A Review:

Farmington Bay Hydrology and Water Management

Great Salt Lake Tech Team

October 19, 2011

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Background & Need

- **Numerous GSL management questions and issues over the years**
  - Water quality (contaminants, nutrients)
  - Waterfowl management/carrying capacity
  - Flood control (i.e., rising lake levels)
  - Mineral extraction
  - Brine Shrimp harvest
  - Recreation
  - Water storage


Photo by UDWR

Background & Need

- **One common question that underlies all of these issues**
  - What drives GSL's hydrology and how does this impact _____ (fill in the blank)?
- **The 2010 Great Salt Lake Issues Forum focused upon this issue**
  - Continues today…
- **But how about for Farmington Bay?**

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Background & Need

- **Nutrient Management is likely the most significant, current issue for Farmington Bay**
- **Its hydrology is a significant factor that affects how the wetlands and open water respond to nutrients**
  - Flow volume, timing, residence time, salinity

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Objective for this Study

- **What information is available that describes Farmington Bay's hydrology?**
  - What drives the hydrology that defines its characteristics?
- **Tasks**
  - Synthesize available information
  - Identify data gaps
  - Recommend future research efforts

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Methods

- **Literature review**
  - Wally Gwynn's archives,
  - UofU, Div Water Rights, Div Water Resources libraries
- **Numerous interviews**
  - Layne Jensen
  - Rich Hansen
  - SLC Dept of Public Utilities
  - Salt Lake County Public Works
  - Davis County Public Works
  - Others…


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Outline

- Overview of the literature
- Contributing areas and water management
- Recommendations for further work

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Overview of the Literature

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GSL Water Balance

- **A lot of work has been done with goals of evaluating:**
  - Effects of railroad causeway on salinity/chemistry
  - Predicting water levels for flood control
  - Storage/consumptive use of water resources
  - Recreation
- **Seminal work was Waddell & Fields 1977**

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Farmington Bay Water Balance

- **Most of the GSL work however did not provide detail to evaluate FB**
  - Jordan River was one inflow to GSL
  - East-side tributaries were treated as one input
  - Precip/evap were treated lakewide
  - Monthly/annual volumes
- **Jordan River/East Side Tribs = 10-15% of inflow to GSL**

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Farmington Bay Water Balance

- **Good news is that there has been work completed to evaluate water balance specifically for FB**
  - Began in 1970's to evaluate "freshening of its waters" (salinity, sediments, odors)
  - 1980's included serious proposals to separate FB from GSL – create a freshwater reservoir
  - 2005 Jordan River Return Flow Study

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Surface Inflow Contributions

- **Gage data extending back to 1942**
  - 27 gages in Salt Lake County
  - 9 gages in Davis County

Groundwater Inflow

- **Carter et al 1971 – 58,000 AF/yr**
  - Used GW to complete water balance
- **Waddell & Fields 1977 – 27,600 AF/yr**
  - Antelope Island – 1,500 AF/yr
  - Salt Lake County – 1,980 AF/yr
  - Davis County – 24,000 AF/yr
- **Chadwick et al 1983 – 20,000 AF/yr**
- **Bishop et al 2009**
  - Davis County - 16,000 AF/yr

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Precipitation

- Methods varied through the use of regional gage networks vs local gages
- Precipitation is something we can get a good handle on

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Evaporation

- Methods varied through the use of regional evap pans to local evap pans
- Hinges on salinity of Farmington Bay

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Other Critical Information

- **Outflow**
  - Attempts to measure throughout 1980's
  - USGS installed gage in 2003 – continuous flow measurement
- **Volume**
  - Waddell & Fields 1977 included an elevation-area-volume curve

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Contributing Areas
&
Water Management

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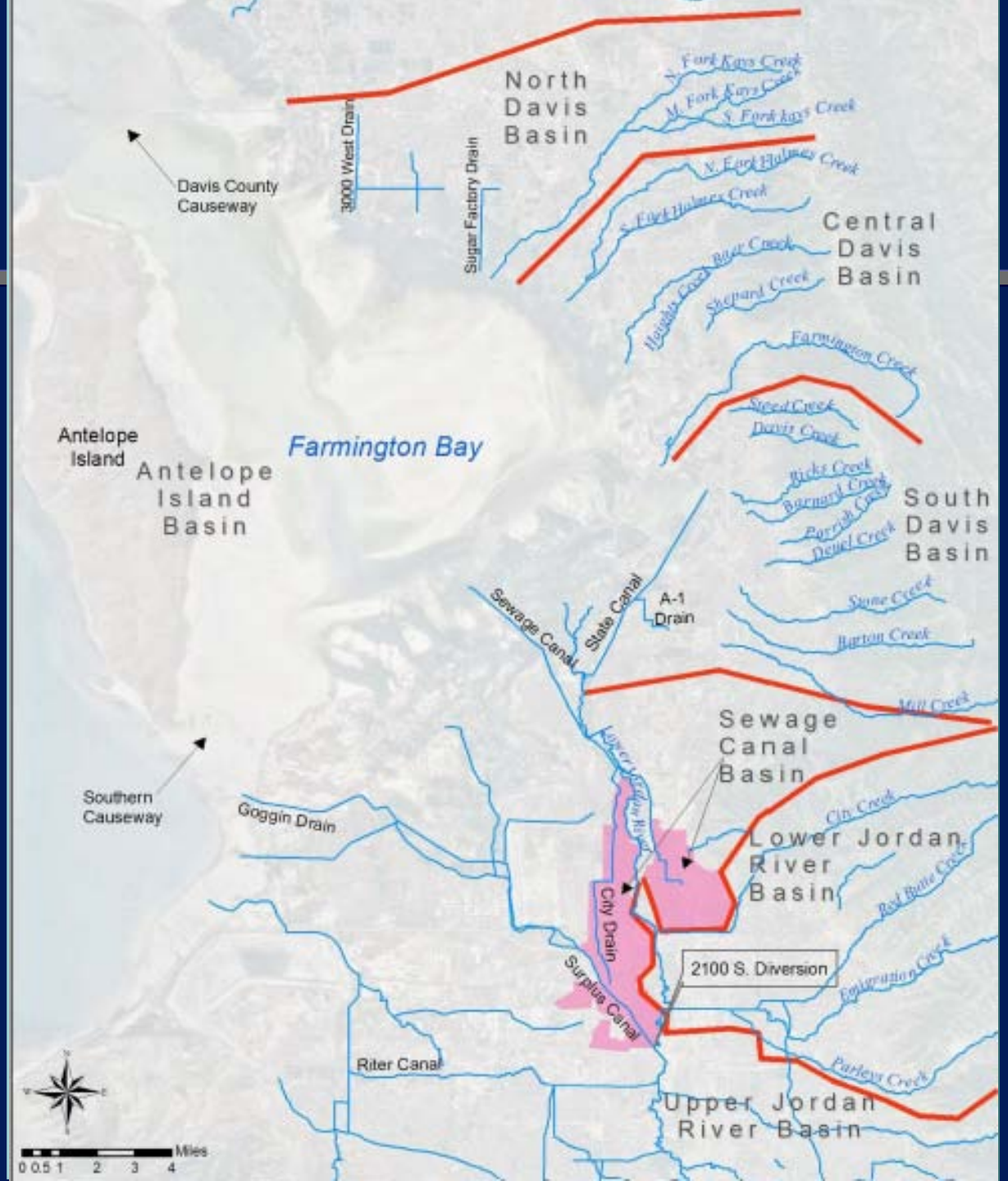
North Davis Basin
Central Davis Basin
South Davis Basin
Antelope Island Basin
Sewage Canal Basin
Lower Jordan River Basin
Upper Jordan River Basin
Farmington Bay
Antelope Island
Davis County Causeway
Southern Causeway
3000 West Drain
Sugar Factory Drain
State Canal
A-1 Drain
Sewage Canal
Goggin Drain
City Drain
Surplus Canal
2100 S. Diversion
Riter Canal
Miles
0 0.5 1 2 3 4

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Antelope Island Drainage

- **Fairly insignificant**
- **Some surface runoff – no information**
- **Groundwater contribution**
  - Waddell & Fields 1977 – 125 AF/mth
  - Mayo & Klauk 1991 – 125 gpm from springs

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Davis County Drainage

- 15 named tributaries
- At least 3 major storm drains
- Three WWTPs
- Three basins: North, Central, South

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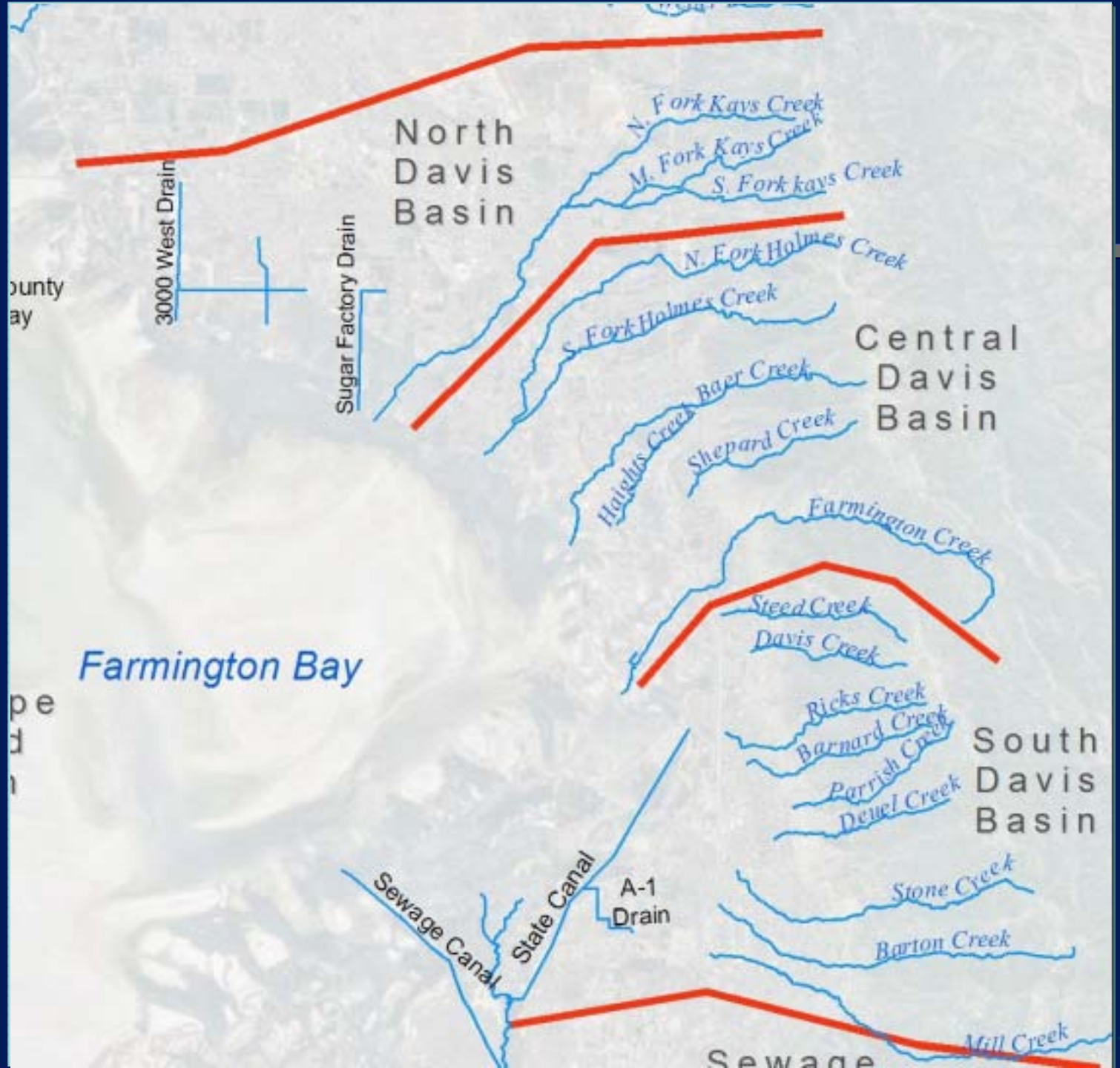
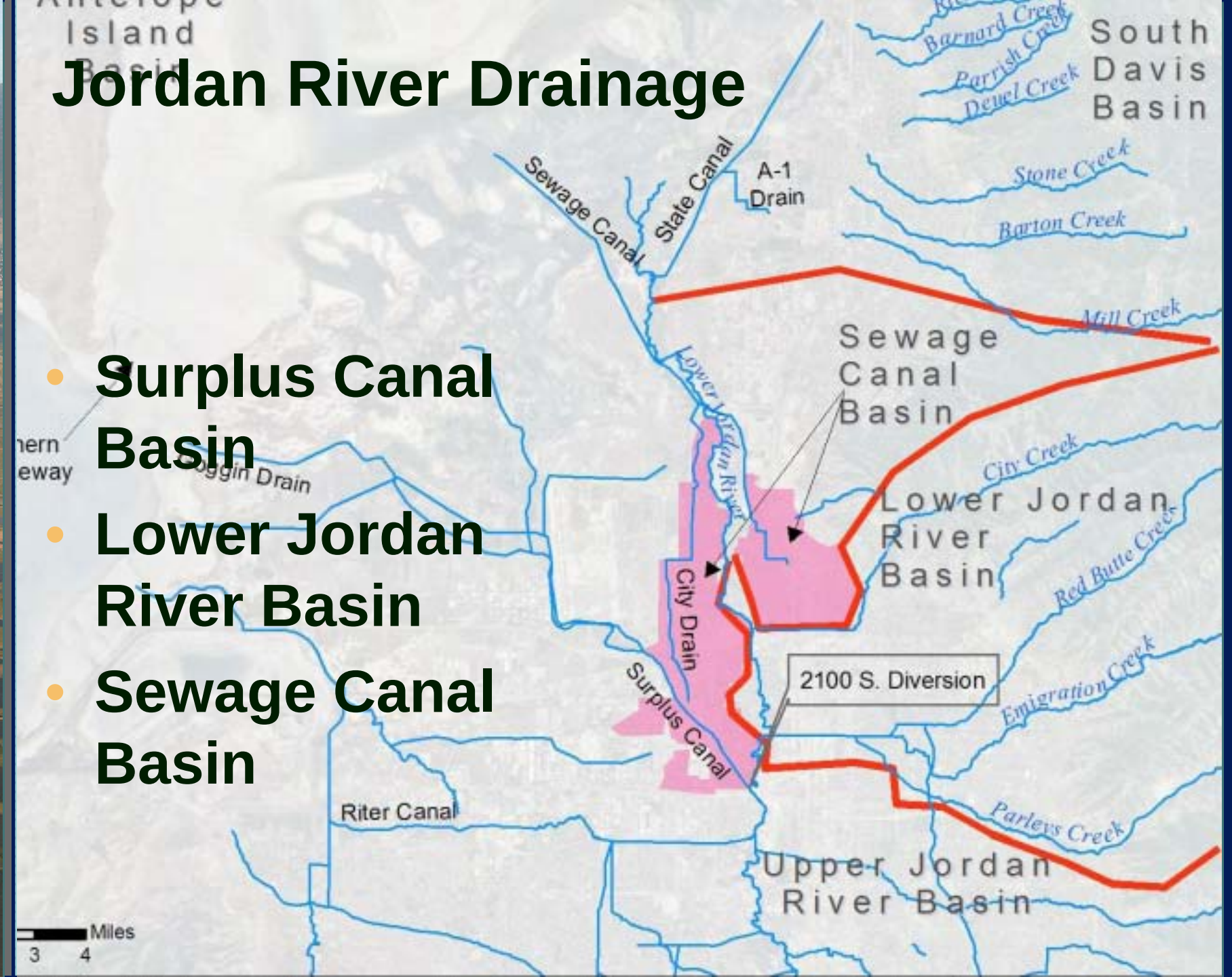

North
Davis
Basin
N. Fork Kays Creek
M. Fork Kays Creek
S. Fork kays Creek
3000 West Drain
Sugar Factory Drain
N. Fork Holmes Creek
S. Fork Holmes Creek
Central
Davis
Basin
Baer Creek
Shepard Creek
Farmington Creek
Steed Creek
Davis Creek
Farmington Bay
Ricks Creek
Barnard Creek
Parrish Creek
Dewel Creek
South
Davis
Basin
Sewage Canal
State Canal
A-1
Drain
Stone Creek
Barton Creek
Mill Creek

Jordan River Drainage

- Surplus Canal Basin
- Lower Jordan River Basin
- Sewage Canal Basin



Jordan River Drainage

- **Not all of Jordan River goes to FB**

TABLE 3-4
Estimate of Flow Contribution from Upper Jordan River to Farmington Bay Using Goggin Drain Data[1]

	Total Annual Jordan River Flow (acre-feet)	Estimated Jordan River to Farmington Bay (acre-feet)	Percent of Jordan River Flow to Farmington Bay
1975	388,128	240,590	62%
1976	495,646	316,606	64%
1977	218,600	197,522	90%
1978	282,137	213,421	76%
1979	323,403	221,841	69%
1980	373,065	231,313	62%
1981	427,995	274,716	64%
1982	506,565	292,033	58%
1983	1,230,599	515,758	42%
1984	1,558,717	777,181	50%

[1] Total Jordan River Flow is the Jordan River at 1700 South plus the Surplus Canal.

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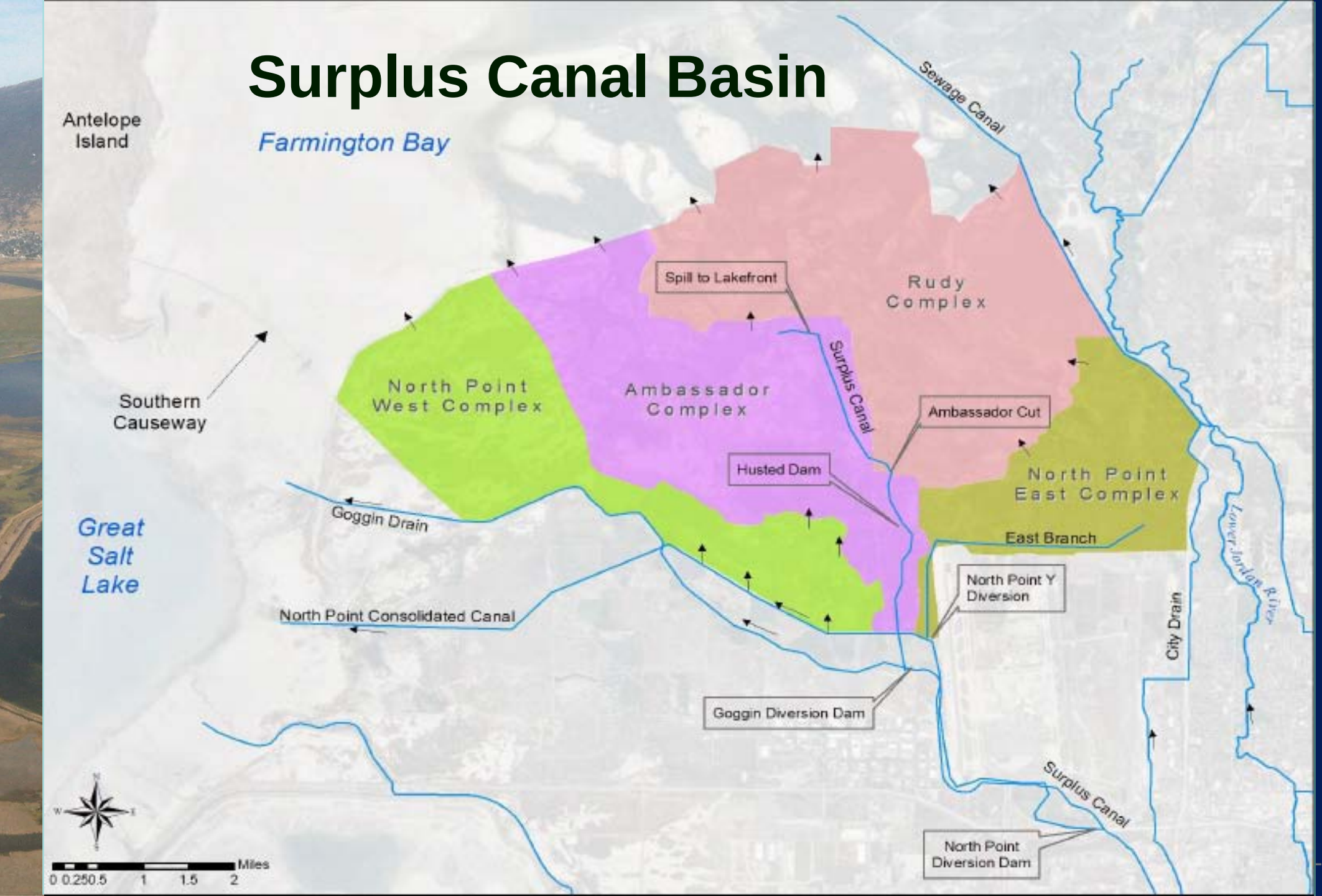
Surplus Canal Basin



Surplus Canal Basin

- **North Point Consolidated Canal**
  - ~100-120 cfs
  - Goal is to use it all
- **Surplus Canal**
  - Typical 120-150 cfs but up to ~700 cfs
  - Excess to Goggin Drain
- **Often short on water in summer months**
- **Utah Lake is primary driver**

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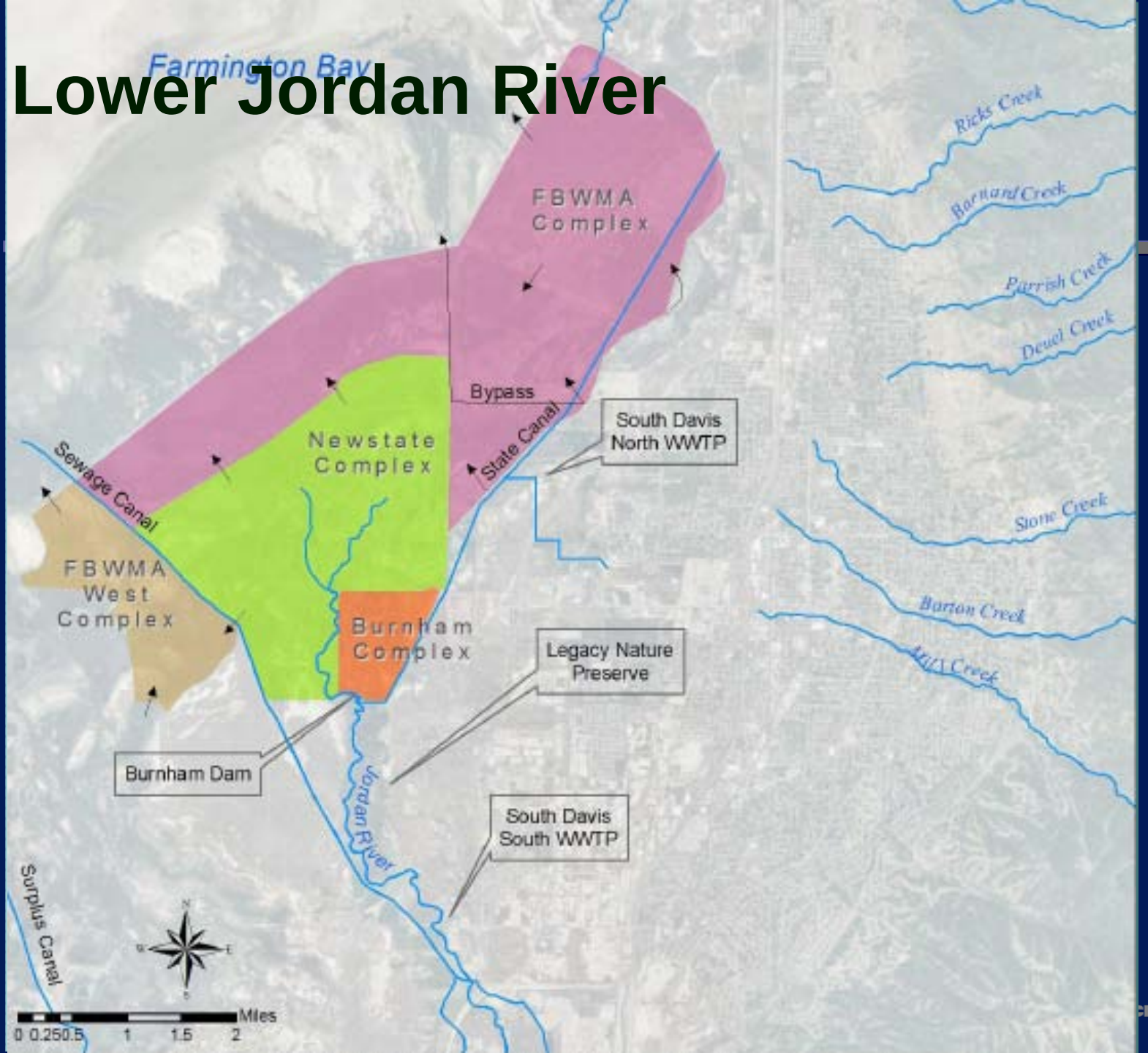
Lower Jordan River



Typical Diversions to LJR

FIGURE 3-16
Average Daily Flows in Lower Jordan River at 1700 South Illustrating Typical Diversions from Jordan River (USGS, 2008-2011)

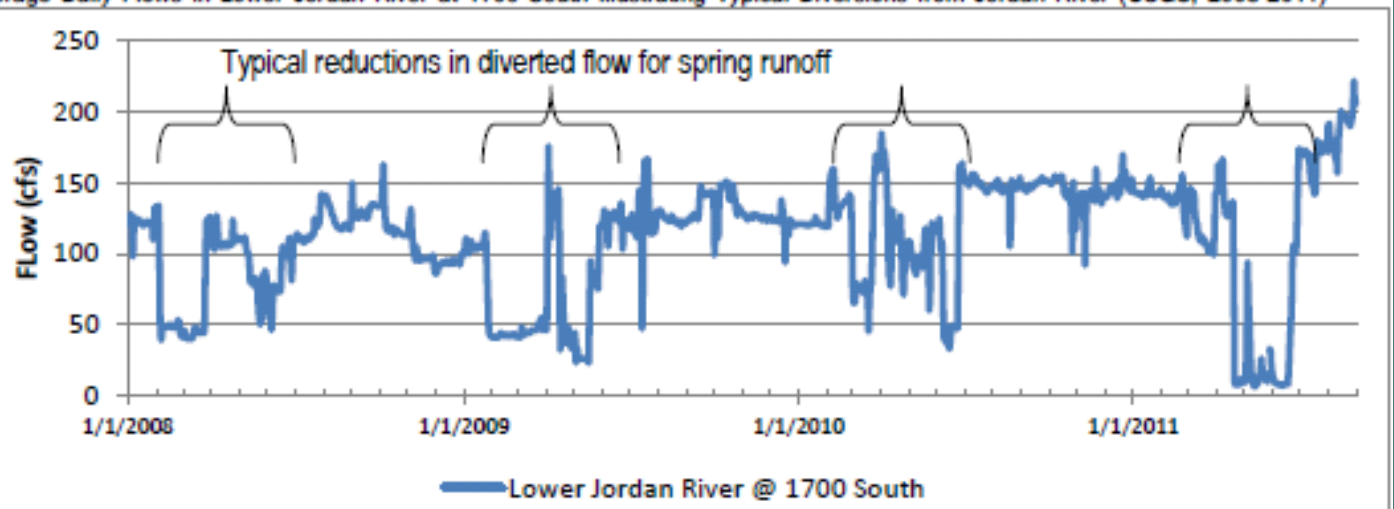
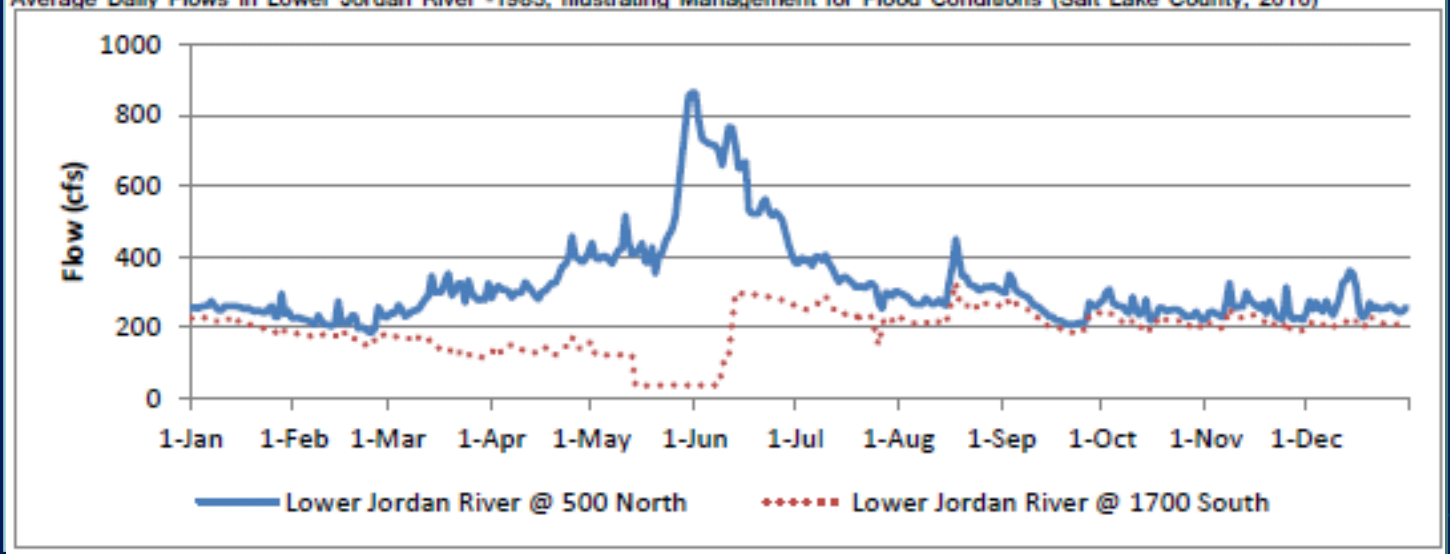


FIGURE 3-17
Average Daily Flows in Lower Jordan River -1983, Illustrating Management for Flood Conditions (Salt Lake County, 2010)



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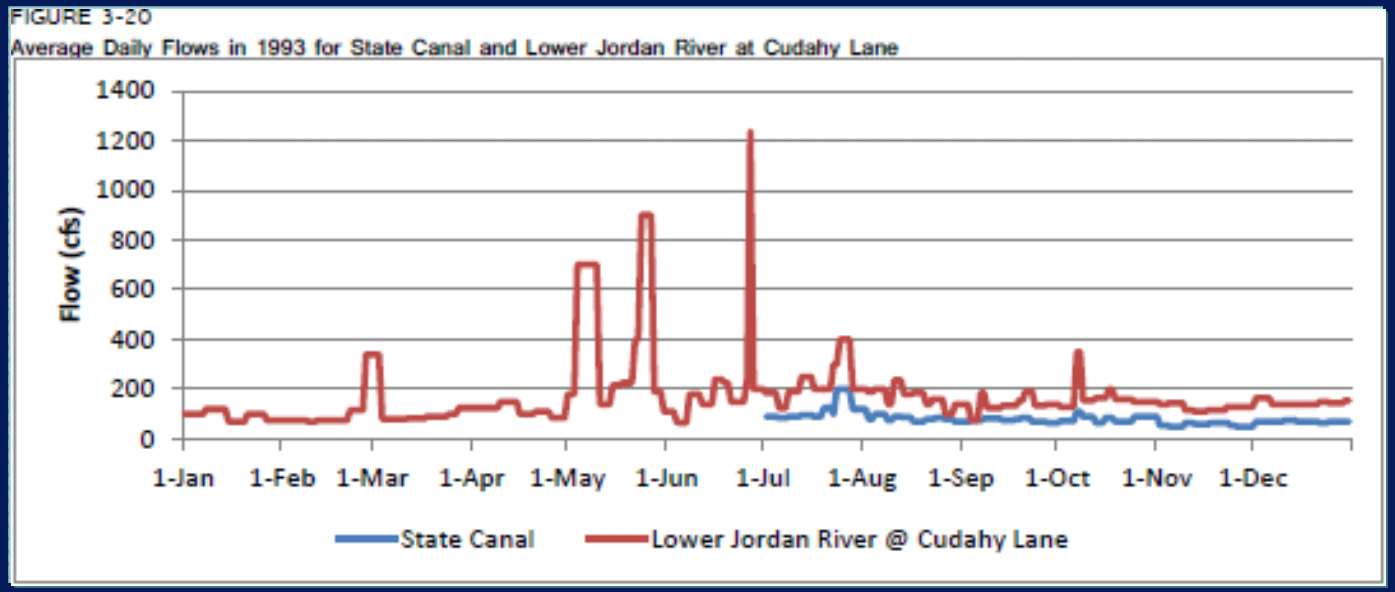
Burnham Dam

- **Flows typically split 50:50**
  - FBWMA gets flow from State Canal but also additional South Davis Basin tributaries & SDSD North Plant



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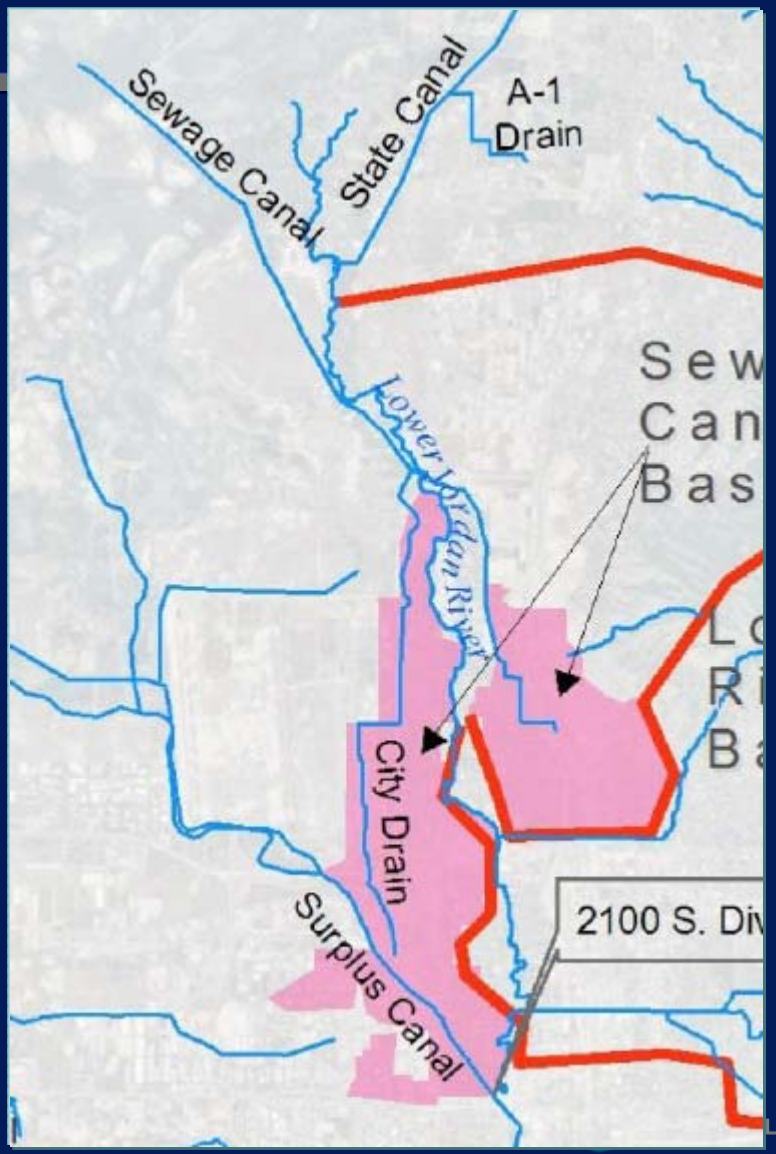
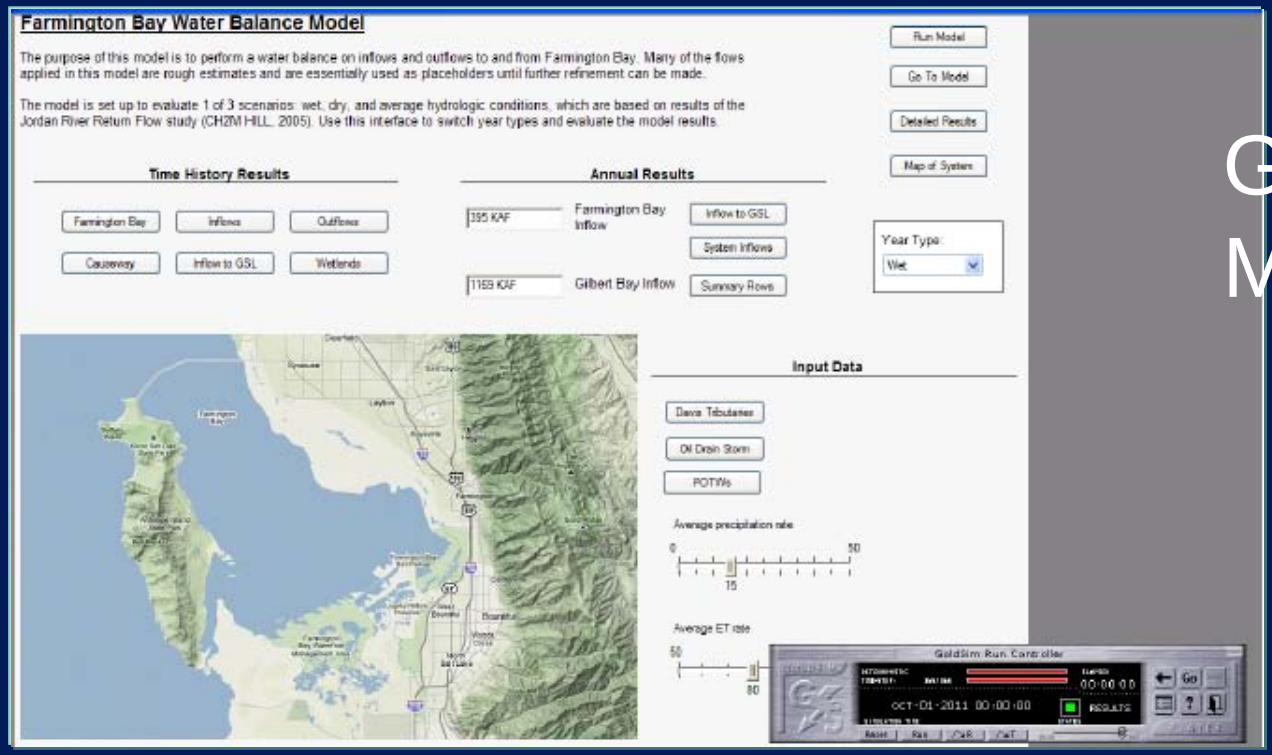
Sewage Canal

- Sources are largely storm water, SLCWRF, springs, and Chevron
- Lack of flow data
- Discharges directly to FB



Water Balance Model

- House available data – identify gaps
- Not a water balance model yet!



GoldSim Model

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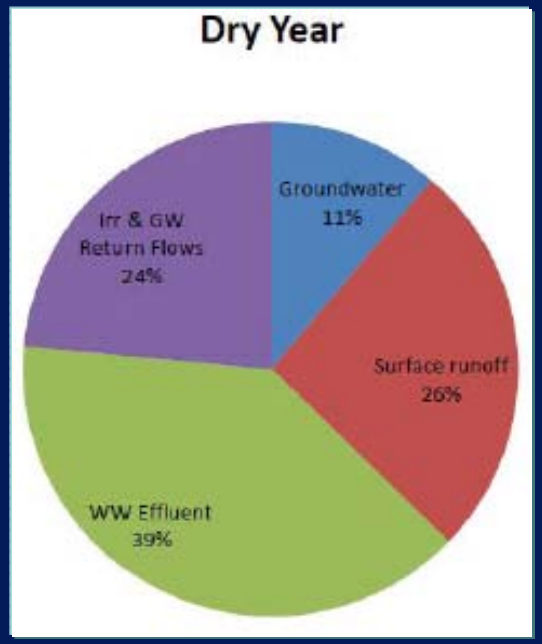
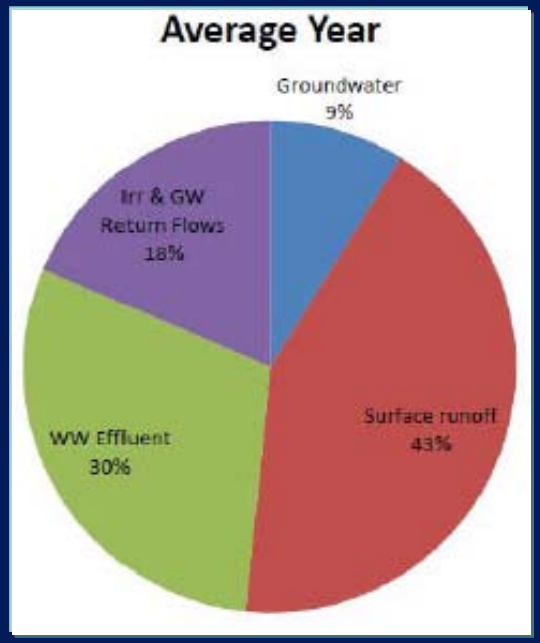
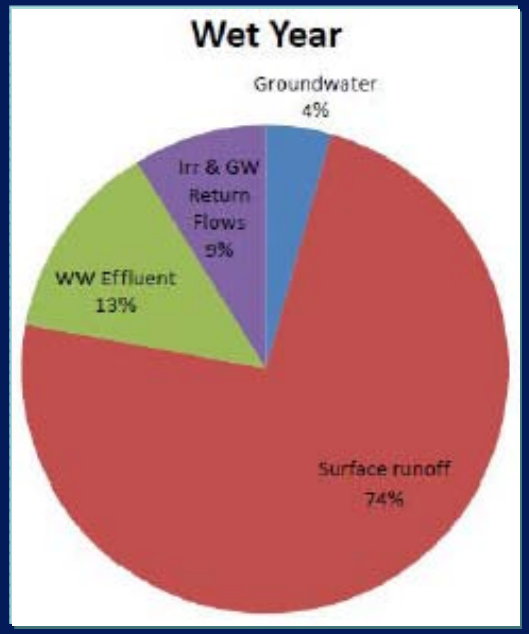
Water Balance Model







- **Model can track sources as well as flows/volume**

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Recommendations

- **Flow Monitoring**
  - Davis County Tributaries
    - *What actually comes into FB?*
  - Jordan River System
    - *Better record of flows entering/leaving duck clubs/preserves*
    - *Sewage Canal*
  - Farmington Bay Outflows
    - *Maintain gage*
    - *Monitor water surface elevation*

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Recommendations

- **Management Practices**
  - Survey duck clubs/preserves to identify water management objectives, strategies, BMPs, lessons learned
  - Water Management Plans
  - Further documentation of diversion practices

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Recommendations

- **Water Balance**
  - Accurate bathymetry
  - Extend Jordan River balance model into Farmington Bay
  - Additional detail to reflect duck clubs/preserves
  - Evaluate water needs vs typical flow patterns to determine flexibility in diversions
    - *Could we alter timing/volume to improve water quality?*

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Why is this important?

- Farmington Bay's hydrology is fundamental to understanding this ecosystem, how it functions, and how we can protect and manage it

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Questions?