RESOLUTION NO. 2015-96

A RESOLUTION OF THE CITY COUNCIL FO THE CITY OF MARINA APPROVING AMENDMENT NO. 1 TO THE AGREEMENT BETWEEN THE CITY OF MARINA AND ROBERT H. ABRAMS OF SAN CARLOS, CALIFORNIA, FOR CONSULTANT SERVICES RELATING TO A TECHNICAL REVIEW OF GROUNDWATER MODELING CONDUCTED FOR THE MONTEREY PENINSULA WATER SUPPLY PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT, EXTENDING THE TERM OF THE AGREEMENT TO PROVIDE FOR THE ADDITIONAL SERVICES, AND INCREASING THE COMPENSATION TO BE PAID TO ROBERT H. ABRAMS BY AN AMOUNT NOT TO EXCEED $21,460.00, AND; AUTHORIZING THE CITY MANAGER TO EXECUTE AMENDMENT NO. 1 ON BEHALF OF CITY SUBJECT TO FINAL REVIEW AND APPROVAL BY THE CITY ATTORNEY

WHEREAS, at the regular meeting of April 21, 2015 City Council received a staff report and timeline for the Responsible Agency review process for the California Public Utilities Commission (CPUC) Draft Environmental Impact Report (DEIR) for the Monterey Peninsula Water Supply Project (MPWSP), and;

WHEREAS, at the regular meeting of May 5, 2015, City Council adopted Resolution No. 2015-48, receiving an informational report with regards to the Responsible Agency review process; authorizing FY2015-16 budget amendment and; authorizing the Finance Director to make the necessary accounting and budgetary entries for funding of the review, and;

WHEREAS, on April 29, 2015, the City of Marina entered into an Agreement for Planning Consultant Services with SWCA Consultants for review of environmental documents for the MPWSP in an amount not to exceed $24,900.00, and;

WHEREAS, at the Special Joint Meeting of May 12, 2015, City Council adopted Resolution No. 2015-54, receiving informational presentations by California American Water regarding the slant test well results, and by CPUC representatives introducing the DEIR for the MPWSP, and;

WHEREAS, on June 23, 2015, City Council adopted Resolution No. 2015-80, receiving a draft comment letter regarding the DEIR for the MPWSP, providing direction to, and authorizing the City Manager to send the comment letter to the to the CPUC, and;

WHEREAS, SWCA Consultants' comments, were submitted to the CPUC on July 1, 2015. Additional comments prepared by hydro-geologist Robert H. Abrams, were also submitted, and;

WHEREAS, following an extension of the comment deadline, on July 7, 2015, the City provided supplemental comments to the CPUC based on new information relating to the shut down of the slant test well by the California Coastal Commission, and;

WHEREAS, on July 9, 2015, the Administrative Law Judge further extended the deadline to receive comments on the MPWSP to September 30, 2015, and;

WHEREAS, retroactively, on July 13, 2015, the City of Marina entered into an Agreement for Consultant Services in an amount not to exceed $9,900.00 for a technical review of groundwater modeling conducted for the MPWSP DEIR, and;

WHEREAS, on July 27, 2015, the City Manager and the Acting Director, Community Development Department teleconferenced with Mr. Robert Abrams to evaluate whether additional hydro-geological analysis would add further value to the City's participation as a Responsible Agency under CEQA, and;

WHEREAS, a data request was prepared and submitted to the CPUC by the July 30, 2015 deadline and a Scope of Services was provided.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Marina that it does hereby:

1. Approve Amendment No. 1 to the Agreement between the City of Marina and Robert H. Abrams of San Carlos, California, for consultant services relating to a technical review of groundwater modeling conducted for the Monterey Peninsula Water Supply Project Draft Environmental Impact Report, extending the term of the Agreement to provide for the additional services, and increasing the compensation to be paid to Robert H. Abrams by an amount not to exceed $21,360.00, as described within the Scope of Services attached as Exhibit A to this Resolution, and;
2. Authorize the City Manager to execute Amendment No. 1 on behalf of City subject to final review and approval by the City Attorney
3. Authorize Finance Director to make the necessary budget and accounting entries.

PASSED AND ADOPTED by the City of Marina City Council at a regular meeting duly held on the 5th day of August, 2015, by the following vote:

AYES, COUNCIL MEMBERS: Amadeo, Brown, Morton, O'Connell, Delgado
NOES, COUNCIL MEMBERS: None
ABSTAIN, COUNCIL MEMBERS: None
ABSENT, COUNCIL MEMBERS: None

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Bruce C. Delgado, Mayor

ATTEST:

_____

Anita Sharp, Deputy City Clerk

EXHIBIT A

Robert H. Abrams, Ph.D., P.G., C.Hg.
Consulting Hydrogeologist

Technical Memorandum

June 29, 2015

To: Theresa Szymanis
Community Development Director, City of Marina

From: Bob Abrams

Subject: Groundwater Model Review, CPUC Monterey Peninsula Water Supply Project DEIR

This Technical Memorandum provides an independent and unbiased technical review of groundwater modeling conducted for the CPUC Monterey Peninsula Water Supply Project (MPWSP) Draft Environmental Impact Report (DEIR) (ESA, 2015). Because of time constraints, this review focuses on broad aspects of model design, model implementation, and interpretation of results rather than a suite of specific details. Travel by air provides a good analogy for the depth of this review. This review was conducted at the 30,000-foot level as opposed to 5,000-foot or 1,000-foot level.

The groundwater modeling, conducted by Geosciences Support Services, Inc (GSS) and Luhdorff and Scalmanini Consulting Engineers (LSCE), is documented in Appendices E1 and E2 of the DEIR. Although the DEIR covers water supply issues in Salinas Valley Groundwater Basin (SVGB) and the Seaside Groundwater Basin (SGB), the groundwater modeling documented in Appendices E1 and E2 does not include the SGB. Hence, this review is relevant only to the SVGB in the MPWSP area.

In general, the groundwater modeling effort appears to have been conducted within industry standards. Alternative approaches to some aspects of the model design and calibration are presented in this Technical Memorandum. The model calibration is somewhat poor in the 900-Foot Aquifer in the vicinity of the City of Marina. This may be due to a lack of high-quality data available for model calibration purposes. Overall, the potential impact of MPWSP pumping on seawater intrusion in the 900-Foot Aquifer in or near the City of Marina, based on the groundwater modeling effort documented in Appendices E1 and E2 of the DEIR, was not reported.

Background

General information is given here regarding hydrogeology, the SVGB, and the basics of groundwater modeling to provide definitions and context for the remainder of the Technical Memorandum. Readers familiar with these topics may skip some or all of these subsections.

Aquifers and Aquitards

The SVGB consists of several *aquifers* and *aquitards*. An aquifer is a permeable subsurface layer (or body) of rock or sediment capable of transmitting economic amounts of groundwater. An aquitard is a subsurface layer (or body) of rock or sediment that inhibits the transmission of groundwater. As such, aquitards are generally much less permeable than aquifers. In the

SVGB, several aquifers, ranging from near-surface to not more than approximately 2,000 feet deep, occur in the layered geologic formations that comprise the basin. In general, these geologic formations are composed of unconsolidated to semi-consolidated sediments ranging in age from recent to approximately 5 million years before present. In the MPWSP area, the aquifers are separated by several aquitards. The aquitards are not continuous across their areas of occurrence. Holes or gaps occur in the aquitards, which can allow groundwater to flow from one aquifer to another (i.e., shallow aquifer to deeper aquifer or vice versa).

Occurrence and Movement of Groundwater

Groundwater is defined as water that exists in the saturated zone of the subsurface and is often thought of as occurring below the *water table*. Strictly speaking, the water table occurs in the shallowest *unconfined* aquifer of a groundwater system (i.e., an aquifer with no aquitard above it). More generally, the water table is one of several *potentiometric surfaces* (or pressure surfaces) that can exist in layered aquifer systems. The elevations (or depths) of these potentiometric surfaces, including the water table, are measured by noting the water level in monitoring wells that are isolated within a particular aquifer. In general, each aquifer in a layered system can have its own potentiometric surface, or depth to water. The reason this occurs is because *confined* aquifers can be isolated from shallower or deeper aquifers by intervening aquitards, which are sometimes referred to as confining layers.

Generally speaking, groundwater in aquifers is always flowing, albeit much more slowly than surface water in a stream or river. The flow of groundwater occurs from areas where the potentiometric surface is at higher elevations to areas where the potentiometric surface is at lower elevations. Because of this, the potentiometric surface is often referred to simply as the "groundwater elevation."

Groundwater Models

The groundwater models relevant to Appendices E1 and E2 of the DEIR fall into two basic classifications: models of groundwater flow and models of solute transport. Both the flow of groundwater and the transport of solutes in groundwater (such as chloride or total dissolved solids) can be described by partial differential equations. Site-specific groundwater models are constructed by using computer codes (i.e., programs) that solve these partial differential equations numerically, subject to particular boundary and initial conditions. The groundwater flow equation and the solute transport equation are sometimes solved within the same computer code, but often each equation is solved by separate computer codes that are linked in the sense that output from the groundwater flow code is used as part of the required input to the solute transport code.

The groundwater flow equation and the solute transport equation are continuous equations—when solved analytically they have solutions at every point in space and time within the model domain. Only the simplest, often hypothetical, problems can be solved analytically. For site-specific problems with complex geology and hydrogeology, such as in the SVGB, the equations must be solved numerically. When solved numerically, solutions can only be calculated at specific, or discrete, points in space and time. In both cases, the solution to the groundwater flow equation is a spatially and temporally distributed set of simulated groundwater elevations, also known as hydraulic heads, and the solution to the solute transport equation is a spatially and temporally distributed set of simulated concentrations.

Spatial discretization is accomplished by defining a grid of cells that covers the area to be modeled. The smaller the cell size, the more closely the numerical (discrete) solution matches the analytical solution, if it exists. The larger the cell size, the more approximate the solution becomes. However, the "computational cost" increases dramatically as cell size decreases and the grid becomes more finely discretized, eventually reaching a practical limit. Thus, grids must be designed considering the trade-offs between accuracy and practicality.

Temporal discretization is accomplished by dividing the period to be modeled into time steps, or groups of time steps known as stress periods. Computational/accuracy trade-offs also occur when defining time-step size.

MPWSP Groundwater Modeling

Model Code Selection

The first step in developing site-specific groundwater models is to (a) define the modeling objective(s) and (b) select appropriate computer codes that can achieve the objective(s). The stated modeling objectives of the MPWSP modeling effort are to (1) evaluate and predict the water level and water quality impacts in the area of the CEMEX site during the long-term pumping test (Appendix E1) and (2) assess the impacts of the proposed MPWSP on groundwater levels and seawater intrusion in the SVGB (Appendix E2).

The modeling approach for the MPWSP effort uses the concept of telescopic mesh (grid) refinement (TMR), in which nested grids are used and the smaller grid-within-a-grid (the "child" grid) has much finer spatial resolution than the "parent" grid. TMR was developed to reduce computational costs while allowing more accuracy in targeted areas. In TMR, the parent and child models are run separately and the parent model provides information to the child model, but the child model does not provide information or feedback to the parent model.

For the modeling efforts described in Appendices E1 and E2, two successively smaller nested grids were used within a larger regional-scale model. The "grandparent" model is the Salinas Valley Integrated Groundwater/Surface Water Model (SVIGSM), which was developed in the 1990s for the Monterey County Water Resources Agency (MCWRA). It should be noted that MCWRA considers this model to be obsolete and out of date, although LSCE did update the SVIGSM for the MPWSP modeling effort, to the extent practical. A new, modern groundwater flow model is currently under development by Monterey County, but it is not available at this time. SVIGSM probably represents the best source of regional-scale hydrogeological data at this time. For example, SVIGSM was recently used as a data source for *State of the Basin* report issued by MCWRA earlier this year.

The parent model is the North Marina Groundwater Model (NMGWM), which was developed by GSS in the 2000s using the industry-standard codes MODFLOW-2000 (groundwater flow) and MT3DMS (solute transport). The child model is the CEMEX Model (CM), which was developed by GSS in the 2010s using the code SEAWAT. SEAWAT was developed by the U.S. Geological Survey (USGS) by coupling MODFLOW-2000 and MT3DMS into a single computer code. It is not clear if GSS used SEAWAT-2000 or the more recent SEAWAT version 4. SEAWAT is not as widely used as the individual component codes, but it has been verified and is conceptually correct. SEAWAT's advantage over the individual codes is that it can simulate density-dependent groundwater flow, which is a factor in seawater intrusion.

Site-Specific Model Design

"Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful."

--George E. P. Box and Norman R. Draper (1987), *Empirical Model Building and Response Surfaces*

All models are "wrong" because they are simplifications of reality, not because they provide incorrect information. Therefore, the goal of any modeling investigation is to capture the essence of the problem. That is, the model should be sufficiently detailed and calibrated to meet the modeling objectives by representing the major physical processes that describe the behavior of the system under investigation. In this sense, models can be very useful and are an essential part of many scientific investigations. One of the best uses of a model is for the investigator to pose "what-if" questions such as: What if slant wells were operating in the coastal area, would there be significant impacts to groundwater resources?

Many decisions and assumptions must be made in order to model a complex groundwater flow system like the SVGB. The availability of data and the experience of the modeler govern these decisions and assumptions. As a practical matter, modeling is an art as well as a science. The modeler must decide which of the many aspects of the system can be ignored or simplified, without losing the utility of the model. The saying, "there are many ways to skin a cat," is very relevant in this regard. For example, different model designs for the same area and time period may both be capable of achieving the stated modeling objective(s). Furthermore, even though a model reviewer may not agree with some or all of the decisions and assumptions made by the model developer, it may not be possible to determine if suggested changes would yield significantly different results and conclusions, without actually changing and re-running the model.

It is in this spirit that the MPWSP groundwater modeling effort is reviewed here. Alternatives to the decisions and assumptions made in the development of the MPWSP model are discussed herein, but these should not be construed as criticisms or statements that particular aspects of the MPWSP models are incorrect.

In general, the NMGWM and the CM appear to be designed, implemented, and calibrated by experienced modelers and within industry standards. Nevertheless, there are three principal aspects of the modeling effort that could have reasonably been approached differently and may have led to results with a higher degree of confidence. These aspects are (1) choice and implementation of boundary conditions, (2) estimation and distribution of aquifer parameters, and (3) model calibration. Additionally, alternatives to the predictive simulations are discussed.

Boundary Conditions

From a heuristic perspective, the natural boundaries of a groundwater flow system prevent the flow of groundwater in certain directions, provide groundwater to the system, or allow groundwater to leave the system. From a modeling perspective, boundary conditions are mathematical statements representing these three processes.

Partial differential equations like the groundwater flow equation and the solute transport equation are known as boundary-value problems. As implied by their mathematical classification, the solution to a boundary-value problem is highly dependent on the applied boundary conditions. The chosen boundary conditions essentially govern the outcomes, or

predictions, of a model. There are at least two aspects related to boundary conditions that could have reasonably been approached differently in the MPWSP modeling effort—the Monterey Bay boundary and the boundaries of the nested models (i.e., the parent and child models, for which the SVIGSM is the grandparent model).

Monterey Bay Boundary

As shown on Figures 17 and 18 of Appendix E2, Layer 1 is designed as a modeling convenience to represent the influence of Monterey Bay and does not function elsewhere in the model. Layer 1 is composed entirely of constant-head and no-flow boundary cells. The constant head boundary cells are fixed at sea level. That is, they are set to maintain a groundwater elevation of sea level and will allow unlimited amounts of water to flow in or out of the model domain to achieve this condition. This makes sense because, relative to the SVGB groundwater flow system, there is an unlimited amount of water in Monterey Bay and the water surface of the Bay is always at sea level.

The definition of the Monterey Bay boundary in deeper model layers is also relevant. As stated in Section 4.4 of the DEIR (main body), the SVGB is hydraulically connected to Monterey Bay by outcrops of the 180-Foot and 400-Foot Aquifers located a few miles offshore. It is these hydraulic connections that have provided the primary pathways for seawater intrusion in the 180-Foot and 400-Foot Aquifers. It is currently unknown by scientists if the 900-Foot Aquifer is connected to the Bay.[1]

Table 4.1 of Appendix E2 indicates that the 180-Foot/180-FTE aquifer is represented in the NMGWM by Layer 4 (Layers, 6, 7, and 8 in the CM), the 400-Foot Aquifer is represented in the NMGWM by Layer 6 (Layer 10 in the CM), and the 900-Foot Aquifer is represented in the NMGWM by Layer 8 (Layer 12 in the CM). Figure 18 of Appendix E2 appears to indicate that the Monterey Bay boundaries in Layers 4, 6, and 8 of the NMGWM have been designated as no-flow boundaries.[2]

It should be noted that these boundaries are not explicitly shown as no-flow cells (gray-colored areas on Figure 18), but the default in MODFLOW is that the outside edge of any active boundary cell is a no-flow boundary unless it is explicitly assigned a boundary condition. The nature of the Monterey Bay boundary in layers below Layer 1 is not discussed in the text of Appendix E1 or E2. If indeed this boundary acts as a no-flow boundary in the model, this does not seem to be conceptually correct because it is known that flow does occur across the Monterey Bay boundary of the 180-Foot and 400-Foot Aquifers.

As noted above, it is currently unknown if the 900-Foot Aquifer is hydraulically connected to Monterey Bay. Nevertheless, the impact on groundwater resources from a potential connection could be evaluated with the model by conducting “what-if” simulations.

Boundaries of Nested Models

The boundaries of the nested NMGWM and CM models are artificial. That is, the boundaries do not coincide with natural features of the SVGB that prevent groundwater flow, provide groundwater to the flow system, or allow groundwater to be removed from the flow system (other than the Monterey Bay boundary). The locations of the artificial boundaries were chosen

[1] Data are limited for the 900-Foot Aquifer.
[2] It is possible that Figure 18 contains drafting errors.

by the modeler to define the extent of the child model. This is the standard approach for models using TMR.

As noted above, boundary conditions have a profound impact on the solution to boundary-value problems, such as the one defined by the groundwater flow equation. Artificial boundaries are commonly used in groundwater flow models, even for models that do not use TMR. This is true because it is often impractical to extend a model's boundaries to natural boundaries, which can be considerably distant from the area of interest. Because boundary conditions greatly influence the simulation results from a groundwater flow model, the industry-standard is to place model boundaries sufficiently far from the area of interest such that the boundaries do not impart significant influence on the modeling results.

In TMR, the parent model provides (at least part of) the boundary conditions for the child model, usually in the form of simulated groundwater elevations and groundwater fluxes. A potential issue with TMR is that the parent model receives no direct feedback from the child model. For example, if pumping in the child model causes impacts to simulated groundwater elevations at or near one or more of the parent-child model boundaries, the simulation results could indicate that the impact should extend across the parent-child model boundary. Such a result may indicate the need to adjust the boundary conditions assigned to the child model. This situation, in which simulation results suggest an influence beyond a model boundary is a primary reason why it is desirable for model boundaries to be as far as practical from the area of interest, for both TMR and non-TMR models: to avoid such boundary effects.

In standard TMR modeling the parent model does not receive information from the child model such as described above, so it is the modeler who must check the simulated groundwater elevations on both sides of the parent-child model boundary to see if they are consistent. If they are not consistent, there would be an incorrect abrupt change in simulated groundwater elevations at the boundary, which could lead to erroneous results in the area of interest.

Figures 7 and 8 in Appendix E1 may indicate boundary effects in the 180-Foot/180-FTE Aquifer (Layers 7 and 8) in the CM. The contour lines closest to the northern and eastern boundaries do not appear as circular in nature as do contour lines further from the boundaries. In Figure 8, the contour line closest to the boundaries appears to become sub-parallel to the boundaries, which may indicate boundary effects. It should be noted that abrupt changes in aquifer parameters (e.g., hydraulic conductivity and storativity, see below) in the area of these contour lines could produce a similar effect, but Figures 31, 32, and 33 in Appendix E2 do not seem to indicate changes in aquifer parameters in this area. There is no discussion of a boundary-effect checking process in Appendix E1 or Appendix E2.

In response to the parent-child boundary issue, the USGS developed a version of MODFLOW-2005 called MODFLOW-LGR (Mehl and Hill, 2005), in which LGR stands for local grid refinement. LGR was implemented as part of the industry-standard MODFLOW code because, as stated in Mehl and Hill (2005), TMR methods generally lack numerical rigor and are prone to significant, often undetected errors. MODFLOW-LGR circumvents the TMR parent-child model boundary issue by using an iterative procedure to adjust the simulated groundwater elevations, using shared nodes, until there is consistency on both sides of the parent-child model boundary. MT3DMS can be used with MODFLOW-LGR, although for some situations MT3DMS must be run separately for the parent and child groundwater flow models (Mehl and Hill, 2005).

Aquifer Parameters

Aquifer parameters are used in groundwater models to represent aquifer properties such as hydraulic conductivity and storativity, which are measures of an aquifer's ability to transmit and store groundwater, respectively. In natural settings, these properties can vary by several orders of magnitude over relatively short distances, due to variability of the geologic processes that created the aquifer.

There are several ways to represent the spatial distribution of hydraulic conductivity in groundwater models. At one extreme, some or all model layers are assigned a single value for the entire layer or model. This is the so-called homogeneous approach. At the other extreme, a different value can be assigned to each model cell using one of several ways to distribute values (heterogeneous approach). Most models use an approach that is between these two extremes. Often, the decision on how much detail can reasonably be included in a model is dictated by data availability. The experience of the modeler and the modeling objective(s) also play a role.

The approach taken for the NMGWM and CM was to use layer-specific hydraulic conductivity zones. Figures 31 and 32 of Appendix E2 show the layer-by-layer distribution of zones. The decision to use zones and their extents and locations may be based on data availability or model calibration (see below), or a combination of both. When model calibration is used, as is usually the case, initial values for all aquifer parameters must be assigned *a priori*.

For the NMGWM and CM, the initial values were determined based on sediment texture, using an equation based on the fractions of coarse-grained and fine-grained sediments determined from well logs in the area. Use of this and similar equations is part of a general procedure frequently used by the USGS for their groundwater models (e.g., Phillips et al., 2007; Faunt, 2009; Phillips et al., 2015), including the proximal Pajaro Valley Hydrologic Model (Hanson et al., 2014). The roots of this methodology were described by the USGS at least as early as 1991 (Phillips and Belitz, 1991).

The equation used for the NMGWM and CM contains an empirical parameter related to ratio of horizontal to vertical hydraulic conductivity (*p* in the equation on page 23 of Appendix E2). Values of *p* for the NMGWM and CM were taken from a groundwater modeling effort for Conaway Ranch in Yolo County. It should be noted that values of *p* from the local Pajaro Valley Hydrologic Model, which includes at least some of the same geologic units present in the SVGB, were markedly different than the Conaway Ranch values in some cases.

The other part of the general USGS procedure described above is to use geostatistical techniques to distribute hydraulic conductivity values, which are determined from point locations, across the entire spatial domain of the model. It does not appear that this step of the USGS procedure was used for the NMGWM and CM. Although not a modeling requirement, use of this geostatistical step may provide insight into uncertain hydrostratigraphic relationships, such as the relationship between the 180-Foot Aquifer and the 180-FTE Aquifer (see Section 3.3.4 in Appendix E2).

Lastly, it should be noted that potential modeling uncertainties created by the change in hydraulic conductivity values across the TMR boundary from the grandparent SVIGSM to the values used in the calibrated NMGWM are not discussed in Appendices E1 and E2.

Model Calibration

Model calibration involves adjusting aquifer parameters and/or boundary conditions in such a way that simulation results match observed values to a particular level of certainty. In general, the level of certainty is dictated by the amount and quality of data and calibrated models provide simulation results that minimize some combination of the differences between simulated and observed values (i.e., residuals). Examples of model inputs that are commonly adjusted during calibration (i.e., calibration parameters) are hydraulic conductivity, storativity, porosity, groundwater elevations at constant or specified head boundaries, and estimated groundwater pumping. Examples of observed values used to calibrate simulated values (i.e., calibration targets) include groundwater elevations, drawdown, and concentration.

From a qualitative perspective, groundwater flow model calibration usually involves “history matching”, in which simulated groundwater elevations at multiple locations (e.g., wells) over a specific time period are matched as closely as possible to observed values over the same time period. Ideally, a second set of observed values from a different time period with similar hydrologic conditions is available to verify the calibration, although such a second data set is not always available.

Detailed procedures for calibrating groundwater flow models can be found in several references, e.g., ASTM-D5981 (2008) and Hill and Tiedeman (2007). Briefly, recommended procedures include conducting a parameter sensitivity analysis, trial-and error (manual) adjustment of calibration parameters, automated parameter estimation to improve initial calibration, and conducting an uncertainty analysis (e.g., see Phillips et al., 2007; Faunt, 2009; Hanson et al., 2014). The evaluation of calibration results (i.e., the “goodness of fit” between observed and simulated values) occurs through the use of various graphical and statistical techniques.

The NMGWM/CM was calibrated to groundwater elevations by the trial-and-error method (i.e., manually) by adjusting horizontal hydraulic conductivity, vertical hydraulic conductivity, effective porosity, and the storage coefficient within ranges of reasonable values. Sensitivity analyses, automated parameter estimation, or uncertainty analyses were not reported in Appendices E1 and E2 of the DEIR. In addition, reported graphical and statistical evaluation of the calibration results could be considered minimal.

On the other hand, the number and distribution of available calibration targets in the MPWSP area could also be considered minimal. For example, Figure 36 in Appendix E2 shows that the closest two (out of a total of four) calibration targets for the groundwater flow model in the 180-Foot/180-FTE Aquifer are nearly five miles away from the CEMEX site and almost six miles from the City of Marina. The four calibration targets in the 900-Foot Aquifer are approximately three to six miles away from the CEMEX site and the City of Marina. The overall degree of calibration across the entire model domain may be acceptable, but it is worth noting that the calibration is rather poor in the 900-Foot Aquifer post-1998. It is not known to this reviewer if additional calibration targets were available to the model developer.

The calibration targets for the solute transport portion of the NMGWM/CM are total dissolved solids (TDS) concentrations at various wells. The calibration results for the solute transport modeling were not evaluated as rigorously as the flow-model calibration. Most of the observed data at the calibration targets show little change of TDS concentration over time (Figure 43-45 in Appendix E2). For the targets that do show changes with time, the data are either too sparse for reasonable evaluation or the calibration is quite poor. For the targets in all three aquifers that do

show changes in TDS concentrations post-1988 (a total of three wells), one shows a good calibration (i.e., the well furthest from the CEMEX site and the City of Marina in the 900-Foot Aquifer, Figure 45 in Appendix E2).

Three calibration targets (out of six) for TDS in the 900-Foot Aquifer are located in the City of Marina (Figure 42 in Appendix E2). Data are very sparse for these 900-Foot Aquifer targets, but the calibration could be considered poor. For example, simulation results show a general increasing trend in TDS concentrations not seen in the observed values and the simulation results are several hundred milligrams per liter greater than the observed values.

Model Results

Results of the MPWSP groundwater modeling effort, as documented in Appendices E1 an E2 of the DEIR, are discussed here relative to potential seawater intrusion impacts in the 900-Foot Aquifer in the vicinity of the City of Marina caused by proposed MPWSP slant well pumping. The reported results related to seawater intrusion appear to be based primarily on particle-tracking simulations, which are founded on the simulated direction and rate of groundwater flow determined by groundwater flow modeling.

Results of solute transport simulations from the MPWSP groundwater modeling effort were not reported beyond the calibration period for the 180-Foot/180-FTE Aquifer, the 400-Foot Aquifer, or the 900-Foot Aquifer. Reporting of the solute transport simulation results seems to be limited to predicted TDS concentrations in the slant wells. In addition, particle-tracking simulations, in which groundwater flow paths are predicted, were not reported for the 400-Foot or 900-Foot Aquifers.

Thus, the potential impact of MPWSP pumping on seawater intrusion in the 900-Foot Aquifer in or near the City of Marina, based on the groundwater modeling effort documented in Appendices E1 and E2 of the DEIR, was not reported. Furthermore, the statements on pages 3 and 40 of Appendix E2, that the slant wells may provide protection from seawater intrusion, are not described adequately enough to determine if they are based on evaluations reported in Appendices E1 and E2 of the DEIR.

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Robert H. Abrams, Ph.D., P.G., C.Hg.
Consulting Hydrogeologist

July 29, 2015

Memorandum

To: Theresa Szymanis
Community Development Director, City of Marina

From: Bob Abrams

Subject: Phase 2 Scope of Work for Groundwater Model Review, Monterey Peninsula Water Supply Project

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This Memorandum provides a Phase 2 scope of work to continue the technical review of groundwater modeling conducted for the California Public Utilities Commission (CPUC) Monterey Peninsula Water Supply Project (MPWSP) Draft Environmental Impact Report (DEIR).

The Phase 2 technical review will be performed objectively and will not include commentary related to the appropriateness or legal aspects of the proposed MPWSP. The focus of Phase 2 will be on evaluating, to the degree possible, the ability of the subject groundwater modeling to estimate potential seawater intrusion impacts on municipal wells in the Deep Aquifer that supply potable water to the City of Marina.

Scope of Work

The work to be performed for the City of Marina for Phase 2 is to consist of a neutral, unbiased technical review of the groundwater modeling effort, as documented in Appendices E1 and E2 of the MPWSP DEIR, which was submitted to the CPUC in April, 2015. Sections within the main body of the DEIR may also need to be assessed to complete the technical review (e.g., Section 4-4). The Phase 1 technical review, which culminated in a Technical Memorandum (dated June 29, 2015) focused on qualitative evaluation of model design, implementation, and interpretation of results and was limited in scope due to imposed time constraints. In addition and as part of Phase 2, available scientific investigations of the Deep Aquifer will be reviewed.

The objective of Phase 2 is to assess the ability of MPWSP groundwater modeling effort to predict potential seawater intrusion impacts to the coastal area of the Deep Aquifer. This assessment will require that digital (electronic) files be obtained from the model developers or CPUC. These digital files include input and output files for the groundwater model(s), supporting data, and statistical and graphical analyses of model calibration and model results. The files will be reviewed for the purpose of providing a quantitative assessment of the modeling effort, to the degree possible, and to further assess issues discussed in the Phase 1 Technical Memorandum (e.g., boundary conditions).

The Phase 2 effort would be enhanced by reviewing data for all wells of concern. These data include well completion reports, water-level measurements, and concentration data for constituents of concern.

Although reasonable attempts will be made to utilize the provided digital files, no additional simulations will be conducted. Thus, it may not be possible to assess the impact of potential changes to the model on the DEIR results and conclusions. Therefore, the primary focus of Phase 2 will be on evaluating work that has already been completed by others.

The benefit of conducting the assessment described in this scope of work is gaining a deeper understanding of the degree to which potential seawater intrusion impacts (from MPWSP pumping) on municipal wells that supply potable water to the City of Marina have been evaluated in the DEIR. Gaining this understanding will provide insight into data and knowledge gaps that currently exist, which would also help in the design of future efforts to characterize the vulnerability of the Deep Aquifer. Thus, Phase 2 may also be considered a first step in developing a strategy for protecting the potable water supply of the City of Marina.

The deliverable will be a concise Technical Memorandum describing the details of the review and the rationale for statements and comments made in the body of the Technical Memorandum.

Estimated Cost

Charges for Phase 2 will be on a time and materials basis. The billing rate is $185 per hour. It is estimated that the review will be completed within 80-100 billable hours ($14,800-$18,500). In the event that extra time is needed, the not-to-exceed cost for Phase 2 is $21,460.

Attendance at the August 5, 2015 City Council meeting will involve additional expenses of 4.5 hours of travel time ($832.50), mileage charges of $105.80 (184 miles at $0.575 per mile), $185 per hour for the length of the meeting, one-night lodging in or near Marina (approximately $160), and approximately $50 for ancillary expenses.

Schedule

Phase 2 will be completed by September 23. Achieving this milestone will only be possible by obtaining the requested files and data in a timely manner.

Closing Remark

Thank you for the opportunity to work on this project. I look forward to our discussion of results and potential for future collaboration.

July 31, 2015 Item No. **11a**

Honorable Mayor and Members
of the Marina City Council

City Council Meeting
of August 5, 2015

CITY COUNCIL CONSIDER ADOPTING RESOLUTION NO. 2015-___, APPROVING AMENDMENT NO. 1 TO THE AGREEMENT BETWEEN THE CITY OF MARINA AND ROBERT H. ABRAMS OF SAN CARLOS, CALIFORNIA, FOR CONSULTANT SERVICES RELATING TO A TECHNICAL REVIEW OF GROUNDWATER MODELING CONDUCTED FOR THE MONTEREY PENINSULA WATER SUPPLY PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT, EXTENDING THE TERM OF THE AGREEMENT TO PROVIDE FOR THE ADDITIONAL SERVICES, AND INCREASING THE COMPENSATION TO BE PAID TO ROBERT H. ABRAMS BY AN AMOUNT NOT TO EXCEED $21,460.00, AND; AUTHORIZING THE CITY MANAGER TO EXECUTE AMENDMENT NO. 1 ON BEHALF OF CITY SUBJECT TO FINAL REVIEW AND APPROVAL BY THE CITY ATTORNEY

REQUEST:
It is requested that the City Council consider:

1. Adopting Resolution No. 2015- , City Council consider adopting Resolution No. 2015- approving Amendment No. 1 to the Agreement between the City of Marina and Robert H. Abrams of San Carlos, California, for consultant services relating to a technical review of groundwater modeling conducted for the Monterey Peninsula Water Supply Project Draft Environmental Impact Report, extending the term of the Agreement to provide for the additional services, and increasing the compensation to be paid to Robert H. Abrams by an amount not to exceed $21,460.00, and;

2. Authorizing the City Manager to execute Amendment No. 1 on behalf of City subject to final review and approval by the City Attorney

BACKGROUND:
At the regular meeting of April 21, 2015 City Council received a staff report and timeline for the Responsible Agency review process for the California Public Utilities Commission (CPUC) Draft Environmental Impact Report (DEIR) for the Monterey Peninsula Water Supply Project (MPWSP).

At the regular meeting of May 5, 2015, City Council adopted Resolution No. 2015-48, receiving an informational report with regards to the Responsible Agency review process; authorizing FY2015-16 budget amendment and; authorizing the Finance Director to make the necessary accounting and budgetary entries for funding of the review.

On April 29, 2015, the City of Marina entered into an Agreement for Planning Consultant Services with SWCA Consultants for review of environmental documents for the MPWSP in an amount not to exceed $24,900.00.

At the Special Joint Meeting of May 12, 2015, City Council adopted Resolution No. 2015-54, receiving informational presentations by California American Water regarding the slant test well results, and by CPUC representatives introducing the DEIR for the MPWSP.

At a Special Joint Meeting with the Planning Commission, on June 23, 2015, City Council adopted Resolution No. 2015-80, receiving a draft comment letter regarding the DEIR for the MPWSP, providing direction regarding the contents of the letter, and; authorizing the City Manager to send the comment letter to the to the CPUC.

SWCA Consultants' comments were submitted to the CPUC on July 1, 2015. Additional comments prepared by hydro-geologist Robert H. Abrams were also submitted (**"EXHIBIT A"**).

Further, following an extension of the comment deadline, on July 7, 2015, the City provided supplemental comments to the CPUC based on new information relating to the shutdown of the slant test well by the California Coastal Commission.

On July 9, 2015, the Administrative Law Judge further extended the deadline to receive comments on the MPWSP to September 30, 2015.

Retroactively, on July 13, 2015, the City of Marina entered into an Agreement for Consultant Services in an amount not to exceed $9,900.00 for a technical review of groundwater modeling conducted for the MPWSP DEIR.

ANALYSIS:

On July 27, 2015, the City Manager and the Acting Director, Community Development Department teleconferenced with Mr. Robert Abrams to evaluate whether additional hydro-geological analysis would add further value to the City's participation as a Responsible Agency under CEQA. The results were inconclusive.

A data request was prepared and submitted to the CPUC by the July 30, 2015 deadline and a Scope of Services was provided (**"EXHIBIT B"**).

Below is a list of data needs to facilitate the work described in the attached scope of work and this data has been requested from the CPUC consultants, who have responded positively that it would provide the data but no earlier than August 21, 2015.

- Digital (electronic) final input files for groundwater models (actual files, not PDFs)
- Digital (electronic) output files for groundwater models (actual files, not PDFs)
- Supporting data used to develop the model input files (actual files, not PDFs unless unavailable)
- Digital (electronic) statistical and graphical analyses of model calibration and model results (actual files, not PDFs unless unavailable)
- Well completion reports for all wells of concern
- Water-level measurements over time for all wells of concern, in digital form if possible
- TDS and chloride concentration data for all wells of concern, in digital form if possible

Based on data acquisition, the Scope of Services details additional work that could be accomplished within the remaining five weeks.

Next Steps
Should the Council choose to proceed with additional analysis, a contract amendment will be prepared for review and approval as to form by the City Attorney prior to execution.

CONCLUSION:
This request is submitted for City Council consideration and possible action.

Respectfully submitted,

_____
Theresa Szymanis, AICP CTP
Acting Director
Community Development Department

REVIEWED/CONCUR:

_____
Layne P. Long
City Manager
City of Marina