RED RIVER RETENTION AUTHORITY

Red River Basin Tile Drainage Study

Briefing Paper #2: Water Management Options for Subsurface Drainage

---

BASIN TECHNICAL AND SCIENTIFIC ADVISORY COMMITTEE (BTSAC)

AVAILABLE @
HTTP://IWINST.ORG/MESMERIZE/WATERSHED-RESEARCH/REPORTS-AND-PAST-RESEARCH-ARCHIVE/

InternationalWaterInstitute
Flood research and watershed education for the Red River Basin

International Water Institute
Flood research and watershed education for the Red River Basin

- International Flood Mitigation Initiative (IFMI) 2000
- 501c3 Non-Profit Organization
- International (US and CA) Management Board
- Mission:
  - *Provide a forum for research, public education, training, and information dissemination relating to flood damage reduction and natural resource protection and enhancement in the Red River Basin*

Presentation Overview

1. Study Origins
   - Basin Technical and Science Advisory Committee
2. Soil Science/Tile Drainage
3. Briefing Paper #1
   - Conclusions/Statements
4. Briefing Paper #2*
   - Conclusions/Options

Study Origins

- 2009 Red River of the North Flood
- ND Red River Joint Water Resources District & MN Red River Watershed Management Board (Joint Drainage Committee)
  - *What are the impacts of agricultural drainage on peak watershed flows?*
  - *How should agricultural drainage systems be designed to maximize benefits while minimizing adverse impacts?*
- ND and MN Joint Boards formed RED RIVER RETENTION AUTHORITY
- Directed the International Water Institute to establish objective process to address questions - BTSAC

BTSAC MEMBERSHIP

Stakeholder	Representative	Stakeholder	Representative
MN Red River Watershed Management Board	Charlie Anderson	ND Red River Joint Water Resources Board	Kurt Lynse
City of Fargo, ND	Mark Bittner	US Geological Survey	Rochelle Nustad
MN Red River Watershed Management Board	Nate Dalager	ND Natural Resources Conservation Service	Dennis Reep
US Fish and Wildlife Service	Josh Eash	ND State Water Commission	Bill Schuh
International Water Institute	Charles Fritz	MN Department of Agriculture	Rob Sip
ND Red River Joint Water Resources Board	Randy Gjestvang	MN Department of Natural Resources	Jim Solstad
MN Natural Resources Conservation Service	Dave Jones	MN Red River Watershed Management Board	Dan Thul
US Army Corps of Engineers	Scott Jutila	MN Center for Environmental Advocacy	Henry VanOffelen
MN Board of Soil and Water Resources	Al Kean	City of Moorhead, MN	Bob Zimmerman

BRIEFING PAPER(S)

- STUDY GOAL
  - Understand Subsurface Drainage Systems Impacts on Watershed and Basin hydrology
  - Develop Management Recommendations
    - Maximize Benefits/Minimize Impacts

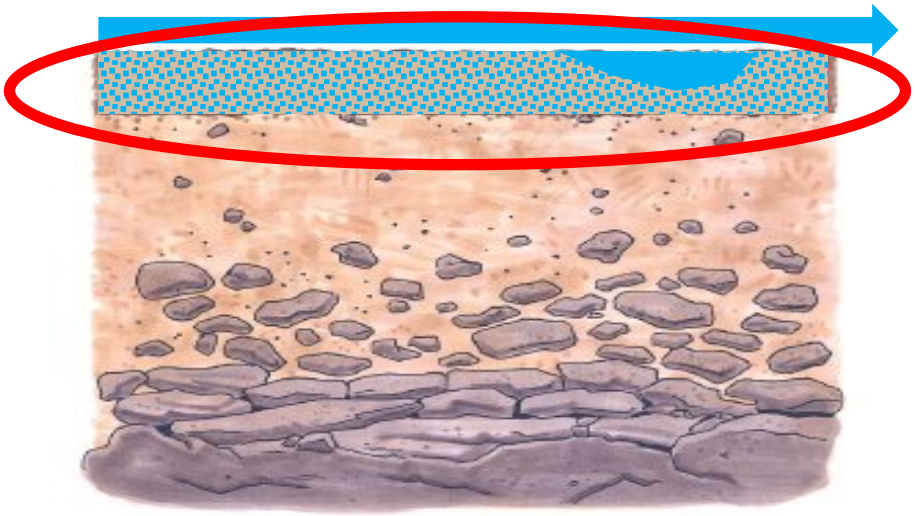
- Audience:

RED RIVER RETENTION AUTHORITY

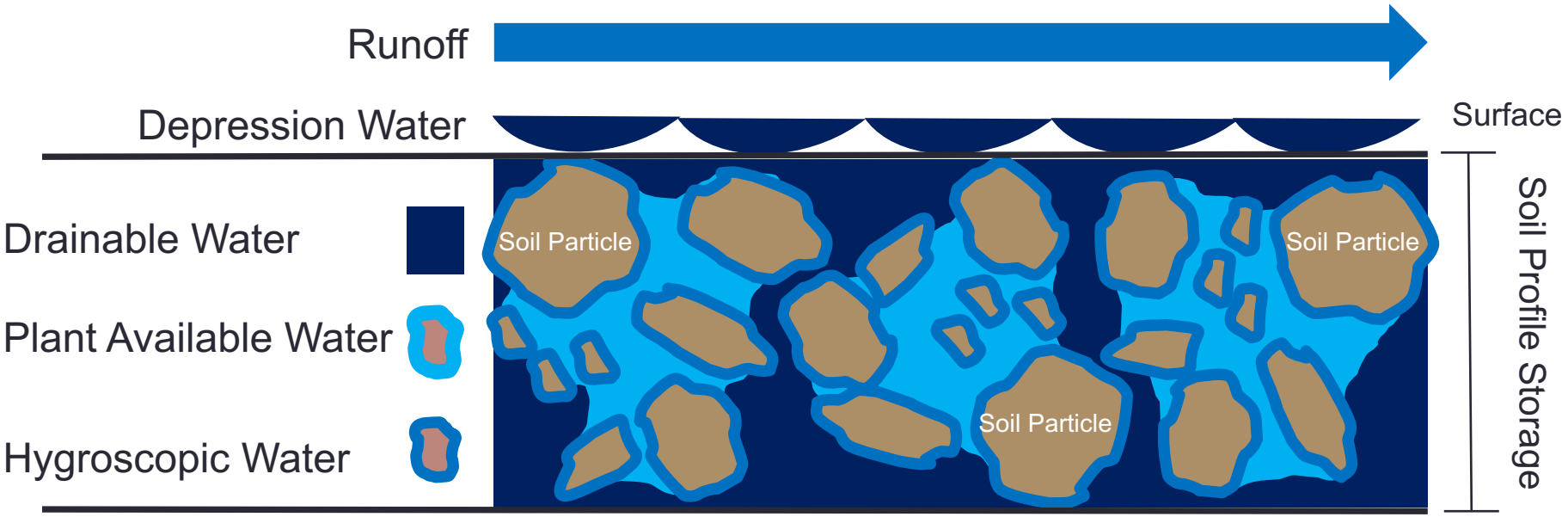
  - MN - Red River Watershed Management Board
    - Member Watershed Districts
  - ND - Red River Joint Water Resources District
    - Member Water Resources Districts

GENERAL PROCESS

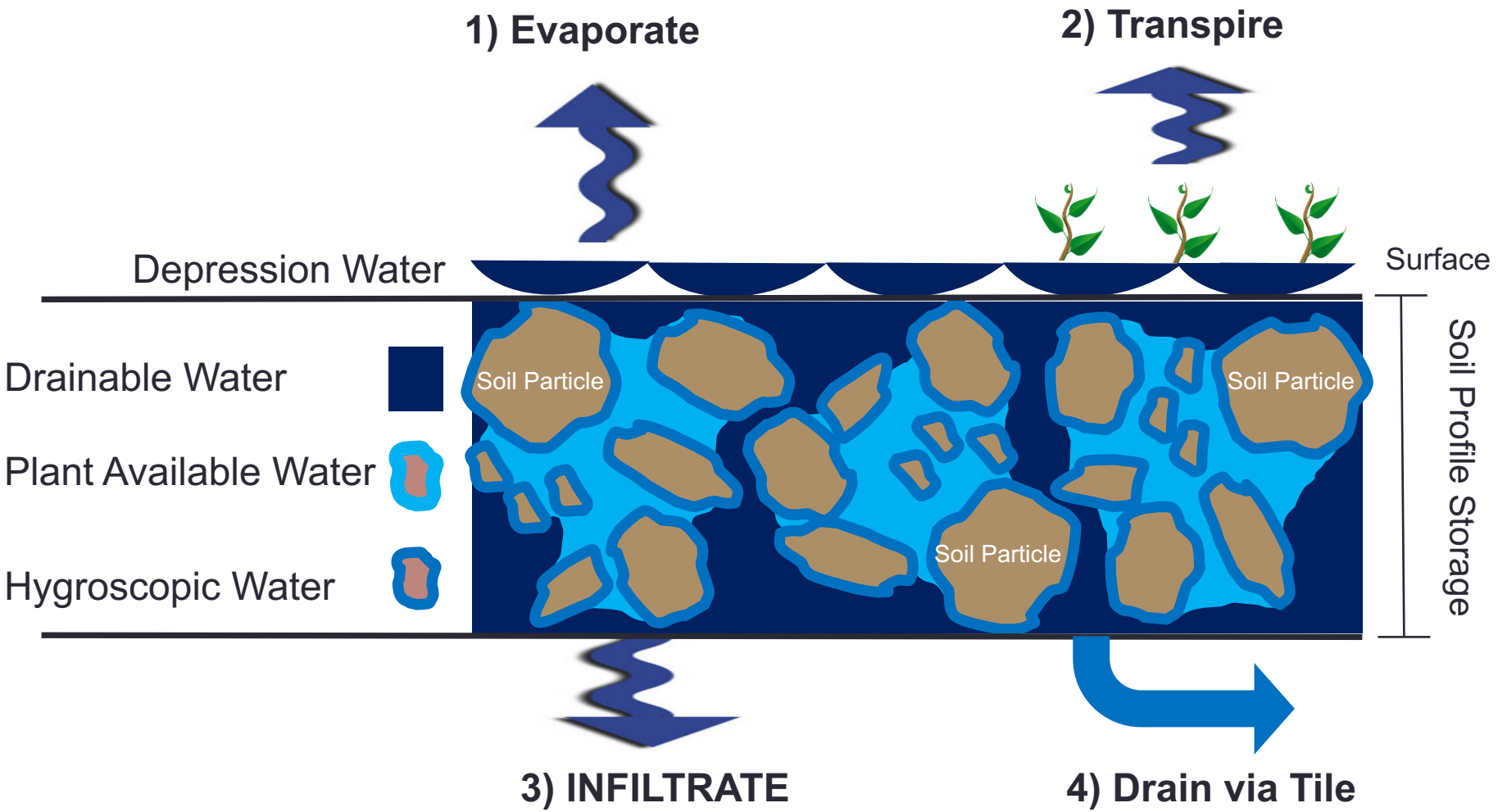
- Rainfall or Snowmelt begins…
  - If not already full, water fills depressions and soil profile
- Excess Water – Surface Runoff
- Fate of Soil Profile and Surface Depression Water?



Partitioning of Soil and Surface Water



Fate of Soil and Surface Water:



Water Storage

- **Retention** – Storing water for extended periods of time (weeks or months) for alternate uses. Sometimes referred to as a “permanent” reservoir or that portion of the reservoir pool that is considered permanent.

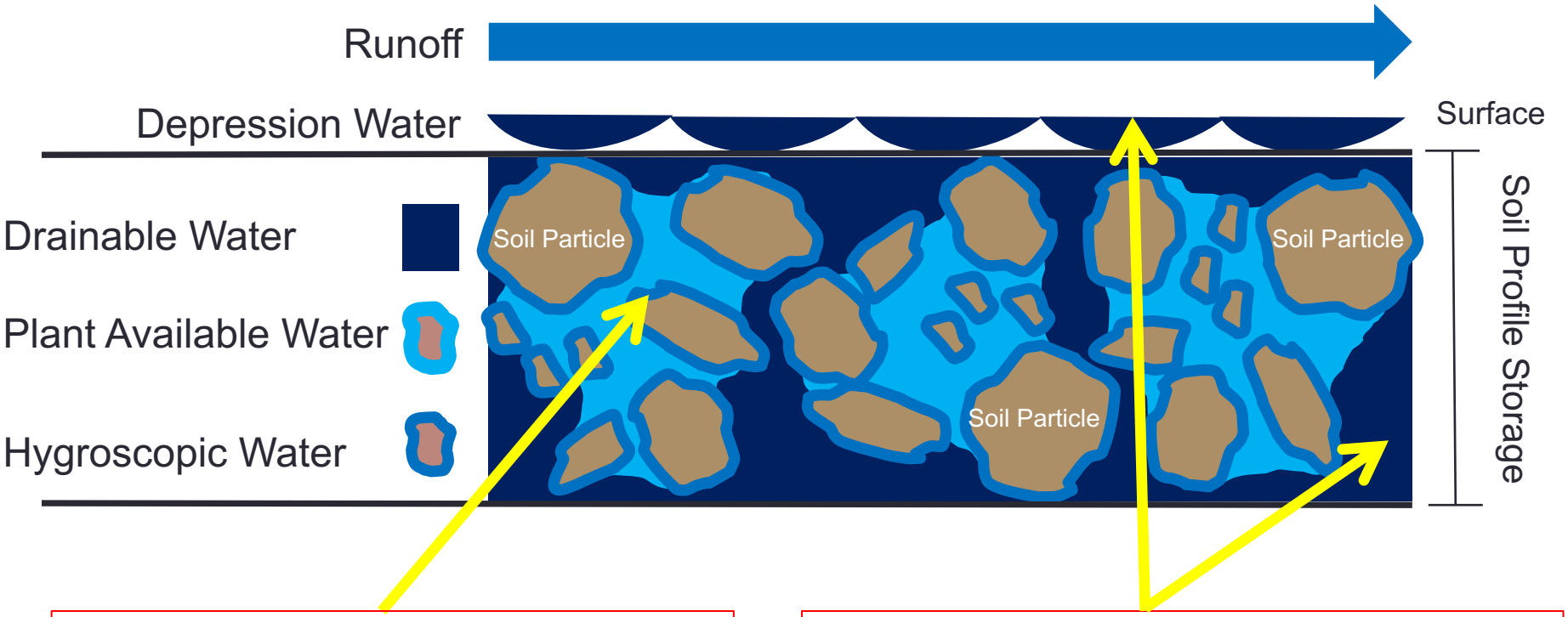
- **Detention** - Storing water for a limited period of time (hours or days). Sometimes referred to as a “dry” pond or that portion of water in a reservoir that can be quickly and easily removed.

Wetland - detention

Wetland - retention

Maple River Dam - detention

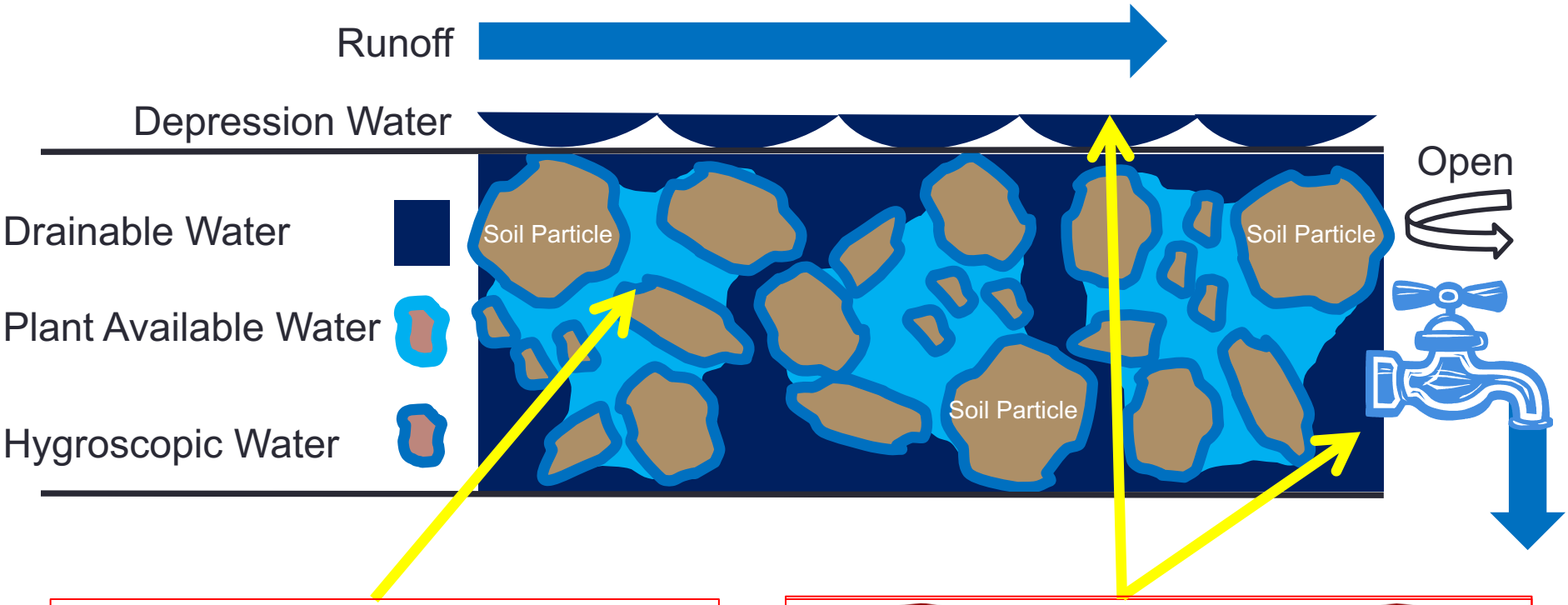
No Subsurface Drainage



Hygroscopic and Plant Available Water =
Retention Storage

Drainable Water and Surface Depression Water =
Retention Storage

With Subsurface Drainage



Hygroscopic and Plant Available Water =

Retention Storage

Drainable Water and Surface Depression Water =

Detention Storage

REVIEW (Briefing Paper #1): Impacts of Agricultural Drainage (Subsurface) on Watershed Peak Flows

- Available literature and hydrologic modeling Subsurface Drained ***FIELDS***:
  - Attenuate outflows
    - Decrease Peak Flow
    - Delayed Discharge*
  - Increase Water Yield
    - Predominately early spring and fall

TAKE HOME MESSAGE (Briefing Paper #1)

…“Any general statement implying that subsurface drainage decreases (or increases) flood peaks is strongly discouraged because it oversimplifies the complex processes involved.”…

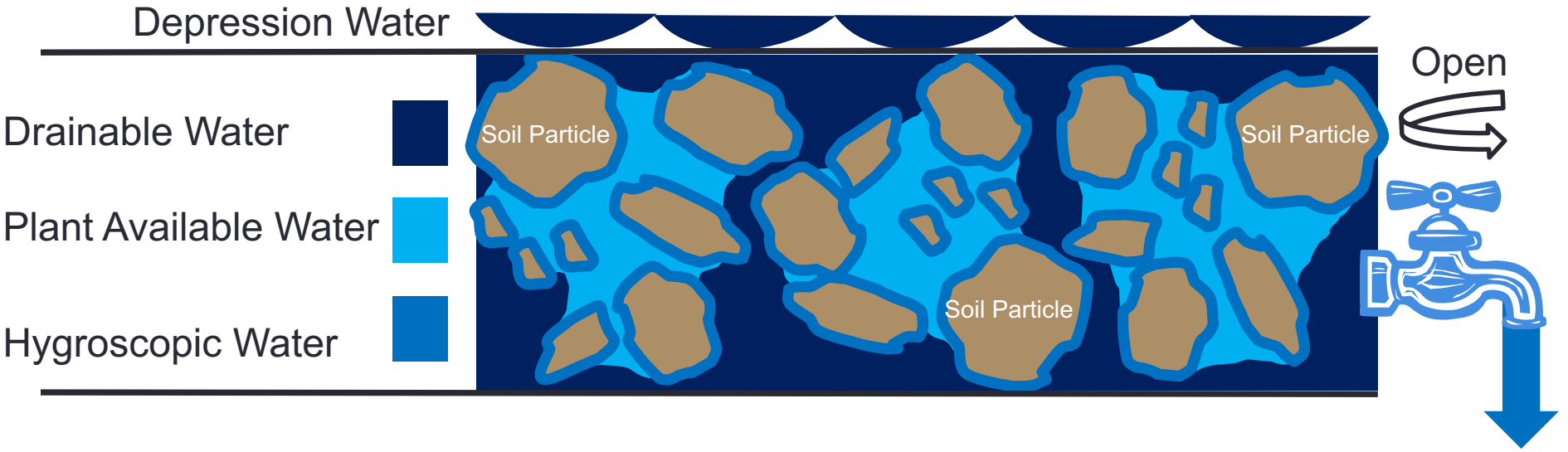
Briefing Paper #2 Conclusions:

- ✓ *Situations do exist where adding uncontrolled subsurface drainage to areas of the landscape has the potential to increase flooding. This risk must be considered and evaluated in water management decision making.*

- ✓ *The inclusion and appropriate operation of control structures on existing and proposed subsurface drainage systems can maximize water storage potential and reduce flood flows.*

Subsurface Drainage Management:

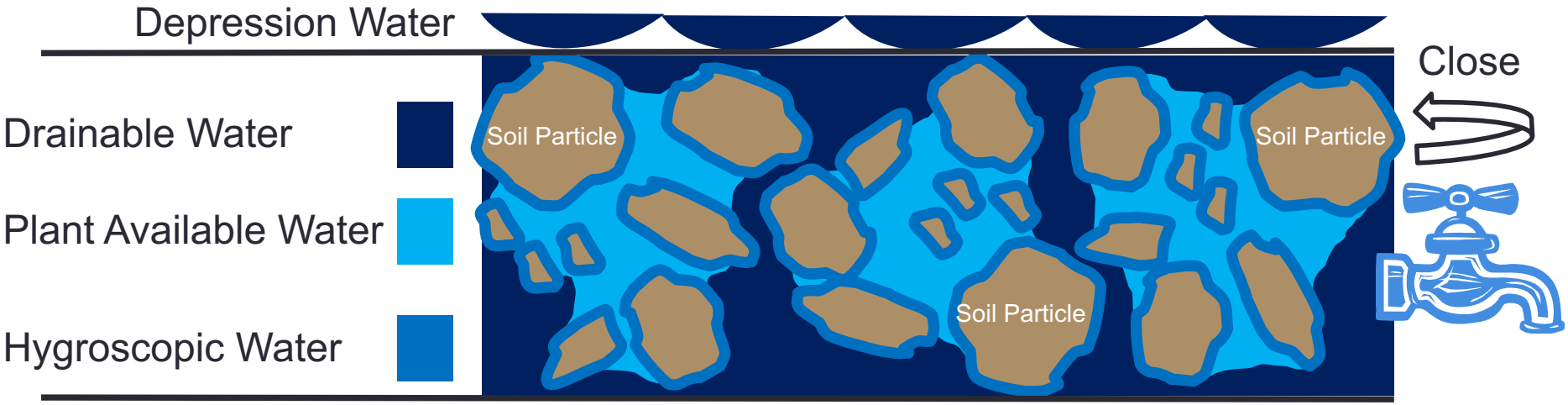
FALL SEASON



- ✓ ***As conditions allow***, subsurface drains can be opened to drain the soil profile and surface depression water in preparation for a spring flood event.

Subsurface Drainage Management:

SPRING (flood) SEASON



- ✓ ***As conditions allow***, subsurface drains can be closed to store water during the spring flood event.

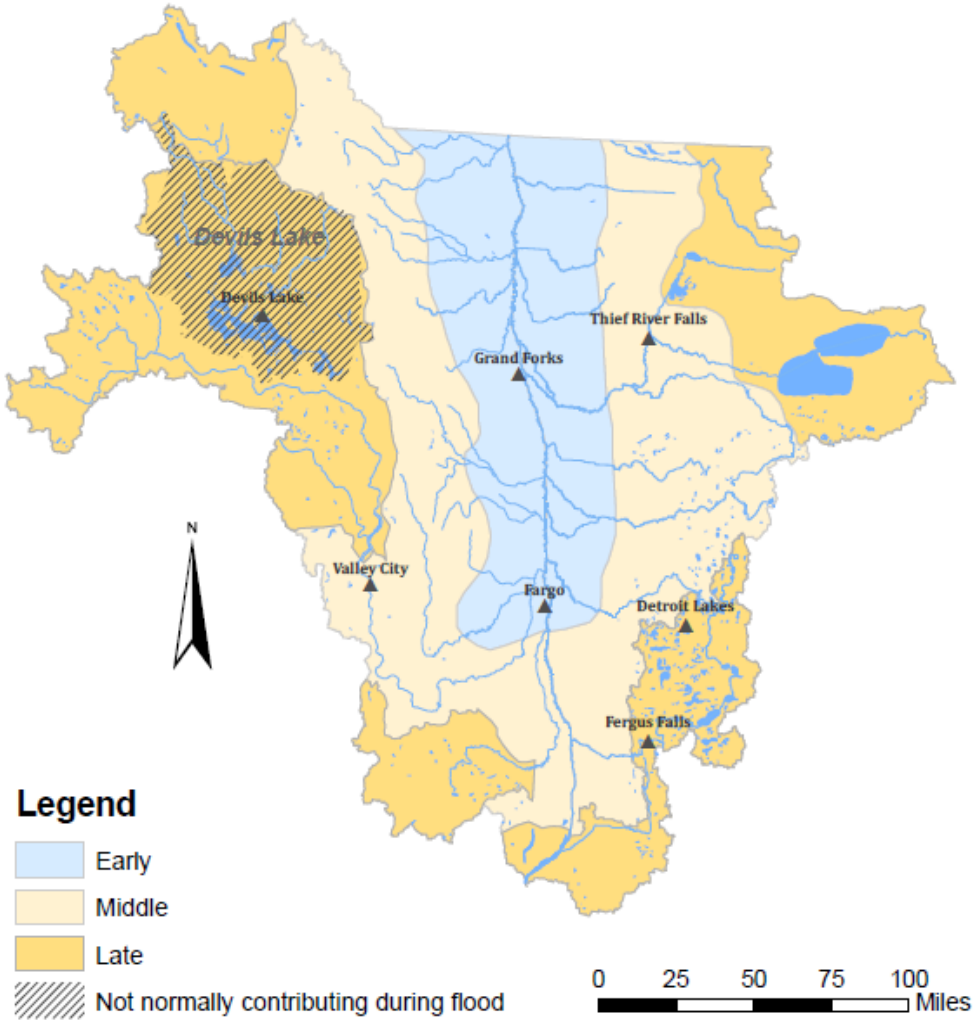
Water Management Objectives

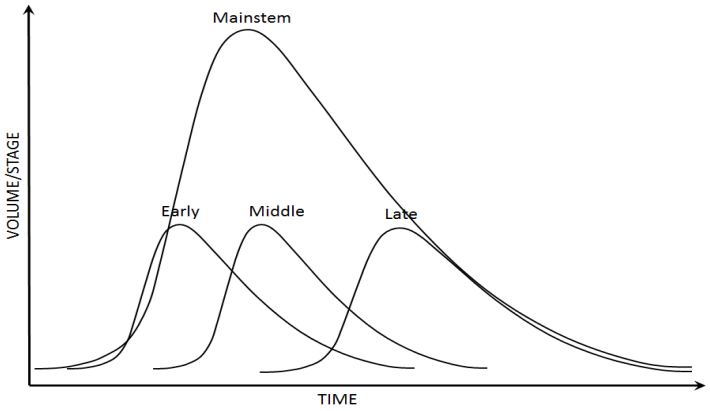
- Field/Producer
  - Optimize Crop Production
    - Remove water during wet periods (planting and harvesting)
    - Conserve water during droughts
- Watershed/Basin/Manager
  - Reduce flood flows (spring/summer events)
    - Minimize flood damages

Options (permitting/management)

1. Field Outlet Control (preferred)
2. Water Storage Trading (preferred)
3. On or Off Site Storage
4. Culvert Sizing
5. DC Limitations

Early, Middle, and Late Water Concept





Unmanaged Subsurface Drainage Effects

Effect	Early Water	Middle Water	Late Water
Increased Volume	(-)	(- -)	(-)
Delayed Peak	(-)	(- or +)	(+)
Decreased Peak	(+)	(+ +)	(+)

Early, Middle, Late Region Considerations

Options	Early Water	Middle Water	Late Water
Preferred - Field Outlet Control	Reduce	Reduce	Reduce
Preferred - Control structure Credits/Bank	Reduce	Reduce	Reduce
Subsurface Drainage Coefficient Limits	Increase	Reduce	Reduce
Off/On-site Storage Option	Reduce*	Reduce	Reduce
Culvert Sizing	Increase	Reduce	Reduce

*Assumes gated storage. Un-gated storage would increase potential in Early Water areas

RED RIVER RETENTION AUTHORITY

Updates

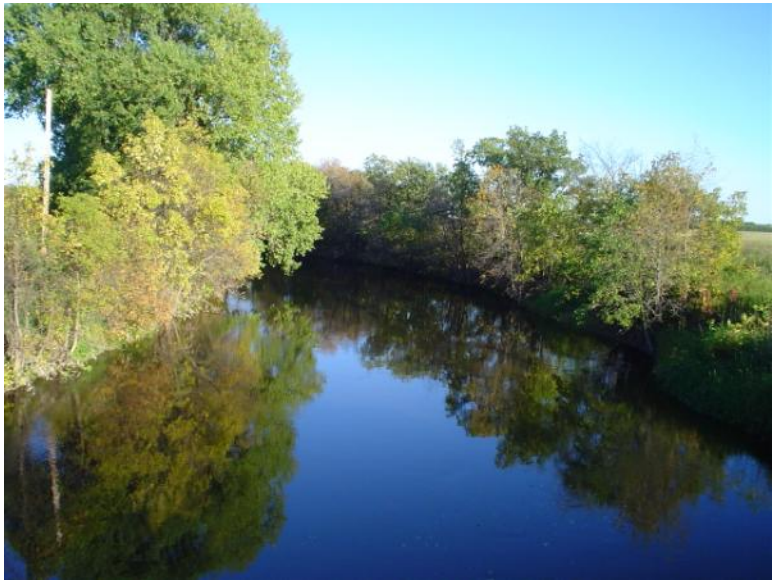
- GSSHA Modeling Results
  - Affirmed BTSAC recommendations
- University of MN Extension
  - *Developing Optimum Drainage Design Guidelines for the Red River Basin* (Sands and Canelon 2013)
- Water Storage Trading/Credit Program
  - TBD
- Address other Technical Issues in Service to the RRRA*
  - Surface Drainage Study (August 2014)

"Availability of good information lies at the heart of effective and equitable decision making"

(Allen and Kilvington 1999)

International Water Institute
Flood research and watershed education for the Red River Basin

FOR MORE INFORMATION CONTACT:
Charles Fritz
Fargo, ND 58102
Email: charles@iwinst.org
Phone: 701.388.0861



RED RIVER RETENTION AUTHORITY