STATE OF COLORADO

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TO: CWCB Board of Directors

FROM: Veva Deheza, Section Chief
Kevin Reidy, Water Conservation Technical Specialist
Office of Water Conservation & Drought Planning

DATE: July 6, 2010

SUBJECT: **Agenda Item #22, July 20-21, 2010 Board Meeting**
Office of Water Conservation & Drought Planning-Sterling Ranch
Application for the Rainwater Harvesting Pilot Project Program

Staff Recommendation
The CWCB staff recommends that the Board approve the Rainwater Harvesting Pilot Project Application from Sterling Ranch.

Introduction
On March 1, 2010, the CWCB received an application from Sterling Ranch to be selected as a Rainwater Harvesting Pilot Project. The application was reviewed in accordance with the Criteria and Guidelines for the "Rainwater Harvesting" Pilot Project Program, approved and adopted by the CWCB Board in January 2010.

Background
The CWCB defines rainwater harvesting pilot projects as:

Rainwater harvesting pilot projects collect precipitation from rooftops and other impermeable surfaces and utilize the collected water for non-potable uses to evaluate water conservation potential. Pilot projects must be designed such that data collection supports the purposes identified in Section 37-60-115(6)(a), C.R.S. and further evaluates water conservation potential through pairing rainwater harvesting with advanced outdoor water demand management. Projects must be located in new residential or mixed-use development.

The goal of the pilot project program is to gain additional field-verified information about the feasibility of rainwater harvesting as a water conservation measure in Colorado, through pairing it directly with advanced outdoor water demand management – particularly efficient landscaping and irrigation practices.

The purpose of the pilot projects shall be to:

(I) Evaluate the technical ability to reasonably quantify the site-specific amount of precipitation that, under preexisting, natural vegetation conditions, accrues to the natural stream system via surface and ground water return flows;

(II) Create a baseline set of data and sound, transferable methodologies for measuring local weather and precipitation patterns that account for variation in hydrology and precipitation event intensity, frequency, and duration, quantifying preexisting, natural vegetation consumption, measuring precipitation return flow amounts, identifying surface versus ground water return flow splits, and identifying delayed ground water return flow timing to receiving streams;

(III) Evaluate a variety of precipitation harvesting system designs;

(IV) Measure precipitation capture efficiencies;

(V) Quantify the amount of precipitation that must be augmented to prevent injury to decreed water rights;

(VI) Compile and analyze the data collected; and

(VII) Provide data to allow sponsors to adjudicate permanent augmentation plans.

Presentation

The Applicant or their consultant, Leonard Rice Engineers, will make a brief presentation outlining the attributes of the project. CWCB staff will present additional information on the results of the application evaluation process.

Attachments

- Appendix A – CWCB Criteria and Guidelines Checklist
- Application Evaluation by Wright Water Engineers Inc.
- Application Evaluation Memo from the Division of Water Resources

APPENDIX A – CWCB CRITERIA AND GUIDELINES CHECKLIST

A Criteria Checklist is provided below that includes a brief discussion of each item in the January 4, 2010 Criteria and Guidelines, and references within the document where additional information about the criteria requirements and our ability to meet those requirements can be found.

1. Pilot Project Sponsor

a. The name and contact information of the pilot project sponsor.

STERLING RANCH

Sterling Ranch, LLC
200 Plaza Drive, Suite 160
Highlands Ranch, CO 80129
(303)202-6800

Harold Smethills – Principal
harolds@sterlingranchcolorado.com
Jack Hoagland – Principal
jackh@sterlingranchcolorado.com
Diane Smethills – Principal
dianes@sterlingranchcolorado.com
Jim Yates – CFO
jimy@sterlingranchcolorado.com

b. A description of how the pilot project sponsor qualifies as an applicant for a new development as defined in Section 29-20-103, C.R.S., for a new planned unit development or new subdivision of residential housing or mixed uses.

Sterling Ranch, LLC filed an application to rezone the property known as Sterling Ranch on February 12, 2009 with Douglas County. Comments were solicited and consolidated by Douglas County staff at the close of the comment period on June 22, 2009. The development plan for Sterling Ranch is authorized by Section 15 – Planned Development District of the Douglas County Zoning Resolution adopted pursuant to the Colorado Planned Unit Development Act of 1972, as amended.

A Water Appeal was filed on August 28, 2009 to appeal the water supply and demand standards set forth in Section 18A of the Douglas County Zoning Resolution. Douglas County staff is currently working with the County's water consultant to perform an initial completeness review. The appeal will be heard by the Planning Commission for a recommendation to the Board of County Commissioners (BCC), and by the BCC, which will include a public comment period. A date for the hearings has not currently been set.

As there is no official preliminary zoning approval in Douglas County, we would interpret the successful changing of the Douglas County Comprehensive Master Plan as representative of such preliminary approval. As such, we interpret Sterling Ranch as being eligible for sponsorship of a rainwater harvesting pilot project for this 2010 selection period. In addition, because Sterling Ranch is actively in the process of applying for zoning, we would interpret these actions to show intent from Sterling Ranch to secure final approval, and intent of Douglas County to continue working with Sterling Ranch in these endeavors.

c. A list of the organizations and/or individuals including those hired or otherwise retained by the entity that will assist in development and implementation of the pilot project and analysis of data, including a written statement of their role and contributions and any applicable professional licensing/certifications (e.g., licensed professional engineer, plumber, landscape irrigation designer, etc.). Applicant must demonstrate its commitment to carrying out the goals of the pilot project through demonstrating adequate staffing (paid or volunteered, in-house or outsourced, consultants, advisors, etc.) and a commitment to make the applicant's resources available to carry out the pilot project.

Sterling Ranch has contracted with several consultants for the planning and preliminary design of the Sterling

Ranch development. These resources have been used for the zoning application, including the water plan and water conservation plan, and for various discussion leading up to the Precipitation Harvesting Pilot Project application development. All aspects of the Sterling Ranch Pilot Project are represented by one or more members of the "Precipitation Harvesting" Team. Each team member will contribute to the Precipitation Harvesting Pilot Project in their area of expertise as it fits into the components of the Pilot Project as described in the application.

Leonard Rice Engineers, Inc. – Water Resources Engineers for Sterling Ranch, Project Manager for Rain Water Harvesting Study

R. Gregory Roush, P.E. – LRE President, Client Principal
Mary Kay Provaznik, P.E. – LRE Project Manager for Sterling Ranch
Val Flory, P.E. – Project Engineer for Rain Water Harvesting Study
Mark Mitisek, H.I.T. – Staff Engineer for Rain Water Harvesting Study
Wayne Eckas, P.E. – Project Engineer for Rain Water Harvesting Study

Braun & Yoshida Architects – Sterling Ranch Site Planner and Architect

Arlo Braun, A.I.A. – Sterling Ranch Architect

Wenk Associates, Inc. – Sterling Ranch Landscape Architects

Bill Wenk, L.A. – Sterling Ranch Landscape Architect
Natalie S. Faber – Sterling Ranch Landscape Architect

Kennedy/Jenks – Sterling Ranch Infrastructure Designers and Planners

Chris Douglass, P.E. – Kennedy/Jenks Project Manager for Sterling Ranch
Gordon C. Muerer – Kennedy/Jenks Vice President, Design Review

Carroll & Lange-Manhard – Stormwater and Drainage Infrastructure Planning and Design

Richard Weed, P.E. – Civil Engineer
Brian Hart – Civil Engineer

Headwaters – Water Resources and Precipitation Harvesting

Beorn Courtney, P.E. – Rainwater Harvesting and Water Conservation Planning and Design

Ryley Carlock & Applewhite – Legal Counsel for Precipitation Pilot Study

Carolyn Burr – Attorney

OneRain – Climate Monitoring and Precipitation Experts

James Logan – OneRain President and COO, OneRain Project Manager for Sterling Ranch
Ilse Gayl – OneRain Owner and CEO
Mike Zucosky – Field Technician for Sterling Ranch Climate Station

Earth Wrights Designs – Precipitation Harvesting Design Expert

Richard Jennings – Rainwater Harvesting Design Consultant

The TSR Group – Data Manager for Sterling Ranch

Matthew C. "Quint" Redmond – Chairman & CEO
Carmen Skeehan – TSR Director of Business Development and Operations, TSR Project Manager for Sterling Ranch
Eric Buehler – GIS and Database Management

2. Application Fees

An application fee of $4,000 and demonstration of ability to provide an annual review fee of $7,000 throughout the pilot project, per Section 37-60-115(6)(b)(I), C.R.S. H.B. 09-1129 limited the CWCB's ability to spend money to implement the Act. **As a result, only those applicants and the fees paid that fall within the Board's authorized spending authority shall be selected.** The CWCB indicated that the spending authority granted by H.B. 09-1129 would be a limiting factor in selecting and awarding projects. The Board will consider the need for the submission of a future budget Change Request if it determines such a request is needed. The annual review fee will be due one year after acceptance as a pilot project.

Sterling Ranch is committed to provide, and has already committed significant resources to the review, education, evaluation, and understanding of precipitation harvesting. As is shown in the pilot project schedule attached, the duration of the pilot project is expected to be approximately seven years. We are enclosing a check for the required application fee of $4,000. We also understand and are committed to the $7,000 annual review fee for the duration of the pilot project.

3. Description of New Development

A description of the proposed new development, per Section 37-60-115(6)(b)(II), C.R.S., including

a. Description of the current conditions of the project site and watershed.

Sterling Ranch is approximately 3,000 acres of contiguous land located on the Front Range of Colorado in northwest Douglas County. The site is a high desert rangeland consisting of two drainages that are tributary to the South Platte River and is south of Chatfield Reservoir. Less than 15%, or approximately 475 acres, have been previously developed or disturbed and the rest is rolling hills with some rocky outcroppings and mid-grass prairie. Several utility corridors, including a pipeline and transmission line corridors also transect the parcel. The Roxborough Filtration Plant is located on 10 acres of the site near the middle of the Sterling Ranch Parcel. Sterling Ranch also includes an occupied residence that is approximately 10 acres north of Titan Road.

Additional Information: Chapter 2 – The Sponsor Development, page 3 and Appendix D

b. Project location map, including identification of location within a Water Division as established in Section 37-92-201, C.R.S., watershed boundaries, location of rainwater catchment area and site where rainwater is applied to non-potable uses, location of climate data measurements, and other pertinent geographic and hydrologic information, per Section 37-60-115(6)(b)(III), C.R.S.

A location map for Sterling Ranch is located on page 5 in **Figure 2-1 – Project Location Map**. The watershed boundaries, data measurement sites and planned development where the rainwater will be applied can be seen on page 6 in Figure 2-2 – Sterling Ranch Planned and Figure 5.1 and page 37.

4. Rainwater Harvesting Collection System

A description of the proposed rainwater harvesting collection system, per Section 37-60-115(6)(b)(II), C.R.S., including:

a. Description of the collection system sizing, design, and maintenance plan.

Precipitation harvesting at Sterling Ranch will be accomplished based on the most feasible outcome found in the scalable components of the Pilot Project. An overall view of two different rainwater collection approaches for Sterling Ranch is discussed in Chapter 3. Regional and Targeted rainwater collection is described where rainwater would be collected through a traditional storm water drainage and storage system and distributed through a non-potable distribution system. A site-specific collection approach is also discussed that would direct rainwater collected from roofs, and possibly parking lots for commercial and school properties, to underground cisterns and pumped onto each site's landscape through the site irrigation system.

The collection system sizing and design for the new portions of the Pilot Project will build on information gained from monitoring the rainfall collection potential and experimenting with harvesting system components and manufacturers at the planned S.B. 09-80 sites. The final design for the precipitation harvesting systems for new sites in the Pilot Project will be based on this data and be representative of the most feasible system that can be implemented at Sterling Ranch.

A description of the maintenance program will be specific to each harvesting design and will be provided as the Pilot Project progresses.

Additional Information: Chapter 3 - Precipitation Harvesting System Designs, page14 and Chapter 6 – Sterling Ranch Precipitation Harvesting Pilot Project, page 38

b. Estimated average volume of water to be captured each month, based on historical precipitation data.

The potential rainfall that could be collected by month for regional, targeted regional, or individual site collection systems is presented in the following table (Table 3.1 in the application) based on the average precipitation data from the Kassler Weather Station located approximately one mile from Sterling Ranch. A theoretical rainwater capture efficiency of 80% is used for this calculation for the individual site collection system, and 56% for a regional system. The regional capture system efficiency is lower because of anticipated conveyance and storage losses. These assumptions will be verified and refined through the Pilot Project.

Estimated Potential Rainfall Collection for the Sterling Ranch Development
(Based on 1950-2004 precipitation data from the Kassler Weather Station) Acre-Ft

Collection System	Summary - Rainfall Collection by Month												
	Annual	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Full Regional Collection System	990	33.9	40.4	93.4	123.6	159.6	103.2	92.9	89.6	78.1	71.2	64.1	38.5
Targeted Regional Collection System	630	21.7	25.9	59.8	79.1	102.2	66.1	59.5	57.4	50.0	45.6	41.1	24.6
Individual Collection System	420	14.4	17.1	39.5	52.3	67.6	43.7	39.3	37.9	33.1	30.1	27.1	16.3

Additional Information: Chapter 3, page 19; Appendix F.

c. Method for metering inflow and measuring capture efficiencies.

All inflows and outflows to the rainwater storage facilities will be measured independently to determine collected rainfall, delivery for irrigation and supplemental potable water required. Flows from rooftops may be collected and brought into one central pipeline before entering the storage cistern where the flow could be measured and recorded with a totalizing flow meter and data logger. Water levels in the different storage facilities will be monitored with a float or pressure transducer style recorder and water delivery to irrigation systems metered through the pump or a gravity outlet pipeline. All supplemental water required to meet irrigation demands will be metered, as well.

Capture efficiencies will be calculated by measuring and comparing the quantity of collected rainwater used for irrigation to the potential rainwater that could be collected based on precipitation data from the Sterling Ranch climate station or nearby rain gage and area of collection.
Additional Information: Chapter 6 – Sterling Ranch Precipitation Harvesting Pilot Project, all phases.

5. Ability to Meet Local Water Supply Requirements

A description of how the proposed development meets any applicable local government water supply requirement through sources other than precipitation harvesting, per Section 37-60-115(6)(b)(IV), C.R.S.

Applicants for land use approvals in Douglas County are required to provide Douglas County with proof of adequate water supply. The recently updated Water Supply Section 8 of the Douglas County 2030 County Master Plan reflects the County's recognition of the dire need for integrated water resource planning. To meet these needs, and to address the requested information by Douglas County, Sterling Ranch has provided Douglas County with the Sterling Ranch Water Plan, April 23, 2009.

Dominion's conjunctive water supply system is currently being developed for eventual approval in water court using the following concepts:

- South Platte River will be the primary water supply diverted with a junior water right as part of an augmentation plan.
- Augmentation sources, or replacement supplies, on average will consist of 60% tributary sources and 40% non-tributary sources.
- Non-tributary ground water imported from the Central Basin and/or Margin B in the Denver Basin Aquifer will serve as back-up in times of drought, or after limiting times of available surface supplies.
- Both tributary and non-tributary water supplies will be regulated in one or more reservoirs before delivery to demands.

Additional Information: Chapter 2, page 8

6. Renewable Water Supply Challenges for the Site

A description of renewable water supply challenges for the area, per Section 37-60-115(6)(b)(V)(A), C.R.S. Indicate how the proposed project addresses key water needs, for example, as identified in the Statewide Water Supply Initiative or as identified in the Basins Needs Assessments and offers opportunity to collect information from a variety of geographic and hydrologic areas throughout the state. Preference may be given to projects that address larger water supply needs or in the locations with critical water supply challenges.

SWSI has identified that by 2030 a 22% gap between estimated demands and planned and built water projects exists in the South Platte Basin and a 56% gap in the South Metro Sub-basin consisting of Douglas, Arapahoe and Elbert Counties. Douglas County, where Sterling Ranch is located, relies primarily on non-tributary, non-renewable ground water which is predicted to decline in production by 40 to 85% if no further wells are developed. Sterling Ranch has devised a conjunctive use water plan using non-tributary ground water for less than 30% of its supply versus 100% as has historically been done.

Sterling Ranch also proposes to reduce its outdoor water demand by 65 to 88% from traditional outdoor water use by pairing rainwater harvesting with progressive outdoor water demand management measures indentified in the Sterling Ranch Water Plan.

Additional Information: Chapter 2, page 7

7. Water Conservation Promoted and Implemented by Pilot Project

A description of the pilot project implementation plan and how the project will promote and implement water conservation, per Section 37-60-115(6)(b)(V)(B), C.R.S., including:

a. Description of how rainwater harvesting will be utilized on-site and paired with advanced outdoor water demand management techniques to promote water conservation, including:

i. Landscape and irrigation design approach and specific advanced outdoor water demand management practices to be utilized.

The Holistic Report (2007) investigated outdoor water demand management concepts paired with rainwater harvesting as a way to save water. Sterling Ranch was a partner in this effort with the intent to use the data in

the Sterling Ranch Water Plan to be implemented as the development is built. The preliminary water conservation plan found in the Water Plan uses water conservation measures, including mandatory water saving landscape plans to meet a target outdoor water demand of 0.08 AF/yr/unit. The measures are as follows:

- Water-wise Home Certification
- Landscape and Irrigation System Regulations
- Individual Water Budgets with Inclining Block Rates
- Dual Metering
- Waste of Water Regulation
- Monitoring and Reporting

Landscape and irrigation design review and audits, soil analysis, appropriate plant selection and use of practical turf areas are some of ways the measures in the water conservation plan will be accomplished. Irrigation system efficiencies will be optimized through the use of properly designed and located sprinklers, micro-irrigation (drip irrigation), hand watering, and appropriate watering intervals. The water conservation plan also discusses ways to encourage and enforce the plan.

Precipitation harvesting systems will be paired with the outdoor water demand management methods to provide a portion of the outdoor water demand and will further reduce the demand for potable water. Outdoor water use will be metered separately and can be compared to tradition outdoor water use to determine water savings. Precipitation collected and applied to the landscape will also be measured and additional water savings can be determined

Additional Information: Chapter 4, page 27

ii. The implementation plan shall provide for metering of all on-site landscape water (harvested rainwater and any supplemental potable water supply) and address any potential cross-connection issues and backflow prevention if the rainwater harvesting system is connected to a backup potable water supply.

Part of the water conservation plan for Sterling Ranch already includes separate metering for outdoor water use. This will be done so homeowners can monitor and manage their own outdoor water use. The new buildings and/or region that will be implemented with precipitation harvesting systems as part of the Pilot Project will provide a connection to the potable water supply to ensure that the outdoor water demand is adequately met in times of low precipitation. All of these connections will be equipped with backflow devices that will prevent untreated rainwater from entering the potable water supply system.

Additional Information: Chapter 3, Figure 3-3, page 18 and Chapter 6, page 63

iii. Irrigation system technology to promote water conservation.

The Sterling Ranch District will require sub-surface drip or highly efficient and properly placed sprinkler head systems for turf. Drip or subsurface systems will also be required for all plantings and narrow turf areas (specific length and width requirements to be determined). This is part of the water conservation plan that will be formally adopted upon zoning approval.

Additional Information: Appendix E – Sterling Ranch Water Conservation Plan

iv. Homeowner/community water conservation education approach.

A targeted water requirement per household has been identified at Sterling Ranch that is less than half of what has been required historically. Public participation will rely heavily on education, incentives, and tools that individuals can use to monitor their own water use. When someone chooses to purchase a home in Sterling Ranch, they will be exposed to water conservation education from the point of purchase and throughout their residency in the development. It is conceived that an educated water conservation staff will be hired and trained to help in the process of reaching required landscape and irrigation design plan approval and will follow up with audits and monitoring of the homeowner's water use. The staff will be responsible for developing and

updating the education program and can effectively do this through interaction and feedback from the Sterling Ranch homeowners.

An on-going responsibility of the Sterling Ranch water conservation staff will be to develop and enforce a public community education program and school education program.

Additional Information: Chapter 4, page 30, Chapter 6, Page 67, and Appendix E

b. Description of metrics that will be used to quantify water usage and an estimate of the projected water savings through rainwater harvesting paired with advanced outdoor water management techniques. These shall include but not be limited to:

i. Landscape plans and water budgets including square footage of irrigated and non-irrigated landscape for common areas and individual homes, description and quantification of landscape plantings, estimated average annual demand in gallons per sf based on historical evapotranspiration rates (water budgets). Landscape plans should reference the *GreenCO BMP Manual*[8] for best practice guidance.

An outdoor residential water use target of 0.08 AF/YR/unit has been established for Sterling Ranch and a water budget for a residential unit assuming 1,500 sf of irrigated area. Five sample landscape plans were evaluated for Sterling Ranch using various amounts of turf, moderate water use plants, and water-wise plants. Water demand for each landscape plan was calculated using the following equations.

$$\text{Plant Water Requirement (PWR)} = K_c \times ET_o \times \text{Area} \times 0.623$$

$$\text{Theoretical Irrigation Requirement } (IWR_t) = (PWR/IE) - P_{eff} * \text{Area} * 7.48$$

Where:
PWR = Plant Water Requirement; Total water demand (gal/yr)
K_c = Crop coefficient; Used to modify reference evapotranspiration to the water use of a particular plant or group of plants (unitless)
ET_o = Grass reference evapotranspiration (inches/yr)
Area = Plant irrigated area (sf)
0.623 = conversion factor to gallons
IWR_t = Theoretical irrigation water requirement. Total plant water demand that must be provided through irrigation (gal/yr)
P_{eff} = Percent of available precipitation for use by the plant (ft/yr)
IE = Irrigation/sprinkler type efficiency (percent)
7.48 = gallons/cubic foot conversion factor

Crop coefficients from the Denver Water Board landscape calculator were used and a reference ETo of 33.2 inches per year. To illustrate a dry year scenario, zero precipitation was considered. Irrigation efficiencies of 85% for sprinkler and 95% for drip, both surface and sub-surface were used. The results are shown in the following table. All but Plan 1 are landscape plans that will be considered at Sterling Ranch.

Estimates shown are preliminary based on currently available information. Actual landscape irrigation demands will be estimated and refined during the Pilot Project

Water Use for Example Landscape Plans

Landscape Sample Plan	Blue Grass	Fescue Grass	Moderate Water Use Plants	Water-wise Plants	Small Vegetables	Irrigation Method	Annual Water Use (gal.)	Annual Water Use (AF)
Crop Coefficient	0.9	0.8	0.6	0.3	0.53			
Plan 1	100%					Sub-surface drip	26,127	0.08
Plan 2	33.3%		33.3%	33.3%		Sprinkler on turf; drip on plantings	20,727	0.06
Plan 3		50.0%		50.0%		drip	17,962	0.06
Plan 4		33.3%		67.6%		drip	15,235	0.05
Plan 5		33.3%			67.6%	drip	20,206	0.06

Additional Information: Chapter 4, page 30, and Appendix E

ii. Design plans of irrigation systems including, but not limited to, emitter types, controller type, rain sensor and meter type for measuring use of water from the rainwater harvesting collection system and any supplemental potable water supply. A system-wide irrigation audit should be performed within the first season of operation and action taken to address findings. Irrigation plans should reference the *GreenCO BMP Manual* for best practice guidance.

The irrigation system for the Pilot Project will be designed and built to demonstrate different irrigation installations, methods, and products as well as proper application of different irrigation controller technology. In general, the following guidelines will be used for the design, installation, and operation of the irrigation systems:

- Irrigation system designs shall reference the GreenCO BMP Manual Guidelines.
- Irrigation systems shall use water saving technology such as subsurface drip and point source drip irrigation where appropriate.
- Sprinkler irrigation components shall be selected for the highest possible uniformity and efficiency based on Center for Irrigation Technology (CIT) testing results.
- Irrigation controllers shall be EPA Water Sense approved controllers and smart controllers.
- Irrigation systems shall incorporate rain sensors, soil moisture sensors, and wind sensors as appropriate for system and site conditions.
- Irrigation system design shall be completed by a certified irrigation designer.
- Irrigation system installation shall be completed by a certified irrigation contractor.
- An audit of the constructed irrigation system shall be completed by a certified landscape irrigation auditor.
- A detailed irrigation schedule shall be completed for the system. Work shall include the determination of individual sprinklers or drip irrigation zone run times based on the appropriate plant material crop coefficient and precipitation rates and efficiencies determined by the irrigation audit.

Final irrigation system designs will be based on site specific development, with the above guidelines used in their development.

Additional Information: Chapter 4, page 32 and Appendix E

iii. Landscape management plan to include irrigation schedule, maintenance schedules, and other ongoing management aspects. Landscape management plans should reference the *GreenCO BMP Manual* for best practice guidance.

The water conservation plan for Sterling Ranch includes measures that will be part of the landscape management plan. An irrigation system design review and audit will be performed that will include an inspection of the system components to ensure proper operation, irrigation scheduling through the controller, and evaluation of the distribution and timing of water application. GreenCO's BMP Manual describes an irrigation audit in detail and provides a checklist and spreadsheets to streamline the process. Educating the homeowner on system controller programming will be part of the plan where it becomes relevant to the Pilot Project as well as the overall Sterling Ranch education program.

Individual water budgets and outdoor metering will provide the homeowner and the Sterling Ranch with tools to monitor the outdoor water use and may also be part of the Pilot Project where it becomes relevant. High usage will be immediately apparent and followed up with customer service to identify and fix any problem that may be related to the high water use. This could include physical problems like broken sprinkler heads or leaking drip lines, or it could involve education on watering schedules or planting selections.

A tiered water rate structure will be set in conjunction with the water budgets. This and a Waste of Water regulation will be part of the landscape management plan and used for the Pilot Project where it applies.

Additional Information: Chapter 4, page 32 and Appendix E

iv. Connection(s) between the rainwater harvesting collection system and irrigation system should be fully metered. At a minimum, sponsors shall consider automated meter reading/data loggers with immediate feedback to pilot project sponsors on impacts from water management decisions.

Precipitation collection will be measured either with a totalizing flow meter in the collection pipeline or a pressure transducer in the collection cistern at the existing S.B. 09-80 sites to determine collection efficiencies. The data will be recorded in a datalogger and downloaded and evaluated regularly. Precipitation harvesting systems on the new buildings or regions will be monitored in a similar manner using the best techniques and equipment found in the existing sites phase of the Pilot Project.

Additional Information: Chapter 4, page 33, and Phase 2 and 3 of the Pilot Project, Chapter 6, pages 54 & 61

v. Description of homeowner/community water conservation education campaign and training program (i.e., how will the pilot project sponsor support and assist homeowners, community members, and maintenance personnel to make the best water management decisions). These educational programs should be comprehensive to include indoor and outdoor water demand management, water supply, and water quality education.

Specific to the Precipitation Harvesting Pilot Project, the following items may be included for the education campaign, but in no way are final or limiting: 1) Website designated to data management and analysis, 2) Sterling Ranch website, 3) Landscape and Agriburbia garden tours, and 4) Water Conservation Plan monitoring tools, including billing software and irrigation system audits. These efforts are described further in Chapter 6.

Additional Information: Chapter 4, page 30 and Chapter 6, page 67

c. Estimated pilot project costs including:

i. Estimated infrastructure and ongoing operations and maintenance costs associated with implementing the system, and

ii. Estimated cost to implement project per acre-foot of water saved. Considerations should include: institutional, legal, technical/design, infrastructure, and augmentation water supply. Potential cost savings and benefits associated with the project should also be quantified: reduced water rights acquisition, reduced storm water system sizing, water quality benefits, etc.

The design of the Pilot Project phases are planned to take into consideration data collected and analyzed in the previous phases. Therefore, the estimated Pilot Project costs for infrastructure, ongoing operations, and maintenance associated with implementing the project are preliminary in nature. Costs will be refined as the

project moves forward and reported in the annual status reports as part of the Pilot Project requirements. The Phase 1 costs are the most defined, while the Phase 2 costs are less defined since some of the sites for collecting data have not been selected yet, and the Phase 3 costs are very conceptual and based upon hypothetical developments. Operation and maintenance costs are assumed to be 10% of total costs for Phase 1 and 2. This estimate is higher than normal for typical operation and maintenance due monitoring instrumentation. The cost of water that will be required for augmentation varies widely and has not been included at this time. Water for use at the Sterling Ranch Development will be in the process of being acquired conjunctively within the Pilot Project timeframe and could be used for augmentation prior to being needed for delivery to future customers. The following table shows the estimated cost for each phase of the Pilot Project.

Sterling Ranch Summary of Pilot Project Costs

Pilot Project Through SWSP	Estimated Costs
Phase 1: Natural Conditions	$152,600
Phase 2: Experimental Precipitation Systems	$133,400
Phase 3: New Precipitation Harvesting Systems	$807,200
Total Operations and Maintenance (7yrs)*	$257,075
Subtotal	$1,350,275
Total Engineering and Legal (50%)	$675,138
Subtotal	$2,025,413
Contingency (25%)	$506,353
**Total ** **	**$2,531,766**

* O&M costs roughly estimated based on proposed Pilot Project schedule

** Cost does not include associated augmentation plan or decreed firm yield water supply

***Phase 3 assumes adequate feasibility identified as a result of research in Phases 1 & 2

Cost to implement the project per AF saved will be based on the following table from Chapter 3, as well as additional information that is gathered in Phases 1 and 2 of the Pilot Project.

Precipitation Collection Systems Opinion of Probable Cost Comparison

Precipitation Harvesting System	Potential Capture Avg Annual Yield, (AF/Year)	Potential Capture Planning Yield, (AF/Year)	Capital Cost (millions)	Engineering Costs	Legal Costs	Contingency	Total Costs (millions)	Total Costs for Planning Yield ($ per AF)
Full Regional Collection	**990**	**850**	**$31**	**15%**	**5%**	**15%**	**$42**	**$49,000**
Targeted Regional Collection	**560**	**480**	**$11**	**15%**	**5%**	**15%**	**$15**	**$30,000**
Individual Collection	**410**	**350**	**$45-$82**	**15%**	**5%**	**15%**	**$61-$111**	**$173,000-$309,000**

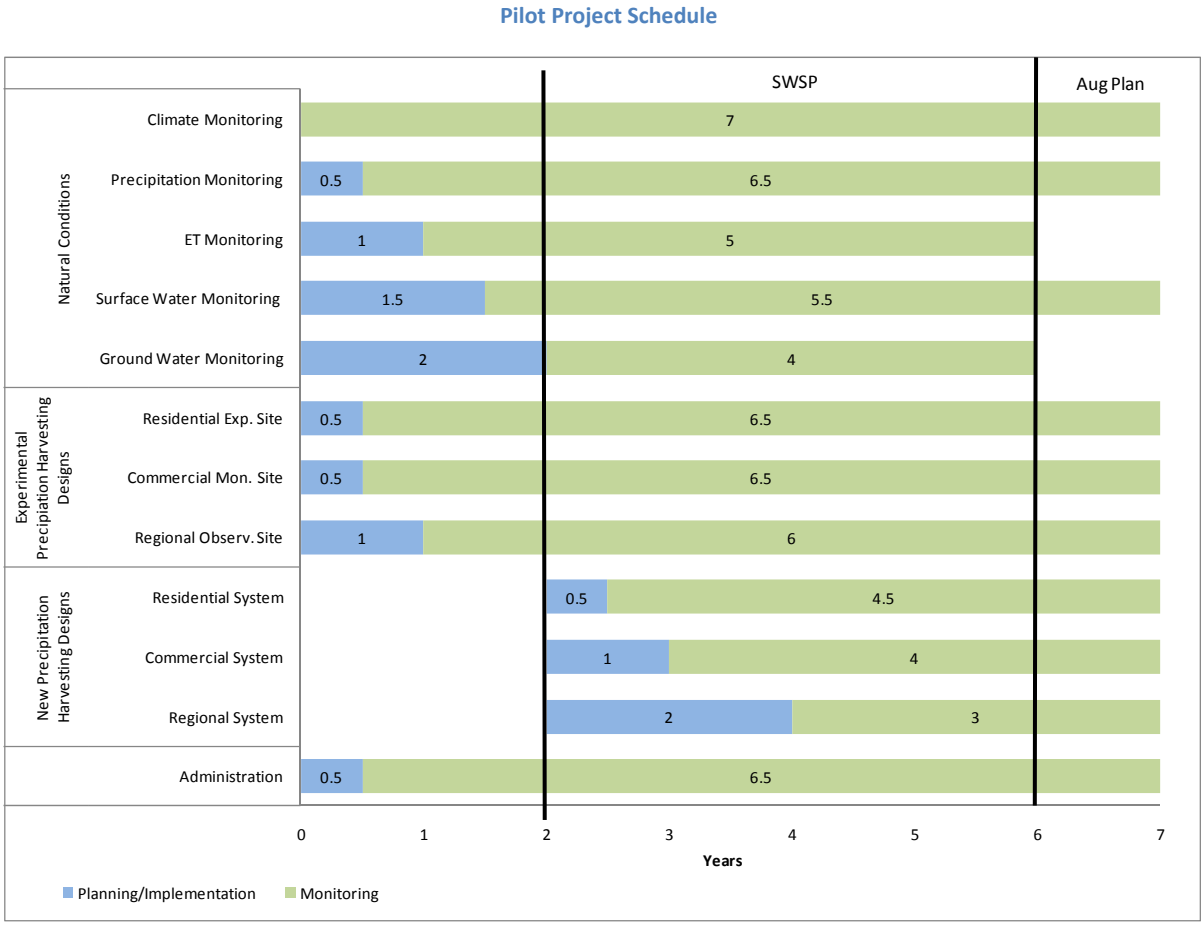
The above table assumes the following:

1. *Full Regional System includes non-potable distribution to all users, including all residential lots*
2. *Targeted Regional System includes non-potable distribution to targeted users – no distribution to residential lots*
3. *Information presented is preliminary for the purposes of relatively comparing the collection concepts only.*
4. *Potential Capture is based on average annual precipitation and capture efficiencies assumed to be 80%.*
5. *Potential Capture Planning Yield is 86% of average annual yield based on the total median monthly rainfall.*

Additional Information: Chapter 3, page 14 and Chapter 6, page 69

d. Pilot project implementation schedule for all major project components and data collection. The minimum two year data collection period begins once water collected through rainwater harvesting, under an approved SWSP, is applied to non-potable demands in combination with advanced outdoor demand management. A project sponsor must make a commitment to implement some level of data collection within the first year of receiving approval as a pilot project.

The schedule for implementation of the Sterling Ranch Pilot Project is shown in the following timeline and includes an estimate for planning, implementation, and monitoring of all of the components of the Pilot Project. This schedule is further broken down within Chapter 6 by the phases and components. By the beginning of the first year the climate station monitoring program will be implemented and monitoring will be taking place.



Additional Information: Chapter 6, pages 53, 60, 66 and 74.

8. Pilot Project

A description of how the rainwater harvesting pilot project will meet the purposes of the rainwater harvesting pilot program per Section 37-60-115(6)(a), C.R.S. Data collection, reporting, and analysis methods may include but not be limited to:

a. Determining local weather and precipitation patterns that account for variations in hydrology and precipitation event intensity, frequency, and duration.

The natural conditions component of the pilot study will be used to determine local weather and precipitation patterns that account for variations in hydrology. Specifically the climate, precipitation, and surface water monitoring programs will be used to answer quantitative and qualitative question about hydrology on the site including precipitation event intensity, frequency, and duration.

Additional Information: Chapter 6, Page 44 – Climate Monitoring Program, page 45 – Precipitation Monitoring

Program, page 46 – Surface Water Monitoring.

b. Quantifying preexisting, natural vegetation consumption.

The Sterling Ranch Pilot Project proposes to quantify preexisting, natural vegetation consumption using data collected from the ET and climate monitoring programs. The ET monitoring program will use lysimeters to observe and quantify site-specific actual native ET and deep percolation on Sterling Ranch. Data from the climate monitoring program can then be used to empirically estimate reference ET. The observed actual native ET estimate can then be compared to the empirical reference ET estimate providing a basis to calibrate native crop coefficients specific to Sterling Ranch that can be used indefinitely.

Additional Information: Chapter 6, page 44 – Climate Monitoring Program, page 47 – ET Monitoring Program.

c. Measuring precipitation return flow amounts.

Sterling Ranch proposes to characterize the precipitation return flow amounts using observed data from the precipitation, surface, and ground water monitoring programs. During the study period of the pilot project the observed data can be used to compile a comprehensive water budget to account for and characterize precipitation return flow amounts. Methods such as Glover and the SCS Curve Number method will be used to simulate and further quantify precipitation return flow amounts.

Additional Information: Chapter 6, page 45 – Precipitation Monitoring Program, page 46 – Surface Water Monitoring, page 48 – Ground Water Monitoring Program.

d. Identifying surface water versus ground water return flow splits.

The surface water versus ground water return flows spit is dependent on the physical characteristics of the watershed, aquifer properties, and precipitation event intensity, frequency, and duration. Sterling Ranch proposes to characterize surface and ground water return flow splits using observed data from the precipitation, ET, surface water, and ground water monitoring programs and empirical methods such as Glover and the SCS Curve Number to simulate and quantify surface and ground water return flows.

Additional Information: Chapter 6, page 45 – Precipitation Monitoring Program, page 46 – Surface Water Monitoring, page 47 – ET Monitoring Program, page 48 – Ground Water Monitoring Program.

e. Identifying delayed ground water return flow timing to receiving streams.

Sterling Ranch proposes to use the Alluvial Water Accounting System model (CSU, 2009) to calculate delayed ground water return flow timing to receiving streams from precipitation. When supplemented with observed data from the ground water monitoring program, a site-specific understanding of the timing of accretions to receiving streams due to precipitation recharge can be identified.

Additional Information: Chapter 5, page 33

f. Quantifying the amount of precipitation that must be augmented to prevent injury to decreed water rights.

The natural conditions component of the pilot project should provide the necessary information to understand the site-specific amount of precipitation that must be augmented to prevent injury to decreed water rights. Once a baseline of the pre-existing natural vegetation consumption, physical water supply, and return flow requirements are quantified using observed data, water budgets, and models. Sterling Ranch can quantify the amount of precipitation that must be augmented to prevent injury to other vested water rights and decreed conditional rights.

Additional Information: Chapter 5, Page 35 and Chapter 6, page 42

9. SWSP

A summary of a SWSP application that demonstrates the applicant can meet the requirements of the *General Guidelines for Substitute Water Supply Plans Submitted to the State Engineer Pursuant to Section 37-92-308, C.R.S. (2003).* The summary shall contain, at a minimum, an explanation of how the applicant will engage resources necessary to determine: 1) the maximum amount of precipitation that will be captured during the year, 2) the timing with which that entire amount of precipitation would accrue to the stream system through overland flow and deep percolation, 3) the potential sources of replacement water that will be available to replace those depletions at the appropriate locations, and 4) how the plan will be operated. The CWCB will not consider a pilot project for selection if, in consultation with the State Engineer, it determines that the applicant does not have the resources to develop a viable SWSP for approval.

As mentioned, the Sterling Ranch Pilot Project will be implemented in phases to gain the appropriate information needed for final design of a precipitation harvesting system. The Pilot Project will operate under an approved SWSP when precipitation harvesting begins on the new design phase (estimated to begin in year 2 of the Pilot Project) for a minimum of two years as required in the Pilot Program criteria.

Initially Sterling Ranch proposes to estimate the annual Pilot Project stream depletions as 100% of the recorded maximum annual precipitation at a nearby climate station times the impervious area within the capture area. This will be the basis for the amount of replacement water that will need to be acquired for approval of the SWSP. Ground water return flows will be lagged using AWAS and surface returns will be quantified based on established rainfall runoff relationships found in the early phases of the project.

Sources of replacement will include but are not limited to transmountain water, reusable effluent, developed water, non-tributary ground water, or other fully consumable water decreed for replacement purposes. Sterling Ranch plans to contract with non-tributary well owners or owners of local storage projects with augmentation water to make releases to the stream system to offset depletions.

Appropriate accounting forms summarizing capture amounts and replacements will be on a daily basis with monthly summaries submitted to the water commissioner. Information in the accounting form will include dates, calling rights, capture amounts, replacement source and amounts, transit losses associated with replacement amounts, and river balance account.

Additional Information: Chapter 5, page 33

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DRAFT FOR REVIEW AND COMMENT

April 30, 2010 (Revised June 7, 2010)

Colorado Water Conservation Board
Office of Water Conservation & Drought Planning
Attn: Ms. Veva Deheza
1313 Sherman Street, Room 721
Denver, CO 80203

Re: Review of Sterling Ranch Precipitation Harvesting Pilot Study Application

Dear Ms. Deheza:

At your request, Wright Water Engineers, Inc. (WWE) has reviewed the *Sterling Ranch Precipitation Harvesting Pilot Study Application* (Sterling Ranch Application) dated March 1, 2010 prepared by Leonard Rice Engineers, Inc. The purpose of our review is to determine whether the Application is in conformance with the Colorado Water Conservation Board (CWCB) Criteria and Guidelines for rainwater harvesting projects and to provide comments and recommendations, as needed. Our review has focused primarily on hydrology, landscape water conservation, project monitoring, and transferability aspects of the pilot. Per your direction, we understand that the State Engineers Office (SEO) will be reviewing water rights aspects of the project, so we have not conducted a detailed review of water rights associated with the project.

Background

The Sterling Ranch development project encompasses approximately 3,000 acres in Northwest Douglas County, Colorado. The land is located south of Chatfield Reservoir, and portions of its west boundary lie adjacent to Roxborough Park. A rainwater harvesting pilot project is proposed for the development.

Colorado House Bill (H.B.) 09-1129, *Act Concerning an Authorization of Pilot Projects for the Beneficial Use of Captured Precipitation in New Real Estate Development, and Making an Appropriation in Connection Therewith*, called for the CWCB to establish Criteria and Guidelines for the applications and selection of pilot projects and, in consultation with the State Engineer, select pilot project sponsors. The CWCB definition of a rainwater harvesting pilot project is:

> *Rainwater harvesting pilot projects collect precipitation from rooftops and other impermeable surfaces and utilize the collected water for non-potable uses to evaluate water conservation potential. Pilot projects must be designed such that data collection supports the purposes identified in Section 37-60-115(6)(a), C.R.S. and further evaluates water conservation potential through pairing*

> *rainwater harvesting with advanced outdoor water demand management. Projects must be located in new residential or mixed-use development.*

This rainwater harvesting pilot program is separate from Senate Bill 09-08 which authorized limited exemptions for water collection from roofs of residences that are served by wells permitted for domestic uses as provided in C.R.S. 37-92-602.

Appendix A of the Pilot Project Application provides the CWCB Criteria and Guidelines and then gives a brief description of how the pilot project would meet the criteria and guidelines. Reference is also given to specific sections of the report that apply to the subject criteria and guideline.

General Comments

Overall, we found that the Sterling Ranch Application was in reasonable conformance with the intent of the CWCB Criteria and Guidelines. Our comments generally relate to providing additional detail on some methodologies that would improve the scalability and transferability of the pilot project monitoring results.

Based on the schedule given in the Application (p. 73) with the "Natural Conditions" and the installation of the experimental precipitation harvesting facilities, it appears that the baseline data collection for the Sterling Ranch Project (identified as Phases 1 and 2) would be in a position to begin fairly soon after authorization. The project schedule indicates one-half year to two years required for planning and implementation of Phases 1 and 2. Phase 3 is the implementation portion of the pilot rainwater harvesting system associated with new development. A clear understanding of the definition of a pilot project with regard to timeframes in the CWCB Criteria and Guidelines for the Rainwater Harvesting Pilot Project Program is important, including the following criteria:

- "The minimum two year data collection period begins once water collected through rainwater harvesting, under an approved SWSP, is applied to nonpotable demands in combination with additional demand management." (p.4)

- "…Projects must be located in new residential or mixed-use development.[6]" (p. 2) Footnote 6 (p. 11): "… Section 29-20-103, C.R.S. indicates that a development permit is generally limited to an application regarding a specific project that includes new water use in an amount more than that used by fifty single-family equivalents, or fewer as determined by the local government."

Per these criteria, for clarity, we recommend that the application clearly state that the two year time period begins with implementation of Phase 3, which involves implementation of rainwater harvesting pilot projects for new development.

The narrative of the report and the appendices differ in terms of what "will" be implemented versus what "may" or "could" be implemented, with the appendix generally being more definitive. We recommend that the terms "may" and "could" be replaced with "will" in most portions of the narrative. Where uncertainties associated with a project of this type do not enable a firm commitment, then caveats explaining the uncertainties should be provided. This is particularly important with regard to commitments for monitoring. A few examples include:

- The data collected at the Sterling Ranch site may include solar radiation, air temperature, wind speed, relative humidity/vapor pressure, and precipitation data. (p. 44)

- Daily summarized climate station data may be used to develop empirical reference ET estimates using methods such as the standardized ASCE Penman reference ET equation. (p. 44)

- A surface water monitoring program may be implemented to quantify the site-specific streamflow that accrues to the natural stream system through surface and ground water return flows from native precipitation. (p. 46)

Similarly, for the Phase 3 Pilot Project Implementation, it is not clear whether all three pilot project concepts (residential, commercial and regional) will be implemented. Given the costs of the systems presented in the report, if the project sponsors realistically envision only implementing one of the systems, then this intention should be clearly stated. Alternatively, information on the decision-making process regarding which of the alternative approaches will be implemented should be provided. As currently written, it is not clear what the Pilot Project stage (Phase 3) is currently expected to include. For context, representative language creating this uncertainty includes:

- Phase 3: New Precipitation Harvesting Designs – To represent a mixed use development, three scenarios may be used to represent precipitation harvesting in the new Sterling Ranch development. A model home may be used to represent a residential system, a commercial complex may be used to represent a commercial system, and a 10-acre neighborhood or equivalent may be used to evaluate regional precipitation harvesting. The new sites can be designed using the insight gained from Phase 1 of precipitation harvest designs. The new designs may be constructed to incorporate the best equipment, materials, and designs to effectively harvest precipitation in Colorado. (p. 40).

- As a mixed use development, Sterling Ranch could incorporate several different designs of precipitation harvesting systems. For the purposes of this application and cost estimating, three scenarios were chosen to be representative of the Sterling Ranch development. Results from this portion of the Pilot Project would help determine the cost effectiveness of precipitation harvesting for the entire Sterling Ranch development and which precipitation harvesting designs are the best. The three scenarios that could be studied at Sterling Ranch are…(p. 60)

- Within the first permitted filing at Sterling Ranch, a model home or homes would likely be built. The home could be equipped with a self-contained precipitation harvesting system that would include rooftop capture gutters, filtering, downspouts, cistern, and a pump to deliver water to the irrigation system… (p. 60)

We recognize that there is much uncertainty and natural evolution associated with a pilot project, but the ambiguity in current wording of the project may create later difficulties in reviewing the annual project reports and differences in expectations regarding what the pilot project will include.

Given CWCB's stated intent that the pilot projects pair rainwater harvesting with advanced outdoor water demand management, we believe that it would be appropriate to include the Headwaters Corporation's April 2009 report "Sterling Ranch Water Conservation (Excerpts from the Sterling Ranch Water Plan)" as an appendix to the application because it provides more descriptive and definitive information related to landscape water conservation aspects of the project.

Specific Comments

Our comments on specific aspects of the Application follow and note where additional detail would be helpful in facilitating scalability and transferability. The relevant CWCB Criteria and Guideline reference is given in bold text in parentheses.

1. (**7.b**) The water use per residential unit given in the Application is summarized below:

Residential Water Demand	0.22 AF/yr	200 gal/day
+10% System Loss	0.022	20
+20% Security Factor	0.044	40
Total[1]	0.286 AF/yr	260 gal/day
Landscaping Portion	0.082 AF/yr for 1500 square feet irrigated area	
	17.4 gal/sf	
	27.9 inches	

[1] Engineers representing the Douglas Planning Department have discussed a surcharge of some amount, such as 0.1 AF/yr per unit until metered water use data from Sterling Ranch is available.

The proposed unit landscaping water use of 17.4 gal/sf/yr is slightly higher than the water budget goal of 15 gal/sf/year given in Division of Local Affairs (DOLA) model landscape ordinance. The *GreenCO BMP Manual* notes that a water budget of 15 gal/sf/yr is a common outdoor allocation target; however, GreenCO does not specify a target water budget. The 17.4 gal/sq ft/yr includes a 33% safety factor, so the underlying

water budget is 13.1 gal/sq ft/yr, which is a reasonable (moderate) basis for design of a conservation-oriented landscape.

Irrigation efficiencies are assumed to be 85 percent for rotor irrigation and 95 percent for drip irrigation (p. 30). (Note: Appendix A [p. 80] gives 80 percent for sprinkler irrigation which likely should be 85 percent to be consistent with the report text.) The irrigation efficiencies used are reasonable.

2. (**5**) The Sterling Ranch (Dominion) Water Plan is described as being currently developed as a conjunctive water supply. Figure 2-4 (page 13) gives the "Framework" of the water supply, but there are no specifics on the water rights to be used. In Table 2-1 "Total Planned Water Supply," "Tributary Consumptive Use Water" at 1,600 af/yr is identified as a water supply source with the footnote "to be acquired plus additional supply to cover conveyance losses for Tributary CU Water Supply TBD after acquisition." We understand that the SEO will review and assess the adequacy of the water rights aspects of the Application.

3. (**7.b**) Table 4-1 "Water Savings from pairing precipitation harvesting with outdoor water demand management" (p. 28) combines water savings from 1) reduced lawn irrigation area, 2) reduced irrigation application, and 3) savings from cistern supply. Providing the individual savings attributable to the three items would be helpful and would provide the potential savings due to rainwater harvesting alone.

4. (**4.b and 4.c**) The Kassler Weather Station near Sterling Ranch's average annual precipitation for the 1950-2004 period of 17.54 inches is reported, but the range of precipitation (minimum to maximum) should be discussed (Monthly Records given in Appendix F). The potential firm yield is based on 15 inches or 86 percent of the annual precipitation (p. 30). Little background information is provided as to how the 15-inch or 86 percent figure was selected. The SEO guidelines for estimating net evaporation from a water surface use a 70 percent factor for effective precipitation. With a goal of the pilot study to be methodology transferability, it would be helpful to outline how the 15-inch firm yield was determined. Footnote Nos. 5 in Tables 3-3 and Table 3-4 (p. 23-25), which both have an identical column "Potential Capture Firm Yield, (AF/Year)," appear contradictory:

   Table 3-3. *5. Firm yield is estimated as 86% of average annual yield based on preliminary annual deficit evaluation.*

   Table 3-4. *5. Potential capture is based on average annual precipitation, not on a firm yield.*

What is the methodology for determining the deficit over a longer term drought such as the 1952-1956 or 1962-1964?

5. (**4.b, 4.c and 8.a**) No discussion of hydrologic patterns based on the Kassler station is presented. Many of the storm events will be quite small, and with depression losses and evaporation, there will be little or no runoff for these small events. The Urban Drainage and Flood Control District *Drainage Criteria Manual - Volume 3* presents data on the Denver Stapleton precipitation and on an average annual basis, 46 of 75 storms are less than 0.1 inch, which will produce practically no runoff. The pilot program's proposed measurements of precipitation and runoff into storage vessels provides a means to calculate these losses, and these losses may be accounted for in the 15-inch firm yield (86 percent capture) figure. A cursory analysis of precipitation patterns would be helpful in methodology transfer.

   Overall, our impression is that the 15-inch firm yield figure is overly optimistic.

6. (**5 and 8.b**) A major thrust of the project will be to quantify the evapotranspiration of the existing natural vegetation, which will be replaced with impervious surfaces through the development process, and also the surface and groundwater returns to the stream. During the pilot program, 100 percent of the precipitation on impervious surfaces will be augmented under Substitute Water Supply Plans (SWSPs). One goal of Sterling Ranch is to support an augmentation plan to harvest precipitation without having to augment 100 percent of the water.

   Two lysimeters are proposed. The vegetation survey in Appendix D (p. 95) notes vegetation communities: mid-grass prairie, medium/high-density shrubland, low-density shrubland, riparian and wetland. In what vegetation community will the lysimeters be installed, and how will results be transferred to other vegetation? Will an estimation of long-term natural vegetation ET be modeled?

7. (**8.c and 8.e**) Figure 6-2 (p. 42) shows the location of three proposed groundwater level monitoring sites. The figure appears to show a section across the stream channel. The description of the groundwater monitoring is somewhat vague:

   > *Monitoring wells and ground water level monitoring equipment may be installed if sufficient ground water information does not exist. Aquifer characteristics can be defined from existing well logs or may be supplemented if monitoring wells are installed.*

   With regard to groundwater timing, the AWAS Ground Water Model is proposed for use. Aquifer parameters such as transmissivity are needed as input to the model. What will be the source for this data?

8. (**7.c**) With regard to pilot project costs, the cost for augmentation water is not included in the Summary of Pilot Project Costs (Table 6-2, p. 70).

9. (**7.b.iii**) The Application states that a "tiered water rate structure" may (emphasis added) be set in conjunction with the water budget (p. 32). In Appendix A, mandatory water saving measures listed include "Individual Water Budgets with Inclining Block Rates (p. 79)." Is there a commitment to a tiered water rate structure?

10. (**7.c**) The preliminary opinion of probable cost for new precipitation harvest designs (pp. 69-70), are summarized as follows:

Residential System, single-family home	$ 23,700
Commercial System, 10-acre site	$451,500
Regional System, 10-acre site	$332,000
(Per acre-foot costs are given on p. 83)	

The preliminary opinion of probable cost for the single family residential system is expensive. During the pilot project analyses, it may be beneficial to consider the feasibility of scaling down the system to lower the cost for an individual system. Alternatively, if pilot project is expected to focus on the commercial or regional alternatives, this should be clearly stated.

Other: A graphics error and a few typographical errors on numbers were noted as follows:

1) The location shown for Sterling Ranch in Figure 2-1 (p. 5) is not consistent with other figures.

2) In Table 3-2, (p. 22), the gross area acreage for Residential Medium Density shows, 1.196 acres, whereas we expect that 1,196 acres was intended.

3) On Table 4-1 (p. 28), 3rd column second row, the number should be "0.347" rather than "0.0347."

4) In Appendix A (p. 79), 5th line, the number should be "0.08 AF/yr/unit" rather than "0.8 AF/yr/unit."

Conclusion

Overall, the Application is responsive to the CWCB Criteria and Guidelines; however, we would recommend that additional information or clarification be sought on Items 4 through 10 above. We also recommend that the three following items be addressed:

- Include Headwater Corporation's April 2009 report "Sterling Ranch Water Conservation (Excerpts from the Sterling Ranch Water Plan)" as an appendix to the application

because it provides more definitive information related to landscape water conservation aspects of the project.

- Clarify the monitoring activities that will be implemented, as opposed to what may be implemented. WWE views all aspects of the monitoring program suggested in the report as necessary for effective evaluation of the pilot project.

- Provide a clear statement of expected direction for the Phase III pilot project implementation regarding which type(s) of rainwater harvesting are expected to be implemented and/or how the decision will be made to make this determination.

Please call us if you have any questions or comments. We have appreciated the opportunity to review this interesting project.

Very truly yours,

WRIGHT WATER ENGINEERS, INC.

By _____
Patricia K. Flood, P.E. LEED AP
Senior Engineer

By _____
Jane K. Clary, LEED AP
Senior Water Resources Scientist

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DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

Bill Ritter, Jr.
Governor

Harris D. Sherman
Executive Director

Dick Wolfe, P.E.
Director/State Engineer

June 18, 2010

To: Veva DeHeza, Section Chief, Office of Water Conservation & Drought Planning, CWCB
From: Kevin G. Rein, Assistant State Engineer *Kevin G. Rein*
Subject: Sterling Ranch Precipitation Harvesting Pilot Project Application

I have reviewed the March 1, 2010 application from Sterling Ranch ("Applicant") for consideration as a precipitation harvesting pilot project as allowed by HB09-1129. My review included a general review of the entire application and a more detailed review of the application document's **Section 6.0 Pilot Project**. My objective in reviewing Section 6.0 was to evaluate whether the applicant had met Eligibility Requirements 8 and 9 in the *Criteria and Guidelines for the Rainwater Harvesting Pilot Project Program.* For convenience, I have summarized those two requirements below.

The application must include:

8. A description of how the rainwater harvesting pilot project will meet the purposes of the rainwater harvesting pilot program per Section 37-60-115(6)(a), C.R.S. Data collection, reporting, and analysis methods may include but not be limited to:
   a. Determining local weather and precipitation patterns that account for variations in hydrology and precipitation event intensity, frequency, and duration.
   b. Quantifying preexisting, natural vegetation consumption.
   c. Measuring precipitation return flow amounts.
   d. Identifying surface water versus ground water return flow splits.
   e. Identifying delayed ground water return flow timing to receiving streams.
   f. Quantifying the amount of precipitation that must be augmented to prevent injury to decreed water rights.
9. A summary of an SWSP application that demonstrates the applicant can meet the requirements of the *General Guidelines for Substitute Water Supply Plans Submitted to the State Engineer Pursuant to Section 37-92-308, C.R.S. (2003).* The summary shall contain, at a minimum, an explanation of how the applicant will engage resources necessary to determine 1) the maximum amount of precipitation that will be captured during the year, 2) the timing with which that entire amount of precipitation would accrue to the stream system through overland flow and deep percolation, 3) the potential sources of

replacement water that will be available to replace those depletions at the appropriate locations, and 4) how the plan will be operated. The CWCB will not consider a pilot project for selection if, in consultation with the State Engineer, it determines that the applicant does not have the resources to develop a viable SWSP for approval.

These eligibility requirements were written with due appreciation for the sequence of a potential pilot project's development in that the requirements do not require, for example, an approved SWSP rather an explanation of how an applicant plans to engage the appropriate resources to ensure an SWSP will be submitted that can be approved. It is also in that context that I reviewed the application.

The Applicant describes a plan to conduct monitoring of Natural Conditions at the Pilot Project location, Experimental Precipitation Harvesting Designs, and New Precipitation Harvesting Designs. For monitoring the Natural Conditions, the Applicant has identified two study basins within the Pilot Project area where a phased implementation for monitoring climate, precipitation, evapotranspiration, surface water, and ground water would be used.

To accomplish climate monitoring, the Applicant will install a climate monitoring station at the Sterling Ranch site. The station may collect data regarding solar radiation, air temperature, wind speed, relative humidity/vapor pressure, and precipitation. This data will allow characterization of local weather patterns and estimates of native evapotranspiration. For direct evapotranspiration motoring, the Applicant proposes a lysimeter to be located near the climate monitoring station. To accomplish precipitation monitoring, the Applicant proposes a series of rain gauges throughout the Pilot Project site and to accomplish surface flow monitoring, the Applicant proposes three surface water monitoring stations in the two study basins. The ground water monitoring approach is not as certain according to the application, relying on data from existing wells, the lysimeter, or possibly new monitoring wells for various components of the ground water flow characteristics.

The monitoring programs, therefore, show a well-contemplated approach to meeting the expectations in Eligibility Requirement 8.

Eligibility Requirement 9 identifies the expectations of an application in regard to the substitute water supply plan ("SWSP") that will be a necessary component of any pilot project. **Section 7.0 Appendix**, presents the Applicant's summary of an SWSP to the extent described in Eligibility Requirement 9. All of the monitoring components, with the exception of evapotranspiration monitoring, will be necessary for the initial SWSP. Beyond that, the important factors for a viable SWSP are a plan for operation developed using experience in hydrology/engineering, experience with the water administration requirements that must be addressed in an SWSP, and a source of replacement water. Inherent in the experience requirement is the understanding that the components of precipitation harvesting used in the Pilot Project and the measurement, analysis, and results are combined to result in an SWSP that accurately identifies the amount of water diverted out of priority, the timing and location with which that water would have become a part of the surface water system, and a means to replace that water with reliable sources. The Applicant presented a summary of an SWSP approach that shows an understanding of these key components and, at least to this point, has contracted with a

consultant known to be experienced in water rights, water administration, hydrology/water resource engineering, and SWSP development.

Therefore, based on my review of the application, I can state that the Applicant has satisfied Eligibility Requirements 8 and 9. Pending confirmation of the Applicant having satisfied other Eligibility Requirements, I recommend approving Sterling Ranch's application to be considered as a precipitation harvesting pilot project.