Update on

Fully Appropriated Evaluation Methodology

NARD Legislative Conference
Embassy Suites – Lincoln, NE
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THE FLATWATER GROUP INC.

NRD

NEBRASKA Department of Natural Resources

Today's Discussion

- Review of Project Background, Goals, and Activities
- Methodology Recommendations
- Next Steps

Project Background

- Project History
  - CPNRD working on IMP
  - Statutes link IMP to evaluation
    - Current evaluation methodology is not linked to IMP
  - Result: CPNRD and NDNR lead effort to look at methodology
  - **Goals:**
    - Best represent supplies and uses in basins
    - Link evaluation to the IMP process.

Scope of Project

- From minor tweaks to wholesale revisions were on the table
- Possible changes to rules and procedures
- Approach:
  - Research what's being done elsewhere – not necessarily looking to reinvent the wheel
  - Identify desired elements of methodology
  - Develop methodology for testing
  - Final recommendations

Literature Review

- Sources
  - State Statutes
  - Administrative Rules
  - Special Management Areas
  - Compacts and their accounting methods

Result = No "off-the-shelf" solution

Desirable Characteristics of Methodology

- Flexible time period – reflect cyclical nature of water budget
- Reflect seasonal variations
- Independently accounts for SW/GW use and supply
- Considers variation in water supply from year to year
- Consumptive/Non-consumptive use
- Utilize existing datasets when possible
- Consider impacts of conservation practices

Methodology Development

- Methodology for Testing
  - **Supply** - Virgin Natural Flow Hydrograph for Supply
  - **Demand** - Identify SW and GW consumptive and non-consumptive uses
  - **SW/GW Integration** - Best available technology for SW-GW interaction (analytic, numerical modeling, etc.)
- Flexibility in tools for analysis
- Applications to Upper Niobrara, Lower Platte River, and full Platte River basin

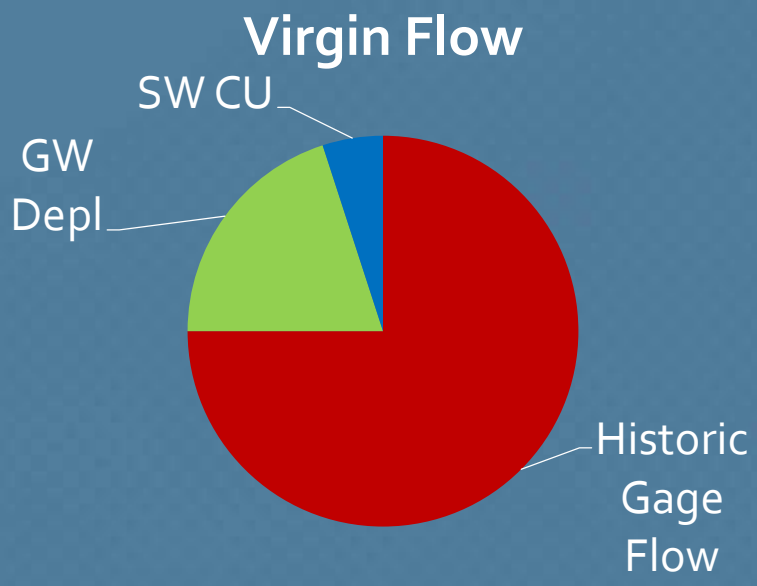
Methodology Recommendations

- Supply
- Demand
- Evaluation

Methodology - Supply

- Virgin Flow Hydrograph
  - Estimate of streamflow hydrograph "undepleted by activities of man"
  - Historic gaged flows + upstream consumptive uses:

Virgin Flow = Historic flow
+ historic SW CU
+ estimated GW depletions



Methodology - Supply

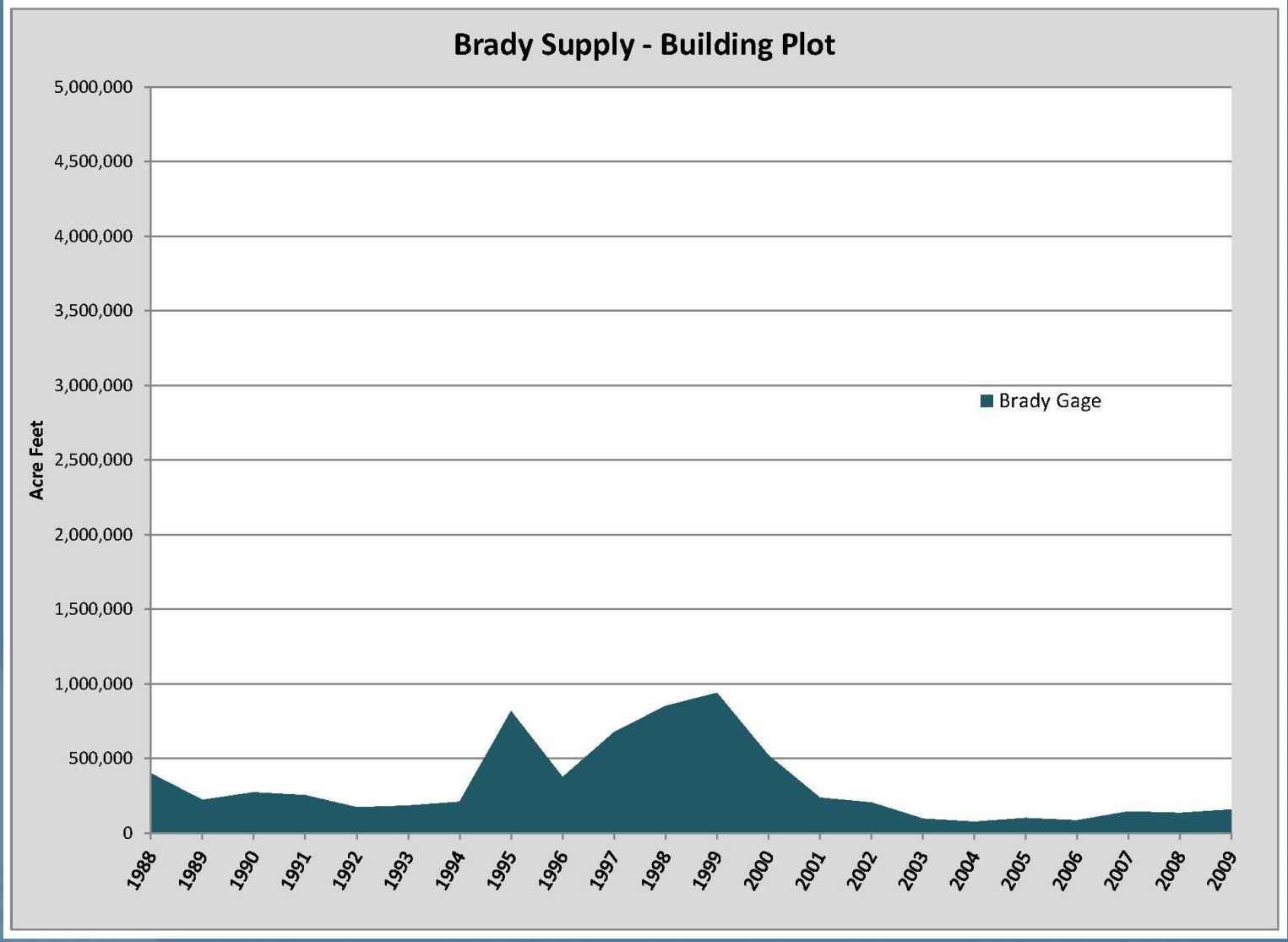
- What are 'SW Consumptive Uses'?
  - Irrigation Canal Diversions
  - Individual irrigation appropriators
  - Reservoir evaporation
  - Municipal and Industrial

Methodology – Supply

- Reservoir Storage
  - Account for change in storage in supply
  - For Lake McConaughy – account for change in storage *AND* total available storage in supply

    => accounts for carryover storage

Brady Analysis – Supply build



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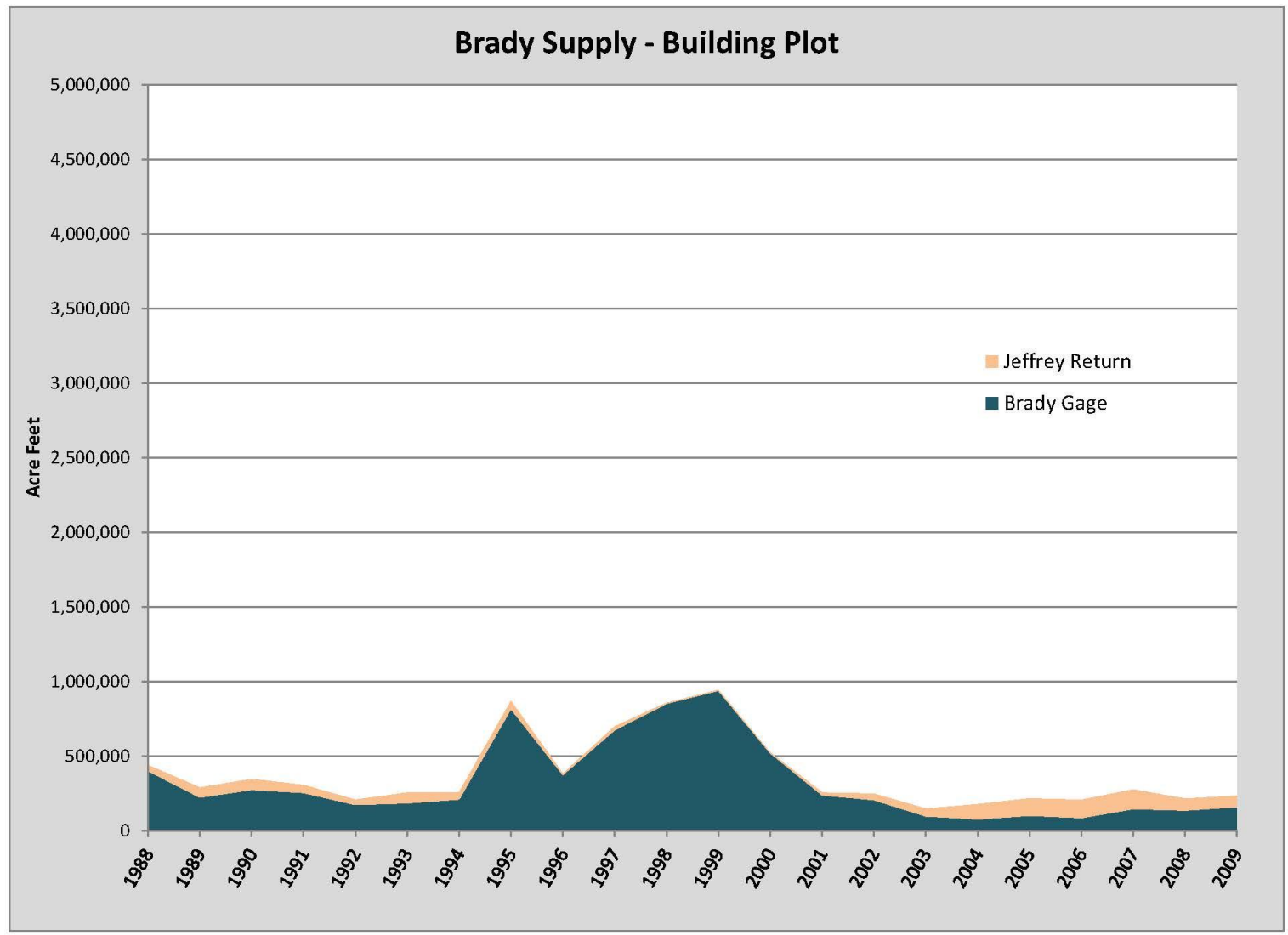

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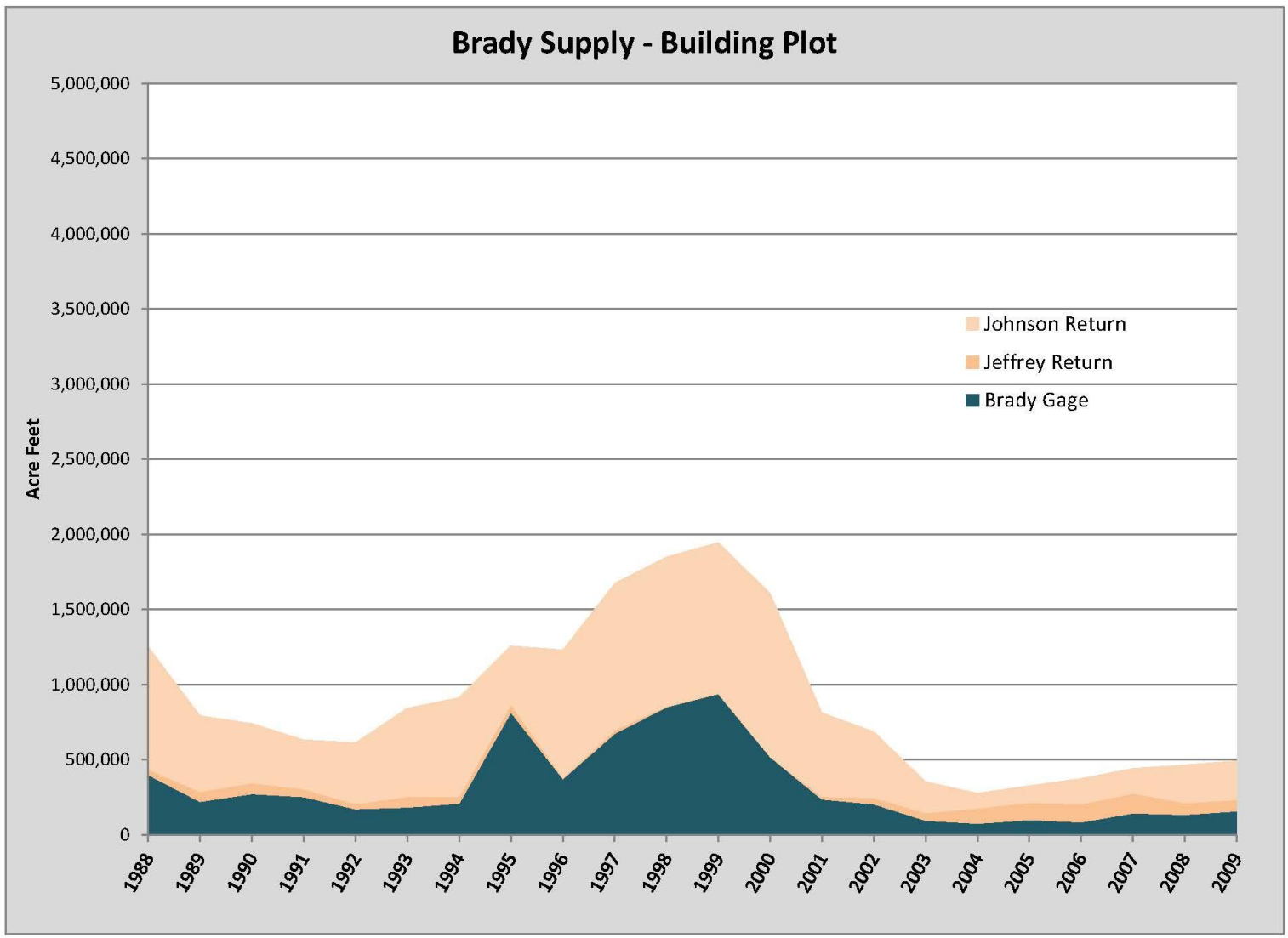

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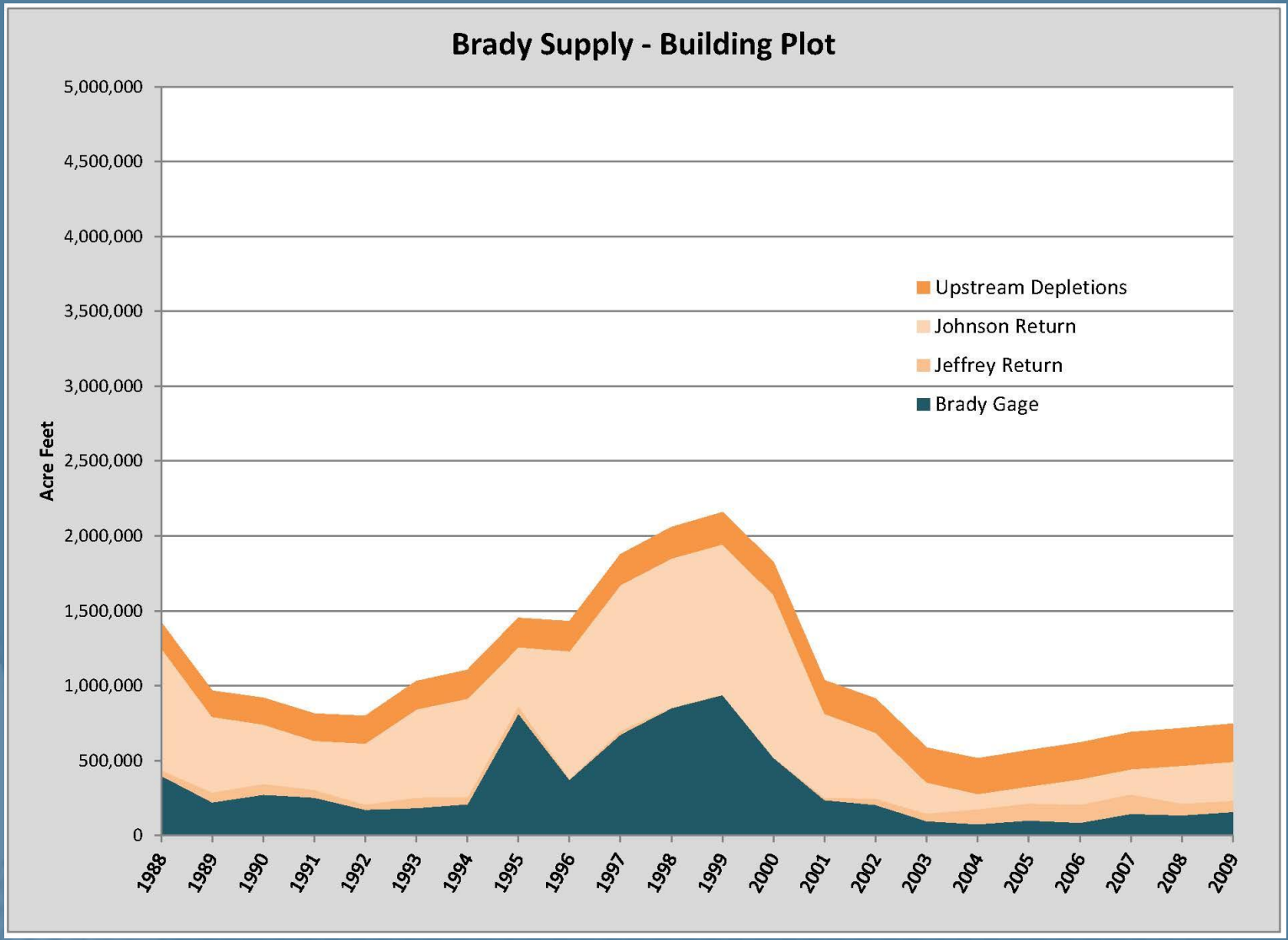

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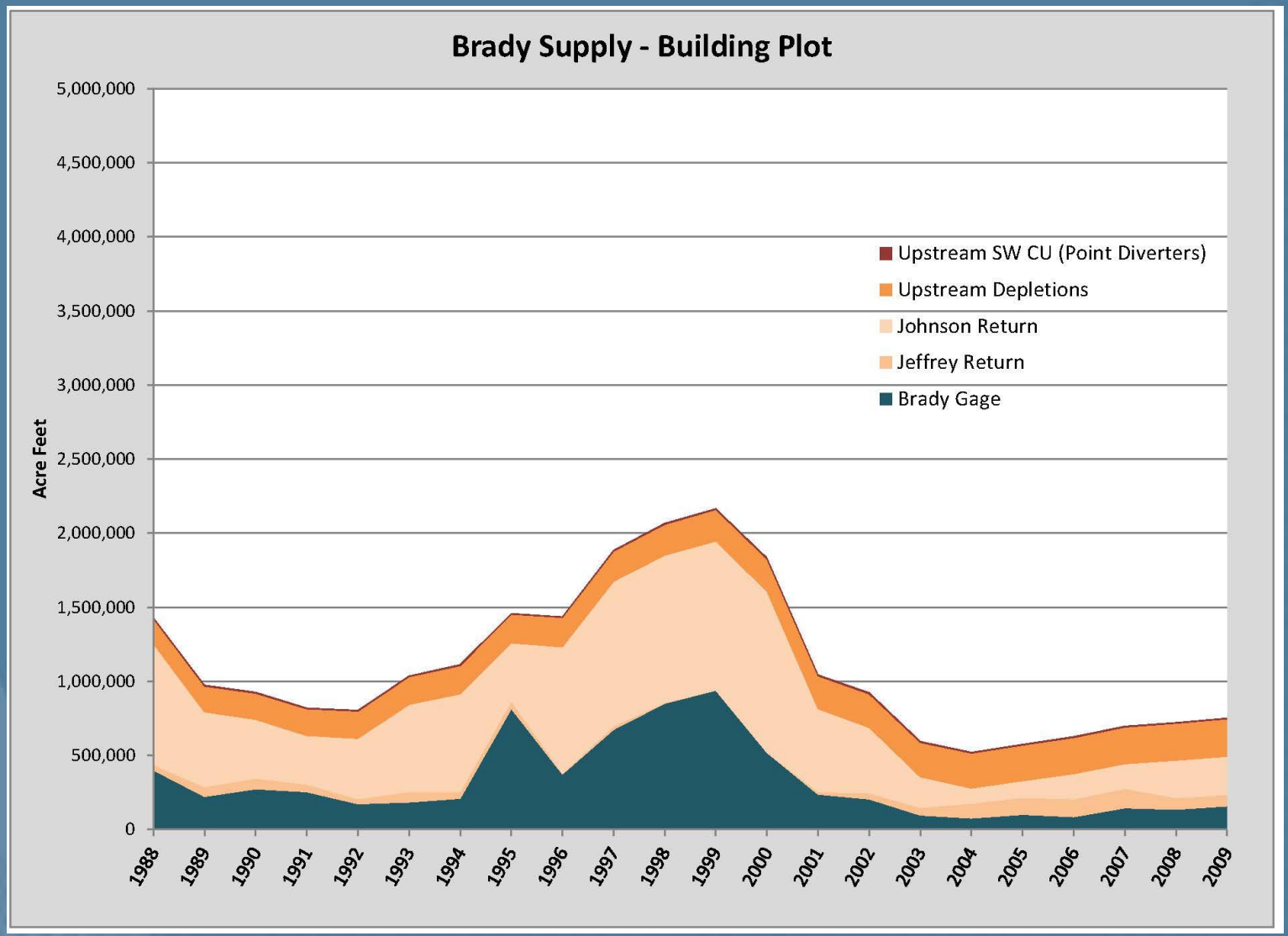

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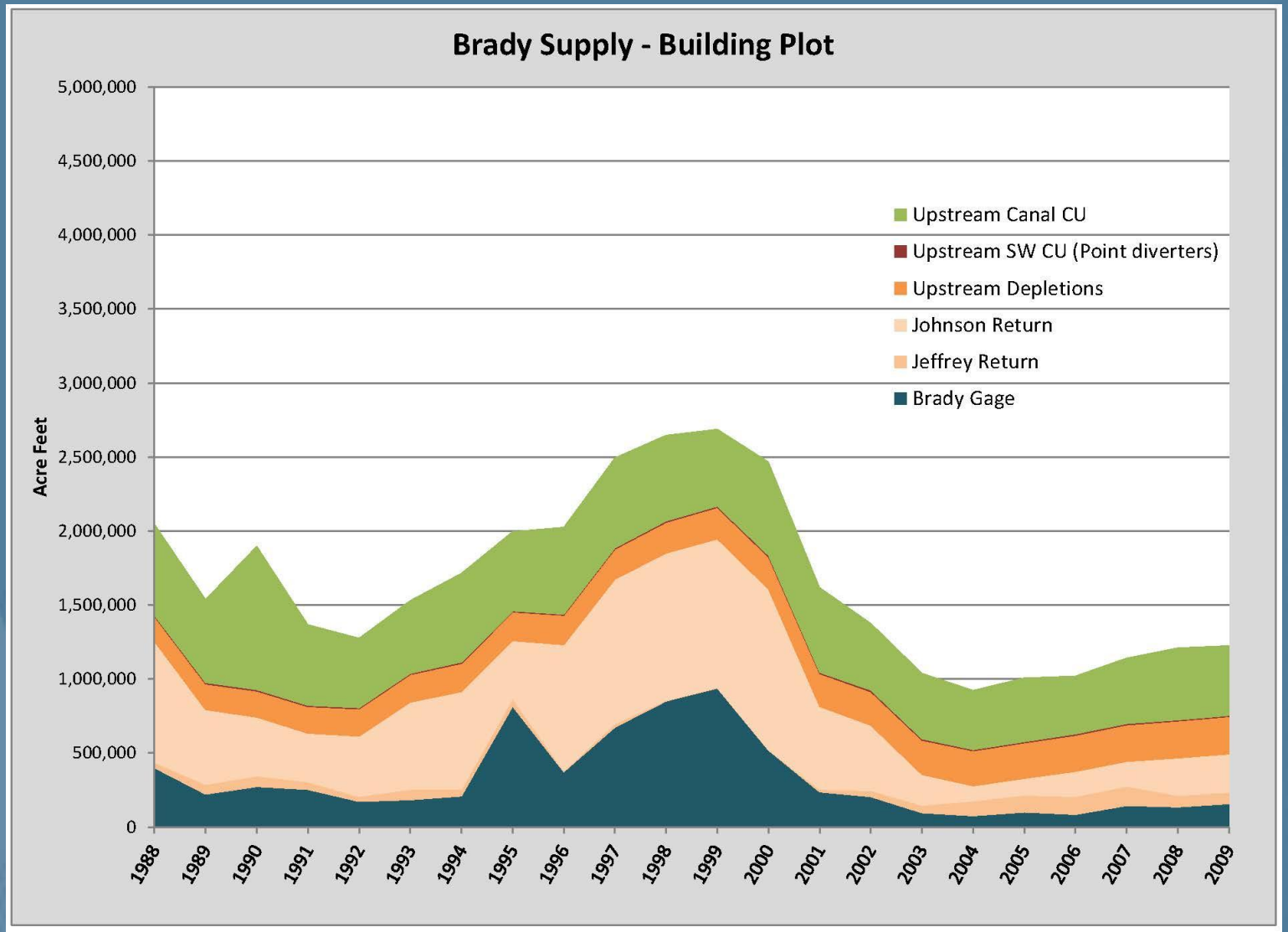

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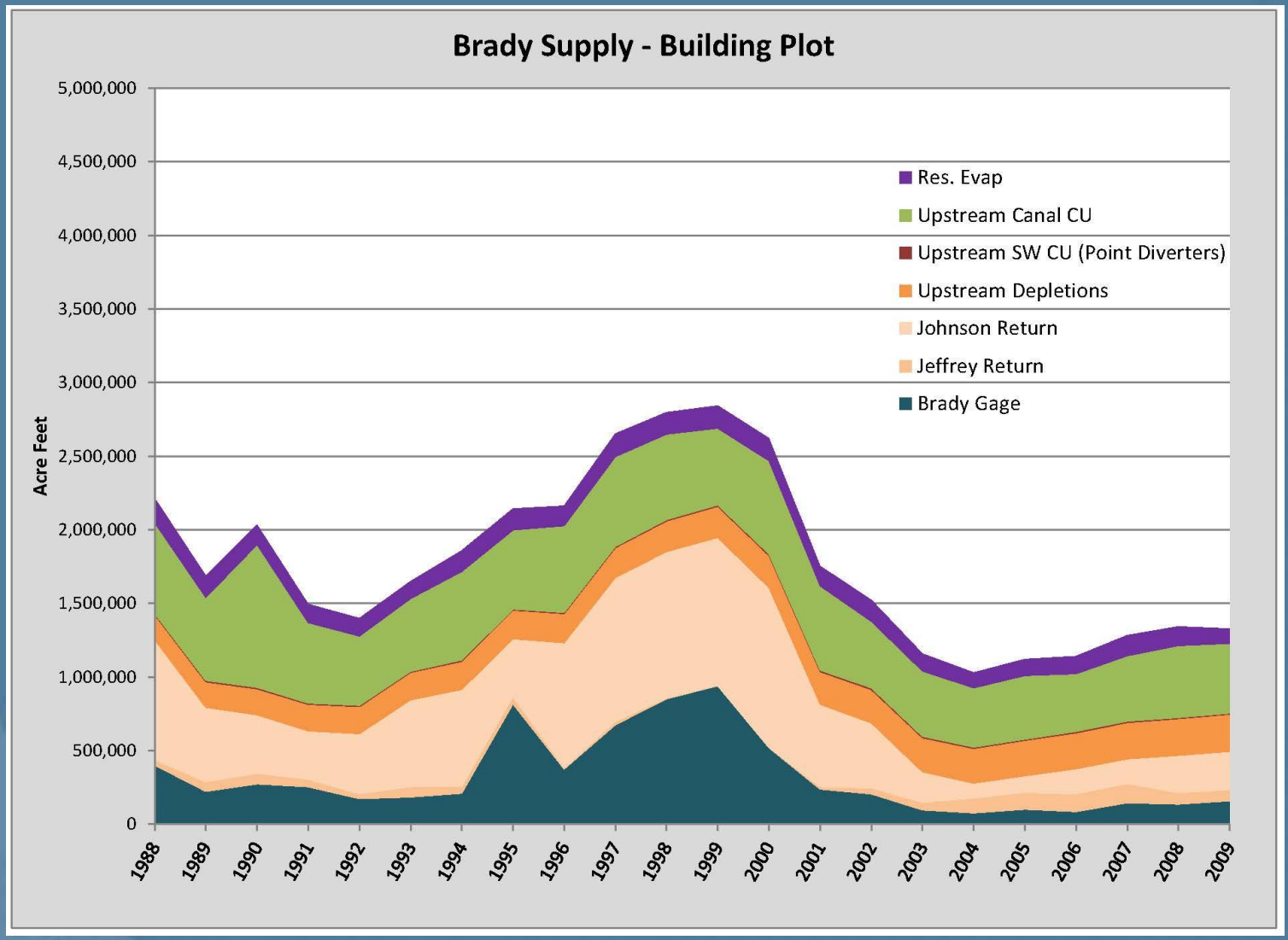

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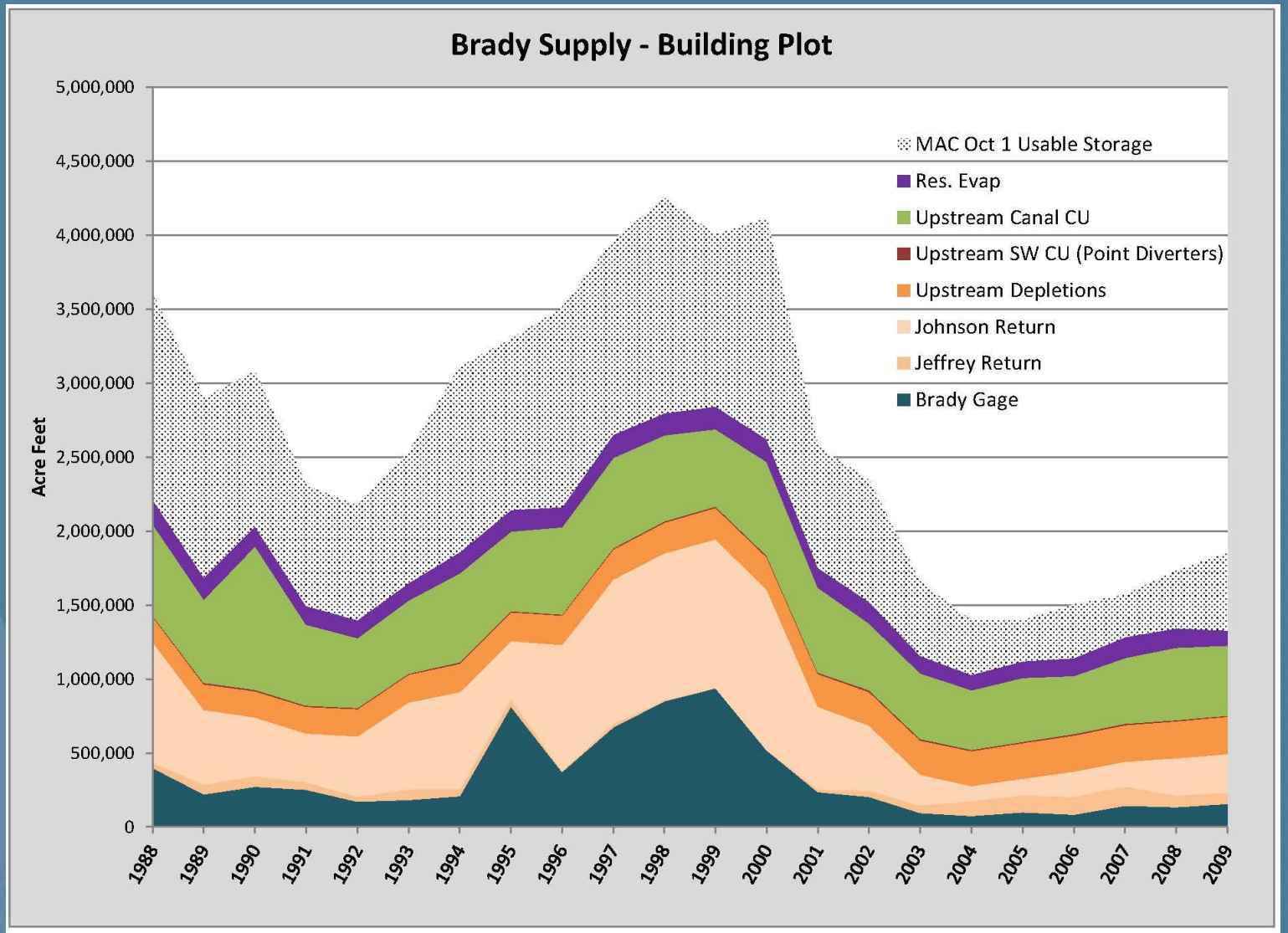

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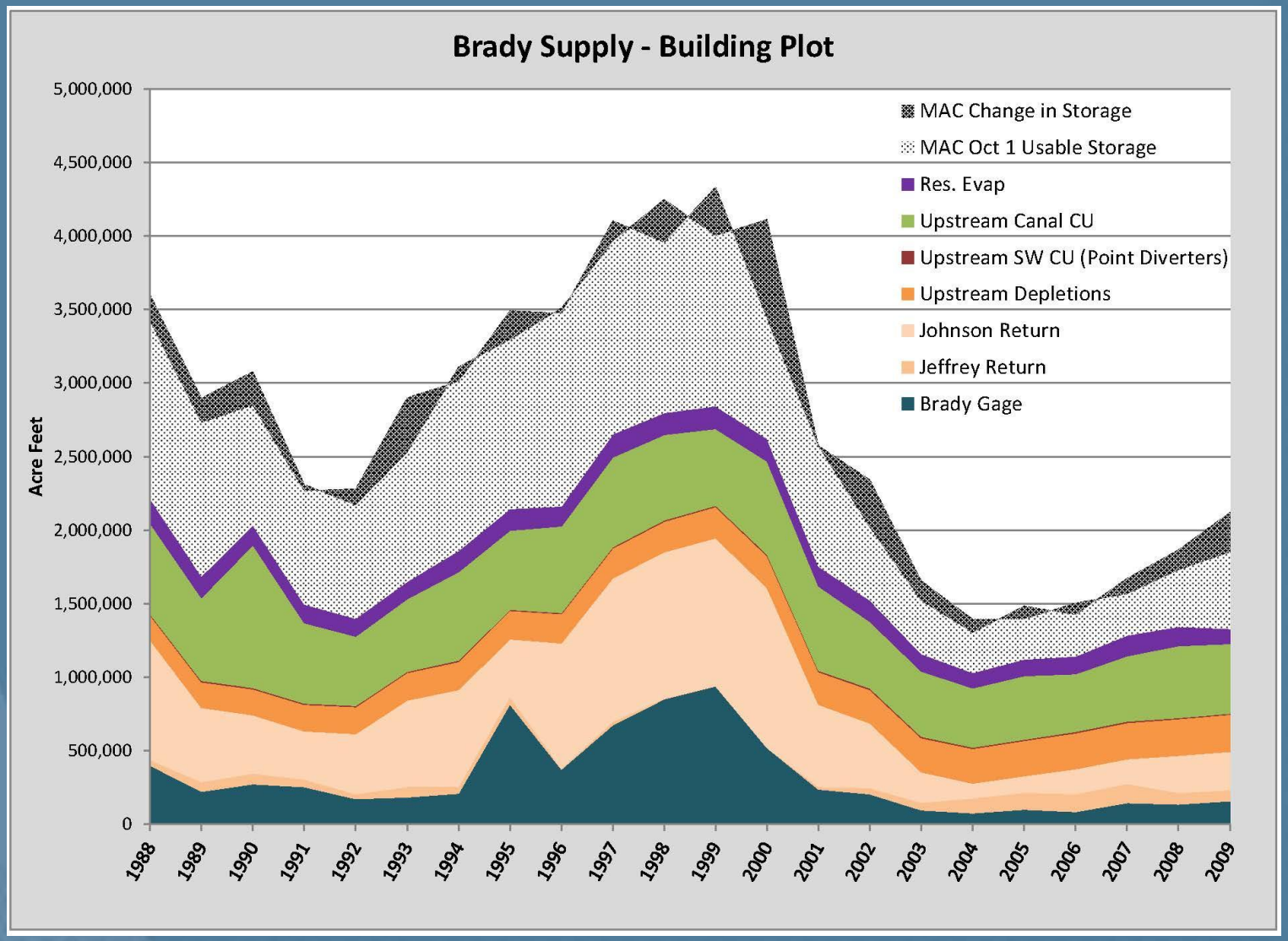
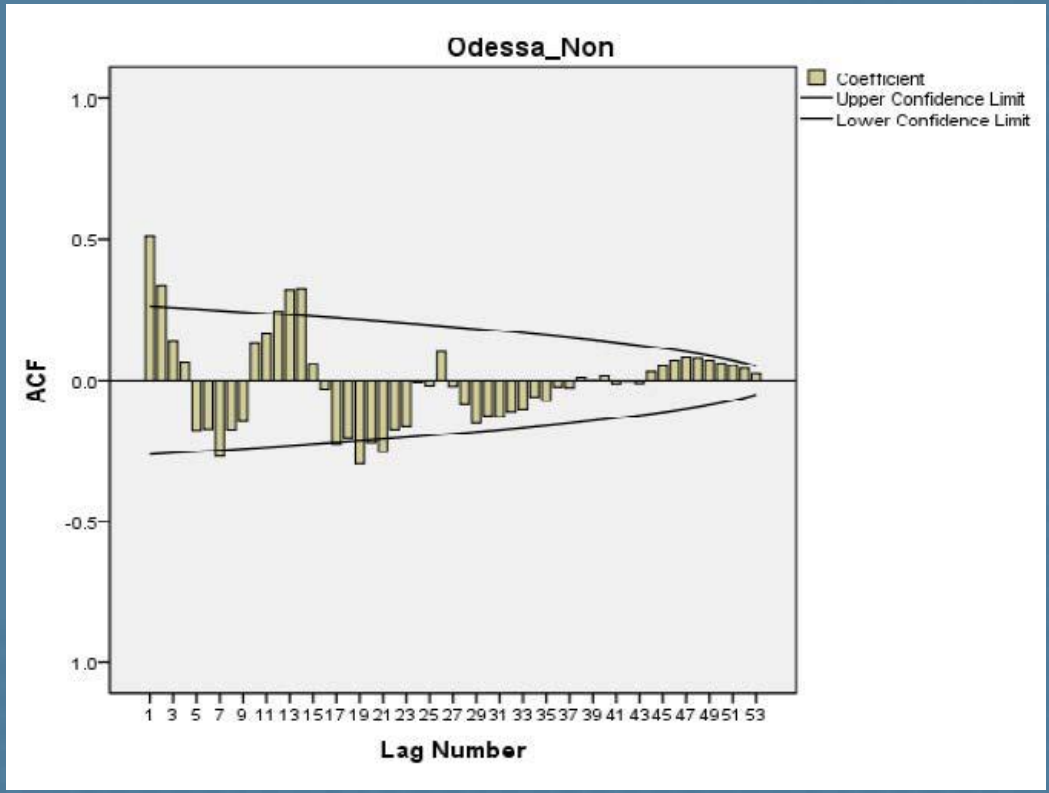


Methodology - Supply

- Discrete components of computed virgin natural flow provide insight into:
  - Relative magnitudes
  - Trends
  - Illustrates importance of key assumptions and areas of future refinements

Methodology - Supply

- Statistical Analysis to select time periods for analysis
  - Kendal Tau
    - Trends
  - Auto-Correlation
    - Cycles



Methodology - Demands

- Differentiate between SW and GW uses
- Represent discrete demands of each

GROUND WATER DEMANDS

Ground water irrigation (CU)
M & I wellfields (CU)

SURFACE WATER DEMANDS

Irrigation Canal Diversions (CU)
Individual irrigation appropriators (CU)
Hydropower (NonCU)
Instream flow appropriations (NonCU)
Reservoir evaporation (CU)

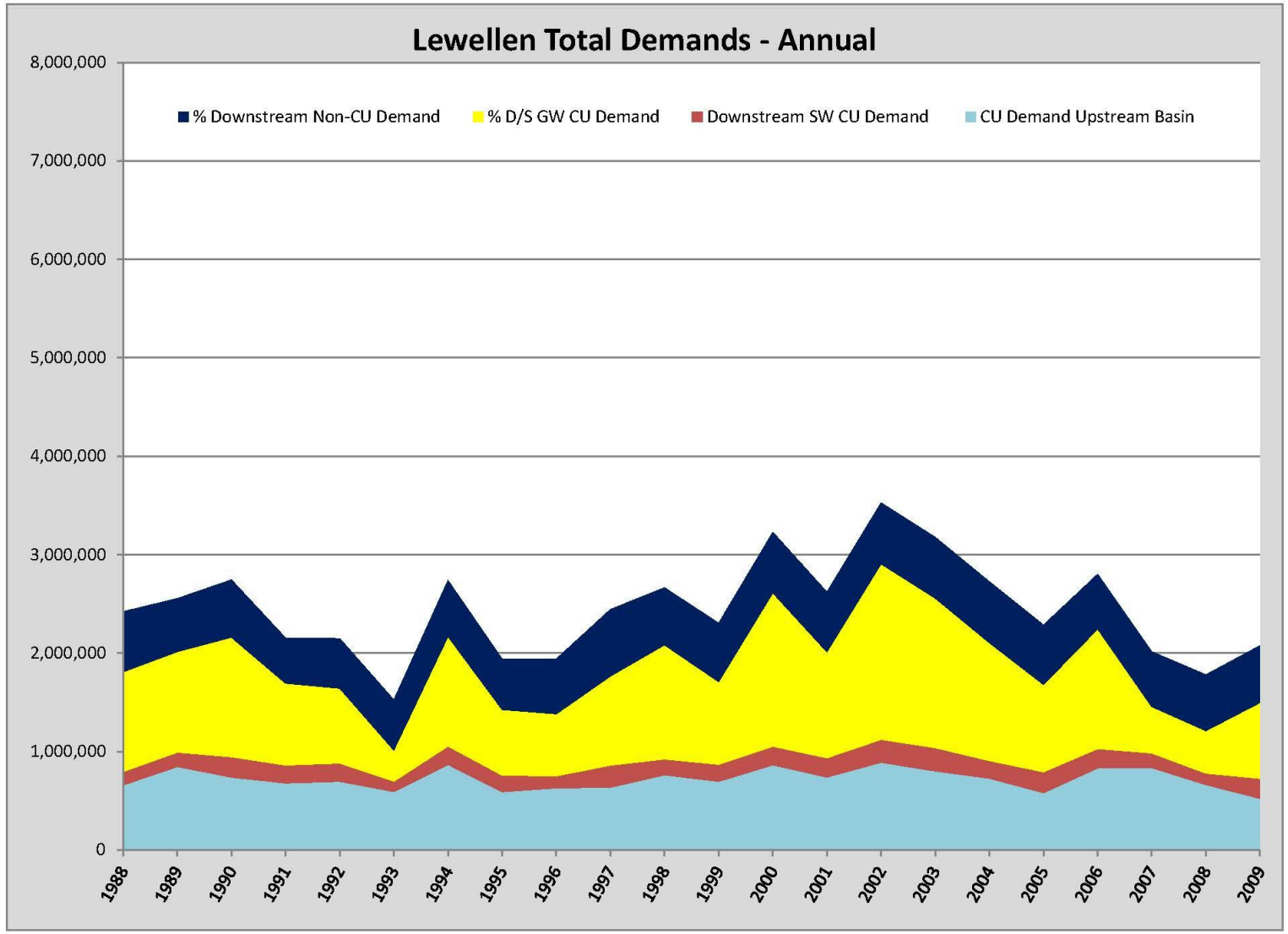
Methodology - Demands

- Consumptive Use
  - Ground Water Irrigation
  - Surface Water Irrigation
  - Municipal and Industrial
  - Reservoir Evaporation

Methodology - Demands

- Non-Consumptive Use
  - Hydro-Power – 3 scenarios
    - No hydropower demand
    - Full appropriation for hydropower
    - Intermediate demand (historic flows, physical capacity, etc.) – case specific
  - Instream Flow Appropriations
    - Appropriated right, capped to the flow available at the time of granting

Lewellen Demand – Build Plot



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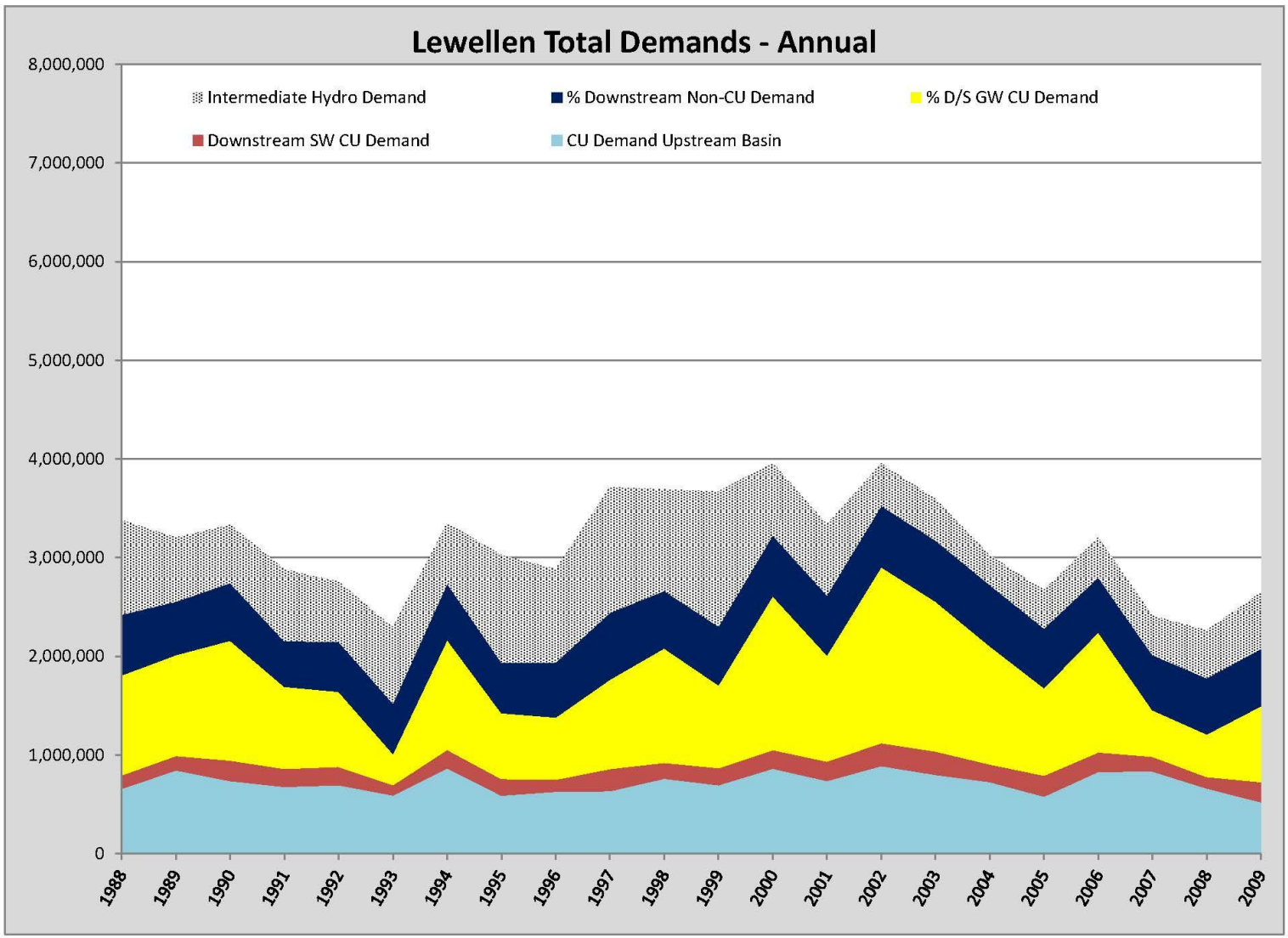

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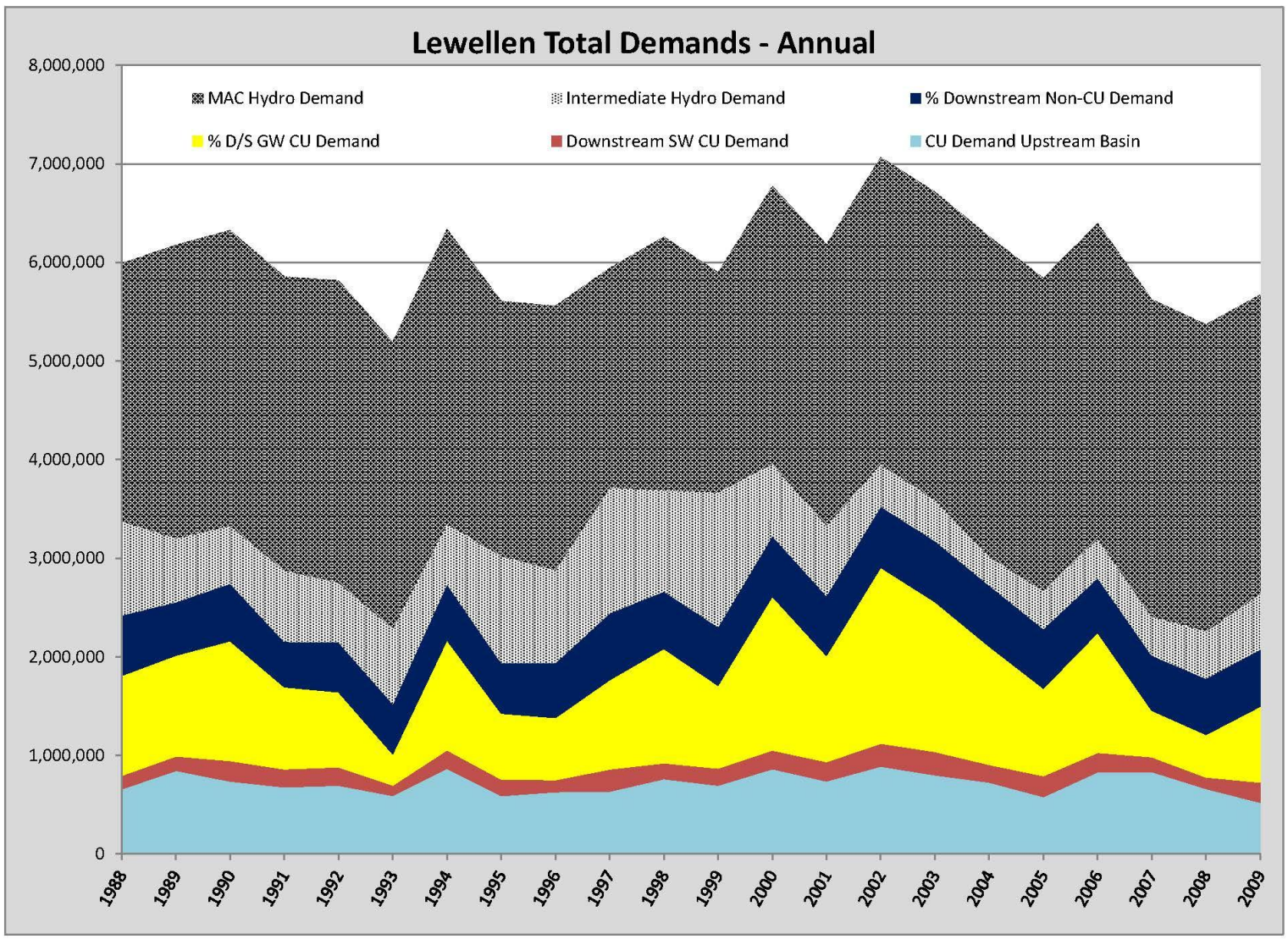


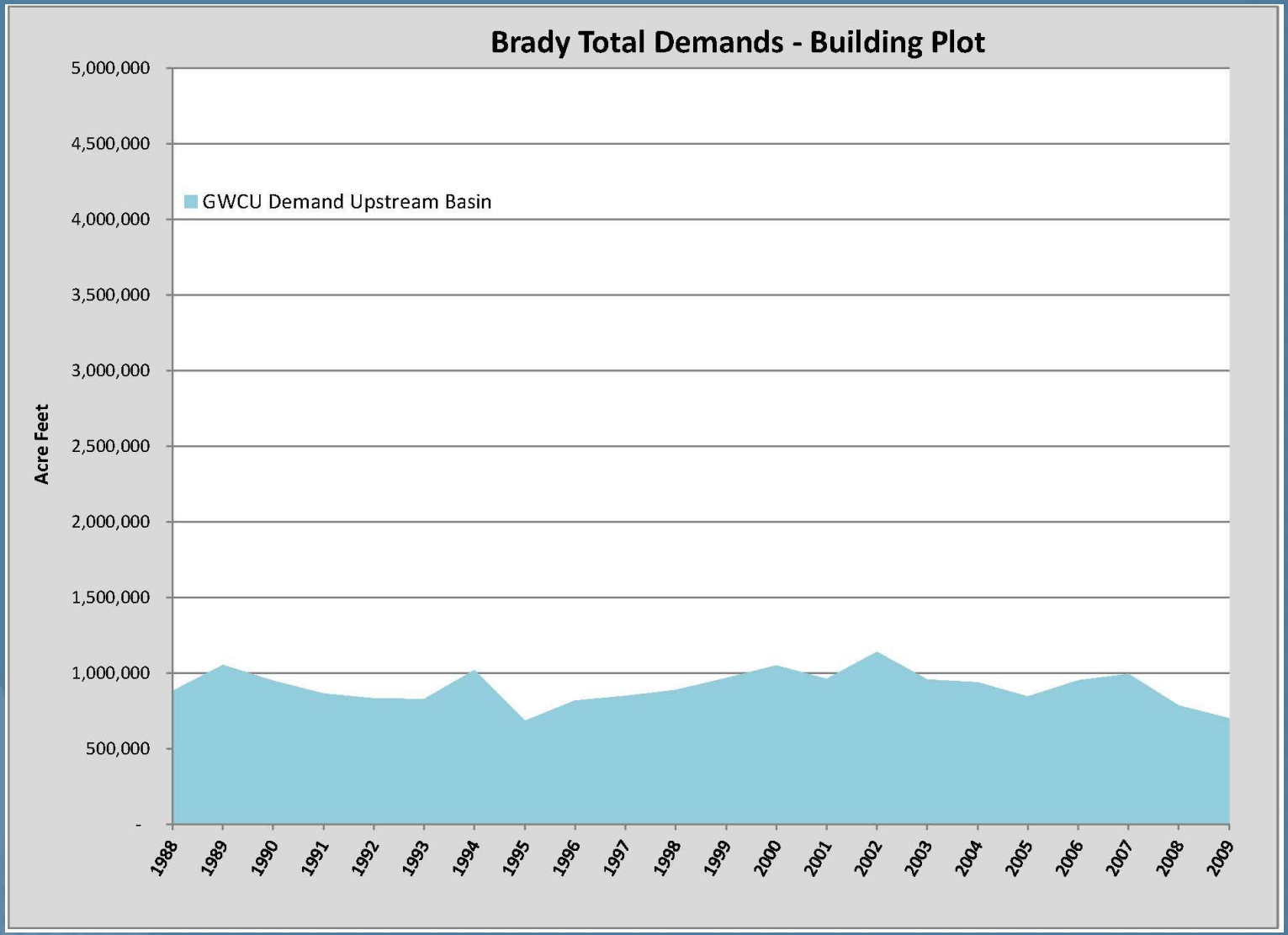
Methodology - Demands

- Representation of Downstream Demands
  - Use ratio of virgin natural flows to allocate downstream demands to upstream reach
- Precipitation – adjusted crop irrigation requirements
  - Variations in climatic conditions can be reflected in demands

Methodology - Demands

- Evaluation of GW demands using both depletions and consumptive use
  - Depletions illustrate historic usage impacts on current water supplies
  - Consumptive use illustrates current usage impacts (lag effect)

Brady Analysis – Demand build



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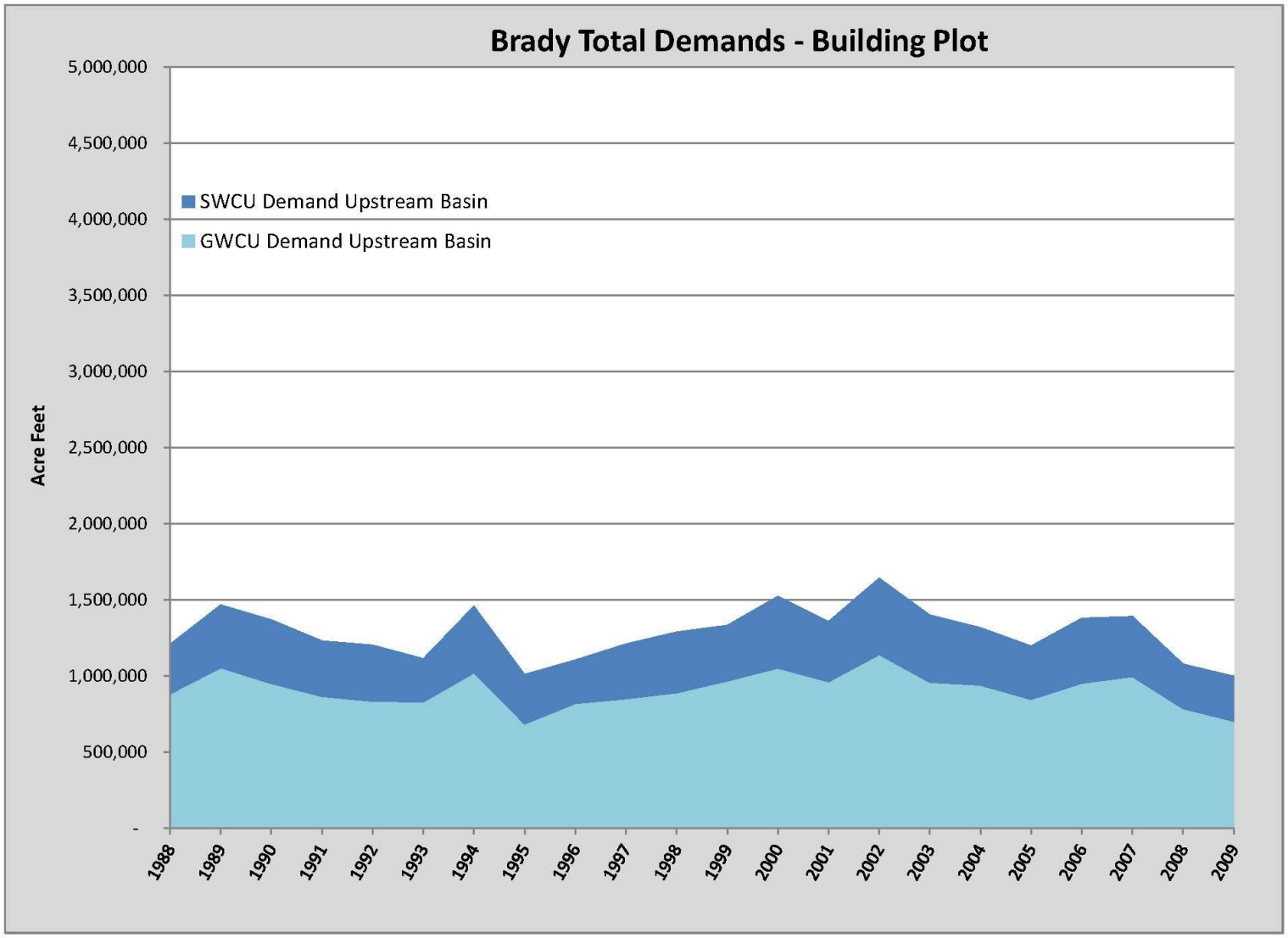

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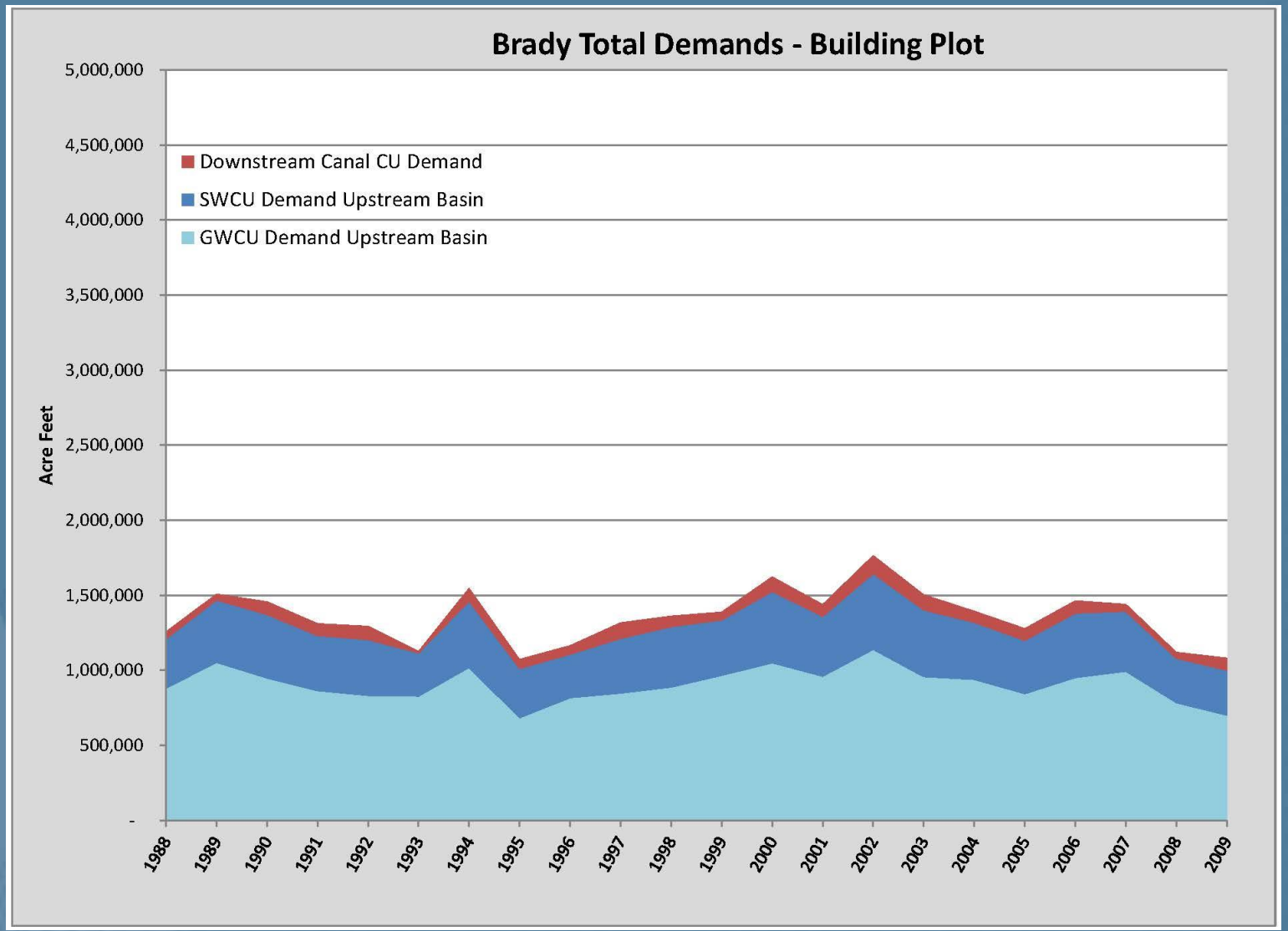

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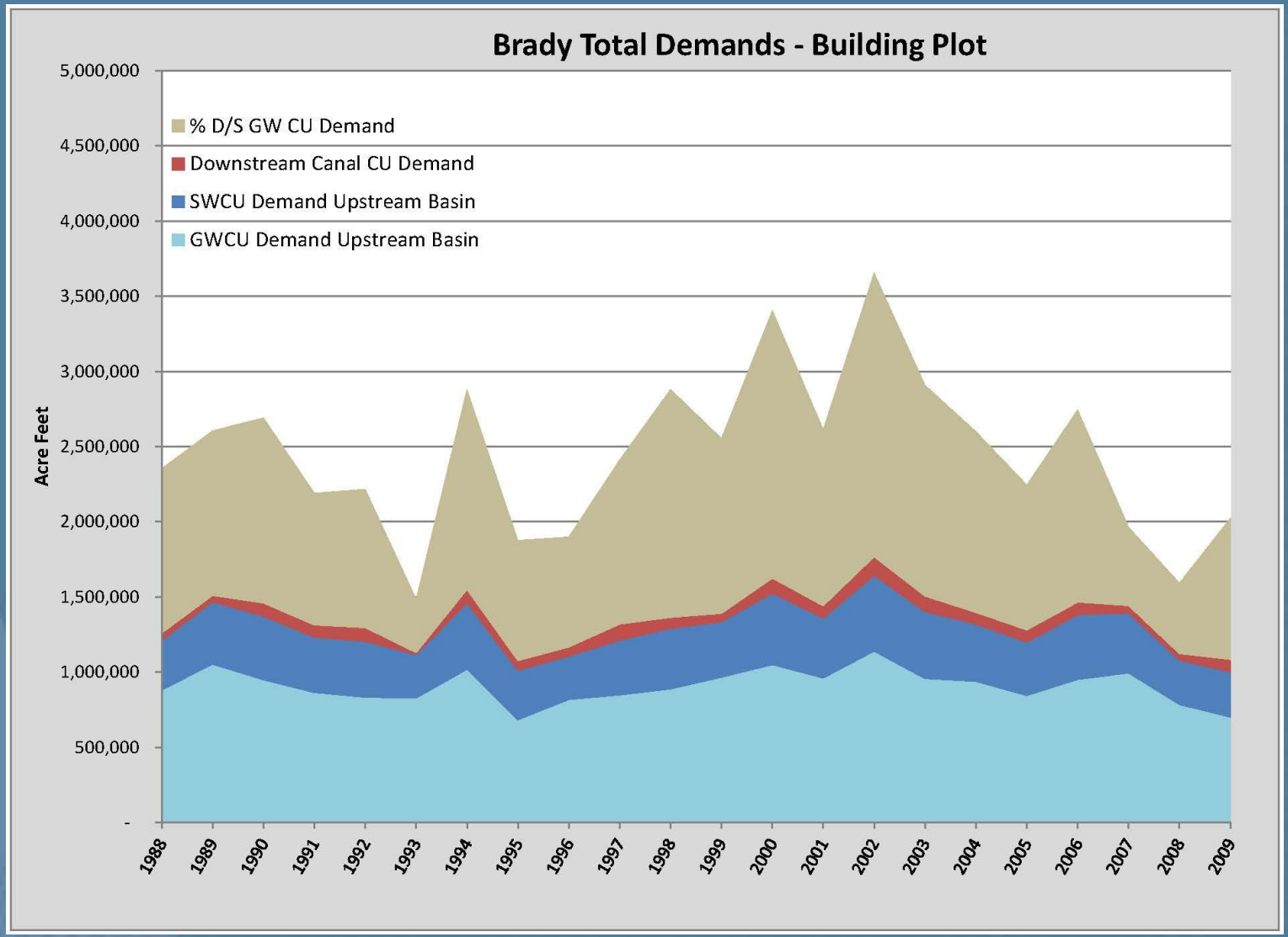

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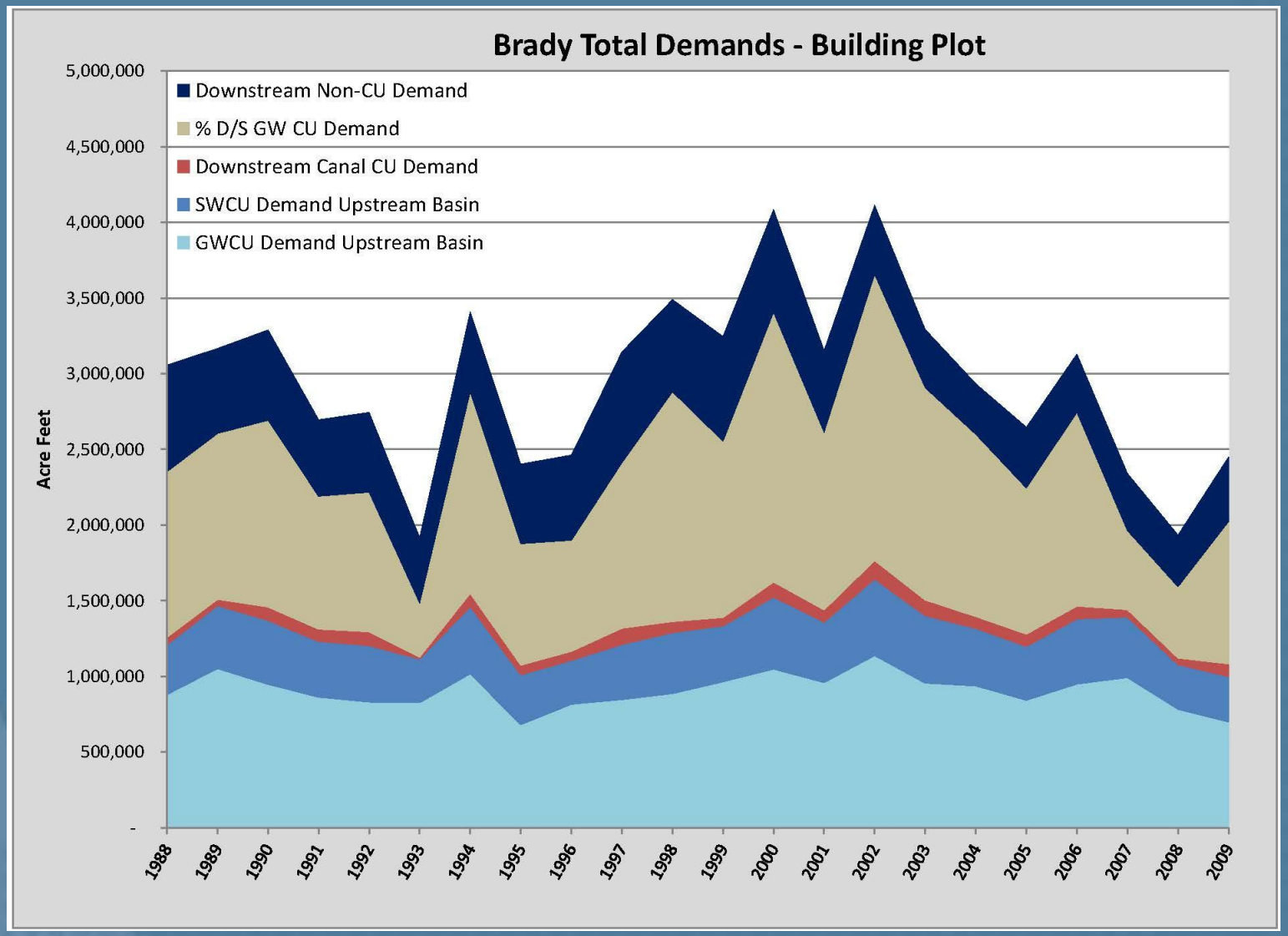
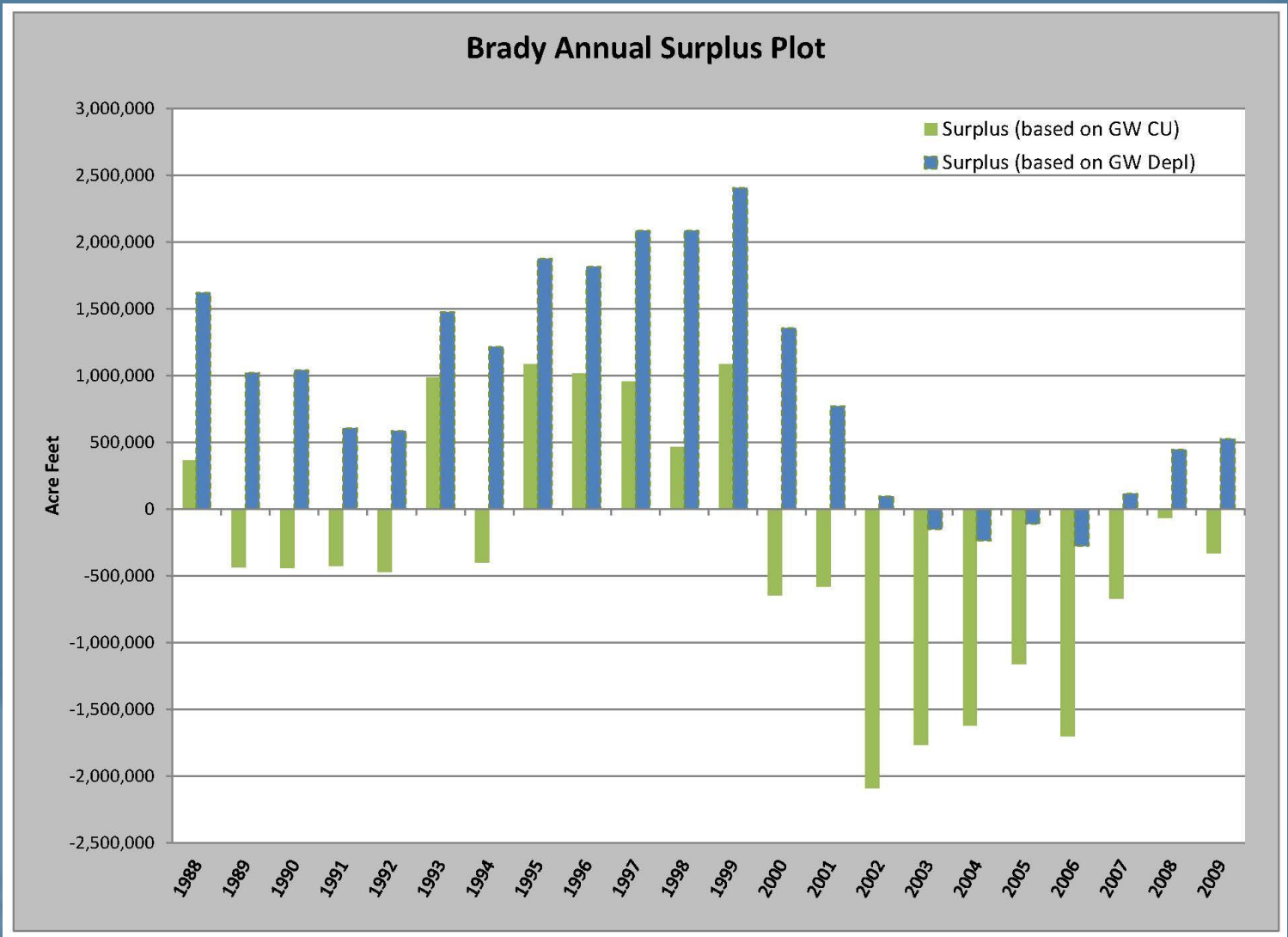


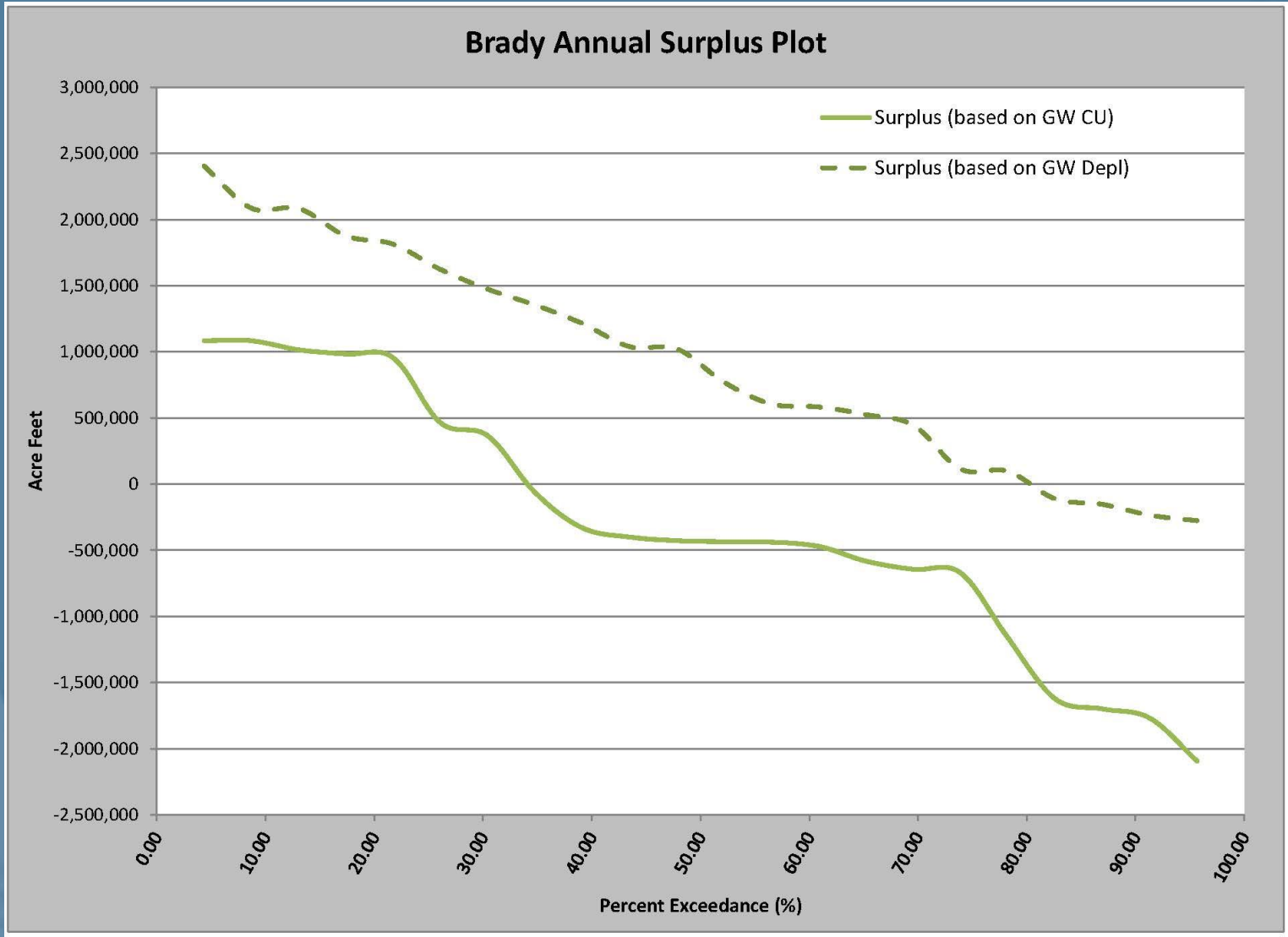
Methodology - Evaluation

- Use of Surplus (Supply – Demand) as a metric
  - To retain the paired supply/demand for each year the surplus or deficit each year is calculated.
  - This surplus is then plotted for each year (arithmetic curve) in addition to being ranked and plotted using a frequency curve.

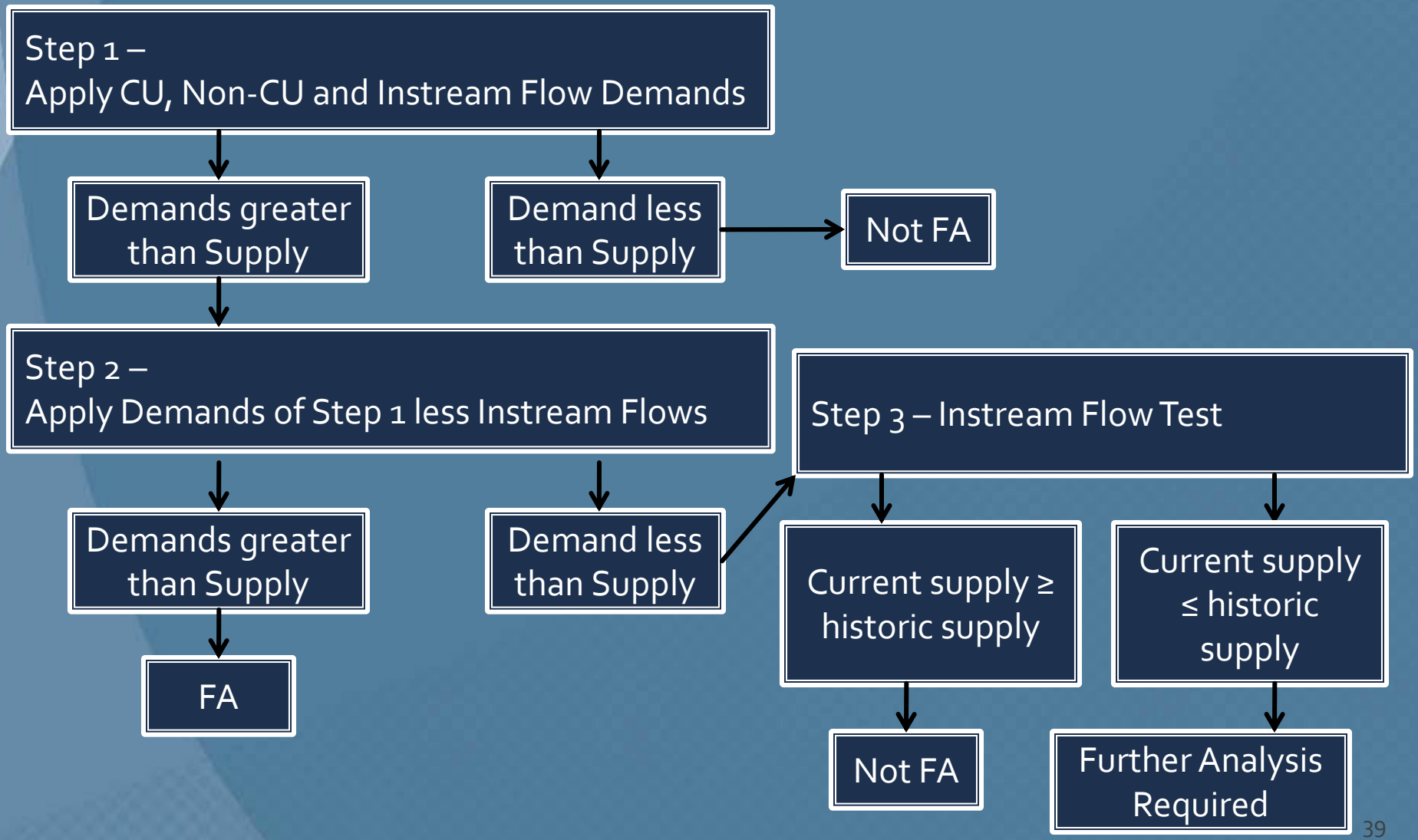
Brady Analysis – Arithmetic Plot



Brady Analysis – Surplus Plot



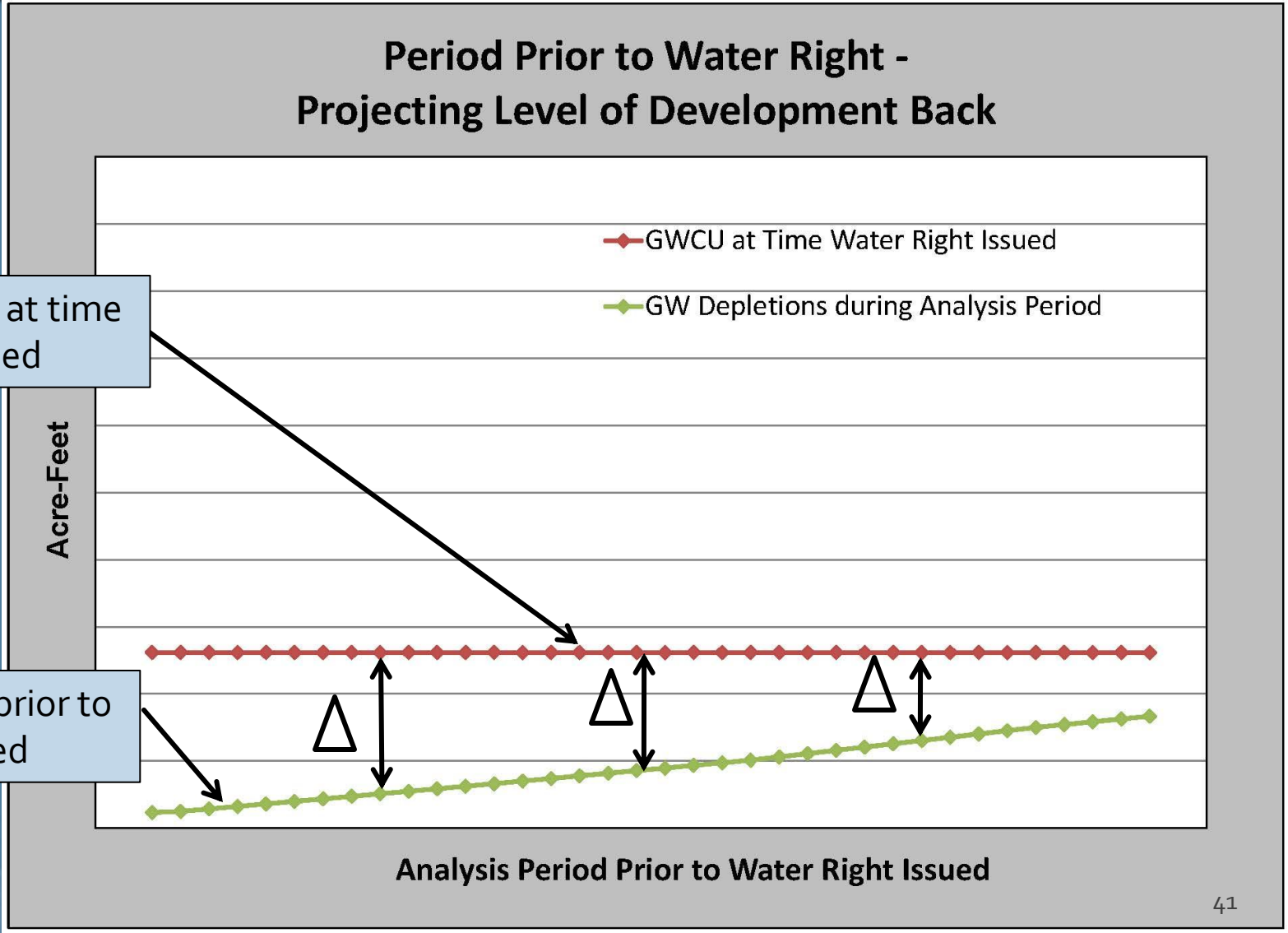
Methodology – Evaluation



Methodology- Evaluation

- Instream Flow Test
  - Statute ties appropriation to that available at time of granting.
  - Two time periods (chosen by statistical analysis)
    - 1) Analysis Period Prior to Water Right Issued
      - Corrections made to account for level of development at time water right issued.
    - 2) Current Analysis Period
      - Correction made to account for current level of depletions.
  - Lesser of adjusted flows ("reasonably expected") or instream flow appropriation.

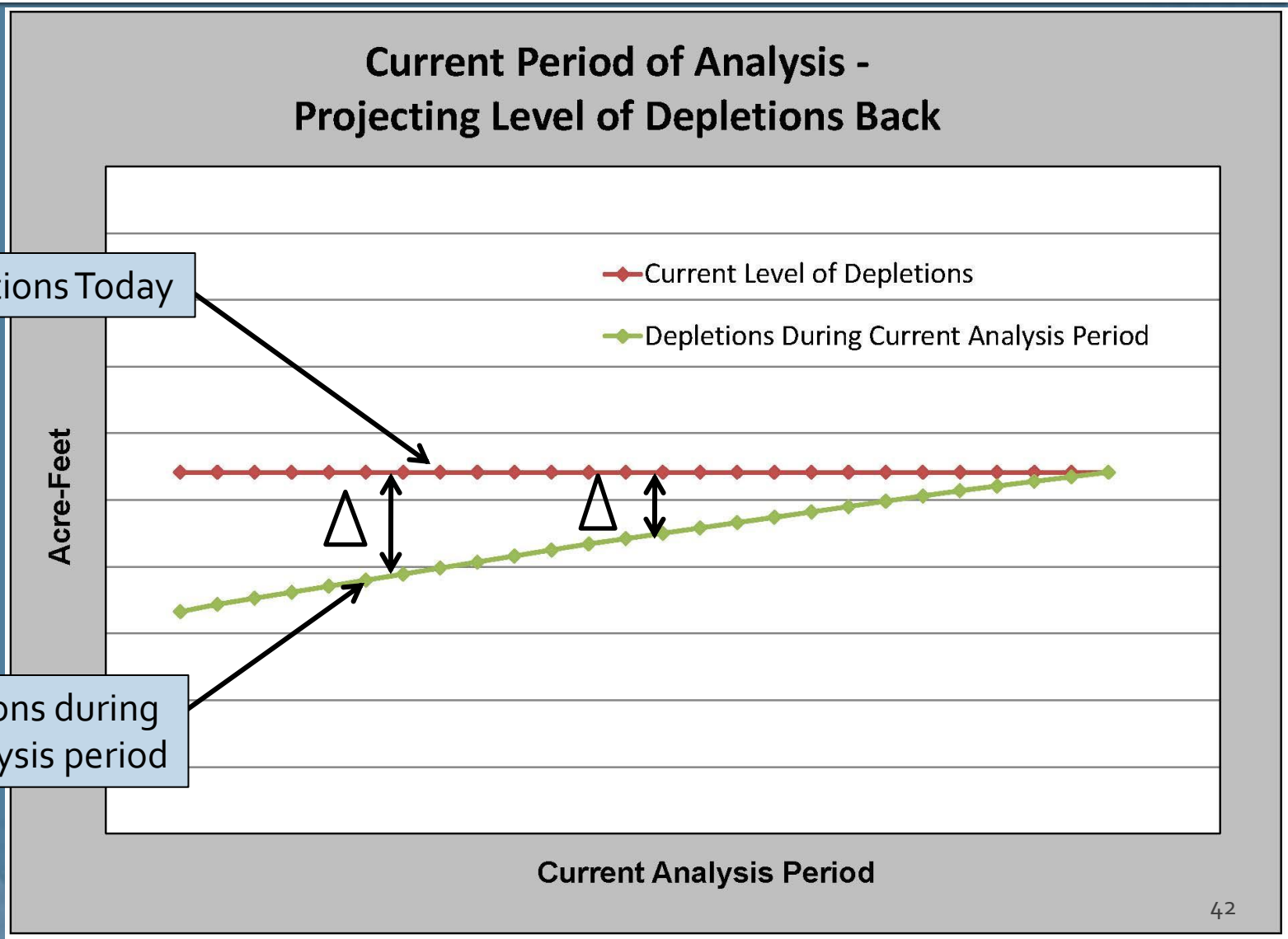
Methodology- Instream Flow Test



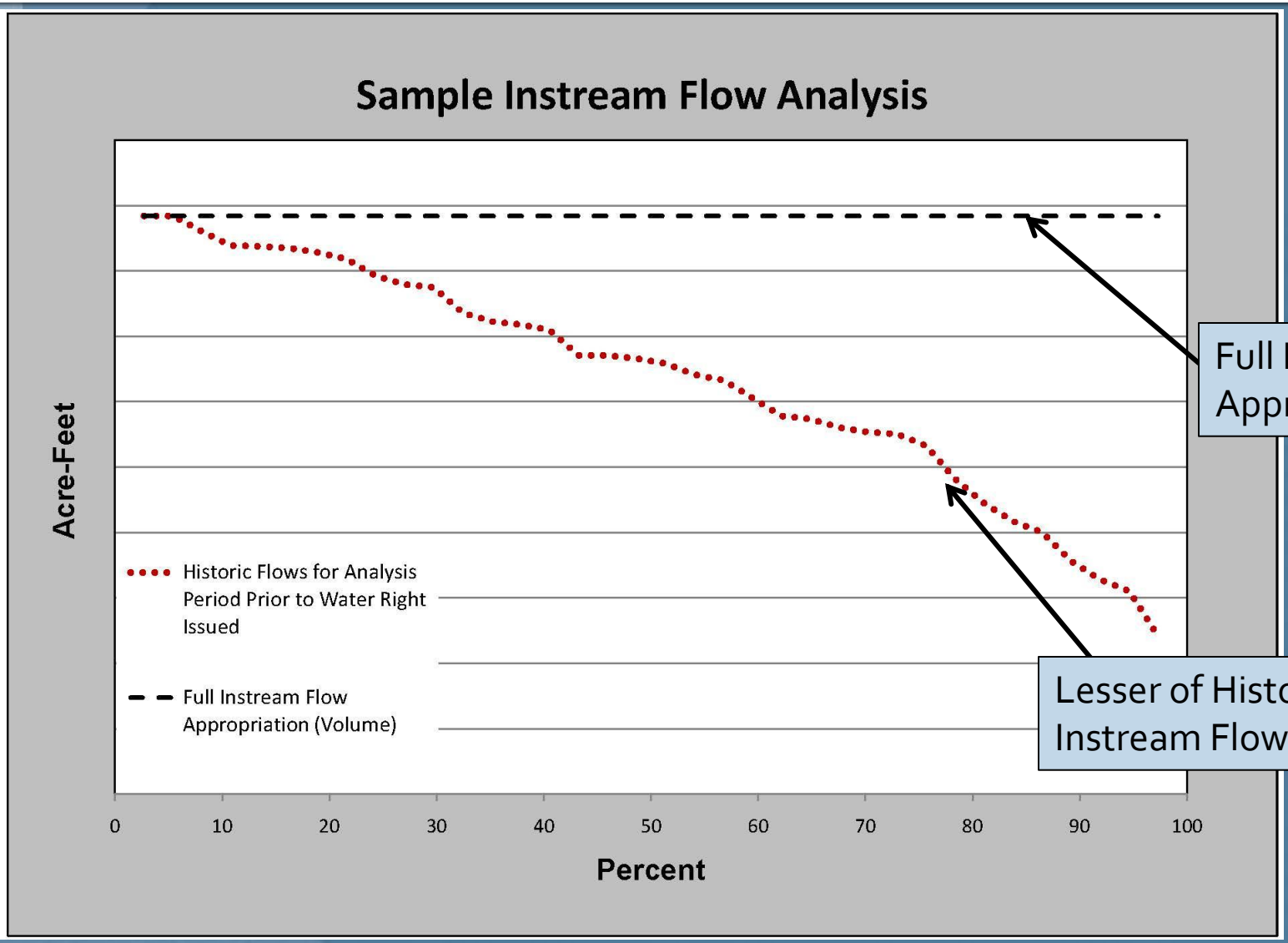
Level of GWCU at time water right issued

GW Depletions prior to water right issued

Methodology- Instream Flow Test



Instream Flow Test Comparison Plot



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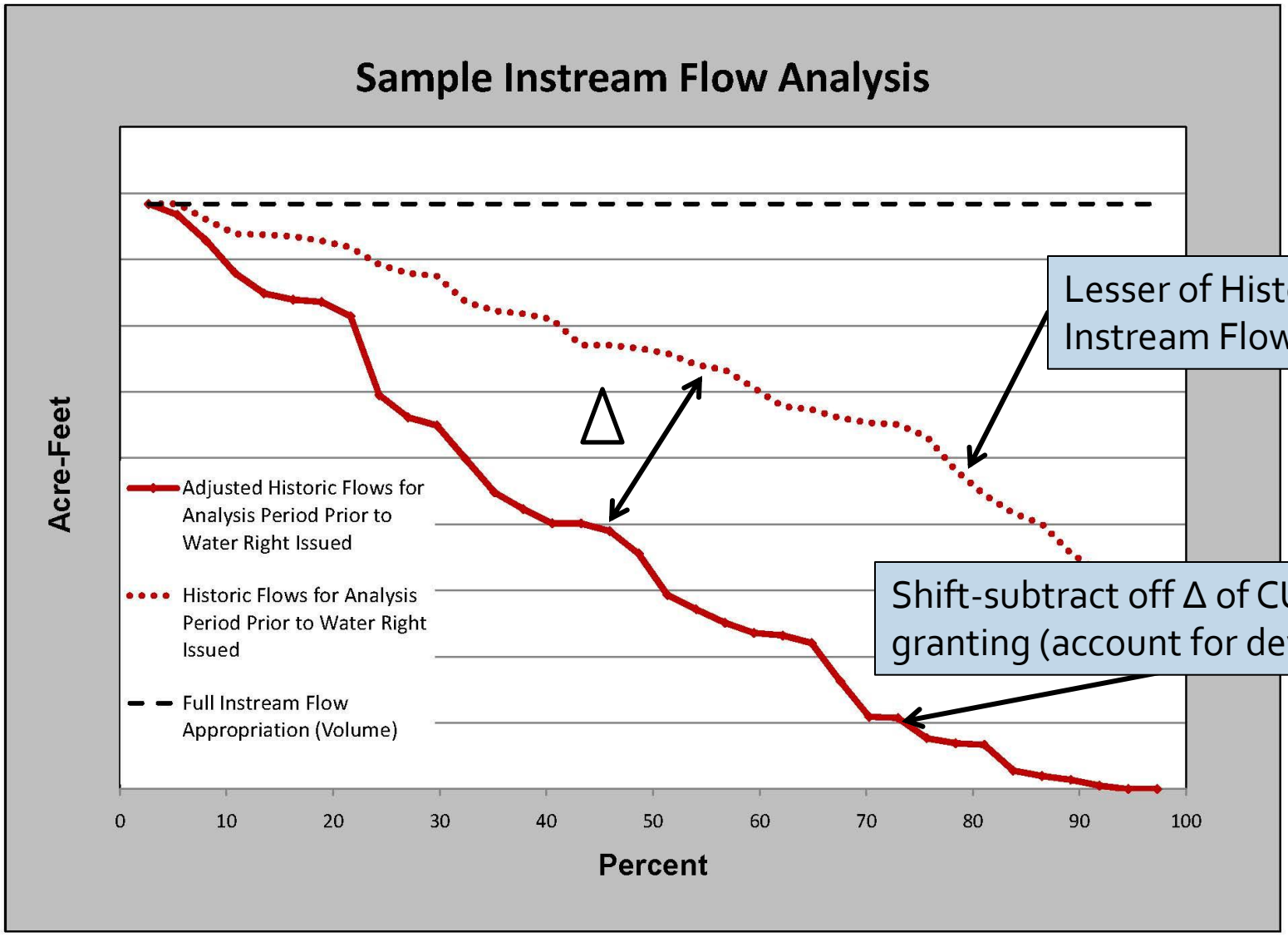

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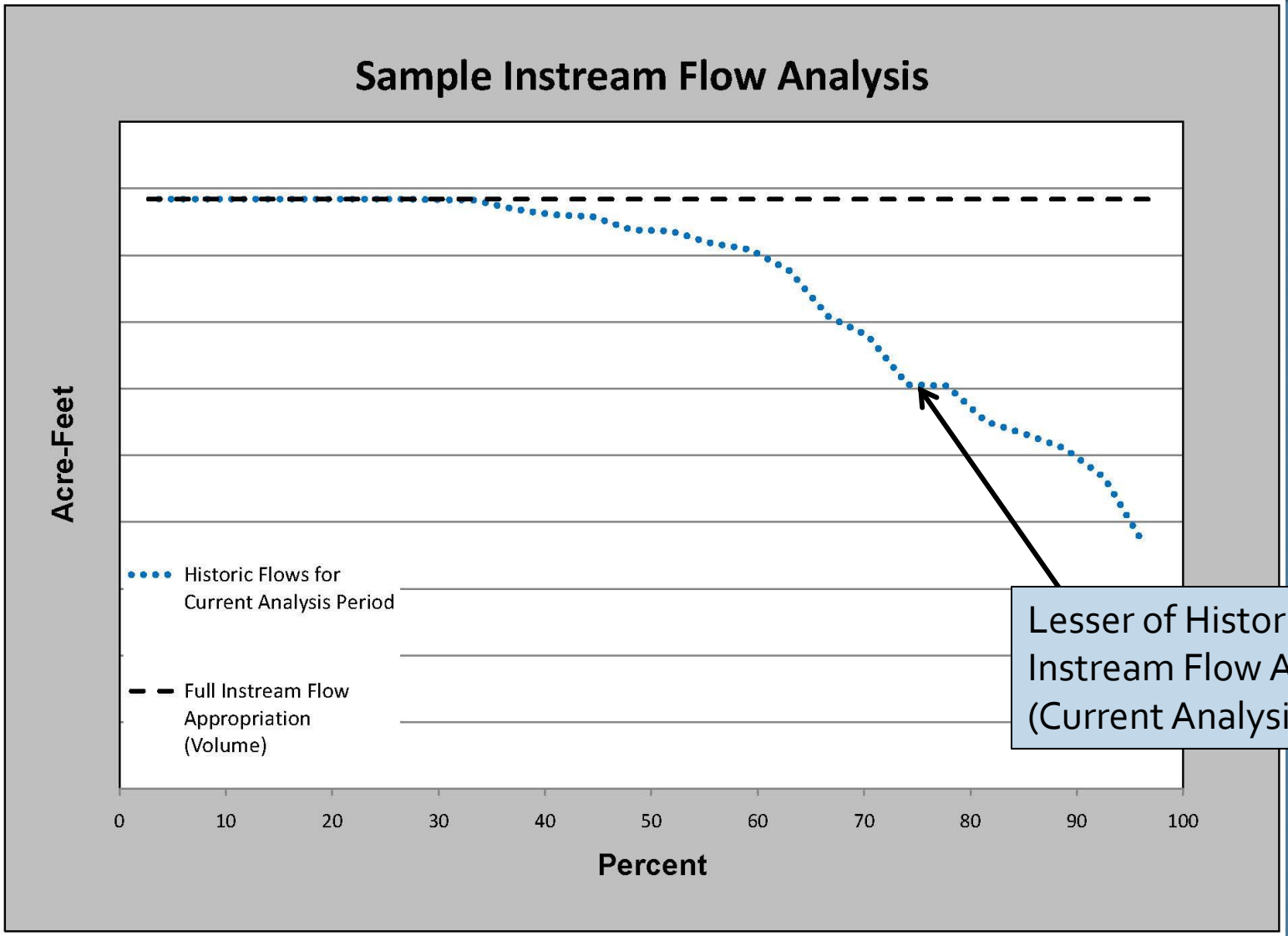

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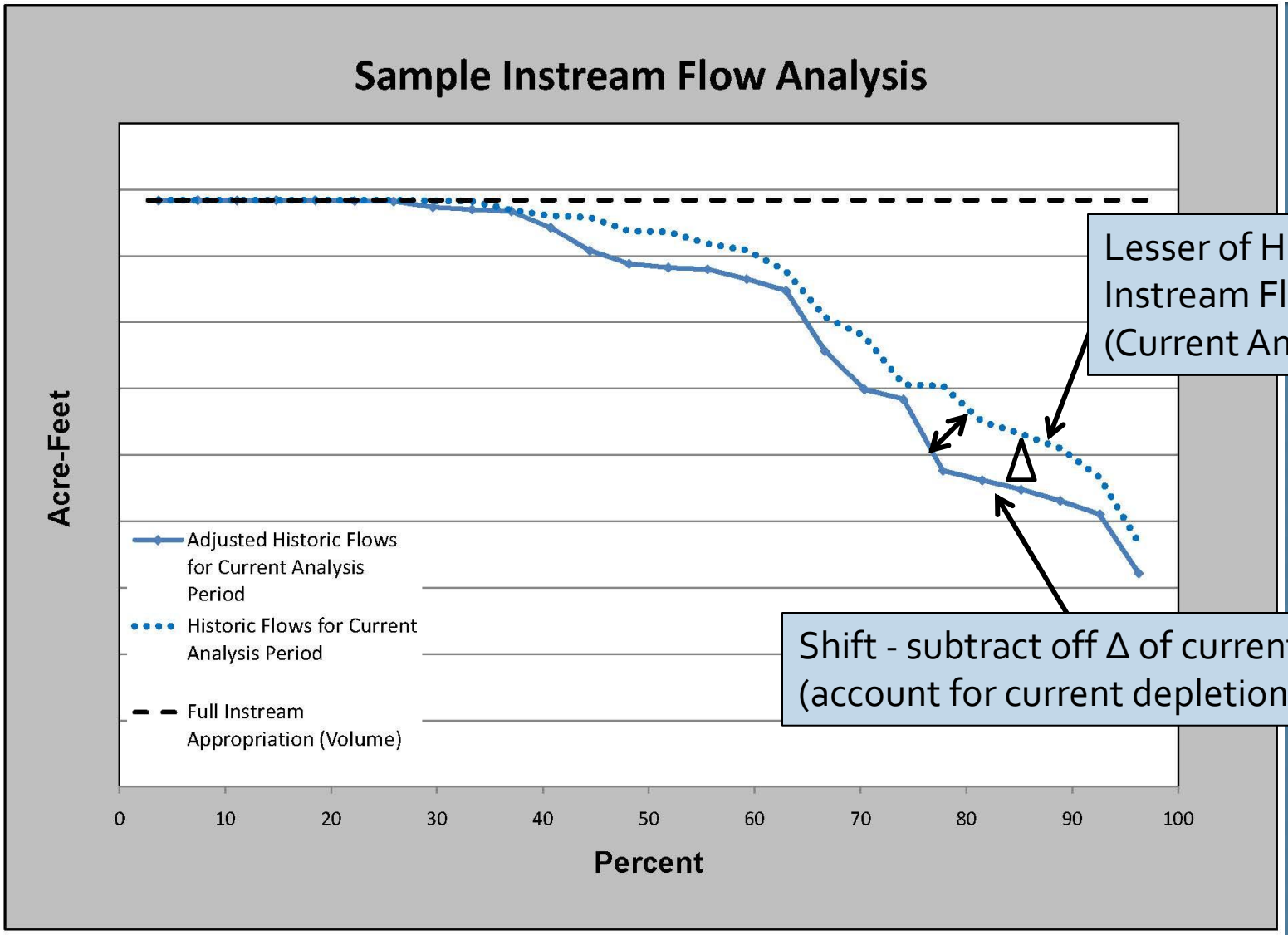

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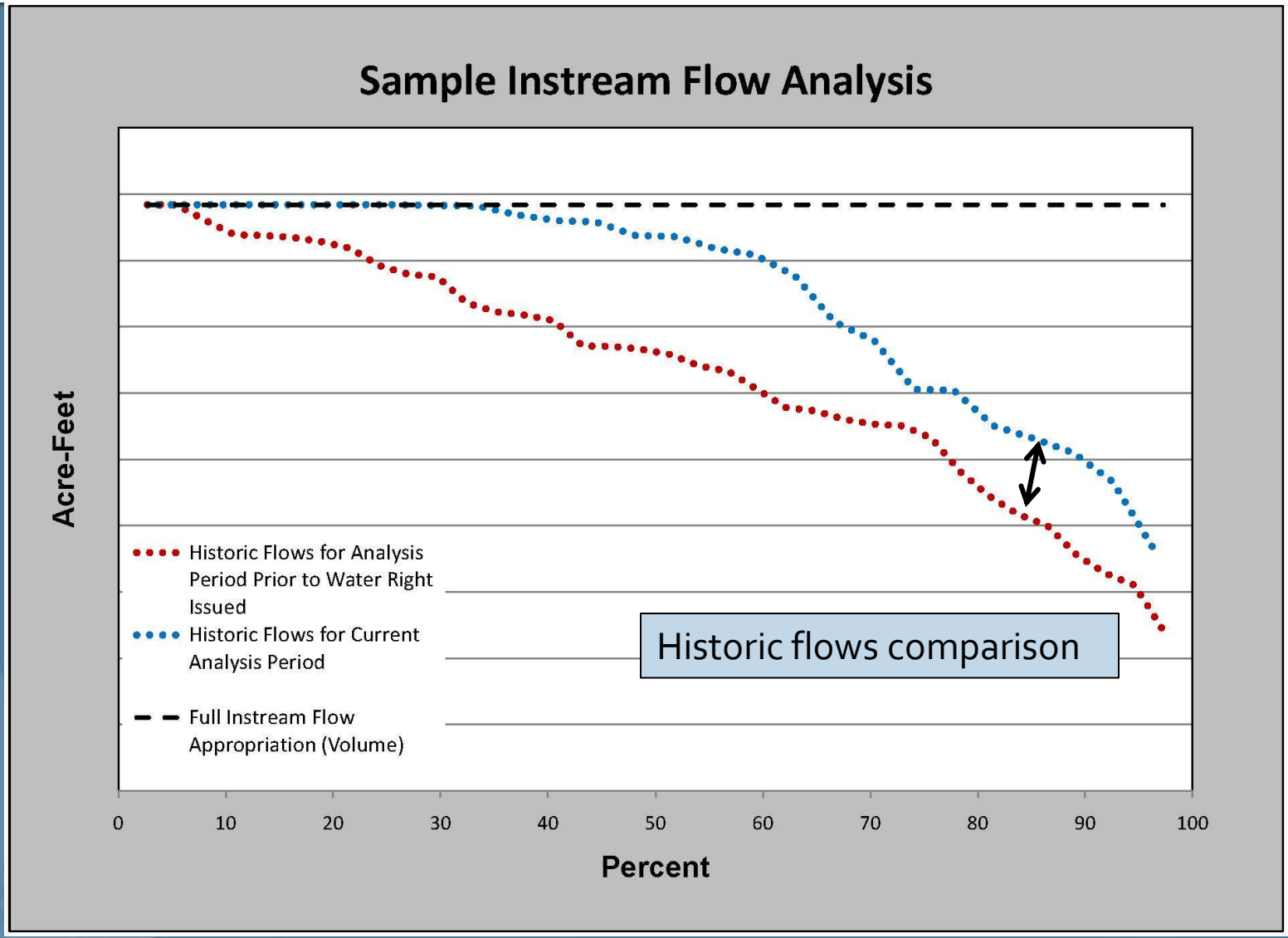

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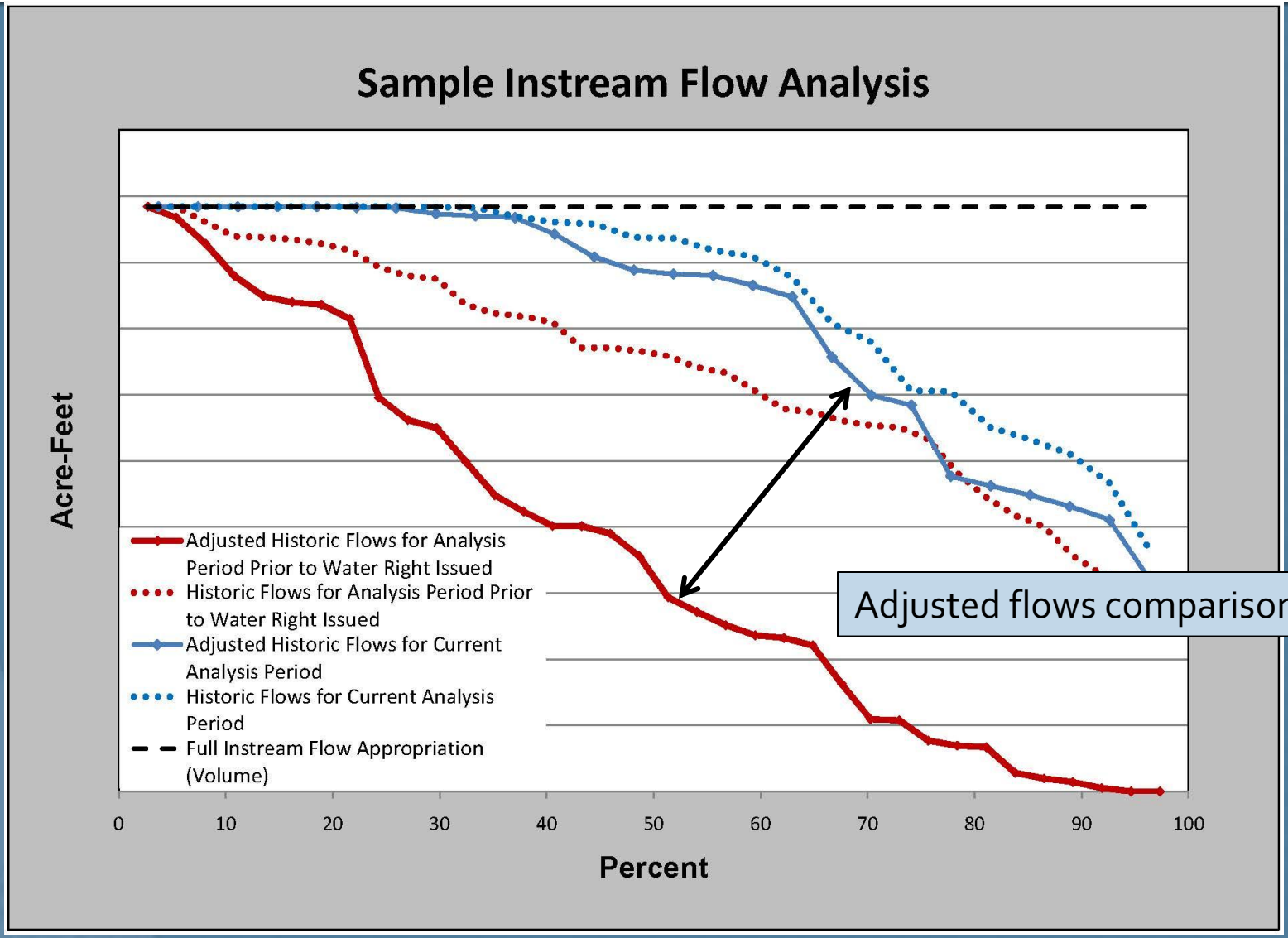

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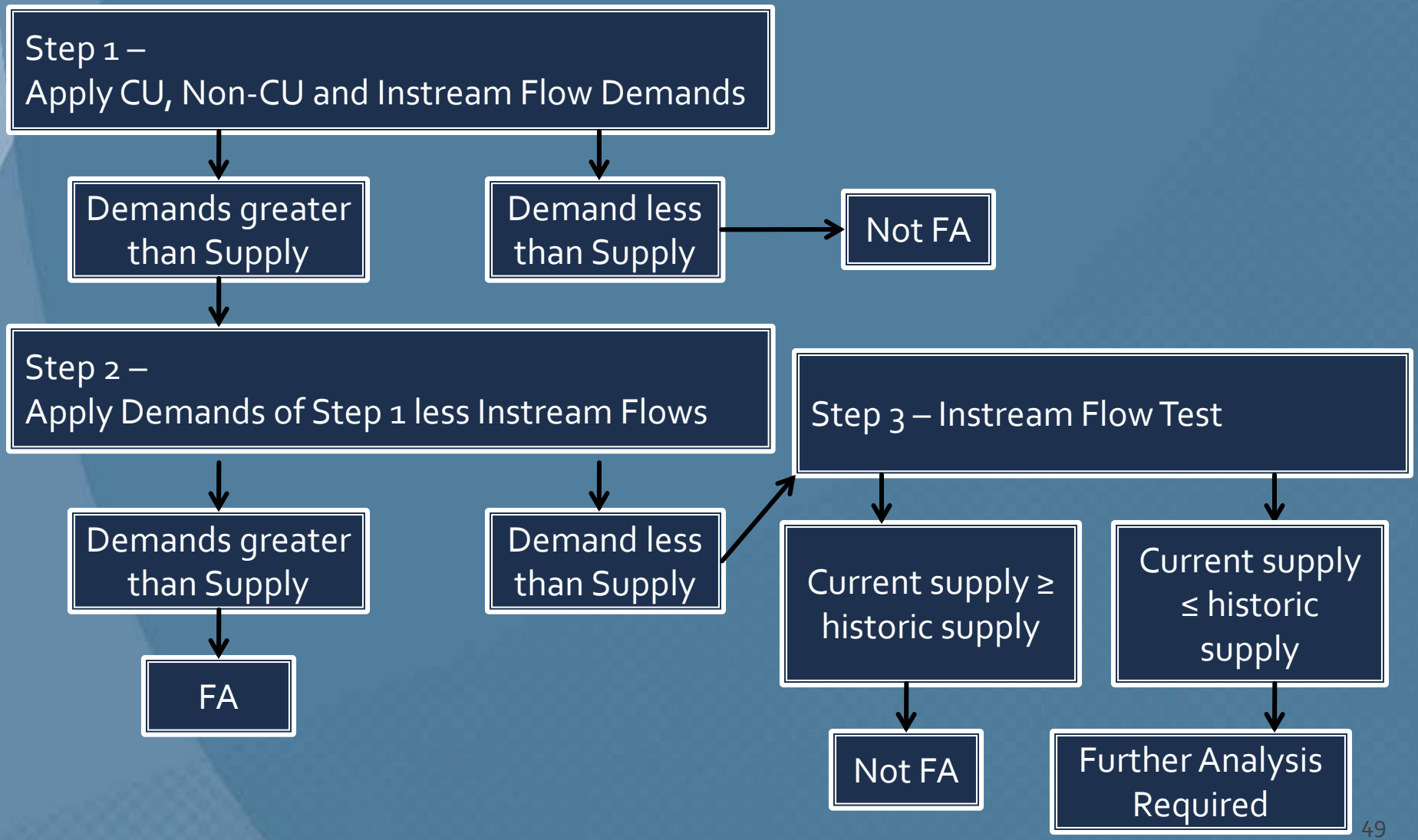

Recommendations Summary

- Virgin natural flow hydrograph
- Statistical testing of virgin natural flow
- Discrete components of supply and demand
- Use of reservoir total and change in storage
- Consumptive use demands
- Non-consumptive uses (hydropower and instream flows)
- Consider GW depletion and full consumptive use
- Consideration of downstream demands
- Use of surplus (supply-demand) as a metric
- Three-step analysis in determining basin status
- Instream flow erosion test

Next Steps

- Incorporation of Platte River Basin analysis and Final Recommendations into Final Technical Memorandum
- DNR begin the rulemaking process

Questions?

Methodology Development – Platte River Basin