



TECHNICAL MEMORANDUM

March 27, 2020

TO: Ground-Level Monitoring Committee
FROM: Chino Basin Watermaster Engineer – Wildermuth Environmental Inc.
RE: Recommended Scope and Budget of the Ground-Level Monitoring Committee for Fiscal Year 2020/21 (Final)

Background and Purpose

Pursuant to the Optimum Basin Management Program Implementation Plan and the Peace Agreement, the Chino Basin Watermaster (Watermaster) implements a Subsidence Management Plan for the Chino Basin to minimize or stop the occurrence of land subsidence and ground fissuring. The Subsidence Management Plan outlines a program of monitoring, data analysis, and annual reporting. A key element of the Subsidence Management Plan is its adaptive nature—Watermaster can adjust the Subsidence Management Plan as warranted by the data.¹

The Watermaster Engineer, with the guidance of the Ground-Level Monitoring Committee (GLMC), prepares the annual reports which include the results of the monitoring program, interpretations of the data, recommendations for the Ground-Level Monitoring Program (GLMP) for the following fiscal year, and recommendations for adjustments to the Subsidence Management Plan, if any.

This memorandum describes the Watermaster Engineer’s recommended activities for the GLMP for FY 2020/21 in the form of a proposed scope-of-work and budget.

Members of the GLMC are asked to:

1. Review this memorandum prior to March 5, 2020.
2. Attend a meeting of the GLMC at 9:00 am on March 5, 2020 at Watermaster to discuss the proposed scope-of-work and budget for FY 2020/21.
3. Submit comments and suggested revisions on the proposed scope-of-work and budget for FY 2020/21 to the Watermaster by March 19, 2020.

¹ The Court approved the Subsidence Management Plan and ordered its implementation in November 2007. The Subsidence Management Plan was updated in 2015, and can be downloaded at this [link](#).



4. Attend a meeting of the GLMC at 9:00 am on April 2, 2020 at Watermaster to discuss comments and revisions to the proposed scope-of-work and budget for FY 2020/21 (if needed).

The final scope-of-work and budget that is recommended by the GLMC will be included in the Watermaster's FY 2020/21 budget. The final scope-of-work, budget, and schedule for FY 2020/21 will be included in Section 4 of the *2019/20 Annual Report of the GLMC*.

Recommended Scope of Work and Budget – FY 2020/21

A proposed scope-of-work for the GLMP for FY 2020/21 is shown in Table 1 as a line-item cost estimate. The proposed scope-of-work is summarized below:

Task 1—Setup and Maintenance of the Monitoring Network

The Chino Basin extensometer facilities are key monitoring facilities for the GLMP. They require regular and as-needed maintenance and calibration to remain in good working order and to ensure the recording of accurate measurements.

Task 1.1—Maintain Extensometer Facilities.

This subtask includes performing monthly visits to the Ayala Park, Chino Creek, and Pomona Extensometer facilities to ensure functionality and calibration of the monitoring equipment and data loggers.

Task 1.2—Annual Lease Fees for CCX Extensometer Site.

Task 2—Aquifer-System Monitoring and Testing

This task involves the collection and compilation of hydraulic head and aquifer-system deformation data from the Ayala Park, Chino Creek, and Pomona Extensometer facilities.

Task 2.1—Conduct Quarterly Data Collection from Extensometers; Data Checking and Management.

This subtask involves the routine quarterly collection and checking of data from the extensometer facilities. Quarterly data collection is necessary to ensure that the monitoring equipment is in good working order and to minimize the risk of losing data because of equipment malfunction. For FY 2020/21, this task includes collection and checking of data from the newly installed Pomona Extensometer facility.

Task 2.2—Conduct Pilot Injection Test in the Managed Area.

This sub-task involves the work to implement a Pilot Injection Test in the Managed Area at City of Chino Hills well CH-16 to test the effectiveness of injection as a tool to manage hydraulic head and land subsidence in the Managed Area. The work involved in this task includes coordinating the injection test with the City of Chino Hills and collecting and compiling the injection/production data at CH-16 (e.g. timing of injection, injection rates, water levels at CH-16, etc.). The results of the test will be documented in a subsequent Annual Report of the GLMC.



This sub-task will not be implemented in FY 2020/21 due to water-quality issues reported by the City of Chino Hills at well CH-16 (M. Wiley, personal communication, January 20, 2020).

Task 3—Basin-Wide Ground-Level Monitoring Program (InSAR)

This task involves the annual collection and analysis of Synthetic Aperture Radar (SAR) scenes to estimate the vertical ground motion that occurred across the western portion of Chino Basin from March 2020 to March 2021.

Task 3.1—Acquire SAR Data from TerraSAR-X (German Aerospace Center) and Prepare Interferograms for 2020/21.

In this sub-task, six SAR scenes that will be acquired by the TerraSAR-X satellite from March 2020 to March 2021 are purchased from the German Aerospace Center. Neva Ridge Technologies of Boulder, CO (Neva Ridge) uses the SAR scenes to prepare 12 interferograms that describe the incremental and cumulative vertical ground motion that occurred from March 2020 to March 2021 and since 2011.

Task 3.2—Convert Interferograms to GIS Rasters and Check Results.

In this sub-task, the Watermaster Engineer converts the interferograms into GIS rasters of vertical ground motion across western Chino Basin and performs checks for reasonableness and accuracy.

Task 3.3—Conduct a Pilot Study with the new Sentinel-1A Satellite.

Over recent years, the GLMC has chosen to acquire and use a single SAR scene from the TerraSAR-X satellite that covers just the western portion of the basin. This decision was made because land subsidence concerns are typically within the western portion of the basin, and to avoid the costs associated with acquiring and analyzing an additional scene across the eastern portion of the basin.

One of the recommendations from the *2018/19 Annual Report of the Ground-Level Monitoring Committee* was to perform a pilot study using a new SAR satellite, the Sentinel-1A satellite, which became active in 2015. The advantage of Sentinel-1A is that a single SAR scene covers the entire Chino Basin, while the disadvantage is lower spatial resolution of the SAR imagery.

At its September 26, 2019 meeting, the GLMC directed Watermaster Engineer to obtain costs to perform a pilot study using the new Sentinel-1A satellite. Specifically, two types of questions should be answered by the pilot study:

1. Has land subsidence occurred in the eastern portion of Chino Basin during the period 2015 to 2018 as hydraulic heads have declined over this period? If so, how much? What is its spatial distribution? Does the GLMC see a concern that would warrant ongoing monitoring of the eastern Chino Basin via InSAR?
2. Across the western portion of the Chino Basin, how do the estimates of vertical ground motion derived from TerraSAR-X and Sentinel-1A compare in terms of spatial distribution, magnitude, coherence, and accuracy? If the GLMC were to switch to using Sentinel-1A, would the monitoring program be compromised? If so, how?



To answer these questions: (i) Watermaster Engineer will identify, download, and compile InSAR rasters (available from the California’s Department of Water Resources SGMA Data Viewer²), showing monthly vertical ground motion displacement from Sentinel-1A for the entire Chino Basin over the three-year period 2015 and 2018; (ii) Watermaster Engineer will compare various aspects of the TerraSAR-X and Sentinel-1A SAR data – namely the magnitude of vertical ground motion, coherence of the InSAR data sets, and the spatial resolution of ground motion across the Chino Basin using tables and maps; (iii) Watermaster Engineer will compare the InSAR estimates of vertical ground motion against the ground-elevation-survey results at select benchmarks across the western Chino Basin; and (iv) Watermaster Engineer will prepare a technical memorandum to document the purpose of the pilot study, methods, results and interpretations, and recommendations to the GLMC on the future use of the Sentinel-1A satellite for the GLMP.

Task 4—Perform Ground-Level Surveys

This task involves conducting elevation surveys at benchmark monuments across defined areas of western Chino Basin to estimate the vertical ground motion that occurred since the prior survey. Electronic distance measurements (EDM surveys) are also performed between benchmark monuments to estimate horizontal ground motion in areas where ground fissuring due to differential land subsidence is a concern. The table below documents the areas surveyed over the last five years as part of the GLMP.

Ground-Level Survey Area	Ground-Level Survey Completed (Y/N)?					
	2015	2016	2017	2018	2019	2020**
Managed Area	Y	Y	N	Y	N	N
Fissure Zone Area*	Y	Y	N	Y	N	N
Central Area	N	N	N	N	N	N
Northwest Area	N	Y	Y	Y	Y	Y
San Jose Fault Zone Area*	N	Y	Y	Y	Y	Y
Southeast Area	Y	Y	Y	Y	N	N
Northeast Area	N	N	N	Y	Y	Y

*Denotes EDM survey area

**The 2020 ground-level surveys are scheduled to begin in late February 2020.

The ground-level surveys efforts recommended for FY 2020/21 include:

Task 4.1—Conduct Spring-2020 Elevation and EDM surveys in Northwest MZ-1.

In this subtask, the surveyor conducts elevation and EDM surveys at the established benchmarks in Northwest MZ-1 in spring 2021. The elevation survey will begin at the new Pomona

² <https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels>



Extensometer Facility and includes benchmarks across Northwest MZ-1 shown on Figure 1. The elevation survey will be referenced to a newly established elevation datum at the Pomona Extensometer. The EDM survey is performed across the San Jose Array of benchmark monuments shown on Figure 1.

These surveys are recommended in FY 2020/21 because of the recent subsidence that has occurred in Northwest MZ-1 and will support the development of a subsidence management plan in Northwest MZ-1.

Task 4.5—Replace Destroyed Benchmarks (if needed).

In this sub-task, the surveyor replaces benchmark monuments that have been destroyed since the last survey, if any.

Task 4.6—Process, Check, and Update Database.

In this sub-task, the Watermaster Engineer receives and catalogs the survey results provided by the surveyor, prepares the data for display as a GIS layer, and performs checks against InSAR and extensometer data for reasonableness and accuracy.

The ground-level surveys efforts **not** recommended for FY 2020/21 include:

Task 4.2—Conduct Spring-2020 Elevation Survey in the Northeast Area.

This survey is not recommended for FY 2020/21 because heads have been relatively stable or increasing across most of this area and recent ground motion as measured by InSAR and ground-level surveys has been minor in this area.

Task 4.3—Conduct Spring-2020 Elevation in the Southeast Area.

This survey is not recommended for FY 2020/21 because over the past several years hydraulic heads have been relatively stable in this area; recent ground motion as measured by InSAR, ground-level surveys, and the Chino Creek Extensometer has been minor in this area; hydraulic heads are not projected to significantly decline in this area over the next year.

Task 4.4—Conduct Spring-2020 Elevation and EDM Surveys in the Managed Area.

This survey is not recommended for FY 2020/21 because over the past several years hydraulic heads have been relatively stable in this area; recent ground motion as measured by InSAR, ground-level surveys, and the Ayala Park Extensometer has been minor in this area.

Task 5—Data Analysis and Reporting

Task 5.1—Prepare Draft 2019/20 Annual Report of the Ground-Level Monitoring Committee.

Prepare the text, tables, and figures for a draft 2019/20 Annual Report of the GLMC and submit the report to the GLMC by September 25, 2020 for review and comment.

One of the recommendations from the *2018/19 Annual Report of the GLMC* was to perform a comparison of InSAR estimates of vertical ground motion and high-frequency head measurements in other Areas of Subsidence Concern – identical to the data analysis performed



at well C-15 (see Section 3 of the *2018/19 Annual Report of the GLMC*).³ This task will include data collection, processing, and analysis of InSAR estimates of vertical ground motion and high-frequency head measurements at up to two locations in the western Chino Basin. The analysis locations will be dependent on where InSAR has been consistently coherent since 2011 and high-frequency head measurements are available since 2011 through present-day.

Also, as part of Task 5, Watermaster's Engineer will work with the GLMC to develop concepts for streamlining the Annual Report of the Ground-Level Monitoring Committee and the reporting process for future years. Watermaster's Engineer will use the scheduled meetings of the GLMC in FY 2020/21 to discuss with the GLMC concepts for streamlining the annual report and reporting process.

Task 5.2—Prepare Final 2019/20 Annual Report of the Ground-Level Monitoring Committee.

Update the text, tables, and figures based on the comments received from the GLMC and prepare a final *2019/20 Annual Report of the GLMC* by October 30, 2020. Responses to comments will be included as an appendix to the final report. The report will be included in the agenda packet for the November 2020 Watermaster meetings for approval.

Task 5.3—Compile and Analyze Data from the 2020/21 Ground-Level Monitoring Program.

In this task, monitoring data generated from the GLMP during 2020/21 is checked, mapped, charted, and analyzed as the first step in the preparation of the subsequent annual report. Some of the maps, charts, and tables are shared with the GLMC at its meetings in early 2021 during the development of a recommended scope and budget for FY 2021/22.

Task 6—Develop a Subsidence-Management Plan for Northwest MZ-1

The development of the subsidence management plan for Northwest MZ-1 is a multi-year effort with the objective to minimize or stop the occurrence of subsidence in this area. Background information and the conceptual framework for this effort is described in detail in the *Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1*.⁴

The Pomona Extensometer (PX) is the main monitoring facility that was constructed at part of the Work Plan and will be fully operational in spring 2020. Several subsequent tasks in the Work Plan are recommended for implementation in FY 2020/21, including:

Task 6.1—Conduct One-Year of Passive Monitoring.

The monitoring of piezometric levels and pumping at wells in Northwest MZ-1 will continue through various techniques, including: (i) SCADA-based monitoring by the Monte Vista Water District; (ii) monitoring of piezometric levels via sonar⁵; (iii) monitoring of piezometric levels via pressure transducers at City of Pomona production wells; and (iv) manual measurements of

³ http://www.cbwm.org/rep_engineering.htm

⁴ http://www.cbwm.org/docs/engdocs/Land%20Subsidence/20150724%20-%20Chino%20Basin%20Subsidence%20Management%20Plan%202015/FINAL_CBSMP_Appendix_B.pdf

⁵ The use of sonar technology to measure piezometric levels in wells is currently being used in Monte Vista Water District wells 28 and 31.



piezometric levels. The PX facility will measure and record piezometric and aquifer-system-deformation data. These data will improve the understanding of the hydrogeology in Northwest MZ-1 and will be used to construct and calibrate computer-simulation models of groundwater flow and aquifer-system compaction. The data and model results will be used to develop the Subsidence Management Plan for Northwest MZ-1 and update the plan in the future as appropriate.

In this subtask, all data is collected, compiled, and analyzed every two months. Charts and data graphics of pumping, piezometric levels, and aquifer-system deformation will be prepared and shared regularly with the GLMC for review and comment.

Task 6.2—Update the Hydrogeologic Conceptual Model.

The objective of this task is to update the hydrogeologic conceptual understanding of Northwest MZ-1, particularly for the parameters that affect aquifer-system deformation and land subsidence. The information generated in this task will form the basis for updating Watermaster’s current groundwater model (Task 6.3) so it can simulate land subsidence and evaluate subsidence-management alternatives.

In this task, a one-dimensional (1D) compaction model will be constructed and calibrated to represent the aquifer-system at the PX location. The lithologic and geophysical data collected from the PX borehole will be used to construct the 1D model. Piezometric data from wells in the area and vertical ground motion data from InSAR will be used to calibrate the 1D model. The calibration results will generate estimates of the hydraulic and mechanical properties of the aquifer-system and the pre-consolidation stress(es).

Task 6.3—Update the Chino Basin MODFLOW Model to Enable Simulations of Subsidence.

The objective of this task is to update Watermaster’s MODFLOW model so it can be used to simulate land subsidence and evaluate subsidence-management alternatives. The subsidence package (SUB) in MODFLOW will be added to the model, including the aquifer-system properties estimated by the 1D models at the PX, the Ayala Park Extensometer, and MVWD Well 28. The SUB package will be calibrated across all Areas of Subsidence Concern using estimates of vertical ground-motion from InSAR, ground-level surveys, and the Ayala Park Extensometer.

A draft technical memorandum—*Updated Chino Basin Groundwater Model with SUB Package*—will be prepared to describe the model update and calibration results. The draft memorandum will be distributed to the GLMC for review and comment. A meeting of the GLMC will be held to discuss the memorandum and receive verbal feedback. The GLMC will submit written comments and suggested revisions to Watermaster. A final technical memorandum will be prepared that incorporates the feedback and comments from the GLMC.

Task 6.4—Refine and Evaluate the Subsidence-Management Alternatives.

The objective of this task is to develop and evaluate additional subsidence-management alternatives to minimize or eliminate the future occurrence of subsidence in Northwest MZ-1.



First, the updated Chino Basin MODFLOW model will be used to characterize the basin response to Baseline Management Alternative (BMA) and the Initial Subsidence Management Alternative (ISMA),⁶ their ability to raise and hold piezometric levels above the pre-consolidation stress, and their ability to minimize or abate the ongoing subsidence in Northwest MZ-1. The alternatives also will be evaluated on the institutional changes that will need to occur and the costs of the associated water-supply plans.

Using the results of the ISMA, a new method to increase and hold piezometric levels at the estimated pre-consolidation stress will be described and called Subsidence-Management Alternative 2 (SMA-2). The assumptions of the SMA-2, including the groundwater production and replenishment plans of the Chino Basin parties, will be described and agreed upon by the GLMC. The updated Chino Basin MODFLOW model will be used to characterize the basin response to SMA-2, its ability to raise and hold piezometric levels above the pre-consolidation stress, and its ability to minimize or abate the ongoing subsidence in Northwest MZ-1. The alternative also will be evaluated on the institutional changes that will need to occur and the costs of the associated water-supply plans.

A GLMC meeting will be held to review the model results and evaluations. The GLMC can select a recommended subsidence-management alternative or choose to develop and evaluate additional subsidence-management alternatives in the following fiscal year. In the following fiscal year, a draft and final technical memorandum will be prepared to document the evaluation of all subsidence-management alternatives and the preferred alternative as recommended by the GLMC.

Task 7—Meetings and Administration

Task 7.1—Prepare for and Conduct Four Meetings of the Ground-Level Monitoring Committee.

This sub-task includes preparing for and conducting four meetings of the GLMC:

- July 2020 – Implementation of the GLMP for FY 2020/21.
- September 2020 – Review the draft *2019/20 Annual Report of the Ground-Level Monitoring Committee*.
- February 2021 – Review the draft recommended scope and budget for FY 2021/22.
- March 2021 – Review the final recommended scope and budget for FY 2021/22 (if needed).

Task 7.2—Prepare for and Conduct One As-Requested Ad-Hoc Meeting.

This sub-task includes preparing for and conducting one ad-hoc meeting of the GLMC, as requested by the GLMC or Watermaster staff.

⁶ The development and evaluation of the BMA and ISMA were reported on here: https://cbwm.syncedtool.com/shares/folder/e83081106c3072/?folder_id=1126



Task 7.3—Perform Monthly Project Management.

This sub-task includes monthly project administration and management, including staffing, financial and schedule reporting to Watermaster and sub-contractor coordination.

Task 7.4—Prepare a Recommended Scope and Budget for the GLMC for FY 2021/22.

This sub-task includes preparing a draft and final recommended scope and budget for FY 2021/22 for the GLMC to support the Watermaster’s budgeting process.

Comments and Responses

City of Ontario

COMMENT: Task 1.1 – Why is the cost of maintenance and calibration decreasing if we are now including the maintenance of the Pomona Extensometer? Was the full budget used for FY 19/20?

RESPONSE: The restructuring of staff roles and responsibilities in FY 2020/21 for Task 1.1 reduced the total labor for this sub-task.

The budget for Task 1.1 in FY 2019/20 is not anticipated to be completely spent.

COMMENT: Task 3.3 – Based on the report out from the GLMC it is suggested we see if we can tie-in the free DWR data and make it useful for WM purposes. Does this change the proposed scope/budget?

RESPONSE: Task 3.3 (InSAR pilot study) is being updated to analyze only the free DWR data (Sentinel 1-A satellite) for the eastern portion of Chino Basin and to analyze and compare only the free DWR data to the data collected by the TerraSAR-X satellite (current satellite used by the GLMC). If the free DWR data collected and analyzed is deemed to be useful to the Ground Level Monitoring Program and the GLMC, there likely would be cost savings in future years. For FY 2020/21, we are still recommending we collect data from the TerraSAR-X satellite until the free DWR pilot study is complete.

COMMENT: Task 4.7 – Can you elaborate on “New Surveyor Support?”

RESPONSE: The recommended budget for “New Surveyor Support” is zero for FY 2020/21. In FY 2019/20, the “New Surveyor Support” task was used for WSP USA (former surveyor) to help transition the new surveyor (Guida Surveying, Inc.) into the GLMP and help check the results from the spring 2019 ground-level surveys.

COMMENT: Task 5.2 – Can you clarify the need for a \$10k increase in the preparation of the Final 2019/20 Annual Report of the Ground-Level Monitoring Committee?

RESPONSE: Please see pages 5 and 6 under Task 5.1 of the draft “Recommended Scope and Budget of the Ground-Level Monitoring Committee for Fiscal Year 2020/21.” The text from these pages state:

One of the recommendations from the 2018/19 Annual Report of the GLMC was to perform a comparison of InSAR estimates of vertical ground motion and high-frequency head measurements in other Areas of Subsidence Concern – identical to the data analysis



performed at well C-15 (see Section 3 of the 2018/19 Annual Report of the GLMC).⁷ This task will include data collection, processing, and analysis of InSAR estimates of vertical ground motion and high-frequency head measurements at up to two locations in the western Chino Basin. The locations analyzed will be dependent on where InSAR has been consistently coherent since 2011 and high-frequency head measurements are available since 2011 through present-day.

Also, as part of Task 5, Watermaster’s Engineer will work with the GLMC to develop concepts for streamlining the Annual Report of the Ground-Level Monitoring Committee and the reporting process for future years. Watermaster’s Engineer will use the scheduled meetings of the GLMC in FY 2020/21 to discuss with the GLMC concepts for streamlining the annual report and reporting process.

COMMENT: Task 6.1 – Why is there carryover for Tasks 6.1.1 and 6.1.2? Was the work planned for 2019/20 and put on hold?

RESPONSE: Completing Tasks 6.1.1. and 6.1.2 was contingent on completing the Pomona Extensometer Facility piezometers and equipping the piezometers with the cable extensometers and all monitoring equipment (i.e. measuring hydraulic head and aquifer-system deformation). Equipping the Pomona Extensometer Facility is scheduled to be complete by the end of June 2020. As such, there will be carryover into FY 2020/21 for completing Tasks 6.1.1 and 6.1.2.

COMMENT: Task 6.2 – How often is the hydraulic conceptual model updated? Is it updated based on a pre-determined interval?

RESPONSE: The 2017 “Initial Hydrogeologic Conceptual Model and Monitoring and Testing Program for the Northwest MZ-1 Area” documented the then-current understanding of the hydrogeology in Northwest MZ-1 and also stated possible mechanisms causing the observed land subsidence in the area. The report also stated the data gaps needed to be filled in order to better understand the mechanisms causing the observed land subsidence. The drilling and construction of the Pomona Extensometer Facility piezometers filled one of those data gaps. The lithologic and geophysical data collected from the drilling of the Pomona Extensometer Facility piezometers will allow us to create a one-dimensional (1D) compaction model to represent the aquifer-system at the PX location and update the hydrogeologic conceptual model of Northwest MZ-1.

There is no pre-determined interval for updating the Northwest MZ-1 hydrogeologic conceptual model. Drafting the “Initial Hydrogeologic Conceptual Model and Monitoring and Testing Program for the Northwest MZ-1 Area,” report constructing the Pomona Extensometer Facility, and completing Tasks 6.1 to 6.3 in FY 2020/21 follows the “Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1.”⁸

⁷ http://www.cbwm.org/rep_engineering.htm

⁸ http://www.cbwm.org/docs/engdocs/Land%20Subsidence/20150724%20-%20Chino%20Basin%20Subsidence%20Management%20Plan%202015/FINAL_CBSMP_Appendix_B.pdf



COMMENT: Task 6.3 – How often is the MODFLOW Model updated? Is it updated based on a pre-determined interval?

RESPONSE: For the GLMC, the Chino Basin MODFLOW model will be updated in FY 2020/21 to include a subsidence package to simulate land subsidence across the entire Chino Basin. The new data collected as part of constructing the Pomona Extensometer Facility, in addition to the data collected as part of the Ground Level Monitoring Program (i.e., Ayala Park and Chino Creek Facilities, InSAR, and ground level surveys) will be used to update the Chino Basin MODFLOW model.

There is no pre-determined interval for updating the Chino Basin MODFLOW model for the GLMC. Updating Chino Basin MODFLOW model in FY 2020/21 follows the “Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1.”

COMMENT: Task 6.4 – How often are subsidence management alternatives evaluated?

RESPONSE: The development and evaluation of subsidence-management alternatives is described in the “Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1.” In 2020/21, Subsidence-Management Alternative 2 (SMA-2) will be described and agreed upon by the GLMC. The updated Chino Basin MODFLOW model will be used to characterize the basin response to SMA-2, its ability to raise and hold piezometric levels above the pre-consolidation stress, and its ability to minimize or abate the ongoing subsidence in Northwest MZ-1. A GLMC meeting will be held to review the model results and evaluations. The GLMC will then be able to select a recommended subsidence-management alternative or choose to develop and evaluate additional subsidence-management alternatives in the following fiscal year. Ultimately, a subsidence-management alternative will be chosen to update the Watermaster’s Subsidence Management Plan.

In the future, if land subsidence is not being effectively managed under the Watermaster’s Subsidence Management Plan, the Watermaster may consider developing and evaluating additional subsidence-management alternatives based on recommendations of the GLMC.

COMMENT: Task 7.1 – What is the \$3k increase for the GLMC meetings attributed to?

RESPONSE: The increase costs for FY 2020/21 are based on past experience and the projected costs to perform monthly project management and to prepare for and conduct up to four GLMC meetings in 2020/21.

Encl.:

Table 1. Work Breakdown Structure and Cost Estimates – Ground-Level Monitoring Program: FY 2020/21

Figure 1. Ground-Level Monitoring Program – Fiscal Year 2020/21

Table 1
Work Breakdown Structure and Cost Estimates
Ground-Level Monitoring Program: FY 2020/21

Task Description	Labor		Other Direct Costs						Totals					
	Person Days	Total	Travel	New Equip.	Equip. Rental	Outside Pro	Misc.	Total	Totals by Task	Recommended Budget FY 2020/21	Approved Budget FY 2019/20	Net Change FY 2019/20 to 2020/21	Potential Carry-Over FY 2020/21	Budget with Carry-Over FY 2020/21
									a	b	a - b	c	a - c	
Task 1 -- Setup and Maintenance of the Monitoring Network		\$25,600						\$7,388	\$32,988	\$32,988	\$36,857	-\$3,869	\$0	\$32,988
1.1 Maintain Extensometer Facilities														
1.1.1 Routine maintenance of Ayala Park, Chino Creek, and Pomona extensometer facilities	14	\$19,360	\$1,056	\$250	\$152			\$1,458	\$20,818	\$20,818	\$23,813	-\$2,995	\$0	\$20,818
1.1.2 Replacement/repair of equipment at extensometer facilities	4	\$6,240	\$264	\$2,000	\$70	\$2,000		\$4,334	\$10,574	\$10,574	\$11,448	-\$874	\$0	\$10,574
1.2 Annual Lease Fees for the Chino Creek extensometer facility	0	\$0						\$1,596	\$1,596	\$1,596	\$1,596	\$0	\$0	\$1,596
Task 2 -- MZ-1: Aquifer-System Monitoring and Testing		\$26,712						\$680	\$27,392	\$27,392	\$34,686	-\$7,294	\$0	\$27,392
2.1 Conduct Quarterly Data Collection from Extensometers; Data Checking and Management														
2.1.1 Download data from the Ayala Park Extensometer facility	2	\$2,624	\$230		\$76			\$306	\$2,930	\$2,930	\$2,895	\$35	\$0	\$2,930
2.1.2 Download data from the Chino Creek Extensometer facility	2	\$2,624	\$26					\$26	\$2,650	\$2,650	\$2,662	-\$12	\$0	\$2,650
2.1.3 Download data from Pomona Extensometer facility	4	\$5,248	\$272		\$76			\$348	\$5,596	\$5,596	\$5,433	\$163	\$0	\$5,596
2.1.4 Process, check, and upload data to database	11	\$16,216						\$0	\$16,216	\$16,216	\$15,712	\$504	\$0	\$16,216
2.2 Conduct Pilot Injection Test in the Managed Area														
2.2.1 Coordinate testing with pumps	0	\$0						\$0	\$0	\$0	\$1,512	-\$1,512	\$0	\$0
2.2.2 Equip CH-15B and CH-17 with high-frequency water-level monitoring devices	0	\$0						\$0	\$0	\$0	\$6,472	-\$6,472	\$0	\$0
Task 3 -- Basin Wide Ground-Level Monitoring Program (InSAR)		\$29,694						\$85,000	\$114,694	\$114,694	\$90,362	\$24,332	\$0	\$114,694
3.1 Acquire SAR data from TerraSAR-X and prepare interferograms for 2020/21	1	\$1,808				\$85,000		\$85,000	\$86,808	\$86,808	\$86,752	\$56	\$0	\$86,808
3.2 Convert interferograms to raster datasets and check results	2	\$3,194						\$0	\$3,194	\$3,194	\$3,610	-\$416	\$0	\$3,194
3.3 Conduct a pilot study with the new Sentinel-1A satellite								\$0	\$0	\$0	\$0	\$0	\$0	\$0
3.3.1 Download and compile the Sentinel-1A monthly InSAR raster datasets between 2015 and 2018	1.25	\$1,764						\$0	\$1,764	\$1,764	\$0	\$1,764	\$0	\$1,764
3.3.2 Prepare maps of the Sentinel-1A estimates of vertical ground motion for the eastern Chino Basin between 2015 and 2018; and maps and charts comparing the TerraSAR-X and Sentinel-1A estimates (downloaded from DWR) of vertical ground motion across the western Chino Basin. The estimates of the vertical ground motion across the western Chino Basin will also be compared against the ground level survey results.	8	\$12,776						\$0	\$12,776	\$12,776	\$0	\$12,776	\$0	\$12,776
3.3.3 Prepare a Technical Memorandum summarizing the results from the Sentinel-1A pilot study	6	\$10,152						\$0	\$10,152	\$10,152	\$0	\$10,152	\$0	\$10,152
Task 4 -- Perform Ground-Level Surveys		\$6,648						\$183,816	\$190,464	\$51,828	\$124,878	-\$73,050	\$0	\$51,828
4.1 Conduct Spring-2021 Elevation and EDM surveys in Northwest MZ-1	0.5	\$904				\$33,880		\$33,880	\$34,784	\$34,784	\$29,476	\$5,308	\$0	\$34,784
4.2 Conduct Spring-2021 Elevation Survey in the Northeast Area	0	\$0				\$43,208		\$43,208	\$43,208	\$0	\$38,056	-\$38,056	\$0	\$0
4.3 Conduct Spring-2021 Elevation Survey in the Southeast Area	0	\$0				\$43,208		\$43,208	\$43,208	\$0	\$0	\$0	\$0	\$0
4.4 Conduct Spring 2021-Elevation and EDM Surveys in the Managed Area/Fissure Zone Area	0	\$0				\$47,320		\$47,320	\$47,320	\$0	\$31,570	-\$31,570	\$0	\$0
4.5 Replace Destroyed Benchmarks (if needed)	0	\$0				\$16,200		\$16,200	\$16,200	\$11,300	\$9,700	\$1,600	\$0	\$11,300
4.6 Process, Check, and Update Database	4	\$5,744						\$0	\$5,744	\$5,744	\$6,076	-\$332	\$0	\$5,744
4.7 New Surveyor Support	0	\$0						\$0	\$0	\$0	\$10,000	-\$10,000	\$0	\$0
Task 5 -- Data Analysis and Reporting		\$74,932						\$0	\$74,932	\$74,932	\$63,842	\$11,090	\$0	\$74,932
5.1 Prepare Draft 2019/20 Annual Report of the Ground-Level Monitoring Committee	22.5	\$35,196						\$0	\$35,196	\$35,196	\$35,312	-\$116	\$0	\$35,196
5.2 Prepare Final 2019/20 Annual Report of the Ground-Level Monitoring Committee	10.5	\$19,088						\$0	\$19,088	\$19,088	\$8,584	\$10,504	\$0	\$19,088
5.3 Compile and Analyze Data from the 2020/21 Ground-Level Monitoring Program	14	\$20,648						\$0	\$20,648	\$20,648	\$19,946	\$702	\$0	\$20,648
Task 6 -- Develop a Subsidence-Management Plan for Northwest MZ-1		\$251,972						\$167	\$252,139	\$252,139	\$7,500	\$244,639	\$30,000	\$222,139
6.1 Conduct One-Year of Passive Monitoring														
6.1.1 Collect pumping and piezometric level data from agencies every two months; check and upload data to HDX	9.75	\$10,599						\$0	\$10,599	\$10,599	\$7,500	\$3,099	\$15,000	-\$4,401
6.1.2 Prepare and analyze charts and data graphics of pumping, piezometric levels, and aquifer-system deformation; share with the GLMC	8.25	\$11,634						\$0	\$11,634	\$11,634	\$0	\$11,634	\$15,000	-\$3,366
6.2 Update the Hydrogeologic Conceptual Model														
6.2.1 Construct a one-dimensional (1D) compaction model at the PX location	8.875	\$17,637						\$0	\$17,637	\$17,637	\$0	\$17,637	\$0	\$17,637
6.2.2 Calibrate 1D model to derive hydraulic and mechanical properties of aquifers/aquifers and estimate the pre-consolidation stress(es)	8.25	\$16,442						\$0	\$16,442	\$16,442	\$0	\$16,442	\$0	\$16,442
6.3 Update the Chino Basin MODFLOW Model to Enable Simulations of Subsidence														
6.3.1 Add SUB package to the MODFLOW model utilizing results from 1D models at PX, MVWD-28, and AP	20	\$39,432						\$0	\$39,432	\$39,432	\$0	\$39,432	\$0	\$39,432
6.3.2 Calibrate SUB package utilizing ground motion data from InSAR, surveys, and extensometers	15	\$29,984						\$0	\$29,984	\$29,984	\$0	\$29,984	\$0	\$29,984
6.3.3 Prepare a draft technical memorandum summarizing the model updates and distribute to the GLMC	21.5	\$36,988						\$0	\$36,988	\$36,988	\$0	\$36,988	\$0	\$36,988
6.3.4 Prepare for and conduct a meeting to receive feedback and comments on draft memorandum	3.75	\$7,058	\$84					\$84	\$7,142	\$7,142	\$0	\$7,142	\$0	\$7,142
6.3.5 Incorporate the GLMC comments and prepare a final technical memorandum	3	\$5,326						\$0	\$5,326	\$5,326	\$0	\$5,326	\$0	\$5,326
6.4 Refine and Evaluate Subsidence-Management Alternatives														
6.4.1 Re-evaluate the Baseline and Initial Subsidence-Management Alternatives	10	\$20,060						\$0	\$20,060	\$20,060	\$0	\$20,060	\$0	\$20,060
6.4.2 Develop Subsidence-Management Alternative 2 (SMA-2)	4	\$8,072						\$0	\$8,072	\$8,072	\$0	\$8,072	\$0	\$8,072
6.4.3 Prepare and present straw-man SMA-2 to GLMC	2	\$3,912	\$84					\$84	\$3,996	\$3,996	\$0	\$3,996	\$0	\$3,996
6.4.4 Review with other agencies that will be required to implement the SMA-2	1.5	\$2,860						\$0	\$2,860	\$2,860	\$0	\$2,860	\$0	\$2,860
6.4.5 Revise SMA-2 based on comments; circulate to the GLMC and other agencies for comments	2	\$3,944						\$0	\$3,944	\$3,944	\$0	\$3,944	\$0	\$3,944
6.4.6 Finalize SMA-2	2	\$3,964						\$0	\$3,964	\$3,964	\$0	\$3,964	\$0	\$3,964
6.4.7 Update groundwater production and replenishment plans per SMA-2	4.5	\$8,944						\$0	\$8,944	\$8,944	\$0	\$8,944	\$0	\$8,944
6.4.8 Run groundwater model to evaluate the basin response to SMA-2	4	\$7,968						\$0	\$7,968	\$7,968	\$0	\$7,968	\$0	\$7,968
6.4.9 Prepare maps, charts, and tables to characterize the basin response to SMA-2	7.25	\$12,694						\$0	\$12,694	\$12,694	\$0	\$12,694	\$0	\$12,694
6.4.10 Summarize evaluation of SMA-2 and present results to the GLMC	2.25	\$4,454						\$0	\$4,454	\$4,454	\$0	\$4,454	\$0	\$4,454
Task 7 -- Meetings and Administration		\$50,832						\$418	\$51,250	\$51,250	\$47,194	\$4,056	\$0	\$51,250
7.1 Prepare for and Conduct Four Meetings of the Ground-Level Monitoring Committee	14	\$25,504	\$334					\$334	\$25,838	\$25,838	\$22,478	\$3,360	\$0	\$25,838
7.2 Prepare for and Conduct One As-Requested Ad-Hoc Meeting	3	\$5,720	\$84					\$84	\$5,804	\$5,804	\$5,620	\$184	\$0	\$5,804
7.3 Perform Monthly Project Management	6	\$10,848						\$0	\$10,848	\$10,848	\$13,560	-\$2,712	\$0	\$10,848
7.4 Prepare a Recommended Scope and Budget for the GLMC for FY 2021/22	4.75	\$8,760						\$0	\$8,760	\$8,760	\$5,536	\$3,224	\$0	\$8,760
Totals									\$605,223	\$405,318	\$199,905	\$30,000	\$575,223	

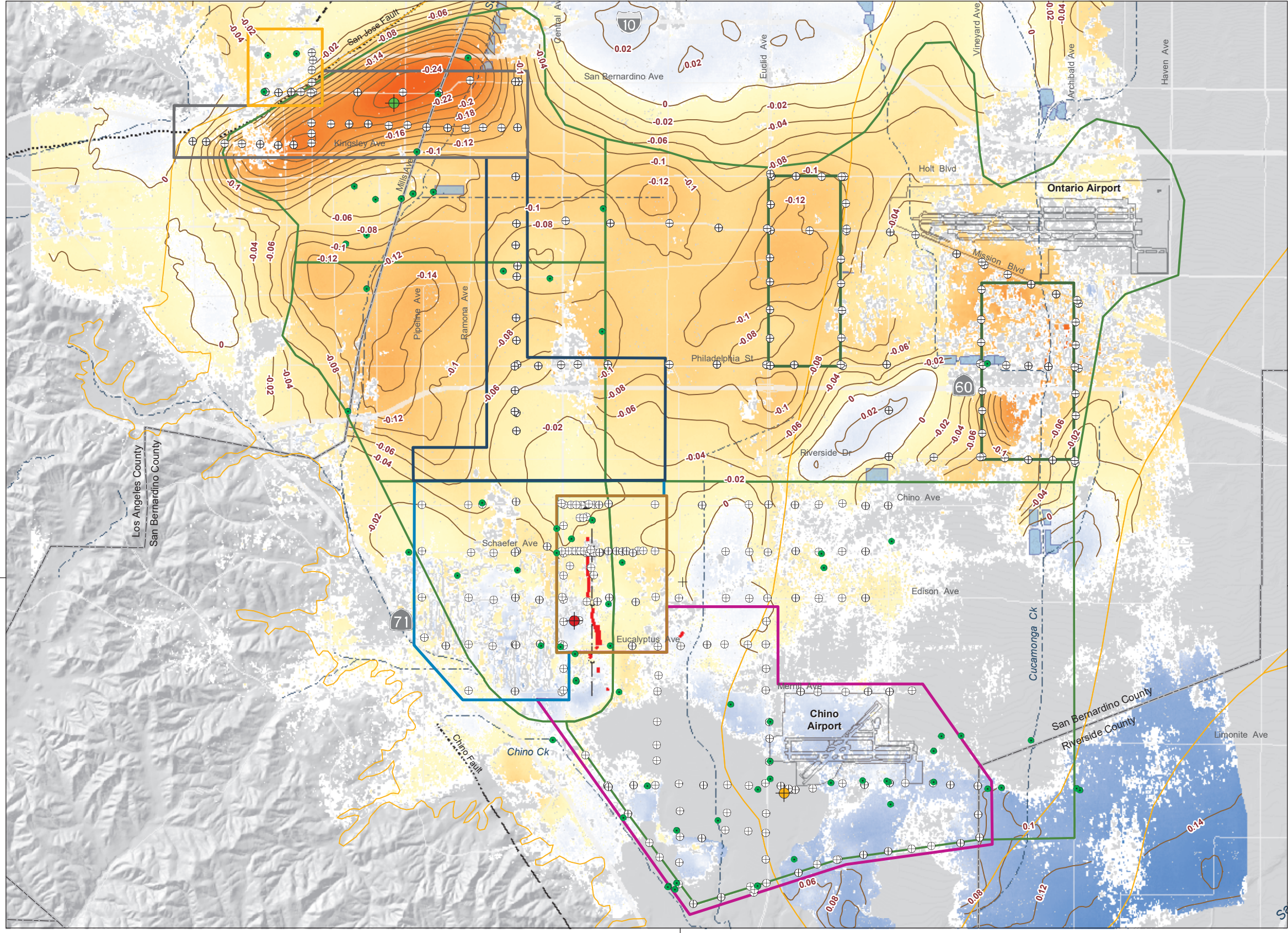


117°40'0"W

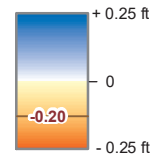
117°40'0"W

34°0'0"N

34°0'0"N



Relative Change in Land Surface Altitude
as Measured by InSAR
March 2011 to March 2019



InSAR absent or incoherent

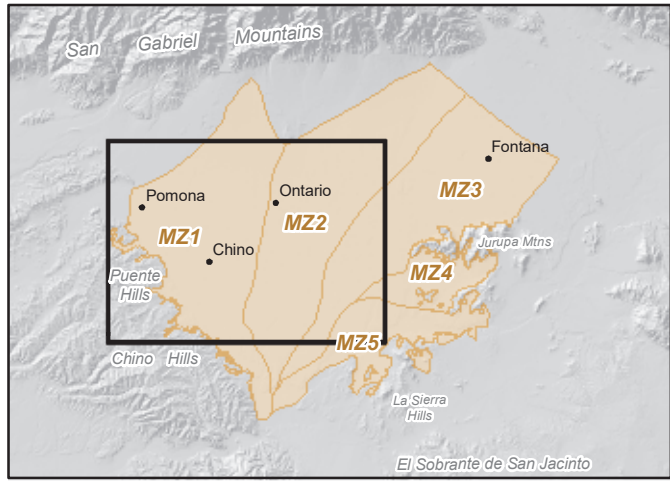
Groundwater-Level and
Aquifer-System Deformation Monitoring

- Well Equipped with Pressure Transducer (2018/19)
- Ayala Park Extensometer
- Chino Creek Extensometer
- Pomona Facility Extensometer

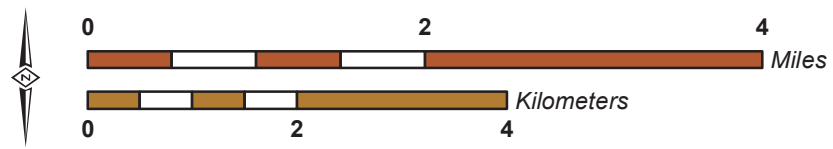
Ground-Level Survey Areas

- ⊕ Ground-Level Survey Benchmark
- Southeast
- Northeast Area
- Central
- Managed Area
- Northwest MZ-1
- Fissure Zone
- San Jose Fault Zone

- Areas of Subsidence Concern
- Flood Control and Conservation Basins
- Ground Fissures
- Approximate Location of the Riley Barrier
- Fault - Solid where accurately located. Dashed where approximately located or inferred; dotted where concealed.



Author: MAB
Date: 2/18/2020
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Ground-Level Monitoring Committee
Ground-Level Monitoring Program

Ground-Level Monitoring Program
Fiscal Year 2020/21

Figure 1