STERLING RANCH

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June 30, 2014

Ms. Rebecca Mitchell
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, CO 80203

Mr. Kevin Rein
Colorado Division of Water Resources
1313 Sherman Street, Suite 818
Denver, CO 80203

RE: 2014 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Ms. Mitchell and Mr. Rein,

The enclosed letter report is the fourth annual report submitted by Leonard Rice Engineers, Inc. on behalf of the Sterling Ranch Development for the Precipitation Harvesting Pilot Study.

The 2014 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report documents the progress that was made in the 2013/2014 study year, including the data that has been collected, the planned tasks for next year, and the variances to the application that was submitted on May 1, 2010.

Tasks accomplished this year for the Pilot Project include:

- Climate data was collected from June 2013 to May 2014 showing several significant rainfall events.
- Continued monitoring and collecting data from the surface water station located on Upper Sterling Gulch. A total of four surface water events were observed with the largest event of 3.34 cfs occurring on September 15, 2014.
- Continued use of trail cameras on Sterling Gulch to document hydrologic events in real-time.
- Continued water level data collection at the ground water monitoring wells, located within Sterling Gulch.
- Designed, constructed, and installed one 24 inch weighing lysimeter that includes a deep percolation vacuum system, and four soil moisture sensors. Preliminary data is being collected and analyzed.

Many exciting steps have been taken during the 2013-2014 project year on the Sterling Ranch Precipitation Harvesting Pilot Study. With the addition of our lysimeter, the information that we gather in the coming years will deepen our understanding of this area's natural conditions water budget. As the program matures, we broaden our understanding of precipitation harvesting as a reliable water supply and as a beneficial component in the overall sustainability and health of surrounding water bodies and throughways.

In the upcoming year, we look forward to more in-depth discussions with the Colorado Water Conservation Board and Colorado Division of Water Resources regarding Sterling Ranch rainwater development plans and the administrative approach we are envisioning. Thank you for your continued support in developing harvested precipitation as a viable water supply.

Best Regards,

Mary Kay Provaznik
DWSD & Sterling Ranch Utilities Director

cc: Harold R. Smethills, Jr.
Diane Smethills
Jim Yates
Beorn Courtney
Greg Roush

Encl: 2014 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

July 1, 2014

Ms. Rebecca Mitchell
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, CO 80203

Mr. Kevin Rein
Colorado Division of Water Resources
1313 Sherman Street, Suite 818
Denver, CO 80203

RE: 2014 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Ms. Mitchell and Mr. Rein,

This is the fourth annual report addressing the Precipitation Harvesting Pilot Study to be submitted by Leonard Rice Engineers, Inc. on behalf of Sterling Ranch Development.

Introduction

The proponents of the Sterling Ranch Development continue to work passionately towards a vision for the land that is in harmony with the area, the community, and the State, and that meets a significant need for housing and infrastructure in Douglas County. Sterling Ranch's participation in the Colorado Water Conservation Board's (CWCB) Rainwater Harvesting Pilot Project Program (Program) is a reflection of their goals for establishing sustainable, defensible, non-potable water supplies for their development, in addition to being a positive example of conservation and efficient resource management.

Generally, the Sterling Ranch Precipitation Harvesting Pilot Study (Pilot Project) has proceeded on schedule. However, there have been some delays in the installation of monitoring equipment and implementation of experimental and new precipitation harvesting designs. The variances to the Pilot Project, including the proposed schedule, are described herein.

Summary of Pilot Project Progress

The following tasks were accomplished during the 2013-2014 monitoring season:

- Climate data collection from the Sterling Ranch Climate Station
- Surface water data collection
- Trail camera data collection
- Data collection from two ground water monitoring wells and one shallow (Datum) well
- Design, construction, and installation of a 24 inch weighing lysimeter.

These tasks, associated costs, and variances to the overall Pilot Project are further discussed in this Annual Report.

CWCB Program and Reporting Requirements

On March 1, 2010, Sterling Ranch provided the "Sterling Ranch Precipitation Harvesting Pilot Study Application" (Application) based on the criteria and guidelines outlined by the CWCB established under House Bill 09-1129. The aim of the Program is to use field verification to evaluate precipitation harvesting in Colorado as a water conservation enhancement when paired with advanced outdoor water demand management and as a legally obtainable water supply.

The Application described the conceptual Sterling Ranch planning policies and requirements, including their current water conservation plan and the Pilot Project strategies to be implemented to assist in the overall precipitation harvesting design.

The Pilot Project is split into three phases; 1) Natural Conditions, 2) Experimental Precipitation Harvest Designs, and 3) New Precipitation Harvest Designs.

Annual Reporting Requirements

One of the requirements of the Pilot Project Program is to submit an annual progress report (Report) by July 1st of every year that the Pilot Project is in operation. In accordance with Section 37-60-115(6)(a), C.R.S., the Report summarizes each component of the Pilot Project and indicates how the data and findings address Program goals. The CWCB Annual Report Requirements serve as an outline for this report and are included in **Attachment A**. The information required includes:

1. A **description of variances** from the Application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.
2. **Precipitation harvesting performance metrics**.
3. Pilot Project **implementation plan and estimated water conservation** achieved through pairing precipitation harvesting with advanced outdoor water management.
4. A **description of the climate and hydrologic data collected** to characterize the pre-existing, natural vegetation conditions.

Sterling Ranch Precipitation Harvesting Pilot Project – Progress and Variances

Four objectives were established in the Application that are designed to meet the guidelines and criteria provided by CWCB. They are:

1. Evaluate natural conditions (climate, hydrology, and ET) to quantify the amount of precipitation physically and legally available as a water supply.
2. Evaluate a variety of precipitation collection designs.
3. Evaluate precipitation harvesting paired with advanced outdoor water demand management as a water conservation practice.
4. Create a baseline set of data to support:
    a) An engineering report for a water court application for an augmentation plan to use harvested precipitation, and define a defensible water supply.
    b) Develop sound, transferable, and scalable methodologies for use at other locations in the State of Colorado.

In 2010, the Pilot Project began with the installation of the measuring devices for the natural conditions, collecting associated data, and implementation of an educational campaign. These efforts are further discussed in the sections below.

Phase 1: Natural Conditions

Two study basins were proposed to evaluate natural conditions of Sterling Ranch as part of a comprehensive monitoring plan. The integrated monitoring plan includes measuring climate, precipitation, surface runoff, native ET, and deep percolation to ground water to provide the foundation for defining physical yield characteristics and return flow obligations.

Figure 1 shows the location of the two watersheds and the location of the implemented and proposed monitoring stations within the Sterling Ranch boundary to date. The study basins are being used to quantify the site-specific amount of precipitation that, under pre-existing natural vegetation conditions, accrues to the natural stream system via surface and ground water return flows. The sections below summarize the progress, variation, and data collected to date for each of the monitoring programs that were designed to characterize the return flows. Note that in April 2014, a 24-inch lysimeter was added to the natural conditions monitoring program. Preliminary data from each of the lysimeter sensors is being collected and analyzed.

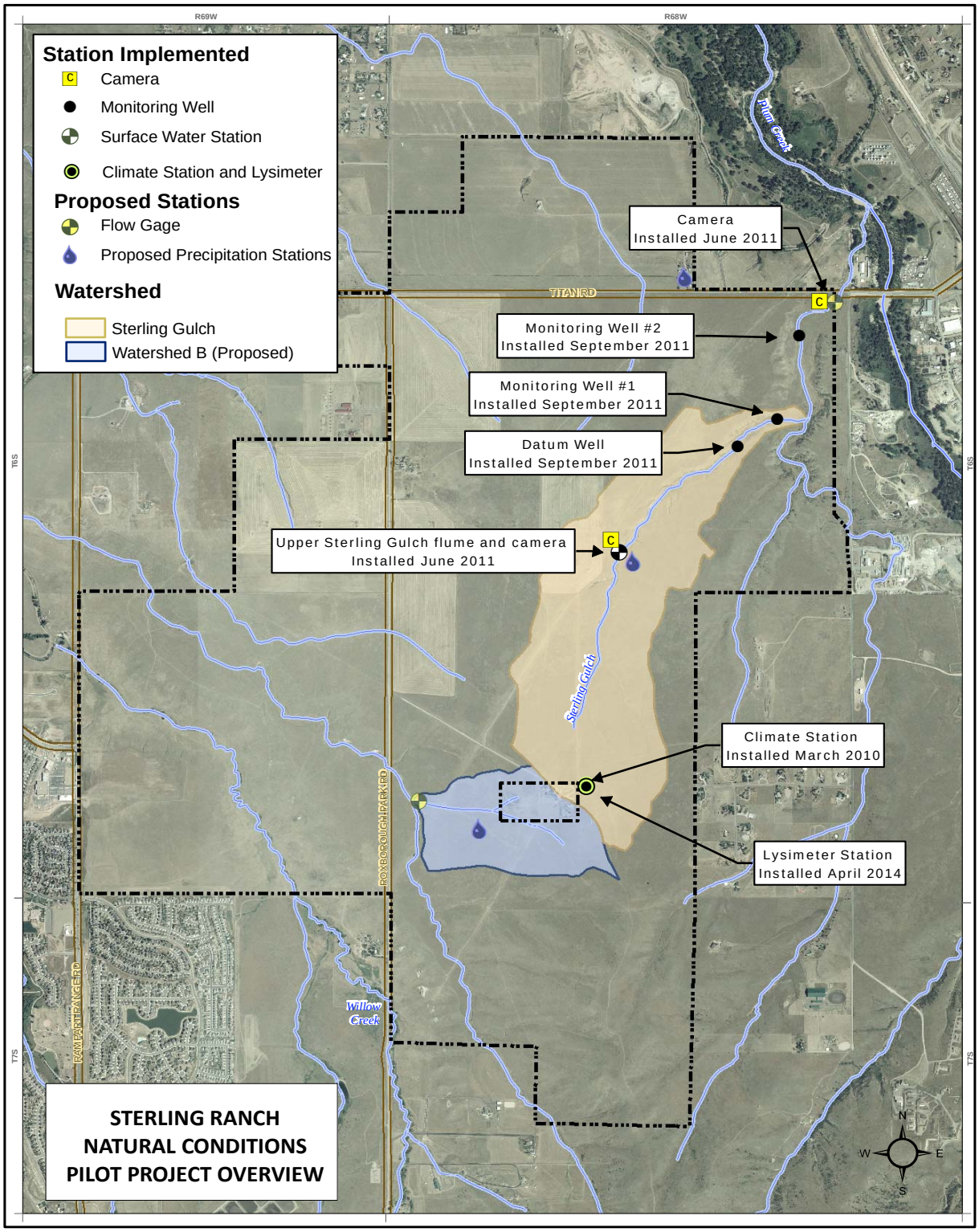

Figure 1 – Proposed Study Basins Map

Climate Monitoring Program

2013-2014 Variance from Application: None

The Sterling Ranch Climate Station was installed on March 29, 2010. The station continues to collect data used to characterize local weather patterns, and will be used for the future estimates of native ET. The data collected at the Sterling Ranch site includes net solar radiation, air temperature, wind velocity and direction, relative humidity, barometric pressure, and soil temperature at varying depths. Most data is recorded in 15-minute intervals, transmitted to the Sterling Ranch website, and archived in a centralized database. **Table 1** is a monthly summary of the data collected to date from the Sterling Ranch Climate Station. Note the Climate Station was taken off-line (March 24 to April 9) to incorporate the lysimeter sensors suite.

Figure 2 – Sterling Ranch Climate Station

Table 1 – Sterling Ranch Climate Station Monthly Summary

Year	2013							2014				
Month	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar***	**Apr***	**May**
Temperature (F)												
Average Temperature	70.3	72.6	72.3	64.8	47.2	41.8	30.2	33.0	31.3	39.4	50.5	55.7
Max Temperature	96.2	96.3	96.3	94.8	78.1	69.2	65.0	63.9	64.2	70.5	76.9	84.8
Min Temperature	39.6	55.4	51.9	32.5	25.0	12.3	-11.6	-4.5	-15.4	7.9	16.2	28.1
Temp Range	57.0	40.9	42.9	62.4	53.1	57.0	76.6	68.3	79.6	62.6	60.7	56.7
Soil Temp (5 cm) (F)												
Average Temperature	74.6	79.5	73.6	66.2	48.3	39.4	32.2	31.7	34.2	39.0	52.0	58.5
Max Temperature	100.0	100.9	92.4	90.2	68.2	50.9	44.7	34.4	47.3	51.5	70.7	84.6
Min Temperature	52.8	61.9	58.7	45.7	35.9	32.3	28.2	29.2	31.6	31.5	36.1	38.8
Temp Range	47.3	39.0	33.7	44.5	32.3	18.5	16.6	5.2	15.8	20.0	34.6	45.7
Soil Temp (15 cm) (F)												
Average Temperature	72.0	77.5	73.2	66.8	50.0	41.0	33.7	32.6	34.7	39.4	51.3	57.1
Max Temperature	84.5	86.7	80.9	80.1	62.6	46.8	41.5	34.0	41.4	45.0	60.6	71.2
Min Temperature	58.1	68.1	63.1	52.1	40.8	35.5	31.5	31.9	32.6	33.8	41.0	41.8
Temp Range	26.4	18.6	17.8	28.0	21.8	11.3	10.0	2.2	8.8	11.2	19.6	29.4
Wind (mph)												
Average Velocity	6.2	6.7	6.1	5.7	5.3	5.8	6.0	6.9	6.8	6.8	8.3	6.3
Max Velocity	32.7	35.2	34.1	33.5	24.9	34.1	34.8	43.7	46.2	33.4	32.0	29.8
Average Direction (Deg N)	182.3	183.3	185.3	195.5	183.9	182.0	177.1	187.0	203.0	188.0	191.7	196.0
Solar Radiation (MJ/m2 h)												
Average Radiation	1.06	0.98	0.87	0.70	0.57	0.43	0.38	0.40	0.56	0.66	0.85	0.90
Max Radiation	4.44	4.27	4.05	4.04	3.11	2.74	2.38	2.32	3.28	3.59	4.00	4.06
Barometric Pressure (mbar)												
Average BP	822.33	825.16	825.90	822.56	821.70	822.69	820.00	820.47	817.35	820.23	818.16	821.50
Max BP	831.90	859.12	831.35	830.16	831.64	838.98	831.17	833.68	828.67	829.94	829.86	833.67
Min BP	812.77	817.97	821.19	807.45	807.67	800.95	804.30	803.45	804.51	801.42	799.88	807.74
Humidity (%)												
Average Humidity	35.6	45.8	42.8	53.8	55.3	41.6	48.9	48.4	55.9	46.9	41.4	51.5
Max Humidity	94.2	94.2	93.4	96.7	99.0	96.0	97.0	99.3	97.7	99.5	98.4	99.4
Min Humidity	4.6	4.6	7.9	11.3	10.8	8.2	10.9	4.1	5.4	6.0	8.4	6.9

* Note the Climate Station was taken off-line (March 24 –April 9) to incorporate the lysimeter sensors suite, values in these months not adjusted.

Precipitation Monitoring Program

2013-2014 Variance from Application: None

The OTT Pluvio[2] weighing precipitation gage was installed on the site and began collecting data on March 29, 2010 (see **Figure 3**). The precipitation gage is located at the same site as the Sterling Ranch Climate Station and reports data in 15-minute intervals. The data collected at the site includes total accumulation and maximum rainfall intensity. This is the first of many proposed precipitation stations for the Pilot Project (see **Figure 1**). The physical measurement of precipitation is important in characterizing the native water supply, native water demand, and other hydrologic processes. **Table 2** is a summary of the data collected from the Sterling Ranch precipitation station. During the 2013-2014 monitoring season there was a total of 16.55 inches of precipitation accumulated with the max intensity of 5.22 in/hr on August 9, 2013.

Figure 3 – OTT Pluvio[2]

Table 1 – Sterling Ranch Precipitation Station Summary

Year	2013							2014				
Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar*	Apr*	May
Precipitation (in)												
Monthly Total	0.61	0.93	2.61	5.08	1.00	0.14	0.46	0.97	0.24	0.99	0.73	2.79
Max Intensity (in/hr)	1.36	1.11	5.22	2.04	0.40	0.00	0.00	0.83	0.72	6.85**	1.04	2.06

* Note the Precipitation Station was taken off-line (March 24 –April 9) to incorporate the lysimeter sensors suite
**Snow Event

Surface Water Monitoring Program

2013-2014 Variance from Application: None

To document surface water events in real-time, trail cameras have been added to the plan at the surface monitoring sites within the Sterling Gulch basin.

A surface water monitoring program was continued during the 2013-2014 monitoring season to quantify the site-specific stream flow that accrues to the natural stream system through surface water flows. One of the three proposed surface water measurement stations has been installed (see **Figure 1**).

The surface water station located on upper Sterling Gulch was completed in June 2011. This station includes a 9-inch Parshall Flume, shaft encoder level sensor, data logger, and a time-lapse camera for visual checks during precipitation events. The trail camera at the culverts at Titan Road

continues to collect photos. Each of the cameras take a photo every 15 minutes documenting hydrologic events in real-time.

Recorded Surface Water Events

Five major events were recorded at the surface water station during the 2013-2014 project year. **Figure 4** is the daily hydrograph for the 2013-2014 project year. In total there were four days with measurable surface water events recorded at the Upper Sterling Gulch flume. Although these events were measured at the Upper Sterling Gulch flume, there was no surface water shown leaving Sterling Gulch at Titan Road trail camera.

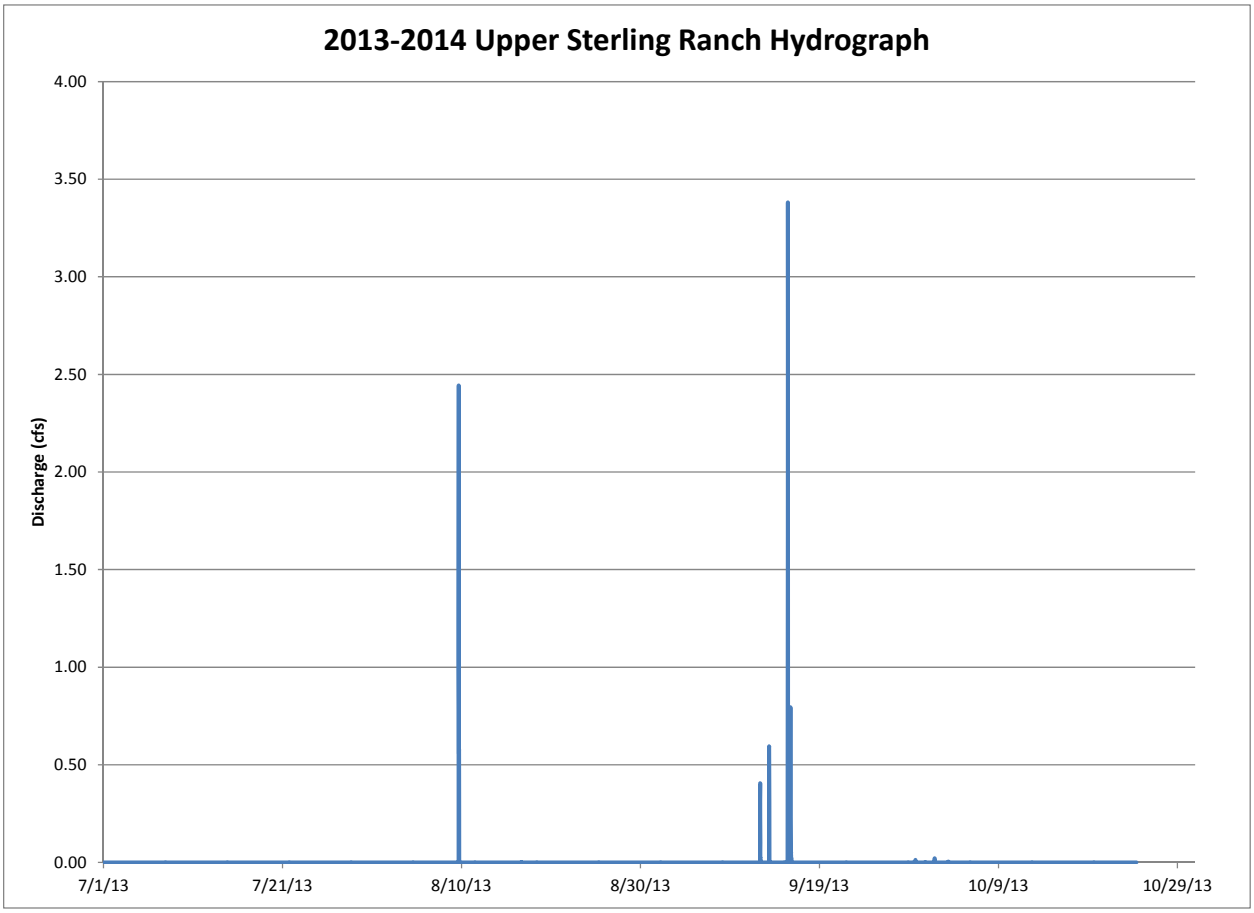

Figure 4 – 2013-2014 Upper Sterling Gulch Hydrograph

The first measurable surface water event was August 9, 2013 lasting approximately 1.5 hours with a peak 15-minute average flow of 2.44 cfs. **Figure 5** is a trail camera picture of the event showing measurable flow through the flume. The photo is poor quality due to debris on the lens, but does show flow in the flume during this event at the bottom center of the photo. Note that photo time may not directly correspond with measured peak discharge.

Figure 5 – August 9, 2013 Upper Sterling Gulch Flume

The other four measurable surface water events were associated with the September storms that occurred from September 12 through 15, 2013. Although significant rainfall occurred during this period Douglas County did not experience significant flooding.

The second event took place on September 12, 2013 lasting approximately 2.25 hours with a peak 15-minute average flow of 0.41 cfs. **Figure 6** is a trail camera picture of the event showing the measurable flow through the flume. Note that photo time may not directly correspond with measured peak discharge.

Figure 6 – September 12, 2013 Upper Sterling Gulch

The third measurable surface water event occurred on September 13, 2013 lasting approximately 1 hour with a peak 15-minute average flow of 0.59 cfs. **Figure 7** is a trail camera picture of the event showing the measurable flow through the flume. Note that photo time may not directly correspond with measured peak discharge.

Figure 7 – September 13, 2013 Upper Sterling Gulch Flume

The fourth measurable surface water event occurred mid-morning on September 15, 2013 lasting approximately 2 hours with a peak 15-minute average flow of 3.34 cfs. **Figure 8** is a trail camera picture of the event showing the measurable flow through the flume. This is the largest surface water event we have measured at the site. **Figure 9** is a trail camera picture approximately 20 minutes later of the event showing no flow made it to the twin culverts at Titan Rd. Note that photo times may not directly correspond with measured peak discharge.

Figure 8 – September 15, 2013 Upper Sterling Gulch Flume

Figure 9 – September 15, 2013 Culverts at Titan Rd

The fifth measurable surface water event occurred on evening of September 15, 2013 lasting approximately 2.25 hours with a peak 15-minute average flow of 0.79 cfs. **Figure 10** is a trail camera picture of the event showing the measurable flow through the flume. Note that photo time may not directly correspond with measured peak discharge.

Figure 10 – September 15, 2013 Upper Sterling Gulch Flume

Native Vegetation (ET) Monitoring Program

2013-2014 Variance from Application: None

The design and construction of a single weighing lysimeter began in January 2014. A representative single intact soil core was collected on April 8, 2014 in an area where future precipitation harvesting is planned. The lysimeter was completed and began transmitting data on April 11, 2014. The lysimeter is 24 inches in diameter and 42 inches tall and is equipped with 3,500 lb load cells, 4 soil moisture sensors, and a tensiometer controlled vacuum system and tipping bucket (**Figure 11**). The lysimeter was constructed next to the climate station to take advantage of the existing sensors and telemetry infrastructure at the site.

The lysimeter will be used specifically to collect data regarding two important aspects of the pilot study; the actual native vegetation ET and the amount of precipitation that percolates through the soil root zone to the ground water table known as ground water recharge or deep percolation. The lysimeters may also provide some insight on site-specific soil moisture storage and surface runoff.

Although some preliminary data has been collected and analyzed during the 2013-2014 monitoring season, data was not compiled for this report.

Figure 11 – Sterling Ranch Lysimeter and Soil Core

Ground Water Monitoring Program

2013-2014 Variance from Application: None

Understanding pre-existing ground water interactions on Sterling Ranch is another important component of the water budget. Quantifying the amount, timing, and location of ground water return flows that accrue to the local alluvial aquifer from precipitation events is important when defining augmentation requirements to local streams. The installation of two monitoring wells and one shallow (Datum) well located within Sterling Gulch was completed in September 2011 (see **Figure 1**). **Table 3** below summarizes the ground water level data collected at each of the monitoring wells.

Table 2 – Sterling Gulch Monitoring Well Recorded Depth to Ground Water

Year	2013		
Date	**Depth (ft)**	**8/7/2013**	**10/17/2013**
Recorded Depth of Ground Water (ft)			
Datum Well	6.25	Dry	Dry
MW-1	15.30	Dry	Dry
MW-2	17.96	Dry*	Dry*

*Some condensation at the bottom of MW-2

During the 2013-2014 ground water monitoring season shown above, there was no naturally occurring alluvial ground water table recorded in Sterling Gulch. Beginning in August of 2013, some moisture was detected at the bottom of MW-2, but was immeasurable. The moisture detected is attributed to condensation collected at the bottom of the well. This does not represent the groundwater level.

Monitoring Program Maintenance Plan

The design of the monitoring plan is modular, and the maintenance requirement of each monitoring program element is different. Once installed, routine physical inspections of all instrumentation were conducted. Real-time sensors were remotely monitored to verify that they are operating correctly. The data-logging sensors were checked and maintained every time that the data was retrieved.

OneRain is the contractor responsible for maintaining the Sterling Ranch climate station and reporting any issues. OneRain has made one visit to the climate station over the last year, in April. The goal of the maintenance visits is to detect failure before it occurs. When servicing a climate station, the inspections are broken down into the following areas: power, telemetry, data logger, and sensors.

OneRain was also responsible for the reconfiguration and programming required to integrate the lysimeter into the existing climate station infrastructure. Climate and Precipitation Stations were

taken off-line (March 24 –April 9) to incorporate the lysimeter sensors suite. The enclosure was rewired and the program rebuilt to incorporate the new sensors.

Beginning in July 2011, Leonard Rice Engineers, Inc. has been responsible for the data collection and maintenance of the Upper Sterling Gulch flume, trail cameras, and monitoring wells. The site has been visited a total of twos times over the 2013-2014 monitoring season with maintenance and data collection occurring each time. Each trail camera requires all photos to be downloaded and cleared from the memory card, a fresh set of batteries, and review of settings to make sure the time-lapse mode is operating correctly. At each of the monitoring wells, water level data is collected manually using an M-scope.

Natural Consumptive Use, Return Flows to the River, Water Budgets, and Models

With most natural conditions monitoring programs in place, it is anticipated that future efforts will be focused on the development and integration of water budgets and modeling. However, there is nothing to report on these sections for the 2013-2014 project year.

Subsequent Phases

Sterling Ranch plans to collect information about different types of precipitation harvesting designs, equipment, and materials and to implement new precipitation harvesting designs in subsequent phases of the pilot project. Recent zoning approval and acquisition of sufficient water supplies marks the beginning of development of Sterling Ranch with the anticipated construction beginning in late 2014. The construction and implementation of planned new precipitation harvesting designs is anticipated to begin as early as winter 2014.

Overall Pilot Project Schedule

Despite the delay in development due to the Douglas County 106 appeal review for the rezoning of Sterling Ranch, the pilot project continues to progress substantially on schedule. However, the delay in development has caused some delays in the progress of the pilot project, especially for the developed conditions. Below is a summary of the variances from the original application:

2013-2014 Variance from Application:

- The first surface water monitoring site was installed in June 2011 and is collecting data. *Ahead of schedule = 6 months*
- Ground water monitoring started in September 2011. *Ahead of schedule = 1 year*
- The lysimeters was installed in April 2014 and ET and deep percolation monitoring has begun. *Delay = approx. 3 years*
- All planning and implementation of Experimental Harvesting Designs has been delayed.
    - Residential Experimental Site - *Delay = approx. 3 years*
    - Commercial experimental monitoring site - *Delay = approx. 3.5 years*
    - Regional observation - *Delay = approx. 3.5 years*
- All New Precipitation Harvesting Designs are planned to begin within the next year.
    - Residential System - Delay = approx. 2 years
    - Commercial System – Delay = approx. 1 year
    - Regional System – Delay = approx. 1 year
- The proposed Administration plan originally included a preliminary administration reporting developed for demonstration site as a test for the development of the new sites. Planning and development of Administration is not planned to begin until next year. *Delay = approx. 3.5 years*

Figure 12 shows the timeline proposed with the adjustments made due to the extended schedule as described above. As shown, the climate and precipitation monitoring programs were implemented and began monitoring in 2010. In 2013-2014 natural conditions data collection has resumed with the addition of the lysimeter, the ET monitoring program will begin. Experimental precipitation harvesting designs is an ongoing planning and implementation effort evaluating the feasibility of residential, commercial, and regional harvesting designs into the development. New construction and implementation of planned new precipitation harvesting designs is anticipated to begin within the next year with the focus on regional capture designs.

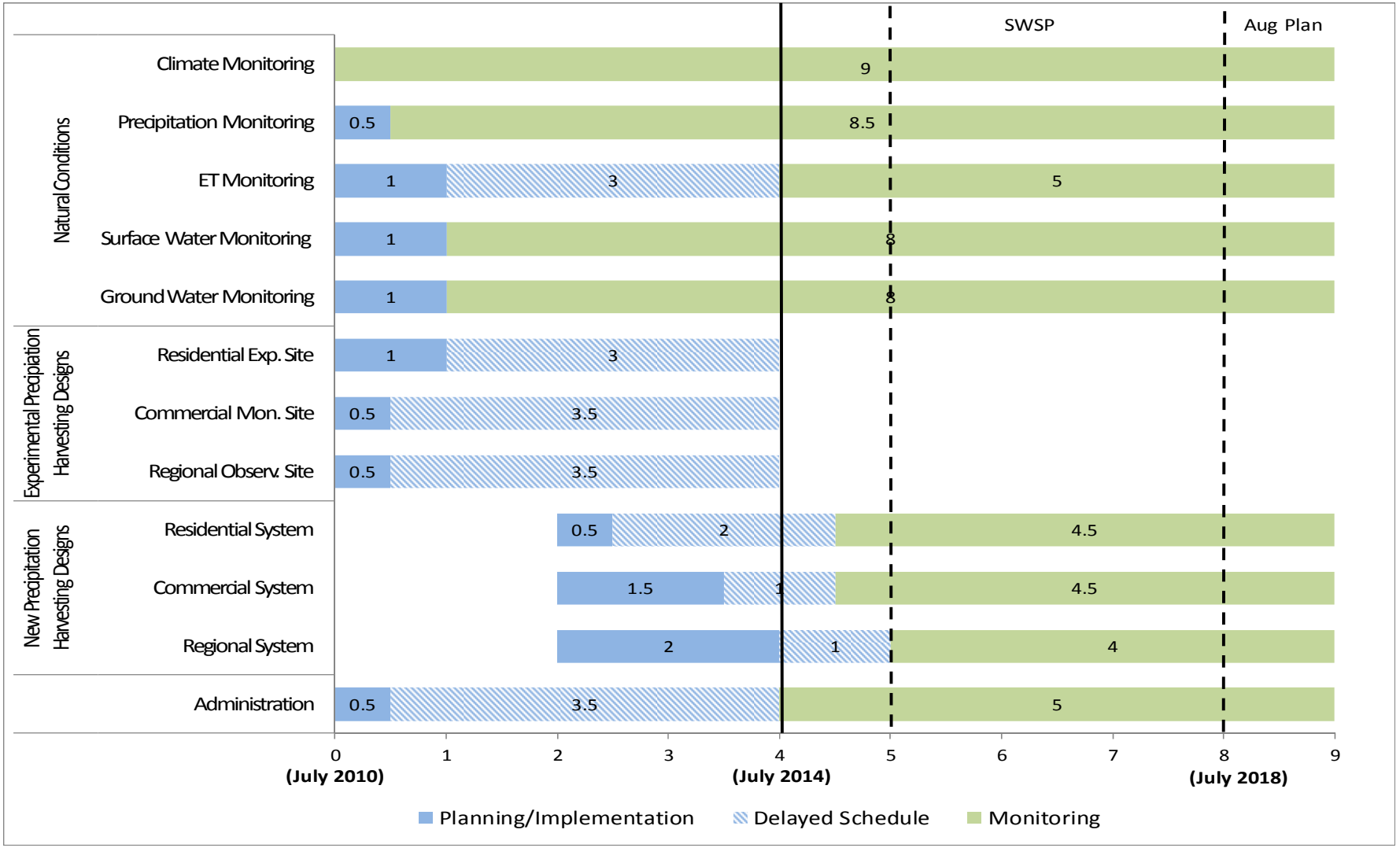

Figure 12 – Updated Pilot Project Schedule

Augmentation Requirements

The Augmentation Requirements that will be met under an approved Substitute Water Supply Plan are expected to begin with Phase 3.

Implementation

Collection and irrigation system design have not currently been finalized or implemented, therefore, no data is yet available for describing operation and maintenance or for estimating collection efficiencies.

Estimated Water Savings, Landscape Plans, Metered Water Use, Consumptive Use and Estimated Water Conservation, and Estimated Unit Cost for Rainwater

Currently there is no new information to provide on the estimated water savings, landscape plans, metered water use, consumptive use, estimated water conservation, and estimate unit cost for rainwater capture and use.

Costs to date

Costs for the Pilot Project have occurred primarily in the efforts for the monitoring of natural conditions and for the Demonstration Site. These are summarized below:

Natural Conditions

In 2013-2014; lysimeter design/construction/installation, station maintenance, data collection, data management and reporting were the primary costs. These costs were:

- Lysimeter Design/Construction/Installation – $39,495*
  (*Cost excludes research and selection of lysimeter design)
- Data Management/Analysis/Reporting – $3,066
- Maintenance and Labor – $4,797

Partnerships and the Sharing of Information

Educational efforts continue to be made during this phase of the Pilot Project to help the community understand the concept of what Sterling Ranch is doing in terms of water conservation and rainwater harvesting. Current education material is provided through the Sterling Ranch website, media articles, and interviews. The Sterling Ranch website, located at http://sterlingranchcolorado.com/, goes into a significant amount of detail about the project overview that includes a description of the lifestyle, housing, and conservation that will be built into the development. The website includes articles that have been published about Sterling Ranch, which is kept current by Sterling Ranch staff. Additional education efforts will be necessary as the project progresses and more programs are implemented.

Special group tours of the rainwater data collection sites continue to be provided to public visitors, other water districts, and water providers as an example of the process and steps required to utilizing rainwater as a reliable water supply. Information on how Sterling Ranch has developed these sites and will continue to gather and apply data to quantify rainwater as a supply is discussed with interested parties throughout the state.

Closing

This letter report describes the fourth year of the Sterling Ranch Precipitation Harvesting Pilot Study. If you have any questions, please feel free to call at 303-455-9589.

Sincerely,

LEONARD RICE ENGINEERS, INC.

Mark Mitisek, P.H.
Project Hydrologist

Greg Roush, P.E.
Chief Operating Officer

Sterling Ranch, Attachment A - CWCB Requirements for Annual Report

1. A description of variances from the Pilot Project application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.

2. Precipitation harvesting performance metrics, including:
    a) Description of final collection system design with plans and specifications of all system components.
    b) Operation and maintenance plans and any issues encountered.
    c) Meter data of water flowing into the precipitation collection device and estimated capture efficiency.

3. Pilot project implementation plan and estimated water conservation achieved through pairing precipitation harvesting with advanced outdoor water management, including:
    a) A description of the applied method used to capture precipitation and any potable water supply with plans and specifications for all system components including any technology utilized (system programmers, ET controllers, etc.).
    b) Landscaping plans including measured irrigated acres, plan descriptions, theoretical irrigation water requirement methods, results, and water budgets reflecting application efficiencies.
    c) Metered water use from precipitation collection system. Water use will be categorized by use if application varies.
    d) Metered water use from other potable water supplies if the precipitation collection is supplemented. Water use will be categorized by use if application varies.
    e) Comparison of actual consumptive use by category of use to estimated water budgets. Estimate amount of water conserved as a result of the precipitation harvesting.
    f) A landscape maintenance assessment of quality of the landscapes, maintenance issues encountered, and any necessary replacement of plantings. The results of the irrigation system audit and corresponding actions.
    g) Cost to date including design, infrastructure, operations, and maintenance costs. Estimated costs to implement precipitation harvesting system per acre-foot of water saved; and comparison of original projected and actual costs from implementing the precipitation harvesting systems. The cost comparison will include institutional, legal, technical/design, infrastructure, and augmentation water supplies.

4. A description of the climate and hydrologic data collected to characterize the preexisting, natural vegetation conditions including:
    a) A description of the methodology and analysis results toward providing information about the technical ability to reasonably quantify the site-specific amount of precipitation that, under preexisting natural conditions, accrues to the natural stream system via surface and ground water return flows.
    b) A description of the baseline set of data and sound, transferrable methodologies used for measuring local weather and precipitation patterns that account for variations in hydrology and precipitation event intensity, frequency, and duration.
    c) Descriptions of the methodology and analysis results 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.

d) Quantification of the amount of precipitation that must be augmented to prevent injury to decreed water rights.
e) Description of the location and methods used to collect climate data measurements, with a summary of data including, at a minimum, temperature and precipitation