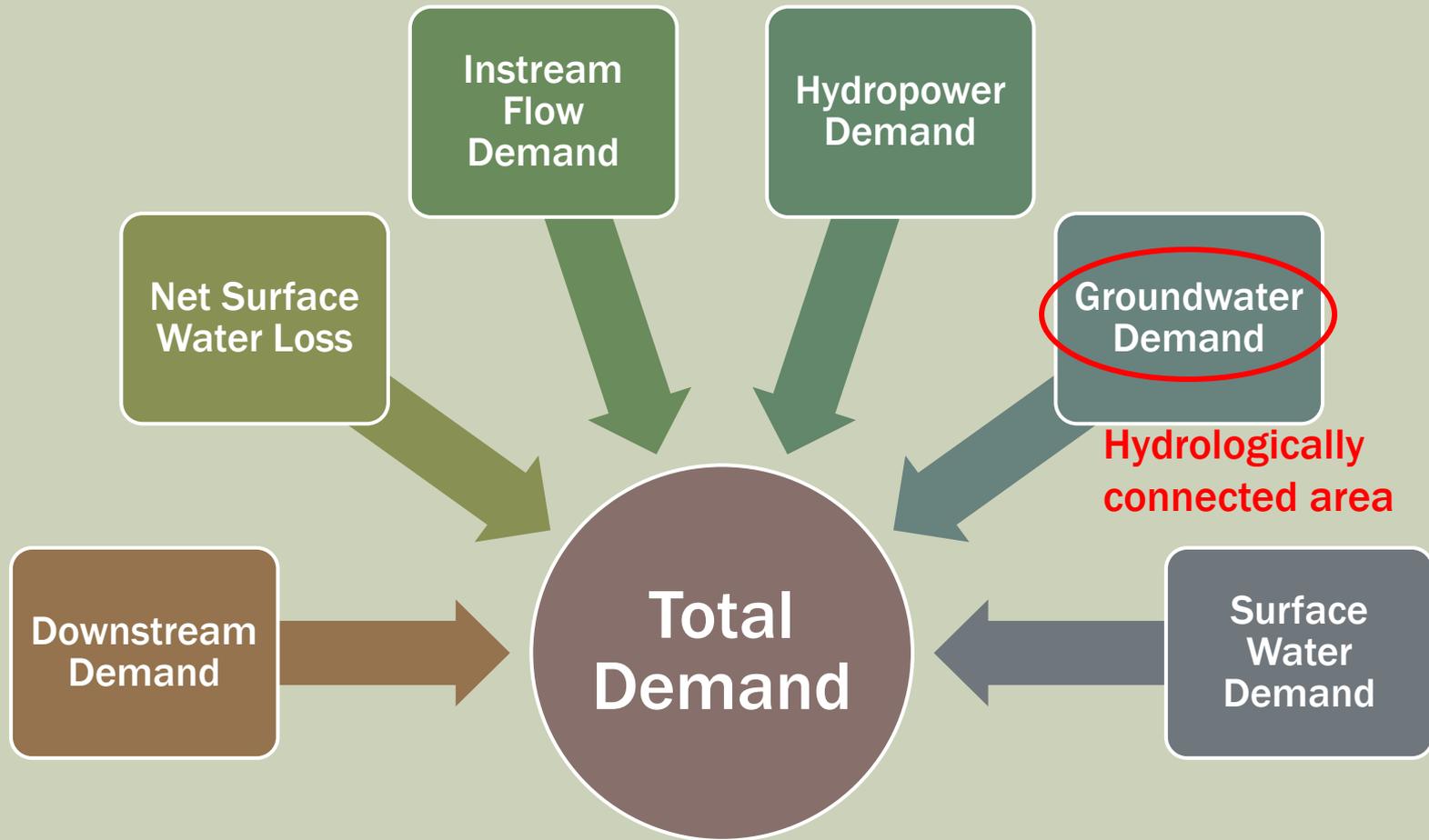


HYDROLOGICALLY CONNECTED AREA & HYDROPOWER DEMAND

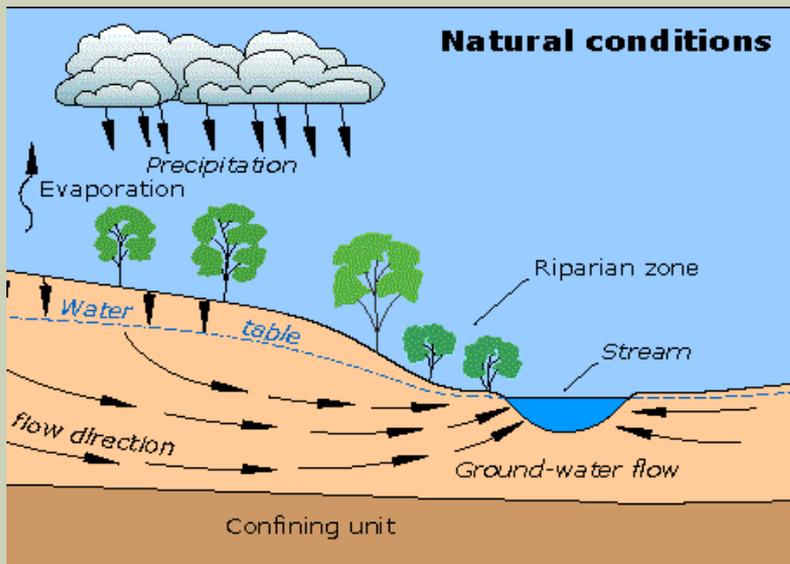
A Component
of Total
Demand as
Calculated for
INSIGHT

OUTLINE

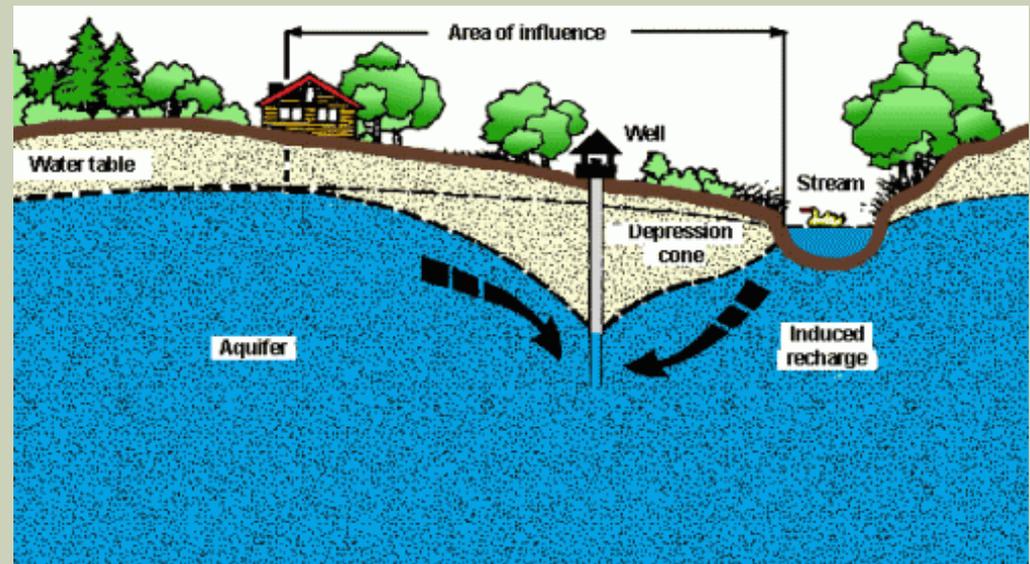


HYDROLOGICALLY CONNECTED AREA

- Geographic area within which groundwater is hydrologically connected to surface water
- 10/50 Area: one type of hydrologically connected area
- Within 10/50 areas, at least 10% of the water pumped over a 50-year period is from streamflow

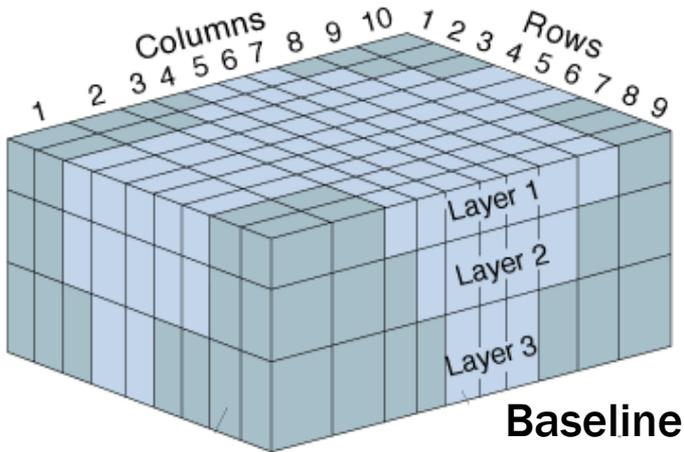


Source: ga.water.usgs.gov



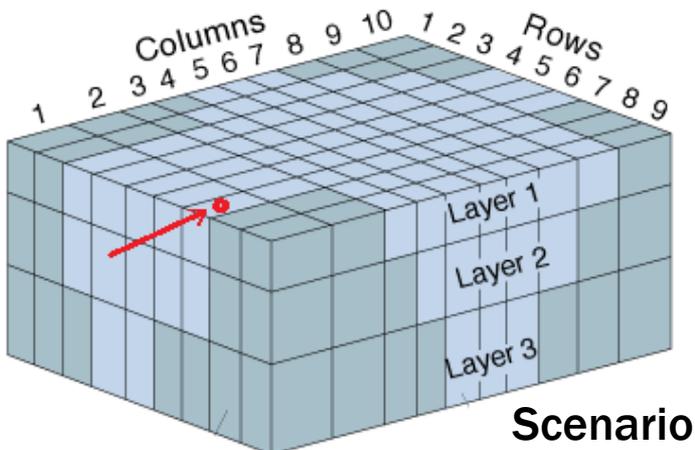
Source: wellwater.oregonstate.edu

CALCULATION-NUMERICAL APPROACH



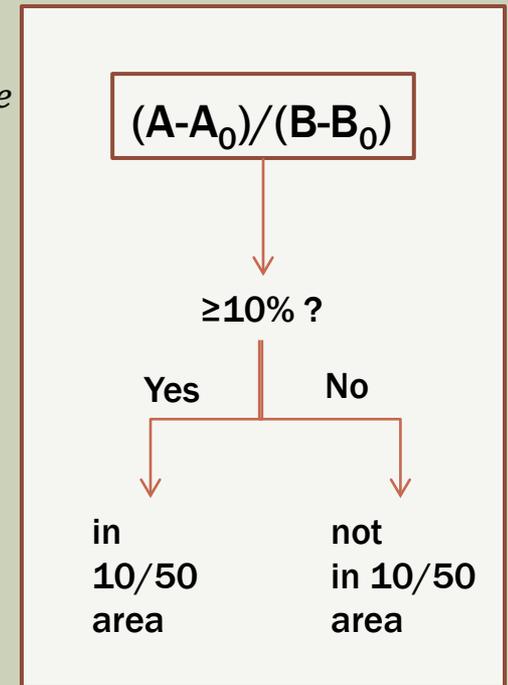
$$A_0 = \text{Streamflow}_{\text{Baseline}}$$

$$B_0 = \text{Well_Pump}_{\text{Baseline}}$$



$$A = \text{Streamflow}_{\text{Scenario}}$$

$$B = \text{Well_Pump}_{\text{Scenario}}$$

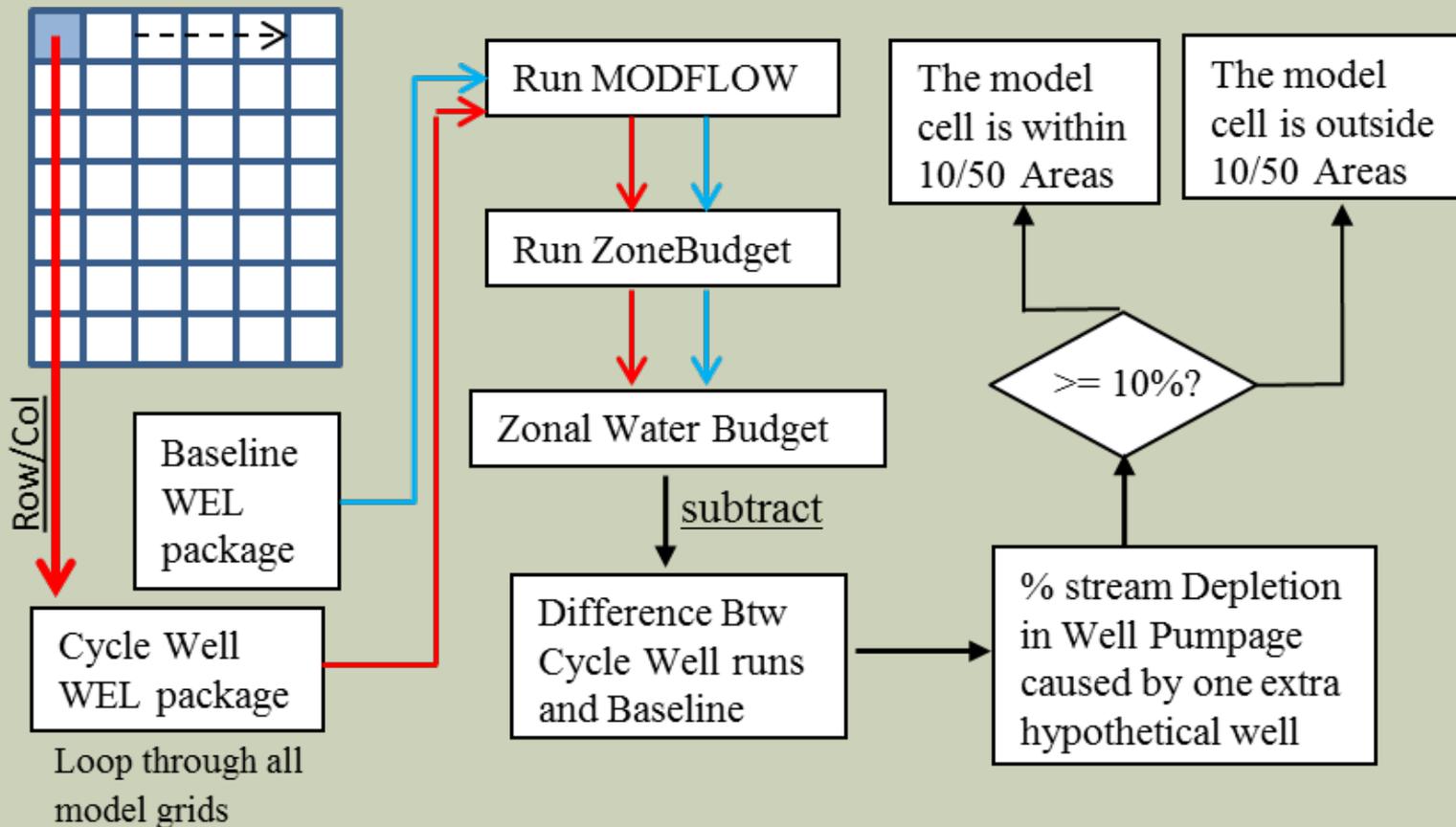


BASIC PROCEDURE

- A. Prepare modeling files with a time span of at least 50 years
- B. Add one hypothetical well to one model cell
- C. Run the **MODFLOW** program
- D. Run **ZoneBudget** program to produce the zonal water budget
- E. **Post-process the ZoneBudget outputs**
- F. Designate that model cell as 10/50 area, or not
- G. Repeat, placing a hypothetical well in the next model cell and loop through the above process until all model grids were designated



PROCEDURE FLOWCHART



CYCLE WELL ANALYSIS (CWA)

Cycle Well Analysis

Basic | Switch To Advance

Enter Pumping Rate (L**3/T) **Item 1**

MODFLOW Version **Item 2** Browse

Select Nam File **Item 3** Browse

Module Boundary File **Item 4** Browse

Number of Rows Number of Columns

Output Summary File **Item 5** Open

Stress Period for Summary **Item 6** Max Stress Period 600

Use Custom Well List **Item 7** Browse

Run Zone Budget List Files Reference

Zone File **Item 8** Browse

Cycle Cells

	Row	Columns
Start	<input type="text" value="134"/> Item 9	<input type="text" value="360"/>
Stop	<input type="text" value="147"/>	<input type="text" value="408"/>
Step	<input type="text" value="1"/>	<input type="text" value="1"/>

Max Rows 275
Max Columns 504

QUIT

Running MODFLOW Cycle (138,368)...

V_1

Cycle Well Analysis Advanced

Advanced | Switch to Basic

Cycle Well List Browse

MODFLOW Version Browse

Select Nam File Browse

Module Boundary File Browse

Output Summary File Open

Stress Period for Summary Max Stress Period 363

Run Zone Budget List Files Reference

Zone File Browse

QUIT

Running MODFLOW Cycle (174,135) with pump rate-32000...

V_1

- AppLaunch
- CWARunner
- CWA.exe
- CWA.exe.config
- CWA.pdb
- CWA.vshost.exe
- CWA.vshost.exe.config

CWA POST-PROCESSING

- Model-wide 10/50 Area
- Subbasin 10/50 Area

A	B	C	D
ZONE	(All)		
Row Labels	Sum of % NET STREAM LEAKAGE	Sum of NET Total	Sum of NET WELLS
100_100	-0.00065248	-107367.5243	-584799999.7
100_101	-0.000600664	-200221.6584	-584799999.7
100_102	-0.000549373	-197407.3021	-584799999.7
100_103	-0.000523896	-102377.9299	-584799999.7
100_104	-0.000510059	-403175.6707	-584799999.7
100_105	-0.000518194	-401052.8879	-584799999.7
100_106	-0.000535009	22062.32956	-584799996.7
100_107	-0.000559225	187615.4462	-584799996.7
100_108	-0.000611343	-114090.6283	-584799999.7
100_109	-0.000678202	-320787.5786	-584799999.7
100_110	-0.000815429	-293681.6359	-584799999.7
100_111	-0.00094277	-61991.26058	-584799999.7
112	-0.001058599	-437206.2485	-584799996.7
113	-0.001227309	-458080.1855	-584799999.7
114	-0.001558908	-144243.6967	-584799999.7
115	-0.002010329	196036.6528	-584799999.7
116	-0.002412921	-607816.6922	-584799999.7
117	-0.002888751	-232547.7291	-584799999.7
118	-0.003655201	-364664.1773	-584799996.7
119	-0.004467814	36407.09795	-584799999.7
120	-0.00524384	-470848.8597	-584799999.7
121	-0.006266194	-157622.3368	-584799999.7
122	-0.007528602	-486788.3688	-584799996.7
100_123	-0.008970668	-418788.9395	-584799996.7

PivotTable Field List

Choose fields to add to report:

- TOTIM
- PERIOD
- STEP
- ZONE
- DAYS
- Cycle
- NET STORAGE
- NET CONSTANT HEAD
- NET WELLS
- NET RIVER LEAKAGE
- NET HEAD DEP BOUNDS
- NET RECHARGE
- NET STREAM LEAKAGE
- NET Other Zones
- NET Total
- % NET STORAGE
- % NET CONSTANT HEAD
- % NET WELLS
- % NET RIVER LEAKAGE
- % NET HEAD DEP BOUNDS

Drag fields between areas below:

Report Filter

ZONE

CWA Summary Analysis Tool

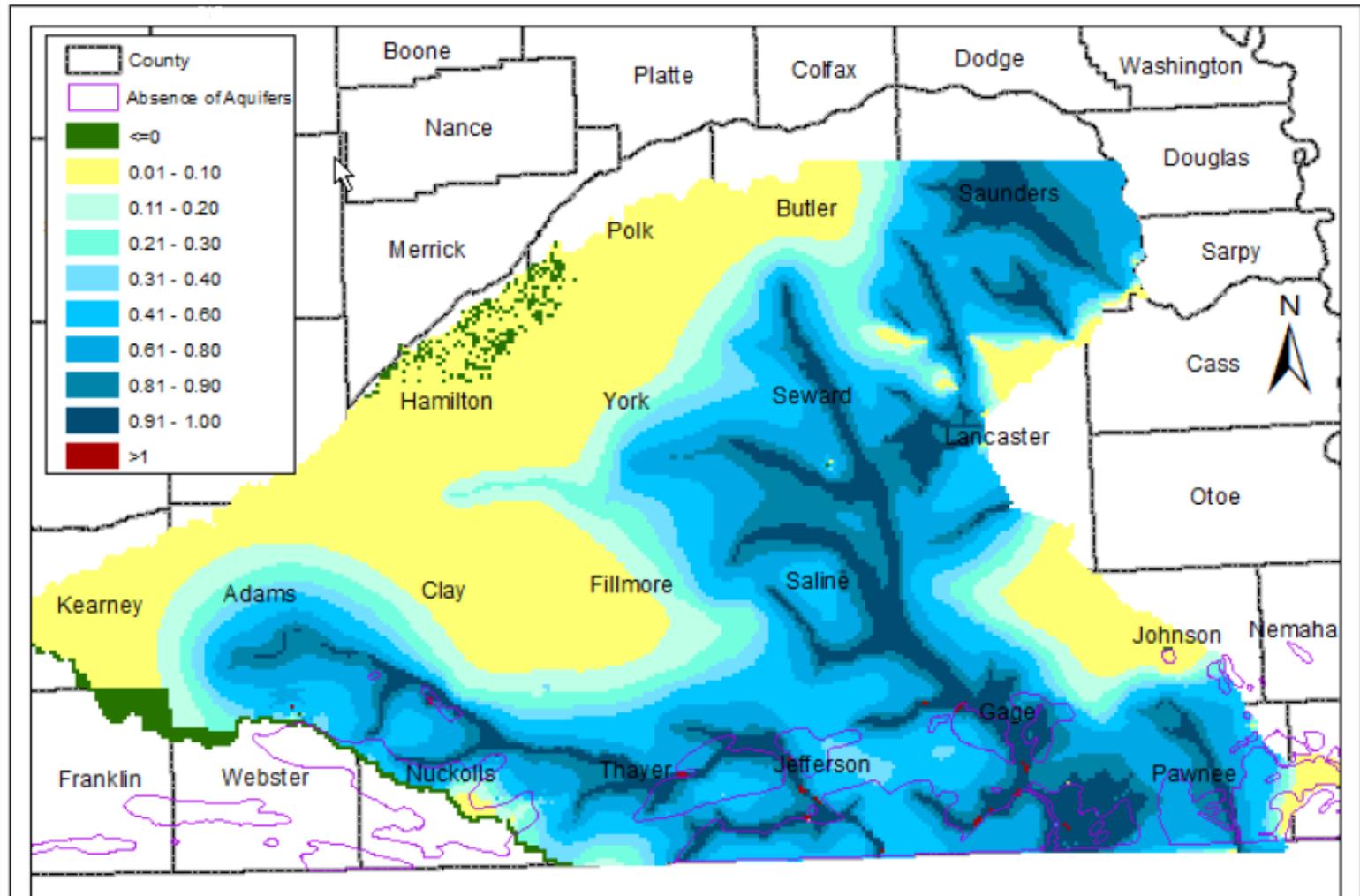
Summary/Archive Folders
Browse

Discretization File
Browse

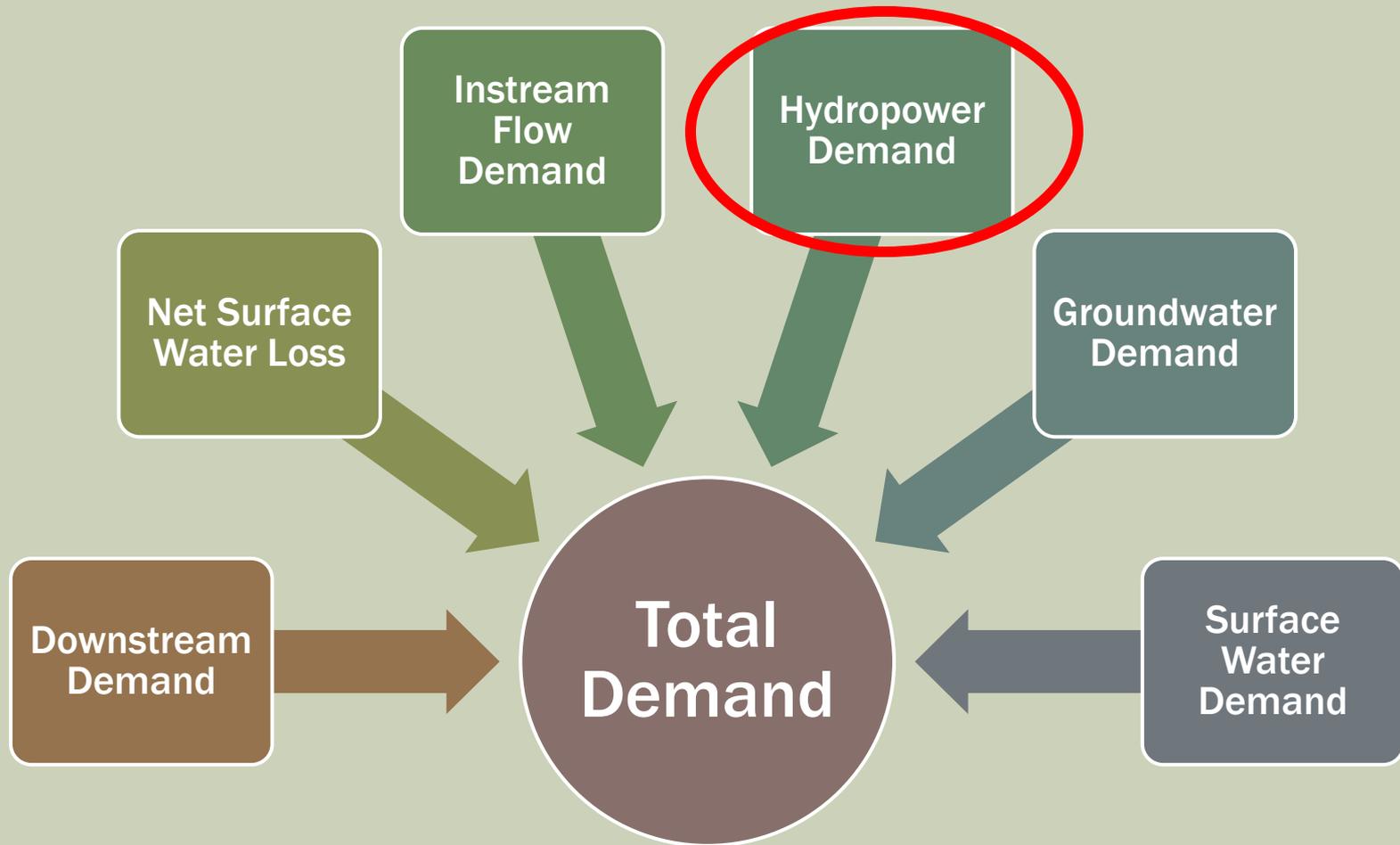
Provide Stress Period and Time Step
Enter Stress Period
Enter Time Step

GO Merge OS CSV's

LINK RESULTS WITH GIS



NEXT...



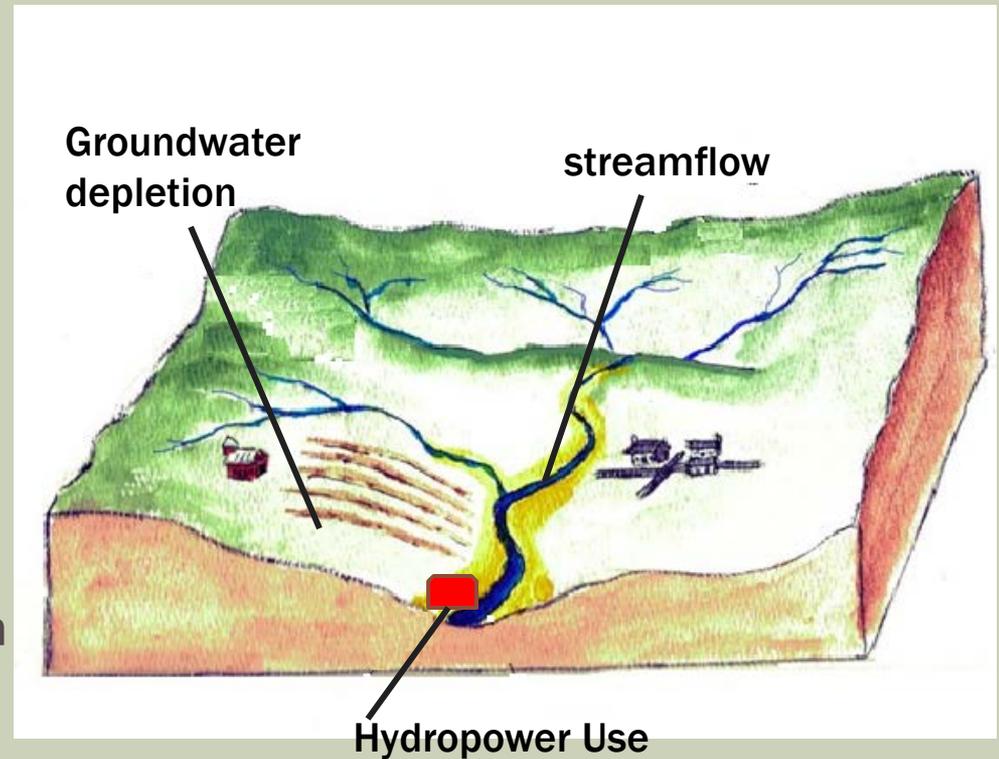
WHAT AND WHERE

- Demands on water supplies to support hydropower uses
- “Non-consumptive” uses
- Equivalent demand relative to the basin’s virgin conditions
- Three basins
 - Niobrara River Basin
 - Platte River Basin
 - Loup River Basin



CALCULATION

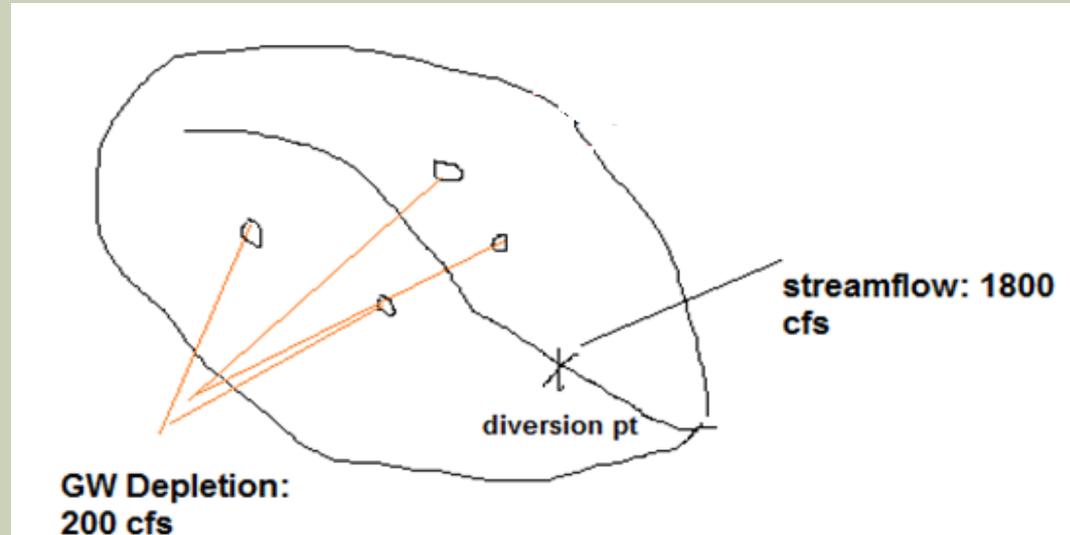
- On a daily basis
- Components
 - Permitted cap on hydropower use (POW)
 - Streamflow
 - Groundwater depletion
- Adjusted streamflow
 - Streamflow + GW depletion



CALCULATION - SCENARIO 1

- If the permitted cap < adjusted streamflow
 - Permitted cap of hydropower (POW) = 1900 cfs
 - Streamflow (SF) = 1800 cfs
 - GW depletion (GWD) = 200 cfs
- Compare adjusted streamflow and permitted cap
 - Final demand = $\min[(SF + GWD), POW]$
 - $1800 + 200 > 1900$

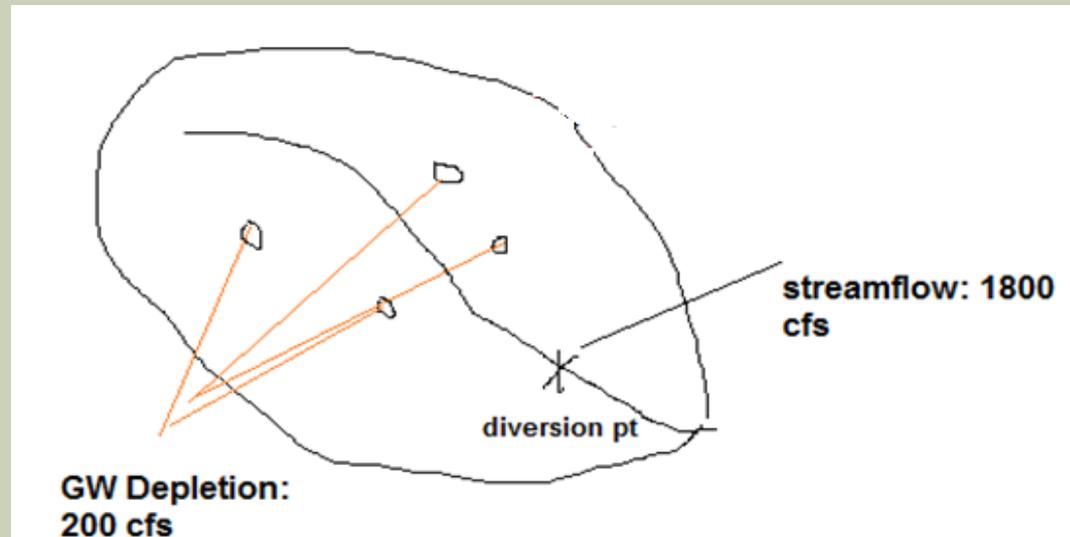
**Final Hydropower demand =
1900 cfs**



CALCULATION - SCENARIO 2

- If the permitted cap > adjusted streamflow
 - Permitted cap of hydropower (POW) = 2100 cfs
 - Streamflow (SF) = 1800 cfs
 - GW depletion (GWD) = 200 cfs
- Compare adjusted streamflow and permitted cap
 - Final demand = $\min[(SF + GWD), POW]$
 - $1800 + 200 < 2100$

**Final Hydropower demand =
2000 cfs**



OTHER DEMAND COMPONENTS

- **Downstream Demand**
 - Amount of water typically received by downstream basin
- **Instream Flows**
 - Permitted flow requirements for fish, wildlife, or recreation
 - Non-consumptive use
- **Surface Water Demand**
 - Surface water demand for irrigation, municipal, or industrial uses
- **Net Surface Water Loss**
 - Water necessary to convey surface water for consumptive uses
- These components are explained in more detail in other presentations