Water Quality Assessment for the Upper South Platte River Watershed

Project Update

October 4, 2013
Agenda

• Background
• Water Quality Analysis
• GIS Information
• Watershed Protection
• Next Steps
Project Background
Watersheds

Williams Fork River
Fraser River
Blue River
S. Boulder Creek
Bear Creek
Chatfield Reservoir
Urban South Platte River
Upper South Platte River
Ralston Creeks
Watersheds
Watershed Program Objectives

- Continue to protect public health,
- Maintain customer confidence,
- Prepare for more stringent drinking water regulations,
- Increase awareness of water quality, and
- Treat contamination at the source.
## Scope of Project with ARCADIS

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Objectives</th>
</tr>
</thead>
</table>
| 1. Assessment of Water Quality in the Upper South Platte Watershed | Characterization of the Upper South Platte River Watershed through data analysis using statistical methods                                     | • Develop a strategy for collecting, storing and analyzing watershed data for all of Denver Water’s watersheds  
• Conduct a statistical analysis on the data collected over 10 years in the Upper South Platte Watershed |
| 2. Assessment of Water Quality Monitoring Program                    | Evaluation of the current watershed monitoring program based on Denver Water goals and in support of the overarching goal                     | • Assess Denver Water’s water quality monitoring program and develop recommendations to update it  
• Provide recommendations for routine data compilation/review by Denver Water in the future |
| 3. Assessment of Watershed Condition                                | Identification of key issues in the Upper South Platte River Watershed                                                                       | • Support Denver Water develop a Watershed GIS Database  
• Evaluate Upper South Platte Watershed based on water quality conditions and potential threats  
• Characterize threats in Watershed based on their potential impact on Denver Water’s water treatment plants  
• Support Denver Water’s documentation of local watershed planning activities |
Important Project Outcomes

1. Identification of the contaminant risks associated with the Upper South Platte Watershed

2. Identification of the impacts to water treatment facilities associated with the Watershed

3. Development of a template/road map for future watershed analyses
# Primary Categories and Key Constituents

<table>
<thead>
<tr>
<th>General Parameters</th>
<th>Pathogens</th>
<th>Nutrients</th>
<th>Sediments</th>
<th>Organics</th>
<th>Radio-nuclides</th>
<th>Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Conductivity</td>
<td>- E.coli</td>
<td>- Total Phosphorus</td>
<td>- Turbidity</td>
<td>- TOC</td>
<td>- Uranium</td>
<td>- Molybdenum</td>
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<tr>
<td>- pH</td>
<td></td>
<td>- Nitrate/Nitrite</td>
<td></td>
<td></td>
<td></td>
<td>- Zinc</td>
</tr>
<tr>
<td>- Alkalinity</td>
<td></td>
<td>- Ammonia-Nitrogen</td>
<td></td>
<td></td>
<td></td>
<td>- Arsenic</td>
</tr>
<tr>
<td>- Flow</td>
<td></td>
<td></td>
<td>- TSS</td>
<td></td>
<td></td>
<td>- Manganese</td>
</tr>
</tbody>
</table>

- Nitrate/Nitrite
- Ammonia-Nitrogen
- Turbidity
- TOC
- Uranium
- Molybdenum
- Zinc
- Arsenic
- Manganese
- Lead
- Copper
- Cadmium
- Selenium
## Task 1: Statistical Plots & Summary Statistics

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Parameter</th>
<th>Locations</th>
<th>Total #</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Statistics</td>
<td>21</td>
<td>All</td>
<td>All</td>
<td>21</td>
</tr>
<tr>
<td>Box and Whisker</td>
<td>21</td>
<td>All</td>
<td>All</td>
<td>42</td>
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<tr>
<td>Time Series</td>
<td>21</td>
<td>All</td>
<td>All</td>
<td>760</td>
</tr>
<tr>
<td>Concentration vs. Flow</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Monthly Loads</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Trend Analysis</td>
<td>10</td>
<td>5</td>
<td>6</td>
<td>37, Turb, TSS, NH3, Total P, TOC, As, Cd, Mn, Mo, Zn</td>
</tr>
</tbody>
</table>

*Key Constituents: Total P, Mo, Zn*
General Observations

- Robust set of water quality data that supports watershed assessment
- Typically trends are decreasing at locations over the time period of the data
- Nutrient levels are generally low throughout the watershed and do not have much seasonal variability
- Significant seasonal patterns exist, however correlations between concentration and flow are generally poor
Main Stem Observations

- Goose Creek contributing to increased *E.coli* concentrations (Lost Creek Wilderness and dude ranch)
- Strontia Reservoir inlet shows impacts from Hayman Fire for several parameters
- Potential impact from geology and land type around Antero Reservoir on water quality
Fire Impacts – TOC and Arsenic

TOC Trend

ARSENIC Trend
North Fork Observations

• Typically lower metal concentrations than the Main Stem with the exception of molybdenum and zinc
• Significant decrease in molybdenum in 2006 as can be seen in the time series plot for locations
• Total coliforms increase as you move downstream on the North Fork
Potential Additional Analytes for Watershed Protection

- Contaminants of emerging concern/microconstituents
  - POTW/septic system sources
  - Regulatory considerations
    - Candidate Contaminant List 3 (CCL3)
    - Unregulated Contaminant Monitoring Rule (UCMR)
- Herbicides/pesticides and hydrocarbons
  - Agriculture, oil/gas, other
Watershed GIS Database

• Identified and prioritized GIS layers and information
• Contacted many organizations to obtain data and build database
  • CDOT, CDPHE, US Fish and Wildlife, COGCC, etc.
• Prepared series of GIS maps for assessment of watershed condition
Mapping

- Relating contaminant sources and watershed protection actions
- Forward looking method to plan and respond to threats and manage risks
- Decision making process for current and future scenarios
- Communication and training
Land Cover/Land Use

- Sampling sites
- Hydraulic unit codes (HUCs)
- County boundaries
- Streams/Rivers
- Canals/Tunnels
- Major lakes and reservoirs
- Towns
- Land cover
Land Ownership

- Private
- Federal (BOR, FWS, NPS)
- USFS
- BLM
- State/Local
- NGO/Land trust
Contaminant Sources

- Oil wells
- Well permit locations (potential septic system)
- Landfills
- Storage tanks
- Mines
- Fires
- Beetle kill area
- EPA – 303(d) impaired segments by class
Additional GIS Maps

- National Resources Conservation Service (NRCS) – soils
- Average precipitation and evaporation
- Elevation
- Sub-watershed boundaries
- Impaired streams and watershed condition
Aligning Water Quality Information and Mapping

- Relating contaminant sources and watershed protection actions
  - Treatment plant impacts
- Forward looking method to plan and respond to threats and manage risks
  - Fire
  - Site development and land use changes
  - Hydrologic variability (floods or droughts)
## Source Tracking

<table>
<thead>
<tr>
<th>Contaminant Source</th>
<th>Original 1999 Rank (L/M/H)</th>
<th>Potential for Source (Y or N)</th>
<th>Observed Impact in USP watershed through Data Analysis (Y or N)</th>
<th>Close Proximity to Water Body (Y or N)</th>
<th>Potential Hazards by Contaminant Class*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture or Ranching</td>
<td>H</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Pathogen Indicators</td>
</tr>
<tr>
<td>Erosion</td>
<td>H</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Mine Discharges</td>
<td>H</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Wastewater or Septic Systems</td>
<td>M/H</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Fires</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Natural</td>
<td>M</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Recreation</td>
<td>M</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Solids or Hazardous Waste Disposal</td>
<td>M</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Beetle Kill</td>
<td>N/A</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>x</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>N/A</td>
<td>Y</td>
<td>Need Data</td>
<td>N</td>
<td>x</td>
</tr>
</tbody>
</table>

*Class* denotes: L (Low), M (Medium), H (High)
## Watershed Protection Categories

<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reservoir Capacity (Sediment Load)</td>
</tr>
<tr>
<td>2</td>
<td>Water Body Integrity</td>
</tr>
<tr>
<td>3</td>
<td>Water Treatment Capital Requirements</td>
</tr>
<tr>
<td>4</td>
<td>Water Treatment Operating Requirements</td>
</tr>
<tr>
<td>5</td>
<td>Water Quality Compliance</td>
</tr>
<tr>
<td>6</td>
<td>Trans-Basin Diversions</td>
</tr>
</tbody>
</table>
Protection Categories

• Watershed based actions
  • Site specific risk assessment (e.g. oil and gas exploration and development)

• Infrastructure based actions
  • Perform base-lining activities
  • Prepare future infrastructure plans
Response Actions - Watershed

• Focus on nutrients and pathogen indicators
• Use mapping tools to understand pollutant load and land management relationship
• Coordinated coalition strategy to update and enhance the South Platte Protection Plan
## Performance Metrics

<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
<th>Potential Parameters</th>
</tr>
</thead>
</table>
| 1  | Reservoir Capacity (Sediment Load)            | • Sediment depth  
• Inlet and outlet solids                                       |
| 2  | Water Body Integrity                          | • Nutrients/Organics  
• Pathogen Indicators                                               |
| 3  | Water Treatment Capital Requirements          | • Finished water compliance  
• Regulatory and customer satisfaction                               |
| 4  | Water Treatment Operating Requirements        |                                                                |
| 5  | Water Quality Compliance                      |                                                                |
| 6  | Trans-Basin Diversions                        | • Interagency parameters for protecting water quality           |
## Monitoring and Reporting

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Frequency of Evaluation</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Series Plots</td>
<td>Annual</td>
<td>Period of Record</td>
</tr>
<tr>
<td>Box-and-Whisker Plots</td>
<td>Every 3 years</td>
<td>Current 3 years</td>
</tr>
<tr>
<td>Box-and-Whisker Plots</td>
<td>Every 3 years</td>
<td>Period of Record</td>
</tr>
<tr>
<td>Trend Analysis</td>
<td>Every 3 years</td>
<td>Period of Record or Interest</td>
</tr>
<tr>
<td>Flow Effects</td>
<td>Every 3-6 years</td>
<td>Period of Interest</td>
</tr>
</tbody>
</table>
Next Steps

• Finalize ARCADIS deliverables
• Update monitoring plan
• Expand program to other watersheds
• Source Water Protection Plan with CDPHE
Colorado SWAP Program

Assessment Phase
- Contaminant Inventory
- Susceptibility Analysis
- Release SWAP Report to Public

Protection Phase
- Delineation
- Monitor & Update Protection Plan
- Involve Stakeholders in Planning Process
- Develop Protection Plan
- Implement Protection Plan
Backup Slides
Reservoir Capacity (Sediment Load)

• Five primary reservoirs (Antero, Elevenmile Canyon, Spinney Mountain, Cheesman, Strontia Springs)

• Erosion

• Forest fires are a major risk
  • Over $8 million spent on post fire mitigation efforts at Cheesman Reservoir
  • Dredging at Strontia Springs > $18 Million to date
Water Body Integrity

- Variety of concerns
  - Nutrient/Organic loading
  - Eutrophication/Algal growth
    - Taste & odor
    - Disinfection byproducts
  - Recreational impacts
- Special Studies needed to define fundamental processes
- Magnitude of impacts – cause & effect relationships and management options
Water Treatment Capital Requirements

- Performance evaluation of current infrastructure, optimization, base-lining
- Risk profiling against changes in feed water specification
- Response planning and revisions to current infrastructure
- Planning for future infrastructure upgrades
Water Treatment Operating Requirements

• Performance evaluation of current operation, optimization, base-lining
• Provide a linkage between monitoring data and operation platform
• Response planning and revisions to current operation
• Preparing for future drinking water standards
Water Quality Compliance

- Public Health Concerns
- Microconstituents
  - Household products
  - Pharmaceuticals
- Laboratory Standards
  - Detection limits
  - Changes in regulatory criteria
Trans Basin Diversions

• Several diversions in the Upper South Platte watershed, including:
  • Blue River
  • Arkansas River
  • Frying Pan River
• Focus on water quality fluctuations due to blending