CITY OF BAINBRIDGE ISLAND

Environmental Technical Advisory
Committee Special Meeting Thursday
May 18, 2023, 3:00 PM
Chamber Conference Room, City Hall
280 Madison Ave N
Bainbridge Island, WA

The Environmental Technical Advisory Committee will hold this meeting in person, in the City Hall Chamber Conference Room, 280 Madison Ave N, Bainbridge Island, WA
It is recommended that attendance be in person, but it is also accessible via the Zoom meeting platform.
Please click the link below to join the webinar:

https://bainbridgewa.zoom.us/j/89038010400

Webinar ID: 890 3801 0400

Or iPhone one-tap: US: +12532158782, 93138375561# or +16699009128, 93138375561#
Or Telephone: +1 253 215 8782 or +1 669 900 9128 or +1 346 248 7799
or +1 301 715 8592 or +1 312 626 6799 or +1 646 558 8656
Call-in Number: (206) 780-8633

Agenda for May 18, 2023, ETAC Regular Meeting

Call to Order / Roll Call / Conflict of Interest Disclosure

Members:	Dylan Frazer	Ben Harrison
	Melanie Keenan	Malcolm Gander
	Charlie Kratzer	Brian Harmon

Council Liaison: Jon Quitslund

COBI Staff: Patty Charnas, Director, Planning & Community Development; Daria Hansen – Public Records Analyst

Approval of Agenda – May 18, 2023

Approval of Minutes – April 20, 2023 (5 min)

Council Liaison Report – Jon Quitslund (10 min)

Chair Report – Charlie Kratzer (15 min)

Discussion of COBI staff support of ETAC- All **(**15 min)

Discussion of Aspect Tech Memo to COBI, 4/19/23 – All (15 min)

- See attached 2023 GW Model Update (Aspect Tech Memo)

Discussion of COBI contract with EA for GWMP completion – All (20 min)

- See attached EA draft Scope of Work

Discussion of Council action on ETAC Workplan for 2023 – All (20 min)

- See attached COBI Ordinance 2014-25 and BIMC 2.36

Discussion of SMP and Comp Plan review process – Jon Quitslund, COBI staff, and All (15 min)

- What is happening?
- How is ETAC to be included?

Public Comment (5 min)

Adjournment – 5:00 pm

CITY OF
BAINBRIDGE ISLAND

Environmental Technical Advisory Committee
Regular Meeting Minutes
Thursday, April 20, 2023
City Hall Chamber Conference Room

Call to Order (Attendance, Agenda, Ethics)
Approval of Meeting Minutes from March 16, 2023
Council Liaison Report
Chair Report
COBI Staff Comments
Review ETAC 2022-23 Workplan Final, Schedule CC presentation/approval
Discussion ETAC Role for GWMP, review outline, review draft emailed to ETAC
Discussion GWMP draft section for CARA Critical Aquifer Recharge Areas, Aquifer Conservation Zones, BIMC- Chapter 16.20 CRITICAL AREAS, Kitsap County Chapter 19.600 CRITICAL AQUIFER RECHARGE AREAS, Advisory input for next meeting.
Discussion Shoreline Management Program schedule and references
Call for Public Comment
Adjournment

Members Present:
Charlie Kratzer, Melanie Keenan, Malcolm Gander, Brian Hamon, and Ben Harrison

Members Absent:
Dylan Fraser, (3 vacant positions)

COBI Staff and City Council Present:
Ellen Schroer (Deputy City Manager), Patty Charnas (Director, Planning & Community Development), Clarence Moriwaki (Council Liaison sitting in for Jon Quitslund), Renee Argetsinger (PCD Administrative Specialist)

Meeting called to order at 3:03 pm

Approval of April 20, 2023, Agenda
ETAC Member Harrison asked to add discussion of KPUD Wastewater facility. Deputy City Manager Schroer asked to add an agenda item to recognize work of ETAC and its members.

Review & Approve Minutes – March 16, 2023

Motion: I'll make a motion to approve the March 16, 2023, minutes
Harrison/Harmon: Passed Unanimously

Council Liaison Report (Jon Quitslund):

No Council Liaison Report

CITY OF
BAINBRIDGE ISLAND

Environmental Technical Advisory Committee
Regular Meeting Minutes
Thursday, April 20, 2023
City Hall Chamber Conference Room

Chair Report (Charlie Kratzer):

No Chair Report

COBI Staff Comments:

No Staff Comments

Review of ETAC 2022-2023 Workplan Final, Schedule CC presentation/approval (Melanie Keenan):

Action Item: ETAC Members Keenan and Harrison to meet ahead of City Council meeting, review, and prepare presentation to City Council.

Discussion ETAC Role for GWMP, review outline, review draft emailed to ETAC:

No discussion.

Discussion GWMP draft section for CARA Critical Aquifer Recharge Areas, Aquifer Conservation Zones, BIMC- Chapter 16.20 CRITICAL AREAS, Kitsap County Chapter 19.600 CRITICAL AQUIFER RECHARGE AREAS, Advisory input for next meeting.

ETAC Member Keenan provided a PowerPoint presentation on aquifer recharge. Discussion followed including how these fits with the ETAC Workplan, the open Stormwater Management Consultant position, and COBI staff goals. Director Charnas offered an update on USGS and COSMOS Model.

Discussion Shoreline Management Program schedule and references

Director Charnas provided update and that additional staff is required to move forward with SMP.

Presentation of Recognition and Appreciation Certificates:

Deputy City Manager Schroer presented certificates to ETAC members and thanked members for their service to the City of Bainbridge Island.

KPUD Wastewater Facility (Ben Harrison):

ETAC member Harrison provided information regarding the KPUD Wastewater Facility and inquired if anyone was interested in touring the plant and learning more about the process as it is applicable to current considerations for water management on Bainbridge Island.

Call for Public Comment – No public comment**.**

Meeting adjourned at 4:17 p.m.

MEMORANDUM

Project No. 220236

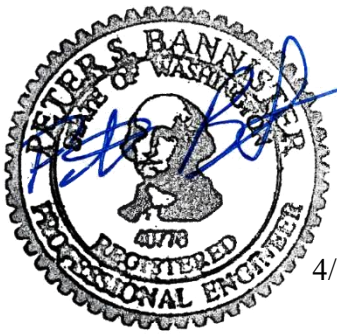
April 19, 2023

To: Chris Wierzbicki

From:

4/19/2023

Ida Fischer, PE
Project Water Resources Engineer
ifischer@aspectconsulting.com



4/19/2023

Peter Bannister, PE
Senior Associate Engineer
pbannister@aspectconsulting.com

Re: **Bainbridge Island Groundwater Model: Updates and Carrying Capacity Assessment**

This memorandum describes Aspect Consulting, LLC's (Aspect) findings from the updated aquifer system carrying capacity assessment and updates to the City of Bainbridge Island (COBI) groundwater model (hereafter: 2023 COBI model). The findings and recommendations discussed below will be used to address the sustainability of the Bainbridge Island aquifer system to support predicted population growth, water conservation goal setting, and stream flow preservation/restoration. As with all groundwater models, the 2023 COBI model is a simplified representation of complex subsurface conditions. As such, the findings based on groundwater modeling should be considered along with historically observed conditions to support the decision-making process. Thus, we recommend that the COBI Groundwater Monitoring Program (COBI, 2009) be continued, and that the Bainbridge Island model be reviewed periodically, updated as needed, and predictive findings be reassessed. We understand that the Groundwater Monitoring Program will be reviewed and possibly updated with the Groundwater Management Plan.

Summary of Findings and Recommendations

In summary, the 2023 COBI model was used to assess long-term changes in groundwater conditions associated with increased groundwater withdrawal rates. Adjustments to the model and input assumptions, described below, included consideration of future potential climate-change effects (decreased groundwater recharge rates and increased sea level) and a 50 percent increase in groundwater withdrawal across Bainbridge Island. In general, the 100-year (2021-2121) simulated model results indicated no seawater intrusion and the average rates of groundwater level decreases

were less than the Early Warning Level (EWL)[1]. Further discussion on project background, groundwater model update methodology, and detailed conclusions and recommendations for future modeling assessments are provided below.

Project Background

The original Bainbridge Island model was developed and published in 2011 by the United States Geological Survey (USGS) in cooperation with COBI. This groundwater model is hereafter referred to as the 2011 COBI model. In 2015 and 2016 Aspect (Aspect 2015a, 2015b, and 2016) completed a groundwater data review and compilation, reviewed the USGS model and recommended updates and changes, and modified the groundwater model and used it to complete a Critical Aquifer Recharge Area assessment, aquifer system carrying capacity assessment, and operational scenario analysis; the model used for that work will be referred to as the 2016 COBI model. Also in 2016, the USGS published the Kitsap Peninsula groundwater model, which includes Bainbridge Island (Frans and Olsen, 2016); this model will be referred to as the 2016 Kitsap model.

Scope of Work

Under our current contract with COBI, Aspect is performing the following model updates:

- Task 1: Model Grid Refinement and Code Change
- Task 2: Sub-basin Modification
- Task 3: Model Updates and Validation
- Task 4: Aquifer Carrying Capacity Forecast

Model modifications and the approach for assessing the Bainbridge Island aquifer system carrying capacity are described below, followed by summaries of model results. This assessment builds upon Aspect's 2016 work and includes a set of recommendations for future carrying capacity assessments. The updated model documented in this memo will be referred to as the 2023 COBI model.

Model Updates

The 2023 COBI model updates required using the 2016 Kitsap model instead of the 2016 COBI model used for previous simulations. Aspect's attempts to update the 2016 COBI model resulted in several logistical problems that were more efficiently addressed by switching to Kitsap model.

Code Change

The model code is the set of calculations used to simulate groundwater conditions. Over time, different versions of model code have been released with different capabilities.

The 2016 COBI model used MODFLOW-SURFACT, an older, proprietary code that simulated the complex groundwater flow within the Puget Sound hydrostratigraphy (Hydrogeologic Inc., 1996).

[1] According to COBI's 2009 *Groundwater Monitoring Program Update* (COBI, 2009), an EWL is a monitoring criterion that, if exceeded, would result in appropriate Management Responses, of which there are two types: (1) additional investigations in order to determine if a potential problem is developing, and (2) protective or remedial actions where appropriate.

The 2016 Kitsap model was developed using MODFLOW-NWT, a publicly available code with capabilities similar to MODFLOW-SURFACT (Niswonger et al., 2011). The 2023 COBI model documented uses MODFLOW-USG, a publicly available code with the NWT solver (Panday et al., 2013), to take advantage of new capabilities including adaptive time stepping and ease future updates.

Grid Refinement and Model Extent

The 2016 COBI model used 800-foot by 800-foot cells. To provide greater resolution of simulated groundwater conditions. the Kitsap Model uses 500-foot by 500-foot cells. The extent of the Kitsap model was reduced to match that of the 2016 COBI model; the 2023 COBI model domain is shown in Figure 1 (attached).

Boundary Condition Modifications

Boundary conditions are used in groundwater models to simulate flow into or out of the model. Aspect made changes to boundary conditions when adapting the 2016 Kitsap model as described below.

- Surface water boundaries assigned to subsurface layers were removed.
- The 2016 Kitsap model uses stream boundary conditions to simulate complex groundwater/surface water interaction in creeks and streams, including gaining (in which groundwater discharges to the stream) and losing (in which streambed infiltration recharges the aquifer) sections of these surface water features. The complexity of these stream boundaries caused model instability during the code conversion from MODFLOW-NWT to MODFLOW-USG. To improve model stability, stream boundaries were converted to drain boundaries. Drain boundary conditions only allow for gaining conditions in streams, where any groundwater discharge to the stream is assumed to discharge to Puget Sound and does not re-infiltrate into the aquifer. This is a more conservative representation with respect to aquifer recharge, as streamflow is not allowed to reenter the subsurface.
- Drain boundaries were added to the top of layer 1 to simulate runoff and avoid simulating groundwater levels above ground surface.

The 2016 Kitsap model simulated return flow, from septic drain fields and golf course irrigation in the top layer. The original 2011 COBI model (and the 2016 COBI model) accounted for septic and irrigation return flow by reducing pumping rates to represent only consumptive use. This new implementation simulates moving groundwater from deeper aquifers to near ground surface.

Subbasin Implementation

Subbasins were delineated across Bainbridge Island to allow for more detailed analysis of groundwater-surface water interactions in watersheds of interest. The mapped watersheds are shown in Figure 2 (attached).

Simulation Period Extension and Validation

The 2016 COBI model simulated 1995 to December 2014 as monthly stress periods. The Kitsap model simulated annual stress periods from January 1985 to December 2004 and monthly stress periods from January 2005 to December 2012.

The 2023 COBI model simulation period extended the 2016 Kitsap model with monthly stress periods from January 2013 through December 2021. To provide consistency with dates over the model validation period, the 2016 Kitsap model stress period lengths were modified to account for leap years. Extending the model simulation period required assigning recharge and pumping rates for 2013 through 2021 as described in the subsequent sections.

Figure 3 shows the updated Bainbridge Island model timeframes compared to the previous 2016 carrying capacity assessment and the 2016 Kitsap model simulated periods. The predictive simulation is discussed in a subsequent section.

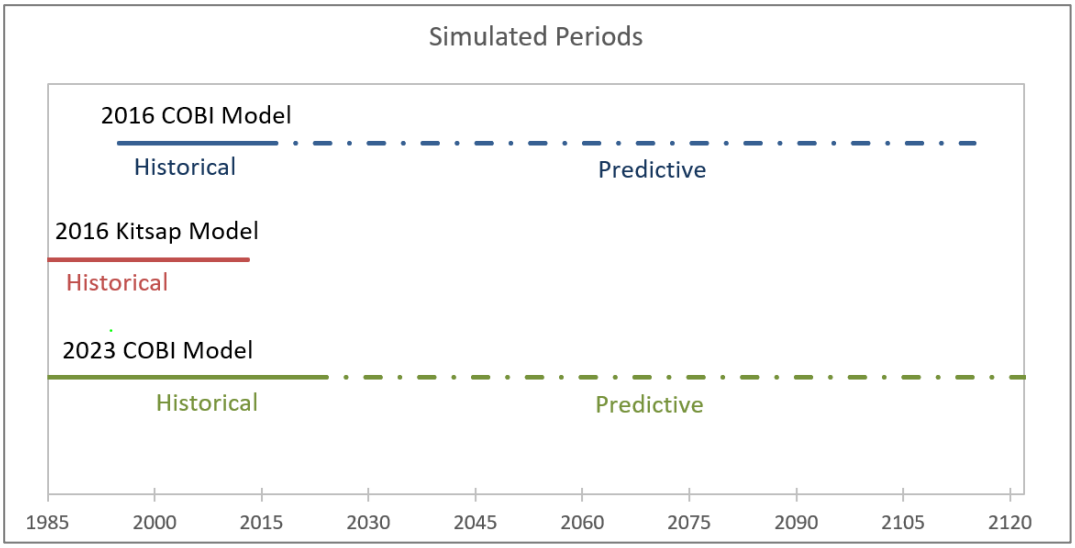


Figure 3. Simulated Periods

Recharge

Aquifer recharge from precipitation for the new simulation period (2013 – 2021) was determined using the same methods for the prior model update (Aspect, 2015b). Recharge was calculated from PRISM precipitation data (PRISM Climate Group, 2022) and the appropriate monthly recharge fraction from a USGS investigation of precipitation and aquifer recharge for till-mantled basins in the Puget Sound (Bidlake and Payne, 2001).

Well Pumping Rates

Well pumping rates were assigned from 2013 through 2021 depending on the data available and the well type. COBI and other public suppliers provided well production rates; monthly averaged production rates were assigned where possible. Pumping rates for wells without data were assigned based on well type. No new wells were added to the model; increased extraction due to population growth was simulated as increased pumping rates. Pumping rates were assigned in the following ways:

- **Wells with data**: The following 21 wells had mostly complete pumping data between 2013 and 2021, and we were able to assign monthly average pumping rates: Fletcher Bay PW, Harbor Crest, Head of the Bay Well #1, Head of the Bay Well #1A, Head of the Bay Well

#2, Head of the Bay Well #3, Head of the Bay Well #4, Head of the Bay Well #5, Head of the Bay Well #6, Hidden Cove Utilities Shop, Island Utilities Well 2, Island Utilities Well 3, North Bainbridge Well 09, North Bainbridge Well 07, North Bainbridge Well 03, Sands Road 2, Sands Road 1, Taylor Road Well, High School Well #2/Commodore, Island Utilities Well 1, North Bainbridge Well 10.

- **Domestic Wells**: An average annual growth rate of 0.63 percent was applied to the monthly pumping rates assigned for 2012 to estimate pumping rates for 2013 – 2021. This is consistent with the growth rate used between 2005 and 2012 in the original Kitsap groundwater flow model.

- **Septic return flow and other return flow**: No discernable pattern of growth was implemented between 2005 and 2012 for wells simulating septic and other return flows (such as golf courses). Monthly rates assigned for 2012 were repeated for 2013 to 2021.

- **All other wells:** Pumping rates at all other wells in the model (including those representing Group A and B water systems whose data was not provided) were increased based on average growth across systems as described. Typical group A and B water system growth was assessed from annual production for the following water systems: City of Bainbridge Island, Bill Point, Harbor Crest, Island Utility, North Bainbridge, South Bainbridge, Ferncliff, Bucklin Water System, Derby Downs, Emerald Heights Water, Graham Place Water System, Hidden Heights, Islandwood Estates, Meadowmeer, Phelps Road Water System, Place Eighteen, Ravens Reach, Rose Avenue Water Assoc., Walden Water System. These systems were considered as they had nearly complete total annual production data from 2013 to 2021 (accessed from the DOH Sentry database). Since complete data was not available for all water systems the percent change in production was calculated for all systems that had consecutive years of data. The percent change in production by year was normalized to production in 2012 and then applied on a yearly basis to all other wells in the model. Annual percent change in production ranged from a decrease of 2.63 percent to an increase of 7.44 percent.

In simulating wells, the "allow automatic flow reduction" option available in MODFLOW-USG was used. During the simulation, this option automatically reduces the pumping rate if the aquifer cannot sustain the assigned pumping rate without running dry. Automatic flow reduction is common in simulated wells that are assigned to a low permeability model cell. Automatic flow reduction can indicate a number of things: a disconnect between model layering and actual stratigraphy, an inappropriately assigned pumping rate, or a difference between actual and model aquifer parameters at that location. These disconnects arise due to generalizations that are necessary in modeling including spatial and temporal discretization and limited data and budgets for model development and calibration.

Validation

The success of the model updates, including code conversion, grid refinement, and extension of simulation period, was assessed through standard validation statistics and figures comparing measured and simulated groundwater elevations. The difference between the measured value and the simulated value is referred to as a residual. The mean residual represents the average difference between all measured and simulated values, and the sign of the mean residuals reflects whether the model is over- or under- predicting groundwater elevations (so a positive residual would indicate that on average, simulated values are lower than observed values). The standard deviation of residuals reflects variation in residuals values compared to the mean residual value; a low standard deviation indicates residuals are close the mean, a high value indicates residuals are spread out over a large range of values around the mean. The root mean squared error (RMSE) is a measure of the distance between simulated values and actual values.

The model extension (2013 – 2021) validation dataset included 4,294 groundwater elevations across 70 wells located on Bainbridge Island. Available groundwater elevation data was resampled on a monthly basis to align with model stress periods to compile this dataset.

Validation statistics are compared to original model calibration statistics in Table 1. Since the model domain was a reduced version of the original Kitsap 2016 model, the calibration statistics for the original 1985 to 2012 simulation period are recalculated and presented for the modified model domain. As shown in Table 1, the extended model period validation statistics agree with the calibration statistics for the original Kitsap Peninsula model. The mean residual is close to 0, indicating on average simulated groundwater elevations closely match observed water levels. Figure 4 (attached) shows observed water levels compared to simulated water levels; perfect agreement between observed and simulated water levels would plot as a straight line with a slope of 1. Groups of data points represent data from individual wells. Near vertical alignment of groups of data points indicates the storage parameters assigned in the model may be too low; near horizontal alignment indicates that the storage parameters may be too high. The RMSE divided by the total range in water levels in the groundwater system is less than 10 percent, which is the industry standard to consider a calibration acceptable (Anderson and Woessner, 1992; Drost et al., 1999). Based on these statistical measures and consistency with the 2016 Kitsap model, the updated 2023 COBI model documented in this memo is appropriate to simulate the groundwater flow system on Bainbridge Island.

Table 1. Validation Statistics

Calibration Statistic	USGS Kitsap Model[1]	Locations within focused model extent	
	1985 - 2012	1985 – 2012 (Original period)	2013 – 2021 (Extended Period)
Residual[2] Mean (feet)	3.7	-6.46	0.12
Residual Standard Deviation (feet)	47.01	45.97	34.16
RMS[1] Error (feet)	47.16	46.42	34.16
Minimum Residual (feet)	Not reported	-251.22	-171.13
Maximum Residual (feet)	Not reported	95.40	193.18

Calibration Statistic	USGS Kitsap Model[1]	Locations within focused model extent	
	1985 - 2012	1985 – 2012 (Original period)	2013 – 2021 (Extended Period)
Minimum Observed Water Level (feet)	Not reported	-49.70	-140.10
Maximum Observed Water Level (feet)	Not reported	597.70	284.50
Range of observations (feet)	647.4	647.40	424.60
Scaled Residual Standard Deviation	0.073	0.071	0.080
Scaled RMS Error	0.073	0.072	0.080
Number of observations	18,834	9,859	4,294

[1]Frans and Olsen (2016)
[2]A residual is the difference between the observed value and the simulated value.
[3]Root Mean Squared

Carrying Capacity Forecast

Defining Carrying Capacity

For groundwater modeling purposes, the concept of "carrying capacity" is defined as the safe yield for the aquifer system. The term "safe yield" has been used in previous reports (Aspect, 2006; Aspect, 2008; Aspect, 2016) to support establishing COBI's EWLs. Essentially, the principle of safe yield is the rate of groundwater withdrawal that is sustainable from multiple perspectives, such as water supply infrastructure, economics, ecological system health, and legal consideration. Indictors of safe yield can be measured by changes in groundwater availability and quality. For this memorandum, the EWLs (discussed in detail in the next section) adopted by COBI—including consideration of potential seawater intrusion and decline in aquifer water levels—were used as safe yield indicators. To address sustainability of the Bainbridge Island aquifer system to support predicted population growth and water conservation, the Bainbridge Island groundwater model was used to predict long-term (i.e., 100 years) groundwater flow conditions.

Approach for Assessing the Aquifer System Carrying Capacity

The approach for assessing the aquifer system carrying capacity involved simulating three concurrent stresses on the aquifer system:

1. Long-term increased groundwater withdrawal rates
2. Reduced recharge rates
3. Sea level rise

The long-term projected increase in groundwater withdrawal rates was selected to reflect both the increase in water supply demand associated with population growth as well as water conservation (i.e., anticipated decrease in water use per capita). Analysis from the University of Washington (UW) Climate Impacts Group was used (Mauger, et al., 2015) as the best available science for the effects of climate change on recharge and sea level rise in the Puget Sound area.

This approach was developed to quantify predicted changes in Bainbridge Island aquifer conditions for two safe-yield indicators with EWLs:

1. Seawater intrusion (with EWL of 100 milligrams per liter (mg/L) chloride); and
2. Rate of groundwater levels changes (with EWL of 0.5 feet per year for 10 years).

The on-Island groundwater balance for the entire aquifer system was also evaluated. The groundwater balance components do not have EWLs, and were evaluated to provide additional context on the predicted changes in groundwater conditions.

Predictive Timeframe

Consistent with the previous carrying capacity assessment (Aspect, 2016) this analysis considered an extended, 100-year timeframe. Historical groundwater modeling extends through 2021 and this model update uses a sustainability assessment period to simulate 2021 to 2121. The historical groundwater conditions calculated for the end of 2021 were used for initial conditions in the updated predictive model.

More conservative model assumptions were used in applying the updated model to assess safe yield (carrying capacity). The long-term stresses, including increased groundwater withdrawal, reduced aquifer recharge, and sea level rise were assumed to occur at the start of the simulation versus occurring gradually over time.

Increase in Groundwater Withdrawal Rates to Reflect Population Increase

Consistent with the 2016 carrying capacity assessment, this analysis assumed a 50 percent increase in groundwater withdrawals over 100 years. This assumption reflects 100 years of compounded 0.4 percent average annual increase in groundwater demand, or a shorter period of time with greater average annual increase in groundwater demand. Simultaneous population growth and water conservation could take many forms yielding a total 50 percent increase in groundwater withdraws, including the following examples:

- 100 years of 1 percent annual population growth and 0.6 percent annual water conservation
- 56 years of 1 percent annual population growth and no increase in water conservation

This assessment implemented a total 50 percent increase in groundwater withdrawal rates for the entire 100-year simulation period. That is, the model simulated 100 years of groundwater withdrawals at 150 percent of current average rates.

The 2023 COBI model simulates 1,363 wells on-Island and 1,989 wells off-Island (that portion of Kitsap County falling within the model domain). Groundwater withdrawal rates were increased by 50 percent for each well across the model area (Bainbridge Island and Kitsap Peninsula). The 2016 Kitsap model used the well boundary condition to simulate septic return flow (including 2,141 on Island and 6,555 off Island), and other return flow to the subsurface. These return flow rates were also increased 50 percent to reflect growth. Figure 5 shows the current, projected, and simulated groundwater withdrawal rates for total pumping in units of millions of gallons per year.

Consistent with the validation model, wells were simulated allowing for automatic flow reduction; that is if the aquifer represented by the model cell cannot sustain the assigned pumping rate, the

pumping rate is automatically reduced to a rate that can be met. As the wells are currently implemented in the model, the projected demand could not be fully met. Allowing for automatic flow reduction, an increase of 44 percent was simulated. Automatic flow reduction impacted more wells off-Island; off-Island wells simulated a total pumping rate of 142 percent of the baseline, and on-Island wells simulated a 148 percent rate, which is closer to the target 150 percent. An alternative simulation approach would be to assign more groundwater demand in the model based on areas of planned development, including Group A or B well system expansion or new wells (Group A or B or domestic).

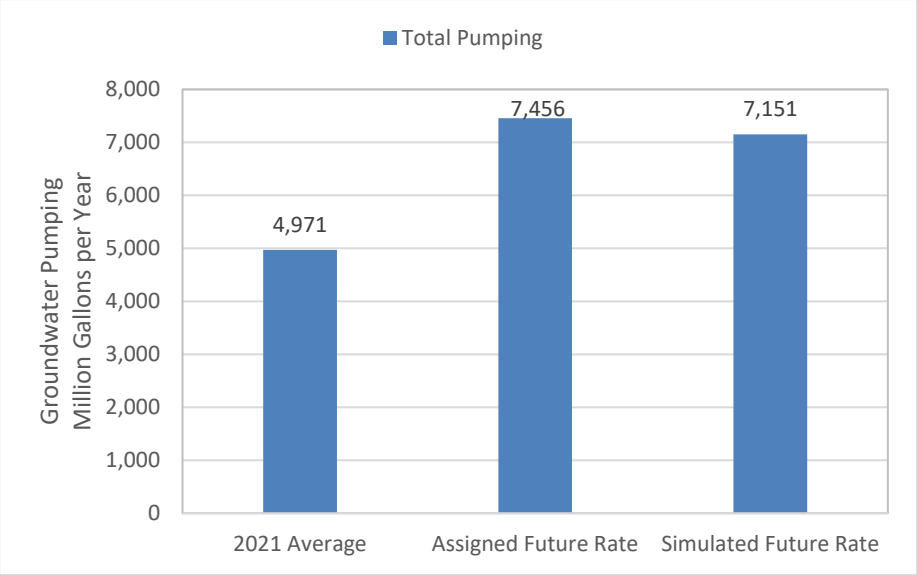


Figure 5. Current and Projected Groundwater Withdrawal Rates (Entire Model Domain)

Change in Recharge due to Climate Change

The UW Climate Impacts Group (Mauger, et al., 2015) simulated future changes in precipitation and runoff for representative hydrologic basins across Washington. Their modeling analysis indicates that by the year 2100, winter runoff is expected to increase in the Puget Sound area by up to 20 percent (which contributes to a reduction in recharge rates) due to more frequent, high-intensity (i.e., heavy) rain events. Warmer temperatures overall will also increase the evapotranspiration rates.

Consistent with the previous 2016 carrying capacity analysis, predictive model simulated long-term groundwater conditions assuming a total 20 percent decrease in recharge rates across the model area due to climate change. That is, the model simulated 100 years of recharge at 80 percent of current average recharge rates. Figure 6 shows the simulated recharge rates.

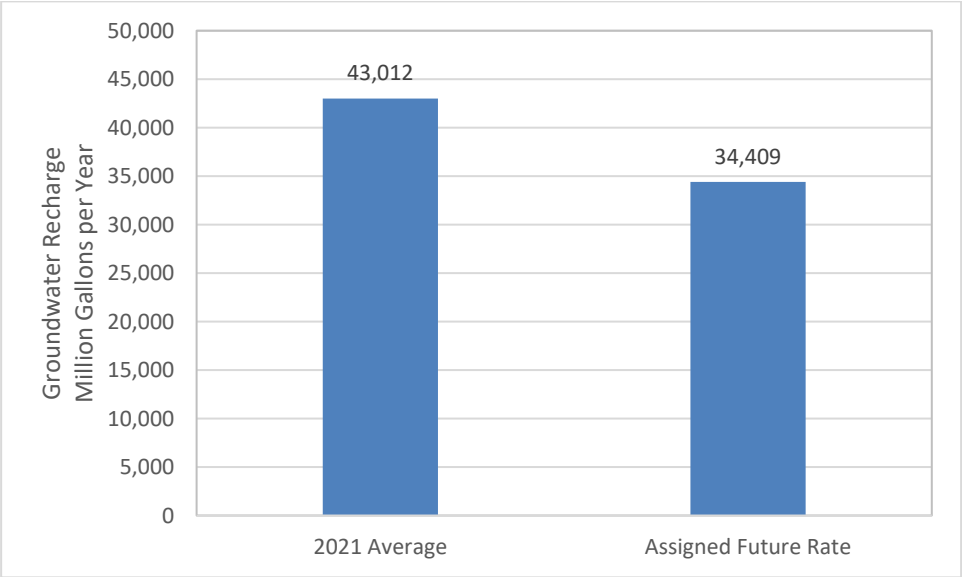


Figure 6. Current and Projected Recharge (Entire Model Domain)

Potential Sea Level Rise due to Climate Change

The UW Climate Impacts Group (Mauger, et al., 2015) projected sea level rise estimates ranging from 6 to 55 inches by the year 2100.

This updated analysis was consistent with the 2016 aquifer carrying capacity assessment, which assumed a 4-foot increase in mean sea level due to climate change. The assigned boundary condition accounted for the density of seawater assuming a density of 63.93 lb/ft^3. The increased sea level was applied to the entire predictive time frame.

Results of Aquifer System Carrying Capacity Assessment

The aquifer system carrying capacity assessment was based on those safe-yield indicators with EWLs adopted by the COBI, including the following:

1. Seawater intrusion (with EWL of 100 milligram per liter [mg/L] chloride)
2. Rate of groundwater level decline (with EWL of 0.5 feet per year for 10 years)

The on-Island groundwater balance (including potential changes in the groundwater discharge to surface water) for the entire aquifer system was also evaluated. The groundwater balance components do not have EWLs but were evaluated to provide additional context on the predicted changes in groundwater conditions.

Seawater Intrusion Assessment

Seawater intrusion is a primary constraint on groundwater supply development and a key indicator of safe yield, because it can be assessed using the predictive model, directly measured (based on empirical water quality data) and compared to the COBI EWL of 100 mg/L chloride. Within the COBI groundwater monitoring program, observed chloride concentrations have generally been below the EWL (Aspect, 2015a). The one historical exception where elevated chloride (i.e., above the EWL) was repeatedly measured includes a community well located near the shoreline and

potentially tapping a thin water bearing zone near mean sea level. We understand that this well is now used with a reverse osmosis treatment system to augment supply.

The predictive model results indicate that groundwater from the Bainbridge Island aquifer system flows to Puget Sound and keeps the freshwater/seawater interface at a distance from the Bainbridge Island shoreline. The following findings were based on the 100-year model results for seawater intrusion as part of the aquifer system carrying capacity assessment:

- The Perched Aquifer and Semi-Perched Aquifer systems are well above sea level and did not show seawater intrusion.
- The Sea Level Aquifer system did not show seawater intrusion within the Bainbridge Island shoreline; the freshwater/seawater interface remained offshore at varying distances from the shoreline depending on location.
- The deeper aquifer systems (including the Glaciomarine Aquifer and the Fletcher Bay Aquifer) did not show seawater intrusion, because of thick aquitards and fresh groundwater flow sourced by off-Island recharge areas.

Rate of Groundwater Level Changes

The long-term rate of groundwater level changes is another indicator of the aquifer system carrying capacity. COBI established an EWL of 0.5 feet per year for 10 years.

The following rates of groundwater level change were based on comparing current (2021) and predicted groundwater levels in 100 years (2121):

- The Perched Aquifer system (Vashon recessional aquifer) showed an average 0.08 feet per year of water level decrease across the Island. Groundwater levels decreased more than the EWL in limited areas of the Perched Aquifer system. The perched aquifer is not a source aquifer and decreases in water levels will not water impact supply.
- The Semi-Perched Aquifer (Vashon Advance aquifer) system showed an average 0.06 feet per year of water level decrease across the Island. Simulated groundwater levels decreased more than the EWL in limited areas of the Semi-Perched Aquifer system which included one simulated well.
- The Sea Level Aquifer system showed an average 0.04 feet per year of water level decrease across the Island. Groundwater levels decreased more than the EWL in a limited area of Sea Level Aquifer system without water supply wells.
- The Glaciomarine Aquifer showed an average 0.03 feet per year of water level decrease across the Island. Groundwater levels decreased less than the EWL across the Glaciomarine Aquifer system.
- The Fletcher Bay Aquifer (referred to as the deep aquifer in Frans and Olsen (2013)) showed an average 0.05 feet per year of water level decrease across the Island. Groundwater levels decreased less than the EWL across the Fletcher Bay Aquifer system.

EWLs calculated by the model may be biased high due to low storage parameters assigned in the model identified during model validation (and illustrated in attached Figure 4 by near vertical groups of points).

Changes in Groundwater Discharge to Surface Water

The updated 2023 COBI model was used to evaluate potential changes in streamflow by calculating the discharge extracted from drain boundary conditions in the model. The calculations were made for the watersheds shown in attached Figure 2 and included the combined groundwater discharge to any surface water points including shoreline seeps, springs, wetlands, and stream channels. Overland runoff and streamflow are not simulated in the 2023 COBI model.

Simulated historical groundwater discharge to surface water is shown in Figure 7 (attached) with annual variability (1985 through 2004) and seasonal variability (January 2005 through December 2021) Groundwater discharge to surface water is higher in the winter and spring, and lower in the summer and fall.

The estimated changes in groundwater discharge under the carrying capacity scenario as compared to 2021 average conditions are shown in Figure 8 (attached). The figures show that predicted groundwater discharge to surface water is less than the historical baseline (2021 annual average) and is typically greater than the seasonal minimum. As listed in Table 2, the percent reduction in streamflow as compared to the historical baseline discharge under 2021 average conditions ranges from 15 to 58 percent.

Table 2. Decrease in Groundwater Discharge to Surface Water

Watershed	Baseline Groundwater Discharge to Surface Water (cfs)	Decrease in Groundwater Discharge to Surface Water (cfs)	Percent Decrease
Agate Passage	0.36	0.11	29%
Port Madison	1.38	0.32	23%
Manzanita Bay	1.11	0.44	40%
Sunrise	1.21	0.27	22%
South Beach	0.54	0.08	15%
Blakely Harbor	1.01	0.18	18%
Pleasant Beach	0.69	0.20	29%
Eagledale	0.44	0.15	33%
North Eagle Harbor	0.53	0.29	55%
Gazzam Lake	0.10	0.06	58%
Fletcher Bay	1.60	0.39	24%
Murden Cove	1.78	0.41	23%

Groundwater Balance Changes

The groundwater balance is expected to change in the future due to increased groundwater withdrawals and decreased recharge rates. Groundwater balance components are typically difficult to measure directly (such as recharge and groundwater underflow). Thus, this groundwater balance assessment relies on modeling results without actual field measurements. The values discussed below reflect the entire model domain, not just Bainbridge Island.

The relationship between groundwater balance inputs and outputs for the Bainbridge Island aquifer system is shown in the following equation:

$R_{ppt} = (W_{ppg} - W_{RF}) + D_{sw} + (GW_{ps} - GW_{kp})$

Where:

Inputs include:

R_{ppt} is precipitation recharge.

W_{RF} is septic and other return flow

Outputs include:

W_{ppg} is groundwater withdrawals;

D_{sw} is groundwater drainage to surface water (such as seeps to bluffs, creeks, streams, etc.); and

$(GW_{ps} - GW_{kp})$ is the net lateral groundwater underflow (groundwater flow toward Puget Sound submarine seeps (GW_{ps}) and groundwater flowing from the Kitsap peninsula in deeper aquifers (GW_{kp})).

To balance the 50 percent increase in groundwater withdrawals and the 20 percent decrease in recharge, the model showed projected changes in groundwater drainage to surface water (approximately 21 percent decrease) and lateral groundwater flow (approximately 20 percent decrease). Figure 9 compares the water balance components under current and projected conditions, based on model results[2].

The updated 2023 COBI model results showed aquifer storage will be reduced by approximately 32,300 million gallons between current and projected conditions, reflecting the water level decreases described above. These groundwater balance results should be carefully interpreted, considering that the model has not been calibrated to observed flows.

[2] The difference between groundwater balance inputs and outputs reflects the modeling methods, and results are within an acceptable level of accuracy for predictive purposes.

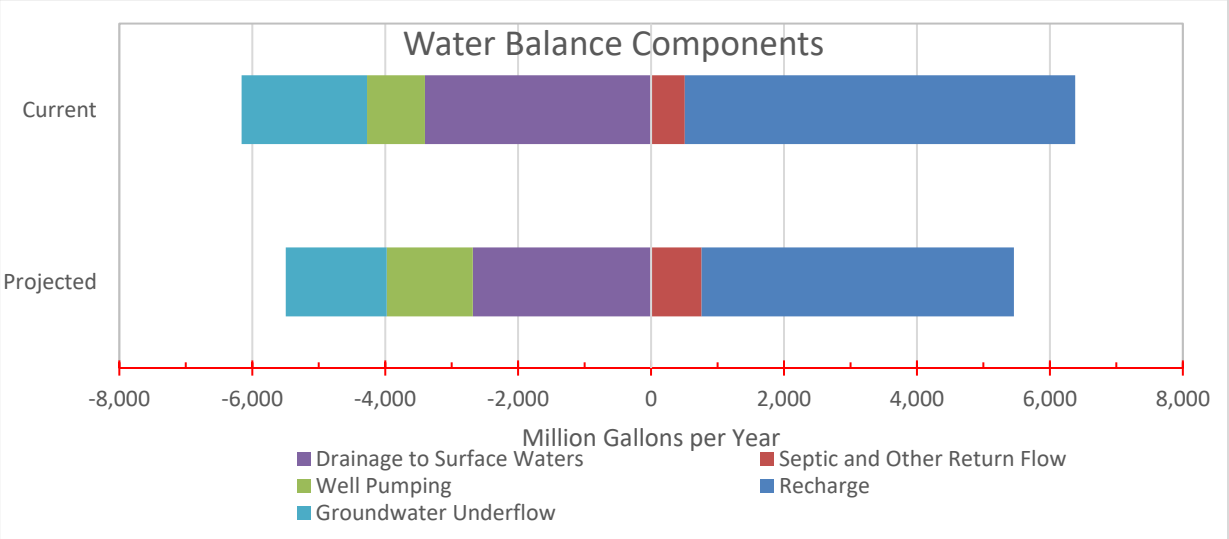


Figure 9. Current and Projected Groundwater Balance Components (Bainbridge Island Only)

Table 3. Water Balance Components (Million Gallons per Year)

Water Balance Component (Million Gallons per Year)	Projected	Current
Recharge	4,700	5,875
Septic and Other Return Flow	759	506
Well Pumping	-1,297	-873
Drainage to Surface Waters	-2,681	-3,401
Groundwater Underflow	-1,519	-1,886

Recommendations for Future Assessments

The Bainbridge Island aquifer system carrying-capacity assessment described above provides an evaluation of long-term changes in groundwater conditions predicted with concurrent stresses on the aquifer system, including increased groundwater withdrawal rates, decreased recharge rates, and sea level rise. To address the sustainability of the Bainbridge Island aquifer system to support predicted population growth and water conservation, our recommendations for future assessments are listed below:

1. Simulate a range of projected future groundwater withdrawal rates, based on input from COBI staff. The assumption of a 50 percent increase over current withdrawal rates was based on the 2016 carrying capacity memo. This assessment did not account for the possible decommissioning of shallow private wells on parcels to be served by expanded public water systems in the future.
2. This assessment simulated increased groundwater demand at existing wells potentially resulting in exaggerated groundwater level declines. An alternative simulation approach would be to assign increased groundwater demand to new Group A or B wells, or new domestic wells based on historical and planned development strategies.

3. Recalibration of model storage parameters may be warranted based on the alignment of data shown in attached Figure 4. Areas assigned lower-than-actual aquifer storage (represented by vertical groups of points in Figure 4) simulate greater-than-actual groundwater level decreases.

4. Perform additional analysis to better characterize the effects of decreasing groundwater levels on shallow wells (e.g., domestic wells). This analysis would identify wells impacted by automatic flow reduction to determine if the assigned pumping rate could not be sustained due to model limitations or actual aquifer limitations. This information may support focused groundwater level monitoring.

5. Validate the groundwater model to stream baseflows. This effort would need to be supported by a stream gaging program. At this point, the updated model has not been validated to stream baseflows, and therefore it is uncertain how well the model simulated surface water – groundwater interactions. Predictive model results can inform focused monitoring and/or mitigation efforts.

6. Provide periodic Bainbridge Island model review, updating the model as needed with new wells, groundwater withdrawal schedules, and groundwater monitoring data. Predictive scenarios should be reassessed using refined assumptions about projected groundwater withdrawal rates, recharge rates, and sea level rise.

7. Continue to implement the Groundwater Monitoring Program. These data provide critical information to support model updates and the decision-making process.

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Limitations

Work for this project was performed for the City of Bainbridge Island (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Attachments:
Figure 1 – Model Domain
Figure 2 – Bainbridge Island Subbasins
Figure 4 – Comparison of Observed and Modeled Water Levels
Figure 7 – Groundwater Discharge by Basin
Figure 8 – Change in Groundwater Discharge to Drainages

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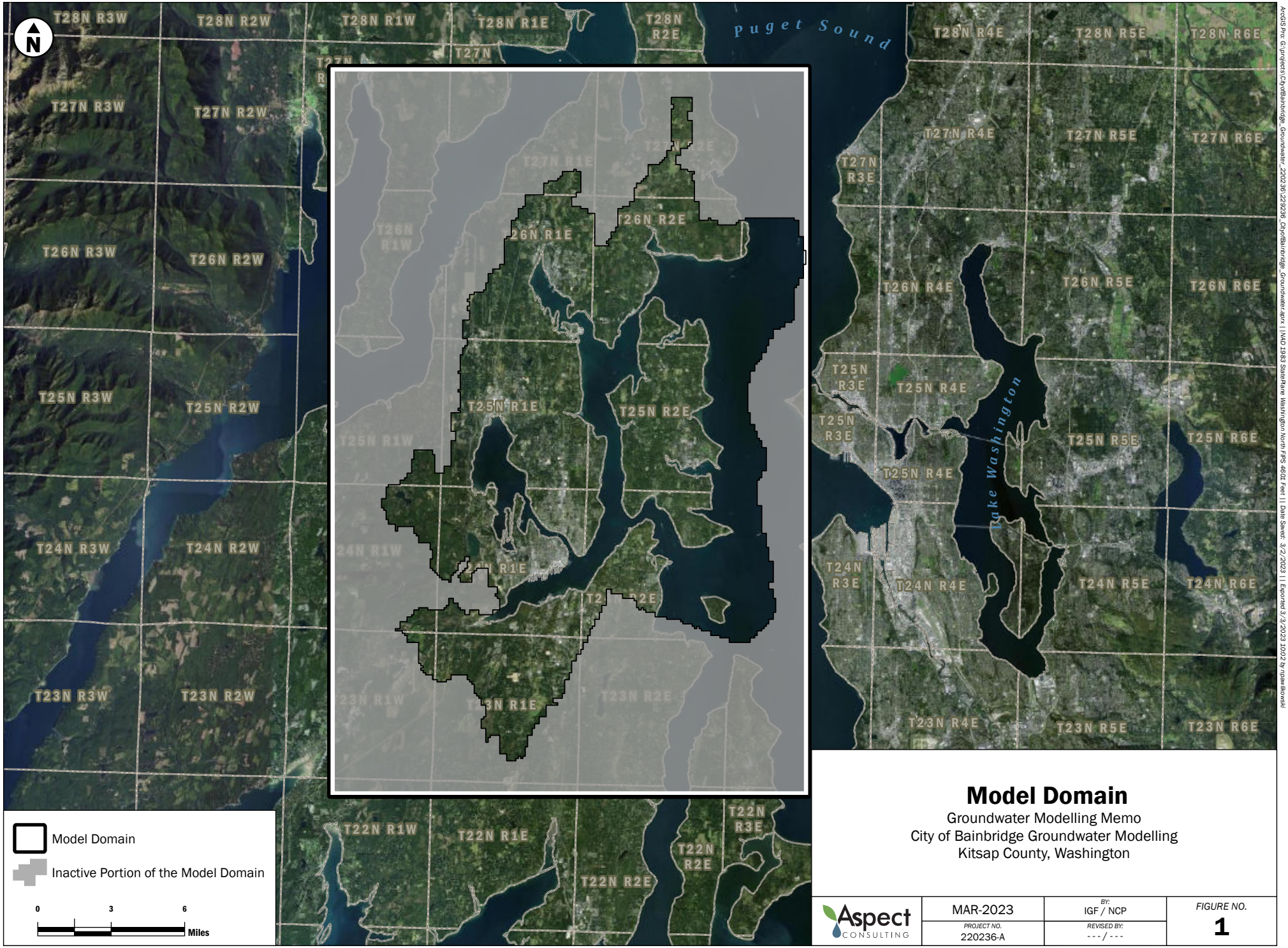
FIGURES



Model Domain

Groundwater Modelling Memo
City of Bainbridge Groundwater Modelling
Kitsap County, Washington

Aspect CONSULTING	MAR-2023	BY: IGF / NCP	FIGURE NO. 1
	PROJECT NO. 220236-A	REVISED BY: ---/---	

Data source credits: None || Basemap Service Layer Credits: Source: Esri, USDA FSA

Bainbridge Island Subbasins

Bainbridge Island Groundwater Model
City of Bainbridge Island
Kitsap County, Washington

Aspect CONSULTING	MAR-2023	BY: IGF / NCP	FIGURE NO. 2
	PROJECT NO. 220236-A	REVISED BY: ---/---	

Data source credits: None | | Basemap Service Layer Credits: Source: Esri, USDA FSA, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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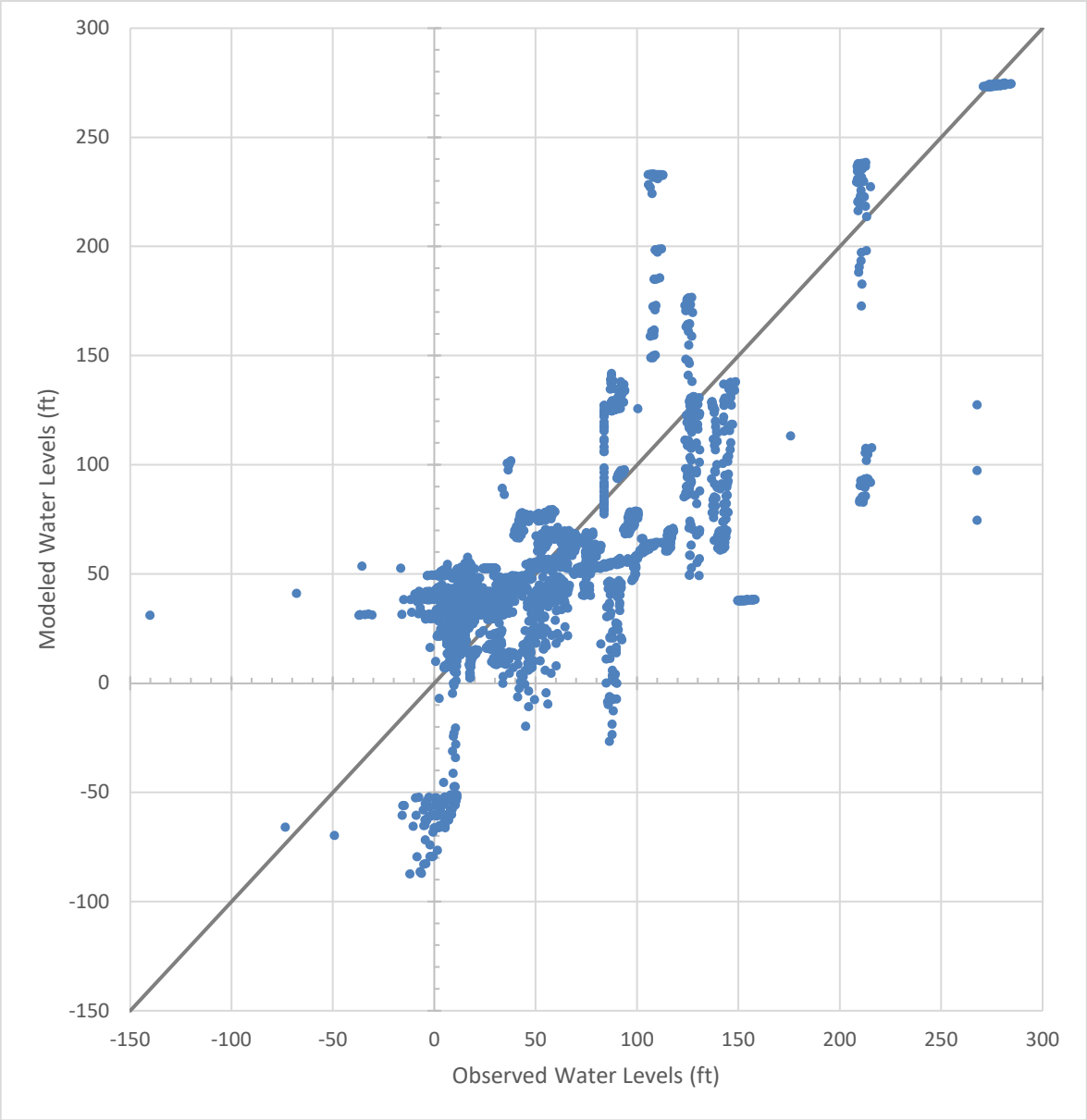

Figure 4
Comparison of Observed and Modeled Water Levels

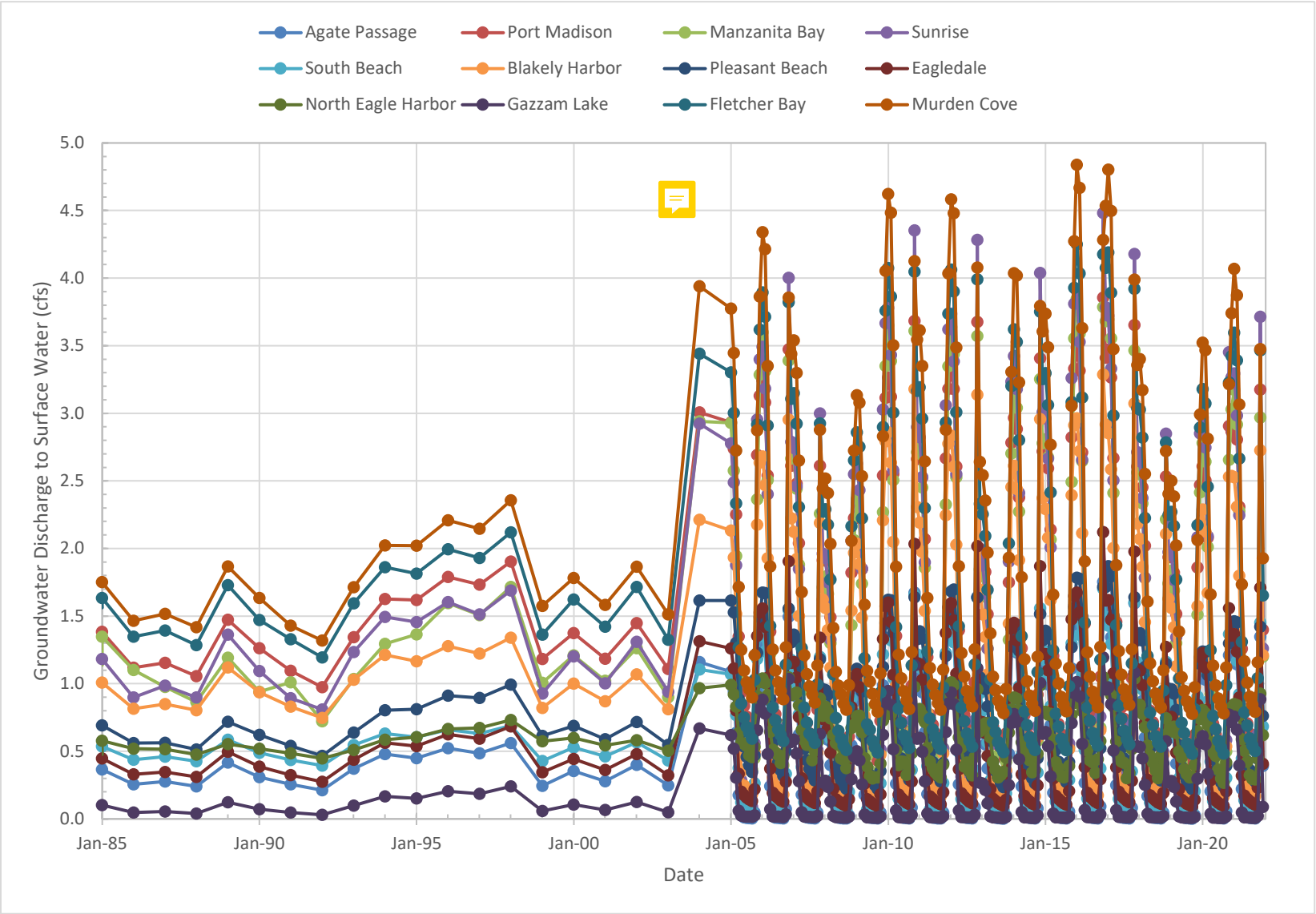

Figure 7a
Groundwater Discharge by Basin
Bainbridge Island Groundwater Model
City of Bainbridge Island, WA

Aspect Consulting
4/19/2023
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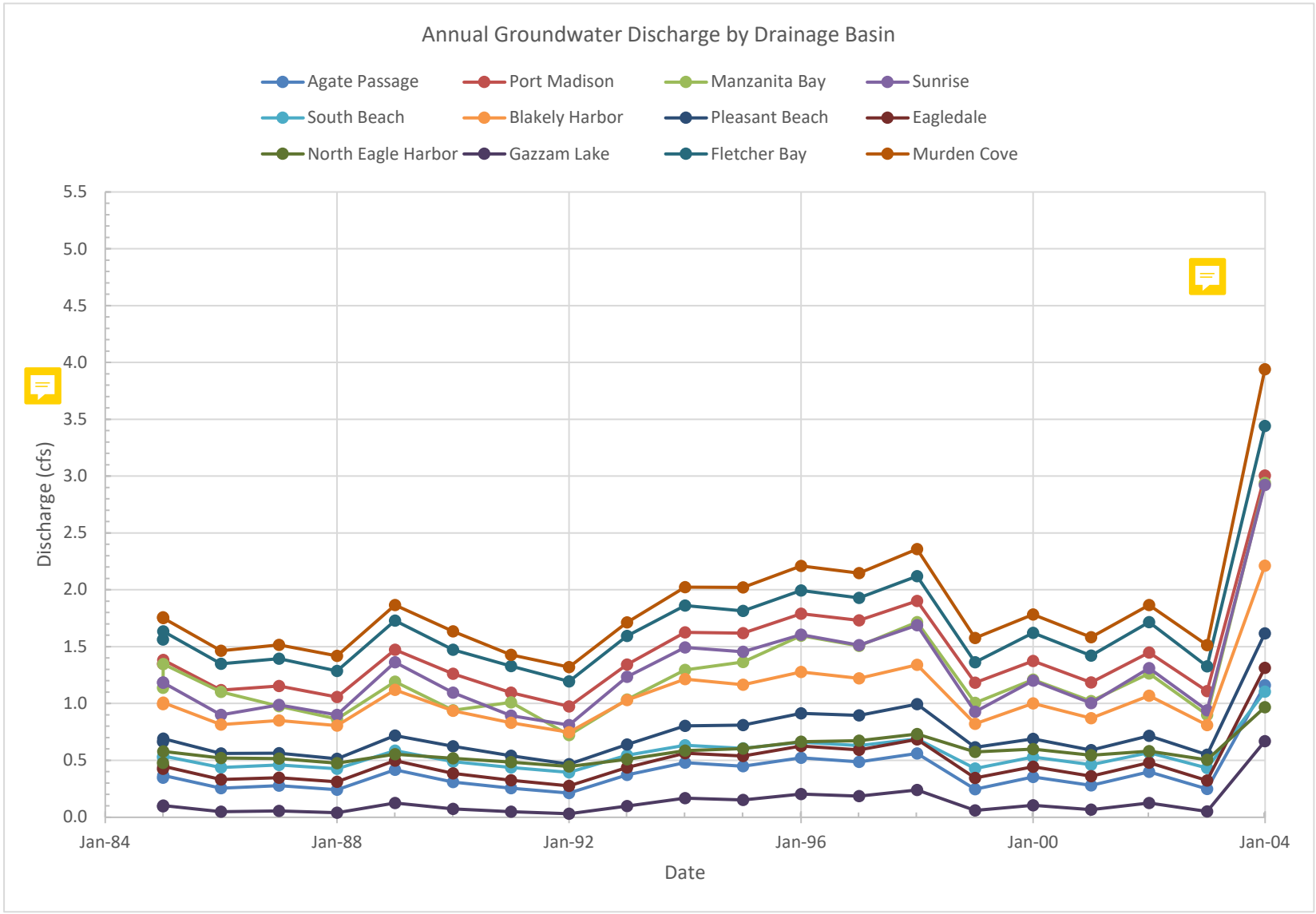

Figure 7b

Groundwater Discharge by Basin

Bainbridge Island Groundwater Model

City of Bainbridge Island, WA

Aspect Consulting

4/19/2023

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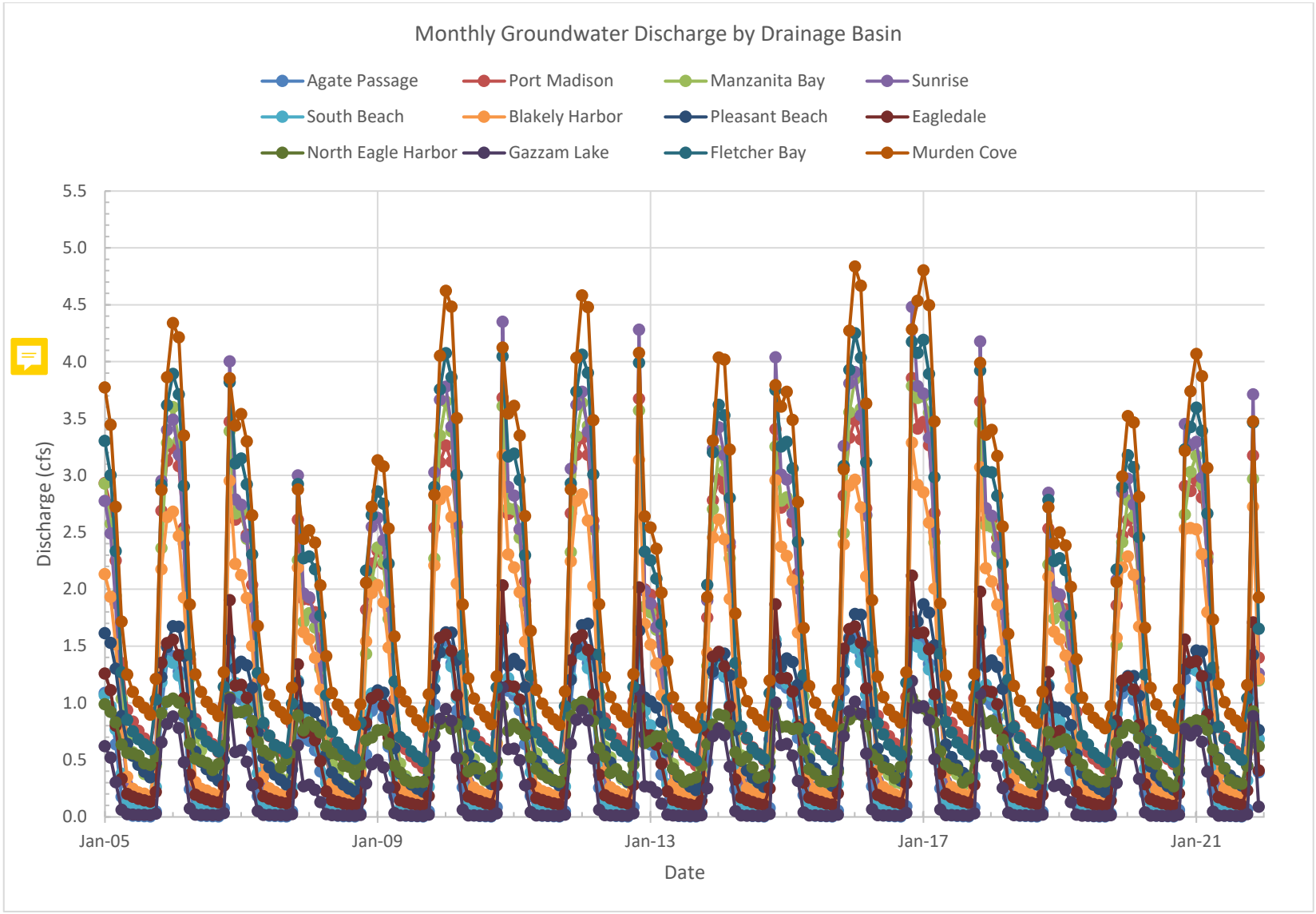

Figure 7c
Groundwater Discharge by Basin
Bainbridge Island Groundwater Model
City of Bainbridge Island, WA

Aspect Consulting
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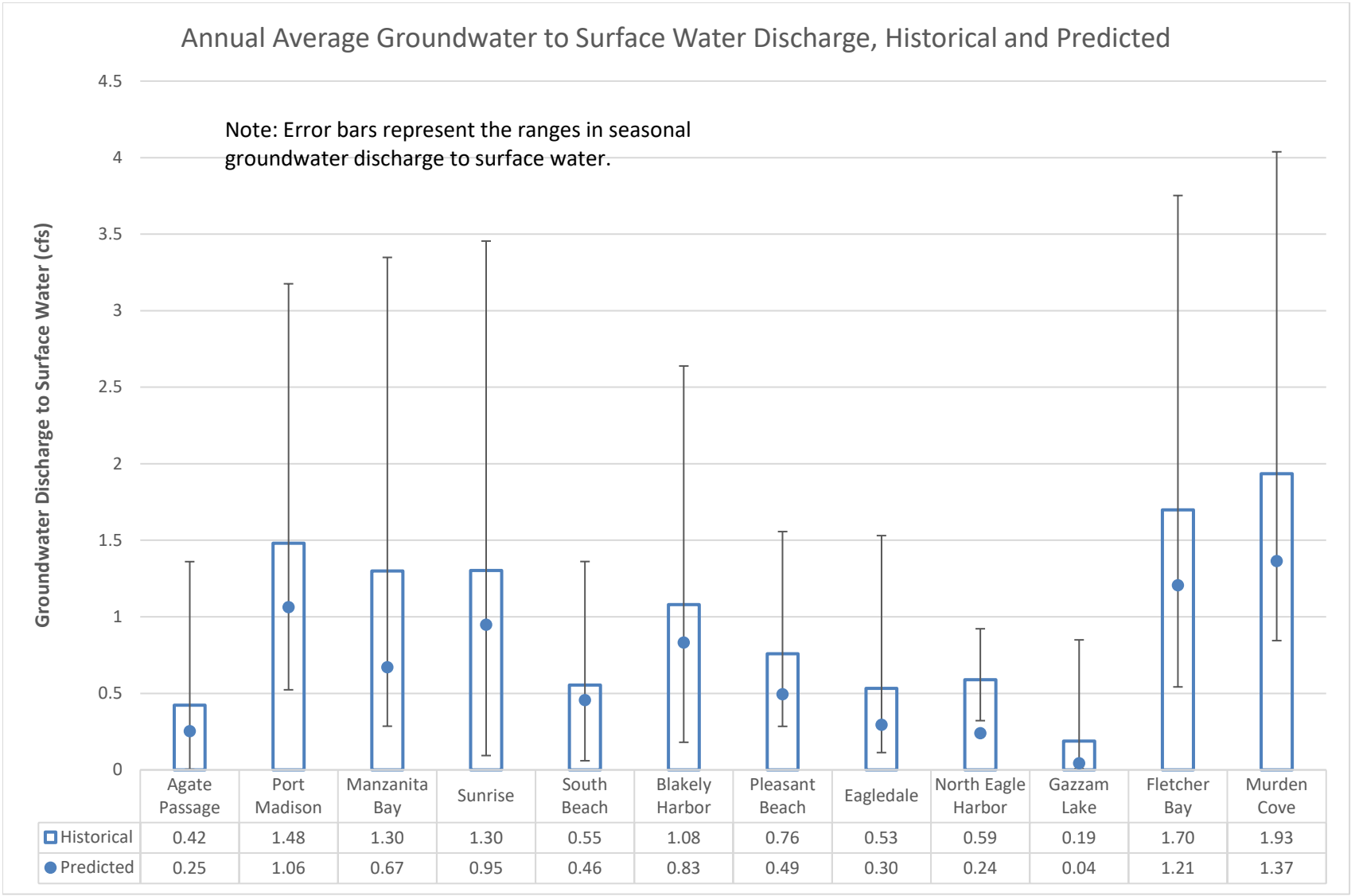

Figure 8

Change in Groundwater Discharge to Drainages

Bainbridge Island Groundwater Model

City of Bainbridge Island, WA

EA Engineering, Science, and Technology, Inc., PBC

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TO: Chris Wierzbicki, P.E., Director of Public Works, City of Bainbridge Island

FROM: Dave Nazy, LHG, CWRE, EA Engineering, Science and Technology, Inc., PBC

SUBJECT: Groundwater Management Plan (GWMP) Draft Scope of Work

DATE: May 1, 2023

EA Engineering, Science, and Technology, Inc., PBC (EA) is pleased to present this proposed scope of work to assist the City of Bainbridge Island (the City) with completion of the Bainbridge Island Groundwater Management Plan (GWMP). Thank you for the opportunity to assist you with this important work.

PROJECT UNDERSTANDING

The City of Bainbridge Island (City) residents, workers and visitors depend on groundwater for all water supply needs. Groundwater also plays a vital role in supporting healthy streams and wetlands across Bainbridge Island. Recognizing management of this precious resource requires a comprehensive, island-wide approach, the City's 2016 Comprehensive Plan directs that a Groundwater Management Plan (GWMP) be adopted. The GWMP will identify and recommend management actions that can be adapted as needs change.

The Bainbridge Island City Council has set the following goals and objectives for the GWMP:

Ensure clean and sufficient groundwater for our natural environment and ourselves	• Produce groundwater models that inform decisions on land-use and population • Develop and implement water conservation and recharge strategies • Minimize and mitigate threats to water quality
Reduce and adapt to climate change impacts	• Identify climate change impacts to groundwater • Develop and implement strategies to reduce and adapt to climate change impacts • Improve climate change indicator monitoring
Develop community-wide understanding	• Establish advisory sub-committee • Establish island-wide stakeholder engagement • Develop on-line platform to share information

Groundwater on Bainbridge Island has been designated as a sole source aquifer by the US Environment Protection Agency (USEPA). This designation recognizes that there is no other water supply source for the island.

There is a wealth of information and knowledge regarding the groundwater system underlying Bainbridge Island and the surrounding area. This includes hydrogeologic characterization investigations and construction of groundwater flow models completed by the US Geological Survey (USGS), groundwater monitoring data collected by the City and Kitsap Public Utility District (KPUD), Washington Department of Ecology (Ecology), Washington Department of Natural Resources (DNR), the US Environmental Protection Agency (EPA) and Aspect Consulting.

The City's 2016 Comprehensive Plan (City of Bainbridge Island, 2017) includes Water Resources Element 6 (WR-6). This element sets out a vision for Bainbridge Island's water resources that are *climate resilient and can support life on the Island*. The vision further provides for monitoring groundwater elevations and groundwater quality, regularly updating the Bainbridge Island groundwater model to support groundwater management decisions, water conservation education and use of low-impact development techniques.

The City has requested EA to prepare this scope of work to assist in the completion of the GWMP. The primary deliverables will be a Summary Document that describes the purpose, methods and major conclusions and recommendations, an Appendix containing all the technical documents related to the GWMP and references, and a High-Level Summary document that presents the GWMP with descriptions and graphics for public presentation. The High-Level document will be accompanied by a Story Map presenting the GWMP in graphical form that will be available on the City's web page.

This document closely follows the GWMP scope of work prepared by the City's Hydrogeologist in March 2022. The City has also prepared a significant portion of the GWMP and worked with Aspect Consulting to improve the groundwater model and evaluate the effects of increased groundwater withdrawals. This scope of work includes review of existing information including the completed portions of the GWMP. This work is intended to effectively continue and complete the GWMP, building on existing information. The focus of this project is to complete the remaining sections of the GWMP, obtain input from all interested stakeholders and produce quality products for use by the City and the public while satisfying the requirements of Ch. 173-100 WAC.

EA understands that in addition to production of comprehensive, technically sound products, a critical component of this project is to engage and work with appropriate City staff, City and County government, State and Federal agencies, the Suquamish Tribe, water purveyors, and other interested stakeholders. This work will coordinate with and seek input from the City's Groundwater Management Sub-Committee, Groundwater Technical Advisory Committee and City Council. EA will also work with and seek input from interested stakeholders and the public.

SCOPE OF WORK

Task 1 - Project Management

Task Description: The objective of this task is to plan and manage project tasks, schedule, and budget, communicate effectively with the City and within the EA Team with the goal of delivering products on time and within budget. This effort includes budget, task, and schedule management, reporting to the City, and incorporating input from Ecology.

1.1 EA Team Meetings

Subtask: This purpose of this Subtask is to manage the EA Team to discuss project activities and progress, identify issues, obstacles, and solutions, maintain the project schedule and budget management. This task assumes up to 1 hour bi-weekly on-line team meetings over the life of the project, currently scheduled to last 82 weeks. Meetings will only be held if deemed necessary and will include EA Project Team members, as necessary. EA's Project Manager will be responsible for organizing and documenting meetings. This task will also be used for less formal communications between Project Team members as necessary.

Subtask deliverables include scheduling, conducting and documenting meetings regarding attendance, topics, and action items.

1.2 EA - City of Bainbridge Island Meetings

Subtask: This purpose of this Subtask is to maintain regular communications between the City and the EA Team to discuss project activities and progress, identify issues, obstacles, and solutions, and to provide updates regarding the project schedule and budget. This task assumes up to 1 hour bi-weekly on-line project meetings over the life of the project, currently scheduled to last 82 weeks. Meetings will only be held if deemed necessary by the City and the EA Project Manager and will only include EA Project Team members needed for the discussion. EA's Project Manager will be responsible for organizing and documenting meetings. This task will also be used for less formal communications between Project Team members with the City as necessary.

Subtask deliverables include scheduling, conducting and documenting meetings regarding attendance, topics, and action items.

1.3 Monthly Status Reporting

Subtask: This purpose of this Subtask is to provide the City monthly status reports and invoices. EA will provide the monthly reports and invoices per the schedule, format and method requested by the City.

Subtask deliverables include monthly billing statements and progress reports to the City summarizing work completed, any problems or obstacles encountered and how they will be addressed, update on schedule and budget, and next steps.

1.4 Senior Technical Review

Subtask: EA employs a Senior Technical Review (STR) Program as an integral component of EA's Quality Management Plan to prevent errors and omissions and to ensure EA's Quality Control standards are met. The program is predicated on an independent and comprehensive review of all project analyses and services by one or more qualified senior EA employees to ensure that appropriate standards have been addressed. The STR will be independent of those who perform the work.

Subtask deliverables include maintaining quality control on all deliverables prior to transmission to the City.

Task 2 - Public and Regulatory Engagement

Task Description: The objective of this task is to work in coordination with the City's Groundwater Management Sub-Committee, Groundwater Technical Advisory Committee and City Council, as well as other stakeholders and the public while completing the GWMP. Stakeholders include City and County government, State and Federal agencies, the Suquamish Tribe, water purveyors, the public and several other organizations that may have interest in providing input to the GWMP. A preliminary list of potential stakeholders has been provided by the City and is included in the table below.

Potential List of Interested Stakeholders	
Suquamish Tribe	Friends of the Farm
Kitsap Public Utility District	Kitsap Realtors Association
Kitsap Public Health District	Bainbridge Island Chamber of Commerce
US Geological Survey	Bainbridge Island Wineries & Breweries
Washington Department of Ecology	Industrial Water Users
Group A Water Systems	Bainbridge Island Schools
Homeowner Water Associations	Bainbridge Island Parks
Bainbridge Island Homeowner Well Associations	Bainbridge Island Watershed Council
Bainbridge Island Land Trust	Sustainable Bainbridge
Wild Fish Organizations	Bainbridge Island Fire Department

EA will work with City staff to identify a list of stakeholders who should be contacted and informed of the GWMP with an invitation to be notified of project milestones and opportunities to provide input to the GWMP. Specific organizations, committees and sub-committees who are already involved in the GWMP or known to have interest have been identified by the City. These include:

2.1 Groundwater Management Sub-Committee, a community-based City committee.

2.2 Groundwater Technical Advisory Committee, composed of regional and agency partners.

2.3 GWMP Advisory Sub-Committee, composed of members of the City's Environmental Technical Advisory Committee, the Climate Change Advisory Committee, and the Utility Advisory Committee.

Commented [ND1]: I may have listed this Sub-Committee twice. Sorry about that if I did. I thought you mentioned 3 committees, but the name of this one is very similar to the first one I listed. I am not sure if these are the same or not.

2.4 Bainbridge Island City Council.

EA will work with City staff to develop a communications plan for each of the organizations listed above. The plan will include compiling a list of contacts, committee meeting dates, important milestones, and opportunities and options for these organizations to provide input to the GWMP.

It is anticipated that several sections of the GWMP will be made available to interested parties and that EA will be responsible for notification of the availability of documents for review, distribution of materials (via email or City web page) for review and comment, recording and compilation of comments received, and preparation of responses to questions and comments regarding the GWMP. It is anticipated that all written communications and documents distributed to interested parties outside of City government will be approved by City staff prior to distribution. EA will conform with all relevant City standards and procedures when communicating with the public.

EA will also work with Ecology to ensure the GWMP meets all requirements of Chapter 173-100 WAC, and that Ecology can review and comment on the GWMP.

Subtask deliverables include those items noted above, as well as attendance at committee meetings, presentations regarding the GWMP, as necessary, answering questions and responding to requests for information. EA understands that some of the activities under these subtasks are not yet well defined, but EA will be flexible regarding what is needed to keep interested parties informed and will maintain close communications with the City regarding any activity under these subtasks before they are conducted.

2.5 On-line Story Map Build, Test, Implement

The objective of this Subtask is to create a Story Map for the City's GWMP web page that describes the purpose, content, results, and recommendations of the GWMP. The story map will be composed primarily of maps, graphs, photos, and other graphics to present the GWMP to the public. It is anticipated that the Story Map will be visually pleasing, informative, and easy to understand. EA will work with City staff to outline the design, content, length, and format.

Subtask deliverables include meetings with the City to discuss content, draft Story Map(s) for the City's review, and final Story Map(s) in a format ready for publication on the City's web page.

2.6 High-Level Public Information Document

The objective of this Subtask is to produce a visually pleasing, easy to understand document presenting a high-level summary of the GWMP. This document could be made available in printed form and as an electronic document to be made available on the City's web page. It is anticipated that this document will summarize all sections of the GWMP and contain links to more detailed sources or information. EA will work closely with City staff to outline the design, content, length, and format and will ensure that all City standards and requirements are met.

Subtask deliverables include meetings with the City to discuss content, a draft document for the City's review, and a final document that incorporates all comments and edits requested by the City. The document can be provided in printed and electronic form ready for publication on the City's web page.

2.7 Public Meeting(s)

It is anticipated that at least one public meeting will be scheduled to present and discuss the GWMP. For this task, EA anticipates preparing a PowerPoint presentation, attending the meeting in person, assisting, or leading the presentation at the meeting, and being available to answer questions and respond to information requests. It is assumed that the meeting will be held following completion of the draft GWMP, although meeting times and dates will be scheduled at the City's discretion.

Subtask deliverables include meetings with the City to discuss schedule, content, roles, and responsibilities. EA will work with the City to create a PowerPoint presentation that will be provided in draft form for review by the City prior to finalizing and presentation at the meeting. It is assumed that the meeting will be held in person and EA staff will be available to help present information, answer questions, and provide follow-up information. EA is available to assist the City on this subtask in any other way that would be helpful.

Task 3 - Draft GWMP

Task Description: The objective of this task is to complete all relevant sections of the GWMP. This task will compile and generate the detailed information that will be contained in the Technical Appendices to the GWMP and will closely follow the outline of the GWMP created by the City's hydrogeologist and approved by the GWMP Sub-Committee. Information generated in this task will satisfy the requirements of Chapter 173-100 WAC and complete the GWMP. Information and analysis performed under this task will be used in the Story Map and High-Level Summary document. This task will also compile and organize all relevant information and will include a list of references with links to data, reports, and other relevant information.

The City has provided a copy of the City's Scope of Work and GWMP report that has been completed to date. EA will use that document as a guide and complete the sections of the document that have not yet been prepared. Because the scope of work included a detailed

schedule, listing individual tasks, EA has followed this format and has broken out this Task into multiple Subtasks.

Because the City has already prepared the *Area Hydrogeologic Characterization* and the *Knowledge and Data Gaps* sections of the GWMP, EA's responsibility includes reviewing these sections and supporting documentation to get familiar with this information and will make recommendations to the City for finalizing these sections. EA will create and complete the other sections needed to complete the GWMP.

Task 3.1 Review Area Characterization Section

This Subtask is intended to review the work the City has previously completed for this section of the GWMP and provide recommendations to the City regarding any suggested edits or revisions to the document. This section of the document summarizes information from many other technical reports and data sources. Thus, as part of the review of the Area Characterization section, EA will also perform a more cursory review of several of those sources of information to become more familiar with the hydrogeologic setting and conditions present on Bainbridge Island.

Subtask deliverables include reviewing the Area Characterization section of the GWMP and related background information and making note of any comments or recommended revisions.

3.2 Area Characterization Recommendations

This Subtask includes documenting comments and recommended edits to the Area Characterization section of the GWMP previously prepared by the City and reviewed in the previous Subtask.

Subtask deliverables includes preparation of a memo to the City documenting EA's review, comments, and recommendations for completing this section of the GWMP. EA will then make any of the recommended changes that are agreed upon by the City to the Area Characterization section of the GWMP.

3.3 Review Knowledge and Data Gaps Section

This Subtask is intended to review the work the City has previously completed for this section of the GWMP and provide recommendations to the City regarding any suggested edits or revisions to the document. This section of the document summarizes information from other technical reports and data sources. Thus, as part of the review of the Knowledge and Data Gaps section, EA will also perform a more cursory review of several of those sources of information to become more familiar with the sources of information and conditions present on Bainbridge Island.

Subtask deliverables include reviewing the Knowledge and Data Gaps section of the GWMP and related background information and making note of any comments or recommended revisions.

3.4 Knowledge and Data Gaps Recommendations

This subtask includes documenting comments and recommended edits to the Knowledge and Data Gaps section of the GWMP previously prepared by the City and reviewed in the previous Subtask.

Subtask deliverables includes preparation of a memo to the City documenting EA's review, comments, and recommendations for completing this section of the GWMP. EA will then make any of the recommended changes that are agreed upon by the City to the Knowledge and Data Gaps section of the GWMP.

3.5 Water Quality and Quantity Issues - Problem Definition

The objective of this Subtask is to complete section 6 of the GWMP. Per the outline provided by the City, this section will be organized as follows:

- Land use impacts to groundwater quality and quantity including:
    - Infrastructure / Assets (including landfills, hazardous and non-hazardous materials storage, use and disposal, water wells, water distribution, wastewater treatment and stormwater)
    - Commercial / Industrial (hazardous and non-hazardous materials storage, use, and disposal / mining activities)
    - Agricultural (hazardous and non-hazardous materials including storage, use and disposal of fuel, fertilizer, pesticide, herbicides)
    - Residential (water use, recharge, on-site septic systems)
    - Recreational / Parks (septic systems, fertilizer, hazardous and non-hazardous material use, storage, and disposal)
    - Open Space
    - Wetlands / streams (including buffers)
- Groundwater extraction and repercussions: water table declines and / or depletion of surface waters.
- Saltwater intrusion:
    - Aquifer over-utilization causing seawater intrusion.
    - Sea level rise and repercussions for saltwater intrusion
- Discussion of extent of the groundwater problems caused or potentially caused by each land use including effects which may extend across groundwater management area boundaries, supported by as much documentation as possible.
    - Analyze historical trends in water quality in terms of their likely causes.
    - Document declining water table levels and other water use conflicts,
    - Establish the relationship between water withdrawal distribution and rates and water level changes within each aquifer or zone,
    - Predict the likelihood of future problems and conflicts if no action is taken.

- Identify land and water use management policies that affect groundwater quality and quantity in the area.
- Areas where insufficient data exists to define the nature and extent of existing or potential groundwater problems shall be documented.
- Recognize existing and future uses of the aquifer are in accordance with water quality standards of the department, the department of social and health services, and the federal environmental protection agency.

EA will perform the research and analysis necessary to complete this section of the GWMP, including incorporation of the groundwater modeling work performed by Aspect and yet to be performed by EA. As part of this process, EA may propose revisions to the organization of this section for the City and GWMP Sub-Committee's consideration.

Subtask deliverables include preparation of text and graphics to complete this section of the GWMP. This document will be provided to the City in Draft form for review.

3.7 Water Quality and Quantity Management Goals and Objectives

Although this topic was listed on the City's project schedule as a specific task, goals and objectives are discussed in several other sections of the draft sections of the GWMP. This item should be discussed with the City to determine if it is specifically desired to be included in the GWMP. It may be helpful to develop quantifiable goals, such as maintaining a specific groundwater elevation in areas susceptible to seawater intrusion.

Subtask deliverables include preparation of text and graphics to complete this section of the GWMP. This document will be provided to the City in Draft form for review.

3.8 Land and Water Management Strategies Alternatives

The objective of this Subtask is to complete section 7 of the GWMP. Per the outline provided by the City, this section will be organized as follows:

- Strategies for reaching the program's goals and objectives that address each of the groundwater problems discussed in the problem definition section.
- If necessary, alternative data collection and analysis programs shall be defined to enable better characterization of the groundwater and potential quality and quantity problems.
- Each of the alternative strategies shall be evaluated in terms of feasibility, effectiveness, cost, time, and difficulty to implement, and degree of consistency with local comprehensive plans and water management programs such as the coordinated water system plan, the water supply reservation program, and others.
- Alternative management strategies shall address water conservation and the effects of climate change on these practices, conflicts with existing water rights and minimum instream flow requirements, programs to resolve such conflicts, and long-term policies and

construction practices necessary to protect existing water rights and subsequent facilities installed in accordance with the groundwater management area program and/or other water right procedures.

Subtask deliverables include preparation of text and graphics to complete this section of the GWMP. This document will be provided to the City in Draft form for review.

3.9 Stakeholder Review/ Input

The objective of this Subtask is to provide completed draft sections of the GWMP to interested stakeholders for review and comment. EA will facilitate distribution of the relevant sections to the stakeholders via email with general instructions for providing comments and a due date for comments to be returned to EA and the City.

Subtask deliverables include assembling a review package, preparation of general instructions and a schedule for returning comments and distributing the review package to interested stakeholders. EA will organize any comments received and provide them to the City. Responses to comments and any edits required will be performed as part of the Task to complete the Final GWMP.

3.10 Recommendations

The objective of this Subtask is to complete section 8 of the GWMP. Per the outline provided by the City, this section will be organized as follows:

- Recommended management strategies chosen from the alternatives section.
- Recommendations may include periodically updating the groundwater model; expansion/refinement of the monitoring well network); and the initiation of a citizen volunteer groundwater monitoring program.
- Rationale for choosing these strategies as opposed to the other alternatives identified.
- Special Area Designations to Enhance Ground Water Protection
- Proposed Citizen Volunteer Groundwater Monitoring Program
- Groundwater Education Program

Subtask deliverables include preparation of text and graphics to complete this section of the GWMP. This document will be provided to the City in Draft form for review.

3.11 Implementation Plan

The objective of this Subtask is to complete section 9 of the GWMP. Per WAC 173-100-100(6), this section will be organized as follows:

- A detailed work plan for implementing each aspect of the groundwater management strategies as presented in the recommendations section. For each recommended management action, the parties responsible for initiating the action and a schedule for

implementation shall be identified. Where possible, the implementation plan should include specifically worded statements such as model ordinances, recommended governmental policy statements, interagency agreements, proposed legislative changes, and proposed amendments to local comprehensive plans, coordinated water system plans, basin management programs, and others as appropriate.

- A monitoring system for evaluating the effectiveness of the program.
- A process for the periodic review and revision of the ground-water management program.

Subtask deliverables include preparation of text and graphics to complete this section of the GWMP. This document will be provided to the City in Draft form for review.

3.12 Executive Summary, Acknowledgements and References

The objective of this Subtask is to complete sections (Executive Summary), 2 (Acknowledgements) and 11 (References) of the GWMP. Portions of these sections have been completed. EA will update and complete these sections and obtain copies or links to all references.

Subtask deliverables include preparation of text and graphics to complete these sections of the GWMP. This document will be provided to the City in Draft form for review.

3.13 Stakeholder Review/ Input

The objective of this Subtask is to provide completed draft sections of the GWMP to interested stakeholders for review and comment. EA will facilitate distribution of the relevant sections to the stakeholders via email with general instructions for providing comments and a due date for comments to be returned to EA and the City.

Subtask deliverables include assembling a review package, preparation of general instructions and a schedule for returning comments and distributing the review package to interested stakeholders. EA will organize any comments received and provide them to the City. Responses to comments and any edits required will be performed as part of the Task to complete the Final GWMP.

3.14 City of Bainbridge Island GWMP Review

The objective of this Subtask is to provide a complete draft including all sections of the GWMP to the City for review and comment. EA will prepare a review package including all text and graphics, as well as all comments received by stakeholders.

Subtask deliverables include assembling a review package for the City for the complete GWMP. EA will be available to meet with the City to discuss any aspect of the project and deliverables. Responses to comments and any edits required will be performed as part of the Task to complete the Final GWMP.

Task 4 - Groundwater Modeling

Task Description: The objective of this task is to become familiar with the groundwater model provided by the City from Aspect Consulting. EA will review the model and identify potential modeling scenarios that could be performed to support management decisions and alternatives in the GWMP. EA will discuss potential modeling scenarios with the City and Interested Stakeholders and make recommendations regarding potential modeling scenarios.

It is assumed that at least one modeling scenario will be selected. Following approval by the City, EA will make any modifications necessary to use the model for the selected scenario. For example, model drain cells may need to be assigned new reach numbers to quantify changes in groundwater discharge to specific areas resulting from groundwater pumping. It is not anticipated that significant changes will be made to the model or that it will need to be re-calibrated. EA will then use the model to evaluate the selected scenario and prepare a technical memorandum describing the scenario, how the model was used, and a summary of the results.

The schedule for Task 5 is intended to have at least one modeling scenario complete around the time the Draft GWMP is complete. Results of the modeling effort will be incorporated into the Final GWMP.

4.1 Review Model Report and Files

The objective of this Subtask is to become familiar with the groundwater model to understand its design, calibration, and potential uses. This review will include work performed by Aspect Consulting, including the model itself, as well as USGS modeling and hydrologic framework investigations for Kitsap County and Bainbridge Island.

Subtask deliverables becoming familiar with the model and hydrostratigraphy of Bainbridge Island for the purpose of using the groundwater model prepared by Aspect Consulting.

4.2 Modeling Scenario Alternatives and Recommendations

After becoming familiar with the model, its limitations, and objectives of the GWMP, EA will identify 2 - 4 potential uses and scenarios that would be beneficial in the development of the GWMP. These alternatives will be described, including a discussion of limitations, complications of running the scenario, usefulness of the results, and a recommendation for a modeling scenario. This information will be presented in a Draft technical memo and provided to the City for review and discussion before finalizing the memo.

Subtask deliverables include a technical memo describing 2 - 4 modeling scenarios that could be beneficial for the GWMP. The memo will also include a recommendation regarding the preferred modeling exercise. EA will also be available to discuss the results of their analysis with the City and interested stakeholders.

4.3 Stakeholder Review/Input

The objective of this Subtask is to provide modeling recommendations memo to interested stakeholders for review and comment. EA will facilitate distribution of the technical memo to the stakeholders via email with general instructions for providing comments and a due date for comments to be returned to EA and the City.

Subtask deliverables include assembling a review package, preparation of general instructions and a schedule for returning comments and distributing the review package to interested stakeholders. EA will organize any comments received and provide them to the City. Responses to comments and any edits required will be performed as part of the Task to complete the Final GWMP.

4.4 Create Modeling Files and Run Scenario(s)

The objective of this Subtask is to make the necessary revisions to the model files and run the modeling scenario(s) approved by the City. The modeling work will be performed in Groundwater Vistas version 8, which is the same software used by Aspect Consulting in their recent modeling work for the City.

Subtask deliverables include editing the modeling files as needed to run the selected scenario(s) and running the model. All edits and work on the model will be documented and presented in a technical memo to be prepared in the following Subtask. All new modeling files and outputs will be provided to the City.

4.4 Modeling Results Technical Memorandum

The objective of this Subtask is to document the modeling work performed in the previous Subtask.

Subtask deliverables include EA preparing a technical memo that describes the objectives, methods, and results of the modeling work. This will include text and graphics that will be incorporated into the GWMP. A Draft of the technical memo will be provided to the City for review and comment.

4.5 City of Bainbridge Island Review

The objective of this Subtask is to provide the groundwater modeling technical memo to the City for review and comment. EA will provide the memo prepared in the previous Subtask, including all text and graphics, to the City for review and comment.

Subtask deliverables providing the modeling memo to the City for review and comment. EA will be available to meet with the City to discuss any aspect of the modeling work and memo. Any suggested revisions and edits will be made before sharing the memo with interested stakeholders.

4.6 Stakeholder Review/ Input

The objective of this Subtask is to provide the modeling memo to interested stakeholders for review and comment. EA will facilitate distribution of the technical memo to the stakeholders via email with general instructions for providing comments and a due date for comments to be returned to EA and the City.

Subtask deliverables include assembling a review package, preparation of general instructions and a schedule for returning comments and distributing the memo to interested stakeholders. EA will organize any comments received and provide them to the City. Responses to comments and any edits required will be performed as part of the Task to complete the Final GWMP.

Task 5 - Final GWMP

Task Description: The objective of this task is to produce a Final version of all sections of the GWMP. This task will incorporate the results of the groundwater modeling work and all comments provided by the City as well as written comments and responses from interested stakeholders. Although this section is broken into Subtasks that mirror the Subtasks in Task 3, the work under each Subtask is essentially the same.

Subtasks include the following:

5.1 Introduction
5.2 Area Characterization
5.3 Knowledge and Data Gaps
5.4 Water Quality and Quantity Issues - Problem Definition
5.5 Water Quality and Quantity Management Goals and Objectives
5.6 Land and Water Management Strategies Alternatives
5.7 Recommendations
5.8 Implementation Plan
5.9 Executive Summary, Acknowledgements and References
5.10 Stakeholder Review/ Input
5.11 City of Bainbridge Island GWMP Review
5.12 Final Edits and Revisions

EA will make any necessary edits and revisions to all sections and appendices of the GWMP. Final graphics and figures will be produced to update the Story Map and High-End Summary document as necessary. Although it is not anticipated that significant revisions will be required, the schedule has been set up to allow for unanticipated delays or revisions.

Task deliverables include Final versions of the GWMP, the Story Map, the High-End Summary document, the groundwater modeling files, and any other documentation produced to support this project. All files will be delivered in electronic format, using a method acceptable to the City.

Schedule

Please refer to the Draft schedule I provided in the spreadsheet yesterday.

Budget

Please refer to the Draft budget I provided in the spreadsheet yesterday. I need to make some revisions but will wait for your comments on this document and the spreadsheet I sent yesterday.

Non-Direct Expenses

Although not currently shown in the budget worksheet, a travel budget is proposed to allow for up to 6 round trips (180 miles x 6 = 1080 miles) between Olympia and Bainbridge Island. The current mileage rate is 0.656/mile. Travel costs for 6 round trips would total around $707.00.

ORDINANCE NO. 2014-25

AN ORDINANCE of the City Council of Bainbridge Island, Washington, clarifying the role, composition and duties of the Environmental Technical Advisory Committee and creating a new Chapter 2.36 of the Bainbridge Island Municipal Code.

WHEREAS, the Mayor appointed the Environmental Technical Advisory Committee ("ETAC") as a ninety-day committee on May 9, 2001; and

WHEREAS, pursuant to Resolution No. 2001-61, the City Council authorized the establishment of the Environmental Technical Advisory Committee as a two-year committee with extensions of six months by the Mayor as necessary; and

WHEREAS, on November 9, 2009, the City Council passed Ordinance No. 2009-27 established ETAC as a permanent committee; and

WHEREAS, the City Council desires to clarify the role, composition and duties of ETAC, and to add ETAC to the Bainbridge Island Municipal Code, now therefore;

THE CITY COUNCIL OF THE CITY OF BAINBRIDGE ISLAND, WASHINGTON, DOES ORDAIN AS FOLLOWS:

Section 1. Resolution Nos. 2001-61 and 2009-27 are hereby repealed.

Section 2. A new Chapter 2.36 of the Bainbridge Island Municipal Code is hereby adopted in its entirety to read as follows:

Chapter 2.36
ENVIRONMENTAL TECHNICAL ADVISORY COMMITTEE

Sections:

2.36.010 Created – Membership, appointment, term and compensation
2.36.020 Vacancies – Removal
2.36.030 Duties and responsibilities
2.36.040 Meetings, officers, records and quorum

2.36.010 Created – Membership, appointment, term and compensation

A. There is created an environmental technical advisory committee for the city, hereinafter called the committee. The committee shall consist of seven (7) members who shall be appointed by the mayor and confirmed by vote of the city council.

B. The committee shall consist of local experts who are qualified as an expert pursuant to WAC 365-195-905(4), as amended, in order to fulfill the purposes described in this section. The committee members should have expertise in one

or more of the following areas: wildlife management, fisheries management, geology, wetlands management, hydrology, forestry, and aquatic or terrestrial ecology.

B. Members shall not be employees or officers of the city or appointed to another city committee, board or commission, except for specialized committees or task forces of limited duration.

C. Members of the committee shall serve for a period of three years, commencing on July 1 and ending on June 30 three years later. Members shall be appointed to a position number, and the terms are to be staggered, with no more than three positions expiring in any given year. A member may be re-appointed, and shall hold office until his or her successor has qualified and been appointed. No member shall serve more than three consecutive terms unless the city council determines that special expertise is required, or there are no other qualified applicants.

D. Members shall serve without compensation.

E. Members shall sign a conflict of interest statement in accordance with the city's ethics program upon appointment and any reappointment.

F. The committee shall develop a pool of qualified experts in the various aspects of environmental science set forth above and shall consult with these experts on issues related to their field of expertise as appropriate and necessary. This pool of experts is to be used for consultation only and will not be compensated or considered members of the committee.

2.36.020 Vacancies - Removal

Members may be removed upon a majority vote of the city council. In the event of a vacancy, the mayor, subject to confirmation of the city council, shall make an appointment to fill the unexpired portion of the term of the vacated position in accordance with the city's appointment cycle. Unexcused absence by any member from three consecutive meetings shall constitute grounds for removal.

2.36.030 Duties and Responsibilities

The committee is established for the following purposes.

A. Serve as a technical advisory committee to the city council, city manager and planning department staff on environmental management issues; and

B. Provide technical recommendations on habitat management plans pursuant to BIMC 16.20.060 as needed to support staff in their review of these plans when technical issues and questions arise; and

C. Provide technical recommendations on environmental management standards for the City of Bainbridge Island Shoreline Management Master Program and Chapter 16.20 BIMC, Critical Areas; and

D. Conduct all items related to Chapter 16.20 BIMC, Critical Areas, consistent with the best available science sections (WAC 365-195-900 through 365-195-925) of the procedural criteria of the Growth Management Act; and

E. Conduct all items related to the shoreline management master program consistent with the scientific and technical standards section (WAC 173-26-201(2)(a) of the procedural criteria of the Shoreline Management Act; and

F. Report annually to the city council prior to the start of the budget process.

2.36.040 Meetings, officers, records and quorum.

A. The committee shall meet as necessary. Generally, meetings will occur at a consistent time on a monthly basis. Meetings shall be open to the public and held in accordance with the Open Public Meetings Act (Chapter 42.30 RCW).

B. The committee shall select from among its members a chairperson for a one-year term at the first regular meeting of each year.

C. For meetings consisting of a majority of the then serving members of the committee, the committee shall provide public notice of the meeting and shall keep a record of its meeting minutes. Minutes of each meeting, including a record of attendance, shall be prepared by the secretary and approved and signed at a subsequent meeting. The minutes do not need to reflect the actual discussion, but only the formal actions taken by the committee. The approved meeting minutes shall be posted on the city's web site.

D. The city shall provide city email accounts to members and related training on the use of email accounts, including personal computer privacy expectations while serving on the committee.

E. A majority of the members then serving on the committee shall constitute a quorum.

Section 3. This ordinance shall take effect and be in force five (5) days from its passage, approval, and publication as required by law.

PASSED by the City Council this 9th day of June, 2014.

APPROVED by the Mayor this 9th day of June, 2014.

By: Anne S. Blair
Anne S. Blair, Mayor

ATTEST/AUTHENTICATE:

By: Rosalind D. Lassoff
Rosalind D. Lassoff, City Clerk

FILED WITH THE CITY CLERK:	May 29, 2014
PASSED BY THE CITY COUNCIL:	June 9, 2014
PUBLISHED:	June 13, 2014
EFFECTIVE DATE:	June 18, 2014
ORDINANCE NUMBER:	2014-25