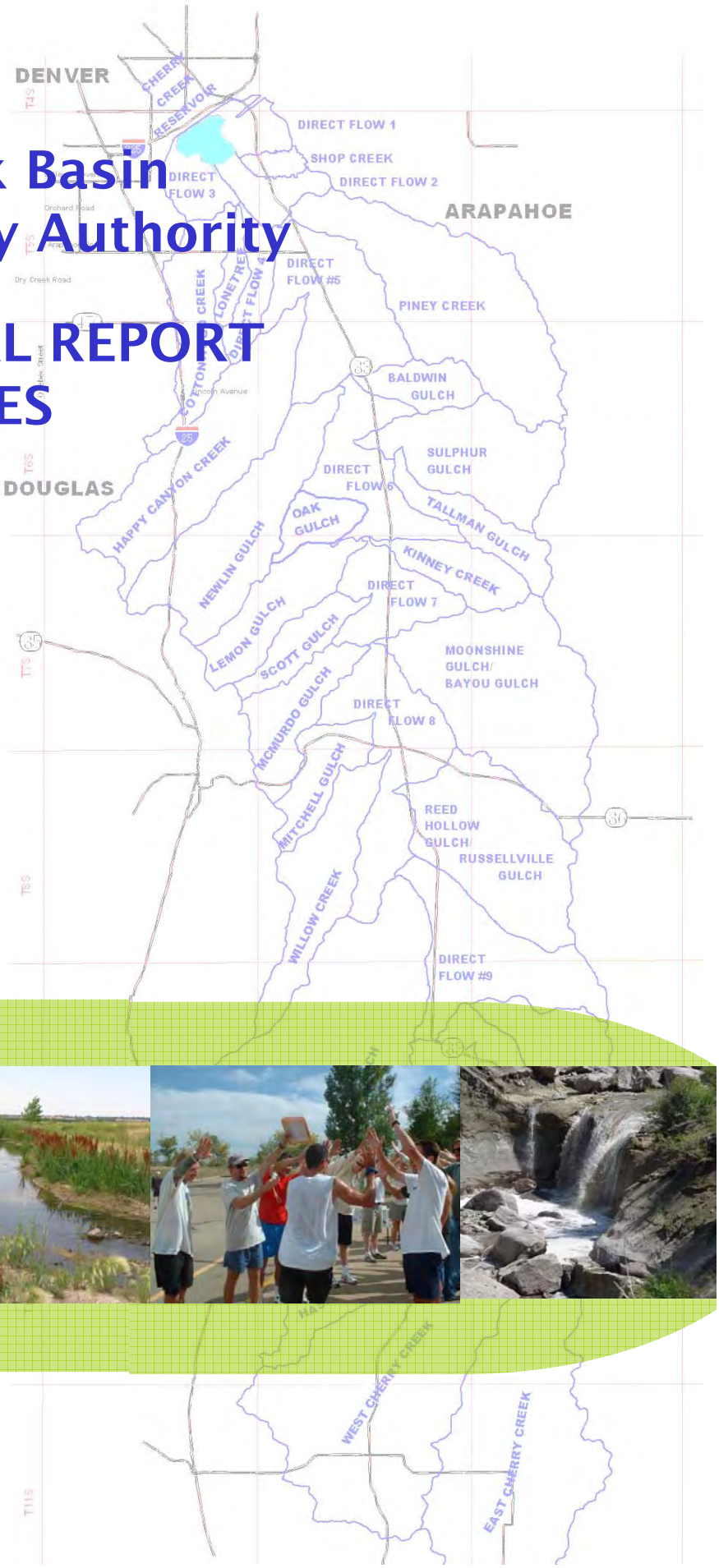
Cherry Creek Basin Water Quality Authority

2005 ANNUAL REPORT ON ACTIVITIES

March 31, 2006




BROWN AND CALDWELL

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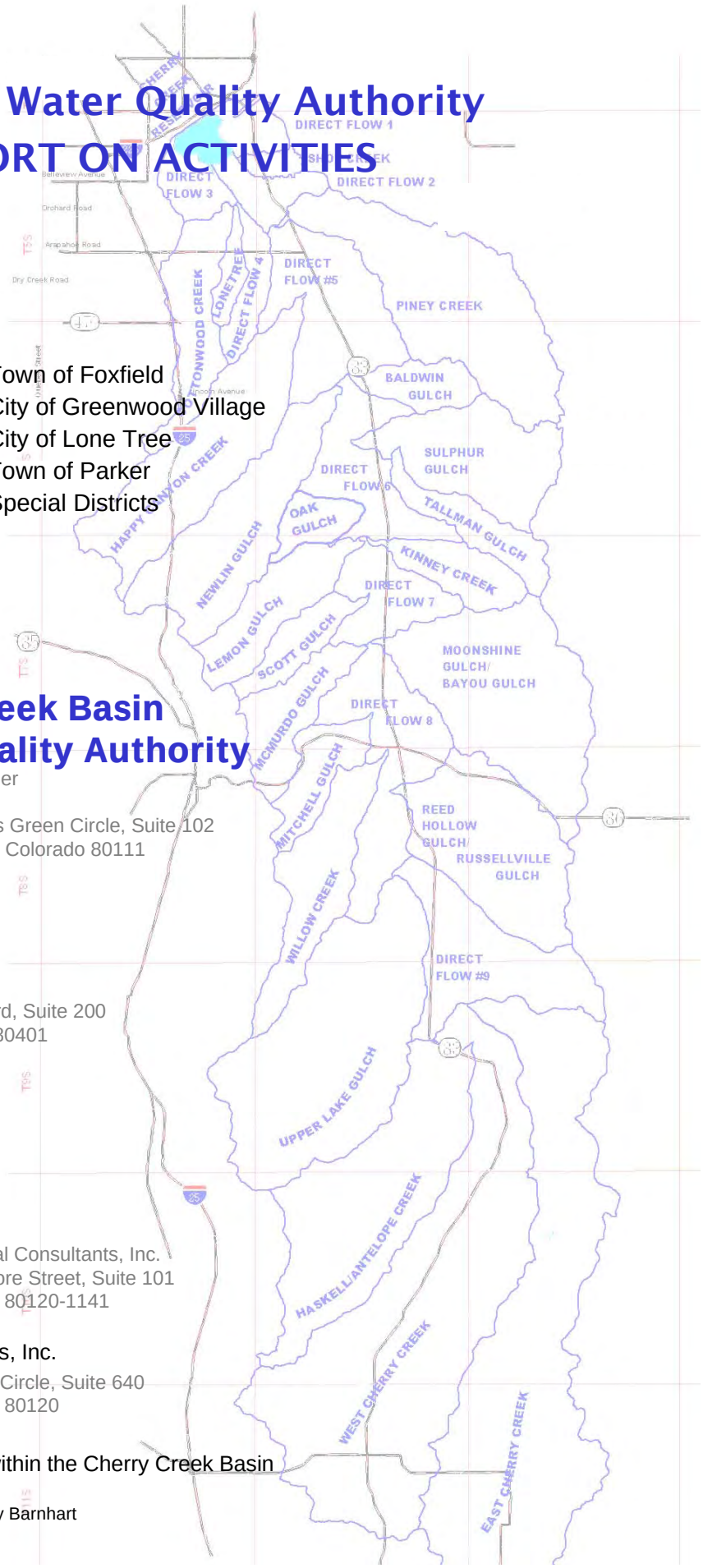

Authority Members in 2005

Arapahoe County	Town of Foxfield
Douglas County	City of Greenwood Village
City of Aurora	City of Lone Tree
Town of Castle Rock	Town of Parker
City of Centennial	Special Districts
Seven Governor's Appointees	

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Land Use Agencies and Utilities within the Cherry Creek Basin

Reservoir photo on cover courtesy of Gary Barnhart

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TABLES

CONTROL REGULATION 72 REPORTING REQUIREMENTS

Look for this symbol in the margin of the 2005 Annual Report to see sections that correlate to the reporting requirements, listed in Section 72.9, Reporting, of Regulation No. 72 – Cherry Creek Reservoir Control Regulation.

Control Regulation Section Number and Reporting Requirement	Section of Annual Report
Section 72.9 - Reporting	
72.9(1) Annual Report Submittal	Cover Letter
72.9(1)(a) Wastewater Facility Controls	
Monthly and annual loads	4.1.1
Permit violations	4.2
Approved site location approval applications	4.3
Effectiveness in reducing nutrient loads	4.1, 4.2
72.9(1)(b) Nonpoint Source Controls	
Sediment and erosion control permit, inspection, and enforcement actions	5.1
Construction BMPs inspection and enforcement actions	5.1
Permanent BMPs construction, inspection, and maintenance actions	5.1
Flood control facilities retrofitting, inspection, and maintenance actions	5.1
Effectiveness in reducing nutrient loads	9.5
Funding of nonpoint source control projects	5.6
Monitoring of nonpoint source control projects	9.5
Public information and education actions	7.1-7.5
72.9(1)(c) Riparian and Wetlands Protection	
Protection, enhancement and restoration actions	5.7
72.9(1)(d) Wasteload Allocation	
Temporary transfers, reserve pool allocations, and semi-urban area transfers	4.1,6.2
72.9(1)(e) Trading Program	
Point and nonpoint source actions, including reporting TMAL reductions from Trading Program	6.1
72.9(2) Provide data and information on the following:	
Water quality monitoring	9
Point and nonpoint source loadings	4.1,9.4
Status of compliance with discharge permit limits and conditions	4.2
Recommendations on new or proposed expansion of treatment facilities	4.3
Recommendations for improving water quality	5.6,10
Annual report format shall provide comparability among previous years	n/a[1]

[1] F*ollowing recommendations provided by the Division and complying with reporting requirements specified in the 2001 Control Regulation 72, the format of the Annual Reports after 2002 will be comparable.*

CONTROL REGULATION 72 TASK REQUIREMENTS

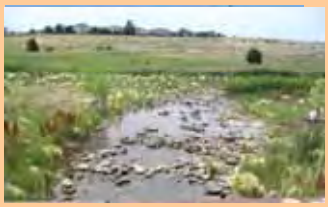
STEPS REG 72

Look for this symbol in the margin of the 2005 Annual Report to see how the Authority is taking steps to meet the task requirements outlined in Regulation No. 72 – Cherry Creek Reservoir Control Regulation.

ABBREVIATIONS

ACWWA	Arapahoe County Water and Wastewater Authority
Annual Report	Cherry Creek Basin Water Quality Authority 2005 Annual Report on
Authority	Cherry Creek Basin Water Quality Authority
BMP	Best Management Practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CIP	Capital Improvement Project
COE	U.S. Army Corp of Engineers
Commission	Colorado Water Quality Control Commission
Control Regulation 72	Regulation No. 72 – Cherry Creek Reservoir Control Regulation
DESC	Drainage, Erosion and Sediment Control
Division	Colorado Water Quality Control Division
DMR	Discharge Monitoring Report
DRCOG	Denver Regional Council of Governments
Education Initiative	Cherry Creek Basin Water Stewardship and Education Initiative
GESC	Grading, Erosion and Sediment Control
ISDS	Individual Sewage Disposal System
LID	Low-impact development
μg/L	micrograms per liter
mg/L	milligrams per liter
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
Park	Cherry Creek State Park
Partners	Cherry Creek Stewardship Partners
PRF	Pollutant Reduction Facility
Requirements	Cherry Creek Reservoir Watershed Stormwater Quality Requirements
SRP	Soluble Reactive Phosphorus
TABOR	Tax Payers' Bill of Rights
TAC	Authority's Technical Advisory Committee
TMAL	Total Maximum Annual Load
UDFCD	Urban Drainage and Flood Control District
WWTP	Wastewater Treatment Plant
2005 Annual Draft Monitoring Report	2005 Annual Aquatic Biological-Nutrient Monitoring Study and Cottonwood Creek Phosphorus Reduction Facility Monitoring

EXECUTIVE SUMMARY

Gary Barnhart Photos

The purpose of the 2005 Annual Report on Activities (Annual Report) is to provide a status report on Cherry Creek Reservoir water quality and review Cherry Creek Basin Water Quality Authority (Authority) progress towards achieving water quality standards in 2005. The Annual Report reviews the Authority's activities to ensure the strategies employed to meet the water quality standards and goals are appropriate and effective in the short and long term. Several objectives guide the development of the Annual Report to achieve this purpose.

- Document the steps taken in 2005 to perform required tasks
- Meet Control Regulation 72 reporting requirements
- Present the results of monitoring activities
- Review the effectiveness of watershed management strategies
- Provide an Executive Summary that can act as a stand-alone abbreviated report of 2005 activities and progress

The mission of the Authority is to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality." Authority activities discussed in the Annual Report are components of a plan directed toward meeting water quality standards, enhancing environmental health in the Cherry Creek Reservoir watershed (Figure ES-1) and implementing the phased Total Maximum Annual Load (TMAL). These activities include water quality monitoring, measurement of loads to the Cherry Creek Reservoir, and implementing point and nonpoint source controls and programs, special study efforts to update the TMAL, and a preliminary discussion of additional strategies for meeting reservoir water quality standards and goals in the foreseeable future.

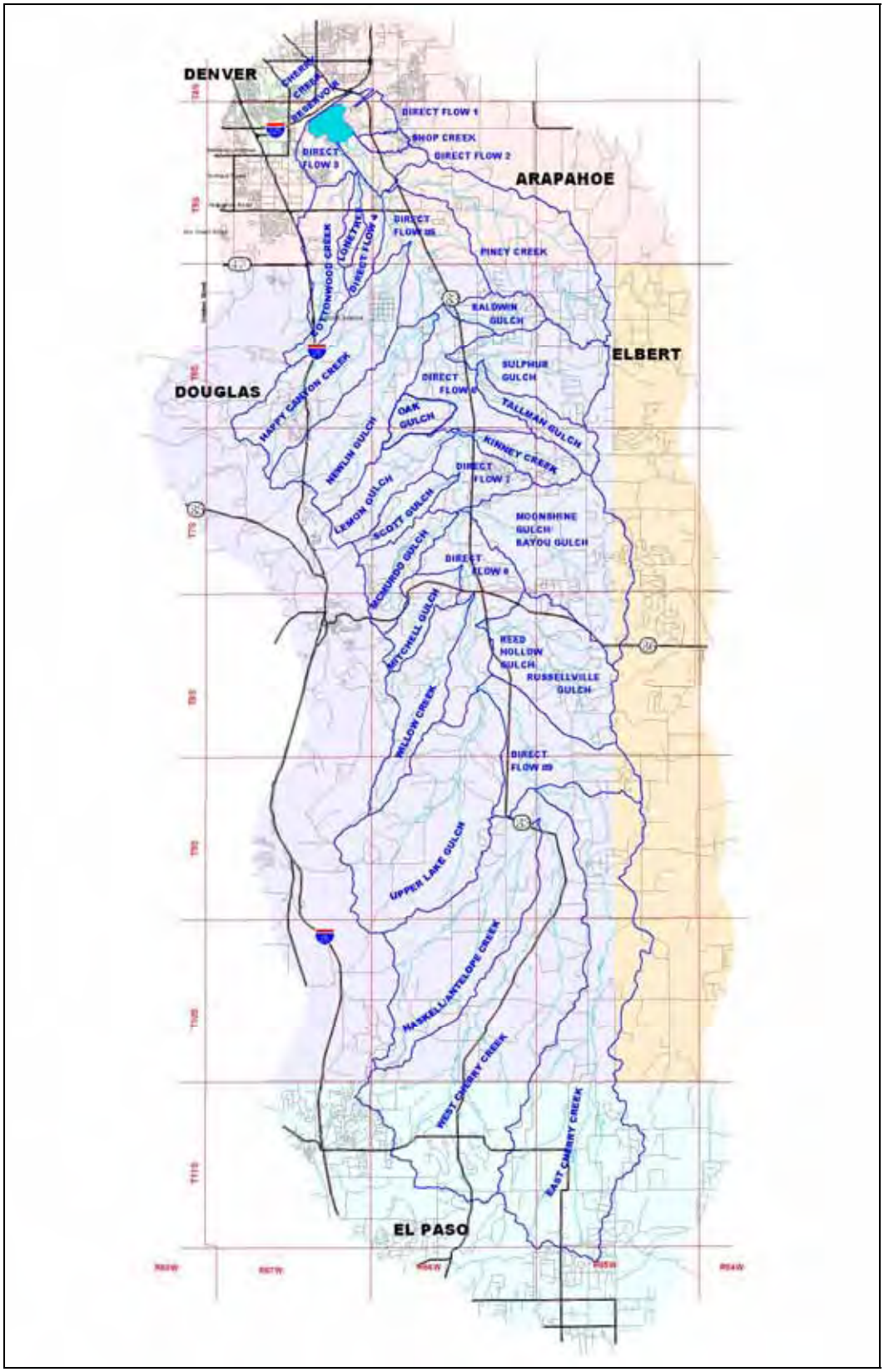
ES.1 Status of Water Quality

The Authority continued to implement its routine annual water quality monitoring program in 2005 for Cherry Creek Reservoir, the watershed, and to evaluate the effectiveness of Authority pollutant reduction facilities (PRFs).

ES.1.1 2005 Water Quality Summary

- Summer mean chlorophyll *a* of 17.1 μg/L exceeded the 15 μg/L standard
- Summer mean total phosphorus of 116 μg/L exceeded the goal of 40 μg/L
- Total phosphorus load of 10,047 pounds to the reservoir was below the TMAL of 14,270 lbs/year

Figure ES-1. Cherry Creek Reservoir Watershed Map



- Cottonwood-Peoria Pond and Cottonwood Perimeter Pond PRFs did not demonstrate the phosphorus removal effectiveness that has been demonstrated in the past. However, channel reconstruction was conducted on Cottonwood Creek downstream of the Cottonwood-Peoria wetland system in 2004, and Phase 2 will be completed in 2006. The channel reconstruction may have accounted for increased loads observed between the two PRFs. The Authority will continue annual monitoring of the PRFs and develop a plan to address the operation of the PRFs as needed.

  Historical sampling of the PRFs on Shop Creek and Quincy Drainage indicate an average annual phosphorus reduction of 63% or 173 pounds (1990 to 2000) and 99% or 138 pounds (1996 to 1999), respectively.

ES.1.2 Long-term Water Quality Summary

The Cherry Creek Reservoir chlorophyll *a* standard of 15 µg/L has only been met three times in the past 14 years, and the phosphorus goal of 40 µg/L has not been achieved in the past 14 years. However, the phosphorus loads have been lower than the TMAL of 14,270 pounds in 13 of the past 14 years (Table ES-1).

Table ES-1. Water Quality and Total Phosphorus Load Data for Cherry Creek Reservoir, July-September 1992-2005

Year	Chlorophyll *a* (µg/L)	Total Phosphorus (µg/L)	Total Nitrogen (µg/L)	Annual Phosphorus Load (lbs/yr)[1]	Annual Inflow (ac/ft)[1]	Standardized Phosphorus Load (lbs/ac-ft)	Net Phosphorus Load (lbs/yr)[2]
1992	17	66	970	**5,857**	7,474	0.78	4,543
1993	**14.4**	62	826	**4,110**	5,905	0.7	3,399
1994	**10**	59	1,144	**4,049**	7,001	0.58	3,056
1995	**9.4**	48	913	**7,972**	11,781	0.68	5,923
1996	20.5	62	944	**4,715**	7,644	0.62	3,723
1997	22.3	96	1,120	**5,761**	10,362	0.56	4,765
1998	26.5	89	880	**13,577**	20,903	0.65	9,370
1999	28.9	81	753	17,471	27,739	0.63	7,821
2000	25.2	81	802	**12,593**	18,610	0.68	8,905
2001	26.1	87	757	**9,837**	17,250	0.57	4,995
2002	18.8	74	858	**4,246**	7,498	0.57	2,745
2003	25.8	90	1,121	**8,568**	14,929	0.57	3,590
2004	18.4	102	977	**12,512**	17,177	0.73	7,007
2005	17.1	116	990	**10,047**	18,534	0.54	6,378
Mean	20.0	80	933	8,665	13,772	0.63	5,444
Median	19.7	81	929	8,270	13,355	0.63	4,880

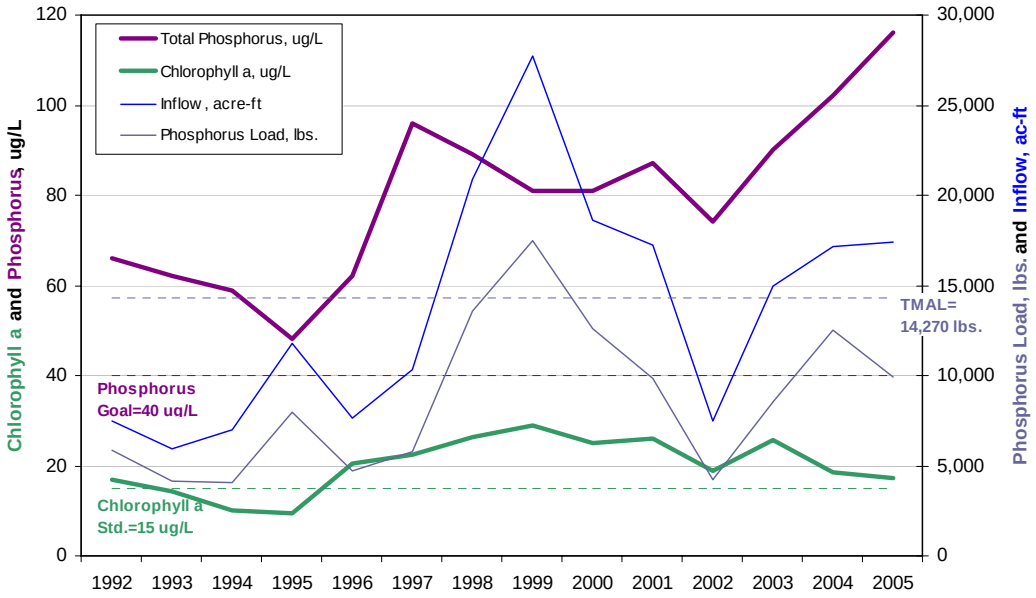
[1] This represents the total load and inflow to Cherry Creek Reservoir from stream, alluvium, and precipitation.
[2] The net phosphorus load is the total load to the reservoir minus the reservoir outflow load.
Bold indicates value meets the respective standard, goal, or TMAL value.

Figure ES-2 provides a picture of water quality concentrations, phosphorus loads, and inflow to the reservoir since 1992. This figure demonstrates how phosphorus loads track closely with inflows to the reservoir and that chlorophyll *a* and phosphorus concentrations do not necessarily have an immediate or significant response to changes in phosphorus loads. For example, load reductions that coincided with the recent drought years (2000 to 2002) did not result in a similar continuous decrease in phosphorus and chlorophyll *a* concentrations.

The Authority's watershed management strategies focus on reducing nutrient loading, both through structural and non-structural management strategies. The Authority PRF monitoring typically shows the PRFs are effective in reducing phosphorus, but the reservoir monitoring does not demonstrate immediate improvements in reservoir water quality related to watershed management strategies. However, the impacts of watershed management strategies are beneficial over the long term, but do not necessarily result in immediate measurable results in the reservoir.

The data indicate that the Authority needs to continue with watershed management strategies, but the Authority also faces a challenge to demonstrate near-term water quality improvements and needs to consider additional strategies. A 2003 special study on nutrient enrichment in Cherry Creek Reservoir identified that nitrogen, not phosphorus, may be the limiting nutrient and suggested reservoir mixing as a possible solution. Subsequently, the Authority evaluated in-lake management strategies (reservoir destratification) to assist with short-term water quality improvements. The Colorado Water Quality Control Commission (Commission) adopted a phased TMAL process that would provide for the continued implementation of both point and nonpoint source control strategies. This phased approach allows the Authority to investigate impacts on reservoir water quality and formulate additional and alternative control strategies, such as in-lake management.

Figure ES-2. Cherry Creek Reservoir Water Quality, Load, and Inflow, 1992-2005



ES.2 Background

Regulation No. 72 – Cherry Creek Reservoir Control Regulation (Control Regulation 72) is established by the Commission and sets forth actions and requirements that the Authority must meet. The Commission revised Control Regulation 72 in November 2004, which became effective on December 30, 2004.

- Emphasis is placed on implementation of watershed measures to control the water quality in Cherry Creek Reservoir.
- The Cherry Creek Reservoir has a chlorophyll *a* water quality standard of 15 μg/L mean July-September concentration to be met 9 out of 10 years.
- The Cherry Creek Reservoir has a phosphorus concentration goal of 40 μg/L.

ES.3 Overview of Progress Made

Although the Cherry Creek Reservoir did not meet the chlorophyll *a* water quality standard for the reservoir in 2005, the Authority continues to take initiative towards meeting standards through key planning, implementation, and evaluation actions, including the following.

- **Planning** – Recommendations of the Watershed Plan 2003 continue to guide the Authority's Work Plan. During the budgeting process, the Authority set aside funds for stream corridor preservation partnering opportunities, a sinking fund for long-term PRF operations and maintenance, and to begin exploring the feasibility of measures to reduce the impact of the TABOR amendment on the Authority's budget.
- **PRF Implementation** – The Authority completed a feasibility study for reservoir destratification and contracted with a consultant to conduct a feasibility study for another PRF. Design of the first phase of the wetlands restoration project (demonstration project) and Phase II of Cottonwood Creek Reclamation were resumed in late 2005 after delays due to pending relocation of Peoria Street and Belleview Avenue.
- **Facilitation and Coordination** – Worked closely with land use agencies to coordinate stormwater permit requirement compliance in the Cherry Creek basin. In addition, the Authority continued the unique program of the "phosphorus facilitator," that focused on transportation corridor requirements, low-impact development, and stakeholder education.
- **Education** – Coordinated with the Partners to implement more avenues for educating the public (e.g., brochure, training, volunteer workdays, and conference).

- **Monitoring** – Continued to monitor water quality, loads, and PRF performance to provide a means of measuring effectiveness of watershed management strategies. This information feeds back into the dynamic planning process.

ES.4 Progress Made in Specific Management Programs

Listed below are specific watershed management programs that the Authority implemented in 2005 to improve watershed health and water quality, along with the associated progress made through each program.

ES.4.1 Wastewater Facility Controls

- Wastewater facility discharges did not exceed annual permitted wasteload allocations or effluent phosphorus concentrations.

- The Authority reviewed five and approved four applications for site location approval and wastewater utility plan amendments within the Cherry Creek Reservoir watershed for compliance with applicable regulations and guidance documents. This includes compliance with wasteload allocations and wastewater utility management plans. The remaining application will be completed in 2005.

ES.4.2 Nonpoint Source Controls

- Coordinated and assisted local land use agencies in implementing Phase II stormwater permit requirements consistent with Control Regulation 72.

- Completed the second year of the "Phosphorus Facilitator" program, to work with local developers to implement BMPs that go well beyond minimum requirements.

- Increased the local land use agencies understanding of Authority goals and requirements relative to water quality through development and distribution of education materials and by providing review comments on land-use change applications.

- Completed feasibility investigations for two additional PRFs, included the projects on the master capital improvement project list, and allocated funds for further activity during 2006. Although one of the PRFs is applied in Cherry Creek Reservoir, the Authority continues to focus on watershed BMPs and PRFs.

- Initiated a process to update the Authority's Stormwater Quality Requirements for consistency with 2004 Control Regulation 72 revisions and the land use agency stormwater quality requirements developed as part of the Phase II stormwater permits.

ES.4.3 Trading Program

In 2005, the Authority improved and built upon its trading program.

- Initiated revisions to the Trading Program Guidelines.
- ACWWA completed construction on the Pond L-3 trade project.
- ACWW submitted an application for a new trade project, Pond W6/W7.

ES.4.4 Public Education Actions and Partnerships

- Leverage resources by supporting the Partners financially and technically and coordinating with other entities to implement the Education Initiative, a comprehensive and coordinated education strategy and action plan.
- Continued distribution of the BMP Series educational fact sheets to increase awareness of water quality BMPs and the Authority's role and efforts in improving water quality, specifically related to the land use and development process within the Cherry Creek Reservoir watershed.
- Continuation of the Authority's website through cooperation with the Partners to facilitate the dissemination of information to parties interested in the Authority's activities.
- Collaborating on information and education efforts with other entities with common interests and goals for the watershed.

ES.4.5 Phased TMAL Implementation

- Under the management of the Division, the Authority completed a required special study that estimated the groundwater inflow rate and phosphorus flux through reservoir seepage.
- Worked with the Division to come to agreement on a significantly reduced scope for the EMC special study.
- Finalized grant contracting and completed consultant selection for three special studies required as part of the phased TMAL. These studies will be conducted in 2006.
- The Authority made progress on determining how to address the question of phosphorus fate and transport in the watershed through the watershed model update.

ES.4.6 Water Quality Monitoring

- Completed annual water quality monitoring and analysis for the reservoir, watershed, alluvium, and selected PRFs in accordance with the Sampling, Analysis, and Quality Assurance Work Plan.

- The Cottonwood Creek-Peoria Pond PRF was not as effective at removing total phosphorus or total suspended solids in 2005 as observed in previous years. Standardized phosphorus loads (lbs/ac ft) were slightly greater downstream of the pond as compared to standardized loads upstream of the system. This decrease in performance may be due, in part, to the Phase I Cottonwood Creek Reclamation completed in 2004, since the vegetation is still recovering from the wide spread land disturbance and a major storm event. In addition, since the inflow concentrations were relatively low (i.e., less than 0.11 mg/l), further reductions in concentrations through natural systems is limited.

- The Cottonwood Creek Perimeter Pond PRF also revealed a similar increase in phosphorus loading downstream of the system. However, standardized phosphorus loads (lbs/ac-ft) showed that the system was slightly effective at removing total phosphorus from Cottonwood Creek. These reductions in loads at the Perimeter Pond PRF were observed despite the potential for increased loads resulting from the channel reconstruction activities upstream during 2004, again pointing to the effectiveness of this structure in reducing phosphorus loads to the reservoir.

- Total phosphorus load to the reservoir was below the TMAL.

- There has been a statistically significant decrease in seasonal whole-reservoir chlorophyll *a* concentrations since 1999.

ES.5 Results and Conclusions

The Authority recognizes the challenge of meeting water quality standards, and continues to plan, gather information, implement strategies, monitor, and reevaluate approaches to meet the challenge. The Authority has undertaken actions through a variety of programs to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality." These actions are components of a plan directed toward meeting water quality standards and enhancing environmental health in the Cherry Creek basin.

The Authority's management strategies have strong focus on the watershed, including the construction of PRFs that have shown to be effective in reducing phosphorus loads. The Authority believes watershed management strategies are beneficial over the long term, but they have not resulted in immediate measurable improvements to reservoir water quality. The Authority is actively investigating and implementing additional strategies for more short-term improvements to reservoir water quality. Overall nutrient loading from the watershed is expected to increase in the future, primarily as a function of increases in stormwater runoff and stream erosion. As a result, the Authority focuses on continued reduction of nutrient loads from the watershed through watershed management strategies.

1. PURPOSE OF THE ANNUAL REPORT

The purpose of the 2005 Annual Report is to summarize activities performed by the Authority in 2005. Authority activities are directed towards meeting water quality standards and enhancing environmental health in the Cherry Creek Reservoir watershed, and implementing the phased TMAL. Activities discussed in the Annual Report are components of a plan for protecting the health of the watershed, and include monitoring water quality, measuring loads to the Cherry Creek Reservoir, and implementing point and nonpoint source controls and programs, completing special studies to update the TMAL, and evaluating additional strategies for meeting water quality standards and goals in the Cherry Creek Reservoir.

Several objectives guide the development of the Annual Report to achieve this purpose.

Objective 1 – Document the steps taken in 2005 to perform required tasks

STEPS
REG 72

The Authority's actions are primarily governed by Control Regulation 72, as developed by the Colorado Department of Public Health and Environment's (CDPHE) Colorado Water Quality Control Commission. Control Regulation 72 establishes various requirements for the purpose of meeting water quality standards and the phased TMAL. Throughout the Annual Report, the "Steps" icon in the left margin indicates the Authority's progress towards completing Control Regulation 72 tasks, which are listed on page viii of the Table of Contents.

Objective 2 – Meet Control Regulation 72 reporting requirements

Reg 72
Reporting

Control Regulation 72 requires that the Authority complete an Annual Report in accordance with specific reporting requirements. The Authority submits the Annual Report to the Commission for review on March 31. The Authority's activities and the Annual Report include more than what Control Regulation 72 requires for reporting. The "Reg 72 Reporting" icon highlights reporting requirements, which are listed on page vi of the Table of Contents.

Objective 3 – Present the results of monitoring activities

The Authority continually monitors water quality to evaluate compliance with water quality standards, establish reservoir and watershed water quality conditions and document changes in water quality. These monitoring efforts also provide the basis for measuring phosphorus loadings to the reservoir and evaluating the effectiveness of PRFs. This data is also utilized by the Division, Colorado State Parks Department, the U.S. Army Corp of Engineers (COE), and other interested parties.

Objective 4 – Provide a framework for a review of strategies

Each section in the Annual Report concludes with a "Progress Made" section, which identifies outcomes of activities, where measurable, and reports if those activities are meeting target goals. Section 10 provides recommendations for directing future water quality efforts, and Section 8 provides the outcomes of special studies that provide additional options for water quality improvements. This information provides a framework for determining if strategies employed to meet Control Regulation 72 requirements are appropriate and effective in the near and long term.

Objective 5 – Provide an abbreviated report of 2005 activities and progress made

The Executive Summary of the Annual Report serves as a stand-alone document providing a brief summary of the Authority's activities in 2005 and progress made towards the phased TMAL. The Executive Summary can be distributed to interested agencies and individuals, and also used to supplement other reports or grant applications developed by the Authority.

2. THE AUTHORITY

The mission of the Authority is to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality." From this mission, the Authority has developed water quality management strategies to minimize point and nonpoint pollutant sources by implementing specific programs and monitoring water quality to evaluate progress. This process creates an effective water quality management approach, as shown on Figure 2-1.

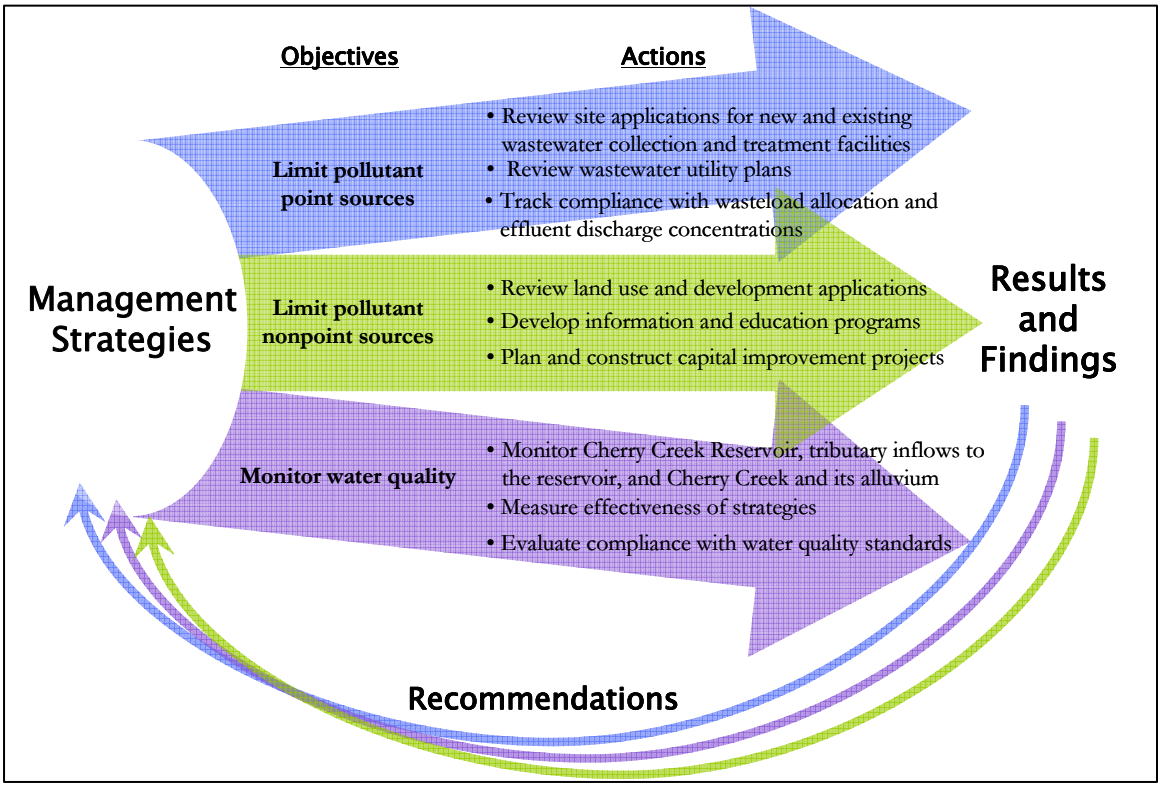


Figure 2-1. Water Quality Management Approach

This section provides information on the Authority's history, the members of the Authority, the 2005 annual budget and funding sources, and 2005 reference materials.

2.1 History

The Authority was formally created in 1985 by the Colorado Legislature to preserve water quality within the Cherry Creek Reservoir watershed. Figure 2-2 provides a summary of the Authority's history.

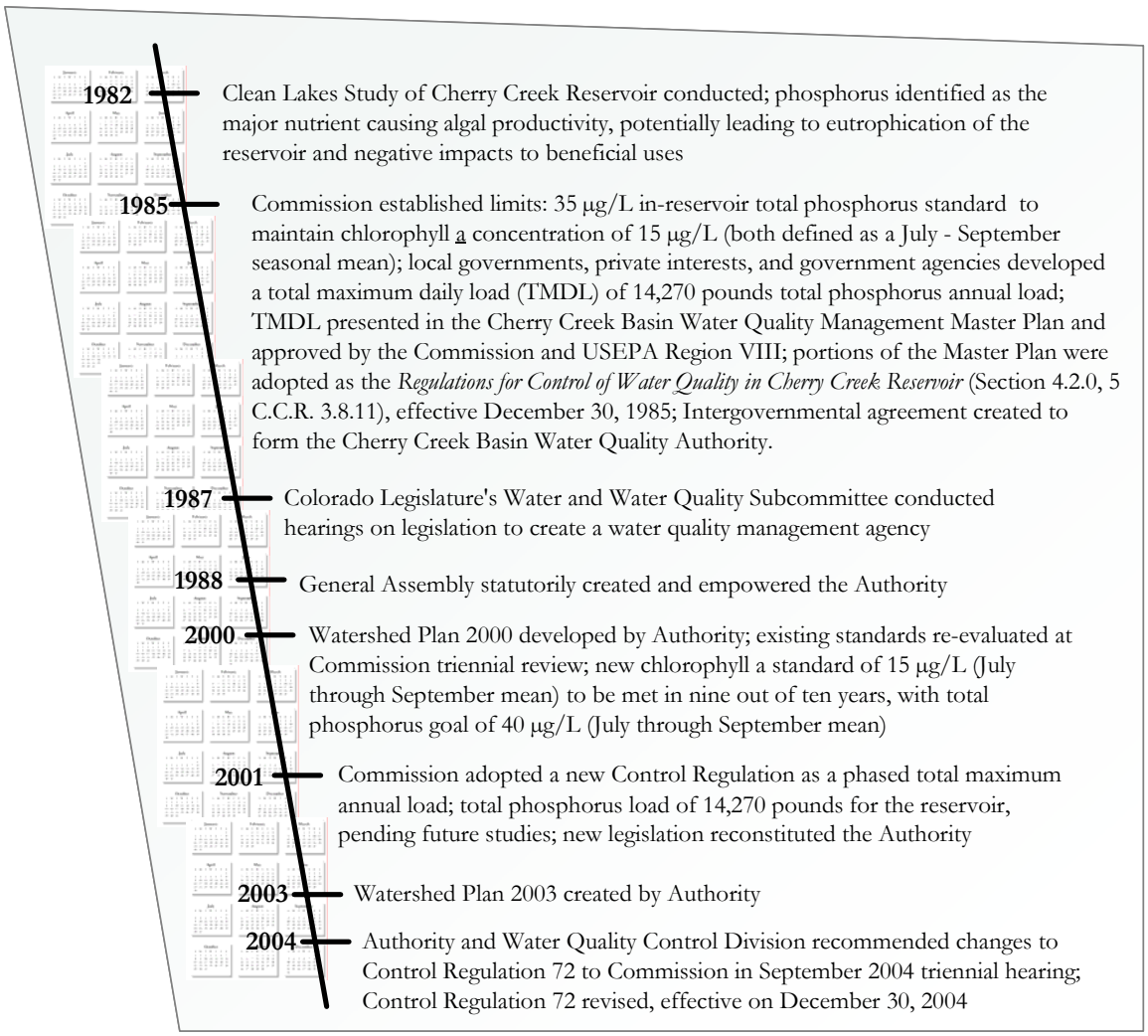


Figure 2-2. Summary of Authority History

2.2 Today's Authority

The Authority consists of a Board and Technical Advisory Committee (TAC). Table 2-1 lists the entities that are represented on the Board, per Control Regulation 72.

Table 2-1. Authority Board Members

Entities That Must be Represented	Number of Representatives
County (Arapahoe, Douglas)	2
Municipality (Aurora, Castle Rock, Centennial, Foxfield, Greenwood Village, Lone Tree, Parker)	7
Special Districts	1
Appointed by the Governor	7
Total members of Authority Board [1]	**17**

[1] Arapahoe County and the Town of Foxfield were represented by one individual on the Board in 2005.

The TAC consists of members representing various agencies and interests within the Cherry Creek Reservoir watershed. The role of the TAC is to consider and report to the Board on matters of a scientific or technical nature, as directed by the Board. Table 2-2 provides a list of entities that are represented on the TAC.

Table 2-2. Authority TAC Members

Entities Represented	Number of Members
County (Arapahoe, Douglas)	2
Municipality (Aurora, Castle Rock, Greenwood Village, Lone Tree, Parker)	5
Special districts	1
Board appointed	3
Other (Cherry Creek State Park, COE, DRCOG, City and County of Denver, and Urban Drainage and Flood Control District)	5
Total members of TAC	**16**

2.3 Work Plan

The Work Plan guides the activities of the TAC and Board. The Work Plan is a spreadsheet that lists all of the upcoming tasks for the calendar year. As shown on Figure 2-3, the Work Plan provides the following information for each task.

- Task description
- Corresponding category in the Authority's budget
- Fulfillment of appropriate Control Regulation 72 section
- Fulfillment of corresponding Watershed Plan 2003 recommendation
- Schedule for completion
- Progress status

Ongoing tasks, tasks scheduled for future years, and completed tasks are also listed on separate pages. The Work Plan is updated on a monthly basis and is reviewed at every TAC meeting.

Figure 2-3 2005 Work Plan

Budget/Task Category	Task	Task Description	Control Regulation Section	Fulfillment of Control Regulation by:	Watershed Plan 2003 Recommendations	Month Start (first of month)	Status	Due Date
2005 Ongoing								
Meetings	Monthly Board and TAC meetings					Ongoing	Ongoing	Ongoing
TAC Work Plan	Maintain and update TAC Work Plan	Update monthly and submit to TAC for review			B - Implement Watershed Plan 2003 as a coordinated management program	Ongoing	Ongoing	Ongoing
	Submit to Board quarterly	Submit abbreviated TAC Work Plan to Board			B - Implement Watershed Plan 2003 as a coordinated management program	Ongoing	Ongoing	Ongoing
Public Information and Education	Promote use of Educational Fact Sheets	Continued distribution of The BMP Series fact sheet program	72.6(2)	Update Public Information and Education Program	L - Develop and implement public involvement plan; A - Consider funding options to achieve capital budget	Ongoing	Ongoing	Ongoing
	Implement Cherry Creek Basin Water Stewardship and Education Initiative	Implement Information and Education Program from Needs Assessment and coordinate with stakeholders	72.6(2)	Implement Public Information and Education Program	L - Develop and implement public involvement plan; A - Consider funding options to achieve capital budget	Ongoing	Ongoing	Ongoing
Trading Program	Review of Trade Applications		72.5(3)(a)	Trading program	E - Promote trading incentives	Ongoing	Ongoing	Ongoing
Watershed Mgmt - Land Use Applications	Review Land Use Development Applications referred to Authority		72.6(1)	Encouraging and ensuring adequate nonpoint source (especially stormwater) BMPs	H - Encourage local gov'ts to work with developers to construct innovative demonstration projects; I - Explore options to reduce septic system loading in Cherry Creek	Ongoing	Ongoing	Ongoing
Watershed Mgmt - Site Application Review	Review of Site Applications		72.4(4)	Effluent discharge		Ongoing	Ongoing	Ongoing
Watershed, Reservoir, and PRF Monitoring	Implement monitoring programs					Ongoing	Ongoing	Ongoing
2005								
Capital Projects	Annual Operations and Maintenance Report	Identify operation and maintenance needs	72.3(4)	Construction of nonpoint source control projects	C - Fund, design, and construct high priority stream improvements	6/1/2005	Completed	9/30/2005
	Cherry Creek Sediment Pond at Arapahoe Road	Develop Scope for Preliminary Design	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	3/1/2005	Completed	6/30/2005
	Cherry Creek Sediment Pond at Arapahoe Road	RFP and consultant selection	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	5/15/2005	Completed	8/15/2005
	Cherry Creek Sediment Pond at Arapahoe Road	Distribute RFP/Proposal submittals	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	5/27/2005	Completed	7/1/2005
	Cherry Creek Sediment Pond at Arapahoe Road	Shortlist and conduct interviews	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	7/7/2005	Completed	8/31/2005
	Cherry Creek Sediment Pond at Arapahoe Road	TAC recommendation/Board selection	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	8/31/2005	Completed	10/20/2005
	Cherry Creek Sediment Pond at Arapahoe Road	Contracting for Preliminary Design	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	8/18/2005	Completed	12/5/2005
	Cherry Creek State Park – Operations and Maintenance Agreement	Board approve	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	10/7/2004	Completed	5/19/2005
	Cherry Creek State Park – Operations and Maintenance Agreement	Annual inspection of PRFs	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	4/22/2005	Completed	4/22/2005
	Cherry Creek State Park Wetlands	Phase I design	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	2/1/2006	In progress	12/31/2006
	Cottonwood Creek Reclamation	Phase II design/construction	72.3(4)	Construction of nonpoint source control projects	C - Fund, design, and construct high priority stream improvements	12/1/2004	In progress	12/31/2006
	Cottonwood Creek Reclamation	Phase II B construction	72.3(4)	Construction of nonpoint source control projects	C - Fund, design, and construct high priority stream improvements	11/1/2005		6/30/2006
	Reservoir Destratification	Scope and budget for feasibility study	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	2/1/2005	Completed	3/15/2005
	Reservoir Destratification	RFP and consultant selection	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	3/15/2005	Completed	6/30/2005
	Reservoir Destratification	Conduct interviews	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	5/13/2005	Completed	5/13/2005
	Reservoir Destratification	TAC recommendation/Board selection	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	5/26/2005	Completed	6/16/2005
	Reservoir Destratification	Contracting for feasibility study	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	6/16/2005	Completed	7/1/2005
	Reservoir Destratification	Feasibility Report and cost analysis	72.3(4)	Construction of nonpoint source control projects	D - Design and construct additional PRFs	7/1/2005	Completed	12/30/2005
Annual Budget	Identify 2006 bidget items	Identify 2006 budget items and present to Board/Budget Committee				8/25/2005	Completed	10/15/2005
Long-term Funding	Overall business program and financing plan	Board develop approach			A,3 - Develop and implement an overall business program and financing plan.			
	Identify a funding champion to generate financial resources for water quality improvement.	Board to set up process to pursue funding champion			A,1 - Identify a funding champion to generate financial resources for water quality improvement			
	Overall business program and financing plan	Board develop plan			A,3 - Develop and implement an overall business program and financing plan.			
Reporting - 2004 Monitoring and Annual Reports	Annual Report	Including updates of: trading program activities; progress of adoption of Model Ordinance regulations; future non point source control projects; O&M activities; Public Information and Education Program; Floodplain Preservation and Conservation Easement Activities; Annual Routine Monitoring Program	72.9, including 72.5(3)(a), 72.6(1), 72.6(2), 72.6(5), 72.8(2)	Gathering and updating required information (see Description) into an Annual Report		1/1/2005	Completed	3/31/2005
	Annual Report - TAC and WQCD provide comment on draft	TAC receives draft before TAC meeting, provide comment by TAC meeting	72.9	Annual Report		1/28/2005	Completed	2/3/2005
	Annual Report - Board provide comment on draft	Board receives draft for Board meeting, provide comment within two weeks	72.9	Annual Report		2/11/2005	Completed	2/23/2005
	Annual Report - TAC provide comment on final draft	TAC receives draft for TAC meeting, provide comment at TAC meeting	72.9	Annual Report		2/25/2005	Completed	3/3/2005
	Monitoring Report - TAC provide comment	TAC receives draft for TAC meeting, provide comment at TAC meeting	73.9	Annual Report		2/25/2005	Completed	3/3/2005
	Board approval of Annual Report	Board reviews and provides approval of Annual Report	72.9	Annual Report		3/11/2005	Completed	3/18/2005
	Annual Report - Submit final to WQCD and WQCC		72.9	Annual Report		3/18/2005	Completed	3/31/2004
	Present Annual Report to WQCC	Present summary of the Annual Report to the WQCC	72.9	Annual Report		5/9/2005	Completed	5/9/2005
Special Project - Park Voluntary Lead Mgmt	Review lead management plan for State Park Shooting Range	Provide review and comment on proposed management plan				2/1/2005	Completed	5/19/2005
Special Project - Phosphorus Facilitator	Phosphorus Facilitator	Develop scope for 2005			G - Encourage local governments to work with developers to construct innovative demonstration projects	1/1/2005	Completed	3/3/2005
	Phosphorus Facilitator	Contract with consultant			G - Encourage local governments to work with developers to construct innovative demonstration projects	3/3/2005	Completed	4/15/2005
	Phosphorus Facilitator	Coordinate with land use agencies and developers. Implement tasks.			G - Encourage local governments to work with developers to construct innovative demonstration projects	3/1/2005	Completed	12/31/2005
	Phosphorus Facilitator	Consultant document 2005 activities			G - Encourage local governments to work with developers to construct innovative demonstration projects	10/1/2005	In progress	2/28/2006
Special Projects - Nonpoint Source Grant	Finalize contract and initiate reimbursable costs	Complete contracting process with Division			A,2 - Achieve capital budget increase; federal funding	6/1/2004	Completed	10/1/2005
	finalize process for implementing the three special studies under Grant	Develop RFPs and select consultants			A,2 - Achieve capital budget increase; federal funding	4/27/2005	Completed	12/31/2005
Special studies	GW/P flux into reservoir	Division present status report and preliminary findings			K - Conduct special studies to optimize water quality improvements	12/1/2003	Completed	3/3/2005
	GW/P flux into reservoir	Division present draft report for TAC comment			K - Conduct special studies to optimize water quality improvements	12/1/2003	Completed	3/18/2005
	GW/P flux into reservoir	Consultant present finding to Board			K - Conduct special studies to optimize water quality improvements	3/17/2005	Completed	3/17/2005
	Further develop EMCs	Discuss basis and need for study with WQCD			K - Conduct special studies to optimize water quality improvements	1/1/2005	Completed	1/12/2005
	Further develop EMCs	Develop documentation regarding eliminating or reprioritizing study			K - Conduct special studies to optimize water quality improvements	1/13/2005	Completed	4/28/2005
	Further develop EMCs	Solicit WQCD comments			K - Conduct special studies to optimize water quality improvements	4/28/2005	Completed	9/22/2005
	Further develop EMCs	Receive WQCD comments			K - Conduct special studies to optimize water quality improvements	4/28/2005	Completed	10/7/2005
	Depth profiling of nutrient content for GW	Develop RFP and consultant selection process	72.4(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	4/27/2005	Completed	11/20/2005
	Depth profiling of nutrient content for GW	Contract with consultant			K - Conduct special studies to optimize water quality improvements	8/25/2005	In progress	2/30/06
	Further quantification of soil and GW background P levels	Develop RFP and consultant selection process	72.4(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	4/27/2005	Completed	11/20/2005
	Further quantification of soil and GW background P levels	Contract with consultant			K - Conduct special studies to optimize water quality improvements	8/25/2005	Completed	12/15/2005
	Evaluation of P removal of phosphorus control projects	Develop RFP and consultant selection process	72.4(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	4/27/2005	Completed	11/20/2005

Figure 2-3 2005 Work Plan

Budget/Task Category	Task	Task Description	Control Regulation Section	Fulfillment of Control Regulation by:	Watershed Plan 2003 Recommendations	Month Start (first of month)	Status	Due Date
	Evaluation of P removal of phosphorus control projects	Contract with consultant			K - Conduct special studies to optimize water quality improvements	8/25/2005	In progress	2/30/06
Special Projects - CC Stewardship Partners	Update Authority website	Update Authority website	72.6(2)	Update Public Information and Education Program	L,1 - Develop public involvement plan; work with Partners to develop website	2/1/2005		12/1/2005
Special Projects - CC Stewardship Partners	Cherry Creek State Park Brochure	Partners develop, TAC review, Board acceptance	72.6(2)	Update Public Information and Education Program	L,1 - Develop public involvement plan; work with Partners to develop website	8/1/2004	Completed	7/21/2005
Trading Program	Make modifications to Trading Guidelines		72.5(3)(a)	Trading program		6/1/2005	In progress	4/30/2006
	ACWWA Pond W6/W7 Trade Application	Accept application	72.5(3)	Trading program		6/16/2005	Completed	7/1/2005
	ACWWA Pond W6/W7 Trade Application	Review application for TAC consideration'	72.5(3)	Trading program		6/17/2005	Completed	12/31/2005
	ACWWA Pond W6/W7 Trade Application	TAC recommendation/Board selection	72.5(3)	Trading program		11/1/2005	In progress	2/28/2006
Watershed Mgmt - Land Use Applications	Coordinate with UDFCD on Cottonwood Creek Master Plan					2/1/2005		12/31/2005
	Update of Stormwater Quality Requirements/Model Ordinance		72.7	Encouraging compliance with stormwater permit requirements	F - Encourage all land use agencies to adopt and implement Authority "Requirements"	6/1/2005	In progress	4/1/2006
Watershed Mgmt - Site Application Review	ACWWA WWTP	Site Application Review	72.4(4)	Effluent discharge		12/20/2004	Completed	2/17/2005
	Inverness Lift Station	Site Application Review	72.4(4)	Effluent discharge		12/20/2004	Completed	2/17/2005
	Meridian Lift Station G	Site Application Review	72.4(4)	Effluent discharge		2/25/2005	Completed	3/31/2005
	Pinery WUP Amendment		72.4(4)	Effluent discharge		9/23/2005	In progress	2/15/2006
	Parker W&S WUP Amendment		72.4(4)	Effluent discharge		10/10/2005	Completed	12/1/2005
Watershed Model Update	Fate and transport/watershed model update	Finalize scope of work to update watershed model	72.8(5)	Calibrate water quality models		12/1/2004	Completed	2/17/2005
	Fate and transport/watershed model update	TAC review scope of work	72.8(5)	Calibrate water quality models		1/3/2005	Completed	2/17/2005
	Fate and transport/watershed model update	Board review scope of work	72.8(5)	Calibrate water quality models		2/11/2005	Completed	2/17/2005
	Fate and transport/watershed model update	Confirm WQCD involvement	72.8(5)	Calibrate water quality models		2/11/2005	Completed	3/31/2005
	Fate and transport/watershed model update	Consulant review team contracting	72.8(5)	Calibrate water quality models		2/17/2005	Completed	5/26/2005
	Fate and transport/watershed model update	Monthly subcommittee and review team meetings	72.8(5)	Calibrate water quality models		5/26/2005	In progress	8/1/2006
Reservoir Model Update	Reevaluate target reservoir load	Subcommittee evaluate lake modeling revisions/needs for 2006	72.8(5)	Calibrate water quality models		6/1/2005	Completed	12/31/2005

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2.4 Financial Matters

Reg 72 Reporting

The Authority receives funding for its activities primarily from property taxes, Cherry Creek State Park (Park) user fees, wastewater bill surcharges and building permit fees. These primary sources are supplemented with funds from various grants and other fees and charges.

The Authority's budget for the 2005 calendar year was approximately $1,580,000 in revenue and approximately $1,770,000 in expenditures. Colorado State Statute § 25-8.5-111(3) dictates that the Authority must spend at least 60% of the annual authorized revenues on the construction and maintenance of PRFs. The budgeting process for PRFs is discussed in Section 5.6. The remaining 40% is allocated towards monitoring, special studies, planning documents, technical reports or memoranda, and administrative costs.

2.4.1 Funding Sources

Approximately $1,050,000 (68%) of the Authority's budgeted revenue was tax based, $410,000 (26%) was from fees and surcharges on wastewater, and $122,100 (8%) was from miscellaneous sources, such as reimbursed expenses, grants, and trading program. In 2005, the Authority was required under provisions of Article X, Section 20, of the Colorado Constitution (TABOR) to temporarily reduce its authorized mill levy. This requirement reduced the Authority's tax-based revenue by $255,220.

2.4.2 Grants

In 2003, the Authority pursued funding from the Colorado Nonpoint Source Program and prepared applications for two projects: "Cherry Creek State Park Wetlands, Phase 1" involving the design and construction of Phase 1 of the multi-phase wetlands construction project, and "TMAL Actions" to conduct three special studies specified in Control Regulation 72. In 2004, the Authority completed the grant application process and was awarded the grants. The grant contracts were executed on October 27, 2005. The Authority will provide $160,000 in matching funds and work on both grants will begin in 2006.

2.5 2005 Reference Documents

The Authority generated documents in 2005 that serve as references for the status of water quality in Cherry Creek Reservoir, guidelines and educational material on water quality BMPs, technical sources on various aspects of water quality, and watershed planning and management strategies. Table 2-3 lists key reference documents generated by the Authority in 2005.

Table 2-3. 2005 Reference Documents

2004 Annual Report of Activities by the Cherry Creek Basin Water Quality Authority Update on activities completed by the Authority in 2004 and progress made towards the phased TMAL
2004 Annual Report of Baseline Water Quality Data Collection Study for the Upper Cherry Creek Basin Flow and water quality data collected at surface and ground water stations in the upper Cherry Creek Reservoir watershed
Cherry Creek Reservoir 2004 Annual Aquatic Biological and Nutrient Monitoring Study Characterization of potential relationships between nutrient loading and reservoir productivity
Estimation of Groundwater Flow into Cherry Creek Reservoir and its Relationship to the Phosphorus Budget of the Reservoir Estimated seepage contributions to Cherry Creek Reservoir made by direct measurement methods and by mass-balance analysis of conservative ions.
Cherry Creek Phosphorus Facilitation Summary Describes outreach program to encourage inclusion of additional stormwater BMPs by demonstrating net water quality and economic benefits.
Cherry Creek State Park Brochure Brochure for distribution to Cherry Creek State Park explaining how the fee paid by visitors goes towards water quality protection.
Annual Inspection of Pollutant Reduction Facilities Inspection of PRFs constructed by the Authority at Cherry Creek State Park to assess whether PRF's are functioning as designed and to identify routine, restorative, and rehabilitative maintenance requirements.
Fact Sheet on Authority Constructed and Maintained PRFs
Draft Feasibility Report for Cherry Creek Reservoir Destratification Recommends the installation of a submerged focused mixing system in the reservoir to destratify and strongly mix the deepest portions of the reservoir, vertically mix algae to compromise their habitat and reduce production of blue-green algae, and oxidize of the deep bottom sediments to reduce the release of nutrients from the sediments into the water column.
Work Plan A routinely updated comprehensive schedule of activities, as prescribed by Control Regulation 72 and recommended by the Watershed Plan 2003

3. DESCRIPTION OF CHERRY CREEK RESERVOIR WATERSHED

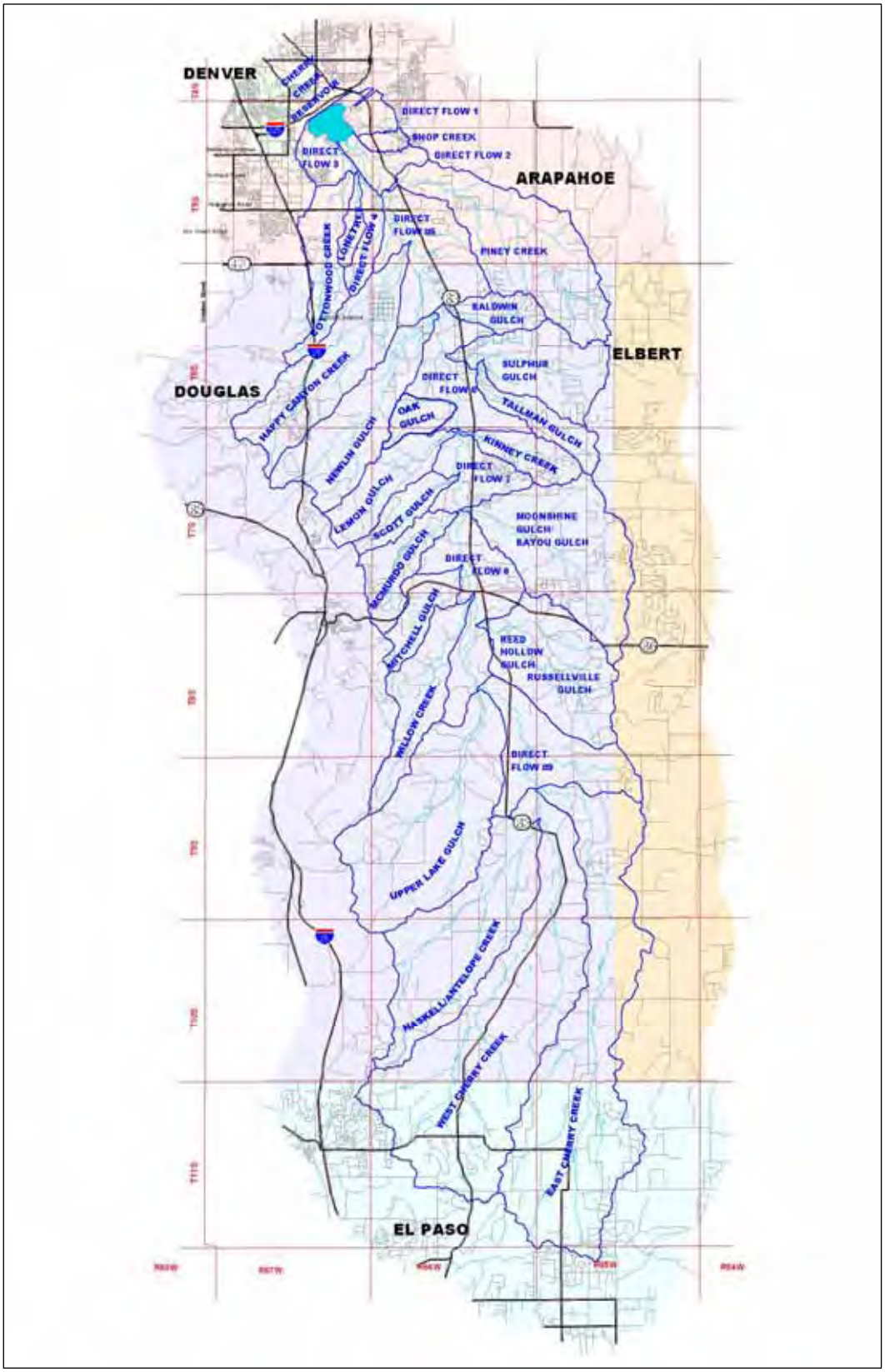
Originally built for flood control, Cherry Creek Reservoir is owned and operated by the COE. The reservoir, with a surface area of approximately 850 acres, and surrounding land was leased to the State of Colorado for use as the Cherry Creek State Recreation Area in 1957. The 3,915-acre park almost immediately received extensive recreational use, a pattern that has continued to the present day. The park had 1.59 million visits last year (2005 fiscal year), which was a 7 percent increase from the previous year. The reservoir and surrounding state park serve as an important urban recreational site, providing opportunities for a variety of activities, including sport fishing, boating, swimming, bicycling, bird watching, horseback riding, and hiking. Additionally, the state park provides important wildlife habitat.

Cherry Creek Reservoir was designed as a terminal stormwater storage facility, intended to hold runoff water that would then be discharged to maintain an acceptable downstream flow and a predetermined lake level. The reservoir, along with subsurface flows from below the dam, has maintained Cherry Creek downstream of the reservoir in a free-flowing condition. As a storage facility with regulated outflows, upstream flows have, over 40 years, accumulated sediment to depths of up to 6 meters at the outlet works with an average overall depth of almost 3 meters. The water in the reservoir undergoes chemical changes from the influences of inflows, sediments, sunlight, temperature, and wind, all of which influence algal growth.

The Cherry Creek Reservoir's watershed includes approximately 245,500 acres and 32 sub-watersheds (Figure 3-1). The northern portion of the watershed has been urbanizing over the past twenty years, especially in the sub-watersheds immediately adjacent to the reservoir. Developed land uses include high to moderate density suburban residential areas, large lot subdivisions, commercial and light industrial parks, and office buildings. Traditional agricultural and agribusiness uses are still present, but mostly in the southern upstream half of the watershed. The reservoir is currently classified for warm water aquatic life, primary recreation, water supply, and agriculture.

Photo 1 courtesy of Garv Barnhart

Figure 3-1. Cherry Creek Reservoir Watershed Map



3.1 Water Quality History and Regulations

Figure 2-2 in Section 2, entitled Summary of Authority History, provides background information on the Authority, water quality and changes in regulations. The Cherry Creek Reservoir chlorophyll *a* standard of 15 µg/L has only been met in three of the past 14 years, and the phosphorus goal of 40 µg/L has never been achieved in the past 14 years. However, the phosphorus loads have been lower than the TMAL of 14,270 pounds in 13 of the past 14 years.

Watershed Plan 2003 identifies investigations and strategies to evaluate as part of arriving at achievable goals and standards. Information from investigations and special studies, discussed in Section 8, will assist in determining how to refine the phased TMAL and identify additional control measures. In the meantime, the phased TMAL process provides a framework for the adoption of point source and nonpoint source controls that will provide protection for the reservoir.

Table 3-1 lists the current Phase I TMAL annual phosphorus allocations, per Control Regulation 72.

Table 3-1. Phase I TMAL Annual Phosphorus Allocations

Allocation Type	Total Phosphorus Pounds/Year
Nonpoint and Regulated Stormwater Sources	10,506[1]
Background Sources	1,170
Wastewater Facility Sources (Including Reserve Pool and Phosphorus Bank)	2,094
Industrial Process Wastewater Sources	50
Individual Sewage Disposal Systems	450
Total Maximum Annual Phosphorus Load	**14,270**

[1] As part of the 2004 Triennial Review Hearing for Control Regulation No. 72, the Commission eliminated the 216 pounds allocated in the Phosphorus Bank for phosphorus trading, which limited the Trading Program. The 216 phosphorus pounds originally in the Phosphorus Bank are now accounted for in the Nonpoint and Regulated Stormwater Sources.

4. WASTEWATER FACILITY CONTROLS

Wastewater and industrial process wastewater sources must have a sufficient phosphorus wasteload allocation prior to discharging in the Cherry Creek Reservoir watershed. Wastewater utilities in the Cherry Creek Reservoir watershed are also required to meet certain standards and follow procedures for the purpose of limiting phosphorus loads that can ultimately reach Cherry Creek Reservoir. Six point source dischargers within the Cherry Creek Reservoir watershed provide centralized wastewater treatment service.

4.1 Wasteload Allocation

Wastewater treatment facilities provide phosphorus removal and treatment using either secondary treatment followed by land application or advanced wastewater treatment followed by land application or direct discharge. As listed in Table 4-1, each facility is limited to an annual allocation of phosphorus pounds.

4.1.1 Monthly and Annual Loading

Reg 72 Reporting

STEPS REG 72

The Colorado Discharge Permit System permits require dischargers to monitor and quantify the concentration and total pounds of phosphorus discharged. Tables 4-1 and 4-2 present the phosphorus allocations and annual and monthly loads, respectively, for the wastewater dischargers in 2005.

Table 4-1. Cherry Creek Reservoir Watershed Point Source Allocation and 2005 Point Source Phosphorus Annual Contribution[1]

Facility	Allocation (pounds)	2005 Phosphorus (pounds)
Arapahoe County Water and Wastewater Authority/Cottonwood Water & Sanitation District[2]	402	106.6
Pinery Water and Sanitation District	304	53.8
Inverness Water and Sanitation District	129	
Parker Water and Sanitation District[3]	593	167.1
Meridian Water and Sanitation District	113	
Stonegate Village Metropolitan District	161	29.1
Plum Creek Wastewater Authority[4]	25	4.4
City of Aurora[4]	10	
Semi-Urban Areas[3,5]	141	
Industrial Process Wastewater Sources[6]	50	
Subtotal	**1,928**	
Reserve Pool	216	
Phosphorus Bank	0	
Total	**2,144**	361

[1] The 2005 phosphorus pounds are as reported to the Division in discharge monitoring reports (DMRs). Inverness and Meridian reported zero phosphorus contributions (i.e., effluent applied at agronomic rates)

[2] ACWWA has 57 pounds of conditionally approved phosphorus trade credits in addition to its 402 pound allocation.

[3] In December 2005, the Authority Board approved the Parker Water & Sanitation District Wastewater Utility Plan Amendment and an allocation from the semi-urban area of 60 pounds.

[4] In 2004, phosphorus pounds were transferred from the semi-urban area allocation to the Plum Creek Wastewater Authority and the City of Aurora for Land Applications within the Cherry Creek Watershed.

[5] Semi-urban areas are potential development areas outside the DRCOG urban growth boundary or are assigned areas not affiliated with a service provider. These areas have not been included within a designated service area assigned to existing wastewater facilities that have wasteload allocations but are designated planning areas planned for urbanization after 20 years.

[6] There are currently no industrial process wastewater sources with a wasteload allocation.

Table 4-2. 2005 Point Source Phosphorus Monthly Contribution [1]

Month	Discharges to Cherry Creek				Discharges to Lone Tree Creek
	Parker Water and Sanitation District (pounds/ month)	Pinery Water and Sanitation District (pounds/ month)	Stonegate Village Metropolitan District (pounds/ month)	Plum Creek Wastewater Authority[2] (pounds/ month)	Arapahoe County Water and Wastewater Authority (pounds/ month)
January	12.0	4.7	5.0		8.7
February	22.6	3.3	3.7		5.8
March	18.6	3.5	1.9		9.9
April	8.2	4.6	0.7		8.9
May	12.8	6.0	1.5		5.5
June	15.1	3.2	1.3		4.9
July	12..8	5.4	1.7	2.0	12.4
August	12.4	10.9	1.4	1.0	24.3
September	11.7	2.2	0.9	1.2	7.8
October	8.3	3.1	0.7	0.2	7.8
November	13.0	3.3	1.3		5.0
December	19.6	3.6	9.0		5.6
Total	**167.1**	**53.8**	**29.1**	**4.4**	**106.6**

[1] The 2005 phosphorus pounds provided are as reported to the Division.

[2] The Plum Creek Wastewater Authority discharges in the Cherry Creek Reservoir watershed are through reuse irrigation and only occur during the irrigation season.

4.1.2 Temporary Transfer and Reserve Pool Actions

Reg 72 Reporting

STEPS REG 72

Control Regulation 72 allows the temporary transfer of the unused portion of a phosphorus wasteload allocation from an existing discharger to another facility (Section 72.5(1)). Both the transferring and receiving facilities must agree upon the temporary transfer.

There were no temporary transfers or reserve pool actions in 2005.

4.2 Wastewater Permits and Limits

Reg 72 Reporting

STEPS REG 72

Control Regulation 72 requires that the Annual Report also include wastewater facility permit violations with regard to phosphorus concentration limits and annual phosphorus loads. There were no reported phosphorus permit violations in 2005.

The wastewater utilities in the Cherry Creek Reservoir watershed met the following Control Regulation 72 discharge requirements:

- By August 1, 2004 direct dischargers in the Cherry Creek Reservoir watershed must discharge phosphorus at a 30-day average effluent concentration less than 0.05 milligrams per liter (mg/L) and dischargers using land application must discharge a 30-day average phosphorus concentration less than 0.05 mg/L divided by the return flow factor.

- Where land application relies on lysimeters to determine phosphorus ground water returns, the effluent concentration prior to land application shall not exceed 1.0 mg/L total phosphorus.

4.3 Site Location Approval Review

Reg 72 Reporting

As the designated regional water quality management agency for the Cherry Creek Reservoir watershed, the Authority reviews applications for site location approval, as required by Control Regulation 72, for site location and design approval of domestic wastewater treatment works. Site location approval reviews address protection of the Cherry Creek Reservoir with respect to phosphorus, general water quality, protection of downstream water supplies, and adequacy of proposed design processes and capacity.

Applications for site location approval are reviewed to determine if the criteria in the following documents have been met:

- Cherry Creek Basin Water Quality Management Master Plan/Control Regulation 72, (Commission, December 2004)

- Emergency Response Plan Criteria for the Cherry Creek Reservoir Watershed (Authority, March 2002)

- Regulation No. 22, "Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works" (Commission, June 2004)

- Metro Vision 2020 Clean Water Plan: "Wastewater Utility Plan Guidance" (Denver Regional Council of Governments, January 2003) and "Lift Station Report Guidance and Checklist" (DRCOG, October 2000)

- Policy 96-1, "Design Criteria Considered in the Review of Wastewater Treatment Facilities" (Commission, expiration date May 31, 2007)

The Authority developed the Emergency Response Plan Criteria for the Cherry Creek Reservoir watershed to establish criteria for emergency response plans, and requires that emergency response plans are included with each application for site location approval.

In addition, the Authority performs a cursory review of the pump selection and sizing for lift stations to ensure that there were no obvious problems with the equipment proposed for the lift station. The purpose of the review is summarized as follows:

- Provide a summary and brief review of the engineering report and application for site location approval, relative to the requirements of the Authority

- Provide opinions on the thoroughness and completeness of the engineering report and application for site location approval

- Provide opinions on whether the engineering report and application meet all criteria as defined by the control regulations

DRCOG relies on completeness and thoroughness of review by the Authority for acceptance of the site location approval. The Authority reviewed three lift station applications for site location approval and two wastewater utility master plans in 2005 (Table 4-3 and 4-4). All wastewater utilities in the Cherry Creek watershed have approved Wastewater Utility Master Plans.

Table 4-3. Summary of 2005 Applications for Site Location Approval

Application for Site Location Approval	Design Features	Wastewater Service Provider
Expansion of the Lone Tree Creek Wastewater Treatment Plant	Flow – expansion from 2.4 mgd to 3.6 mgd (maximum month flow)	Arapahoe County Water and Wastewater Authority
Inverness Lift Station No. 2	Flow – 0.9 mgd, daily average Force main – 14" Onsite emergency storage - 15 hrs. at avg. flow	Arapahoe County Water and Wastewater Authority
Meridian New Lift Station G	Flow – 0.39 mgd, daily average Force main – 12" Onsite emergency storage - 3 hrs. at avg. flow	Meridian Metropolitan District

Table 4-4. Summary of Updated Wastewater Utility Master Plans in 2005

Wastewater Utility Master Plan	Description
Parker Water & Sanitation District	Amendment adds to the District's service area (Sierra Ridge, Canyons North, and Ridgegate) and identifies a new wastewater reclamation facility as part of the District's wastewater treatment system.
Pinery Water and Wastewater District	Amendment confirms the addition of the Canyons South Development to the District's service area and updates mapping of the wastewater utility service area, Clean Water Plan planning area, and urban growth boundaries.

4.3.1 Arapahoe County Water and Wastewater Authority (ACWWA)—Expansion of the Lone Tree Creek Wastewater Treatment Plant

ACWWA proposed an expansion, from 2.4 mgd to 3.6 mgd (maximum month flow), to treat increasing wastewater flows from the ACWWA service area and consolidate the Inverness Water and Sanitation District wastewater treatment plant and Lone Tree Creek Wastewater Treatment Plant.

The Authority approved the application on February 17, 2005.

4.3.2 Inverness Water and Sanitation Disrict— Lift Station No. 2

In December 2004, the Inverness Water and Sanitation District submitted an application for site location approval to construct a new lift station. Review of the plan was continued in 2005. The Inverness Water and Sanitation District proposes to construct, own, operate, and maintain the lift station and associated forcemain that will convey its wastewater to the ACWWA Lonetree Wastewater Treatment Plant for treatment.

The Authority approved the application on February 17, 2005.

4.3.3 Meridian Metropolitan District—New Lift Station G

The Meridian Metropolitan District proposed a new lift station for the Meridian International Business Park. The lift station is in the District's approved Wastewater Utility Master Plan, and the Meridian Metropolitan District will construct, own, operate, and maintain the lift station and associated forcemain and sewer mains.

The Authority approved the application on April 21, 2005.

4.3.4 Parker Water and Sanitation District—Wastewater Utility Plan Amendment

The Wastewater Utility Plan Amendment adds three areas to the Parker Water and Sanitation District's service area (Sierra Ridge, Canyons North, and Ridgegate) and identifies a new wastewater reclamation facility at Ridgegate as part of the wastewater treatment system. In conjunction with the Wastewater Utility Plan Amendment, the Parker Water and Sanitation District requested the following:

- DRCOG approve a Clean Water Plan Amendment to reflect the new wastewater reclamation facility, lift stations, and expanded service area.
- The Authority approve a 60-pound phosphorus allocation from the semi-urban wasteload allocation.

The Authority approved the Wastewater Utility Plan Amendment, and the semi-urban phosphorus allocation of 60 pounds, on December 15, 2005.

4.3.5 Pinery Water and Wastewater District—Wastewater Utility Plan Amendment

The Wastewater Utility Plan Amendment confirms the addition of the Canyons South Development to the District's service area and updates mapping of the wastewater utility service area (WUSA), Clean Water Plan (CWP) planning area, and urban growth boundaries. Review of the Wastewater Utility Plan Amendment will be continued in 2006.

4.4 Progress Made

Reg 72 Reporting

- Wastewater facility discharges did not exceed annual permitted wasteload allocations or effluent phosphorus concentrations.

STEPS
REG 72

- The Authority reviewed five and approved four applications for site location approval and wastewater utility plan amendments within the Cherry Creek Reservoir watershed for compliance with applicable regulations and guidance documents. This includes compliance with wasteload allocations and wastewater utility plans. The remaining application will be completed in 2006.

5. NONPOINT SOURCE CONTROLS

Due to the broad scope of nonpoint and regulated sources in the Cherry Creek Reservoir watershed, several programs are in place to target nonpoint source pollutant reduction. Programs include regulations for stormwater controls and long-term planning for PRF construction, discussed in this section, as well as Cherry Creek Reservoir and watershed monitoring (Section 9), and public education and outreach programs (Section 7).

5.1 Land Use Agency Implementation of Stormwater Permit Requirements

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In 1999, the National Pollutant Discharge Elimination System (NPDES) Stormwater Phase II Rule expanded the Phase I Rule to include several of the land use agencies that are part of the Authority. Prior to 2004, the City of Aurora was the only agency in the Cherry Creek Reservoir watershed covered under the Phase I Rule. Phase II permits became effective on March 10, 2003.

The Phase II Rule requires small municipal separate storm sewer systems (MS4s) to, at a minimum, adopt BMPs for six minimum control measures, implement them to the "maximum extent practicable," identify measurable goals for control measures, show an implementation schedule of activities or frequency of activities, and define the entity responsible for implementation. These requirements fit closely with the current programs in the Cherry Creek Reservoir watershed as part of Control Regulation 72. Erosion and sediment control and water quality BMP programs for each agency under the NPDES Phase II requirements are complimentary to the same programs required under Control Regulation 72. Phase II permittees in the Cherry Creek Reservoir watershed formed cooperative workgroups to coordinate Phase II compliance and identify opportunities for effective stormwater program implementation to minimize overlap and redundancies.

Reg 72 Reporting

Stormwater permit reporting information was provided to the Authority by the land use agencies on the following key elements (Table 5-1).

- Sediment and erosion control permit, inspection, and enforcement actions
- Construction BMPs inspection and enforcement actions
- Permanent BMPs construction, inspection, and maintenance actions

Detailed information on implementation for each Phase I and Phase II permittee can be found in the Stormwater Annual Reports for MS4s submitted to the Division.

Table 5-1. Summary of Cherry Creek Reservoir Watershed Permit, Inspection and Enforcement Actions

Land Use Agency	Permit Inspection Actions[1]	Permit Enforcement Actions	Other
Arapahoe County	Illicit discharges: 1 inspection Construction: 260 inspections (GESC) Post construction: 28 inspections for	Illicit discharges: 0 enforcement actions Construction: 2 stop work orders and 14 notices of non-compliance	All entities have public education and outreach programs that include, but are

Land Use Agency	Permit Inspection Actions[1]	Permit Enforcement Actions	Other
	installation of extended detention ponds with new development and 6 inspections for permanent BMP operation and maintenance	issued Post construction: no construction site or permanent BMP enforcement actions	not limited to: ▪ Coordination with other entities (Authority, Phase II Co-op workgroup, Partners, UDFCD) ▪ Distribution of issue-specific fact sheets and brochures to residents and commercial entities ▪ Participation on school programs (e.g., project WET) ▪ Educational projects such as willow planting with scout troops ▪ Web sites, hot lines, surveys, public service announcements
Douglas County	Illicit discharges: 152 Construction: 2,468 inspections (GESC) Single-family dwelling construction: 5,273 DESC inspections No complaints regarding permanent water quality BMPs	Illicit discharges: 152 response actions Level I GESC Violations (stop work orders): 42 DESC complaint visits: 2,512	
City of Aurora	Construction: 131 inspections	Construction: 10 violations	
City of Centennial	Illicit discharges: 5 inspections Construction: 102 inspections based on Erosion Control program (prior to GESC approval) Post construction: 5 inspections for installation of extended detention ponds with new development and 6 inspections for permanent BMP operation and maintenance	Illicit discharges: no enforcement actions Construction: no enforcement actions Post construction: no enforcement actions	
City of Greenwood Village	Illicit discharges: 17 inspections Construction: 4,082 inspections at 602 sites Post construction: 29 BMP inspections for final construction and 62 inspections for permanent BMP operation and maintenance:	Illicit discharges: 17 actions to identify source of discharge and require responsible party to mitigate. Construction: resolved informally with contractors. Final Construction and Permanent BMP Operation and Maintenance: no enforcement actions	
City of Lone Tree	Illicit discharges: 7 inspections Construction: 26 inspections	Illicit discharges: no notices of violation Construction: 10 minor violations, 1 major violations	
Town of Castle Rock	Illicit discharges: 7 inspections Construction: 695 inspections (GESC) and 3,862 inspections for single-family residential (DESC) Post construction: 31 inspections, 147 post-storm inspections	Illicit discharges: 1 violation issued Construction: 4 notices of non-compliance issued for single-family residential DESC	
Town of Parker	Illicit discharges: 72 inspections Construction: 1,192 inspections (GESC) Post construction: 172 inspections of detention basins	Illicit discharges: 3 notices of violation and 1 citation Construction: 1,073 non compliance notices, 3 stop work orders Post construction: 143 maintenance activities	

GESC = Grading, erosion, and sediment control; DESC = Drainage, erosion, and sediment control

[1] The land use agencies do not separately track inspection and enforcement action within the Cherry Creek Reservoir watershed. Information provided represents actions for the entire land use agency area.

5.2 Cherry Creek Reservoir Watershed Stormwater Quality Requirements

STEPS REG 72

In 2000, the Authority adopted requirements related to construction activities and post-construction control of stormwater quality in the Cherry Creek Reservoir watershed entitled the Cherry Creek Reservoir Watershed Stormwater Quality Requirements (Requirements). The purpose of the Requirements is to recommend implementation of substantive BMP measures to control the quality of stormwater runoff from land disturbances on private and public property. The Requirements are necessary to reduce and maintain nonpoint source and stormwater phosphorus loads in accordance with the TMAL set forth in Control Regulation 72. In addition, the requirements establish the minimum water quality BMPs in the reservoir watershed for all new development activities.

Land use agencies within the Cherry Creek Reservoir watershed now have NPDES Phase II stormwater permits which have requirements that meet, and in some cases, exceed the Authority Requirements. Therefore, the Authority will work with local agencies in 2006 to update the Authority Requirements.

5.3 Land Use Application Review

STEPS REG 72

The Authority serves as a referral agency in the land use application process for nine local land use agencies within the Cherry Creek Reservoir watershed. When a land use agency receives an application for land use or development, a copy is sent to the Authority for review. The Authority then has the opportunity to comment on the potential water quality impacts of the proposed application prior to construction and to determine whether the proposed project complies with the Authority's Requirements.

In March 1997, Brown and Caldwell, as consultant to the Authority, began providing review of land use and development applications on behalf of the Authority. Table 5-2 provides a review of the number of land use and development applications that the Authority has reviewed annually since March 1997.

Table 5-2. History of Land Use and Development Applications Reviewed by Authority

Year	Number of Land Use and Development Applications Reviewed by Authority
March – December 1997	103
1998	179
1999	135
2000	190
2001	144
2002	126
2003	156
2004	176
2005	**189**
Total	**1398**

In 2005, the Authority reviewed and provided comment on 189 land use and development applications. Table 5-3 provides a breakdown of the various agencies that referred land use applications to the Authority in 2005.

Table 5-3. Sources of Land Use and Development Application Referrals

Referring Agency	Number of Land Use and Development Applications Referred to Authority in 2005
Arapahoe County	19
Douglas County	49
City of Aurora	26
City of Centennial	20
City of Greenwood Village	1
Town of Castle Rock	4
Town of Foxfield	1
Town of Parker	69
Total	**189**

The Authority's review of each application focuses on nonpoint pollutant source impacts and water quality considerations related to the proposed project. Review comments generally fall into the categories listed in Table 5-4. The Authority took no exception for 76% percent of the land use applications reviewed, and did not recommend approval for 14%. In many of these cases, the Authority reserves the right for review of future submittals to determine if recommendations were incorporated.

Table 5-4. Summary of Comments on Land Use and Development Applications

Comment Category	Number of Applications	Percent of Applications
No exception	**143**	**76%**
No exception, minimum requirements are met	56	29%
No exception, provided additional recommendations	38	20%
No exception, reserve right to review subsequent submittals	39	21%
No exception, previous concerns were addressed	3	2%
No exception, project is part of larger approved project	7	4%
No approval	**27**	**14%**
No approval until BMPs requirements are met	4	2%
No approval, provided recommendations	21	11%
Insufficient materials (e.g., drainage reports referenced but not provided)	2	1%
BMP recommendations only (early in application process)	**17**	**9%**
Not in Cherry Creek Reservoir watershed	**2**	**1%**

5.4 Compliance with Cherry Creek Reservoir Watershed Stormwater Quality Requirements

The Authority's review of applications for land-use change in the Cherry Creek Reservoir watershed provides the following benefits.

1. A better understanding of where and how development is occurring in the Cherry Creek Reservoir watershed. Currently, the bulk of development is occurring in the central reservoir watershed, around the Towns of Parker and Castle Rock in several tributaries that previously were undeveloped. This pattern points to the need to focus on preventing erosion in the tributaries by stabilizing the tributary simultaneously with, if not in advance of, development. The extent to which tributary streams require stabilization will be discussed in 2006 as part of the update to Authority Stormwater Requirements (see section 5.2).

2. A better understanding of how well developers are complying with Authority Requirements and improved communication with the land-use agency personnel. Previously, some community officials were unaware of the Authority and its Requirements to protect the water quality in the Cherry Creek Reservoir watershed. Currently, the Authority's review and comments are integral to the development process and a negative response from the Authority can result in changes to the land use application.

3. An opportunity for the Authority to work more closely with developers during the initial stages of land use planning, by identifying projects where land use plans that include water quality enhancements would be more appropriate. The Authority expects to capitalize on these opportunities through the Phosphorus Facilitator program (Section 5.5).

4. The opportunity to stress the importance of meeting minimum requirements for BMPs through negative referrals, which have resulted in implementation of better water quality plans, some of which have gone beyond minimum requirements.

5.4.1 Proprietary Best Management Practices

The Authority and local land-use agencies receive requests to utilize proprietary BMPs for erosion and sedimentation control and to substitute proprietary BMPs for the Authority's minimum BMP requirement, which is extended detention basins. The Authority relies primarily on recommendations of the Urban Drainage and Flood Control District (UDFCD), provided in the Urban Storm Drainage Criteria Manual Volume 3 Best Management Practices (UDFCD 1999), when evaluating proprietary BMPs. Referrals to the Authority have been reviewed on a case-by-case basis and the Authority has approved the use of proprietary BMP in some cases, as a test-case for others, and not approved in other applications.

The Authority does not have the resources to properly evaluate all proprietary BMPs to make a specific recommendation on which units are acceptable and which are not. We rely on the design engineer and other independent agencies, such as the UDFCD to provide

guidance, justification, and recommendations. The Authority therefore, requires the applicant's engineer to evaluate various BMP units and recommend a specific unit based on the following criteria.

- Requirements of the local jurisdictions.
- The ability to remove floatables, oil/grease and phosphorus should be the primary basis for selecting a unit. The standard deviation in performance differences, as stated by the manufacturer, should be considered.
- Operation and maintenance requirements assigned to a governmental or quasi-governmental organization will be given priority over other organizations, such as home owner associations.
- Cost should not be the only or primary basis for selecting one unit over the other.

5.5 Phosphorus Facilitator

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In 2005, the Authority continued the Phosphorus Facilitator program. The role of the Phosphorus Facilitator, an independent consultant, is to investigate opportunities to improve water quality by working with developers to improve land-use plans and exceed minimum requirements for immobilization of phosphorus. The development of such plans is being accomplished through a more coordinated working relationship between a land use agency, a developer, and their planners and engineers (collectively called "development group"). The intent is to identify water quality opportunities within a parcel of land before a developer selects a land-use plan, and to encourage the developer to implement an enhanced water quality plan. The land use agency can provide various incentives to encourage developers to implement enhanced water quality plans. However, sometimes the developer recognizes the benefits of an enhanced water quality plan in terms of cost savings, greater open space, and good-will and implements the plan without local government incentives.

The Phosphorus Facilitator focused on three activities in 2005: transportation corridor requirements, low-impact development, and stakeholder education.

5.5.1 Transportation Corridor Requirements.

Transportation corridor projects require special and separate considerations due to the linear nature of the project area, which leaves little room for implementation of many BMPs. BMP requirements for transportation corridors are different than for residential and commercial development, requiring greater expertise to identify, design, and implement. There is also the question of what constitutes local standard practices for minimum BMPs within a transportation corridor, which may be different than other types of land use changes.

In 2005, the Phosphorus Facilitator researched the potential pollutant loading impact from transportation corridors and investigated BMPs that would provide treatment levels beyond the Authority's minimum requirements. The Phosphorus Facilitator met with representatives from Arapahoe and Douglas Counties, and the Town of Parker to discuss

possible demonstration projects and has begun preparation of a guidance document for transportation corridors. This effort will likely continue in 2006.

5.5.2 Low-impact Development

Low impact development (LID) to reduce pollutant loads is particularly important to the Authority. LID can reduce runoff volume at the source, which has been shown to be an effective technique for controlling pollutants.

In 2005, the Phosphorus Facilitator and the Authority worked with Arapahoe County staff to implement a LID, with plans that included depressions for individual lots to allow the minor storm to be filtered and infiltrated, rather than discharge to street gutters and storm sewers. This approach reduced runoff volume and, therefore, runoff pollutants over traditional drainage practices. By working with County staff, developers, and developer engineers, the Authority was instrumental in brokering an acceptable LID plan and agreement for operations and maintenance. The developer-initiated LID was presented an award for the project at the Stewardship Partner's annual conference on November 4, 2005.

5.5.3 Stakeholder Education

The 2004 Phosphorus Facilitator program focused on two development projects, but several other developers expressed interest in participation in the program at that time. Also, land use agencies expressed an interest in a hands-on session to obtain more detail about the process, and the potential tools that may be available to them for improving the review process or enhancing projects within the watershed.

October 5, 2005 Workshop

In 2005, the Phosphorus Facilitator and the Authority assisted with program development and participated in a half-day workshop on October 5, 2005 that focused on better site design for water quality. The Phosphorus Facilitator discussed past experiences and developer benefits from implementation of better site design practices. The Authority emphasized the need to do more than minimum requirements to protect the health of the watershed. The workshop, attended by over 90 engineers and planners, is part of the Authority's coordinated education and outreach program.

The Phosphorus Facilitator and the Authority also participated in the Cherry Creek Stewardship Partner's annual conference held on November 4, 2005.

5.6 Capital Improvement Projects

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In accordance with statutory requirements, the Authority must spend at least 60% of the annual budget on design, construction, operations, and maintenance of PRFs. To meet this requirement, the Authority conducts a multi-year, capital improvement project (CIP) planning process (currently three-year projections are made) to construct potential PRF projects. Potential PRFs are identified and evaluated, and costs are estimated over the life of design and construction for the project. The three-year projections, which are part of the Authority's annual budgeting process, are separated into design, capital, land acquisition, water augmentation requirements, and operations and maintenance costs. These costs are then spread-out over a multi-year period for longer-range planning purposes, subject to available Authority funds.

The first step in the process is development of a list of all potential PRF (called the master PRF list), which includes capital and operation and maintenance costs and potential benefits in terms of phosphorus reduction. As pollution reduction opportunities are identified during the year, they are evaluated at the conceptual level to determine costs and benefits. If a project appears to be reasonable, the TAC recommends to the Board that the project be included on the 'master PRF list'. Once the Board approves the project for inclusion on the master list, any future work towards design and construction is considered to be part of capital expenses of the Authority.

The next step is the selection of the best projects from the master list of PRFs to be included on the three-year CIP list, as listed in Table 5-5. The TAC annually evaluates the projects on the master list and forwards recommendations to the Board for inclusion on the three-year CIP. The Board then selects projects for the three-year CIP subject to available funds. The PRF projects that progressed during 2005 and those projects recommended for further consideration in 2006 are discussed below.

- Reservoir Destratification
- Cherry Creek State Parks Wetlands Reclamation
- Cherry Creek Sediment Pond at Arapahoe Road
- Cottonwood Creek Stream Reclamation, Phases II
- Projects Projected for 2007 Activity

Table 5-5. 2005 Three-Year Capital Improvement Projections

(Table 5-5 provided in separate PDF file)

5.6.1 Reservoir Destratification

Reservoir destratification employs aggressive and focused mixing of the reservoir with the goal of reducing algal growth and internal nutrient loading.

5.6.1.1 Project Purpose

The Authority has been implementing watershed-based BMPs and constructing PRFs for 16 years. However, the chlorophyll *a* standard (15 μg/l) has not been met in 10 years and the phosphorus goal (40 μg/l) has not been met in 14 years. The reservoir has an overabundance of phosphorus and algal growth is currently limited by nitrogen, and possibly iron. Despite the Authority's programs to reduce phosphorus loads from the reservoir watershed, it will likely take many years before phosphorus once again becomes the limiting nutrient and water quality benefits are seen in Cherry Creek Reservoir.

A recent special study of in-lake nutrient enrichment indicates that nitrogen is the limiting nutrient at this time and that artificially mixing Cherry Creek Reservoir could decrease the tendency for algal blooms and lower chlorophyll *a* concentrations. In addition, anoxic bottom water, typical of eutrophic conditions, occurs irregularly in summer despite the top-to-bottom mixing (polymixis) that occurs on windy days in shallow areas. When the reservoir is stratified, significant amounts of ammonia, iron, and phosphate are released to the deep water and thus to the surface waters when the lake mixes a few days or weeks later. Therefore, reservoir destratification (i.e., mixing) could provide multiple water quality benefits over a shorter period of time than relying solely on watershed measures.

5.6.1.2 Project Activity

The Authority conducted a technical feasibility investigation into in-lake management techniques that could be beneficial to reducing chlorophyll *a* and nutrient concentrations and increasing dissolved oxygen concentrations in the near term. The Authority considered destratification as a method to address internal loading and other factors that increase algal growth and therefore, chlorophyll *a*, and phosphorus and nitrogen concentrations. The consultant team recommended the installation of a submerged focused mixing system in that portion of the reservoir greater than 20 feet deep. This system will be designed to achieve the following:

1. Destratify and strongly mix the deepest portions of the reservoir
2. Vertically mix algae to compromise their habitat and reduce production of blue-green algae
3. Oxidize deep, bottom sediments to reduce the release of nutrients from the sediments into the water column

The recommended system is projected to achieve the following:

1. Reduce the releases of phosphorus and nitrogen nutrients from the bottom sediments into the reservoir in a typical year by 810 lbs/yr and 1,140 lbs/yr, respectively

2. Decrease the seasonal mean (July-September) chlorophyll *a* concentrations by approximately 8 μg/L under typical year conditions

3. Decrease annual peak chlorophyll a concentrations by up to 30 μg/L

4. Increase dissolved oxygen concentrations, in the deepest and most vulnerable zones of the reservoir, into the range of 5 mg/L

5. Reduce the production of blue-green algae by vertical mixing to make the habitat of the reservoir less suitable for the production of blue-green algae

The recommended system will accomplish these objectives without harming existing uses of the lake and will complement the continuing watershed-based control measures to reduce nutrient loadings to the reservoir. The capital costs for the recommended submerged focused aeration system are estimated to be $945,000, and the annual operation, maintenance and replacement costs are estimated to be $27,700. Based on these costs, and estimated annual phosphorus removal (810 lbs/year), this produces an equivalent phosphorus removal cost of $127 per pound of phosphorus. However, watershed management is a necessary component of the Watershed Plan 2003 and both BMPs and PRFs must be implemented along with any in-lake management techniques.

5.6.1.3 Project History

The technical feasibility report, including 35% level design, construction specifications, and cost estimate, was completed in 2005. The recommendations were presented to the TAC and Board in January 2006. The Authority will consider the recommendations to proceed with final design and construction during 2006.

5.6.2 Cherry Creek State Park Wetlands Reclamation Project

The Cherry Creek State Park Wetlands Reclamation project consists of a combination of wetlands restoration and reclamation, with some constructed wetlands, all within the Park. The general project area starts near the reservoir and extends upstream along Cherry Creek.

5.6.2.1 Project Purpose

As Cherry Creek meanders through the delta area of the reservoir, the main channel has become incised and floodplain flows have become more concentrated over time by sediment deposition in the floodplain and erosion of the channels. These changes have reduced the quality and quantity of wetlands within the delta. The purpose of the project is to restore and enhance the wetland environment. Specific strategies proposed as part of the concept are listed below.

- Provide better distribution of flows at the culvert crossings along the Park Perimeter Road so that Cherry Creek is allowed to spread over a wider floodplain area. This will redistribute Cherry Creek flows across the flood plain and will increase wetland area and functionality.

- Improve the distribution of surface flows in the existing incised reach of Cherry Creek (downstream of the Perimeter Road). This will be achieved by raising the invert of Cherry Creek and promoting more frequent overtopping of storm runoff into the adjacent floodplain, increasing treatment through bio-filtration and infiltration.

- Create impoundments within the flood plain by raising the elevation of selected trails. These impoundments would temporarily capture and detain storm flows and promote phosphorus reduction through settling, infiltration, and wetland treatment. Such improvements will balance cut and fill so that there will be no net loss in storage in the reservoir area.

- Create additional wetland treatment cells. These cells would be excavated in small open areas within and adjacent to the existing cottonwood woodlands.

The entire project, when completed, will restore about 60 acres of wetlands at a capital cost of $1,928,000 and immobilize 600 pounds of phosphorus per year, resulting in a long-term average annual cost of $280 per pound of phosphorus. The project implementation will be phased over several years to minimize impacts on the heavily used recreation area and the wetlands themselves. Design and construction of the demonstration project (approximately $90,000) is expected to be completed in 2006 with construction beginning in 2006 or 2007.

5.6.2.2 Project Activity

Design and construction of the first phase of the wetlands restoration project (demonstration project) was delayed. Because of the relatively small size of the demonstration project, the Authority determined that it was more cost effective to construct the wetlands restoration under the same contract as the Cottonwood Creek Reclamation Phase II (see below). However, Phase II of Cottonwood Creek Reclamation was also delayed, by the proposed realignment of Peoria Street and Belleview Avenue, and limited activity on the wetlands demonstration project occurred in 2005.

5.6.2.3 Project History

The concepts for the Cherry Creek State Park Wetlands project were reviewed with the Park staff. Park staff were supportive of the concept because it involved multiple, smaller projects that minimize impacts to the Park and because it focuses on restoration of wetlands, the existing land use. The Park and the Authority also recognized that smaller, focused projects could be used for education purposes through volunteer activities to supplement the projects. The Authority and the design engineer have and will continue to coordinate construction details with the Park for all phases of the project.

5.6.3 Cherry Creek Sediment Pond at Arapahoe Road

The Cherry Creek Sediment Pond at Arapahoe Road project begins upstream of Arapahoe Road and extends downstream to the confluence with Piney Creek, near the Bowtie Project, for a distance of approximately 6,000 feet.

5.6.3.1 Project Purpose

Project objectives are to design a sediment basin and stream stabilization measures that accomplish the following:

1. Minimize sediment load for base flows in Cherry Creek, and therefore, attached phosphorus, from reaching the Reservoir.

2. Minimize erosion of channel bed and banks during floods up to the 100-year flood.

3. Minimize operation and maintenance requirements while preserving long-term performance.

4. Integrates and enhances existing and proposed multiple uses along Cherry Creek.

5.6.3.2 Project Activity

In 2005, the Authority requested proposals to conduct a technical feasibility study from qualified consultants. After interviewing two consultants, the Authority approved a contract with Tetra Tech, Inc, dated November 28, 2005. Work was initiated in January 2006 and the feasibility report is expected to be completed by August 2006.

5.6.3.3 Project History

In January 2004, the UDFCD completed a master drainageway plan for Cherry Creek from Cherry Creek Reservoir to Scott Road in cooperation with Arapahoe and Douglas Counties, the Cities of Aurora and Centennial, and the Town of Parker. The Authority reviewed and recommended to the UDFCD that Alternative 5, Reclamation and Water Quality Enhancements, be selected for preliminary design. The consultant prepared the preliminary design of the project, which included a sediment basin on Cherry Creek at Arapahoe Road and stream stabilization measures in Cherry Creek.

A conceptual analysis of the phosphorus immobilized by the proposed sediment basin was conducted based on data collected by the Authority. The conceptual analysis concluded that about 3,100 tons of sediment would be trapped annually, which could include up to 2,000 pounds of phosphorus attached to the sediment. The TAC reviewed the project and recommended that a technical feasibility study be included in the 2005 CIP, which was adopted by the Authority Board in 2005.

5.6.4 Cottonwood Creek Stream Reclamation

The Cottonwood Creek Stream Reclamation project begins at the Perimeter Road, within Cherry Creek State Park, and extends about 11,600 feet upstream to the Cottonwood/Peoria Street PRF (completed in 2002).

5.6.4.1 Project Purpose

The primary purpose of the reclamation project is to reduce soil erosion of the streambed and stream banks, which contains phosphorus that makes its way into Cherry Creek Reservoir and contributes to water quality degradation in the reservoir. The project will also enhance growth of riparian vegetation, attract wildlife, and provide passive recreation opportunities, all of which are important objectives in the design approach.

Cottonwood Creek reclamation will go beyond simply stabilizing the creek in place. The concept proposes to re-create, as closely as possible, a natural, well-vegetated, functional stream system that will provide water quality, habitat, and aesthetic benefits for the Authority and the Park. Based on the Authority's experience with the Shop Creek channel, the proposed concept for Cottonwood Creek channel can reduce phosphorus loading through wetlands treatment, infiltration, and settling, in addition to immobilizing phosphorus through stream stabilization. When both phases of the Cottonwood Creek Reclamation are completed, the project is expected to cost $2,100,000 and immobilize 730 pounds of phosphorus annually, which results in an average annual cost of $330 per pound of phosphorus.

5.6.4.2 Project Activity

Substantial completion of Phase I was accomplished on May 3, 2004. Design of Phase II of the reclamation began in early 2004 by coordinating the design with the relocation by Greenwood Village of Peoria Street and the planned expansion of the shooting range on Cherry Creek State Park. Relocation of Peoria Street provided the opportunity to move Cottonwood Creek back to historic location in the valley, affecting the restoration part of the project. Expansion of the shooting range is being accommodated by relocating the main channel to the west of the range. This will reduce, but not eliminate, the flooding potential of the shooting range.

Since construction of Phase II is dependent on relocation of Peoria Street, the street relocation must be near completion before starting Phase II construction. Peoria Street relocation is projected to begin in spring 2006 such that Phase II construction can begin around winter 2006 and be completed in 2007.

5.6.4.3 Project History

The feasibility analysis was completed in January 2003 and final design for two phases of the project began in February 2003. Phase I design from Peoria Street to the confluence with Lone Tree Creek was completed and bid in December 2003. A contract was awarded for $477,299 and construction of Phase I began in late December 2003 and was substantially

complete as of May 3, 2004. Phase II design is expected to be completed in 2006 with construction beginning in late 2006 or early 2007. Phase II is projected to cost $1,400,000, which includes design, construction oversight, and construction.

The Authority has worked closely with Park staff and the Park Board to develop a concept that was acceptable to the Park. A presentation was made to the Park Board on September 18, 2003 and a public informational meeting was held on October 16, 2003, at the request of the Park Board. The Park Board officially approved the project at their November 2003 meeting contingent upon the following.

1. The shooting center plans as approved by the Park are adequately addressed by the Authority in the planning process.
2. An agreement between the Authority and the Park memorializes the ownership, function and maintenance of the project.
3. Trail planning and construction is an integral part of the project.
4. An adequate monitoring program is put in place to ensure that the project supports Park values.

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5.6.5 Projects Projected for 2006 Activity

Since the projects planned for implementation in 2006 exceed the Authority's current ability to fund in 2006, one or more projects may be phased, if possible, or be delayed until 2007 when additional funds are available for construction.

Reg 72 Reporting

5.6.6 Operations and Maintenance Activities

The Authority is required by statute and Control Regulation 72 to operate and maintain (or arrange for) all PRF constructed by the Authority. To this end, the Authority includes in its annual budget funds for operation and maintenance for specific facilities and, beginning in the 2004 budget (Table 5-5), has included a "sinking fund" in anticipation of future needs.

In 2004, the Authority began drafting an agreement with the Park for maintenance of all existing and future PRF located within Cherry Creek State Park. The agreement identifies requirements for routine and restorative maintenance activities and responsibilities between the Authority and the State. In anticipation of the agreement being signed in 2005, the first required annual inspection of PRFs located with the Park was conducted in July 2005 and recommendations were made to the Authority for consideration in the 2006 budget. Several recommended operations and maintenance activities are included in the 2006 budget. The agreement was signed on January 12, 2006.

5.7 Riparian and Wetlands Protection

Reg 72 Reporting

As described in the Section 5.6, the Authority has contributed wholly, or in part, to the construction of projects during 2005 as part of its capital improvement program that address riparian and wetlands enhancement and restoration. In addition to capital projects, the Authority's Requirements also recognize the importance of stream corridors to water quality

by placing additional restrictions on development within the stream preservation area. When a land disturbance is proposed within the stream preservation area (except for implementation of water quality facilities themselves), the Authority requires additional BMPs (above minimum requirements). These additional BMP must enhance infiltration of stormwater to protect and enhance riparian habitat.

5.8 Progress Made

The Authority has made progress in meeting the requirements of Control Regulation 72 for control of nonpoint source pollution in the following ways.

- Coordinated and assisted local land use agencies in implementing Phase II stormwater permit requirements consistent with Control Regulation 72.

- Completed the second year of the "Phosphorus Facilitator" program, to work with local developers to implement BMPs that go well beyond minimum requirements. Initial response to the program by developers and local land use agencies has been positive, and the Authority plans on continuing the program in 2006.

- Increased the local land use agencies understanding of Authority goals and requirements relative to water quality through development and distribution of education materials and by providing review comments on land-use change applications.

- Completed feasibility investigations for two additional PRF, included the projects on the master CIP list, and allocated funds for further activity during 2006. Although one of the PRFs is applied in Cherry Creek Reservoir, the Authority continues to focus on watershed BMPs and PRFs.

- Initiated a process to update the Authority's Requirements for consistency with 2004 Control Regulation 72 revisions and the land use agency stormwater quality requirements developed as part of the Phase II stormwater permits. In addition, the Authority has gained experience in implementing nonpoint source pollution controls on a watershed scale through its capital improvement program and review of land use changes. From this experience, the Authority identified a potential need to update the technical requirements outlined in the Requirements. Possible updates could include the following.

  - Address minimum stream-stabilization measures to prevent erosion and sediment transport (along with attached phosphorus) along the drainage system. Currently, minimum requirements allow some degradation of the streambed that would result in significant sediment transport. The updated criteria would place requirements that are more stringent on stream stabilization during development and would target critical sub-watersheds.

  - Evaluate the need to be more restrictive in floodplain development, such as increasing restrictions regarding encroachments into the floodplain. Exceptions could be made for roads, utilities, water quality facilities, and others. Impervious surfaces, fill, and others, if appropriate, could be expressly prohibited.

- Establish a buffer to the floodplain limits. The Town of Parker adopted an ordinance that could be used as a model, with modifications if necessary, for other agencies.

- Consider minimum BMP requirements for developments that discharge to "waters of the state" when the runoff drains to a regional stormwater quality facility, in recognition of NPDES requirements.

6. TRADING PROGRAM AND RESERVE POOL

Reg 72 Reporting

The Authority initiated the Cherry Creek Reservoir watershed phosphorus trading program in 1997. The trading program allows point source dischargers and other entities requiring a load or wasteload allocation (i.e., allocatee) to receive phosphorus pounds for new or increased phosphorus allocations in exchange for phosphorus load reductions from other sources. The Authority can also sell or lease phosphorus credits through the Reserve Pool.

The Authority received one new trade project application in 2005. Interest in trade projects continues to be strong, and a potential trade project was identified for 2006 involving Inverness Water and Sanitation District.

6.1 Trading Program

The Authority is authorized to implement and maintain a Trading Program in the Cherry Creek Reservoir watershed that allows phosphorus trading from the Phosphorus Bank. Through the Trading Program, entities in the watershed that require a load or wasteload allocation (i.e, point source dischargers, holders of wastewater reuse authorizations, entities providing land applications, industrial dischargers) can receive phosphorus pounds for new or increased phosphorus wasteload allocations from the Phosphorus Bank in exchange for phosphorus loading reductions from nonpoint source control projects that are built by the entity or third parties. These entities are also called "allocatees." Landowners, local governments, and allocatees can construct phosphorus removal projects and receive credits for their own use or to transfer to an allocatee. The goal of the Trading Program is to encourage and facilitate the construction of nonpoint source control projects.

6.1.1. Trading Program Guidelines

The Authority initiated revisions to the Trading Program Guidelines in 2005. The following summarizes substantive changes considered by the TAC in 2005. These and other changes will be discussed further in 2006.

- Reflect applicable changes made in the November 2004 Control Regulation 72 amendments.
- Separate the document into two documents: 1) Trading Program Guidelines and 2) Reserve Pool Guidelines.
- Clarify the use of "Reserve Pool" and "Phosphorus Bank"
- Remove the 216-pound cap for new trade projects
- Remove the pre-application requirement for purchase or lease of sale credits from the Reserve Pool
- For a lease of credits, require the applicant to provide a 20-year planning period for population and wastewater flow projections

6.1.2. Tracking Trades

Watershed-based trading is a successful water quality management strategy that will provide net reductions to the phosphorus TMAL, as well as provide additional environmental benefits in the Cherry Creek Reservoir watershed. Trading provides incentive for landowners, local governments, and allocatees to subsidize the design and construction of additional stormwater controls and phosphorus removal technologies, that go beyond baseline BMPs. Watershed-based trading is a water quality management strategy that promotes incentive opportunities for entities in the Cherry Creek Reservoir watershed to implement additional phosphorus removal technologies needed to achieve the Cherry Creek Reservoir TMAL, sooner than later.

An example of how trades are tracked is provided in Table 6-1, which reflects the ACWWA trade project approved in 2003. ACWWA constructed a project to remove 165 pounds, and by applying a calculated trade ratio of 2.9:1, ACWWA will receive 57 phosphorus credits. For accounting, ACWWA will receive an increased allocation of 57 pounds and the nonpoint/regulated stormwater allocation will be reduced by 114 pounds, by applying a conservative 2:1 ratio (minimum allowable trade ratio). This results in a net reduction of the TMAL.

Table 6-1. Example of Tracking Trades

Allocation Source	2004 Allocation, Lbs/Yr		Post Trade Allocation, Lbs/Yr
Nonpoint and Regulated Stormwater	10,506	-(2 x 57)→	10,392
Background	1,170		1,170
Wastewater Facilities	2,094	+ 57→	2,151
Industrial Process Wastewater	50		50
Individual Sewage Disposal Systems	450		450
Total Maximum Annual Load	**14,270**		**14,213**

Facility	2004 Allocation		Post Trade Allocation
ACWWA/Cottonwood	402	+ 57→	459
Denver Southeast Suburban	304		304
Parker Water & Sanitation District[1]	533		593
⋮	⋮		⋮
Semi-urban Areas	201		141
Subtotal	**1,878**		**1,935**
Reserve Pool	216		216
Trading Program (currently held pounds)	0		0
Total Point Source Allocation	**2,094**		**2,151**

[1] The increase in Parker Water & Sanitation District allocation reflects a 2005 transfer from the semi-urban areas allocation.

6.1.3. Trade Projects

6.1.3.1. ACWWA Pond L-3 Trade Project

The Authority approved the ACWWA Pond L-3 trade project in 2003. This trade project includes retrofitting the existing stormwater dry detention pond (Pond L-3). The retrofit includes modifying the outlet works to extend the detention time from 6 to 24 hours, increasing the sediment forebay storage, and creating a micropool at the outlet.

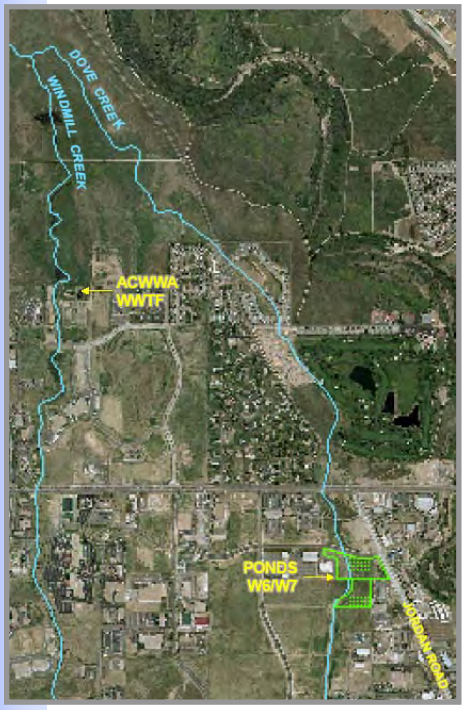
ACWWA completed construction for this project and began monitoring in 2005.

6.1.3.2. ACWWA Pond W6/W7 Trade Project Application

STEPS REG 72

The Arapahoe County Water and Wastewater Public Improvement District (ACCWPID) submitted a preapplication for phosphorus trade credits on May 26, 2005. The Authority Board referred the application to the TAC on June 16, 2005 for review.

ACCWPID requested phosphorus trading credits of 34 pounds from the Nonpoint and Regulated Stormwater phosphorus allocation through a new trade project. The requested credits are based on a trading ratio of 2.5:1. The project is an eligible new trade project as "additions to existing development." The project combines and modifies two existing stormwater, dry-detention ponds (Pond W-6 and W-7). The modifications include adding forebays, micro-pools, modified outlet works to extend the detention time to 40 hours, and adding water quality capture volume of 17.7 acre feet to treat storm runoff from a 1.2-square mile watershed.



The ACWWA Lone Tree Creek Wastewater Treatment Facility would the receive trade credits. ACCWPID requested phosphorus trade credits from development that existed prior to January 2000. Since BMPs were not constructed during the original development activities, then phosphorus removals from added BMPs are available for trading. No trade credits were requested for phosphorus reductions from development after January 2000. However, the project is expected to immobilize 50% of the phosphorus from all development, existing and future, which meets the Authority's minimum requirements.

The project was completed in October 2005 at a total project cost is $1.18 million, of which $773,000 was for construction. The Authority anticipates completing review of the trade project application in 2006.

6.2 Reserve Pool

The Authority is authorized to implement and maintain the sale or lease of phosphorus pounds from the Reserve Pool. The Reserve Pool includes 216 pounds of phosphorus credits from projects already constructed by the Authority (and approved by the Water Quality Control Commission) and can be sold by the Authority to allocatees in the watershed. The Reserve Pool phosphorus credits are based on the following historic Authority projects:

- Shop Creek detention and wetlands (1991);
- Quincy Drainage detention (1995);
- East Shade Shelter streambank improvements and parking area retrofit (1995); and
- Cottonwood Perimeter Road Pond (near Reservoir) (1997).

The 216 pounds of phosphorus allocated to the Reserve Pool are available for transfer and may be purchased or leased from the Authority at a price established by the Authority. Pounds sold or leased from the Reserve Pool are subtracted from the Reserve Pool and allocated to the entity acquiring the pounds, for long-term or short-term use.

There were no Reserve Pool actions in 2005.

6.3 Progress Made

Reg 72 Reporting

STEPS REG 72

In 2005, the Authority improved and built upon its trading program.

- Initiated revisions to the Trading Program Guidelines.
- ACWWA completed construction on the Pond L-3 trade project.
- ACWW submitted an application for a new trade project, Pond W6/W7.

7. PUBLIC EDUCATION ACTIONS AND PARTNERSHIPS

Reg 72 Reporting

STEPS REG 72

As part of the Authority's water quality management approach (Figure 2-1) and as prescribed by Control Regulation 72, the Authority is committed to providing educational programs that provide policy makers, government agencies, local land use agencies, private industry, and the general public with information and suggested actions to reduce nonpoint source pollution to Cherry Creek Reservoir.

7.1 Education Initiative

The Authority has provided manpower and funding to support the Cherry Creek Stewardship Partners (Partners) in developing a comprehensive and coordinated education strategy and action plan on a reservoir watershed scale. This plan was completed in 2004 and is entitled the Cherry Creek Basin Water Stewardship and Education Initiative (Education Initiative). The purpose of the Education Initiative is to set forth the approach recommended by the Cherry Creek Stewardship Partners and the Authority.

This document contains a compilation of the key education and public involvement goals, strategies and activities that will be used to engage the community in active stewardship of Cherry Creek, parks, open space, trails and tributaries within the watershed. In coordination with key stakeholders in the Cherry Creek watershed, the Education Initiative makes recommendations and identifies next steps for the development and implementation of a public information and education outreach program for the Cherry Creek watershed that meets the regulatory requirements of Control Regulation 72 and the objectives identified in the Cherry Creek Basin Watershed Plan 2003.

7.1.1 Cherry Creek Stewardship Partners

The Partners is an association of a broad range of stakeholders actively promoting effective stewardship and providing education and outreach activities in the Cherry Creek Reservoir watershed. The Partners emerged from the first Cherry Creek Reservoir watershed forum held in the fall of 1999. The Partners bring together representatives from land use jurisdictions, state and federal resource management agencies, conservation, recreation, and historic preservation groups, the business community, and interested citizens.

In 2005, the Authority provided $18,500 to the Partners to help implement priority activities identified in the Education Initiative. In addition to organizing and sponsoring a wide variety of activities in the Cherry Creek Reservoir watershed that support water quality goals, the Partners are frequently asked to help identify, plan, and support open space projects such as restoration of riparian areas along Cherry Creek at the Cherry Creek Valley Ecological Park, restoration support for the Cottonwood Creek PRF, and projects that provide a positive and fun spin on our watershed's recreational opportunities, such as the 2005 "Run for the Watershed" Relay Race. These projects take much time and effort in planning, coordination and successful completion. The Partners presence in these watershed activities and technical projects has expanded greatly in the last couple of years. The Partners enable watershed entities, such as stormwater permittees, Cherry Creek State Park, and the

Authority to more efficiently implement collaborative education and outreach activities. The following provides a summary of the Partners 2005 outreach accomplishments.

Activities Enabling Participants to Get to Know the Watershed

- Prairie Canyon Ranch Volunteer Work Day–April 16, 2005
- Cherry Creek Valley Ecological Park Volunteer Work Day–July 30, 2005
- Cottonwood Creek Restoration Volunteer Work Day–September 17, 2005
- 1st Annual 'Run for the Watershed'–September 24, 2005

School and Teacher Education and Training

- Metro Regional Science Fair Judging–February 28, 2005
- Front Range Earth Force Environmental Education Training–August 1, 2005
- Project WET Training–October 8, 2005
- Colorado Science Teachers' Convention Presenter–November 17-18, 2005
- West Middle School–Get to Know Your Watershed–November 2005
- County and Regional Science Fair Participation
- Science Teacher and School Awards Criteria Development

Integrating Watershed Interests

- Hosted State Weed Network Meeting - January 25, 2005
- Organized 5-hour Training for Land Use and Development Professionals – October 5, 2005
- Partners' Stakeholder Presentations
  - Douglas County Planning Commission – February, 2005
  - Arapahoe County Homeowners – March, 2005
  - Colorado Association of Conservation Districts – April, 2005
  - Colorado Watershed Assembly – September, 2005
- Leverage resources, which includes solidifying funding base through ongoing contributions from Member Partners, the WQCD, and significant in-kind support
- Hosted strategy planning sessions for possible development of Water Education Center

7.1.1.1. Seventh Annual Cherry Creek Stewardship Partners Conference

The Authority, which is an active member of the Partners, contributed funding for the Partners 7th annual conference held on November 4, 2005 at the DoubleTree Inn Conference Center in Aurora, Colorado. The conference theme for 2005 was "Building Community, Enhancing Ecology, and Celebrating Legacy." Numerous TAC members have

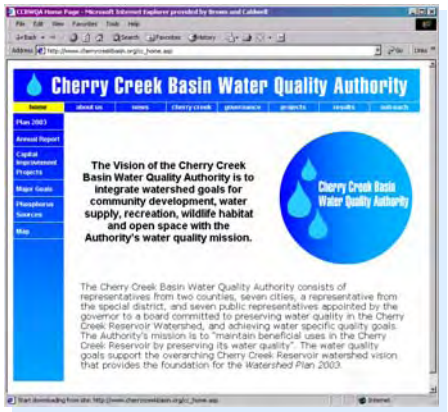
lead roles in planning and coordination of the conference and participated in the conference as session moderators, and four Authority consultants made seven of the 18 session presentations on Authority activities including, the Phosphorus Broker and roadway BMPs, the trading program, a progress report on Authority PRFs, and low impact development.

7.1.1.2. Brochure – Water Quality Protection at Cherry Creek State Park

The Partners designed and printed an educational brochure that discusses the issue of phosphorus in the Cherry Creek Reservoir watershed and the role of the Authority. This brochure is being distributed to Park visitors, as well as other interested individuals and groups, and provides information on the basis for Park fees how the Authority puts that money towards constructing water pollutant reductions facilities.

7.2 Website

The Partners maintained the Authority website, which provides information and education on water quality issues within Cherry Creek Reservoir watershed and also serves as a storehouse of documents generated by and related to the Authority. The website can be found at http://www.cherrycreekbasin.org/cc_home.asp.



7.3 Collaboration with Other Entities

The Authority has built relationships with several entities to carry out water quality objectives.

7.3.1 Projects with Direct Impact to Cherry Creek State Park

Though most of the land adjacent to the Park is developed, there are still locations where storm runoff from new development can be a threat to the State Park environment. In addition, local jurisdictions often make improvements to the infrastructure, particularly the roadways that surround the Park. Finally, activities within the Park are also of interest to the Authority when they may impact water quality. Improvements or incidents within the Park boundaries can impact water quality in Cherry Creek Reservoir, if not properly managed.

During 2005, the Authority worked directly with the Park staff and local jurisdictions on the following projects or incidences:

- Parker/Quincy interchange improvements in the City of Aurora
- Volunteer Lead Management Plan
- Clean Water Act Section 404 permit violation that had potential to impact the Park

The City of Aurora and the Colorado Department of Transportation (CDOT) have agreed to investigate proprietary BMPs to reduce sediment and trash entering the Park, as part of the Parker Road upgrade at Quincy Avenue. Aurora and CDOT have agreed to install below ground treatment systems to collect coarse sediment, debris and floatable in the storm sewer system, preventing them from entering the Park.

The Colorado Division of State Parks implemented a volunteer lead management plan at the Family Shooting Center at the Park. The Authority provided review comments and suggestions on the plan, which were incorporated in the clean up of the lead at the pistol and rifle range.

The Long Meadows Estates development in the City of Greenwood Village received a notice of violation of the Clean Water Act for failure to obtain a Section 404 permit. Storm runoff from the project drains directly onto the west end of the Park. The violation notice resulted in a stop-work order that left the site in a highly disturbed state, which could result in severe erosion and sedimentation on the Park. The Authority worked with the Corps of Engineers regulatory branch to develop an erosion control plan to protect the Park while the project was modified to mitigate for wetland impacts. The action was completed in 2005 and there were no reports of problems on the Park as the result of the project or corrective actions.

7.3.2 Land Use Agencies

The Authority continues to work directly with the nine local land use agencies in the Cherry Creek Reservoir watershed through activities such as the following.

- TAC routine monthly meetings and subcommittees to scope and coordinate special projects (e.g., Stormwater Quality Requirements revisions).
- Review of land use and development applications for compliance with Authority's Requirements (Section 5.2).

- Participation in and review of outfall system and major drainageway systems planning studies conducted in conjunction with UDFCD. In 2003, the Authority was part of the review committee for the Cherry Creek Corridor – Reservoir to Scott Road, Major Drainageway Planning Study. One of the Authority's capital projects initiated in 2005 (Sediment Pond at Arapahoe Road, see Section 5) was obtained from the Preliminary design report.

7.4 Tours of PRFs at Cherry Creek State Park

The Authority and the Park staff continue to conduct tours for various groups to discuss the pollution reduction facilities constructed to manage urban storm runoff. The program typically starts out with a brief overview of the watershed, the Park and the role of the Authority in managing water quality in the watershed. Then a walking/bus tour is conducted to one or more PRFs to discuss the aspects and benefits of the PRF.

7.5 Progress Made

The Authority made progress in meeting the requirements of Control Regulation 72 for implementing public information and education programs in the following ways.

- Leveraged resources by supporting the Partners and coordinating with other entities to implement the Education Initiative, a comprehensive and coordinated education strategy and action plan.

- Continued distribution of the BMP Series educational fact sheets to increase awareness of water quality BMPs and the Authority's role and efforts in improving water quality, specifically related to the land use and development process within the Cherry Creek Reservoir watershed.

- Continuation of the Authority's website through cooperation with the Partners to facilitate the dissemination of information to parties interested in the Authority's activities.

- Collaborated on information and education efforts with other entities with common interests and goals for the watershed.

8. PHASED TMAL ACTIVITIES

The Commission adopted Control Regulation 72 as a phased TMAL to provide for the implementation of point and nonpoint source requirements and controls while concurrent required investigations are implemented "to better define hydrology, phosphorus sources, chemical processes, and relative loads to the watershed and reservoir" (Commission, 2004). The Commission recognized "that until additional investigations are completed, a new TMAL cannot be calculated."

Control Regulation 72 identifies 13 specific activities to provide reasonable progress in attaining water quality standards and support revisions to the TMAL. Table 8-1 provides a description and status of these activities and other studies that have since been identified. The Authority and the Division completed one study in 2005 and contracting for three additional studies was initiated in 2005.

Reg 72 Reporting

Table 8-1. Updated List of Activities and Proposed Priorities

Proposed Priority	Special Study	Description/Purpose	Status
1	Evaluation of phosphorus removal effectiveness of nonpoint source control	Evaluate the infiltration component of various detention/retention BMP to determine the infiltration contribution to phosphorus loading in the watershed. Results used to estimate performance of BMP to predict impacts of future growth and controls on phosphorus loads by the watershed model.	**2005** - Authority selected a consultant and began contracting. The study will be conducted in 2006.
2	Depth profiling of nutrient content for ground water	Conduct alluvial sampling at various depths to determine phosphorus concentration variation with depth of alluvium.	**2005** - Authority selected a consultant and began contracting. The study will be conducted in 2006.
3	Further quantification of soil and groundwater background phosphorous levels	Characterization of Cherry Creek water quality based on limited human influences (i.e., natural, background conditions). The results would be used to establish background as part of the TMAL source load.	**2005** - Authority selected a consultant and began contracting. The study will be conducted in 2006.
4	Further development of event mean concentrations (EMCs) for storm water flows	Characterization of storm runoff quality based on monitoring runoff of various land-uses in the Cherry Creek watershed. Event mean concentrations are used in the watershed model to predict impacts of future growth and controls on phosphorus loads.	**2005** - After discussions between the Authority and Division, the Division supported narrowing the study requirements to focus on a site-specific EMC for undeveloped land.
5	Monitoring of shallow alluvial ground water loading in tributaries	Nature of the study undetermined at this time. Purpose is to better understand fate and transport of phosphorus for the watershed model and ultimately for determining TMAL allocations.	Lower priority level as determined by Division and Authority.

Proposed Priority	Special Study	Description/Purpose	Status
6	Quantification of individual sewage disposal system phosphorus loading.	Nature of the study undetermined at this time. Purpose is to better understand fate and transport of phosphorus for the watershed model and ultimately for determining TMAL allocations.	Lower priority level as determined by Division and Authority.
7	Characterization of watershed hydrology to establish reference condition for evaluation of phosphorus loading	Develop specific set of hydrologic conditions to represent an index hydrological year such that annual phosphorus loads can be referenced to this index. Results used to adjust the TMAL for wet and dry runoff conditions.	Results of ongoing update of watershed model to provide insight to this special study.
8	Revised calculations of background sources, industrial process wastewater sources, and individual sewage disposal systems sources of phosphorus contributions	Complete special studies and revise the watershed model to identify these point and nonpoint source components of the TMAL.	*Requires the completion of other special studies and activities.*
9	Reservoir study on groundwater inflow	Evaluate groundwater flow and phosphorus flux into the reservoir. This study is not required by the Control Regulation, but the Division identified this as a high priority.	**2005 - Completed on February 9.**
10	Reservoir nutrient studies	Determine the concentration of phosphorus in the Reservoir necessary to suppress the growth of algae by a field study of nutrient limitations.	Completed January 22, 2004
11	Implementation of lower phosphorus effluent limits	No direct discharge with an effluent total phosphorus concentration greater than 0.05 mg/L as a 30-day average and no land application discharge of a 30-day flow-weighted average total phosphorus concentration greater than 0.05 mg/L/land application return flow factor.	Completed August 1, 2004
12	Identify industrial process wastewater sources and associated phosphorous loading	Investigate existing industrial process type land uses to estimate contribution to phosphorus loading in Cherry Creek and to establish limits for the TMAL.	In 2003, the Authority confirmed there were no permitted industrial sources with phosphorus allocation.
13	Construct nonpoint source control projects	The Authority plans and implements a capital improvement program on a continuous basis.	Completed and ongoing

8.1 Groundwater Phosphorus Loading to Reservoir

STEPS REG 72

Under management of the Division, the Authority funded a study to estimate the groundwater inflow rate and phosphorus flux through reservoir seepage sampling. The study was completed in February 2005 as part of a Colorado Nonpoint Source Program Grant.

The study concluded that annual seepage to the reservoir is approximately 2,200 acre-feet/year and the associated phosphorus loading from seepage is about 1,170 lbs/year. The seepage load is about 8% of the TMAL. Because inorganic nitrogen passing through the groundwater system shows loss of nitrogen through denitrification, the seepage water contributes to a bias in the nitrogen to phosphorus ratio favoring phosphorus. This is part of the explanation for the low nitrogen to phosphorus ratio, which favors the development of nitrogen-fixing bluegreen algae.

8.2 Further Development of Event Mean Concentrations for Storm Water Flows

STEPS REG 72

In 2005, the Authority initiated a process to request eliminating or reprioritizing this EMC special study. Initially, the Authority presented, to the Division, technical arguments in support of modifying the special study, based on a literature review and discussions with experts in stormwater pollutant characterization. The Authority recommended 1) using the UDFCD reported phosphorus EMCs for different land uses in the revisions to the Cherry Creek Reservoir watershed model to predict phosphorus loads and 2) eliminating the EMC study. In response, the Division felt that there was a shortage of data for undeveloped areas and recommended maintaining the EMC study but with a narrower scope that focuses on a site-specific EMC for undeveloped land. The Division also provided an analysis of other EMC data in and around the watershed, which resulted in the Division recommending EMC values for the updated watershed model.

8.3 Three Special Studies Funded by the "TMAL Actions" Grant

STEPS REG 72

The Authority was awarded a Colorado Nonpoint Source Grant to conduct the following three implementation actions, or special studies, required for the Cherry Creek Reservoir phased TMAL.

1. Conduct depth profiling of phosphorus concentrations in the Cherry Creek alluvium.
2. Quantify phosphorus infiltration to the alluvium from pollutant reduction facilities.
3. Determine background phosphorus levels in alluvial soils, groundwater, and surface water for the revised TMAL.

The objectives of the grant project focus on fate and transport of phosphorus through the Cherry Creek Reservoir watershed, including soil-phosphorus equilibrium, confirming effectiveness of BMPs, and defining background phosphorus.

The Authority received final contracts for the grant funding on August 18, 2005. The Authority subsequently issued a Request for Proposal and consultant selection process for the three studies and began contracting with selected consultants in December 2005 and January 2006. The three studies will begin in early 2006.

8.4 Watershed Model Update

STEPS
REG 72

The Authority convened a TAC subcommittee in July 2004 to develop agreement on refining the Authority's watershed model and better define the change in water quantity and phosphorus, as it moves from the point of origin in the watershed to Cherry Creek Reservoir (i.e., fate and transport). The subcommittee developed the following working definition for fate and transport:

> *The change in water quantity and quality as it moves from the point of origin in the watershed to Cherry Creek Reservoir.*

The Authority identified the need to better define phosphorus fate and transport for evaluating watershed trade projects, identifying the most effective BMPs, providing input to the reservoir model for refining source loads and allocations as part of the refined TMAL.

The subcommittee determined that refining the existing watershed model, which predicts phosphorus loads and runoff volumes, was the best way to address fate and transport and to answer the questions regarding additional special studies. The goal of the watershed model is to provide at least seasonal, if not monthly, runoff volume and phosphorus loads to Cherry Creek Reservoir that better estimate:

- Annual phosphorus loads and runoff volumes for land-use conditions in the Cherry Creek Reservoir watershed.
- Effective annual phosphorus load reductions for watershed-based BMPs and individual PRFs. This knowledge will help identify, evaluate and prioritize BMPs and PRFs in the watershed.
- Effects of pumping and point source discharges and phosphorus attenuation within the Cherry Creek alluvium. This information will help evaluate impacts of alluvial pumping and control of point and nonpoint source discharge concentrations on phosphorus loads into the reservoir.
- Potential benefits from phosphorus trades between point and nonpoint source projects.

In 2005, the Authority began updating and recalibrating the watershed spreadsheet model, which included the following primary activities:

- Defining the test reach between the Franktown and Parker gages - 13 miles of Cherry Creek, 172 subbasins, 61 Tributary reaches, and 26 mainstem reaches
- Data collection

- Defining the water balance and associated algorithms
  - Precipitation and runoff
  - Franktown input
  - Infiltration
  - Bank storage
  - Evapotranspiration loss
  - Pumping
  - Wastewater discharges
  - Return flows
  - Surface flow
  - Alluvial flow

- Integrating review and input from a review committee, which includes four consultants that are familiar with the watershed data and conditions and a representative from the Division
- Calibrating the water balance and identifying additional information needs
- Initiate the phosphorus load balance, which will be further refined in 2006

In 2006, the phosphorus load balance for the test reach will be completed and the model will be extended for the remainder of the watershed.

8.5 Planning Progress for 2007 Triennial Review

To begin preparing for the 2007 triennial review for Control Regulation 72, the Authority will need to update the existing reservoir model as part of reevaluating the target reservoir phosphorus load (i.e., TMAL). The reservoir model update will include incorporating the past five years of data and multiple study results to re-evaluate long-term trends, nutrient and chlorophyll *a* relationships, test the scenario model, and calculate permissible load for revising the TMAL. The Authority has expanded its 2005 work plan to include planned activities for 2006 and 2007. In 2006, the Authority has budgeted to update the existing reservoir model and TMAL, evaluate revising phosphorus source load estimates, and prepare for the 2006 information hearing and 2007 triennial review hearing.

8.6 Progress Made

Reg 72 Reporting

STEPS REG 72

The Authority has continued to develop and implement point and nonpoint source controls and has worked with the Division to complete one more, and make progress on four, required investigations for the phased TMAL.

- Under the management of the Division, the Authority completed a required special study that estimated the groundwater inflow rate and phosphorus flux through reservoir seepage.
- Worked with the Division to come to agreement on a significantly reduced scope for the EMC special study.

- Finalized grant contracting and completed consultant selection for three special studies required as part of the phased TMAL. These studies will be conducted in 2006.
- The Authority made significant progress on determining how to address the question of phosphorus fate and transport in the watershed through the watershed model update.

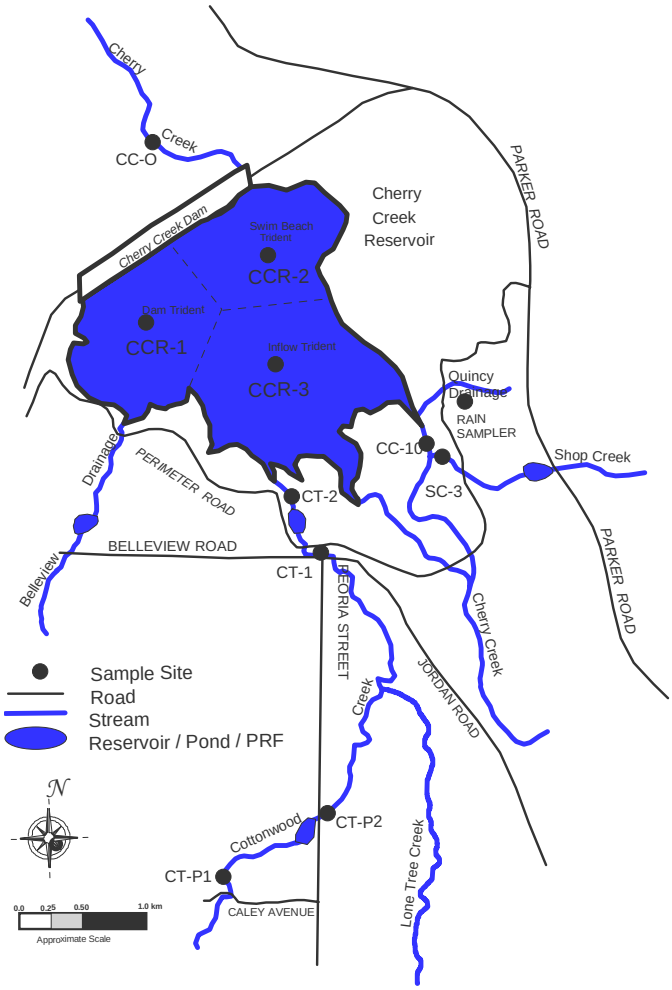
9. WATER QUALITY MONITORING – POINT SOURCE AND NONPOINT SOURCE LOADS

Reg 72 Reporting

The Authority continued to implement a routine annual water quality monitoring program in the Cherry Creek Reservoir and basin. The program monitors reservoir water quality, reservoir inflow and loading, surface and groundwater quality in the watershed, and effectiveness of Authority PRFs.

STEPS REG 72

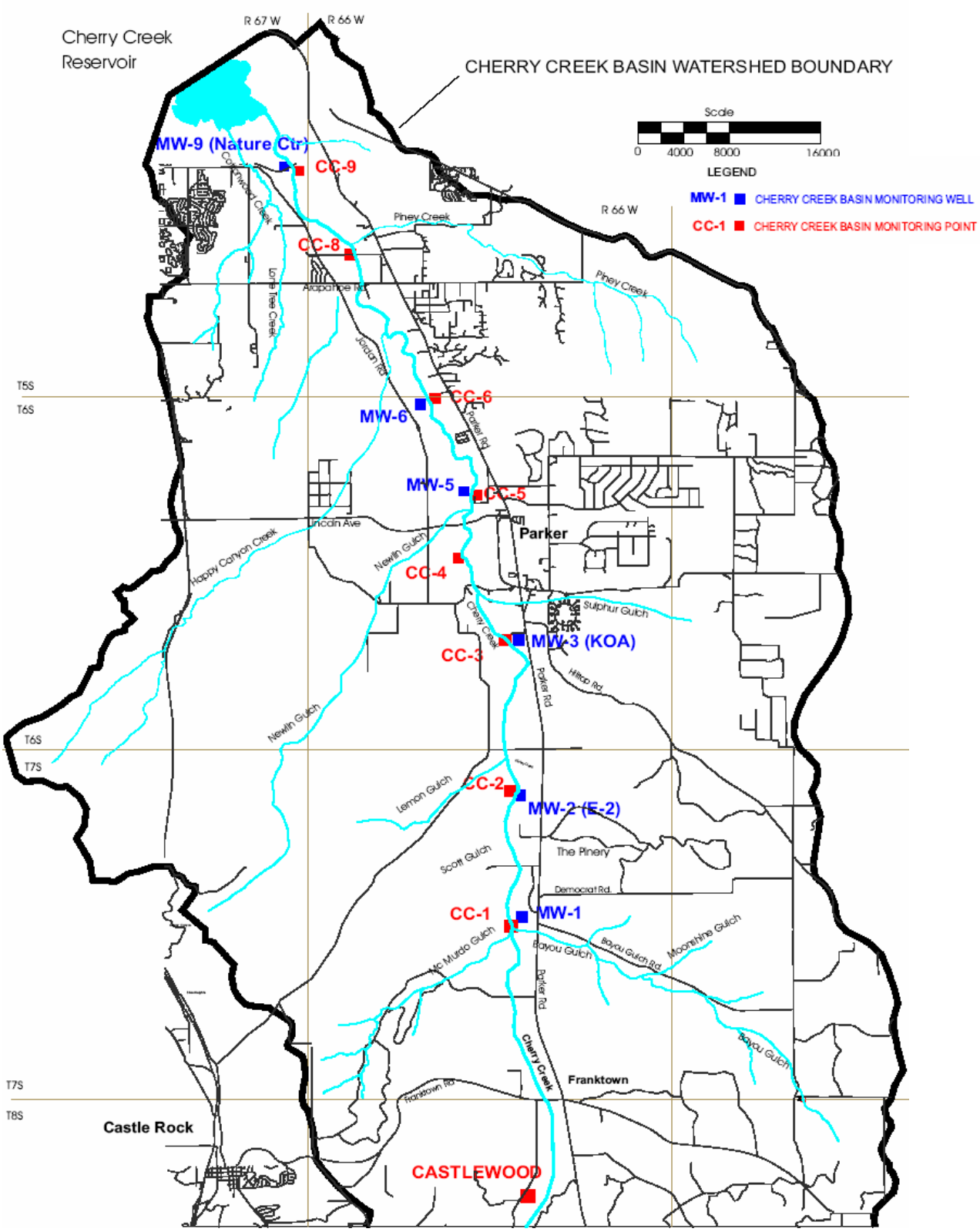
Figure 9-1. Sampling Sites on Cherry Creek Reservoir and Selected Streams



The Authority conducted reservoir and tributary sampling at ten sites in 2005, including three sites in Cherry Creek Reservoir, six sites on tributary streams, and one site on Cherry Creek downstream of the reservoir (Figure 9-1). The Authority conducts sampling at sites upstream and downstream of the Cottonwood Creek-Peoria Pond and the Cottonwood Creek Perimeter Pond to evaluate the effectiveness of these PRFs.

Watershed monitoring includes an additional nine surface water sites along Cherry Creek, from Castlewood Canyon to Cherry Creek Reservoir and nine alluvial ground water well locations from Franktown to Cherry Creek Reservoir (Figure 9-2). Complete data reports are provided in the Cherry Creek Reservoir 2005 Annual Aquatic Biological-Nutrient Monitoring Study and Cottonwood Creek Phosphorus Reduction Facility Monitoring Report prepared by Chadwick Ecological Consultants Inc. (2005 Annual Monitoring Report.), and the 2005 Water Quality Data Report – Baseline Water Quality Data for the Upper Cherry Creek Basin prepared by John C. Halepaska and Associates, Inc.

Figure 9-2. Surface Water and Alluvial Ground Water Sampling Sites in the Watershed



9.1 Summary of Long-term Cherry Creek Reservoir Water Quality

Presented below is a summary of water quality in Cherry Creek Reservoir as determined by various constituents. This summary is based on the past fourteen to nineteen years of monitoring, as presented in the 2005 Annual Monitoring Report. Data are untransformed and generally represent whole-lake mean values with estimates of variation. However, data used in statistical analyses may be transformed depending upon the distributional characteristics of the data. If the transformation did not improve normality, the untransformed data were used in subsequent analyses.

9.1.1. Chlorophyll *a*

- Analysis of Variance indicates significant differences ($p<0.05$) among the summer mean chlorophyll *a* levels from 1999 to 2005, with the 1999 summer mean chlorophyll *a* values being greater than the more recent years of 2002, 2004, and 2005. Since 1999, there has been a significant decreasing trend in summer mean chlorophyll *a* concentrations.

- The reservoir did not meet the chlorophyll *a* standard (15 µg/L July-September) in 2005 and has only met the standard in three of the last fourteen years and not since 1995.

- The 2005 summer mean chlorophyll *a* concentration (17.1 µg/L) was the lowest value observed in past 10 years (Table 9-1).

Table 9-1. Water quality and total phosphorus loads data for Cherry Creek Reservoir, July – September 1992 – 2005

Year	Chlorophyll a (µg/L)	Total Phosphorus (µg/L)	Total Nitrogen (µg/L)	Annual Phosphorus Load (lbs/yr) [1]	Annual Inflow (ac/ft) [1]	Standardized Phosphorus Lead (lbs/ac-ft)	Net Phosphorus Load (lbs/yr) [2]
1992	17	66	970	**5,857**	7,474	0.78	4,543
1993	**14.4**	62	826	**4,110**	5,905	0.70	3,399
1994	**10**	59	1,144	**4,049**	7,001	0.58	3,056
1995	**9.4**	48	913	**7,972**	11,781	0.68	5,923
1996	20.5	62	944	**4,715**	7,644	0.62	3,723
1997	22.3	96	1,120	**5,761**	10,362	0.56	4,765
1998	26.5	89	880	**13,577**	20,903	0.65	9,370
1999	28.9	81	753	17,471	27,739	0.63	7,821
2000	25.2	81	802	**12,593**	18,610	0.68	8,905
2001	26.1	87	757	**9,837**	17,250	0.57	4,995
2002	18.8	74	858	**4,246**	7,498	0.57	2,745
2003	25.8	90	1,121	**8,568**	14,929	0.57	3,590
2004	18.4	102	977	**12,512**	17,177	0.73	7,007
2005	17.1	116	990	**10,047**	18,534	0.54	6,378
Mean	20.0	80	933	8,665	13,772	0.63	5,444
Median	19.7	81	929	8,270	13,355	0.63	4,880

[1] The total load to the reservoir from stream, alluvium, and precipitation. The COE monitors inflow as a function of change in storage (i.e., reservoir volume) based on changes in reservoir level, measured outflow, precipitation, and evaporation.
[2] The net phosphorus load is the total load to the reservoir minus the reservoir outflow load.
Bold indicates value meets the respective standard, goal, or TMAL value.

9.1.2. Phosphorus

- Analysis of Variance indicates significant differences among the summer mean total phosphorus concentrations ($p < 0.001$) between 1999 and 2005, with the summer of 2005 exhibiting the highest mean total phosphorus concentrations since routine monitoring began. Since 1987, there has been a significant increasing trend in the reservoir summer mean concentration of total phosphorus.

- The summer mean total phosphorus concentration in 2005 was 116 µg/L and greatly exceeded the seasonal phosphorus goal of 40 µg/L. Cherry Creek reservoir has exceeded the current seasonal goal in all years since 1989.

9.1.3. Nitrogen

- Since 1987, the total nitrogen record has been discontinuous, with the period between 1999 to 2005 representing the most complete record. Analysis of Variance indicates significant differences among the annual means between 1999 and 2005. Since 1999, there has been a significant increasing trend in the summer mean nitrogen levels, with the 2005 level (0.99 mg/L) being the second highest recorded summer mean value.

9.1.4. Transparency

- Lake transparency values (as measured by Secchi depth) in 2005 ranged between 0.68 and 1.45 m during the summer and were approximately 13% deeper than in 2004, and approximately 4% deeper than the mean Secchi depth between 1997 and 2005. [*Note: A Secchi disk is lowered into the water to measure transparency or clarity of the water. The Secchi depth is the depth at which the disk is no longer visible from the surface.*]

9.1.5. Temperature and Dissolved Oxygen

- Periodic thermal stratification was observed in the reservoir in 2005. During periods of stratification, the lower layers of the reservoir experienced depressed dissolved oxygen concentrations (e.g., <5 mg/L). Lower dissolved oxygen was also occasionally observed when the lake was not thermally stratified.

9.1.6. Phosphorus Loading

Reg 72 Reporting

- The 2005 total external phosphorus load (10,047 pounds) was below the phased TMAL (14,270 pounds).

- Annual total phosphorus loads have averaged 8,665 pounds/year over the past fourteen years (Table 9-1), meeting the phased TMAL of 14,270 pounds each year, except for 1999. The exceedance of the phased TMAL in 1999 (referred to as a TMDL prior to May 2001) appeared to be related to substantially increased inflows (Table 9-1).

- Inflow (18,534 ac/ft) and phosphorus load (10,047 lbs) were above the fourteen-year mean values in 2005.

9.2 Cherry Creek Reservoir - Summary of 2005 Data

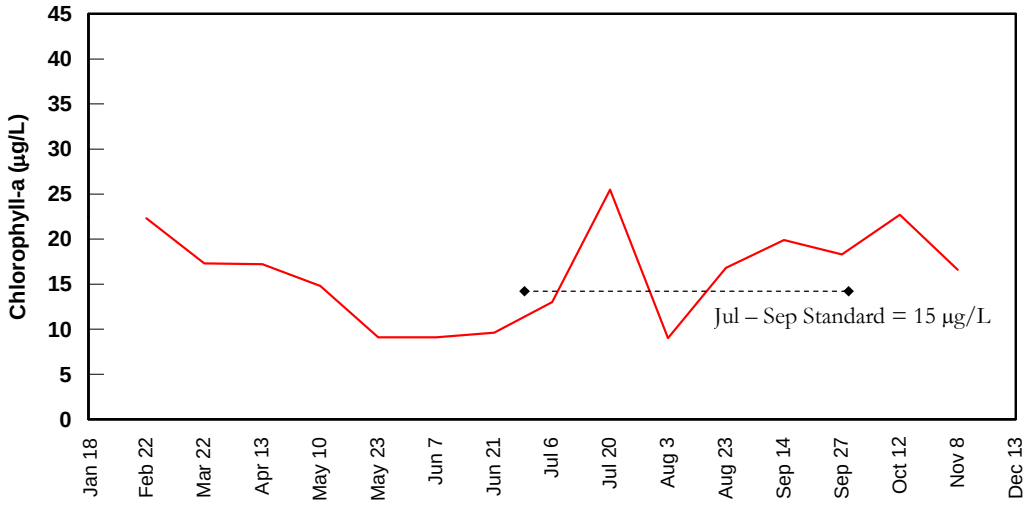
Presented below is a summary of 2005 water quality data for various constituents. This information is also summarized in the 2005 Annual Monitoring Report.

9.2.1. Chlorophyll *a*

Reg 72 Reporting

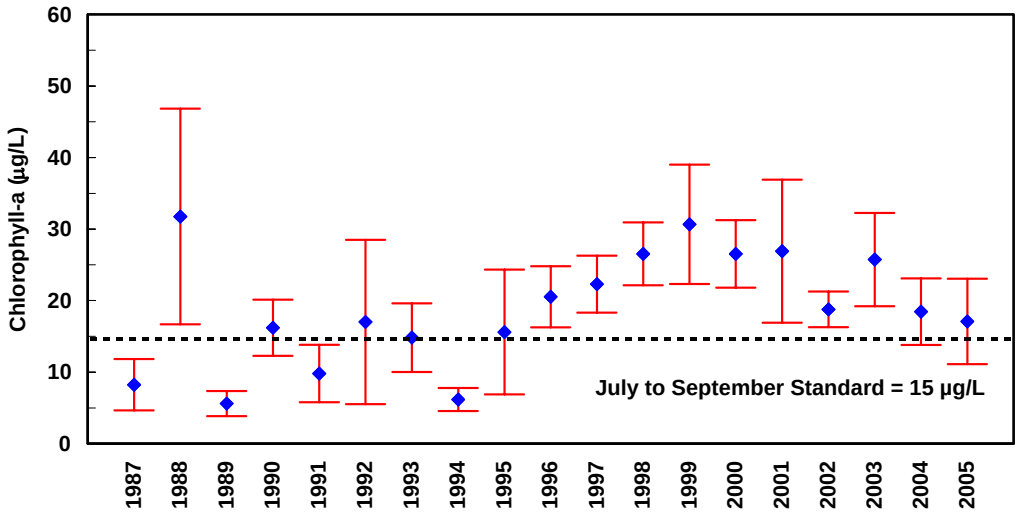
The annual pattern of chlorophyll *a* concentrations revealed relatively low concentrations (9.0-9.6 µg/L) of chlorophyll *a* in late May, June and early August, with peak levels (22.3-25.5 µg/L) occurring in late February, early July, and October (Figure 9-3). The annual mean chlorophyll *a* concentration of 16.1 µg/L is similar to the 2004 value and is the lowest value since 1997. The July-September mean chlorophyll *a* concentration was 17.1 µg/L, and exceeded the goal of 15 µg/L for the reservoir.

Figure 9-3. Concentration of Chlorophyll *a* (µg/L) in Cherry Creek Reservoir, 2005



July to September mean chlorophyll *a* concentrations have met the standard of 15 µg/L only five out of the past 19 years, and not since 1995. Since 1987, there has been no significant trend, in the July to September mean concentration of chlorophyll *a* in Cherry Creek Reservoir (Figure 9-4).

Figure 9-4. Seasonal Mean (July to September) Chlorophyll a Concentrations Measured in Cherry Creek Reservoir, 1987 to 2005



Note: Error bars represent a 95% confidence interval around each mean

In any long-term database, consistency in data analysis (i.e., analytical chemistry) is paramount, especially when evaluating long-term trends. Differences in methodologies or analytical laboratories may bias the data, which hinders the evaluation of potential trends. This is particularly evident in the total phosphorus and chlorophyll *a* database for Cherry Creek Reservoir. This database represents a variety of data produced by different analytical laboratories, and while the same standard method may have been utilized, subtle differences are apparent in the database. Over the long-term period, analytical method detection limits varied and the precision of the analyses appears to have increased with time. During the late 1990's, a transition from Metro Wastewater analytical services to Chadwick Ecological Consultants occurred, with the period between 1999 and 2005 representing the most consistent data processing methodologies. Therefore, Chadwick Ecological Consultants also evaluated trends in the data between 1999 and 2005.

Analysis of Variance indicates significant differences ($p<0.05$) among the reservoir summer mean chlorophyll *a* levels from 1999 to 2005, with the 1999 summer mean chlorophyll *a* values being greater than the more recent years of 2002, 2004, and 2005. Since 1999, there has been a significant ($p<0.01$) decreasing trend (slope = -0.19, $R^2 = 0.12$) in summer mean chlorophyll *a* concentrations.

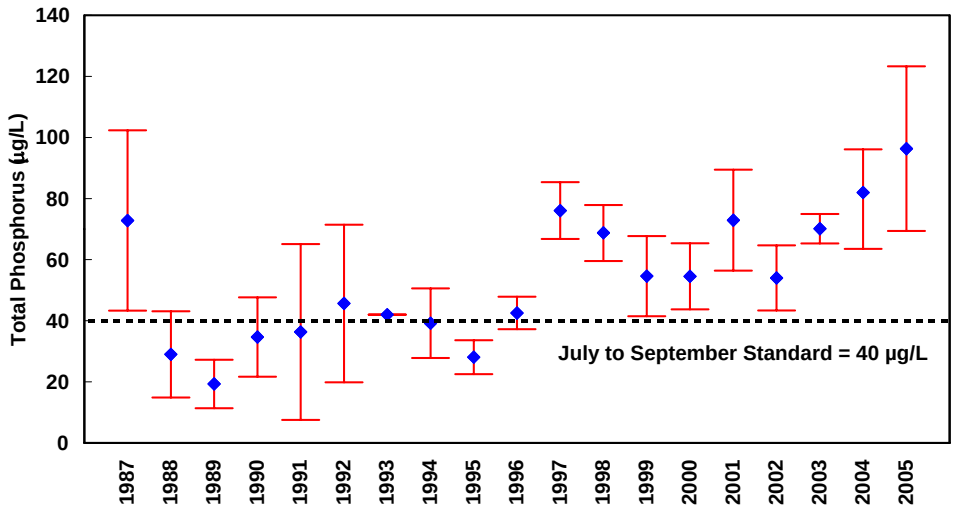
9.2.2. Phosphorus

Reg 72 Reporting

Nutrient profile samples collected in 2005 showed a well-mixed reservoir in spring and fall. It appears there were brief periods of nutrient release from bottom sediments in May, July, and September as evidenced by increasing total phosphorus concentrations with increasing depth, despite little or no surface inflow to the reservoir.

Routine monitoring data collected since 1987 indicate an increasing trend in the summer mean concentration of total phosphorus ($p < 0.01$, slope = 2.6, $R^2 = 0.47$) (Figure 9-5). In 2005, the summer mean concentration of total phosphorus was 116 µg/L. This value is the highest observed over the past 18 years.

Figure 9-5. Seasonal Mean (July to September) Total Phosphorus Concentrations (µg/L) Measured in Cherry Creek Reservoir, 1987-2005



Note: Error bars represent a 95% confidence interval around each mean

Analysis of Variance indicates significant differences among the summer mean total phosphorus concentrations ($p < 0.001$) between 1999 and 2005, with the summer of 2005 exhibiting the highest mean total phosphorus concentrations since routine monitoring began. Since 1999, there has been a significant ($p<0.001$) increasing trend (slope = 0.31, $R^2 = 0.24$) in summer mean total phosphorus concentrations.

9.2.3. Temperature and Dissolved Oxygen

Analysis of past Cherry Creek Reservoir temperature profiles indicates that stratification occurs when there is a >2°C difference between surface and bottom temperatures. Differences of approximately 1°C suggest a recent mixing event. Using these criteria, Cherry Creek Reservoir was investigated for periods of potential stratification and anoxic levels (Figure 9-6 and Figure 9-7). Periodic stratification occurred through the summer, with significant whole lake mixing events appearing to occur in late June and early August.

Figure 9-6. Temperature (C) Profiles Recorded During Routine Monitoring at Site CCR-2 in 2005

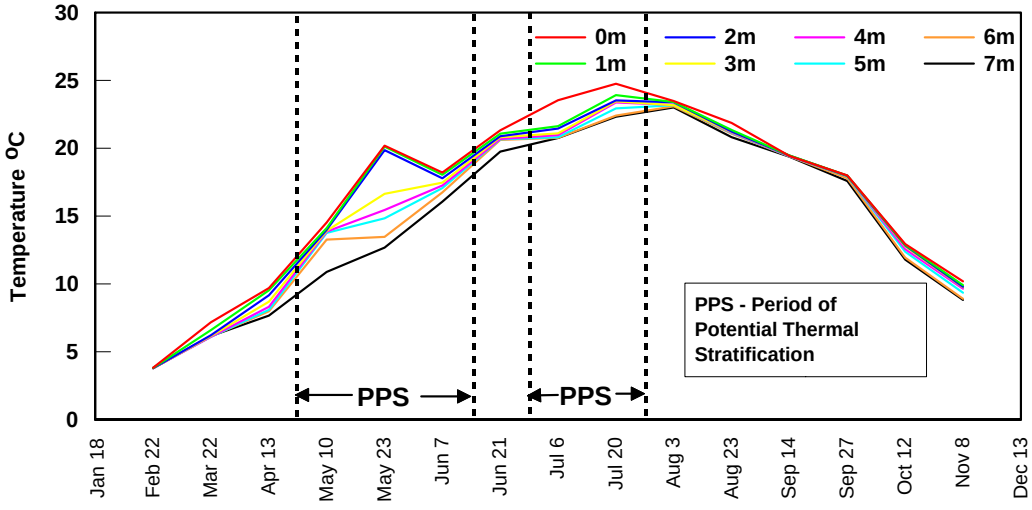
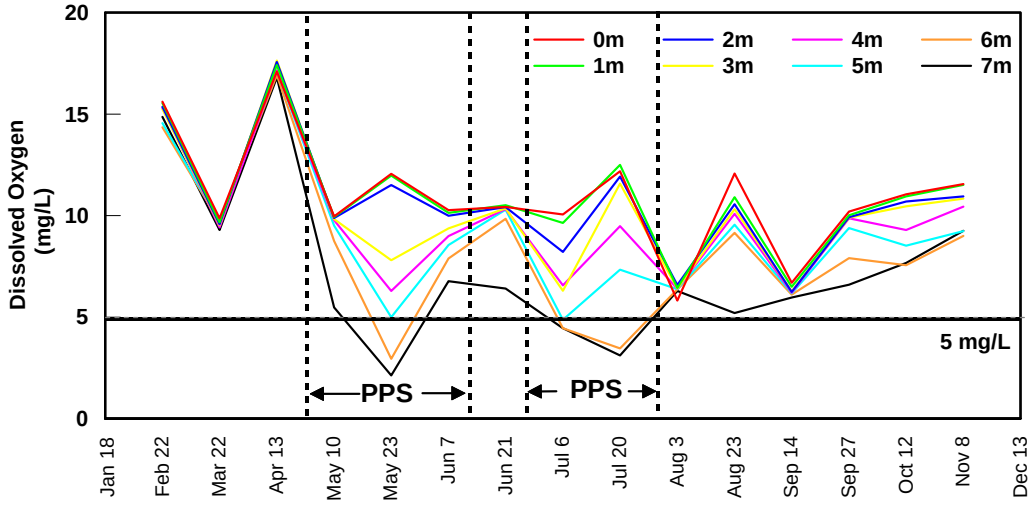


Figure 9-7. Dissolved Oxygen (mg/L) Profiles Recorded During Routine Monitoring at Site CCR-2 in 2005



During periods of stratification, the lower layers of the reservoir experienced depressed dissolved oxygen concentrations. During July and August, even with extensive periods with dissolved oxygen at less than 5 mg/L in the deeper waters, only two percent of the lake volume experienced depletions below 5 mg/L.

9.3 Cherry Creek Mainstem Monitoring

The Cherry Creek mainstem watershed monitoring was initiated in 1994 (Phase I Baseline Water Quality Data Collection Study) and is conducted by John C. Halepaska and

Associates, Inc. The monitoring includes semi-annual sampling at nine surface water sites and nine alluvial ground water sites along Cherry Creek for the following constituents.

- Nitrate
- Ammonia
- Total dissolved phosphorus
- Total phosphorus (surface water only)
- Soluble reactive phosphorus (SRP)
- Chloride
- Sulfate

The sampling frequency over the years was reduced from monthly monitoring to semi-annual monitoring (May and November) in 2003. Table 9-2 shows the list of water quality monitoring sites for the Cherry Creek mainstem. Surface water and groundwater sites are paired at the same location and given corresponding numbers (e.g., CC-1 and MW-1). A summary of surface and groundwater monitoring data is provided in the following sections.

Table 9-2. Quality Monitoring Stations for Cherry Creek Mainstem

Site	Description
Surface Water Location (upstream to downstream)	
Castlewood	0.2 mile north of the USGS Cherry Creek near Franktown gaging station
CC-1	1 mile south of Scott Road
CC-2	¾ mile south of Stroh Road
CC-3	1 mile south of West Parker Road (not a water quality sampling location)
CC-4	½ mile south of Lincoln Avenue
CC-5	½ mile north of Lincoln Avenue
CC-6	On Arapahoe/Douglas County Line
CC-7	¾ mile south of Arapahoe Road (not a water quality sampling location; abandoned in 2000 due to development)
CC-8	½ mile north of Arapahoe Road
CC-9	In the Park, near Nature Center. In 2002, site replaced by CC-10 (Chadwick Ecological Consultants)
Ground Water (upstream to downstream)	
MW-1	Monitoring well adjacent to Pinery production well #6
MW-2	Monitoring well E-2 downgradient of Pinery discharge
MW-3	Parker KOA production well
MW-4b	Parker NPDES monitoring well M-3
MW-5	Monitoring well adjacent to Arapahoe Loyd #2 production well
MW-6	Monitoring well adjacent to Arapahoe Race #1 production well
MW-7	Monitoring well adjacent to Arapahoe Ford #2 production well; abandoned in 2000 due to development
MW-8	Arapahoe Deem production well
MW-9	Monitoring well in Cherry Creek State Park near Nature Center
Kennedy	Denver production well adjacent to Kennedy Golf Course (downstream from reservoir)

9.3.1. Soluble Reactive Phosphorus

- The SRP concentrations in the underlying alluvial aquifer range from <0.01 to 0.97 mg/L with a median of 0.18 mg/L (1994 through 2005). Figure 9-8 presents annual average alluvial SRP concentrations.

- The SRP concentrations in Cherry Creek range from <0.01 to 0.37 mg/L with a median of 0.16 mg/L (1994 through 2005). Figure 9-9 presents annual average surface water SRP concentrations.

- Trends in SRP over time (1994 to present) indicated a decreasing trend for the most upstream surface water and ground water sites and an increasing trend at the most downstream ground water site (Table 9-3).

Table 9-3. Summary of Soluble Reactive Phosphorus Temporal Trend Analysis

Site	Type	Trend	Slope (mg/L per year)
Castlewood	Upstream surface water	Yes, decreasing	-0.002
CC9/CC10	Downstream surface water	No	
MW-1	Upstream ground water	Yes, decreasing	-0.002
MW-9	Downstream ground water	Yes, increasing	0.003

Note: To minimize the effects of seasonality, the Seasonal Kendall tau test was applied, which is a nonparametric test for trend (i.e. uses the relative magnitude of the data rather than the actual values) and removes seasonal cycles.

- Spatial trend evaluations to determine whether SRP concentrations are significantly different between upstream and downstream sites and surface and ground water sites are summarized in Table 9-4.

Table 9-4. Spatial Differences in Soluble Reactive Phosphorus

Site	Spatial Difference in SRP Concentration?
Surface water upstream and downstream (Castlewood and CC9/CC10)	Yes, downstream>upstream
Ground water upstream and downstream (MW-1 and MW-9)	Yes, upstream>downstream
Upstream surface water (CC1) and upstream ground water (MW-1)	Yes, ground water>surface water
Downstream surface water (CC9/CC10) and downstream groundwater (MW-9)	Yes, surface water>ground water

Figure 9-8. Average SRP Concentrations in Cherry Creek Groundwater

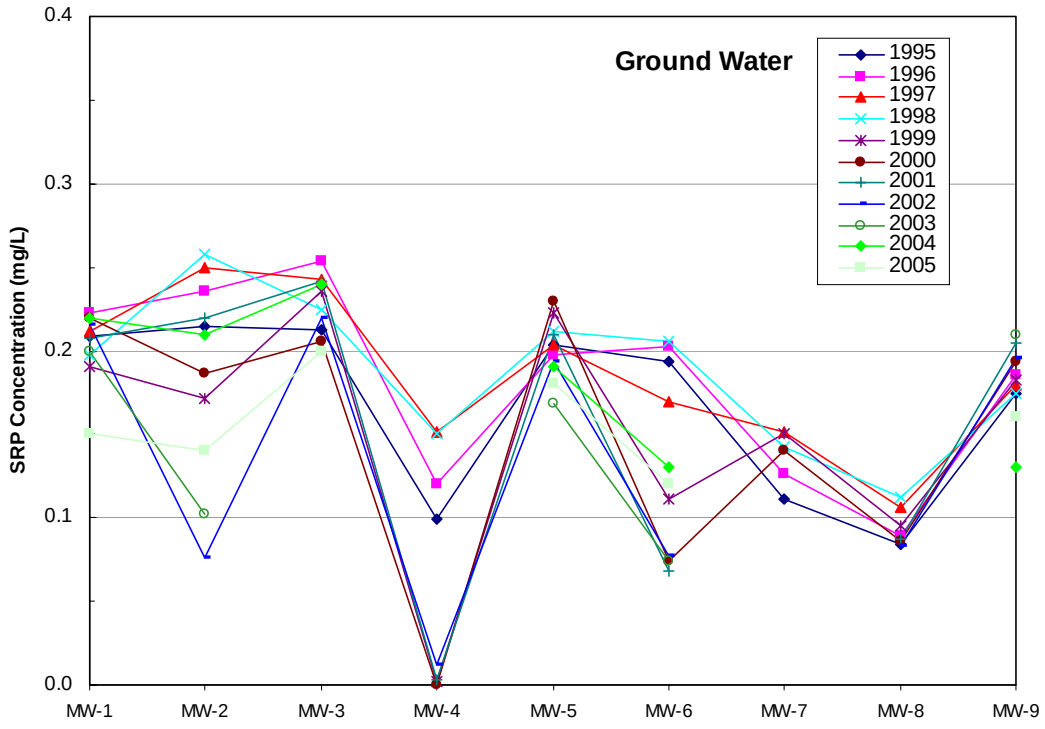
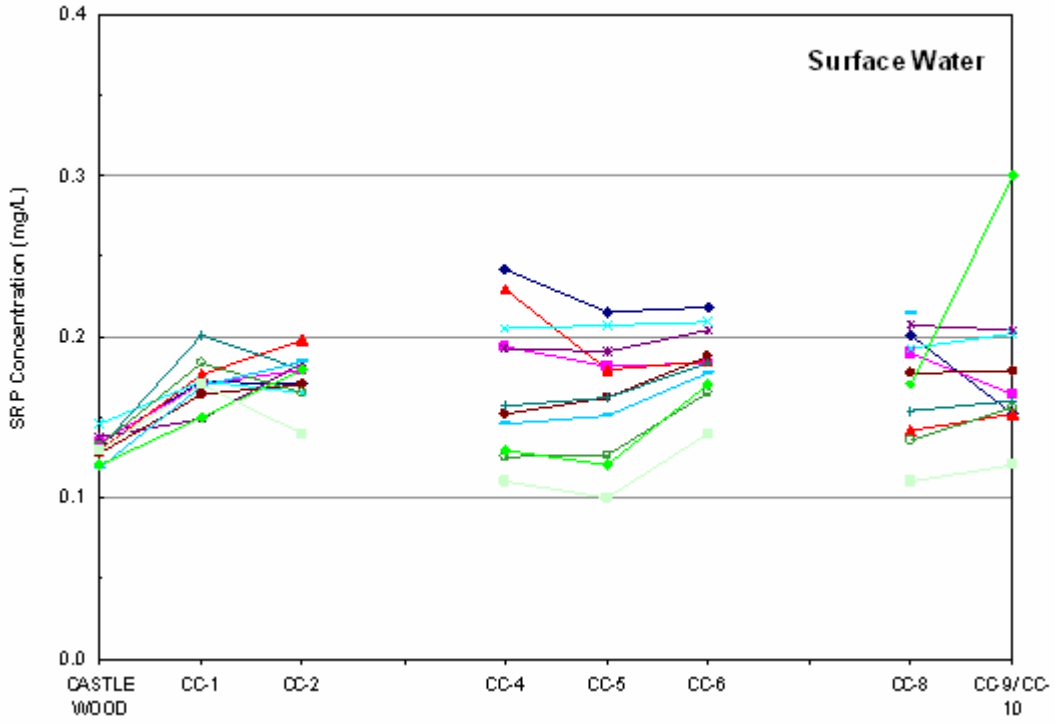


Figure 9-9. Average SRP
Concentrations in Cherry Creek Surface Water



9.3.2. Nitrate

- The nitrate concentrations in Cherry Creek range from 0.009 and 16.7 mg/L (the maximum from 2005) with a median of 0.49 mg/L (1994 through 2005).

- The nitrate concentrations in the underlying alluvial aquifer range from 0.003 to 6.42 mg/L with a median of 0.52 mg/L (1994 through 2005).

- Trends in nitrate over time (1994 to present) indicated increasing trends for the most upstream and downstream Cherry Creek sites and decreasing trends for the most upstream and downstream alluvial aquifer sites (Table 9-5).

Table 9-5. Summary of Nitrate Temporal Trend Analysis

Site	Type	Trend	Slope (mg/L per year)
Castlewood	Upstream surface water	Yes, inceasing	0.01
CC9/CC10	Downstream surface water	Yes, increasing	0.05
MW-1	Upstream ground water	Yes, decreasing	-0.06
MW-9	Downstream ground water	Yes, decreasing	-0.27

Note: To minimize the effects of seasonality, the Seasonal Kendall tau test was applied, which is a nonparametric test for trend (i.e. uses the relative magnitude of the data rather than the actual values) and removes seasonal cycles.

- Spatial trend evaluations to determine whether nitrate concentrations are significantly different between upstream and downstream sites and surface and ground water sites are summarized in Table 9-6.

Table 9-6. Spatial Differences in Nitrate

Site	Spatial Difference in Nitrate Concentration?
Surface water upstream and downstream (Castlewood and CC9/CC10)	Yes, downstream>upstream
Ground water upstream and downstream (MW-1 and MW-9)	No
Upstream surface water (CC1) and upstream ground water (MW-1)	Yes, surface water > ground water
Downstream surface water (CC9/CC10) and downstream groundwater (MW-9)	Yes, ground water > surface water

Figure 9-10 and Figure 9-11 present average nitrate concentrations in Cherry Creek and the underlying alluvial aquifer from upstream to downstream (1995 to 2005).

There are fluctuations in the nitrate levels, which is not expected since nitrate is conservative and does not attenuate over distance, except due to dispersion and biological assimilation. The shallow water table may facilitate assimilation of nitrate by riparian plants.

Figure 9-10. Average Nitrate Concentrations in Cherry Creek Groundwater

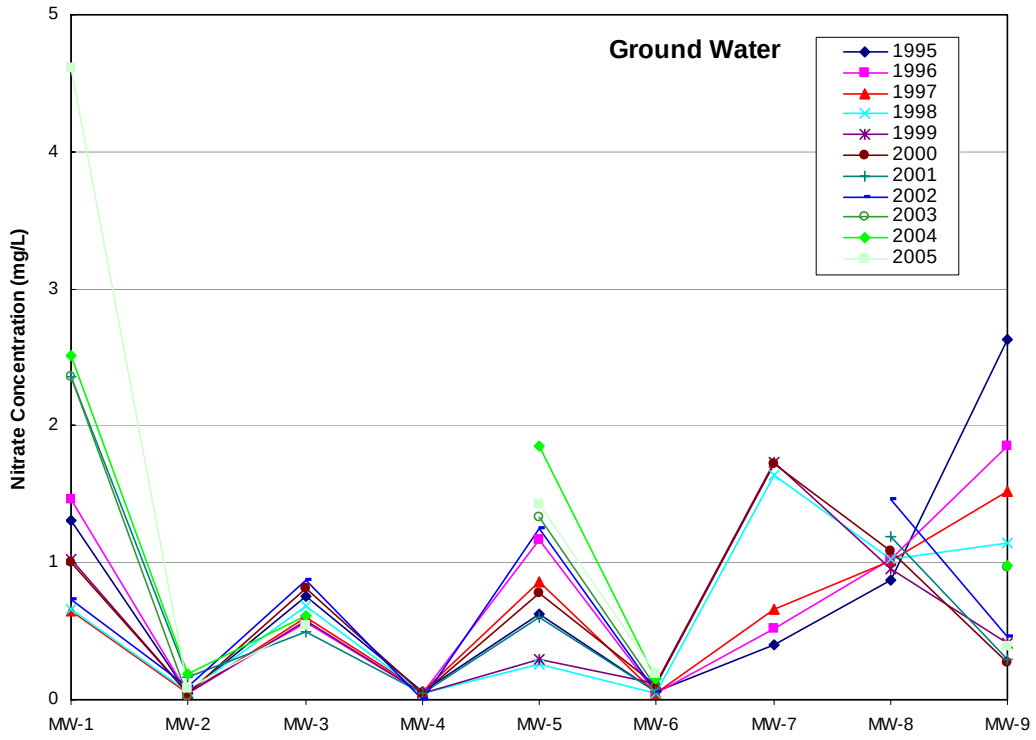
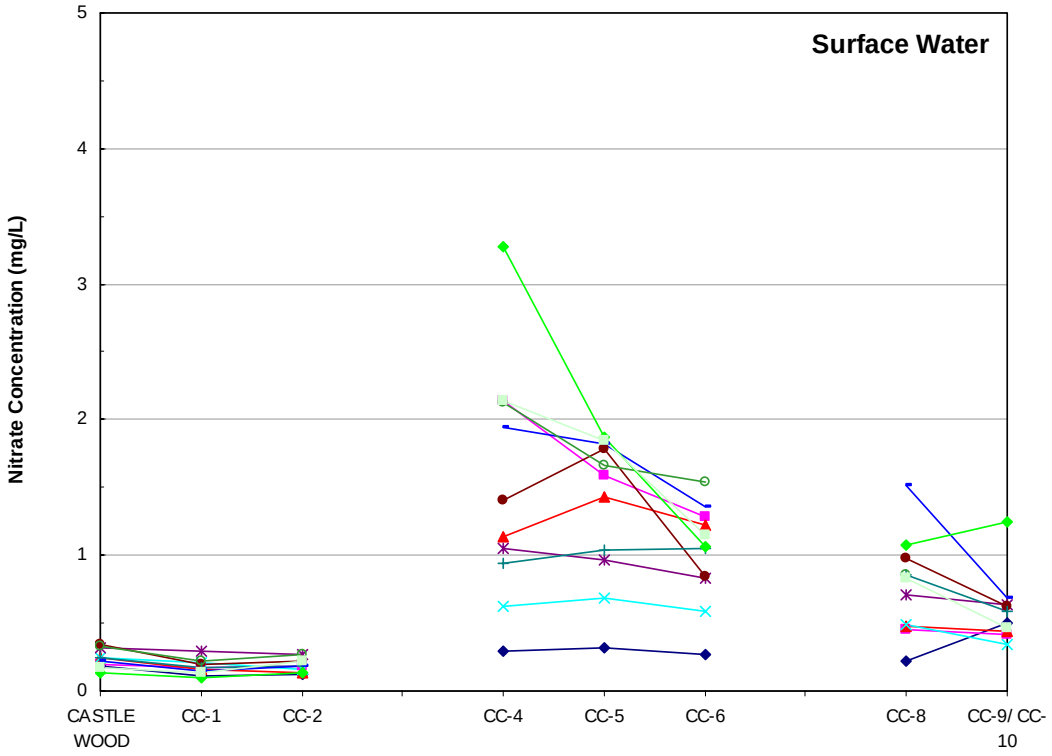


Figure 9-11. Average Nitrate Concentrations in Cherry Creek Surface Water



9.4 Phosphorus Loading to the Reservoir

Reg 72 Reporting

Nutrients that can limit or enhance algal growth in a reservoir have many sources, either within the reservoir (internal loading) or from outside the reservoir (external loading). Fish and plankton excrement, direct sediment re-supply, and the decay of organic matter are all internal sources of nutrients in a reservoir. Based on past modeling efforts, net internal phosphorus loading to Cherry Creek Reservoir has been estimated to be 4,000 lbs/year. Recent studies evaluating internal loading using a variety of methodologies suggest phosphorus loading ranges between 810 lbs/yr and 1,590 lbs/yr (AMEC *et al.* 2005), and alluvial phosphorus loads of approximately 1,170 lbs/yr (Lewis *et al.* 2005). Note that the phased TMAL of 14,270 lbs/year set in the May 2001 hearing does not include internal loads.

External sources of nutrients include inflow from streams and precipitation, which carry nutrients from soil erosion, agricultural and residual runoff, treated wastewater, and airborne particulates. Phosphorus loading was determined for several primary sources in 2005, including the tributary streams Cottonwood Creek, Cherry Creek, and Shop Creek, as well as from precipitation and alluvium, as summarized below.

9.4.1. Inflowing Streams

As part of the reservoir influent stream monitoring, annual phosphorus loading (based on calendar years) was calculated for Cherry Creek, Cottonwood Creek, and Shop Creek prior to their confluence with the reservoir. Note that for data prior to 1992, values are only available for water years. A water year begins on October 1 of the previous year and continues until September 30.

Total phosphorus loading to the reservoir from surface flows of Cherry Creek, Cottonwood Creek, and Shop Creek was estimated at 8,460 pounds in 2005 (Table 9-7). Total phosphorus loading from the above influent streams was considerably higher than the fourteen-year mean value (Table 9-1). Despite the higher loads in 2005, the standardized phosphorus loading in pounds per acre foot was the lowest recorded value during the past fourteen years (Figure 9-12).

Inflow, measured as the change in reservoir elevation by the COE, was dominated in 2005 by six major precipitation events between mid-April to mid-October (Figure 9-13), and was above the long-term average of 13,772 ac-ft for the reservoir.

Table 9-7. Estimated Net Phosphorus Loading (pounds/year) into Cherry Creek Reservoir, 1992 to 2005

Data Source	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Mean
Shop Creek	131	83	135	115	107	117	127	96	82	103	79	103	210	127	115
Cherry Creek	2,894	1,727	2,142	2,795	2,347	2,041	7,666	8,745	8,306	3,412	1,105	4,637	7,379	6,636	4,417
Cottonwood Creek	1,081	117	321	2,184	553	646	1,143	1,822	1,087	1,292	789	1,130	2,592	1,697	1,175
Subtotal for Streamflows	**4,106**	**1,927**	**2,598**	**5,094**	**3,007**	**2,804**	**8,936**	**10,663**	**9,475**	**4,807**	**1,973**	**5,870**	**10,181**	**8,460**	**5,707**
Cherry Creek Alluvium	874	1,387*	967	1,676	968	1,937	3,787	5,912	2,341	4,444	1,006	2,307	2,181	1,123	2,208
Direct Precipitation	877	736	484	1,202	740	1,020	854	896	777	586	1,267	391	150	464	746
Total Load	**5,857**	**4,110**	**4,049**	**7,972**	**4,715**	**5,761**	**13,577**	**17,471**	**12,593**	**9,837**	**4,246**	**8,568**	**12,512**	**10,047**	**8,665**
Cherry Creek Outflow	1,314	711	993	2,049	992	996	4,207	9,650	3,688	4,842	1,501	4,978	4,812	3,669	3,172
Net Load	**4,543**	**3,399**	**3,056**	**5,923**	**3,723**	**4,765**	**9,370**	**7,821**	**8,905**	**4,995**	**2,745**	**3,590**	**7,007**	**6,378**	**5,444**

*Based on mean of 1994-1997 total alluvial loads.

Figure 9-12. Long-Term Trends in Total Phosphorus Load (pounds/year), Inflow/acre-feet (year), and Standardized Phosphors Load (pounds/acre feet) from Cherry Creek Reservoir, 1992-2005

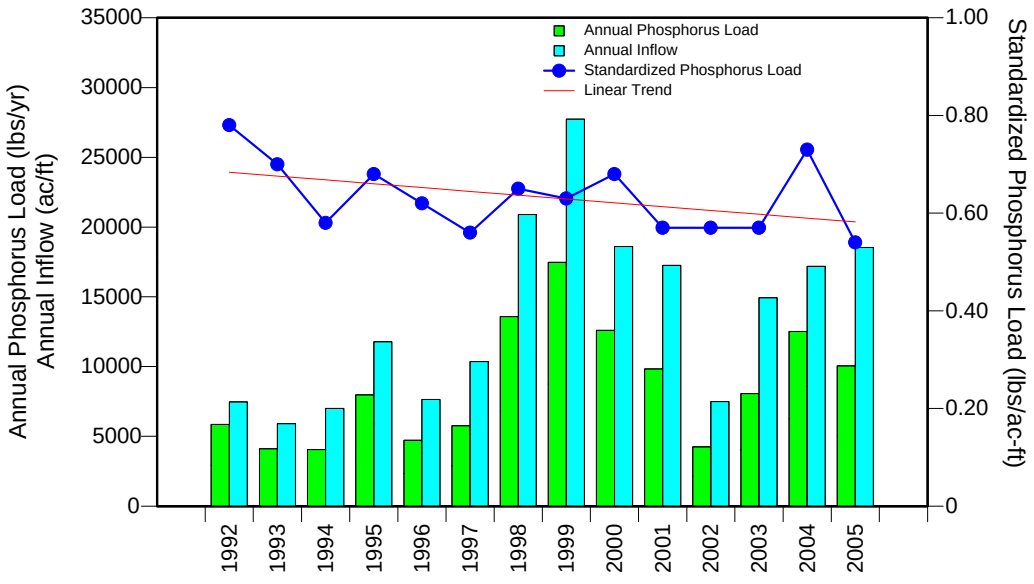
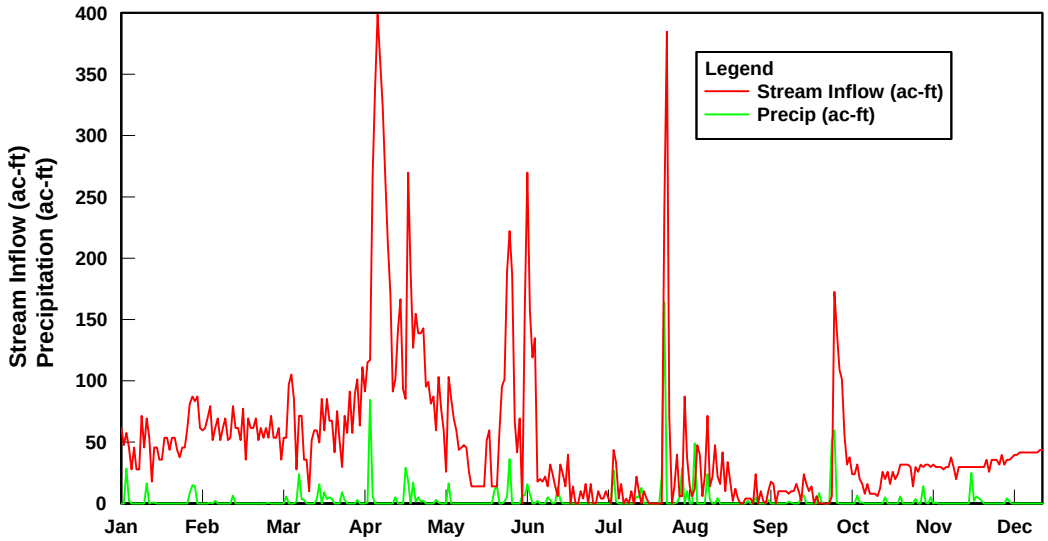


Figure 9-13. Comparison of Direct Precipitation on the Reservoir and Inflow for 2005



In order to provide further evaluation on inflowing streams, additional analyses were performed on data from the three main tributaries at Cherry Creek Reservoir. Concentrations of total phosphorus and orthophosphate were examined for a ten-year period (1995-2005). Total phosphorus and orthophosphate concentrations in Shop Creek exhibit significant, increasing trends over time. Concentrations of orthophosphate at the Cottonwood Creek inflow site exhibit a significant, decreasing trend over time. Trends in Cherry Creek mainstem phosphorus concentrations were not statistically significant.

9.4.2. Precipitation

Total annual precipitation in 2005, as measured by the KAPA rain gage located at Centennial Airport, approximately 4.3 miles due south of Cherry Creek Reservoir, was 15.5 inches (Figure 9-13). This value is approximately 27% less than the measured annual precipitation in 2004 (20.3 in). Additionally, the 2005 annual precipitation total was less than the 1987 to 2005 mean of 17.5 inches.

Given the approximate surface area of Cherry Creek Reservoir (850 acres), and the long-term median total phosphorus concentration for precipitation events, total phosphorus loading was estimated to be 464 pounds for 2005. This increase in load, as compared to 2004 estimates, is attributed to changes in the load calculations. The 2005 load estimate utilizes a long-term median total phosphorus concentration rather than an annual average as used in more recent years. These changes are more consistent with historical estimates of precipitation loads. In future reports, historic precipitation loads based upon an annual mean value will be revised accordingly. The mean annual load from precipitation between 1992 and 2005 is 746 pounds.

9.4.3. Outflow

When measuring phosphorus loading in Cherry Creek Reservoir, phosphorus leaving Cherry Creek Reservoir in the outflow from the dam to Cherry Creek downstream of the reservoir is also important. Total phosphorus leaving the reservoir from the outflow was estimated at 3,669 pounds for 2005. This value is lower than that observed in 2004; however it is slightly higher than the 1992 to 2005 mean of 3,159 pounds (Table 9-7).

9.4.4. Alluvial Phosphorus

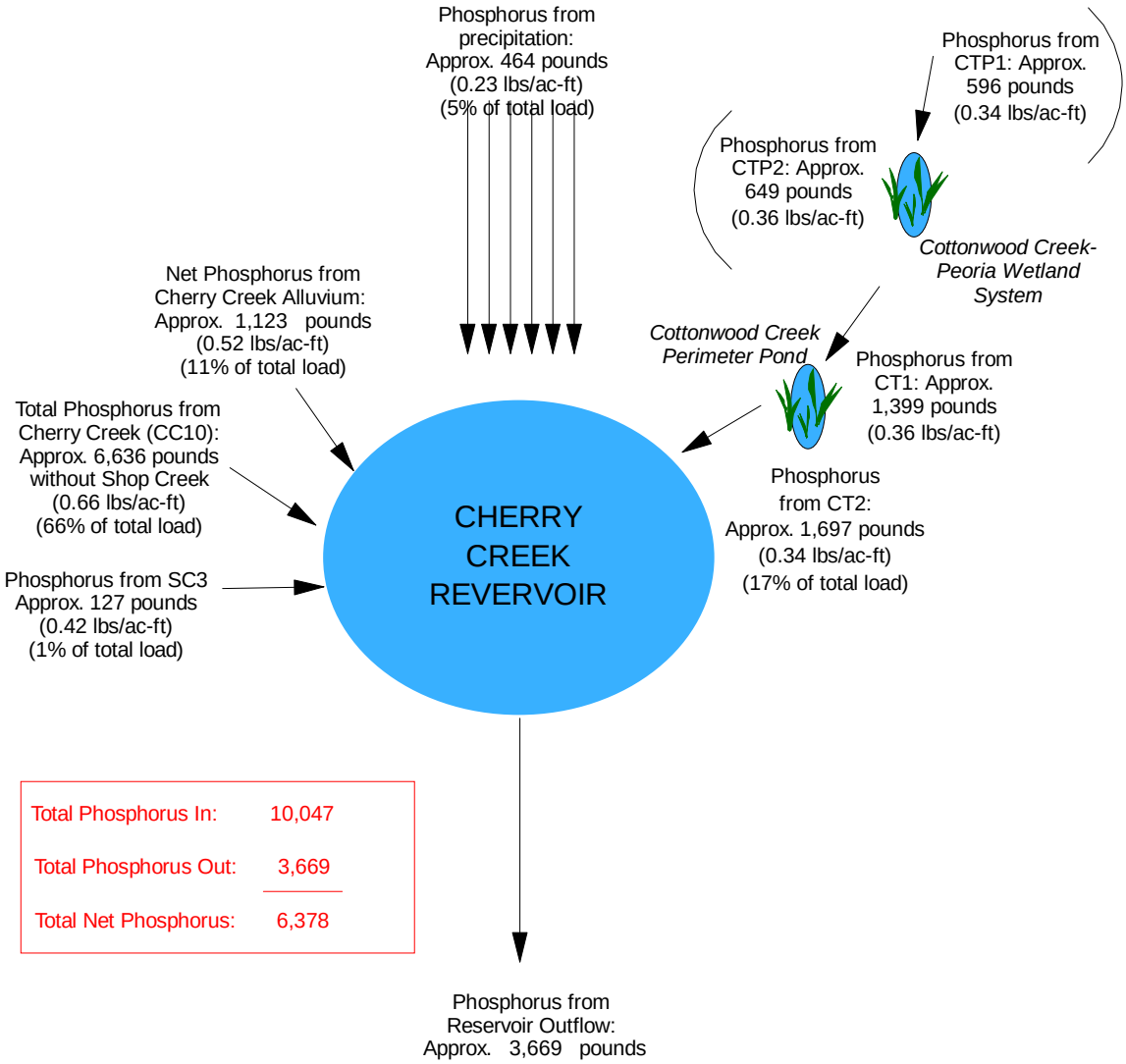
The estimated net alluvial phosphorus load for 2005 is 1,123 pounds The 2005 load estimate utilizes an alluvial water budget value and a longterm median TDP concentration, rather than an annual mean value for MW-9. In future reports, historical alluvial loads based upon an annual mean value will be revised accordingly. The alluvial water budget estimate is very similar (only 1.2 % less) to an annual estimate provided by Lewis *et al.* 2005.

9.4.5. Mass Balance Loadings for Phosphorus

In general, the phosphorus load budget for Cherry Creek Reservoir is comprised of phosphorus inflow (influent streams, precipitation, and alluvium) and reservoir outflow. During 2005, phosphorus contribution from precipitation was an estimated 464 pounds, influent streams contributed 8,460 pounds, and alluvial inflow contributed 1,123 pounds (Figure 9-14) for a total load of 10,047 pounds. Outflow from the dam contained an estimated 3,669 pounds in 2005. After totaling the additions and losses, the net loading of phosphorus was estimated at 6,378 pounds during 2005 (Table 9-6).

The total load of 10,047 pounds estimated in 2005 represented a 20% decrease in total phosphorus load as estimated in 2004. The phosphorus load in 2005 met the phased TMAL of 14,270 pounds established for Cherry Creek Reservoir. The pounds per acre-foot measured in 2005 was well within the range observed in previous years (Table 9-1 and Figure 9-12). In fact, while flows and phosphorus loads have generally varied over the past fourteen years based on a variation in annual flows, the standardized phosphorus loads (pounds/ac-ft) have generally exhibited a declining trend. Also of interest is that while the phosphorus load in 2005 was approximately 14% greater than the long-term mean value (and the inlake total phosphorus the highest measured in recent monitoring), the mean summer chlorophyll *a* value in 2005 was 16% less than the long-term mean value.

Figure 9-14. Mass Balance Diagram of Phosphorus Loading in Cherry Creek Reservoir, 2005



9.5 Evaluation of PRFs

Reg 72 Reporting

The effectiveness of the pollution reduction facilities constructed on Cottonwood Creek appeared reduced in 2005. PRF effectiveness is gauged by monitoring the concentration of phosphorus and suspended solids and the phosphorus loading upstream and downstream of each facility.

9.5.1. Cottonwood Creek- Peoria Pond

This structure came on line midway during 2002. As such, the values from 2002 represent less than a full calendar year (i.e., only July - December 2002). The mean concentration of total phosphorus in 2005 increased from 92 µg/L at Site CT-P1 to 101 µg/L at Site CT-P2 (Table 9-8). The mean concentration of TSS also was slightly greater downstream of the pond/wetland system as compared to the upstream value. The standardized phosphorus load upstream of the pond/wetland system was 0.34 lbs total phosphorus/ac ft, while the standardized load downstream of the system was 0.36 lbs total phosphorus/ac ft. These data show that the PRF was not as effective in 2005 at removing total phosphorus from Cottonwood Creek flows when compared to the past three years of data.

Table 9-8. Annual Historical (2002-2005) Total Phosphorus and Total Suspended Solids Concentrations through the Cottonwood Creek-Peoria Wetlands System

Parameter	Year	Sampling Sites		Difference	Percent Reduction
		CT-P1	CT-P2		
Average Total Phosphorus Concentration (µg/L) (baseflow and storm samples combined)	2002	138	152	+ 14	(10)
	2003	101	92	- 9	9
	2004	142	123	- 19	13
	2005	92	101	+9	(9)
	Mean	**118**	**117**	**-1.3**	**0.8**
Average Total Suspended Solids (mg/L)	2002	66	79	+ 13	(20)
	2003	31	34	+ 3	(10)
	2004	87	53	- 34	39
	2005	47	51	+4	(8)
	Mean	**58**	**54**	**-3.5**	**0.3**
Loading of Total Phosphorus (pounds)	2002	449	231	-228	64
	2003	771	574	- 197	26
	2004	2,590	1,499	- 1,091	42
	2005	596	649	+53	(9)
	Mean	**1102**	**738**	**-363**	**31**

9.5.2. Cottonwood Creek Perimeter Pond

During 2005, the mean concentration of total phosphorus decreased from 128 to 113 µg/L after passing through the pond (Table 9-9). While the total phosphorus load increased downstream of the pond, from 1,399 lbs to 1,697 lbs, the standardized phosphorus load actually decreased from 0.36 lbs/ac-ft to 0.34 lbs/ac-ft. The concentration of TSS also decreased by 63 percent from 126 mg/L upstream to 66 mg/L downstream of the pond. In past years, higher phosphorus concentrations observed at the Cottonwood Creek perimeter pond, when compared to the Cottonwood Creek – Peoria wetland system, indicate potential

loading from stream channel erosion. In an effort to reduce phosphorus loading in the reservoir from the stream itself, channel reconstruction was conducted on Cottonwood Creek downstream of the Cottonwood Creek – Peoria wetland system in 2004 and will be completed in Phase 2 in 2006. This channel reconstruction may have accounted for the increased loads observed between these two existing PRFs, e.g., 649 lbs at Site CT-P2 and 1,399 lbs total phosphorus at Site CT-1 (Table 9-9 and 9-10). Regardless, the standardized load reduction indicates that this PRF continues to be effective in reducing the loads of suspended solids and total phosphorus to Cherry Creek Reservoir.

Table 9-9. Annual Historical (1997 To 2005) Total Phosphorus and Total Suspended Solids Concentrations through the Cottonwood Creek Stormwater Detention Pond

Parameter	Year	Sampling Sites		Difference	Percent Reduction
		CT-1	CT-2		
Annual Average Total Phosphorus Concentration (µg/L) (baseflow, storm samples combined)	1997	200	133	-67	34
	1998	289	210	-79	27
	1999	158	157	-1	0
	2000	187	149	-38	20
	2001	165	114	-51	31
	2002	146	143	-3	2
	2003	144	129	-15	10
	2004	212	151	-61	29
	2005	180	142	-38	21
	Mean	**187**	**148**	**-39**	**19**
Annual Average Total Suspended Solids (mg/L)	1997	207	87	-120	58
	1998	311	129	-182	59
	1999	267	68	-199	74
	2000	96	64	-32	33
	2001	79	43	-36	46
	2002	130	79	-51	39
	2003	84	62	-22	26
	2004	155	77	-78	50
	2005	126	66	-60	48
	Mean	**162**	**75**	**-87**	**48**
Annual Loading of Total Phosphorus (pounds)	1997	3,351	1,103	-2,248	67
	1998	3,209	1,930	-1,279	40
	1999	6,329	3,868	-2,461	39
	2000	3,243	1,712	-1,531	47
	2001	3,356	2,205	-1,151	34
	2002	886	789	-97	11
	2003	1,777	1,130	-647	36
	2004	3,334	2,592	-742	22
	2005	1,399	1,697	298	(21)
	Mean	**2987**	**1892**	**-1095**	**31**

9.6 Historical Sampling of the PRFs on Shop Creek and Quincy Drainage

Historical sampling of the PRFs on Shop Creek and Quincy Drainage indicate efficient phosphorus removal in these streams. Shop Creek was monitored from 1990 to 2000 and had an average phosphorus load reduction of 173 lbs, with an average of 63% reduction in load. Quincy Drainage was even more efficient with 99% reduction in loads over the period of 1996-1999. The average phosphorus load reduction was 138 lbs.

9.7 Status of Water Quality

In 2005, the average July-September mean chlorophyll *a* content in Cherry Creek Reservoir was 17.1 µg/L, which exceeds the standard set at 15 µg/L. This standard has only been met five times in the past 19 years. The seasonal mean of total phosphorus (116 µg/L) also exceeded the current goal of 40 µg/L. However, the annual phosphorus load in 2005 was, which did not exceed the phased TMAL of 14,270 pounds.

9.8 Progress Made

Reg 72 Reporting

STEPS REG 72

- Completed annual water quality monitoring and analysis for the reservoir, watershed, alluvium, and selected PRFs in accordance with the Sampling, Analysis, and Quality Assurance Work Plan.

- The Cottonwood Creek-Peoria Pond PRF was not as effective at removing total phosphorus or total suspended solids in 2005 as observed in previous years. Standardized phosphorus loads (lbs/ac ft) were slightly greater downstream of the pond as compared to standardized loads upstream of the system. This decrease in performance may be due, in part, to the Phase I Cottonwood Creek Reclamation completed in 2004, since the vegetation is still recovering from the wide spread land disturbance and a major storm event. In addition, since the inflow concentrations were relatively low (i.e., less than 0.11 mg/l), further reductions in concentrations through natural systems is limited.

- The Cottonwood Creek Perimeter Pond PRF also revealed a similar increase in phosphorus loading downstream of the system. However, standardized phosphorus loads (lbs/ac-ft) showed that the system was slightly effective at removing total phosphorus from Cottonwood Creek. These reductions in loads at the Perimeter Pond PRF were observed despite the potential for increased loads resulting from the channel reconstruction activities upstream during 2005, again pointing to the effectiveness of this structure in reducing phosphorus loads to the reservoir.

- Total phosphorus load to the reservoir was below the TMAL.

- There has been a statistically significant decrease in seasonal whole-reservoir chlorophyll *a* concentrations since 1999.

10. IMPLEMENTING WATERSHED PLAN 2003 RECOMMENDATIONS

Reg 72 Reporting

Recommendations and specific opportunities for improving water quality can be found in the Watershed Plan 2003. The Watershed Plan 2003 and recommendations were developed by an independent consultant under the direction of the Authority. The Board has adopted the Watershed Plan 2003 and will consider these recommendations. Listed below are the recommendations provided in the Watershed Plan 2003 and progress made during 2005.

- Consider various funding options to achieve capital budget increase of $2 million to $4 million annually.

  2005 The Board adopted a budget that included funds thought adequate to begin exploring the feasibility of addressing the impacts of the TABOR amendment on the Authority's budget (i.e., de-Brucing). The Board will continue to explore this in 2006.

  2005 The Authority finalized contracting with the Division for two Nonpoint Source Program grants for near-term funding to assist with both capital projects and revising the TMAL.

- Implement the Cherry Creek Reservoir Watershed Plan 2003 as a coordinated management program.

  2005 Watershed Plan 2003 recommendations are incorporated into the Work Plan and assist in prioritizing and determining activities for completion.

- Fund, design, and construct high priority stream improvements.

  2005 The Authority included funds in the 2006 annual budget for potential stream corridor preservation partnering opportunities.

- Design and construct additional pollutant reduction facilities.

  2005 Completed feasibility study for reservoir destratification alternatives.

  2005 Contracted with consultant to conduct a technical feasibility study for the Cherry Creek Sediment Basin at Arapahoe Road and stream stabilization to Piney Creek confluence in 2006.

- Promote trading incentives and request removal of the 216-pound "Reserve Pool" cap.

  2005 Initiated review of a new trade project from ACWWA.

- Encourage all land use agencies to adopt and implement the stormwater policy and design criteria outlined in the Authority's Requirements.

  2005 Initiated cooperative effort with the land use agencies to revise the Authority Requirements to reduce redundancy with land use agency adopted requirements and determine where the Authority can provide needed support.

- Encourage local governments to work with developers to construct innovative demonstration projects.

  2005 Completed second year of Phosphorus Facilitator program

  2005 The Partners and Authority coordinated a training program for land use and development professionals.

- Encourage local governments to provide developer incentives to preserve and enhance stream corridors.

  2005 Continue to review land use applications and provide land use agencies and developers with comments and recommendations consistent with the Authority's Requirements.

- Explore options to reduce septic system loading in Cherry Creek.

  2004 revisions to Control Regulation 72 prohibit individual sewage disposal systems within the 100-year floodplain.

- Promote reuse of wastewater through land application.

  2004 revisions to Control Regulation 72 and the trading program provide support for reuse projects.

- Conduct special studies to optimize water quality improvements.

  2005 Completed a study that estimated groundwater flow (seepage), and associated phosphorus load into Cherry Creek Reservoir.

  2005 Finalized funding contract and completed consultant selection to conduct three special studies in 2006.

- Develop and implement a comprehensive public involvement plan.

  2005 Continued cooperation with the Partners to implement the Education Initiative.

- Consider participation in several federally funded programs that support sustainable agriculture and habitat protection and restoration.

  2005 Submitted a letter of intent to join the COE in implementing 1135 Environmental Improvement Project at the Belleview Wetlands. Congressional funding was not approved for the project.

- Coordinate with other stormwater Phase I and II entities and efforts.

  2005 The Authority's consultants regularly interface with land use agencies and stormwater permittees to answer questions and provide guidance for enhanced BMPS.

- Collaborate with other private and public interest groups to leverage funding mechanisms to meet watershed goals.

2005 The Authority coordinated with the Partners' efforts and activities to promote education and outreach in the watershed for water quality enhancements.

Cherry Creek Reservoir did not meet the chlorophyll *a* standard or phosphorus goal in 2005, but the phosphorus loading to the reservoir continues to be below the TMAL. The Authority's management strategies have focused on the watershed, including the construction of PRFs that have shown to be effective in reducing phosphorus loads. The Authority believes watershed management strategies are beneficial over the long term, but they have not resulted in immediate measurable improvements to reservoir water quality. The Authority is pursuing the design and construction of reservoir destratification in 2006 for more short-term improvements to reservoir water quality. The Authority will continue to develop and implement watershed management strategies as a priority.

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