

WATER HARVESTING INITIATIVES IN TUCSON AND PIMA COUNTY

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Arizona-Mexico Commission, Tucson, AZ



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Pima County Regional
Flood Control



Presentation Outline

- Motivations
- Regulatory Framework
- Rainfall and Runoff Characteristics
- Initiatives
- Summary

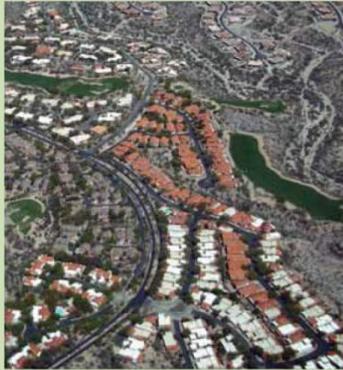


Presentation Outline

- **Motivations**
 - **Water Scarcity**
 - **Clean Water Act Requirements**
- Regulatory Framework
- Rainfall and Runoff Characteristics
- Initiatives
- Summary

2011-2015

Action Plan for Water Sustainability



A City of Tucson and Pima County
Cooperative Project

Goal

Demand Management Goal #5:
Increase the use of rainwater and stormwater to reduce demands on potable supplies

Action Plan

Demand Management Action Plan #7:
Develop Design guidelines for neighborhood stormwater harvesting to encourage the creation of habitat and water efficient landscapes.

Low Impact Development and Green Infrastructure

LID/GI ~ Water Harvesting

Low Impact Development (LID)

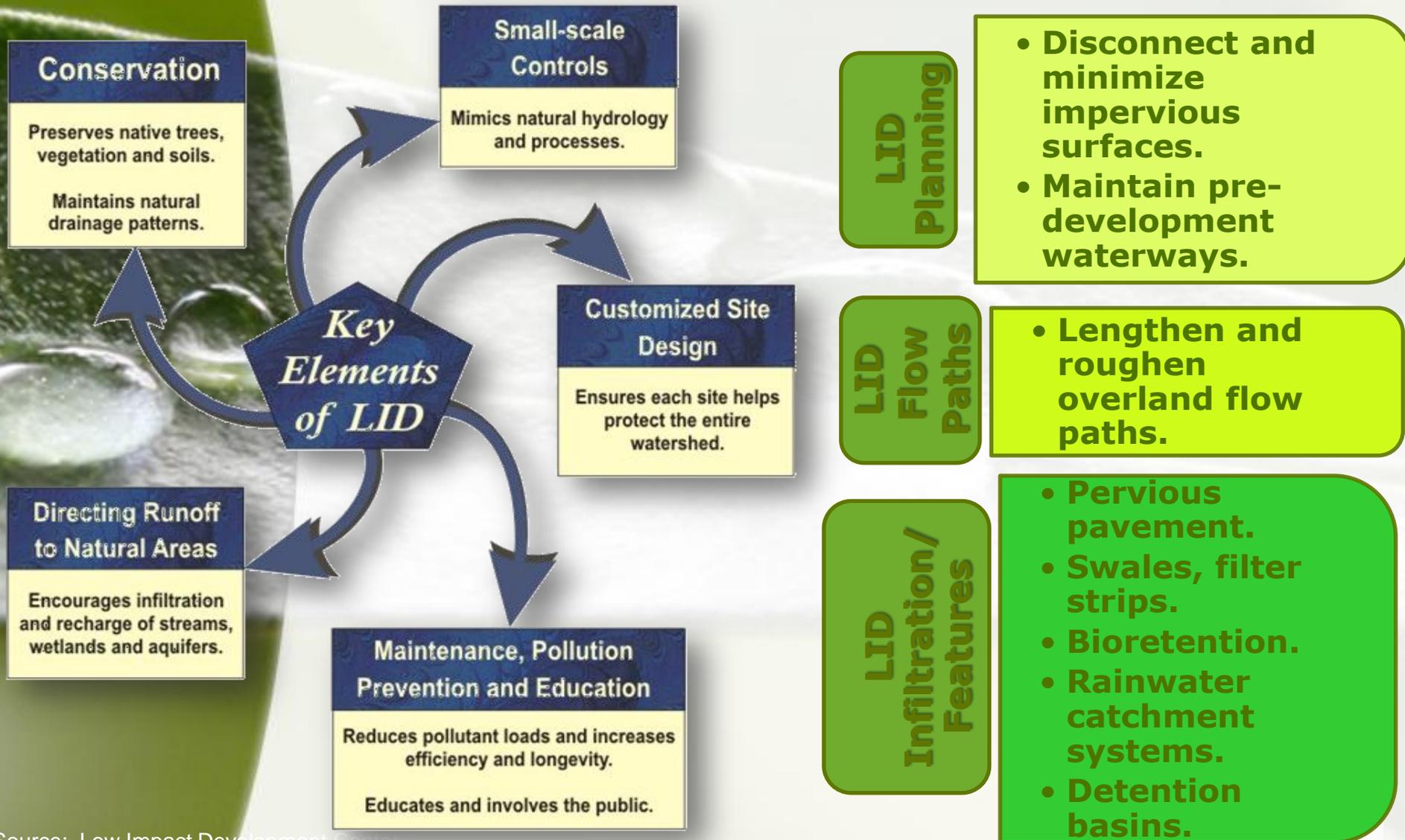
'A comprehensive stormwater management and site-design technique. . . the goal of any construction project is to design a hydrologically functional site that mimics predevelopment conditions...'

Green Infrastructure

As a general principal, Green Infrastructure techniques use soils and vegetation to infiltrate, evapotranspire, and/or recycle stormwater runoff...

Low Impact Development (LID)

Mimic pre-development hydrology





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Regulatory Efforts to Encourage Integrated Use of Stormwater

Regulatory:

- City of Tucson
 - Commercial Water Harvesting Ordinance + Development Standards (2010)
 - Stormwater Discharge Permit (AZPDES)
 - General Plan *Green Infrastructure* component.
- Pima County:
 - Revised Detention/Retention Manual (expect – 2012)
 - Stormwater Discharge Permit (AZPDES)
- Town of Oro Valley:
 - Stormwater Ordinance and Stormwater Utility

AZPDES:MS4

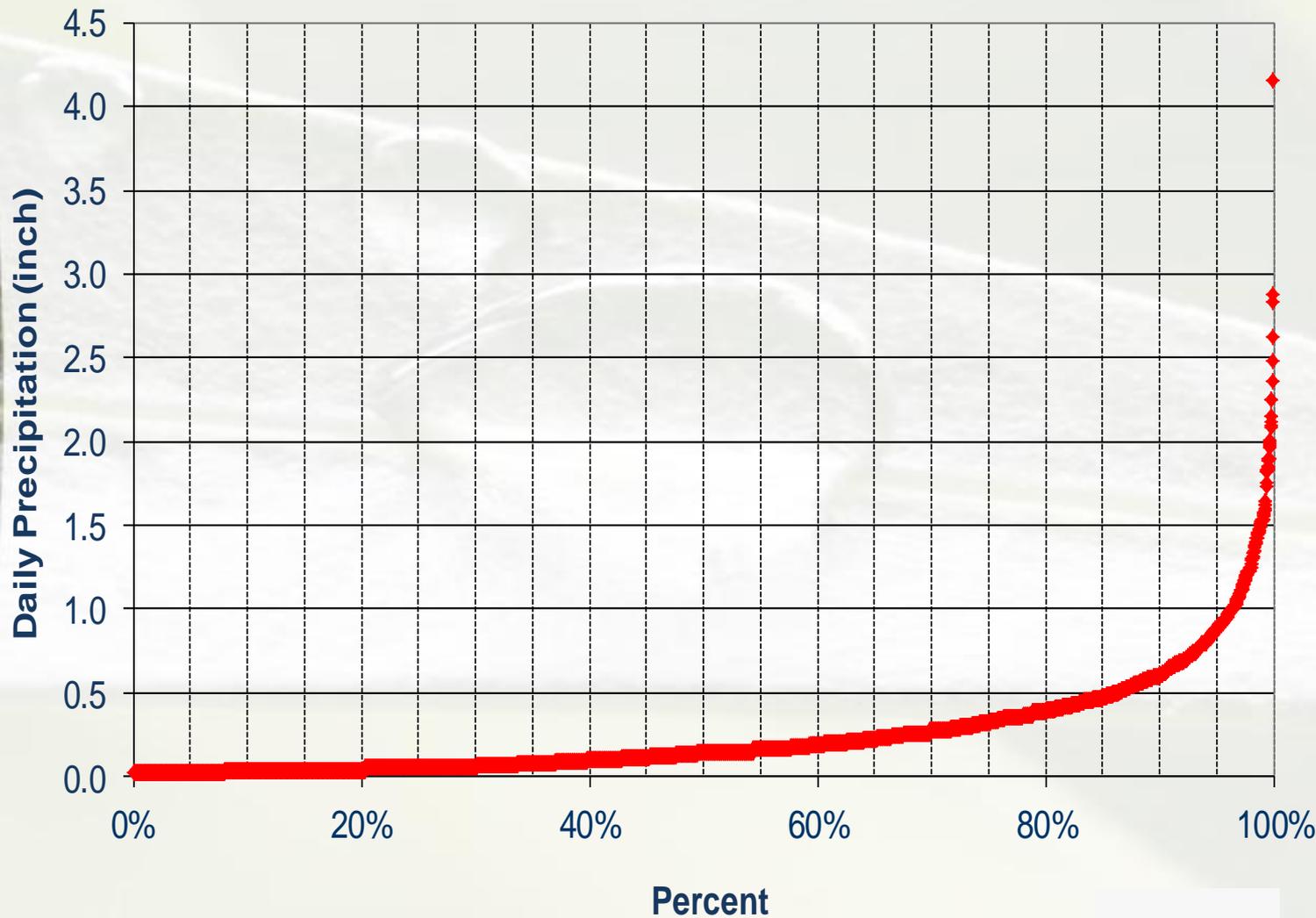
- **Measurable Goal:** The county shall include in the fourth (4th) year annual report the findings of how the implementation of LID practices would contribute to the reduction of pollutants in stormwater discharges to the MS4 and identify a plan and schedule for incorporation into design standards.



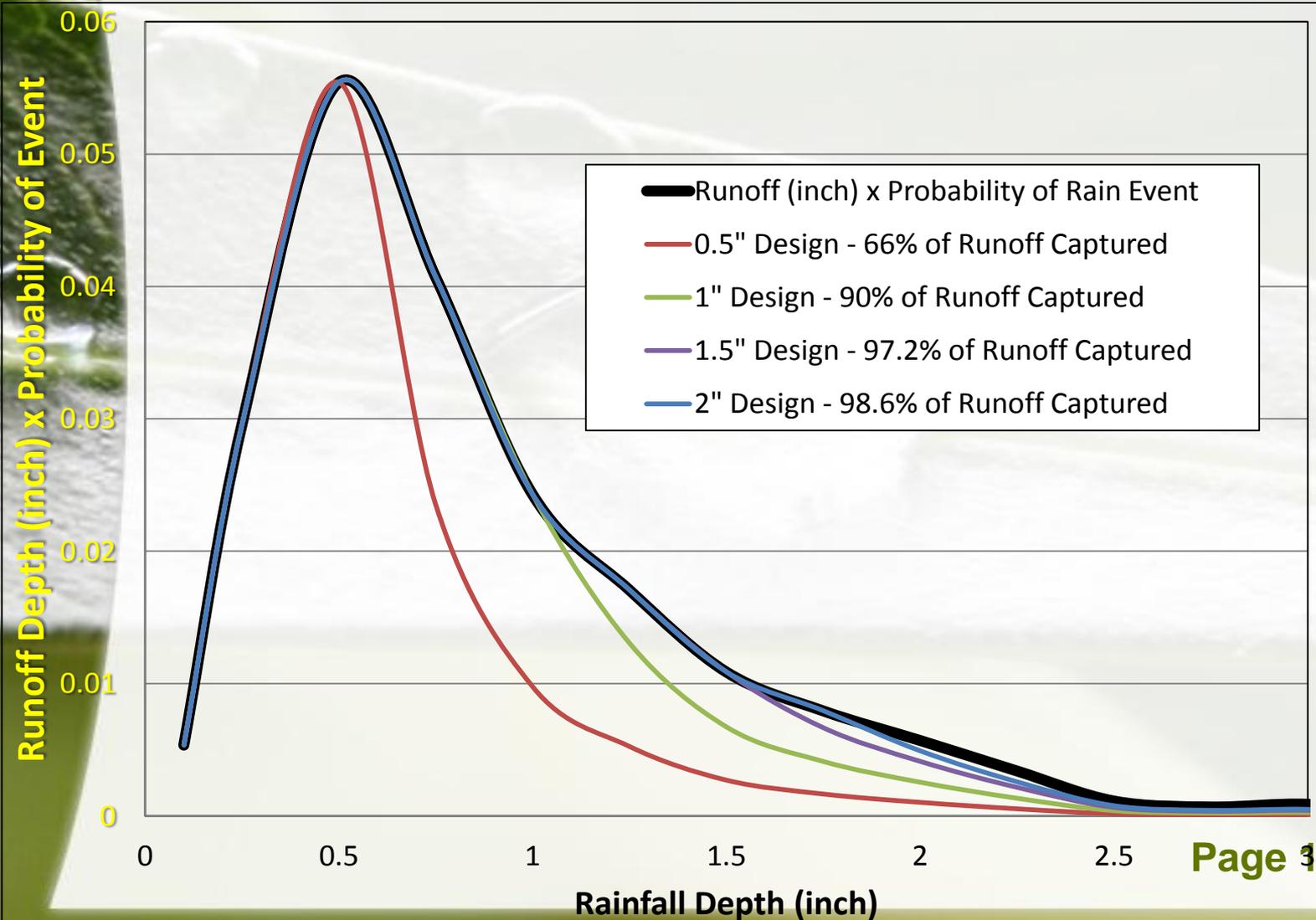
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Cummulative Distribution 105 years of Daily Rainfall from University of Arizona

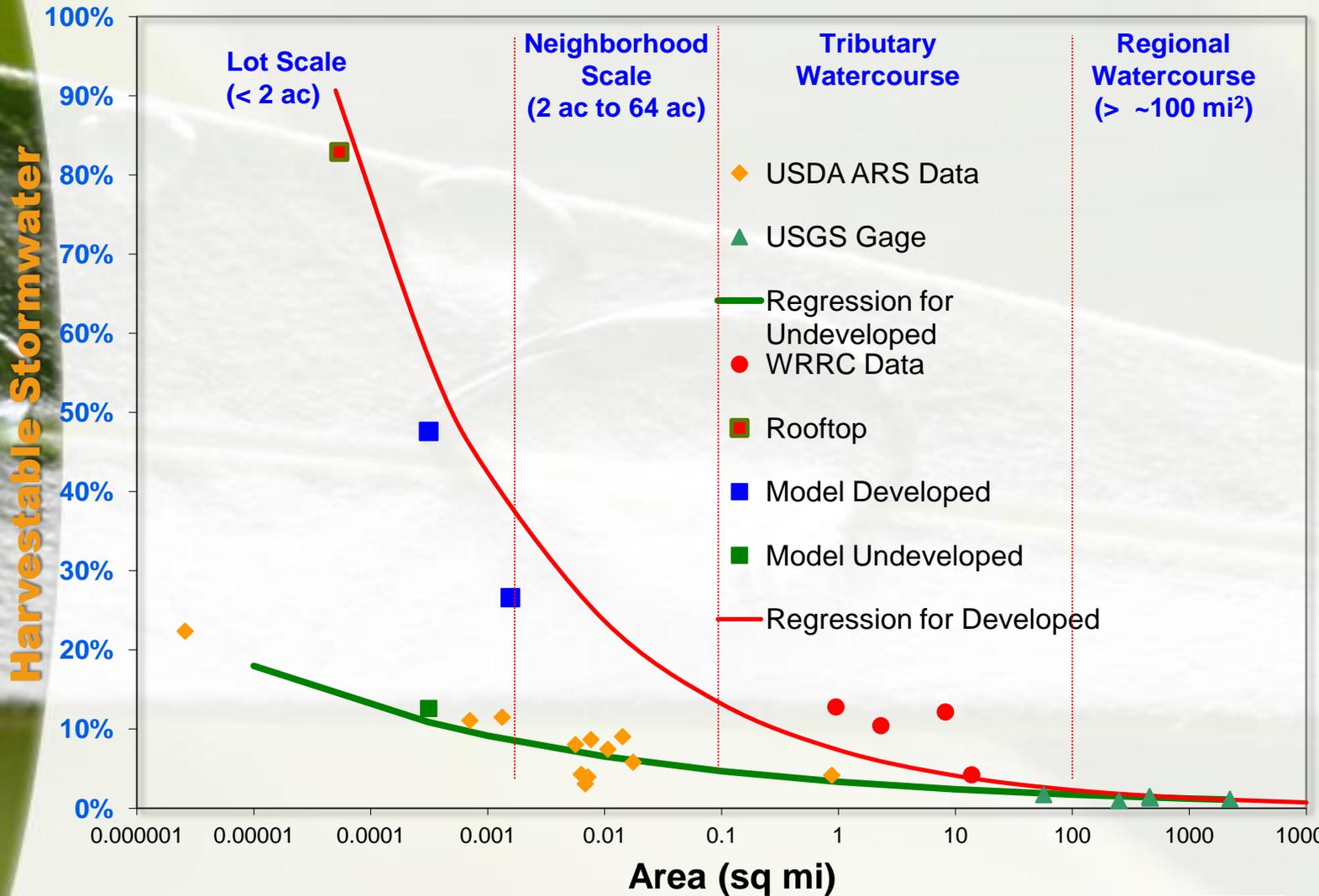


Probability of Runoff From Impervious Surfaces



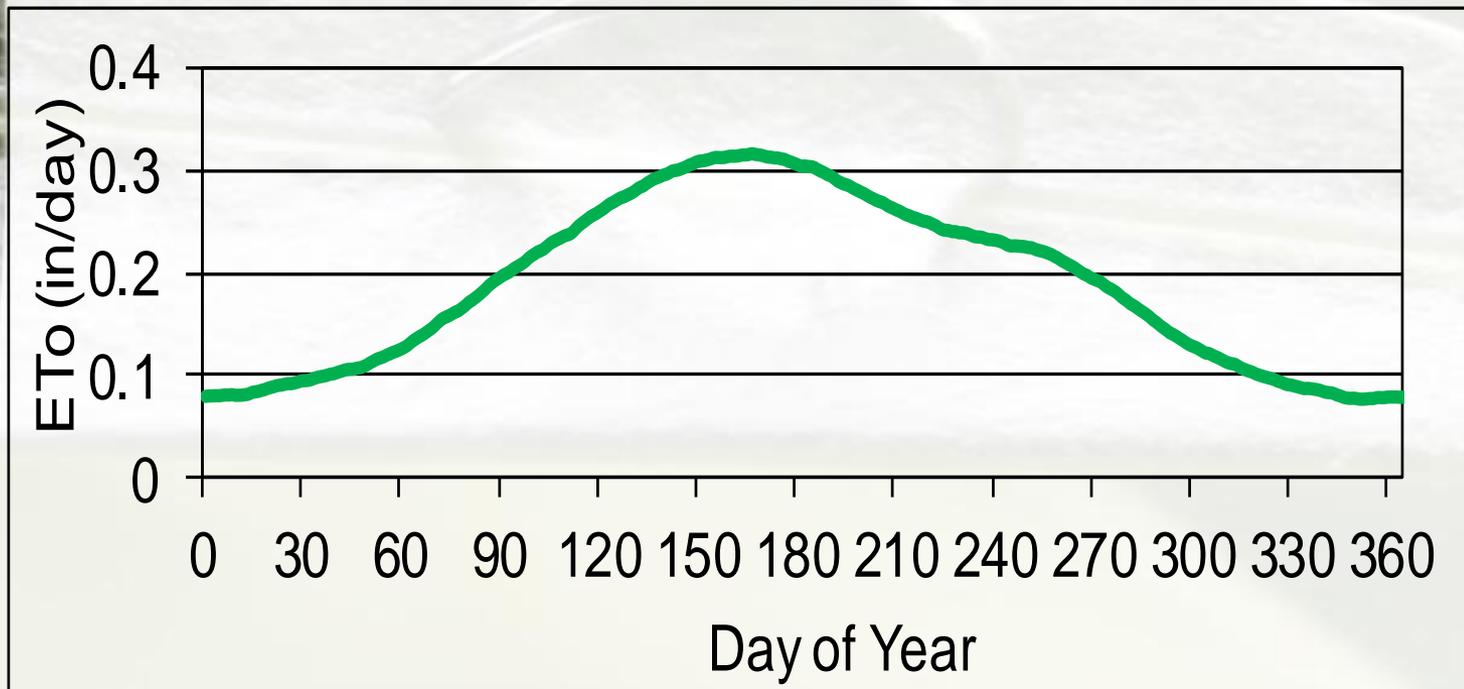
'Harvestable' Water (Rainwater/Stormwater)

i.e. water yield

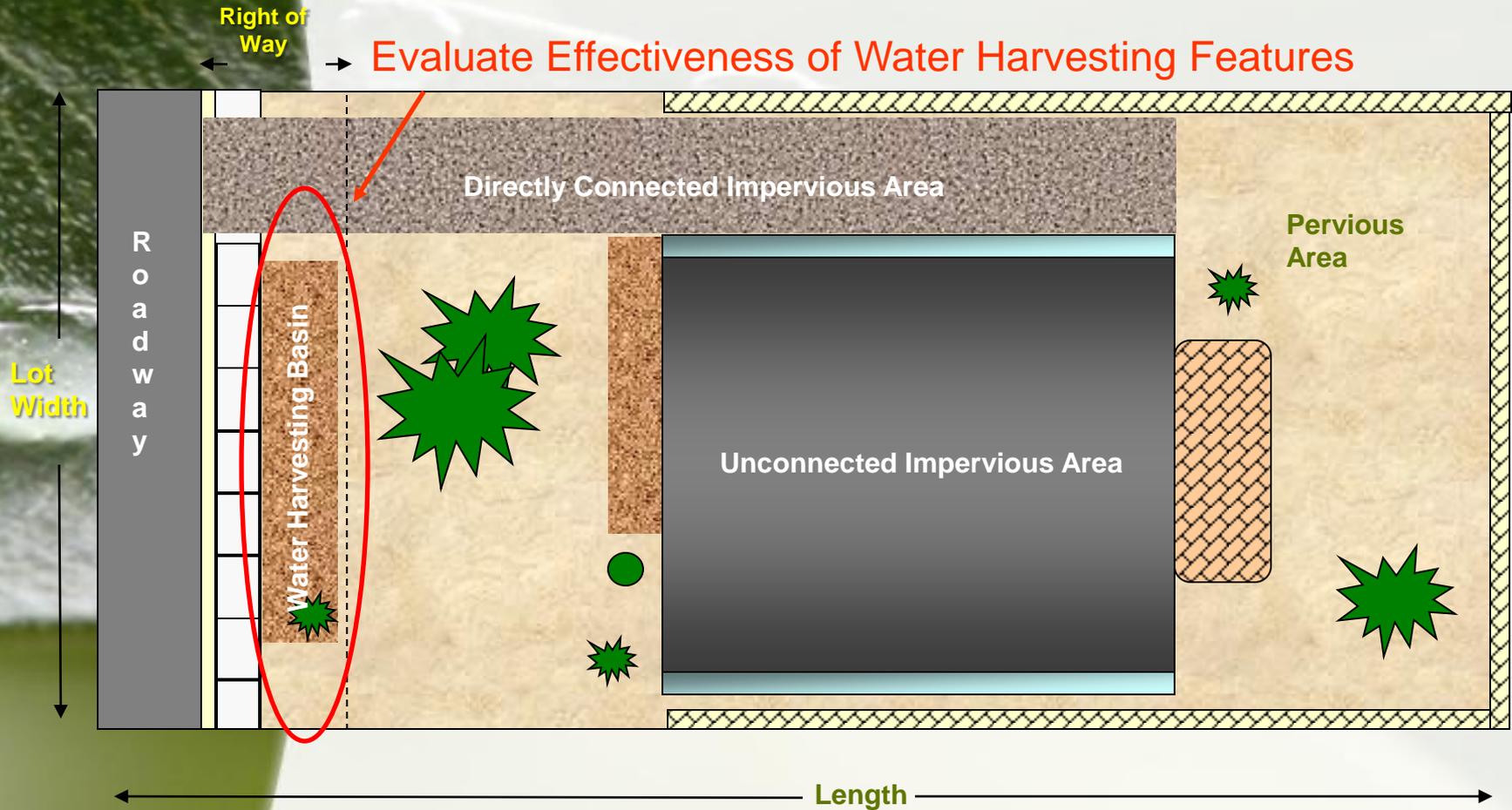


Data Sets

- Daily Rainfall Data – 105 years of data gathered at U of A.
- Mean Daily Reference ET (ET_o) – from Campbell Avenue Farm

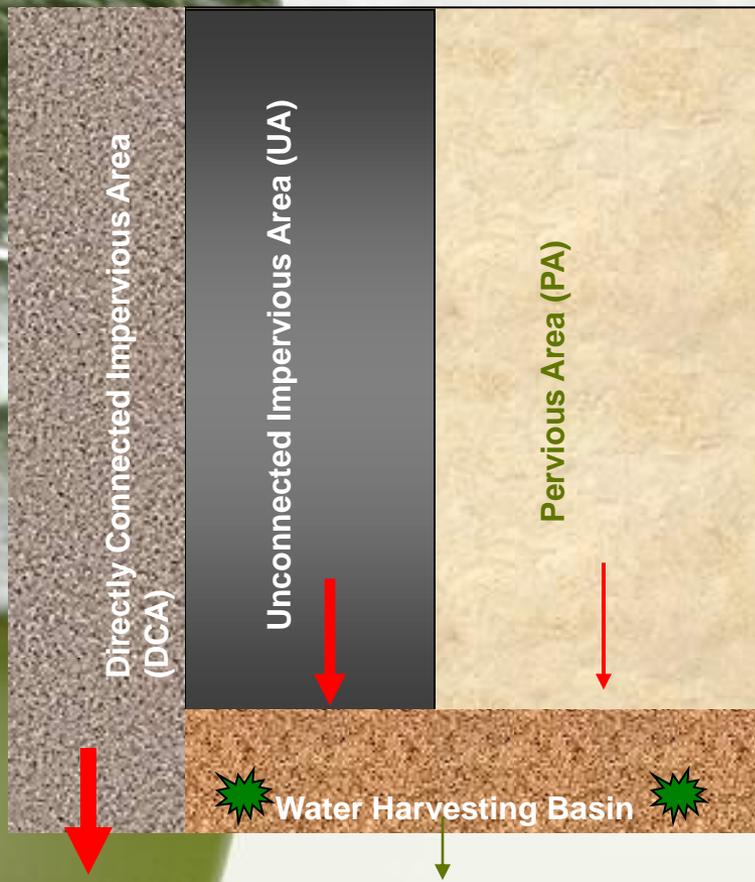


Lot Scale Evaluation (1/5 acre lot example)



Conceptual Model

Conceptual Representation



Mathematical Representation

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

- Q is the total depth of runoff (inches);
- P is the daily rainfall depth of precipitation (inches);
- S is the potential abstraction (inches)

$$S = \frac{1000}{CN} - 10$$

CN is the Curve Number.

Rainwater off lot from Directly Connected:

$$Vol_{(DCA)i} = Q_i(f(CN_{DCA}, P_i)] \times Area_{DCA}$$

Rainwater in to Water Harvesting Basin:

$$Vol_{(UA)i} = Q_i(f(CN_{UA}, P_i)] \times Area_{UA}$$

$$Vol_{(PA)i} = Q_i(f(CN_{PA}, P_i)] \times Area_{PA}$$

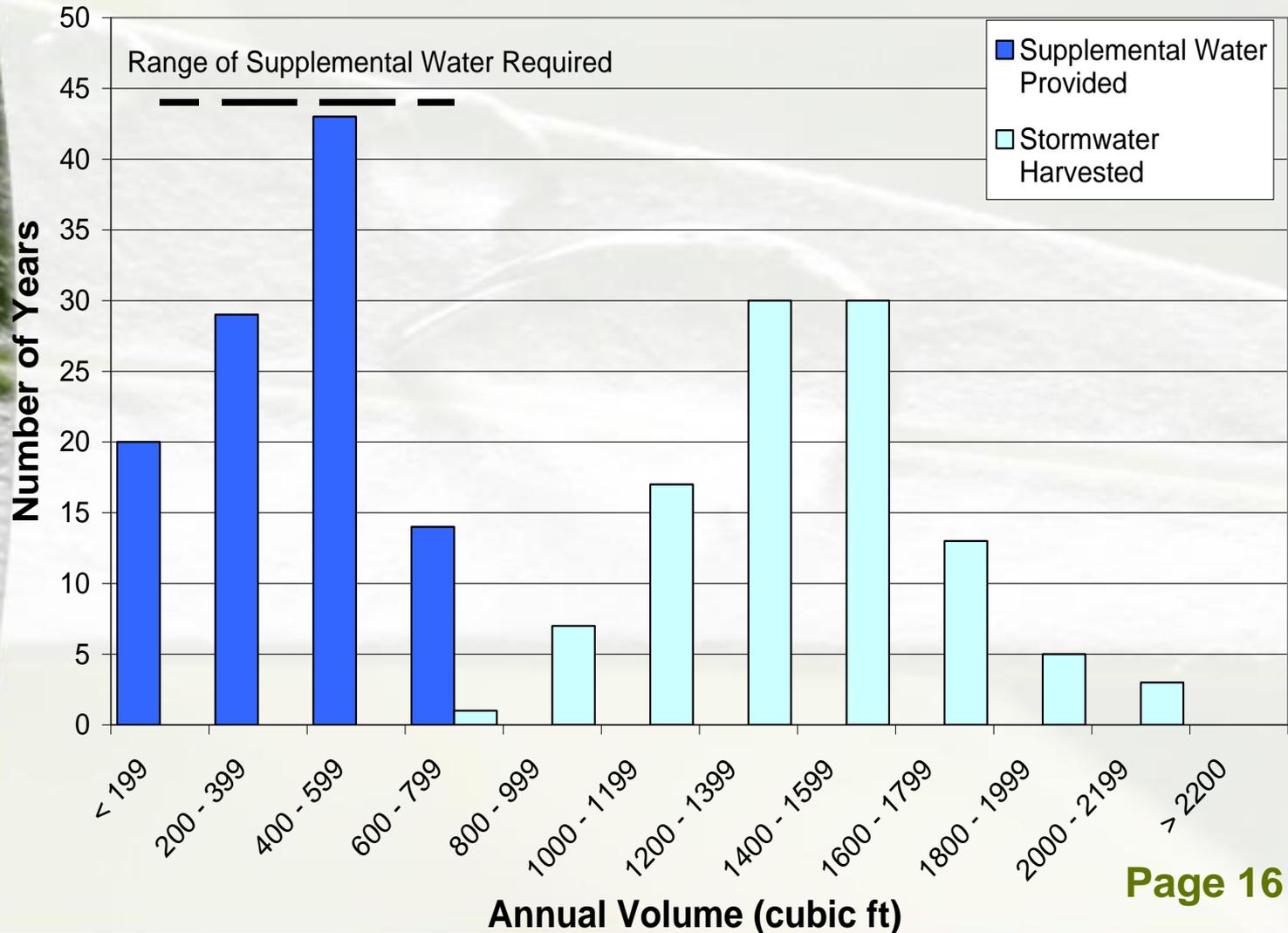
Storage Accounting in Basin:

$$Storage(i) = Storage(i - 1) + \Delta Storage$$

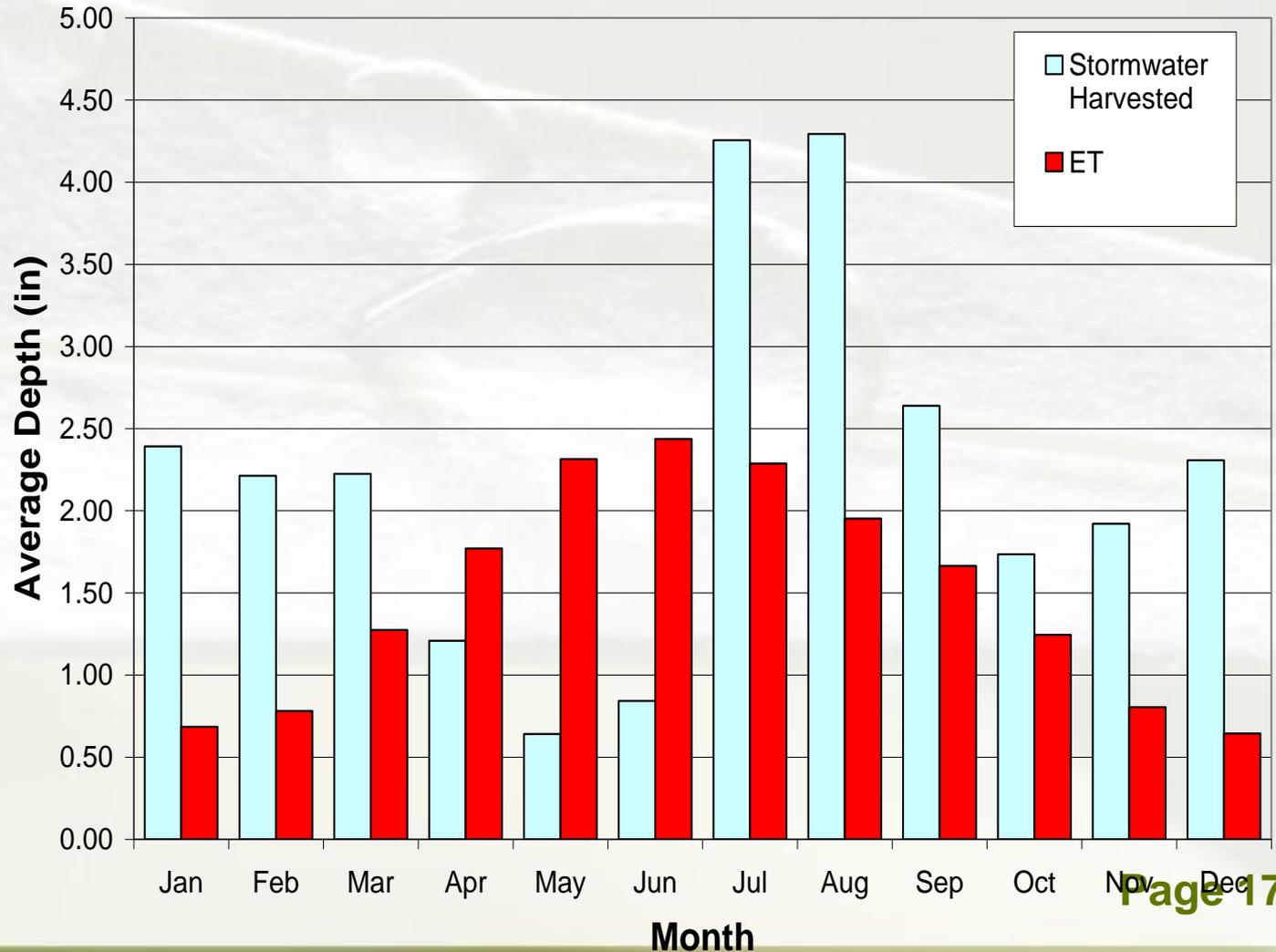
$$\Delta Storage = Rainwater_i - ET_i$$

$$(ET_{ToAZmet} * Kc)$$

Supplemental Water Supplied, and Harvested Stormwater from a Water Harvesting Basin on a 1/5 acre lot



Modeled Mesquite Water Requirements (ET) and Water Harvested



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Joint Effort: LID Working Group Members



Public: Pima Co.



Regional Flood Control District



Development Services Dept.



Dept. of Transportation

dot.pima.gov



Public: City of Tucson



Office of Conservation & Sustainable Development



Dept. of Transportation: Stormwater Division



Education: Univ. of Arizona



Environmental Research Lab



Drachman Institute



Facilities



Water Research Resource Center



Biosphere 2



Public: Pima Assoc. of Gov.



Pima Association of Governments



Non-Profit/Other



Watershed Management Group



Living Streets Alliance



Imagine Greater Tucson



Professional/Trade



Norris Design



Wheat Scharf & Assoc.

Joint Effort – LID Working Group

Products of the LID Working Group

Revised *Pima County Detention/Retention Manual*

Neighborhood Scale Water Harvesting Manual

Case Studies Catalogue

Joint Effort – LID Working Group

Products of the LID Working Group

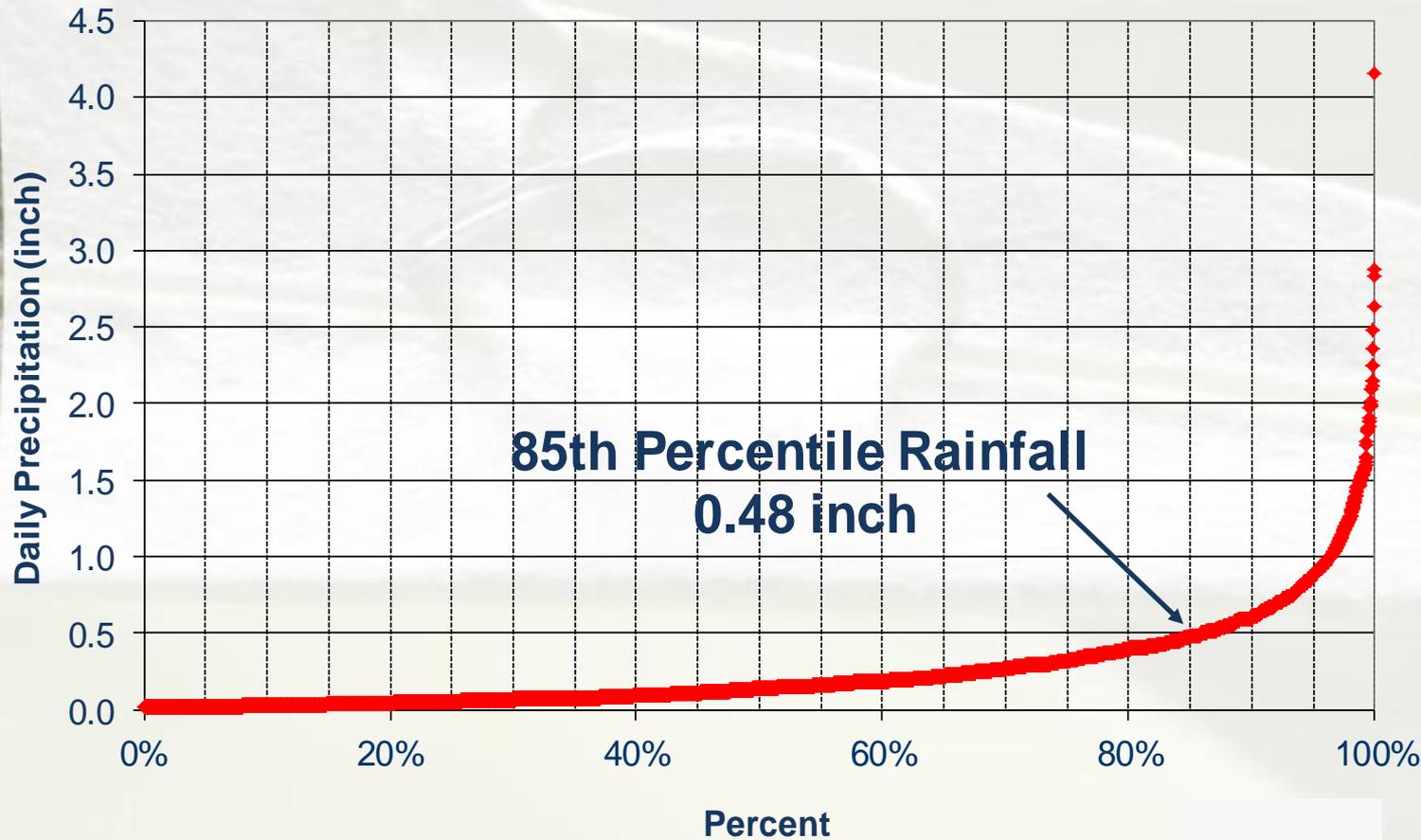
Revised ***Pima County Detention/Retention Manual***

Neighborhood Scale Water Harvesting Manual

Case Studies Catalogue

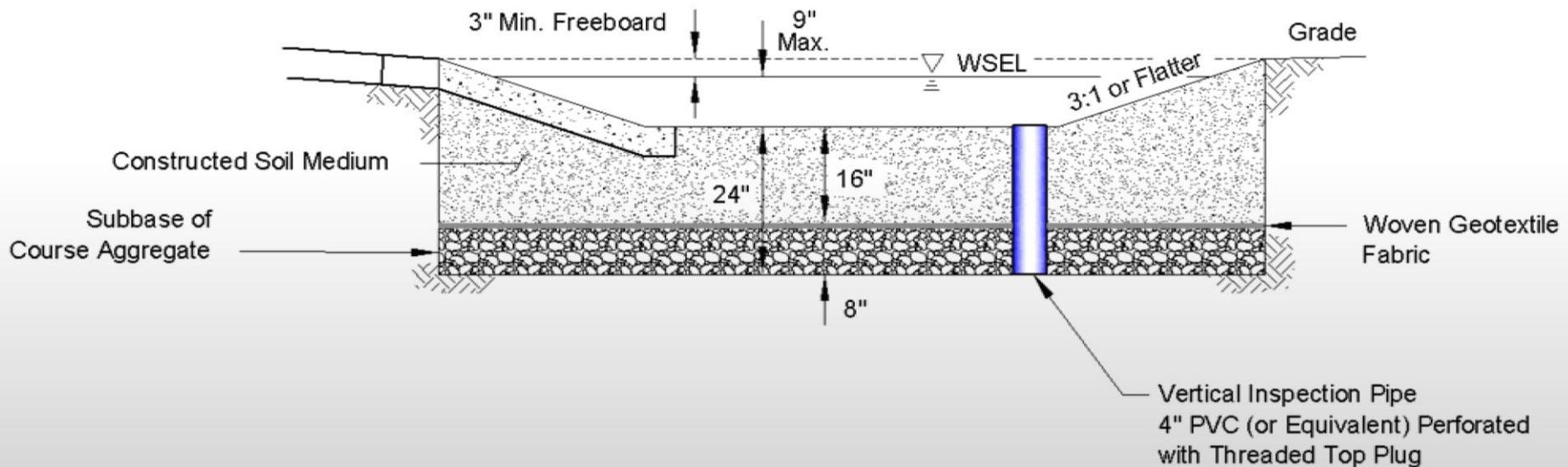
Pima County: **DETENTION-RETENTION MANUAL (Draft)**

Replace Retention Requirement with a
'First Flush' Retention Requirement



Bioretention Basin

Pima County Regional
FLOOD CONTROL
DISTRICT

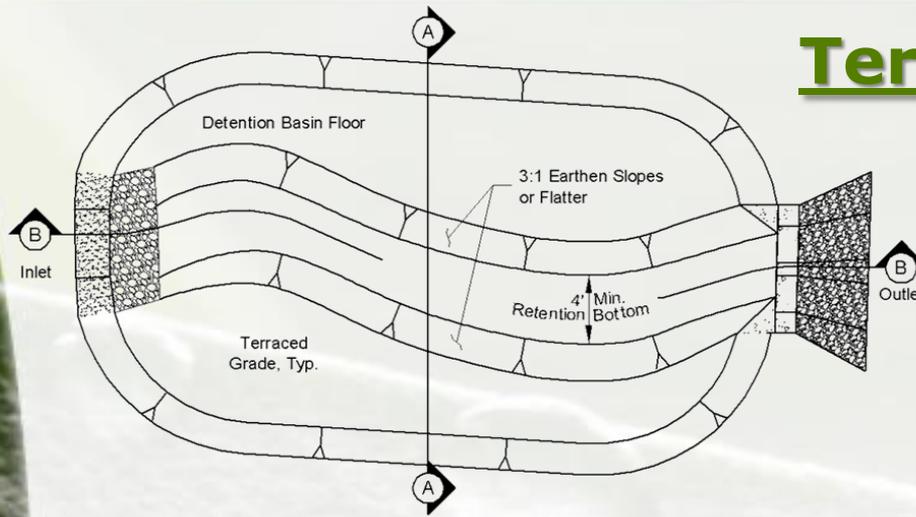


BIORETENTION BASIN

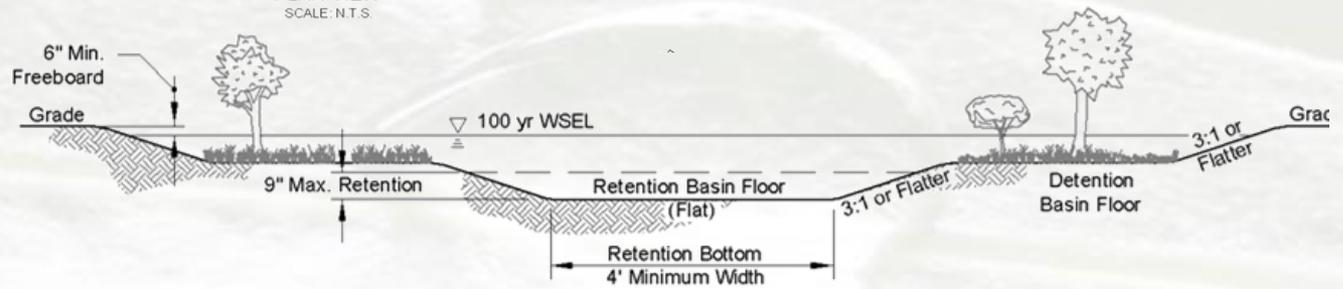
SCALE: N.T.S.



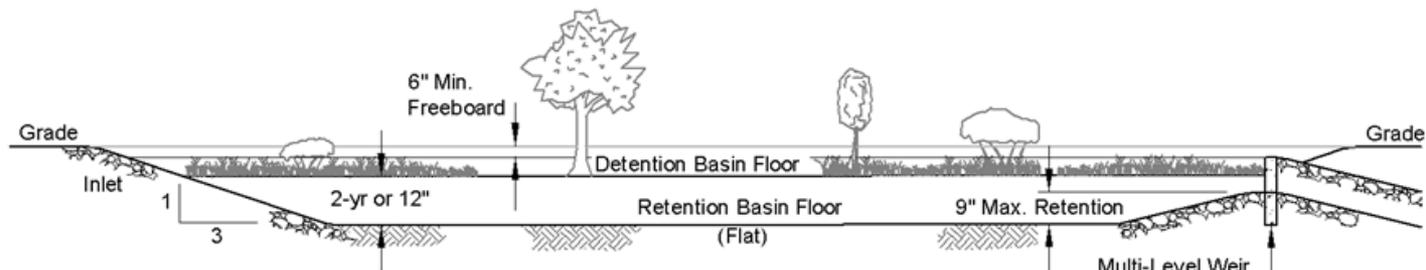
Terraced Detention Basin with Retention



PLAN VIEW
SCALE: N.T.S.



A SECTION
SCALE: N.T.S.



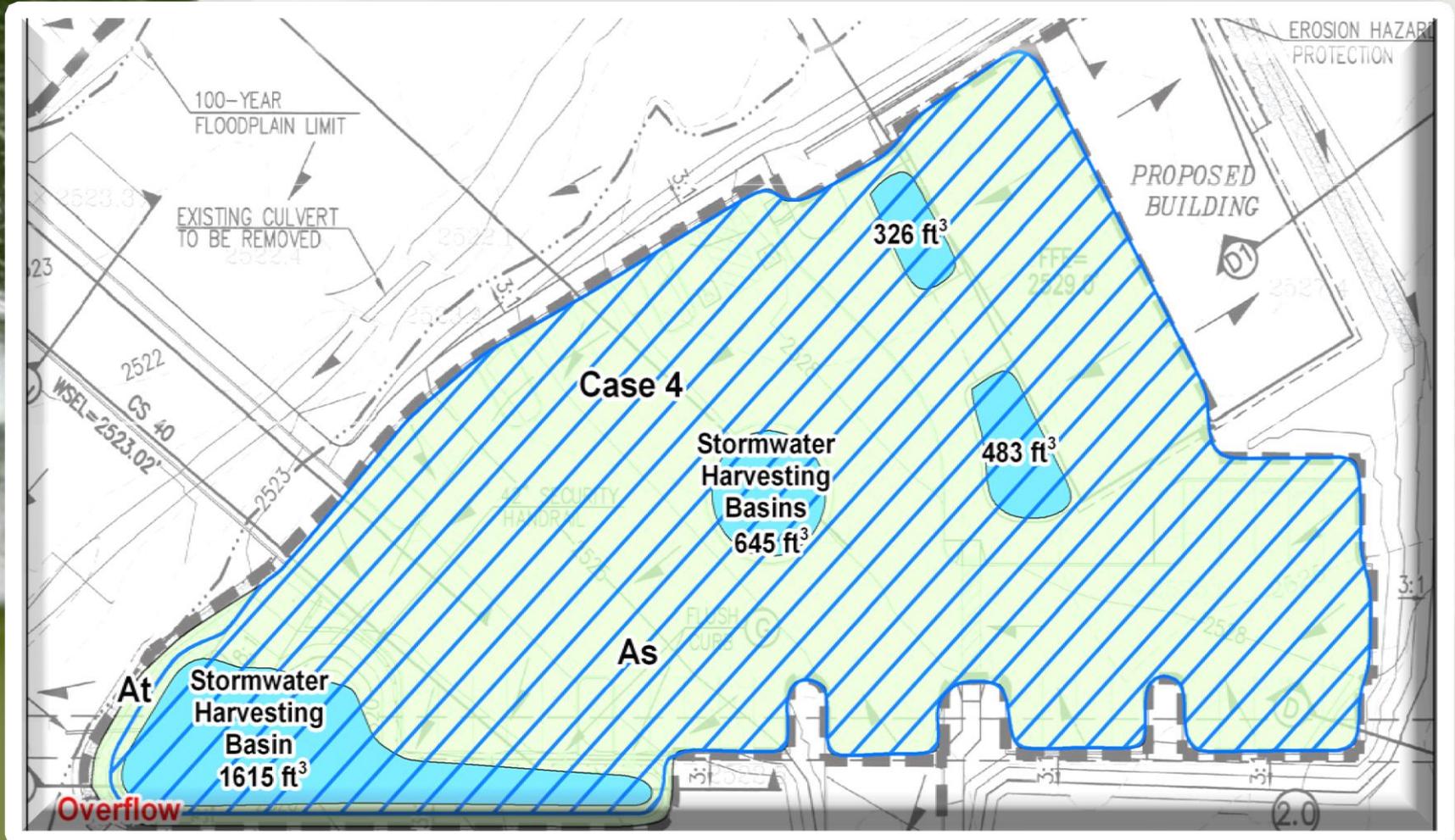
B PROFILE
SCALE: N.T.S.

Multi-Level Weir
Outlet As Shown
in Fig. 4.8



Pima County:

DECENTRALIZED 'FIRST FLUSH' RETENTION



Joint Effort – LID Working Group

Products of the LID Working Group

Revised *Pima County Detention/Retention Manual*

Neighborhood Scale Water Harvesting Manual

Case Studies Catalogue

Stormwater Harvesting Guidance Manual

Pima County Regional
FLOOD CONTROL
DISTRICT



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- 3. Site Assessment, Design and Planning Process**
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 - a. Non-Structural
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 - iii. Promoting Open Space
 - iv. Preserving Natural Flow Paths and Buffers
 - v. Conserving and Restoring Sensitive Natural Areas
 - vi. Disconnection of Impervious Area
 - b. Structural
 - i. Stormwater Harvesting Basins
 - ii. Swales
 - iii. Bioretention systems
 - iv. Infiltration Trenches
 - v. Dry Wells



Neighborhood-Scale Water Harvesting Manual

Local Priority	Type						Agency / Jurisdiction	Document	Date of Publication	Research Team Member Assignments	City of Santa Barbara
	Pretreatment	Bioretention	Filtration	Infiltration	Runoff Volume Minimization	End of Pipe					
							 Stantec				
high								Best (LID) Site Design Practices (Non Structural BMPs)			X
high					O			Natural/Sensitive Area Conservation/Restoration			O
high					O			Impervious Area Disconnection			O
high					O			Minimize Impervious/Disturbed Areas			O
high					O			Cluster Development (Minimize Construction Footprint)			
high					O			Minimize Soil Compaction			
high				O				Protect/Use Natural Flow Paths and Buffers			O
high				O				Promotion of Open Space Design/Natural Infiltration			
high	O							Implement Source Controls			
medium	X	X						Media Filters / Filtration Devices			X
high	X	X						Sand Filter and Gravel Filters			X
medium	X							Hydrodynamic / Solids Removal Devices			X
medium	X							Oil and Water Separators			
high		X						Bioretention / Rain Gardens			Dave
high		X						Tree Pits / Tree Box Filters / Planters			Irene
high			X					Xeriscaped Buffers / Filter Strips / Swales			Evan
high				X				Dry Wells			Evan
high				X				Infiltration Basin / Systems			X
high				X				Infiltration Trench or Gallery			Stantec (JT)
high				X				Soil Amendments / Structural Soils			Irene
high					X			Porous/Pervious Pavements			Irene
high					X			Rainwater Harvesting for Use (Rain Barrel / Cistern)			Irene
high					X			Self-Treating Areas (Zero Discharge Microbasins)			Dave
high					X			Downspout Disconnection / Redirection			Stantec (JT)
high						X		Detention Basin / Gallery / Dry Ponds			Stantec (JW)
high						X		Retention Basin			Stantec (JW)
medium								Diversion Structures / Flow Splitters / Green Outlets			Stantec (JT)
high								Source Controls (Non Structural BMPs)			X
?					O			Runoff Volume Minimization			O
?	O							Manage Potential Stormwater Hotspots			
?	O							Roof Runoff Protection			
?	O							Runoff Quality Protection			O

Joint Effort – LID Working Group

Products of the LID Working Group

*Revised Pima
County
Detention/
Retention
Manual*

*Neighborhood
Scale Water
Harvesting
Manual*

***Case
Studies
Catalogue***

Case Studies Catalogue

Tucson Water: East Side Service Center

City of Tucson Water Eastside Satellite Center

Tucson, Arizona



SOUTH ENTRY VIEW

- * RAIN WATER COLLECTION
- * SHADE TRELLIS
- * DESERT OASIS
- * RECYCLED STEEL COMPONENTS



SUSTAINABLE DESIGN ELEMENTS

Daylighting: offsets 10.57% energy usage

Siting: maximizes natural lighting, minimize solar heat gain

Rainwater Harvesting: via rooftop gutters to cisterns

Xeriscaping: eliminates need for potable water for irrigation

Heat-Island Reduction: solar reflective roofing

Energy Cost/Square Foot: \$0.99

Building/Space Type: Office, Operations and Warehouse

Total Square Footage of Building: 20,041

KEY RESULTS

Energy Use Intensity (EUI) = 128 kBtu/sf/yr

Percent CO₂ Reduction = 29%

ENERGY STAR Design Rating = 76

Energy Savings = 1,049,172 kBtu

CO₂ Savings = 55 metric tons CO₂/yr



INTERIOR VIEW

- * NATURAL LIGHT TO ALL OFFICES, INCLUDING SKY LIGHTS
- * VIEWS TO OUTSIDE
- * EXPOSED STRUCTURE
- * VISIBLE MECHANICAL SYSTEMS



NORTH WINDOW WALL

- * SHADE FINNS
- * NO WEST FACING GLASS
- * WATER EFFICIENT LANDSCAPING
- * GLASS WALL FOR DIFFUSE NORTH LIGHT

Case Studies Catalogue

20-30 Park (Highland Vista Park):

Collector street – residential land use

Native vegetation irrigated with harvested stormwater,
reduced ponding and associated mosquito problems



Case Studies

Scott Avenue: Collector street - commercial land uses



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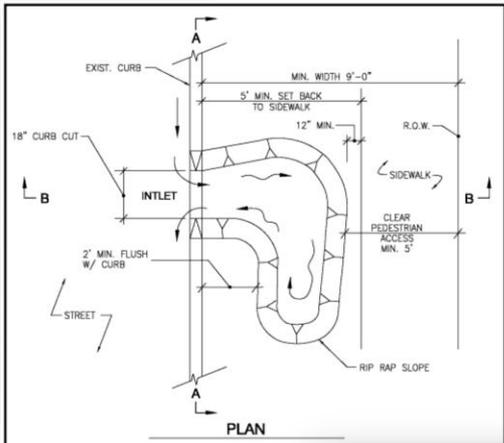
City of Tucson

Ordinanced: Commercial Rainwater Harvesting



City of Tucson

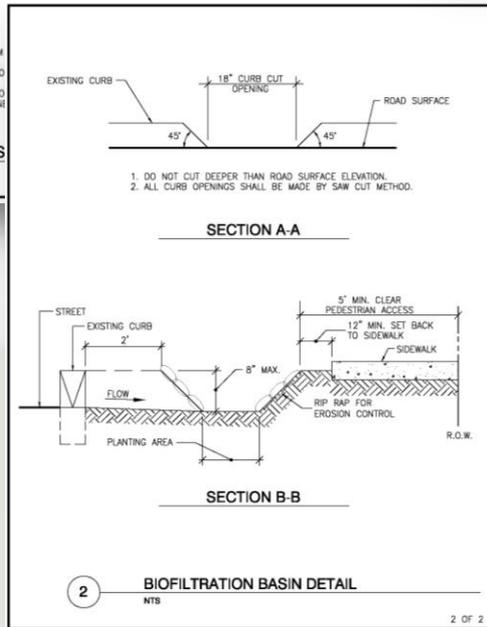
Approved: Curb cut standards



- NOTES:
1. CURB CUTS MUST HAVE A MINIMUM
 2. CURB CUTS MUST BE A MINIMUM 0
 3. CURB CUTS MUST BE A MINIMUM 0 A MINIMUM OF 50' BACK OF CORN

1

BIOFILTRATION BASIN
NTS



Initiatives of Tucson Water



- Demonstration Projects (13)
- Residential Water Harvesting Rebate Program
 - Required Training
 - Two Levels
 - Implement training concepts.
 - Prepare design to capture 1" rainfall.



Initiatives of Oro Valley

- Rainwater Harvesting Ordinance
- Stormwater Utility



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Summary

Motivation for G/LID:

- Reduce need for additional groundwater pumping by providing non-potable water source for street landscaping
- Alternative management strategy for residential street stormwater runoff
- Use LID practices to mitigate flooding
- Promote small urban waters restorationMitigate Urban Heat Island

Existing Req'ments:

- The City of Tucson and Pima County have 4 years to determine if how to implement LID.
- Water Harvesting Ordinance requires commercial sites to supply 50% of irrigation need (Tucson).
- Required to consider water harvesting for comprehensive plan ammendments (Pima County).

Next Steps:

- Finalize new Detention/Retention Manual (Pima County).
- Develop City-County Neighborhood Scale Water Harvesting Manual
- Compile Case Studies Catalog

Acknowledgements

- **Dave Stewart** (RFCD) developed the water harvesting credit methodology.
- **Ann Moynihan** and **Patricia Gilbert** (RFCD) led the effort to update the Detention/Retention Manual.
- **City of Tucson Water Harvesting Technical Advisory Committee** assisting to create methodology for Development Standards submittals

Resources

City-County Water Study White Paper on Stormwater

<http://www.tucsonpimawaterstudy.com/Reports/Phase2/Stormwater.Mgt.Tech.Paper.pdf>

City of Tucson Water Harvesting Ordinance

<http://www.tucsonaz.gov/ocsd/sustainability/water/rainwaterharvesting.php>

LID Working Group Website

<http://rfcd.pima.gov/pdd/lid/workinggroup.htm>

AridLID

<http://www.aridlid.org/>



Questions



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Irene Ogata: irene.ogata@tucsonaz.gov

Next Steps: CITY-COUNTY WATER-WASTEWATER INFRASTRUCTURE & PLANNING STUDY

March 21,
2011 LID
Workshop

Initiate a
Dialogue
Among
Experienced
Professionals
in a
Workshop
Setting

Form LID
Working
Group of
Interested
Professionals

Provide
Input to
the
Planning
of 2012
Regional
LID
Conference

Identify
Motivation
for LID /
GI in
Southwest

Identify
Need for
Research/
Design LID
Vision for
Southwest

Consider
Educational
Venues
and
Target
Audience

ctiveness

Milagro



Minimized Site Grading
Reduced Landscaping Cost
Reduced Site Paving
Reduced Drainage Infrastructure

saves
opers,
ties

•in the vast majority
savings ranged from 15
methods were used (EP

• Developers expect eco
increasing the number
costs on stormwater in
2009).



Reduced Paving
Better Stormwater Management
Reduced Landscape Watering