

# Scientific Analysis of Existing STGPD and Aquifer Infiltration

## **First Stage (from project description and narrowed scope):**

Focus on aquifer natural infiltration/recharge and explore surface pavement relation to aquifer volume.

## **Background:**

See the original grant application and project description for the background of the South Tacoma Aquifer, citizen's economic green zone and counteractive proposed mega-warehouse.

We need expert input (such as: hydrologist, hydrogeologist, aquifer/groundwater/wetland/watershed professionals) to support the need of retraining natural water infiltration above this vulnerable drinking water source for appropriate recharge, and to assist explaining how large areas of impervious pavement (directly over the aquifer/wetland/watershed) could be detrimental to this important water system.

This input is needed (first, most immediately) to support a moratorium until (second) the groundwater code is appropriately updated.

In addition to the other information provided, this is what we covered in our 10/4/22 phone call with Yining.

Four points for updating the groundwater code to reflect best science (and attract suitable scientists to support):

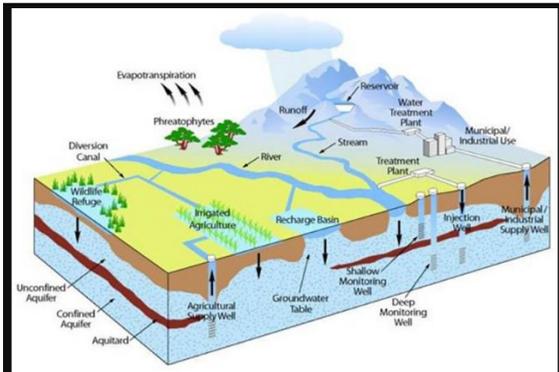
1. Scientific analysis of existing STGPD (best-science review of the current existing code) and analysis of aquifer infiltration/recharge policy (since the city Planning Department is misrepresenting the vulnerability of the wells) which needs to be updated by including current best science (such as which industries' practices are allowed or prohibited).
2. Analysis of current Wellhead Protection plan (re: aquifer recharge) and impact of restricted reduced local infiltration (such as how the proposed mega-warehouse will impact three wells) and 6,000+ unmentioned contamination sources.
3. Susceptibility Analysis / terrain hydrology vulnerability model (area needing examination, such as using state studies showing susceptible soil types (susceptibility analysis / 2D and/or 3-D modeling to understand the hydrological impacts prior to development, best places for infiltration), and a clear modeling of where best infiltration, contamination is and needs to be protected versus where certain practices may be allowed.
4. Synergistic link between isolated studies which all need to be reviewed together (2007 infiltration policy side steps the law, allowing improper infiltration / impact on the aquifer's health, restored Flett creek and marsh creation for ease of development permitting)... this location has been fairly stable for about 30 years so has a good control data start to then show possible negative impacts.

Additional information (to what has previously been supplied) associated to the points above:

### 1. First point:

General overview of aquifers image found on this site:

<https://ecology.wa.gov/Water-Shorelines/Water-quality/Groundwater/Groundwater-resources>

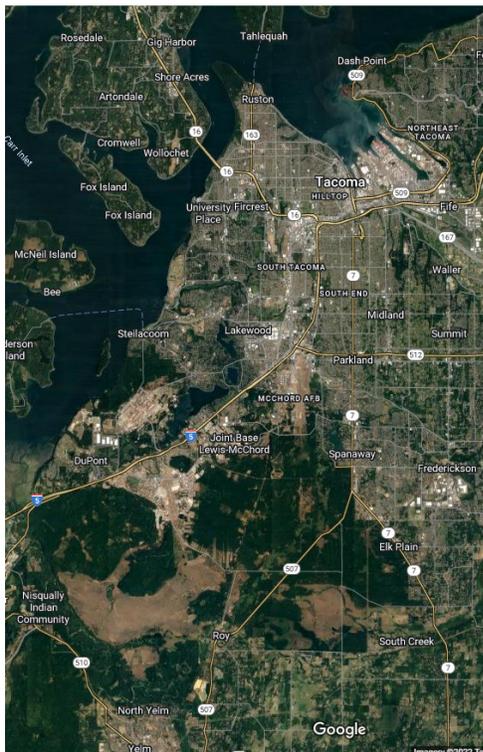


<https://ecology.wa.gov/Water-Shorelines/Water-quality/Groundwater/Groundwater-resources#gallery>  
[Piercecountywa.gov/ImageRepository/Document?documentID=108808](https://ecology.wa.gov/ImageRepository/Document?documentID=108808)

The above is a generic image, but the South Tacoma Aquifer is a similarly vast waterbody multilayered system which extends from the Cascade Mountains (where snow and rainfall comes down streams and rivers, some used as wildlife refuge some as agriculture – some are recharge points, as well as urban areas where this aquifer is). On the righthand side of this example (as the vast 180 square mile aquifer) are the wellfields in the South Tacoma Ground Water Protection District.

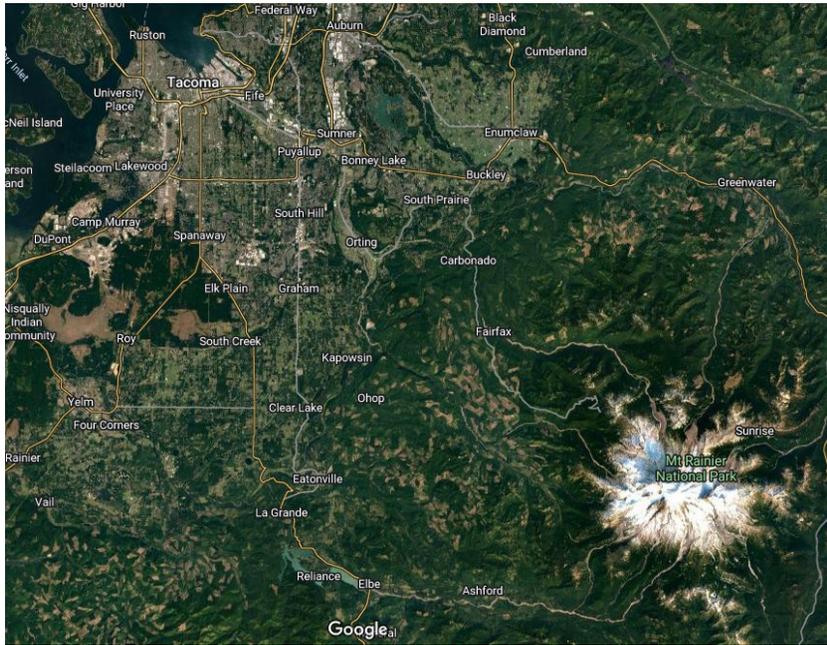
Our effort is focused not on this entire area, but on the urbanized aquifer recharge area which has a protection code but which needs updating within the South Tacoma Groundwater Protection District (STGPD).

Here you can see the sedimentary water outflows from the Puyallup River into Commencement Bay, most of Pierce County and South Tacoma. This large vegetated area is Joint Base Lewis McChord (“JBLM” Army Base and an Air Force base).

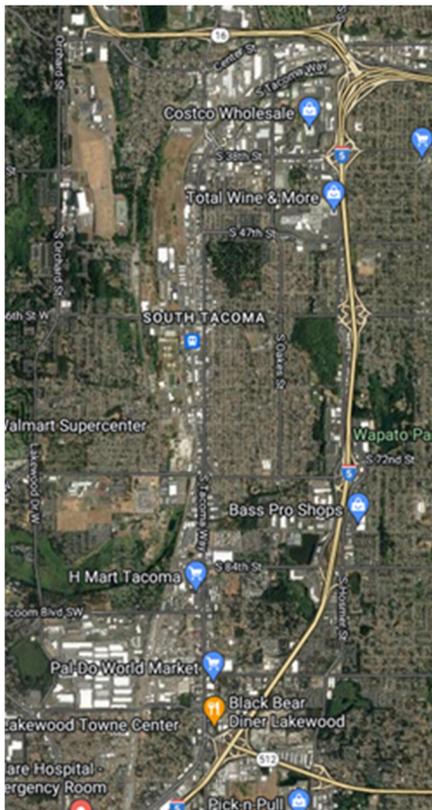


<https://www.google.com/maps/@47.1573901,-122.4444591,46986m/data=!3m1!1e3>

This aquifer system extends all the way up to Mount Rainier...



... starting at the base of the foothills and filling much of this area, much of it culminating in South Tacoma where it needs better protection. Updating the current code to include best science regarding contaminants but especially more inclusion of natural infiltration/recharge to keep the aquifer at a healthy volume and not depleted.



The city is not including any such science in their haste to approve more and impervious paved surface. The city's hydrologists and the water resource managers assume that because the system is so large, that they don't need to worry about it, despite the fact that most of the county is become paved and that open green space (especially directly above the aquifer) needs to be preserved.

We need expert input to help explain how this aquifer functions, to be included when updating the groundwater code.



now at the foot on the Cascade Mountains is probably a 100 maybe 200 years away. There may be water from 200 year ago which hasn't yet reached the STGPD area, because it's still traveling down through the system toward South Tacoma and/or being extracted by other wells that are closer to the mountains.

Part of the challenge with updating the groundwater code is helping the city understand hydrology and what the existing code is for: if we pave or cover this area over, then we're blocking recharge and the wells will not function as they have been – instead they'll have to be drawing water from outside of the existing recharge area in order to continue to function.

We don't want that to happen, for a couple of reasons, one being JBLM. This large military base has a massive PFAS contamination problem. Their wells were found to be contaminated, but the U.S. Military sold the wells to a private company in a way to pass-off the problem with the PFAS but wells have also been found to be contaminated in the next community of Lakewood, approaching the south-end of Tacoma, probably coming from JBML (likely originating from a training center where they practice burning airplanes, and then putting the fires out which toxic foam).

So, the first point is simply looking at the existing code and understanding proper infiltration, and analysis to include with the Well Head Protection plan about aquifer recharge.

## 2.Second point:

The Well Head Protection program was put in place following Federal Law through the State level done in 2015, being updated now. A critical part of the scientific study are over 6,000 potential contamination sources.

Source of contamination total sites Tacoma Wellhead Protection Plan page 82

<https://www.mytpu.org/wp-content/uploads/appendix-k.pdf>

**Tacoma Wellhead Protection Program  
Summary of Potential Contaminant Sources  
To be Included in the Agency Notification Process**

April 2002

<u>Agency</u>	<u>Number of Sites</u>
No Regulatory Agency -	1,106 Sites
DNR -	1 Site
DOA -	9 Sites
Ecology -	1,374 Sites
PCD -	7 Sites
PCPWU -	2 Sites+
TPCHD -	1,503 Sites*
	<b>4,002 Total Sites</b>

DNR- Washington State Department of Natural Resources  
DOA- Washington State Department of Agriculture  
Ecology- Washington State Department of Ecology  
PCD- Pierce Conservation District  
PCPWU- Pierce County Public Works and Utilities  
TPCHD- Tacoma-Pierce County Health Department

+ These two sites are Pierce County Public Works and Utilities' property and the PCPWU was notified through the Potential Contaminant Source mailing. Hence, no letter needs to be mailed regarding agency notification.

\* The TPCHD does not have regulatory jurisdiction over the great majority of these sites but rather has a small quantity hazardous materials education program that may be able to assist these sites in handling and disposal of hazardous materials. The TPCHD only has regulatory jurisdiction over those businesses in the South Tacoma Groundwater Protection District.

Currently, less than 2000 sites are monitored by the Health Department. There are another 1,300 sites which are monitored by the State. None of those agencies/entities are currently being included by the city as part of the current discussion of the groundwater code update, and there are another 1,300 sites which aren't even being monitored. We (residents) don't even know where they all are -- we only know they exist.

So, what we know: there are many more contamination sources. We also know that the recharge area is very sensitive within South Tacoma where infiltration is more important than that coming from the foothills. We have the 30 years of data that show how well it's working and the Tacoma Water staff will say that our wells are currently productive, but they aren't taking into account upcoming climate change and proposed paving. The wells are undergoing a major update but they will be directly impacted if we inhibit the direct infiltration within in South Tacoma. The city's Tacoma Public Utility and Planning Department instead continues to misrepresent the vulnerability of the aquifer and those wells to the City Council, and we have to show (with better science) that there will be an impact. We need people (other than us) with the correct credentials to explain this.

### 3.Third point:

In order to show the negative impacts, we are narrowing our area of focus to where the city is pending to approve a mega-warehouse – directly covering over where natural infiltration is imperative. This development plans to put 50 football fields (2.5 million square feet) of impervious pavement directly over the aquifer and over some of the most sensitive and important recharge areas. We can use understanding of similar geography/geology from other regions within Washington State.

For example, this is on the Kitsap Peninsula, close to Tacoma – different water system, but similar, with these two-dimensional, hydrological surveys regarding the critical aquifer recharge.

Critical Aquifer Recharge Area – Guidance Document (WA Dept. of Ecology)  
<https://apps.ecology.wa.gov/publications/parts/0510028part2.pdf>

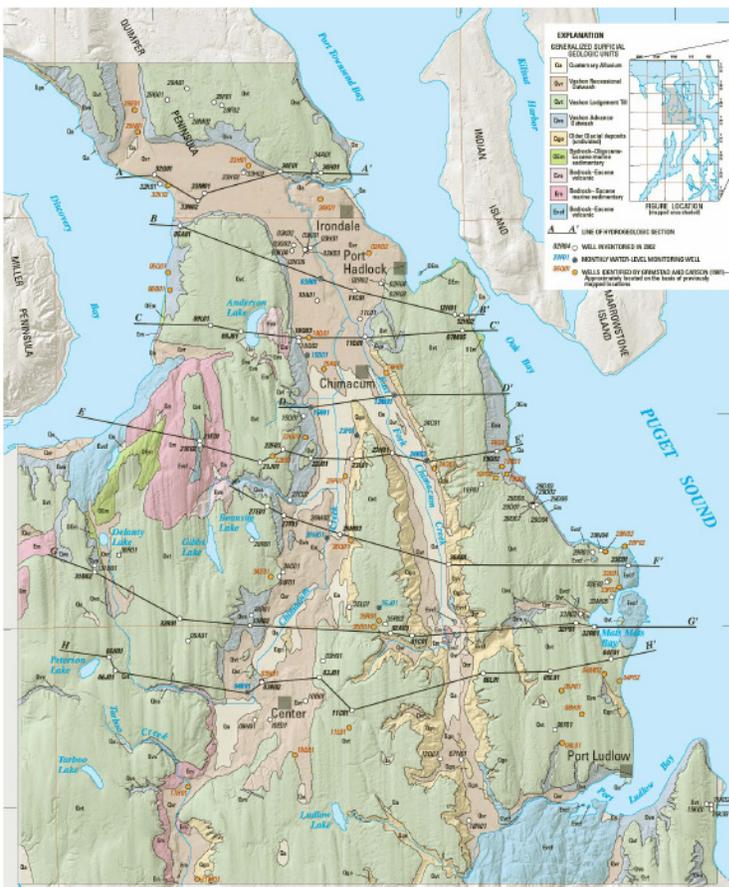


Figure 8: Hydrogeologic map of the Chimacum Basin (Simonds, 2004)

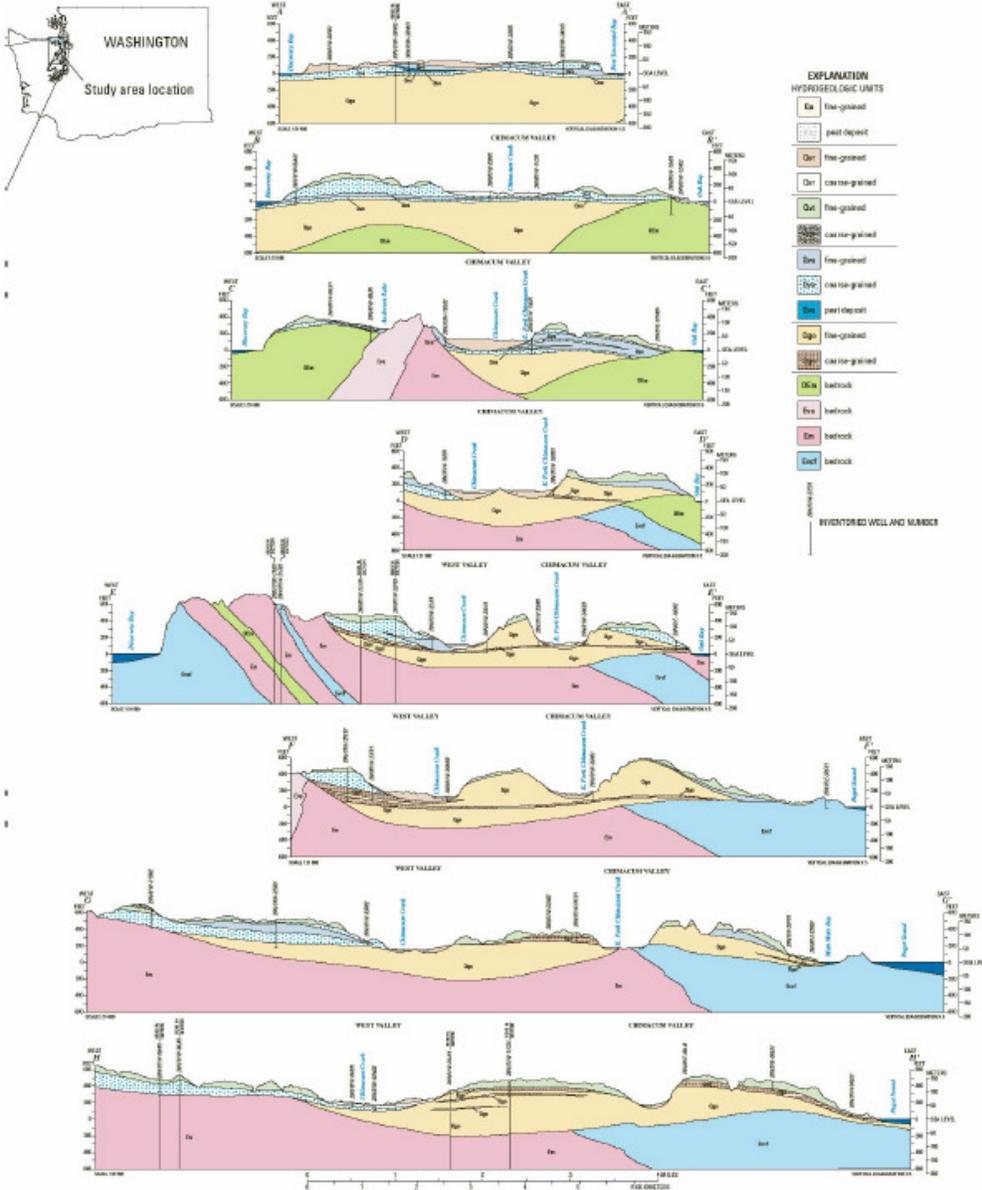


Figure 9: Hydrogeologic cross-sections of the Chimacum Basin (Simonds, 2004)

This is the guidance from the State to the City for their Well Head Protection plan, showing the cross-sections of areas susceptible (more than others) to contamination. The city is currently allowing for highly toxic substances to be stored in various methods within the STGPD, but doesn't seem to have a good understanding of areas with more porous soil with more risk to groundwater contamination. Some areas South Tacoma Groundwater Protection district may be on higher ground or on a different kind of soil/rock not as conducive to infiltration, but understanding the locations of the most sensitive places for infiltration is important.

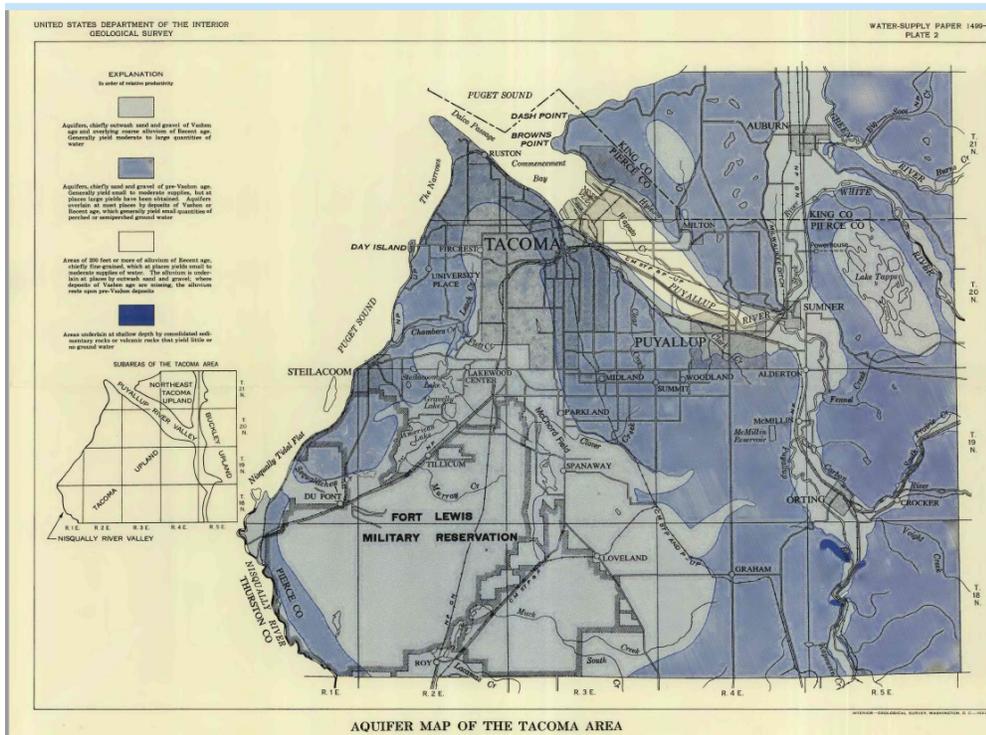
Such as:

*The study and monitoring of an aquifer threatened by pollution intrusion requires knowledge of the geometry of the aquifer, its hydrodynamic characteristics such as transmissivity and porosity, and the diffusion-dispersion parameters of the pollutant propagating as a solute. Upstream and downstream water flows, water heads and pollutant concentrations on the boundaries must be determined. Some values of these physical quantities are measured or determined by previous studies and others must be calculated.*

<https://www.nature.com/articles/s41598-022-20131-9>

There has been some modeling done, and more data available. The previous “recharge” map shows high-level soil types affecting infiltration, but we need updated mapping for this STGPD to better guide zoning/activities within this geohydrologically environmentally sensitive district, such as including:

United States Geological Survey, USGS Survey - the whole aquifer system, with various soils indicated by color.  
<https://pubs.usgs.gov/wsp/1499b/plate-2.pdf>



South Tacoma is one of the best places for the infiltration but is also the most vulnerable to contamination. Yet the city has allowed the area to become polluted, and now developers want to pave over it for a mega-warehouse while redirecting surface water either into a single funneled infiltration pond -or- gutters to the bay, bypassing the aquifer and watersheds to downstream creeks -and- turning the natural creek and wetland into a piped system.



Outside of the light gray and the blue colored area, the soils are different; the water does not infiltrate as quickly or as fast as the areas in JBLM where there are contaminated zones for infiltration. We don't want to deplete our own aquifer so as to pull contaminated water from JBLM into our wells.

The way to prevent pulling in JBLM water, is by allowing better infiltration within South Tacoma to keep our groundwater plentiful. If we keep the soils around the aquifer well saturated with water, we have higher pressure than outside our area (which would allow our good water to spread out of STGPD to other places, places where they're building more massive warehouse industries, too, outside of Tacoma city limits (more giant warehouse complexes plus an airfield also, filling in hundreds of acres of marshes) because outside of our city district, the county is destroying aquifer recharge areas affecting us. There's really only one place available for Tacoma to protect this aquifer, which where our focus is: South Tacoma, and yet the city is following the county's lead assuming current water supply will always be endless no matter what we do.

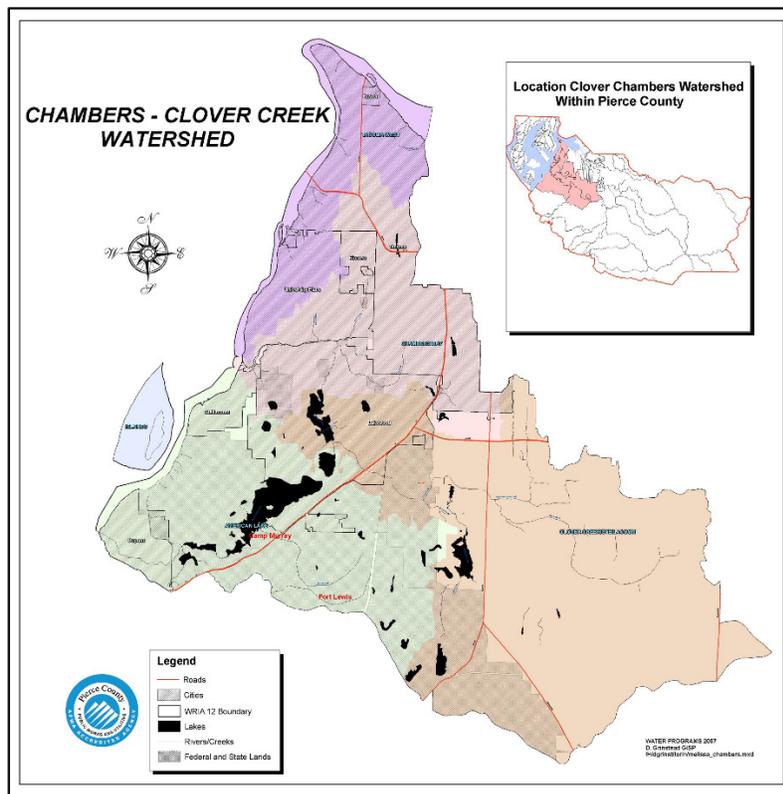
So, obtaining 2D-3D modeling is important to help others understand the hydrological and geological impacts before the city considered building the groundwater protection district. Such modeling could show what can or can't be in certain locations. There is some reference to that in the current code, but it needs significant updating.

#### 4.Fourth Point:

We currently don't have a synergistic link between groundwater and stormwater runoff. "Groundwater" is too often referred to by the city when they actually mean stormwater runoff from rain onto streets (instead of infiltration to the aquifer).

Some runoff may be infiltrated at some point, but in 2016 the city updated the infiltration policy in a way to aid developers to build retention ponds/etc. as a way to side-step the groundwater code. The city didn't update/change the code (the code is policy/law) but this memo enabled the city Planning Department to provide exceptions to the groundwater code (such as the auto-crushing facility, approved in 2019 which should not have been allowed), infiltrating contaminants which shouldn't be going into ground above the aquifer nor into the Flett Creek and Chambers-Clover Creek watershed.

<https://www.piercecountywa.gov/1860/Chambers---Clover-Watershed-Council>



Seven municipalities, three military installations, and one drainage district, as well as Pierce County, have jurisdiction concerning water quality. The cities are: Tacoma, Lakewood, Fircrest, University Place, Steilacoom, DuPont, and Ruston.

We need to present the importance of better understanding potential scientific restoration methods, the benefits of retaining/protecting Chambers-Clover Creek watershed. One part of the large Chambers-Clover Creek watershed is Flett Creek, which starts just north of the South Tacoma Groundwater Protection District where it's urbanized. Much of that creek is now in pipes underground, but comes out again where the city may now allow massive paving; a current wetland with many birds and other wildlife, after 30 years of unindustrialized activity here. Part of the 2.5 million square feet of development, now planned for this area, will be to cover this and instead create one infiltration point or run-off into gutters.

And yet, going on at the same time, the State has provided significant funds to study the restoration of this "middle" Flett Creek, all the while the city is moving to build on and destroy it.

So, we need scientific analysis of one-sided information provided to the city (such as the poorly-done studies/documents from the proposed builder, available in the permit file) to explain the negative impacts to the aquifer of their current plan, but the benefits of restoration measures and naturally occurring infiltration. This will not only help us oppose the development plans, but will also support our green zone project.

We need the experts and synergistic product to link all these together, since the city is not doing it.

Instead the city is circumventing both a complete review (such as looking at the Flett Creek watershed in conjunction with the plan to upgrade the wells and the Wellhead Protection Plan) or transparency of violations... our proposal to update the groundwater code and create sustainable zoning has been put on a backburner while the city's "explores" a drawn-out moratorium while letting the mega-warehouse permit continue.

The moratorium which is currently being debated could actually addressing a lot of the issues which should be part of the groundwater code update, but (since the city isn't including good science) we're now in a political back-and-forth with various people who aren't subject matter experts, and who are ignoring the scientific facts of the aquifer for their own agendas.

There are other places in the country where urban aquifers are being impacted by development, which can be pointed to.

Memphis is an example of pushback against both pipelines and other contamination sources through social, economic racial justice issues, such as can be found in South Tacoma.

Sadly, our attempt to update the groundwater code (asking for no more exceptions and bring in best science) may instead be further corrupted because the city isn't relying on the right science data but is using their own internal staff for their own development agendas. So we need experts who can bring/support solid data for understanding aquifer protection needs.

EMAILS:

**From:** Heidi S. <heidigs@hotmail.com>

**Sent:** Wednesday, August 10, 2022 2:34 PM

**To:** Yining Bai <yhb@nmsu.edu>

**Cc:** Timothy Smith <mr\_tjsmith@hotmail.com>

**Subject:** Project Description - Updating South Tacoma Aquifer Code and Land Use

Yining,

- Attached is the completed "Project Description" to share with prospective scientists... that form appears to want only short summaries, but most info was taken directly from our original application, so (once scientists have been assigned) we may want to share the more complete application with them, too.
- I've also left Tim's previous email message (below) at the bottom of this thread, which includes relevant weblinks, too.

I hope this is helpful to secure our scientific collaboration soon (I believe you said you already had specific people in mind). Meanwhile, I'll also work on that letter I'm hoping you can sign-on to.

Thank you and please keep us posted regarding experts assigned to us! ~ Heidi S.

PS ~ The other document template, "Project Scoping Questionnaire", seemed more for your needs and what you already covered with us during our first meeting, so I didn't do anything more with that.

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发件人: Timothy Smith <mr\_tjsmith@hotmail.com>

发送时间: Saturday, July 23, 2022 7:33:55 AM

收件人: Yining Bai <yhb@nmsu.edu>

抄送: Heidi S. <heidigs@hotmail.com>

主题: Understanding the Aquifer and Document Library

**WARNING:** This email originated external to the NMSU email system. Do not click on links or open attachments unless you are sure the content is safe.

Yining,

So very happy to be working with you on protecting this very amazing water resource - The "South Tacoma Aquifer". We have a host of documents to aid in our analysis and study. Most a very large and technical. I wanted to start with a few that may help you begin to understand the nature of the "South Tacoma Groundwater Protection District" (STGPD). Most of those directly involved or responsible probably have not read them and those in charge of protecting and enforcing the law probably haven't either. Very few of the persons and residents working on this project have read them.

Do you have any suggestions for where to host or store these files for common use and reference?

We already have messed this up by having multiple places for multiple efforts so there is not one sacrosanct 'library'. I have a 1TB 'DROPBOX', there is a 'Google Drive or two' and the City of Tacoma and Pierce County have a hodgepodge of resource locations. Part of the problem has been a unified "Aquifer Library". I am sending mostly inks to very large documents that I have downloaded - so I reckon they links are safe.

So, here are a few documents to start the journey to the true aquifer. This first is a 1999 study of the water hydrology of Tacoma and Puyallup area.

This report describes and quantifies the ground - water system in the Quaternary deposits in northwestern Pierce County. The report includes descriptions of the geometry and physical characteristics of selected hydrogeologic units , ground - water movement system , recharge, water

use , water- level fluctuations, and general ground - water chemistry.

<https://pubs.er.usgs.gov/publication/wri994013>

The next goes straight to one of the most formerly toxic points and discusses "Well 12A" one of 13 in the "South Tacoma Wellfield". This well has been undergoing remediation and recovery for decades. This is also the well that gives us the most available data about the local aquifer nature and activity. This link takes you to a recent summary of those efforts and helped me understand the need for a "3d" model for the entire STGPD.

LINK: <https://www.cdmsmith.com/en/Client-Solutions/Projects/Well-12A-Superfund-Remediation>

### [Rethinking Remediation: The Well 12A Superfund Site - CDM Smith](https://www.cdmsmith.com/en/Client-Solutions/Projects/Well-12A-Superfund-Remediation)

EPA and CDM Smith introduced a new strategy with three additional treatment technologies, made possible by CDM Smith's research efforts. The pump-and-treat method, called a "groundwater extraction and treatment system," continued operation, while the project team concurrently ran a new comprehensive, multi-component treatment reconfiguration.

[www.cdmsmith.com](https://www.cdmsmith.com)

This entire portion of the northern STGPD is an area of previous heavy polluting sources. Just a few hundred feet away are other sites with other contaminations. The next link takes you to a review of the site known as "West Coast Doors" - named for the polluting firm. I enjoyed the very nice description of the complete area known as the "South Tacoma Channel" of the Nalley Valley in Tacoma. The South Tacoma Channel is filled by Vashon era fluvial deposits, which were deposited in a high-energy glaciofluvial environment and are composed primarily of sand and gravel. The Vashon era deposits were created as a result of the South Tacoma channel acting as a spillway for proglacial lakes that formed during the recession of the Vashon ice

sheet in the late Pleistocene. This study also shows the challenges presented for this vast surface and subsurface area that covers 1/5 of Tacoma's land

area. <https://apps.ecology.wa.gov/gsp/DocViewer.ashx?did=76496>

## Morris, Matthew (ECY)

1 Morris, Matthew (ECY) From: Morris, Matthew (ECY) Sent: Monday, August 06, 2018 3:30 PM To: Tom Colligan Cc: Kim Seely; Tina Huff; John Houlihan; 'Kristin Anderson' Subject: RE: Revised West Coast Door Site RI Data Gaps Work Plan Hello Tom, I have received the July 2018 Remedial Investigation Data Gaps Work Plan for the West Coast Door Cleanup Site (FSID

apps.ecology.wa.gov

Another very important (and a MUST read) is one that provides the historic background for protecting the aquifer, and analysis of the wellfield, and some key data points for our current STGPD update. This "Wellhead Protection Plan" is currently being updated in isolation from the code review but is one of the most important elements - distinct from the STGPD code - and required by Federal Law. LINK: <https://www.mytpu.org/wp-content/uploads/appendix-k.pdf>

Finally, the most detailed analysis of each well, the aquifer capabilities, and detailed overview is a Request For Proposal (RFP) document for a Hydrogeologist to advise and assist Tacoma Water for repairs and upgrades to each well. Much detail contained in the RFP of great value to our modeling and understanding. I think they hired the person, and this is an on-going project, but a MUST read. Great side job if one happens to be a hydrogeologist 😊 [https://www.cityoftacoma.org/UserFiles/Servers/Server\\_6/File/cms/Purchasing/FormalBids/TW20-0388F.pdf](https://www.cityoftacoma.org/UserFiles/Servers/Server_6/File/cms/Purchasing/FormalBids/TW20-0388F.pdf)

I have also attached the transcript from the zoom call. The video did not record for some reason.

Vr,

Tim