THE UNIVERSITY OF BRITISH COLUMBIA, OKANAGAN CAMPUS
FACULTY OF APPLIED SCIENCE, SCHOOL OF ENGINEERING

APSC 169
Fundamentals of Sustainable Engineering Design
Project Report #1 - A2

Water and sediments contamination: Develop technologies for detecting and treating contaminants in water and sediments from mining areas to guarantee water quality and protect aquatic ecosystems and human health

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Background and Significance

The mining industry is a trillion dollar field, employing millions of workers worldwide. In accordance with the industry being such a large and competitive space, it is inevitable that some companies end up out of business, leaving mines and operations abandoned without a liable figure.

In the present day, each nation has its own stringent laws and regulations governing both the quality and quantity of waste released from active mines. However, previous to these acts, over a million abandoned mines were left unregulated, and a sizable portion of these mines continue to pose significant environmental and public health risks (Coelho et al., 2011, p. 793). According to a 1987 symposium paper, within British Columbia, approximately 30% of abandoned mines leach toxic contaminants into the water (Errington & Ferguson, 1987, p. 8). The accumulation of these xenobiotics—particularly heavy metals and sulphates—in the ecosystem not only degrades the aquatic surroundings but also ends up biomagnified through the food web, culminating in the reduction of biodiversity, as well as detriments individuals and Indigenous settlements who rely on the said environment.

To further hone in on the problem, acid mine drainage (AMD) is the primary water-based effluent emerging from these mines—with about 90% of AMD coming from abandoned operations (Skousen, 2002, p. 880). AMD arises from the mining of precious metals and ores (nickel, copper, silver, gold, coal etc.), which are often rich in sulphide material, resulting in the exposure of sulphur-based minerals such as pyrite and pyrrhotite to air, water and naturally occurring acidophilic bacteria (eg. Acidithiobacillus ferrooxidans)—which establishes optimal conditions for oxidation, yielding sulphates and sulphuric acid (Martí-Calatayud et al., 2014, p. 120).

$$FeS_2(Pyrite) + \frac{7}{2}O_2 + H_2O \rightarrow Fe^{2+} + 2SO_4^{2-}(Sulfate\ Ion) + 2H^+ \quad (1)$$

$$2H^+ + SO_4^{2-}(Sulfate\ Ion) \rightarrow H_2SO_4\text{(Sulphuric Acid)} \quad (2)$$

The presence of sulphuric acid serves to lower the pH of the solution until reaching an optimal pH of 5, where acidophilic bacteria can then act as catalysts to further accelerate the breakdown of further sulphur-based minerals—bringing about a positive feedback loop (Icer et al., 2023, p. 2). Consequently, the highly acidic concentration tends to weather surrounding rocks, which ends up leaching the heavy metal elements stored within them (Martí-Calatayud et al., 2014, p. 121). Depending on the location and geology, these heavy metals may vary, however the most prominent of them include iron, aluminum, manganese, zinc, copper, arsenic and lead—the ingestion of these elements, even at minuscule dosages, have the ability to cause irreversible organ damage (Singh et al., 2023, p. 50).

Most countries have established discharge recommendation limits for sulphates in water effluents ranging between 250 to 500 mgL^{-1} (Paulo & Katie, 2024, p. 400). As such, it is crucial for mining companies to treat wastewater, causing lots of research and capital investment towards sulphate removal technologies. However, the focus on the removal of sulphates only brings about a secondary effluent waste rich in heavy metals (Mosai et al., 2024, p. 3). Whilst this may not be as significant of a problem in active mines—as the effluent is constantly being pumped out (leaving minimal time for the high concentrations to accumulate and for heavy metals to dissolute)—it is much more significant in abandoned mines, where rainwater may pool-up over long periods of time. Thus, further technologies which can target and treat heavy metal pollutants are of major importance in the drainage of abandoned mines.

Significance of the Need

AMD has significant global impacts, as the waste material can leach into the environment, affecting the habitats of animals, increasing toxicity in aquatic ecosystems, and destroying the natural environment (Liao et al., 2016, p. 460). These effects can be observed far beyond the general area of the polluting mine, as waterways have been found to carry pollutants up to 100 km away in certain cases (Adamovic et al., 2021, p. 123). The sweeping reach of the issue causes significant adverse health effects as contaminants can find their way into human food chains. For instance, farms located downstream from abandoned mines with significant AMD have been found to grow certain crops with heavy metal concentrations over 38x the allowable limit (Liao et al., 2016, p. 465). This is not limited to crops, however, as several aquatic species including fish and shrimp have also been found to be exceeding acceptable levels of heavy metals fit for human consumption due to runoff from mining operations (Chan et al., 2021, p. 4415). Although all heavy metals pose significant risks, high concentrations of cadmium and arsenic in particular have been directly correlated with lung cancer, bone fractures, lesions, kidney dysfunction and hypertension (Liao et al., 2016, p. 463). The significance does not end at just the public health risk, however, as farmers may be forced to close their farms or even relocate if the soil is too highly contaminated, altogether causing millions in damages for farmers around the world. A cheap, autonomous solution to AMD discharged from abandoned mines would decrease the threat that heavy metals pose to human health, save millions in lost revenue and fines, and increase the quality of life of those people who rely on the land.

Need Statement

"A way to address contaminated water runoff originating from abandoned mining operations located in the Pacific Northwest"

Justification of the Scope and Need Statement

The scope of the need statement is based on many factors that work towards narrowing the main focus of the problem at hand. The need statement "A way to address contaminated water runoff originating from abandoned mining operations located in the Pacific Northwest" describes both the problem and the population affected. In addition, the diction used reinforces the problem and population components of the need statement. For instance, "contaminated water runoff" implies the subject of the issue while keeping it broad enough using the word "contaminated" as a way to prevent the statement from being solution-dependent. Next, the population is based around mining operations and is further scoped by only addressing abandoned mines that are located in the Pacific Northwest. The choice to concentrate on abandoned mines is because the majority of contaminated water runoff affecting the environment derives from abandoned mines (Escudero L. et al, pg.11085-11091). The specificity of abandoned mines was also chosen to lower the scope of the issue to a certain population of mines. Mines located in the Pacific Northwest were chosen because they share similar geological environments, climates, and have comparable studies on the subject (Cannings R. et al, pg.9-10). This scope was chosen because a larger scope would become too broad and there would be differences in the type of mines, how the mines were maintained or operated, and geological differences would provide too much diversity in the water contaminates (Lintern A. et al, pg.1-3). Furthermore, a smaller scope would provide inadequate studies and would cause the solution to be focused on a specific set of conditions that may become too limiting. To justify the need statement, it is believed that this best represents the problem of contaminated water coming from mines into the environment.

Functions

- Must reduce amounts of sulphide contacting water—measured in gL^{-1}
- Must reduce amounts of heavy metal contamination in the water—measured in ΔgL^{-1}
- Must decrease the acidity of water—measured in ΔpH

As we set forth to design an adequate solution for AMD, there are certain functions our project must accomplish. For starters, our design must be able to reduce the amount of sulphides that come in contact with water. This is to reduce the frequency of sulphide reactions (Equations 1 & 2 above) and thus reduce the amount of heavy metals that get leached out into the environment.

The second function our design must have is to reduce the amount of heavy metals entering the water due to AMD to the Ambient Water Standards of each State and Province in the PNW. (Table 1 below shows these standards in detail.) The change in the amount of heavy metals in the water before and after purification will be measured in grams per litre (ΔgL^{-1}) and the quantity of heavy metals entering the water after purification will be measured in μgL^{-1}.

The final function our design must accomplish is reducing the acidity of the water to the standards set by each State and Province. This will be measured in ΔpH.

All these functions are in place to ensure that the local aquatic life and surrounding environment are protected from the harms caused by AMD and can continue to thrive and grow for years to come.

Objectives

- Maximize the variety of heavy metals that can be treated—number of heavy metals removed/cycle of treatment
- Minimize contaminants in water—measured in gL^{-1}
- Maximize rate of purification—measured in ΔLs^{-1}
- Minimize human control needed—measured in hours spent by workers at a mine site
- Maximize affordability (Cost in CAD$)

We have also set 5 higher objectives we would like to accomplish with our design. We want our treatment method to maximize the variety of contaminants it can treat, therefore minimizing the amount of contaminants in the water. We hope by doing so we can maximize the purity of the water to meet the drinking water standards for each respective State or Province. Secondly, we want to maximize the rate at which water can be purified and released back into the environment; which can be measured in Ls^{-1}. We also want to minimize the level of human control, or maximize automaticity, so water can be treated at these abandoned mine sites passively without requiring anyone to operate or supervise it. This would alleviate the need to pay added wages to such a worker and help to achieve our final objective, which is to minimize the cost. Most mine sites have to work within a reclamation budget, so if we can produce cheaper treatment methods, more mine sites can afford to have properly treated water.

Constraints

- 100 CAD$ budget for the prototype
- Need proper permitting

- Working within the “Land Reclamation Budget”
- Monitoring the volume of effluent leaving a mine site
- Adhering to the Freshwater Guidelines set by the respective policymakers of the PNW

There are many constraints that will impact our project. The most apparent within these planning stages is the $100 budget cap on the prototype production. This severely limits the quality of testing our design will receive and may not produce reliable results as a consequence. Outside of that, the majority of our constraints come from the law. A common theme across all the regions of the Pacific Northwest is the need for a permit to build on a mine site. The BC Environmental Assessment Act states in Section 6 that, “Despite any other enactment, a person must not (a) undertake or carry on any activity that is a reviewable project, or (b) construct, operate, modify, dismantle or abandon all or part of the facilities of a reviewable project, unless the person (c) first obtains an environmental assessment certificate for the reviewable project”. Similarly the United States Surface Mining and Control Reclamation Act states in Section 506 (a) that “no person shall engage in or carry out on lands within a State any surface coal mining operations [or Reclamation project, (as later iterated in Section 507 (a))] unless such person has first obtained a permit issued by such State pursuant to an approved State program or by the Secretary pursuant to a Federal program”. Both these Acts require us to obtain a permit before building a Reclamation Project of any sort on a mine site.

Both the US and Canada consider water treatment a land reclamation project. This means its construction and operation would be covered by the Mines’ or local government’s land reclamation fund. (As dictated by the BC Mines Act (Section 10 [ss. 2.01, 4 and 5] and the SMCRA Section 401 (a)) That means we have to work within the budget given to us; this could be a lot, or very little depending on the government. This will determine the quality of treatment we can manufacture, especially if we don't have adequate funding. Both countries also require that the amount of effluent, or water leaving the mine site must be recorded and under surveillance. The Canadian Metal Mining Effluent Regulations require us under Section 19 to "for each month during which there was a deposit, record the monthly mean concentration (a) in mg/L for deleterious substances." Likewise, in the US, the Federal Water Pollution Control Act states in Section 104 (a) (5) that "in cooperation with the States, and their political subdivisions, and other Federal agencies establish, equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of the navigable waters and ground waters and the contiguous zone and the oceans […] and shall report on such quality."

Some constraints are only for mines in the US. For example, no reclamation fund is allocated for Uranium mines, so we would have to fund the project out-of-pocket, or not touch them entirely (SMCRA, (2021), Section 411 (d)). We also cannot treat lands that exceed 25,000 acres (SMCRA, (2021), Section 406 (d)(2)).

The most important constraints that have defined our parameters for this project are each state's and Province's Water Quality Standards. Below is a table comprised of the legal limits of Heavy Metals that can be in the water, measured in μgL^{-1}. Each statistic comes directly from the law based on the Freshwater Chronic Criteria or Criteria Continuous Concentrations (CCC). The CCC "equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects" (Establishment of numeric criteria for priority toxic pollutants for the State of California. 40 CFR § 131.38(B)(1)(d)). This standard was chosen due to its strictness and focus on aquatic life in freshwater, which is what we are trying to preserve through this project. The 6 heavy metals listed in the table below were chosen based on the average heavy metals reported to leach into the environment due to AMD (Errington J.C., & Ferguson K.D.. (1987)).

Table 1: Freshwater Chronic Criterion Concentration of the Pacific Northwest for Basic Heavy Metals (Measured in μgL^{-1})

	Aluminum (Al)	Arsenic (As)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Zinc (Zn)
Alaska [a]	87	150	N/A [1]	1000	N/A [2]	N/A [3]
BC [b]	N/A [4]	5	3 †	350^Δ	N/A [5]	N/A [6]
California [c]	N/A *	150	9	N/A *	2.5	120
Idaho [d]	N/A *	150	7.6	N/A *	2.5	120
Montana [e]	87	150	N/A [7]	1000	N/A [8]	N/A [9]
Oregon [f]	N/A *	150	N/A ✦	1000	N/A [2]	N/A [3]
Washington [g]	180	130	1.2	N/A *	N/A [10]	N/A [11]

Footnotes:

* Not Listed

^Δ Short-term measurement (CMC) because CCC was not listed

✦ Calculations Unavailable

[1] Alaska Copper Chronic (dissolved) = exp{(0.8545)[ln(hardness)] - 1.702}× (0.960)

[2] Alaska/Oregon Lead Chronic (dissolved) = exp{(1.273)[ln(hardness)] - 4.705} × (1.46203 - [(ln(hardness) (0.145712)])

[3] Alaska/Oregon Zinc Chronic (dissolved) = exp{(0.8473)[ln(hardness)] + 0.884}× (0.986)

[4] BC Aluminum WQG =

$$\frac{exp\{[0.645*ln(DOC)] + [2.255 * ln(hardness)] + [1.995*pH] + [-0.284 * (ln(hardness) * pH)] - 9.898\}}{3}$$

[5] BC Lead Dissolved WQG = exp(0.514 [ln(DOC)] + 0.214[ln(hardness)] + 0. 4354)

[6] BC Zinc WQG = $\frac{exp(0.947[ln(hardness)] - 0.815[pH] + 0.398[ln(DOC)] + 4.625)}{2}$

[7] Montana Lead Chronic (dissolved) =exp{(0.8545)[ln(hardness)] - 1.702}

[8] Montana Lead Chronic (dissolved) = exp{(1.273)[ln(hardness)] - 4.705}

[9] Montana Zinc Chronic (dissolved) = exp{(0.8473)[ln(hardness)] + 0.884}

[10] Washington Lead Chronic (dissolved) = (0.951)(exp(1.273[ln(hardness)] - 4.705))

[11] Washington Lead Chronic (dissolved) = (0.986)(exp(0.8473[ln(hardness)] – 0.6900))

Sources:

[a] Alaska Department of Environmental Conservation. (2022, September 8). *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances*

- *Water Quality Criteria For Toxic And Other Deleterious Substances*. State of Alaska. https://dec.alaska.gov/media/q5njdzbc/alaska-water-quality-criteria-manual-for-toxic-and-other-deleterious-organic-and-inorganic-substances-2022.pdf

[b] British Columbia Ministry of Environment and Climate Change Strategy. (2024). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Government of British Columbia. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

[c] Establishment of numeric criteria for priority toxic pollutants for the State of California. 40 CFR § 131.38. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-131/subpart-D/section-131.38

[d] *Water Quality Standards - Section 210 - Numeric Criteria For Toxic Substances For Waters Designated For Aquatic Life, Recreation, or Domestic Water Supply Use*. IDAPA 58.01.02.210.01(a). Table 1. https://adminrules.idaho.gov/rules/current/58/580102.pdf

[e] Montana Department of Environmental Quality. (2019, June). *Montana Numeric Water Quality Standards*. State of Montana. https://deq.mt.gov/files/Water/WQPB/Standards/PDF/DEQ7/DEQ-7.pdf

[f] *Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon - Attachment 2 - Aquatic Life Water Quality Criteria for Toxic Pollutants*. OAR 340-041-8033. Table 30. https://www.epa.gov/sites/default/files/2020-11/documents/orwqs.pdf

[g] *Water Quality Standards for Surface Waters of the State of Washington - Section 240 - Toxic Substances*. WAC 173-201A-240. Table 40. https://app.leg.wa.gov/WAC/default.aspx?cite=173-201A-240

[†] British Columbia. Ministry of Environment and Climate Change Strategy. (2019). Copper Water Quality Guideline for Protection of Freshwater Aquatic Life-User's Guide. Government of British Columbia. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/copper/bc_copper_wqg_aquatic_life_users_guide.pdf

For many of these values, it is necessary to know the hardness or the pH of the water, which can only be determined after further research. We also want to make our design universal across the Pacific Northwest, as such, we are constrained by the highest quality bar across all the States and provinces.

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Appendix A: Team Contract

Team: 3

Name:	Contact Info:	Emergency Communication:
Axel	axelbendl@gmail.com	604-368-8884
Connor	connorjones9@outlook.com	250-309-3591
Hasan	hasanbm.stu@gmail.com	236-795-6566
Zach	phonezachary@gmail.com	778-363-9737
Jacky	Jackylovecanada@gmail.com	431-279-0152

Deliverable (Marks)	External Communications Lead	Deliverable Lead	Minute-Taker
Report 1	Hasan	Axel	Zach
Report 2	Connor	Hasan	Axel
Report 3	Jacky	Connor	Hasan
Report 4	Zach	Jacky	Connor
Report 5	Axel	Zach	Jacky
Final Video	Hasan	Axel	Zach

Team Communications

Meeting Times:

Monday: 12:30-2:00
Tuesday: 6:30-8:00
Additional Meeting times may be added as necessary.

Preferred method of communication:

WhatsApp Group Chat will be used for communication, although direct text messages will be used for emergencies. Replies should be received within 5 hours.

Meeting Location:

Meet in the first-floor library. If a groupmate is available, but not able to attend the session at the library, they may video call in.

Decision Making Policy:

Majority vote

Method for setting and following meeting agendas (Who will set each agenda? When? How will team members be notified/reminded? Who will be responsible for the team following the agenda during a team meeting? What will be done to keep the team on track during a meeting?).

We will set the agenda as a team, you yourself are responsible for showing up. The deliverable lead will be responsible for keeping the team on track.

Method of **record keeping** (who will be responsible for recording & disseminating minutes? How & when will the minutes be disseminated? Where will all agendas & minutes be kept? Who is responsible for maintaining the log?

We will create a new Google Doc for each meeting to keep track of minutes. Whoever is the designated minute taker will create the document and share it with the rest of the group.

Topic of Choice:
A2: Water and sediments contamination: Develop technologies for detecting and treating contaminants in water and sediments from mining areas to guarantee water quality and protect aquatic ecosystems and human health.

Team Expectations

Work Quality

1. **Project standards** (what is a realistic level of quality for team presentations, collaborative writing, individual research, preparation of drafts, peer reviews, etc.?):

   We want to strive for a high quality of work in all categories of projects and group work.

2. **Strategies** to fulfill these standards:

   We'll work as a team and communicate with each other to ensure everyone is supported and understands their roles. If anyone needs help, they can reach out to any members of the team. All work will be compared to the rubric to ensure all requirements are met.

Team Participation

1. Strategies to ensure cooperation and equal distribution of tasks.

   We will assign specific tasks to each member of the group to be worked on or *completed before the next meeting. We will allocate 5-10 minutes at the end of each meeting to communicate and assign these tasks to each other. Thus, at the beginning of each meeting, we will report the progress made on our tasks to ensure everyone is meeting the deadlines and managing an even workload.*

2. Strategies for encouraging/including ideas from all team members (team maintenance) in a positive and supportive way.

   Focus on listening and consider everyone's ideas equally and work towards filtering them to find the best option.

3. Strategies for keeping on task (task maintenance).

   We will allocate designated tasks for each member after every meeting, to keep on track.

4. Preferences for leadership (informal, formal, individual, shared).

   The leadership style will be informal and shared, with all members contributing and taking lead when needed. However, the Project Deliverable Lead for each week is expected to take charge when needed to ensure all work is completed.

Personal Accountability

1. Expected individual attendance, punctuality, and participation at all team meetings — be specific (use numbers, not words like "always" or "occasional").

   12:30-2:00 on Monday, 6:30-8:00 on Tuesdays, and maybe on the weekends if need be. Attendance is mandatory unless there are extenuating circumstances, in which case it must be shared with the team at least 1 hour before. Members may not be more than 10 minutes late to each meeting.

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines.

   Team members are 100% responsible for fulfilling team assignments, timelines, and deadlines and are encouraged to communicate with other team members if concerned about fulfilling these expectations.

3. Expected level/amount of communication with other team members (when do you copy each other or your TA on emails?).

   Open communication is expected, with members updating each other on their progress often. Communications should be made during reasonable hours of the day, except in the case of urgent matters. If any problems arise, all members *should be notified. The External Communications Lead should CC all members of the team for all emails with the Professor or TA.*

4. Expected level of commitment to team decisions and tasks.

   A high level of commitment/contribution is expected towards all team decisions and tasks.

Consequences for Falling Below Expectations:

1. Describe, as a group, how you would handle **infractions** of any of the obligations of this team contract.

   If a team member does not show up to meetings, they will still be assigned work by the group to make up for the meeting, as well as work outside of the meeting (like everyone else). For all infractions, the team member will be reminded of their obligations and their role in the team.

2. Describe what your team will do **if the infractions continue.**

   Communicate with said member before considering their iPeer percentage.

By signing this contract, I confirm that:

a) *I participated in formulating the standards, roles, and procedures as stated in this contract.*
b) *I have added all course deadlines and any team internal deadlines to my personal calendar or other organizational tool.*
c) *I understand that I am obligated to abide by these terms and conditions.*
d) *I understand that if I do not abide by these terms and conditions, I will accept the consequences as stated in this contract.*

Name: Jiaqi Zhou Date: September 10th

Name: Connor Jones Date: September 10th

Name: Axel Bendl Date: September 10th

Name: Zachary Boos Date: September 10th

Name: Hasan Mohammad Date: September 10th

Appendix B: Meeting Minutes

APSC 169 Team 03 Meeting Minutes

Date: Tuesday September 10th, 2024

Location: ART Floor 1; Room #110

Time: 10:35 am – 11:50 am

Present: Axel Bendl, Zach Boos, Connor Jones, Hasan Mohammad, Jacky Zhou

Regrets: N/A

Note-Taker: Zach Boos

Points of discussion:

- Formed group.
- Created a group chat to keep in contact outside of school hours.
- Decided on open times to meet outside of class hours.
- Created and signed the team contract.
- Agreed on research prompt A2 for our project.

Before our next meeting, we hope to do:

Task:	Assigned to:	Additional Conditions:
Research issue of Water and sediments contamination	All Members	
Research what type of mine to look into	All Members	

Next meeting: Monday September 16th, 2024; 12:30pm-2:00pm at the Library

We hope to decide what kind of mines to look into and what problems need to be solved there during our next meeting.

Meeting adjourned: 10:50am

APSC 169 Team 03 Meeting Minutes

Date: Monday September 16th, 2024

Location: Library

Time: 12:30 pm – 1:55 pm

Present: Axel Bendl, Zach Boos, Connor Jones, Hasan Mohammad, Jacky Zhou

Regrets: N/A

Note-Taker: Zach Boos

Points of discussion:
- Background Research Findings
- Acid Mine Drainage (AMD) Scenarios
- The Treating of Sulphides and Heavy Metals in Water
- What Problem Are We Trying to Solve
- The Scope of Our Project
- Divided Up Research Tasks

Before our next meeting, we hope to:

Task:	Assigned to:	Additional Conditions:
Research what the suitable concentrations for these heavy metals to discharge back into public streams are. (Further Constraints)	Zach	
Research which heavy metals are most commonly the problem. (And other loose ends)	Axel	
Research what the impacts of these heavy metals are.	Connor	
Research ways to detect these heavy metals.	Jacky	
Research how to collect AMD from abandoned mines.	Hasan	

Next meeting: Tuesday, September 17th 2024; 10:00am-12:00pm
in the Arts Building Room #110

In our next meeting, we are hoping to have a more thorough understanding of AMD and its treatments and an idea of the direction we would like to take the project.

Meeting adjourned: 1:55pm

APSC 169 Team 03 Meeting Minutes

Date: Tuesday, September 17th, 2024

Location: Arts Building, Room #110

Time: 10:30am – 11:50pm

Present: Axel Bendl, Zach Boos, Connor Jones, Hasan Mohammad, Jacky Zhou

Regrets: N/A

Note-Taker: Zach Boos

Points of discussion:

- Recount Research Findings
- Clarified Scope and Direction of Report
- Divided Who Would Write What For The Report
- Canceled 6:30pm Meeting

Before our next meeting, we hope to complete our respective sections of Report 1. The portions were divided up as follows:

Task:	Assigned to:	Additional Conditions:
Functions, Objectives and Constraints	Zach	
Intro and Background Research	Axel	
Table of Contents and Justification	Connor	
Adding Supporting Data	Jacky	
Significance and Citations	Hasan	

Next meeting: Monday, September 23rd 2024; 12:30pm - 2:00pm
in the Library

In our next meeting, we are hoping to proofread and edit our report before submission.

Meeting adjourned: 11:50pm

APSC 169 Team 03 Meeting Minutes

Date: Monday, September 23rd, 2024

Location: Library

Time: 12:30pm – 2:10pm

Present: Axel Bendl, Zach Boos, Connor Jones (present online), Hasan Mohammad

Regrets: Jacky Zhou (Has COVID)

Note-Taker: Zach Boos

Points of discussion:

- Proofread the full report
- Make edits where needed
- Make sure everyone is on the same page (Report is consistent)
- Dividing up tasks before submission

Before our next meeting, we hope to complete our respective sections of Report 1. The portions were divided up as follows:

Task:	Assigned to:	Additional Conditions:
Finishing touches on each section	Everyone	
Citations/References	Hasan	
Law Citations	Zach	
Submit Report 1	Axel	Only after checking in with everyone to confirm we are all done.

Next meeting: Tuesday, September 24th 2024; 10:30am – 12:00pm
in the Library

We are hoping to have Report 1 done by tonight at 12am. Next meeting we begin Report 2.

Meeting adjourned: 2:10pm