Impacts of Restoration on Hydrology & Ecosystem Services:

Studies at Deer Grove East Forest Preserve

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FOREST PRESERVES of Cook County

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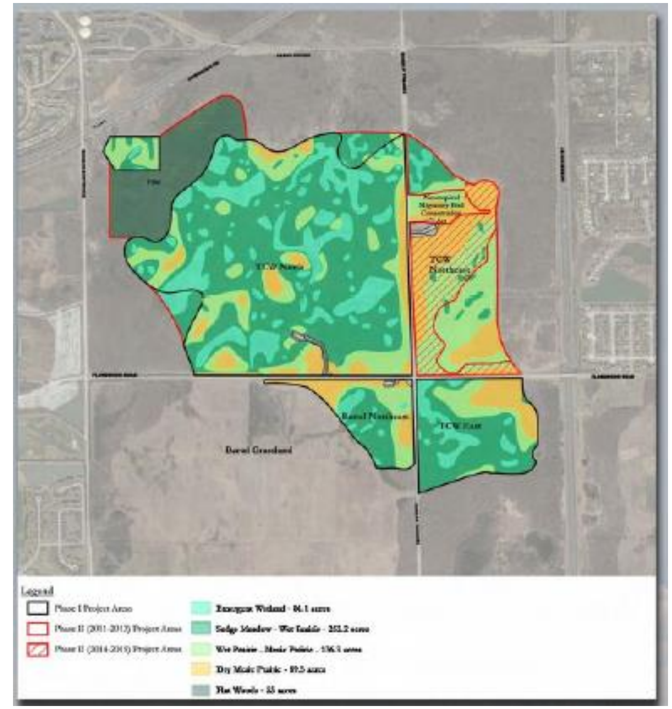
Question 1: How Does Restoration Impact Stormwater & Water Quality?

Question 2: What Value Does Restoration Have for the Local Economy?



Question 1: Two Sites – Deer Grove East and Tinley Creek

Question 2: One Site – Deer Grove East

Q1: How Does Restoration Impact Water?

- **Literature Review** of 100+ studies & peer review by public & private sector partners.
- **Data** from 50 shallow groundwater monitoring wells and a weather station over 5 years pre- and post-restoration.
- **Modeling** (SWMM) to fill any data gaps.

Model Selection

SWMM

- Can simulate drain tile hydraulics with aquifers
- Watershed-based
- Robust hydrologic and hydraulic simulation routines
- Scalable to large/complex watersheds
- Widely accepted
- Adequate user interface
- Recommended during peer outreach

Methodology

Modeling Restoration Changes (Factors Influencing Model Results)

- Drain tile hydraulics
- Land use changes
  - Depression storage modification
- Vegetation changes
  - Evapotranspiration
  - Root depth

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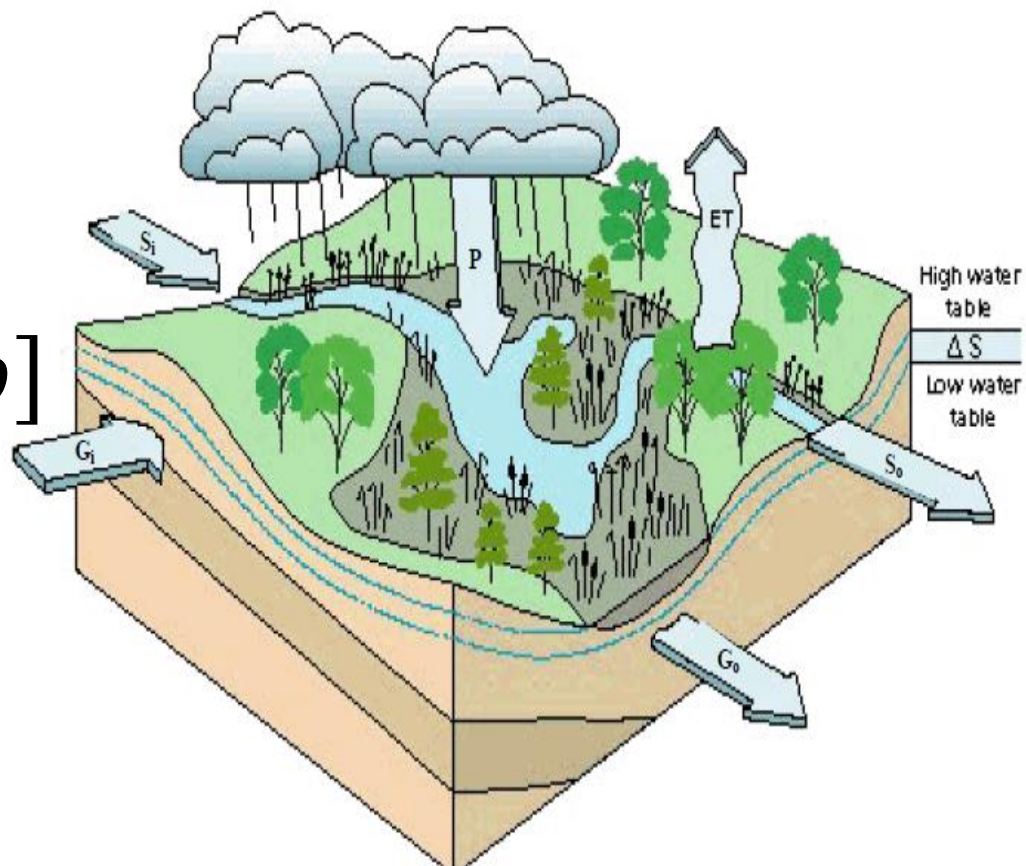
SWMM Methodology

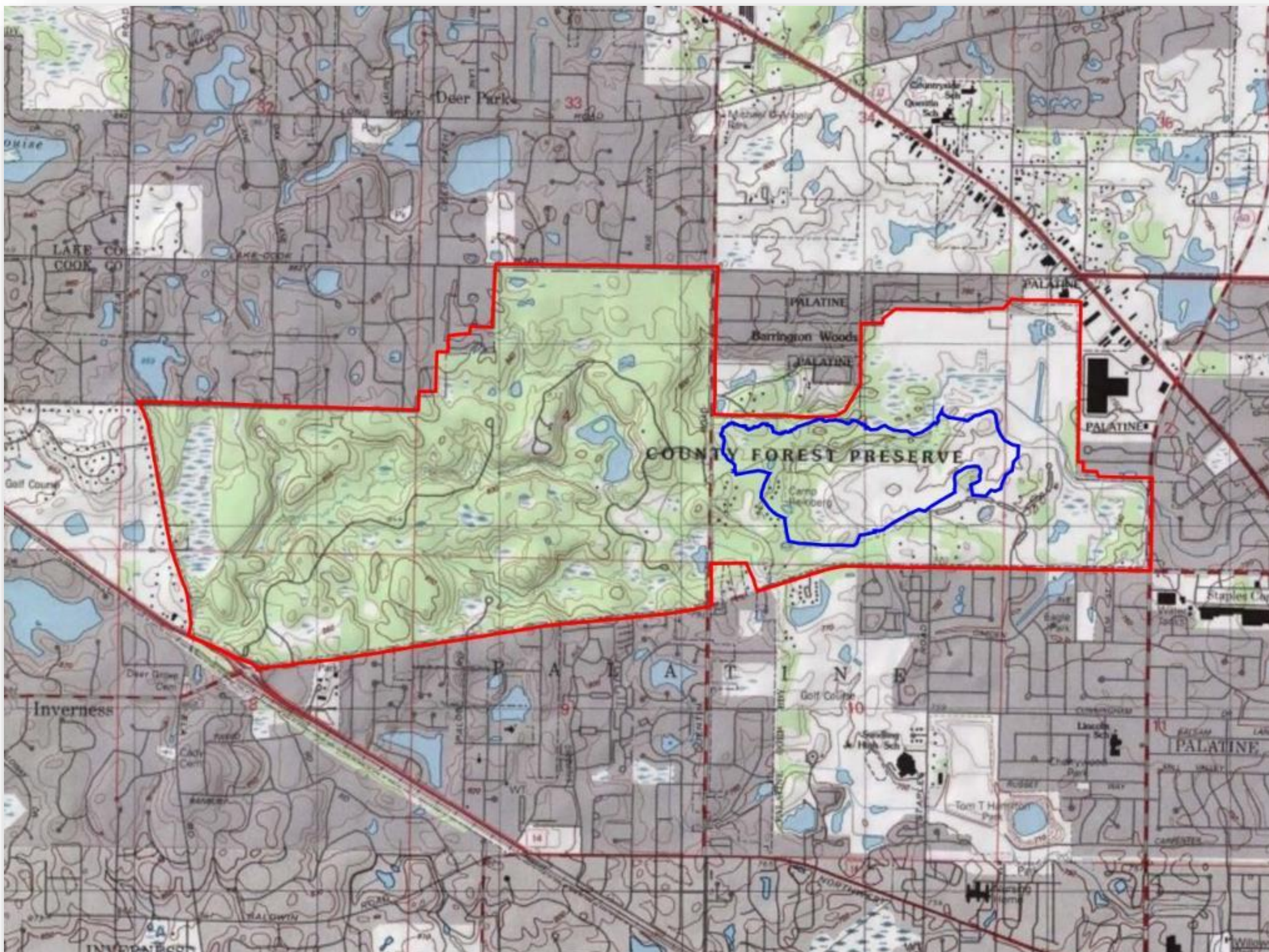
- Water budgets/mass balance
- Compare system storage pre- & post-restoration

$$\Delta S = [P + Si + Gi] - [ET + So + Go]$$



Simplified SWMM Equation

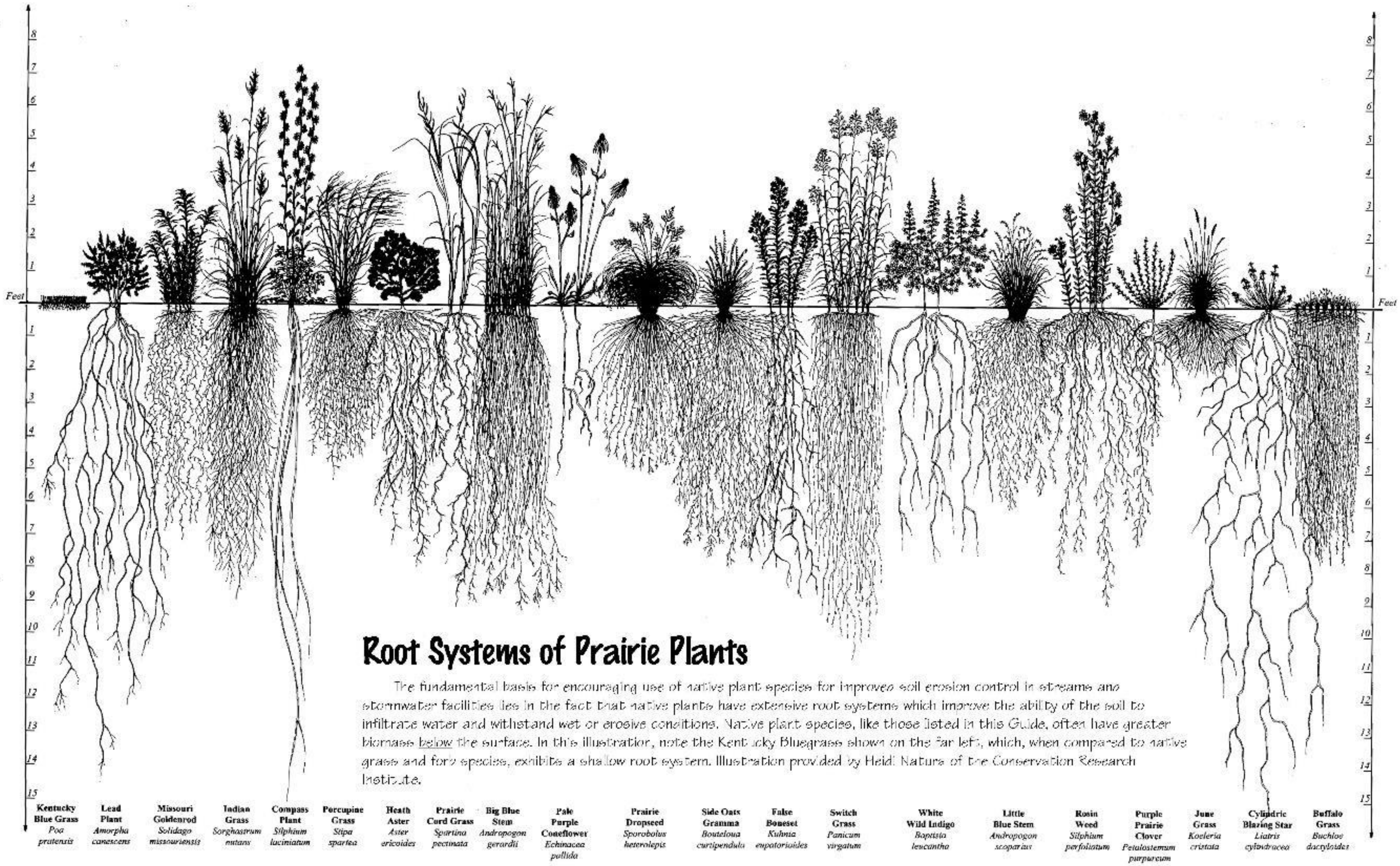
- Deer Grove East @ top of watershed, so
- S*i* & G*i* = 0. Only *P* impacts water budget.



	2014			2015		
	Pre-Restoration	Post-Project	Percent Change	Pre-Restoration	Post-Project	Percent Change
	Sub-catchment Results (inches)					
Precipitation	27.0	27.0	0%	28.7	28.7	0%
Surface Evaporation	1.9	1.2	-36%	2.2	1.0	-56%
Infiltration (to Groundwater)	20.0	21.7	9%	22.7	24.7	9%
Surface Runoff	5.3	4.2	-20%	3.9	3.2	-19%
	Groundwater Results (inches)					
Total Infiltration	19.5	21.4	10%	22.2	24.4	10%
Upper Zone ET	1.6	1.9	19%	1.7	2.2	24%
Lower Zone ET	12.6	20.9	67%	13.2	22.8	72%
Groundwater Loss	2.5	2.5	-1%	2.5	2.4	-4%
Tile Drainage	6.7	0.1	-99%	7.0	0.0	-99%


Deer Grove East Before:

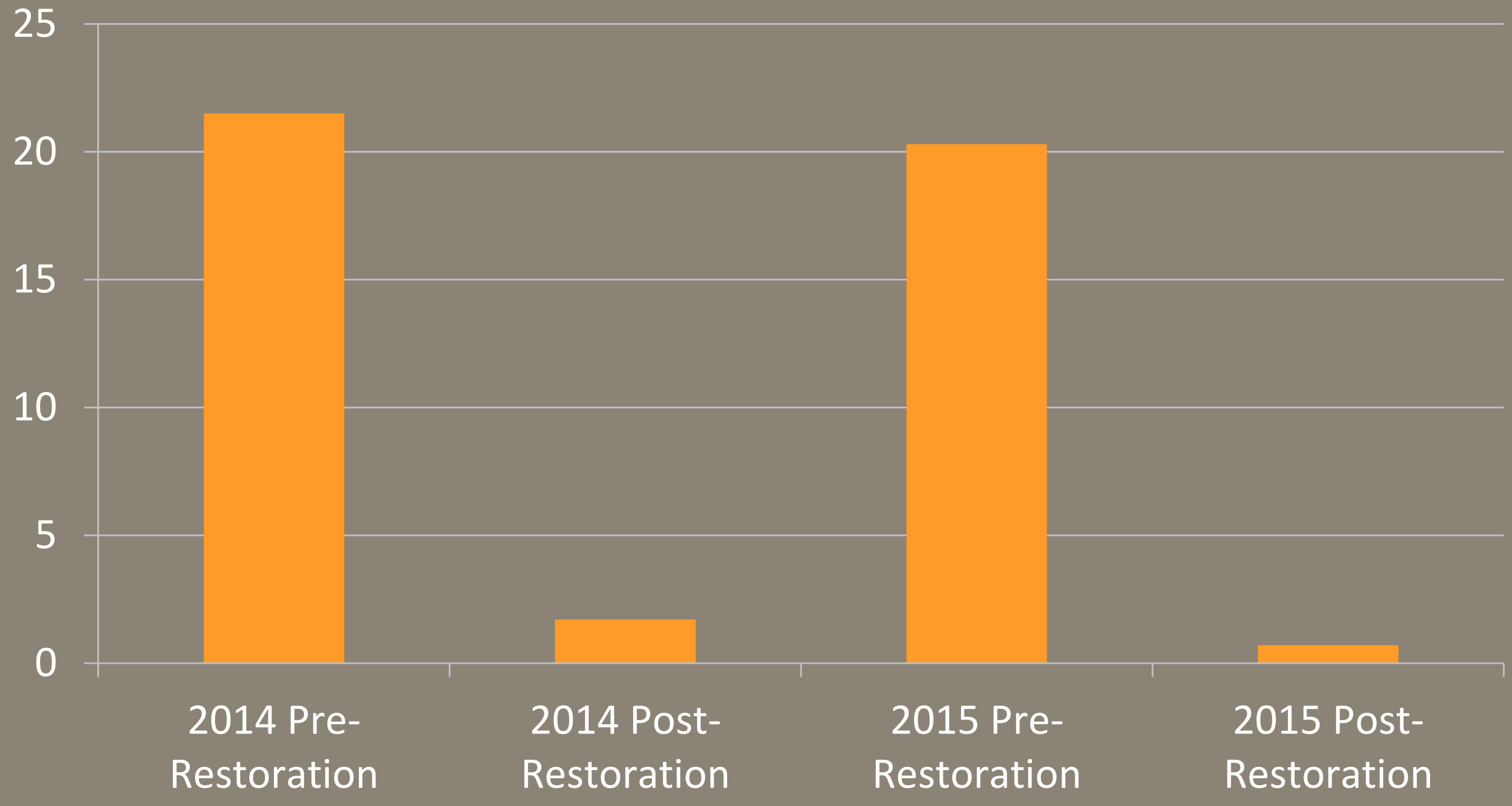
Deer Grove East After:



Root Systems of Prairie Plants

The fundamental basis for encouraging use of native plant species for improved soil erosion control in streams and stormwater facilities lies in the fact that native plants have extensive root systems which improve the ability of the soil to infiltrate water and withstand wet or erosive conditions. Native plant species, like those listed in this Guide, often have greater biomass below the surface. In this illustration, note the Kentucky Bluegrass shown on the far left, which, when compared to native grass and forb species, exhibits a shallow root system. Illustration provided by Heidi Natura of the Conservation Research Institute.

Site Discharge Volumes (MG)



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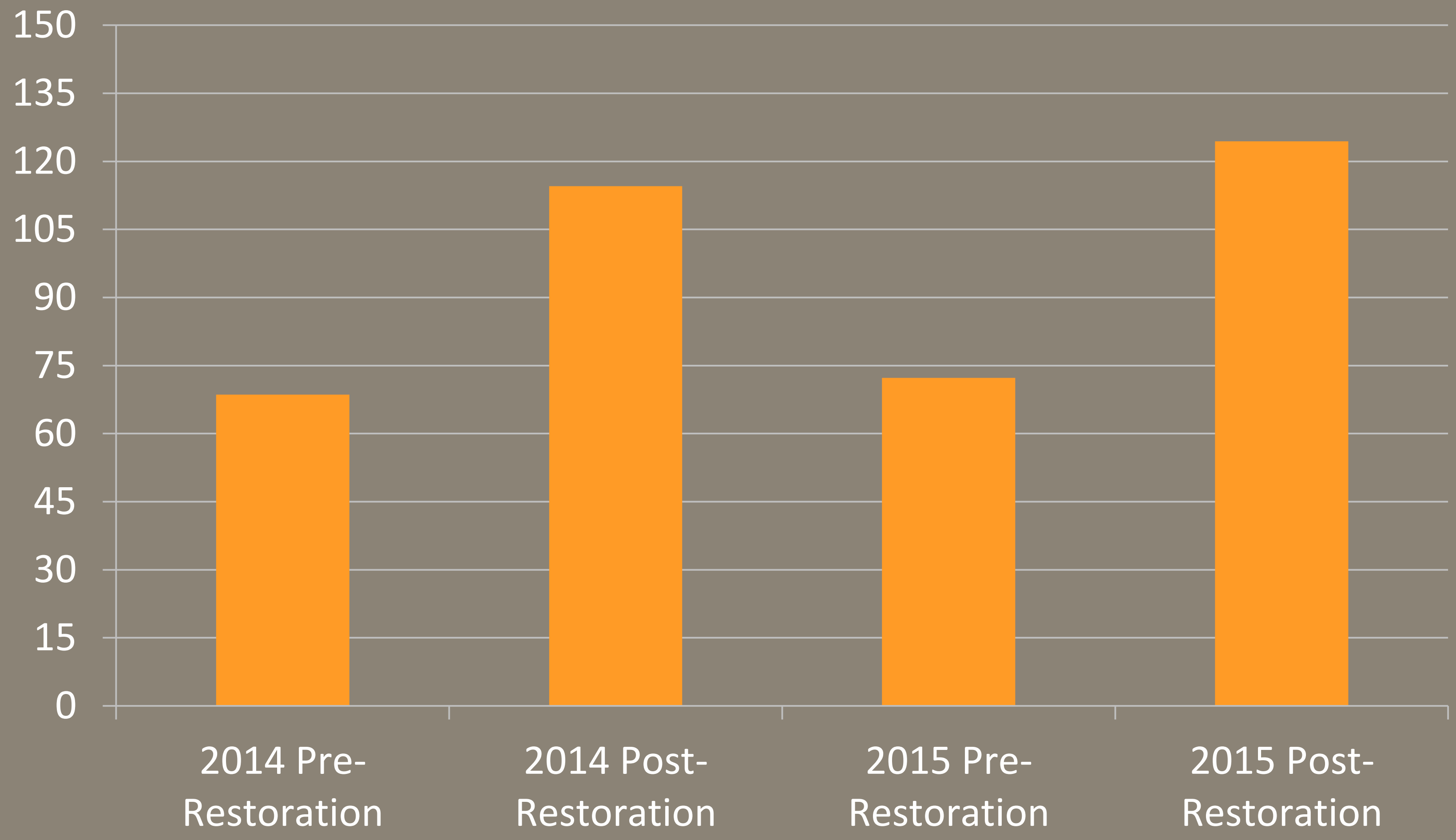
Lower Zone ET Volumes (MG)



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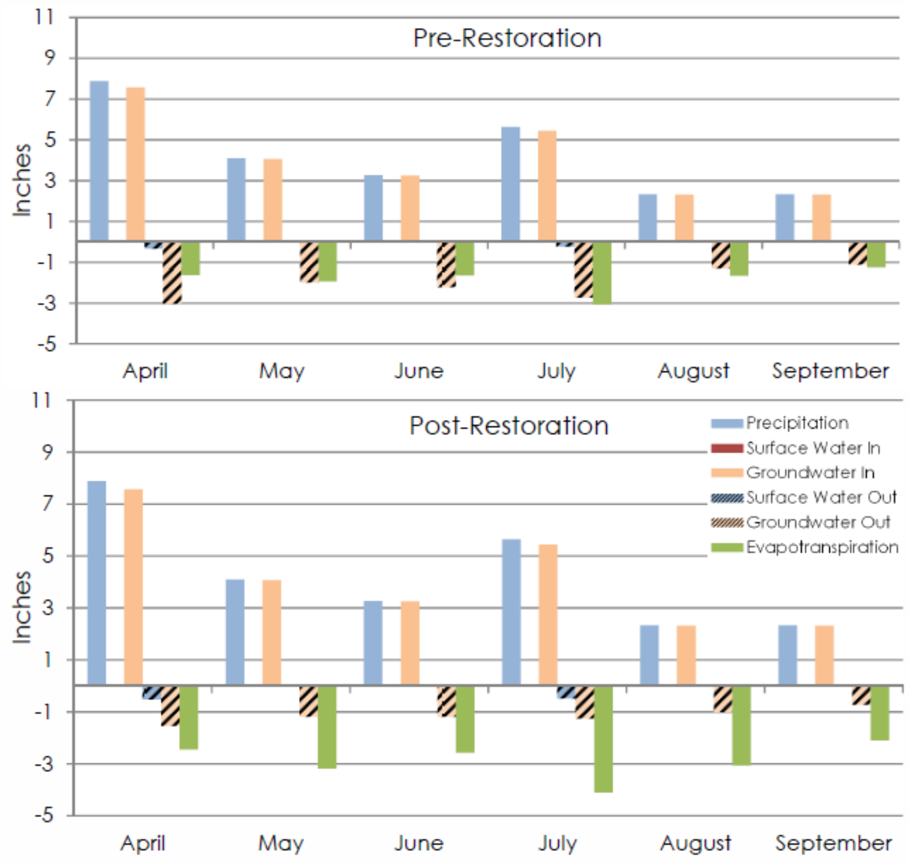


Figure 6. SWMM-generated water budgets for Deer Grove East test sub-catchment.

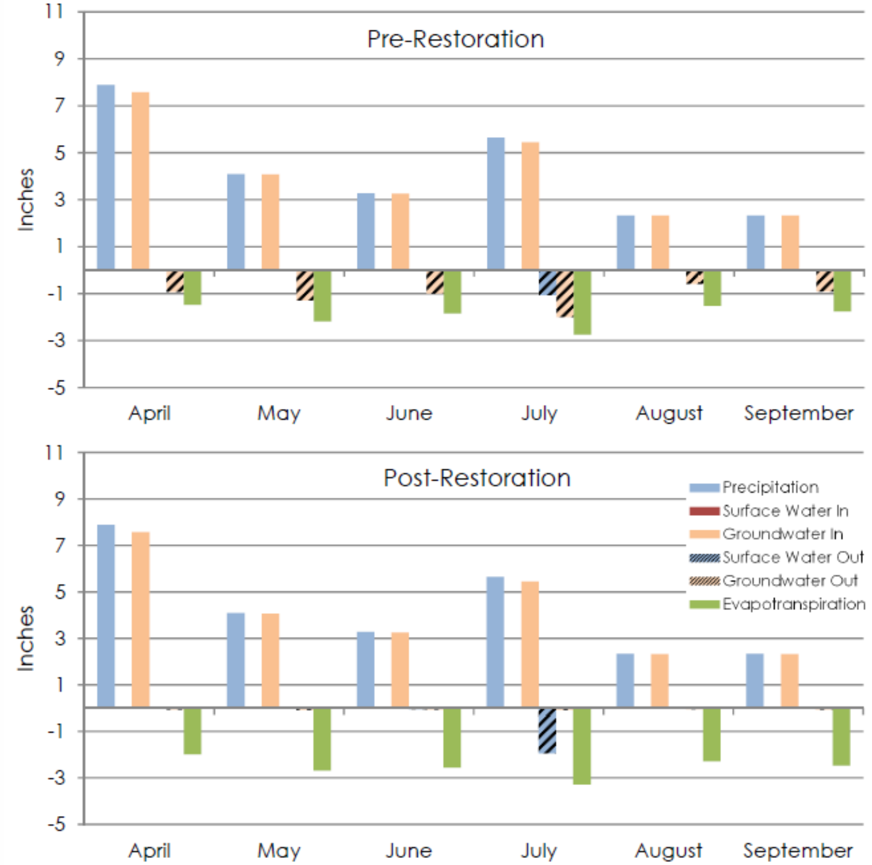


Figure 7. SWMM-generated water budgets for Tinley Creek test sub-catchment.

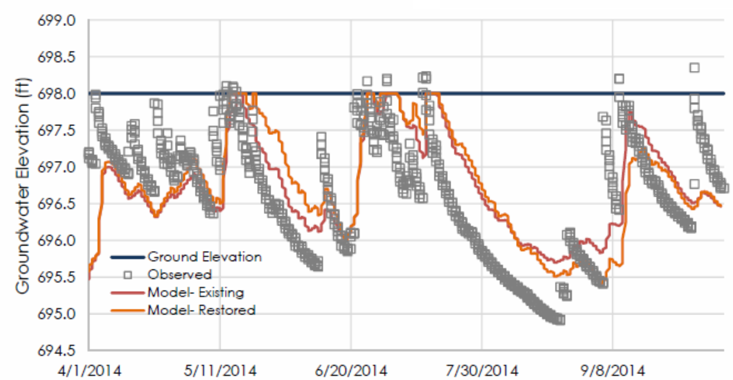


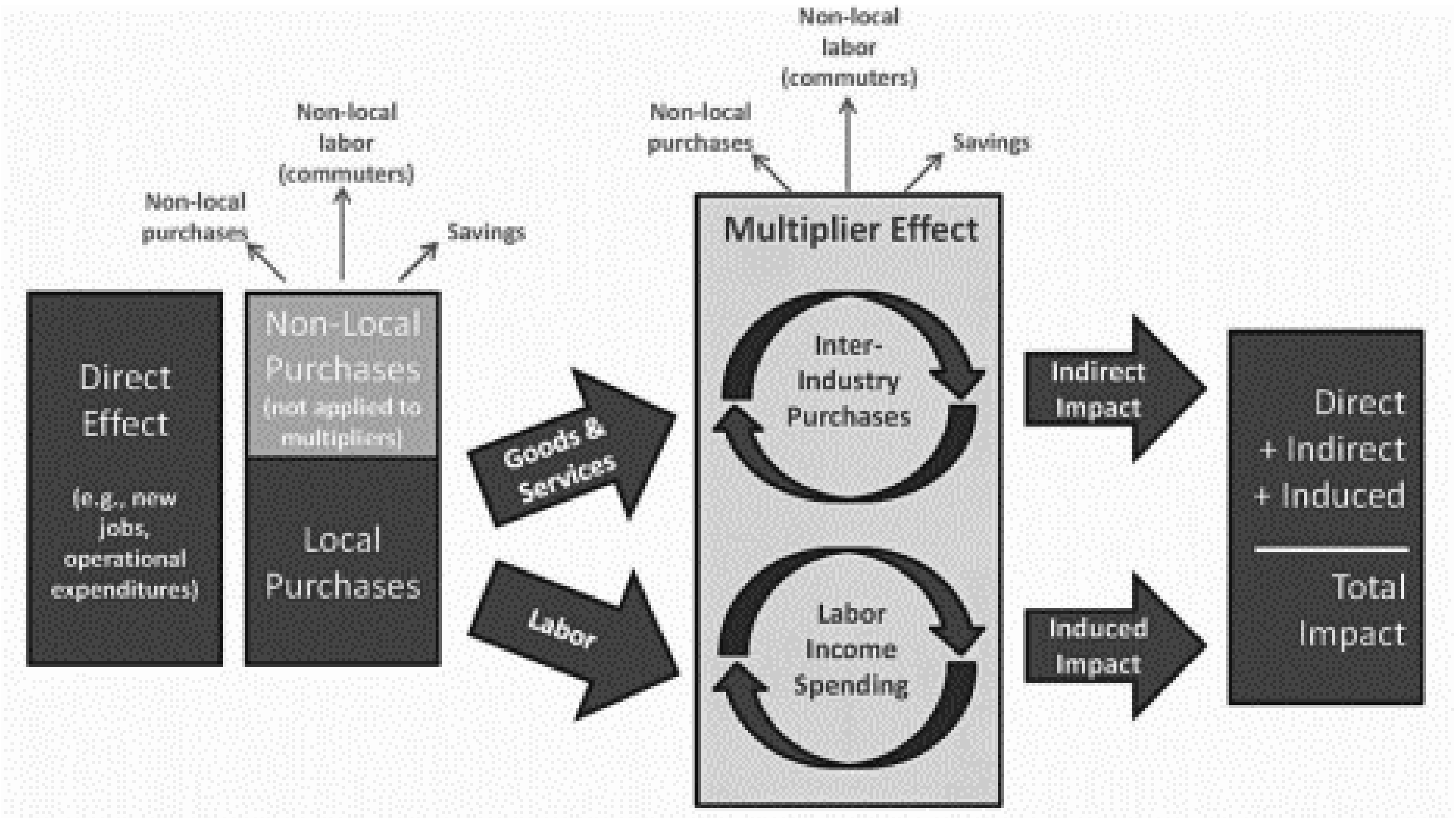
Figure 8. Calibration results for Tinley Creek test sub-catchment model.

Q2: What's Restoration "Worth"?

- **Literature Review** of 100's studies on ecosystem service values & methods.
- **Data** from FPCC user surveys, municipal water rates, etc., etc.
- **Modeling** ('IMPLAN') to quantify value.

IMPLAN Methodology

- Input-Output Analysis of "x" Costs ($5.3M) yielding "y" Benefits.



Short-term Economic Impact

- Costs ($5.3M) yielded $10.5M in Benefits.
  - Jobs (FTEs), Materials, Induced & Indirect Spending by Firms, Employees.



Long-term (20 years) Economic Impacts

Cultural Services – personal value of visits to restored ($28) v. unrestored ($19) x 290k visits per year over 20 yrs.

- FUN FACT: 290k visitors to DGE add $14.1M to local economy *annually.* Will more come?

Ecosystem Services – Water Quality (+30%); Water Flow/Regulation (+60%), & other services generate $2.4M per year, slowly decreasing over 20 years.

Costs ($5.3M) yielded $33.5M in Benefits.

Short-term (\$10.5M) + Long-term (\$33.5M) = \$8.3:1 Benefit-Cost Ratio

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LESSONS LEARNED

- There is potential to conduct restoration at scale.
- Modeling can help design different restoration outcomes that meet local needs (i.e. stormwater).
- There is an economic case for local communities to participate in (& support) restoration projects.
- Economic data & methods need continuous review & improvement.
- Ecosystem services are tough (& expensive) to calculate on a local scale.

Models Indicate Strong Economic & Stormwater Case for Restoring Natural Areas and Great Financial Incentive to Conduct Projects Elsewhere.