

Lower Jordan River TMDL



Jordan River Water Quality Model Calibration



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Modeling Programs



- HEC-RAS
 - Simulates hydraulics of river networks
 - One-dimensional, steady state flow
 - Calculates water surface profiles, flow velocities and travel times
 - Maintained by US Army Corps of Engineers
- QUAL2K
 - Simulates water quality of river networks
 - One-dimensional, steady state flow
 - Simplified hydraulics – trapezoidal channel
 - Calculates water quality constituent concentrations
 - Maintained by US EPA



Jordan River HEC-RAS Model



- Compiled from existing Jordan River Flood Control Project HEC-2 models
- Included river cross-sections, channel characteristics, bridge sections, weirs and other structures
- Augmented with cross-sections from Jordan River Dredging Project (Salt Lake County, Dec 1984) and Davis County Flood Restoration Plans (Davis County, March 1984)
- No calibration or field verification was performed
- Used to develop average channel hydraulic characteristics for each reach input to the QUAL2K model



Jordan River QUAL2K Model



- Previous water quality models
 - QUAL2E model developed by Dr. Brett Borup and Justin Logan, 1999
 - Customized model developed by Dr. William Moellmer, 2003
- Flow change locations verified through communication with agencies, aerial photography and field reconnaissance



Model Segmentation



- Divided into 10 “hydraulic reaches”
 - Uniform channel slope, bottom width, side slope and roughness
 - Based on HEC-RAS analysis
 - 8 DWQ segments + 2 slope breaks
- Subdivided into 163 “segments” of 0.50 km length
 - Uniform mixing within segments
 - Model calculates output for each segment



Model Flows



- Point Sources
 - 11 tributaries
 - 3 wastewater treatment plants
- Point Abstractions
 - 10 canals/diversions
- Stormwater
 - 47 outfalls – no load for dry weather
- Diffuse Sources
 - Groundwater added from Turner Dam to Burton Dam



Model Data Sources



- Flows
 - USGS Gages
 - Salt Lake County Gages
 - Utah Division of Water Rights
 - POTW's
- Water Quality
 - EPA STORET
 - POTW's
- Weather
 - Salt Lake City Airport Meteorological Station



Model Calibration



- Simulated average conditions for July 1 – 14, 2004
 - Dry period with no precipitation
 - 6 day simulation - ~ 2.7 day travel time
- Calibration constituents
 - Flow and travel time
 - Temperature
 - Conductivity
 - CBOD, DO, TP
 - TSS
 - E coli
 - Alkalinity and pH
- Default rate parameters with minor adjustments

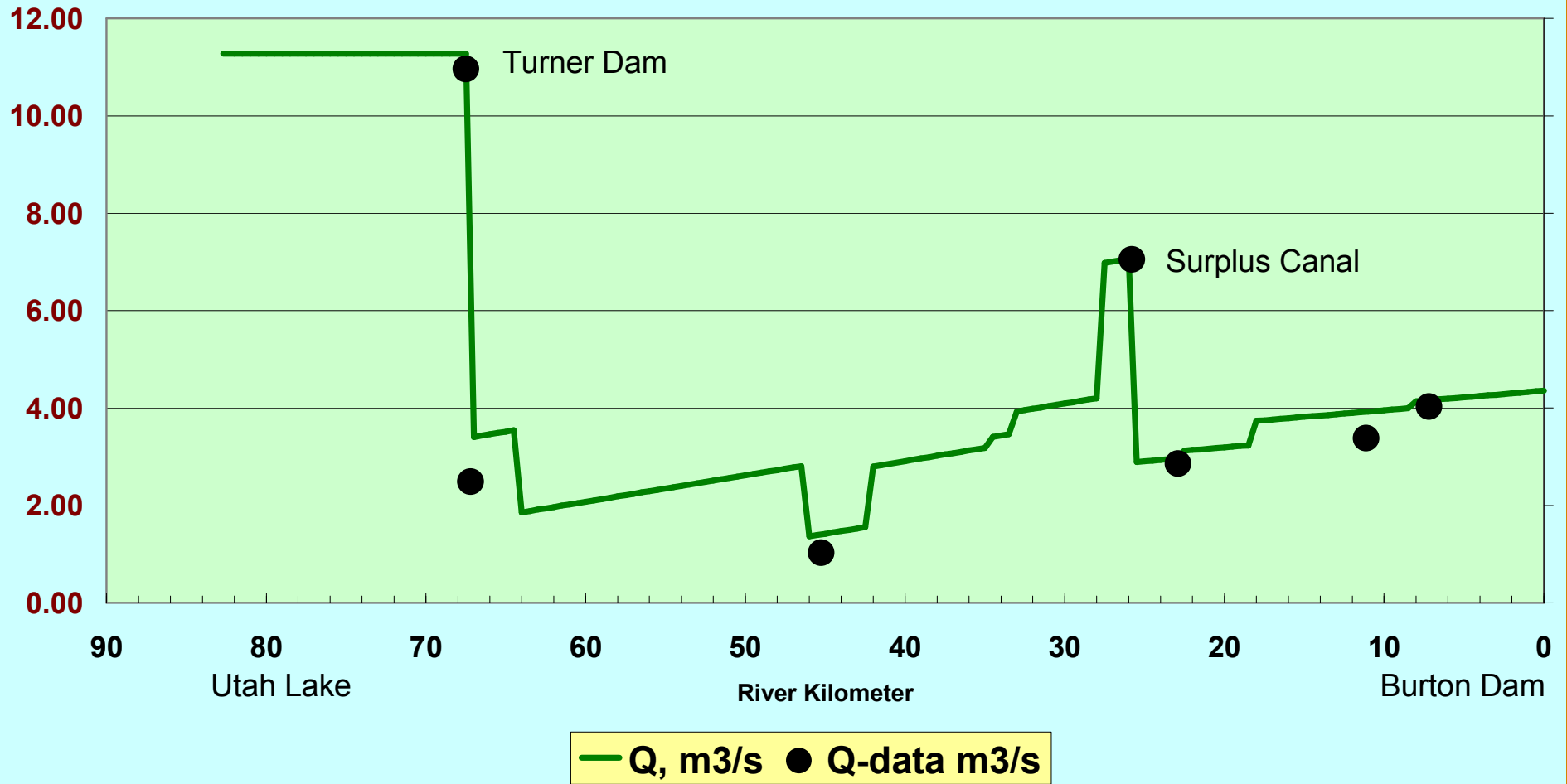
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Calibration Results - Flow

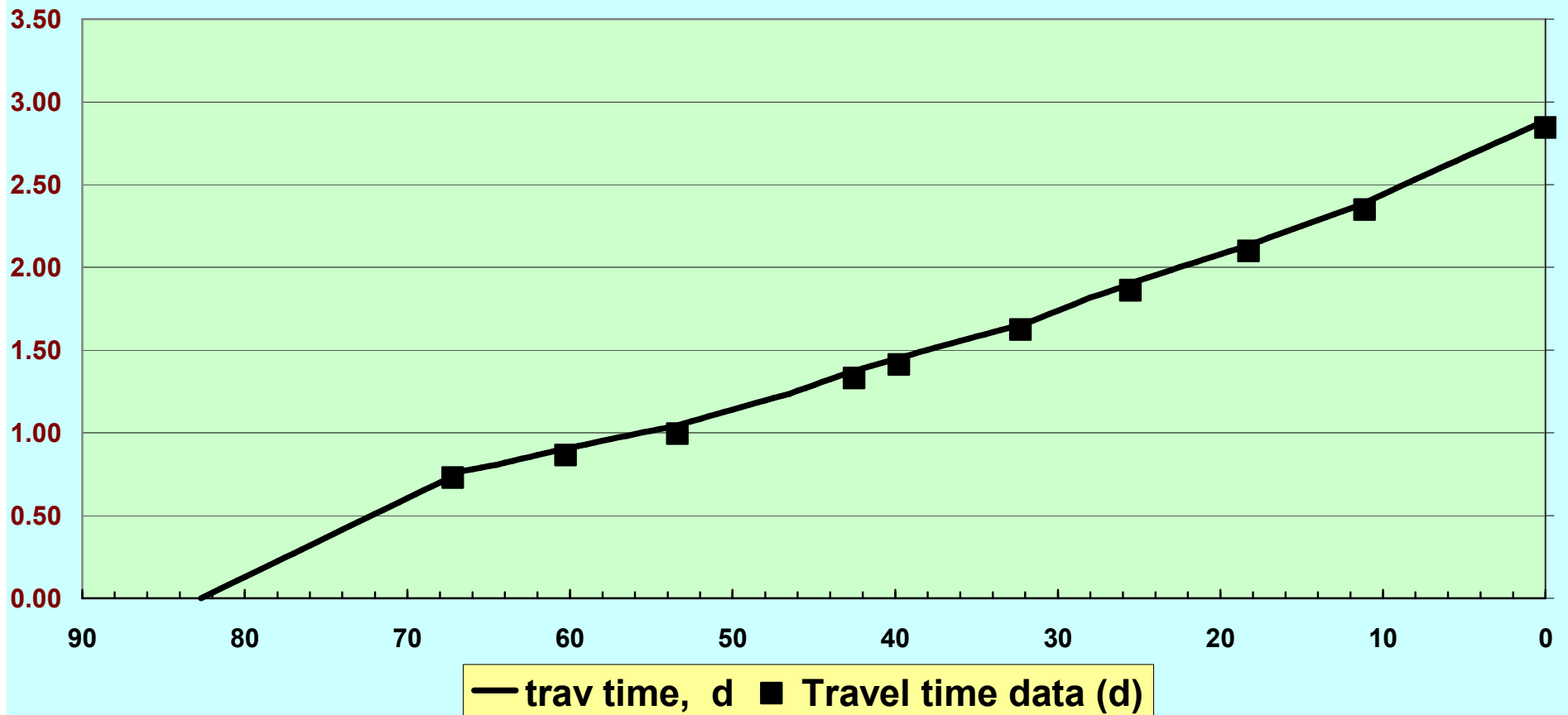
Jordan River (7/7/2004)



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Calibration Results – Travel Time

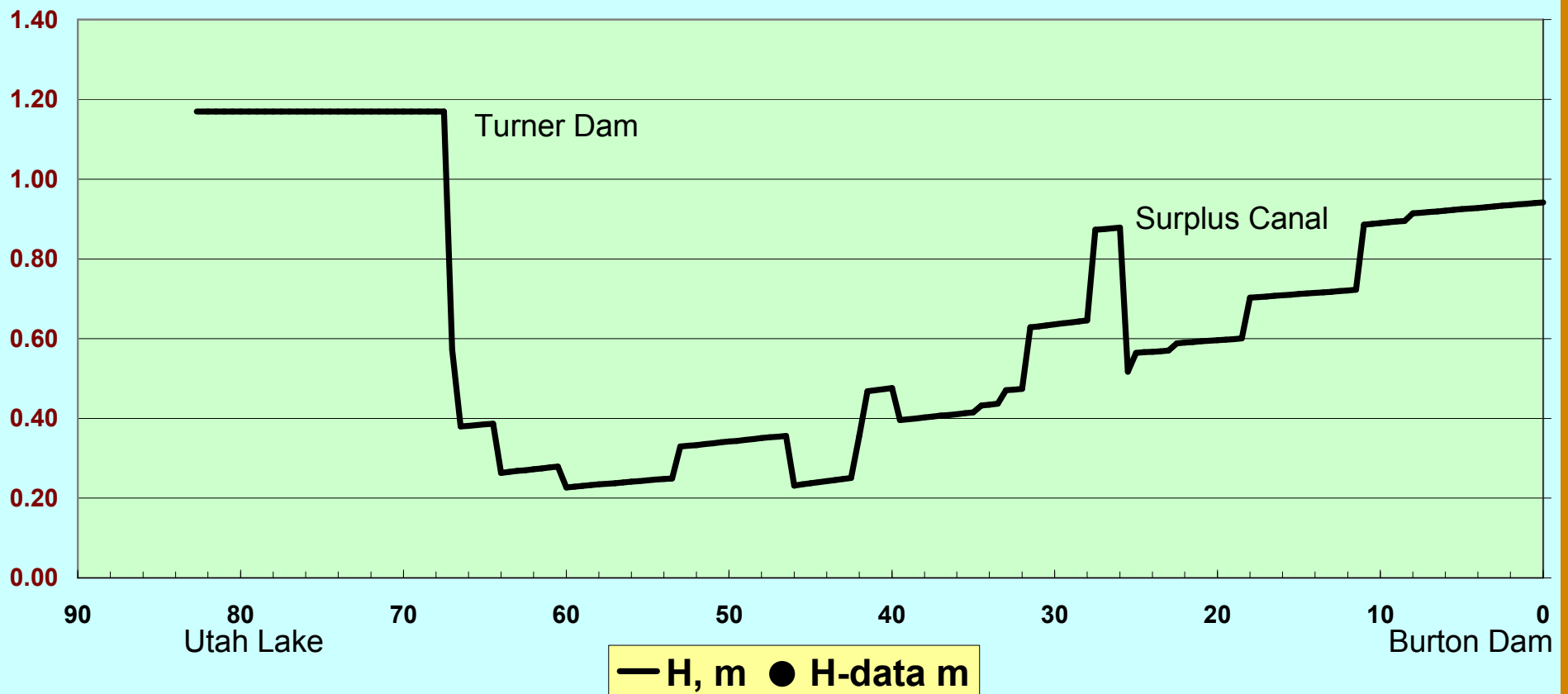
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Calibration Results - Depth

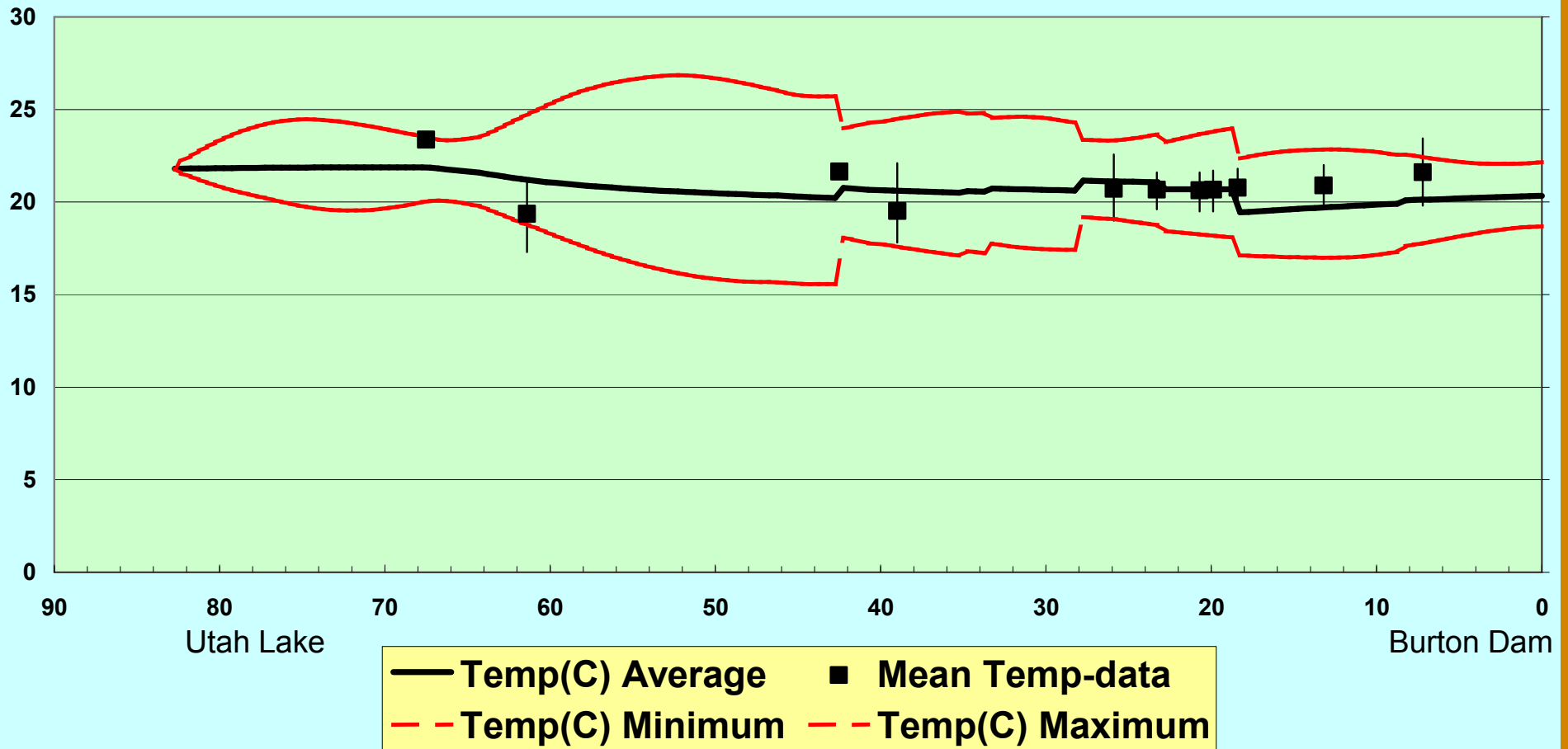
Jordan River (7/7/2004)



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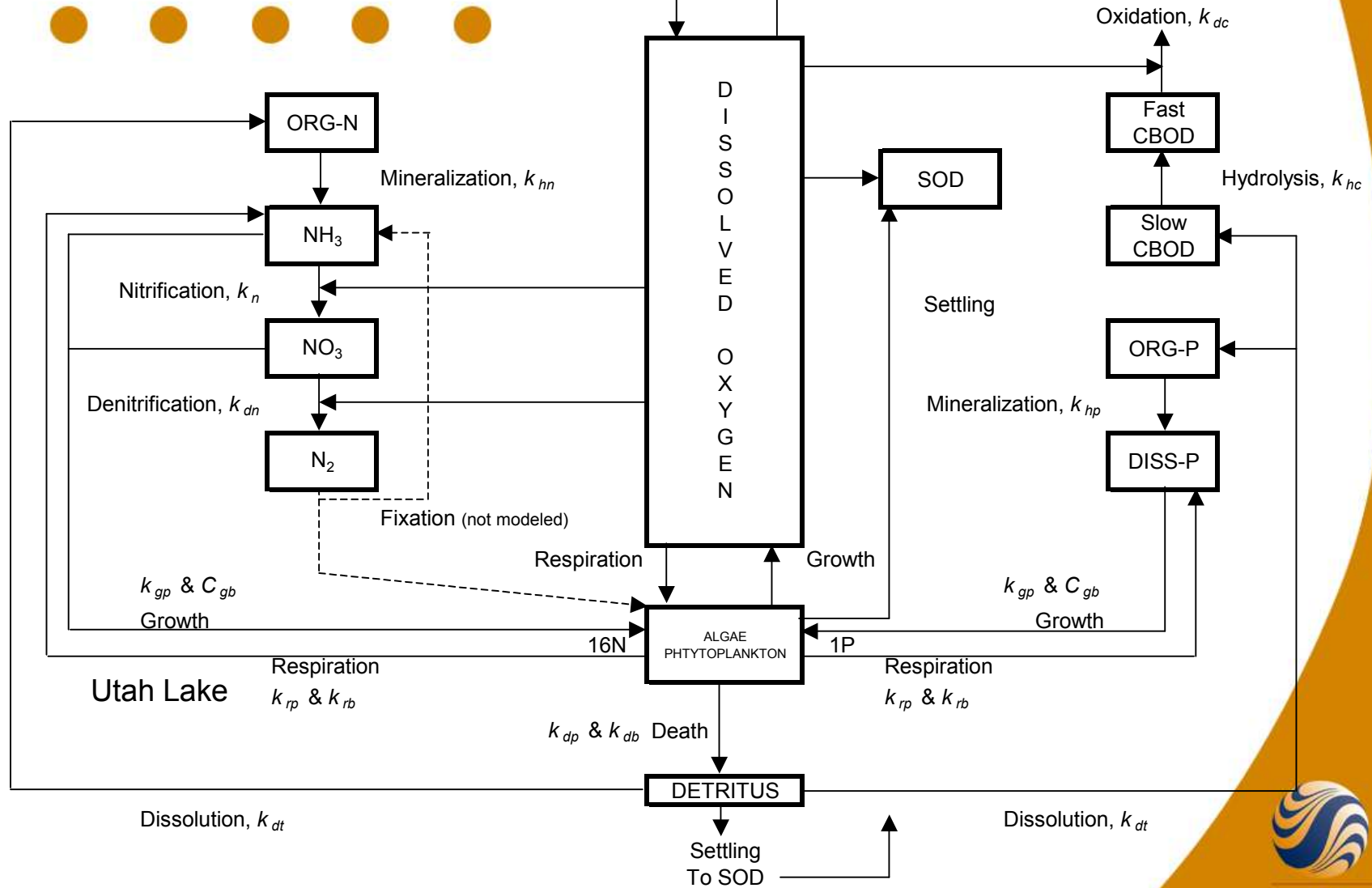
Calibration Results - Temperature

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Dissolved Oxygen Interactions in QUAL2K



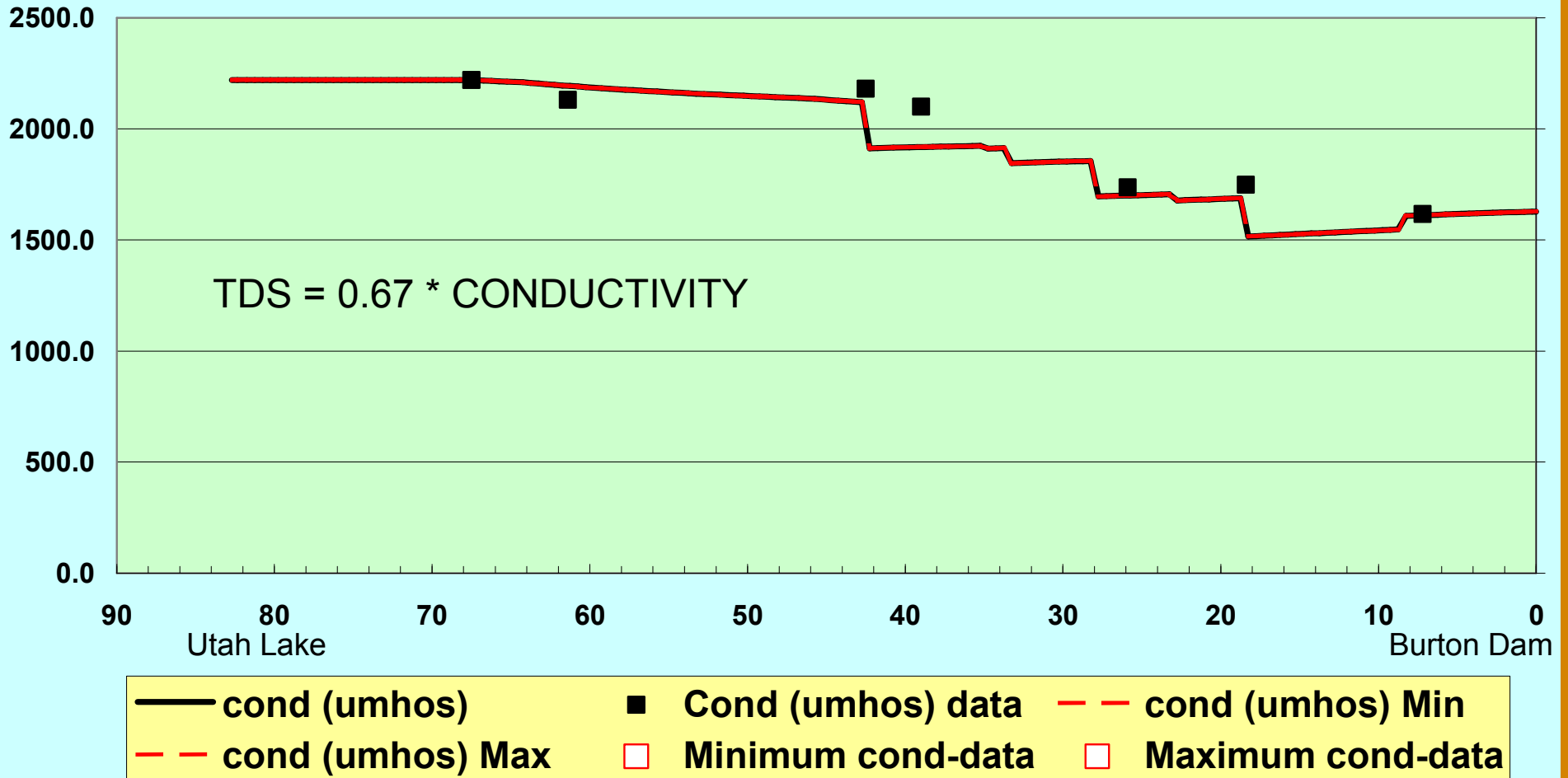
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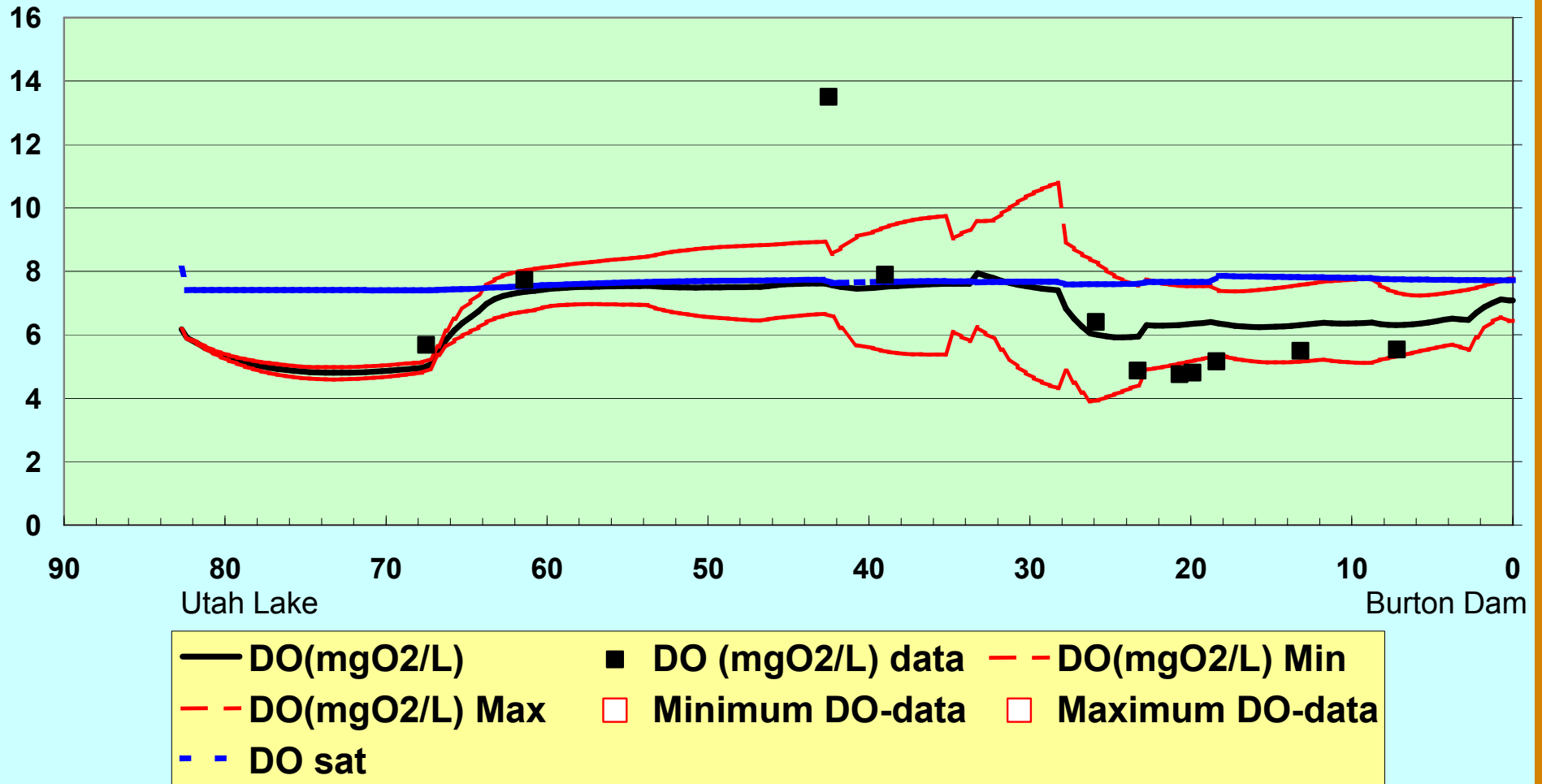
Calibration Results - Conductivity

Jordan River (7/7/2004)



Calibration Results – Dissolved Oxygen

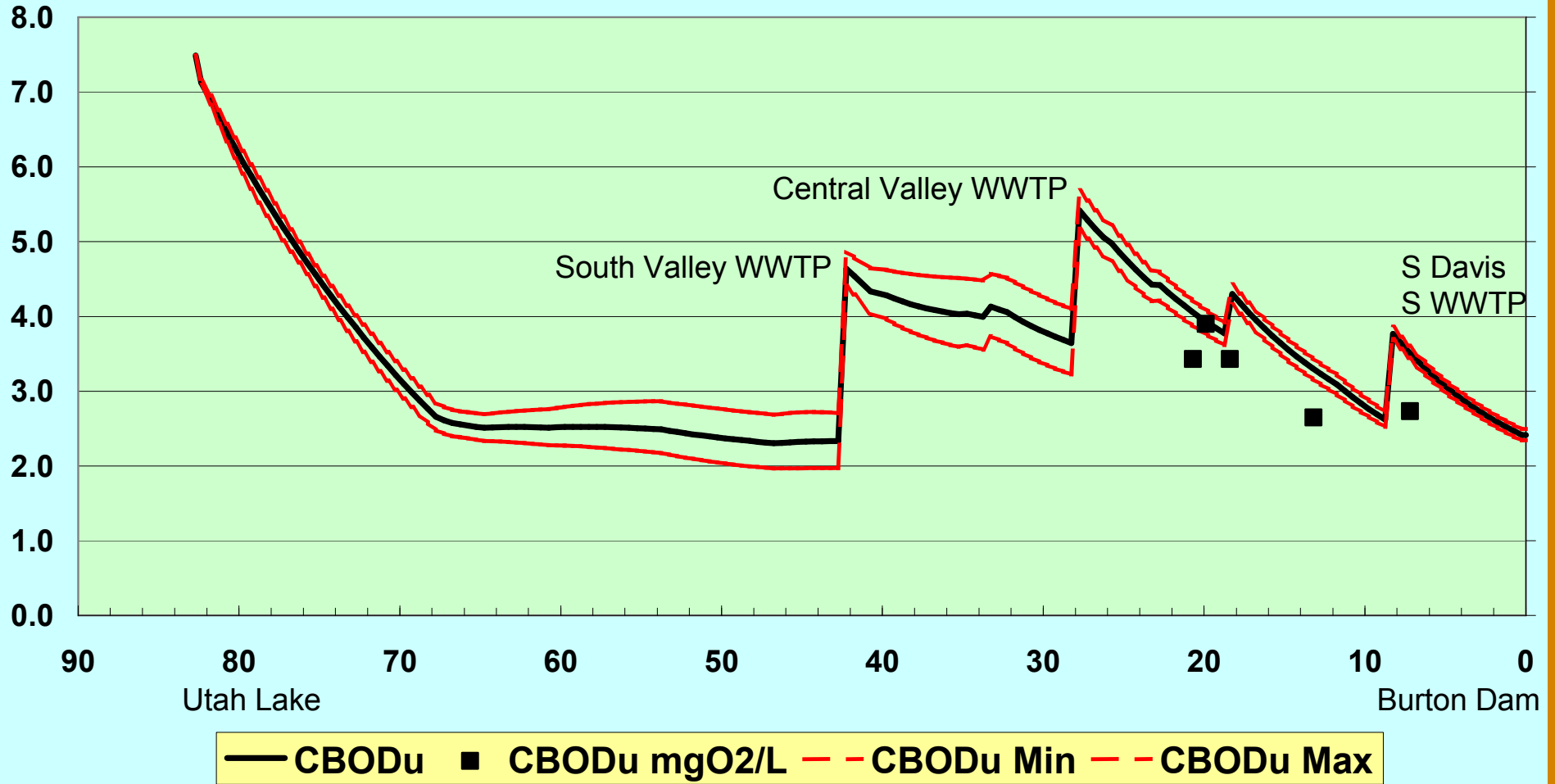
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Calibration Results - CBOD

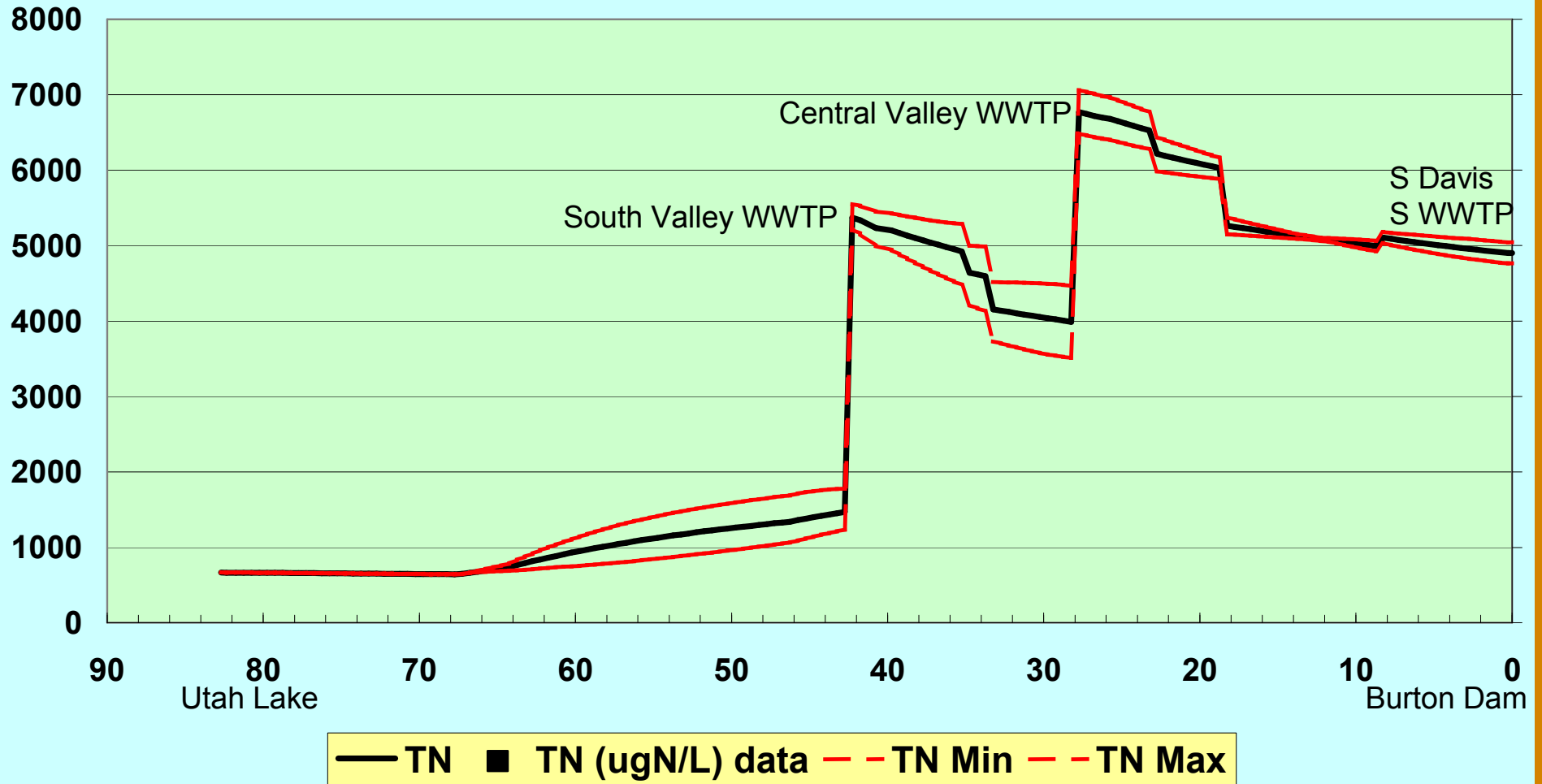
Jordan River (7/7/2004)



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Calibration Results – Total Nitrogen

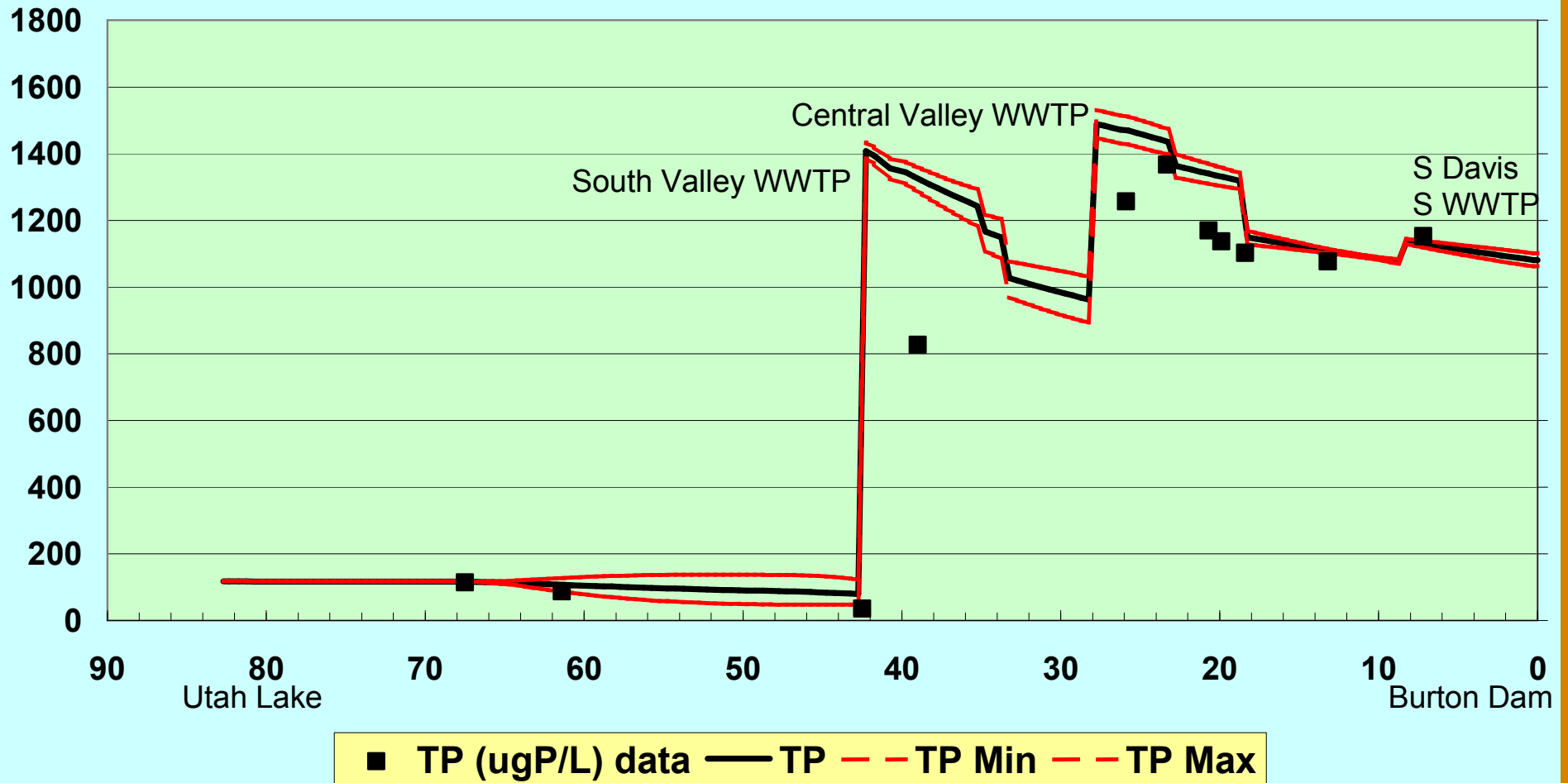
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Calibration Results – Total Phosphorus

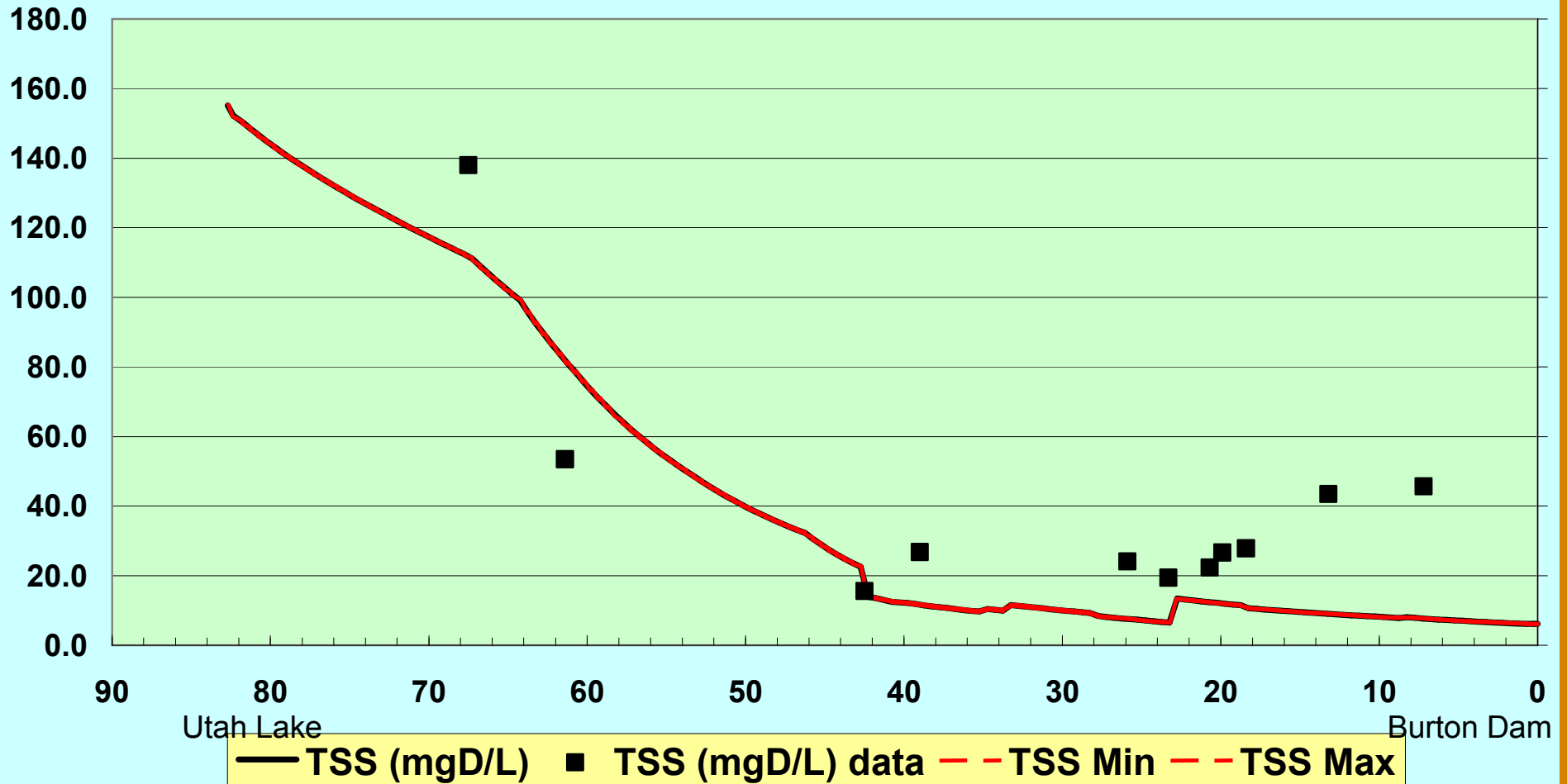
Jordan River (7/7/2004)



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Calibration Results – Total Suspended Solids

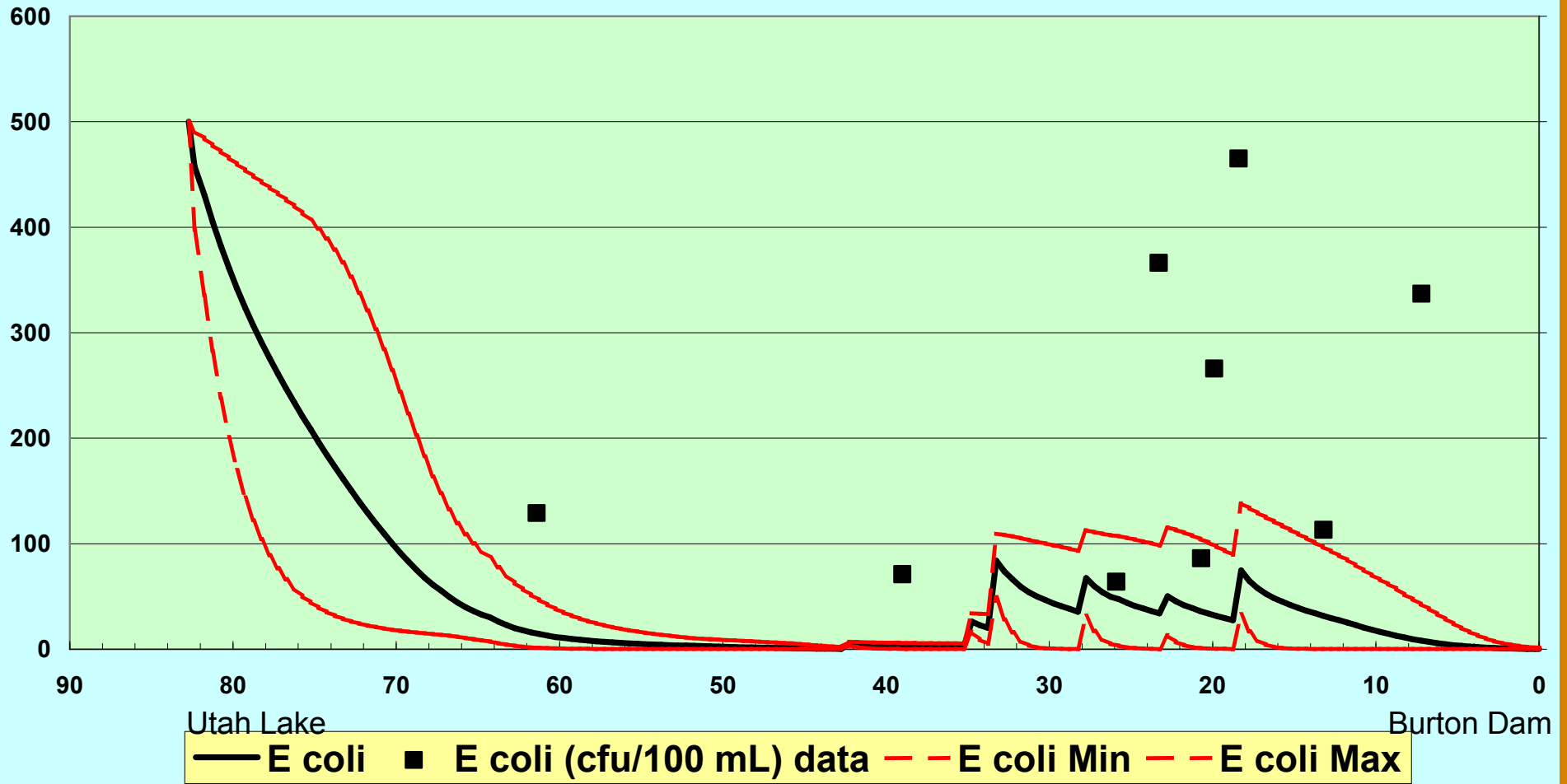
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Calibration Results – E coli

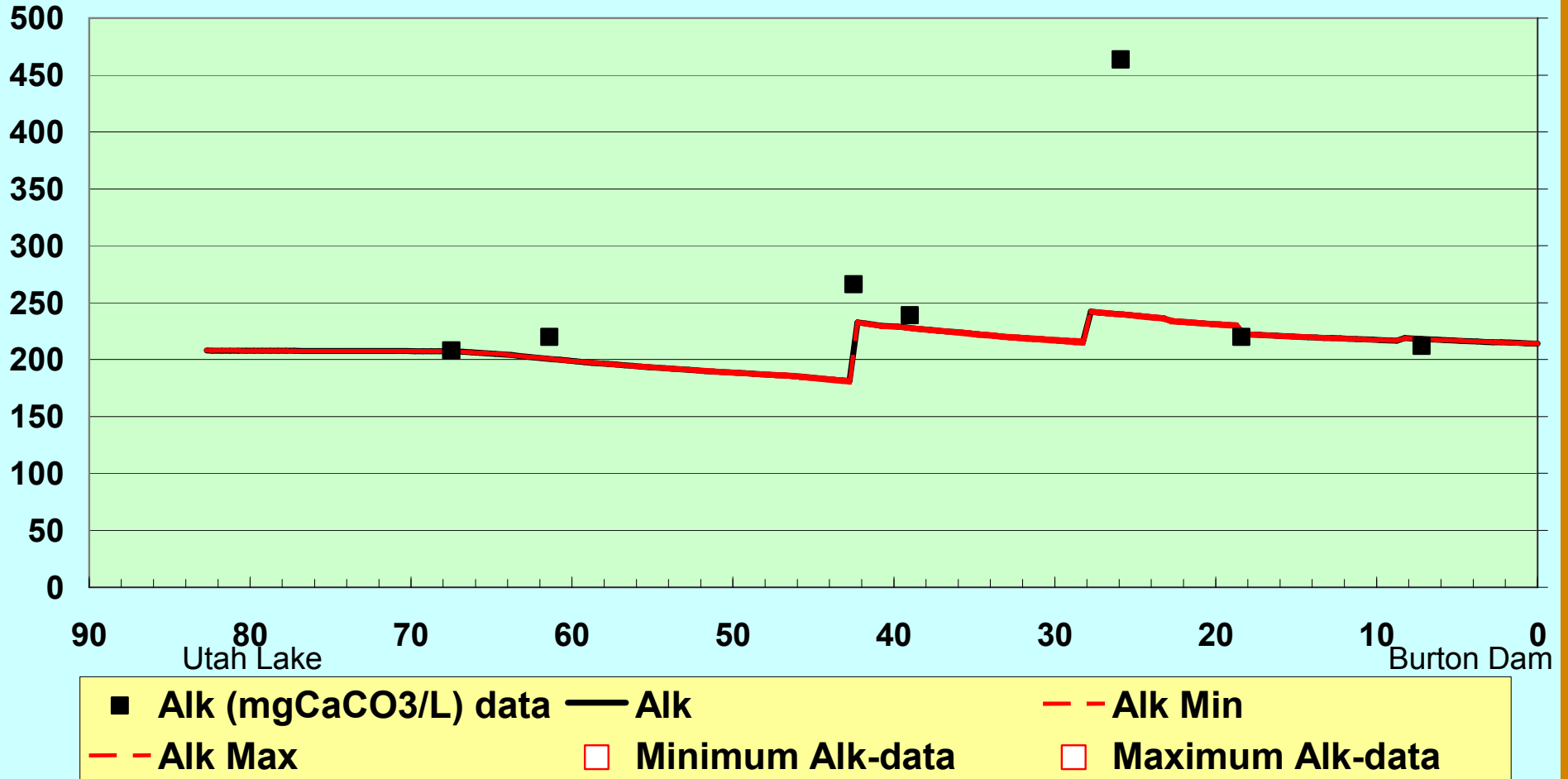
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Calibration Results – Alkalinity

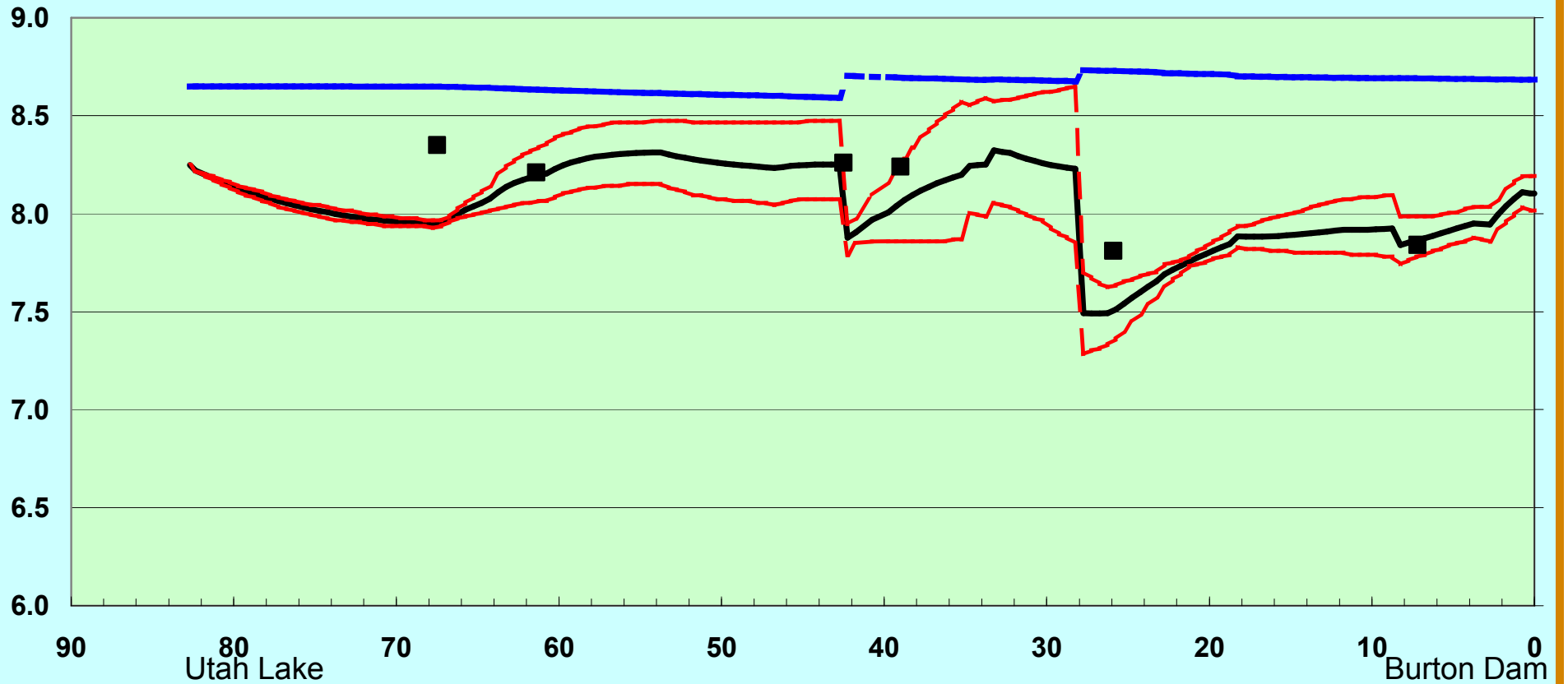
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Calibration Results – pH

Jordan River (7/7/2004)



— pH ■ pH data - - pH Min - - pH Max □ Minimum pH-data □ Maximum pH-c

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Model Validation

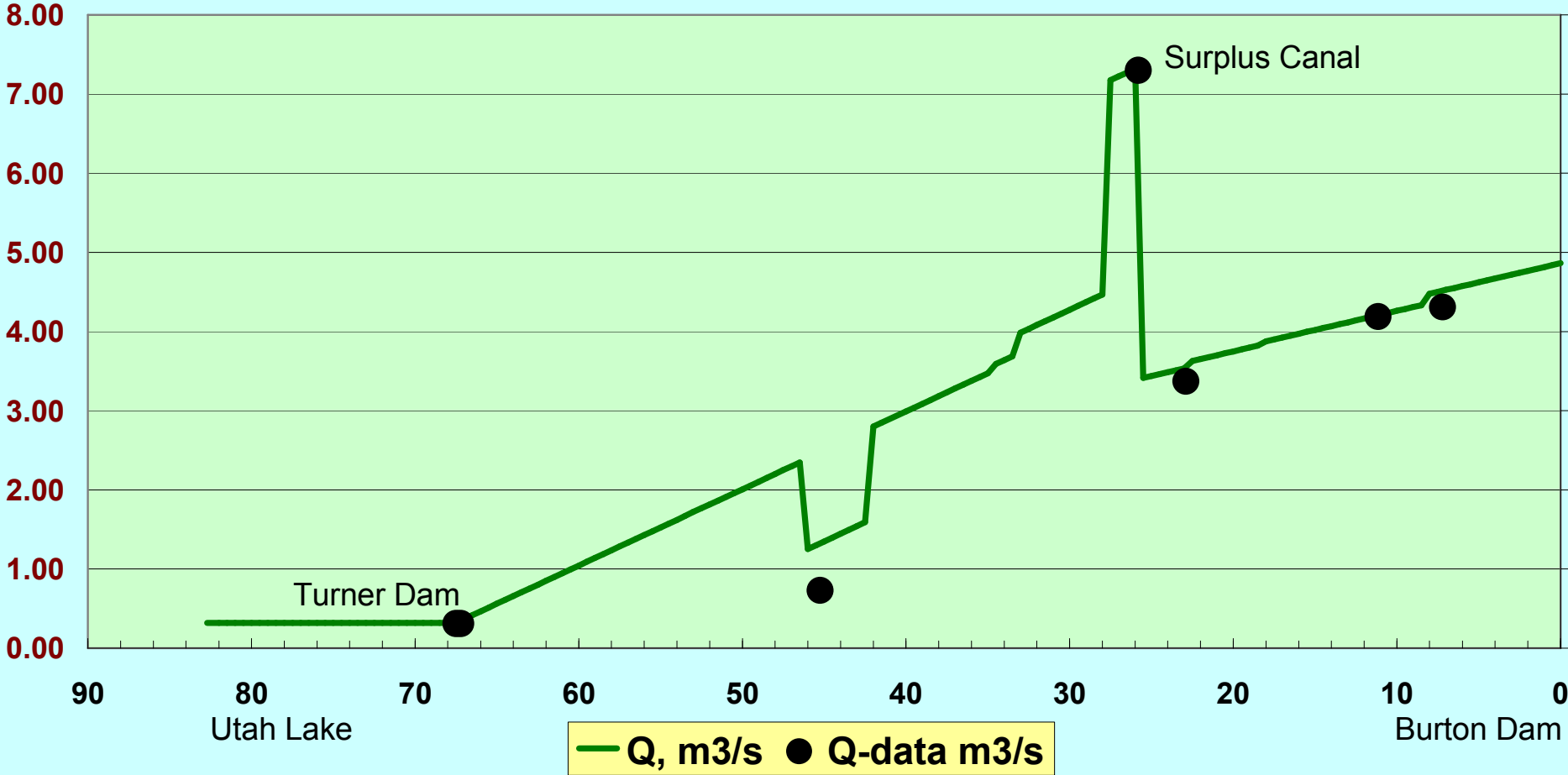


- Simulated average conditions for January 1 – 14, 2004
 - Dry period with no precipitation
 - 6 day simulation - ~ 2.7 day travel time
- Less monitoring data available
 - No E. coli, CBOD
- No adjustment of rate parameters



Validation Results - Flow

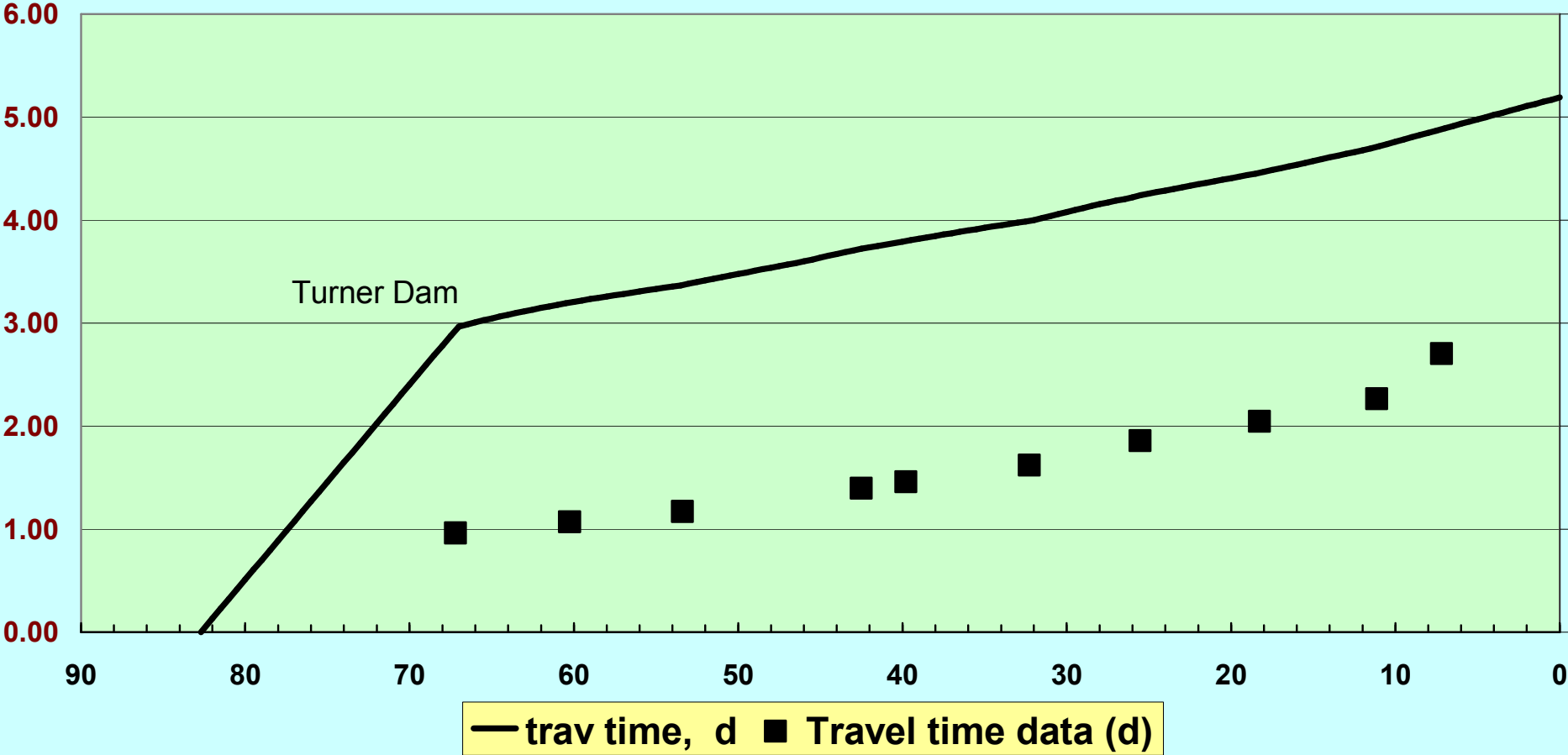
Jordan River (11/7/2004)



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Validation Results – Travel Time

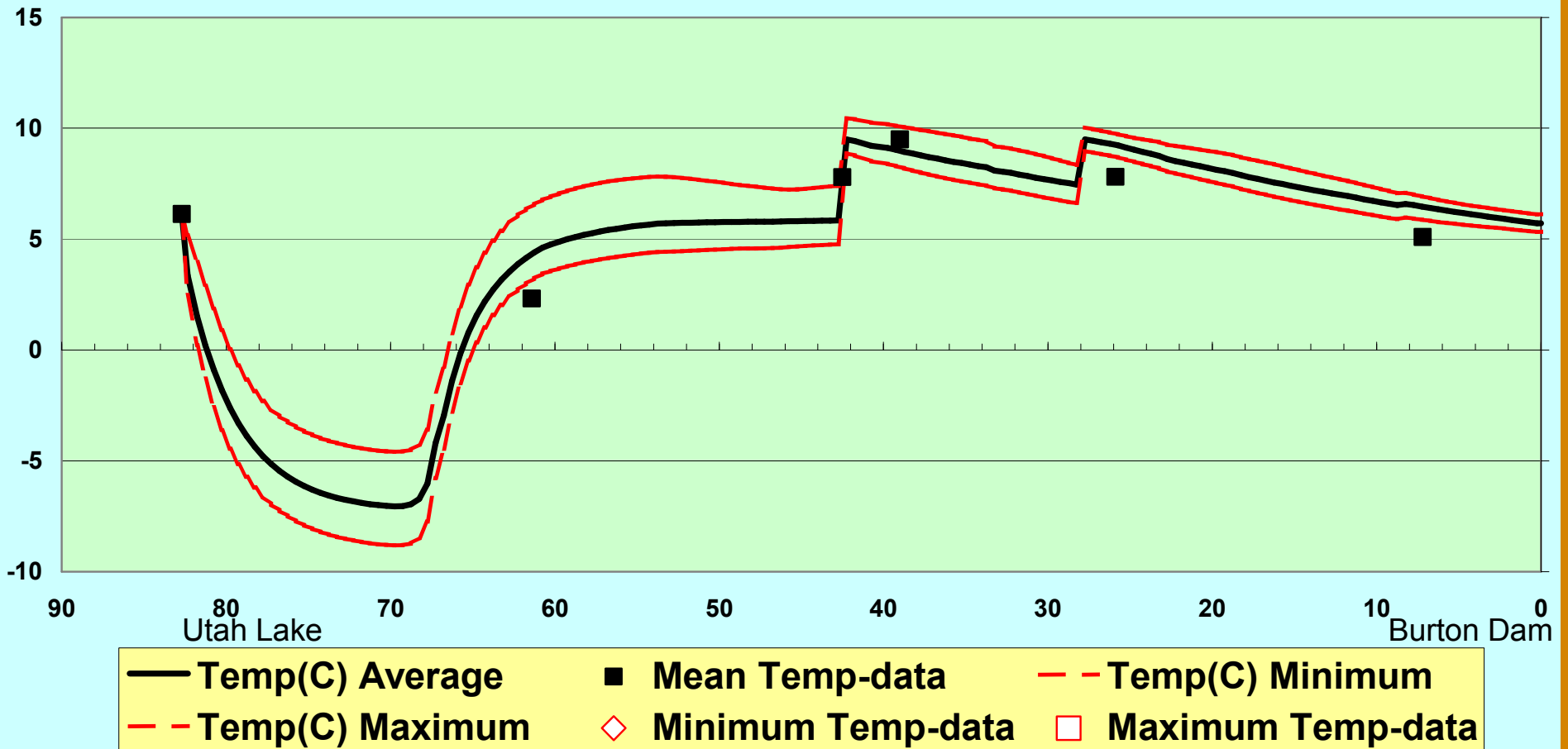
Jordan River (1/7/2004)



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Validation Results - Temperature

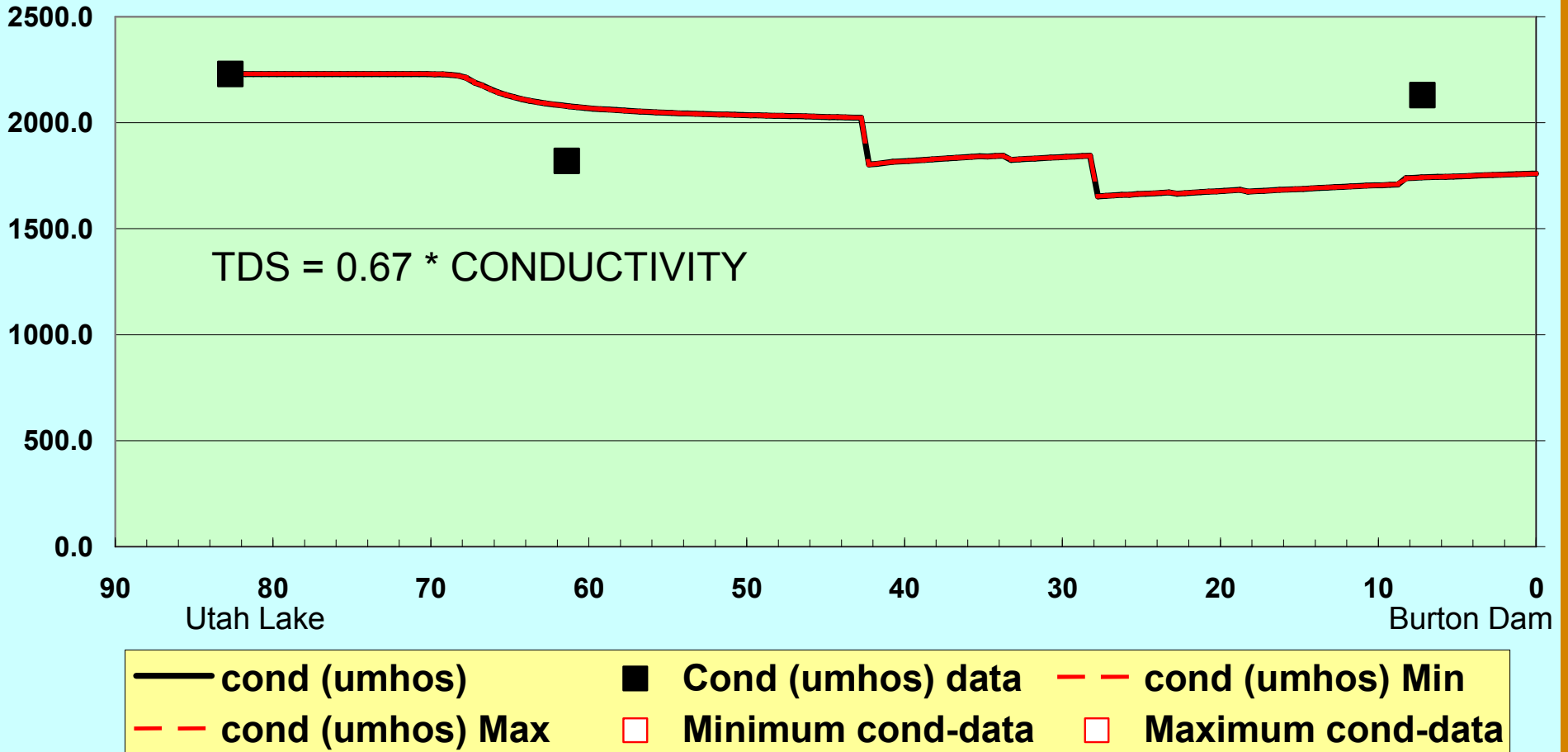
Jordan River (1/7/2004)



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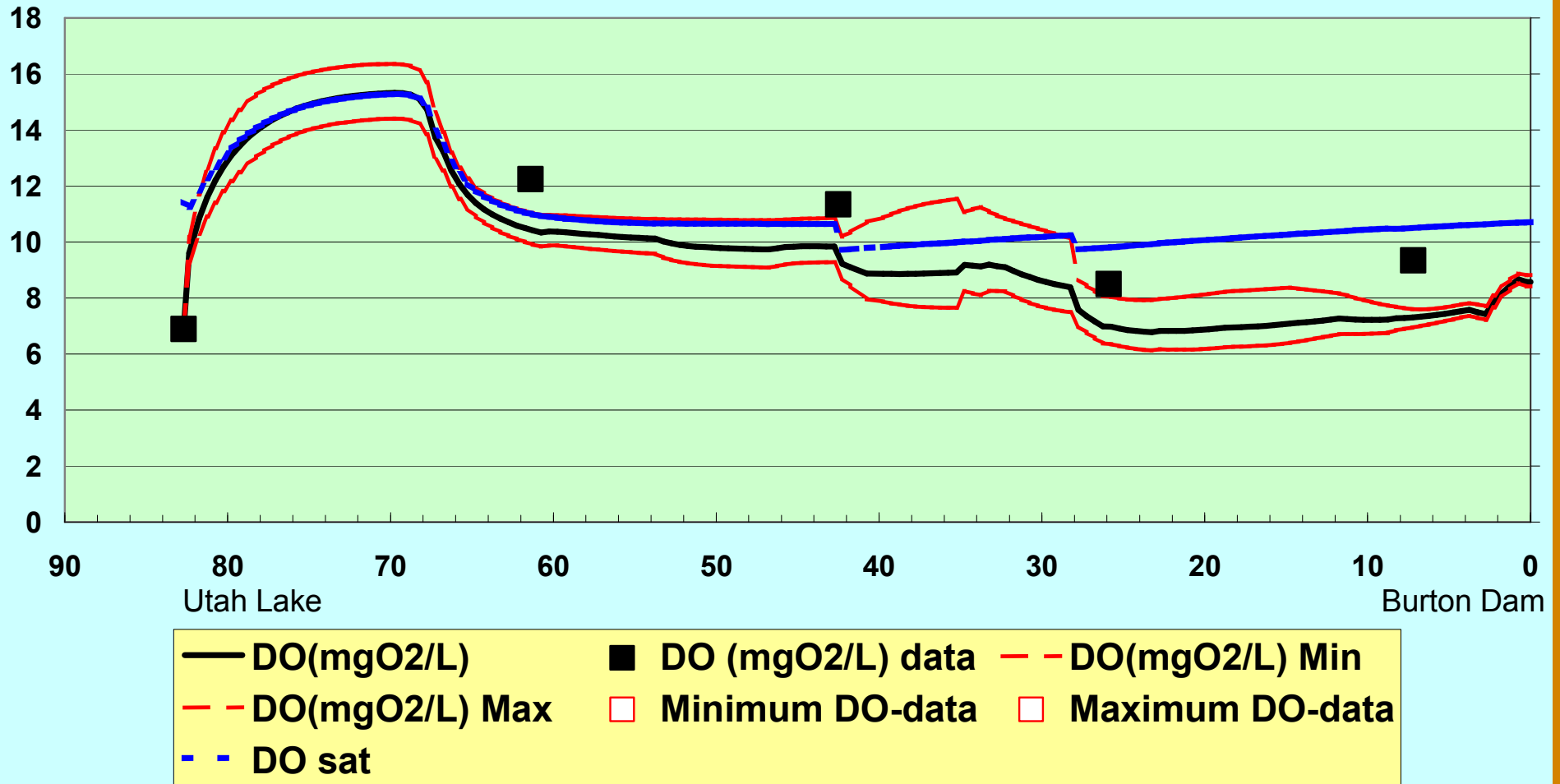
Validation Results - Conductivity

Jordan River (1/7/2004)



Calibration Results – Dissolved Oxygen

Jordan River (11/7/2004)



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Monitoring Data Gaps



- Little or no data available on the following input/output water quality constituents
 - Nitrogen (nitrate, ammonia, dissolved organic)
 - Phosphorus (inorganic, dissolved organic)
 - Particulate organic matter (detritus in QUAL2K)
 - Free floating plants (phytoplankton)
 - Fixed plants (periphyton)
 - Sediment oxygen demand (SOD)



Conclusions



- Calibration performance
 - Excellent for hydraulics
 - Good for most water quality constituents
- Validation performance
 - Low flow from Utah Lake to Turner Dam caused problems
- Results highly dependent on amount and quality of input data
- Primary unknowns
 - POM
 - Nutrients
 - Plants
 - SOD
 - Groundwater quantity and quality

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Recommendations



- Simulate additional scenario with higher flows closer to average annual
- Evaluate sensitivity of model to unknown input constituents
- Evaluate effect of Utah Lake on Jordan River
- Evaluate effect of groundwater on Jordan River
- Collect more monitoring data!

