

RETAINING RUNOFF AT ITS SOURCE

Atlantic Beach Case Study



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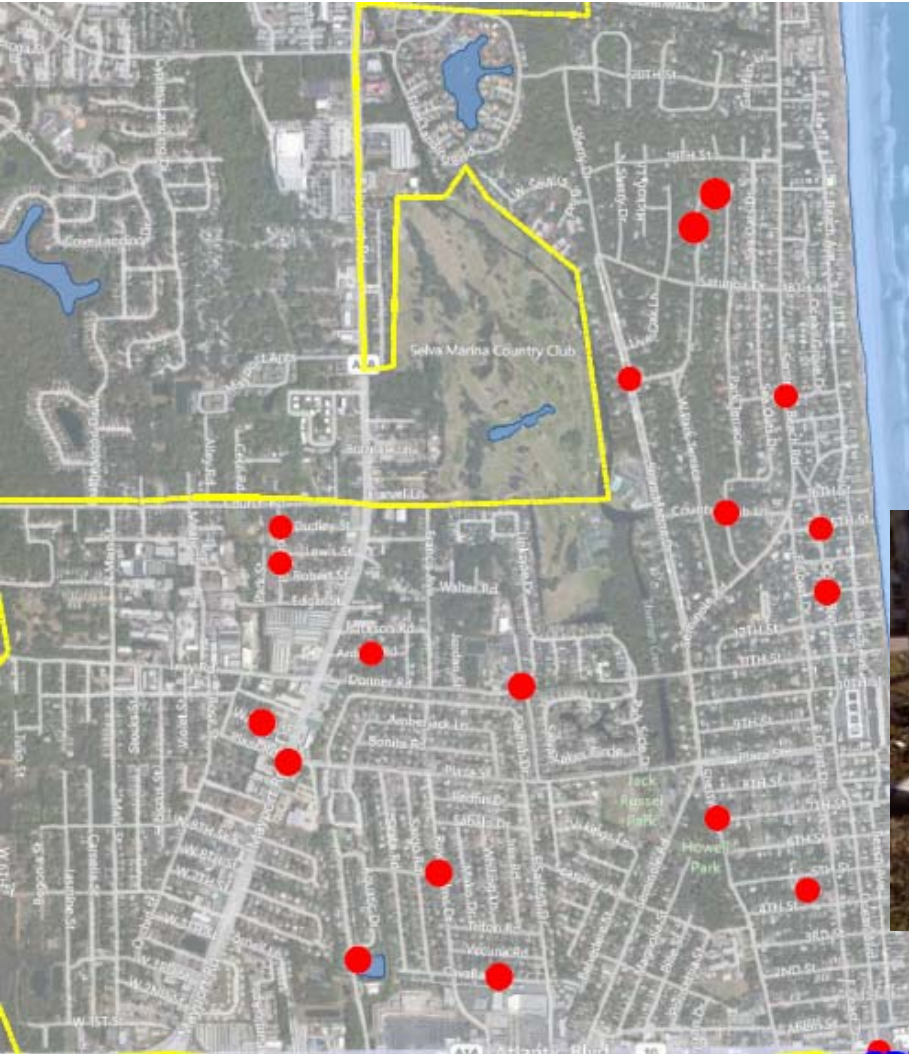
Jacksonville Environmental
Symposium

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Outline

- Overview of stormwater issues in Atlantic Beach, FL
- City's ordinance limits for urban development
- Test case evaluation to confirm cost effectiveness of current practice

Capital Improvement Projects Completed Since 1999



CORE CITY PROJECT - 2001



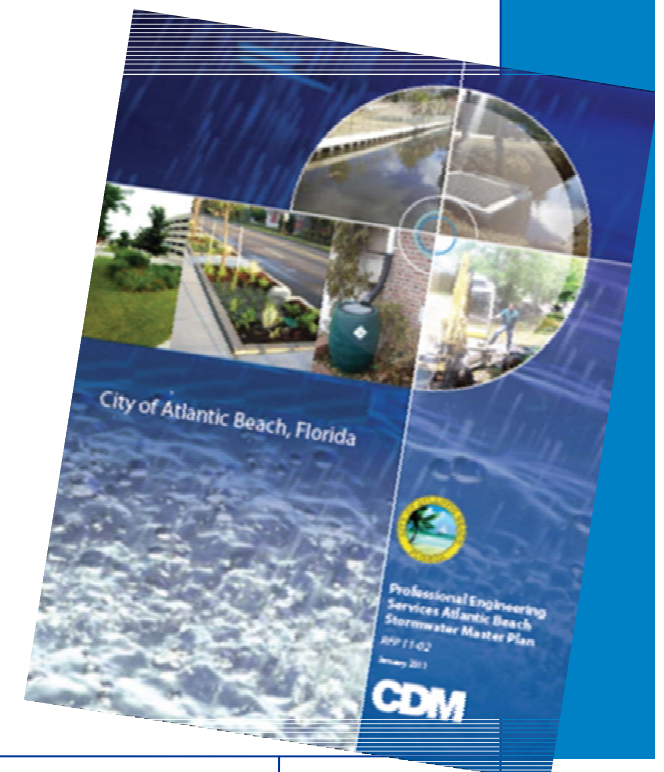
SEMINOLE ROAD DITCH
OCEAN/14TH STREET 2007



HOPKINS CREEK RSF
- 2008

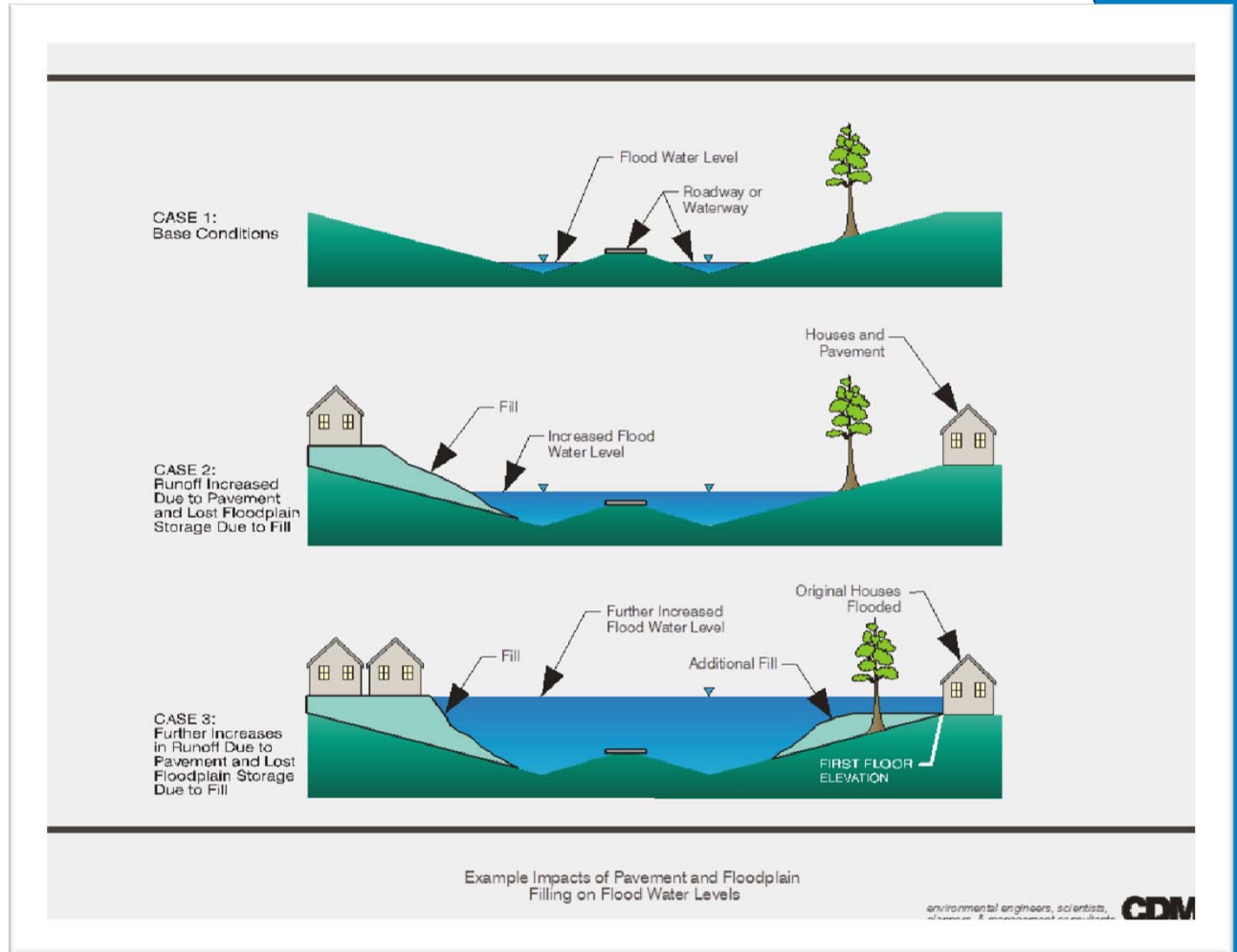
The City of Atlantic Beach has reduced flooding conditions in the past years

1. Major flooding problem areas were identified in 2002
2. City implemented a series of capital improvement projects
3. City established limits on impervious area on parcels
4. In 2012 the City developed an updated list of capital improvement projects, and reviewed the effectiveness of its stormwater ordinance



Flooding Will Increase Without Onsite Stormwater Controls

- City Streets
- Adjacent properties
- Downstream systems
- Water quality Impacts
- Reduced recharge



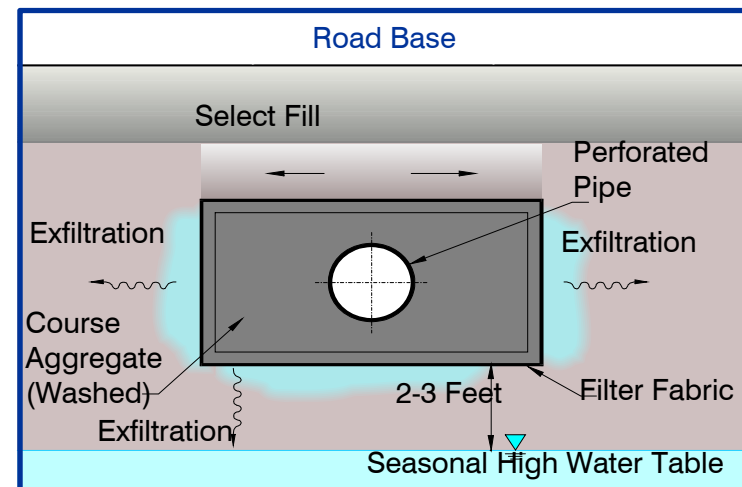
City's ordinance promotes low impact development



- Application of Low Impact Development concepts to redevelopment by more than 10% or 400 sq-ft of impervious area
- No net loss of onsite surface storage (to avoid displacing historic onsite stormwater onto adjacent parcels and to maintain existing aquifer recharge)
- No increase in runoff volume for the 25 year 24 hour design storm (to avoid increases in runoff volume, flooding and pollution to offsite while maintaining aquifer recharge)

The 2012 master plan update included an evaluation of onsite stormwater control practices

- Test area
- Evaluation for existing and potential redevelopment conditions
 - Impervious area,
 - Groundwater table
- Considered four LID BMPs
 - Swales/retention
 - Rain gardens/bioretention
 - Exfiltration trench
 - Underground storage



Test Area Evaluated

- 81 Parcels
- Total Area: 17.7 Acres
- Existing parcels impervious
Range: 0-78%
- Composite : 32% impervious

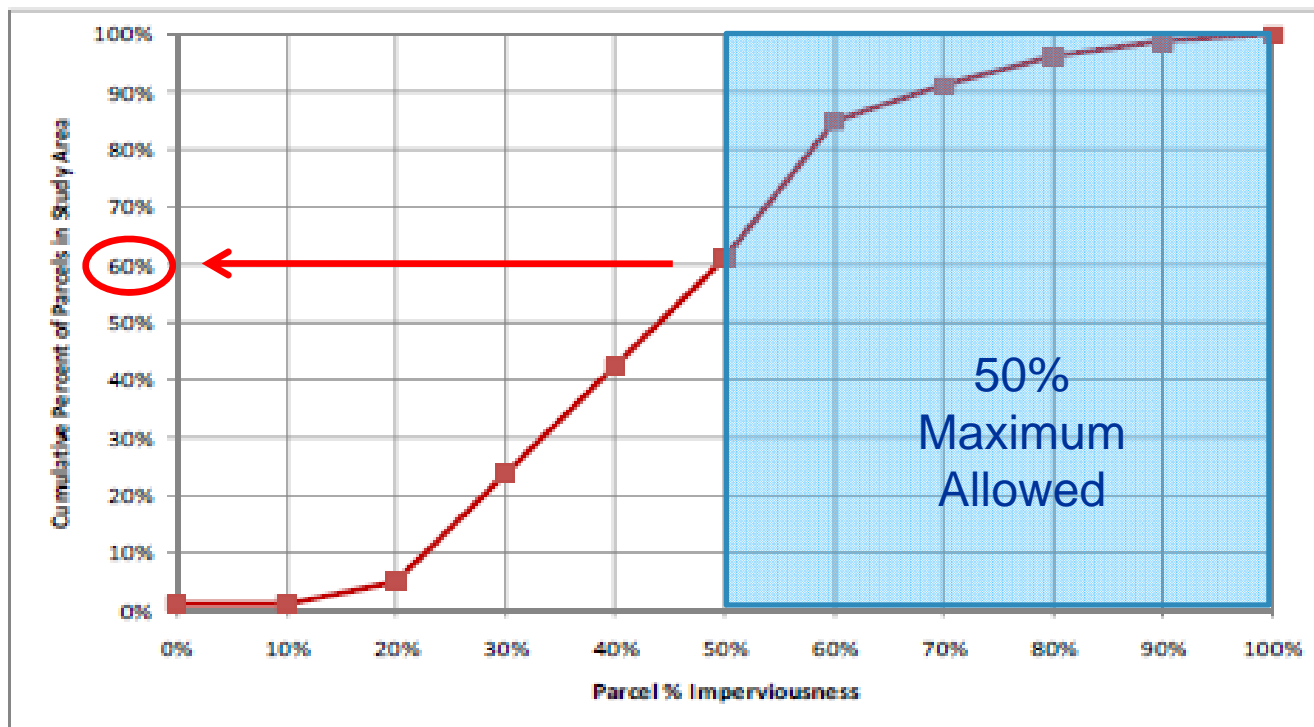


Residents are commonly interested in upgrading existing structures, or developing available parcels



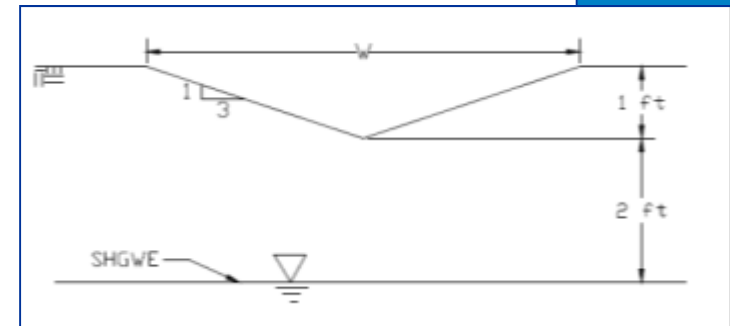
49 parcels could increase their impervious cover in the test area

- 60 % of the parcels can increase their impervious area to the maximum allowed (50%)



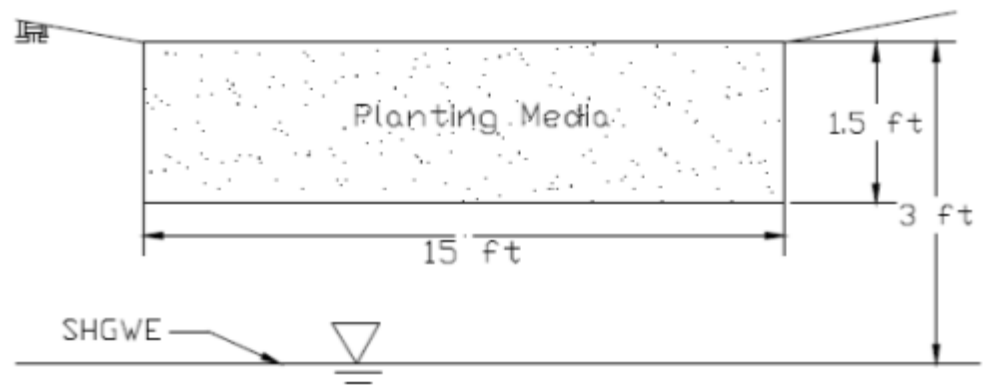
Swales and Retention

- Can be a traditional swale
- Can be a shallow retention area for grassed yard areas to allow dual use
- Should not be deeper than 1 ft above seasonal high groundwater table
- Should be maintainable by homeowner



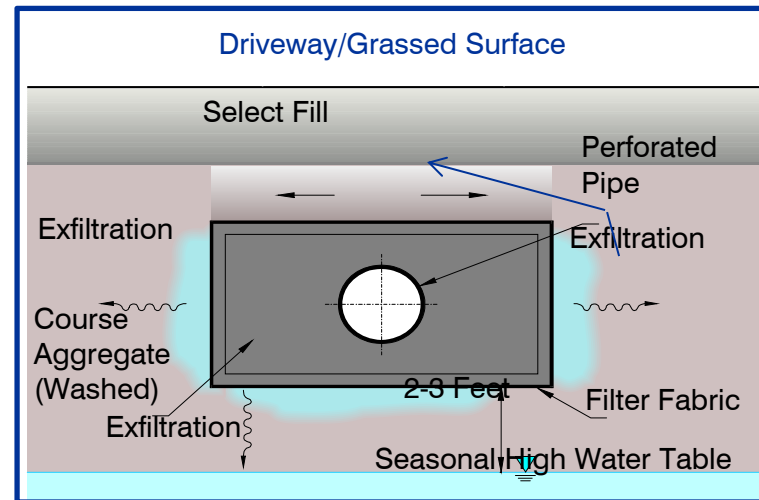
Bioretention (Rain Gardens)

- Special form of a swale or retention
- Added aesthetic factor with plants/flowers
- Must retain the required volume below the overflow elevation.



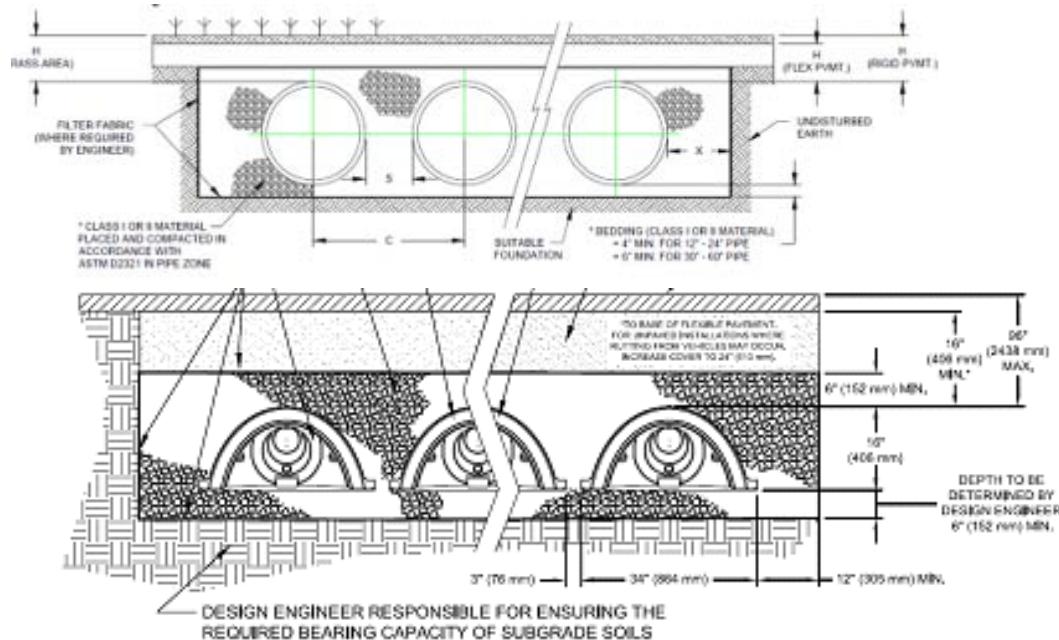
Exfiltration Trenches

- Underground option
- Can go under pavement or grassed areas
- Filter wrap around perforated pipe and trench

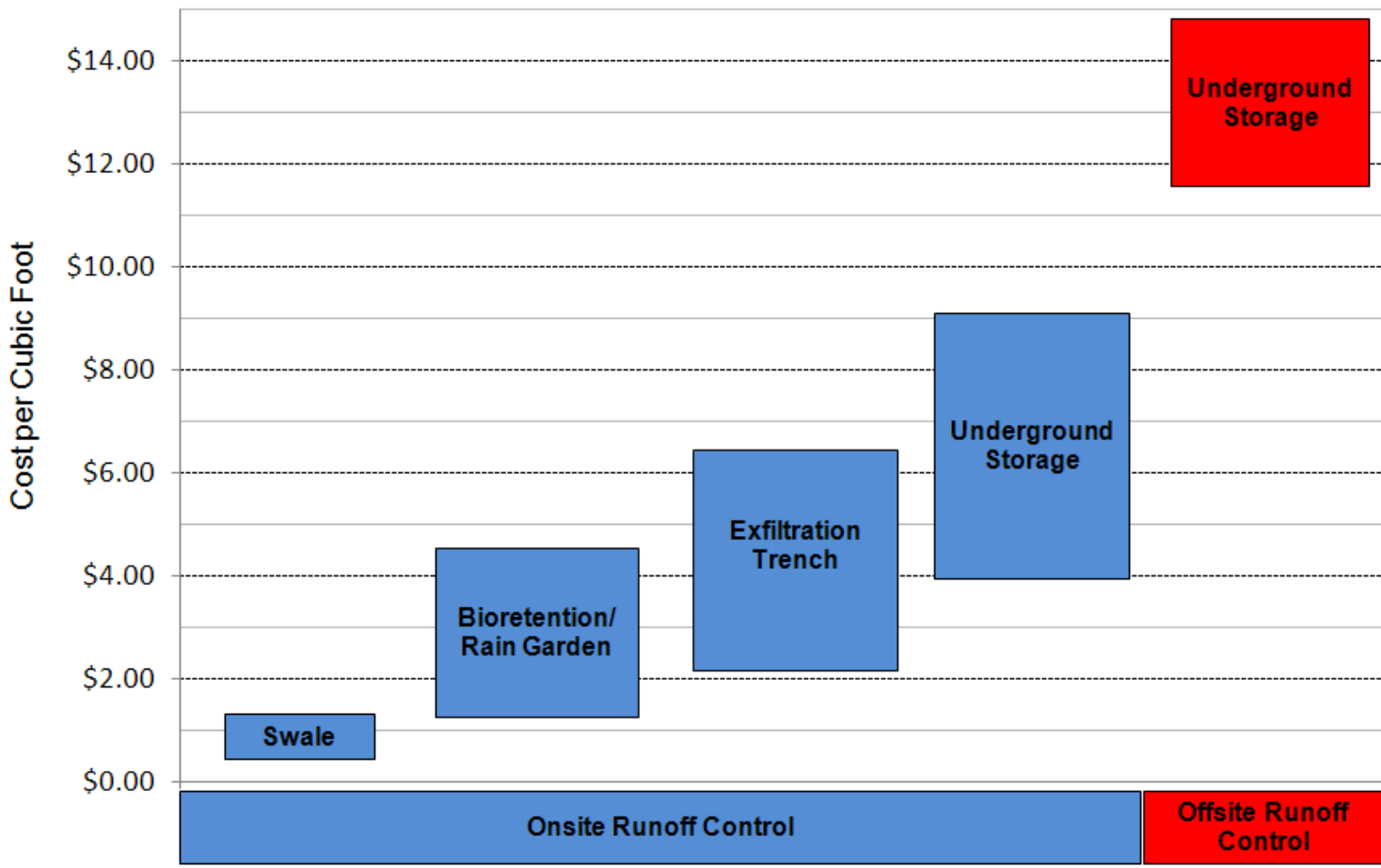


Underground Storage

- An alternative consists in excavating underground vaults/pipes that can provide runoff retention volume.
- Access required for maintenance.



Costs comparison for onsite versus offsite neighborhood-scale stormwater controls



Conceptual Cost to Meet the Current Ordinance

- Swales or yard retention are the most cost-effective controls and allow for dual use
- Based on all parcels applying the same BMP type

	Swale/ Retention	Bioretention	Exfiltration Trench	Underground Vault	Offsite Underground Vault
Test Area Total Cost	\$18,300	\$144,100	\$210,700	\$352,500	\$673,000
Ratio	36.8	4.7	3.2	1.9	1.0
Cost per Parcel	\$200	\$2,900	\$4,300	\$7,200	\$13,700
Cost/cu-ft	\$0.40	\$2.80	\$4.10	\$6.80	\$13.10

The City has available information for residents to guide their selection of the appropriate BMP

Evaluation of Low Impact Development Best Management Practices (BMPs)

UNDERGROUND STORAGE

SWALE

EXFILTRATION TRENCH

BIORETENTION

Exfiltration Example Application:

A residential lot proposes to add an increase of 20% impervious area on a 0.2 acre lot (existing a total of 20% impervious). The lot dimensions are 120 ft x 100 ft. The required size of the BMP to reduce the runoff volume needs to be calculated.

First, obtain the appropriate runoff coefficient for the proposed impervious area.

$$C = 0.6 \text{ for 20\% impervious area}$$

$$C = 0.2 \text{ for 20\% impervious area}$$

$$\Delta C = 0.4$$

Next, determine the required storage volume (reducing runoff from the increase in impervious area, since that is the required storage to be based on the 25 year rainfall volume of 0.3 inches).

$$V = Rainfall \times \Delta C \times Area$$

Where:

$$Rainfall = 0.3 \text{ inches} = 0.025 \text{ ft}$$

$$\Delta C = 0.4$$

$$Area = 0.2 \text{ acres} = 0.0277 \text{ acres}$$

$$V = 0.025 \text{ ft} \times 0.4 \times 0.0277 \text{ acres} = 0.000277 \text{ acre-ft}$$

Calculate the required exfiltration trench volume by setting the runoff volume (0.000277) in the following:

Storage volume of trench = Volume of Pipe (V₁) + Volume of Trench Aggregate (V₂)

$$V_1 = Area \text{ of Pipe } (A_1) \times \text{Length } (L)$$

$$A_1 = 16 \times 16 \text{ ft}^2$$

$$V_2 = Porosity \text{ of Aggregate } (P) \times \text{Area of Trench } (A_2) \times L$$

$$A_2 = \text{Depth } (D) \times \text{Width } (W)$$

For this design the City will only provide stormwater treatment volume credits for the trench depth from the top of the trench to 18 inches maximum high groundwater elevation.

Assuming an 18" x 18" pipe diameter of 18 inches (R), an available depth of a foot, and a width of 6 feet the exfiltration trench length is 12.8 feet for a 100% budget of 98 square feet.

Please note this example is simplified to only for sizing purposes and does not consider structural conditions. Soil characteristics on the property of interest should be investigated before installing this BMP, as exfiltration rates through the soil play a large role in these systems.

Additional calculations and examples are provided in the St. John's Water Management District Applicant's Handbook: Regulation of Stormwater Management Systems, Section 4.0.

Buffers can also provide privacy and aesthetic value along with their stormwater function



Summary

- Benefits of controlling runoff at its source:
 - Reduction of operation and maintenance, and
 - Reduction of complexity associated with underground storage, control structures, and piping
- CDM Smith evaluated a test area and confirmed that the most cost effective method to control runoff is at its source
- Cities interested in implementing low impact development practices and reducing operation and maintenance should consider onsite runoff retention.