Questions NOT Answered during June 18th BI "Water Workshop"

The Aquifer System

1. What is the relationship between the identified aquifers on the island? Are they connected? Does drawdown in one aquifer effect the water levels in other aquifers? i.e.; Does drawdown in deep aquifers lower the water level in shallow aquifers?

Answer (Cami, COBI): Though water levels in a particular aquifer are more immediately responsive to (vulnerable to) direct withdrawals from that same aquifer, there is some limited exchange between aquifers. This means that if withdrawals from the deep aquifers are excessive, it may have an impact on the shallow aquifers.

2. Is there a General Plan in place for the aquifers?

Answer (Cami, COBI): The City's Groundwater Management Program conducts monitoring, assesses data, reports on aquifer system status and trends, and provides some management guidance in response to monitoring observations.

However, we do not currently have a comprehensive Islandwide Groundwater Management Plan. During the presentation, the City suggested creating such a plan as a measure that the community can take to fully manage this resource. This would involve all stakeholders (citizens, water purveyors, businesses, agriculture, local governments, etc.) working together to establish groundwater management policy, goals, initiatives and so forth, similar to the City's Comprehensive Plan. This management plan would cover everything from water resource development and conservation to emergency management response such as drought, earthquake, or contamination.

3. What plan for water does the City have in place if there is a major earthquake?

Answer (Doug, COBI): If a major earthquake causes damage to the City's drinking water conveyance system, the City emergency response plan calls for pumping water from undamaged infrastructure using backup generators and trucking water to areas in need until such time as infrastructure can be repaired and supply restored. Emergency response procedures also include coordination with off Island agencies and emergency responders who may be able to bring water on-Island as well.

4. What percentage of Island wells are using shallow aquifers?

Answer (Cami, COBI): The Level II Assessment (Kato & Warren and Robinson and Noble, 2000) reported that approximately 29%-30% of Island wells utilize the shallow aquifers (Perched and Semi-Perched) and these wells are domestic (private) wells.

5. How much of our water comes from aquifers with only on-island contribution compared to off-island water origination such as the Fletcher Bay aquifer. I wonder if we know how much we have full control over?

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Answer (Cami, COBI): First, the only aquifer that appears to receive recharge from off-island is the Fletcher Bay Aquifer. Although only 1% of the wells on the Island use this aquifer, they are public purveyor production wells, and provide approximately 30% of total groundwater production on the Island.

Next, the right to use water (water right) is fully controlled by the Department of Ecology. Additionally, permitting and certifying wells is under the joint control of the Department of Ecology and the Kitsap Public Health District. So, the City has, and can only ever have, very limited control over water use on the Island, usually through zoning and development within the context of state and federal growth and development regulations.

6. Is rainfall the major replenishment source for all Bainbridge aquifers, or are there now indications that the deep aquifer is being replenished by external flows? (That was an unknown in the USGS report).

Answer (Cami, COBI): Recharge comes from both rainfall/precipitation and off-Island through the deep Fletcher Bay Aquifer which continues under Port Orchard Passage and under the Kitsap Peninsula. The USGS model report stated that approximately 95% of the recharge comes from on-Island precipitation and 5% from off-Island. However, Aspect's refinement of the model may produce different percentages, but we won't have that information until later this year (Fall).

Water Budget (Quantity)

7. How can we justify additional use of the aquifers when other implementation of the sewer system is "mining" the aquifer.

Answer (Cami, COBI): It is unclear what is meant by "other implementation of the sewer system". However, the new work by Aspect will give us a better idea of our water budget and the status of each of our aquifers, particularly in light of projected population change (i.e., additional use of our aquifer systems).

8. Do we know our current annual water consumption on the Island? Can we use conservation measures to maintain current levels of consumption, while allowing for projected growth?

Answer (Cami, COBI): The USGS model determined that annual water consumption (termed "withdrawals") is approximately 2,000 acre-feet (or 652 million gallons) of water per year which constitutes approximately 6.5% of the flow through the entire groundwater system.

Absolutely, water conservation measures can help to maintain or even reduce water consumption while allowing for projected growth, particularly as newer water-saving devices are developed and become available. As a nation, we've already seen significant reductions in

water consumption in the last 20 years due to better technologies and other conservation efforts.

9. Wouldn't it be important to budget some of that groundwater to surface water?

Answer (Cami, COBI): Yes, it is important to maintain sufficient water in our streams, lakes, and wetlands to support a healthy habitat for aquatic flora and fauna. In fact, aside from water extraction for human consumption, the primary form of groundwater discharge (outflow of water from the system) is to surface water features such as streams, lakes, wetlands, springs, and seeps, including seepage to marine waters along shorelines.

A water budget can account for, and help us balance, these outflows.

10. How do we know the early warning levels (EWLs) being used are protective of aquifer sustainability? Do the EWLs have protections "built in" to account for periods of extreme draught?

Answer (Cami, COBI): The EWLs are designed to be particularly conservative, meaning the warning would be triggered well in advance, allowing time for additional monitoring and assessment to prevent a significant problem from developing, thereby protecting sustainability in terms of water quality and quantity.

The EWL for seawater intrusion (≥100 mg/L chloride or any increasing trend) is in keeping with conservative approaches taken by Jefferson County and San Juan County, both counties which have experienced seawater intrusion. This level is well below EPA's secondary maximum contaminant level for chloride in groundwater (250 mg/L).

The EWL for safe yield (≥ 0.5 feet per year for 10 years) allows for screening out of natural fluctuations in water levels, while minimizing water level decreases, again allowing enough time for additional assessment and mitigation actions.

However, these EWLs are designed to alert us to potential developing conditions due to seawater intrusion or excess water use. They are not designed to protect or mitigate for impacts due to climate change such as extreme drought. The best protective action and mitigation for drought is water conservation (i.e., reduction in use). The City is currently working on an Island-wide water conservation plan which will not only address incentives for reduced water use, but emphasize education and outreach. The City is partnering with the Bainbridge Island Watershed Council to develop the education and outreach component in order to more effectively reach a broader, Islandwide audience.

11. What is the County Health District doing to measure use of wells to determine whether there is over subscription/ demand of groundwater?

Answer (John Kiess, KPHD): We permit new wells in accordance with Washington State Department of Ecology's groundwater withdrawal rules.

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Contaminated Sites

12. How does the contamination at the Jiffy Mart LUST (No. 5529) affect the City's well on Foster? Second, at what level is the aquifer that is contaminated?

Answer (Cami, COBI): It should not affect the City's well at all due to both the distance from the site and the aquifer that the City's well is utilizing. According to the site documentation online on Department of Ecology's website (fortress.wa.gov/ecy/gsp/), there are two "states" of pollutants at this site, the undissolved or Light Non-Aqueous Phase Liquid (LNAPL) pollutants and dissolved pollutants. A Light Non-Aqueous Phase Liquid (**LNAPL**) is a groundwater contaminant that is not soluble (won't dissolve) in water and has lower density than water. Once a **LNAPL** infiltrates the ground, it will stop at the height of the water table because the **LNAPL** is less dense than water. The figures provided in the documentation show the LNAPL at the water table at approximately 23 feet below land surface in what appears to be, based upon sediment description, the shallow Perched/Semi-Perched Aquifers on site.

The dissolved pollutants, which tend to be more mobile, have been reported observed in what appear to be, again, based upon sediment description, the Sea Level Aquifer at approximately 45 – 70 feet below land surface. However, the documentation reports that based upon monitoring, both the LNAPL and dissolved pollutants appear to be contained (laterally/horizontally) to the old mart location and the eastern edge of the property to the west of the site.

The City's well is utilizing the Fletcher Bay Aquifer which is separated vertically from the contamination by the Glacio-marine Aquifer and two additional "confining" layers of silt and clay, and is a significant distance from the contaminated site. For more details about this site, please contact the Ecology Site Manager, Dale Myers, at 425-649-4446.

City Water System

13. What chemicals are used to treat City water?

Answer (Chuck, COBI): At each well site the water is treated with chlorine and fluoride. Chlorine treatment provides a disinfectant residual to maintain a barrier against potentially harmful microorganisms and help prevent bacterial regrowth in the distribution systems and storage reservoirs. Fluoride treatment is used as a water additive to promote dental health. Fluoridation is an optional treatment that was voted on and approved for use in city-owned water systems by City of Bainbridge Island Council Resolution 92-47.

14. How many B.I. residents are aware of the city program that pays $100 for replacing an older high flow toilet with a new low flow toilet?

Answer (Cami, COBI): This incentive was adopted through city ordinance in 1999. Here is the excerpt from the ordinance:

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13.14.110 Reimbursement for "low-flush" commodes.

A. Any private property owner who is connected to the city's sewer main, who is using one or more "high-flush" commode(s) as of the effective date of the ordinance codified in this chapter and who subsequently replaces the high-flush commode with a low-flush commode may be reimbursed by the city, in its discretion, $100.00 or one-half of the cost of a new "low-flush" commode, whichever is less.

B. To qualify for the reimbursement provided by this section, a private property owner must provide the city with a valid receipt evidencing the purchase price of the low-flush commode and the date of the purchase. The private property owner must further provide to the city evidence which the city deems to be reliable proof that the low-flush commode for which the owner seeks reimbursement has been installed and is in working condition.

C. For the purposes of this section, a "high-flush" commode shall mean a commode which uses between five to seven gallons of water per flush. A "low-flush" commode shall mean a commode which uses no more than 1.6 gallons of water per flush. (Ord. 99-23 § 1, 1999)

The City is currently working on an Island-wide water conservation plan which will not only address incentives such as this, but emphasize education and outreach. The City is partnering with the Bainbridge Island Watershed Council to develop the education and outreach component in order to more effectively reach a broader, Islandwide audience.

Development

15. When future developments and new construction building permits are approved, is the fixed water supply being considered?

Answer (Jen, COBI): The water utilities manage the water supply with oversight from the County and State Departments of Health, and the Department of Ecology, who manages exempt well permits. New construction has to demonstrate water availability prior to building permit issuance.

16. Are there any recommended changes to the existing building codes related to water use?

Answer (Jen, COBI): Not in relation to drinking water, but stormwater management regulations will become more rigorous about requiring low impact development practices in the near future.

17. Is the map of the high aquifer recharge areas used in the permitting process? If so, how?

Answer: (Jen, COBI) The USGS model contained a map showing areas with different recharge rates. Reviewing that work is in the scope of work that Aspect is reviewing. In the fall, Aspect will produce a revised recharge rate map, which can be used by the City Council to determine what rate of recharge should qualify as high enough to qualify as a "critical aquifer recharge area" through the Critical Areas Ordinance update, also in the Fall/ Winter of 2015.

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18. Assuming we care about ground water availability far into the future, is a twenty year planning window adequate for managing the use of Bainbridge Island's ground water resources?

Answer (Cami, COBI): The planning window that was used for the original model runs that USGS performed for the City was primarily influenced by funding. In order to maximize the number of questions (i.e., model runs) that could be answered, a shorter planning window was required. Certainly a longer planning window is desirable and sometimes necessary depending upon the question we want the model to answer.

As the City works through its comprehensive plan update, potential new questions will arise that citizens and council need answered by the model. In that case, all the details of the model run, including planning window, will be discussed and decided. It is important that citizens provide input in this process to guide council and city staff.

19. What is the downside and benefits to erring on the side of protecting our aquifers by allowing less ground water pumping on Bainbridge Island?

Answer (Doug Wood, DOE): The decline in aquifer levels, while sometimes thought of as continuous, is a history of development followed by a loss of storage, then more development followed by more lost storage. Between each pulse of development, the aquifer achieves a new, lower equilibrium water level that reflects the loss of storage.

The downside of the loss of storage and lower water levels is that wetlands can dry up and streams lose baseflows that support plants and animals. The only consequences that could be construed as benefits that come to mind are drier basements in some areas and possibly fewer insects and wild animals where habitat is lost. It is highly unlikely that such "benefits" would be uniformly acceptable to citizens.

20. Our comprehensive plan directs that "*The long-term sustainability of the Island's water resources is maintained.*" How are the general declines for our three main aquifers under the expected impact scenario consistent with our comprehensive plan and long-term sustainability?

Answer (Cami, COBI): For the Expected Conditions scenario USGS model simulation of water levels in the Perched Aquifer (Vashon Advance - Qva) show water level decreases of less than five feet for most of the aquifer with only isolated pockets of water level decreases greater than five feet by the year 2035 (USGS report, figure 37A, page 78).

Similarly, the model results showed water level decreases of less than five feet for most of the Sea Level Aquifer (QA1) with few isolated pockets of decreases greater than five feet. Additionally, the model simulated water level *increases* in portions of the Sea Level Aquifer of up to five feet (USGS report, figure 37B, page 79). These conditions are not indicative of a general decline in this aquifer.

Lastly, the model simulated water level decreases of less than six feet in the majority (approximately 2/3rds) of the Fletcher Bay Aquifer (Deep aquifer – QA3), with decreases less than 10 feet in the remaining third of the Aquifer (USGS report, figure 37C, page 80).

These results are not sufficient evidence of a lack of sustainability of the entire aquifer system comprised of all six available aquifers. It certainly warrants some consideration of moving water demand from areas of higher projected decreases to areas of lower projected decreases, or areas of projected *increases*, to maintain the overall sustainability of the system.

Approaches that could be considered are to either distribute a higher portion of growth into these least impacted areas or devise ways to transmit water from the least impacted areas to the areas of greater impact. This is a management strategy that can be "tested" using the USGS model in support of the comprehensive plan update.

Alternative Drinking Water Sources

21. What are the realistic possibilities/feasibilities of getting more water from either off-island wells or distillation from sea water or converting the WWTP's effluents into potable or ground rechargeable water? Has the City studied alternate water sources such as desalination?

Answer (Doug Wood, DOE/Cami, COBI): Off island sources are not realistic since approval, notwithstanding technical issues, would require a major change in State Water Resource Policy regarding transferring water from one basin to another.

Desalination requires large amounts of electrical power to produce enough water to supply a community of over 20,000 people, so it would not likely be feasible at present.

WWTP treated effluent can replace some of the current production, but since sewered areas are near sea-level there would be limitations on where treated water could be used. Pumping of treated water to upland areas for recharge or use would be better, but expensive.

The City has not conducted an in-depth assessment of alternative approaches at this time.

Miscellaneous

22. I would like to hear how all of this will impact/interact with the numerous independent water companies on the island. We are on a Public Water System that serves approx. 9 private residences on Blakely Ave and we are having a very hard time communicating with the owner of this small company.

Answer (Cami, COBI): As part of the data gathering for Aspect's work-in-progress, we are going directly to the Kitsap Public Health District for information on the public water systems. If you are having problems communicating with the water purveyor, I suggest you contact the Health District for assistance. You can reach them at 360-337-5235; ask for the Drinking Water Section.

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23. Does the city or other public water systems on Bainbridge test for pharmaceutical contamination in well water due to septic system recharge into Island aquifers?

Answer (John Kiess, KPHD/Chuck, COBI): The Kitsap Public Health District is not aware of any public water systems that test for pharmaceuticals, and the city does not test for pharmaceuticals.

24. Please explain why shallows wells, (dug wells) over time, seem to produce less water.

Answer (Cami, COBI): All wells will produce less water over time due to diminished pump performance, breakdown or clogging of the well screen, or compaction of the aquifer material around the screen. Sometimes replacing the pump and/or well screen may help regain some production, though likely not all.

25. Case study: My house was built in 1927 and it worked with a brick lined 19' deep well until 1986. In 1986 a new drilled 205' deep well was dug, this well produced 4 gal per minute. This well continued to produce until neighbors (maybe coincidental) dug wells in the 300' range. In 2005 this 205' deep well had to be replaced with a 350' deep well. This new well produces 20 gallons per minute. Is it possible that over production of deep public water wells will cause this new well to produce less water or need to be dug deeper?

Answer (Cami, COBI): First, let's discuss well "production" (i.e., gallons of water produced per minute). Well production is primarily driven by two things (capacity of the pump and the water conveyance properties of the aquifer from which the well draws water). Bigger, stronger pumps can "pull" more water. Regarding the aquifer properties, if water moves slowly or less efficiently through the aquifer based on its sediment composition, you will typically see less production. Whereas, you will see higher production in aquifers whose sediment transmits water more efficiently.

However, all wells will produce less water over time due to diminishing pump performance, breakdown or clogging of the well screen, or compaction of the aquifer material around the screen. Therefore, it is possible that any diminished production (i.e., fewer gallons of water per minute) observed in the 19' well (1927 – 1986) and the 205' deep well (1986 – 2005) may be due to one or more of those causes.

It is a strong possibility that the shallow well, the 205' well, and the 350' well all utilized different aquifers. Without more specific information about pump, screen conditions, and knowledge about which particular aquifer each was utilizing, we can only speculate on the cause of lost production.

Regarding the possibility that the neighbor's 300' deep wells or deep public supply wells impacting production…again, production is driven by the capacity of your pump and the properties of your aquifer, so typically a neighboring well shouldn't impact your well's production. However, if nearby wells are using the same aquifer and using an excessive

amount of water, you may see water levels in the aquifer drop temporarily and your well may run out of water faster. In most cases, it is declining water levels that require a well to be dug deeper.

Again, without specifics on your location and aquifer in relation to public supply wells, any speculations would be just that, speculation.

26. Are reservoirs being identified or planned to capture the water from those predicted large storm events (likely given climate change scenarios) so it can be metered our during the intervening dry periods? For example, all those irrigation ponds built in the 1950's.

Answer (Cami, COBI): Up until very recently, climate change models were only able to generalize impacts on a global or national scale. Only recently has the UW Climate Impacts Group, using more regional-specific models, been able to project regional-specific changes in rainfall patterns. Also, they have only examined consequential impacts to stormwater runoff to date. I have encouraged them, and they appeared interested in, modify or expanding their models to look at how these rainfall pattern changes will impact aquifer recharge and water levels, if at all. Therefore, it is a little early to be able to determine what the appropriate course of action should/may be.

That being said, the concept of capturing the excess runoff and somehow "storing" it for later use during the dry season to enhance summer stream base flows and groundwater aquifer recharge has arisen in the conversation and will be explored by the scientific/engineering community moving forward. As the scientific and engineering community learns more through these studies, the City may choose to explore the feasibility of particular approaches for our community.

27. The city-owned Suzuki property (almost 14 acres) at New Brooklyn and Sportsman Club Roads are known to the locals as an area with a natural spring and underground streams that are very effective uptake area. How do we get this land designated as "conservation" versus sold to a high density developer in the next 45 days?

Answer (Jen, COBI): The City Council is currently considering how to surplus the city-owned Suzuki property. Contact the City Council with your comment.

Aspect's Current Work-in-Progress

28. The current Aspect consultancy study is not yet available to the public - will it be available Thursday evening and will Aspect discuss?

Answer (Jen, COBI): The Aspect report will be completed in the Fall of 2015.

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29. What kind of information and/or monitoring is being gathered to get a handle on the groundwater / surface water connections on the Island? Can the USGS model incorporate this information?

Answer (Cami, COBI): The USGS model was not specifically designed to detail groundwater/surface water interaction beyond amount of flow from aquifers to adjacent surface waters. This has been identified as a potential modification that Aspect Consulting will be assessing as part of their current work for the City, and they will be providing a description and cost estimate for that modification.

The primary types of data that would be helpful in characterizing the groundwater/surface water interaction are stream flow volumes, groundwater flow direction and level elevations, and stream substrate (bottom) elevations. Much of this data is already available, and the City has continuous stream flow monitoring data from three Island streams from the City's surface water monitoring program, the Water Quality and Flow Monitoring Program. The City continues to collect groundwater level data and continuous stream flow data as part of those monitoring programs.

30. Looking at Aspect "Task 1" Charts, we can see the correlation between pumping and water levels but looking at the chloride chart the last 2 years show an uptick in chloride. Does this mean the "mixing area" between aquifer and seawater moved, potentially disguising the real impact of "potable" water level in the Fletcher Bay aquifer?

Answer (Cami, COBI): There is insufficient data at this time to make a determination. The Early Warning Level criteria for seawater intrusion is a concentration greater than or equal to 100 mg/L or any increasing trend. However, it takes four consecutive increasing sampling results to confirm a trend as there can be natural variability in the system.

The charted data are well below the 100 mg/L triggering level, and there have only been two samples, so far, that show increasing concentrations. Therefore, these data do not meet the Early Warning Level criteria at this time. Should the next two samples also show an increase over the previous sampling results, this would trigger the need for site-specific study to determine the cause and take management action. Only site-specific study can determine whether or not these increases are from seawater intrusion.

31. Will the City reserve some of the consulting budget allocated to Aspect to continue to sample and report during this significant drought period to see what the impacts are to the wells on the Island?

Answer (Cami, COBI): The City's Groundwater Management Program collects monthly groundwater levels and annual chloride samples from wells Islandwide, paid for through the program's operating budget, so there is no need to use Aspect's project funds for those efforts.

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Questions that Aspect's Current Work-in-Progress Should Help Answer

32. The City had a plan to rest their water draw on the deep aquifer during the rainy season and use the shallower aquifers, largely around the Head of the Bay, to supply City water. What are the know results to date of that water draw plan?

33. Are there any major changes recommended as to how and where BI is currently obtaining their water … for example, overused or underused aquifers, water storage not properly timed or sized, etc.

34. From a science standpoint, is there anything missing in the way water is currently being obtained or managed?

35. Is there a maximum carrying capacity of the islands water resources, taking into account the projection of warmer and possibly drier seasons predicted? What would that maximum capacity be, and how can we plan for anticipated growth of the island while staying mindful that there will be an upper limit to how many people the island can easily support?

36. Are they [the aquifers] at full capacity and healthy? How many households can they support?

37. What is the upper estimated island population to have the BI aquifers adequate support using best scientific evidence to date?