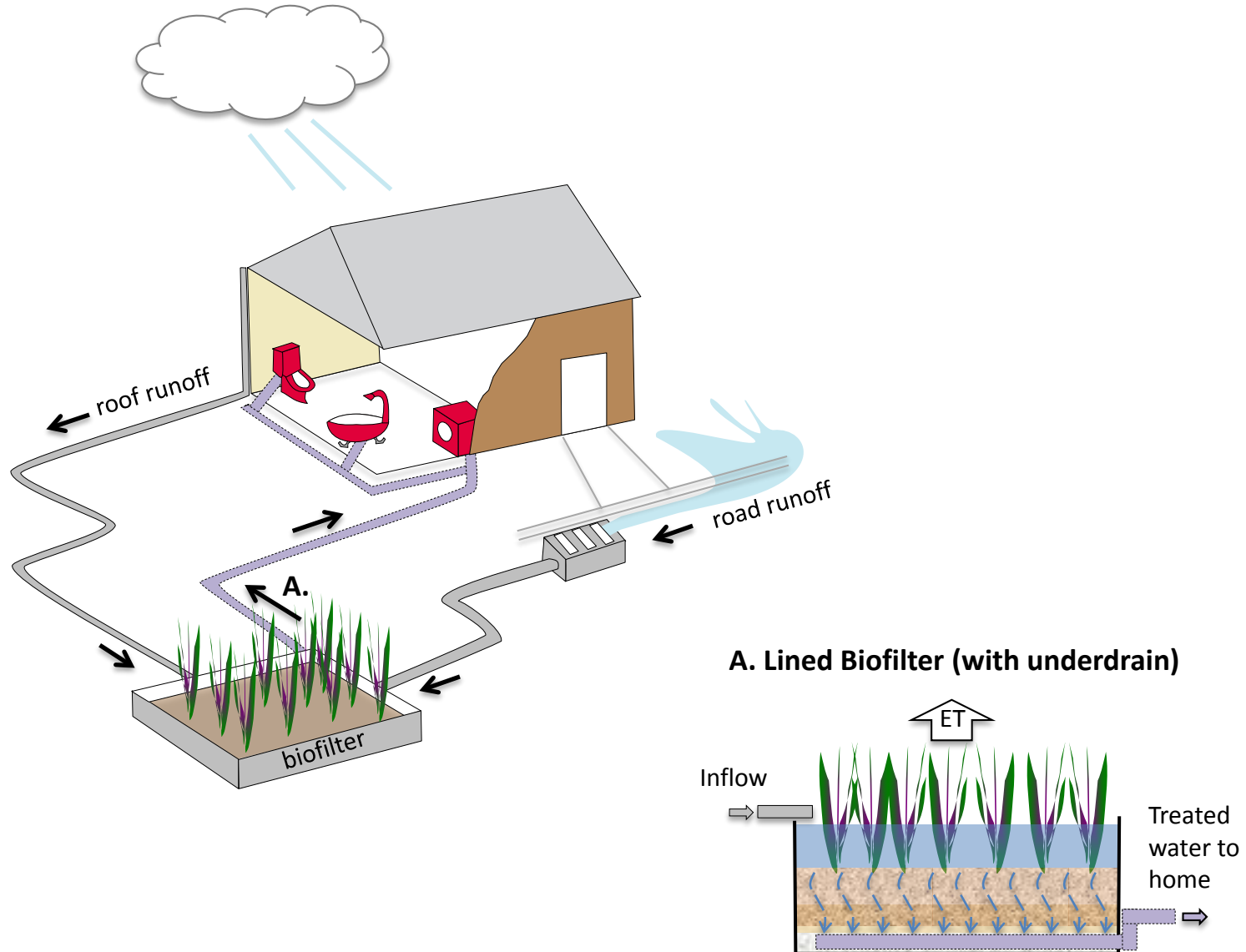


# Stormwater Harvesting Technologies



Askarizadeh et al., (2015) "From rain tanks to catchments: Use of Low Impact Development to Address the Hydrologic Symptoms of the Urban Stream Syndrome", Environ. Sci. Technol., in press.

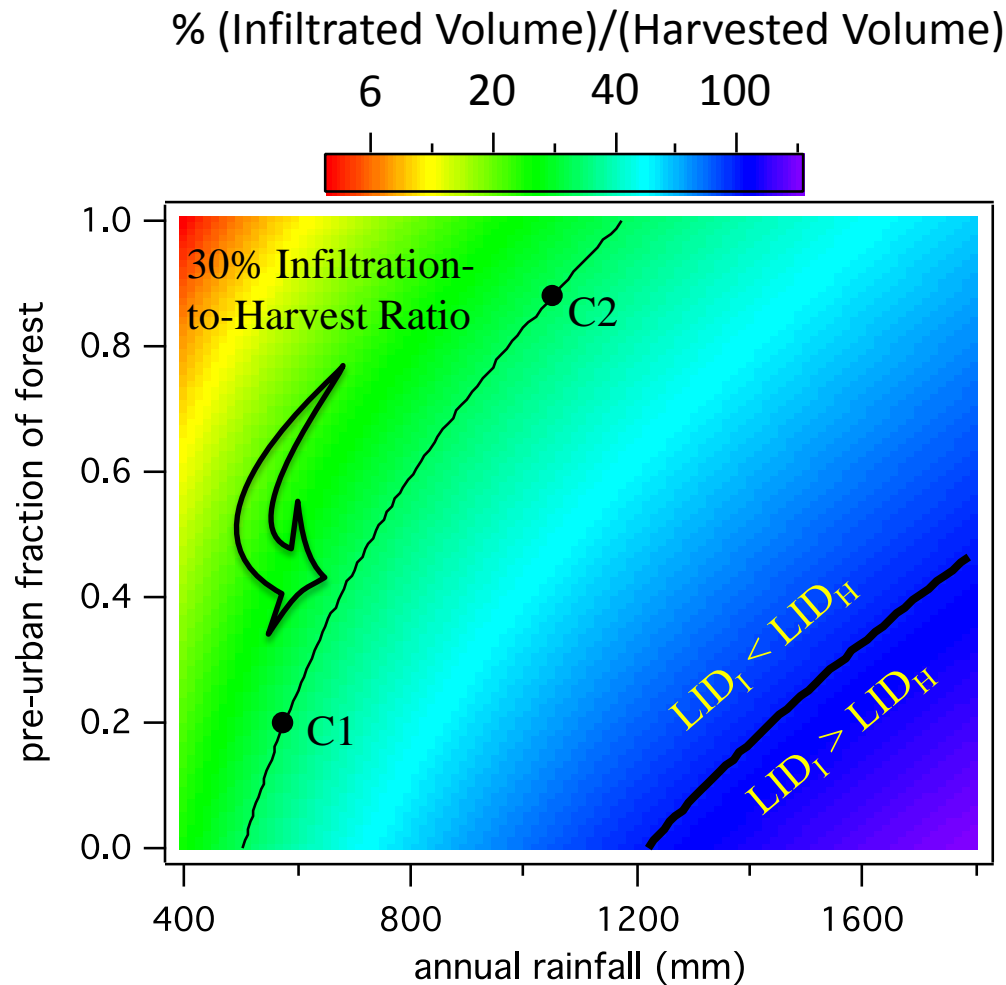
Q: If we want to restore pre-urban hydrology, how much stormwater runoff should be infiltrated versus harvested?

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A: Depends on the local mean annual rainfall and fraction of pre-urban land area covered with forest\*.

\*Walsh,C.J.; Fletcher, T.D.; Burns, M.J. (2012) "Urban Stormwater Runoff: A New Class of Environmental Flow Problem", *PLoS ONE* 7(9):e45814

# Right Mix of Infiltration and Harvest



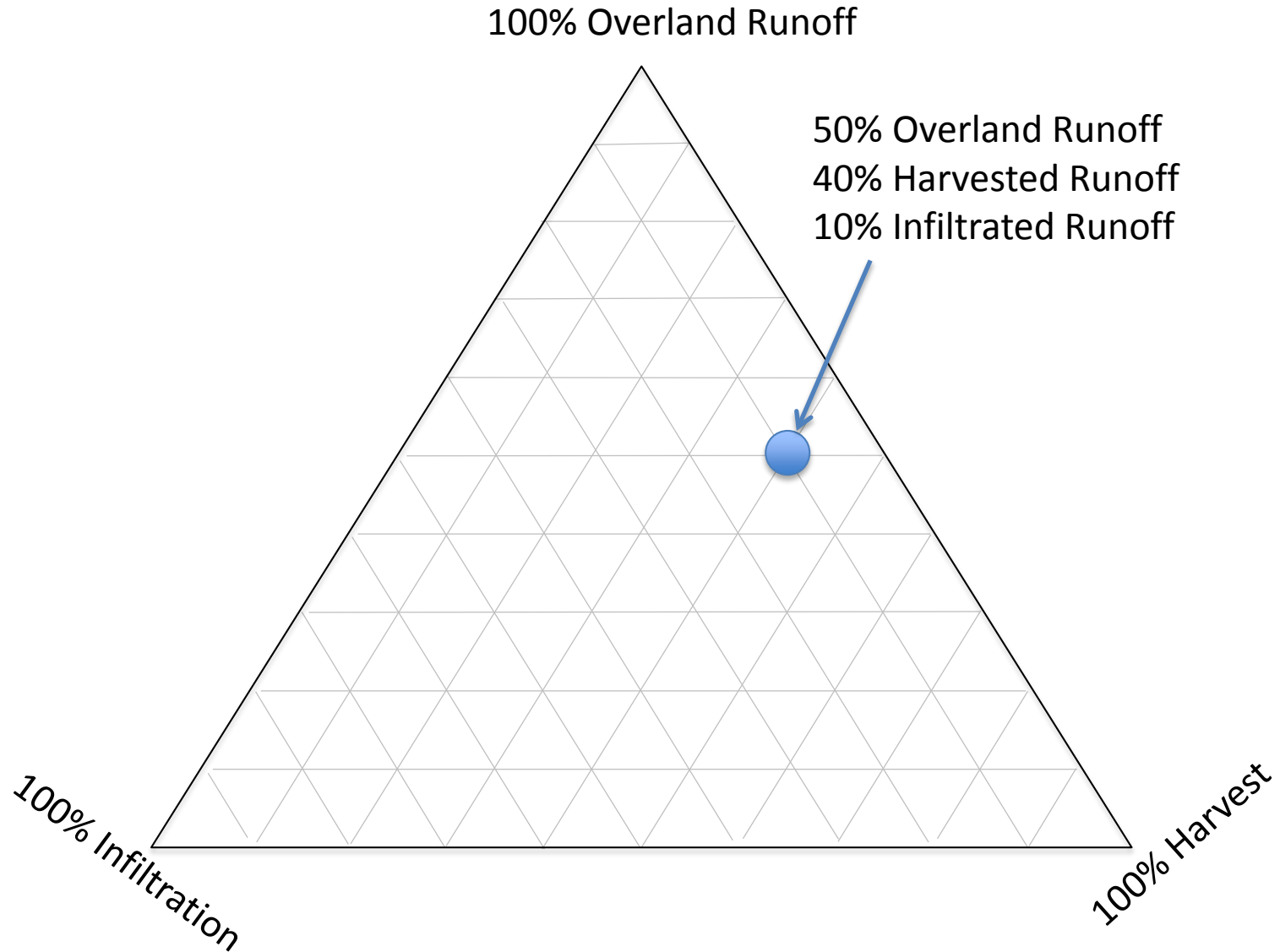
Askarizadeh et al., (2015) "From rain tanks to catchments: Use of Low Impact Development to Address the Hydrologic Symptoms of the Urban Stream Syndrome", Environ. Sci. Technol., in press.

How might we choose Low Impact Development (LID) technologies to achieve a given harvest/infiltration ratio?

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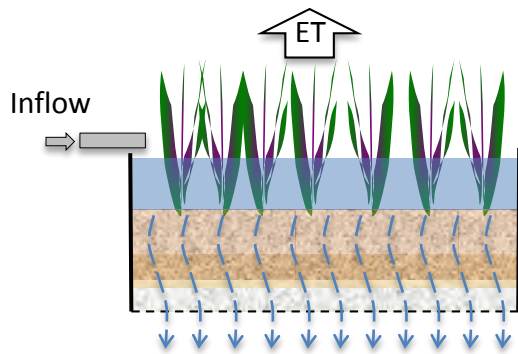
*All LID technologies can be categorized according to the percentage of runoff they harvest, infiltrate, or leave as runoff*

# The LID Universe



Askarizadeh et al., (2015) "From rain tanks to catchments: Use of Low Impact Development to Address the Hydrologic Symptoms of the Urban Stream Syndrome", Environ. Sci. Technol., in press.

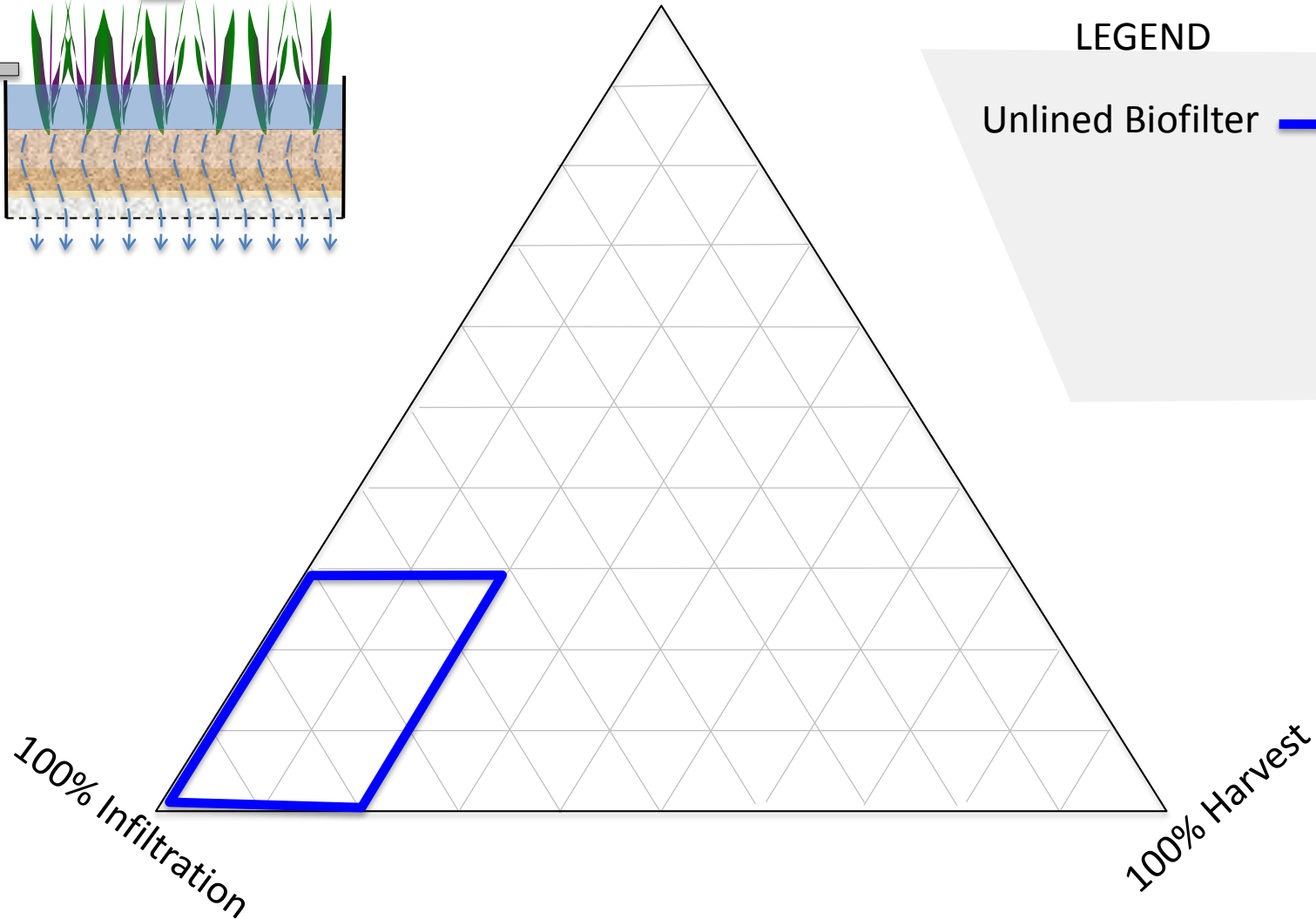
# The LID Universe



100% Overland Runoff

LEGEND

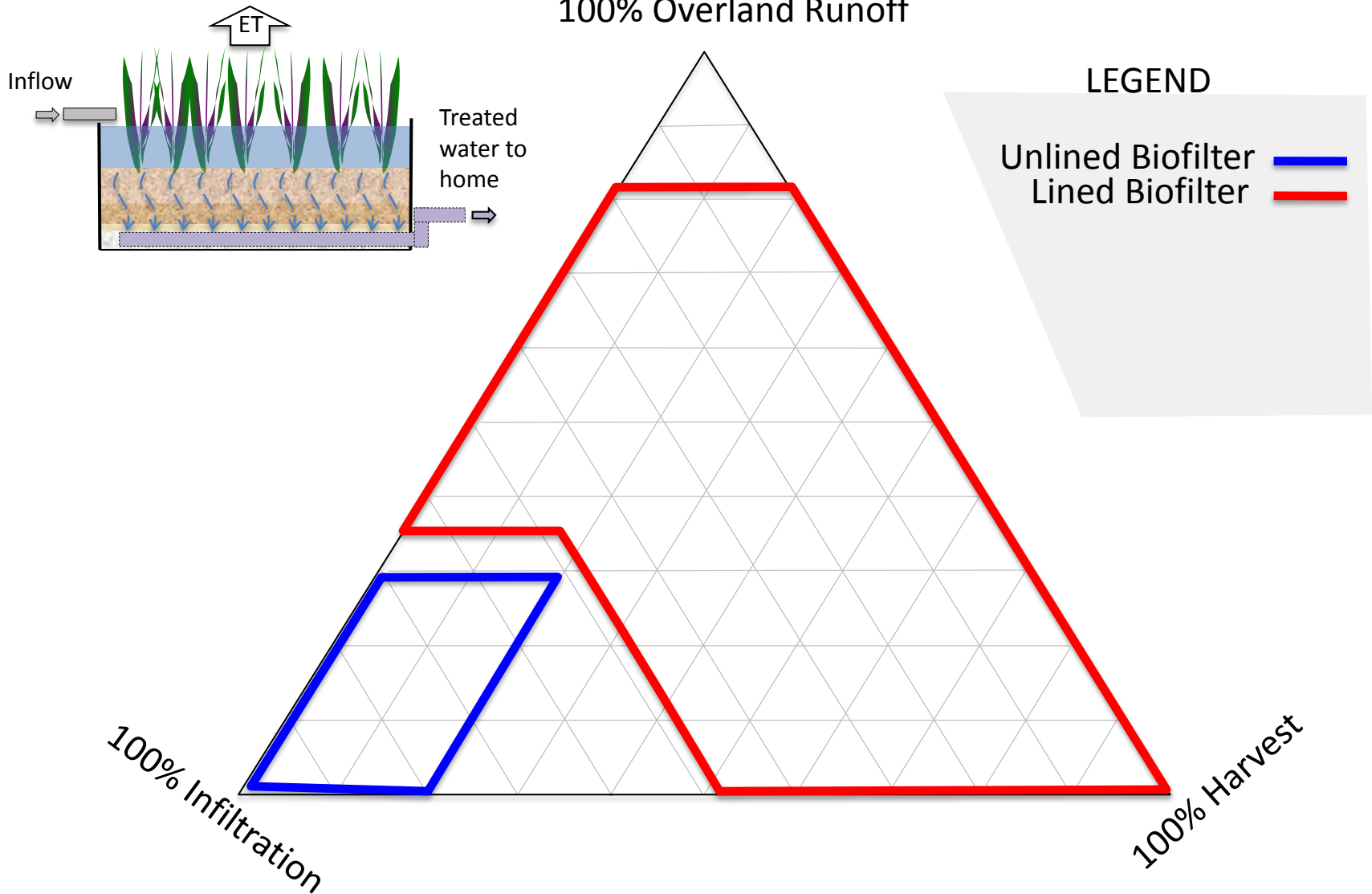
Unlined Biofilter



Askarizadeh et al., (2015) "From rain tanks to catchments: Use of Low Impact Development to Address the Hydrologic Symptoms of the Urban Stream Syndrome", Environ. Sci. Technol., in press.

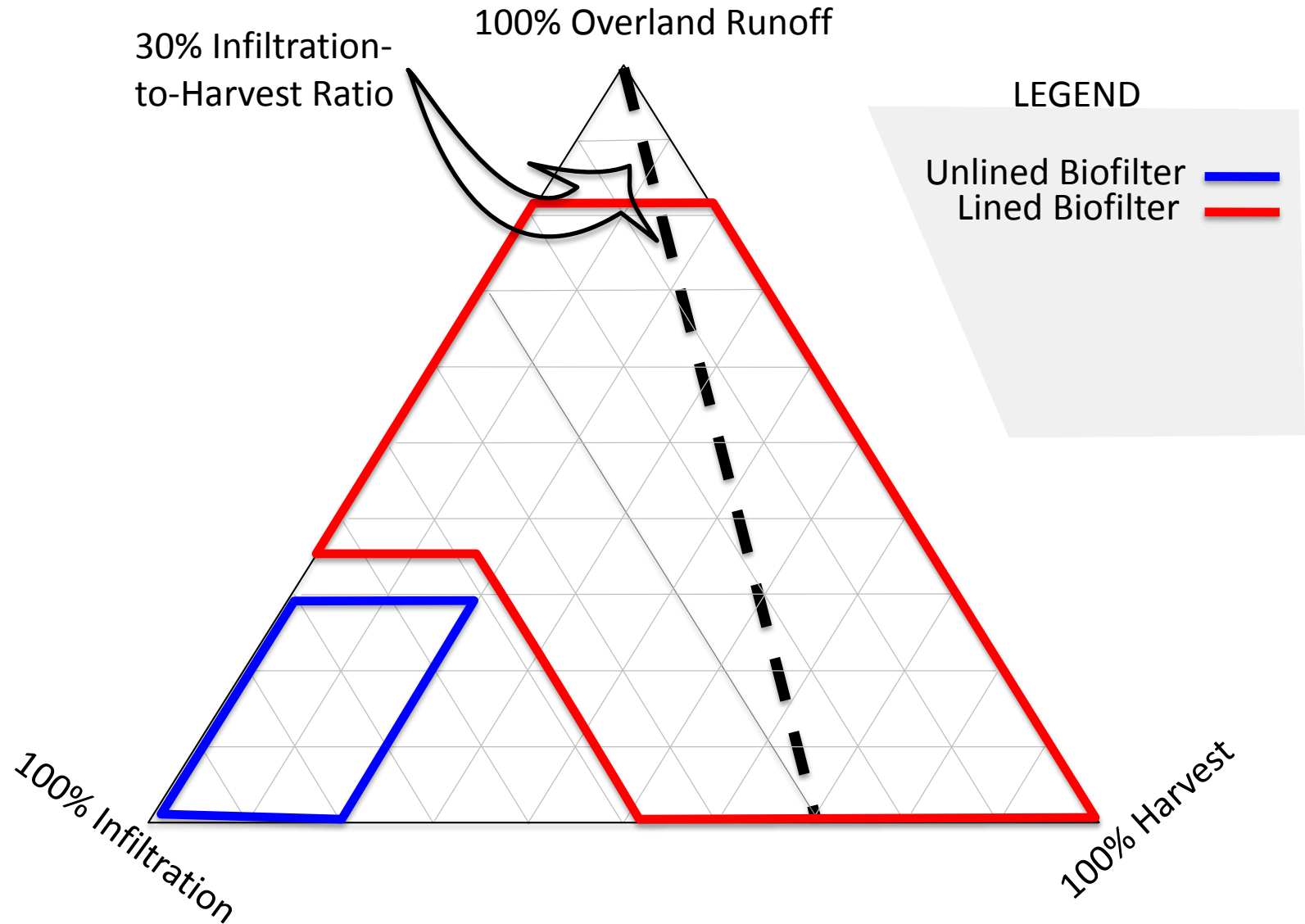


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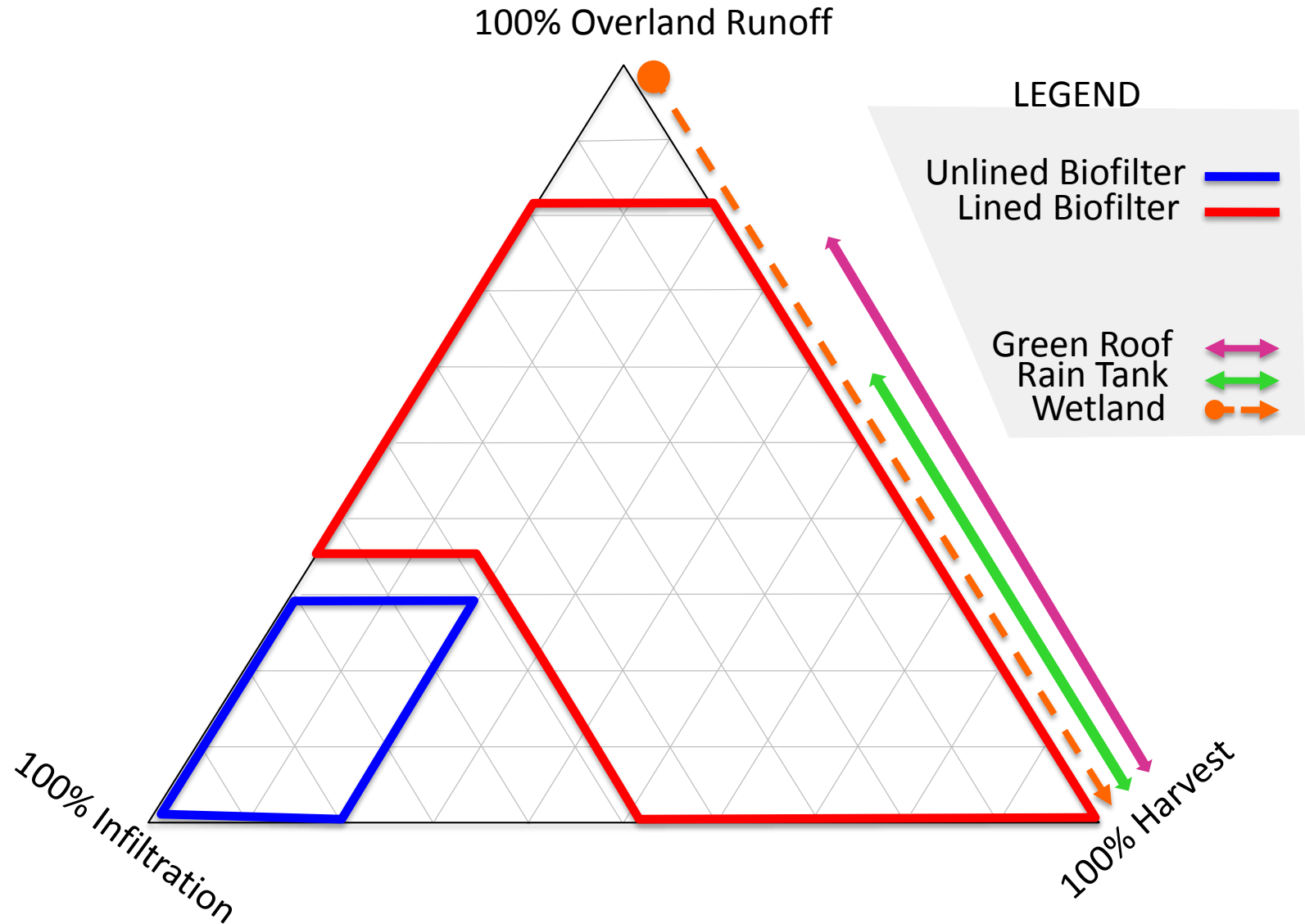
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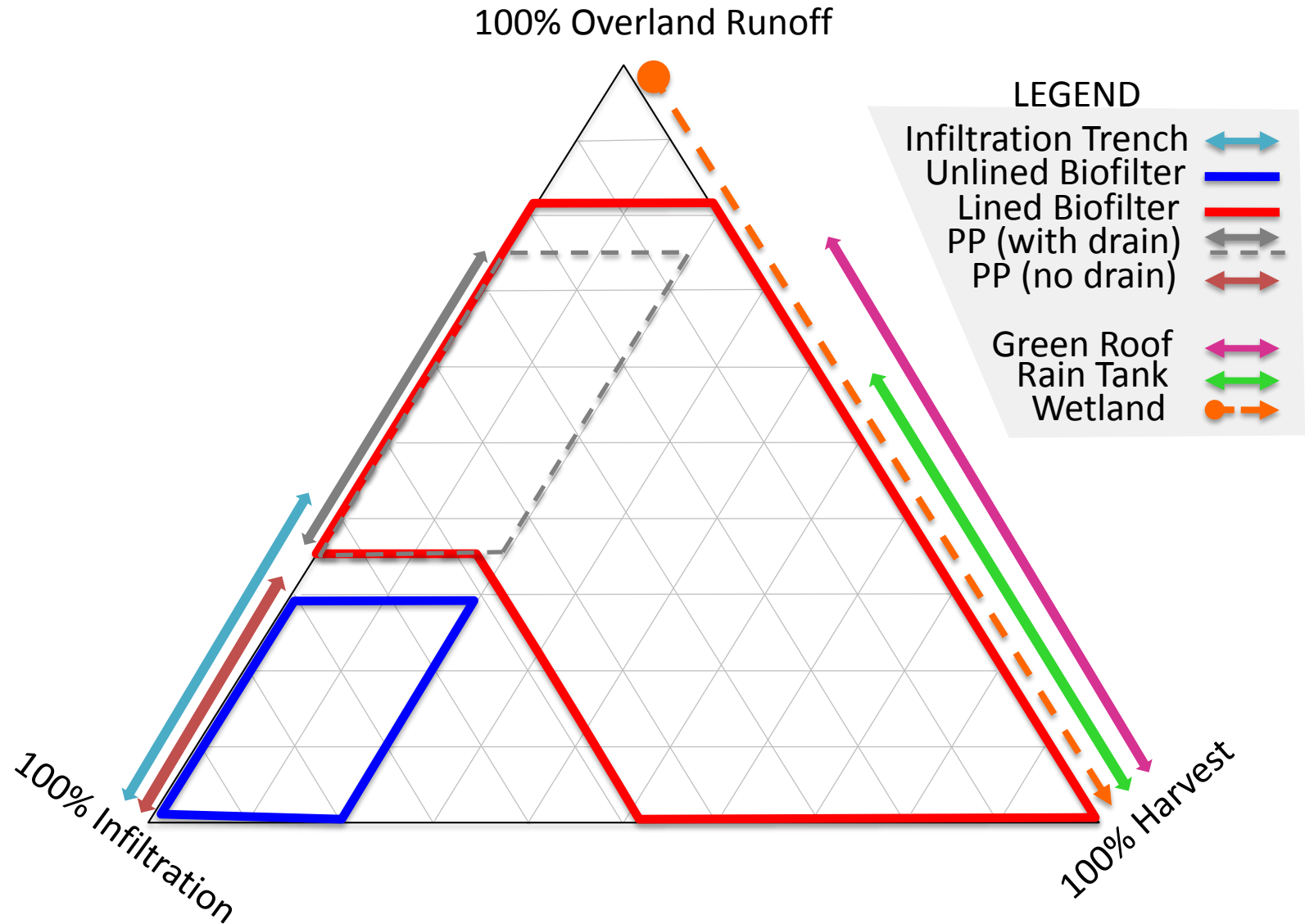
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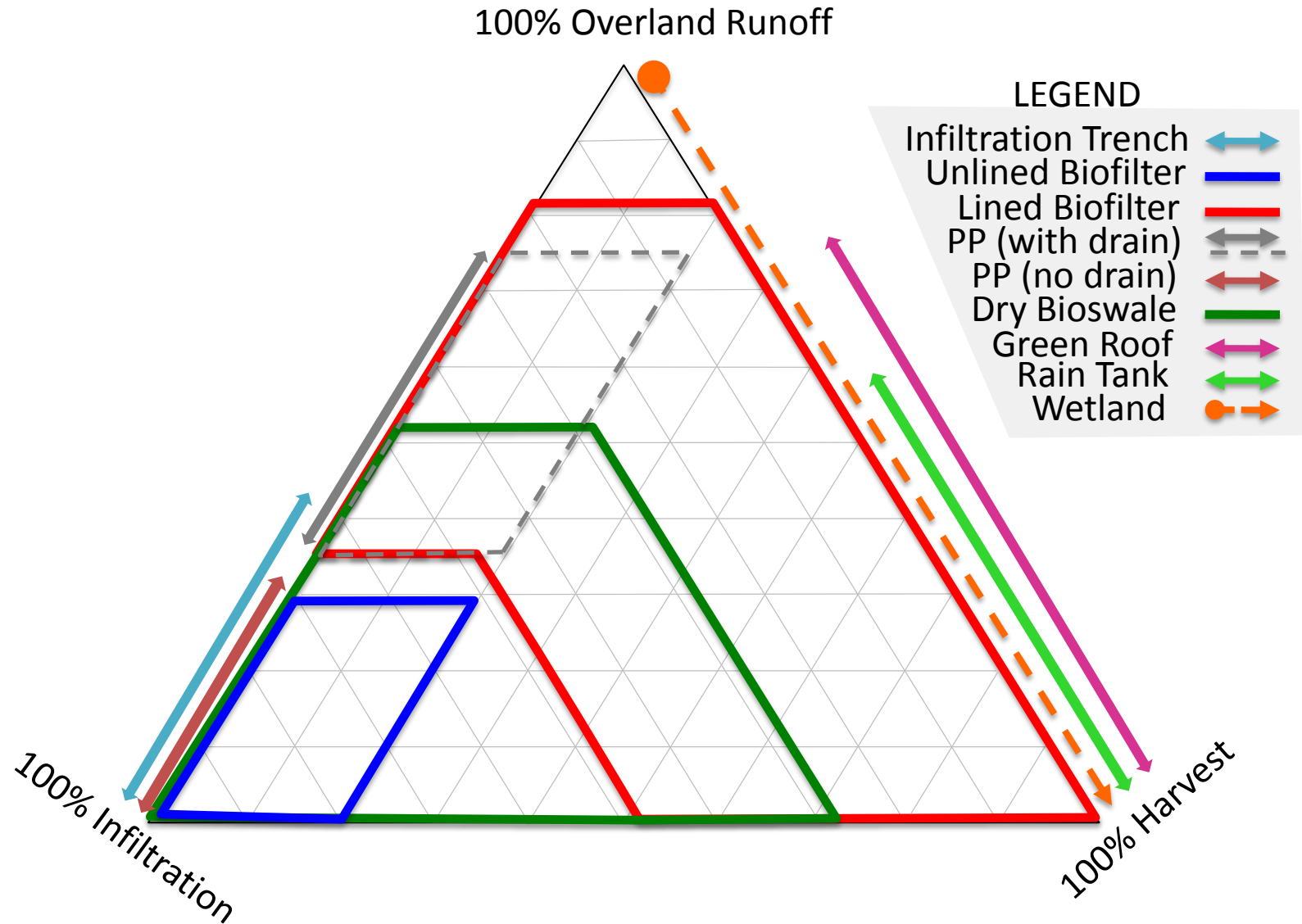
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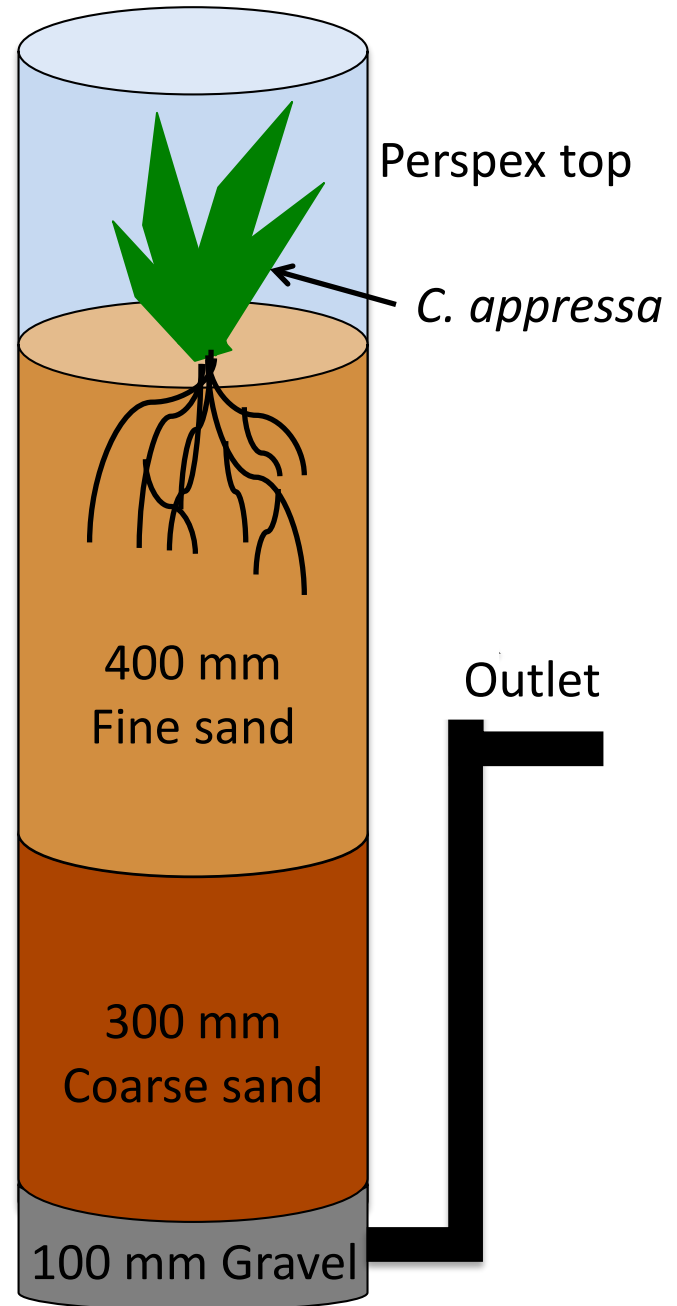
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# Conclusions

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  - Increases flow during storms
  - Reduces base flow during dry weather
- Distributed LID have can restore pre-urban hydrology provided all stormwater is harvested and infiltrated
- The infiltration-to-harvest ratio depends on:
  - Mean Annual Rainfall
  - Pre-Urban Forest cover
- For most regions of the world (including So Cal), much more water should be harvested than infiltrated

# Teaser: Engineering Design of Stormwater Biofilters

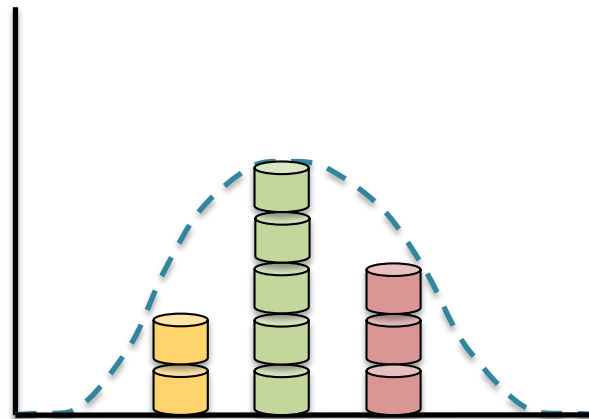


Hypothesis: pollutant removal in the biofilter is a **convolution** of the residence time distribution (RTD) and reaction rate

$C_{\text{exit}}$

=

$E(t) \text{ (time}^{-1}\text{)}$



\*  $C = C_0 e^{-kt}$

Mathematically, this is what a convolution looks like

$$C_{\text{exit}} = \int_0^{\infty} \underbrace{C_0(t - \tau) e^{-k\tau}}_{\text{First-Order Decay of Pollutant}} \underbrace{E(\tau)}_{\text{RTD}} d\tau$$

Integrate over all residence times in the biofilter

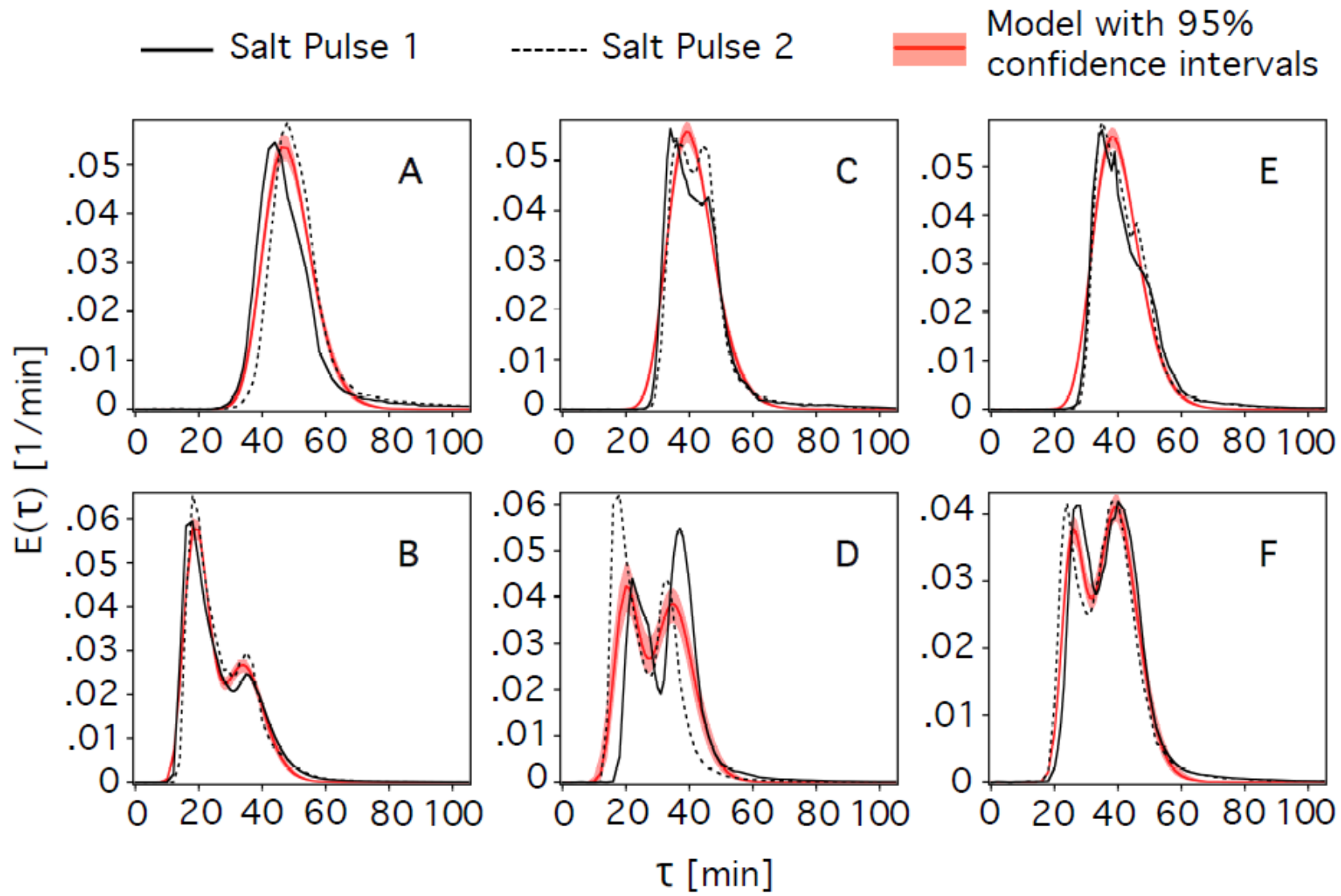


Figure 2

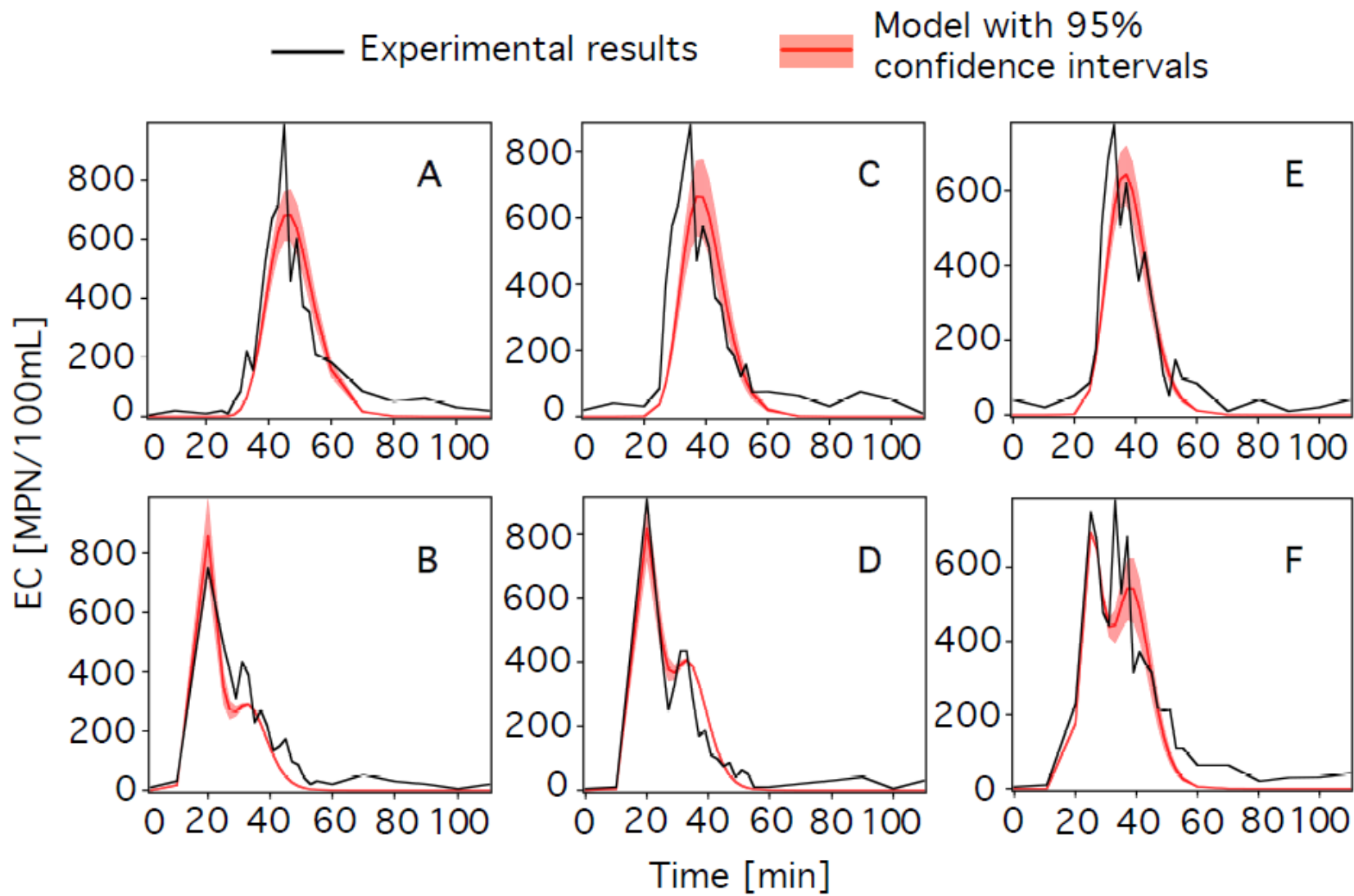


Figure 3

Mathematically, this is what a convolution looks like

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# Thank you for listening!



<http://faculty.sites.uci.edu/stanleygrantresearchgroup/>