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KERN GROUNDWATER AUTHORITY COORDINATION AGREEMENT COMPONENTS WHITE PAPER SERIES

Item B Groundwater Extraction Data

Introduction

There are seven components to Groundwater Sustainability Plan (GSP) coordination agreements. The coordination components are further described in the Department of Water Resources (DWR)'s GSP regulations, which were released in draft form in February 2016. The seven components are:

- a. **Groundwater Elevation Data.**
- b. **Groundwater Extraction Data.**
- c. **Surface Water Supply.**
- d. **Total Water Use.**
- e. **Change in Groundwater Storage.**
- f. **Water Budget.**
- g. **Sustainable Yield.**

The Kern Coordination Committee of the Kern Groundwater Authority (KGA) is preparing a series of white papers addressing each of the coordination elements identified above. This white paper addresses *Item b) Groundwater Extraction Data*. The information presented in this white paper provides a suggested methodology and protocols for the consistent collection of groundwater extraction data throughout the Kern Subbasin. The intent of this white paper is to advance the dialogue between participating members of the KGA on the development of a coordination agreement required under the Sustainable Groundwater Management Act (SGMA). The information presented herein is draft and subject to the input and revision from members of the Coordination Committee.

Water Budget Components

Water budgets estimate change in groundwater storage by comparing supplies to consumptive uses and outflows. This section explains the supply and consumptive use components that need to be

considered when developing a water budget for the Kern Subbasin. Figure 1 shows the summary equation.



Supply can be calculated by documenting and adding together water supply inputs into the Kern Subbasin, which include:

- Kern River
- Minor streams
- CVP imports
- SWP imports
- Precipitation
- Groundwater inflows from small watersheds
- Groundwater inflows from the Tule Subbasin
- Groundwater inflows from Tulare Lake Subbasin
- Produced water from oil extraction
- Withdrawals from groundwater storage (groundwater extractions)

Consumptive use can be calculated by documenting and adding together consumptive uses and outflows, which include:

- Managed habitat evapotranspiration
- Undeveloped land evapotranspiration
- Soil moisture evapotranspiration
- Agriculture evapotranspiration
- Groundwater outflows to small watersheds
- Groundwater outflows to Tule Subbasin
- Groundwater outflows to Tulare Lake Subbasin
- Municipal consumptive use (Municipal use minus municipal discharge)
- Evaporation during energy production
- Contributions to groundwater storage (deep percolation)

This white paper discusses methods that can be used to measure or estimate groundwater extractions. Other components of the water budget are discussed in other white papers.

Groundwater Extraction Data and Monitoring Protocols

There are two available methods for the determination of groundwater extraction from within the Kern Subbasin. These methods are proposed as potentially viable methods that KGA participating members can collectively agree to for the determination of groundwater extractions. Establishing common, defined methods for determination of groundwater extractions, or any other coordination element, is important to establishing a creditable coordination agreement between Groundwater Sustainability Agencies (GSA)s within the Kern Subbasin and KGA participating members.

Calculated Groundwater Extraction Data

Groundwater extraction can be calculated as a part of the water budget. All other components of the water budget can be estimated or measured, which allows for groundwater extraction to be calculated. The water budget's data is spatial in nature, groundwater extraction can be estimated at the district or GSP chapter level. The full water budget is explored in an upcoming white paper.

Monitored Extraction with Meters

Groundwater extraction can also be monitored with meters. For metering to be effective for monitoring, every well in a district or chapter GSP that produces over 2 acre feet per year must be metered. Meters will be installed, certified, and tested following the guidance of Chapter 5 of the *Guidebook to Assist Agricultural Water Suppliers to Prepare a 2015 Agricultural Water Management Plan* (DWR 2015). The guidebook's Chapter 5 provides guidance for water measurement, documentation, accuracy, and certification. Chapter 5 is included as Attachment A to this white paper. Chapter 5 also cites sections of the California Code of Regulations (CCR) §597.3 and §597.4 which are included as Attachment B, as well as AWWA specifications.

Reporting of Extraction Data

SGMA requires annual reporting of groundwater elevation data, groundwater extraction, surface water use, total water use, and change in groundwater storage. Extraction data can be calculated on an annual basis, and metered extractions can also be reported on an annual basis.

Quality Control and Assurance

Whether calculated or monitored with meters, groundwater extraction data can be evaluated for accuracy against values prepared in Agricultural Water Management Plans (AWMP)s and values determined by monitoring groundwater levels and determining the change in storage. Data from previous AWMPs can be used to check calculated groundwater extraction at the district level. If data from AWMPs is significantly different than the calculated extraction, the AWMP and/or the calculated extraction should be reviewed. Potential changes in irrigation practices and land use may be the cause of the difference and should be investigated.

Extraction data can also be compared to data collected during the investigation of change in groundwater storage. Change in groundwater storage should be estimated based on monitoring well information. Monitoring of well levels provides a clear indicator of groundwater conditions and includes a large number of wells throughout the Kern Subbasin. The monitoring data from these monitoring wells can be contoured and compared annually to determine what the change in storage in the Kern Subbasin was year to year. Change in storage will be further discussed in a future white

paper. The change in storage can be compared to groundwater extraction data and used for comparison and quality control.

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Attachment A – Chapter 5 of the Guidelines

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5 Water Measurement Documentation

The Agricultural Water Measurement Regulation applies to water suppliers that serve more than 25,000 acres (excluding recycled water), and requires that water measurements be conducted at the Delivery Point or Farm-gate of a single customer and that measurement devices are certified as accurate through field-testing, laboratory/engineer certification, or inspection. There are specific requirements for water measurement and reporting in the AWMP that are identified in CCR §597.3(b)(2), §597.4(b)(2) and §597.4 (e). This chapter describes the pertinent Agricultural Water Measurement Regulation documentation that must be included in the AWMP, if applicable. The pertinent text of this regulation is included in Appendix B.7.

All documentation needed for water measurement compliance may be included in Section VIII of the AWMP or as attachments/additions to CVPIA/RRA water management/conservation plans submitted to DWR.

If the agricultural water supplier cannot measure water deliveries at the Delivery Point or Farm-gate of a single customer, they may be able to measure deliveries at an upstream location, provided certain criteria are met and that this is documented in the AWMP. The criteria for allowing upstream measurements are specified in CCR §597.3(b)(1). The criteria for measurement device accuracy and certification are specified in CCR §597.3(a), §597.4(a), and §597.4(b).

The following information is required in the AWMP to document that this criterion was satisfied, if applicable (see Table 5.1 for summarized detail):

A. Legal Certification and Apportionment Required for Water Measurement – Lack of Legal Access to Farm-gate

If a water supplier cannot measure water at the Farm-gate because of lack of legal access needed to install, measure, maintain, operate, and monitor a measurement device (CCR §597.3(b)(1)(A)), the following must be included in the AWMP or CVPIA/RRA plan/attachment(s):

1. Certification for lack of legal access by the water supplier legal counsel (CCR §597.3(b)(2)(A)).
2. Documentation on apportionment of volume of water delivered to customers (CCR §597.3(b)(2)(C)).

Under CCR §597.4.b(2)(C), if water measurements cannot be conducted at the Delivery Point or Farm-gate of a single customer, all of the following criteria about how the agricultural water supplier apportions the volume of water delivered to individual downstream customers must be documented in the AWMP:

- a. How differences in water use among individual customers is accounted for based on (but not limited to):
 - Duration of water delivery
 - Annual customer water use patterns

- Irrigated acreage
 - Crops planted, and
 - On-farm irrigation system
- b. That this delivery apportioning is sufficient for establishing a pricing structure based at least in part on the volume delivered, and
- c. That it was approved by the agricultural water supplier's governing board or body.

B. Engineer Certification and Apportionment Required for Water Measurement – Technically Infeasible

If a water supplier does not measure water at the Farm-gate but instead measures water at the lateral (upstream of multiple customers) because flow or water level fluctuations or other conditions prevent the ability to accurately measure at the Farm-gate, the water supplier must provide the following in the AWMP or CVPIA/RRA plans:

1. Engineer determination that accuracy standards of CCR §597.3(a) cannot be met at the Farm-gate (CCR §597.3(b)(1)(B) and §597.3(b)(2)(B)),
2. Documentation on apportionment of volume of water delivered to customers as described above (Guidebook Section 6.A.2) (CCR §597.3(b)(2)(C)).

C. Description of Water Measurement Best Professional Practices

All water suppliers required to implement agricultural water measurement in accordance with CCR §597 must include a description of Best Professional Practices about, but not limited to: (CCR §597.4(e)(2))

- The collection of water measurement data.
- Frequency of measurements.
- Method for determining irrigated acres.
- Quality control and quality assurance procedures.

Include this description in the AWMP, or USBR plan/ attachment(s) submitted to DWR.

D. Documentation of Water Measurement Conversion to Volume

If water measurement device(s) are not measuring water volume, the water supplier must provide documentation on how measurements are converted to volume (CCR §597.4(b)(2)(e)). Specific flow-rate, velocity, and water elevation measurement conversions are identified in CCR

§597.4(b)(2)(e)(3). Include this description in the AWMP, USBR plan/attachment(s) submitted to DWR.

E. Device Corrective Action Plan Required for Water Measurement

All existing water measurement devices must measure water delivered at the Delivery Point or Farm-gate of a single customer with the following accuracy: **(CCR §597.3(a))**

- Existing devices with an accuracy of + 12% by volume.
- New or replacement devices with a laboratory certified accuracy of 5% by volume or field-certified accuracy of 10% by volume.

CCR §597.4(a) describes the initial certification of device accuracy protocols and **CCR §597.4(b)** describes the field-testing and field-inspection of existing device protocols. Field-testing must be conducted as a statistically random representative sample of devices. However, field inspections and analysis must be completed for every measurement device. In both cases, only trained and qualified individuals can perform these assessments and the tests must be documented in a report that is approved by an engineer.

If field testing or inspection shows that a measurement device does not meet the accuracy criteria, it must be repaired and brought into compliance or replaced with a measurement device meeting the accuracy criteria above. If this was not accomplished by submittal of the 2012 plan, a corrective action plan was required to bring devices into compliance by 2015 **(CCR §597.4 (b)(2) and §597.4 (e))**. Agricultural Water Measurement Regulation requires that the corrective action plan was to be included in the 2012 Plan submittal to DWR and must include a schedule, budget, and finance plan for taking corrective action in three years or less **(CCR §597.4 (e)(4))**.

Include this description in the AWMP or USBR plans/attachments submitted to DWR.

F. Table 5.1 Water Measurement Documentation Information:

Information that may be submitted to DWR in the AWMP or with a USBR-accepted water management/conservation plan to satisfy water measurement requirements.

Subject	State Regulation (CCR)	Information that may be submitted
Requirements for Measuring at Upstream of Multiple Customers	Section 597.3(b) – allows installing measurement device upstream of multiple customers if certain conditions are met.	If water measurement device is installed upstream of multiple Farm-gates, provide information on lack of legal access or conditions as described in Sections 597.3(b)(1)(A), 597.3(b)(1)(B), and 597.3(b)(2) of regulation.
Performance Requirements	Section 597.4(d) – <ol style="list-style-type: none"> 1. Devices shall be correctly installed, maintained, operated, inspected, and monitored. 2. Devices no longer meeting the accuracy requirements shall be repaired or replaced. 	Provide a description of device performance.
Reporting Requirements	Section 597.4(e)(1)-(4) - Document compliance w/ 597.3 (b). Description of best professional practices used. Protocols used to convert non-volume readings. Schedule, budget and finance plan for taking corrective actions.	Provide documents for Section 597.4(e)(1)-(4).
Requirements for bringing existing devices under compliance	Section 597.4(e)(4) – Schedule, budget and finance plan.	If applicable, provide information for Section 597.4(e)(4).

Attachment B – Sections of the California Code of Regulations

§ 597.3. Range of Options for Agricultural Water Measurement.

An agricultural water supplier subject to this article shall measure surface water and groundwater that it delivers to its customers pursuant to the accuracy standards in this section. The supplier may choose any applicable single measurement option or combination of options listed in paragraphs (a) or (b) of this section. Measurement device accuracy and operation shall be certified, tested, inspected and/or analyzed as described in §597.4 of this article.

(a) Measurement Options at the Delivery Point or Farm-gate of a Single Customer

An agricultural water supplier shall measure water delivered at the delivery point or farm-gate of a single customer using one of the following measurement options. The stated numerical accuracy for each measurement option is for the volume delivered. If a device measures a value other than volume, for example, flow rate, velocity or water elevation, the accuracy certification must incorporate the measurements or calculations required to convert the measured value to volume as described in §597.4(e).

(1) An existing measurement device shall be certified to be accurate to within $\pm 12\%$ by volume. and,

(2) A new or replacement measurement device shall be certified to be accurate to within:

(A) $\pm 5\%$ by volume in the laboratory if using a laboratory certification;

(B) $\pm 10\%$ by volume in the field if using a non-laboratory certification.

(b) Measurement Options at a Location Upstream of the Delivery Points or Farm-gates of Multiple Customers

(1) An agricultural water supplier may measure water delivered at a location upstream of the delivery points or farm-gates of multiple customers using one of the measurement options described in §597.3(a) if the downstream individual customer's delivery points meet either of the following conditions:

(A) The agricultural water supplier does not have legal access to the delivery points of individual customers or group of customers needed to install, measure, maintain, operate, and monitor a measurement device.

Or,

(B) An engineer determines that, due to small differentials in water level or large fluctuations in flow rate or velocity that occur during the delivery season at a single farm-gate, accuracy standards of measurement options in §597.3(a) cannot be met by installing a measurement device or devices (manufactured or on-site built or in-house built devices with or without additional components such as gauging rod, water level control structure at the farm-gate, etc.). If conditions change such that the accuracy standards of measurement options in §597.3(a) at the farm-gate can be met, an agricultural water supplier shall include in its Agricultural Water Management Plan, a schedule,

budget and finance plan to demonstrate progress to measure water at the farm-gate in compliance with §597.3(a) of this article.

(2) An agricultural water supplier choosing an option under paragraph (b)(1) of this section shall provide the following current documentation in its Agricultural Water Management Plan(s) submitted pursuant to Water Code §10826:

(A) When applicable, to demonstrate lack of legal access at delivery points of individual customers or group of customers downstream of the point of measurement, the agricultural water supplier's legal counsel shall certify to the Department that it does not have legal access to measure water at customers delivery points and that it has sought and been denied access from its customers to measure water at those points.

(B) When applicable, the agricultural water supplier shall document the water measurement device unavailability and that the water level or flow conditions described in §597.3(b)(1)(B) exist at individual customer's delivery points downstream of the point of measurement as approved by an engineer.

(C) The agricultural water supplier shall document all of the following criteria about the methodology it uses to apportion the volume of water delivered to the individual downstream customers:

(i) How it accounts for differences in water use among the individual customers based on but not limited to the duration of water delivery to the individual customers, annual customer water use patterns, irrigated acreage, crops planted, and on-farm irrigation system,

and;

(ii) That it is sufficient for establishing a pricing structure based at least in part on the volume delivered,

and;

(iii) That it was approved by the agricultural water supplier's governing board or body.

Note: Authority cited: Section 10608.48, Water Code. Reference: Sections 531.10, 10608.48(i)(1) and 10826, Water Code.

§ 597.4. Accuracy Certification, Records Retention, Device Performance, and Reporting.

(a) Initial Certification of Device Accuracy

The accuracy of an existing, new or replacement measurement device or type of device, as required in §597.3, shall be initially certified and documented as follows:

(1) For existing measurement devices, the device accuracy required in section 597.3(a) shall be initially certified and documented by either:

(A) Field-testing that is completed on a random and statistically representative sample of the existing measurement devices as described in §597.4(b)(1) and §597.4(b)(2). Field-testing shall be performed by individuals trained in the use of field-testing equipment, and documented in a report approved by an engineer.

Or,

(B) Field-inspections and analysis completed for every existing measurement device as described in §597.4(b)(3). Field-inspections and analysis shall be performed by trained individuals in the use of field inspection and analysis, and documented in a report approved by an engineer.

(2) For new or replacement measurement devices, the device accuracy required in sections 597.3(a)(2) shall be initially certified and documented by either:

(A) Laboratory Certification prior to installation of a measurement device as documented by the manufacturer or an entity, institution or individual that tested the device following industry-established protocols such as the National Institute for Standards and Testing (NIST) traceability standards. Documentation shall include the manufacturer's literature or the results of laboratory testing of an individual device or type of device.

Or,

(B) Non-Laboratory Certification after the installation of a measurement device in the field, as documented by either:

(i) An affidavit approved by an engineer submitted to the agricultural water supplier of either (1) the design and installation of an individual device at a specified location, or (2) the standardized design and installation for a group of measurement devices for each type of device installed at specified locations.

Or,

(ii) A report submitted to the agricultural water supplier and approved by an engineer documenting the field-testing performed on the installed measurement device or type of device, by individuals trained in the use of field testing equipment.

(b) Protocols for Field-Testing and Field-Inspection and Analysis of Existing Devices

(1) Field-testing shall be performed for a sample of existing measurement devices according to manufacturer's recommendations or design specifications and following best professional practices. It is recommended that the sample size be no less than 10% of existing devices, with a minimum of 5, and not to exceed 100 individual devices for any particular device type. Alternatively, the supplier may develop its own sampling plan using an accepted statistical methodology.

(2) If during the field-testing of existing measurement devices, more than one quarter of the samples for any particular device type do not meet the criteria pursuant to §597.3(a), the agricultural water supplier shall provide in its Agricultural Water Management Plan, a plan to test an additional 10% of its existing devices, with a minimum of 5, but not to exceed an additional 100 individual devices for

the particular device type. This second round of field-testing and corrective actions shall be completed within three years of the initial field-testing.

(3) Field-inspections and analysis protocols shall be performed and the results shall be approved by an engineer for every existing measurement device to demonstrate that the design and installation standards used for the installation of existing measurement devices meet the accuracy standards of §597.3(a) and operation and maintenance protocols meet best professional practices.

(c) Records Retention

Records documenting compliance with the requirements in §597.3 and §597.4 shall be maintained by the agricultural water supplier for ten years or two Agricultural Water Management Plan cycles.

(d) Performance Requirements

(1) All measurement devices shall be correctly installed, maintained, operated, inspected, and monitored as described by the manufacturer, the laboratory or the registered Professional Engineer that has signed and stamped certification of the device, and pursuant to best professional practices.

(2) If an installed measurement device no longer meets the accuracy requirements of §597.3(a) based on either field-testing or field-inspections and analysis as defined in sections 597.4 (a) and (b) for either the initial accuracy certification or during operations and maintenance, then the agricultural water supplier shall take appropriate corrective action, including but not limited to, repair or replacement to achieve the requirements of this article.

(e) Reporting in Agricultural Water Management Plans

Agricultural water suppliers shall report the following information in their Agricultural Water Management Plan(s):

(1) Documentation as required to demonstrate compliance with §597.3 (b), as outlined in section §597.3(b)(2), and §597.4(b)(2).

(2) A description of best professional practices about, but not limited to, the (1) collection of water measurement data, (2) frequency of measurements, (3) method for determining irrigated acres, and (4) quality control and quality assurance procedures.

(3) If a water measurement device measures flow rate, velocity or water elevation, and does not report the total volume of water delivered, the agricultural water supplier must document in its Agricultural Water Management Plan how it converted the measured value to volume. The protocols must follow best professional practices and include the following methods for determining volumetric deliveries:

(A) For devices that measure flow-rate, documentation shall describe protocols used to measure the duration of water delivery where volume is derived by the following formula: $\text{Volume} = \text{flow rate} \times \text{duration of delivery}$.

(B) For devices that measure velocity only, the documentation shall describe protocols associated with the measurement of the cross-sectional area of flow and duration of water delivery, where

volume is derived by the following formula: $\text{Volume} = \text{velocity} \times \text{cross-section flow area} \times \text{duration of delivery}$.

(C) For devices that measure water elevation at the device (e.g. flow over a weir or differential elevation on either side of a device), the documentation shall describe protocols associated with the measurement of elevation that was used to derive flow rate at the device. The documentation will also describe the method or formula used to derive volume from the measured elevation value(s).

(4) If an existing water measurement device is determined to be out of compliance with §597.3, and the agricultural water supplier is unable to bring it into compliance before submitting its Agricultural Water Management Plan in December 2012, the agricultural water supplier shall provide in its 2012 plan, a schedule, budget and finance plan for taking corrective action in three years or less.

Note: Authority cited: Section 10608.48, Water Code. Reference: Sections 531.10, 10608.48(i)(1) and 10826, Water Code.