

COCHISE COUNTY, ARIZONA
SCOPE OF WORK (SOW)
PALOMINAS RECHARGE AND FLOOD CONTROL FACILITY MONITORING YEAR 5
EPHEMERAL STREAMFLOW AND GROUNDWATER MONITORING YEAR 3
Date: February 25, 2019

Introduction and Background

With the successful July, 2014 construction of the Palominas Flood Control and Recharge Facility on the County-owned parcel and downstream channel, the pilot project entered the operations and monitoring phase of its service life. Instrumentation of the facility monitored since installation has led to conclusions regarding the amount of stormwater recharged, the relative effectiveness of technologies used, management practices, etc. Although the system was designed to minimize erosion, sediment transport and sediment deposition, periodic inspection and maintenance will be required. Program components that will be critical to the continued successful future operation of this facility are: continued monitoring/ analysis and reporting of the system inflow/outflow data, inspection, and maintenance.

JE Fuller along with sub-consultant GeoSystems Analysis, Inc. (GSA) who designed and installed the Palominas facility monitoring program, have provided monitoring data collection, retrieval, and analysis under contract to the County beginning with the July, 2014 completion of construction. The current contract (PSA 18-01-HFP-03) specifies a monitoring period ending December 31, 2018. Monitoring of the facility for a period of five years after construction was one stated expectation of the project outcomes, identified during application for grant funding from the Walton Family Foundation (WFF), which initiated the project work efforts undertaken to-date. Five years from the completion of facility construction will be mid-July, 2019.

Following the 2016 installation of a network of surface flow monitoring sensor stations along ephemeral watercourses tributary to the Upper San Pedro River at or near project site locations, Cochise County (County) will maintain that network and support the acquisition and processing of data provided by the sensors during the third year of monitoring activities. Measurements of groundwater depths at selected locations are also included in this Scope of Work (SOW).

The goal of establishing this network of monitoring stations is to estimate the natural surface water runoff flow depths, rates and volumes that are conveyed by the tributary watercourses on an annual basis in order to facilitate understanding of the rainfall/runoff characteristics of the subject watersheds, guiding improvements in potential future aquifer recharge facility design. Another goal of the network is to document groundwater depth changes over time at selected locations at or near project sites.

Attachment A

The data collected by this network of surface- and groundwater monitoring stations will provide the context within which future aquifer recharge projects will be conceptualized, designed, constructed and operated. It is intended that the results of these monitoring efforts will provide a comprehensive pre-project monitoring program to continue following project development, allowing for direct measurement of the effects of future recharge project implementation. It is also intended that the results of these monitoring efforts will be used to guide and refine modeling practices for estimating rainfall/runoff responses for future projects.

The current contract (PSA 18-12-HFP-03, as extended) specifies a monitoring period ending December 31, 2018. Project deliverables will include maintenance/replacement of monitoring equipment at the selected stations, topographic survey of the monitoring stations (if required), data collection and analysis, and reporting.

Consultants will perform the tasks listed in the SOW. The SOW includes participation in the regularly-scheduled quarterly Cochise County Recharge Network (CCRN) Technical Team meetings for a calendar year following contract award. Contract administration will be conducted by the County.

It is understood that the intent of this monitoring network is to estimate annual runoff flow volumes, typically reporting to the stations under low-stage conditions. These monitoring installations are considered temporary, and damage to the installed stations may occur if the sites are subjected to large (high-stage) flows.

Note that this SOW relates to a monitoring period covering calendar year 2019. Also note that this SOW combines two previously-separate contracts: Palominas Monitoring and Ephemeral Streamflow Monitoring. Descriptions of proposed work for each task are provided in the Scope of Work Outline, below.

Scope of Work Outline

The tasks listed below are the identified elements to this SOW. Palominas Monitoring tasks are denoted by a 'B' prefix, and Ephemeral Streamflow/Groundwater Monitoring activities are denoted by a 'C' prefix.

Task A1: Project Management

The Consultant shall:

- Identify a project manager who will be responsible for managing the budget, schedule, and deliverables throughout the project, including the management of budget, schedule, and deliverables of any Subconsultants, as well as report directly to the County's project manager;
- Identify all Subconsultants who will be involved in the project;
- Schedule and coordinate field work, including equipment installation, data collection, and periodic data downloads;

Attachment A

- Participate in and lead conference calls/meetings for the duration of the contract, including the regularly-scheduled quarterly Cochise Conservation and Recharge Network (CCRN) Technical Team Meetings (6 meetings assumed);
- Assign roles and communication system for Consultant and Subconsultant project team members; and
- Identify key stakeholders groups, contacts for each group, and timing for project participation with assistance from the Project Team.

Deliverable 1: Monthly Reports and Invoices and Quarterly Conference Calls/Meetings

Task B: Palominas Monitoring

Task B1: Palominas Monitoring System Data Collection and Management

Dataloggers at the Palominas recharge facility record sensor measurements of groundwater elevation (4-hour intervals); basin water level elevations (15-minute intervals); drywell and infiltration trench water level elevations (15-minute intervals); and soil matric potential and soil water content in vadose zone boreholes (4-hour intervals). Three rain gauges record total precipitation and average temperature precipitation on 15-minute intervals.

USDA-ARS staff will download data quarterly during the monitoring period (4 events from January to December 2019). One data download site visit is budgeted for staff to allow for concurrent maintenance and calibration of monitoring equipment, as needed (Task B2). Data will be checked and processed at least quarterly. Spreadsheet processing will include calibrations, corrections, and time-series plotting of sensor measurements, and modeled estimates of stormwater capture and groundwater recharge. The monitoring period ends December 31, 2019.

Assumptions include:

- 2 field days per data download trip (1 person)
- 2 field days to troubleshoot and replace datalogger equipment as needed in 2019 (1 person)
- USDA-ARS will download data from the Palominas facility on a quarterly basis

Task B2: Palominas Monitoring System Maintenance

Monitoring station maintenance will consist of up to two site visits, as necessary, to troubleshoot and fix any problems. To the extent practicable, maintenance visits will be scheduled together with data downloading visits. For budgeting purposes, and because equipment is now five years old, \$3,000 for instrument replacement during the annual monitoring period is estimated.

Task B3: Palominas Data Analysis and Annual Report

Data analysis will include estimates of precipitation, evaporation, basin-specific infiltration volumes using the mass balance and field-based approaches, duration of ponding, water flow between basins, recharge enhancement feature infiltration volumes, groundwater elevations and gradients, and soil moisture trends.

A 2019 calendar year annual report will be provided by March 31, 2020 (**Deliverable 2**). Preliminary tabular data summaries will be provided as requested by CCRN members following any of the quarterly monitoring data downloads.

Task B4: Palominas Facility Inspection and Memo

The facility will be inspected once in March and once in September, 2019. A memorandum will be prepared following each inspection visit detailing the observations made and recommendations for facility maintenance. Recommended maintenance actions will be ranked for priority using 3 categories: critical, high priority, low priority. It is assumed that County crews or a County contractor will perform all maintenance

Deliverable 3: Two inspection report memos including all site photos will be provided within one week following the inspections

Task C: Ephemeral Streamflow and Groundwater Monitoring

Task C1: Survey of Monitored Channel Reaches/Stations

Ephemeral streamflow monitoring stations installed during the first year of monitoring activities were surveyed using real-time kinematic (RTK) satellite positioning during installation. Stream flow events have the potential to alter cross section geometry, presenting the need to update the cross section geometry used in the analyses. Each sensor location will be visually assessed for changes since installation/survey to evaluate the need for re-survey. Where re-survey is warranted, the sensor locations will be re-surveyed using RTK.

Information gathered during site surveys will be used to modify monitoring sensor placement locations as needed, and to generate data necessary for input into the CSA2SAC computer model, the HEC-RAS files, and the roadway crossing analyses.

Task C2: Ephemeral Streamflow and Groundwater Monitoring and Reporting

Task C2a: Quarterly and Mid-Monsoon Data Downloads

Data will be manually downloaded from all monitoring equipment at Bella Vista, Riverstone, Horseshow Draw and Palominas watershed five times during the annual monitoring period. Also included is download of pressure transducer data installed under separate contract at the Babocomari River groundwater well installed on The

Attachment A

Nature Conservancy property. All pressure transducers, rain gauges, and the surface water imagery stations will be assessed for functionality, battery life, and sensor and clock drift. Data trends will be examined in the field to assure data quality, and any necessary adjustments will be made. Precipitation data from on-site rain gages will also be downloaded during the data downloads.

Five data download visits (March 2019, June 2019, August 2019, September 2019, and December 2019) are assumed with one staff for two days each visit.

Task C2b: Equipment Maintenance

Flow events at the sensor stations may create the need to routinely clear vegetation and other debris from the sensors in order to allow for accurate measurement readings. Minor debris removal will occur coincidentally with the data downloads. Large flow events have the potential to scour channel bottoms and erode channel banks, which may necessitate adjustments to sensor installation locations and depths, as well as re-survey of channel cross sections and characteristics (roughness, uniformity, etc). One additional site visit shall be assumed to allow for such maintenance, as changes may not be evident until data has been processed and analyzed.

Task C2c: Data Processing and Analysis

Data from the third year monitoring period at all CSA stations will be analyzed following methods provided in Smith et al (2010), and using HEC-RAS, depending on the station. Data for individual runoff events will be pre-processed and formatted as necessary for input into the SAMDC program developed by Trent University or HEC-RAS. Output files provide instantaneous stream discharge estimates which will be used to develop complete event hydrographs of discharge.

Data from the third year of monitoring activities at roadway crossing stations will be analyzed following accepted engineering methods provided by the FHWA. At roadway crossing stations (Palominas watershed), culvert and/or roadway overtopping rating curves/tables will be generated to provide stage-discharge relationships to estimate flow volumes.

Data collected at the stock pond installations within the Riverstone property will be analyzed using the County's 2-foot contour resolution mapping, in order to develop a stage/storage relationship to translate recorded depths to volumes. The Ramsey drop structure data will be analyzed through the use of a broad-crested weir rating, to translate recorded flow depths to volumes.

Task C2d: Reporting-Ephemeral Streamflow Monitoring

Following analysis of monitoring data, an annual report will be generated which summarizes project findings. The following metrics will be calculated for each of the monitoring stations:

- Complete event hydrographs of discharge
- Total annual and individual event flow volumes (acre-feet)
- Peak channel discharge (cfs)
- Event flow durations (hours)

Data from the surface water imagery station will be summarized to provide estimates of water depth and extent during flow events.

Task C2e: Reporting-Groundwater Monitoring

Groundwater data for the annual monitoring period will be summarized in a data memo (subtask 3e), and provided to Cochise County and The Nature Conservancy in support of development of the Walton Family Foundation's Groundwater Metric. This Memo will also be included in the Task C2d Annual Report.

Task C2f: Annual Results Presentation

Following report submittal, a meeting will be held with the CCRN technical team to present results for year 2 ESM monitoring

Deliverables 4, 5 and 6: A Draft Annual Monitoring Report will be submitted to the project team at the end of the one year monitoring period. All project activities will be clearly documented, including data interpretation and analysis. All associated data will be provided in electronic format, as an appendix to the draft and final reports. **(Deliverable 4)**

A Final Annual Monitoring Report will be submitted within one month of receipt of comments from the project team. **(Deliverable 5)**

A memorandum summarizing the groundwater monitoring data will be submitted to the project team. **(Deliverable 6)**

Schedule

It is anticipated that the contract will be awarded in January 2019 in order to provide a monitoring period continuous from the end of the previous year monitoring period. The Consultant shall work closely with the County's project manager to develop a schedule for review and approval by the Project Team within 10 days of contract award.

Manual data downloads (Task C2a) will occur during March 2019, June 2019, August 2019, September 2019, and December 2019). All reporting for this monitoring project will be completed before March 2020.