2023

# Dept of Ecology - GIS Intern

Keiman Park-Egan
*Western Washington University*

# COLLEGE OF THE ENVIRONMENT

**Internship Title:** GIS Technician

**Organization Worked For:** Department of Ecology, Washington State

**Student Name:** Kiernan Park-Egan

**Internship Dates:** 3/27/23 3/27/24

**Faculty Advisor Name** Aquila Flower

**Department** ENVS



**STUDENT SIGNATURE** Kiernan Park-Egan

**DATE:** 5/26/23

**Water Resources GIS Technician Internship Report**
**Kiernan Park-Egan**
**4/8/2023**


Photo Credits: (DoE State of Washington, “Washington Department of Ecology: Protecting, preserving and enhancing our state's environment,” 2023)

# Table of Contents

## Introduction

In March of 2023, I was contacted by Geography Professor Andy Bach. He offered to refer me to a part-time job at the Washington State Department of Ecology: an entry-level position dedicated to mapping water rights in Washington State using a Geographic Information System (GIS). The job was advertised by Kasey Cykler of the Water Resources Department. I was honored and flattered that Professor Bach contacted me for the internship before advertising it to other geography students. It was a golden opportunity for me to grow my skill set and work experience, and after short (but careful) consideration I accepted. Soon after my interview with Kasey (now my boss) and Kellie Gillingham (my GIS supervisor), I was offered the job and I accepted it immediately.

For background purposes, finding GIS work fresh out of college is a difficult task. Although there are several internship opportunities, many of them only last a few months, which isn't enough experience to impress employers that offer full-time GIS jobs. Many of these employers require at least two years of GIS work experience. My part time job lasts a year, can be extended at the discretion of the Agency, offers full benefits if you work at least 20 hours a week and is eligible for overtime. In addition, I can work a maximum of 36 hours a week regardless of how much overtime I get, which is more money in my pocket to support me economically as I begin graduate school next Fall. Having the opportunity to work almost 40 hours a week will allow me to gain extensive experience which will be valuable to finding a full-time job. Although I had significant experience in GIS before accepting this job, I had no experience putting those skills to use in a fast-paced work environment. As such, the first (and most important) goal of this internship was to do exactly this, as well as balancing this experience with other aspects of my job, including filling out paperwork, attending weekly meetings, as well as attending various training sessions. This report details the methods and tasks completed during this employment, the results of my work, and a personal reflection of my experience in this role.

## Methods/Tasks completed

My employer, The Washington State Department of Ecology, is dedicated to maintaining and protecting the environment. There are numerous environmental issues it tackles, including deforestation, habitat maintenance, air quality and more (DoE, State of Washington, "Air & Climate", n.d.; DoE, State of Washington, "Forestry Runoff", n.d.; DoE State of Washington, "Water rights", n.d.). I work for the Department of Water Resources, which addresses water rights and claims within Washington State (DoE State of Washington, "Water rights", n.d.). My purpose within this department is to map claims made by numerous citizens dating back several decades. This mapping information can be used by the Department of Ecology to accurately analyze where water is used, information that can be utilized to better understand how water is being consumed and what geographical challenges may arise from its usage (DoE State of Washington, "Water rights", n.d.).

This mapping was done in ArcGIS Desktop, an older predecessor to ArcGIS Pro. The first step of mapping a claim is to look it up in the Department of Ecology's Water Resources Database. Each claim that we map has a digitized written application which tells us (more or less) of the person filing the claim, and the location of that claim. Afterwards, I would have to transcribe and map the location as best as I can in ArcGIS Desktop.

ArcGIS Desktop is a program that is accessed remotely. That means I had to access it on another computer located in Lacey, WA via an online connection to my work laptop in Bellingham. The exact file in ArcGIS Desktop was a digital map of Washington State which features several vector and raster feature classes: these include townships, government lots, roads, railroads, satellite imagery and more. Picking and displaying the right map layers is crucial to finding locations specified in those digitized applications.

There are several steps to mapping water rights. First you have to read the original water right documents, or applications and claims, to see where those documents apply geographically. Many of these claims were written out by hand and used various geographical acronyms that I had to memorize. I used the "Create Features" tool to trace out written directions on a map. When you create a line in ArcGIS Desktop, the program allows you to trace them based on written coordinates. If the document says that a directional line follows certain coordinates, you can type them into the tool and it will give you a line that follows that course. It also allows you to input the length of the line, if it is given, to more accurately trace it to the origin point of the water right, if one is specified.

What if the description doesn't have any directional data, but refers to an area or address that's not present in one of ArcGIS Desktop's layers? To find out which piece of land the claim is referenced to, you might have to utilize several resources. These include county government websites which have extensive documentation of land use, some of which date back almost a hundred years. When finding unknown areas, specifically in King County, Washington, the three most useful websites are the King County Assessor's website, the King County Recorder's website, and the King County Road Services Map Vault website. I've had the most luck with the latter, as the Map Vault has several scanned images of old, paper published maps which document land parcels.

If you need to use an old paper map in your work, it must be georeferenced first. What does this mean? It needs to be inserted into ArcGIS Desktop for digitization so it matches up with the correct parcel in the parcel layer. Most water rights are documented by parcel, so this layer is especially important. Downloading it and print screening/pasting it into a Microsoft Paint document is the first step. After that, you save it as a JPEG (or a raster dataset) in a drive that can be accessed by both your laptop and the computer that's being remotely utilized to run the GIS software. Once you log into the GIS computer, you can access the raster and input it into ArcGIS desktop. After you zoom in on the general area which the parcel is located on, you then go to the Geoprocessing pane and click "Fit to Screen." The raster map will paste onto the area you're focused on, but it might be out of proportion or aligned at a slight angle that doesn't match up with the parcel layer. Not to worry: you can use georeferencing points to match up the two maps and make them relatively proportional and aligned at almost-matching angles. This is done by matching two of the same landmarks together at a time, from both maps: these could be street corners or parcel land corners. Coastlines for water bodies or streams/creeks/rivers cannot be trusted as their boundaries can change often over the course of a few years, meaning they often won't match up in both maps. You must find several proper landmarks located in multiple areas of the two maps to make sure that the raster matches up more accurately to the parcel layer. It's recommended that you make at least 4 georeferencing points per map. However, you don't need a perfect match, you just need to align the maps enough so you know which parcel(s) you are covering.

There are a minimum of two areas that you have to find for a claim or water right application. These include the area which the water is taken from, as well as the area in which

the water is being used. Most water rights have the area of extraction located on the land for which the water is used, but there are some exceptions. A number of people applied to extract water on a certain part of land, but intended to use it at a location some distance away, particularly on home properties. These two areas have to be represented on a map: the area where the water is being used is represented by a polygon, while the area of extraction is represented by a point. You must map these locations via the "create features" tool.

When mapping a point of water withdrawal or an area which that point is serving, you have to give those features the right designations. Points are represented in several ways: a hexagon represents a groundswell, and a triangle represents a surface water pump. Although there are other point designations, pumps and wells represent basically all of the water right claims that I have mapped so far. Likewise, polygons that represent areas that are served have a specific numerical designation and a fill color. Although there are 150 fills, less than fifty of them represent water claims (labeled fills #101 through #148) which make up a solid majority of documented water rights. Of those you must select, each fill has colored lines that run through them. They run diagonally, horizontally, or at a 45-degree angle. If you are mapping two water right areas side by side, you will have to pick two different, numerically appropriate fills that have separate colors and/or differing angles of lines so viewers can tell them apart.

After mapping the features, you have to specify the locational data within these points and polygons. The shapefiles for these have attribute tables. Every feature needs to be represented in its attribute table by certain qualitative and quantitative information. The land use polygons need to have reference to their water document IDs as well as its claim number. The point needs to have a special numerical designation for organizational purposes. Both points and land use polygons have a field which describes which dataset was used to help in identifying their locations. For example, most points and polygons are found using parcel data in addition to the written applications themselves, so their designation in that situation would be a "P" (standing for parcels) and the date of the parcel data itself. The main piece of parcel data, which is a shapefile featured in ArcGIS Desktop, was assembled on January 7, 2021, so if that parcel data was used the field would read "P20210107;" 2021 is the year, 01 is the month, and 07 is the day.

Immediately following that, there is one more important step. There's an additional table that links these points to the land that the water is used on. This is important, because the GIS personnel that have to analyze these points need to know which point matches up with which area the water is used for. You can access the table through the table of contents in ArcGIS Desktop. Once you open it up, you type the water right document number and the "dpointID" number in it. You can check if the point and polygon land areas match up by selecting the point or area in their respective layer attribute tables, click table options in the top left corner, scroll down to "related tables" and select the connecting table to see if the point and/or areas are related in the matching table.

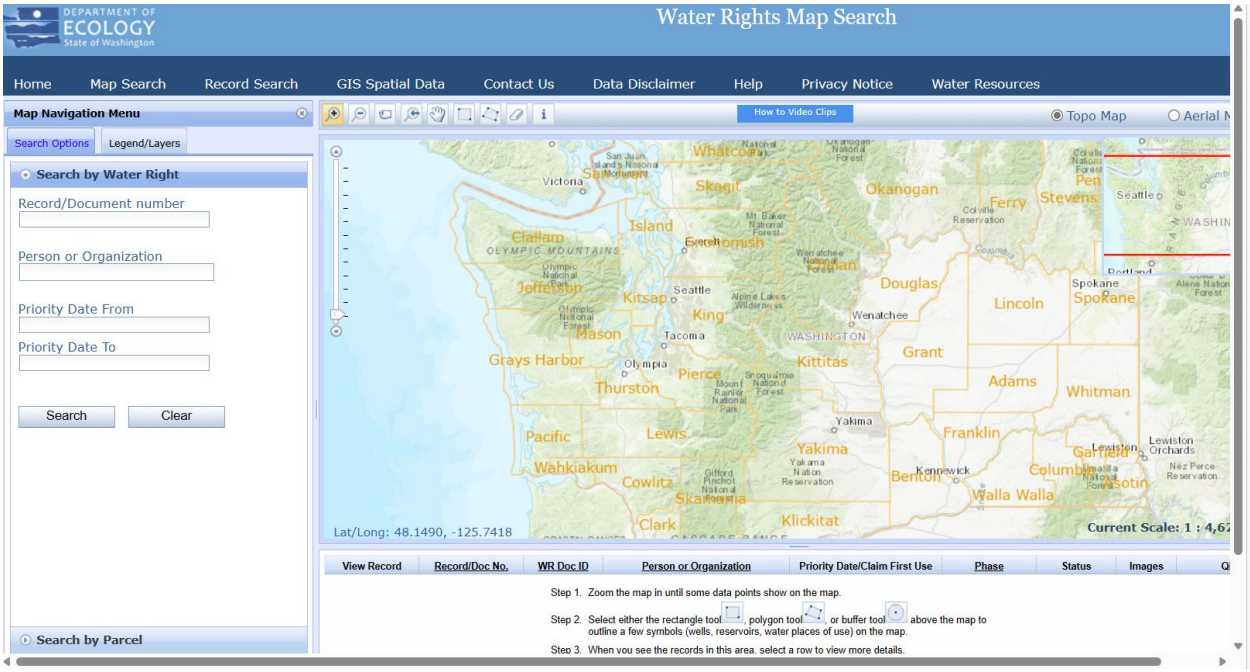
**Results**

The first product is a map in ArcGIS Desktop that represents all of Washington State, and includes points for each water right or claim that's been documented. The map breaks down the state by township, section, government lots, parcels and more. All these elements are represented by individual layers, all of which can be turned on or off at one's convenience. There are tens of thousands of points representing different water right claims all over the state (DoE State of

Washington, “Water Rights Map Search”, 2023). As mentioned, the most common withdrawal points are ground wells and surface pumps. This water can be used for irrigation, manufacturing, consumption for humans and other animals, as well as other purposes (Boeing, 2009; Brunell, 2017; EPA, “Saving Water in Washington”, 2016; EPA, “Saving Water in Washington”, 2016; Jenkins, 2021).

The map is cartographically underwhelming, at least in ArcGIS Desktop. Although it represents its data in a way that is coherent and understandable, it is made featuring an old version of ArcGIS software. The resolution of features, be they points or polygons, are somewhat coarse, even with a high-resolution computer screen.

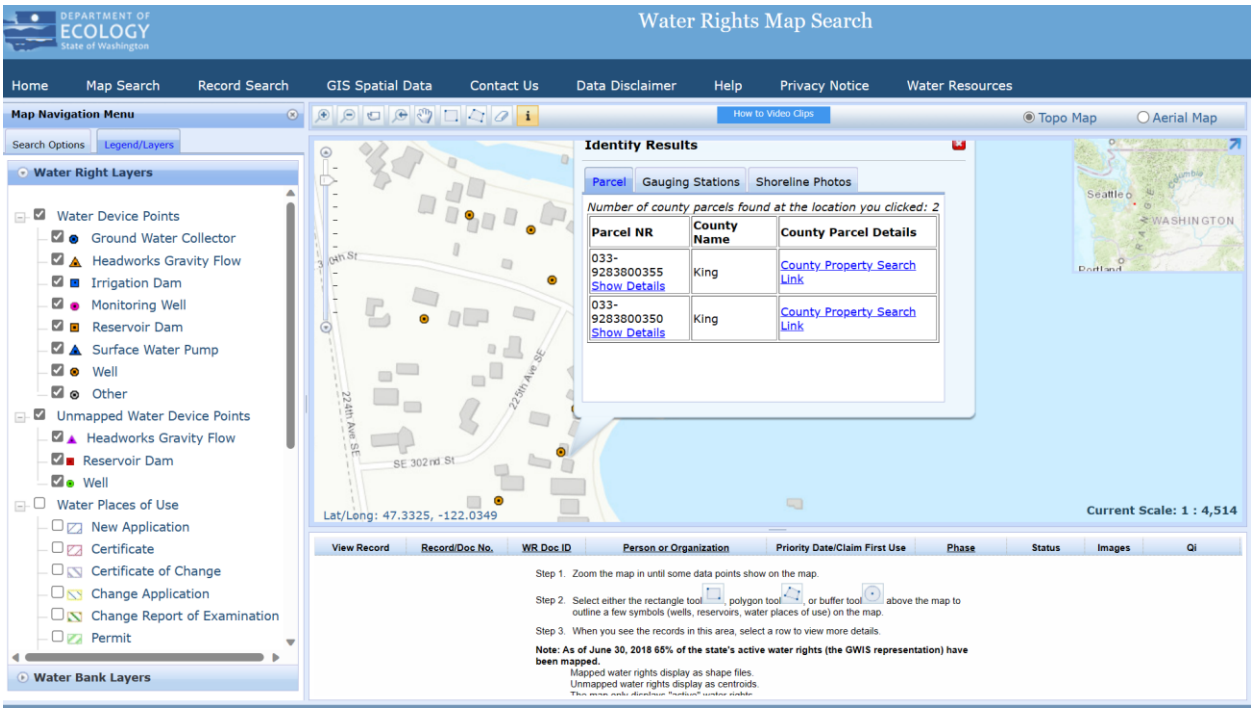
Regardless, there’s an interactive version of this map on the internet. This online version features all layers including water device points (ground wells, surface pumps, etc.), unmapped water devices (ground wells, pump and reservoir dams), places of use, hydrographic features (gauging stations, buffers, shore photos) and administrative boundaries (sections, townships, parcels, watersheds and subwatersheds). It is much more cartographically sound, featuring roads, buildings, mountains, and county labels. The map is updated every 24 hours. That means that if you create several water withdrawal points and areas of usage in the ArcGIS Desktop version, it will be featured in the interactive version the next day. Several individuals including myself have contributed to this map over several years.




*The Washington State Department of Ecology’s Interactive Water Rights Map (DoE State of Washington, “Water Rights Map Search”, 2023)*

However, if you want to use the interactive version, you have to know how it works. Because the map features tens of thousands of data points and different parcels of land, it can’t display all of this information if you’re looking at the entire state as a whole. If you want to see these features, you have to select the magnify tool in the top left of the map. After that, you’ll have to pan to a specific area, using the zoom-in tool. There are also buttons to zoom out, zoom to a statewide view, a panning tool, two tools which select all points/areas within certain parts of the map, an erase tool and an information tool, the latter of which will give you information for

any point/polygon you click on. For example, if you click on a withdrawal point, the point's parcel data will pop up as well as links to the respective county's Assessor's Office, where you can search for information on different parcel numbers. Lastly, if you want to use the select tool, you have to enable parcels, gauging stations or shore photos in the Legend/Layers table on the left side of the map.




*The Washington State Department of Ecology's Interactive Water Rights Map, pinpointing a water right on Lake Sawyer, King County, WA (DoE State of Washington, "Water Rights Map Search", 2023)*

Regardless of which version of the map you use, the map is only as good as the water rights applications are accurate. Many claims, regardless of legibility, may specify directions to these lands or points in a way that's hard to wrap your head around. They may specify that a well is, say, 40 feet from the South East corner of the parcel it's being used on, but don't mention what direction the well is located from said corner. At least one water right I looked at specified that a water source was a few feet east from a parcel corner, yet failed to say which parcel corner it was. If a water claim is only partially legible, you may have to use what lackluster information is available to map a water withdrawal point and its associated land(s) to the best of your ability, which may or may not be 100% accurate. Despite its analytical uses, the Department of Ecology has put a disclaimer on the map, saying that the agency won't accept responsibility if someone uses this map to make an erroneous decision. Keep that in mind if you ever use it for professional purposes. Another thing to keep in mind is that there are thousands of unmapped water right documents that the Department of Ecology is in possession of. You could submit a water right claim and it could take years to show up on the map, perhaps because the DoE doesn't have the manpower and the funding to do the job faster.

## Discussion

The Washington Department of Ecology was founded in 1970, being formed by the state government, and featuring a department dedicated completely to water rights (DoE State of Washington, "History of Ecology, n.d.). Washington State mandated the public documentation of water records beginning in 1967 (DoE State of Washington, "FAQ", 2006). The historical context at that time was that several politicians in the United States Federal Government were looking to approve interbasin transfers, which would take water from some areas of the U.S. and distribute it to others (Schad & Reuss, 1989). This garnered strong opposition from the powerful Washington Senator Scoop Jackson, who used his clout to influence the National Water Commission to make it harder for these transfers to occur (Schad & Reuss, 1989). By doing it, he acted for the best interests of his constituents (Schad & Reuss, 1989).

It's not hard to see why Scoop Jackson had a huge interest in protecting Washington State's water supply (Schad & Reuss, 1989; DoE State of Washington, "FAQ", 2006). Airplane manufacturers like Boeing and aluminum factories relied on large quantities of fresh water for operational purposes (Boeing, 2009; Brunell, 2017). Dams also required great volumes of water to power their turbines, and fishermen relied upon healthy stream flows to ensure that salmon would be able to migrate upstream (Brunell, 2017; Washington Department of Fish and Wildlife, 2023; Couch, 2023). Today, Washington State is home to 8 million residents, which is about four times the amount of people who occupied this area less than a hundred years ago, starting in the early-1940s (Macrotrends, 2023). This has put a huge strain on Washington's water supply, regardless of whether other states find loopholes to hijack it (Macrotrends, 2023; DoE State of Washington, "Water use compliance and enforcement," n.d.; Schad & Reuss, 1989).

As such, over the five decades, tens of thousands of people have applied to use large amounts of water (DoE State of Washington, "FAQ", 2006). This includes the eastern side of the state, which is traditionally drier (DoE State of Washington, "FAQ", 2006; DoE State of Washington, "Water Rights Map Search", 2023). Because so many claims have been staked, most people who apply today may find it very difficult to obtain these rights (AQUAOSO, 2020; DoE State of Washington, "FAQ", 2006). In 1917, Washington State enacted a system which dictated that if there wasn't enough water to satisfy every water user, then people who filed claims earlier had priority to consume it, even at the expense of others (AQUAOSO, 2020).

Water is a public resource and cannot be privately owned (DoE State of Washington, "Water rights", n.d.). As such, it needs to be distributed fairly amongst Washington's citizens (DoE Washington State, "Water Resources," n.d.). Although residents can use almost as much tap water as they need for their own consumption, other consumers, perhaps including farmers, need vast quantities of it to grow crops, raise livestock, or for other legitimate uses (DoE State of Washington, "Water rights", n.d.; Jenkins, 2021; USGS, 2018). If you need more water than can be provided to you for bathroom, kitchen, or small-scale gardening endeavors, you will probably need the state's permission to consume more (DoE State of Washington, "Water rights", n.d).

With that context in mind, the interactive map from the results section was made for analysis and public transparency (DoE State of Washington, "Water rights", n.d; DoE State of Washington, "Water Rights Map Search", 2023). The Department of Ecology wants to know where water is being used, how much of it is being used, and by whom so that they can distribute it properly (DoE State of Washington, "Water rights", n.d; DoE State of Washington, "Water use compliance and enforcement", n.d.). If someone is drawing too much water, various sanctions, including fines, may be placed on the user (DoE State of Washington, "Water rights", n.d; DoE

State of Washington, “Water use compliance and enforcement”, n.d.). Water users themselves can view the map to see if the DoE has mapped their water rights (DoE State of Washington, “Water Rights Map Search”, 2023).

Despite the fact that Washington has a reputation for being a moist and rainy state, population growth and agricultural use has put a strain on our water supply (DoE State of Washington, “Water use compliance and enforcement,” n.d.; EPA, “Saving Water in Washington”, 2016). Climate change is exacerbating this demand, threatening stream flows, which in turn jeopardize the habitat for salmon (EPA, “Stream Flow,” 2021). As such, it’s also threatening the supply of other water users, including many agricultural and livestock farmers (EPA, “Saving Water in Washington,” 2016; Jenkins, 2021; USGS, 2018). This is why water resources and withdrawal points need to be tracked vigilantly to reduce waste and improper use so that future generations may utilize it.

## Reflection

### *Challenges*

The first two weeks of employment had their difficulties. I had to submit a significant amount of paperwork to Human Resources and Payroll the second day of work. The following week I missed an important GIS training which caused me quite a bit of stress. I missed the meeting because I was not aware that the time for this meeting began at 8 AM, not 10 AM. In response, I requested a smartphone for official work duties, as the cellphone they issued me was heavily outdated and couldn’t keep track of all my meetings. I also updated my calendar in Microsoft Outlook so that people wouldn’t schedule me for appointments when I was away from my work laptop, and put a reminder in my phone to check my computer a few hours before work to confirm scheduled appointments.

Although the stresses listed above may seem normal, they are worse when you have a major anxiety disorder. The hiring paperwork, which was significant, was thrown at me all at once. This made me anxious that the entirety of the job would be too fast paced, and that I would be left behind. When I missed that GIS training, I immediately panicked and thought that this mistake would bottleneck my ability to work the minimum hours not only for me to achieve full health benefits (you have to work a minimum of 20 hours a week for health insurance), but also to fulfill the hourly requirement for college credit for this internship. However, I prevailed through those tough moments through sheer determination, in addition to getting some reassuring words from my supervisors.

I also encountered stress from outside work which affected my ability to be a productive employee. A death in my family brought some unwanted tensions to the forefront of my mind. During this time, I was easily distracted and thus less productive. However, I relayed that fact both to my GIS supervisor, Kellie Gillingham, and my boss, Kasey Cykler, and they had nothing but words of encouragement. Kellie was able to get me in touch with employee services to help mitigate the tension and put me on a path of productivity. Their moral support was essential to navigating that hardship.

I was unfamiliar with the GIS application used by Water Resources to map water claims. Out of years of GIS training, I had not worked with the DoE’s preferred program, ArcGIS Desktop. There was a steep learning curve with this new GIS application.

The first step to learning the new software was getting acquainted with all the layers. The ArcGIS desktop program I worked with had numerous shapefile layers, including but not limited

to parcel data, points where water was utilized (like wells or pumps), road data, railroad lines, bodies of water, etc. Getting acquainted with the layers is critical in being able to pinpoint a location on a map from a hand-written water right document, as many applicants describe the areas of their consumption relative to other geographical points of interest. This was achieved through repeated memorization.

As mentioned, you have to learn the terminology and jargon related to those geographical locations. Wells take the form of hexagon points and are represented by a "WL" acronym, as an example. Both layers in the software, as well as the descriptions in water usage applications use many acronyms you must learn in order to figure out what part of the map they are referring to. Completing this task also took days of pain-staking memorization.

Regardless of all the acronyms you memorize, you can't read unreadable handwriting. Many applications are written by hand and are thus illegible because the person writing it might have had a physical disability which prevented them from writing cleanly, or they were just sloppy and careless. Unfortunately, this caused some of our applications to be unmappable. However, probably 90% of applications are legible, so poorly written documents are somewhat rare. Other documents are somewhat legible but not entirely so. For example, they may have text that's cleanly written, but it's written in a form of cursive that's difficult to transcribe. No amount of effort can fix unreadable documents, but at the same time you have to push yourself and struggle to read those that aren't completely unreadable.

Despite the fact that some water rights documents may be readable, they might not make any sense or contradict themselves. I had some documents that featured two locations for one point of withdrawal. In these cases, the person filling out the paperwork made a mistake, attempting to put two accurate yet different directional descriptions for a point of withdrawal, but messing up at least one of these descriptions so that they contradict each other. This can be frustrating, and requires subjective guesswork as to how to represent these points of withdrawal on a map, if they can be represented at all. In these cases, you would have to represent the point with a "UD" code which means that the point of withdrawal is unchecked (most points are in general) and dubious since the directions are clearly wrong. My ability to do this guesswork has improved incrementally with more practice.

However, the biggest hurdle for mastering this GIS software is learning how to do an edit session. Edit sessions allow the user to make modifications to the map. I've edited maps countless times in ArcGIS Pro, and although ArcGIS Desktop offers most of the same functionalities, finding the correct buttons to press is difficult at first. This is because ArcGIS Desktop uses a different layout. As such, I've spent multiple hours trying to navigate around the software to locate buttons for the most trivial of GIS functions. This too required hours of memorization.

As I mentioned in the results section, you have to be careful when making geographical features. Sometimes I would accidentally create a water withdrawal point when I wanted to make a land-use polygon. Other times I would misread the description of the water right claim and map something where it wasn't supposed to be. In these cases, you have to go into the attribute tables for these features and mark them as errors in the comment's column. If you misplace any features or put in wrong descriptions of correctly placed features in the attribute table, a supervisor may contact you over email and tell you to fix it. It is your sole responsibility to carefully do your work, and I've struggled with this aspect of the job. However, like most other GIS challenges, I've improved with time.

From learning new geographical acronyms to finding out how to make basic edits, I've had to rely on the help of a supervisor to learn the ropes. Kellie Gillingham is the main supervisor for my GIS work. We've worked together several hours over the quarter to help me learn a new GIS platform. She has been a great resource and a positive supporter as I've navigated learning the software from the ground up. Despite this, edit sessions that last up to two hours can be somewhat exhausting, and require significant mental endurance.

Navigating web sites which map and specify parcel data is also challenging. You have to be very particular in your wording to accurately search for a land tract. Some websites have address data that only go back to the 1970s, so you might have to search multiple websites to find one single parcel. This is time consuming and somewhat tedious. However, if and when you find a corresponding address, particularly on an old, scanned paper map, the georeferencing is relatively straight forward and satisfying. My ability to utilize historical resources has only gotten better with time.

As mentioned, georeferencing was doable most of the time, but on May 1st I encountered a glitch. It seems that the georeferencing application would fail to match up the paper map with the shapefile boundaries, regardless of where you placed the georeferencing points. Punching the "update georeferencing" button seemed to put the program back to normal, and I've used this as a solution whenever the program repeats this error.

Despite the presence or lack of georeferencing glitches, your ability to complete this task hinges on the quality of the maps you are importing. One georeferenced map that I placed back in mid-May had some parcel lines match perfectly to those in ArcGIS Desktop after placement, but not all of them. In this case, I had to copy the correct boundaries in ArcGIS Desktop, paste it into Microsoft Paint, manually label dozens of parcels (for which ArcGIS Desktop had reference to) and import it back into the software to georeference it.

Sometimes there will be maintenance on the GIS software itself. Usually this is conducted at 5:00 PM on Wednesday. If you are working in GIS at that time, it might make the software unusable. As with time, I've learned that you have to save your work often so that you don't lose your progress to this obstacle or other random glitches. Whenever I'm unable to use GIS, I fill time doing employer-approved LinkedIn trainings regarding GIS, excel, critical thinking skills and other topics that are important to my job or work environment. Employer-mandated trainings can also fill these time slots.

*My education, my experience and career goals*

Majoring in Environmental Studies with a GIS emphasis was the perfect background for this job. My degree taught me the importance of proper resource management, which added historical context and importance to my work mapping water rights. The GIS skills I learned at the College of the Environment aided with the technical aspects of GIS. Although I still learned GIS through my internship, the classes I took at the CoE were much more technically difficult then the concepts I learned at the Department of Ecology, which made me much more psychologically fit for this work.

This job was much more laid back than I originally anticipated. Regardless of the stresses of early-hire paperwork, the steadiness and stability of this job has put my mind at ease. Of course, I learned new technical aspects of GIS as mentioned previously, but the most important takeaway is that the job improved my state of mind. Dealing with an anxiety disorder, I struggled constantly with GIS courses, so much so that I contemplated dropping out of WWU's GIS

program twice, as I had doubts that I could work a GIS job effectively. Those fears were mostly put to rest, at least at the Department of Ecology. All the staff, including my boss, Kasey Cykler, and my GIS supervisor, Kellie Gillingham, are very kind and accommodating. Also, I am constantly learning and working at a pace which seems satisfactory or better in their view. This job has had its tough points, but overall, its smoothness has lowered my blood pressure considerably. To answer the question "What has this job taught me that my college classes didn't?" It has taught me the most useful caveat of all: that I am capable of surviving and adapting in a fast-paced work environment.

This internship is a great-stepping stone for future GIS work. Most GIS jobs require years of experience, which the internship provides. It will also keep me economically buoyant for my first year of graduate school. I'm attending Northwest Missouri State University Online to achieve a Master's of Science in Geographic Information Systems. Regardless of whether my internship lasts only a year or longer, a master's degree offers a serious advantage when searching for GIS jobs, and with the addition of work experience I will be very hirable from any practical standpoint.

In the end, I plan on acquiring a high-ranking, high pay GIS job. I am unsure if I will seek one in the Washington State Department of Ecology, but I would prefer this organization because of its great staff and friendly, safe atmosphere. If I can't find another job in ecology after my part-time job ends, I would like to work in the political sector creating election maps and doing in-depth analysis regarding voter trends and turnout. I love election maps, which is why I started creating them on Microsoft Paint after I dropped out of high school. Election cartography was one of the few activities in my life that allowed me to zone-out from teenage drama and helped me topple depression, so a job creating election maps would be very satisfying. However, I would prefer to have a GIS job in a public, governmental organization, as you are less likely to face discrimination for joining a union. Perhaps the pay in public-sector GIS jobs is a bit lower, but the main element I'm concerned about is job stability. If I get hired and then fired from a private business, I would have to worry about having enough income to pay my mortgage, if I have one. I feel much more secure working for a state agency because I think there's more transparency, accountability and union protection in the government. Thus, finding another job in the DoE, or at least getting an extension of my current contract with the Department of Ecology, would be ideal.

However, there's a small chance that I'll pursue a slightly different path. GIS will always be a part of my future employment, but there are other options as well. For example, my GIS supervisor Kellie Gillingham has a GIS certificate and is a "Water Master." Most of her work relates to enforcing water rights throughout the state. If I ever decide that a Master's of Science in GIS is not for me, perhaps I will return to Western Washington University to get a M.A. in environmental studies and return to the Department of Ecology to complete other important environmental work regarding conservation.

## *Conclusion*

This internship has been a goldmine of education. Despite some challenges, it has given me valuable work experience, and set my mind at ease as I develop GIS skills for future challenges. My degree has almost certainly put me on the right path to be successful in future jobs and educational experiences, including graduate school. The challenges in learning an entirely new GIS software were tough, but were marginally easier than learning GIS in a school

environment. This would not have been possible without the kindness of my supervisors and fellow employees. I am forever grateful for the opportunity to work a year-long position in a geographical field where experience is hard to come by.

**Works Cited**


AQUAOSO. "Washington State Water Rights – The Evergreen State's System." Blog, November 26, 2020. https://aquaoso.com/water-rights/washington-state-water-rights/.

Boeing. "Water Conservation." Boeing, 2009. https://www.boeing.com/aboutus/environment/environmental_report_09/water-conservation.html.

Brunell, Don. "Lessons Learned from Demise of Northwest Aluminum Industry." Tri-Cities Area Journal of Business, April 2017. https://www.tricitiesbusinessnews.com/2017/04/aluminum-industry/.

Couch, Eryn. "New WDFW Report Calls for Science-Based Approaches for Climate-Resilient Water Supply." Washington Department of Fish and Wildlife, February 2, 2023. https://wdfw.wa.gov/newsroom/news-release/new-wdfw-report-calls-science-based-approaches-climate-resilient-water-supply.

Department of Ecology, State of Washington. "Air & Climate." Ecology.Gov, n.d. https://ecology.wa.gov/Air-Climate.

Department of Ecology, State of Washington. "Forestry Runoff." Ecology.Gov, n.d. https://ecology.wa.gov/Water-Shorelines/Water-quality/Runoff-pollution/Forestry-runoff.

Department of Ecology, State of Washington. "Frequently Asked Questions about Water Right Claims." FAQ: Water Rights Claims, February 2006. https://s3.wp.wsu.edu/uploads/sites/2092/2021/04/FAQ-Water-Right-Claims.pdf.

Department of Ecology, State of Washington. "History of Ecology." Ecology.Gov, n.d. https://ecology.wa.gov/About-us/Who-we-are/Our-

history#:~:text=Making%20history%20as%20the%20first,1970%2C%20by%20Governor%20Dan%20Evans.

Department of Ecology, State of Washington. “Water Resources.” Ecology.Gov, n.d. https://ecology.wa.gov/About-us/Who-we-are/Our-Programs/Water-Resources.

Department of Ecology, State of Washington. “Water rights.” Ecology.Gov, n.d. https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights#:~:text=Waters%20of%20the%20state%20belong,purpose%2C%20in%20a%20specific%20place.

Department of Ecology, State of Washington. “Water Rights Map Search.” Washington State: Department of Ecology, 2023. https://appswr.ecology.wa.gov/waterrighttrackingsystem/WaterRights/Map/WaterResourcesExplorer.aspx.

Department of Ecology, State of Washington. “Water Use Compliance and Enforcement.” Ecology.Gov, n.d. https://ecology.wa.gov/Regulations-Permits/Compliance-enforcement/Water-use-compliance.

*Washington Department of Ecology: Protecting, Preserving and Enhancing Our State’s Environment*. YouTube Video, 2023. https://www.youtube.com/watch?v=iPtWrUfHx_k&t=3s.

Environmental Protection Agency. “Saving Water in Washington.” EPA.Gov, May 2016. https://www.epa.gov/sites/default/files/2017-02/documents/ws-ourwater-washington-state-fact-sheet.pdf.

Department of Ecology, State of Washington. “Stream Flow.” EPA.Gov, June 2021. https://www.epa.gov/salish-sea/stream-flow.

Jenkins, Don. “Washington Ecology: Cows Need Water Right to Sip from a Creek.” Capital Press, November 30, 2021. https://www.capitalpress.com/ag_sectors/livestock/washington-ecology-cows-need-water-right-to-sip-from-a-creek/article_80dc6082-5220-11ec-a472-c78b1da9d00a.html.

Macrotrends. “Washington Population 1900-2022.” macrotrends.net, 2023. https://www.macrotrends.net/states/washington/population.

Schad, Theodore, and Martin Reuss. *Water Resources People and Issues*. US Army Corps of Engineers, 1989. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_870-1-61.pdf.

United States Geographical Survey. “Water Use in Washington, 2015.” USGS, September 2018. https://pubs.usgs.gov/fs/2018/3058/fs20183058.pdf.

Washington Department of Fish and Wildlife. “Fishing & Shellfishing.” Washington Department of Fish and Wildlife, 2023. https://wdfw.wa.gov/fishing.

**Appendix: Work Log**

Times are approximate, but hours worked are accurate:

**Monday 3/27/2023: Worked from 8:50 AM to 11:50 AM and from 12:01 PM to 4:16 PM (>6 hours total)**

I got acquainted with Ecology staff at headquarters. I began filling out paperwork.

**Wednesday 3/29/2023: Worked from 8:10 AM to 10:38 AM and from 12:00 PM to 5:40 PM (>8 hours total)**

I finished most of my financial and HR paperwork.

**Friday 3/31/2023: Worked from 8:10 AM to 10:00 AM and from 10:15 AM to 2:30 PM (>6 hours total)**

I was introduced to ArcGIS Desktop. I filled out more HR paperwork.

**Saturday 4/1/2023: Worked from 9:45 AM to 1:45 PM (4 hours total)**

I engaged in employee training (COVID regulations and procedures), ArcGIS Desktop training and memorization of key terms used in this particular GIS software.

**Monday 4/3/2023: Worked from 8:58 AM to 10:38 AM and from 10:58 AM to 2:58 PM and from 3:36 PM to 6:56 PM (9 hours total)**

I engaged in IT and cybersecurity training, as well as ArcGIS Desktop training (placing points and polygons representing water access points/associated land).

**Wednesday 4/5/2023: Worked from 10:00 AM to 5:00 PM (7 hours total)**

I engaged in ethics training & ArcGIS Desktop training (placing points of water access & polygons representing land associated with points).

**Friday 4/7/2023: Worked from 10:30 AM to 4:00 PM and from 4:30 PM to 6 PM (7 hours total)**

I engaged in ArcGIS Desktop training, which featured placing points on a map and filing out attributes regarding those locations, as well as reading water right documents.

**Saturday 4/8/2023: Worked from 1:00 PM to 3 PM (2 hours total)**

I classified water documents according to how legible they are and I got started on my ENVS 498B report.

**Monday 4/10/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I completed more GIS training. I worked on reading and transcribing written water documents.

**Tuesday 4/11/2023: Worked from 10:00 AM to 11:00 AM (1 hour total)**

I attended a staff meeting.

**Wednesday 4/12/2023: Worked from 9:40 AM to 3:40 PM (6 hours total)**

I met with Kelly Hamilton to talk about the legal history of water claims in Washington State, and I completed more water document & GIS trainings.

**Friday 4/14/2023: Worked from 10:30 AM to 6:30 PM (8 hours total)**

I had ArcGIS Desktop training all day, with the exception of attending a presentation on hydrology by John Covert. I managed to place a water distribution source and associated land-use polygon on a map with the help of my supervisor.

**Saturday 4/15/2023: Worked from 3:17 PM to 4:00 PM and from 4:20 PM to 5 PM and from 5:20 PM to 6:45 PM (2 hours and 8 minutes)**

I completed more ArcGIS desktop work: I managed to place my first water distribution point and associated land-use polygon completely on my own. I also added to my ENVS 498B report.

**Monday 4/17/2023: Worked from 9:58 AM to 4:21 PM and from 5:16 PM to 6:56 PM (8 hours total)**

I engaged in the following LinkedIn trainings: Python in GIS, Unconscious Bias and DIBS (Diversity, Inclusion and Belonging). I completed more ArcGIS Desktop training. My GIS supervisor was pleased with my progress. She said that I am mastering GIS faster than she had anticipated. I'm at the point when I can almost map continuously on my own.

**Tuesday 4/18/2023: Worked from 10:00 AM to 10:30 AM (½ hour)**

I made edits to my daily log.

**Wednesday 4/19/2023: Worked from 10:00 AM to 5:00 PM and from 6:00 PM to 7:00 PM (8 hours total)**

I placed several points/polygons representing water right claims on a map. I also worked on an ArcMap tutorial.

**Friday 4/21/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I placed only a few water right points and their associated land-use polygons. I struggled with finding government lots. I worked on the "Fundamentals of GIS" LinkedIn tutorial. I also started a time-management LinkedIn tutorial.

**Saturday 4/22/2023: Worked from 1:51 PM to 3:40 PM (1 hour and 49 minutes total).**

I worked on my report.

**Monday 4/24/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I made and corrected water right points and their associated polygons. I also finished the DIBs, ArcGIS Python and time management LinkedIn tutorials.

**Wednesday 4/26/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 Hours total)**

I made and corrected more water right points. I learned how to use the King County Assessor/Records/Road Services websites. I started a Microsoft Outlook tutorial on LinkedIn.

**Friday 4/28/2023: Worked from 4:10 PM to 5:00 PM (50 minutes total)**

I made progress on my ENVS 498B report. I didn't participate in regular work because I had to go to the emergency room the night before. I made the tactical decision to add to my report this day (which is less time consuming) and save my regular GIS work for a day in which I wouldn't have to sleep in (also known as Saturday, April 29th, 2023).

**Saturday 4/29/2023: Worked from 11:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (7 hours total)**

I added almost 18 water right points to the map in ArcGIS Desktop.

**Sunday 4/30/2023: Worked from 12:58 PM to 2:08 PM (1 hour and 10 minutes total)**

I added a few water right points and their associated polygons, and updated my work log.

**Monday 5/1/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added some water right points and was trained on georeferencing.

**Tuesday 5/2/2023: Worked from 7:00 PM to 8:00 PM (1 hour total)**

I worked on my report.

**Wednesday 5/3/2023: Worked from 11:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (7 hours total)**

I added more water right points and their associated polygons. I also practiced reading their associated acronyms and started a racial history training video.

**Friday 5/5/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added at least 20 more water right points and their associate polygons. I continued the racial history training video.

**Saturday 5/6/2023: Worked from 12:20 PM to 1:20 PM and from 2:20 PM to 3:30 PM (2 hours and ten minutes total)**

I finished my racial history training video and modified my report.

**Monday 5/8/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added several water right points and their associated polygons. I had a training session with Kellie Gillingham regarding ArcGIS Desktop.

**Wednesday 5/10/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 6:10 PM (7 hours and 10 minutes total)**

I added several points and had a shorter training session with Kellie. I got booted out of ArcGIS online due to maintenance work on the platform, ending the day 50 minutes early.

**Friday 5/12/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added several water right points and their associated polygons. I struggled with georeferencing for the last 2 hours of the day.

**Saturday 5/13/2023: Worked from 10:57 AM to 11:43 AM and from 11:46 AM to 12:11 PM and from 5:30 PM to 6:19 PM (2 hours total)**

I georeferenced maps and added content to my report.

**Monday 5/15/2023: Worked from 8:10 AM to 11:10 AM and from 2:30 PM to 4:00 PM and from 4:58 PM to 7:28 PM (7 hours total)**

I added some water right points and their respective polygons, and I georeferenced some maps. I began switching over to a new list of water rights, but that list was flawed so I abandoned it later.

**Tuesday 5/16/2023: Worked from 5:56 PM to 6:56 PM (1 hour total)**

I made progress on my new water rights list. I started a LinkedIn Learning seminar about productive thinking.

**Wednesday 5/17/2023: Worked from 9:40 AM to 3:40 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added several water right points and their respective land-use polygons, georeferenced a map, finished the LinkedIn Learning about productive thinking and started a new LinkedIn training about better listening skills.

**Friday 5/19/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added several water right points and their associated land-use polygons. I completed the productive thinking LinkedIn training.

**Saturday 5/20/2023: Worked from 1:10 PM to 3:58 PM (2 hours and 48 minutes)**

I worked on my report and my work log.

**Monday 5/22/2023: Worked from 6:50 AM to 8:50 AM and from 12:00 PM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added some water right points and polygons, but the software wasn’t accessible for a few hours and I had to send a report to IT. I had a training session which focused on making lists for

unmapped water rights. I finished the listening training on LinkedIn and started a GIS training on the same platform.

**Tuesday 5/23/2023: Worked from 10:00 AM to 11:00 AM and from 4:40 PM to 6:40 PM (3 hours total)**

I attended a staff meeting and added some more water right points and polygons.

**Wednesday 5/24/2023: Worked from 10:00 AM to 12:30 PM and from 2:50 PM to 3:50 PM and from 5:00 PM to 6:30 PM (5 hours total)**

I added several more water right points/polygons, almost finishing my first list.

**Friday 5/26/2023: Worked from 10:00 AM to 3:20 PM and from 4:20 PM to 7:00 PM (8 hours total)**

I added some water right points and polygons, finished one section of my "Fundamentals of GIS" LinkedIn tutorial, and I taught myself how to filter a large list of water rights. I also started a LinkedIn Excel tutorial.

**Saturday 5/27/2023: Worked from 1:10 PM to 2:40 PM (1 ½ hours total)**

I worked on my report.

**Sunday 5/28/2023: Worked from 1:30 PM to 4:30 PM (3 hours total)**

I finished the rough draft of my report.

**Monday 5/29/2023: I can't recall the exact times for this day, but I still worked for the following hours (4.9 hours total)**

I worked on the new water rights mapping list, georeferenced some challenging maps, and finished the LinkedIn Excel tutorial.

**Tuesday 5/30/2023: Worked from 2:08 PM to 5:32 PM (3.4 hours total)**

I added some points and georeferenced some maps.

**Wednesday 5/31/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added some water right points and attended an anti-racism training.

**Friday 6/2/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I added several points and had another training session with my supervisor, Kellie.

**Monday 6/5/2023: Worked from 10:00 AM to 4:00 PM and from 5:00 PM to 6:00 PM (7 hours total)**

I added several water right points and polygons, and trained with Kellie.

**Tuesday 6/6/2023: Worked from 12:00 PM to 4:00 PM and from 5:00 PM to 6:00 PM (5 hours total)**

I added several water right points/polygon and got feedback from Kellie: I still need more training with point/land classifications.

**Wednesday 6/7/2023: Worked from 9:00 AM to 10:50 AM and from 11:50 AM to 4:00 PM and from 5:00 PM to 7:00 PM (8 hours total)**

I finished the final draft of my report and added several water right points/polygons to the map. I also continued my GIS training (ArcGIS Pro Essential Training).

**Total Hours Worked: At least 275.9**