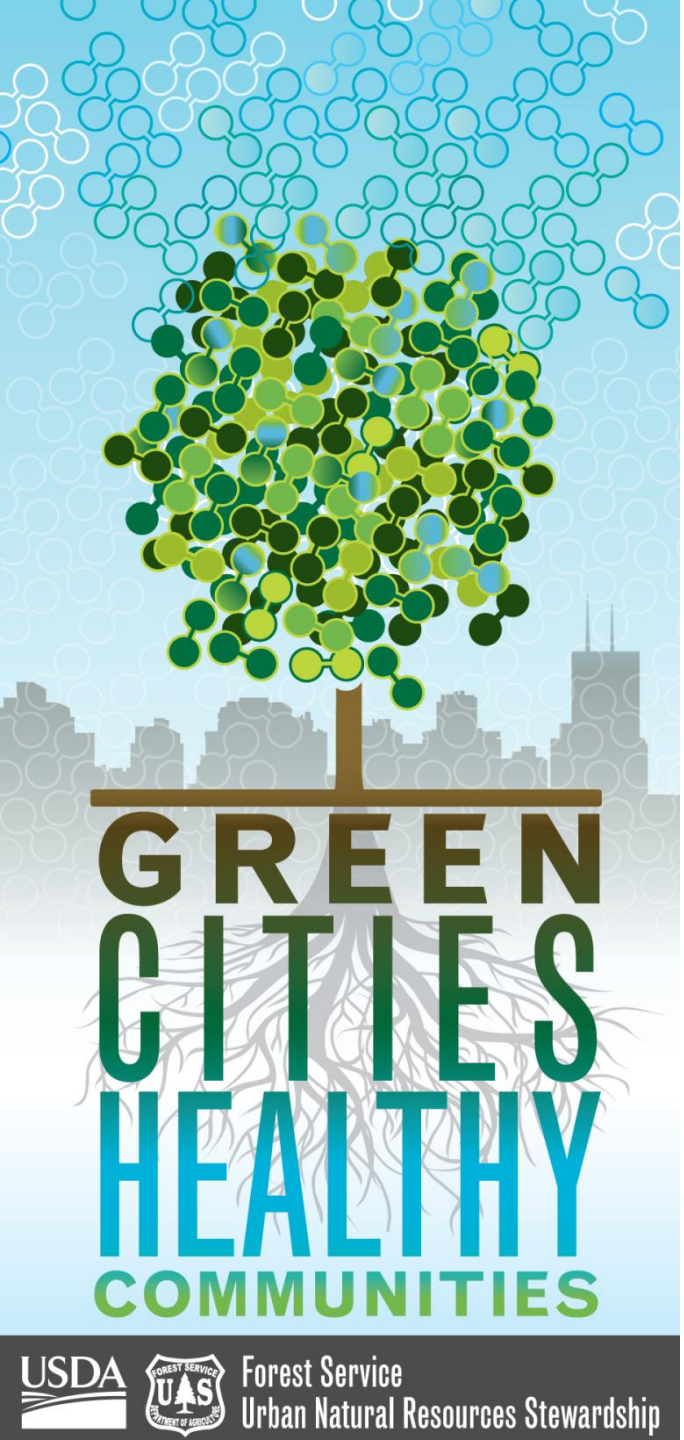

USDA Forest Service

URBAN FOREST CONNECTIONS

webinar series

Second Wednesdays | 1:00 – 2:15 pm ET

www.fs.fed.us/research/urban-webinars

USDA is an equal opportunity provider and employer.

Making Urban Trees Count: Quantifying and Crediting Stormwater Benefits

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American Forests

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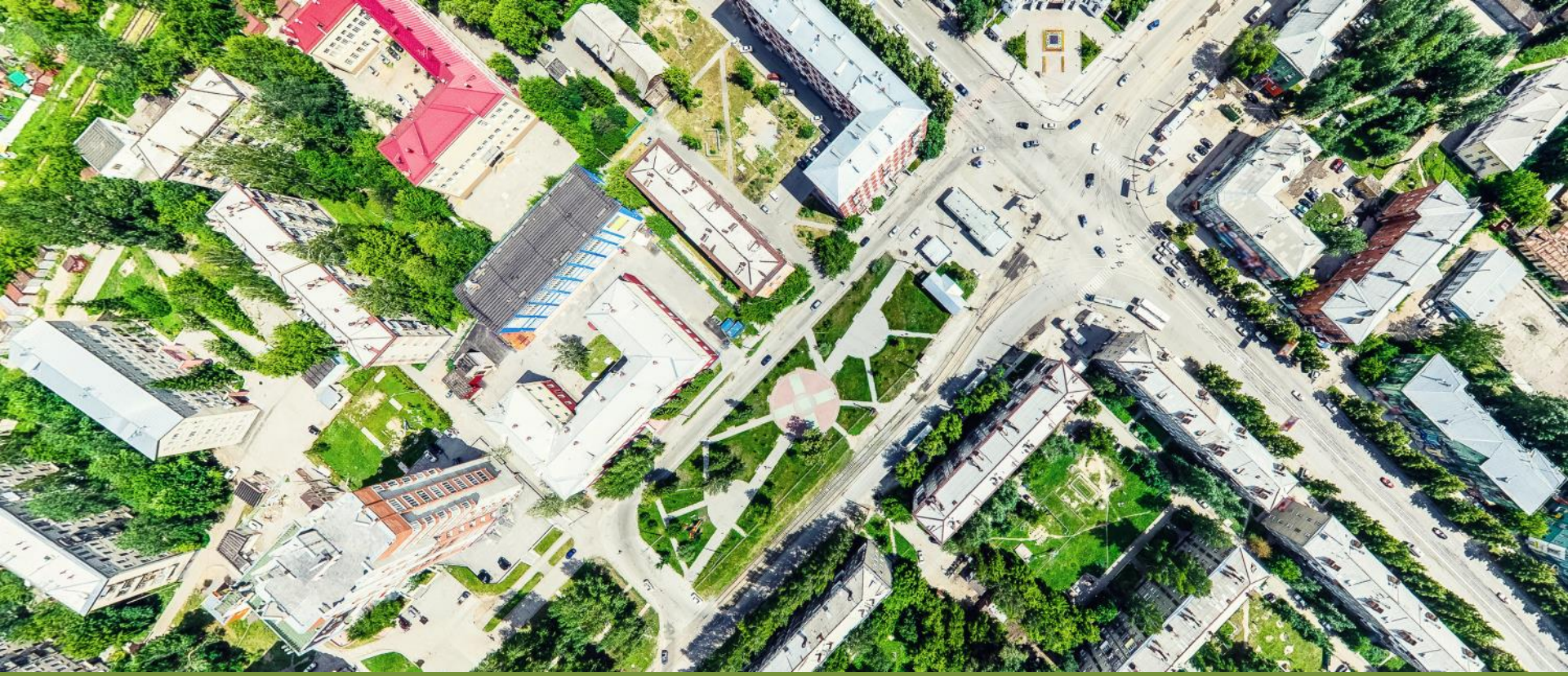


Relative Reductions in Water Yield by Urban Trees

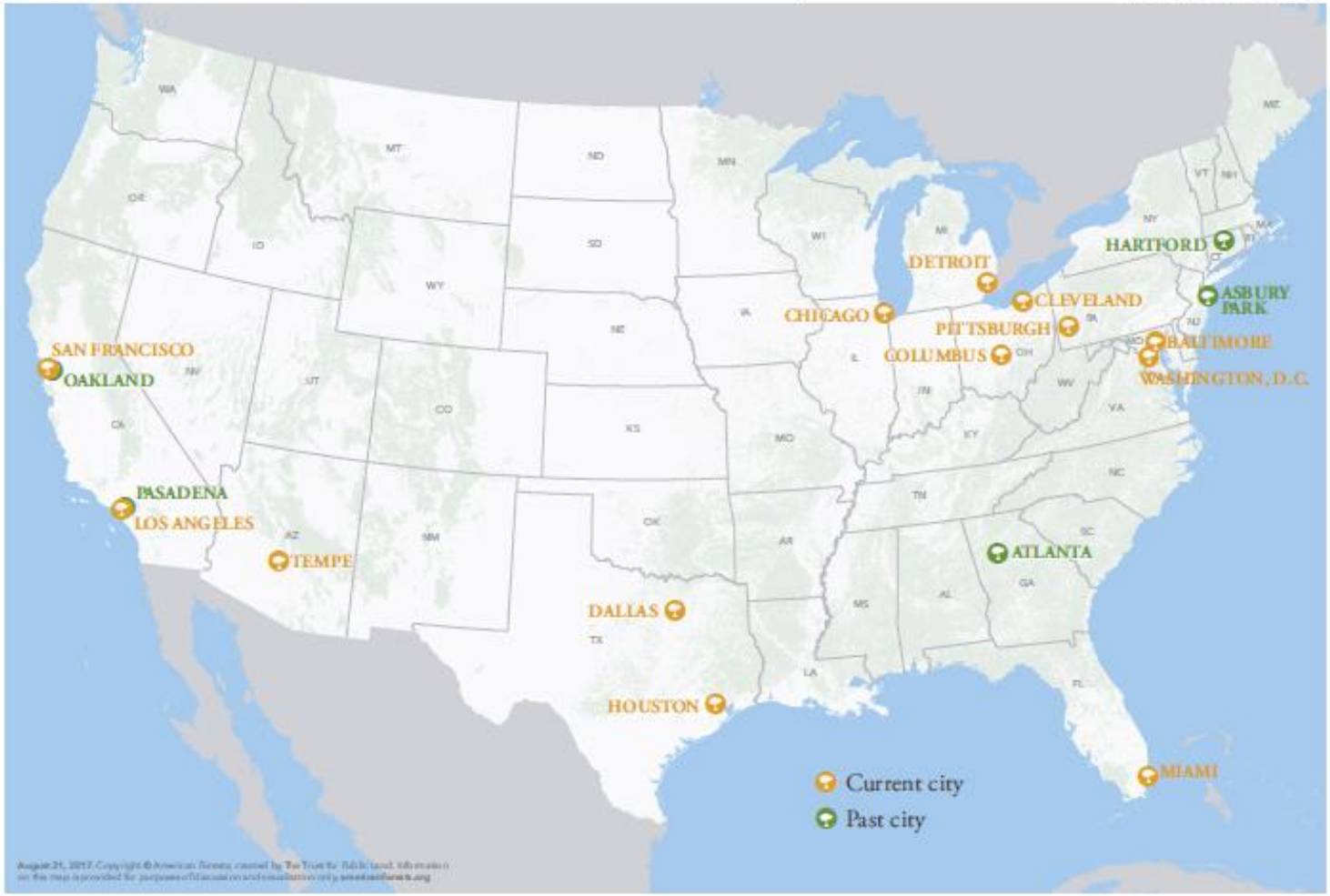
Justin Hynicka
Manager of Forest Conservation, American Forests

AMERICAN FORESTS

COMMUNITY RELEAF PROGRAM

Current and past cities

AMERICAN FORESTS



Balancing Urban Growth and Wellness

- We're gaining more urban forests as communities grow
- But we're losing urban tree canopy due to continued development, pests and disease, choices of private land owners, etc.
- This work highlights one of many benefits of urban trees.

LEARN MORE ABOUT HOW TREES IMPACT

EDUCATION

ECONOMIC DEVELOPMENT

AIR QUALITY

WATER QUALITY

PUBLIC SAFETY

HUMAN HEALTH

EQUITY

TRANSPORTATION

CITY PLANNING

SMART CITIES TECH

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AMERICAN FORESTS

LOGO

ANOTHER LOGO HERE

Why water balance?

- Water balance is a mathematical framework that accounts for all additions and losses of water from a drainage area.
- Different land uses are compared using similar assumptions and inform nutrient and sediment transport to streams, rivers, and estuaries.

(www.longtom.org)

(J. Hynicka)

Water measurements in cities are difficult

- Water balance modelling is the best approach for estimating the impacts of long-term practices in complex watersheds.

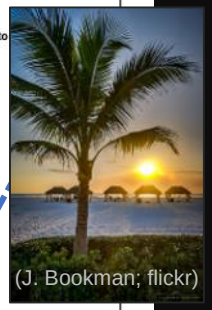
(www.longtom.org)

(D. Hancock, flickr)

Key Factors: Location

(mnholcomb; flickr)

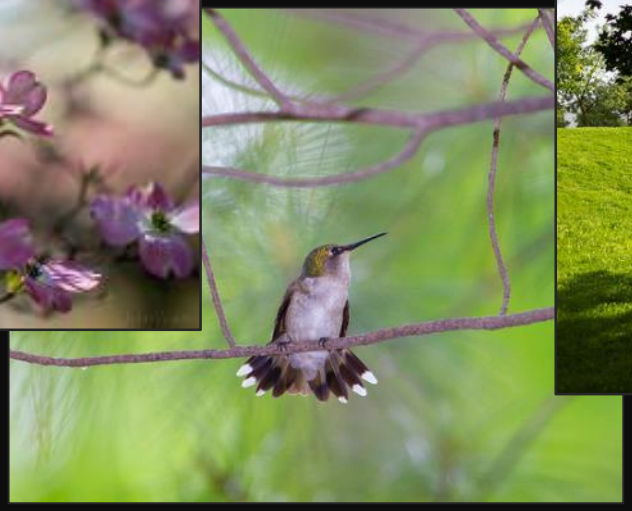
- Climate data from 31 cites (National Climatic Data Center and National Solar Radiation Database).
- Cities grouped into 11 broad climate zones modified from STRATUM climate zones.


(J. Bookman; flickr)

(T. Shoemake; flickr)

Key Factors: Tree Choice

- For each city, selected 5 reference native tree species of different size (McPherson Tree Guides and other reference books).
- Obtained key physical attributes near maturity for those trees using i-Tree Forecast (U.S. Forest Service).



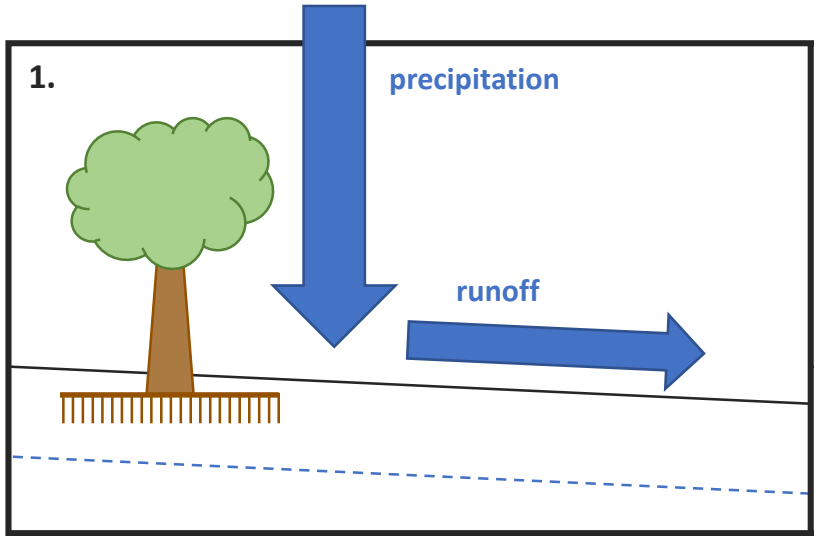
Key Factors: Soils

- USGS, Urban Hydrology for Small Watershed (TR-55)

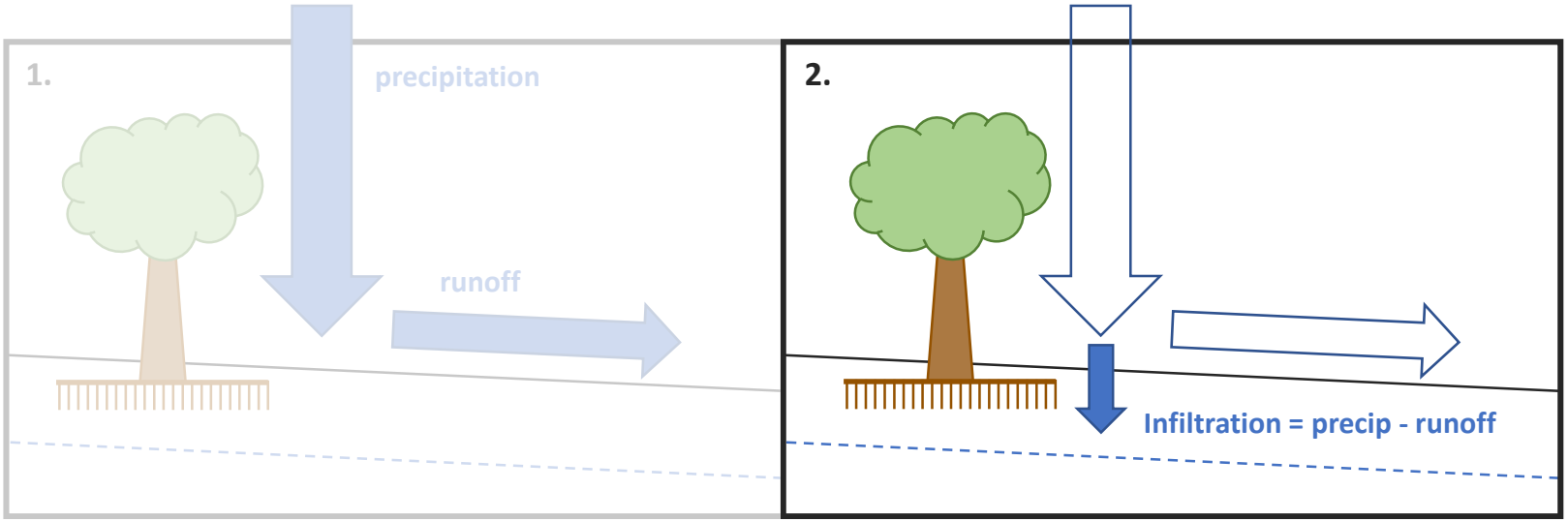
Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89

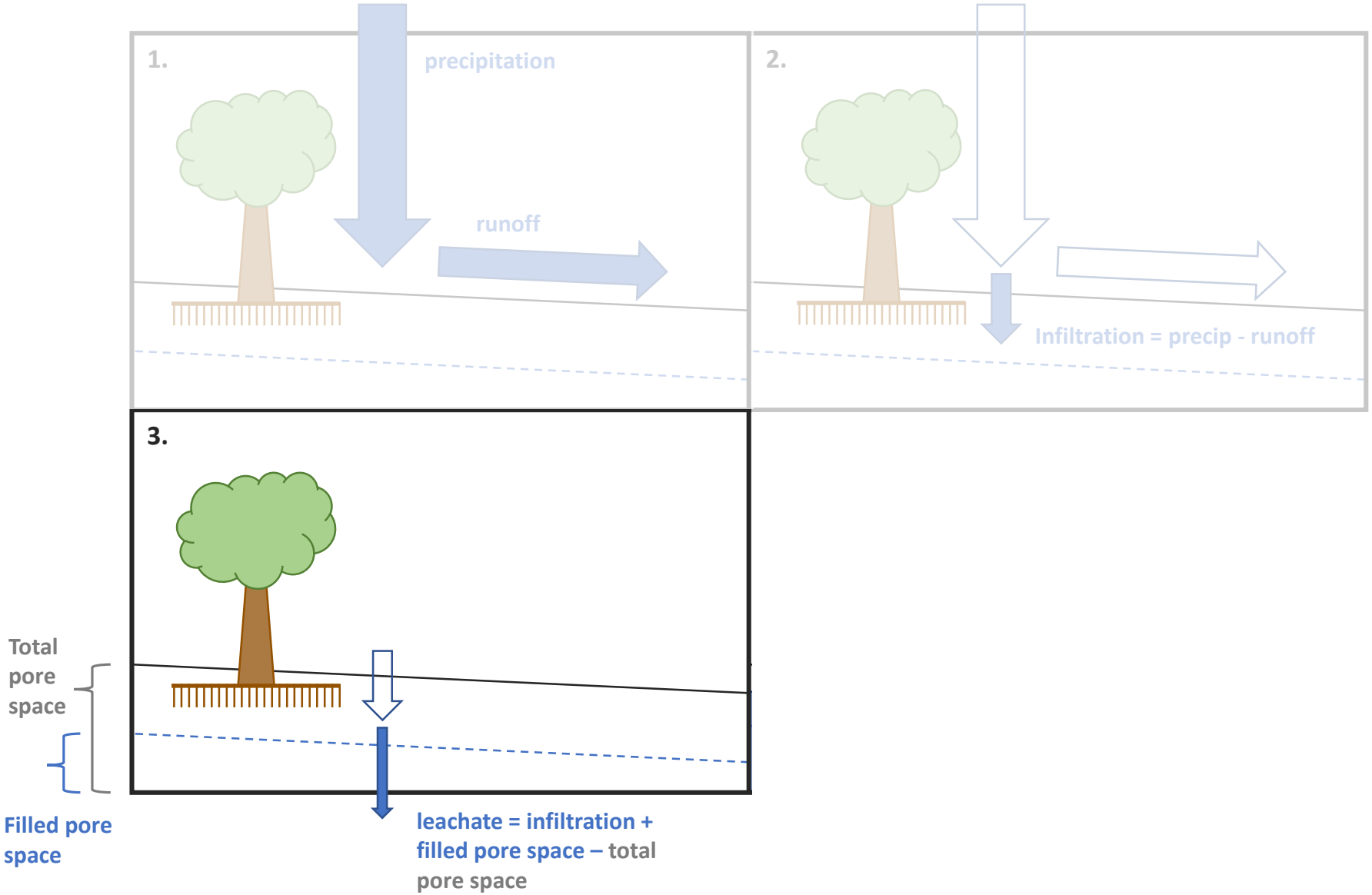
Water balance calculations: runoff



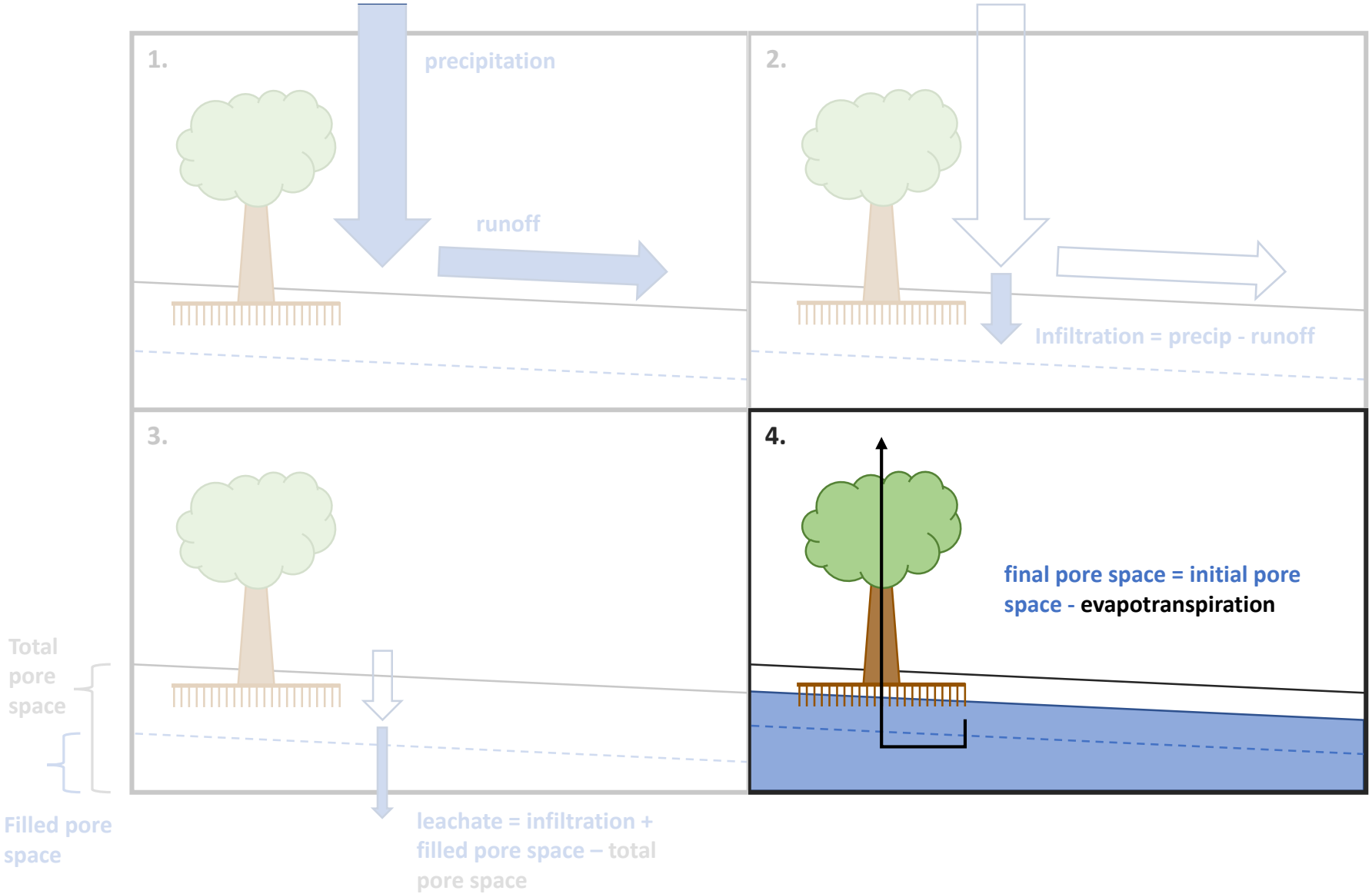
Water balance calculations: infiltration



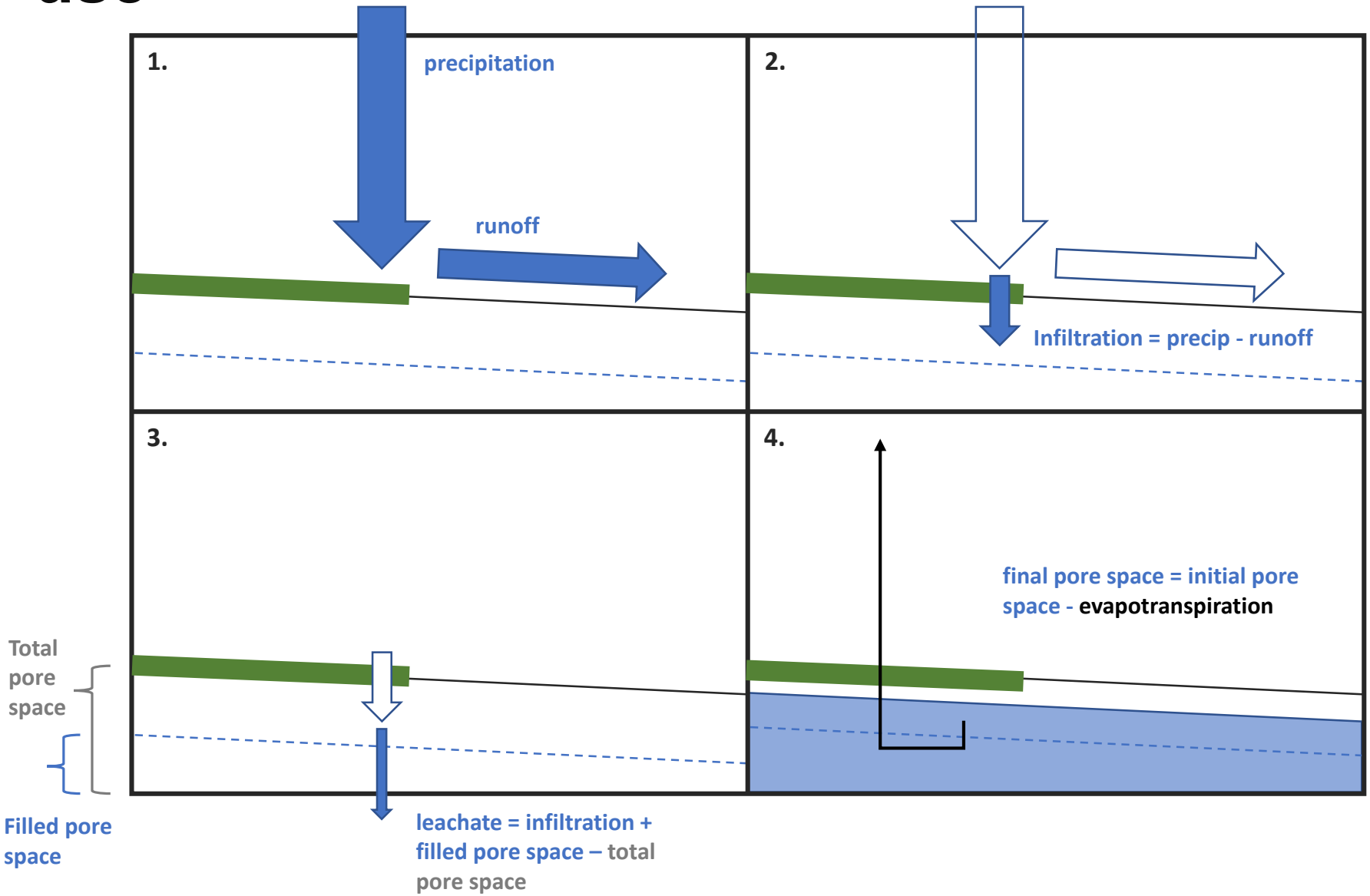
Water balance calculations: soil leaching



Water balance calculations: soil storage



Repeat calculations with different land use



Preliminary data products and interpretation

		Open Space by Soil Group (% reduction)				
Climate Zone	Tree Type	A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf					
Northeast	Medium Broadleaf					
Northeast	Small Broadleaf					
Northeast	Large Conifer					
Northeast	Small Conifer					

- Series of six look-up tables including: total water reductions, stormwater runoff reductions, shallow groundwater reductions, and adjustment tables for nitrogen, phosphorus, and sediment.

Preliminary data products and interpretation

Climate Zone	Tree Type	Open Space by Soil Group (% reduction) A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf	44.9				
Northeast	Medium Broadleaf	45.6				
Northeast	Small Broadleaf	25.7				
Northeast	Large Conifer	63.1				
Northeast	Small Conifer	68.5				

- Total water reductions for trees near maturity

Results mask the importance of tree size

Climate Zone	Tree Type	Open Space by Soil Group (% reduction) A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf	44.9				
Northeast	Medium Broadleaf	45.6				
Northeast	Small Broadleaf	25.7				
Northeast	Large Conifer	63.1				
Northeast	Small Conifer	68.5				

- Total water reductions for trees near maturity
- Designed to inform benefits and consequences of land use change scenarios
- Results are unitless and do not value tree canopy area

Preliminary data products and interpretation

Climate Zone	Tree Type	Open Space by Soil Group (% reduction) A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf	44.9	41.9	39.5	37.7	5.6
Northeast	Medium Broadleaf					
Northeast	Small Broadleaf					
Northeast	Large Conifer					
Northeast	Small Conifer					

- Total water reductions for trees near maturity

Soils with good quality perform even better

Climate Zone	Tree Type	Open Space by Soil Group (% reduction) A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf	44.9	41.9	39.5	37.7	5.6
Northeast	Medium Broadleaf					
Northeast	Small Broadleaf					
Northeast	Large Conifer					
Northeast	Small Conifer					

- Total water reductions for trees near maturity
- Policies and procedures that protect soil quality during development maximize benefits of tree planting in the future

Preliminary data products and interpretation

		Open Space by Soil Group (% reduction)				
Climate Zone	Tree Type	A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf					5.6
Northeast	Medium Broadleaf					5.8
Northeast	Small Broadleaf					2.1
Northeast	Large Conifer					12.4
Northeast	Small Conifer					15.4

- Total water reductions for trees near maturity

Low percentages have a meaningful impact

		Open Space by Soil Group (% reduction)				
Climate Zone	Tree Type	A	B	C	D	Impervious (% reduction)
Northeast	Large Broadleaf					5.6
Northeast	Medium Broadleaf					5.8
Northeast	Small Broadleaf					2.1
Northeast	Large Conifer					12.4
Northeast	Small Conifer					15.4

- Total water reductions for trees near maturity
- For impervious surfaces, trees can only influence the amount of water reaching the ground

Street Tree Planting in Raleigh, NC

Climate Zone	Tree Type	Open Space by Soil Groups (% reduction) A	B	C	D	Impervious (% reduction)
South	Large Broadleaf	25.8	22.1	22.3	23.0	7.1
South	Medium Broadleaf	23.0	19.1	19.2	19.9	2.8
South	Small Broadleaf	13.0	10.5	10.4	10.8	1.9
South	Large Conifer	23.8	19.8	20.0	20.7	3.9
South	Small Conifer	18.4	16.5	16.6	17.1	9.7

- Total water reductions for trees near maturity
- 100 London planetrees and 400 flowering dogwood trees ; canopy area near maturity = 166.0 and 58.9 ft^2 , respectively.
- Reduced water yield by 4.0% over 0.92 acres