HABs on Utah Lake

- Utah Lake, July 2016
- Blue green algae
- Can double in mass in less than 24 hours
- Release toxins harmful to fish, animals, and humans
- Decomposition consumes oxygen, killing fish

Source: Rick Egan/The Salt Lake Tribune via AP

HABs Reported in Utah, 2019

- Calder Reservoir
- Deer Creek Reservoir
- East Canyon Reservoir
- Echo Reservoir
- Forsyth Reservoir
- Holmes Creek Reservoir
- Jordan River and Canals
- Jordanelle Reservoir
- Kents Lake
- Lower Box Creek Reservoir
- Manning Meadow Reservoir
- Mantua Reservoir
- Matt Warner Reservoir
- Maybey Pond
- Mill Meadow Reservoir
- Minersville Reservoir
- Newcastle Reservoir
- Otter Creek Reservoir
- Panguitch Lake
- Payson Lakes
- Pineview Reservoir
- Piute Reservoir
- Rockport Reservoir
- Scofield Reservoir
- Starvation Reservoir
- Strawberry Reservoir
- Utah Lake
- Upper Box Creek Reservoir
- Upper Kents Lake
- Yuba Lake

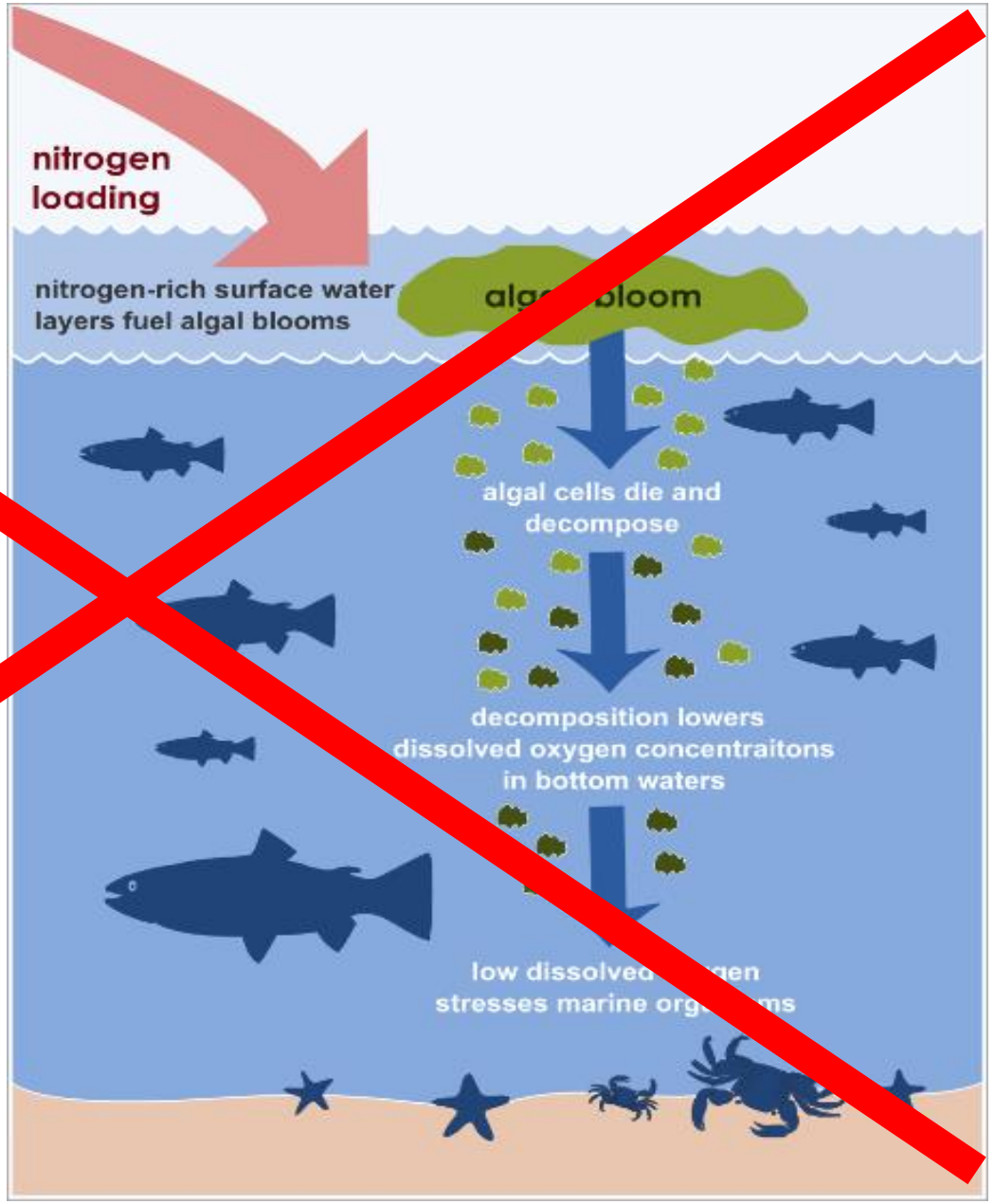
Source: Utah Department of Environmental Quality, Water Quality

How Do We Prevent or Stop HABs?

- Kill the algae (?)
  - Herbicides (glyphosate)
  - Oxygen radicals (superoxide O_2^-)
  - Ozone (O_3)
  - Ultrasonic sound
  - Other
- Reduce nutrient load (?)
  - Upgrade waste water facilities
  - Reduce fertilizer use
  - Capture and treat runoff
- Harvest the algae !

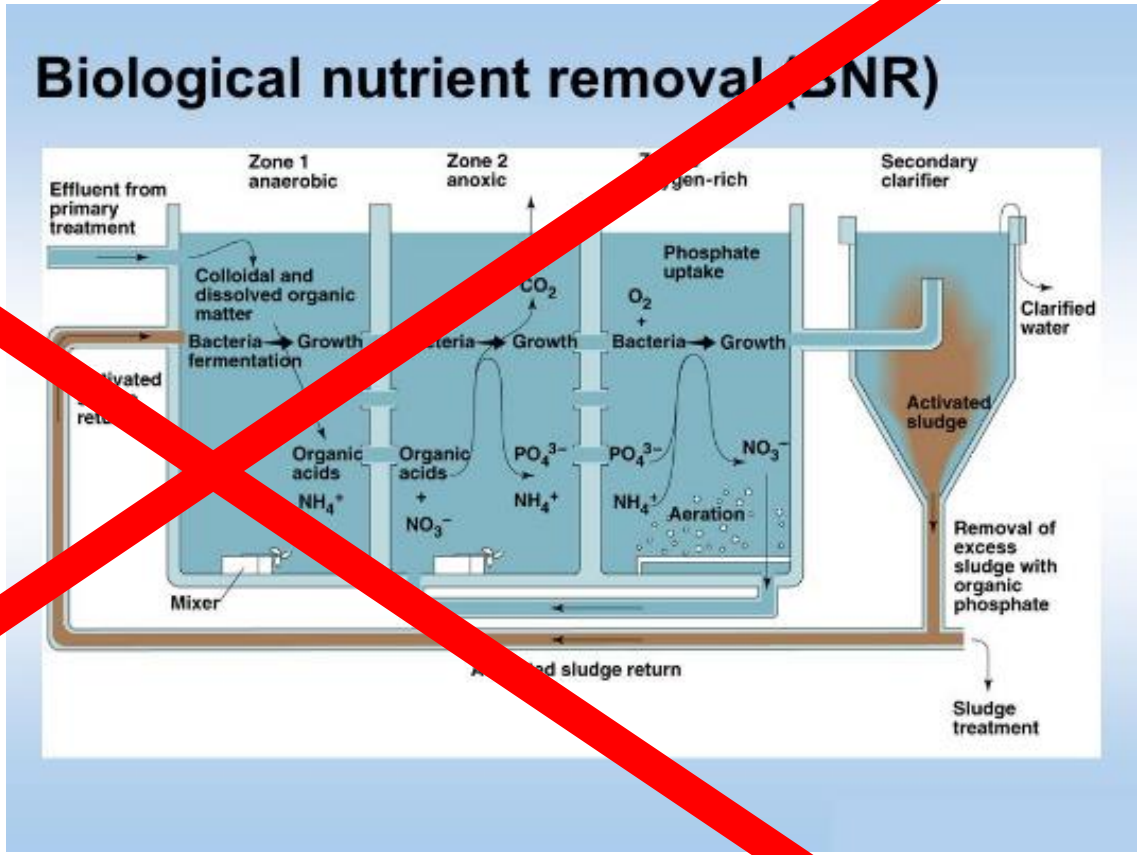
Option to End Harmful Algae Blooms

- Kill the microalgae with biocide or pesticide.
  - Death releases endotoxins, potentially increasing harm.
  - Decomposition consumes oxygen, producing harmful anoxic water.
  - Decomposition releases nutrients back into the water for future blooms.
  - Biocide/pesticide may kill other, non-targeted, species.



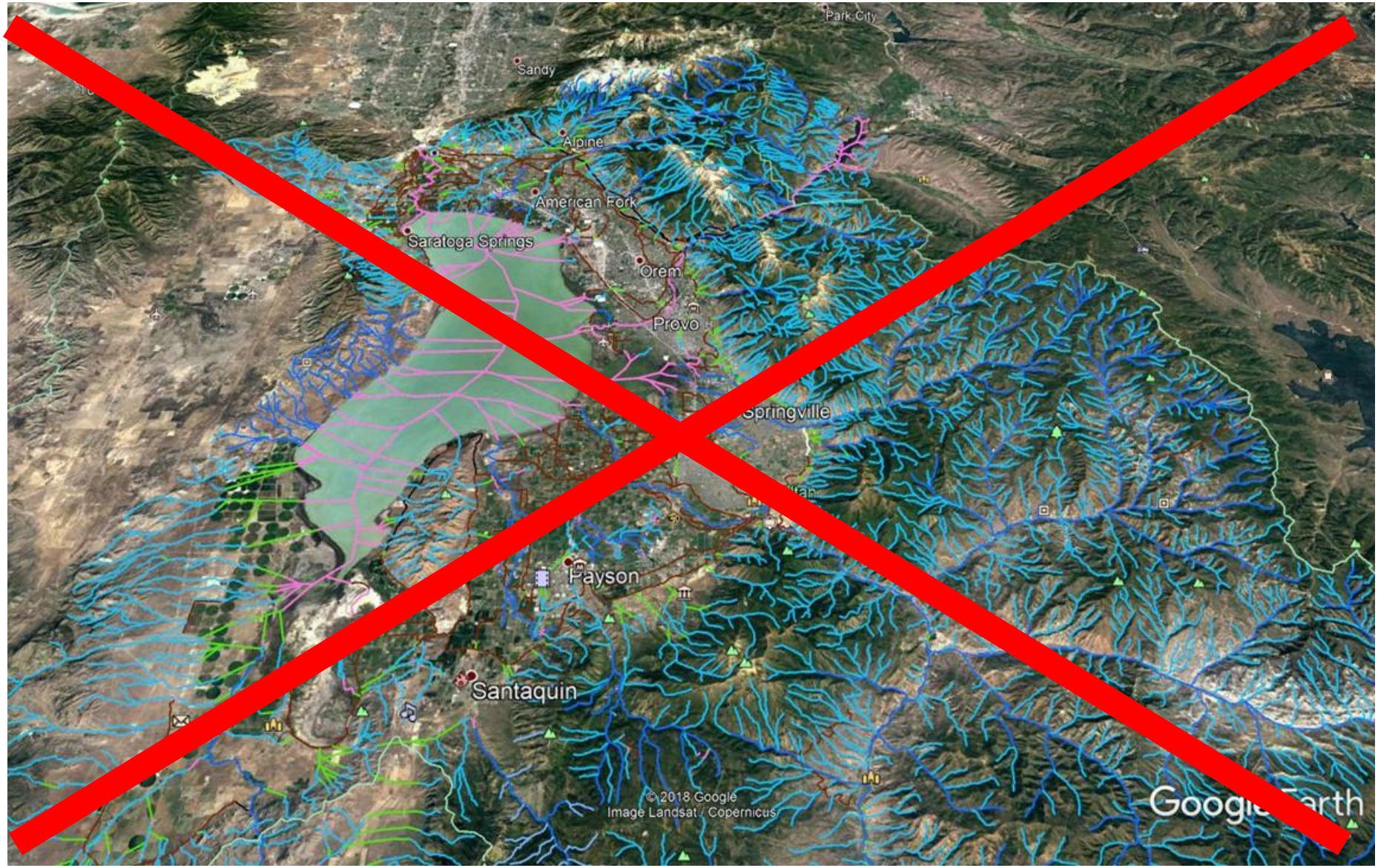
Option to Prevent Harmful Algae Blooms

- Wastewater treatment upgrades to prevent nutrient addition.
  - Does NOT solve current HABs.
  - Does not reduce existing water nutrients.
  - Very expensive to implement on existing wastewater treatment facilities (>16 million)
  - Impossible to control agricultural runoff.

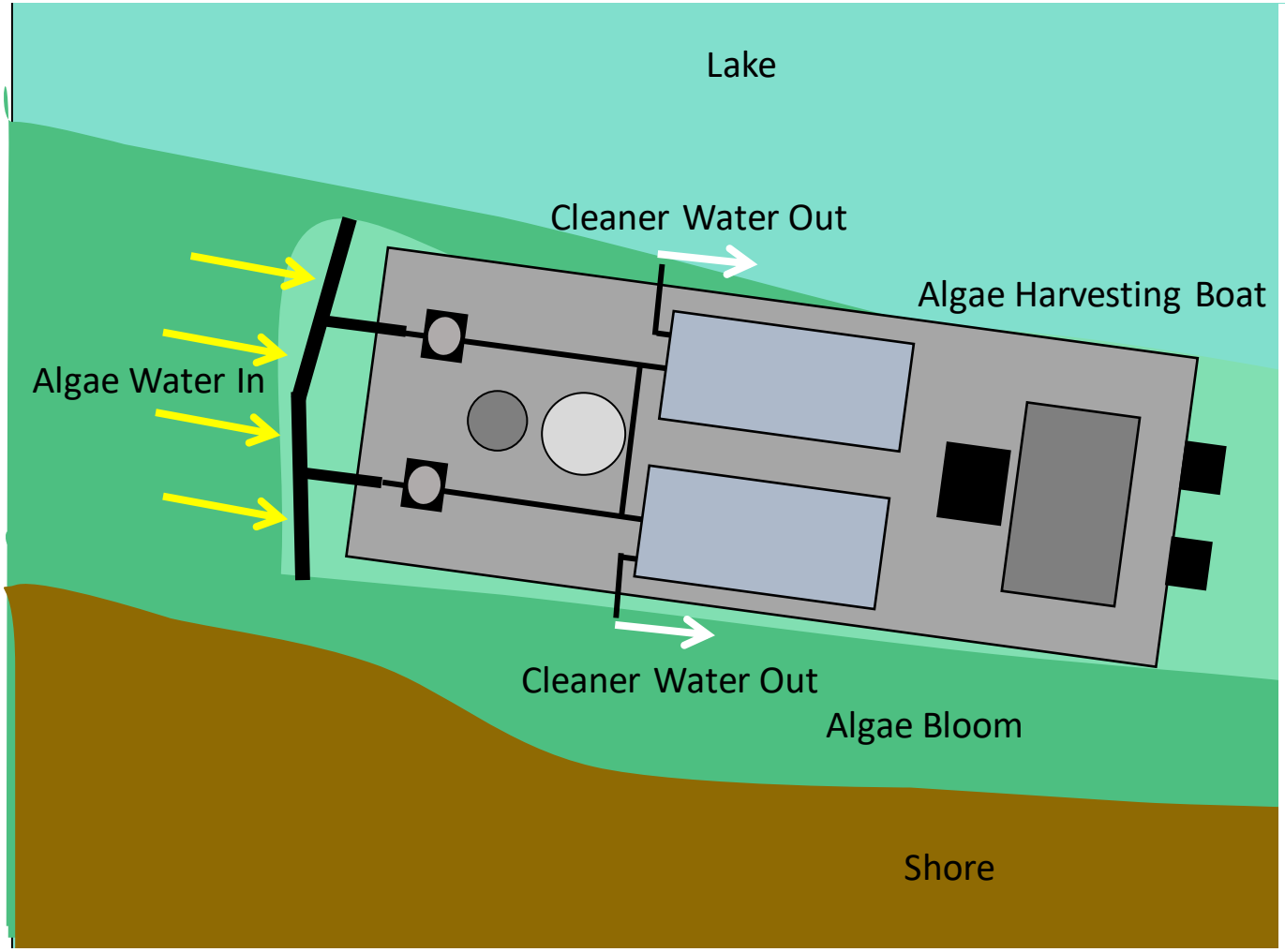


Sources of Nutrients in Utah Lake

- Hundreds of tributaries entering Utah Lake



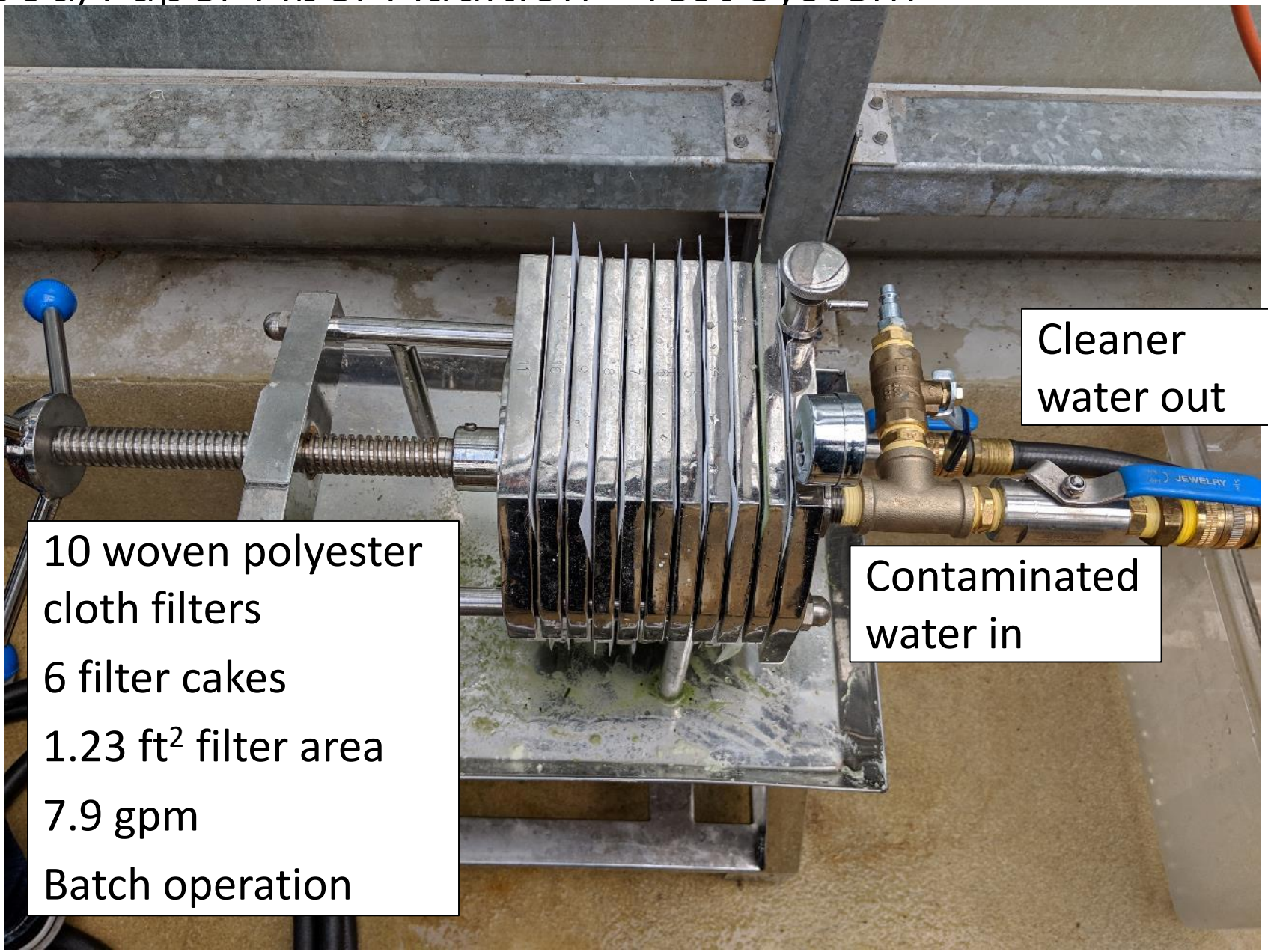
UVU Solution: Algae Harvesting Boats



UVU patent pending designs and proprietary processes

- Direct water filtration with a floating water treatment system
- Permanently removes algae from the water
- Discharges cleaner, clearer water
- Reduces lake's nutrient load
- Seeking funding from Utah Legislature to build and operate it

Water Filtration using Plate and Frame Filter Press with Wood/Paper Fiber Addition - Test System

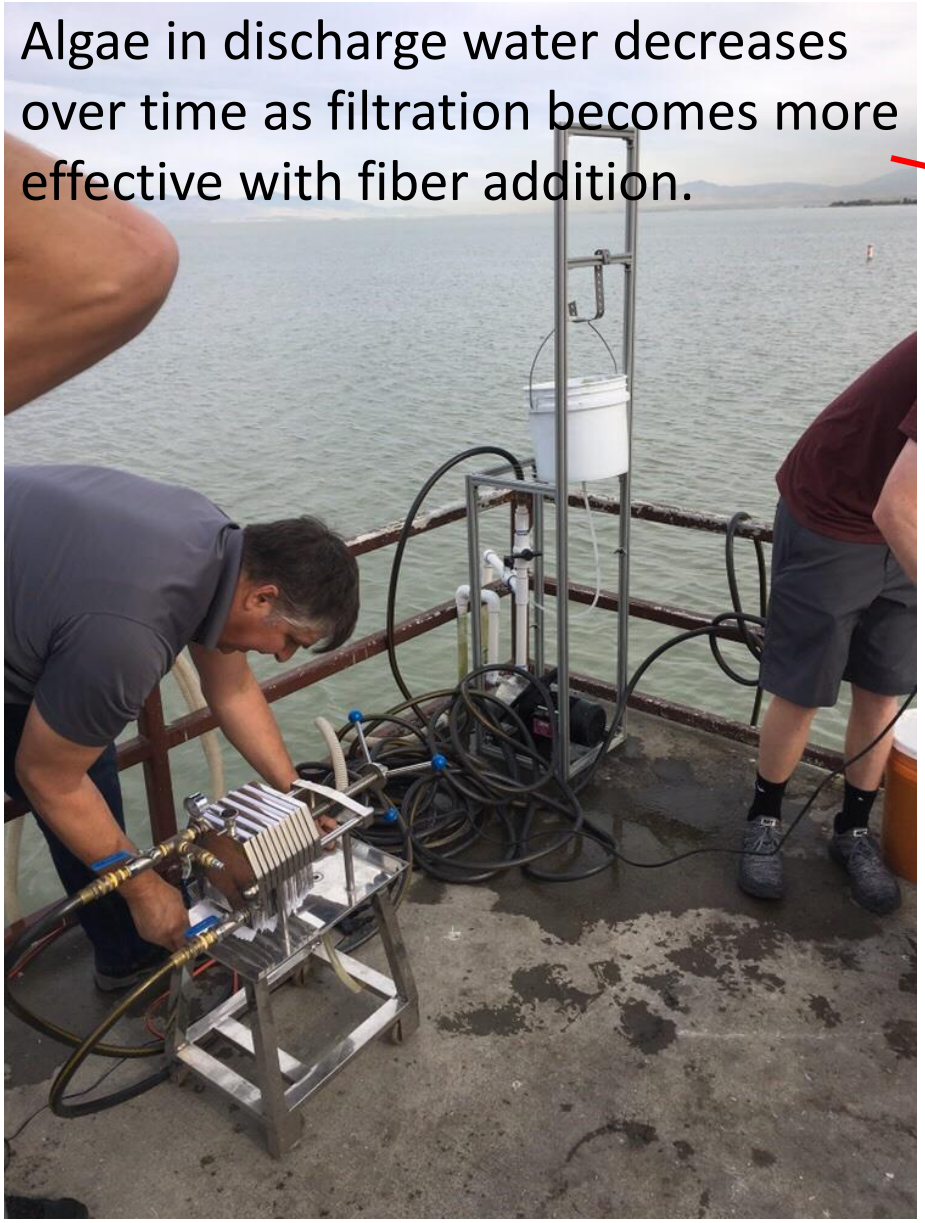


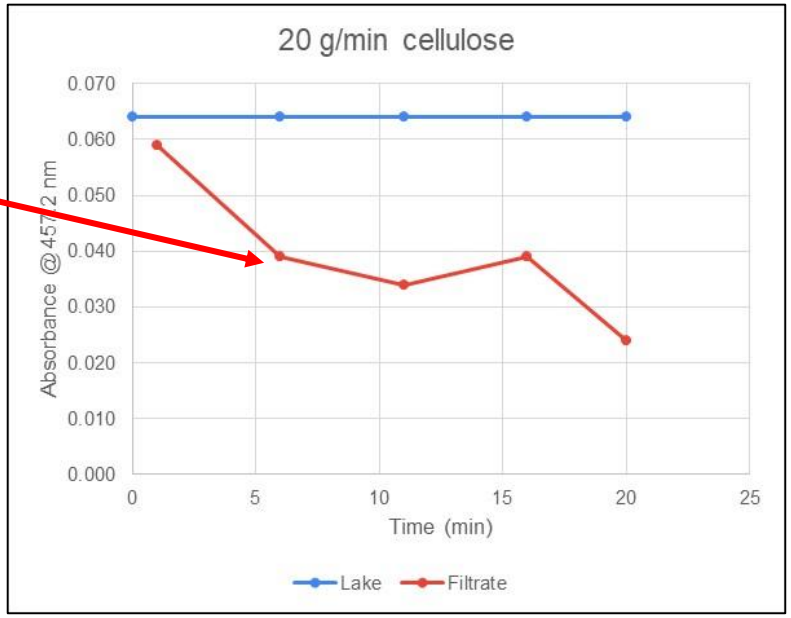
Filter Cake – Captured Algae Biomass

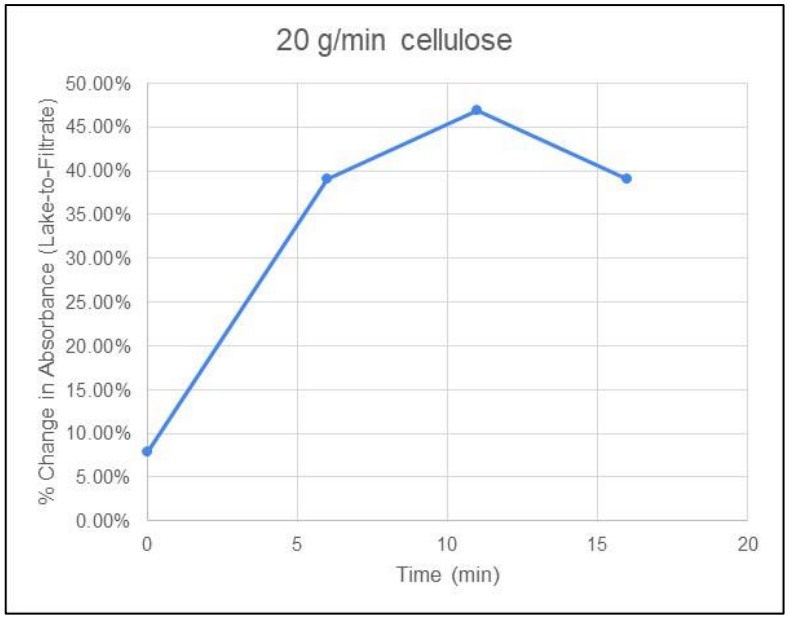
- The addition of a filter aid is REQUIRED to remove algae from the water, otherwise, the algae plug the filter immediately
- The wood/paper fibers are produced from natural, organic, renewable, recycled, materials
- Filter press produces low water fiber/algae filter cake (45% solids)
- Dried filter cake can be used as a carbon neutral fuel or **sequestered for carbon credits**

Small-scale Demonstration – Utah Lake

Algae in discharge water decreases over time as filtration becomes more effective with fiber addition.







Mobile Algae Harvesting - Boat

The algae harvesting equipment will be attached to a boat similar to this flat bottom deck boat.

- Medium-sized Harvester (proposed)
  - Truckable, self-propelled, flat bottom work boat
  - 30 ft x 10 ft
  - 2 ft draft
  - 5,000 lb weight
  - 30,000 lb load

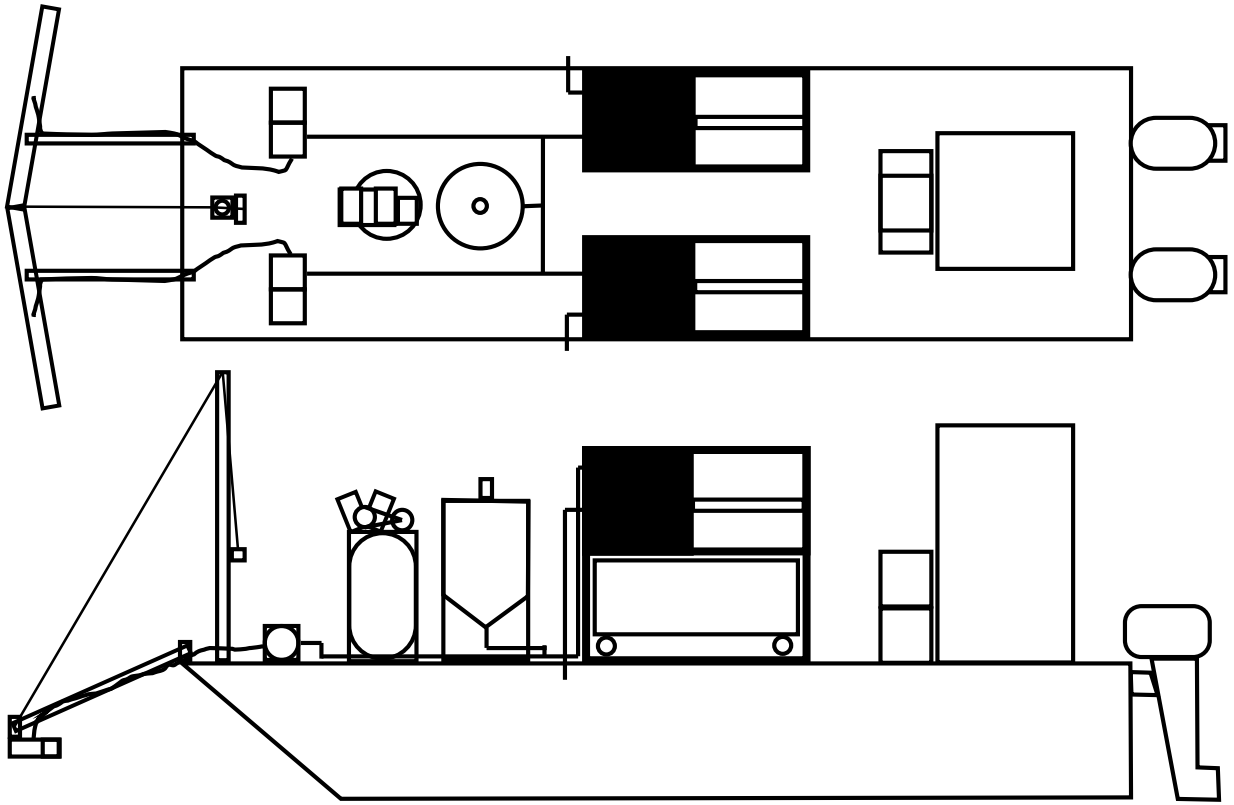
Scaling Algae Harvesting – Industrial Filter Presses

Two semi-automatic, industrial, plate and frame, filter presses like the one shown are the key components of the algae harvesting boat.

- Industrial plate and frame filter press
  - Proven, scalable, solid filtration technology
  - Proven capture of algae with cellulose addition
  - Low technical risk
- Medium-sized Harvester
  - Two – 800 mm x 800 mm filter presses with collection bins
  - 373 ft^2 total filter area
  - 2400 GPM

Top and side views of proposed medium-sized algae harvesting boat (proposed).

UVU patent pending designs and proprietary processes



Scale: 1 ft = 0.2 in

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Algae Harvesting Boat Design – Medium-sized

- 30 foot long x 10 foot wide boat
- 2400 gpm water filtration
- 2 x 8 hour shifts, 16 hours/day
- 2.3 million gallons of water filtered each day
- 872 kilograms of dry algae removed each day
  - @ 2,000,000 cells/mL (0.2 dry gram algae per liter)
  - 50% removal efficiency
- 2.7 metric tons of CO_2 collected as biomass each day
- 29 miles per day at 1.8 mph
- Clean 42 acres of water in one day

Questions

Thank You

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Algae Harvesting Boat Budget

Size	Medium
Flow (gpm)	2400
Size Scaling	4
Operating time (months)	4
Capital Costs per Boat	$187,400
truckable, self-propelled, work boat size	30x10
work boat cost	$80,000
total filter press size (cu ft)	16
# filter presses	2
filter press cost	$65,000
generator	$12,000
air compressor	$2,000
pumps	$8,000
intake skimmer	$3,000
valves and piping	$3,000
electric winch and crane	$1,200
electrical wiring supplies	$2,000
miscellaneous	$4,000
cellulose mixing tank	$2,200
construction	$5,000

Algae Harvesting Boat Budget

Operating Costs per Operational Year	$118,673
Operators (8 students (2 per shift), 4 hr shifts/day, 5 days/week, 4 weeks/month)	$38,400
Management (1)	$19,200
Fuel	$10,752
Consumables	$23,281
Travel per year	$4,000
Overhead	$23,040
Total cost	$306,073