Stormwater Capture and Recharge to Enhance Riparian Habitat

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Stormwater Capture and Recharge

- Highly disturbed watersheds
- Stormwater capture/detention:
  - Reduce flooding/peak flows
  - Increase groundwater recharge
  - Support riparian habitat (via groundwater storage)
  - Sediment reduction/improve water quality
- Design issues/questions:
  - Scale
  - Hydrogeology
  - Design parameters and longevity?

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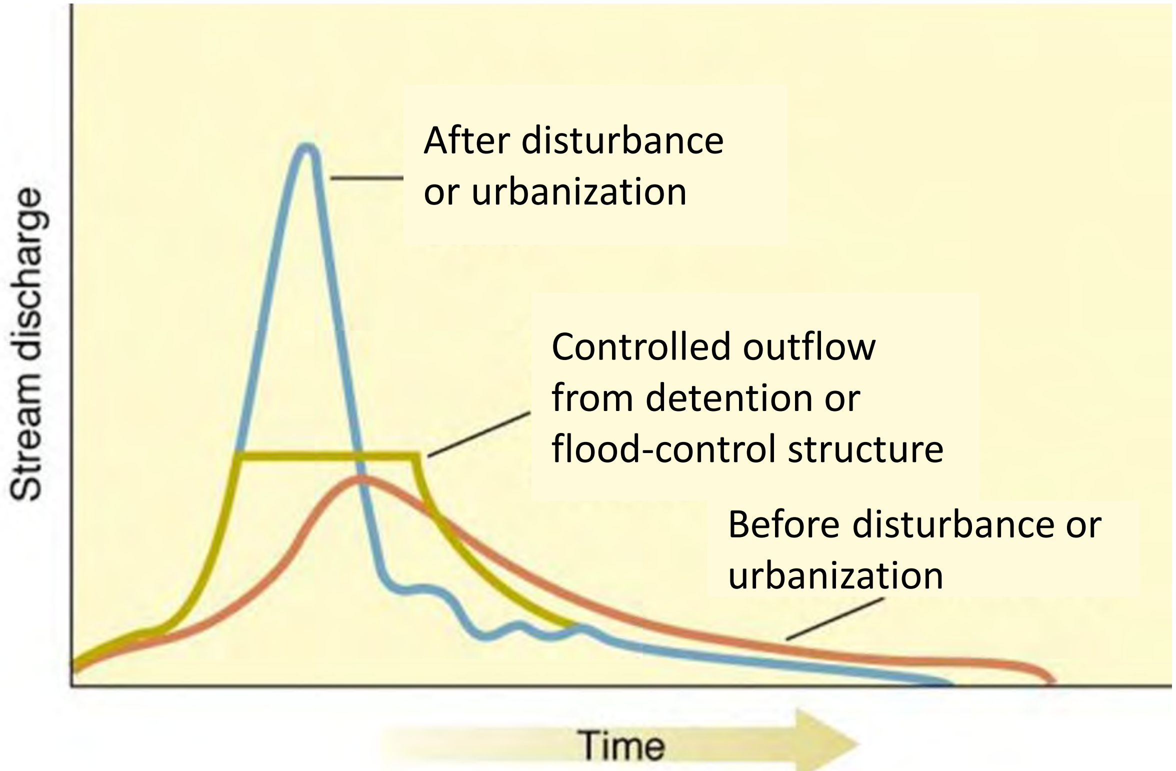
Stream Flow Disturbance



http://d32ogoqmya1dw8.cloudfront.net/images/introgeo/socratic/examples/Hydrograph.jpg

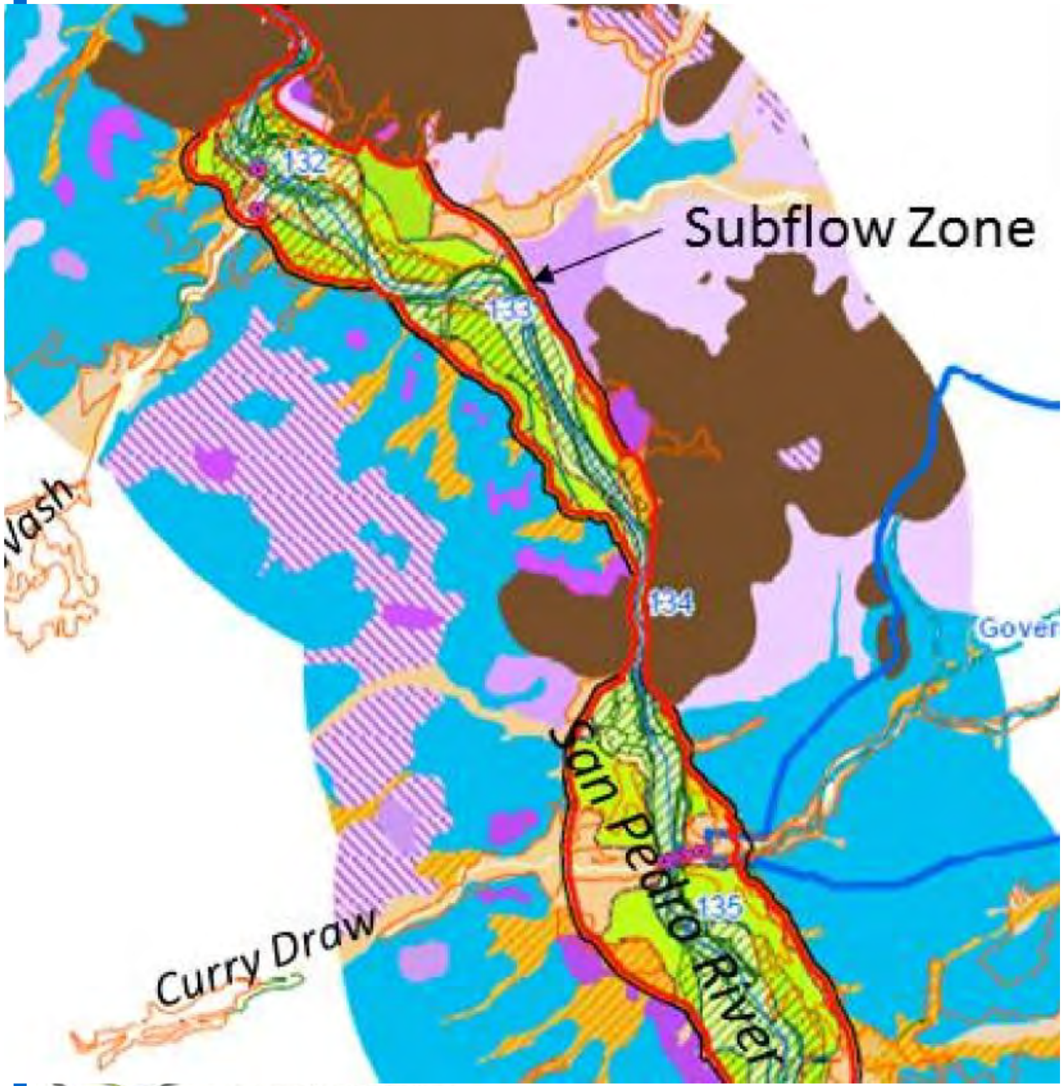
- Changes in upstream watershed characteristics
- Channel degradation
- Reduced groundwater availability/quality

Watershed Scale Characteristics

Figure 1 – Percent of Total Rainfall Available as Harve

From City of Tucson and Pima County Stormwater Harvesting Technic
Infrastructure, Supply and Planning Study Phase II

Hydrogeologic Conditions



- Not all locations are created equal
  - Infiltration rates/ permeability/lithology
  - Depth to groundwater /gradients
  - Distance from riparian area

Case Study - San Pedro River

- Groundwater mining affecting flows in the San Pedro River
- Interagency/public/private partnership to protect river
- CONCEPT: Flood control basins to capture stormwater and recharge groundwater by river
  - Groundwater modeling to identify best places to help base flow
  - Surface water modeling to estimate surface water flow and urban enhanced runoff
  - GIS screening and field investigations
  - Detention/recharge basin(s) design
- Pilot project at flood control basin designed to protect school

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ARIZON
Flagstaff
I40
I17
I10
Phoenix
Arizona
Tucson
I19
8

Surface Water Modeling

- How much stormwater runoff, how much UER?
- AGWA/KINEROS
  - Highly detailed watershed model
  - Model individual events from 57 year precipitation record
  - Use of regression relationships for other watersheds
- Model runs to predict stormwater runoff and infiltration:
  - pre-urbanized vs urbanized conditions,
  - w/ and w/o detention basins
  - high and low permeability basins

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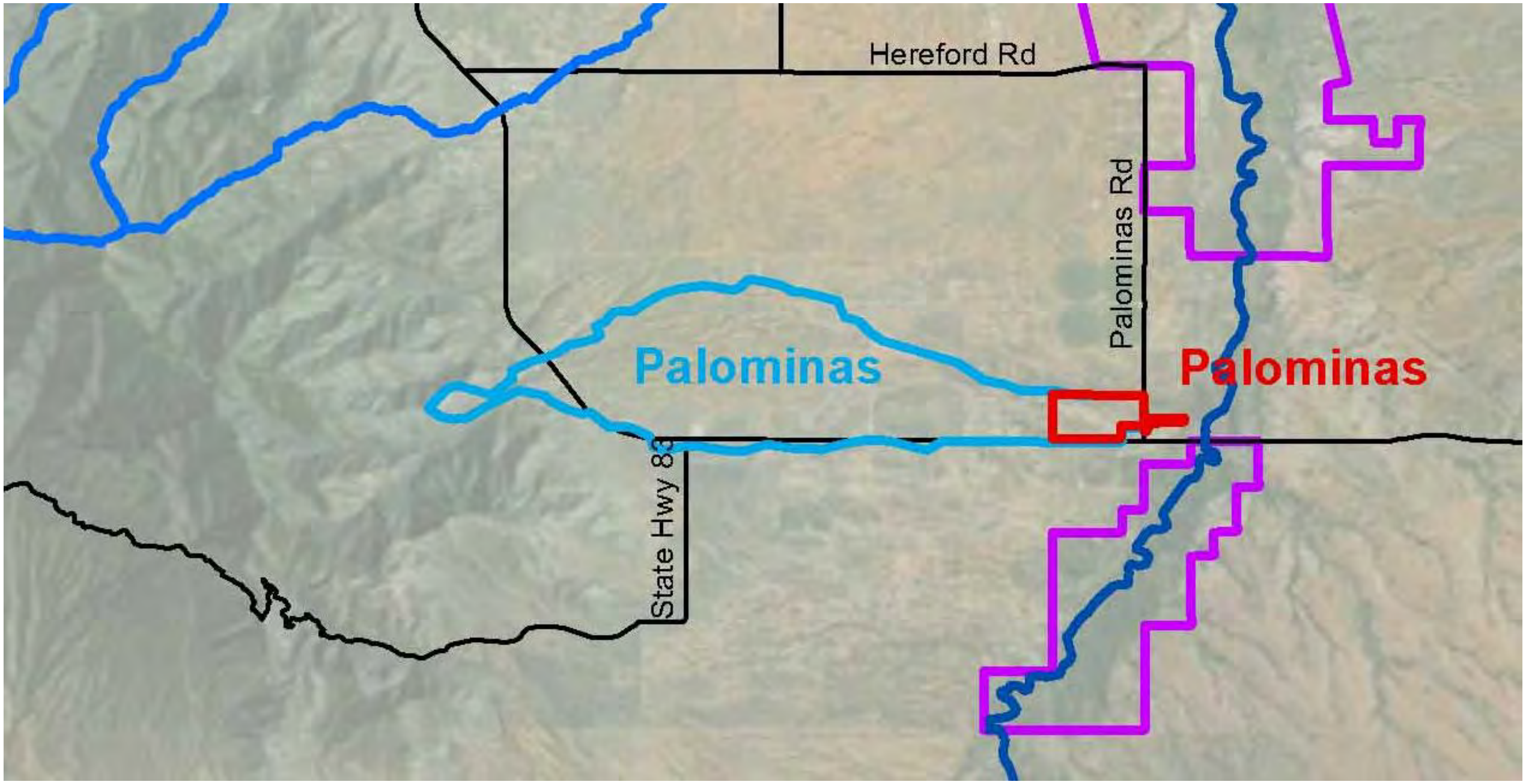
Palominas Watershed



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- 4820 acres (≈ 7.5 sq miles)
- 8% impervious surface

Predicted Runoff and Infiltration – Palominas Wash

Percent Impervious Surface Area	Average Annual Precipitation		Average Annual Runoff into Channels	Average Annual Channel Infiltration	Average Annual Channel Recharge[1]	Average Annual Inflow to Basin
Percent	**cm**	**in**	**acre-feet**	**acre-feet**	**acre-feet**	**acre-feet**
0.00%	37.34	14.70	294	90.7	35.4	203
8.00%	37.34	14.70	530	178	69.6	351

Predicted UER = 148 afa

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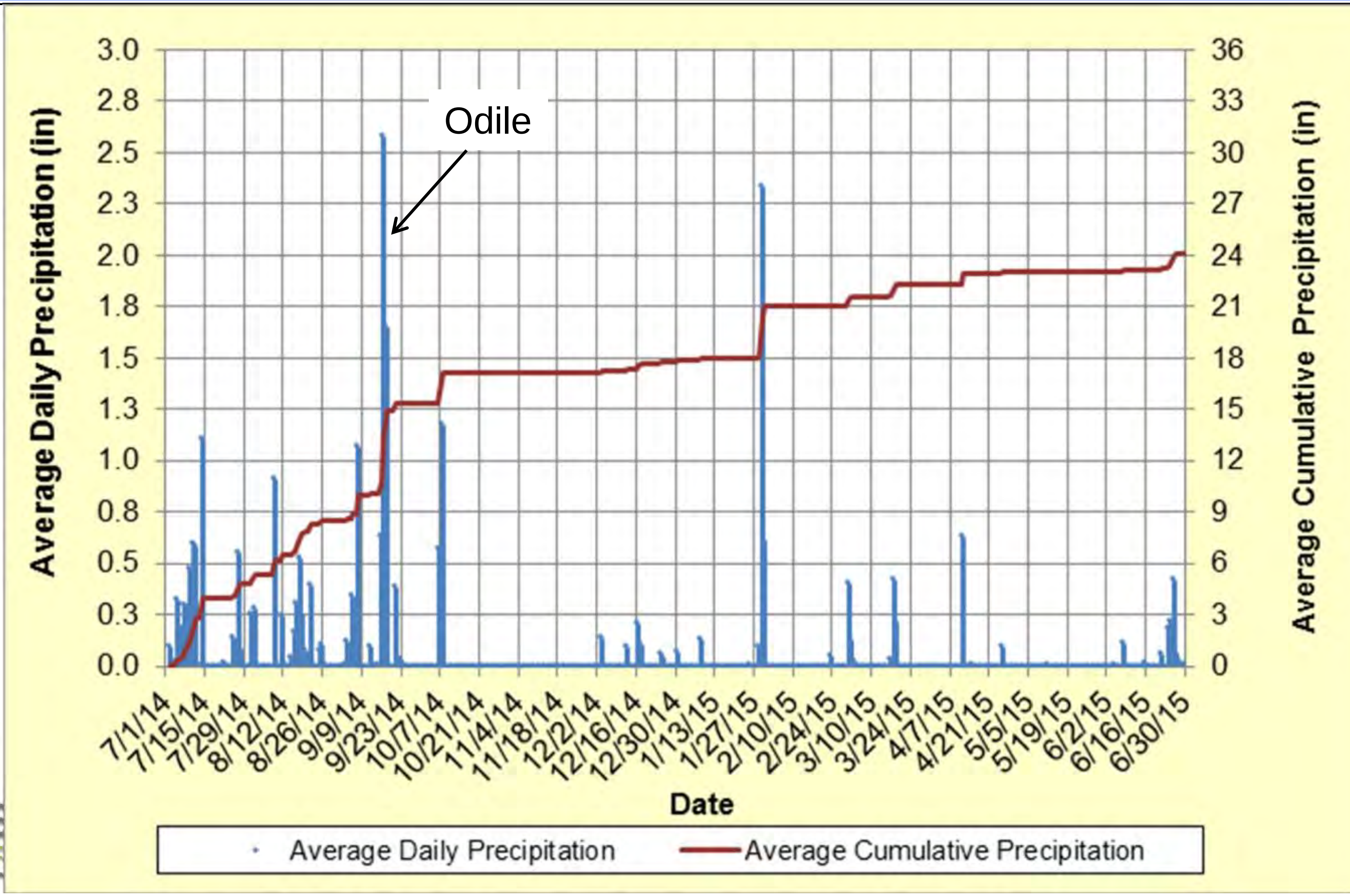
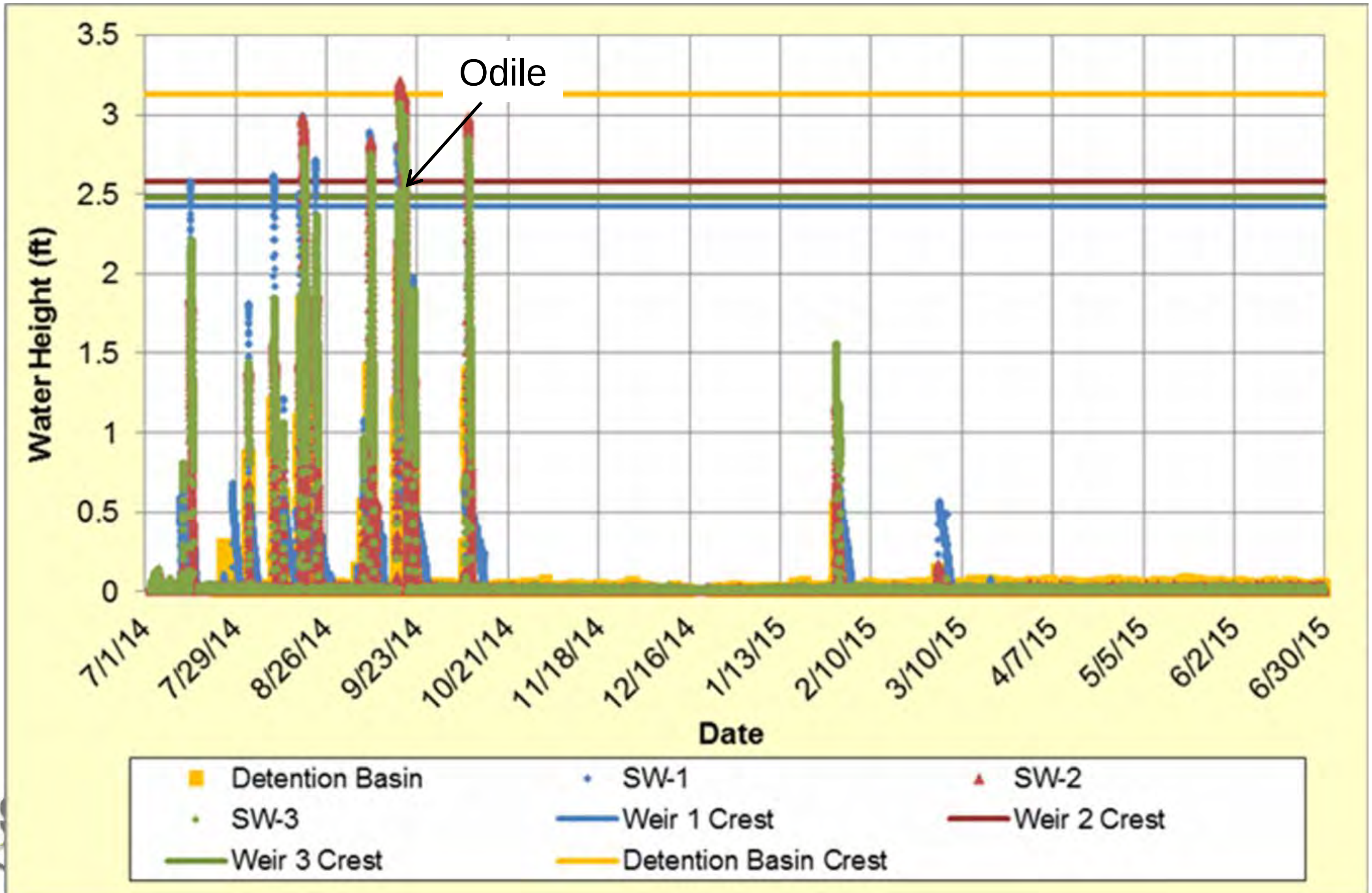
Palominas Detention/Recharge Basin Design

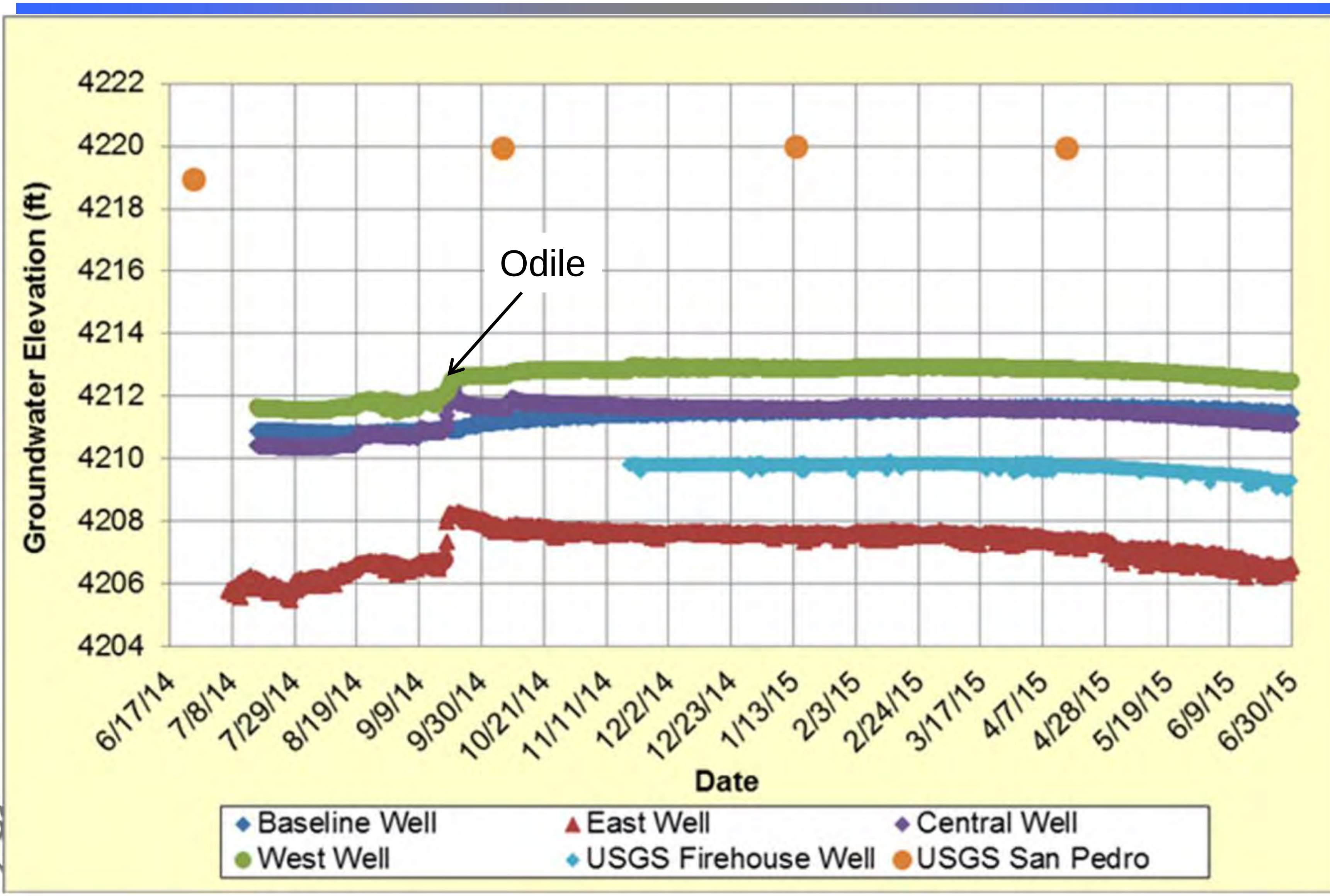
Average Precipitation (7/23/14 – 6/30/15)



Basins 1-3 Water Depth (7/23/14 – 6/30/15)



Depth to Groundwater (7/23/14 – 6/30/15)



Palominas Recharge Facility Works! But…..

- Odile stormwater runoff:
  - Models predicted about 270 acre-feet of runoff
  - Palominas (San Pedro River) USGS gauge:
    - Contributing watershed 100X Palominas watershed
    - Approximately 35,000 acre-feet
  - So, flow should have been 270 to 350 acre-feet
- Monitoring data indicated 13 acre-feet (5% of predictions)
- Where did the runoff go??!!!
  - Watershed surface conditions
  - High permability areas
  - Low intensity precipitation, Only one year of data

What we know and what we don't

- Small is good….
  - High capture efficiency – more is better
  - Generally limited to upper parts of watershed
  - Shallow groundwater conditions facilitate riparian recovery
  - Enhances vegetation and likely increases mountain front recharge
- Larger watershed capture and recharge facilities
  - How big to design? - need modeling AND monitoring
  - Need to find appropriate hydrogeology
  - Design for sediment control
  - Need to monitor – BEFORE and AFTER

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- Mike@gsanalysis.com

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