The proposed project is entitled "Ojai Groundwater Basin Inflow/Outflow Study," which has been abbreviated to the acronym of "IOS." As the name implies, the IOS strives to quantify the inflowing surface water that recharges the basin, the outflowing surface water that discharges from the basin, and quantify the surface water flowing through the central portion of the basin at the point of compliance for the SACSGRP. The following work plan items corroborate the schedule and budget

Scope of the Proposed Project

One of the main goals set forth in the Ojai Basin Groundwater Management Plan is to improve understanding of the basin hydrology. Measurement of surface flow into the basin and discharge from the basin is a key component of achieving this goal.

We propose that the surface flow measurements be conducted to corroborate and facilitate future self-funded updates to the OBGMA's MODFLOW groundwater model completed in 2011 under previous grant funding from the LGAP. The groundwater model included the area located within the boundaries of the Ojai Valley Groundwater Basin located in Ventura County (Figure 1). Key components of the model required an understanding of streamflow recharge and discharge, for which a dearth of data existed.
This section presents our proposed scope of work for developing a program to monitor and gage stream flow for a better understanding of basin components critical to the model and future management scenarios.

Background

The Ojai Basin underlies the intermontane lower Ojai Valley of the western Transverse Ranges geomorphic province of California. The basin is predominantly filled with Quaternary alluvial fan, floodplain, and lacustrine deposits, which unconformably overlie older folded and faulted sedimentary rocks of the Sespe, Vaqueros, and Rincon formations. The following description represents our conceptual model of the hydrogeology of the basin.

Coarse grained sand and gravel aquifer units appear to be thickest near the north and east portions of the basin (the alluvial fan heads) and thinnest to the south and west where fine grained lacustrine and floodplain deposits predominate as confining layers, separating the water-bearing zones into as many as a half-dozen correlative aquifer units. The drainage area for the Ojai Basin is relatively large (36 square miles) compared to the alluvial surface area of about 10 square miles, and as such the amount of groundwater in storage responds quickly to heavy precipitation. Most of this recharge occurs where Horn Canyon (Thacher Creek), Gridley Canyon and Senior Canyon (San Antonio Creek), and Reeves Creek enter the basin at alluvial fan heads. Each of these intermittent streams coalesce over the basin and exit as San Antonio Creek, which has nearly perennial flow as it leaves the basin, sourced by effluent groundwater from the Ojai Basin (DBS&A, 2006). Groundwater in the alluvial sediments may be unconfined or confined, depending on water levels and the presence of clay-rich confining units. With the exception of higher elevation areas associated with the alluvial fan heads, the aquifer system is capable of being under confined conditions in most of the basin, but may be confined or unconfined at different times depending on the degree of saturation and the thicknesses of aquifer and aquitard units (Kear, 2005).

The total storage capacity of the Ojai Basin is reported to be as high as 85,000 acre-feet (ac-ft), and the “safe yield” of the basin has been reported to be on the order of 7,000 to 8,000 acre-feet per year (ac-ft/yr). Amounts of water in storage reached maximum levels in 1993, 1998, and 2005, when numerous wells in the southwestern and south central portion of the basin flowed at ground surface under artesian conditions during the late winter and early spring. Much of this water flowed toward San Antonio Creek and exited the basin as surface water (DBS&A, 2006).

The primary discharge mechanism for the basin is groundwater pumping. Because of the basin's relatively limited storage capacity, the basin may be depleted rapidly during drought periods by groundwater pumping and groundwater outflow to San Antonio Creek at the basin's natural discharge points.

Measuring this outflow and inflow will help to bracket the yield of the basin and better inform past and future modeling and management efforts.

The scope of the IOS is the hydrologic domain managed by the OBGMA, with a scope divided into five tasks to determine surface stream inflow and outflow to and from the Ojai Basin. The five tasks are:

Task 1: Project Management
Task 2: Design and selection of materials and equipment
Task 3: Gage Purchase, Setup and Installation
Task 4: Gage Monitoring and Measurements
Task 5: Reporting

Purpose, Goals and Objectives of the Proposed Project

The goals of the IOS project are, in concert with the GWMP, to measure surface water inflow to the Ojai Basin and measure outflow along San Antonio Creek. These data will help to quantify and supplant indirect measurements of inflow to the basin used in previous studies, as well as provide key information to deduce the annual recharge to the basin and bracket groundwater extractions or other uptakes.

Work Items to be performed

Five tasks are proposed under the OBGMA IOS Project:
1) Project Management and administration
2) Design and selection of materials and equipment
3) Gage purchase, setup and installation
4) Gage monitoring and measurements
5) Reporting

Task 1: Project Management

The Project Management task includes all items related to project coordination, setting and maintaining scope of deliverables and schedules, project meetings with the OBGMA, and budget supervision and control. The OBGMA Project Manager will be Jordan Kear of Kear Groundwater (KG), who serves in the capacity of OBGMA Hydrogeologist. He will be the point of coordination and communication for all project activities and tasks, both internal to the KG team (e.g., directing team activities and maintaining schedule control) and external (e.g. coordinating and conducting stakeholder forums and communicating with OBGMA). Consequently, it is essential that the Project Manager (1) possess the appropriate professional experience required to successfully manage and complete the project, (2) possess excellent communication skills, and (3) have a demonstrated ability to work with OBGMA and other stakeholders. Mr. Kear meets each of these criterion. At KG, project management and control functions are carried out in accordance with a well-established company system with automated, multi-level reporting for cost-control and project schedule evaluation.

Task 2: Design and selection of materials and equipment

Preliminary selections of equipment and materials are presented herein, and include hardware and software associated with the stream gaging equipment. Under this task, OBMGA will further evaluate the applicability and utility of equipment and specify instrumentation that will best apply to the reomte and continuous, non-contact measurement of water levels in the five stream gage locations.

Radar, or radio-frequency transmission, is a distance-measuring method that has been used since before World War II. A radio frequency is the propagation of an electro-magnetic field, and therefore, is performed at the speed of light. The advantages of radar are that the signal is generally immune to weather conditions, such as snow and rain, and the radio wave used for this application is harmless to humans and wildlife. The usable sensor-to-water sensing range is minimally from near zero to about 66 ft, and can be greater, depending on the radar instrument. The technology for using radar for measurement of water levels is still new, although several commercially developed instruments are available. Some of these units are being tested. Also, as in all radio-frequency transmissions, the radar frequency must meet approval from the USGS Office of Information Services and ultimately the U.S. Federal Communications Commission (FCC).

Several radar sensors are commercially available for use in streams and reservoirs. Radar sensors are usually self-contained units having typically a horn-like transmitting device and electronic circuitry. Radar sensors are internally programmed to convert radar-frequency reflections from units of distance to the water surface to stage.
To use these sensors, the OBGMA will have to provide a separate data logger and battery. These units are mounted directly above the stream using a bridge handrail or other stable structure.

Typically, radar sensors used to measure stream stage have a beam angle of 8 degrees. This means at 25 ft of air gap, the footprint measured has a diameter of 7 ft on the water surface. When using one of these instruments for the measurement of stage, OBGMA will make routine checks to ensure the instrument footprint does not have obstructions that will affect the measurement of stage, such as debris, boulders, and other material in the stream.

Examples of radar sensors which meet USGS accuracy requirements, are: the Design Analysis Associates H–3611, the Ohmart Vega VegaPuls 61, the Ohmart

Vega VegaPuls 62, and the Ott RLS radar level sensors. For simplicity the OBGMA has preliminarily selected the VegaPuls model, but will evaluate the final model under this task.

Also under this task, OBGMA will secure encroachment permits from applicable agencies to allow the fixture of the equipment on the bridges. Conditions of such permits may necessitate additional design of mounting hardware or other operation design parameters.

This task will culminate with a technical memorandum providing specifications of instrumentation and detailed plans for installation and operations.

Task 3: Gage Purchase, Setup and Installation

Under this task, OBGMA will purchase all hardware and software to establish gaging stations at each of the five proposed locations. Qualified personnel shall install the hardware at each of the locations, and set up the loggers, recorders, and transmitters such that the equipment functions at an optimal rate and within standard specifications as established by the USGS.

Task 4: Gage Monitoring and Measurements

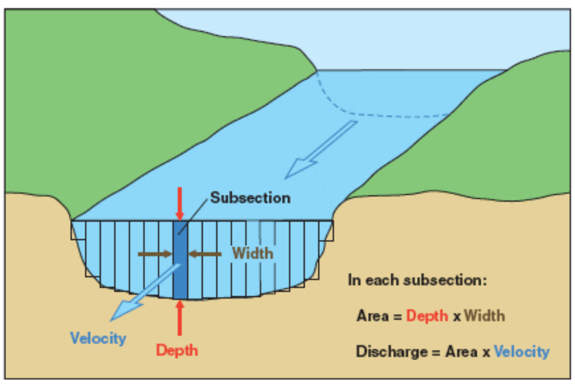
Gage monitoring will be continuous, recorded by instrumentation at each location and downloaded or transmitted to OBGMA computers for evaluation or interpretation.

During the dry season, quarterly measurements flows or observations of a lack of flow will be recorded. At each location, a transect along a determined and fixed cross sectional area will be established, and consistently measured over the life of the project. Each transect will be directly perpendicular to the flow fot he stream and directly beneath (or above if pressure instrumentation is emplaced) the continuous recording devices such that stage rating can be prepared and flows quantified.

A flow probe, such as a Global Water FP111 (pictured below) will be used to measure stream velocity in each location according to USGS standards.

Each transect will be divided into 0.5-foot intervals. For the USGS “6 tens method”, the Flow Probe is placed at the center of the subsection at a depth from the surface of 0.6 of the total depth. The Flow Probe is held in place and the average velocity is obtained over a period of 40 seconds. The 0.6 depth is assumed to be the average velocity point for the vertical profile.

All measurements will be digitally and manually recorded, converted to cross sectional area, such that flow volumes can be quantified and extrapolated through periods of automated measurement to quantify cumulative flows over several periods of record.



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

Task 5: Reporting

OBGMA will report each of the gaging measurements via several methods: monthly at meetings, updated in real time via the OGMA Website, reported quarterly to the DWR, annually via OBGMA Annual Reports, and via a final report to the DWR on completion of the project. It is anticipated that the program can continue to be conducted and reported as funded by the OBGMA extraction fees.

Each report will provide a summary of materials and installations, measurements and calculations, and flows over the period of monitoring records.

Each report will provide a rating curve relating flow and stage of creeks, as well as graphics depicting cross sectional areas of transects.

Access to gage locations

Part of the criteria for proposed gage locations included access and each is a publicly-accessible bridge over the target creek areas. The relatively minor placement of gages on the bridge rails or bottoms will be permitted from the various agencies under whose purview the bridges have been placed.

Safety at each location is paramount, and only trained personnel will

Environmental Compliance Plan

Because the proposed project is effectively a study, with no physical infrastructure or physical changes, there are no anticipated California Environmental Quality Act (CEQA) obligations in connection with the proposal.

No permits are needed for the proposal. Care will be taken by all field staff to ensure minimal impacts on flora and fauna during field work.