

# Malden River Human Health Risk Study for Boating 2018

Andrew Hrycyna and Kathy Vandiver    EPA Science Forum, April 30, 2019



*Spoiler alert:*

*The news is favorable for boating!*

## ***Favorable for Boating? How can it be true?***

- 1) There are so many Contaminates present in the Sediments from years of Heavy Industrial Waste!**
  - To name just a few: Rubber Factories; Steel Factories; Chemical Plants; Leather Tanning....

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  - To name just a few: Rubber Factories; Steel Factories; Chemical Plants; Leather Tanning....
- 2) There have been many Health Warnings by Officials!**
  - Precautionary Warnings for Public Safety were Entirely Appropriate given that Human Health Risk Studies were Incomplete.

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- 1) There are so many Contaminates present in the Sediments from years of Heavy Industrial Waste!**
  - To name just a few: Rubber Factories; Steel Factories; Chemical Plants; Leather Tanning....
- 2) There have been many Health Warnings by Officials!**
  - Precautionary Warnings for Public Safety were Entirely Appropriate given that Human Health Risk Studies were Incomplete.
- 3) This New Study (2016-2018) has Thoroughly Identified the Hazards and Assessed the Risks for Boaters in Accordance with both State and National Standards.**



# Let's Review Some Health Information



*1) Just because a harmful chemical is present, does not mean that it is harmful in the amount present.*

**The dose matters.**

# Let's Review Some Health Information

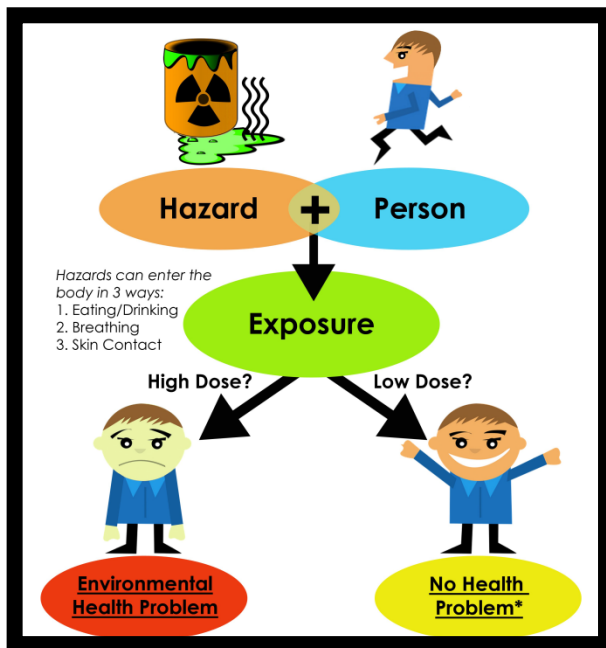


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**The dose matters.**

*2) A person must come in contact with the harmful chemical.*

**The dose and exposure matter.**



# Let's Review Some Health Information



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**The dose matters.**

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**The dose and exposure matter.**






**Dose and Exposure Factors were included in the 2018 Health Risk Study for Boaters**

# Boating Sites

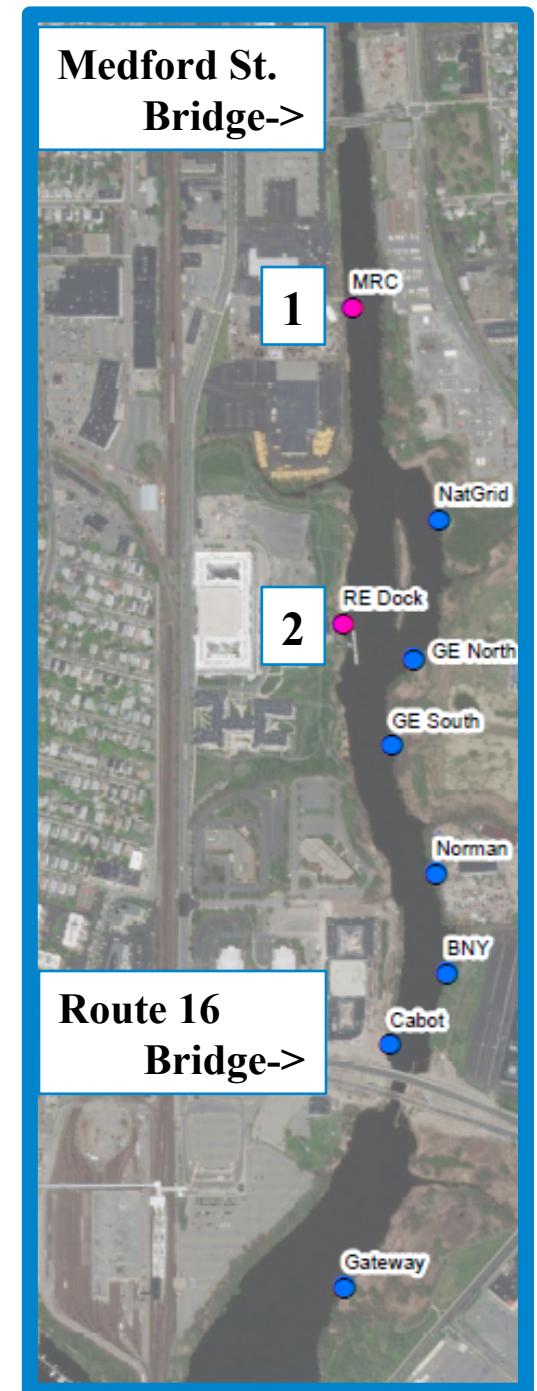
## Sampled in this Study

See Map of the Malden River

-  1 Malden /Mystic Valley Charter/ Gentle Giant Boat House
-  2 Tufts University Boat House / Rivers Edge
-  Seven Potential Boating Sites

## Sediments were sampled from 9 Boat Sites

- Representative samples of water were analyzed as well at a certified laboratory for potential contaminants of concern.
- This work provided info about chemical dose for the risk calculation.



# Malden River Human Health Risk Study is a “Conservative Study”

*Good news !! “Conservative” means the study ...*

- ❑ Maximized Exposures to Hazards Present
- ❑ Included Multiple Ages and Types of Boaters
  1. Occasional Boater, Child (most sensitive)
  2. Occasional Boater, Adult
  3. Frequent Adult Boater
  4. *Youth Competitor (See Example, next slide)*
  5. Collegiate Competitor
  6. Adult Employee working at Launch Site
- ❑ Applied both State and Federal Guidelines





# Example Exposure Numbers

## *Youth (High School) Competitor*

Exposure data applied in calculations:

- 8 years rowing (4 HS + 4 College)
- Rows for 134 days/year
- Boater wades into sediments -No dock!
- Sediments swallowed each day rowing
- Rower capsizes every day
- Capsizing, rower swallows more water

A Conservative Study creates a safety margin by over-estimating exposures.



# Calculating Health Risks

## Explaining these Numbers

1) The Target Risk Numbers (**in red**) are valuable for setting guidelines for Public Health.

Mass Dept. of Environmental Protection (MassDEP)  
U.S. Environmental Protection Agency (EPA)

2/16/2019

US EPA's limit

**1 in 10,000**

additional cases  
of cancer

$1 \times 10^{-4}$

Mass DEP's limit

**1 in 100,000**

additional cases  
of cancer

$1 \times 10^{-5}$

**1 in 1,000,000**

additional cases  
of cancer

$1 \times 10^{-6}$

Greater  
Risk



Least  
Risk



# Calculating Health Risks

## Explaining these Numbers

- 1) The Target Risk Numbers (**in red**) are valuable for setting guidelines for Public Health.
- 2) However this system doesn't apply to personal risk. The numbers can't predict personal risk.

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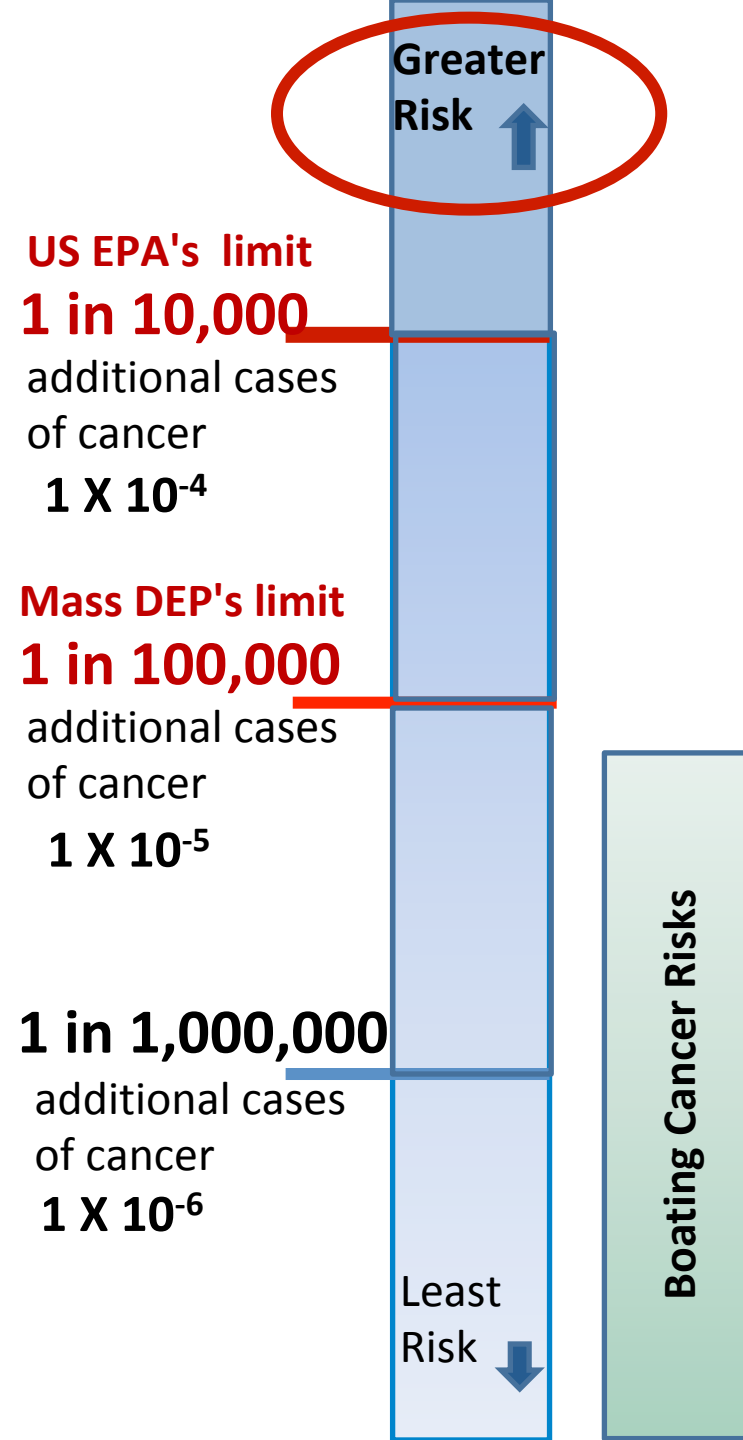
Greater  
Risk ↑

Least  
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# Boating's Bottom Line

Mass Dept. of Environmental Protection (MassDEP)  
U.S. Environmental Protection Agency (EPA)

2/16/2019



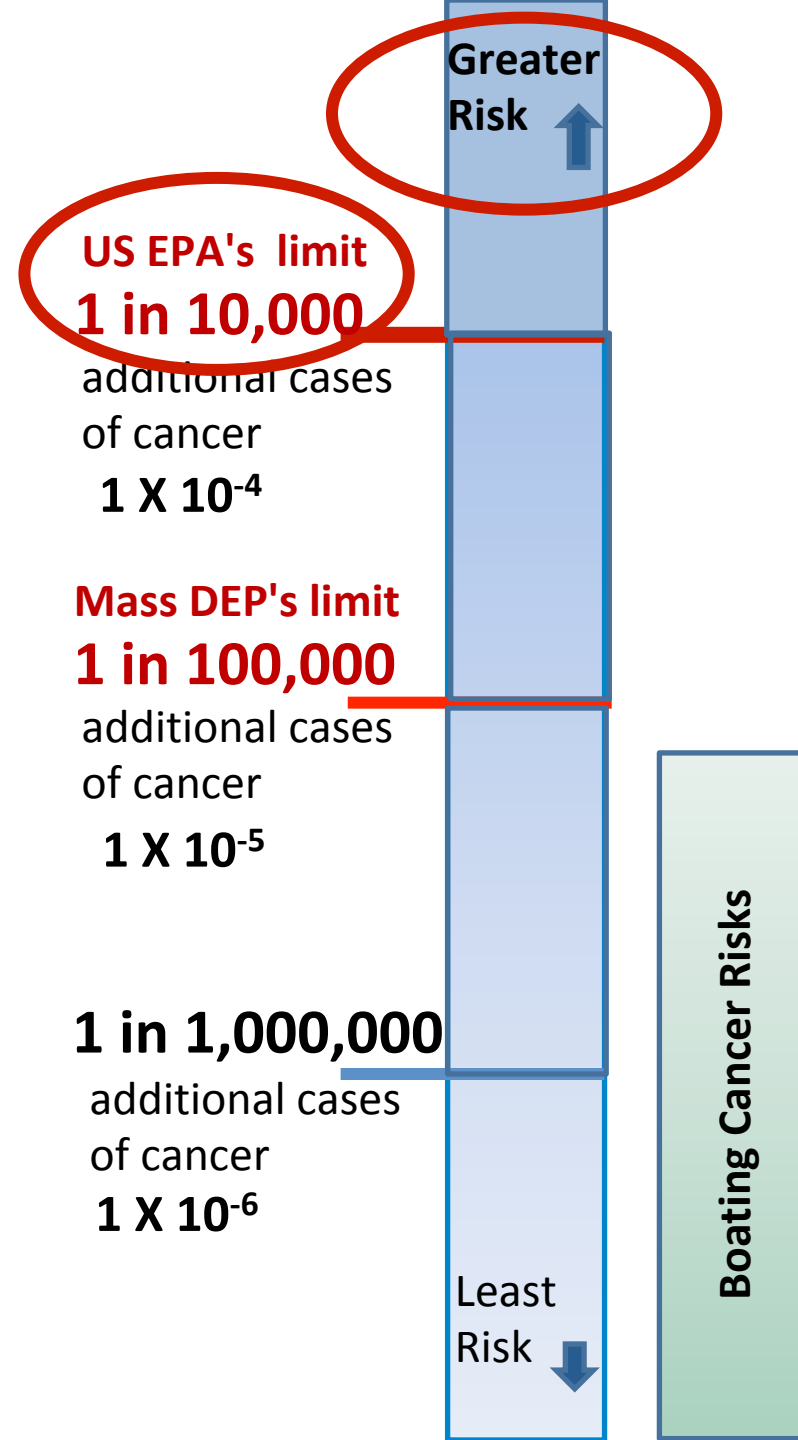
# Boating's Bottom Line

## Explaining these Results:

1) No Boating Cancer Risk exceeded **US EPA's limit of ( $10^{-4}$ )** (1 in 10,000 additional cases of cancer)

Mass Dept. of Environmental Protection (MassDEP)  
U.S. Environmental Protection Agency (EPA)

2/16/2019





# Boating's Bottom Line

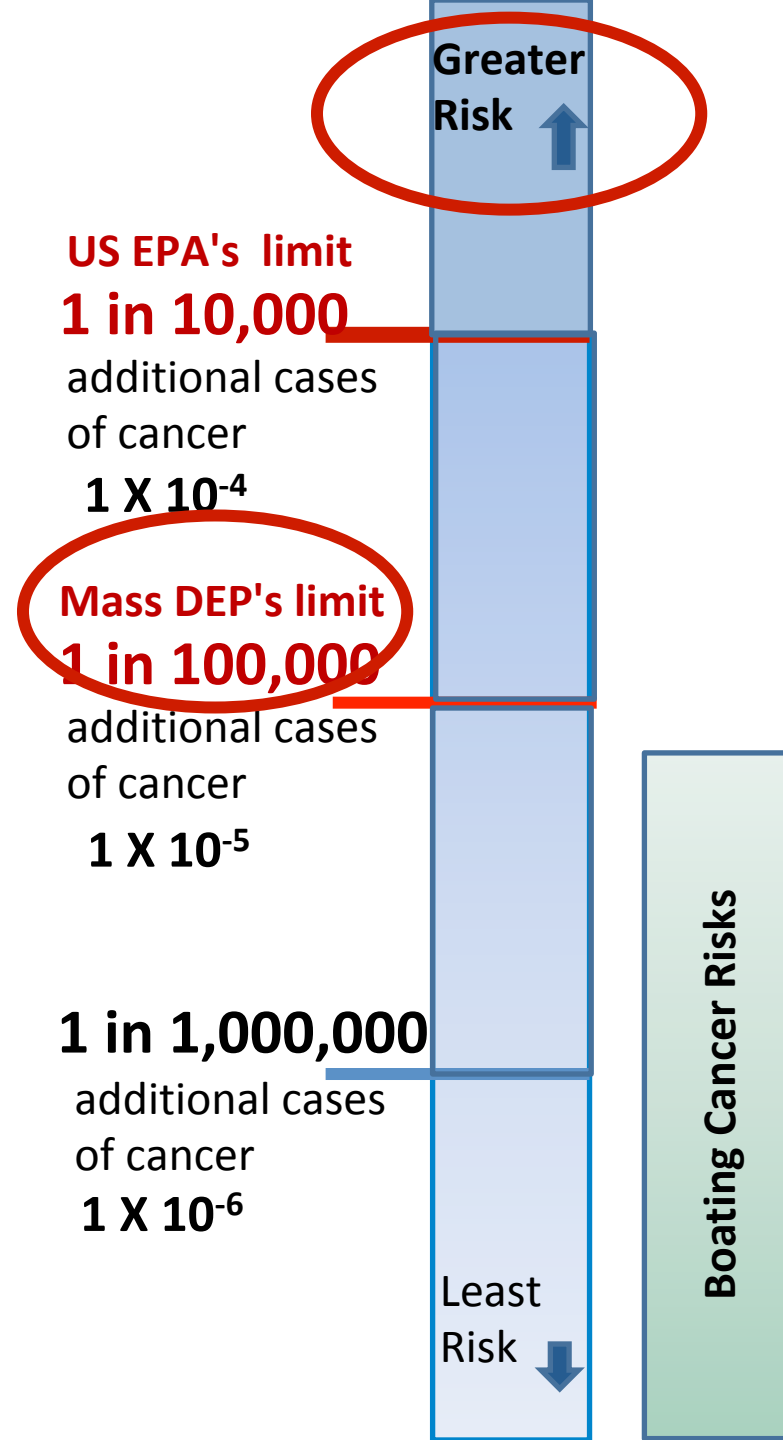
## Explaining these Results:

1) No Boating Cancer Risk exceeded US EPA's limit of ( $10^{-4}$ ) (1 in 10,000 additional cases of cancer)

2) No Boating Cancer Risk exceeded MassDEP's limit of ( $10^{-5}$ ) (1 in 100,000 additional cases of cancer)

Mass Dept. of Environmental Protection (MassDEP)  
U.S. Environmental Protection Agency (EPA)

2/16/2019



# Boating's Bottom Line

## Explaining these Results:

- 1) No Boating Cancer Risk exceeded US EPA's limit of **( $10^{-4}$ )** (1 in 10,000 additional cases of cancer)
- 2) No Boating Cancer Risk exceeded MassDEP's limit of **( $10^{-5}$ )** (1 in 100,000 additional cases of cancer)
- 3) No Boating Risk for non-cancer Hazards exceeded the limit (**HI=1.0**) (Hazard Index not shown here)

Mass Dept. of Environmental Protection (MassDEP)  
U.S. Environmental Protection Agency (EPA)

2/16/2019

US EPA's limit  
**1 in 10,000**

additional cases  
of cancer  
 $1 \times 10^{-4}$

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Greater  
Risk ↑

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Boating Cancer Risks

# Results

Exposure Area	Boater (Adult)		Boater (Child)		Frequent Boater (Adult)		Youth Competitor (Adult)		Collegiate Competitor (Adult)		Employee (Adult)	
	Cancer Risk	Non-cancer HI	Cancer Risk	Non-cancer HI	Cancer Risk	Non-cancer HI	Cancer Risk	Non-cancer HI	Cancer Risk	Non-cancer HI	Cancer Risk	Non-cancer HI
<b>BNY</b>	3 x 10 <sup>-7</sup>	0.005	1 x 10 <sup>-6</sup>	0.04	5 x 10 <sup>-6</sup>	0.07	4 x 10 <sup>-6</sup>	0.07	1 x 10 <sup>-6</sup>	0.15	7 x 10 <sup>-6</sup>	0.2
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<b>MRC</b>	5 x 10 <sup>-7</sup>	0.004	2 x 10 <sup>-6</sup>	0.04	8 x 10 <sup>-6</sup>	0.07	6 x 10 <sup>-6</sup>	0.07	1 x 10 <sup>-6</sup>	0.14	8 x 10 <sup>-6</sup>	0.2
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Cabot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gateway	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GE North	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GE South	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MRC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
National Grid	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Norman	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RE Dock	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

- No cancer risks exceed MassDEP's target risk limit ( $10^{-5}$ ) or the upper bound of US EPA's target risk range ( $10^{-4}$ ).
- No hazard indices exceed the US EPA and MassDEP's target HI of 1.

# Other Malden River Health Risks?

## Microbial Contaminations /Typical in Urban Waters




Be Safe! Check this out...  
“Mystic Daily Boating Advisory” can be found on the MyRWA Website listed below.

Bacterial levels in the rivers can rise after heavy rain-fall events.

### MYSTIC DAILY BOATING ADVISORY

**HOW SAFE IS IT TO BOAT TODAY?**

These estimates of water quality conditions are generated by an automated bacteria prediction model and by additional cyanobacteria testing during boating season. For more on what the estimates mean and how they are arrived at, see the questions below.

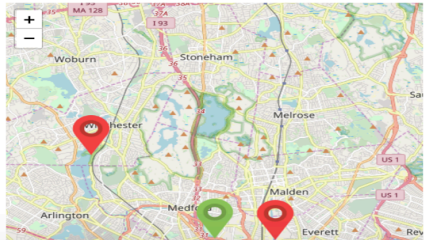
Mystic River MYSTIC VALLEY PARKWAY (RT 16)	Malden River REVERE BEACH PARKWAY (RT 16)	Upper Mystic Lake SHANNON BEACH
 <p><b>Status: Good</b> Low probability of elevated bacteria levels.</p>	 <p><b>Status: Advisory</b> High probability of elevated bacteria levels.</p>	 <p><b>Status: Advisory</b> High probability of elevated bacteria levels.</p>

**What do the categories mean?**

**GOOD**  
Boating is probably safe! The chances that E. coli bacteria levels exceed state recreational standards are low, and there is no evidence of a cyanobacteria bloom.

**ADVISORY**  
The chances that E. coli bacteria levels exceed state recreational standards are high, or there is evidence of a cyanobacteria bloom with concentrations exceeding state safety guidelines.

**UNCERTAIN**  
There is no evidence of elevated bacteria levels, but screening values



<https://mysticriver.org/boatingadvisory/>



# Some Take-Aways....

- ❖ **The sediments do not pose a health risk that should prevent people from boating on the Malden River.**



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- ❖ The sediments do not pose a health risk that should prevent people from boating on the Malden River.
- ❖ Check MyRWA's online "Mystic Daily Boating Advisory" for health info on microbial levels after heavy rain-fall.



*Time for  
Questions ?*



# Some Take-Aways....

- ❖ The sediments do not pose a health risk that should prevent people from boating on the Malden River.
- ❖ Check MyRWA's online "Mystic Daily Boating Advisory" for health info on microbial levels after heavy rain-fall.
- ❖ *Lastly, Mom told us to wash our hands before eating ... and this is still timeless good advice!*



*Time for  
Questions ?*

# Our Thanks to all Study Partners

## **Study Partners - Alphabetic list**

**Friends of the Malden River (FoMR)**  
**Gradient Corp, Cambridge, MA**  
**MIT Center for Environmental Health Sciences (CEHS)**  
**Mystic River Watershed Association (MyRWA)**  
**Mystic Valley Development Corp (MDVC):**  
**Cities of Everett, Malden and Medford**  
**Preotle Lane & Associates**



# Questions

Andrew Hrycyk

Watershed Science

Mystic River Watershed

Association

andy@mysticriver.org

**Mystic River**  
WATERSHED ASSOCIATION



MIT CENTER FOR  
ENVIRONMENTAL HEALTH  
SCIENCES





Presentation Concluded  
Additional Slides such as some Tables.  
Available in the Appendix

# **Malden River Human Health Risk Slides in this Appendix:**

**Slide 2 Project Partners**

**Slide 3 Partnership Roles**

**Slide 4 Map of Malden River**

**Slide 5 Study method overview**

**Slide 6 Example Conservative Study  
w. Youth Competitive Rower**

**Slide 7 Calculating Chemical Intakes Risks**

**Slide 8 Risks for Boater Types at Study Sites ( #30 overall )**

**Slide 9 Conclusions from Risk Data**

**Slide10 Wrap up/ Conclusions**

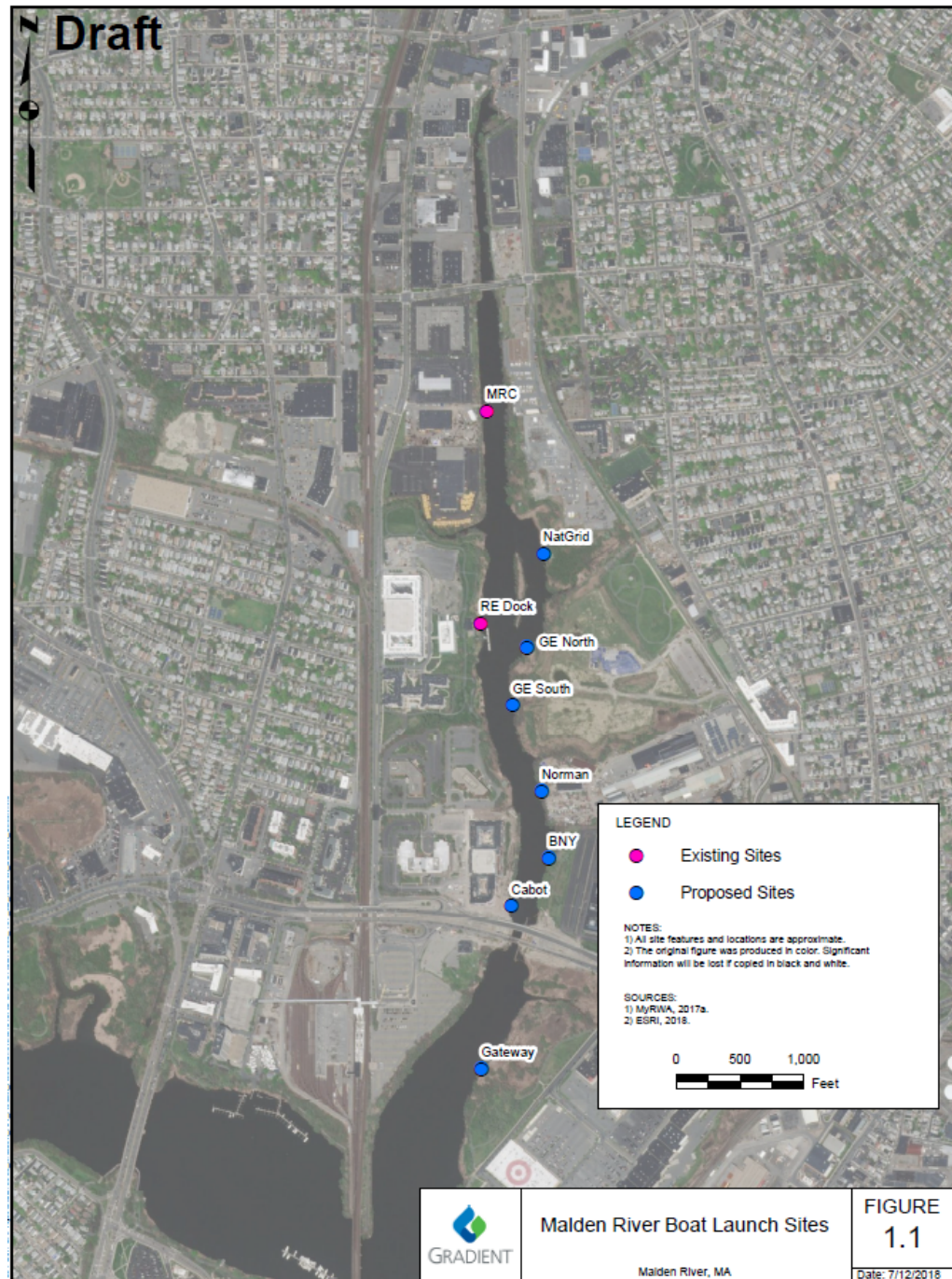
**Slide 11 Boating Advisory Website MyRWA URL**



# Study Partnerships Roles

- 1) The study partners chose a world-class risk assessor, Gradient Corp., to evaluate and collect data, using EPA risk assessment methodology
- 2) MyRWA collaborated in developing with sampling methods in collaboration with MIT, EPA, and Gradient Corp. MIT funded the Certified Lab Work.
- 3) MyRWA collected the sediment samples at 7 potential boat launch locations informed by community partners, and also 2 existing boating sites.
- 4) Water and Sediment Samples were analyzed at State-Accredited Lab, Alpha Analytics.

# Map of the Sites



# Study Method Overview

## **1. Understand human exposure routes:**

mouth, nose, skin contact

## **2. Research the boaters' habits:**

competitive, youth, frequency, occasional

## **3. Make Conservative assumptions:**

**(Use a wide safety margin)** For example, include highest figures for capsizes, for contact with the sediments, for swallowed amounts, etc.

## **4. Use the samples' contamination concentrations to calculate exposures and risks.**



# Example of the **Conservative\*** Study: Competitive Youth Rower

## Exposure Assumptions for Health Risks for this Group

- 8 years of competitive rowing (includes HS + College )
- Rowing 134 days/year
- Hands, forearms, lower legs, feet in contact with sediment (boater wades into river-- no dock!)
- 100 mg sediment swallowed each day while rowing
- Rowers capsized every day when rowing
- Whole body exposed when capsizing (for 30 min? AH ck?)
- Swallowed water with every capsize event

**\* Conservative Studies create a wide safety margin by over-estimating the potential exposure scenario.**

# Calculating Chemical Intakes

$$I = \frac{EPC \times CR \times EF \times ED \times CF}{BW \times AT}$$

where:

I	=	Intake, the amount of chemical (mg/kg body weight-day) at the exchange boundary
EPC	=	Exposure Point Concentration, the chemical concentration contacted over the exposure period at the exposure point ( <i>e.g.</i> , mg/kg in sediment)
CR	=	Contact Rate, the amount of contaminated medium contacted per unit time or event ( <i>e.g.</i> , sediment ingestion rate [mg/day])
EF	=	Exposure Frequency, how often exposure occurs (days/year)
ED	=	Exposure Duration, how long exposure occurs (year)
CF	=	Conversion Factor ( $1 \times 10^{-6}$ kg/mg)
BW	=	Body Weight, the average body weight over the exposure period (kg)
AT	=	Averaging Time, period over which exposure is averaged (days) Expressed as a dose, for ingestion and dermal contact, and as a concentration, for inhalation exposure.

Note: this is the generalized equation for calculating chemical intakes. Intake equations will differ based on medium and exposure pathway.

# Risks for All Boaters Types at Study Sites

Boaters in 6 different categories:												
<b>Sites:</b> Green= Proposed Red = Existing	1) Boater (Adult)		2) Boater (Child)		3) Frequent Boater (Adult)		4) Youth Competitor (Adult)		5) Collegiate Competitor (Adult)		6) Employee (Adult)	
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# Boating Risk Data

## Official Public Health Policy is set by

Massachusetts Department of Environmental Protection (MassDEP)  
and the U.S. Environmental Protection Agency (EPA)

### Cancer Risks

- No cancer risks exceed Mass DEP's limit of ( $10^{-5}$ ) or 1 in 100,000 additional cases.
- No cancer risks exceed the upper bound of US EPA's target risk range ( $10^{-4}$ ) or 1 in 10,000 additional cases.

### Hazard Indices (HI)

#### Non-cancer health effects

- No hazard indices (HI) values exceed the US EPA and MassDEP's target Hazard Index value of 1.0

# Wrap up and Conclusions

- 1) The sediments do not pose a risk that should prevent people from rowing or paddling on the Malden River
- 2) Please check MyRWA's online "Mystic Daily Boating Advisory" for info about occasional microbial health warnings on our urban waters.





# Other Malden River Health Risks?

## Sometimes, Microbial Advisories Occur as is Typical in Urban Waters

<https://mysticriver.org/boatingadvisory/>




Be Safe! Check this out!  
“Mystic Daily Boating  
Advisory” can be found on  
the MyRWA Website.  
See URL above.

Bacterial levels in the rivers  
can rise after heavy rain-fall  
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### MYSTIC DAILY BOATING ADVISORY

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