

**SAN LUIS & DELTA-MENDOTA
WATER AUTHORITY**

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GRASSLAND DRAINAGE AREA COALITION

October 20, 2015

Pamela Creedon, Executive Officer
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114

Subject: Grassland Drainage Area Coalition - Submittal of Groundwater
Assessment Report Outline

Dear Pamela:

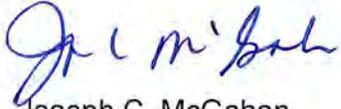
The Waste Discharge Requirements (WDR), General Order R5-2015-0095, which applies to growers within the Grassland Drainage Area, were adopted by the Central Valley Regional Water Quality Control Board (Board) on July 31, 2015. This approval triggers the date of October 29, 2015 for submittal of the Groundwater Quality Assessment Report (GAR) Outline.

Attached is the GAR outline for the Grassland Drainage Area Coalition. The outline includes a table of data sources, a preliminary bibliography, and a table that cross references the GAR outline with the requirements contained in the WDR General Order R5-2015-0095. The preliminary bibliography represents references that may be used during preparation of the GAR, with the recognition that not all of these references are necessarily going to be used and additional references are likely to be added. Similarly, not all of the data sources listed are necessarily going to be used, and additional sources are likely to be added. Additionally, numerous figures and tables are anticipated in order to illustrate components of the GAR; these are not explicitly identified in the Outline.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel or represented members properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for knowingly

submitting false information, including the possibility of fine and imprisonment for violations.

Very truly yours,

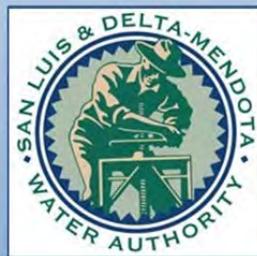
A handwritten signature in blue ink, appearing to read "Joe McGahan". The signature is fluid and cursive, with the first name "Joe" and last name "McGahan" clearly distinguishable.

Joseph C. McGahan
Drainage Coordinator
Grassland Drainage Area Coalition

Outline for Groundwater Quality Assessment Report Grassland Drainage Area

October 16, 2015

Prepared for
San Luis and Delta-Mendota Water Authority



Prepared by



Outline for Groundwater Quality Assessment Report Grassland Drainage Area

The Grassland Basin Drainage Steering Committee (Steering Committee) serves as the third-party group for growers within the Grassland Drainage Area (GDA) (**Figure 1**). The Waste Discharge Requirements (WDR), General Order R5-2015-0095, which applies to growers within the GDA, were adopted by the Central Valley Regional Water Quality Control Board (Board) on July 31, 2015. The approval date associated with the WDR starts the timeline for several requirements, including the requirement for submittal of a Groundwater Quality Assessment Report (GAR). In advance of preparing the GAR, the WDR also specifies that, 90 days after Order approval from the Board, the Steering Committee “will provide a proposed outline of the GAR to the Executive Officer that describes the data sources and references that will be considered in developing the GAR.” (Attachment B, Monitoring and Reporting Program [MRP]). Accordingly, we understand that the due date for submittal of the Groundwater Quality Assessment Report (GAR) outline is October 29, 2015.

This GAR Outline presents the general structure to be followed in the GAR and also includes a table of potential data sources, a preliminary bibliography, and a table that cross references the GAR outline with the requirements contained in the WDR. The preliminary bibliography provides references that may be used during preparation of the GAR, although not all included references will necessarily be used and additional references are likely to be added. Similarly, not all of the data sources listed will necessarily be used, and additional sources are likely to be added. Numerous figures and tables are anticipated in the GAR; these are not explicitly identified in the Outline.

1. INTRODUCTION

a. Background

- i. San Luis and Delta-Mendota Water Authority
 - 1. Grassland Basin Drainage Management Activity Agreement
 - 2. Grassland Basin Drainage Steering Committee (Grassland Committee)
- ii. Waste Discharge Requirements and Other Timelines

b. Purpose of Groundwater Quality Assessment Report (GAR)

c. Grassland Drainage Area

- i. Central Valley Floor (extent of DWR Bulletin 118 groundwater basins/subbasins, specifically Delta-Mendota Groundwater Subbasin 5-22.07)
 - 1. Grassland Drainage Area (GDA), approximately 97,400 acres
- ii. Overview of high salinity in shallow groundwater
 - 1. Tile drain system
 - a. Order covers discharge to groundwater not captured by tile drains
 - b. Grassland Bypass Project (GBP) and San Joaquin River Water Quality Improvement Project (SJRIP)
 - c. Relation of perched water table to protected groundwater (i.e., degree of hydraulic communication)
- iii. SJRIP reuse area and use of salt tolerant crops

2. PHYSICAL SETTING

a. Location

- i. Topography (Source: USGS Digital Elevation Model)
- ii. Climate (Source: CIMIS and NCDC weather stations)
- iii. Surface Water
- iv. Tile drains in relation to perched water table.
- v. San Joaquin River Water Quality Improvement Project and Grassland Bypass Project conjunctively involve reuse of tile drainage to irrigate salt tolerant plants and transport of subsurface ag drain water (not surface tail water) in Grassland Bypass Channel (GBC) to San Luis Drain, bypassing wetland habitat areas).

b. Geologic Setting (Sources: Geologic and hydrogeologic data from published reports, including USGS Central Valley Hydrologic Model (CVHM); existing maps and relevant cross-sections; DWR Bulletin 118 basin/subbasin information)

- i. General Hydrogeologic Setting
- ii. Natural Surface Water and Groundwater Chemistry
- iii. Physical Conceptual Model
 1. Very Shallow Unconfined Groundwater (water table aquifer)
 2. Semi-Confined Upper Aquifer (above Corcoran Clay)
 3. Corcoran Clay
 4. Confined Lower Aquifer (below Corcoran Clay)
 5. Hydrogeologic Conceptualization

c. Surface and Subsurface Sediments Characterization

- i. Surficial Soils (Sources: Natural Resources Conservation Service (NRCS), CVHM, soil and soil surface characteristics, including soil permeability and chemistry and surface slope and drainage characteristics; map(s) of soils)
 1. Soil Hydraulic Conductivity
 2. Soil Drainage (Source: tile drain information [GDA Districts, USBR, DWR], published literature)
 3. Soil Chemistry (including soil salinity and alkalinity)
- ii. Hydraulic Properties of Subsurface Sediments (Sources: CVHM, published literature)
 1. Very Shallow Groundwater Zone
 2. Upper Aquifer
 3. Corcoran Clay
 4. Lower Aquifer
 5. Subsurface Sediment Texture

3. Groundwater Hydrology

- i. Groundwater Levels (Sources: DWR, USGS, USBR, SWRCB GeoTracker, GDA districts, other local entities)
 1. Groundwater Level Dataset
 2. Development of Groundwater Level Contours (various time periods)
 3. Spatial Patterns in Depth to Groundwater (spring and fall depth to groundwater; very shallow depth to groundwater compared to depths representing semi-confined and/or confined conditions)

4. Groundwater Flow Directions
5. Temporal Groundwater Level Trends (primary focus on shallow groundwater)
 - a. Shallow wells
 - b. Deep wells
- ii. Recharge to Groundwater (Sources: existing publications; special attention to potential for recharge upgradient of existing public areas for urban and rural communities)
 1. Recharge Areas Upgradient of Public Water Systems Reliant on Groundwater (including any rural and/or Disadvantaged Communities)
 2. Drained Areas

4. LAND USE

a. Lands within the Grassland Drainage Area

- i. Irrigated Agriculture Lands
- ii. Non-Irrigated Lands
- iii. Managed Wetlands
 1. Private Wetlands

b. Available Data Describing Land Use and Extent of Irrigated Lands

(Sources: DWR, USDA, USBR, UC Cooperative Extension, GDA Districts; several snapshots of historical to more recent land use, pending data availability)

- i. DWR Land Use Data
- ii. USDA Land Use Data
- iii. GDA Districts' Land Use Data

c. Land Use Categorization

d. Land Use Change

e. Predominant Commodities

- i. Based on current, available land cover information; particularly commodities representing the top 80% of irrigated agricultural crops

f. Irrigation Practices (Sources: GDA districts, DWR land use surveys, UC Cooperative Extension, USDA)

- i. Irrigation practices generally associated with predominant commodities (as presently known and available)

g. Fertilization Practices (Sources: CDFA, UC Cooperative Extension, published literature)

- i. Fertilization methods and soil amendments generally associated with predominant commodities (as presently known and available)

h. Nitrogen Cycle

i. Common Application Methods and Use for Primary Commodities

5. GROUNDWATER QUALITY

a. Groundwater Quality Dataset (Sources: GDA districts, USBR, DWR, USGS, GAMA Domestic, CDPH, SWRCB GeoTracker GAMA, RWQCB Dairy, Department of Pesticide Regulation, County Health Dept. data for domestic wells (or other wells, as readily available))

- i. Data used in the evaluation will incorporate the best available location coordinates as provided through publicly available online resources or the best available information provided by the above entities
- ii. Well information may be limited to that typically provided by the above entities (i.e., such information as well construction may not be readily available for many of the above datasets)
- iii. Locations of water systems and/or wells serving disadvantaged communities will be obtained as available

b. Historical Presence of High Salinity in Shallow Groundwater (Sources: Datasets as noted above, published literature)

- i. Sources of salinity (naturally occurring and other; broad overview of historical salinity; legacy effects)
- ii. Mechanisms contributing to increased salinity

c. Spatial Patterns in Groundwater Quality (focus on nitrate, TDS, and pesticides; upper and lower parts of aquifer system)

- i. Nitrate Concentrations
- ii. TDS Concentrations
- iii. Pesticides
 - 1. Detections
 - 2. Exceedances
- iv. Boron and Selenium

d. Temporal Trends in Groundwater Quality (focus on nitrate and TDS; evaluated separately for upper and lower parts of aquifer system, as possible from available data)

- i. Time-Series Nitrate Concentrations
- ii. Notable Temporal Trends in Nitrate Concentrations

- iii. Time-Series TDS Concentrations
- iv. Notable Temporal Trends in TDS Concentrations

e. Additional Groundwater Quality Data (Sources: published literature)

- i. Summarize selected constituents (related to irrigated agriculture) other than nitrate, salt and pesticides that exhibit elevated concentrations (e.g., above a drinking water standard as applicable) such as trace metals (selenium), other cations or anions, etc.; these data would be summarized based on readily available published reports. These would be reconnaissance level summaries.

f. Summary of Groundwater Quality Data

6. GROUNDWATER VULNERABILITY AND PRIORITIZATION

a. Overview of Groundwater Vulnerability Assessment

- i. Previous Assessments of Groundwater Vulnerability in the Grassland Drainage Area
 - 1. SWRCB Hydrogeologically Vulnerable Areas
 - 2. DPR Groundwater Protection Areas
 - 3. Other Evaluations of Potential for Groundwater Contamination

b. Grassland Drainage Area Groundwater Vulnerability Approach

- i. Conceptual Model
 - 1. Shallow Unconfined Groundwater and Upper Aquifer (above Corcoran Clay)
 - a. Salinity conditions
 - b. Nitrate conditions
 - 2. Confined Lower Aquifer (below Corcoran Clay)
 - a. Salinity conditions
 - b. Nitrate conditions
 - 3. Variable role of Corcoran Clay as barrier to vertical movement of nitrate (depending on depth and thickness)
- ii. Groundwater Quality in the Context of the Physical Conceptual Model
 - 1. Comparison of trends in salinity and nitrate concentration by aquifer
 - a. Salinity and nitrate concentration trends in wells in the shallow unconfined groundwater (pending data availability)
 - b. Salinity and nitrate concentration trends in wells above Corcoran Clay (upper aquifer)

- c. Salinity and nitrate concentration trends in wells below Corcoran Clay (lower aquifer)
 - d. Salinity and nitrate concentration trends in relation to properties of the Corcoran Clay (e.g., presence, depth, thickness)
 - 2. Approach to Assessing Groundwater Vulnerability
- iii. Statistical Analyses of Associations between Observed Water Quality and Physical Hydrogeologic Conditions (Variables)
 - 1. Groundwater Quality Characteristics Variables (Dependent Variable)
 - 2. Hydrogeologic Variables of Interest (Independent Variables)
 - 3. Accounting for Land Use and Agricultural Practices
- iv. Description of Statistical Analyses
 - 1. Assumptions
 - 2. Data Investigation and Statistical Analyses
- v. Multiple Regression Results
 - 1. Hydrogeologic Independent Variables
 - a. Soil hydraulic conductivity
 - b. Depth to groundwater
 - c. Corcoran Clay properties
 - d. Topographic slope
 - e. Well depth
 - f. Groundwater recharge
 - g. Subsurface texture
 - h. Other potential variables of interest
 - 2. Non-Hydrogeologic Variables of interest
 - a. Date
 - b. Land use and agricultural practices (as currently known and available)
 - 3. Multiple Regression Equation Development
 - 4. Multiple Regression Results and Diagnostics
- vi. Groundwater Vulnerability Model Evaluation and Characterization
- vii. Comparison of Groundwater Vulnerability to Groundwater Quality Conditions in the Grassland Drainage Area

1. Nitrate
2. TDS
3. Pesticides
4. Other Water Quality Constituents of Interest

viii. Summary of Grassland Drainage Area High Vulnerability Area

c. Prioritization of High Vulnerability Area

i. Prioritization Calculation Approach

1. Matrix with Values Assigned to Criteria (below are examples of the criteria)
 - a. Consideration of existing groundwater quality observations especially exceedances of water quality objectives (e.g., nitrate exceeding the MCL)
 - b. Consideration of historical groundwater quality and trends (improving groundwater quality, declining groundwater quality, rate of trends, including rate of trends for wells that exceed half the nitrate MCL)
 - c. Proximity of high vulnerability areas to areas contributing recharge to urban and rural communities that rely on groundwater; water systems and/or wells serving disadvantaged communities will be considered pending the availability of information that identifies such systems or wells
 - d. Consideration of constituent toxicity and mobility
 - e. Existing operational practices identified to be associated with irrigated agricultural waste discharges (i.e., practices as currently known and available).
 - f. The largest acreage commodity types comprising up to at least 80% of the irrigated agricultural acreage in the high vulnerability areas and the irrigation and fertilization practices employed by these commodities (i.e., irrigation and fertilization practices as currently known and available).

ii. Identified Priority Areas

iii. Summary of Prioritization

7. GROUNDWATER MONITORING PROGRAMS

a. Sources of Information on Existing Groundwater Monitoring Programs

- i. DWR/CASGEM
- ii. State Water Resources Control Board
- iii. USGS
- iv. CDPH
- v. DPR
- vi. RWQCB – Dairy Monitoring Programs
- vii. GAMA
- viii. USBR
- ix. GDA Districts
- x. Grassland Basin Drainers
- xi. Groundwater Management Plans (e.g., Southern Agencies in the Delta-Mendota Canal Service Area (2009), Westside-San Joaquin Integrated Water Resources Plan (2014), others as available)

b. Summary of Existing Groundwater Monitoring Programs

- i. Recent Monitoring Programs
- ii. Overview of Data Gaps (Identify key data gaps for wells in existing monitoring programs (e.g., well construction information, accurate spatial coordinates, constituents analyzed, etc.))
- iii. Potential Monitoring Well Candidates (i.e., potential existing monitoring wells for future Trend Monitoring purposes (availability of construction information, distribution of wells, availability to access, etc. to be assessed as part of Trend Monitoring Workplan))
- iv. Area participates in CASGEM through the San Luis & Delta-Mendota Water Authority

8. REFERENCES

Preliminary Bibliography¹

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¹ This is a preliminary list of potential references that may be used during the preparation of the Groundwater Quality Assessment Report. Not all of the references shown at this time will necessarily be used. Other references may also be added.

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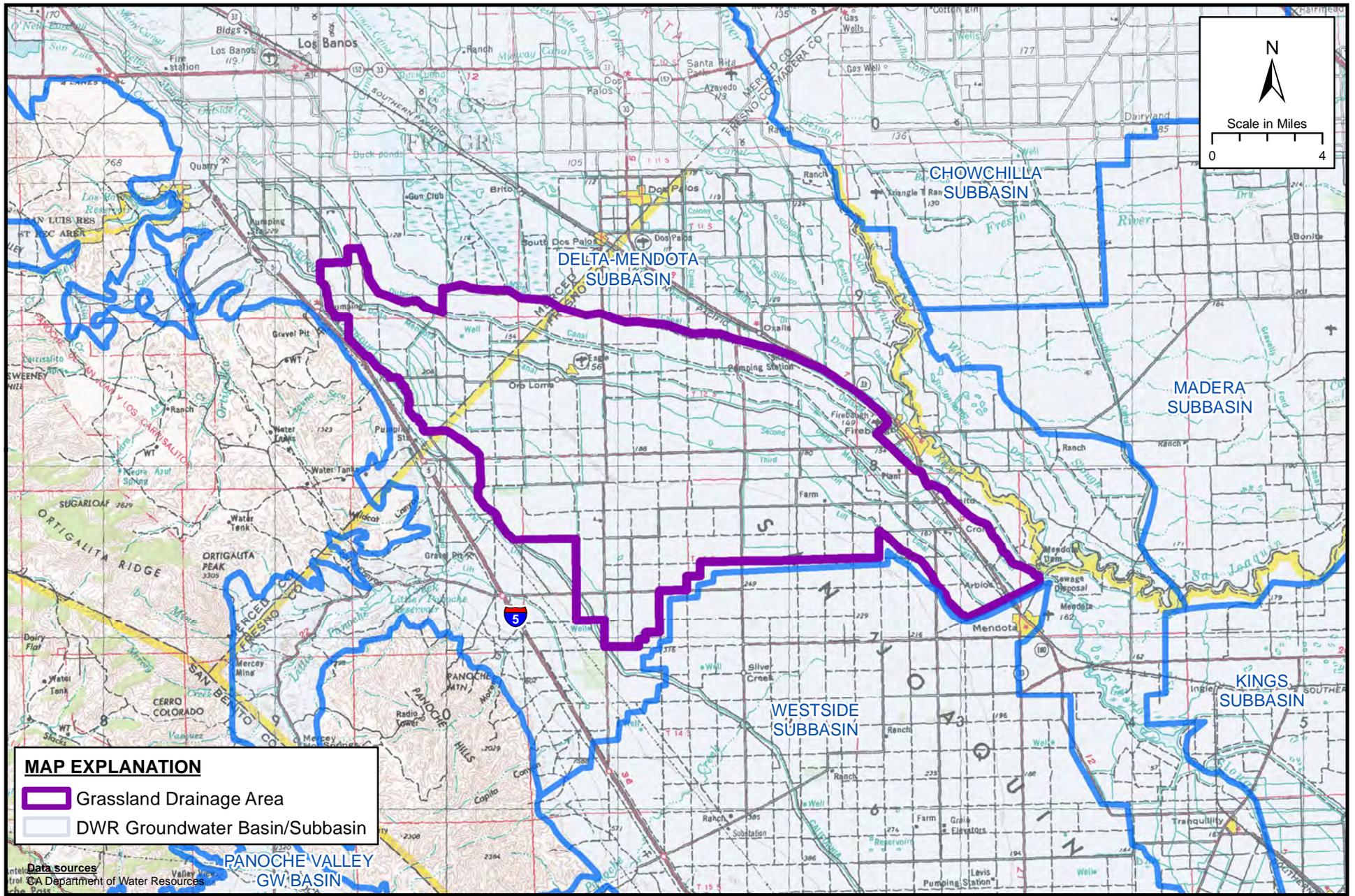
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Preliminary List of Potential Data Sources

Data Type	Database Source	Source Location or Description
Slope/DEM	USGS National Elevation Dataset (NED)	http://ned.usgs.gov/
Hydrogeology/ Recharge	Central Valley Hydrologic Model (CVHM)	http://ca.water.usgs.gov/projects/central-valley/central-valley-hydrologic-model.html
	Published hydrogeology literature	Important publications on hydrogeology of area; USGS mapping data
Soils	Natural Resources Conservation Service (NRCS)	http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
Tile Drain Locations	GDA Districts, USBR, DWR	Readily available tile drain location data
Water Level	DWR: Water Data Library	http://www.water.ca.gov/waterdatalibrary/
	DWR: California Statewide Groundwater Elevation Monitoring (CASGEM)	http://www.water.ca.gov/groundwater/casgem/
	SWRCB GeoTracker	http://geotracker.waterboards.ca.gov/data_download_by_county.asp
	USGS: National Water Information System	http://waterdata.usgs.gov/nwis
	Local Entities (e.g. GDA Districts)	Personal Communications
Groundwater Quality – TDS/Nitrate/ Pesticides	USGS: National Water Information System	http://waterdata.usgs.gov/nwis
	CDPH	http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Monitoring.aspx
	Geotracker GAMA	http://geotracker.waterboards.ca.gov/gama/
	RWQCB (WDR Dairy Data)	San Joaquin Valley Data: SWRCB Region 5 office, Fresno, CA.
	DWR: Water Data Library	http://www.water.ca.gov/waterdatalibrary/
	County health departments	Readily available domestic well water quality data
	California Department of Pesticide Regulation (DPR)	Environmental Monitoring Branch, Sacramento, CA
Local Entities (e.g. GDA Districts)	Personal Communications	
Land Use/Crop	GDA Districts	Existing data as available from Districts
	DWR	www.water.ca.gov/landwateruse/lusrvymain.cfm
	USDA	http://www.nass.usda.gov/research/Cropland/SARS1a.htm
	CDFA	http://www.cdfa.ca.gov/is/ffldrs/frep/index.html
	County agricultural departments	Crop reports and other readily available data
	UC Cooperative Extension	www.ucanr.edu
	USBR	Existing readily available data

Cross-Reference Table between GAR Outline and WDR General Order R5-2015-0095

GAR Items Identified in Monitoring and Reporting Program (Attachment B) of the Grassland Drainage Area WDR General Order	Where Addressed in GAR Outline
1. Objectives	
A. Provide an assessment of all readily available, applicable and relevant data and information to determine the high and low vulnerability areas where discharges from irrigated lands may result in groundwater quality degradation.	Throughout
B. Establish priorities for implementation of monitoring and studies within high vulnerability areas.	Sections 6 & 7
C. Provide a basis for establishing monitoring workplans to assess groundwater quality trends.	Throughout
D. Provide a basis for establishing management practices evaluation program workplans and priorities to evaluate the effectiveness of agricultural management practices to protect groundwater quality.	Throughout
E. Provide a basis for establishing groundwater quality management plans in high vulnerability areas and priorities for implementation of those plans.	Throughout
2. Components	
A. Detailed land use information with emphasis on land uses associated with irrigated agricultural operations. The information shall identify the largest acreage commodity types in the Grassland Drainage Area (GDA), including the most prevalent commodities comprising up to at least 80% of the irrigated agricultural acreage in the GDA.	Section 4
B. Information regarding depth to groundwater, provided as a contour map(s).	Section 3
C. Groundwater recharge information, including identification of recharge areas for urban and rural communities where groundwater serves as a significant source of supply. Disadvantaged communities must be identified.	Sections 3 and 5
D. Soil survey information, including significant areas of high salinity, alkalinity and acidity.	Section 3
E. Shallow groundwater constituent concentrations from existing monitoring networks (potential constituents of concern include any material applied as part of the agricultural operation, including constituents in irrigation supply water [e.g., pesticides, fertilizers, soil amendments, etc.] that could impact beneficial uses or cause degradation).	Section 5
F. Information on existing groundwater data collection and analysis efforts relevant to this Order (e.g., Department of Pesticide Regulation [DPR], United States Geological Survey [USGS], State Water Board Groundwater Ambient Monitoring and Assessment [GAMA], State Water Board Division of Drinking Water (formerly CDPH), local groundwater management plans, etc.). This groundwater data compilation and review shall include readily accessible information relative to the Order on existing monitoring well networks, individual well details, and monitored parameters. For existing monitoring networks (or portions thereof) and/or relevant data sets, the Grassland Basin Drainage Steering Committee should assess the possibility of data sharing between the data-collecting entity, the Steering Committee, and the Central Valley Water Board.	Sections 5 & 7
3. Data Review and Analysis of Existing Federal, State, County, and Local Databases and Documents	
A. Determine where known groundwater quality impacts exist for which irrigated agricultural operations are a potential contributor or where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities.	Sections 5 & 6
B. Determine the merit and feasibility of incorporating existing groundwater data collection efforts, and their corresponding monitoring well systems for obtaining appropriate groundwater quality information to achieve the objectives of and support groundwater monitoring activities under this Order. This shall include specific findings and conclusions and provide the rationale for conclusions.	Section 7
C. Prepare a ranking of high vulnerability areas to provide a basis for prioritization of workplan activities, with emphasis on communities reliant on groundwater as a significant source for water supply and higher priority given to disadvantaged communities.	Section 6
D. The GAR shall discuss pertinent geologic and hydrogeologic information for the Grassland Drainage Area and utilize GIS mapping applications, graphics, and tables, as appropriate, in order to clearly convey pertinent data, support data analysis, and show results.	Sections 3, 5 & 6
4. Groundwater Vulnerability Designations	
A. Designate high/low vulnerability areas for groundwater in consideration of high and low vulnerability definitions provided in Attachment E of the Order.	Section 6
B. The vulnerability designations will be made by using a combination of physical properties (soil type, depth to groundwater, known agricultural impacts to beneficial uses, etc.) and management practices (irrigation method, crop type, nitrogen application and removal rates, etc.).	Section 6
C. Provide the rationale for proposed vulnerability determinations.	Section 6
5. Considerations for Prioritization of High Vulnerability Groundwater Areas	
A. Identified exceedances of water quality objectives for which irrigated agriculture waste discharges are the cause, or a contributing source.	Sections 5 & 6
B. The proximity of the high vulnerability area to areas contributing recharge to urban and rural communities where groundwater serves as a significant source of supply.	Sections 3 & 6
C. Existing field or operational practices identified to be associated with irrigated agriculture waste discharges that are the cause, or a contributing source (i.e., practices as currently known and available).	Sections 4 & 6
D. The largest acreage commodity types comprising up to at least 80% of the irrigated agricultural acreage in the high vulnerability areas and the irrigation and fertilization practices employed by these commodities.	Sections 4 & 6
E. Legacy or ambient conditions of the groundwater. Groundwater basins currently or proposed to be under review by CV-SALTS.	Sections 5 & 6
F. Identified constituents of concern, e.g., relative toxicity, mobility.	Sections 5 & 6



**Location Map and DWR Groundwater Basins
 Grassland Drainage Area**