CDM

Town of Castle Rock Colorado

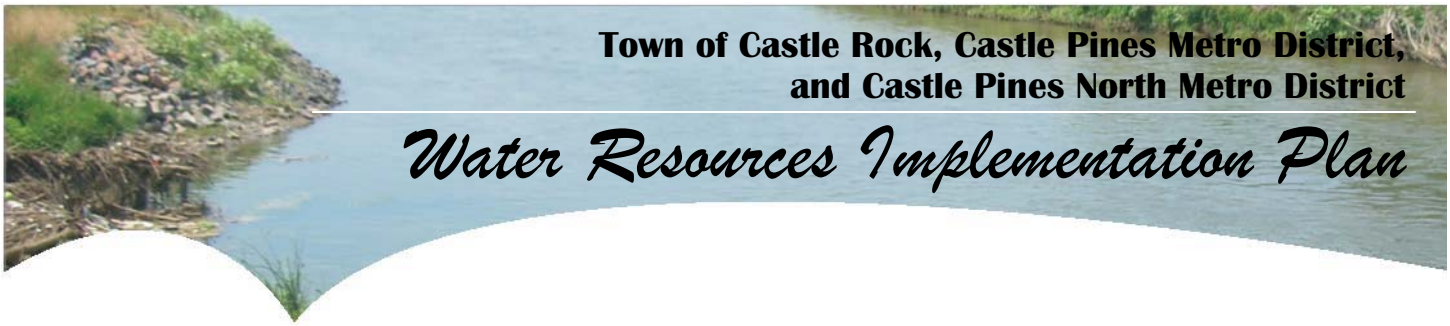
Castle Pines Metropolitan District

Castle Pines North Metro District

Water Resources Implementation Plan

March 2008

FINAL REPORT



Town of Castle Rock, Castle Pines Metro District, and Castle Pines North Metro District

Water Resources Implementation Plan

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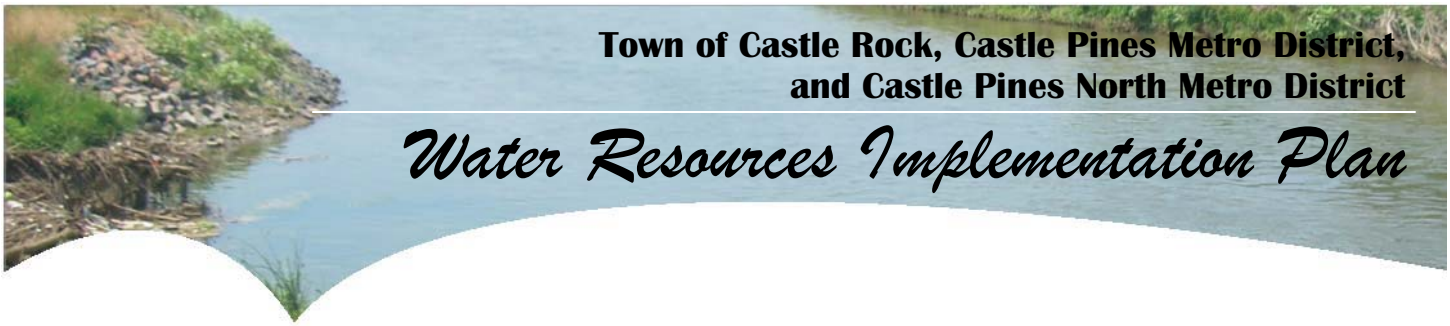


Town of Castle Rock, Castle Pines Metro District, and Castle Pines North Metro District

Water Resources Implementation Plan

Overview

The Town of Castle Rock (TCR), Castle Pines Metro District (CPMD), and the Castle Pines North Metro District (CPNMD) rely primarily on nonrenewable groundwater supplies to meet the water needs of their respective service areas. Looking towards development of sustainable, renewable water supplies, each of these entities (the Participants) participated in the Water Resources Optimization Study (WROS). The results of WROS were incorporated in this Water Resources Implementation Plan (WRIP or Plan), a joint project undertaken to establish a plan to fully utilize water supplies and return flows that are currently unused or under-utilized. These supplies include, among others:

- East and West Plum Creek alluvial and surface water rights
- Treated wastewater effluent return flows from the Plum Creek Wastewater Authority (PCWA) Wastewater Treatment Plant (WWTP)
- Lawn irrigation return flows (LIRFs)
- Future imported renewable water supplies

This Plan documents the plan for development and use of the local renewable supplies, drawing on detailed analyses of alternative infrastructure systems that would capture, store, convey, treat, and distribute the renewable water from various points of diversion. The development of this Plan was a cooperative effort between the Participants to develop a regional approach to management of the local renewable supplies. The Participants developed water management alternatives based upon the project objectives. The alternatives were refined and evaluated through a series of technical memoranda and workshops.

This Plan also documents the recommended approach to integrating the local renewable supplies with imported renewable water that could be conveyed to the Participants from north of the Denver metropolitan area via a supply system spearheaded by the South Metro Water Supply Authority (SMWSA). This plan also builds on the Wastewater and Reclaimed Water Master Plans (CH2MHill 2003) developed by TCR. The result is a phased capital investment plan that will bring renewable supplies from both the SMWSA north source and the local Plum Creek and return flow supplies to dramatically increase the sustainability of the Participants' water supply portfolios. This document provides a summary of the Plan. Detailed information used to develop the Plan is provided in a series of Technical Memoranda.

Renewable Water Supplies

Existing water demands in the Participants' service areas are primarily addressed with use of nonrenewable bedrock groundwater wells. Treated effluent from the PCWA WWTP is also used for golf course irrigation at three golf courses in CPMD and CPNMD's service areas. Estimates of yield, reliability, and water quality were made for the three entities' local renewable water sources, as a precursor to developing infrastructure alternatives for diversion, storage, treatment, and conveyance of those sources.

The estimated average reusable yield of each of the local renewable water sources is summarized in Table 1. Variability of the projected yield for each source is discussed below. Significant storage would be needed to fully capture and utilize the average-year Plum Creek supplies. Only the estimated reusable portion of return flows are included in the tabulated values, reflecting this Plan's focus on managing and utilizing available local supplies. Treated effluent that cannot be recaptured and reused was not considered in development of the Plan.

Table 1 Reusable Flows (acre-feet per year [AFY])[1]

Source	TCR	CPMD	CPNMD
Reusable Return Flows[2]			
LIRFs at build-out[3]	843	0[4]	0[4]
PCWA WWTP effluent at build-out[5]	5,320	475	893
Pinery WWTP effluent at build-out	464	N/A	N/A
TOTAL AT BUILD-OUT	**6,627**	**475**	**893**

1 Yields are rounded to the nearest whole AF

2 Reusable return flows are estimated based upon future imported water supplies that are assumed to be 100 percent reusable

3 LIRFs for TCR are based upon projected outdoor use and are decreed to be up to 14 percent of outdoor use; for the purposes of this study, LIRFs were rounded down to 10 percent of outdoor water use

4 LIRFs were not included from CPMD and CPNMD; however, CPMD and CPNMD plan to use LIRFs in the future

5 PCWA return flow credits estimated for build-out based on current PCWA WWTP effluent production rates and an assumption that 90 percent of effluent return flows will be reusable, after TCR obligation to CPMD is subtracted

6 Pinery WWTP return flow credits estimates based upon TCR future land use and typical wastewater flows and an assumption that 90 percent of effluent return flows will be reusable

Plum Creek Surface and Alluvial Water Rights

TCR, CPMD, and CPNMD each have tributary water rights with varying priorities. TCR holds several tributary water rights that are relatively senior, thus allowing water to be diverted on a more consistent basis. Since the CPMD and CPNMD 1985 water right is relatively junior, it may not yield water for several years depending on hydrologic conditions. CPMD and CPNMD are seeking water court adjudication of additional rights in pending 2004 water court applications on East Plum Creek.

Reuse of Treated Effluent Return Flow Credits

Under Colorado water law, treated wastewater effluent return flows may be reused, depending on the original source of the water. Nontributary groundwater can typically be reused to extinction, as can certain other sources of water. In WRIP evaluations, it was assumed that future renewable water imported by the Participants would be fully reusable. PCWA return flow credits at build-out include assumptions on reusable percentage of effluent and TCR effluent delivery to CPMD.

Treated effluent return flows would primarily be available for recapture at the PCWA WWTP outfall or downstream of the outfall. However, a small portion of TCR's service area is tributary to the Pinery Water and Wastewater District WWTP. Those return flows could be captured for reuse at or downstream of the Pinery WWTP on Cherry Creek. Given the amount of flow and the location of the Pinery WWTP relative to areas of demand in TCR's service area, the Plan assumes that reusable return flows from the Pinery WWTP will be sold, leased, or otherwise used to TCR's benefit, rather than TCR directly diverting those flows.

Under all scenarios evaluated, it was assumed that irrigation demands associated with the International Golf Course and the Country Club Golf Course (CPMD service area) would continue to be met with PCWA WWTP effluent reuse. Alternate means of irrigating The Ridge Golf Course (CPNMD) considered in the plan included continued reuse of PCWA WWTP or use of other potable and nonpotable sources.

The PCWA WWTP produces highly-treated, filtered effluent, capable of meeting Colorado's "Category 2" reclaimed water standards. This facilitates the potential for unrestricted nonpotable urban reuse. Reclaimed water can also be used for augmentation of raw water supplies for potable water, a practice that is becoming increasingly used in the western United States.

Lawn Irrigation Return Flows

Potential LIRF credits associated with water use have been identified for each of the three water providers' service areas. Due to the topography of the service areas, the LIRFs flow either toward Cherry Creek or East Plum Creek.

TCR identified its LIRFs in a study in 2002 (TCR November 2002). For the purposes of the WRIP study, the LIRFs for TCR at build-out were estimated as 10 percent of the difference between demands and effluent flows.

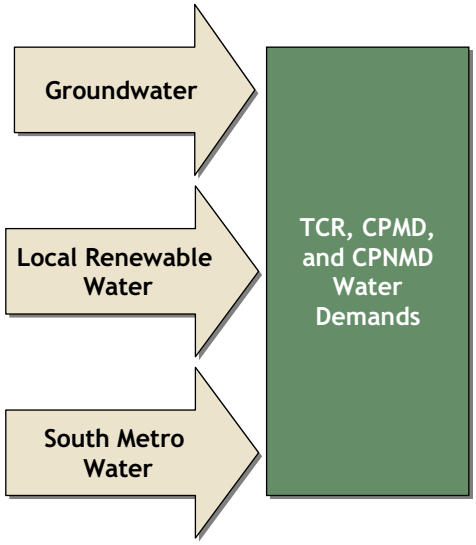
CPMD and CPNMD quantified their LIRF credits in decree number 85CW479. This decree specifies that the CPMD and CPNMD can receive the lesser return flow credit of either the physically measured flow at specified gages or the return flow estimates. For the purposes of this study, the LIRFs were not included. CPMD and CPNMD retain the right to their LIRF credits for future use or credit.

Future Imported Renewable Water Supplies

TCR, CPMD, and CPNMD are each members of the SMWSA. One of SMWSA's core goals is to facilitate the transition of its member water providers toward renewable, sustainable water supplies. The June 2007 SMWSA Regional Water Master Plan provided a plan for bringing in additional renewable water to the area in support of that goal. Through about the mid-2020s, the Master Plan calls for using existing infrastructure to the degree possible to bring surface water supplies from the middle South Platte River area to the South Metro area, including TCR, CPMD, and CPNMD. Participation in such a project is subject to the discretion of each SMWSA member.

For purposes of the WRIP, it was assumed that water delivered through the SMWSA project would be treated water meeting all applicable potable water quality standards. Various combinations of peak and off-peak availability of SMWSA water were assumed in evaluating infrastructure layouts and sizing.

Thus, the WRIP was developed in recognition of the planned SMWSA water supply system, building on the findings of the SMWSA Master Plan. Specifically, the WRIP presents a phased approach to implementing both the SMWSA system and local water supplies to augment the water resources portfolios for TCR, CPMD, and CPNMD with substantial renewable supplies. Deep groundwater can and should be maintained as an auxiliary source for each of the three water providers, and to serve as a drought backup supply.



Demands

Projected water demands at build-out were compiled from existing reports and information provided by the Participants. Those demands are summarized in Table 2. Annual demands are typically used in water rights and water supply planning, whereas peak day demands are used to size infrastructure. For this study, "build-out" refers to the area within the currently defined or projected service area boundaries. The timing and magnitude of build-out demands are subject to future land-use decisions and growth patterns. CPMD and CPNMD build-out demands are expected to occur between about 2010 and 2015, whereas TCR is expected to reach build-out by about 2030.

Table 2 Projected Build-out Water Demands

Entity	Annual Demand (AFY)	Peak Day Demand (mgd)
TCR	15,400	41.0
CPMD	1,600	3.4
CPNMD	2,500	5.2
TOTAL	**19,500**	**49.6**

mgd = million gallons per day

At build-out, full capture, use, and reuse of local supplies could supply a significant portion of the annual combined demands of the Participants. Future imported renewable water supplies via SMWSA supply projects will be needed to make up the difference between local renewable supplies and build-out demands, allowing the three entities to transition to supply portfolios that are substantially or fully renewable.

Alternatives for Capture of Local Renewable Supplies

Several alternatives were considered for capture and use of the local renewable water supplies. Because of the highly variable flows in Plum Creek, CPMD and CPNMD's native Plum Creek rights will only periodically be available for diversion from the creek. Legally-divertible flows could quickly spike from zero to very high flow rates, suggesting the need for local storage and/or high-capacity diversion and conveyance infrastructure to fully capture and utilize the Plum Creek rights. Treated effluent supplies, in contrast, are relatively constant from day to day and throughout the year.

Resource Allocation Model

A spreadsheet-based model was developed to assist in sizing storage, conveyance, and treatment infrastructure.

The Resource Allocation Model (RAM) accounts for water availability, diversions, storage, conveyance, and water use on a monthly basis for each of the local renewable water supply sources. The RAM was used to evaluate a series of infrastructure combinations for each alternative, to identify a cost-effective balance between storage capacity, conveyance (pumping and pipeline) capacity, and capture of these supplies. The intermittent and high-peaking nature of native Plum Creek water rights makes this balance particularly challenging. Sizing of infrastructure was based on projected build-out supply and demand conditions, recognizing that implementation will be phased over time.

Key Factors in Alternatives Evaluation and Screening

Seven preliminary alternatives were screened and modified to a list of three revised alternatives for further evaluation. After a series of more detailed evaluations, one preferred alternative was identified for phased implementation. The evaluation criteria, expressed as objectives for meeting the water supply needs of the Participants, are shown in Table 3.

Table 3 Evaluation Criteria

Objective	Description
System Operability	Minimize system complexity, for ease of maintenance and operation.
Improve Reliability and Sustainability	Ensure a reliable and sustainable water supply by maximizing use of renewable water sources.
Customer Acceptability	Provide water that is aesthetically pleasing, meets or exceeds water quality standards, and avoids perception of direct reuse.
Manage Costs	Manage system costs, both capital and lifecycle costs.
Timely Implementation	Ensure that the project is technically feasible and minimize burden of permitting and intergovernmental agreements.
Minimize Environmental Impacts	Minimize construction in environmentally sensitive areas, such as identified Preble's mouse habitat.

The screening process and results are described in WRIP Technical Memoranda (TM) 2 and 3. Key drivers guiding the selection of the preferred alternative for diversion and use of local renewable water supplies included the following:

- Water quality standards. Anticipated Rueter-Hess Reservoir water quality standards would preclude the use of Rueter-Hess to store local renewable water supplies, particularly total dissolved solids (TDS) and phosphorus, without significant pre-treatment.
- Compatibility with anticipated SMWSA water supplies and infrastructure. Location of storage and treatment infrastructure to serve both the local renewable supplies and SMWSA supplies allowed a reduction in pipeline lengths and costs.
- Co-location of major infrastructure. To enhance cost-effectiveness and operational simplicity, the use of shared storage, treatment, and conveyance facilities was favored over individual systems.
- Cost-effectiveness. The preferred alternative includes ways of reducing overall capital costs and phasing implementation to defer capital costs while addressing the three entities' renewable water supply goals.
- Supply Vulnerability. A water treatment plant (WTP) dedicated to local renewable supplies would be highly susceptible to variability in the quality and quantity of Plum Creek supplies, whereas a single facility treating water from multiple sources could better absorb these variabilities.

Overview of Recommended Plan

The resulting WRIP includes phased implementation of renewable water supply sources to meet the current and future needs of the Participants. Key components include:

- Construction of a pipeline interconnection with the Centennial Water and Sanitation District's (Centennial) potable water system to divert, treat, and deliver a portion of the local renewable water supplies via Centennial's South Platte River diversions and treatment/distribution infrastructure
- Acquisition of capacity in the East Cherry Creek Valley Water and Sanitation District (ECCV) Northern Water Supply system to treat and deliver additional local renewable supplies plus future imported water supplies
- Construction of new pipelines to deliver water from the ECCV Northern pipeline's terminus to the Participants' service areas
- Acquisition of storage in Rueter-Hess Reservoir to store off-peak deliveries of water through the ECCV Northern system for subsequent periods of peak demand

- Construction of a new Regional WTP to treat water withdrawn from storage in Rueter-Hess Reservoir
- Develop and implement aquifer storage and recovery (ASR) pilot testing program to convert groundwater well to ASR and evaluate technical feasibility of ASR for seasonal storage
- Possible future development of a reclaimed water distribution system to serve certain nonpotable water demands (primarily irrigation) in the TCR service area
- Possible future local diversion of Plum Creek water rights and PCWA WWTP effluent through a surface diversion, a new Plum Creek Reservoir, and a series of Lower Plum Creek alluvial wells, with conveyance to an expanded Regional WTP for treatment and subsequent distribution to the Participants

Successful and timely implementation of the Plan schedule is dependent upon several factors and entities. Key partners in implementing the Plan include the SMWSA and its members, Centennial, ECCV, and the Parker Water & Sanitation District. Negotiations with these entities to obtain water storage, pipeline capacity, or treated water may impact the cost and schedule of program implementation and capital cost. A wide range of infrastructure capacities could be required to implement the Plan, depending on the following variables.

Peak Treated Water Capacity Available in the ECCV Northern System

TCR has purchased 1.4 mgd in peak capacity in the ECCV Northern pipeline. Additional peak capacity may potentially be available in the ECCV Northern pipeline. For purposes of the recommended Plan, it was assumed that up to 10 mgd total peak capacity could be available in the ECCV Northern system. If additional peak capacity in the pipeline can be acquired, the required storage volume in Rueter-Hess Reservoir and the size of the Regional WTP could be reduced, as could the sizes of the raw water pipeline and pump station from Rueter-Hess to the Regional WTP.

Seasonal Availability of Off-Peak Capacity

To the degree that off-peak capacity in the ECCV Northern System is available and used by the Participants, the timing and amount of off-peak capacity will affect infrastructure sizing. For example, if off-peak capacity is only available 7 months per year (e.g., October-April), additional storage capacity would be needed in Rueter-Hess Reservoir. Year-round access to the pipeline, albeit at reduced summertime flows, would reduce storage and local treatment infrastructure needs.

Local Diversion versus Northern Diversion of Local Water Supplies

The local renewable water supplies (e.g., Plum Creek surface water, effluent return flows, and LIRFs) may be captured through either local diversion (alluvial wells, surface water diversion, and new Plum Creek Reservoir near the PCWA WWTP) or allowed to flow downstream. If they are allowed to flow downstream, these rights could be captured either at Centennial's diversion points and delivered through the Centennial interconnection, and/or diverted and treated through the ECCV Northern system. Water court approval may be required to divert certain rights at downstream locations. If the water is captured locally, the Regional WTP will need to include a membrane-based treatment process to reduce TDS. If the water flows downstream for delivery through the ECCV Northern system, that system and its related components (e.g., Rueter-Hess Reservoir storage capacity) must be sized adequately to accommodate that flow.

The variables discussed are summarized in Table 4 along with the eight scenarios considered.

Table 4 Water Resources Optimization Study Variables

Scenario	Peak Cap. in North (mgd)	Diversion Point for Local Renewable Water	Total AFY through North	No. mo/yr off-peak Available	Off-peak North Cap. Required (AFY)	Max. mgd use of ECCV Off-peak Cap. (mgd)
1	10	North	19,536	7	8,300	13.9
2	10	Local	11,426	7	190	1.1
3	10	North	19,536	All	8,300	11.3
4	10	Local	11,426	All	190	0.6
5	1.4	North	19,536	7	17,963	30.5
6	1.4	Local	11,426	7	9,853	21.5
7	1.4	North	19,536	All	17,963	19.9
8	1.4	Local	11,426	All	9,853	9.2

The components of the WRIP are proposed to be implemented in the three major phases described below.

Phased Implementation Plan

The recommended implementation actions are described below in a three-phase approach, facilitating transition to renewable supplies while managing capital expenditures and cash flows. Recommended actions (planning and studies, water rights actions, and infrastructure) are summarized in Table 5.

This phased approach provides for flexibility in implementing Phases 2 and 3 as negotiations are completed with ECCV for peak and off-peak capacity in the ECCV Northern system and with Centennial for use of Centennial's infrastructure to deliver treated water through the planned interconnection. The phased implementation approach also provides for changes in Phases 2 and 3 as the technical feasibility of ASR is determined, the yield and quality of water from Lower Plum Creek alluvial wells is better characterized, and imported water rights and transport mechanisms are identified and secured.

Table 5 Water Resources Optimization Study Implementation Matrix

Time frame	Planning/Studies	Water Rights	Infrastructure
Phase 1: 2007 - 2012	• Negotiate with ECCV for peak and off-peak capacity in Northern Pipeline • Negotiate with ECCV for capacity in the Western Pipeline • Purchase storage capacity in Rueter-Hess • Secure land for Reuter-Hess pump station • Participate in ECCV pilot testing for the reverse osmosis zero liquid discharge (ZLD) process • Confirm location and secure land for new Regional WTP, initiate zoning changes as required • Investigate gravel lake storage and alluvial well field sites for diversion and firming of middle South Platte water rights • Develop and implement an alluvial well testing plan for the proposed Lower Plum Creek and West Plum Creek alluvial well field (quality and quantity) • Develop watershed quality management plan for Lower Plum Creek area to address septic system and other potential contaminant sources • Negotiate terms of storage, treatment, and delivery with Centennial for Chatfield diversions delivered through interconnect • Conduct Denver Basin ASR feasibility study and pilot testing • Form PCWA for operation/ownership of future Regional WTP if warranted • Determine need for additional Denver Basin bedrock groundwater wells	• Acquire new middle South Platte water rights to supply ECCV Northern WTP • Acquire gravel lake storage and alluvial well field sites for diversion and firming of middle South Platte water rights • Initiate water court proceedings to transfer middle South Platte water rights to municipal use • Divert available Plum Creek water rights and return flow credits (lawn returns and treated effluent) at Centennial and/or middle South Platte diversion • Complete Chatfield Reservoir Reallocation Environmental Impact Statement (EIS), acquire Chatfield reallocation storage capacity • Decree CPN/CP 2004 Water Rights Applications • Quantify and permit TCR/CPMD/CPNMD LIRFs	• Identify and evaluate alternative ways to divert and convey water from the South Platte River to the ECCV WTP • Design and construct interconnect between Centennial and the Participants • Design and construction modifications to either convert the Participants to chloramination for disinfection or provide break-point chlorination at point of connection with the Centennial system • Finalize routing and initiate acquisition of easements for the following pipelines: – Treated water connection from ECCV Northern pipe terminus to Regional WTP site, including spur to Rueter-Hess – Raw water pipeline from Rueter-Hess pump station site to Regional WTP site – Treated water pipeline from Regional WTP site to TCR distribution system connection point – Raw water line from Lower Plum Creek and West Plum Creek alluvial well fields to Plum Creek reservoir site then to Regional WTP site • Connect TCR golf courses to alluvial wells • Design and permit 10-mgd expansion to ECCV WTP (including ZLD)

Table 5 Water Resources Optimization Study Implementation Matrix (cont.)

Time frame	Planning/Studies	Water Rights	Infrastructure
Phase 2: 2013 - 2017		• Continue acquisition of middle South Platte water rights to supply ECCV Northern WTP	• Construct a 10-mgd expansion to the ECCV WTP including a ZLD treatment train • Design, permit, and construct treated water pipeline from ECCV Northern line terminus to the site of the future Regional WTP • Design, permit, and construct treated water pipelines from the site of the future Regional WTP to the point of connection with TCR's water distribution system near the Ray Waterman Regional WTP and to CPMD/CPNMD's distribution systems near CPNMD's existing groundwater WTP • Design, permit, and construct Plum Creek Reservoir and surface water diversion on East Plum Creek
Phase 3: 2018 - 2022	• Determine economic benefit of local capture of Plum Creek rights and return flows versus continued diversion via Centennial and/or middle South Platte diversion	• Continue acquisition of middle South Platte River water rights to supply ECCV Northern WTP	• Design, permit, and construct raw water diversion and pipeline from the Greeley area to ECCV WTP • Design, permit, and construct a new pipeline (stub) from the south end of the ECCV Northern pipeline to Rueter-Hess • Design, permit, and construct raw water pipeline and pump station from Rueter-Hess to Regional WTP • Design, permit, and construct Regional WTP (modified conventional treatment train)
Local Diversion of WRIP Water	• Design, permit, and construct pump station and pipelines from West Plum Creek and Lower Plum Creek to Plum Creek Reservoir then to Regional WTP (if locally diverting renewable water) • Design, permit, and construct expansion to Regional WTP (reverse osmosis train to treat effluent return flows) • Construct nonpotable reclaimed water system		

Phase 1: 2007 through 2012

Phase 1 initiates deliveries of renewable water, while securing infrastructure capacities and rights-of-way that will be needed to implement Phases 2 and 3 for additional renewable supply. This allows deferment of many capital costs but addresses the "opportunity risk" associated with the availability and/or cost escalation of key infrastructure components, easements, and rights-of-way. Also during Phase 1, additional engineering analyses will be conducted to identify the technical feasibility of Phase 2 and 3 components such as ASR, alluvial well recovery in the Lower Plum Creek well field, and methods of raw water delivery from the South Platte River to the ECCV Northern system.

Phase 1 is subdivided into activities that should commence immediately and capital investments that can occur later in the phase. Figure 1 depicts major capital investments and other key actions required in Phase 1. At the end of Phase 1, the Participants will be able to deliver limited amounts of treated renewable water to their customers using off-peak or limited capacity in the ECCV Northern system and the Centennial interconnect.

Immediate Actions: Year 2007/2008

To initiate deliveries of renewable water, the Participants should immediately pursue implementation of the Centennial interconnection pipeline. The quantity and seasonality of treated water deliveries from Centennial

have not yet been determined but are currently estimated between 5 and 10 mgd. During the early portion of Phase 1, the Participants should complete discussions with Centennial to determine costs, capacities, and other operational terms associated with diverting, treating, and conveying water through the Centennial system to the Centennial boundary delivery point. Sizing of the interconnect pipeline from that point should consider the agreed-upon peak delivery capacities from Centennial as well as potential future uses of the pipeline, at which point the pipeline should be designed and constructed from the point of connection with the Centennial/ Highlands Ranch system to the TCR, CPMD, and CPNMD systems.

Because Centennial uses chloramines as its disinfectant, implementation of the interconnection will need to include either conversion of the Participants' systems to chloramination, or breakpoint chlorination of the Centennial water deliveries at the point of interconnection between the systems.

Additional actions should be taken in 2008 to secure infrastructure and easements critical to future phases of the plan.

In order to provide direction for future implementation steps, the Participants should immediately initiate negotiations for acquisition of peak and off-peak capacity in the ECCV Northern pipeline. By securing capacity in the ECCV Northern pipeline, the Participants can mitigate the risk associated with potential sale of this capacity to others, and the related infrastructure needs can then be finalized for implementation in Phases 2 and 3.

Based on WRIP analyses, the Participants should jointly pursue acquisition of a total of 10 mgd of peak capacity (available for use at any time, not shared with ECCV or others) in the ECCV Northern pipeline. Because TCR already holds 1.4 mgd of peak capacity in the line, the net addition of peak capacity would be 8.6 mgd. The Participants should also jointly pursue an additional 14 mgd of off-peak capacity in the ECCV Northern pipeline for use in October through April, plus any excess available capacity in the pipeline not used by ECCV from May through September. These capacities may not be fully used until some time closer to build-out, but securing them now addresses the potential that they would no longer be available if the Participants sought to acquire the capacity at or near build-out. WTP and booster pump station capacities will be acquired separately, as further described below.

Assuming those pipeline capacities and no ASR storage, a total of 9,000 acre-feet (AF) of terminal storage in Rueter-Hess Reservoir would ultimately be needed to manage the Participants' build-out renewable water supplies. Additional storage to accommodate possible other future sources and water management practices should be considered in making final decisions on the volume of storage to acquire in Rueter-Hess Reservoir. Current schedules call for any participants in the expanded Rueter-Hess Reservoir to remit payment in full to the Parker Water and Sanitation District for the desired capacity in late 2007 or early 2008.

The initial 10-mgd ECCV Northern WTP to serve ECCV's near-term needs is under design and is expected to be online as early as 2009. Permitting will restrict the discharge of membrane process concentrate from the WTP to ECCV's use of the 10-mgd facility. Because the ECCV Northern pipeline conveys treated water to ECCV's service area, the Participants must also treat raw water supplies at the north end of the pipeline. To use the anticipated additional 10 mgd of peak pipeline capacity allocated to the Participants, ECCV's 10-mgd treatment plant will need to be expanded with a second 10 mgd, including a ZLD treatment train to eliminate concentrate discharge associated with the expansion. Phase 1 includes design and permitting of the 10-mgd expansion of the ECCV WTP and ZLD treatment train, to coincide with the timing of design of ECCV's own initial 10 mgd of WTP capacity. Construction of the expanded 10 mgd of peak ECCV WTP capacity for the Participants' peak use and associated booster pump station capacities is planned for Phase 2.

The Participants should also initiate acquisition of capacity in the ECCV Western Pipeline in collaboration with Centennial. The ECCV Western Pipeline would be used to move water from the terminus of the ECCV Northern Pipeline (near Smoky Hill Road and E-470) to Centennial, and then on to the Participants via the Centennial interconnection. By using the ECCV Western Line and Centennial interconnect, the Participants can defer the need to build a new pipeline from the ECCV Northern line terminus to their respective service areas.

Rights-of-way for the future treated and raw water pipelines should be secured in Phase 1 as indicated in Figure 1. Douglas County is preparing to pave Hess Road from east of the Rueter-Hess Reservoir to Interstate 25. In addition, Douglas County is re-aligning Daniels Parkway and Castle Pines Parkway. Although these pipeline segments will not be used in Phase 1, it may be cost-effective to accelerate construction of certain pipelines (e.g., along Hess Road and Daniels Parkway) to avoid the need to re-pave roads that are currently unpaved. Costs and phasing described in this Plan assume that pipeline construction will occur in later phases.

Additional immediate steps for near-term implementation include:

- Participate in the planned ECCV ZLD reverse osmosis membrane concentrate water pilot testing
- Evaluate alternate methods to divert existing and future Participant water rights from the South Platte River and convey them to the ECCV Northern WTP
- Complete the formation of the Plum Creek regional water authority including determination of cost sharing terms and facility ownership and operation protocol
- Conduct siting analyses for the future Regional WTP and acquire the necessary property
- Develop and implement an ASR feasibility testing program
- Develop and implement a Lower Plum Creek alluvial well production and quality testing program
- Initiate acquisition of South Platte River water rights for future diversion and use
- Continued use of the nonpotable reuse system to meet the irrigation demands of the three golf courses in the CPMD and CPNMD service areas

Year 2009-2012

The initial years of Phase 1 (2007/2008) include acquisition of ECCV Northern pipeline capacity, but do not include acquisition of treatment or pumping capacity. To allow use the off-peak capacity of the Northern system in the near-term, the Participants should negotiate operational terms and costs associated with up to 14 mgd of off-peak use of ECCV's future Northern WTP and the Northern Pipeline Booster Pump Stations. Off-peak capacity in the Northern System will be phased in as ECCV expands its WTP and Booster Pump Stations to meet its own needs.

Additional implementation actions recommended during the second half of Phase 1 include:

- Purchase reallocated storage capacity in Chatfield Reservoir upon successful completion of the Chatfield reallocation EIS and related permitting, to facilitate management of Plum Creek water rights and effluent return flows.
- Complete testing to determine the technical feasibility of ASR for storage of water conveyed via the Northern system during off-peak demand periods. ASR could provide alternative storage to surface water with limited or no retreatment required prior to entering the distribution system.
- Complete Lower Plum Creek alluvial well testing and identify the feasibility of using alluvial wells to divert local renewable supplies in the future.
- Connect TCR's Red Hawk Ridge and Plum Creek golf courses to the existing East Plum Creek alluvial wells to supply those demands with nonpotable water, easing demands on the Denver Basin aquifer.

Phase 2: 2013 through 2017

Under Phase 2, infrastructure will be added to the renewable water treatment and delivery system to allow significant increases in peak renewable water supply capacity. Figure 2 shows the major components added during Phase 2. Phase 2 primarily includes construction of the capital improvements planned during Phase 1. At the end of Phase 2, the Participants will have access to the following renewable water deliveries:

- Treated water delivered via the Centennial interconnect (from Phase 1)
- Up to 10 mgd of peak treated water delivered via the ECCV Northern system

Sources of renewable water during this phase will include the local water supplies and additional acquisitions in the South Platte River, which will be diverted from the South Platte River through the Centennial system and diversion(s) feeding the ECCV Northern system.

Full use of the ECCV Northern system capacities to meet build-out demands with renewable supplies will require

the use of Rueter-Hess Reservoir and the Regional WTP, which will be implemented in Phase 3.

During Phase 2, the ECCV WTP 10-mgd expansion (including a ZLD treatment train) will be constructed to serve the Participants' 10-mgd peak water deliveries. Similarly, the Northern line's three booster pump stations that transport the treated water through the Northern pipeline will each be expanded by 10 mgd of peak capacity dedicated to the Participants.

This phase also includes connection of the ECCV Northern system directly to the Participants' distribution systems. A 42-inch diameter treated water pipeline will be constructed from the terminus of the ECCV Northern pipeline (near Smoky Hill Road and E-470) south and west past Rueter-Hess Reservoir to the site of the future Regional WTP. The length of this pipeline could be shortened if sufficient capacity is available in the ECCV Western line on a long-term basis. In that event, the ECCV Western pipeline would convey treated water to a point along E-470 north of Rueter-Hess Reservoir, and a new 24-inch diameter treated water pipeline segment would be constructed to tap into the Western line and deliver water south past Rueter-Hess Reservoir to the site of the future Regional WTP.

From the site of the future Regional WTP, separate pipelines and pump stations will be built to convey the treated water to distribution delivery points. This includes a 24-inch diameter pipeline to a CPMD/CPNMD delivery point near CPNMD's existing groundwater WTP, and a 48-inch diameter pipeline to a TCR delivery point near TCR's existing Ray Waterman Regional groundwater WTP.

Finally, this phase includes design and construction of a surface diversion on East Plum Creek just upstream of the PCWA WWTP outfall and a new 1,300 AF Plum Creek Reservoir to capture and manage the highly-variable Plum Creek water rights. Water will be captured in the reservoir as needed to meter flows downstream for diversion via the Centennial system and ECCV Northern system, and can be stored in Plum Creek Reservoir if and when needed to avoid losing the water during times of dry-up in Plum Creek between the Plum Creek Reservoir site and Chatfield Reservoir.

Phase 3: 2018 through 2022

Phase 3 primarily consists of adding infrastructure required to manage off-peak deliveries of water through the ECCV Northern system, such that Participants' peak day demands and year-round demands can all be met with renewable water. In addition, Phase 3 includes optional construction of local diversion, treatment, and conveyance infrastructure that could be used if and as needed to meet future demands without expanding the Centennial interconnect or ECCV Northern delivery systems. Figure 3 shows the major components added during Phase 3.

Phase 3 includes construction of a new 42-inch diameter pipeline from a South Platte River diversion in the greater Greeley area down to the ECCV Northern WTP, to bring additional raw water supplies to the plant for treatment and conveyance. The final siting and length of this pipeline will depend in large part on the nature and location of the water rights acquired in the South Platte River.

Also in Phase 3, a new stub pipeline from the south end of the ECCV Northern treated water delivery system will be constructed to allow off-peak deliveries to be discharged to Rueter-Hess Reservoir for subsequent peak season use. Also included are construction of a raw water pump station and pipeline to withdraw water from Rueter-Hess Reservoir and deliver it to the site of the Regional WTP.

The Regional WTP will be sized to meet the peak day demands of the Participants, after subtracting out peak day water delivered directly from the ECCV Northern system (without storage in Rueter-Hess Reservoir). Assuming a combined 49.6-mgd peak day demand at build-out, and 10 mgd of peak capacity in the ECCV Northern system, the Rueter-Hess raw water pump station and pipeline and the Regional WTP will each be sized for 39.6 mgd of peak capacity.

Water withdrawn from Rueter-Hess Reservoir will be treated using an advanced conventional treatment process at the newly-constructed Regional WTP. Membrane treatment will not be required for this source water, because Rueter-Hess water quality standards are expected to govern TDS levels to within applicable secondary drinking water standards. Water discharged to Rueter-Hess from the Northern system will meet these standards, as it will already have been treated to drinking water standards including TDS removal. Water treated at the Regional WTP will be distributed using treated water pipelines constructed in Phase 2.

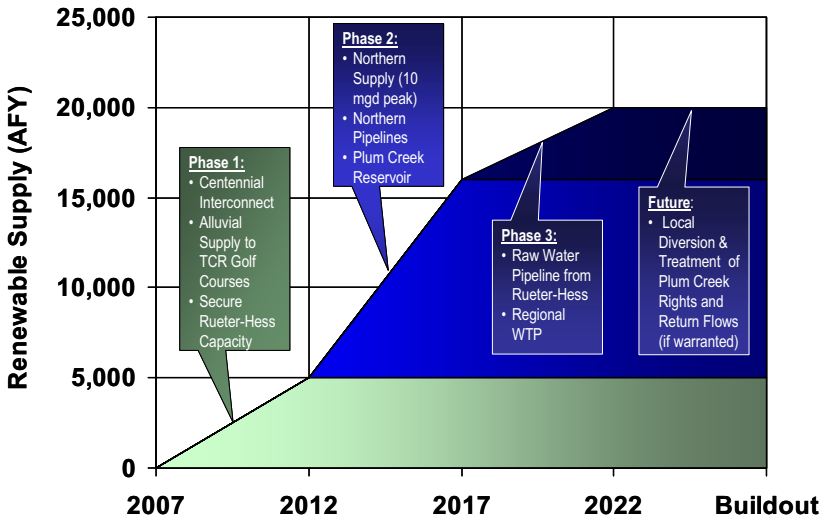
By Phase 3, the Participants will have additional information that will facilitate final determinations of whether to add infrastructure to locally divert local water supplies (e.g., treated effluent return flows and Plum Creek supplies), rather than diverting them through the Centennial interconnect and ECCV Northern system. Factors that could influence the need to locally divert these sources include:

- Peak and off-peak capacities, costs, and operational conditions associated with use of the Centennial interconnect and the ECCV Northern system
- Use of those capacities in light of growth rates or patterns and demands that differ from those assumed in developing this Plan
- Cost-effectiveness of continued north diversion of local renewable supplies, considering instream losses of water rights, Northern system pumping and treatment costs, etc.
- Other sources of water rights and utilization of the Phase 1, 2, and 3 infrastructure to manage those sources

Local diversions of local renewable water supplies could include one or more of the following:

- Construction of a 20-mgd Plum Creek Pump Station and a 36-inch diameter raw water pipeline to convey Plum Creek water rights from Plum Creek Reservoir to the new Regional WTP for treatment and distribution
- Construction of approximately 36 alluvial wells along Lower Plum Creek and approximately 4 alluvial wells along West Plum Creek well field to divert West Plum Creek rights and treated effluent return flows
- Construction of a 24-inch diameter raw water pipeline and associated pump stations to transport up to 10.3 mgd of alluvial water to new Regional WTP
- Addition of a 10.3-mgd membrane-based treatment train at the Regional WTP to treat raw water from the alluvial wells (effluent return flows) down to acceptable TDS levels, considering the elevated TDS concentrations of effluent return flows in Lower Plum Creek
- Implementation of some or all phases of the TCR nonpotable reuse system, primarily for nonpotable irrigation demands, as described in the TCR 2005 Reclaimed Water Master Plan, offsetting up to 2,900 AFY of annual and 4.6 mgd of peak day potable demand

The three phases of implementation will incrementally increase renewable water supplies to the Castle Rock region. Key elements of the phases are indicated above.



Schedule of Capital Investments

Planning level opinions of probable cost were prepared for each infrastructure component, for guidance in project evaluations and recommendations. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, terms of negotiated acquisition of existing infrastructure capacity (e.g., ECCV Northern pipeline), and other variable factors. Consequently, the final project costs will vary from the opinion of probable cost presented in this evaluation report. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

The level of accuracy for construction cost estimates varies depending on the level of detail to which the project has been defined. The American Association of Cost Engineers has developed guidelines that indicate that master plans such as this should have an anticipated accuracy of +50 percent to –30 percent.

The opinions of probable cost includes a 30 percent contingency. Sales tax and legal fees are not included. The total opinion of probable cost includes engineering and administration costs. Land acquisition is included, but is highly variable and is only estimated in the total cost. Land acquisition could cause a significant change in program costs.

For this Plan, infrastructure was sized under the assumption that all local renewable supplies would be diverted, treated, and delivered through the ECCV Northern system. Should growth, cost-effectiveness, or other factors dictate the need for local diversions of renewable supplies and development of a TCR nonpotable reuse system, those costs would be added to the overall total. Estimates of costs associated with these optional future components are also presented under the Phase 3 costs, assuming that they would not be needed until at least 2017.

Estimated capital costs for the combined needs of TCR, CPMD, and CPNMD, including infrastructure investments and water rights acquisitions, range from about $750 million to $900 million in 2007 dollars. Annual operations and maintenance costs are estimated to range from about $11 million to $13.5 million. Allocation of costs between the three entities was not estimated as part of this Plan.

These cost variations are illustrated in the capital improvement plan (CIP) schedule diagram (Figure 4), including a summary of costs in 2007 dollars by major implementation phase.

Conclusion

This Plan, as designed, will maximize the use of the Participants' local Plum Creek tributary supplies, ensure the ability to recapture all of the reusable return flows, and implement the renewable water supply goals of TCR, CPMD, and CPNMD in coordination with the adopted South Metro Regional Water Master Plan (Figure 5). Through phased implementation of the components described in this Plan, the Participants will be able to transition to renewable water supplies in a timely and fiscally responsible manner to meet their customers' current and future water needs.

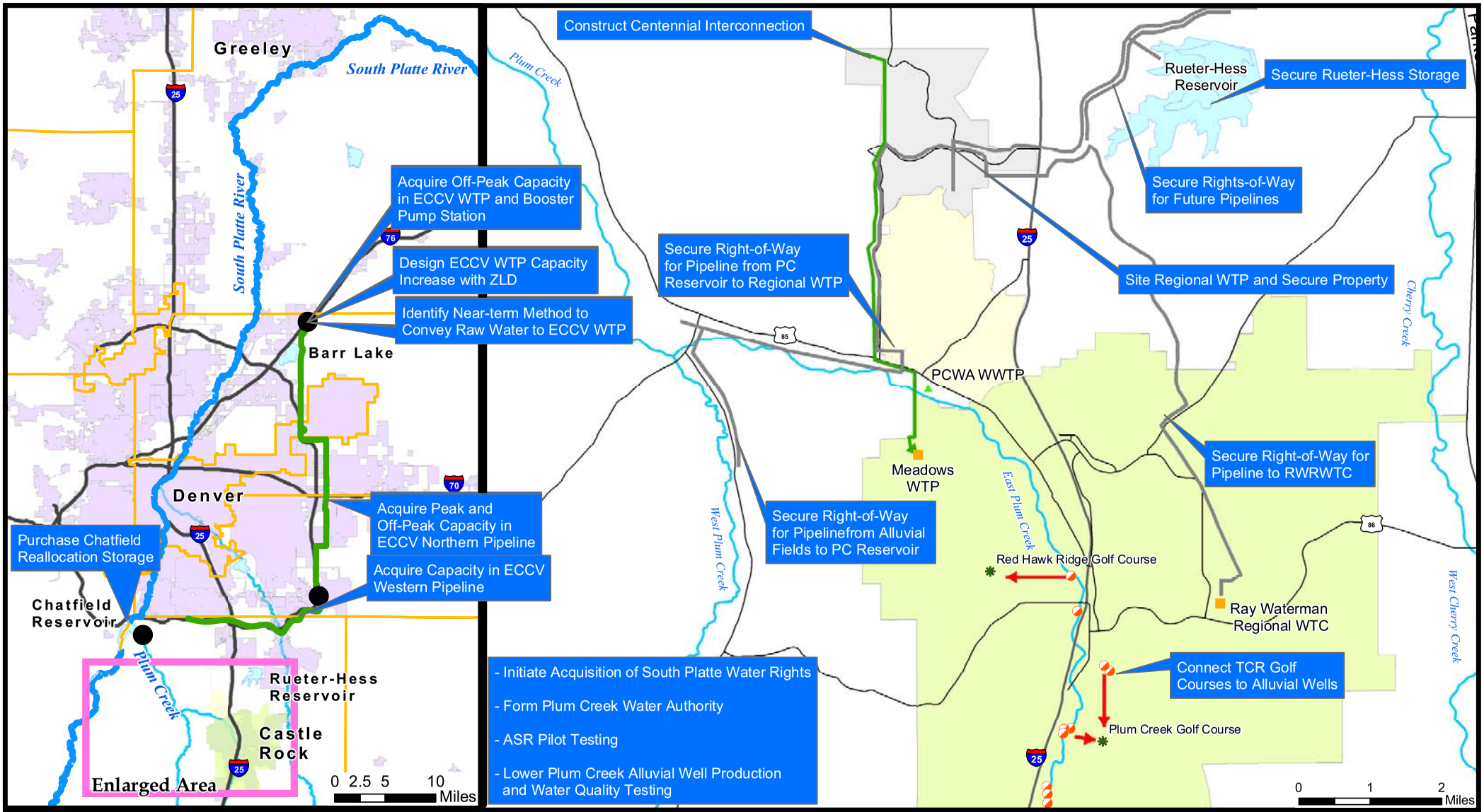


Figure 1: Implementation Phase 1 - 2007 through 2012

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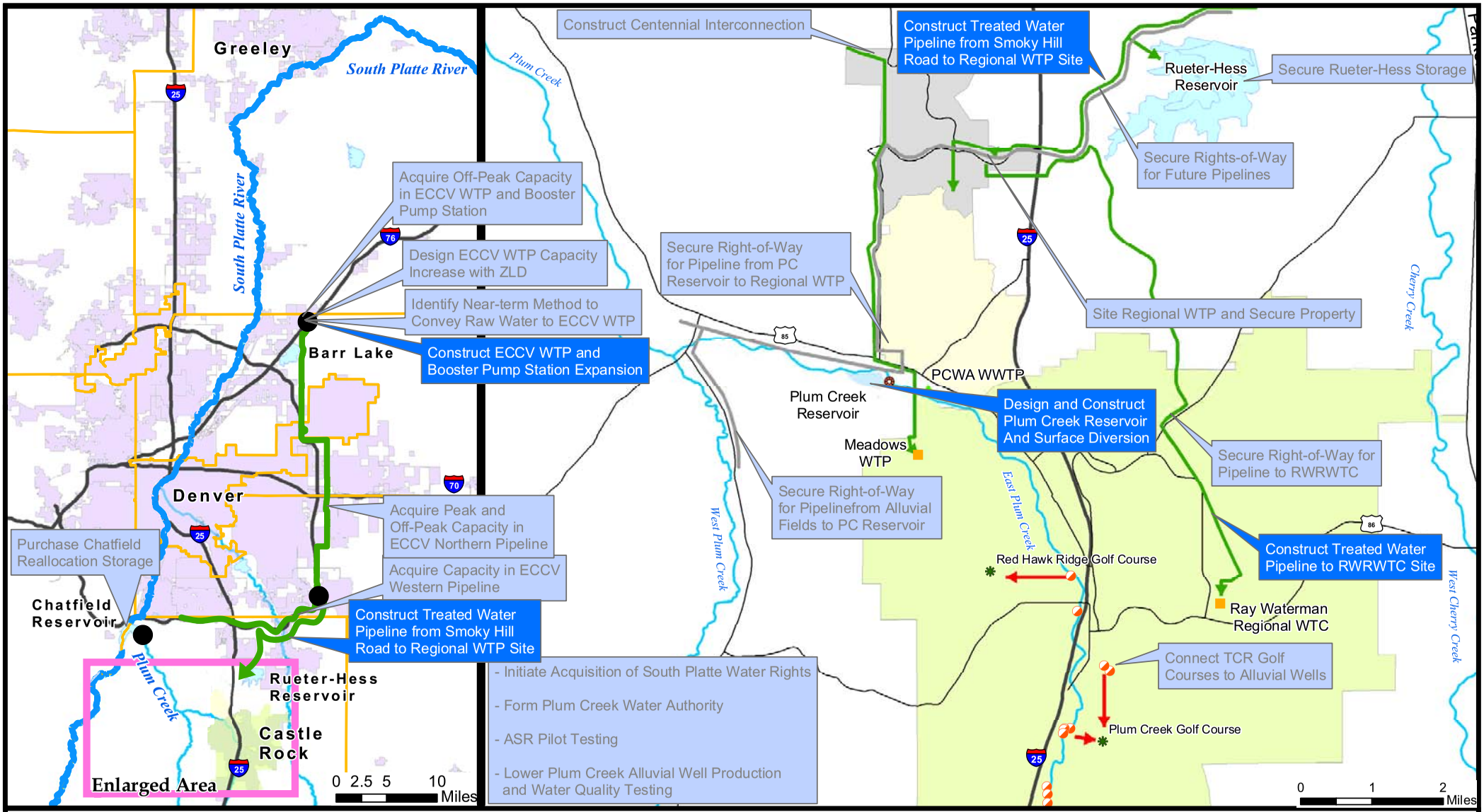

Figure 2: Implementation Phase 2 - 2013 through 2017

Water Resources Implementation Plan

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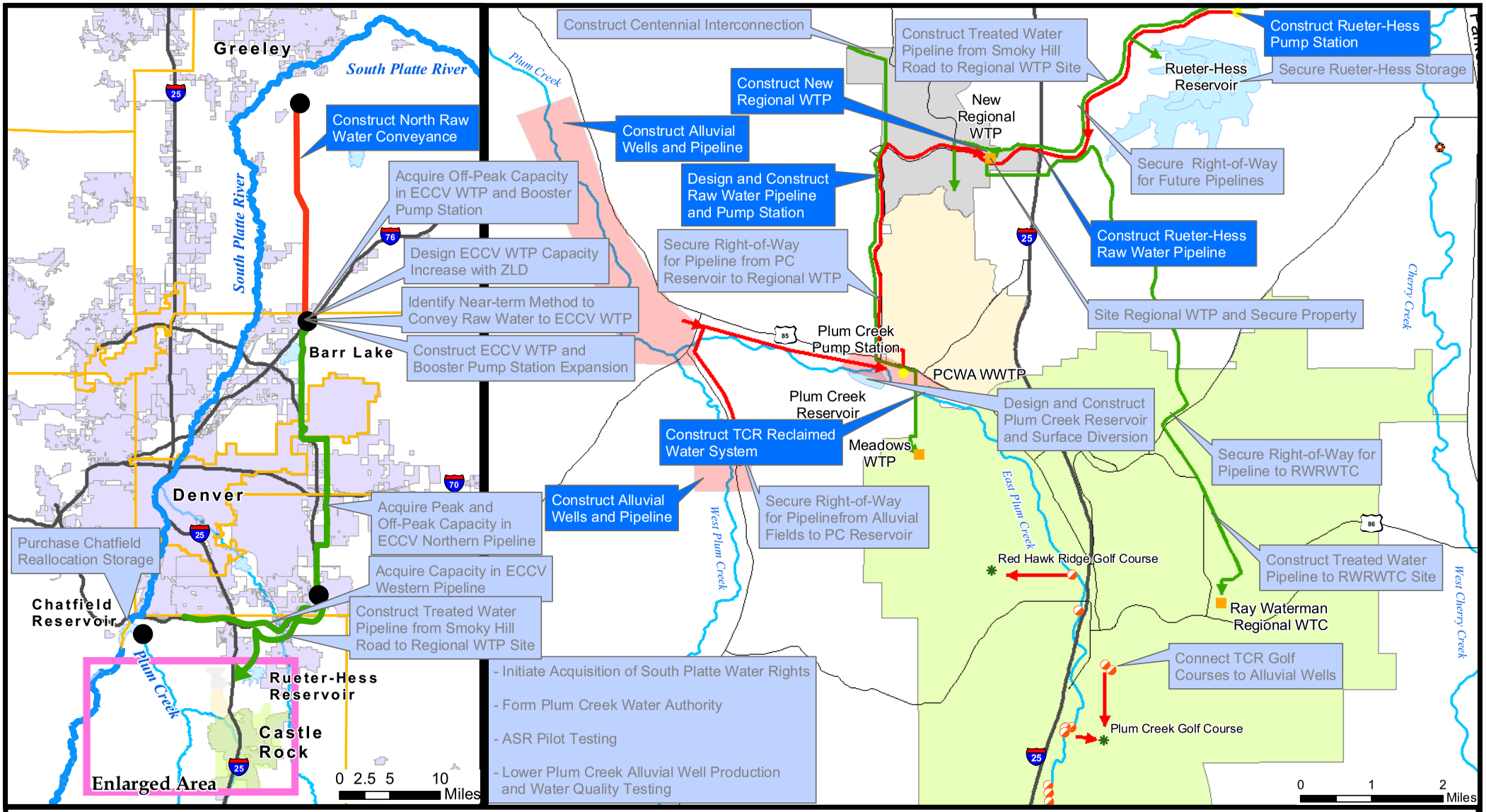

Figure 3: Implementation Phase 3 - 2018 through 2022

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Stream | Roads | Castle Pines North Metro District | WWTP | TCR Alluvial Well | Raw Water
Lake or Reservoir | Highway | Castle Pines Metro District | WTP | Alluvial Well Field | Treated/Potable Water
County Boundary | Golf course | Town of Castle Rock | Pump Station | Surface Diversion | Right of Way

Water Resources Implementation Plan

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Figure 4: Capital Improvement Recommended Implementation Schedule

			Phase 1: 2007-2012						Phase 2: 2012-2017					Phase 3:2018-2027
Phase	Component	Total Cost ($M)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018-2027
All	Water Rights Acquisition, Diversion and Firming Facilities	$ 200	$ -	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$100
1	ECCV Northern Pipeline (PW): Acquire peak capacity	$ 15		$15										
1	ECCV WTP: Acquire off-peak capacity	$ 30						$30						
1	ECCV Northern Booster Pump Stations: Acquire off-peak capacity	$ 6						$6						
1	ECCV Northern Pipeline (PW): Acquire off-peak capacity	$ 10		$10										
1	Rueter-Hess Reservoir: Purchase capacity	$ 50	$50											
1	Centennial Interconnection Pipeline & Pump Stations (PW)	$ 12	$1.6	$9.8	$0.6									
1	ECCV Western Pipeline (PW): Acquire capacity	$ 15		$15										
1	Connect TCR Golf Courses to Plum Creek Alluvial Wells (RW)	$ 6					$0.49	$5.4	$0.31					
2	PW Pipeline from ECCV Northern Pipeline terminus to Rueter Hess site	$ 25									$1	$ 2 $20	$1	
2	PW Pipeline from Rueter-Hess site to Regional WTP site	$ 28									$2	$ 2 $23	$1	
2	PW Pipeline/PS: Regional WTP to TCR distribution point at Waterman	$ 53									$3	$ 4 $43	$3	
2	PW Pipeline: Regional WTP to CPNMD/CPMD point of connection	$ 4									$0.2	$0.3 $3	$ 0.2	
2	ECCV WTP: Construct 10 MGD dedicated expansion	$ 43								$ 3	$ 3 $12	$23	$2	
2	ECCV Northern Booster Pump Stations: Construct 10 MGD dedicated	$ 9									$0.5	$0.6 $7	$0.5	
2	Plum Creek Reservoir and Surface Diversion	$ 7										$0.6	$6 $0.4	
3	RW Pipeline/PS from South Platte River diversion to ECCV WTP	$ 122												$122
3	Rueter-Hess Pump Station	$ 15												$15
3	RW Pipeline from Rueter-Hess PS to Regional WTP	$ 26												$26
3	Regional WTP: Advanced Conventional Treatment for RH Water	$ 76												$76
	TOTAL PHASES 1 THROUGH 3	$ 751.5					SUBTOTAL PHASE 1	$194.1			SUBTOTAL PHASE 2		$218.0	SUBTOTAL PHASE 3 $339.4

PW = Potable Water; RW = Raw Water; PS = Pump Station; RH = Rueter-Hess Reservoir

Capital project components that may be implemented after 2017 based on economics or demand conditions:

RW Pipeline from Plum Creek Reservior to Regional WTP	$ 14
Plum Creek Reservoir PS	$ 10
Lower Plum Ck. alluvial wells (diversion of effluent return flows)	$ 11
West Plum Ck. alluvial wells and pipeline to Plum Creek Reservoir	$ 9
RW Pipeline from Lower Plum Creek Alluvial wells to Regional WTP	$ 33
Regional WTP: Add Reverse Osmosis Train for Alluvial Water Diversions	$ 35
TCR Reclaimed Water System: all phases per Reclaimed Water Master Plan	$ 23

Annual O&M Cost (in $M)

System Component	Treatment	Pipeline	Pump station	Surface Diversion	Reservoir	Alluvial Wells	Total O&M
O&M Cost ($M)	$11	$0.6	$0.5	$0.01	$0.1	$0.3	$12.3

Notes:

Total cost includes estimate for engineering, 30 percent contingency. Cost does not include land acquisition. Costs are in 2007 dollars.

Implementation of local capture of water may be initiated by changes in discharge regulations for the PCWA WWTP or results of pump testing for alluvial wells at Lower Plum Creek or West Plum Creek wellfields.

Permitting/acquisition/study
Design
Construction
Start-up

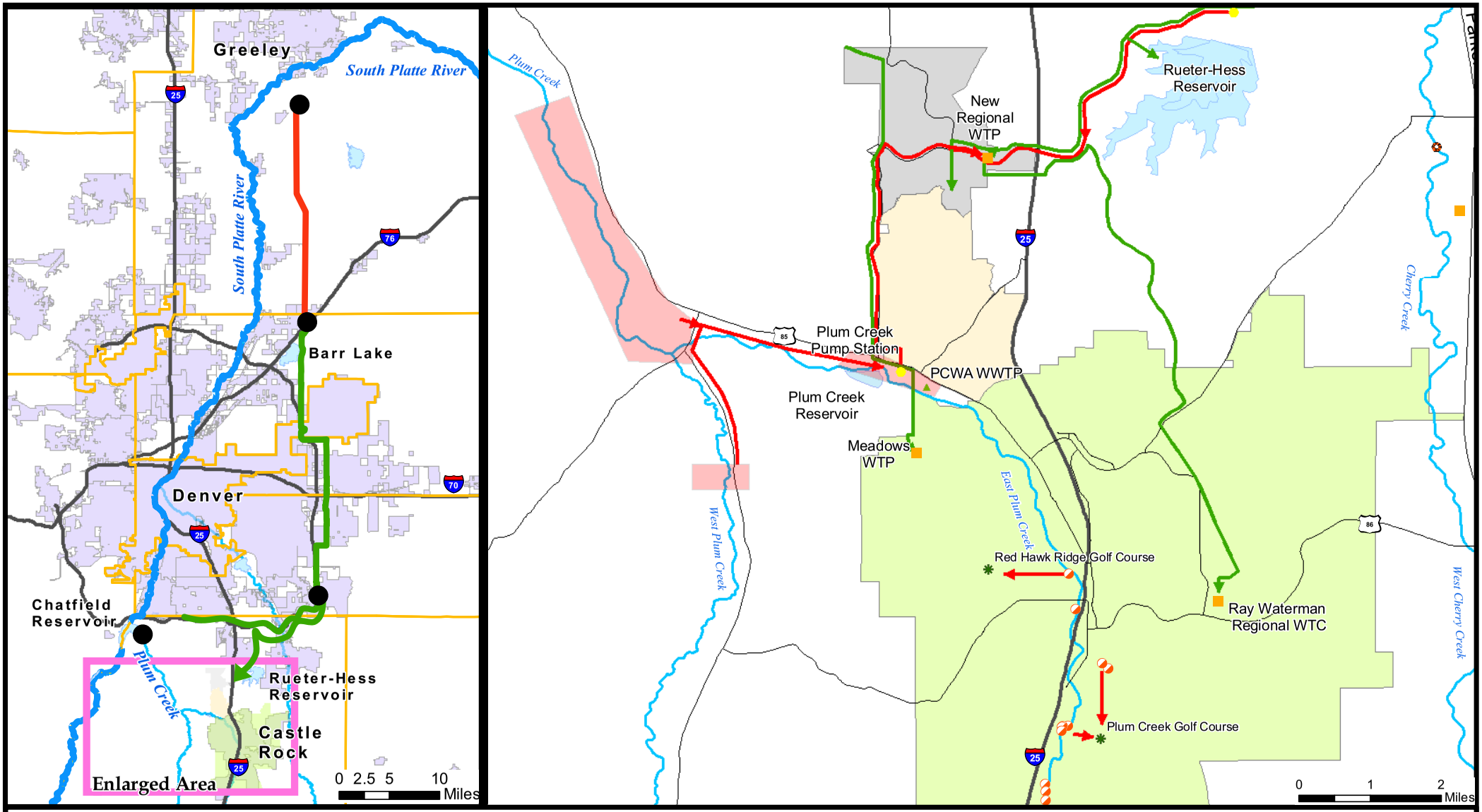

Figure 5: WRIP Infrastructure after Implementation Phases 1 to 3

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Stream
Lake or Reservoir
County Boundary
Roads
Highway
Golf course
Castle Pines North Metro District
Castle Pines Metro District
Town of Castle Rock
WWTP
WTP
Pump Station
TCR Alluvial Well
Alluvial Well Field
Surface Diversion
Raw Water
Treated/Potable Water
Right of Way

Water Resources Implementation Plan

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