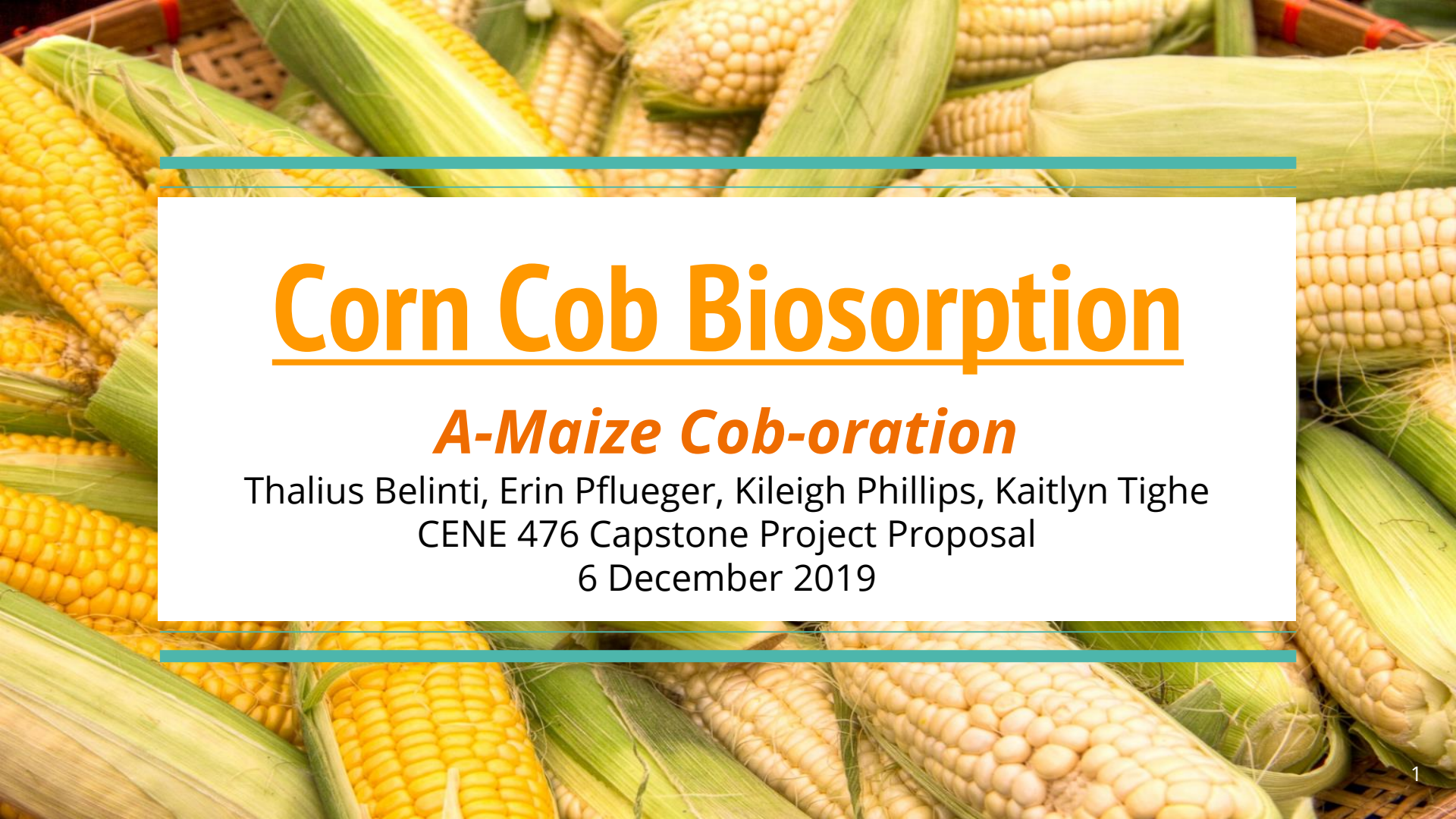


Corn Cob Biosorption

A-Maize Cob-oration

Thalius Belinti, Erin Pflueger, Kileigh Phillips, Kaitlyn Tighe

CENE 476 Capstone Project Proposal

6 December 2019

Background

Purpose: Create an isotherm for Arsenic, validate the Cadmium isotherm, test for Total Coliform using corn cobs as a biosorbent

Client: Dr. Ozis

Stakeholders: Dr. Ozis, marginalized communities

Location: Inspired by the Gold King Mine Spill

A-Maize Cob-oration

Figure 2-1: Gold King Mine Spill Before and After
https://www.sudrum.com/news/2018/08/31/three-year-water-quality-study-reveals-no-lasting-impacts-from-gold-king-mine-spill/c

Background - Corn Corps

Cadmium Testing

- Testing Using Untreated Biosorbent
  - Average removal efficiency of 76%
- Testing Using Treated Biosorbent
  - Average removal efficiency of 97%
- Prototype Development
  - Column design

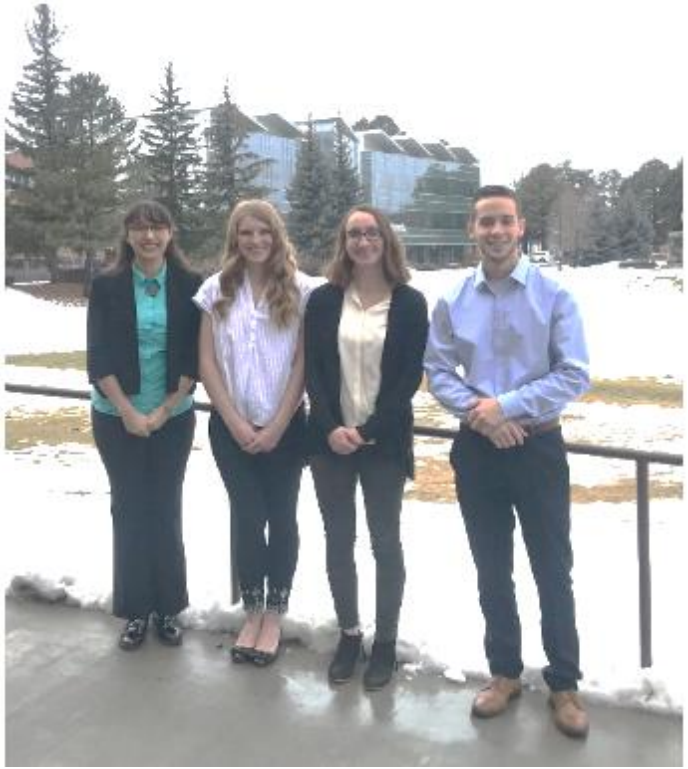


Figure 3-1: Corn Corps Team Members

https://www.cefns.nau.edu/capstone/projects/CENE/2019/NASAResearch/index.htmll

Scope - Task 1.0

Task 1.0: Biosorbent Preparation

- Task 1.1: Corn Preparation
  - Task 1.1.1: Biosorbent
  - Task 1.1.2: Activated Biosorbent

Figure 4-1: Sieved Corn

Corn Corps, "CENE 486 Final Presentation," NAU, 2018.

Figure 4-2: Example of Corn That Will be Used for the Analysis

https://scitechdaily.com/researchers-discover-simple-way-sweet-corn-growers-could-dramatically-increase-yield/l

Scope - Task 2.0

Task 2.0: Testing of Contaminants

- Task 2.1: Sample preparations
  - Task 2.1.1: Cadmium Sample Preparation
  - Task 2.1.2: Arsenic Sample Preparation
  - Task 2.1.3: Total Coliform Sample Preparation
  - Task 2.1.4: Batch Reactor Sample Preparation
- Task 2.2: Cadmium Testing
- Task 2.3: Arsenic Testing
  - Task 2.3.1: Chemistry Department Planning
- Task 2.4: Total Coliform Testing

Table 5-1: Cadmium Testing Concentrations

Cadmium (Treated) Testing Concentrations		
1	5	µg/L
2	10	µg/L
3	20	µg/L
4	35	µg/L
5	50	µg/L
6	75	µg/L
7	100	µg/L

Table 5-2: Arsenic Testing Concentrations

Arsenic Testing Concentrations		
1	10	µg/L
2	20	µg/L
3	35	µg/L
4	50	µg/L
5	65	µg/L
6	80	µg/L
7	125	µg/L
8	250	µg/L
9	500	µg/L

Scope - Task 3.0

Task 3.0: Analysis

- Task 3.1: Cadmium Analysis
- Task 3.2: Arsenic Analysis
- Task 3.3: Total Coliform Analysis

	Original form	Linearized form
1. Langmuir model:	$q = \frac{q_m . K_L . C}{1 + K_L . C}$	$\frac{C}{q} = \frac{1}{K_L . q_m} + \frac{1}{q_m} . C$
2. Freundlich model:	$q = K_F . C^{\frac{1}{n}}$	$\log q = \log K_F + \frac{1}{n} . \log C$

Figure 6-1: Isotherm Models for Arsenic

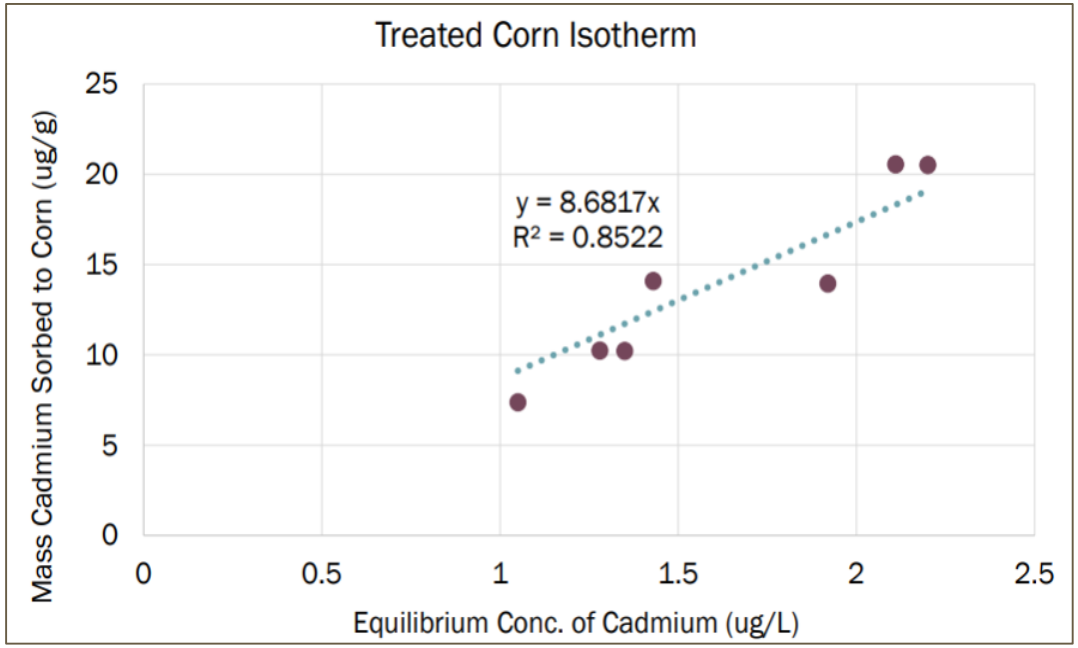


Figure 6-2: Results from Freundlich Isotherm Method for Treated Corn from Corn Corps

Scope - Task 4.0

Task 4.0: Project Impacts

- Task 4.1: Environmental Impacts
- Task 4.2: Social Impacts
- Task 4.3: Economic Impacts

Figure 7-2: Animas River After the Gold Kings Mine Spill

https://cbsnews1.cbsistatic.com/hub/i/2015/08/10/37bd050c-1cd7-4584-ba59-0a2f967fae72/animasriver839584589424.jpg

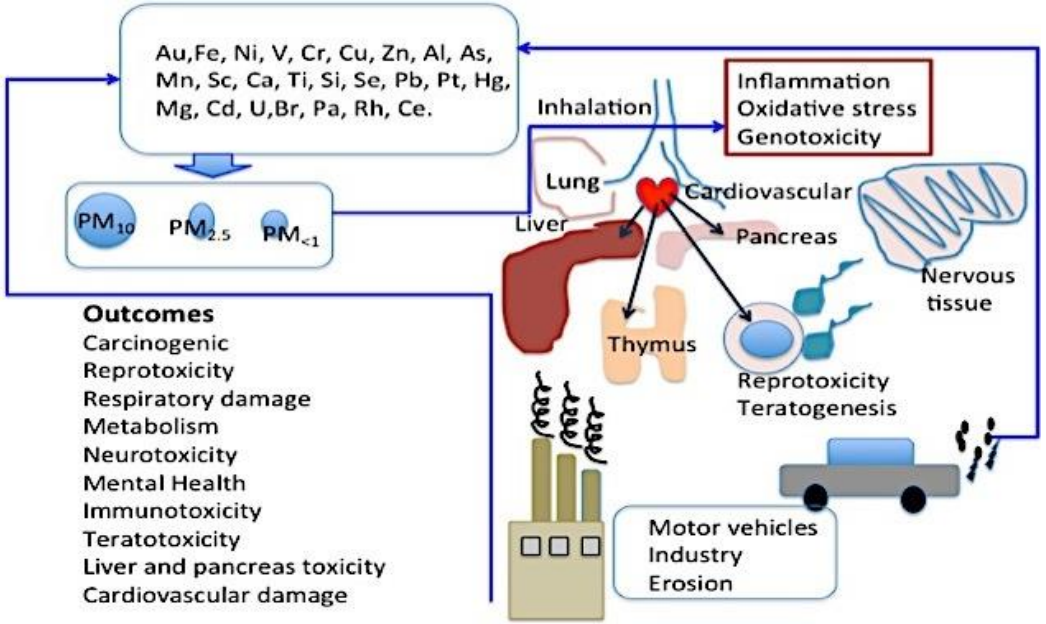


Figure 7-1: Health Effects of Metals

https://www.intechopen.com/books/current-air-quality-issues/health-effects-of-metals-in-particulate-matter

Scope - Task 5.0

- Task 5.0: Project Deliverables
  - Task 5.1: 30% Deliverables
    - Task 1.0
  - Task 5.2: 60% Deliverables
    - Tasks 2.0 and 3.0
  - Task 5.3: 90% Deliverables
    - Tasks 4.0 and 5.0
  - Task 5.4: Final Deliverables
  - Task 5.5: Other Professional Deliverables
    - Task 5.5.1: Project Presentations
    - Task 5.5.2: Compiled Project Results Publication

Figure 8-1: NAU Undergraduate Symposium Logo

Figure 8-2: Example Engineering Journal

Figure 8-3: NAU Water Symposium Logo

Scope - Task 6.0

Task 6.0: Project Management

- Task 6.1: Meetings
  - Task 6.1.1: Meeting with Client and Technical Advisor (TA)
  - Task 6.1.2: Meeting with Grading Instructor (GI)
  - Task 6.1.3: General Meeting Requirements
- Task 6.2: Project Schedule
  - Gantt Chart
- Task 6.3: Resource Management

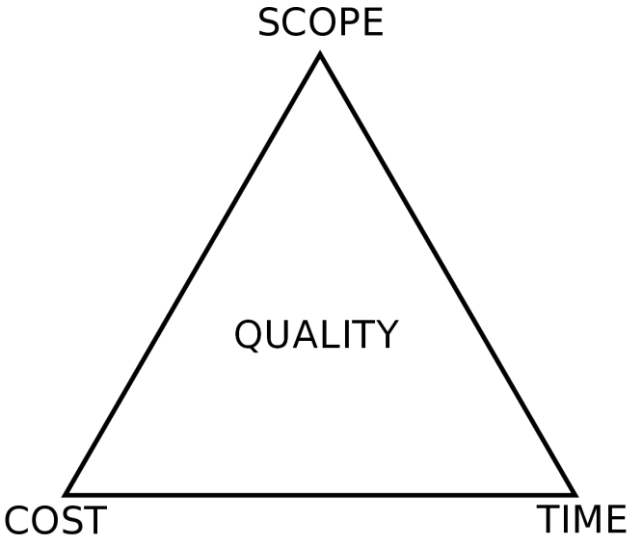
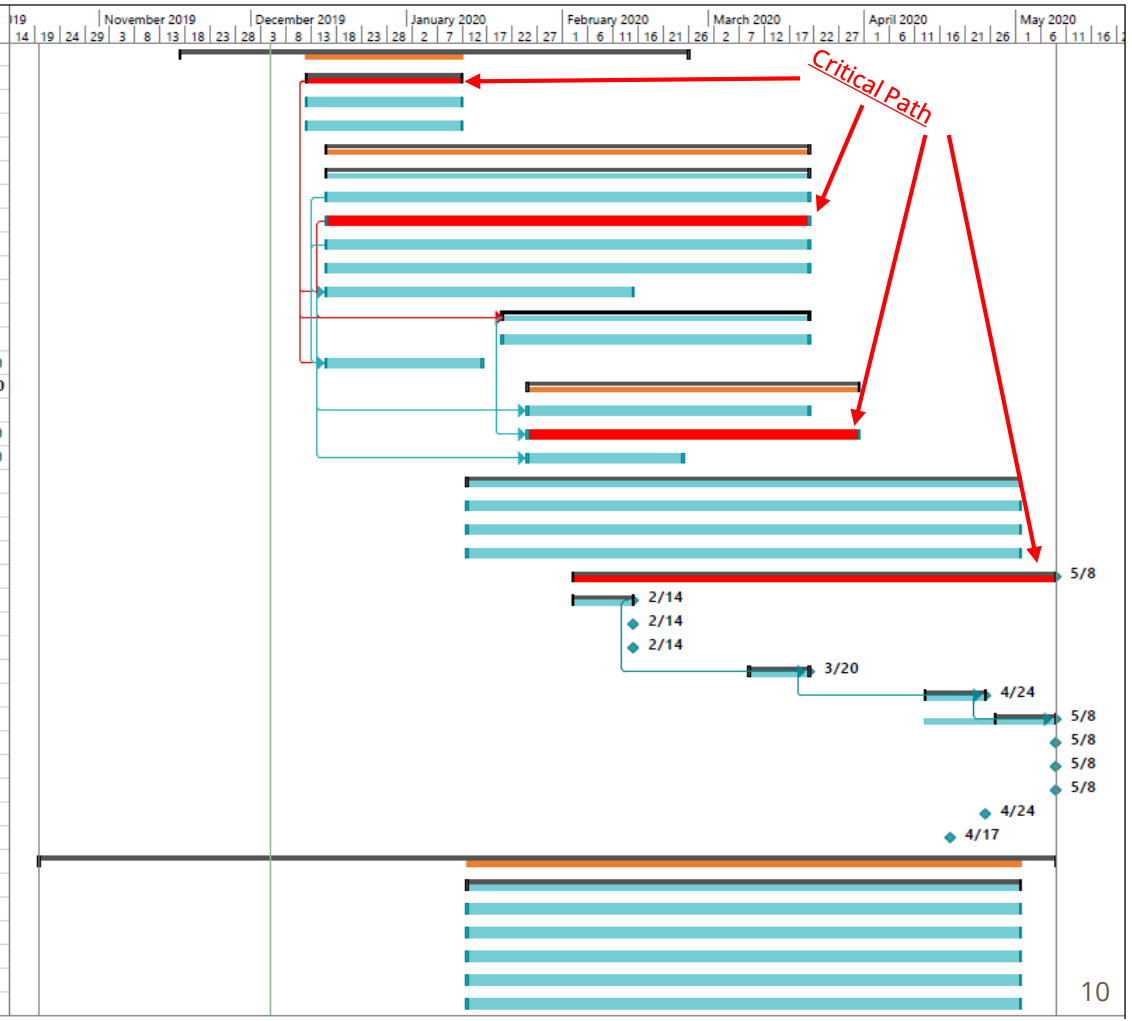


Figure 9-1: Triangle of Success

https://upload.wikimedia.org/wikipedia/commons/thumb/8/88/Project-triangle-en.svg/1200px-Project-triangle-en.svg.pngl

ID	Task Name	Duration	Start	Finish
1	**Task 1.0 - Biosorbent Preperation**	**73 days**	**Sun 11/17/19**	**Tue 2/25/20**
2	Task 1.1 Corn Preparation	23 days	Thu 12/12/19	Sat 1/11/20
3	Task 1.1.1 Biosorbent	23 days	Thu 12/12/19	Sat 1/11/20
4	Task 1.1.2 Activate Biosorbent	23 days	Thu 12/12/19	Sat 1/11/20
5	**Task 2.0 Testing**	**70 days**	**Mon 12/16/19**	**Fri 3/20/20**
6	Task 2.1 Sample Preparation	70 days	Mon 12/16/19	Fri 3/20/20
7	Task 2.1.1 Cadmium Sample Preparation	70 days	Mon 12/16/19	Fri 3/20/20
8	Task 2.1.2 Arsenic Sample Preparation	70 days	Mon 12/16/19	Fri 3/20/20
9	Task 2.1.3 Total Coliform Sample Preparation	70 days	Mon 12/16/19	Fri 3/20/20
10	Task 2.1.4 Batch Reactor Sample Preparation	70 days	Mon 12/16/19	Fri 3/20/20
11	Task 2.2 Cadmium Testing	45 days	Mon 12/16/19	Fri 2/14/20
12	Task 2.3 Arsenic Testing	45 days	Mon 1/20/20	Fri 3/20/20
13	Task 2.3.1 Chemistry Department Planning	45 days	Mon 1/20/20	Fri 3/20/20
14	Task 2.4 Total Coliform Testing	23 days	Mon 12/16/19	Wed 1/15/20
15	**Task 3.0 Analysis**	**47 days**	**Sat 1/25/20**	**Mon 3/30/20**
16	Task 3.1 Cadmium Analysis	41 days	Sat 1/25/20	Fri 3/20/20
17	Task 3.2 Arsenic Analysis	47 days	Sat 1/25/20	Mon 3/30/20
18	Task 3.3 Total Coliform Analysis	22 days	Sat 1/25/20	Mon 2/24/20
19	**Task 4.0 Poject Impacts**	**80 days**	**Mon 1/13/20**	**Fri 5/1/20**
20	Task 4.1 Environmental Impacts	80 days	Mon 1/13/20	Fri 5/1/20
21	Task 4.2 Social Impacts	80 days	Mon 1/13/20	Fri 5/1/20
22	Task 4.3 Economic Impacts	80 days	Mon 1/13/20	Fri 5/1/20
23	**Task 5.0 Project Deliverables**	**70 days**	**Mon 2/3/20**	**Fri 5/8/20**
24	Task 5.1 30% Deliverables	10 days	Mon 2/3/20	Fri 2/14/20
25	Task 5.1.1 30% Report	10 days	Mon 2/3/20	Fri 2/14/20
26	Task 5.1.1 30% Presentation	10 days	Mon 2/3/20	Fri 2/14/20
27	Task 5.2 60% Deliverables	10 days	Mon 3/9/20	Fri 3/20/20
30	Task 5.3 90% Deliverables	10 days	Mon 4/13/20	Fri 4/24/20
33	Task 5.4 Final Deliverables	10 days	Mon 4/27/20	Fri 5/8/20
34	Task 5.4.1 Final Website Design	10 days	Mon 4/27/20	Fri 5/8/20
35	Task 5.4.2 Final Report	10 days	Mon 4/27/20	Fri 5/8/20
36	Task 5.4.3 Final Presentation	10 days	Mon 4/27/20	Fri 5/8/20
37	Task 5.4.4 Undergraduate Presentation	10 days	Mon 4/13/20	Fri 4/24/20
38	Task 5.4.4 Water Symposium	5 days	Mon 4/13/20	Fri 4/17/20
39	**Task 6.0 Project Management**	**146 days**	**Sun 10/20/19**	**Fri 5/8/20**
40	Task 6.1 Meetings	80 days	Mon 1/13/20	Fri 5/1/20
41	Task 6.1.1 Team Meetings	80 days	Mon 1/13/20	Fri 5/1/20
42	Task 6.1.2 Client/TA Meetings	80 days	Mon 1/13/20	Fri 5/1/20
43	Task 6.1.3 GI Meetings	80 days	Mon 1/13/20	Fri 5/1/20
44	Task 6.2 Scheduling	80 days	Mon 1/13/20	Fri 5/1/20
45	Task 6.3 Resource Management	80 days	Mon 1/13/20	Fri 5/1/20



Scope - Exclusions

- Field Sample Testing
  - Mine spill sampling
- Prototyping
- Column Testing
- Physicochemical Characteristics

Figure 11-1: Example of Water Sampling for the King's Mine Spill, Colorado

https://www.washingtontimes.com/news/2017/jan/19/obamas-epa-refuses-pay-claims-gold-king-mine-spill/

Staffing Plan

- Staffing reasonable for scope
- Project Roles:
  - Senior Engineer (SENG)
  - Engineer (ENG)
  - Lab Technician (LAB)
  - Intern (INT)
  - Admin Assistant (AA)

Task	SENG hrs	ENG hrs	LAB hrs	INT hrs	AA hrs
1.1 Corn Preparation	4	0	250	80	0
1.1.1 Biosorbent Preparation	2	--	150	40	--
1.1.2 Activated Biosorbent Prep	2	--	100	40	--
2.1 Cadmium Testing	--	25	40	10	--
2.2 Arsenic Testing	--	30	60	10	--
2.3 Total Coliform Testing	--	25	35	10	--
3.1 Cadmium Analysis	15	30	--	5	5
4.0 Project Impacts	6	10	--	--	2
5.0 Project Deliverables	20	20	--	--	30
6.0 Project Management	30	10	15	5	15
Subtotal	95	210	400	120	52
Total Hours	877				
Total (person-days)	109.625				

Table 12-1: Staffing Table Determined by Team

Cost of Engineering Services

- Easy to follow and inclusive of necessary items
- Overhead costs include:
  - Base pay rate
  - Position benefits
  - Profit %
- Supply costs are adjusted to be conservative
- In-house subcontracting with NAU Chemistry Department
  - ICP-MS Testing

Cost Table				
	Classification	Hours	Rate, $/hr	Cost
1.0 Personnel	SENG	95	194	$ 18,430
	ENG	210	117	$ 24,570
	LAB	400	82	$ 32,800
	INT	120	19	$ 2,280
	AA	52	23	$ 1,196
	Total Personnel			$ 79,276
	Item	Quantity	Cost	Total
2.0 Supplies	Corn cob	100	0.75	$ 75
	Total Coliform Testing Kit, 50 Bottles	1	218	$ 218
	Total Coliform Testing Kit, 15 Brilliant Green Tubes	2	32.15	$ 64
	0.45 µm filters, 100 units	1	3.79	$ 4
	Total Supplies			$ 361
	Item	Quantity	Cost	Total
3.0 Subcontract	NAU Chemistry Dept, ICP Testing	54	30	$ 1,620
4.0 Total				$ 81,269

Table 13-1: Cost Table Determined by Team

Thank You!