

Development of Water Quality Standards for Willard Spur

Willard Spur Dynamics

Willard Spur Science Panel

August 15, 2011





Willard Spur Dynamics

- **Significant dynamics that affect Willard Spur:**
 - Inflow from tributaries
 - *Affects dilution, residence time, water surface area, open/closed, etc.*
 - GSL Water Level
 - *Affects salinity and mixing in Willard Spur*
 - Open or Closed condition
 - *Is Willard Spur connected to Bear River Bay? When?*





Willard Spur Dynamics

- **Time series of satellite imagery**
 - 1984 – 2009
 - See video



Inflow from Tributaries

- Primarily from Bear River but also some from Weber River





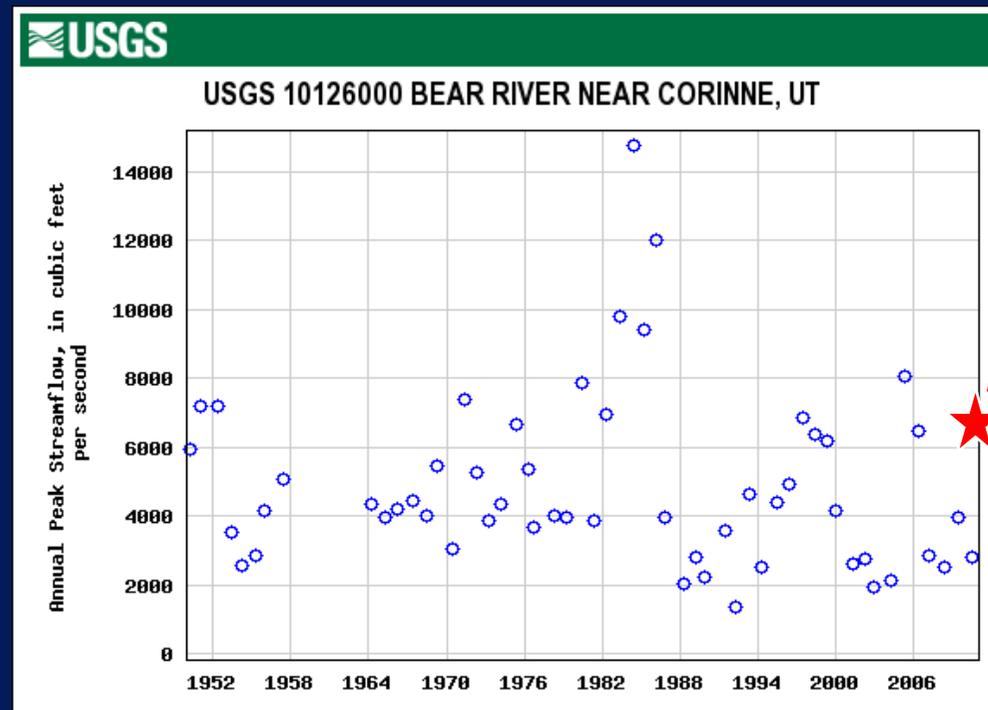
Inflow from Tributaries

- **Bear River represents ~60% of inflow to GSL**
 - Dominated by snowmelt from mountains
 - *Typical peak flows in June*
 - Significant agricultural/municipal use upstream
 - *Irrigation season (April – October)*
 - Buffered by BRMBR
 - *Can be diverted around Willard Spur*



Inflows from Tributaries

- Annual Peak Flows – Bear River



6,460 cfs



Inflow from Tributaries

- **Weber River drainage provides water from the south**
 - Through Willard Bay & Harold Crane WMA
 - *Willard Bay overflows*
 - *Harold Crane –irrigation return flows, storm water*
 - Much smaller contribution than Bear River but Harold Crane maintains flow through year





Inflows from Tributaries

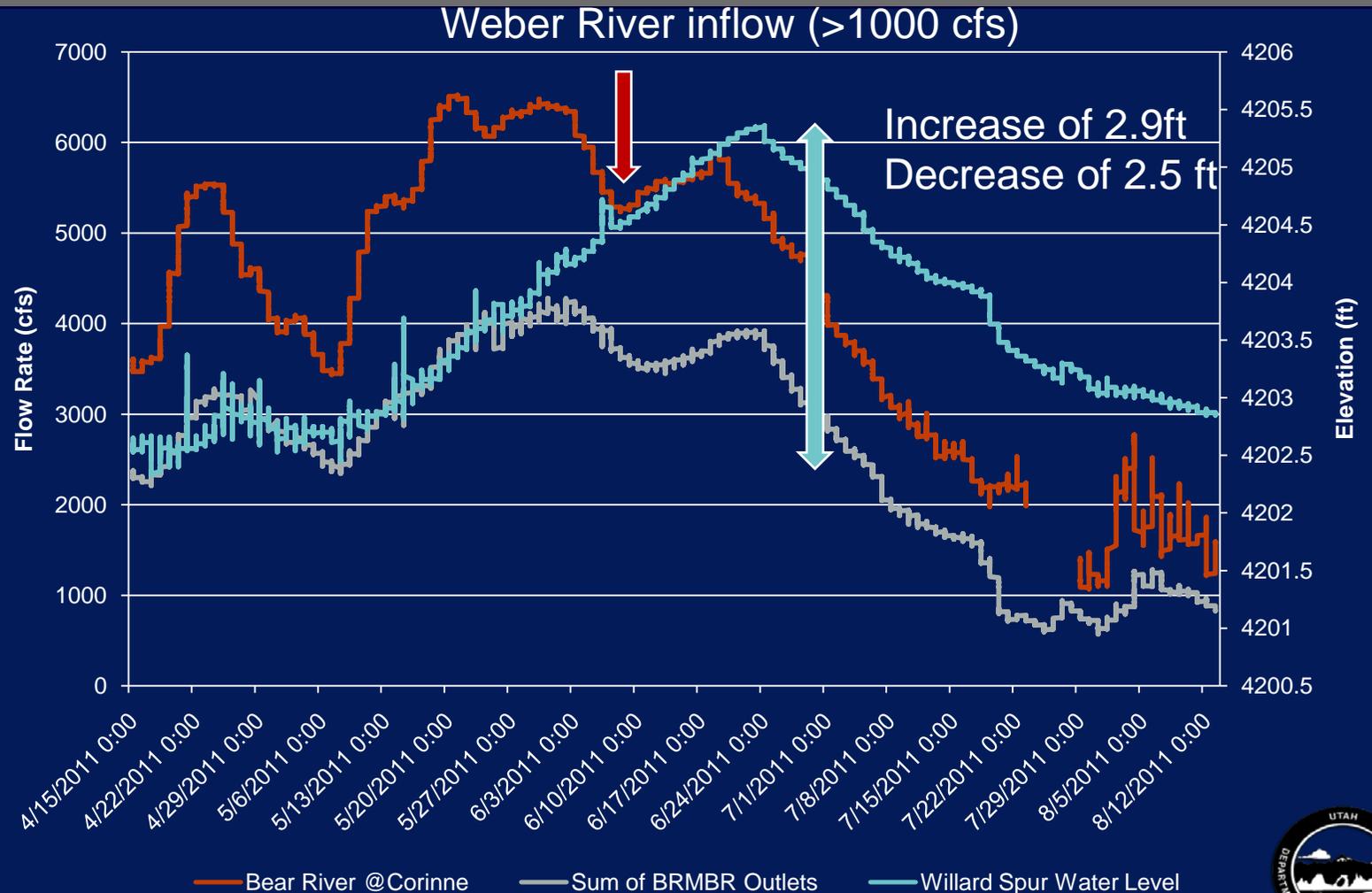
- **Extremely high flows from Weber River basin in 2011**
 - Breached several dikes/levees
- **Flow was bypassed to the north through Harold Crane WMA**
- **Unfortunately could not measure these peak flows (>1,000 cfs)**

Inflow from Tributaries

- **Inflow has a significant effect on:**
 - Water level
 - Water surface area
 - Outflow to Bear River Bay
- Change in habitat
- *Residence time, dilution – water quality?*



Inflow from Tributaries



Source: <http://waterdata.usgs.gov/nwis>





Bear River Migratory Bird Refuge (BRMBR)

June 20, 2011
Elev. 4205.2

April 14, 2011
Elev. 4202.6

Willard Bay
Reservoir

Great Salt Lake
Minerals

Estimated pools (to be refined)

- WQ Sample Location
- ⋯ Great Salt Lake 4205 ft. Contour
- ⋯ Great Salt Lake 4209 ft. Contour
- Shoreline on 8/25/2010
- BRMBR Dike Road
- 1 Foot Contour (solid) NGVD 1929
- - - Six Inch Contour (dashed)
- ⬭ Willard Spur Boundary
- ⬭ Bear River Migratory Bird Refuge

0 0.5 1 1.5 2 2.5 3 Miles scale 1:80,000



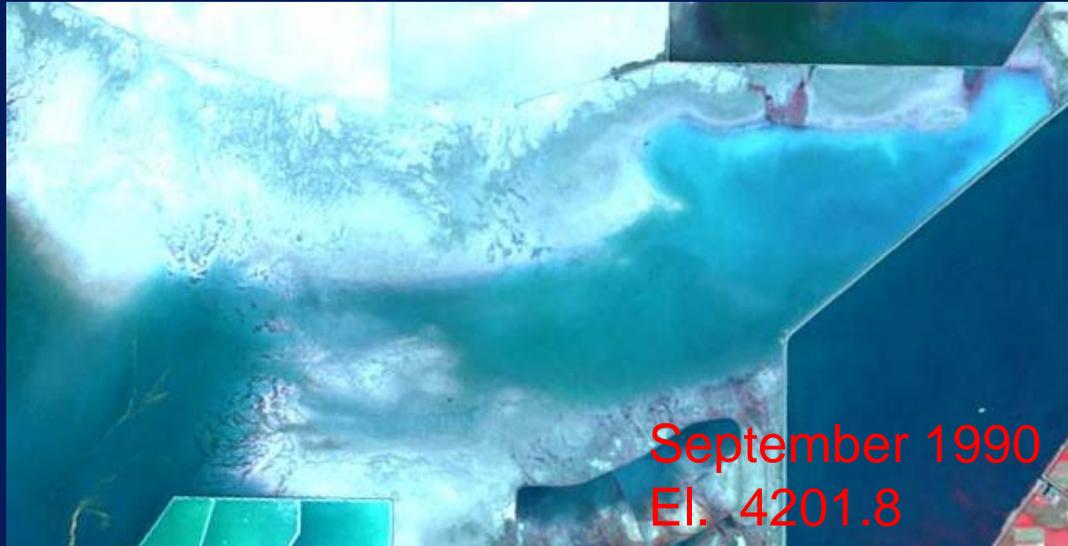


Great Salt Lake Water Level

- Water from GSL mixes with Bear River Bay – mixes with Willard Spur if high enough



Great Salt Lake Water Level

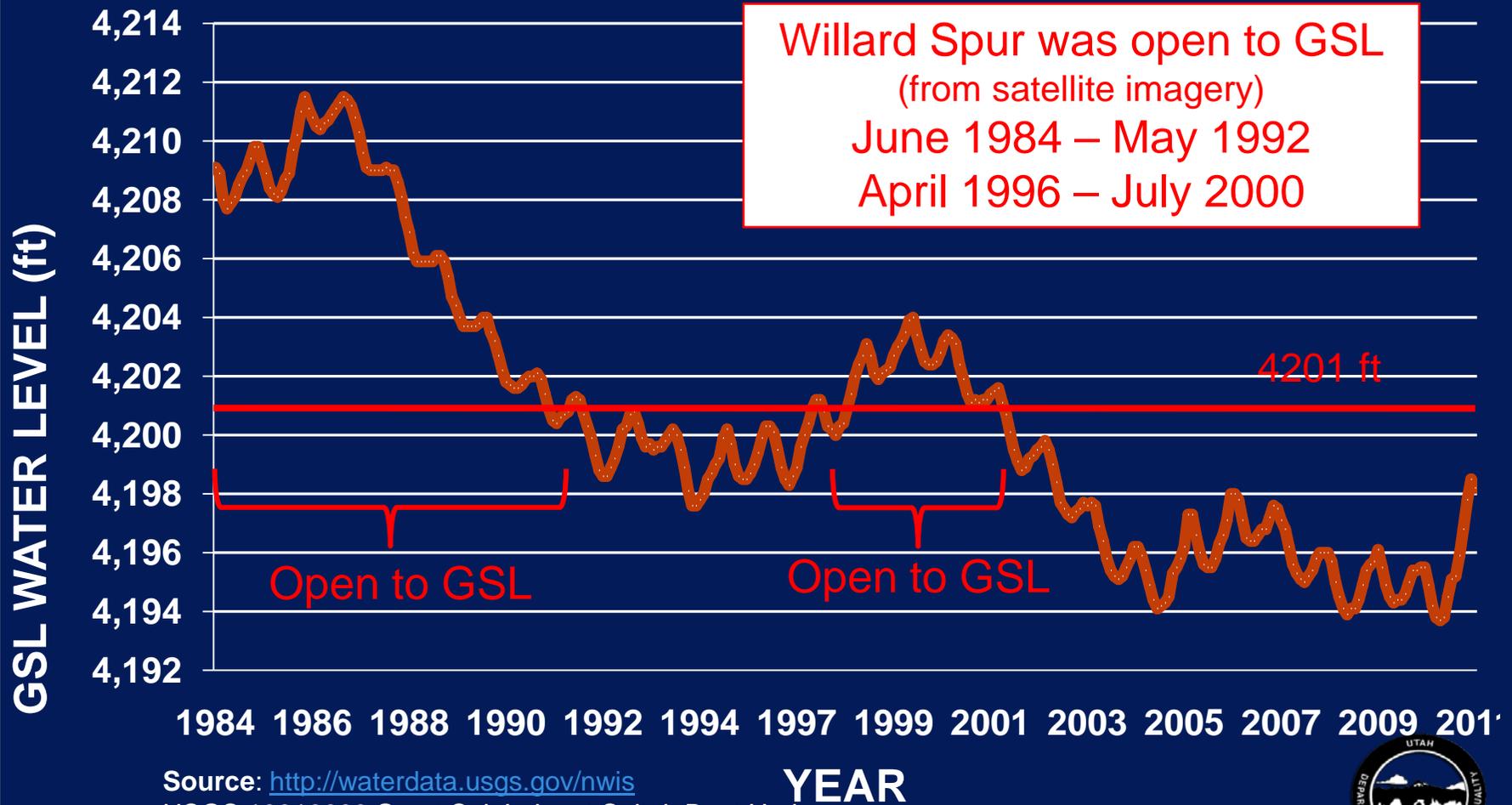


4201-4202 ft
appears to be
the “spill” point





GSL Water Level 1984-2011 (27yrs)



Source: <http://waterdata.usgs.gov/nwis>
USGS 10010000 Great Salt Lake at Saltair Boat Harbor,
Utah

YEAR





Great Salt Lake Water Level

- **What are the impacts?**
 - Mixing of more saline waters in Willard Spur – acts more as traditional estuary
 - Habitat changes (vegetation, sediments, fauna)?
 - Longer residence times? Stratification of water column?
 - How long does salinity affect WS after lake level drops?

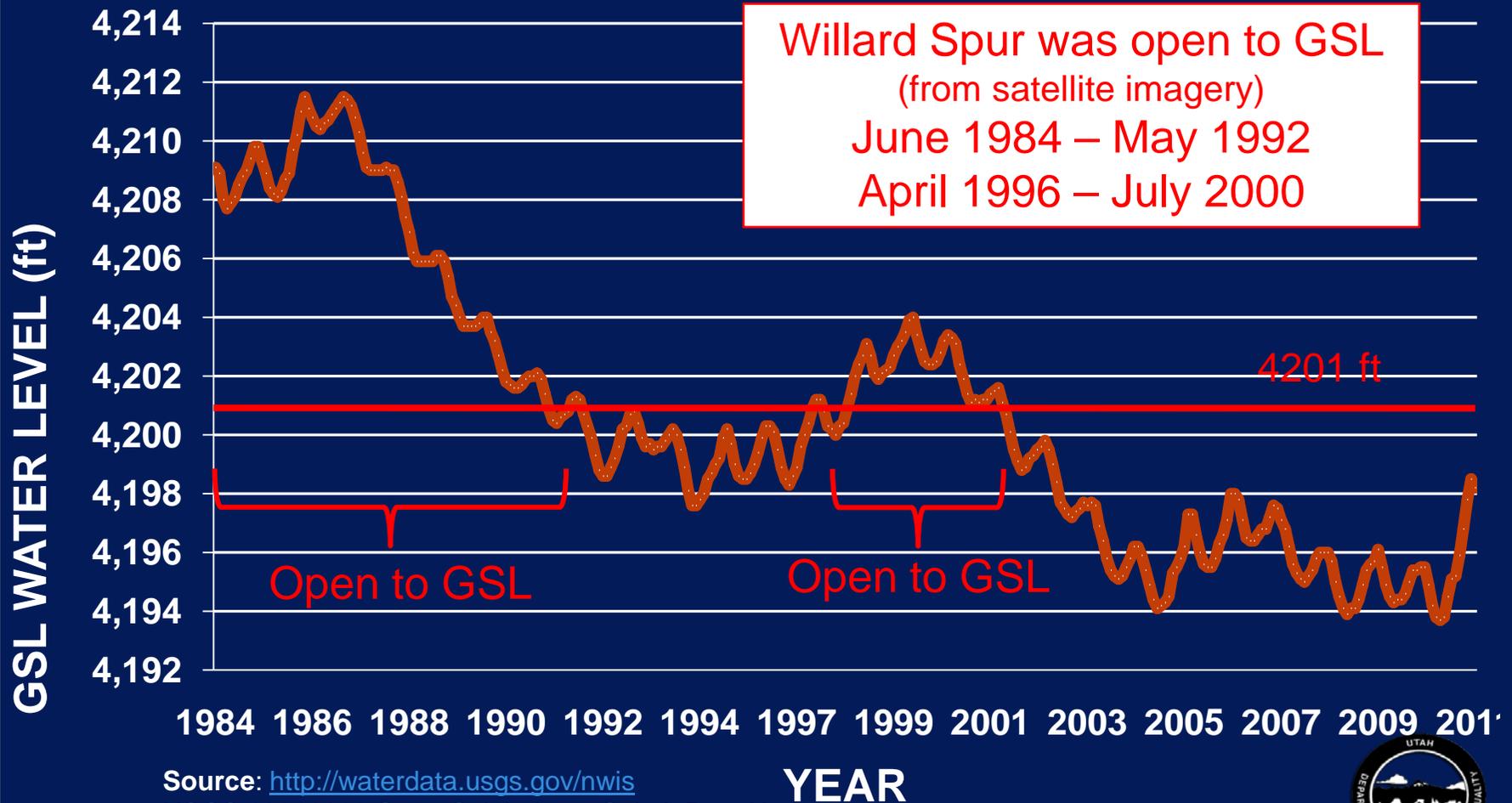


Open or Closed Condition

- **Driven by two factors:**
 - Great Salt Lake water level
 - *When does GSL “spill” into or control outflow from Willard Spur?*
 - Inflow from tributaries
 - *High inflows (with outflow) – open*
 - *Low inflows (no outflow) – closed*



GSL Water Level 1984-2011 (27yrs)



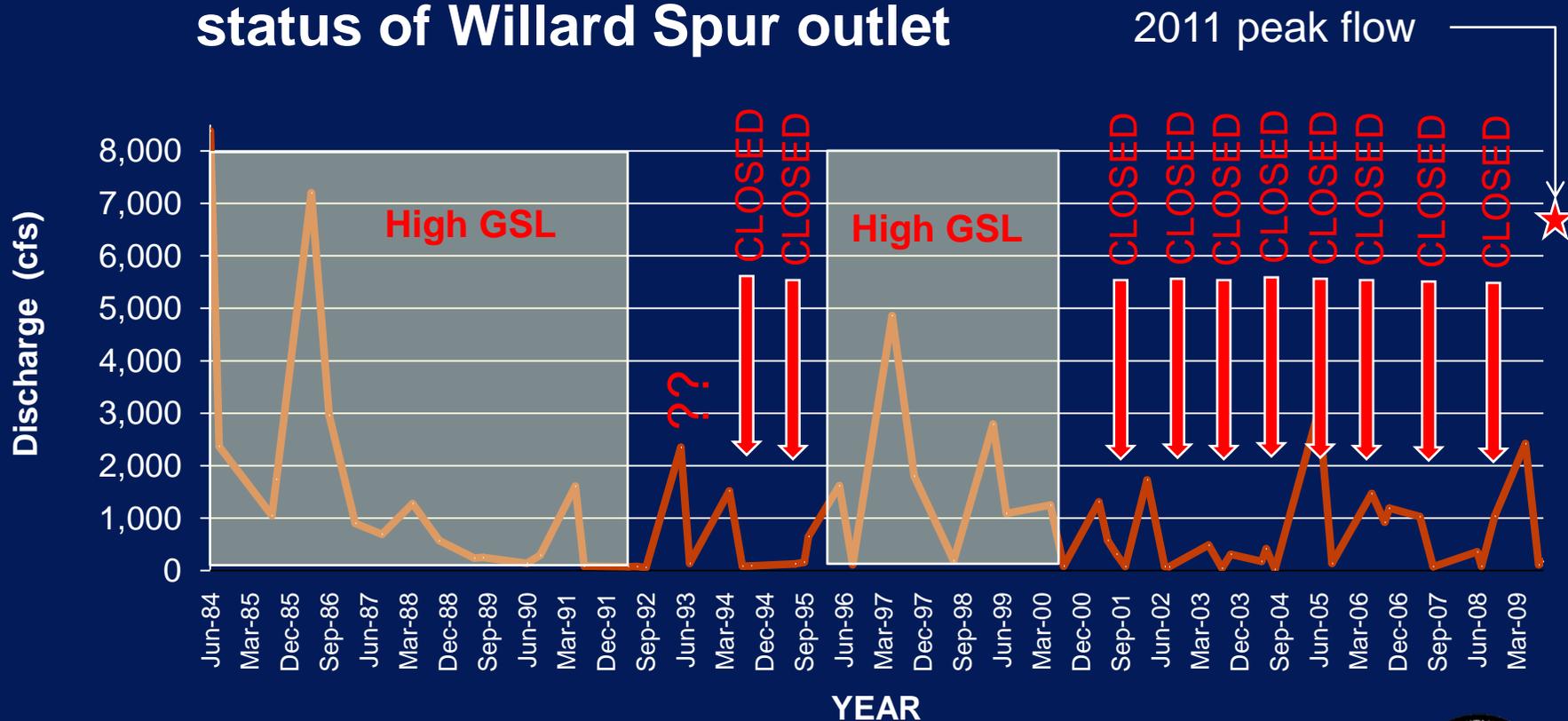
Source: <http://waterdata.usgs.gov/nwis>
USGS 10010000 Great Salt Lake at Saltair Boat Harbor,
Utah

YEAR



Open or Closed Condition

- Bear River flows vs. status of Willard Spur outlet



Source: <http://waterdata.usgs.gov/nwis>
USGS 10126000 BEAR RIVER NEAR CORINNE, UT
Outlet status from satellite imagery





Open or Closed Condition

- **Initial Observations:**

- Inflow has great effect on water depth and surface area, thus also on habitat
- GSL encroaches on Willard Spur when GSL water level exceeds ~4201 ft
- When GSL is below 4201 ft:
 - *Inflows flood and have flowed out of Willard Spur annually*
 - *Outflow even for dry years with Bear R @ ~1,000 cfs*
 - *Willard Spur outlet closed every year*
 - *HOWEVER, none of the years of record had Bear R flows >6,000 cfs*
- High inflow years ~ high GSL water level





Conclusion

- **Hydrology and GSL create a dynamic environment**
- **Habitat and water quality respond to these dynamics**
- **Conservative assumption of “closed system” appears to occur annually**
 - To be confirmed

