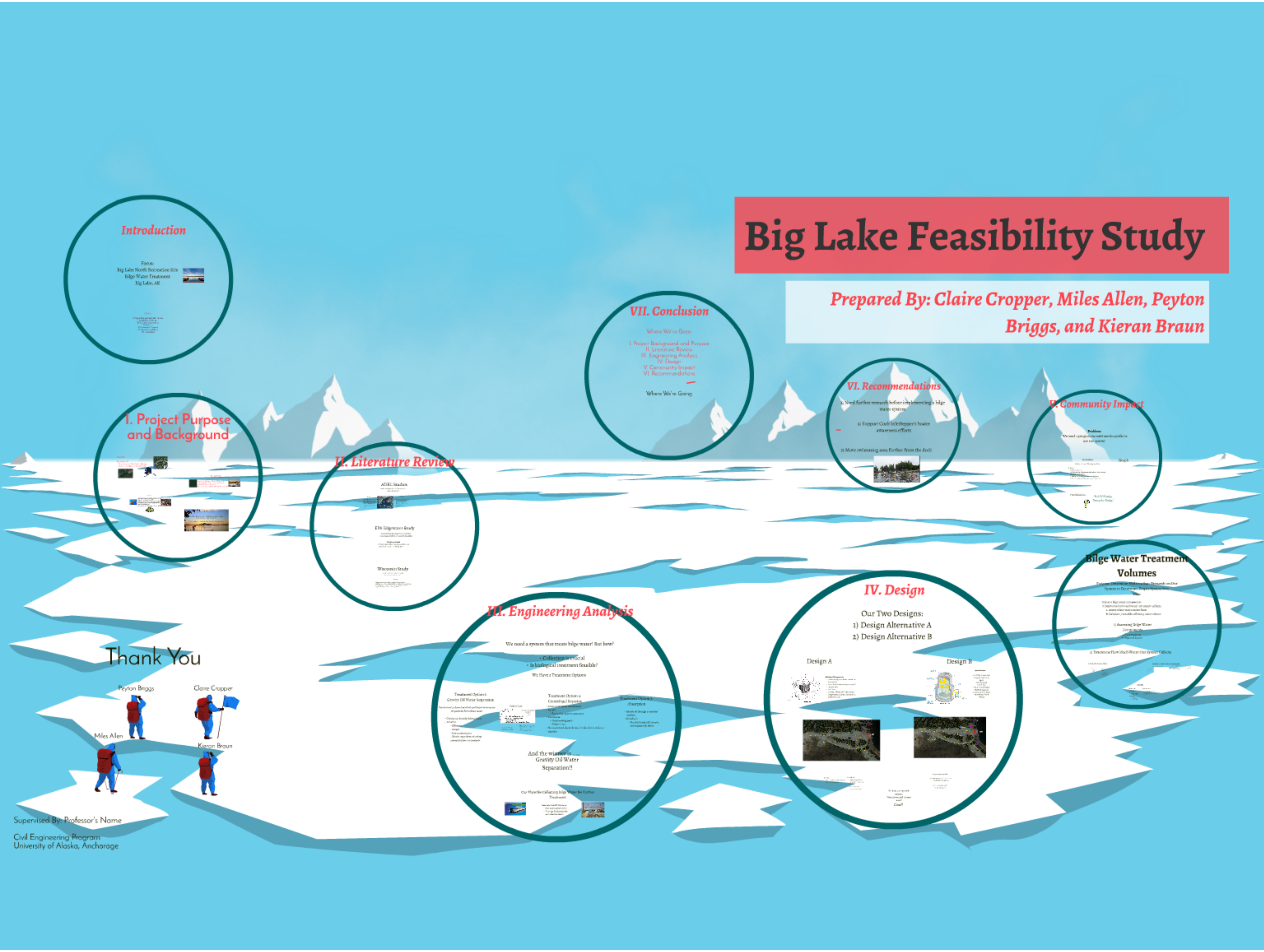

Big Lake Feasibility Study
Prepared By: Claire Cropper, Miles Allen, Peyton Briggs, and Kieran Braun
Introduction
I. Project Purpose and Background
II. Literature Review
III. Engineering Analysis
IV. Design
Our Two Designs:
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2) Design Alternative B
Design A
Design B
V. Community Impact
Bilge Water Treatment Volumes
VI. Recommendations
VII. Conclusion
Where We're Going
And the winner is ...
Gravity Oil Water
Separation!!
Thank You
Peyton Briggs
Claire Cropper
Miles Allen
Kieran Braun
Supervised By: Professor's Name
Civil Engineering Program
University of Alaska, Anchorage

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Big Lake, AK
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Big Lake, AK

Outline

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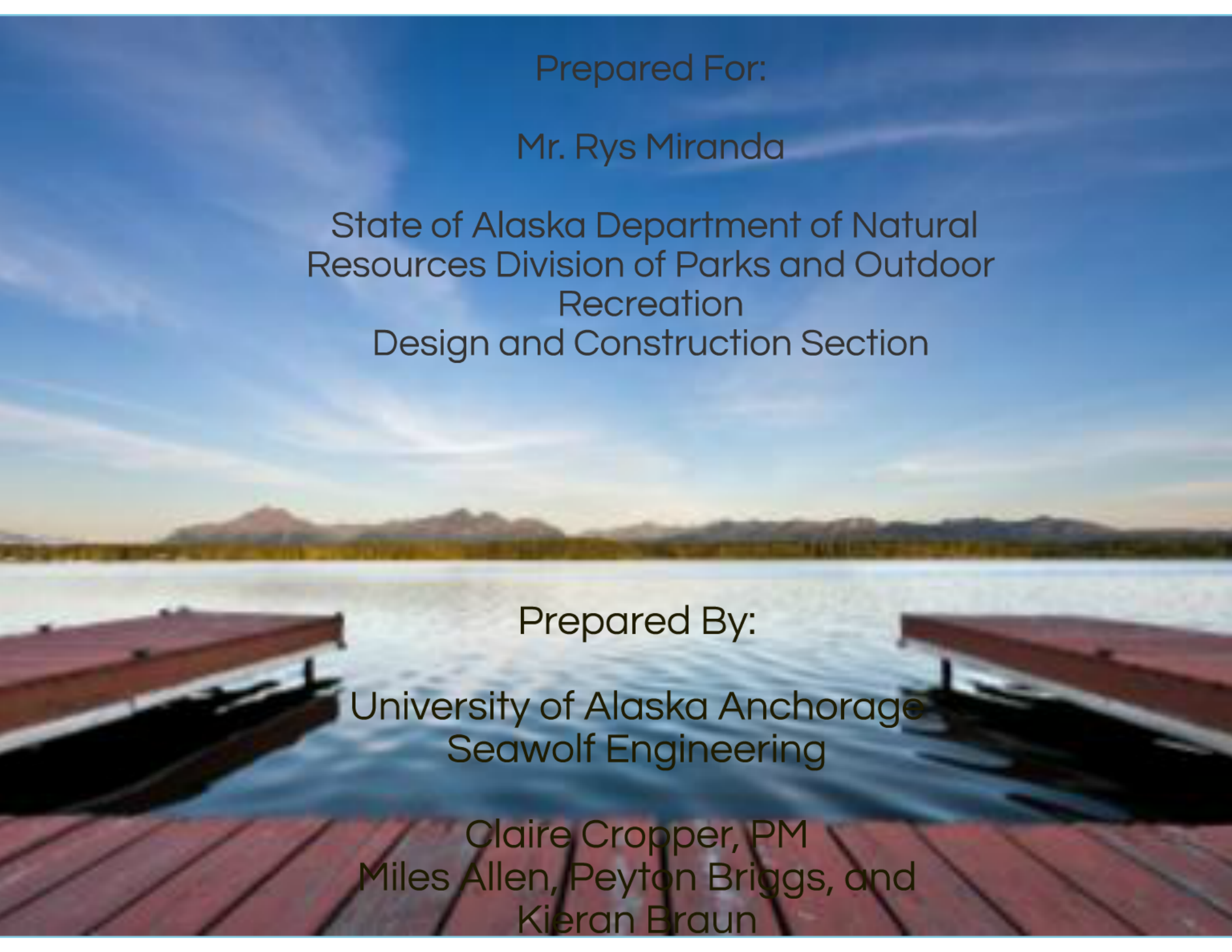

Prepared For:

Mr. Rys Miranda

State of Alaska Department of Natural Resources Division of Parks and Outdoor Recreation
Design and Construction Section

Prepared By:

University of Alaska Anchorage
Seawolf Engineering

Claire Cropper, PM
Miles Allen, Peyton Briggs, and Kieran Braun

Outline

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I. Project Purpose and Background

Location

Big Lake, AK
- 10 minutes off the Parks Highway
- 30 minutes West of Wasilla, AK

Existing Facility

- Managed by Alaska Department of Natural Resources' Division of Parks and Outdoor Recreation
- Dual-Launch Ramp is main access point
- 470-1,100 boats per summer
- By far the most used inland boat launch in AK

Background:

- *Alaska Department of Energy Conservation has listed Big Lake as an "impaired waterbody"*
- *High levels of Total Aromatic Hydrocarbons (TAHs)*
- *During high traffic weekends, the quality standard value was exceeded by 400%*
- *Concerning because oil has negative effects on wildlife*

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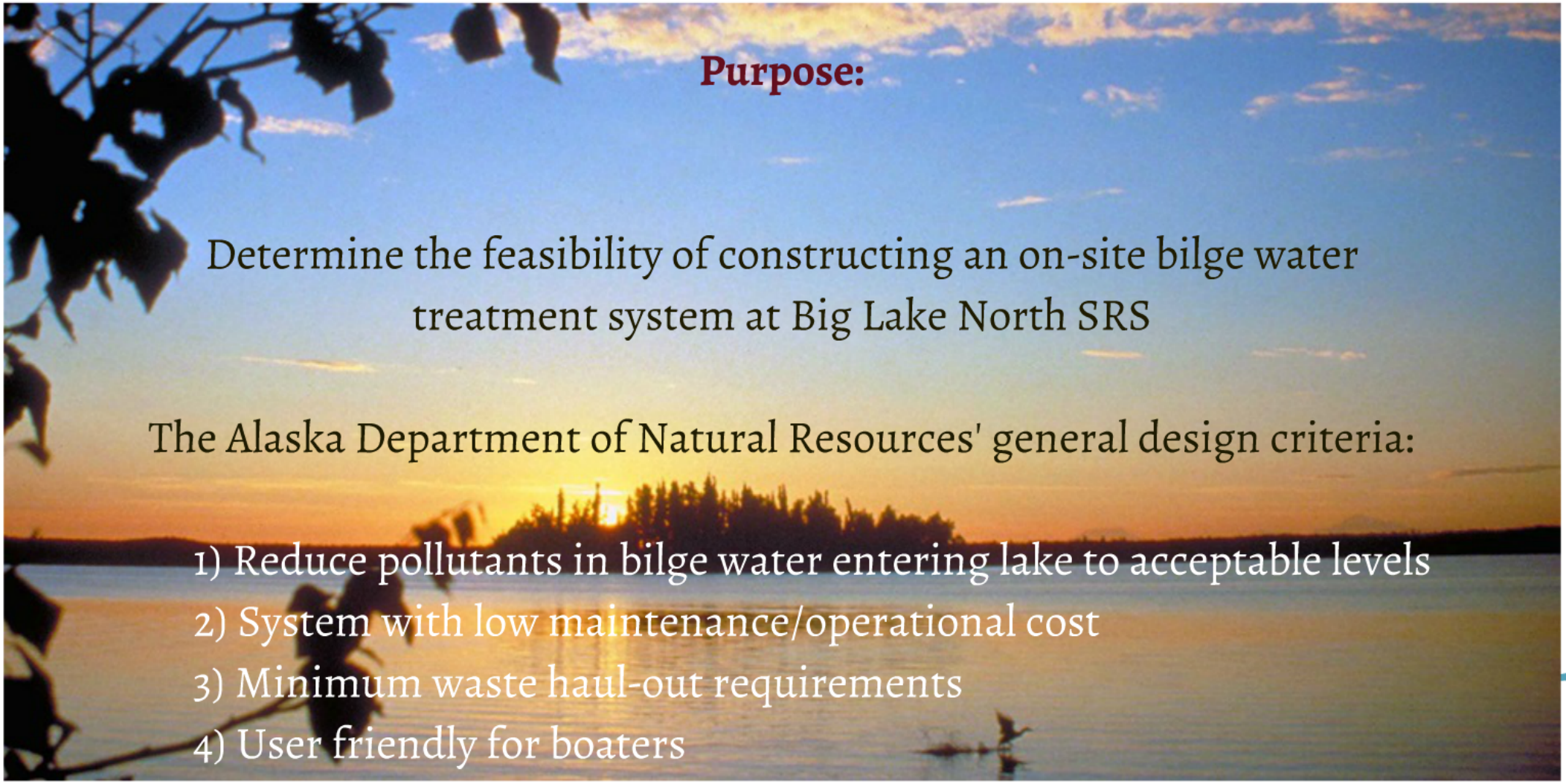

Purpose:

Determine the feasibility of constructing an on-site bilge water treatment system at Big Lake North SRS

The Alaska Department of Natural Resources' general design criteria:

1) Reduce pollutants in bilge water entering lake to acceptable levels
2) System with low maintenance/operational cost
3) Minimum waste haul-out requirements
4) User friendly for boaters

II. Literature Review

ADEC Studies

Studies on hydrocarbon levels in Big Lake in 2004, 2006, and 2014

Table

Method:

- Measured TAHs levels around various depths and locations
- Measured levels of TAHs using a volatile organic carbon compound designed by the USGS

Findings:

- Direct correlation between the number of boats on Big Lake and hydrocarbon levels
- Hydrocarbon levels are not rising each year
- Jet skis are bad! ... for the lake...

EPA Bilgewater Study

A survey of current bilge water treatment technologies available for ocean-faring ships

Why This is Helpful:

1) Explained how bilge water is generally treated
2) Explained composition of bilge water

Wisconsin Study

Aimed to determine effects of motorized watercraft on aquatic ecosystems

Findings:

- Most significant impact boats have on wildlife in lakes is turbulence
- Most hydrocarbons were injected directly into lake by two-stroke (onboard) motors
- Observed no negative short-term effects of increased hydrocarbon level
- Suggested that agencies be cautious of long-term effects

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III. Engineering Analysis

We need a system that treats bilge water! But how?

- Collection is crucial
- Is biological treatment feasible?

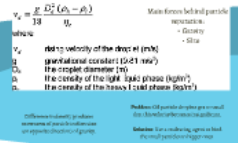
We Have 3 Treatment Options

Treatment Option 1: Gravity Oil Water Separation

Use dissimilar densities of oil and water to separate oil particles from clean water

- Gravity as the only driving force
- Benefits:
  - Efficient
  - Simple
  - Low maintenance
  - Works regardless of inflow concentrations or contents

Stokes' Law



Treatment Option 2: Centrifugal Separion

- Force: Centripetal Acceleration
- Benefit
  - Faster than gravity separation
- Drawbacks:
  - Many moving parts
  - Higher costs
- Not concerned about the time it takes for particles to separate

Treatment Option 3: Absorption

- Absorb oil through a material medium
- Drawback:
  - Need to frequently remove and replace oily fabric

And the winner is..... Gravity Oil Water Separation!!

Our Plans for Collecting Bilge Water for Further Treatment:

Concrete Slab Will Serve as:

- New Boat Launch Ramp
- Drainage Mechanism for our Collection Basin

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$$v_d = \frac{g}{18} \frac{D_d^2 (\rho_h - \rho_l)}{\eta_c}$$

where

v_d	rising velocity of the droplet (m/s)
g	gravitational constant (9.81 m/s^2)
D_d	the droplet diameter (m)
ρ_l	the density of the light liquid phase (kg/m^3)
ρ_h	the density of the heavy liquid phase (kg/m^3)

Main forces behind particle separation:
- Gravity
- Size

Difference in density produces movement of particle in direction (or opposite direction) of gravity.

Problem: Oil particle droplets get so small that this velocity becomes insignificant.

Solution: Use a coalescing agent to bind the small particles to bigger ones.

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Gravity Oil Water

Separation!!

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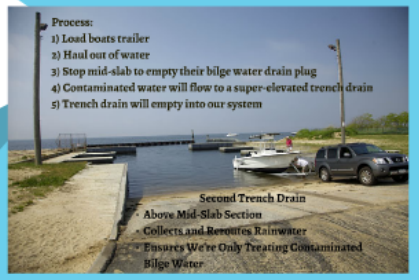
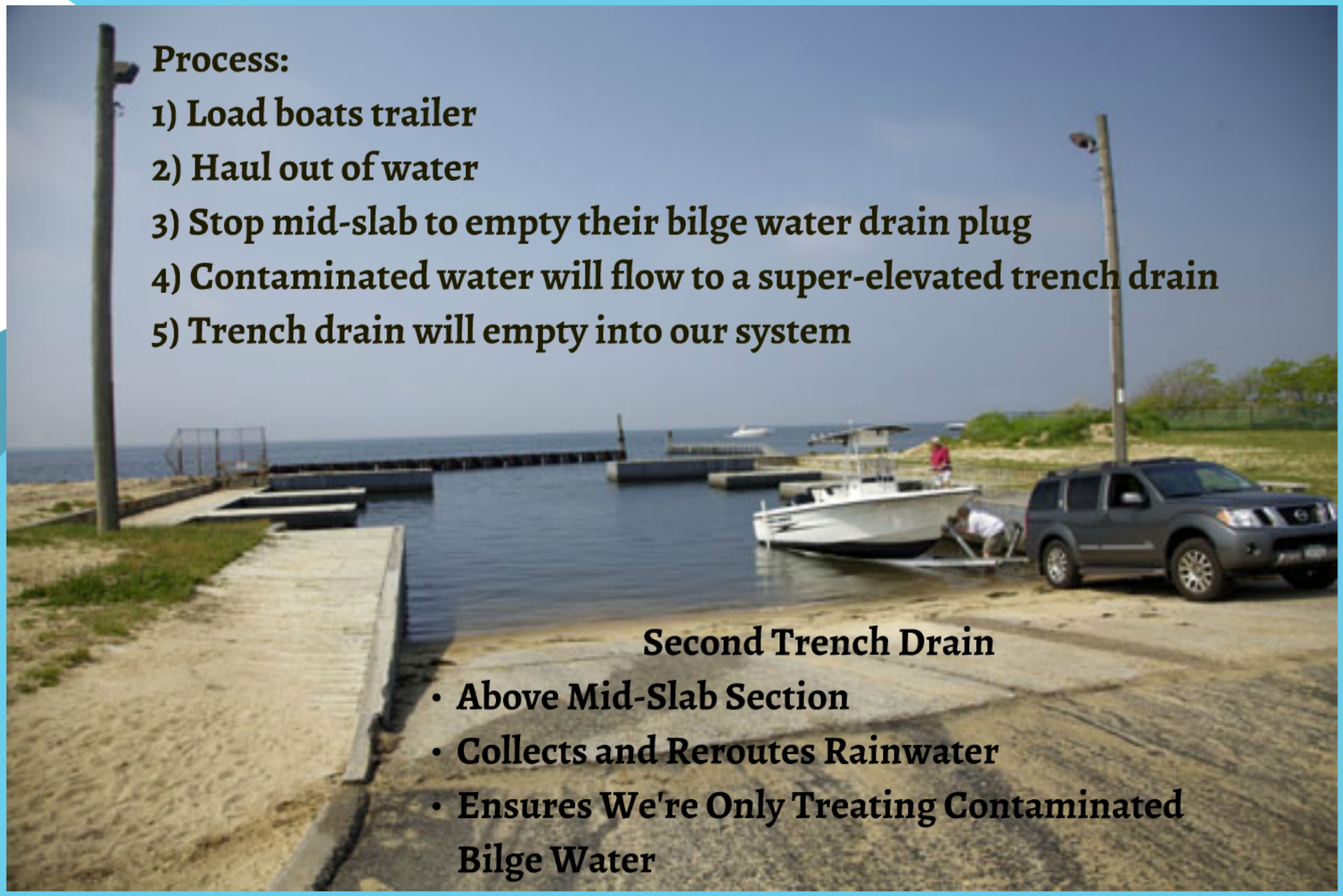


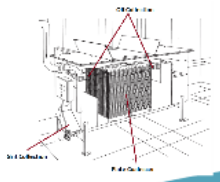

Process:
1) Load boats trailer
2) Haul out of water
3) Stop mid-slab to empty their bilge water drain plug
4) Contaminated water will flow to a super-elevated trench drain
5) Trench drain will empty into our system
Second Trench Drain
• Above Mid-Slab Section
• Collects and Reroutes Rainwater
• Ensures We're Only Treating Contaminated Bilge Water

IV. Design

Our Two Designs:

1) Design Alternative A
2) Design Alternative B

Design A



Additional Components:

- Coalescing Agent (calcium-carbonate based plate)
- Auger for filtration of larger material
- Pump station
- GAC Unit
- Additional Waste Oil Tank (100 gal)
- Pump Station Activated by Sensors in Collection Basin

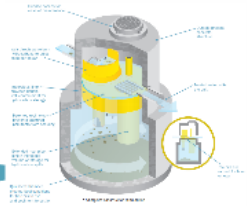
Benefits:

- Low mechanical complexity
- Low maintenance

Drawbacks:

- System sits above-ground, thus, it's an eyesore
- Requires extra energy to operate

Design B



Specifications:

- Centrifugal Separation
- Separate Coalescing Agent
- Underground Installation
- Pumps aren't Needed
- Minimal Footprint
- Large Catchment Basin
- No Additional Tank Needed

Design B Testing Results:

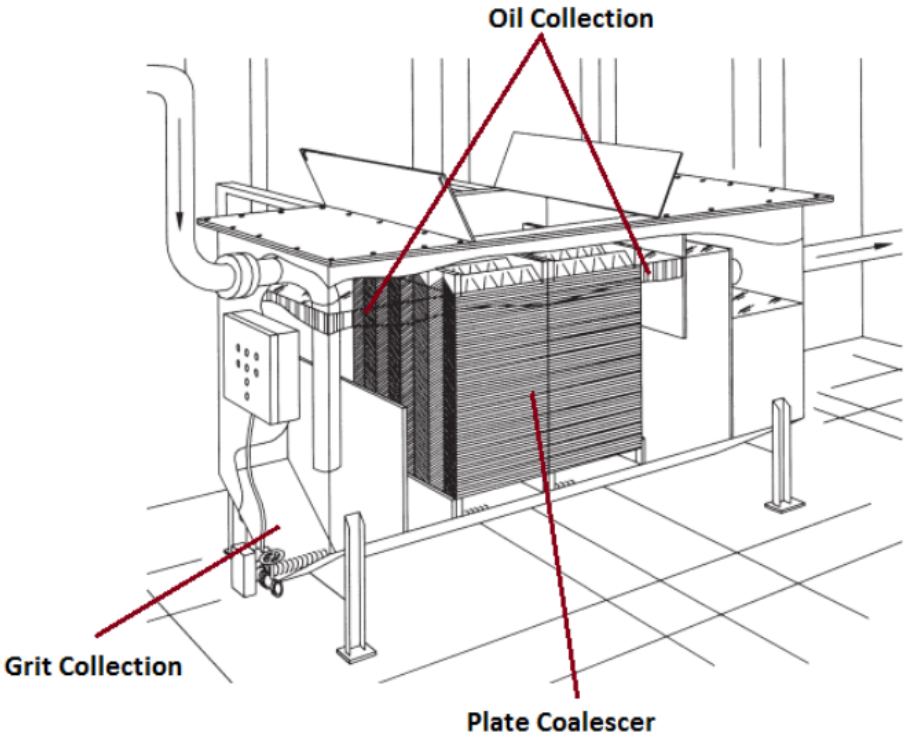
- Separates 97.8% of oil contaminants
- Inflow Rate: 142 gal/min

Still, we need an OGS Polishing System

We have 2 comparable systems.
What do we need to know now??

Cost!!

Design A



Additional Components:

- Coalescing Agent (calcium-carbonate based plate)
- Auger for filtration of larger material
- Pump station
- GAC Unit
- Additional Waste Oil Tank (300 gal)
- Pump Station Activated by Sensors in Collection Basin

Location

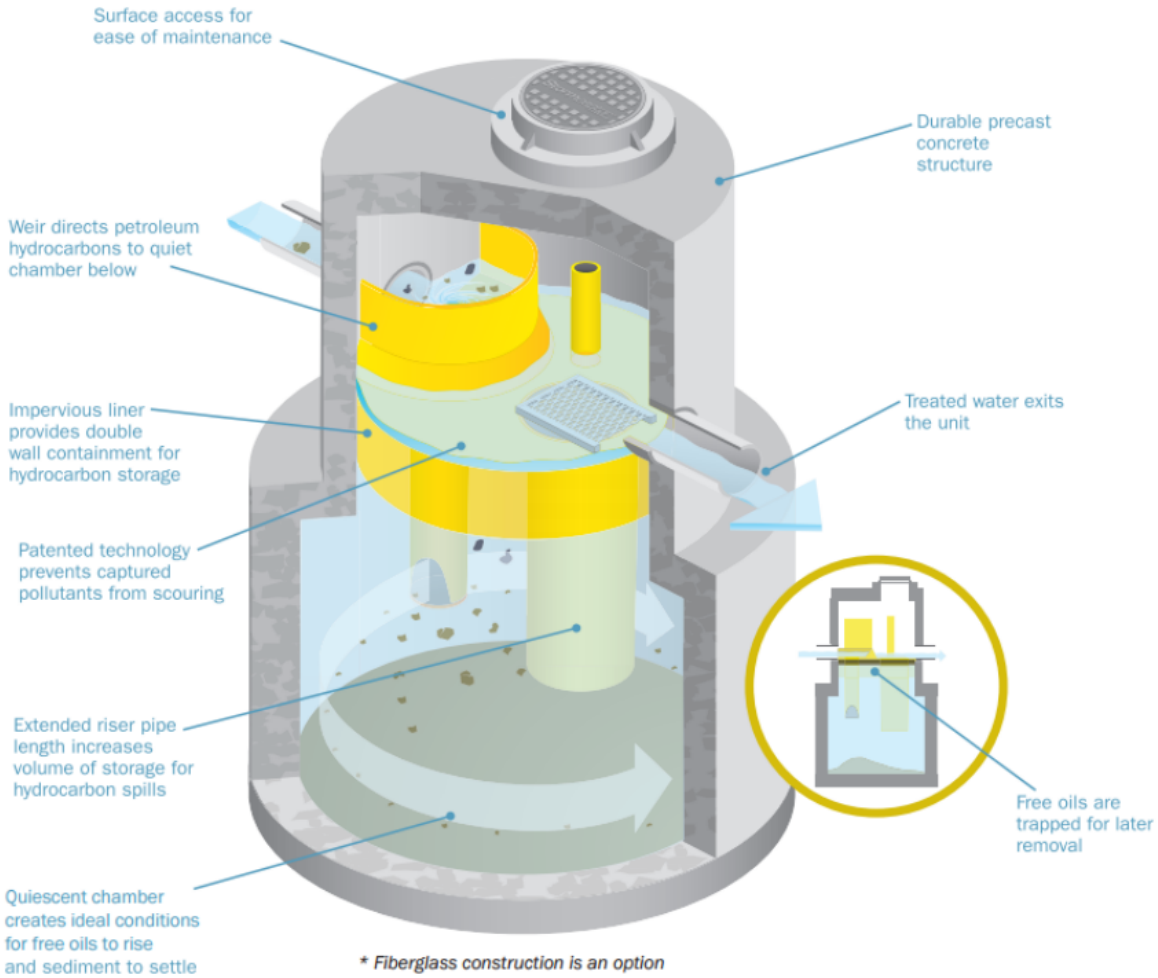
Benefits:

- Low mechanical complexity
- Low maintenance

Drawbacks:

- System sits above-ground, thus, it's an eyesore
- Requires extra energy to operate

Design B



** Fiberglass construction is an option*

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Bilge Water Treatment Volumes

Purpose: Determine Hydrocarbon Demands on Our System to Determine Proper System Size

Steps:

1) Assess bilge water components
2) Determine how much water our system collects
    a. Assess where water comes from
    b. Calculate 3 variables affecting water volume

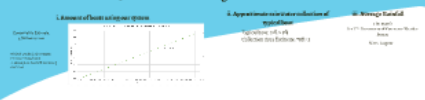
1) Assessing Bilge Water Components

a. Water (majority)
b. Engine oil deposit

2) Determine How Much Water Our System Collects

a. Two Possible Sources of Water

b. Calculate 3 Variables Affecting Water Volume



3) Results

a. Bilge Water Volume

i. Lower bound
- low traffic
- 50% entering allowance
- ~2,700 gal/ summer

ii. Upper bound
- High traffic
- 0% entering allowance
- 105,000 gal/ summer

b. Hydrocarbon Volume

i. Assume bilge water composition:
about 0.1% hydrocarbons
ii. Final Hydrocarbon Results: 70-105 gal/ summer

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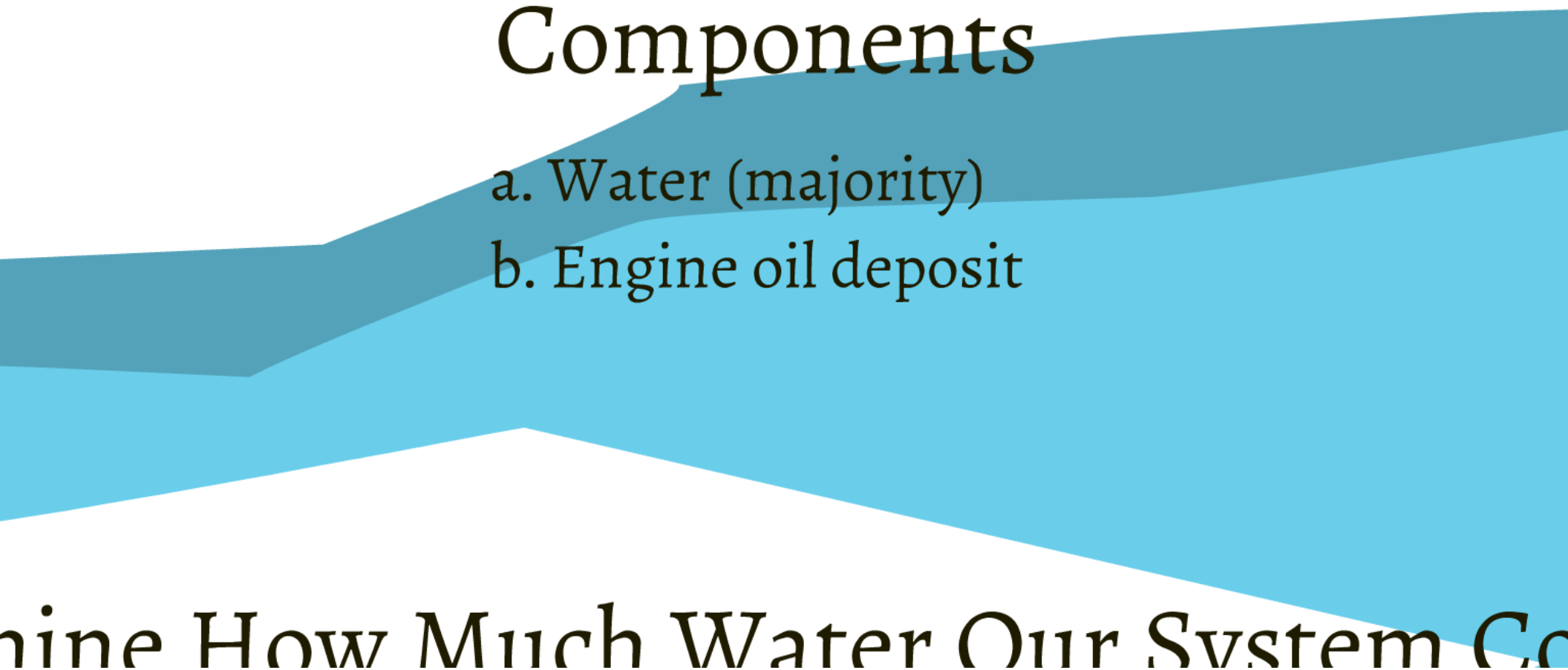

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1) Assessing Bilge Water Components

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2) Determine How Much Water Our System Collects

a. Two Possible Sources of Water

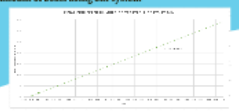
i. Lake
- Possible Sources
  - Splash
  - Leak
- Unlikely

ii. Sky
- Only other option
- Easy to determine with 3 variables

1) Amount of boats using our system
2) Approximate rainwater collection area of typical boat
3) Average rainfall

b. Calculate 3 Variables Affecting Water Volume

i. Amount of boats using our system



ii. Approximate rainwater collection of typical boat

Typical boat: 11ft x 8ft
Collection Area Estimate: 20ft×2

iii. Average Rainfall

May - August

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- Low traffic
- 30% awning allowance
- 70,000 gal/ summer

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- High traffic
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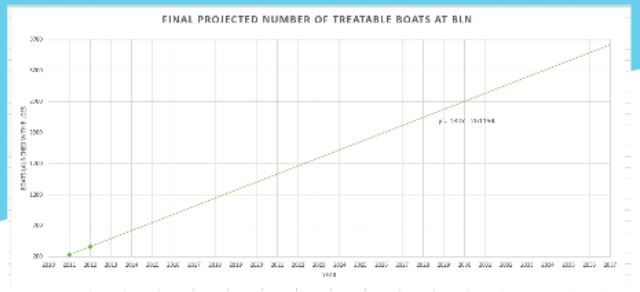
Conservative Estimate:
3,700 boats/ year

Mitigating Calculation Factors:
1) Linear Extrapolation
2) Assumption that we'll be treating every boat



ii. Approximate rainwater collection of typical boat

Typical boat: 12ft x 8ft
Collection Area Estimate: 70ft^2

iii. Average Rainfall

3 in/ month
Per U.S. Department of Commerce Weather Bureau

May - August

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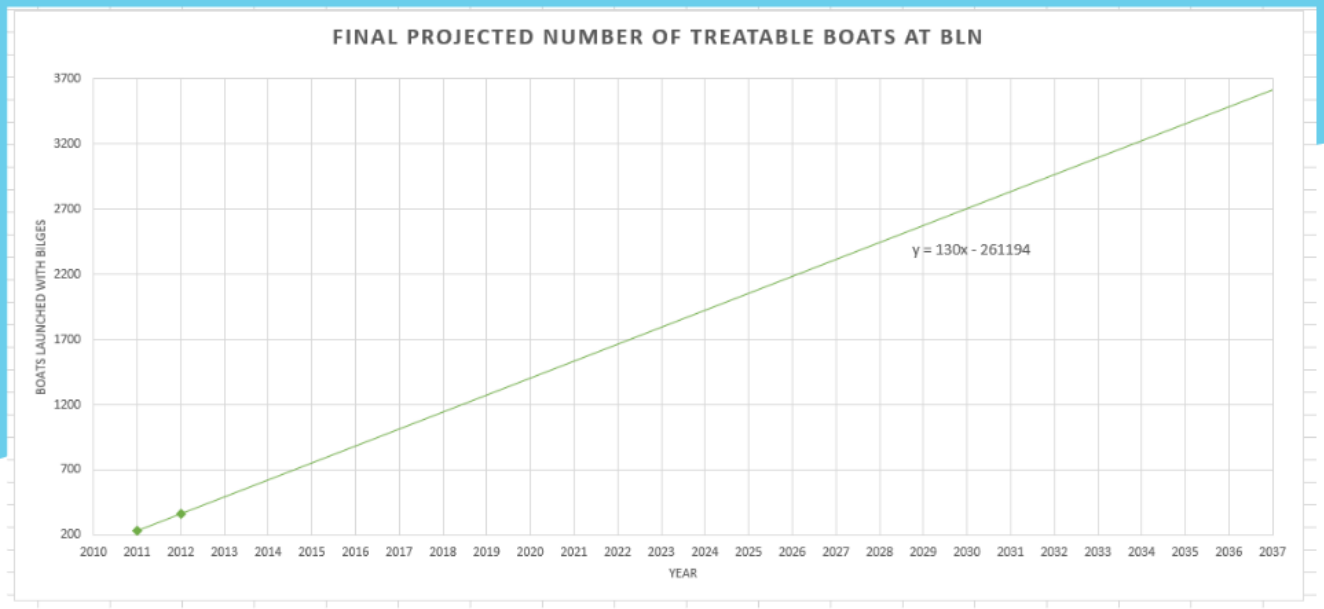

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V. Community Impact

Problem:

We need a program to convince the public to use our system!

Current Solution:

Cook Inletkeeper's "Keep Big Lake Clean"

Methods:

1) Educate Boaters
2) Work with local businesses to develop a clean boating discount card program
3) Hand clean boating kits out to ~~local~~ boaters
4) Conduct surveys to measure boater awareness

Graph

Our Solution:

"Fish Will Judge, Dump the Sludge"

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Thank You

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Supervised By: Professor's Name

Civil Engineering Program
University of Alaska, Anchorage