# Identification and Characterization of Surface Water Intakes on the Chesapeake Bay

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# Where are the intakes in tidal waters?

- No national database
- States have detailed databases, but characterization is inconsistent in terms of
  - Location information
  - Tidal vs. non-tidal
  - Salinity
  - Use type
  - Volume withdrawn

# State of Maryland Plan to Adapt to Saltwater Intrusion and Salinization: 2024 Update

Research priorities:

- “identify currently vulnerable water users”
- “map the locations of intake pipes (surface water appropriation permits) relative to the current freshwater–saltwater transition zone”

# Goals of this study

1. **Develop a database of tidal intakes for the Chesapeake Bay**
   (a) Access intake data from Maryland Department of the Environment (MDE) and Virginia Department of Environmental Quality (VADEQ)
   (b) Identify tidal intakes
   (c) Homogenize use types and volume of water withdrawn
   (d) Determine salinity class of water
2. **Conduct analysis by**
   (a) Use type
   (b) Volume withdrawn
   (c) Salinity class

# MD and VA surface water intake data

| State | Total # of intakes | Location | Tidal or nontidal designated? | Fresh or salty designated? | Use types | Volume withdrawn |
|---|---|---|---|---|---|---|
| **MD** | 895 | Descriptive | Mostly | Yes | 24 | Permitted, sometimes reported |
| **VA** | 1515 | Latitude and longitude | No | No | 9 | Reported |

Data acquired from MDE (Robert Peoples) and VADEQ (Ryan Green) in 2021

# Two issues to resolve in mapping the locations of tidal water intakes

1. For most MD intakes, we know which are tidal, but we don't know exactly where they are. Example:

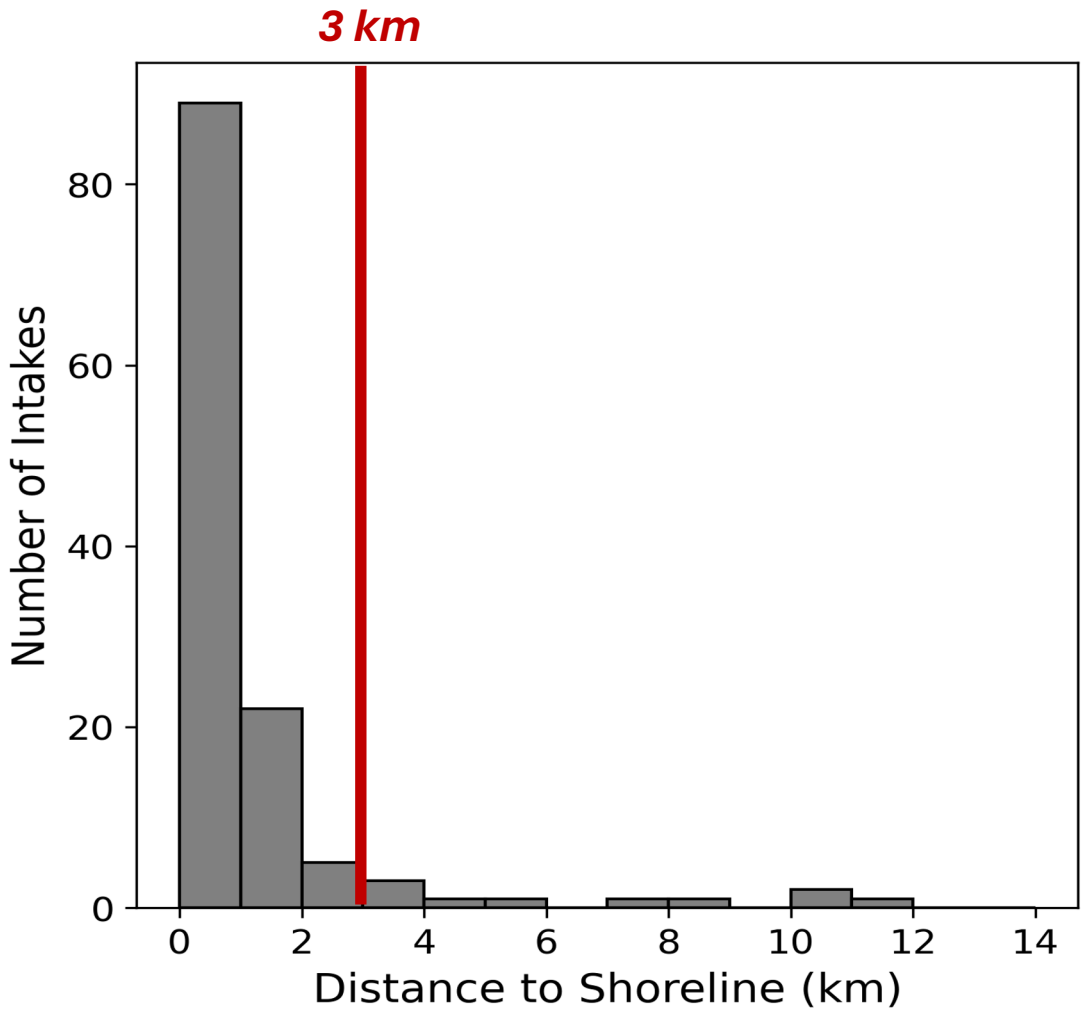
at 720 Holly Landing Road and 5071 and 4975 Muddy Creek Road, West River, west of Galesville, Anne Arundel County, Maryland.

*Use geocoding script*

2. We know exactly where the VA intakes are, but we don't know if they are tidal

*Apply distance-to-shoreline knowledge from MD*

Histogram of distance to shoreline of Maryland tidal water intakes




- *We applied a **3 km** threshold to the VA intakes and to the undesignated MD intakes*
- *We also applied filters to the MD intakes based on county, salinity, address, and stream name*
- *Finally, we applied a filter to make sure no intakes were upstream of dams*

**Maryland data summary**

- Start with 895 surface water intakes
- Use only 298 designated as tidal or unknown
- Apply multiple filters (including dam filter)
- 153 tidal water intakes remain

**Virginia data summary**

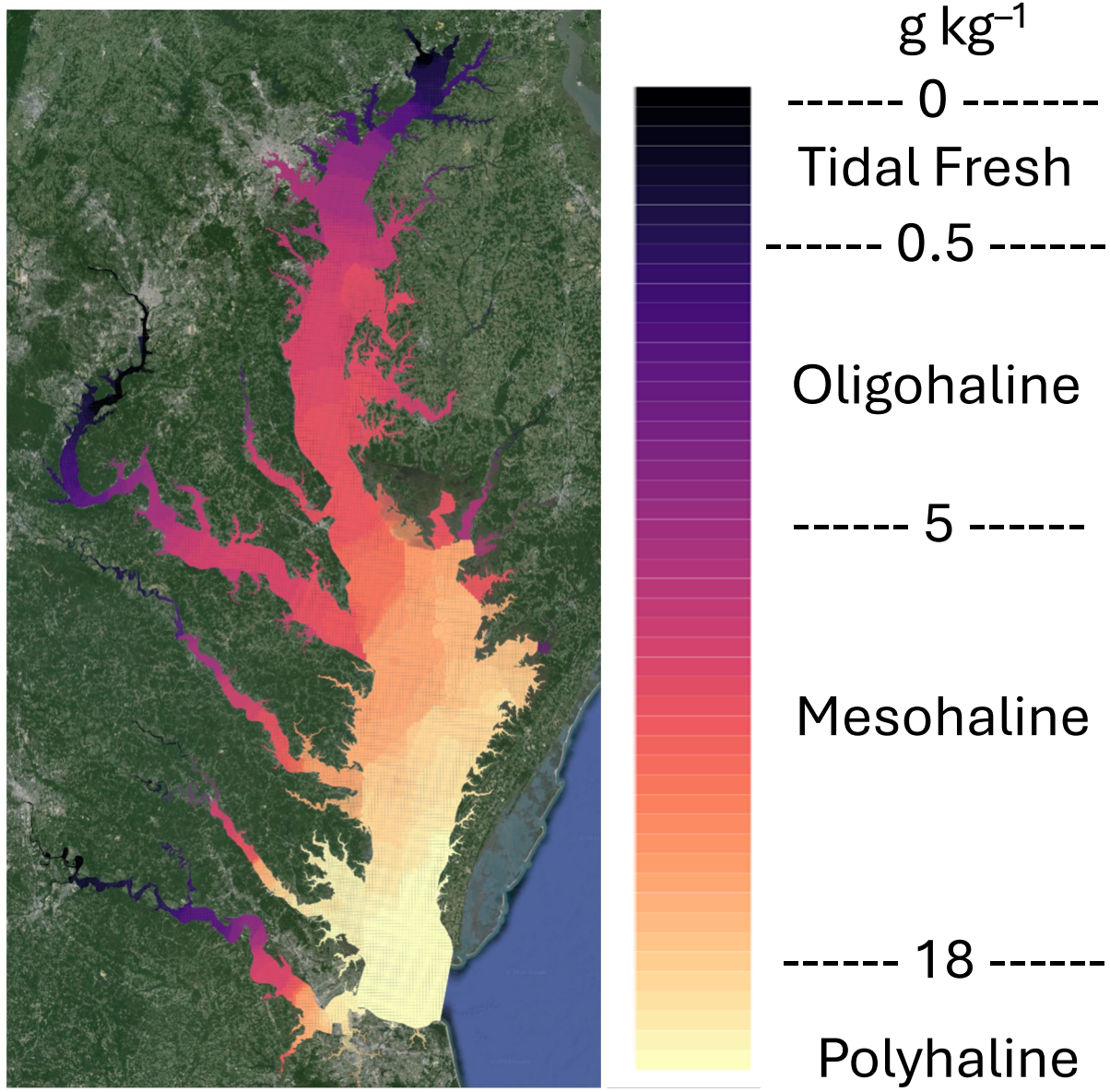
- Start with 1515 surface water intakes
- Apply 3 km distance filter (and dam filter)
- 236 tidal water intakes remain

**Grand total: 389 intakes on the Chesapeake Bay, 291 of which had non-zero water withdrawal during 2016–2020**

# Determining salinity

- **Problem:** Maryland provides Freshwater vs. Saltwater distinction, but delineation is subjective
- **Solution:** Utilize Chesapeake Bay Program mapped salinity data
- Used nearest grid cell to each intake location
- Salinity categories →

Chesapeake Bay Mean Surface Salinity (1984–2018)



# Homogenization of use types between VA (**bold**) and MD (•bulleted)

**Irrigation and Agriculture**

- Crop irrigation
- Golf course irrigation
- Lawn & park irrigation
- Nursery irrigation
- Sod farm irrigation
- Small intermittent irrigation
- Irrigation (Undefined)
- Aquaculture

**Municipal**

- Government run water supply
- Recreational drinking/sanitary
- Institutional drinking/sanitary
- Commercial drinking/sanitary
- Environmental enhancement
- Laboratories
- Wildlife ponds and recreational

**Industrial, Commercial, and Manufacturing**

- Industrial (undefined)
- Industrial heating and cooling water
- Industrial wash and separation processes
- Commercial (undefined)
- Hydrostatic testing and fire protection
- Sand and gravel washing

**Fossil Power**

- Fossil fueled power generation

**Nuclear Power**

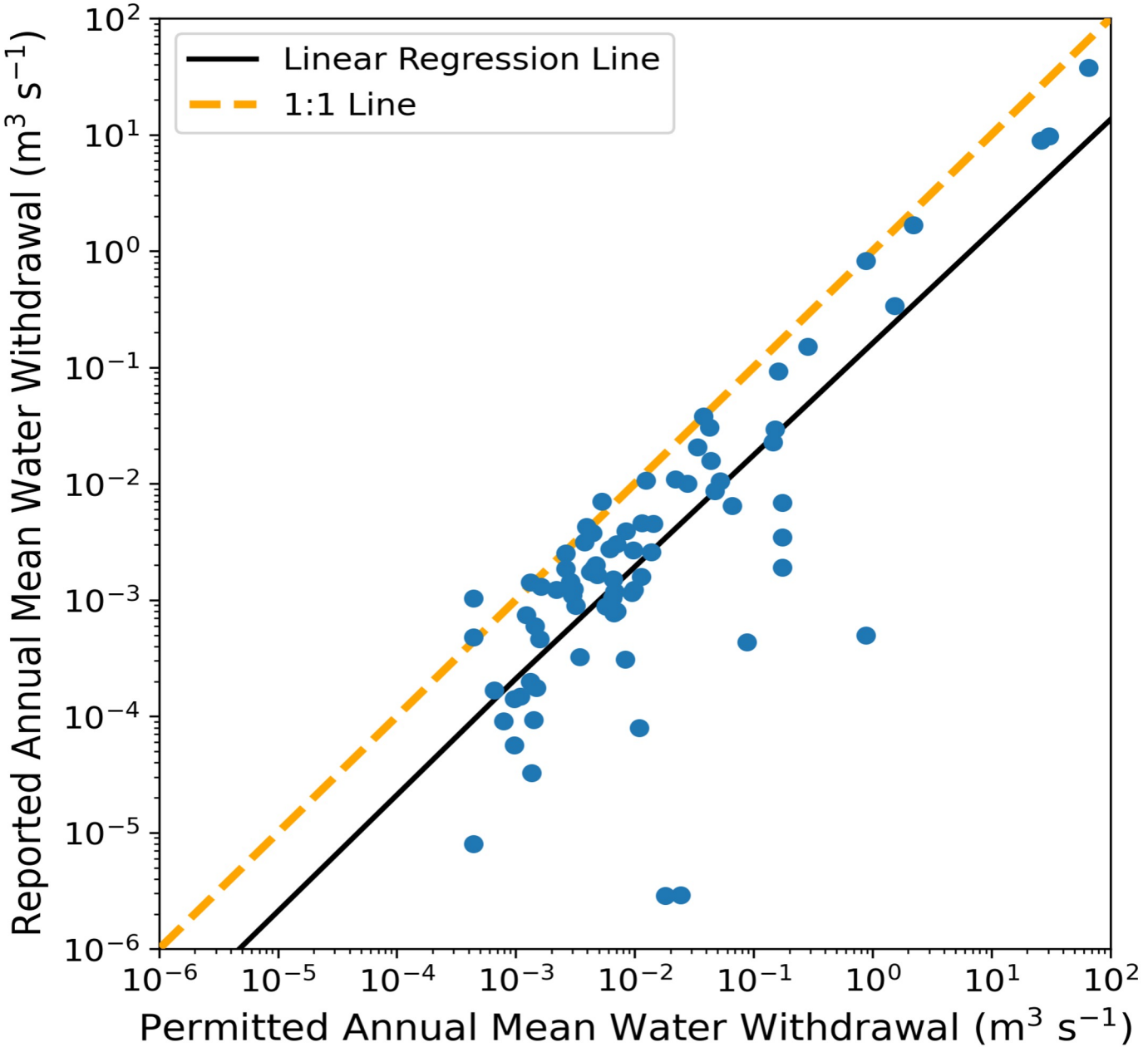
- Nuclear power generation

**Mining**

- Mining operations (undefined)

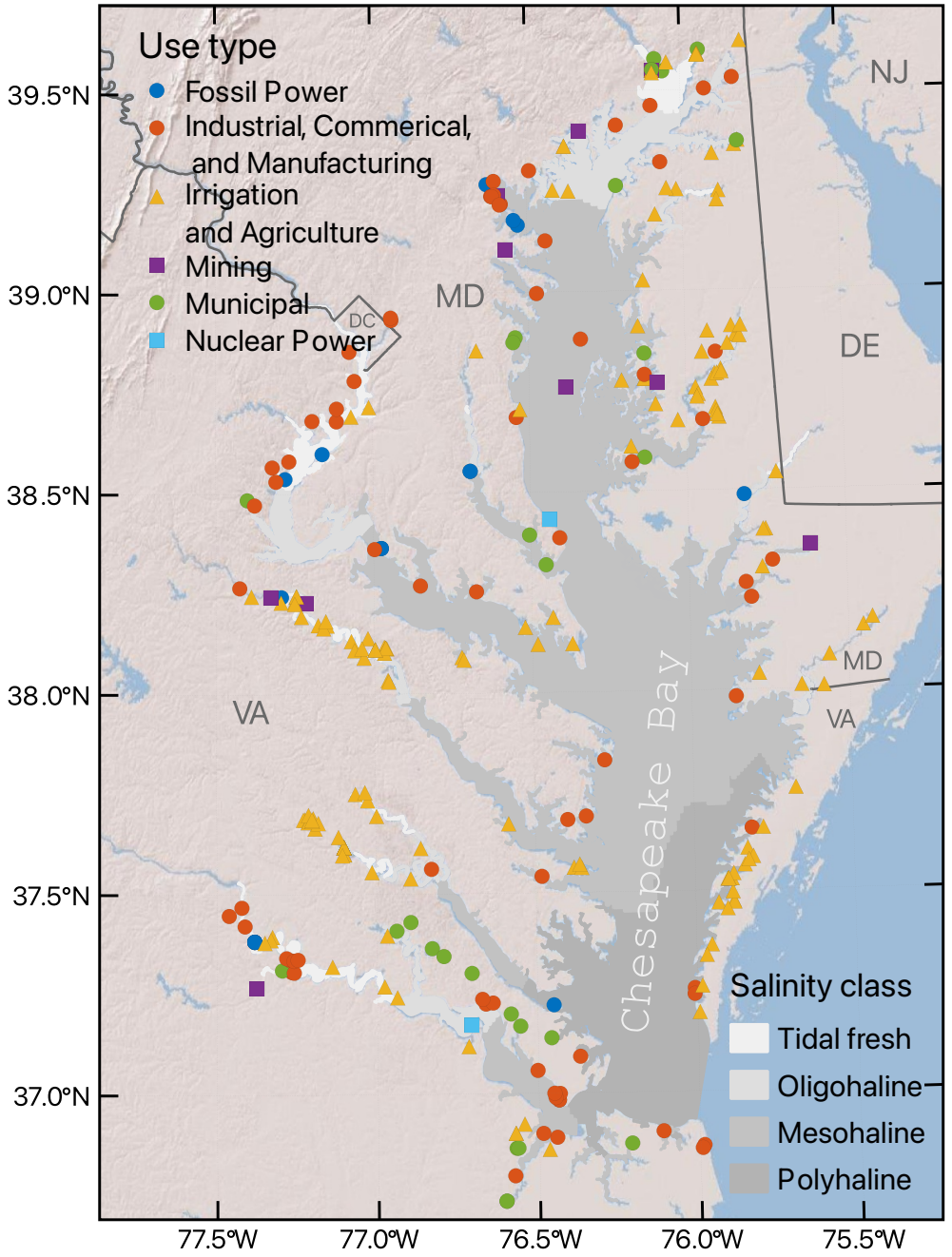
**Problem:** 50 of the Maryland intakes only had permitted values of volume withdrawn

**Solution:** Use regression of reported vs. permitted values for other 103 intakes



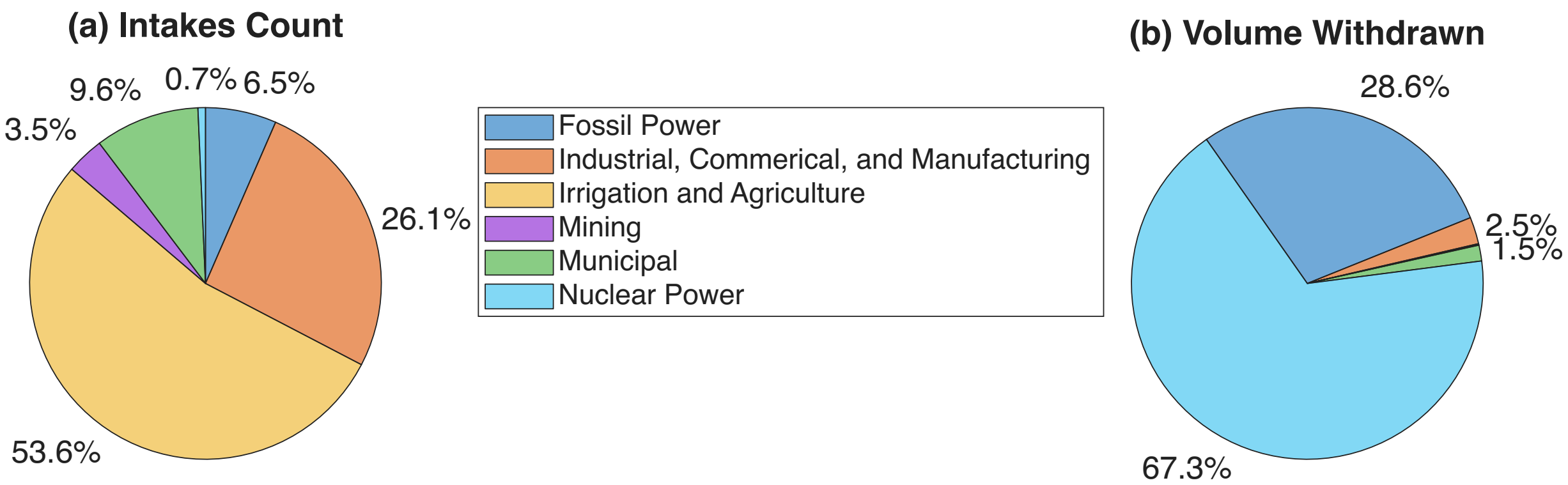
# Final Chesapeake Bay water intake map

*Intakes are well distributed along the Bay's shoreline*

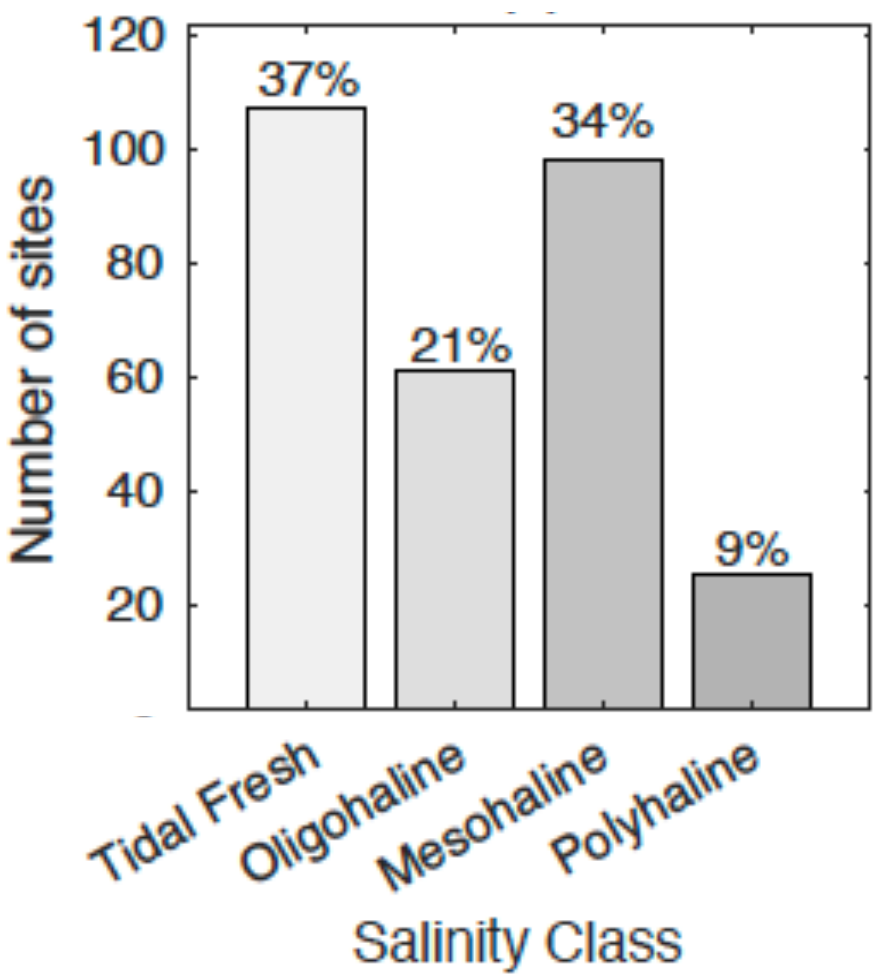


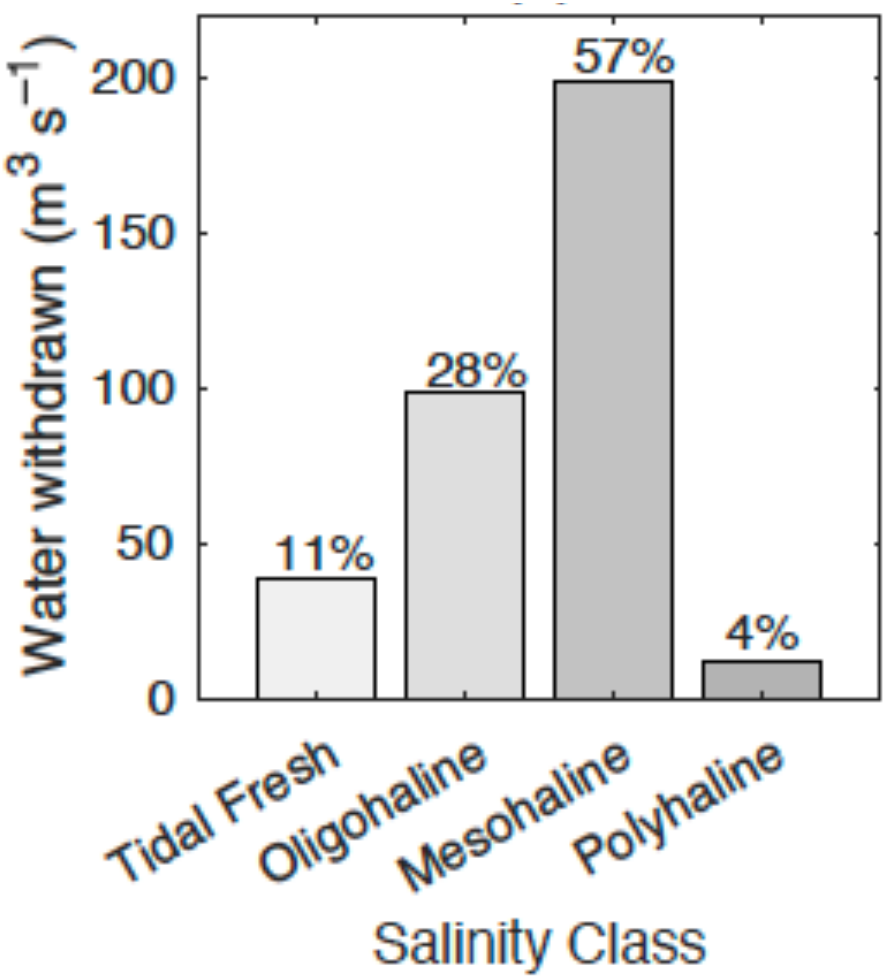
Most of the intakes are for irrigation and agriculture

Most of the volume withdrawn is for power



# Water is withdrawn from all salinity classes




*Total = 348 $m^3 s^{-1}$ = 13% of the river input*

# Summary

- A database of 291active intakes (2016–2020) on the Chesapeake Bay has been created
- Each site is characterized by salinity zone, use type, and volume withdrawn
- Most of the intakes are for irrigation and agriculture
- Most of the volume withdrawn is for power
- *Larger message: This was a non-trivial effort! Some organization is needed at the national level to map tidal water intakes*.

# Learn more

- ESS Open Archive Paper QR Code →

- Under review as a chapter in an AGU book: Kausal, S.S. (editor) “Human Impacts on the Global Salt Cycle”