Appendix 7-A
Model Maintenance and Improvements for the Santa Rosa Plain Groundwater Sustainability Plan

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Model Maintenance and Improvements
Groundwater Sustainability Plan
Santa Rosa Plain Groundwater Subbasin

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1 Projects and Management Actions

The Groundwater Sustainability Plain (GSP) for the Santa Rosa Plain (Subbasin) relied on groundwater modeling to support development of historical, current, and projected water budgets, and to evaluate projected benefits from implementing Projects and Management Actions (PMA) scenarios.

The Santa Rosa Plain Hydrologic Model (SRPHM) is a thoroughly developed, documented, and tested tool that has been used in the development of the GSP. The SRPHM was originally developed by the USGS (Wolfenden and Nishikawa, 2014), and revised by Sonoma Water for purposes of developing more accurate water budgets in the Subbasin. The accuracy of the model is dependent on the data available used to inform its development. As new data becomes available assessments will be made to determine if changes to the model may be necessary. Changes to the model could be small, such as adjusting a parameter that controls runoff, or it may be systemic, such as changing location of a boundary or fault or hydraulic properties of a local area. Recommended model improvements that are relevant to GSP implementation will be addressed during the first five years of GSP implementation. In addition to recommended model improvements, routine model maintenance activities will also be conducted during GSP implementation. Routine model update tasks include updating the model with recent land use, pumping, and climate data, and recalibrating the model, if necessary. Finally, model predictive simulations will be updated to reflect new information on alternative future climate scenarios and PMA planning and implementation.

All model improvements incorporated during GSP implementation will build on additional data collection and interpretation activities described in GSP Section 7. These additional data will be used to verify model inputs (Section 2.2), compare against model outputs (Section 2.3), and guide improvements to model structure (Section 3).

This appendix summarizes model improvements that are planned during the first five years of GSP implementation, including updating input data, improving the model structure, and refining the representation of projected PMAs for the 5-year GSP assessment.

2 Update Data Inputs to Model

2.1 Update Simulation Period

The SRPHM simulation period covers the period from 1976 through 2018. During GSP implementation, the simulation period will be extended through Water Year (WY) 2025 for the 5-year GSP update due in 2027. As part of extending the simulation period, the following data inputs will be updated and incorporated in the model:

- Update land use with available spatial dataset(s), both inside and outside of the Subbasin, if available
- Update agricultural irrigation pumping based on new information and land use changes
- Update rural domestic pumping based on updated parcel database and/or updated rural domestic pumpage estimates, if available
- Update municipal and industrial pumping rates, add new wells if necessary
- Streamflow diversion locations and rates
- Update recycled water deliveries and distribute to receiving model cells
- Precipitation and reference evapotranspiration

2.2 Verify Model Inputs Against Available Data

During assessment of SRPHM, several model inputs were identified as sources of uncertainty due to uncertain or limited data. During GSP implementation, these model inputs will be validated against the following additional datasets collected as part of GSP implementation, depending on necessity and impact:

- Irrigation well locations and depths
- Metered irrigation pumping
- Locations and rates of surface water diversions and surface-water storage
- Assignment of distribution of model hydraulic properties, which will be compared against updated hydrogeologic conceptual model from future aquifer test results and airborne electromagnetic survey data
- Estimates of riparian consumptive use to include as model structure improvements

2.3 Verify Model Outputs Against Available Data

Existing groundwater level and interconnected surface water networks will be expanded during GSP implementation (GSP Section 7.2.4). Data collected from these monitoring networks will be used to check model simulation results, and provide guidance to model re-calibration planned toward the end of the first 5 years of GSP implementation.

- Compare simulated streamflow against discharge measurements where available
- Compare simulated shallow groundwater levels against recent data from interconnected surface water wells
- Comparison of mapped seeps and springs against simulated exfiltration
- Compare observed actual evapotranspiration rates to simulated rates for agricultural areas in order calibrate agricultural pumpage

3 Improvements to Model Structure

The following model structural improvements will be addressed during GSP implementation:

- Incorporate updates to model code of AG Package as they become available and if applicable. Such improvements would include surface-water diversions and water-storage for agriculture uses
- Examine how agricultural irrigation practices are implemented in model, and compare with newly available data, existing studies, and other information
- Consider developing explicit representation of riparian consumptive use
- Review and consider any appropriate and necessary modifications to boundary conditions along the Petaluma Valley basin, Healdsburg Area, and Wilson Grove Formation Highlands Groundwater Basin (Wilson Grove Basin). Given the nature and importance of the Wilson Grove boundary, specific tasks are recommended to assess how this boundary is currently simulated by the model and whether the model domain should be expanded further into the Wilson Grove Basin:
    - Evaluate in detail the groundwater conditions at this boundary, focusing on determining the hydraulic gradient, estimated fluxes and its sensitivity to nearby groundwater pumping
    - Perform sensitivity analyses of existing model to determine sensitivity of boundary flux
    - Analyze groundwater levels, groundwater geochemistry, and other information
    - Analyze hydraulic properties of the faults along the Wilson Grove boundary that are likely to be at least 'minor barriers to flow' (p. 140; Nishikawa, 2013)

4 Five-Year Model Update and Maintenance

The SRPHM, incorporating model updates and improvements described in GSP Sections 2 and 3, will be used to support the five-year update to the GSP. The updated model will be re-calibrated to both existing and new data collected during GSP implementation, and will be used to update historical and current water budgets (Section 4.1, below), and to provide future projected water budgets and water levels for comparison against Sustainable Management Criteria (Section 4.2, below) and to support planning and implementation of PMAs.

As part of the five year update to the GSP, the latest available projected climate science and data will be reviewed and considered for incorporation into the scenarios for the Water Year 2026 through 2072 projected period.

4.1 Update Historical and Current Water Budgets for Reporting

As part of the five-year update to the GSP, the model will be assessed to determine if recalibration is necessary. If necessary, recalibration will occur after completing the model update and improvement tasks described in the above Sections 2 and 3. Model recalibration would entail adjusting model hydraulic properties and other model parameters to improve the goodness-of-fit between hydrologic and hydrogeologic datasets, and their model-simulated equivalents. At a minimum, datasets to be used during model calibration would include:

- Groundwater level hydrographs at groundwater-level and interconnected surface water Representative Monitoring Point (RMP) wells, including all new wells
- Streamflow hydrographs from existing and any new stream gages
- Individual low-flow discharge measurements and groundwater-surface water exchange rates collected during future seepage runs

After completing model recalibration, revised simulated historical and current water budgets will be prepared through the extended simulation period (Section 2.1, above).

4.2 Update Future Projected Conditions

A number of PMAs were evaluated using the SRPHM (GSP Appendix 6A). These included implementation of water-use efficiency and other demand reduction projects, construction and operation of ASR wells and construction and operation of stormwater recharge facilities. Specific project details, such as assumptions for water-use efficiency programs, ASR and stormwater recharge volumes and schedules, and infrastructure locations, were defined based on limited best available information at the time.

As stated in Section 7.2.6 of the GSP, the GSA plans to immediately begin implementation of select PMAs. This will include permitting and conceptual design. As specific project details are refined, the representation of PMAs in the model will be updated so that groundwater model projections are based on updated designs of PMAs. Specific areas of update for each project grouping are summarized below:

Simulation of Group 1 Projects

- Update simulation to include refined estimates of conservation and groundwater-use efficiency

Simulate Group 2 Projects:

- Improve simulations of On-Farm and other dispersed recharge by incorporating information as it becomes available

Simulation of Group 3 Projects:

- Simulate proposed ASR projects, optimize project implementation, and additional recycled water opportunities
    - Update source water availability and transmission system capacity assumptions
    - Optimize and update locations and operations, with cost benefit analysis for future alignment options

Management Actions:

- Simulate potential policy options for future GSA consideration or recommendation, including the below initial list of potential policy options:
    - Water conservation plan requirements for new development
    - Low impact development or water efficient landscape plan requirements

Predictive simulation results based on the updated and recalibrated model, with refined representation of PMAs, will then be processed to provide:

- Projected water budgets
- Projected groundwater levels relative to Sustainable Management Criteria for RMP wells
- Projected changes in exchange with interconnected surface water

Updated future projected conditions will likely vary from projections in the GSP due to the following:

- Starting head distributions will reflect groundwater responses to climate and pumping stresses through WY2025
- The model structure and calibration will be revised relative to the SRPHM
- Details of PMAs will have been further developed since GSP preparation

Citations

Nishikawa, Tracy, ed., 2013, Hydrologic and geochemical characterization of the Santa Rosa Plain watershed, Sonoma County, California: U.S. Geological Survey Scientific Investigations Report 2013–5118, 178 p.