Stormwater Infiltration using Dry Wells as a Low Impact Development (LID) Tool

Presented by:
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Today’s Discussion

• Background
  – California’s water situation
  – Groundwater recharge (hydrologic cycle)
  – Effects of urbanization
  – Stormwater as a resource

• Use of Dry Wells as a Low Impact Development Tool
  – What is Low Impact Development?
  – What are dry wells?

• Elk Grove Dry Well Projects
  – State funded projects
  – Other projects
Background

• California is in a severe drought
• Legislation is calling for:
  – Water reuse
  – Treating stormwater as a resource
  – Strengthen groundwater management
• A solution may be the use of dry wells for these challenges
Groundwater recharge is a hydrologic process where water moves downward from the surface water to groundwater.

Surface water and groundwater have always been interconnected!

Naturally occurring process and is the primary input to the aquifer.
Effects of Urbanization

• Decrease in the infiltration of rain water due to hardscapes such as building and roads

• This alteration in the natural flow patterns is called hydromodification
  – Impacts aquatic ecosystem
  – Increased flood risk
Effects of Urbanization

Typical cycle in an undeveloped area.

- 40% evapotranspiration
- 25% shallow infiltration
- 25% deep infiltration
- 10% runoff

Typical cycle in an developed area.

- 30% evapotranspiration
- 55% runoff
- 10% shallow infiltration
- 5% deep infiltration

5-fold increase in urban runoff in a developed area.
Groundwater Supplies Depleting in Central Valley in Northern California

- Sinking Land
- 50 million acre feet groundwater lost

Source: Sacramento Bee, April 2014
One Solution is to Treat Stormwater as a Resource

- Improve water quality
- Reduce urban runoff
- Provide groundwater argumentation
- Reduce localized flooding
- Provide habitat enhancement and protects aquatic resources
- Aesthetically pleasing

“Greener approach…return to natural hydrologic regime.”

Dry Wells as a Low Impact Development Tool
What is Low Impact Development?

Innovative stormwater management approach
• Mimics natural hydrology
• Manage stormwater at the source
• Captures, stores, cleanses and slowly releases stormwater (reducing peak flows)
• Water quality treatment through filtration
• Recharges stormwater to groundwater
• Treats small to medium storm events
• Mitigate flooding, erosion and reduction in sedimentation
Example of Low Impact Development

Bioretention and grassy swale
Example of Low Impact Development

- Sandy Loam
- Water Storage
- Mulch Layer
- Native Plants & Grasses
- Drainage Flows
- Native Soil

Rain gardens
What are Dry Wells?

- Promote infiltration of stormwater runoff to recharge groundwater
- Can infiltrate stormwater through clay soils
- Use in conjunction with Low Impact Development practices
How does it Work?

• Receives water from one or more entry points
• Collect, store and disburse water
• Discharges water through small openings
• Bottom of dry well is placed at permeable soils
Example Grassy Swale and Dry Well

Bioretention and grassy swales
Challenges

• Competing regulations:
  – Water Code 13710: guidelines to prevent surface water entering water well (DWR Bulletin 74-81/90)
  – State Water Board promotes stormwater infiltration and dry wells are an important tool in the Low Impact Development tool kit

• Perception that dry wells contribute to groundwater contamination
Elk Grove Dry Well Projects
City of Elk Grove, California
Project 1: Dry Wells as Low Impact Development
Background

- State funded Stormwater Grant Program
- Total project budget $825,000
- Received grant funding amount $489,820
- In-kind services $335,180
Project Purpose

Evaluate the potential for using dry wells, in combination with low impact development practices to:

• Infiltrate stormwater runoff
• Alleviate localized flooding
• Recharge groundwater

…without negatively impacting quality of groundwater.
Project Team

WILLDAN | extending your reach

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CITY OF ELK GROVE
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Hydrology | Hydraulics | Geomorphology | Design | Field Services
Phase 1:
Site Selection, Design and Construction
2012 - 2014
Project Site Locations

Site 1: Residential Site (Strawberry Creek Detention Basin)

Site 2: Industrial Site/Parking Lot (City of Elk Grove Corp Yard)
Project Site Schematic

Shallow groundwater well: 55 feet
Deep groundwater wells: 110 feet
Monitoring Well Network
Dry Well Design
Phase 2: Field Study
Begins Fall, 2014
Field Study

- Collect and sample stormwater and groundwater for 2 years
  - 3 wet weather stormwater samples
  - 3 wet and 1 dry weather groundwater samples
Stormwater Water Sampling

Water collected prior to entering the dry well

Water collected at beginning of vegetated pre-treatment
Water Quality Chemistry

- Constituents to be tested in stormwater and groundwater
  - General physical & chemical
  - Metals (EPA 200)
  - Volatiles (EPA 8260)
  - Semi-volatiles (EPA 625)
  - Herbicides (EPA 515)
  - Pyrethroids (WPCL, DFW method)
  - TPH (EPA 8015)
  - Pyrogenic PAHs (EPA 8310)
  - Total coliform
Estimate Recharge and Infiltration Capacities

Velocity sensor to monitor flow

Pressure transducer to estimate the volume of flow
Phase 3:
Fate and Transport Modeling
2014 - 2015

Logging boring soil samples at well sites
Phase 4: Education and Outreach

Literature Review
Factsheets
Reports
Website
Questions that will be Addressed

• Primary question:
  – Are contaminants introduced into groundwater through dry wells?

• Secondary questions:
  – How effective is pre-treatment at removing contaminants and sediment from stormwater?
  – What is groundwater recharge potential?
  – What are maintenance requirements?
Project 2: Sleepy Hollow Detention Basin Retrofit
Background

- State funded Implementation Grant
- Total project budget $850,000
- Received grant funding amount $240,000
- In-kind services $610,000
Retrofit an existing detention basin for multifunctional purposes to:

- Infiltrate stormwater runoff
- Alleviate localized flooding
- Recharge groundwater
- Improve water quality
- Provide habitat enhancement/riparian zones
Sleepy Hollow Detention Basin

Footprint of Existing Detention Basin

Dry Wells (location to be determined)

New Low Flow Channel

New Habitat Islands/Riparian Zones

New Trails

New Seasonal Wetlands/Water Quality Treatment Zones

Existing Creek Channel and Basin Outfall

Existing Flood Control Weir
Other Elk Grove Dry Well Projects
Dry Wells Rural Roadway

- Alternative to typical storm drain system
- Localized flood control
- Less expensive
- Groundwater recharge potential
Elk Grove Rain Garden Plaza

- Largest rain garden in California
- Educates sustainable stormwater practices
- Demonstrates Low Impact Development techniques

“9 State and Regional Awards”

http://www.elkgrovecity.org/rain-garden/
Conclusion

• Sustainable Water Resource Management
  – Multiple purposes and beneficial uses
• Incorporate into any project
• Maintain groundwater quality
• Proposition 84 Projects
  – Provide scientific data to help local and State agency on the beneficial uses of dry wells as a Low Impact Development tool
Contacts

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Questions?
Thank you