Overland Boundary Conditions

Overland Boundary Conditions

- Since we solve a PDE for 2D flow we can have boundary conditions other than no-flow
- Used to look at hydrologic fluxes
  - primary driver isn't rainfall
  - special geometry situations
- Specified slope (off of the grid)
- Constant specified head
- Time-varying specified head
- Time varying specified hydrograph
- All cells not specified as special boundary cells are treated as normal cells

Specified Slope

- Specify *S* in Manning's Equation ($q=1/n\ S^{1/2}h^{5/3}$)
- Choice of *S* will affect on-grid backwater calculations
  - As *S* goes to 0 then it will act more like a no-flow boundary
- Useful when
  - Don't have a single outlet point but rather an outlet boundary
    - Edge of reservoir is downstream boundary
    - Inland regions of a storm surge model. This boundary should be set such that it will not impact the storm surge modeling but rather to allow rainfall that doesn't impact the surge modeling to run off the edge of the model.

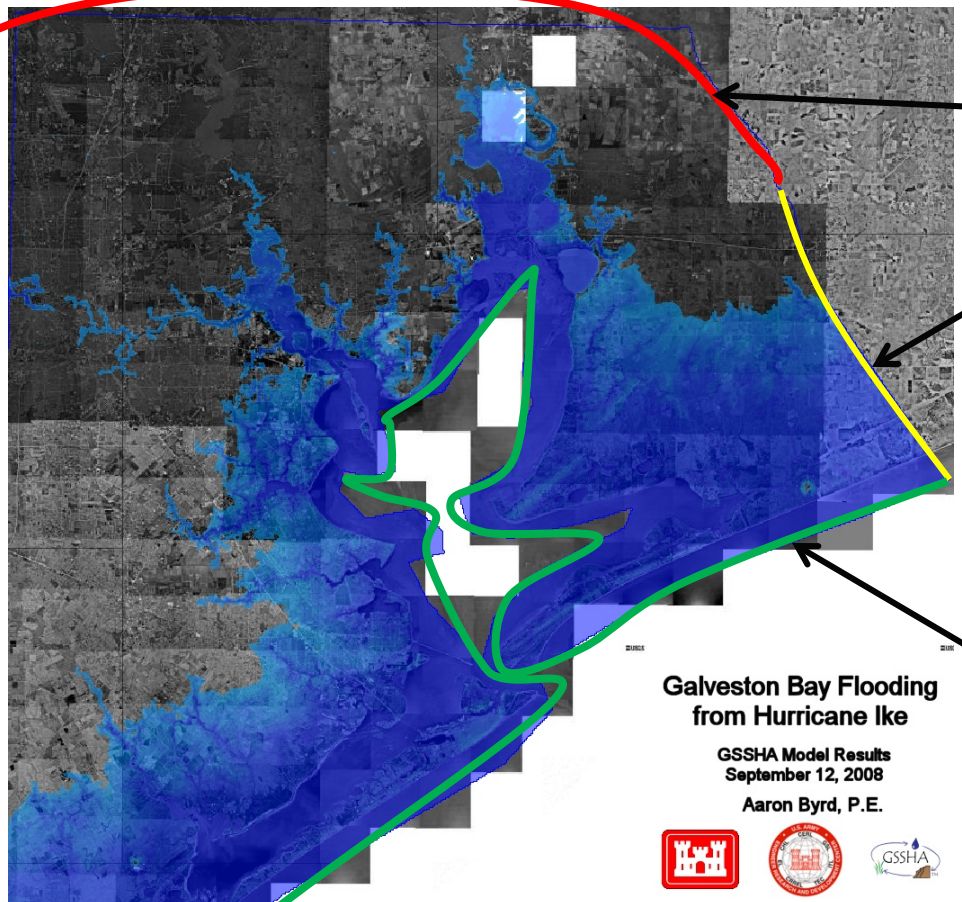
Specified Head

- At the end of each time step the head is reset to the specified head
- Can be
  - Specified as constant value
  - Constant due to a time series with only one value
  - Time variable
    - time series with several values
- Assumes an infinite supply of water (!)
- Uses
  - Downstream boundary for shoreline models
  - Flow from breached levee
    - doesn't simulate the development of the breach

Specified Hydrograph

- Hydrograph input to an *overland* cell
- Computes the volume of water that would be input for the last time step and adds that volume to the cell
- Allows for a controlled volume of water to enter each cell
- Uses:
  - Add results from riverine model to GSSHA overland flow
    - E.g. - In the new HEC-WAT/HEC-FRM, can use HEC-RAS to simulate breaching hydrograph and GSSHA to simulate the spreading of the flow from the breaching hydrograph.

Example: Hurricane Ike

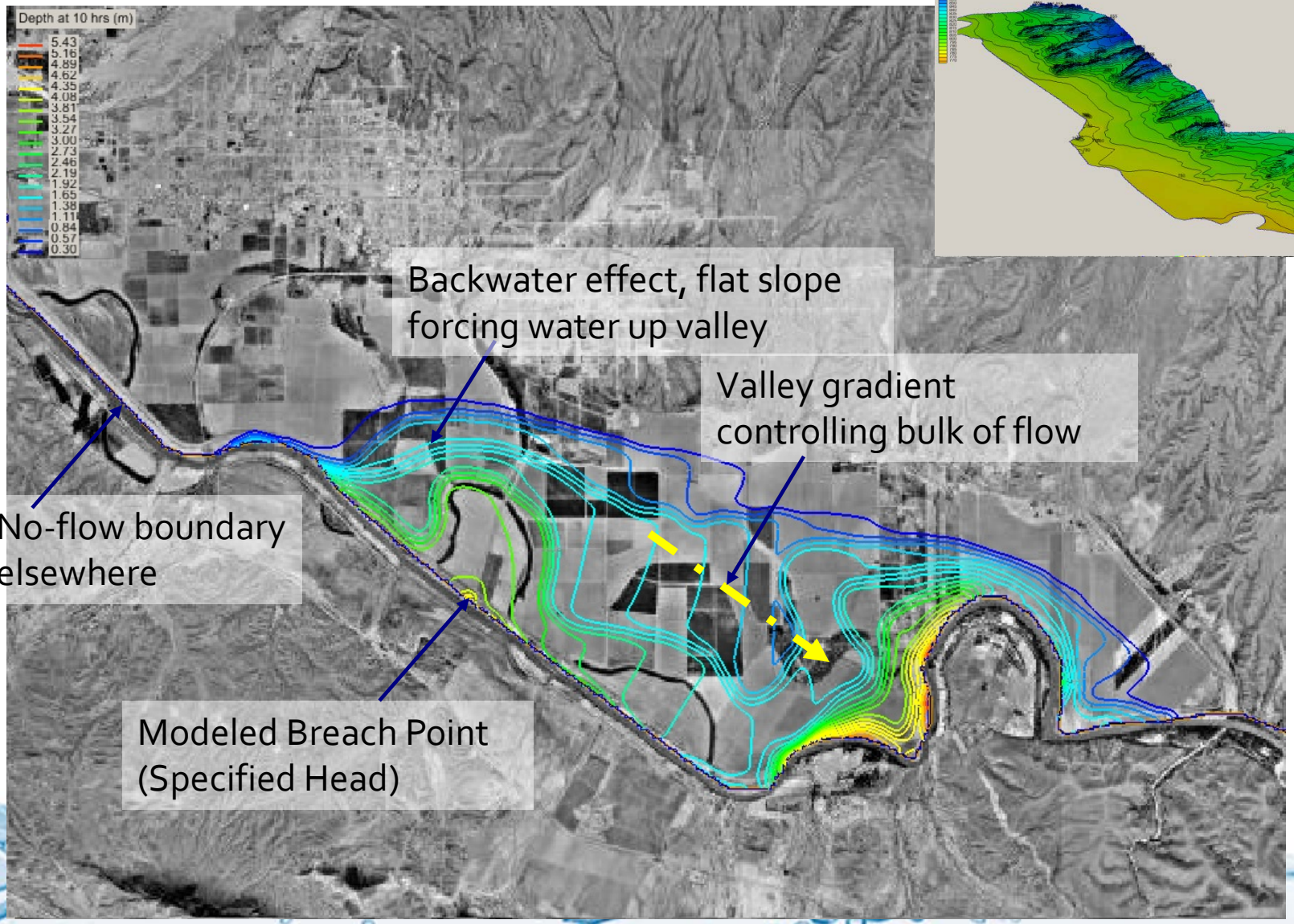


Red-Specified slope

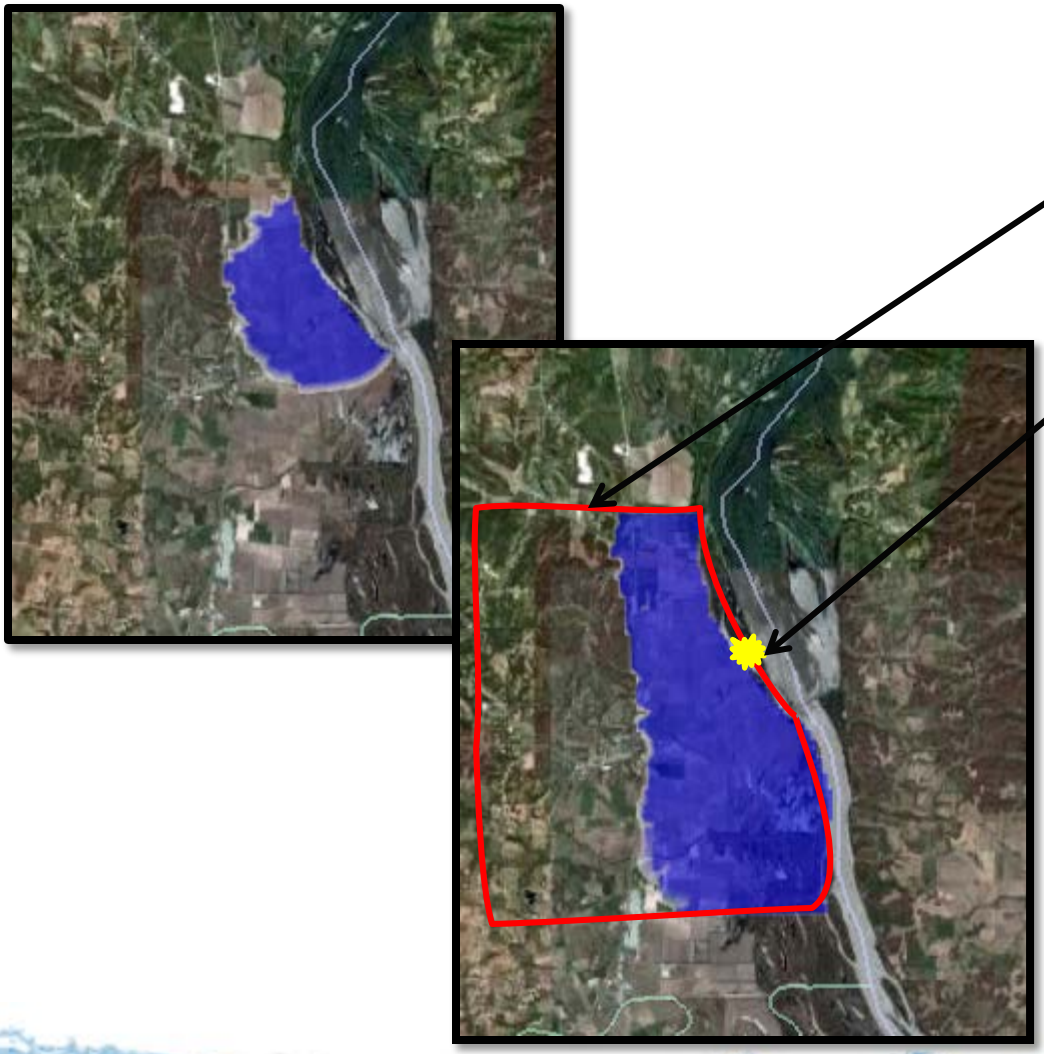
Yellow-No Flow - Assume equivalent head (and insignificant cross-flow) on the other side of the boundary.

Green-Time varying specified head - Assume no momentum loss across the bay.

Example: Presidio, Tx
Flooding from Overtopped Levee



Bad Example: Winfield



- No flow around most of boundary (red)
- Time varying specified head at breach point (yellow)

Why is this a bad example? The no flow boundary conditions do not allow water to spread to areas that it should, creating a depth of water that forces flow into areas that should not be flooded.

File Inputs

- Project file:
  - OV_BOUNDARY card
  - TIME_SERIES_FILE card(s)
- Mapping table file:
  - TIME_SERIES_INDEX
  - OVERLAND_BOUNDARY

Project File Cards

- OV_BOUNDARY
  - Tells GSSHA to use the overland boundary conditions
- TIME_SERIES_FILE "filename.ext"
  - Read in a time series file
  - May have more than one of these cards
  - Can have one or many time series in a time series file

Mapping Table File: Time Series Index

- Associates an ID number to a time series name
- Used with OVERLAND_BOUNDARY and WELL_TABLE tables
- Does not have an index map

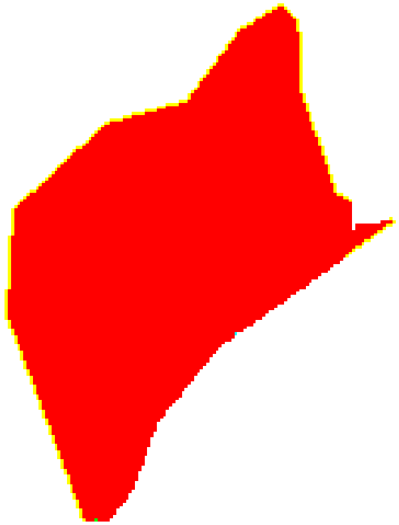
```
TIME_SERIES_INDEX ""
NUM_IDS 2
1 "Municipal well #4"
2 "Storm surge"
```

Time series ID (for use in mapping tables)

Time series name (must be the same as in the time series file)

Mapping Table File: Overland Boundary Table

- Does use an index map
  - Start with a uniform map
  - Change boundary locations to IDs you want
- Two parameters:
  - Code for boundary condition type
    - 0=Regular, no-flow cell
    - 1=Specified slope
    - 2=Constant specified head
    - 3=Time variable specified head
    - 4=Specified hydrograph
  - Value for boundary condition
    - E.g. 0.001 (slope), 4.3 (stage), 3 (time series id)



Time Series Format

- Identified by a name
- Can specify absolute time or time relative to the beginning of the simulation
- Values are
  - linearly interpolated between time steps
  - equal to the first or last value for times before or after those specified
- Time is:

```
year month day hour minute
```

```
GSSHA_TS
levee_breach
RELATIVE
0 0 0 0 0 140.0
0 0 1 0 0 139.5
END_TS

GSSHA_TS
storm_surge
ABSOLUTE
2005 8 26 4 0 2.4
2005 8 26 8 0 3.2
2005 8 26 13 0 3.4
2005 8 27 0 0 2.4
END_TS
```