# EXHIBIT 14

# Technical Memorandum

DATE: June 26, 2020

TO: Hydrogeologic Working Group

FROM: Tim Durbin, Martin Feeney, Peter Leffler, Dennis Williams

SUBJECT: **HWG COMMENTS ON AGF FINAL REPORT ON THE 2019 AIRBORNE ELECTROMAGNETIC SURVEY OF SELECTED AREAS WITHIN THE MARINA COAST WATER DISRICT, UNDATED**

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This technical memorandum provides the comments of the Hydrogeologic Working Group (HWG) on the Marina Coast Water District (MCWD)/Aqua Geo Frameworks (AGF) study, "Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District" (2019 AEM Report), which spans portions of the 180/400-Foot Aquifer Subbasin, Monterey Subbasin, and Seaside Subbasin. The report's Introduction states that the study was commissioned to help develop a hydrogeological framework for use in groundwater management plans. More specifically, the purpose was stated as defining the distribution of aquifer materials and total dissolved solids (TDS) in the survey area, and to compare 2019 AEM data with 2017 AEM data.

This letter provides both an Executive Summary highlighting some of our main comments, and a Detailed Comments section. It should be noted that the Executive Summary and Detailed Comments provided in this letter are not comprehensive (due in part to the poor quality graphics in the 2019 AEM Report and lack of availability of Report appendices), and our lack of comment on a specific point or issue in the AEM Report should not be taken as HWG concurrence on or acceptance of that specific point or issue.

## EXECUTIVE SUMMARY

The 2019 AEM Report has several major flaws relating to use of data from the MPWSP Monitoring Report No. 160 that can generally be categorized as follows: misstating data values from the MPWSP monitoring report, incorrectly plotting data, misrepresenting data from the MPWSP monitoring report, manipulation of data from the MPWSP report to better fit AEM TDS predictions, and misunderstanding data/analyses presented in the MPWSP monitoring report. The use and interpretation of data in this manner is inappropriate and deeply troubling. The comparisons of AEM profiles for 2017 vs. 2019 AEM data raises several concerns including: apparent use of AEM data in the 2017 survey that should not have been used and were removed from overlapping survey lines in the 2019 data analysis (but still remains in the 2017 data analysis profiles); general lack of resolution of stratigraphy and variation in TDS concentrations in the AEM profiles; a misleading legend for chloride profiles where red for saline water is assigned chloride concentrations ranging from 19,000 mg/L (the concentration of chloride in pure seawater to 40,000 mg/L (more than double the concentration of chloride in seawater); misrepresenting that AEM profiles in Figures 4-9 to 4-15, 4-20 to 4-27, and 4-40 to 4-46 show correlation of geophysical logs (they only show borehole lithology); a general lack of correlation between AEM profiles and borehole logs; and a general lack of correlation of AEM TDS/chloride profiles to well data. In addition, many of the previous comments and critiques by the HWG of hydrogeologic interpretations of the 2017 AEM data are applicable to the 2019 AEM data.

Additional details regarding our high-level summary comments on the AGF 2019 AEM Report are provided below, with a more detailed comments section following this Executive Summary.

HWG summary comments on the flawed 2019 AEM Report are:

- The Report claims the use of 36 geophysical logs; yet it still only uses the seven geophysical logs for the MPWSP monitoring wells (for some reason, the 2019 AEM Report still doesn't use the geophysical log for the MPWSP MW-3 location pointed out as being available in previous comments by HWG on the 2017 AEM Survey);
- The Report presents a flawed basis for estimation of chloride and TDS concentrations, because it only uses measured data for 12 of the 24 MPWSP monitoring wells;
- The authors refer to conductive and resistive zones throughout the document without describing lithology and potential ranges of water quality that impact conductivity and resistivity. Without lithology there is little certainty in the distribution of water quality in an aquifer with wide variations in salinity from seawater intrusion;
- The authors do not appear to understand the data they use from the MPWSP monitoring report; specifically, they use data from the in-situ transducers that only measure electrical conductivity (EC) (values for TDS and salinity presented in transducer data are merely internal calculations based on conductivity); the graphic obtained from MPWSP Report Appendix D and reproduced by AGF as Figure 4-30 is based solely on lab data with emphasis on relatively high salinity water and should not be applied to low EC in-situ field transducer data (which already provides its own estimate of TDS in the transducer data);
- Additionally, the authors ignore the fact the EC transducer represents the EC value in a particular location with the screen, not the entire screen length. It is documented that there are significant differences (up to 40%) between the EC data and the lab data from the MPWSP monitoring wells due to salinity stratification within the wells and the physics of well sampling. Taking the single value from a particular spot in the screen and rejecting it because it doesn't match the AEM data for the entire zone does not make the data "low confidence EC values", it demonstrates the authors misunderstanding of data they use and well physics;
- The units of salinity on Figure 4-31 are not mg/L as labeled on AGF plots; more importantly, the data point for MW-4M is plotted incorrectly and actually plots very close to the trend line; thus, the related discussion and conclusion drawn in the Report text that "This suggests

that there might be some other values with low confidence in the data…coming from MPWSP monitoring well reports" is completely false;

- The authors would have been better served to use lab data that provides a more representative sample of the screened interval due to purging conducted to collect samples and because EC and TDS are independently analyzed in lab data;
- The false premise of low confidence in data from the MPWSP monitoring report is the apparent basis for the authors resorting to data manipulation (i.e., discounting use of water quality data for several MPWSP monitoring wells) in an attempt to demonstrate AEM data provide good estimates of actual TDS concentrations at MPWSP monitoring wells; in fact, the original $R^2$ = 0.53 (i.e., correlation coefficient between actual field-measured EC/TDS and AEM predicted EC/TDS) described by AGF as "low and indicates a poor relationship" is the correct conclusion of their analysis (i.e., interpreted AEM data provide poor predictions of field measured salinity);
- The data evaluation process followed by AGF is they, "iteratively removed EC values that are located the most distant from the trend line in Figure 4-33 and re-run the regression analysis" to obtain an $R^2$ = 0.96. This data manipulation process (which involved throwing out data for several MPWSP monitoring wells because these data didn't fit their trend line) was justified using the false and incorrect premise of "low confidence EC values" from the MPWSP monitoring reports. There is no justification for throwing out valid monitoring well data;
- The "Dune Sand Fresh Water Capture Zone" depicted on several AEM Report figures is being misrepresented and inappropriately applied in the 2019 AEM Report.

Our high-level summary comments on the February 25, 2020 MCWD Meeting presentation of the 2019 AEM Report are provided below, with a detailed comments section following this Executive Summary.

HWG summary comments on the February 25, 2020 presentation of the 2019 AEM Report are:

- The 2017 AEM study field work conducted in May 2017 was stated as occurring at end of the drought, when the drought actually ended in 2015, followed by an above normal year in 2016 and one of the wettest years on record in 2017 immediately preceding the May 2017 field AEM survey;
- It was stated that the AEM survey confirmed the presence of abundant "fresh water"; yet the 2017 AEM Report only attempts to delineate water with TDS up to 3,000 mg/L and the 2019 AEM Report does not provide justification (and shows a very poor match to field-measured data) for its flawed attempts to classify water with TDS less than the fresh water standard of 1,000 mg/L TDS;
- AGF continues to insist that there is an abundance of freshwater (the AGF representative uses this term consistently in the presentation) and even provides estimates of purported freshwater volumes with very little control on actual water quality; the authors are implying

that this water (area in blue) can be developed as a potable supply. As admitted by EKI, the development of this supply is hydraulically impractical, and even if it were practical, the produced water would not be useable without treatment. There are multiple factors impacting the ability to develop potable water supplies in this area, including the first four MCWD water wells (No. 1-4) that were completed in the shallower aquifer and were abandoned in the 1970's due to elevated nitrate concentrations even though the TDS and chloride concentrations were still relatively low at that time;

- AGF attempted to point out that the construction of MPWSP MW-7 purposely did not screen a claimed fresh water zone located between about 25 to 40 meters (80 to 130 feet below ground surface); however, this finer-grained zone is just below the Dune Sand/Perched Mounded Aquifer and just above the main zone of the 180-FTE Aquifer and is generally not where a water supply well would be screened (and likely represents some residual lower salinity water trapped in the silty to clayey sediments within this zone); the monitoring wells were intended to be screened within the most productive aquifer zones based on lithologic data;
- AGF provides numerous colored figures in 3-D and cross-sectional view; the overall observation is that all of these figures do not display the control points for geophysical logs, show very few lithologic logs, and more importantly show no water quality depth distribution; put simply, the figures lack validity for interpretation without control points;
- AGF claimed that 2019 AEM data compared to 2017 AEM showed "dilution" or "washing out" of saline water from the 400-Foot Aquifer over a two-year period; this theory is highly unlikely as no other field/ground-truth data is cited to support major reductions in 400-Foot Aquifer salinity; rather, this discrepancy between 2017 and 2019 AEM data at several locations more likely shows flaws or inconsistencies in AEM data interpretation (in fact, elsewhere in the presentation, comparisons of 2017 and 2019 AEM data that show the same interpretations are cited as evidence of AEM data being well calibrated);
- AGF showed graphics and made statements that claimed bulk resistivity values of 20 -75 ohm-m demonstrate TDS less than 1,000 mg/L; however, this correlation is not demonstrated or justified; in fact, the 2017 AEM data was previously only used to attempt to delineate water less than 3,000 mg/L TDS;
- EKI demonstrated that AEM data incorrectly represented salinity in two MCWD wells with screens in the 400-Foot Aquifer; further statements were made about correcting and recalibrating AEM data in this area using existing available MCWD geophysical logs; while the 2019 AEM Report states it already compiled and used available geophysical logs, these statements indicate otherwise;
- Review of the extended lines in the Seaside Basin, particularly Line L206800, appears to capture the structure of the consolidated materials but the water quality interpretation provided is much different than the existing ground truth. This line goes directly thru the four ASR injection wells operated by MPWMD, two reclaimed water injection wells operated

by Pure Water Monterey, and six monitoring wells associated with these injection wells. Data from these wells show ground water to be potable and fresh. The text describing the interpretation of this line suggests “intruded saline water at depth.” There is no detected seawater intrusion in Seaside Basin, much less 9000 feet from the coast. Why the existing data (lithology logs, geophysical logs, water quality data) were not used for control is not understood, and is not in accordance with best engineering practices.

- EKI stated that “Dune Sand fresh water extends almost to the shoreline”, but this is a false statement based on HWG review of AEM data and field data for MW-1, MW-3, MW-4, and MW-7 that demonstrate no potentially fresh water for greater than one mile from the shoreline; if this EKI statement is based solely on the authors’ interpretation of AEM data, then the AEM data interpretations by the authors are incorrect, similar to what has occurred in the area of the MCWD and Seaside Basin wells;
- EKI stated that 2019 AEM results confirm relatively fresh water in the Dune Sand Aquifer and Upper 180-Foot Aquifer immediately upgradient of the MPWSP; however, similar to above statement – monitoring well data do not support this conclusion and AEM data interpretations are simply incorrect regarding this conclusion;
- EKI noted that development of lower TDS groundwater from the Perched/Mounded Aquifer is likely not practical;
- EKI does acknowledge that proposed MPWSP slant wells will always take in predominantly saline water despite potential climatic fluctuations and GSP projects;

One topic of particular importance (non-uniqueness of AEM data interpretation) is summarized in more detail below:

When more than one kind of earth material can produce the same response for a geophysical technique it is called “inherently non-unique”, such that there are inherent doubts about the interpretation that cannot be resolved by the data itself. In some cases, other supplemental methods may be able to help reduce uncertainty related to the non-uniqueness of the data.

For sites involving stratified unconsolidated sediments and groundwater within them that may have varying quality, the non-uniqueness is between the lithologic characteristics of the sediment (sand/gravel vs. clay/silt), and the groundwater characteristic of salt content (expressed as total dissolved solids, TDS). Coarse-grained sediments (sand/gravel) and lower TDS groundwater both exhibit higher resistivities; alternatively, lower resistivities are related to fine-grained sediments and/or higher salinities. In such cases of both variable lithology and variable groundwater salinity, other pertinent supplemental information may come from subsurface exploration in the form of borings, possibly including resistivity measurements, induction logs, and water samples from wells constructed in the same borings. In addition, detailed knowledge of the depth to water is needed, because the unsaturated zone is associated with high resistivities as well. As was pointed out in the MCWD meeting presentations, most of the supplemental subsurface data that could be used to lessen the impact of inherent non-uniqueness on the hydrogeologic interpretation was from the MPWSP monitoring network, whereas the area to the east-southeast that was interpreted to contain a large body of low-TDS water had a paucity or lack of such data. Thus, in this area of purported lower salinity water, the resolution of lithology vs. water quality is likely not adequately resolved.

More specific and detailed comments on AGF's 2019 AEM Report are provided below.

## DETAILED COMMENTS

1. The 2019 AEM Report states that 36 borehole geophysical logs were used in the AEM data analysis. (Section 2, page 3)

***HWG Comment:*** *The 2019 AEM Report only demonstrates use of the same seven borehole geophysical logs used in the 2017 AEM data analysis. Our previous comments on this issue still apply.*

2. The 2019 AEM Report states that AEM data are dependent on "…material composition of the geology including the amount of mineralogical clay, the water content, the presence of dissolved solids, the metallic mineralization, and the percentage of void space. (Section 3, page 5)

***HWG Comment:*** *As stated in our previous comments on the 2017 AEM survey, the multiple variables impacting the AEM data in the Marina area create significant uncertainty in the hydrogeologic interpretation of AEM data.*

3. The 2019 AEM Report provides a brief description of the AEM data inversion process with an example sounding curve and corresponding resistivity earth model in Figure 3-2 (Section 3.1, page 6)

***HWG Comment:*** *There is inadequate explanation of the inversion process and the example figure is barely legible. The assumptions and non-uniqueness inherent in the inversion process need further explanation/documentation.*

4. The 2019 AEM Report states all skyTEM systems are, "…calibrated to a ground test site in Lyngby, Denmark prior to being used for production work." (Section 3.4, page 9)

***HWG Comment:*** *The calibration procedure, as described in Foged et.al. (2013), involves deploying the airborne instrument over a test area that has been previously surveyed via ground-based resistivity, and verifying that the resulting AEM data are acceptably close. This is essentially a licensing procedure for use in Danish groundwater exploration. The Denmark test site is interpreted (but not verified via borings) to have a flat-lying (i.e. one- dimensional) sequence of "clay till, meltwater sand, heavy Paleogene clay, and salt water saturated chalk" to a depth of approximately 300 meters, apparently some type of glacial outwash deposit. While this type of geologic configuration may have some similarities to the marine/non-marine and aeolian deposits in the Marina area, there are substantial differences in the geologic conditions. In addition, complications introduced by variable salinity concentrations in the Marina area are not problematic for the Denmark test site.*

5. The 2019 AEM Report states that the SkyTEM 312 system used in the 2019 survey was different than the SkyTEM system used in the 2017 survey, and included use of a Total Field magnetometer. The

magnetometer is, "…sensitive to anthropogenic features that contain ferrous metal and is also used in the electromagnetic decoupling process." (Section 3.4.4, page 20). The Report notes later that, "The data were examined for possible electromagnetic coupling with surface and buried utilities and metal, as well as for late time-gate noise. Data affected by these were removed." (Section 3.4.6, page 24)

***HWG Comment:*** *A comparison of AEM profiles from the 2017 and 2019 AEM surveys shows significant differences in data removed from the analyses, with the 2017 AEM survey retaining significantly more data for final AEM hydrostratigraphic interpretation than was retained in the 2019 survey for the same overlapping flight lines. The implications are that the 2017 AEM survey retained many section lines of poor quality data that should have been removed, and contributed to the poor quality hydrogeologic interpretations from AEM data documented in previous HWG comments. Given that it is unlikely (and no supporting field data is provided) that salinity changed significantly in the last two years in the 400-Foot Aquifer, this data retention issue also likely explains many of the differences seen in AEM data interpretations for 2017 vs. 2019.*

6. The 2019 AEM Report presents vertical resolution with depth in Table 3-5 (Section 3.5, page 29).

***HWG Comment:*** *This table indicates that, in general, vertical resolution of AEM data is 7 to 15 feet for the Dune Sand and Perched/Mounded Aquifers, 15 to 30 feet for the 180-FTE Aquifer, and 30 to 60 feet for the 400-Foot Aquifer. This means that, at best, AEM data can only provide an average value of resistivity over these thicknesses. This issue of vertical resolution (especially when combined with resistivity variation due to water quality differences) means it will be very difficult, if not impossible, to resolve the thickness and spatial distribution of important stratigraphic layers (e.g., clay aquitard layers).*

7. The 2019 AEM Report describes (and shows) comparisons of AEM data with seven MPWSP borehole geophysical logs, and subsequently claims to show a good match between AEM and borehole geophysical data. The Report further notes in reference to 36 geophysical log locations, "The geophysical logs…are very useful in validating the AEM survey results." (Section 4.2, page 35)

***HWG Comment:*** *We note, again, that only seven borehole geophysical logs are demonstrated to be used in any capacity in the Report to ground-truth the AEM data, as opposed to the 36 geophysical logs claimed to be used in the analysis. Furthermore, we note that significant areas of deviation occur between AEM and borehole resistivities (e.g., above 30 meters and below 50 meters in MW-1; below 60 meters in MW-5; several zones in MW-6; and portions of other geophysical logs as well). The general lack of vertical resolution of AEM data is also readily apparent on the comparisons (see Figures 4-2 through 4-8 on pages 36-42). Overall, it is clear that the very limited number of geophysical logs actually used (7 in total) and poor overall matches to AEM data do not qualify as "validating the AEM survey results."*

8. The 2019 AEM Report makes liberal use of the term "fresh water" without defining the term. The Final AEM Report for the 2017 AEM survey generally deleted use of the term "fresh water" from its Final Report for the 2017 AEM survey after the HWG pointed out the Preliminary Report for the 2017 survey only attempted to define a class of water with TDS up to 3,000 mg/L (i.e., it included both fresh and brackish water in the same grouping). (e.g., pages 35, 54, 120; Figures 4-25, 4-26)

***HWG Comment:*** *While maps are presented in the 2019 AEM Report purporting to show areas with TDS less than 500 mg/L and for TDS 500-1,000 mg/L (i.e., fresh water TDS concentrations), no analysis or* *justification is provided as to how AEM data were evaluated and validated to develop these narrow water quality groupings. Without such analysis/justification, it is not possible to validate these fresh water claims.*

9. The 2019 AEM Report makes several references to key materials being included in appendices to the Report (e.g., pages iv, 22, 35, 65, 83, 95, 159; Figure 3-13).

***HWG Comment:*** *Similar to the 2017 AEM survey, the 2019 AEM Report data and appendices were not made available by MCWD for review by others.*

10. The 2019 AEM Report provides several AEM profiles (e.g., Figure 4-9, page 43), which state that "geophysical 16-inch Short Normal electrical logs" are provided for comparison.

***HWG Comment:*** *The 16-inch short normal resistivity curves are not actually provided for comparison.*

11. The 2019 AEM Report provides AEM profiles (e.g., Figure 4-14, page 48; Figure 4-27, page 62; Figure 4-45, page 89, Figure 4-57, page 102) that extend into and show "intruded saline water at depth" in Seaside Basin, according to AGF.

***HWG Comment:*** *Seaside Basin is south of Monterey Subbasin. The hydrogeology in Seaside Basin is significantly different from Salinas Valley Groundwater Basin, and seawater intrusion is not present in Seaside Basin. Thus, AEM profiles that extend into Seaside Basin are providing inaccurate characterization of salinity, which raises further questions about the validity of the entire 2019 AEM survey conducted by AGF. The area where AGF noted "intruded saline water at depth" is the location of the MPWMD's ASR well field, Monterey One Water's reclaimed water injection wells and six monitoring wells. The hydrogeology and water quality of the area where AGF noted "intruded saline water" is well documented and quite different from AGF's interpretation of AEM data.*

12. The 2019 AEM Report presents a comparison of several AEM profiles for 2017 and 2019 AEM data, such as Figure 4-26 on page 61, and includes a notation about the difference in resistivity distribution within the blue boxes on the right-hand side of the profiles. (Section 4.3).

***HWG Comment:*** *We note that these areas of purported differences in resistivity occur in areas where the 2019 AEM survey removed significant sections of the flight line (likely due to anthropogenic features described earlier in the Report) that were retained in the 2017 AEM survey. Much, if not all, of the difference in AEM resistivity at these locations is likely due to retention of different AEM datasets in the two surveys, and not to distinguishable changes in salinity.*

13. Figures 4-20 through 4-27 and 4-29 provide a comparison of 2017 and 2019 AEM data in cross-sectional view. Each figure provides a legend that provides a color code for each lithologic type. The titles of these figures note blue dots for lithology logs and green dots for geophysical logs in the inset map (pages 55-62).

**HWG Comment:** *Along the flight line in Figure 4-20 (showing an AEM Profile extending to depths exceeding 500 meters) there are no green dots and only four blue dots (with logs deeper than about 100 meters) over a distance of what appears to be more than 10 miles, indicating an overall lack of ground-*

*truthing of the AEM data. In addition to large spacing between control points, this interpretation has no validity without knowing the distribution of water quality in order to assign lithology. Lithologic variation in the limited number of borehole logs presented is not reflected in the AEM profile data. It is obvious that the methodology cannot capture the complexity of the stratigraphic sequences, much less water quality distribution without the addition of a significant amount of combined lithologic, geophysical, and water quality data, or at least lithologic and water quality data at the same locations for several data points. Figure 4-25 notes "Likely Freshwater" apparently pointing to a blue layer which is approximately 50 feet thick. No description is provided as to how the relatively lower resistivity relates to lithology; for example, if lower salinity water is really present it is important to know if it is in a clay or sand layer. However, the bigger issue is that in no scenario could this water be put to beneficial use without treatment. In Figure 4-27, the title suggests a change in water quality as indicated by the change in the color assignments in the sections; however, there are no water control points to validate the interpretation.*

*On Figure 4-29, as with all of the figures with inset maps, the insets are nearly unreadable. The title notes blue dots for lithology and green dots for geophysical logs. There appears to be one geophysical log (although the actual resistivity curve is not plotted on the section or cannot be seen) on the cross-section over a distance of nearly 5 miles. Despite the fact that there are an insufficient number of control points, a geophysical log is a snapshot in time and water quality changes can impact a subsequent geophysical log at the same location. There are no water quality control points indicated on this or any other AEM profile.*

14. AGF states "Since some data from the Marina area is now available online at the MPWSP website…." (page 65)

**HWG Comment:** *The MPWSP has been completely transparent with data collected all through the project and continuing to date even though it is not required. Data has been made public on the website since early 2015 - nearly five years now. MPWSP data was available for previous AEM work conducted by AGF for Marina. We note that the MPWSP data provides the only reliable complete dataset for any type of AEM interpretation in the entire AEM survey area from the middle of Salinas Valley to Fort Ord.*

15. The 2019 AEM Report describes the process for conversion of bulk AEM resistivity to TDS and chloride concentrations. (Section 4.4, page 65)

***HWG Comment:*** *The process described does not explain how the significant variation in lithology present in the AEM survey area is accounted for in the conversion process.*

16. The 2019 AEM Report refers to the "Hydrologic Working Group (HWG) and their contractors". (Section 4.4, page 65)

***HWG Comment:*** *It is not known what is meant by "their contractors".*

17. The 2019 AEM Report refers to "…varying versions of monitoring data…" being available in MPWSP monitoring reports posted online (Section 4.4, page 65).

***HWG Comment:*** *The monitoring reports clearly explain the monitoring data included is derived from transducers installed in the wells and periodic water quality sampling/lab testing. The analysis conducted by AGF indicates they don't understand these two different data sets and that values from each for a given well should not be mixed when applying EC/TDS conversions.*

18. The 2019 AEM Report refers to a graph showing the relationship between TDS and EC presented in the MPWSP monitoring report that AGF reproduced as Figure 4-30 (Section 4.4, page 65).

***HWG Comment:*** *The referenced graph is a plot of lab tests of EC and TDS from purged water quality samples collected from each monitoring well. Laboratory testing for EC and TDS are independent analyses and the plot was intended to show the general relationship between EC and TDS, with an emphasis on high TDS samples. It is important to note that the graph cannot be applied to low TDS samples, because it is known that the relationship between EC and TDS is dependent on the valences of the ions in the water. Furthermore, because of the fact that purged water quality samples collected for lab testing result in at least some mixing of water from different depths within the well casing, the resulting lab EC and TDS will not necessarily be equivalent to EC values obtained from the in-situ transducers. This is because it is known that the EC measured by the transducers is dependent on the depth setting within the well. Therefore, the referenced graph based on lab data cannot necessarily be applied to in-situ transducer-based EC data.*

19. The 2019 AEM Report makes a comparison of AEM predicted TDS concentrations to actual concentrations from MCWD production wells in Table 4-1, which demonstrate a poor match. The Report states the AEM predicted TDS values are not accurate because, "…no TDS data from inland boreholes was available during this analysis." (Section 4.4, pages 65-66)

***HWG Comment:*** *Given the wells listed in Table 4-1 are MCWD wells and have TDS data listed in the table, it is not clear why this data was not obtained by AGF during their analysis of 2019 AEM data. The problem is further magnified in the February 25 MCWD Board Meeting AEM data presentation where EKI pointed out that AEM profiles showing high salinity in MCWD-34 (deep aquifers) and MCWD-35 (400-Foot Aquifer) production well screen zones were incorrect. EKI indicated that geophysical logs were available for AGF to use, but they were not included in the analysis provided in the AGF 2019 Final AEM Report.*

20. The 2019 AEM Report states with regard to the MPWSP monitoring report, "It would have been nice to have used all the data from the AEM acquisition period. However, the data was not in a format amenable to the option." The Report also states there were no data available for MW-5S, MW-5M, and MW-7M. (Section 4.4, page 66)

***HWG Comment:*** *It is not clear why AGF couldn't use "all the data", as it is provided in the monitoring report. Regardless, monitoring well EC does not change significantly over the short time frame of AEM data collection. Furthermore, there is data provided for MW-5S, MW-5M, and MW-7M. We also note that AGF only uses the in-situ transducer EC data, even though a complete round of monitoring well field sampling and lab testing water quality data were available for April 2019 (within days of the AEM survey).*

21. The 2019 AEM Report states that they inserted an EC value of 294.9 uS for MW-9D in the equation in Figure 4-30 to obtain a negative TDS value. (Section 4.4, page 66)

***HWG Comment:*** *The EC value of 294.9 uS from MPWSP monitoring report No 160 is cited incorrectly by AGF, as the actual value provided in the monitoring report is 594.9 uS. Furthermore, it is incorrect to insert the in-situ transducer value into the equation in Figure 4-30 to obtain a TDS value, because the TDS value for the in-situ transducer EC value is already calculated and provided with the same data set from which the EC value was obtained. Lastly, the graphic and equation reproduced in Figure 4-30 is only representative of high TDS water, and is not applicable to MW-9D. Thus, this whole discussion by AGF is invalid.*

22. The 2019 AEM Report describes how the mean AEM resistivities do not align with differences in EC for MW-1S, MW-1M, and MW-1D (e.g., MW-1D has the lowest EC for the three monitoring wells yet has the highest mean AEM resistivity). The author states this doesn't make sense because, "…the AEM inverted resistivities matched both the lithological and geophysical logs very well, which provides confidence in their distribution over the survey area." (Section 4.4, page 66)

***HWG Comment:*** *Although AGF appears to cite incorrect mean AEM resistivities of 8.8, 8.7, and 12.1 ohm-m in this paragraph, their general observation that AEM data do not match monitoring well water quality details is correct. Review of Figures 4-2 through 4-8 indicates that the AEM data does not provide a particularly good match to the borehole geophysical logs. Furthermore, the presentation on February 25 demonstrated that the AEM data was not representative of MCWD's own production wells. Therefore, it is not surprising that AEM data is unable to properly represent actual field-measured differences in EC with depth at MW-1.*

23. The 2019 AEM Report provides a "regression relationship" between in-situ transducer EC and salinity (mg/L) in Figure 4-31. This discussion notes how this regression equation results in a positive value for salinity, unlike the regression equation in Figure 4-30 (Section 4.4, page 66).

***HWG Comment:*** *There are several technical points to unravel here as AGF does not appear to understand the data. First, the in-situ transducer data (which is the only data utilized by AGF) only measures EC, and then uses internal formulas to calculate TDS (in units of mg/L) and salinity (in units of psu). Thus, it is incorrect to develop a separate regression relationship because the EC and salinity values being plotted by AGF are not independently analyzed. On the other hand, the regression relationship between EC and TDS provided in the MPWSP monitoring reports (and reproduced by AGF in Figure 4-30) is derived from independently analyzed EC and TDS values for each well from laboratory testing. Second, as stated previously, the regression relationship between EC and TDS in Figure 4-30 does not apply to low EC values, such as the EC = 100 uS cited here by AGF. This is because the conversion factor changes with the magnitude of EC, and the equation in Figure 4-30 emphasizes high EC values. Third, the units of salinity are psu and not mg/L.*

24. The 2019 AEM Report notes that the data point for MW-4M is "far off the trend line which directly affects the relationship between Salinity and EC…This suggests that there might be some other values with low confidence in the data listed in Table 4-2 coming from the MPWSP monitoring well reports." (Section 4.4, page 67)

***HWG Comment:*** *AGF has incorrectly plotted the data point for MW-4M; the data point actually plots on the trend line. Again, because AGF is only using the in-situ transducer data, it is important to note that the transducer is only measuring EC and the salinity is simply an internally calculated value. Thus, it is incorrect to plot these data to try to obtain a regression equation in the first place. Overall, the claim made here by AGF of low confidence in MPSP monitoring well report data is completely false and invalid.*

25. The 2019 AEM Report describes their development of a relationship between groundwater EC and AEM resistivity. AGF provides that relationship in Figure 4-32, and notes, "The calculated $R^2$ = 0.53 which is low and indicates a poor relationship." AGF then states the poor AEM results are because field measured EC values are greater than 40,000 uS and less than 8,000 uS. (Section 4.4, page 67)

***HWG Comment:*** *The wide range of field EC values from the MPWSP monitoring well network actually provides a good data set to start with for AEM data calibration. Were it not for the extensive drilling and monitoring network installed for the MPWSP, apparently AGF would have had no data at all to conduct ground-truthing of AEM data. Furthermore, MCWD has water quality and geophysical log data that apparently were not used in the AEM data analysis. Thus, it is not clear why AGF is attributing the poor predictive capabilities of AEM data to having only a limited field data set to work with. Regardless, if the inverted/interpreted AEM values were correct, they would presumably represent the field EC values much better than is demonstrated in Figure 4-32.*

26. Following AGF's realization that the AEM data is a poor predictor of actual TDS in the field, the 2019 AEM Report then applied a methodology using the natural log of measured EC to try to show a better fit to the AEM data. (Section 4.4, page 67)

***HWG Comment:*** *Applying a natural log to the measured EC data is really just an attempt to alter the way the data is presented, and still resulted in a poor fit to the data as evidenced by the $R^2$ value of 0.66.*

27. Following the realization that the AEM data is a poor predictor of the natural log of the field measured data, the 2019 AEM Report then applied an approach where field data demonstrating a poor fit to the trend line were removed from the data set and then a regression analysis was reapplied to obtain an $R^2$ = 0.96, as shown in Figure 4-35 (Section 4.4, page 67).

***HWG Comment:*** *The only way to characterize this analysis by AGF to achieve an $R^2$ = 0.96 is that they resorted to data manipulation. AGF stated that the way they conducted this analysis was to, "…iteratively remove EC values that are located the most distant from the trend line in Figure 4-33 and re-run the regression analysis." The caption of Figure 4-35 notes that EC values from only 12 of the 24 MPWSP monitoring wells were used in this analysis. It is easy to achieve high $R^2$ values when data that don't fit the trend line are removed (with no legitimate justification) from the regression analysis; an approach that constitutes data manipulation.*

28. AGF investigated how the lithologies in each screen interval may affect AEM resistivities and summarized results in Table 4-3 and Figure 4-34. The caption for Figure 4-34 states that differences in lithology in monitoring well screen intervals do not explain the poor match of AEM data to field measured EC data (Section 4.4, page 67).

***HWG Comment:*** *As described in other HWG documents commenting on the 2017 AEM survey, the occurrence of two major variables (i.e., lithologic differences and salinity differences) in the MPWSP/Marina area creates tremendous uncertainty in AEM data interpretation. In most cases, AEM data interpretations are conducted for study areas where one of these two variables can be considered relatively homogeneous. Reliable interpretation of AEM data when dealing with only one of these major variables is challenging enough; needing to resolve these two major variables simultaneously (such as in the 2019 AEM Survey in the MPWSP/Marina area) is nearly impossible within any reasonably acceptable range of uncertainty. This is demonstrated for the 2019 AEM survey by the $R^2$ of 0.53 when comparing AEM data to field measured EC values.*

29. AGF attempts to justify their data manipulation by stating there is "low confidence" in the EC values presented in the MPWSP monitoring reports. Furthermore, AGF states, "…it is suggested that it is not the AEM data that has issues with quality, noise, and/or calibration…" (Section 4.4, page 67)

***HWG Comment:*** *As is described in other HWG Comments above, the basis for AGF concluding there is "low confidence" in MPWSP EC values is completely invalid. AGF has incorrectly stated and misplotted MPWSP monitoring report EC values. AGF fails to understand the difference between in-situ transducer data and lab data, and does not understand how the relationship between EC and TDS changes with differing levels of TDS. For some reason, AGF does not even use the lab data for purged water quality samples collected in April 2019 that provide independently analyzed EC and TDS values using certified laboratory methods. The overall conclusion can be nothing other than AGF demonstrated the AEM data is a poor predictor of field-measured EC/TDS/chloride, and had to resort to making disparaging comments about the MPWSP monitoring report water quality data to justify throwing out half the data points to achieve an acceptable correlation. In fact, it is clearly the AEM data that "…*has issues with quality, noise, and/or calibration…"

30. AGF presents additional data comparisons and notes that the $R^2$ value is, "…not as high as it could be if more data were cut…" (Section 4.4, page 68)

***HWG Comment:*** *The HWG notes that any regression analysis can be made to look good if the analyst is allowed to cut specific data points (with no justification) that are furthest from the trend line. AGF has misstated, misplotted, and mischaracterized the data they used from the MPWSP monitoring report. There is no justification for cutting data derived from the MPWSP monitoring report for the analysis conducted by AGF. The reader should understand that AGF has demonstrated that the interpreted AEM data from the 2017 and 2019 surveys are simply poor predictors of field measured EC, TDS, salinity, and chloride.*

31. The 2019 AEM Report states, "Note that the results of the regression analysis of the local MPWSP monitoring well data suggests that several of the TDS, Salinity, and EC data may be questionable or non-existent (in the case of MW-5S, MW-5M, and MW-7M). As mentioned above, besides the missing data, this is likely due to measurement quality, noise in the system, and/or calibration of the borehole measuring tools." (Section 4.4, page 68)

***HWG Comment:*** *The HWG has demonstrated in our above comments that the MPWSP monitoring report data are not questionable; rather AGF has misstated, misplotted, misunderstood, and otherwise misrepresented the field measured data from the MPWSP monitoring reports. Data are not missing for the three wells cited by AGF, and it is not clear why AGF makes this claim. AGF also had the option of using certified lab data collected in April 2019 but chose not to use this data set. AGF has demonstrated that the AEM data suffers from measurement quality, noise in the system, calibration, and/or other data inversion/interpretation issues that result in AEM data being a poor predictor of field TDS concentrations.*

32. The 2019 AEM Report cites use of a Florida study (Fitterman and Prinos (2011) to develop a "…reasonable approximation of the Salinity to EC to AEM resistivities…" (Section 4.4.1, page 68)

***HWG Comment:*** *The HWG reviewed the referenced Florida study and associated studies. It is important to note that USGS SIR Map 3438 states that the Biscayne Aquifer is wedge shaped, highly porous karstic limestone (carbonate rock with a high degree of secondary porosity) and sand aquifer. The Biscayne Aquifer in Florida is described as homogeneous, which is very unlike conditions in the unconsolidated clay, silt, sand, and gravel aquifer system in the MPWSP vicinity.*

33. The 2019 AEM Report provides the color scale/legend for its chloride concentration profiles in Figure 4-39 (Section 4.5, page 83)

***HWG Comment:*** *The highest category for chloride concentration (red color) is for chloride concentrations of 19,000 to 40,000 mg/L. However, this category is not useful given that the concentration of chloride in seawater is about 19,000 mg/L, and therefore chloride concentrations greater than 19,000 mg/L would generally not be expected to occur in the study area. The low end of the scale (dark blue and medium blue colors) represent chloride concentrations of 1 to 250 mg/L and 250 to 1,000 mg/L); however, the Report provides no justification for being able to reliably distinguish these classes of chloride concentration at the low end of the scale. Furthermore, we note that the medium blue 250 to 1,000 mg/L chloride range encompasses the commonly used chloride concentration thresholds for mapping seawater intrusion (250 and 500 mg/L). Thus, the blue areas on the profiles may represent areas of seawater intrusion. In addition, given the general lack of water table elevation data utilized in the 2019 AEM survey, some blue areas may also represent unsaturated zones; thereby giving the false impression of potential saturated fresh water zones (because saturated fresh water zones and unsaturated zones may have similarly elevated resistivity values).*

34. The 2019 AEM Report states that the chloride profiles are presented, "…in comparison with the 34 logs…" (Section 4.5, page 83)

***HWG Comment:*** *The inverted resistivity profiles presented in Section 4.2 and the chloride profiles presented in Section 4.5 do not show a comparison to geophysical logs; rather they only show a comparison to a few borehole lithology logs.*

35. The 2019 AEM Report refers to a "Dune Sand Fresh Water Capture Zone" in Figure 4-80. (Section 4.7, page 120)

***HWG Comment:** While the source and details related to the "Dune Sand Fresh Water Capture Zone" are not stated in the 2019 AEM Report, review of the video for the February 25 MCWD Board Meeting indicates it was derived from the Weiss Hydrogeologic Review Report (November 2019). The HWG reviewed the Weiss Report, and it is apparent that the "Dune Sand fresh Water Capture Zone" was merely a simplified flow-net analysis derived solely to develop a very conservative (meaning low bookend ocean water percentage) estimate to derive a worst-case ocean water percentage (OWP) estimate for the MPWSP of 85% to 90%. However, the Weiss analysis then states, "…this result is likely to be an underestimate of the true OWP…", and then proceeds to develop a high bookend estimate of 96 to 99% for estimated OWP. The conclusion of the Weiss analysis is that the actual OWP will most likely be between 90% on the low end and 96 to 99% on the high end. This analysis of OWP by Weiss is consistent with field, analytical, and numerical evaluations of OWP conducted by the HWG. Therefore, the so-called "Dune Sand Fresh Water Capture Zone" does nothing more than provide a means to evaluate an OWP that "…is likely to be an underestimate…"*

*The HWG further notes that, as demonstrated by Fort Ord documents, most of the area included within the "Dune Sand Fresh Water Capture Zone" is the Perched/Mounded Aquifer (which includes the Fort Ord "A" Aquifer). Groundwater level data for from the "A" Aquifer demonstrate its flow is directly west towards the ocean. This flow direction in the "A" Aquifer will not be changed by MPWSP pumping, because it is controlled by the slope of the FO-SVA surface. Furthermore, as stated in the Weiss Report, their analysis of the low end OWP value does not account for the Perched/Mounded Aquifer water that flows over the western edge of the FO-SVA Aquitard and flows back inland in the underlying aquifer (i.e., this water does not flow to the slant wells). Thus, the Dune Sand Fresh Water Capture Zone is an artificial "construct" that was merely intended to provide a means to estimate the lowest possible end of the range for estimate OWP, and it is in no way representative of an actual capture zone that could actually occur in the field. Therefore, the application of Weiss' capture zone in the AEM Report is not valid.*

36. The 2019 AEM Report refers to the potential presence of, "…fresher water overlying more brackish water…" in various AEM profile figures (Section 4.7, page 120)

***HWG Comment:** Notwithstanding all the previous HWG comments (and previous HWG documents) regarding AGF's (and others) interpretation of the AEM data and the poor predictive capabilities of AEM data, the potential presence of less saline water above more saline water is just a description of a salt water intrusion wedge. A sea water intrusion wedge is how seawater intrusion manifests itself because saline water is more dense than fresh water. Even if the upper zone of a given salt water intruded aquifer contains fresher water, it cannot be developed without causing upconing and contamination of the pumping well with saline water from below.*

37. The 2019 AEM Report states, "…the 400-Foot Aquifer TDS>10,000 mg/L distribution indicates that there is much less saline water intruded in 2019 than in 2017 away from the coast." (Section 4.7, page 121)

***HWG Comment:** There is no evidence to support this contention by AGF, and the 2019 AEM Report provides no field data to support this conclusion. It is more likely that inconsistencies in the data* *collection/retention, hydrogeologic interpretation, and/or lack of sufficient inverted AEM data calibration to field data explain the observed differences between 2017 and 2019 AEM survey data. It is important to note that the AEM interpretations in the area of MCWD wells Nos. 30, 31, 34, and 35 (and wells in Seaside Basin) have not been ground-truthed by the data these wells provide.*

38. The 2019 AEM Report provides "hydrostratigraphic volume" calculations in Section 4.8. (Section 4.8, pages 154-157)

***HWG Comment:*** *The calculations presented in Section 4.8 must be considered unreliable given all the previous HWG Comments provided in this TM.*

39. The 2019 AEM Report provides "Key Findings and Recommendations" in Section 4.9. (Section 4.9, page 158)

***HWG Comment:*** *The Findings/Recommendation presented in Sections 4.9.1 and 4.9.2 must be considered unreliable given all the previous HWG Comments provided in this TM. With regard to the Section 4.9.3 Finding that there is no publicly available groundwater level or groundwater quality available other than that provided by the MPWSP website, it seems odd that AGF could not obtain and use such data from Monterey County Water Resources (MCWRA), Monterey Peninsula Water Management District (MPWMD), Seaside Basin Watermaster, MCWD or the many publicly available reports for Fort Ord and Monterey Peninsula Landfill.*

*The AGF 2019 AEM study uses the earth resistivity exploration method, with data collected via an aerial electromagnetic survey. The earth resistivity method of sensing subsurface materials properties is inherently non-unique when both sediments of variable lithologic characteristics and groundwater of varying salinity within them are involved. The 2019 AEM study attempted to resolve and overcome this non-uniqueness by using borehole lithologic data and monitoring well groundwater data. As noted in AGF Report Section 4.9.3, "The only available water quality information was from the MPWSP monitoring well reports…" Thus, the 2019 AEM study extrapolated the correlations of resistivity to water quality sideways from the western side of the study area and were lacking in important areas of interpreted fresh water. As noted in detail above, AGF's use of MPWSP data for both water quality and lithologic characteristics is flawed, and other presumably available data were not used, so the conclusions and resulting maps and cross sections should be regarded as speculative and of uncertain confidence. While AGF attempts to claim that MPWSP monitoring reports are inconsistent in their data reporting and/or provide data with accuracy/calibration problems, we have demonstrated in this Letter that MPWSP monitoring report data are valid and that inverted AEM data interpretations lack calibration (i.e., ground truthing) and suffer from accuracy issues and provide unreliable correlations with field data that lead to poor predictive capabilities.*

## REFERENCES

California Public Utilities Commission (CPUC), CalAm Monterey Peninsula Water Supply Project Environmental Impact Report/Environmental Impact Statement, SCH#2006101004, March 2018.

The Hydrogeologic Working Group (HWG), *Monterey Peninsula Water Supply Project – Test Slant Well Long Term Pumping Test and Coastal Development Permit #A-3-MRA-14-0050*, letter addressed to California Coastal Commission, July 23, 2015.

HWG, *HWG Hydrogeologic Investigation Technical Report*, November 6, 2017.

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