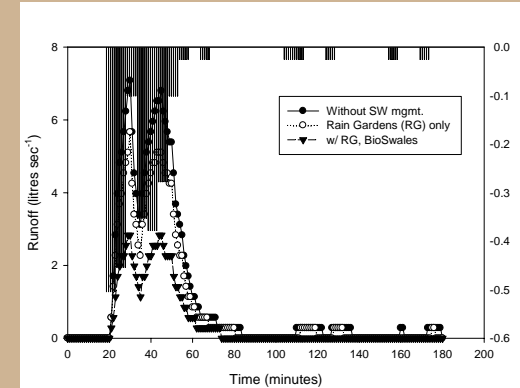
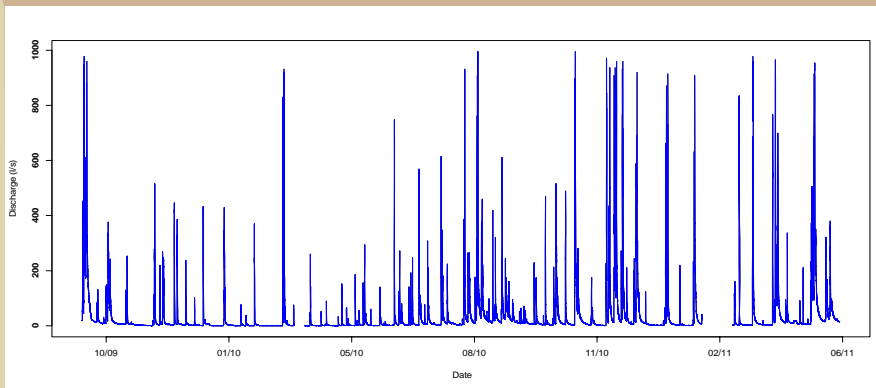




Implications for Stormwater Management



Tim Fletcher & Bill Shuster

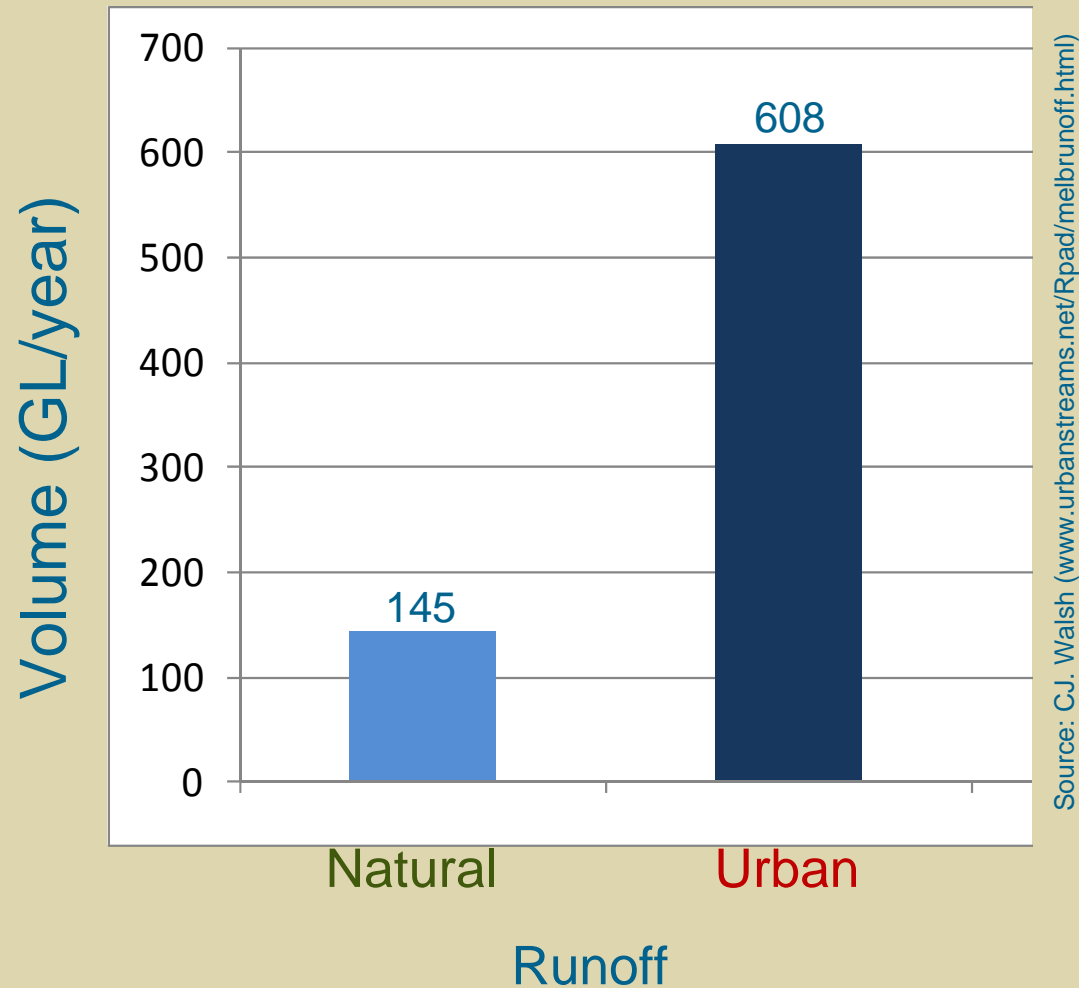
If we want to protect or restore streams...

Five golden rules:

1. Restore/protect hydrologic regime
2. Engage all actors (private, public, big, small & treat all imp. areas (private, public, big, small))
3. Simple, robust, flexible
4. Always be demanding
5. If it's worth protecting...



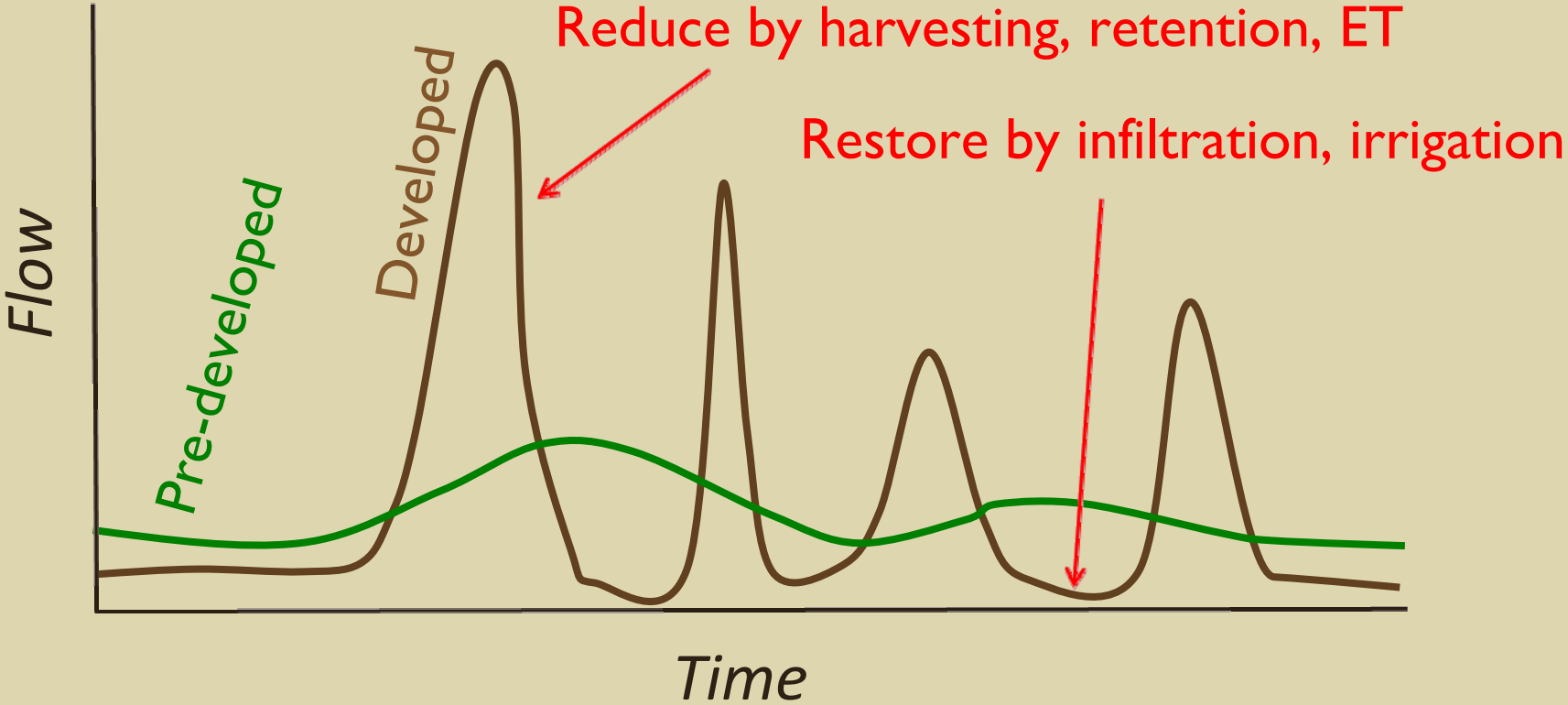
Stormwater; there's simply too much of it



Rule 1: Restore natural hydrology



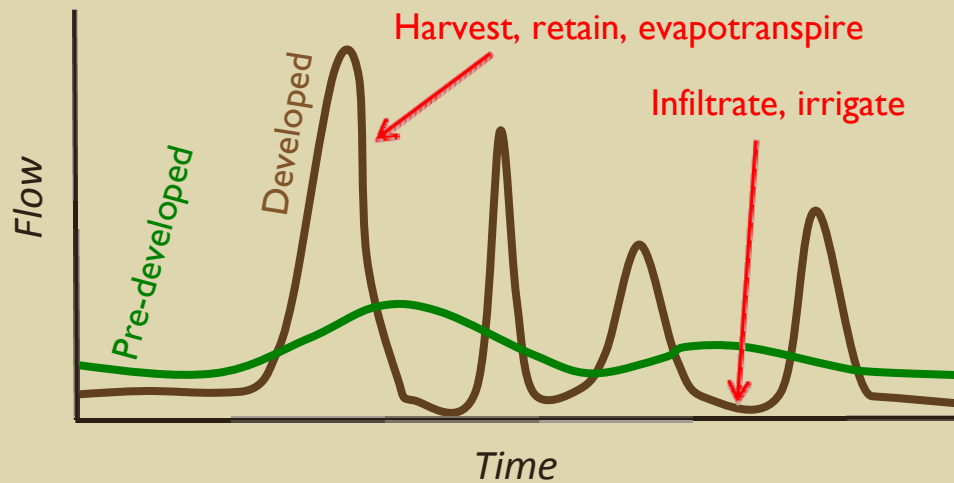
Restoring pre-development hydrology



Rule 1: Restore natural hydrology



Targets for hydrological restoration



1. Reduce runoff frequency
2. Restore baseflows (filtered)
3. Reduce overall volume (restore lost ET or export)

Indicator	Natural value (TARGET)	Value for impervious	Rationale
Runoff frequency (days/yr)	12	121	Frequency of disturbance (hydraulic, water quality)
Filtered baseflow (% of annual rainfall); % of flow through filtration or infiltration where $Q < Q_{natural_baseflow}$	15-35	0	Restore dry weather flows (naturally perennial) <u>and</u> water quality. Natural $Q_{baseflow}$ determined by (i) ref. catchment or (ii) infiltration rates
Runoff volume (% of annual rainfall)	15	85	Necessary to achieve others. Restore ET or equivalent



Rule 1: Restore natural hydrology



Hydrological restoration - *harvesting*

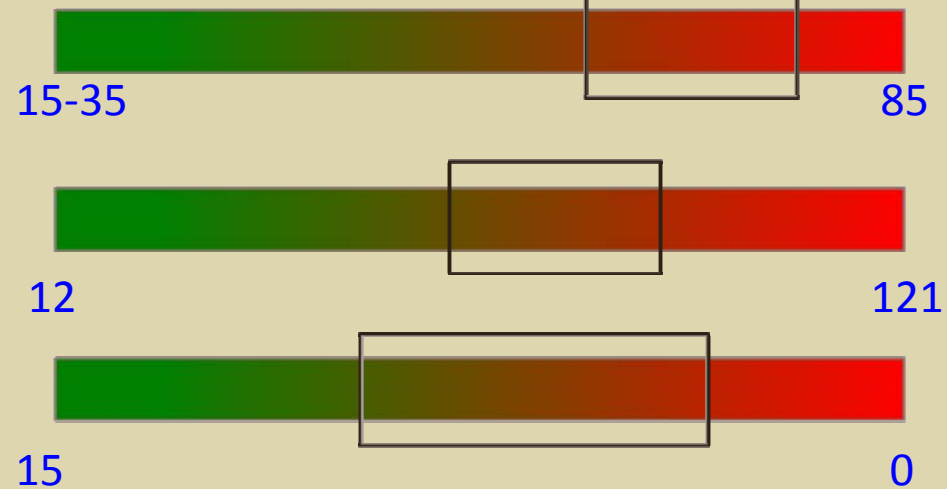


Outdoor uses only

- Runoff volume (*% of rainfall*)
- Runoff frequency (*days/yr*)
- Filtered baseflows (*% of rainfall*)

Natural (forest)

Impervious



Rule 1: Restore natural hydrology



Hydrological restoration - *harvesting*

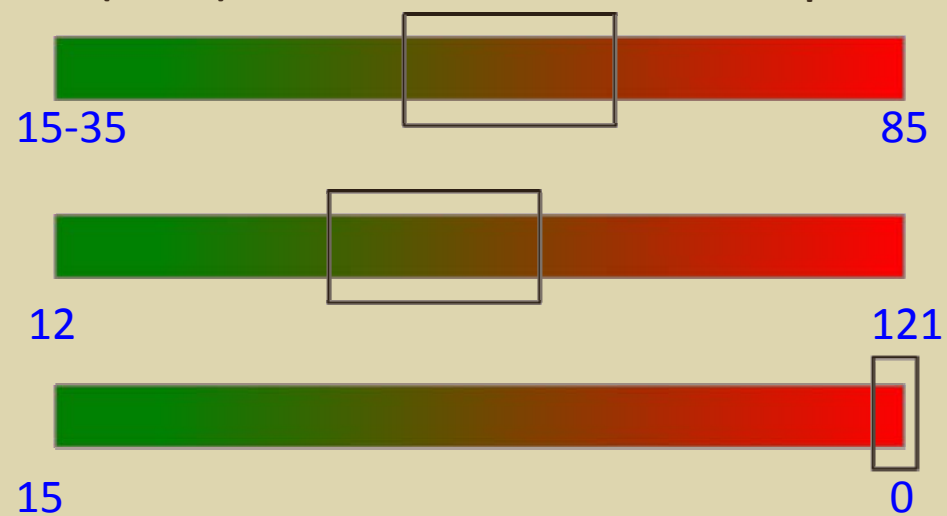


Indoor uses only

- Runoff volume (*% of rainfall*)
- Runoff frequency (*days/yr*)
- Filtered baseflows (*% of rainfall*)

Natural (forest)

Impervious



Rule 1: Restore natural hydrology



Hydrological restoration - *harvesting*

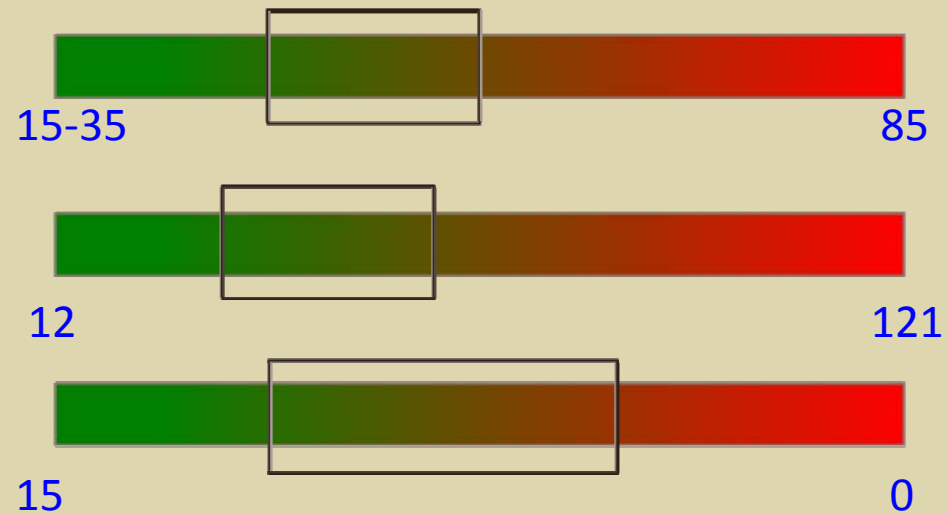


Indoor & outdoor use

- Runoff volume (*% of rainfall*)
- Runoff frequency (*days/yr*)
- Filtered baseflows (*% of rainfall*)

Natural (forest)

Impervious



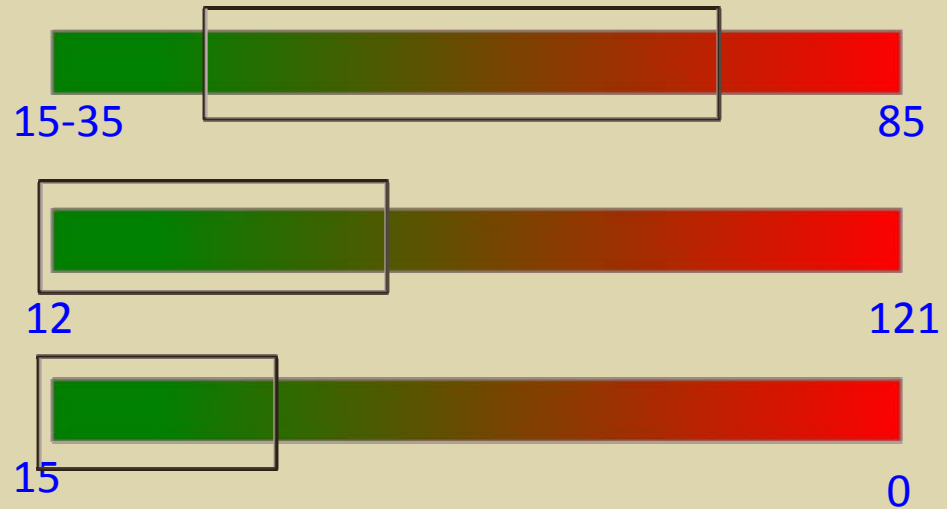
Hydrological restoration – infiltration/raingarden



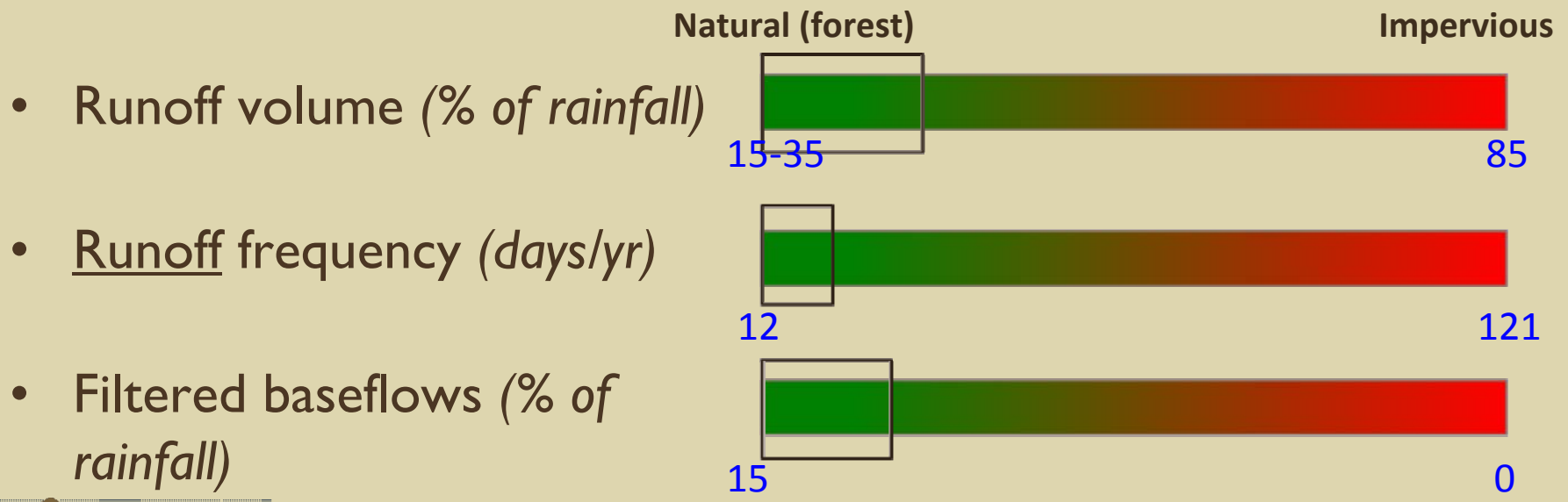
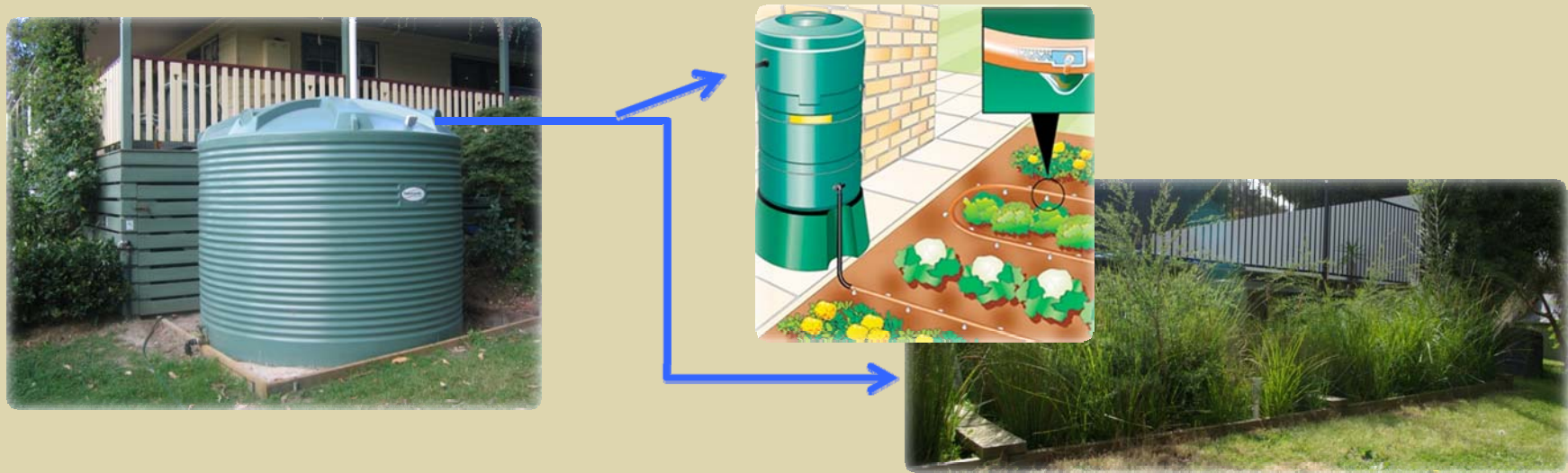
- Runoff volume (*% of rainfall*)
- Runoff frequency (*days/yr*)
- Filtered (base)flows (*% of rainfall*)

Natural (forest)

Impervious



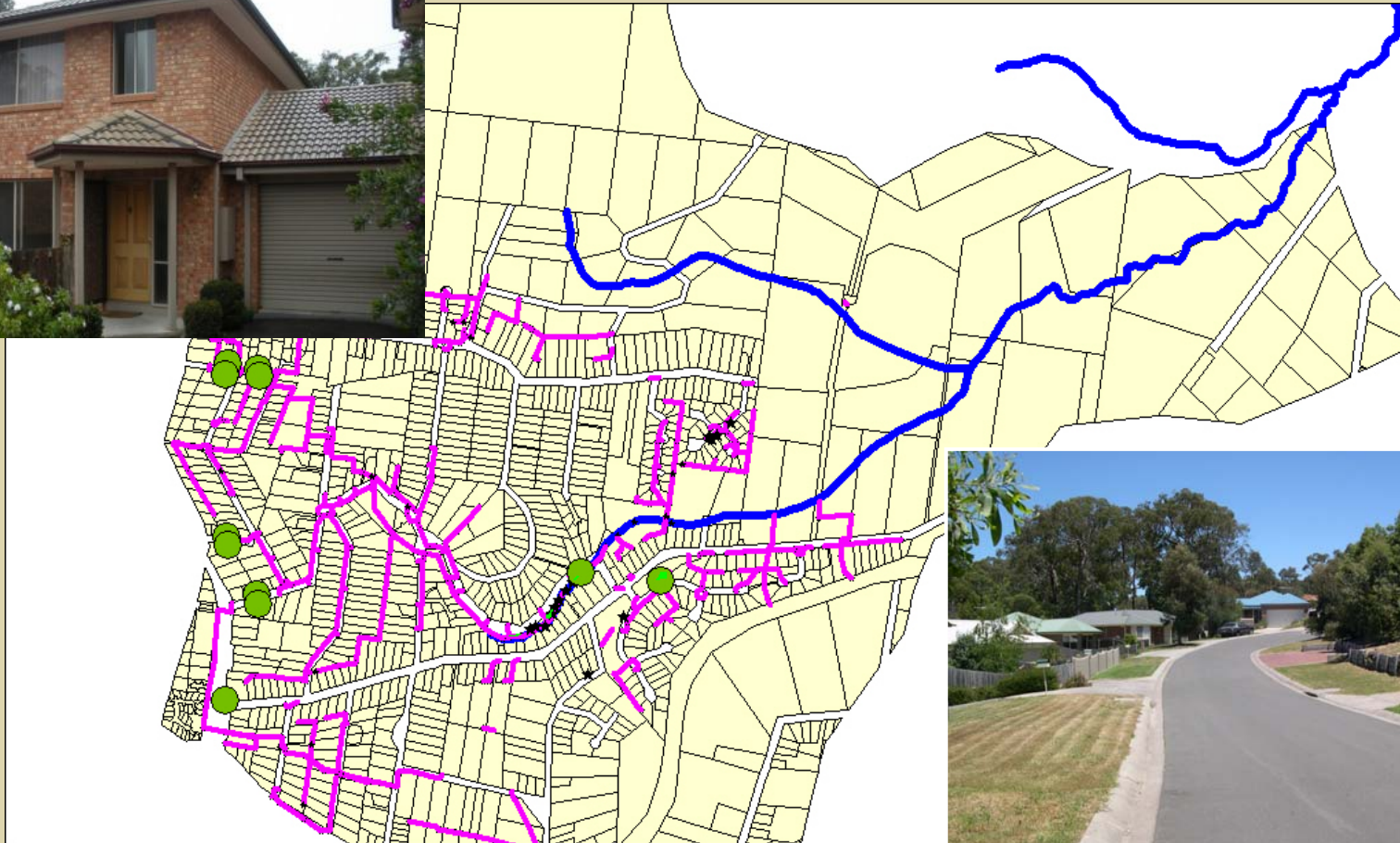
Harvesting then to raingarden / passive irrigation



Rule 1: Restore natural hydrology



Stormwater doesn't respect boundaries

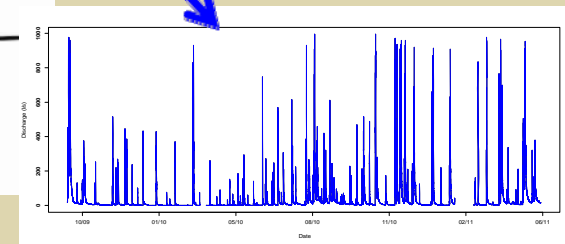


Rule 2: Engage all actors, treat all areas



Engaging all actors

- All projects should ‘compete’; funding should go to the best value projects, regardless of ownership
- But try to optimise arrangement (*synergy, antagonism*)



Rule 2: Engage all actors, treat all areas



Simple, robust, flexible



Encourage innovation



Rule 3: Simple, robust, flexible

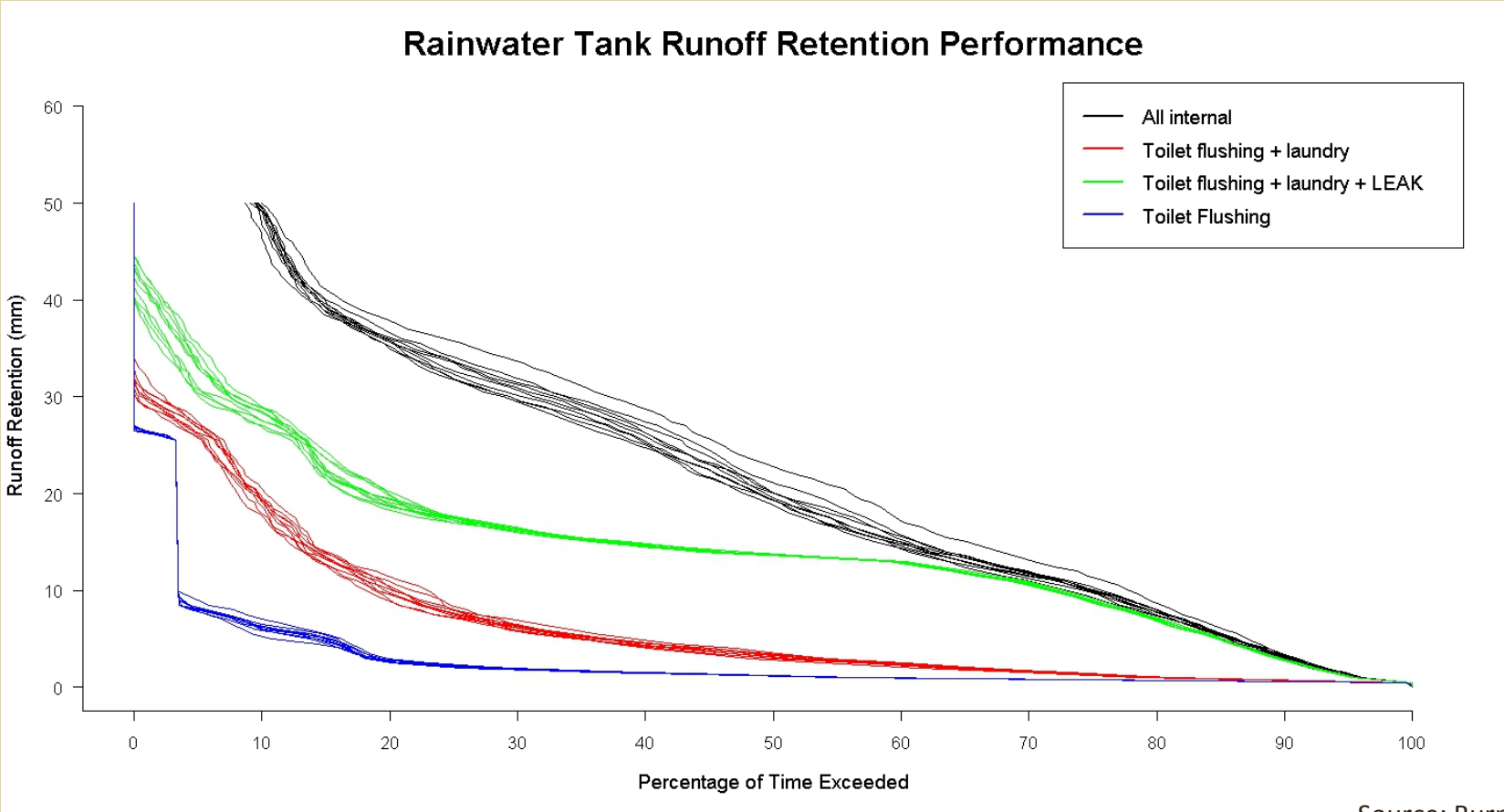




Passive irrigation 'leaky-tank'



Demands must be regular... or *passive*



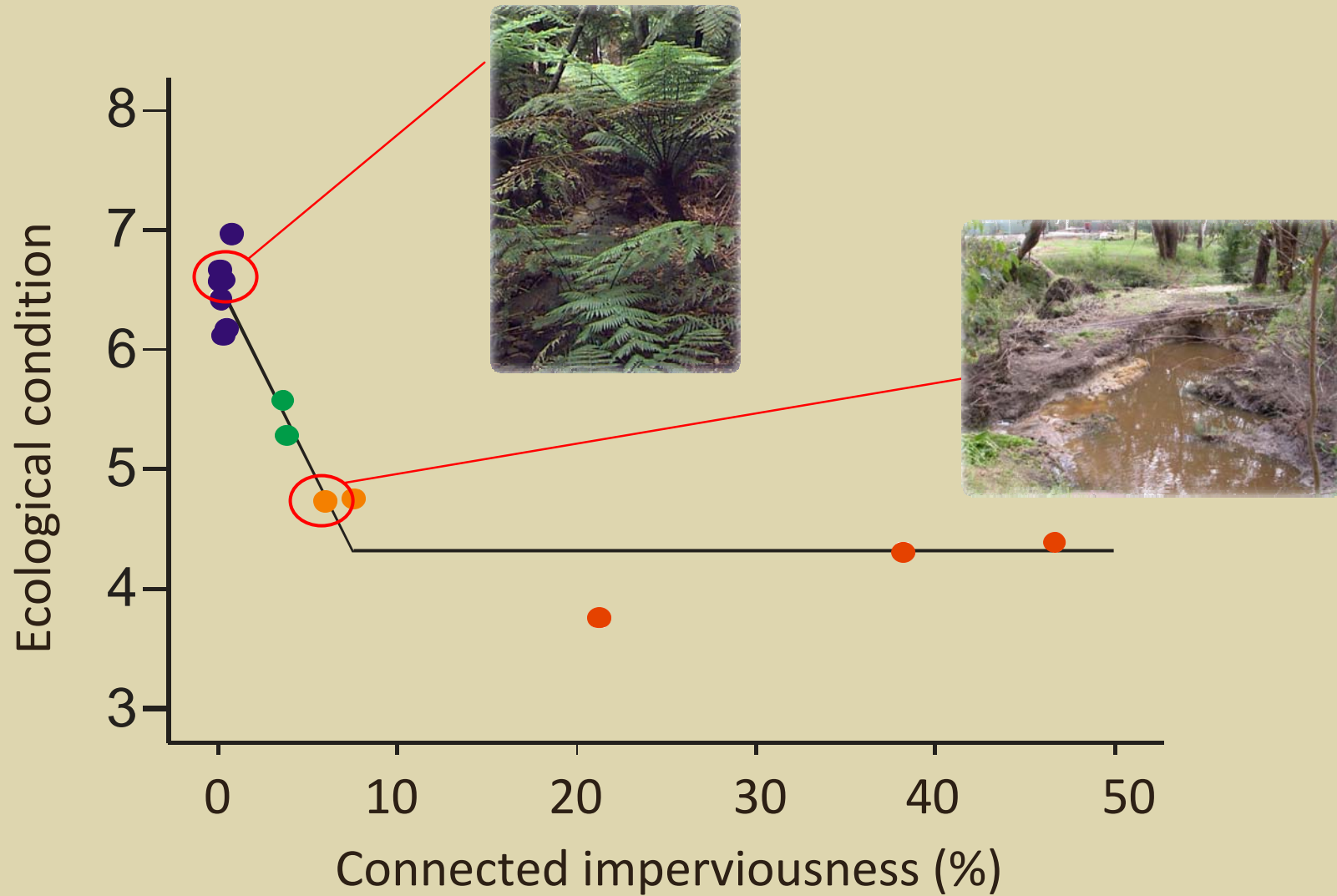
Source: Burns



Rule 4: Always be demanding



Protecting high value waterways



Rule 5: If it's worth protecting...

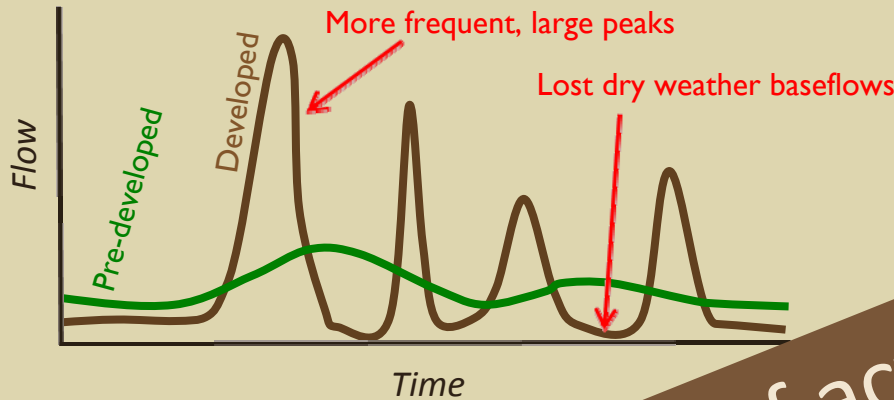


Objectives for each impervious surface...

- Reduce runoff frequency

- Restore baseflows

(filtration... time equiv.)



Combination of active (incentives, projects) & passive (regulation) strategies are required

Indicator	Value for pervious	Value for impervious
Annual runoff volume through <u>filtration</u> where $Q < Q_{natural_baseflow}$	5-15	80-125
Runoff volume (% of annual rainfall)	15-35	0
Runoff volume (% of annual rainfall)	15-35	80-90



Rule 5: If it's worth protecting...



Five golden rules:

1. Restore/protect hydrologic regime
2. Engage all actors (private, public, big, small & treat all impervious areas (private, public, big, small))
3. Simple, robust, flexible
4. Always be demanding
5. If it's worth protecting...

