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DRAFT TECHNICAL MEMORANDUM

DATE: December 11, 2020 **PROJECT #:** 9090.0901

TO: Ad Hoc Sustainable Groundwater Planning Advisory Committee (GSU22 Committee)

CC: Brian Lockwood, P.G., C.Hg. and Casey Meusel
Pajaro Valley Water Management Agency

FROM: Cameron Tana, P.E., Luis Mendez, and Georgina King P.G., C.Hg.,

PROJECT: Basin Management Plan: Groundwater Sustainability Update 2022 (GSU22)

SUBJECT: Seawater Intrusion Sustainable Management Criteria Chloride Isocontour Value

BACKGROUND

The Pajaro Valley Water Management Agency (PV Water) submitted a Groundwater Sustainability Plan (GSP) Alternative for the Pajaro Valley Subbasin (Basin) on December 31, 2016 per the Sustainable Groundwater Management Act (SGMA). The California Department of Water Resources (DWR) assessed the Alternative and approved PV Water's GSP-Alternative. DWR's assessment staff report recommended PV Water develop sustainable management criteria for seawater intrusion as follows:

- Recommended Action 6: Staff recommend that the Agency should define a specific location of an isoconcentration contour or some other equivalent method that can be used on an ongoing basis to assess progress toward eliminating undesirable results associated with seawater intrusion to assess the goal of eliminating seawater intrusion through implementation of projects and management actions as described in the Plan.

- Recommended Action 7: Staff recommend that the Alternative should be updated to set objective criteria consistent with achieving the stated goal that a 100 percent reduction in annual seawater intrusion rate is the operational goal for the Basin or to provide quantify (sic) the extent to which additional seawater intrusion would not be significant and unreasonable.

In response to DWR's recommendations, PV Water plans to develop specific seawater intrusion sustainable management criteria (SMC) for inclusion in the Basin Management Plan:

Groundwater Sustainability Update 2022 (GSU22). The GSU22 will be submitted as the five-year update for the GSP Alternative to DWR by January 1, 2022.

QUESTIONS TO HELP DEFINE SIGNIFICANT AND UNREASONABLE CONDITIONS FOR SEAWATER INTRUSION

As introduced at the 2nd meeting of the GSU22 committee in November 2020, the first step in developing sustainability management criteria for any sustainability indicator is to qualitatively describe significant and unreasonable conditions for the indicator. DWR Recommended Action 7 describes the need for PV Water to describe significant and unreasonable conditions for seawater intrusion.

The main questions the GSU22 committee will help answer in describing significant and unreasonable conditions for seawater intrusion are:

- How far inland for seawater intrusion is acceptable and why?
- How should we define whether seawater intrusion is occurring in the Basin?

The adjacent basins to the Basin define significant and unreasonable conditions by answering the first question:

- Santa Cruz Mid-County Basin: "Seawater moving farther inland than has been observed from 2013 through 2017" (MGA, 2019).
- Salinas 180/400 Foot Aquifer Subbasin: "Seawater intrusion in excess of the seawater intrusion line defined by MCWRA in 2017" (SVBGSA, 2020).

Both basins use existing conditions to define how far inland seawater intrusion is acceptable, but the GSU22 can recommend defining a different location for acceptable seawater intrusion, either closer to the coast or more inland.

The scope of this technical memorandum is to provide information for the GSU22 Committee to give input for the second question on how to define whether seawater intrusion is occurring.

USING CHLORIDE CONCENTRATIONS TO DEFINE WHETHER SIGNIFICANT AND UNREASONABLE SEAWATER INTRUSION IS OCCURRING

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SGMA requires the use of chloride concentrations to define whether significant and unreasonable seawater intrusion is occurring. This technical memorandum (memo) presents initial considerations to define a chloride isoconcentration contour (isocontour) as sustainable management criteria (SMC) to address Recommended Action 6. An isocontour is the geographic line where chloride in groundwater is estimated be a specified concentration. Figure 1 is a graphic from DWR's Sustainable Management Criteria Best Management Practices (BMP) guidance document (2017) that provides an example isocontour set at 250 mg/L as the orange line in the shallow aquifer. For a seawater intrusion minimum threshold, this means chloride concentrations inland of the isocontour (grey area in Figure 1) that are above the 250 mg/L isocontour concentration would be considered an exceedance of the minimum threshold. Chloride concentrations on the coastal side of the isocontour (orange areas in Figure 1) greater than the 250 mg/L isocontour concentration would not be considered an exceedance of the minimum threshold.

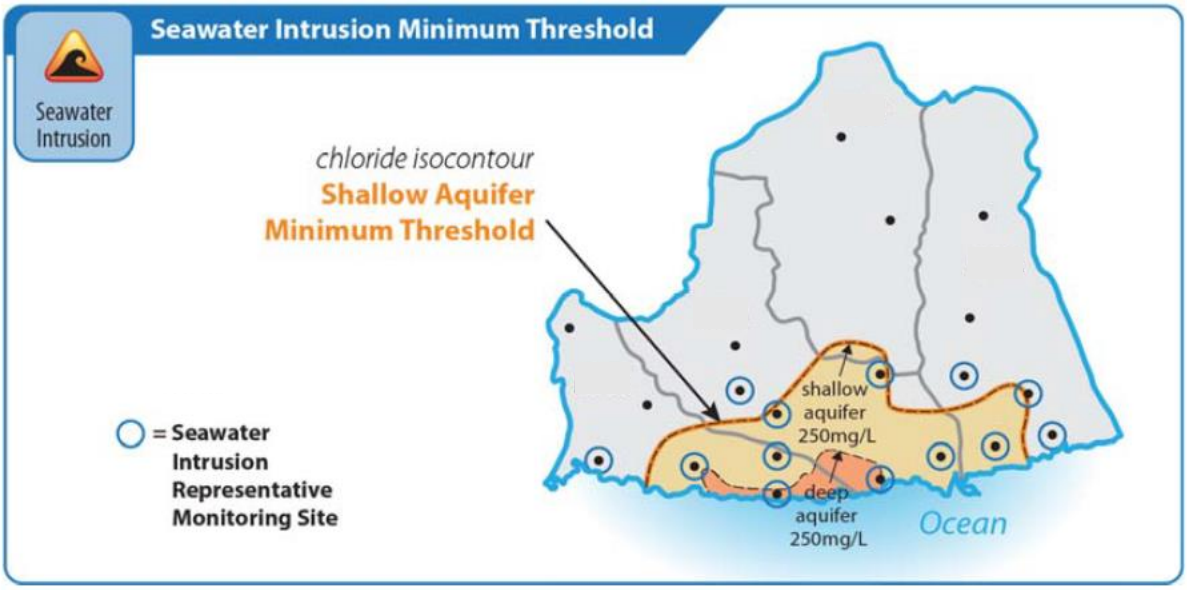

Figure 1. Example Seawater Intrusion Minimum Threshold Established at the Chloride Iscontour (modified from DWR, 2017)

SMC include minimum thresholds and measurable objectives as quantitative metrics. Implementing DWR's recommendation will result in seawater intrusion SMC for the Pajaro Valley Subbasin consistent with the regulatory requirements for GSPs:

- GSP Regulations § 354.28 (c)(3): "The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results."

- GSP Regulations § 354.30 (c)(b): "measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds." Therefore, measurable objectives for seawater intrusion should also be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.

Setting locations for chloride concentration isocontours as seawater intrusion SMC to be consistent with GSP regulations is different from how PV Water's Alternative describes the SMC. As alluded to in DWR's Recommended Action 7, PV Water's Alternative bases the seawater intrusion SMC as a rate with the minimum threshold being the pre-SGMA rate of intrusion.

This memo provides supporting information and options for the GSU22 Committee to consider when providing input on chloride isocontour concentrations for the seawater intrusion minimum threshold and measurable objective. As minimum thresholds are used to define undesirable results, the chloride concentrations used for the minimum threshold isocontour should represent significant and unreasonable conditions for beneficial users and uses in the Basin. Defining this concentration will be the first step for PV Water to address DWR's Recommended Action 6. Measurable objectives are goals meant to reflect desired groundwater conditions in the Basin and provide operational flexibility to avoid undesirable results even during varying conditions. Therefore, defining a concentration for the measurable objective isocontour will be the first step for PV Water to address DWR's Recommended Action 7.

CHLORIDE ISOCONTOUR CONCENTRATIONS CURRENTLY USED IN REGION

PV Water has traditionally used a chloride isocontour concentration of 100 mg/L to assess seawater intrusion in the Basin. **Error! Reference source not found.** replicates a figure from PV Water's Basin Management Plan Update (BMP, 2014), which was the primary document submitted as part of PV Water's approved GSP Alternative. **Error! Reference source not found.** shows the advancement of seawater intrusion over time based on the 100 mg/L chloride isocontour.

The BMP does not describe the basis of using 100 mg/L as the concentration for the chloride isocontour, although it does reference chloride concentrations above 140 mg/L as likely causing problems for agricultural irrigation based on a Central Coast Regional Water Quality Control Board report from 1995.

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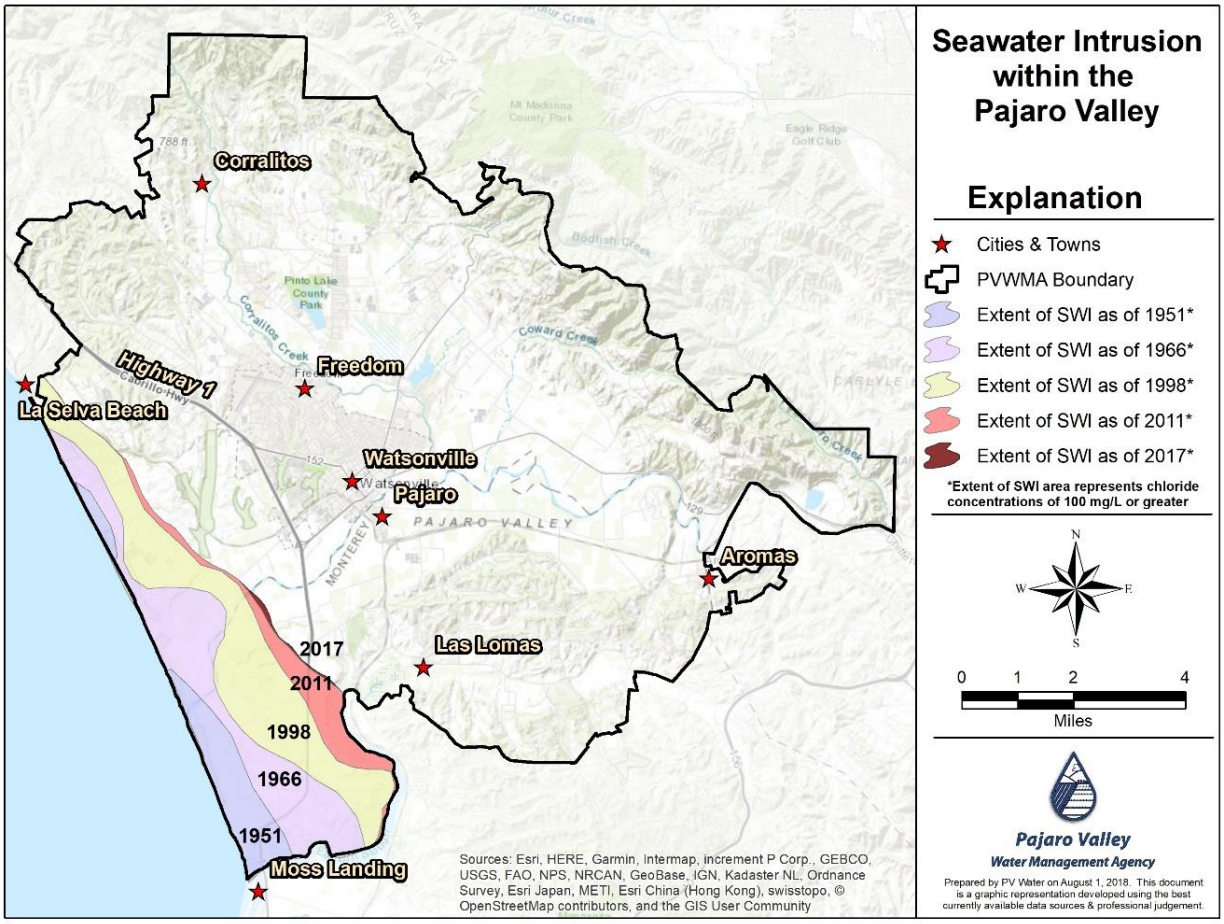

Figure 2. Seawater Intrusion within the Pajaro Valley Based on 100 mg/L Isocontours

Using a different concentration than 100 mg/L for the minimum threshold is worth considering. As the chloride isocontour minimum threshold will be used to define undesirable results, the concentration used for the minimum threshold should represent significant and unreasonable conditions for beneficial users and uses in the Basin, which are primarily for agricultural and domestic supply.

The minimum threshold is more likely to be exceeded if set at a low level, which could result in the conclusion that undesirable results are occurring. State intervention to manage the Basin may occur if undesirable results are assessed to occur after 2040. Therefore, PV Water should not set a minimum threshold lower than what represents significant and unreasonable conditions

DWR's SMC BMP guidance document (2017) lists the following considerations when establishing minimum thresholds for seawater intrusion:

- What is the historical rate and extent of seawater intrusion in affected principal aquifers?
- How are land uses in the basin sensitive to seawater intrusion?
- What are the financial impacts of seawater intrusion on agricultural, municipal, and domestic wells?
- What are the Regional Water Quality Control Board Basin Plan objectives?
- What are the adjacent basin's minimum thresholds?

Initial considerations for the chloride isocontour concentration focus on land uses in the Basin that are sensitive to seawater intrusion and potential impact on wells. The historical rate and extent of seawater intrusion will be addressed when defining isocontour location based on the chosen concentration.

The Water Quality Control Plan for the Central Coast does not include groundwater quality objectives for the Basin, but Table 1 lists groundwater quality objectives for nearby sub-areas in the Pajaro River watershed and Salinas Valley groundwater basin (RWQCB, 2019). Table 1 also includes the different minimum thresholds used in GSPs for the adjacent Santa Cruz Mid-County Basin (MGA, 2019) and Salinas Valley 180/400 Aquifer Subbasin (SVBGSA, 2020).

Table 1. Groundwater Quality Objectives and Minimum Thresholds for Chloride Used in Region

Category	Location	Chloride Concentration (mg/L)	Source
Basin Plan Groundwater Quality Objective	Hollister Sub-Area	150	RWQCB, 2019
	Tres Pinos Sub-Area	150	
	Salinas Valley 180 Ft Aquifer	250	
	Salinas Valley 400 Ft Aquifer	50	
Groundwater Sustainability Plan Minimum Threshold for Seawater Intrusion	Santa Cruz Mid-County Basin	250	MGA, 2019
	Salinas Valley 180-400' Aquifer Subbasin	500	SVBGSA, 2020

Depending on the concentration(s) selected for the Basin's minimum thresholds, PV Water's past use of 100 mg/L could be a reason to use that concentration as the measurable objective for the Basin. This provides a consistent operational goal with what was used to develop the projects and management actions in the Basin Management Plan. Using 100 mg/L as the measurable objective could also facilitate comparisons of future conditions with past conditions based on its use in prior reporting.

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AGRICULTURAL BENEFICIAL USE

The largest beneficial use of groundwater in the Basin is for agricultural supply with the greatest crop acreage being vegetable row crops and strawberries (PV Water, 2014). Figure 3 shows 2020 summer crop usage in the Basin relative to the mapped extent of seawater intrusion based on the 100 mg/L chloride isocontour (blue hatched area). Although other crops are grown in the Basin, Figure 3 shows that vegetable row crops and strawberries are the crops most likely to be affected by seawater intrusion based on their proximity to existing seawater intrusion.

Irrigating with high levels of chloride can be toxic to some crops through soil or foliar adsorption. Berries and woody perennial plants are typically more sensitive to chloride than vegetable row crops. Soil adsorption is considered to be more relevant for agriculture in the Basin because drip irrigation is the prevalent method for growing strawberries (PV Water, 2014). Reports by Central Coast Regional Water Quality Control Board (RWQCB) and University of California Agriculture and Natural Resources (ANR) have estimated crop sensitivity to chloride concentrations. Table 2 summarizes estimates of crop sensitivity to chloride concentrations based on root adsorption.

Table 2. Crop Sensitivity to Chloride Concentrations for Root Adsorption

Relevant Crops	Effect Level	Chloride Concentration (mg/L)	Source
Tree crops and woody ornamentals	No Issues	<142	RWQCB, 2019
	Increasing Problems	142-355	
	Severe	>355	
Berries and avocado	Tolerant	<120	ANR, 2002

Another potential standard that can inform selection of a chloride isocontour minimum threshold concentration is the water quality objective for delivered water to agriculture in the Basin. As shown in Figure 3, the delivered water zone overlaps substantially with the extent of seawater intrusion based on the 100 mg/L chloride isocontour. Delivered water in this area replaces groundwater pumping for the agricultural beneficial users. PV Water's water quality objective for chloride in its delivered water is 150 mg/L (PV Water, 2019). The current Monterey One Water delivered water quality goal for the Castroville Seawater Intrusion Project (CSIP) is 250 mg/L for an area where strawberries are also grown (Platts, 2020). This indicates that chloride concentrations below 250 mg/L in irrigation water may not represent significant and unreasonable conditions for agriculture in the Basin.

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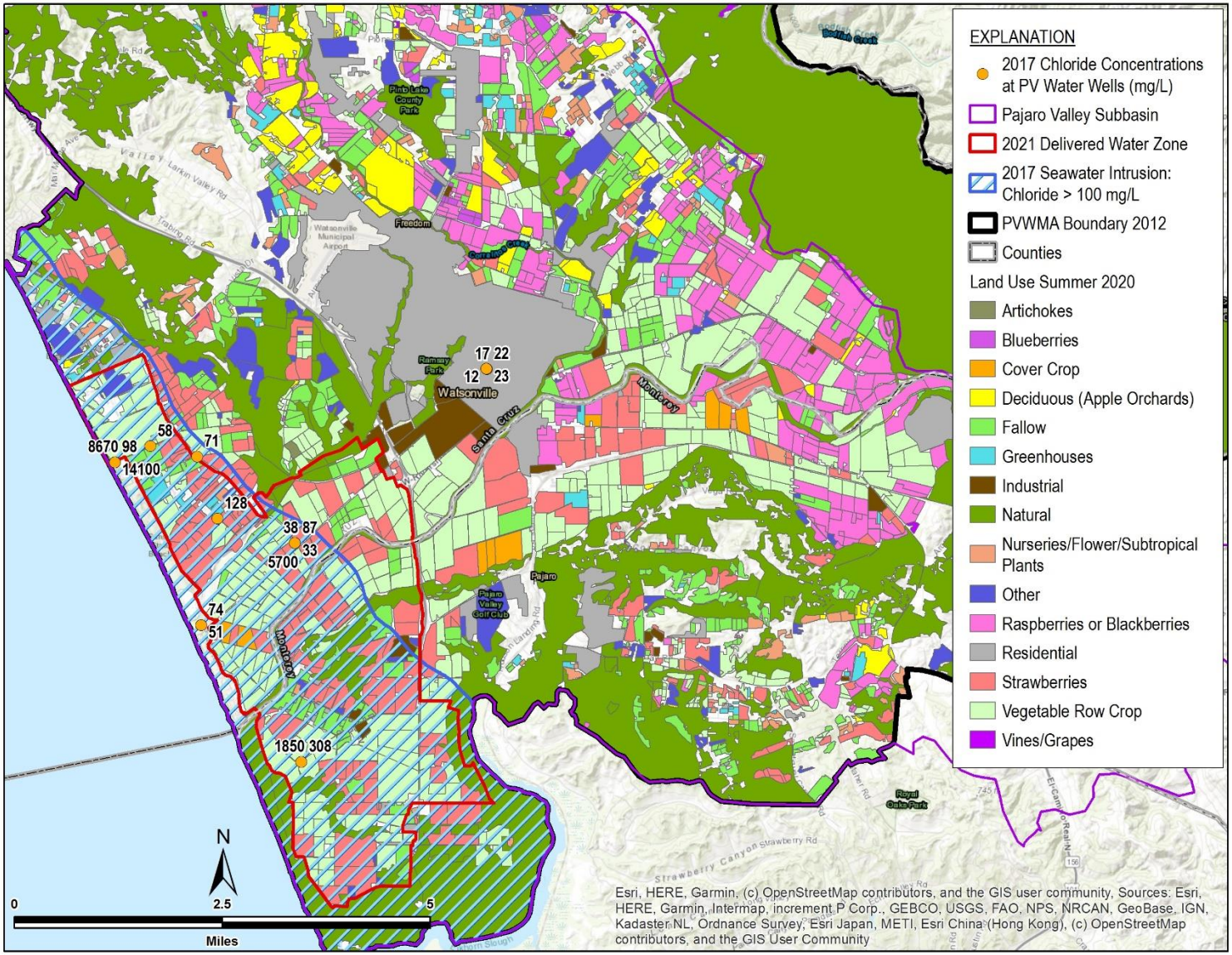

Figure 3. Pajaro Valley Subbasin Land Use and 2017 Seawater Intrusion

DOMESTIC BENEFICIAL USE

Figure 3 shows there are residential land users that are potentially affected by seawater intrusion. Figure 4 shows the locations of water systems in the Basin. Within the area of seawater intrusion defined by the 100 mg/L chloride isocontour, there are small water systems with 15 to 199 connections and a portion of Pajaro Sunny Mesa Community Services District. The closest system inland of the 100 mg/L chloride isocontour is California Water Service Company's Las Lomas water system.

Chloride has a secondary drinking water standard based on taste and odor concerns. California Division of Drinking Water provides a recommended secondary maximum contaminant limit (SMCL) for chloride of 250 mg/L but does list 500 mg/L as the upper limit to the consumer acceptance contaminant level range (DDW, 2018).

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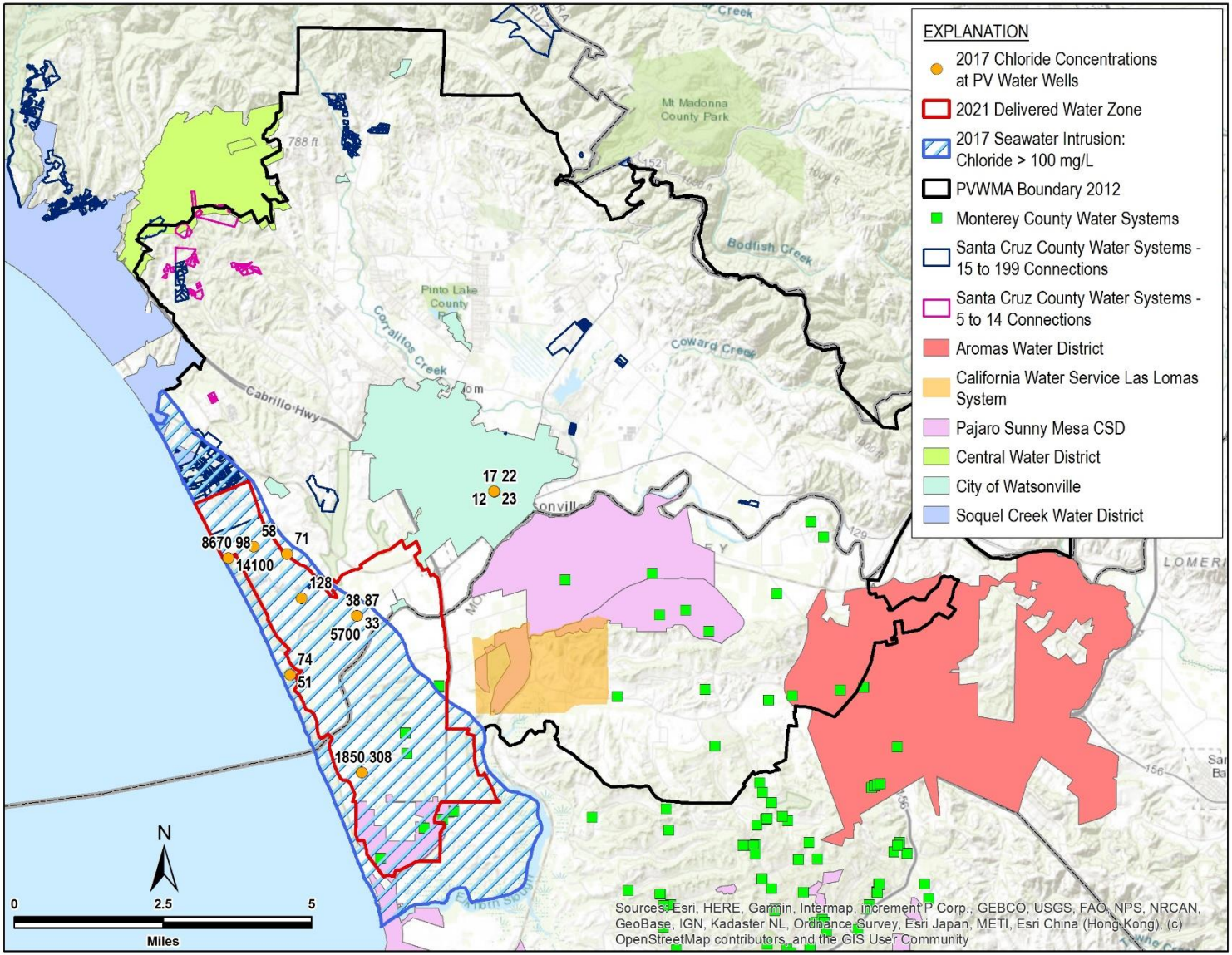

Figure 4. Water Systems and 2017 Seawater Intrusion

OPTIONS FOR CHLORIDE ISOCONTOUR CONCENTRATIONS FOR MINIMUM THRESHOLD AND MEASUREABLE OBJECTIVE

As the above summaries show, chloride concentrations that are protective of agricultural beneficial use (120-355 mg/L) are lower than domestic beneficial use (250-500 mg/L). The above summaries also show that an isocontour protective of agricultural beneficial use can be inland of an isocontour protective of domestic beneficial use based on the delivered water zone supplying supplemental water to agriculture extending farther inland than domestic water systems. Meanwhile, observations of lower chloride concentrations will occur farther inland from observations of higher chloride concentrations, as shown in from PV Water's Salt and Nutrient Management Plan (2014).

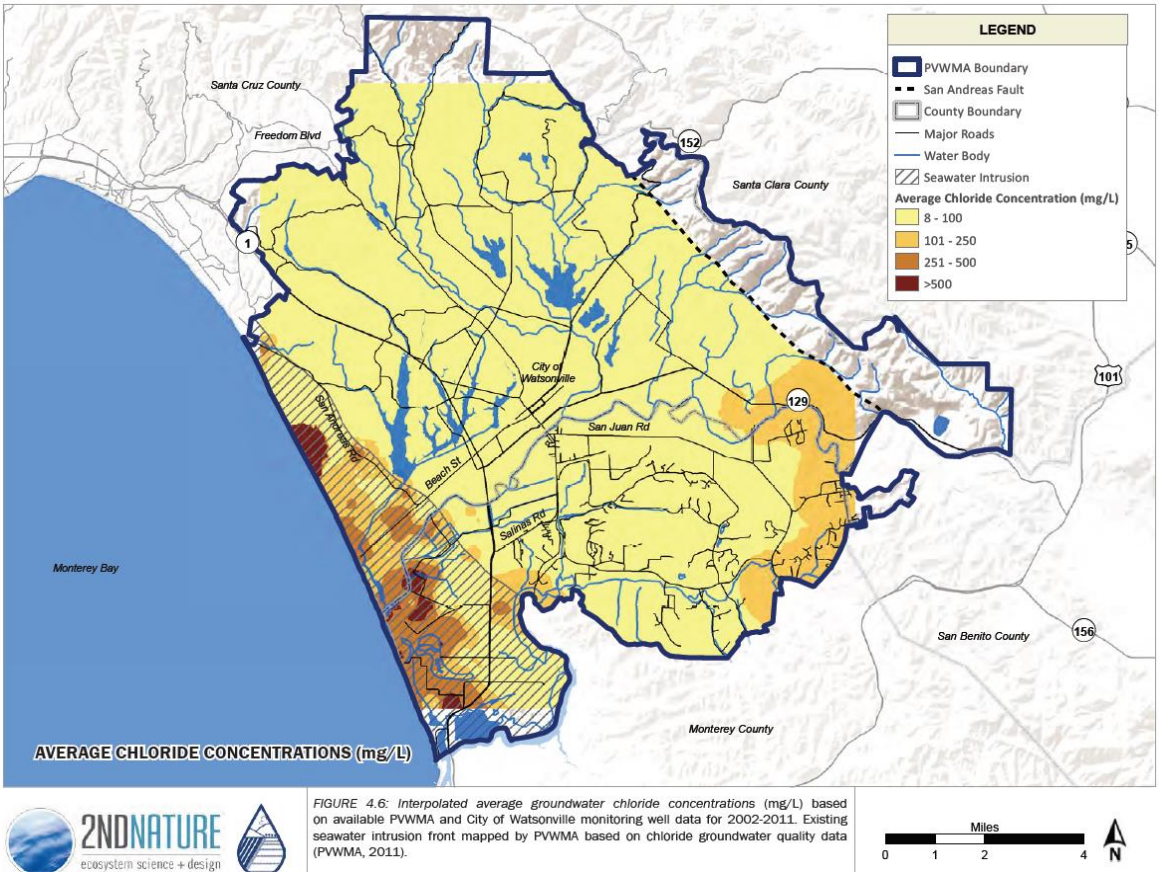

FIGURE 4.6: Interpolated average groundwater chloride concentrations (mg/L) based on available PVWMA and City of Watsonville monitoring well data for 2002-2011. Existing seawater intrusion front mapped by PVWMA based on chloride groundwater quality data (PVWMA, 2011).

Figure 5. Interpolated Average Groundwater Chloride Concentrations (PV Water, 2014)

Based on this, there are three suggested options for selecting a chloride isocontour concentration for the seawater intrusion minimum threshold.

1. Select a lower concentration protective of the agricultural beneficial use (e.g., a chloride concentration between 120-150 mg/L) and apply it to protect both agricultural and domestic uses. This is not recommended because this would require delineating the isocontour to ensure domestic supply wells near the coast have these low concentrations and this may not be achievable.

2. Select a concentration based on the drinking water standard (e.g., 250 mg/L) and apply it to protect both agricultural and domestic uses. The isocontour would be delineated at a similar location to option 1 but the higher concentration would more likely to be achievable. It would require stakeholder consensus that the concentration higher than what is provided in Table 2 and more similar to Monterey One Water's water quality goal for CSIP will not result in significant and unreasonable impacts to agricultural use.

3. Select one concentration for agricultural beneficial use (e.g., a chloride concentration between 120-150 mg/L) and a different concentration for domestic use (e.g., a chloride concentration between 250-500 mg/L). This will require drawing two isocontours for the principal aquifer with the isocontour for domestic use closer to the coast than the isocontour for agricultural beneficial use as illustrated by Figure 6. This option would be feasible based on delivered water area for agriculturesbeing extended inland of domestic water supply systems closer to the coast.

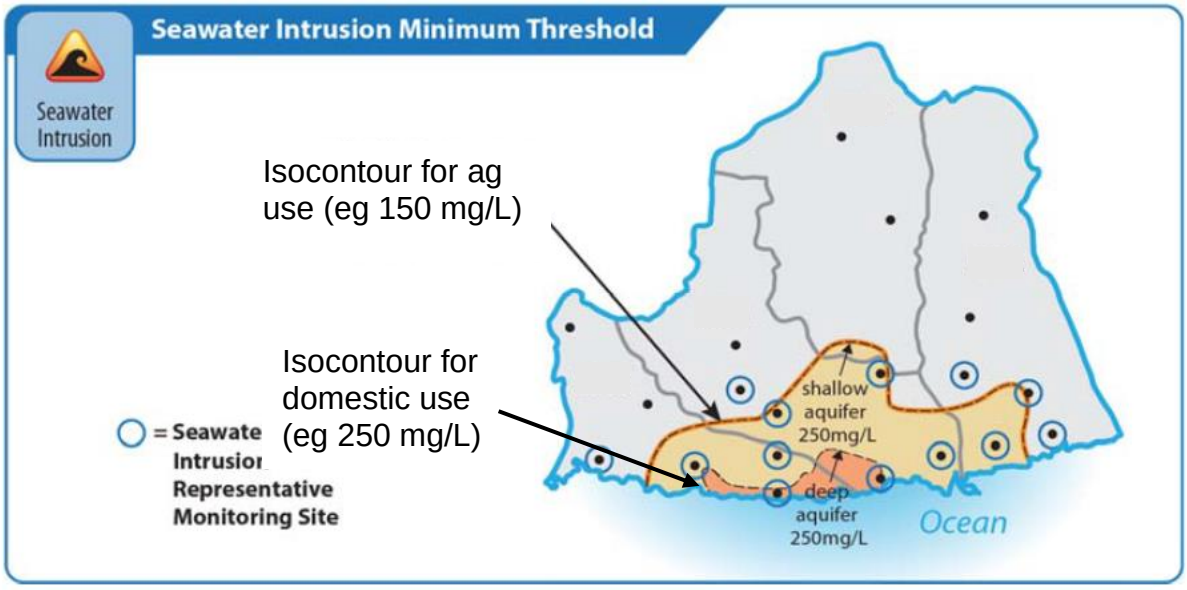

Figure 6. Illustration of Option 3 with Two Mininum Thresholds for Chloride Concentrations (modified from DWR, 2017)

The seawater intrusion measurable objective can be set at a lower concentration than the minimum threshold as a management goal that does not define undesirable results and is not enforceable by the State. As potential chloride concentrations for minimum thresholds are higher

than 100 mg/L, we recommend using 100 mg/L for the measurable objective for consistency with prior planning and reporting. Another option is to use the same concentration(s) as the minimum threshold but locate the measurable objective isocontour closer to the coast.

REFERENCES

University of California Agriculture and Natural Resources (ANR), 2002, *Irrigation Water Salinity and Crop Production*, by Stephen R. Grattan, Publication 8066, FWQP Reference Sheet 9.10.California Department of Water Resources (DWR), 2017, Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria BMP, Draft.

Central Coast Regional Water Quality Control Board (RWQCB), 2019, *Water Quality Control Plan for the Central Coastal Basin, June 2019 Edition*. California Environmental Protection Agency. http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/index.shtmlPlatts, B. 2020, personal communication, December 10.

Pajaro Valley Water Management Agency (PV Water), 2014, *Salt and Nutrient Management Plan*, prepared by 2nd Nature, et. Al., October.

Salinas Valley Basin Groundwater Sustainability Agency (SCBGSA), 2020, Salinas Valley Groundwater Basin 180/400-Foot Aquifer Subbasin Groundwater Sustainability Plan, prepared by Montgomery & Associates, January 3.

Santa Cruz Mid-County Groundwater Agency (MGA), 2019, Santa Cruz Mid-County Groundwater Sustainability Plan, November.

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