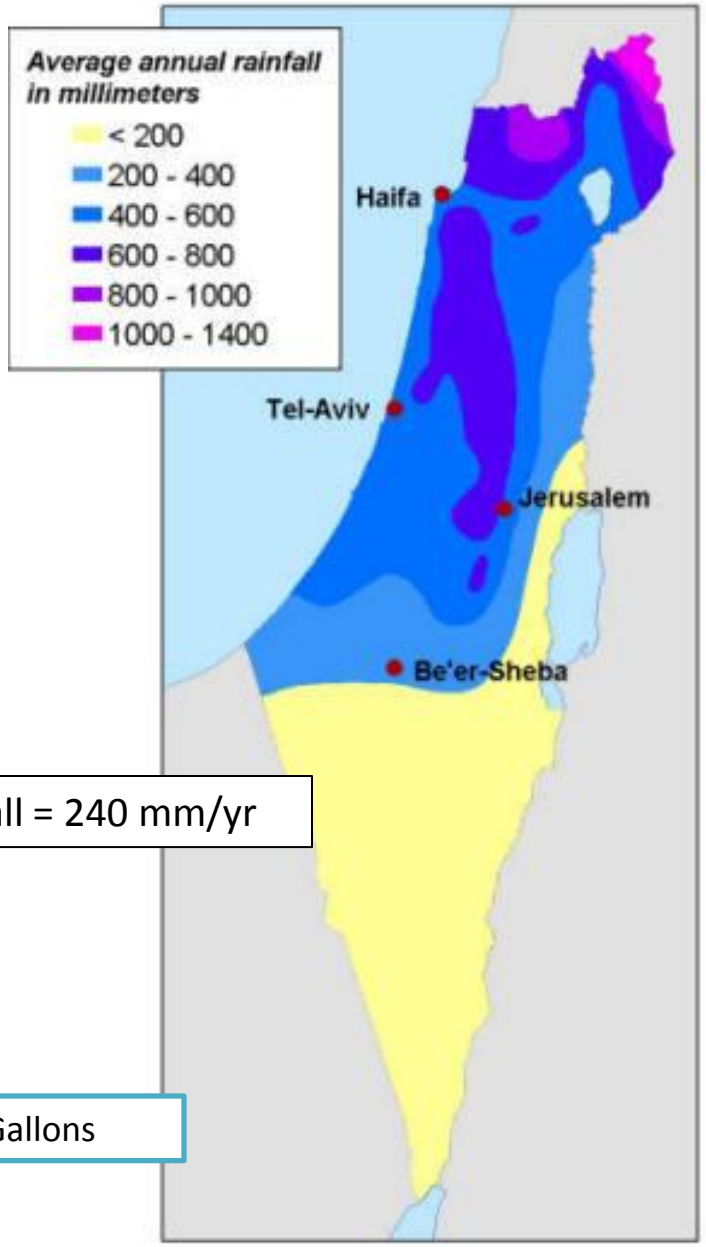


Kidron Valley Master Plan

- Theory:
  - ❖ Sustainable management of ecological resources **creates an opportunity** for cooperation **distinct** from economic and political spheres.
- Participants are not waiting for Peace Treaty
- Builds transboundary communities based on shared resources.
- Examples of NGO's involved in Environmental Peacebuilding
  - Kidron Valley Master Plan
  - Arava Institute for Environmental Studies (AIES)
  - Water Resources Action Project (WRAP)

Limited Water in the Israel/Palestine

- Climate variable over small region and time period
  - Coastal/north Israel: cool rainy winters
  - West Bank and south & east Israel
    - arid, extended hot and dry season
- Rainfall
  - Varies greatly (< 50 to >1000 mm/yr):
    - Israel- 429 mm/yr average
    - >90% of Jordan – less than 200 mm/yr
    - Jerusalem – 490 mm in 2012
    - Since 1845 annual rainfall in Jerusalem has decreased by 234 mm/yr
- Water Resources
  - Surface water in Israel (30% of supply)
    - 550 MCM/yr
  - Groundwater
    - 850 MCM/yr
  - Desalination
    - 850 MCM/yr by 2020



ABQ rainfall = 240 mm/yr

1 MCM = 264 MGallons

Ave annual precip (1961-1990)

Water Resources Action Project

- US-based non-profit organization founded in 2009.
- Seeks to improve public health in underserved communities in Israel, Palestine and Jordan through improved water stewardship.
- Sponsors, designs, and installs rainwater harvesting systems at schools.
- Seeks to connect Arab and Jewish students through environmental educational program.
- Works with other grass-roots environmental organizations in Middle East.
- All-volunteer; private donations fund 1 new system per year.

Why Rainwater Harvesting Systems?

- **Good environmental choice** – Preserves water resources that are quickly diminishing in the Middle East. Also reduces the millions of plastic bottles used every day.

- **Alternative source of water** – Reduced reliance on conventional water supply systems such as lakes, rivers, underground aquifers, bottled and desalinated water.

- **Collects rainwater during 5 month rainy season**.
  Used for toilets and gardens, which account for >85% of water use

- **Saves money** – Conventional supplies of water are often costly, especially when water resources are scarce.
  - Schools in Israel spend tens of thousands of shekels on water annually. Rain harvesting systems can save up to two thirds of this cost.
- **Relatively easy/inexpensive to construct** – Costs of implementation, construction, and maintenance for rainwater harvest systems are often recovered within a few years.

Components of Harvesting System

Catchment Area

- Rooftop
- Land surface

Collection Device

- Storage tanks
  - Rain barrel
  - Water cistern

Conveyance System

- Gutters
- Down-pipes
- Pumps

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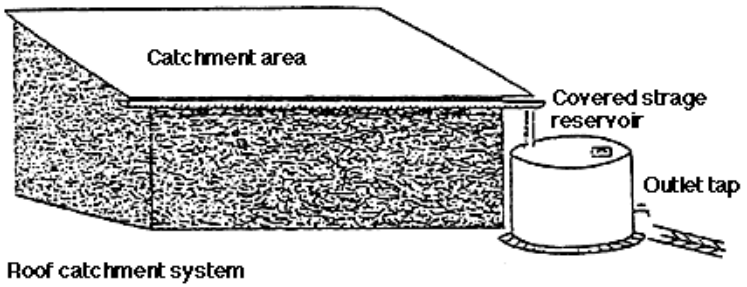
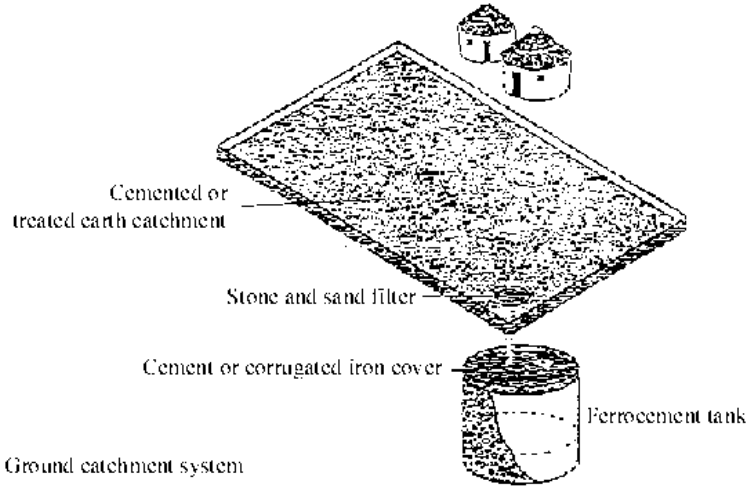
Catchment Area

- **Rooftop**
  - Amount of water collected dependent on **surface area** and **type** of roofing
  - Usable material: galvanized corrugated iron, aluminum, asbestos cement sheets, tiles and slates
  - Avoid metallic paint or other coatings that are hazardous to health
  - Water is collected in gutters and carried to storage



Roof catchment system

- **Land surface**
  - Often has larger surface area for collecting water
  - Requires techniques to improve runoff capacity
    - ❖ Clearing or altering vegetation cover
    - ❖ Increasing the slope of the land
    - ❖ Soil compaction
    - ❖ Reducing soil permeability with chemicals



Ground catchment system

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Collection System: Style One

Rain Barrels

- **Material**: polyethylene
- **Volume**: 1,520L
- **Cost**: recovered in few years
- **Quality of water**: high
- **Space requirement**: minimal
- **Maintenance**: easy
- **Sediment collection**: little (all sediment is collected in the first barrel)
- **Supply**: Can supply 7-10 days of water depending on use
- **Use**: shorter periods between rains, situations in which rain is not the sole source of water

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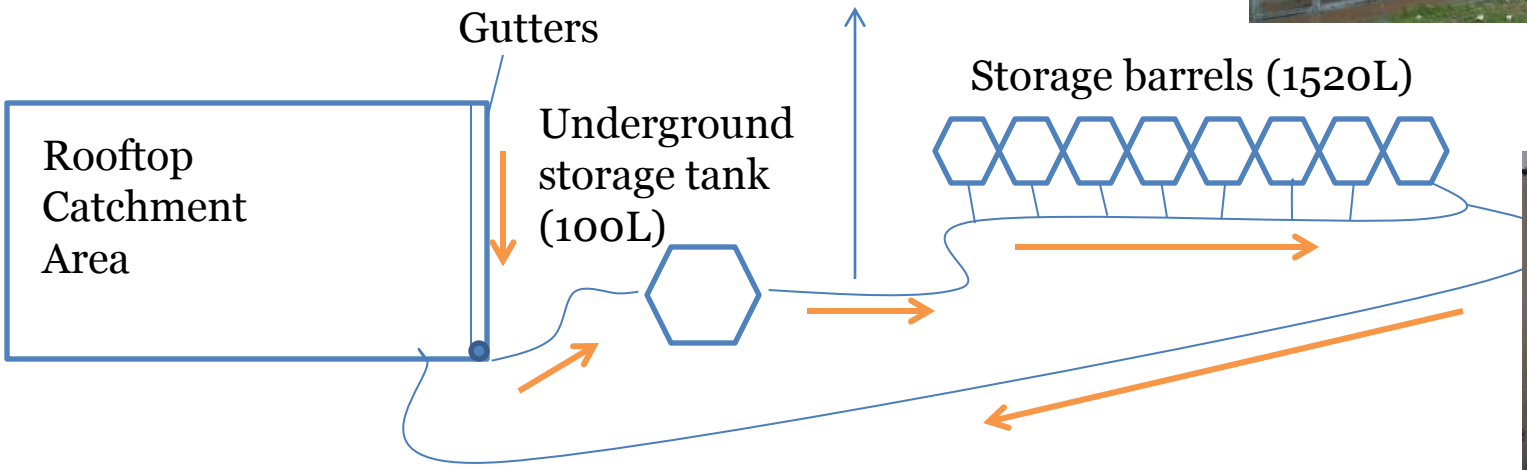
Basic Schematic of Rain Barrel System

Submersible pump starts pumping water from underground storage tanks to storage barrels when underground storage tank is ¾ full and shuts down when it is less than ½ full.



Water is piped from storage directly into the school.

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Cost vs. Benefit – Rain Barrel System- WRAP

Benefits

- Cheaper to implement than a water cistern
- Cost recovered in a few years
- Ensures more high quality water
- Minimal space requirement
- Fairly easy to design, construct, and maintain
- Does not require a special permit to implement
- Little sediment collection
- Can be refilled 20-30 times during rainy season

Item	Cost
8 Rain storage barrels (1,520L easy flush tank)/stand	3,520
3 Rain collection units (100L with submersible pump)	900
Pump w/ pressure valve & parts (piping, faucets, fittings)	1,990
Pumphouse (protects from vandalism and electrification)	250
sub-total	$6,660
Labor & Maintenance	
Installation, planning, & design by licensed contractor	3,650
Routine maintenance (3 yr)	860
sub-total	$4,510
Oversight	
Ongoing monthly reporting, annual oversight visits (3 yr), education & routine maintenance coordination	3600
sub-total	$3,600
Education & Community Outreach	
In school project educator, includes training & ongoing supervision (3 yr)	6,900
sub-total	$6,900
Total Poject Cost	$21,670

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Collection System: Style Two

Cistern

- **Material**: primarily concrete with epoxy coating and bituminous on walls
- **Volume**: 62,000L
- **Cost**: recovered in several years
- **Quality of water**: medium to low
- **Space requirement**: large
- **Maintenance**: difficult
- **Sediment collection**: large (up to a foot of mud can accumulate on the bottom every year)
- **Supply**: Can supply water during longer periods of drought
- **Use**: summer/ long periods between rains/ situations in which rain is the sole source of water

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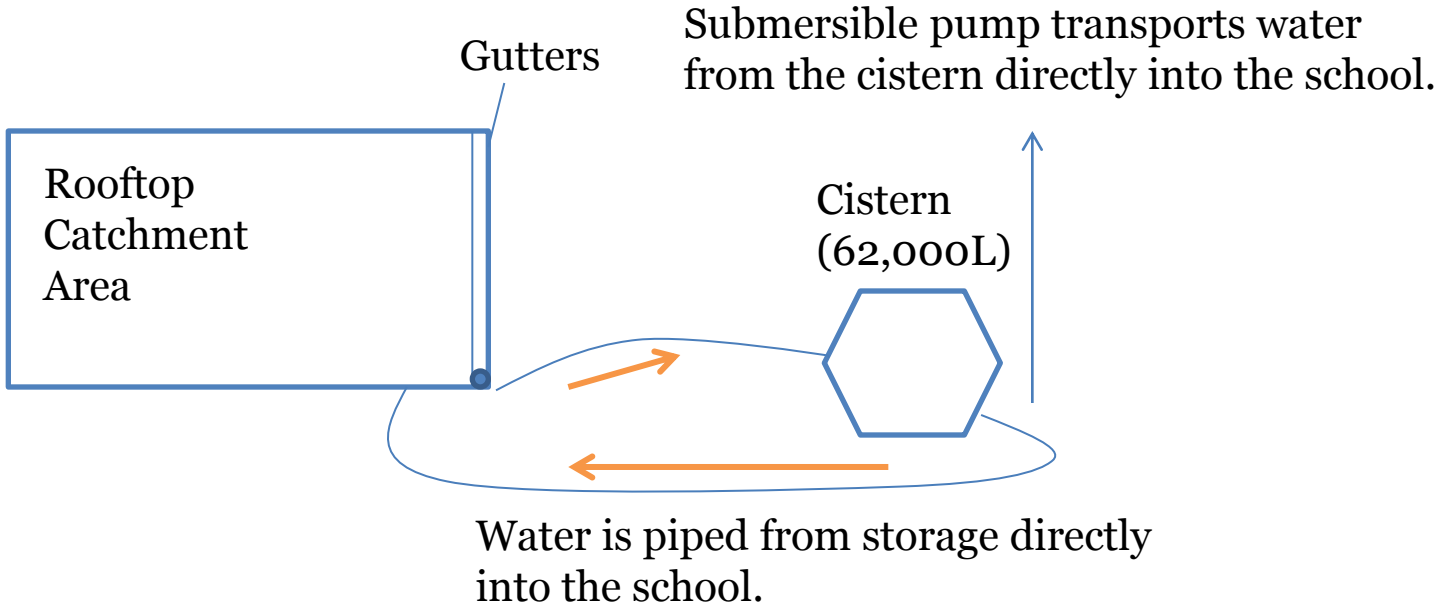
Basic Schematic of Cistern System



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Cost vs. Benefits – Cistern - WRAP

Benefits

- Stores large amounts of water over long periods of time without rain
- Durable – lasts for long time periods
- Best used for summer time with long periods between rains
- Best used when rain is the sole supply of water

Item	Cost
Plastering the cistern walls (internally & externally)	1,120
Epoxy coating/bituminous on walls	560
sub-total	$1,680
Labor & Maintenance	
Excavation & removal of surplus material	1,800
Supply & construction of reinforced concrete for cistern base, walls, & roof	11,000
Supply & installation of water pump, one horse power	1,500
Supply & installation of rain gutters	2,020
Routine maintenance (3 years)	860
sub-total	$17,180
Education & Community Outreach	
Project educator, included training and ongoing supervision (3 years)	6,900
sub-total	$6,900
Total Project Cost	$25,760

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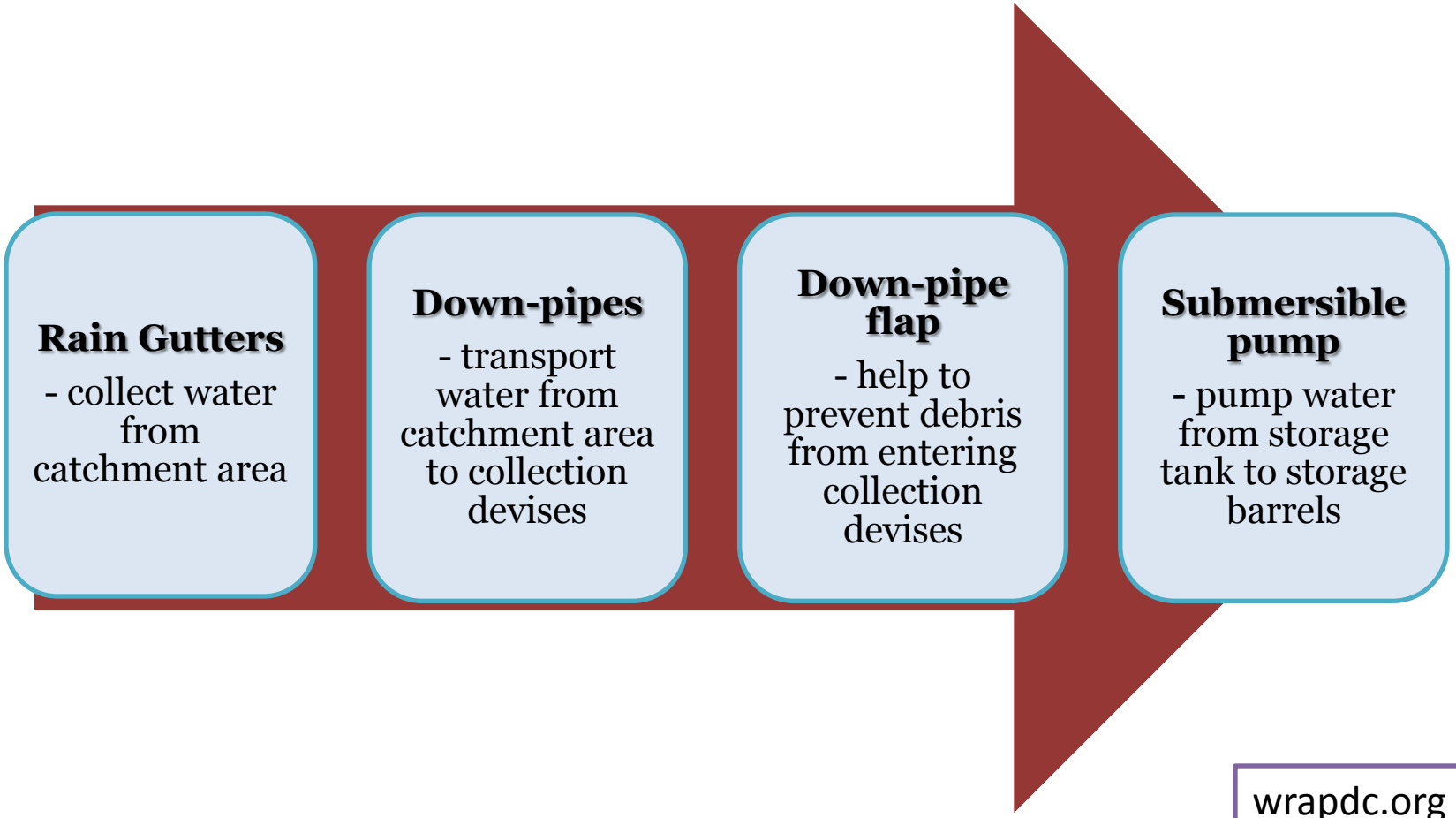
Conveyance System



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RWH and Environmental Education

- Water Resources Action Project Schools
- Israeli Science Fair- Ganey Aviv, Lod
- Web-based tools
  - ESRI Save the Rain website
    - Combat Drought – Calculate Your Rain Harvesting Potential
    - www.save-the-rain.com

Sur Baher Girls School and Al-Afaq School for Special Education

- **WRAP** constructed rain barrel systems for two schools in East Jerusalem.
- Before : Both schools faced costly and unreliable municipal water .
- After
  - Monthly reporting through 2.5 rainy seasons show on average 70% of Sur Baher's total water usage supplied by system.
  - Reduced water bills and provided greater understanding of water's value, importance of conservation.
  - Recycling and gardening programs
  - Provides focus for environmental education
  - Pilot project involving Sur Baher and ABQ Academy.

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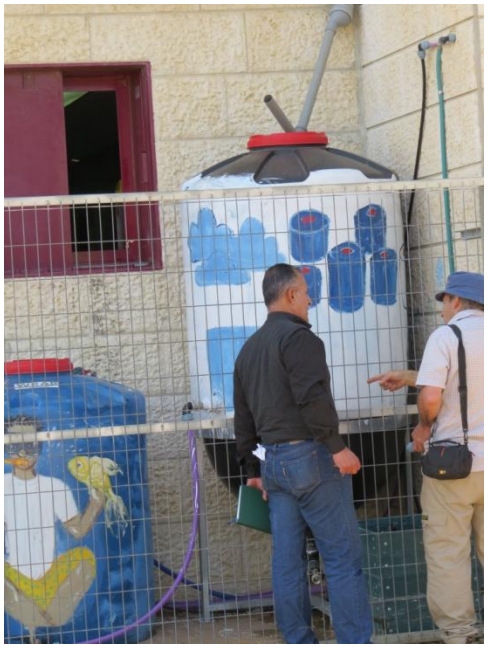
Al Afaq, East Jerusalem

Environmental Recycling Garden

Rainwater Harvesting



Sur Baher, East Jerusalem

Water Harvesting Tanks

Battir Girls High School

- **WRAP** constructed a cistern for the Battir Girls High School, located in the West Bank
- **Before**

  The Battir Girls High School bathrooms closed as a result of insufficient water supplies and unsanitary conditions
- **After**

  The school can:
  - Keep its bathrooms open
  - Host a summer camp
  - Implement a community garden

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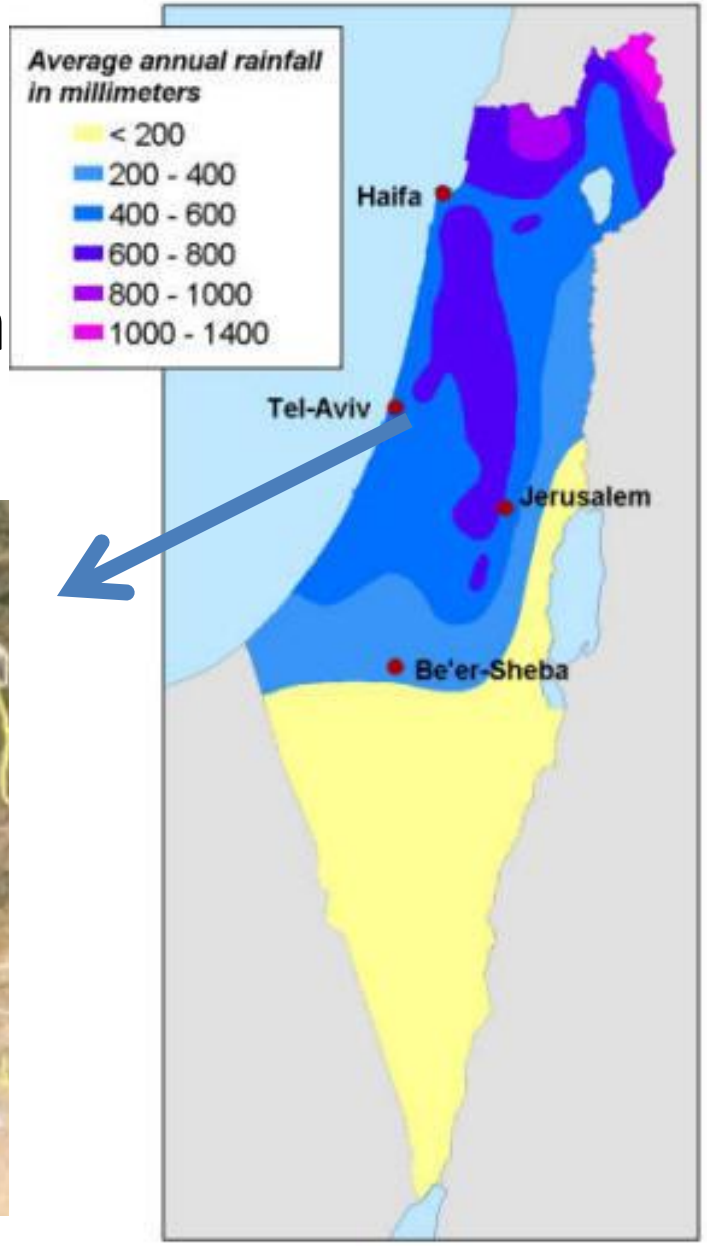
Cistern Construction

Example Project

- Ganey Aviv School in Lod, Isra



Ganey Aviv – Lod , Israel

- Roof collection system
  - 8500 liter reservoir: 10 toilets (1/2 of school bathrooms).
  - Research questions
    - What is optimal system parameters (collecting surface, reservoir volume) given the daily consumption rate and historic meteorological data?
    - How many times would reservoir spill over or run dry ?
    - How much water can be saved in average winter?

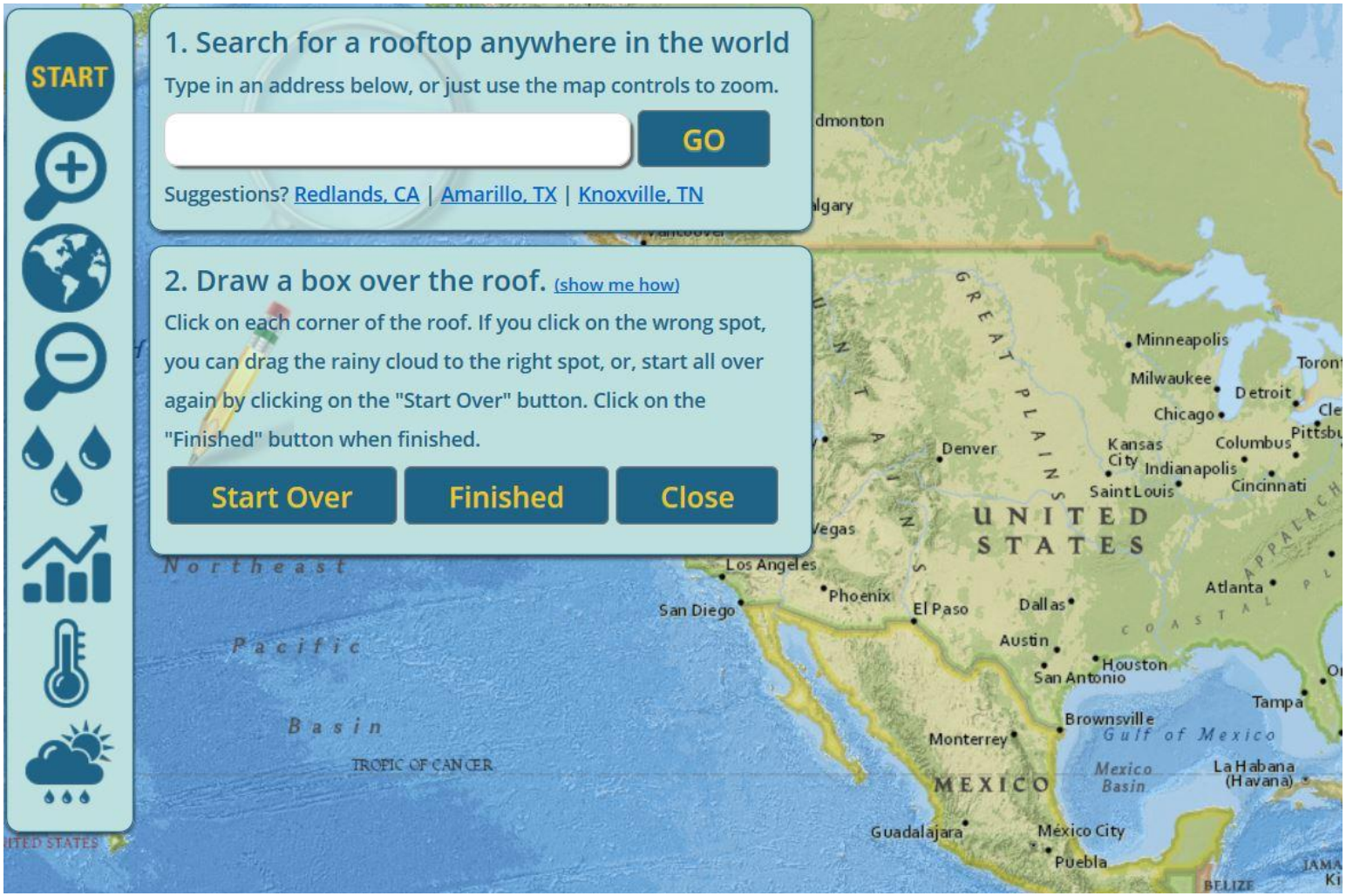
Methodology

- Measurements during winter
  - Rainfall (mm)
  - Water level in reservoir
  - Daily usage by 10 toilets (metered)
  - Water supplied by city source (metered)
- Calculate
  - Ratio of rainfall (mm) to rise in water level in reservoir (mm) -> collection surface area.
  - Collection potential (liters) of roof per mm rainfall.

Results and Conclusions

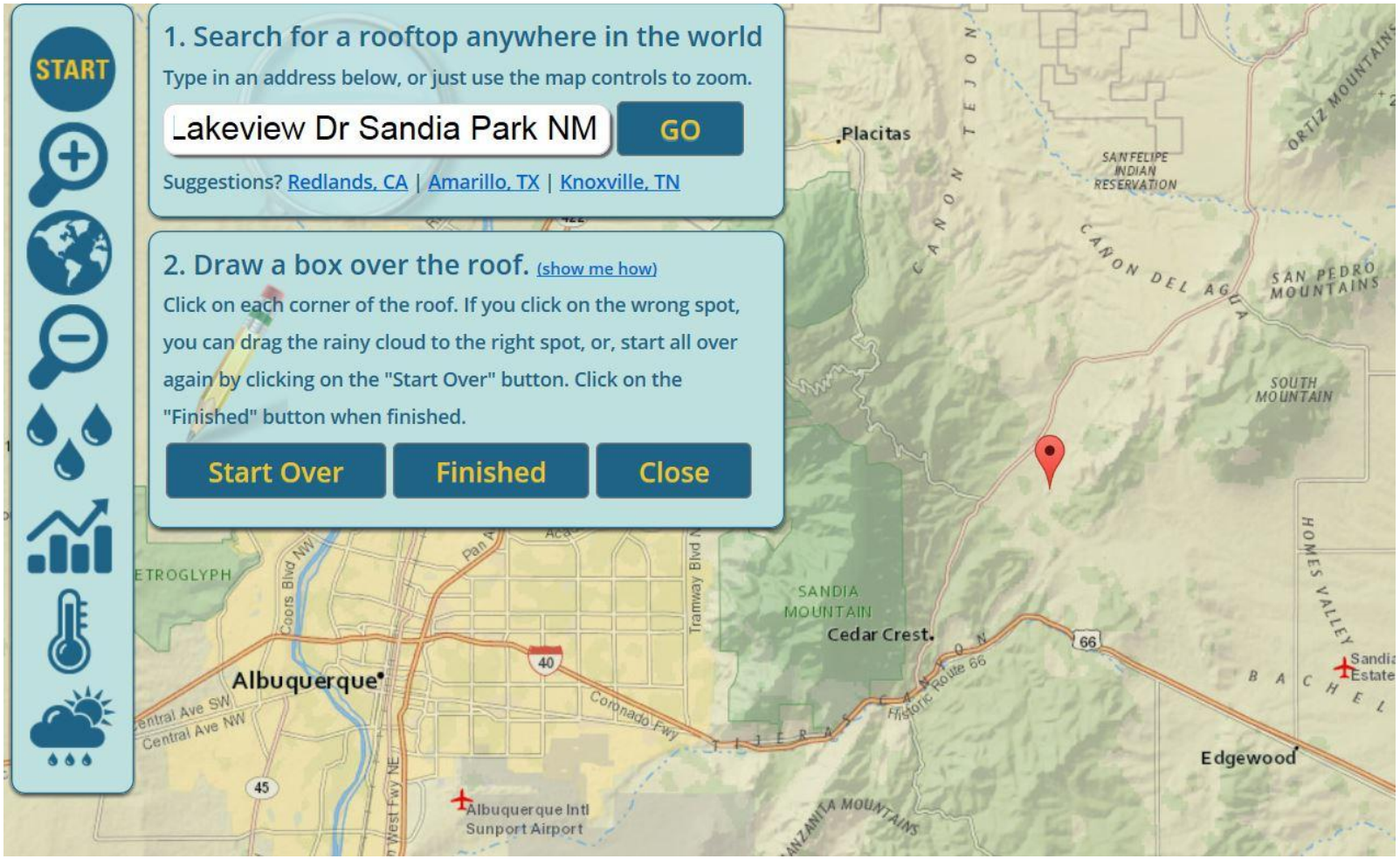
- Daily use = 1000 L/day
- Rain event-> 1 mm rain added 170 L to tank.
  - 1mm x 1 sq meter = 1 liter
  - Roof size = 170 sq meters
  - 6 mm rain needed to collect 1000 L (1 day use)
  - 50 mm rain needed to fill 8500 L tank (50mm x 170 sq. m)
- 8-yr average Lod annual rainfall = 482 mm
  - Can fill reservoir about 10 times -> 85 days of usage
- Actual 8-yr rain event pattern led to several overflows (2-6/yr) and several times running dry (2-5/yr).
- Conclusions
  - Increased roof collection rather than storage is more useful - exploit minor storms
  - Increase number of supplied toilets not helpful

Save the Rain Website



http://www.save-the-rain.com/SR3/

Save the Rain Website -2



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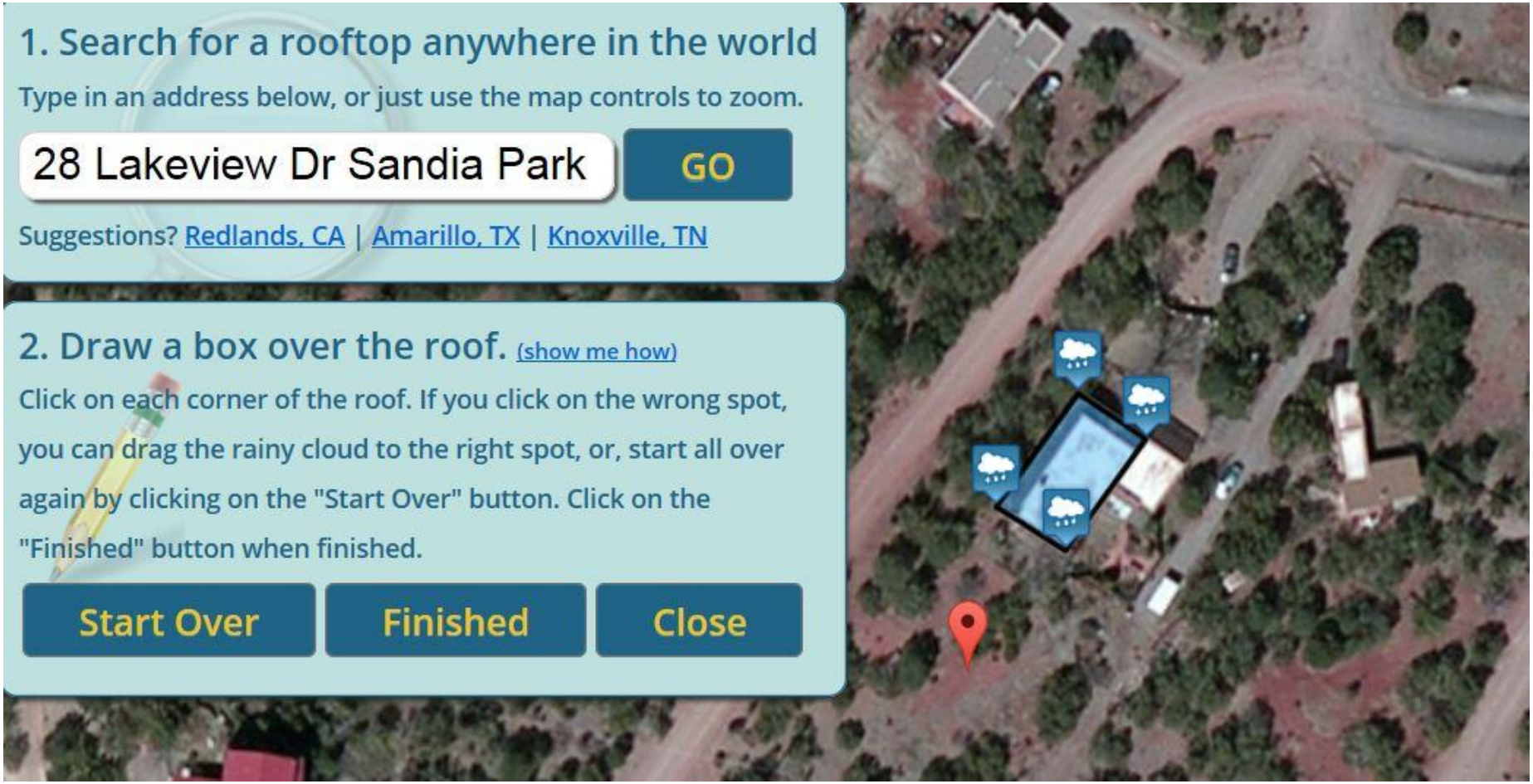
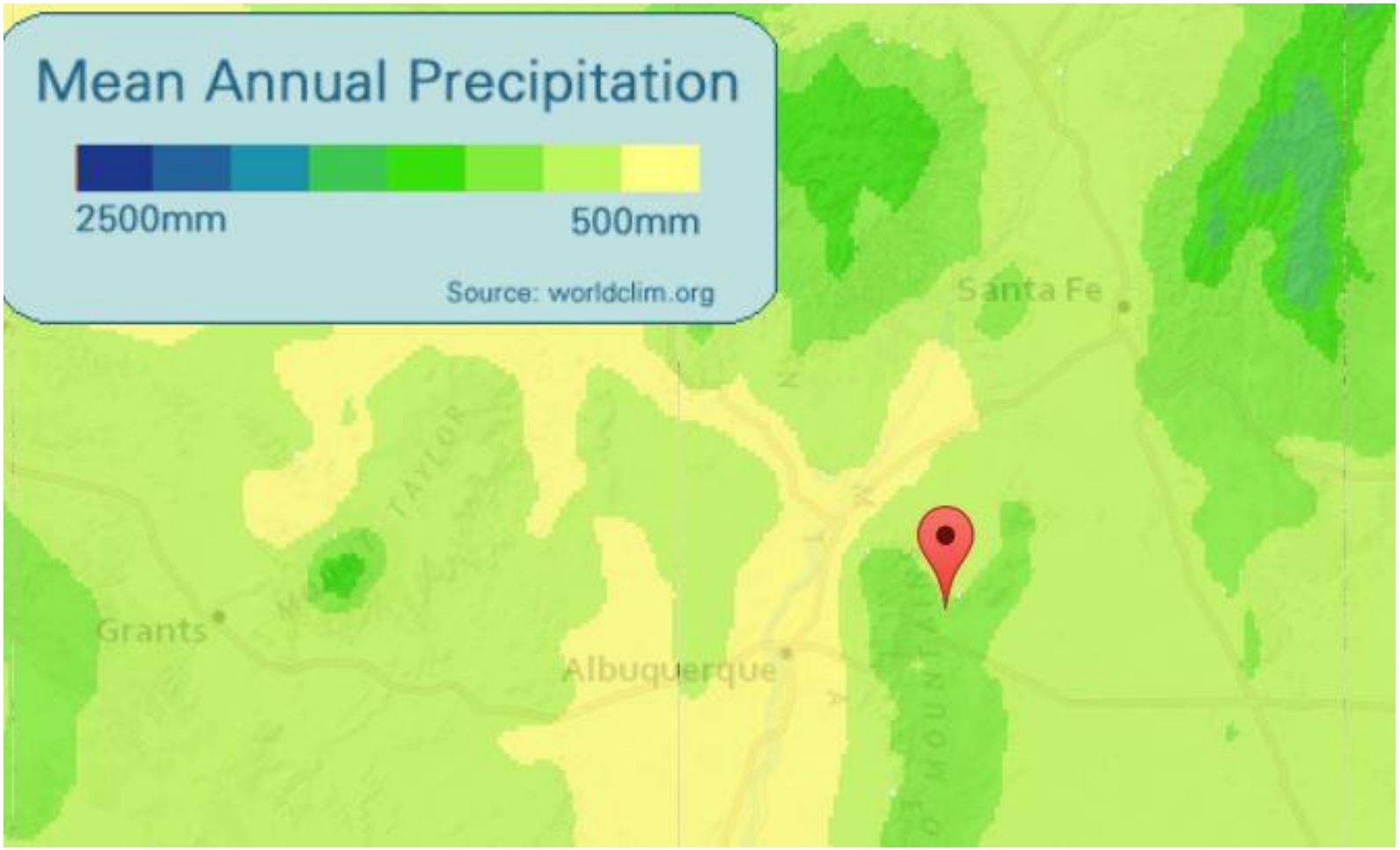
Save the Rain Website -3



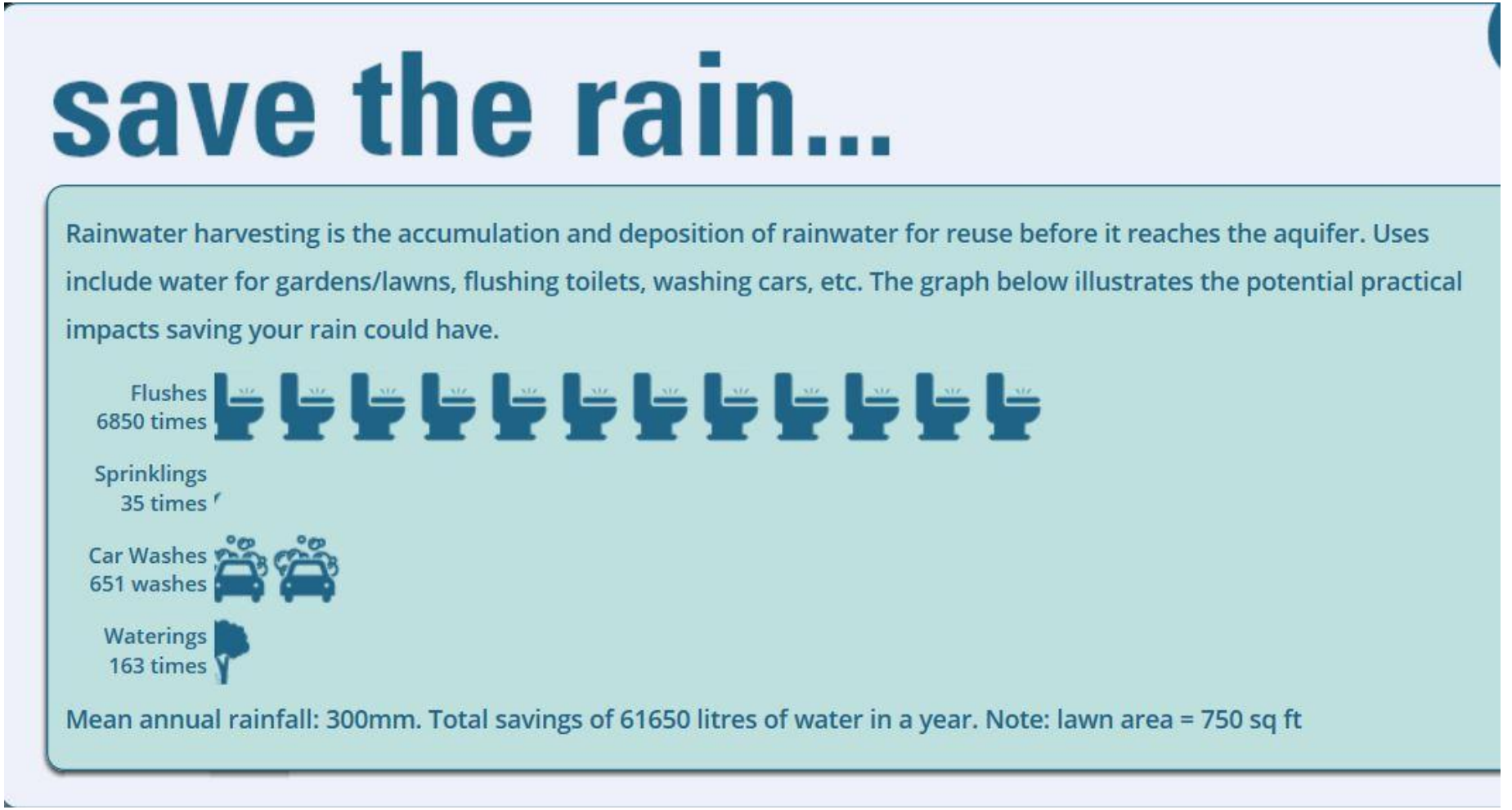
http://www.save-the-rain.com

Save the Rain Website -4



http://www.save-the-rain.com

Save the Rain Website -5



http://www.save-the-rain.com

Interesting Sources

- Water Resources Action Project
  - www.wrapdc.org
  - www.savingtherain.org (Amir Yechieli's site)
  - https://rainwatercollection.com/numbers/ (Amir's supplier)
  - http://www.wrapdc.org/how-it-works/ (WRAP tutorial on systems)
- Eco-Peace/Friends of the Earth
  - www.foeme.org – main website
  - www.watercare.org/RainCatcher/
- Project Learning Tree
  - https://www.plt.org/newsletter-stem-connection-every-drop-counts
- Brad Lancaster
  - http://www.harvestingrainwater.com/rainwater-harvesting-inforesources/rainwater-harvesting-online-calculator/
- Office of the State Engineer (NM)- Roof Reliant Landscaping
  - http://www.ose.state.nm.us/water-info/conservation/pdf-manuals/Roof-Reliant-Landscaping/RRL-CoverContentsIntro.pdf
- American Rainwater Catchment Systems Association (ARCSA)
  - www.arcsa.org

DISCUSSION

HOW CAN WE USE RAINWATER HARVESTING IN STEM ACTIVITIES?