

Microplastics in the Great Lakes: the Problems and Solutions

Art Hirsch



Detroit News

Indigenous Tribal Acknowledgement



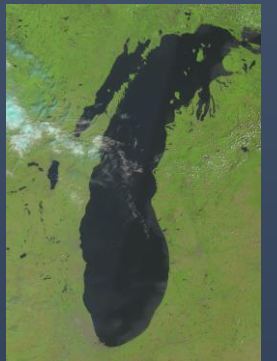


Microplastics Presentation

- Overview of the microplastics problem in the Great Lakes
 - What are microplastics
 - Extent
 - Sources/pathways
 - Controls
 - Regulations
- What we can do to address microplastics
- Hearing your thoughts, concerns and questions
- Presentation Goal- is for you to become better aware, educated, and become concerned to take action

A Common Theme

- It is a complex-complex issue
- Microplastics represents a real potential risk to the environment (human/aquatic)
- There are huge data gaps that need to be filled via research; many unknown unknowns
- The problem is going to get worse and we need to act now



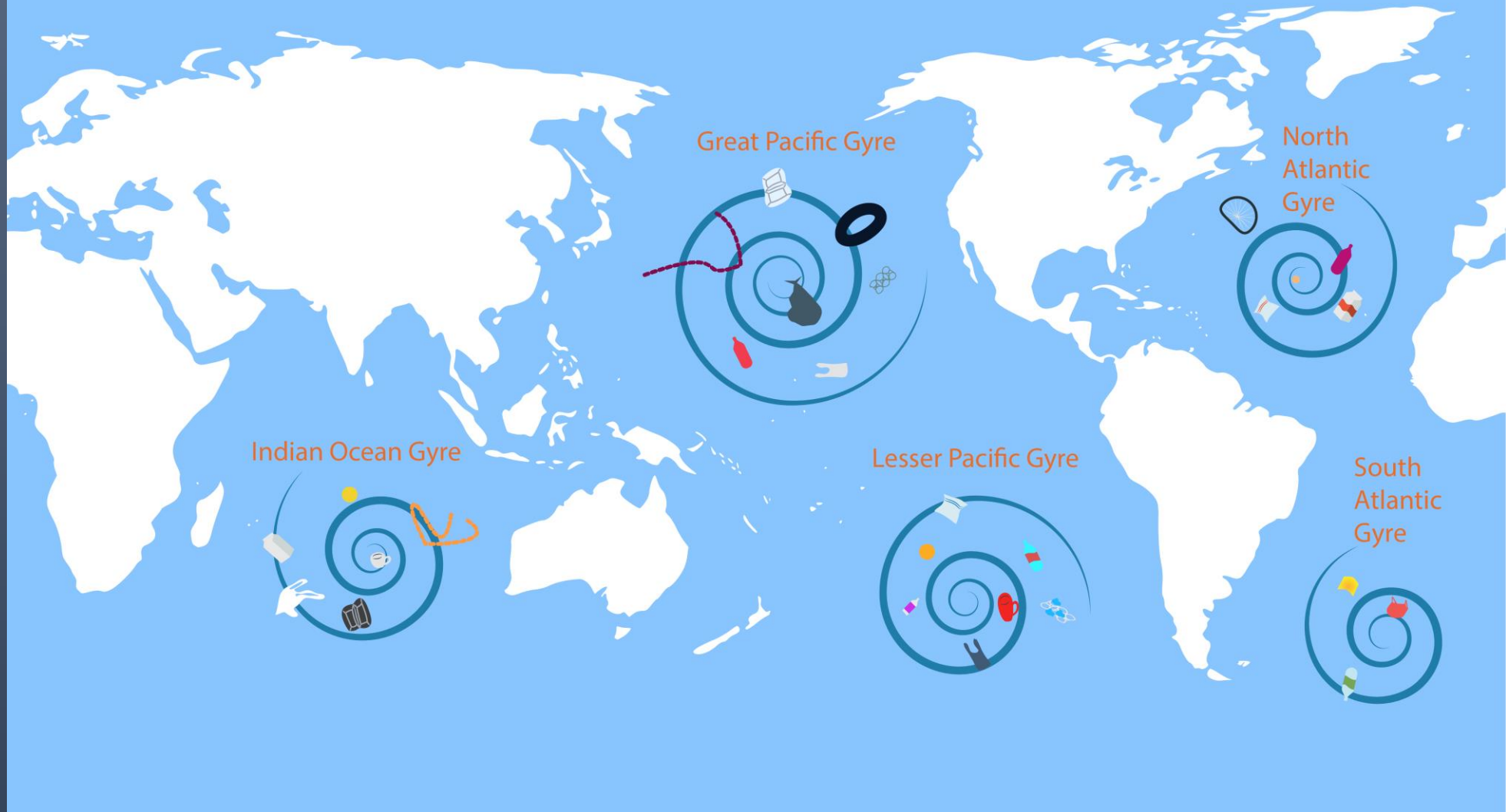


Great Lakes Abuse

- Direct discharge of raw sewage
- Industrial discharges (heavy metals and petroleum)
- Freighter oil and ballast discharges
- Phosphorous from detergents/algae
- PCBs
- Invasive species
 - Alewife
 - Zooplankton
 - Zebra mussels
 - Quagga mussels
- Combined Sewer Overflows/E-coli
- Agricultural runoff-nutrients
- Potential Asian Carp introduction
- Perfluoroalkyl substances (PFAS)
- Plastics/microplastics



Ocean Gyres of the World



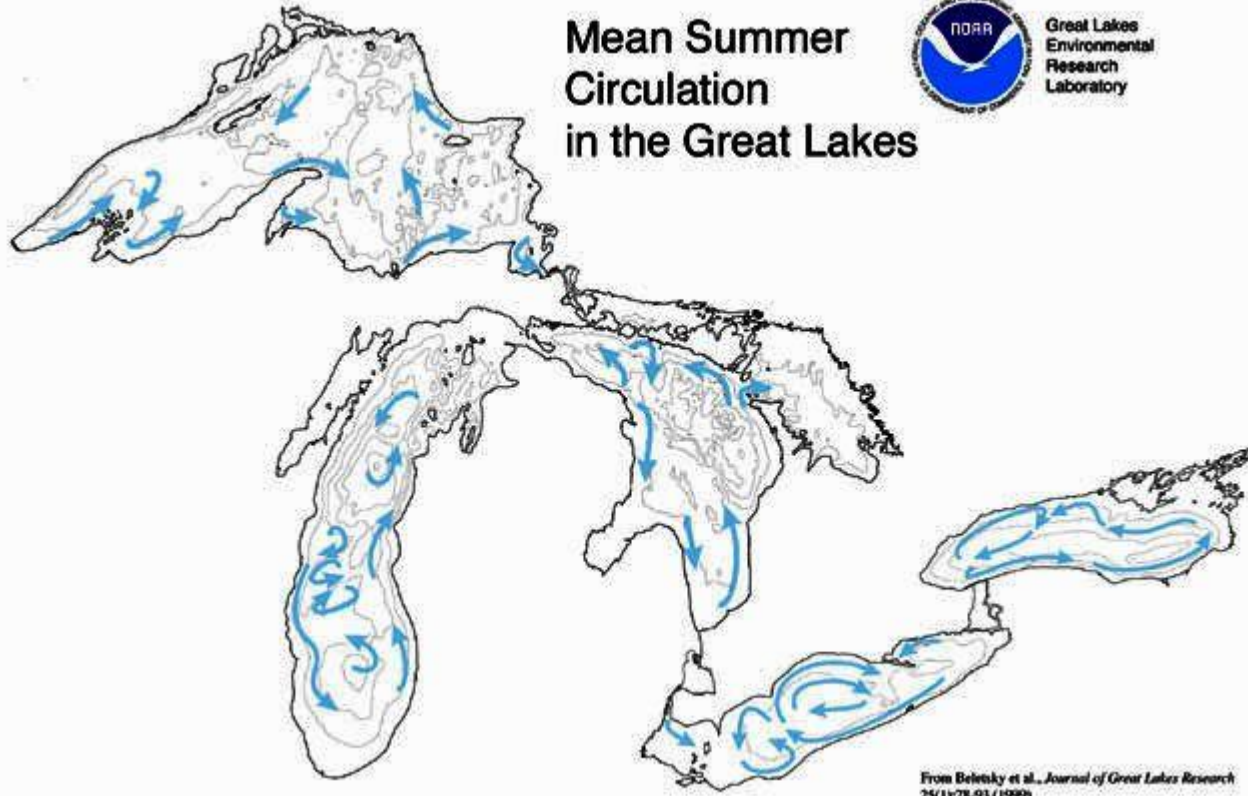


Purple Turtle

Mean Summer Circulation in the Great Lakes

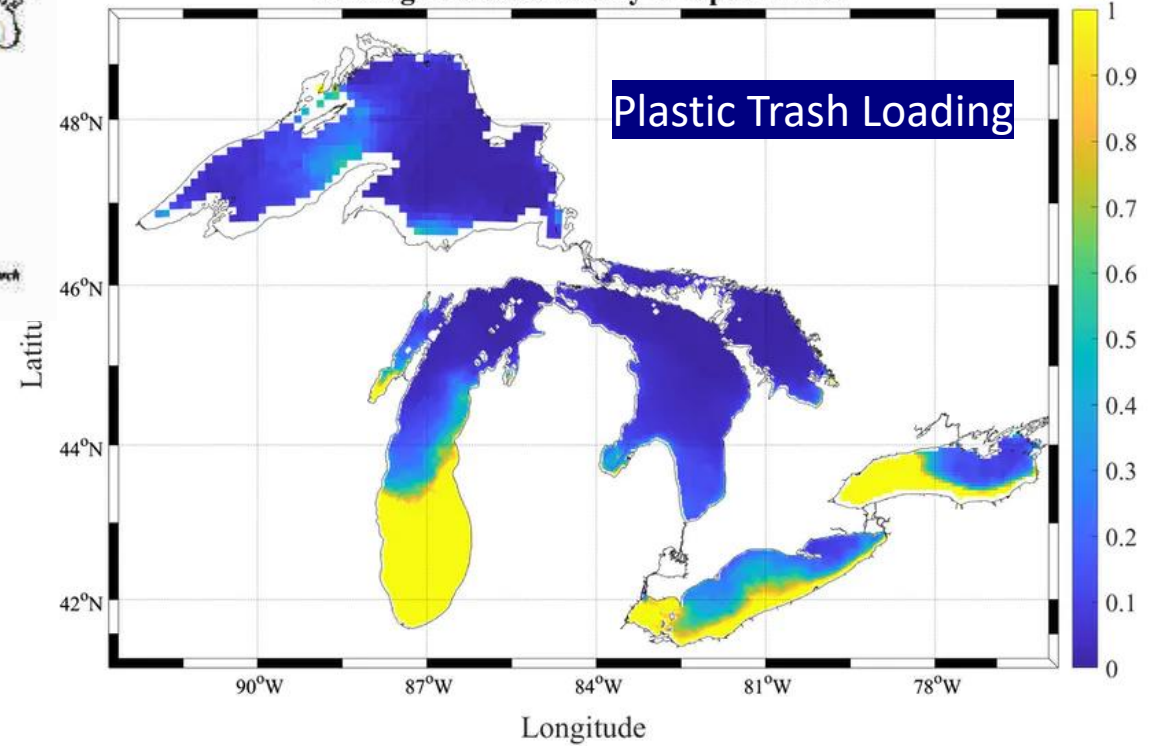


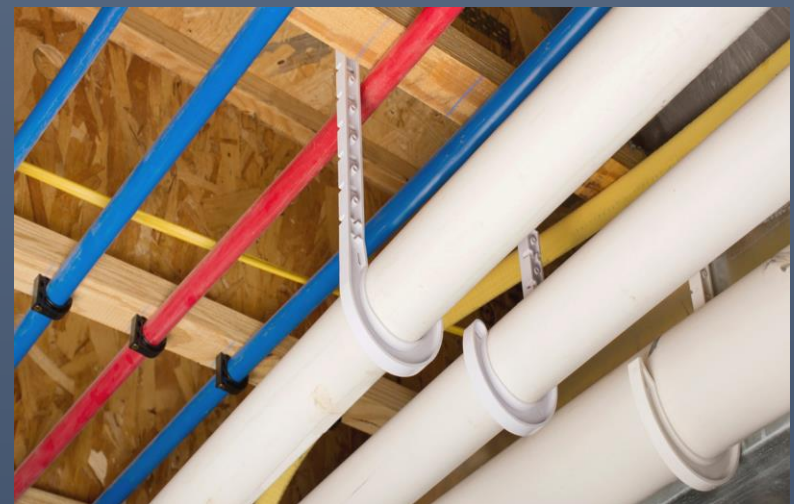
Great Lakes Environmental Research Laboratory



From Beletsky et al., *Journal of Great Lakes Research* 25(1):78-93 (1999)

Average Particle Density in Open Water





Most Common Plastics/Applications

Plastic Polymer Name

- Acetal (Polyoxymethylene)
- Acrylic (Polymethyl methacrylate)
- Acrylonitrile butadiene styrene
- High density polyethylene (HDPE)
- Low density polyethylene (LDPE)
- Nylon (Polyamide)
- Polyester
- Polybutylene Terephthalate
- Polycarbonate
- Polyetheretherketone
- Polyethylene
- Polyethylene terephthalate (PET)
- Polylactic acid
- Polypropylene (PP)
- Polystyrene (PS)

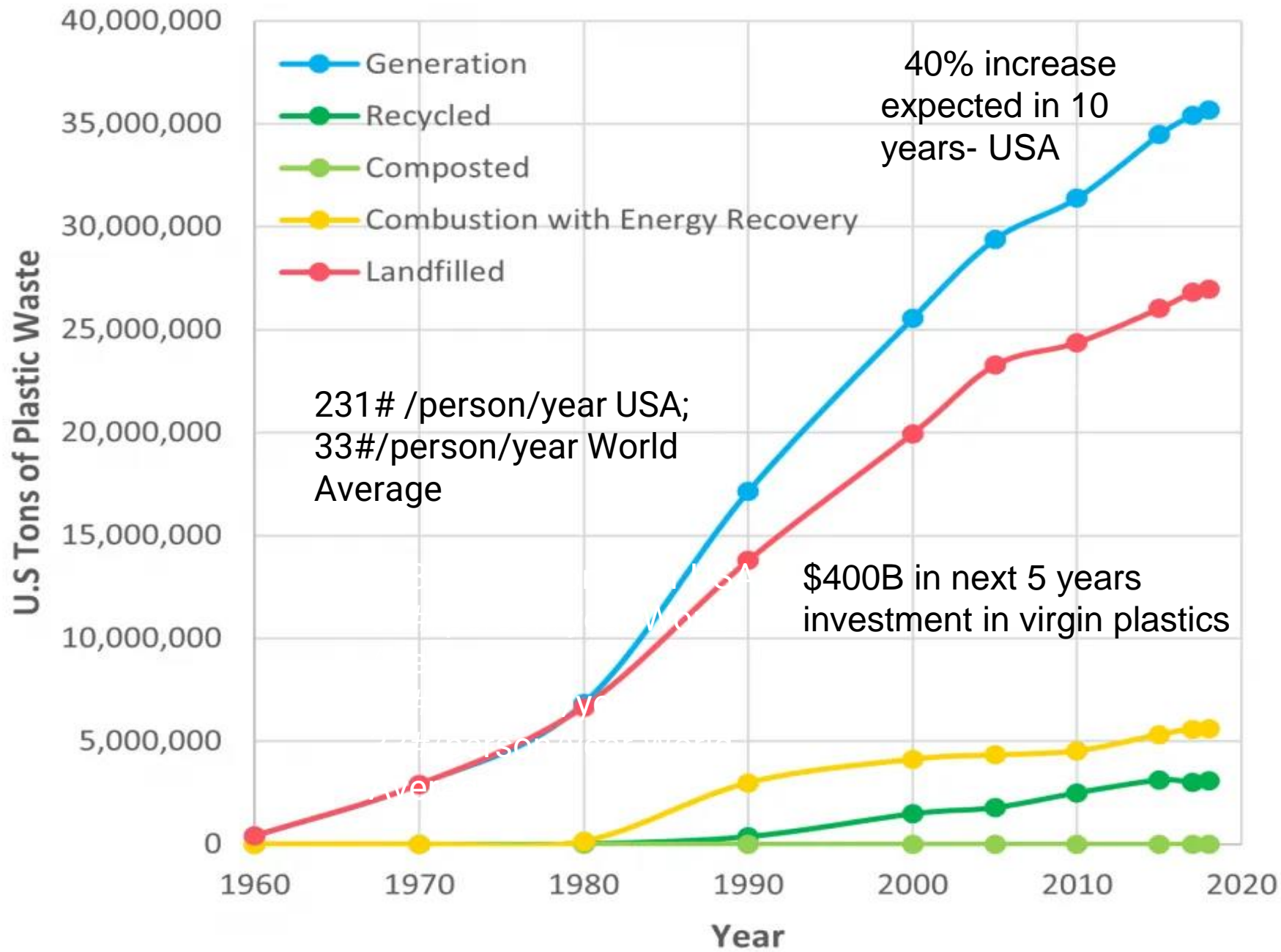
Application

- Screws, wheels, gears
- Paint, fiber optics, aquariums
- Car parts, legos
- Milk jugs, trash bags, shampoo bottles
- Shopping bags, bubble wrap, bottles food wrap
- Air bags, clothing, thread
- Fibers, rope
- Keyboards, switches
- Eyewear, helmets
- Bearings, pumps, pistons
- Mulch, toys
- Water bottles, fibers, food containers
- Packaging, syringes, textiles
- Medicine bottles, straws, packaging, car parts
- Cups, egg cartons, take out cartons, insulation



© Von Wong Production 2021 - #TurnOffThePlasticTap

Benjamin Von Wong



It is cheaper to make “virgin” plastic from fossil fuels than from recycled plastics



US Plastics being sent to

- India
- Malaysia
- Vietnam
- Africa
- Thailand
- Indonesia
- Turkey





Plastic Manufacturing

- 90% of plastic manufacturing ghg emissions occur in 18 poor counties in the USA
- 15% of greenhouse gas emission in USA

Plastic Additives

Endocrine Disruptor Chemicals (EDC)

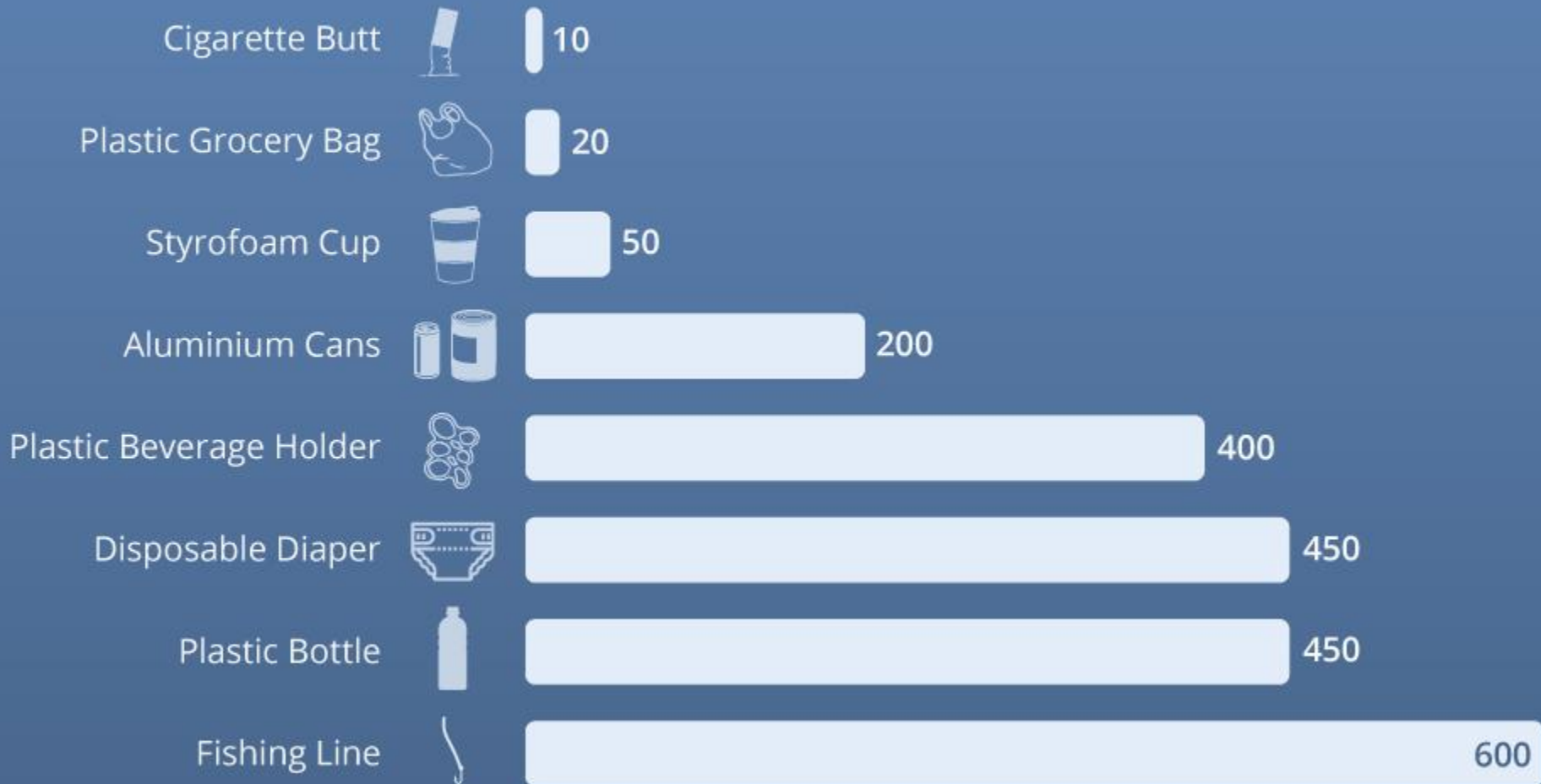
- Chemicals that are toxic to reproduction, which means that they may damage fertility or the unborn child.
- Bisphenol A (BPA) -used to coat the inside of water pipes and the inside of cans for food and drink.
- Phthalates-used as softeners for PVC plastic for flexibility; most used additive
- Alkyl Phenols- block chemicals that are also used in making fragrances, thermoplastic elastomers, antioxidants, oil field chemicals and fire retardant materials
- PFAS, Polybrominated diphenyl ethers (PBDE)- flame retardants



Notes: Fertility rates in the US has decreased 30% over the past 35 years (Icahn School of Medicine at Mount Sinai in New York)

Plastic Can Take 500 Years To Bio-Degrade In The Ocean

Estimated number of years for selected items to bio-degrade in a marine environment*

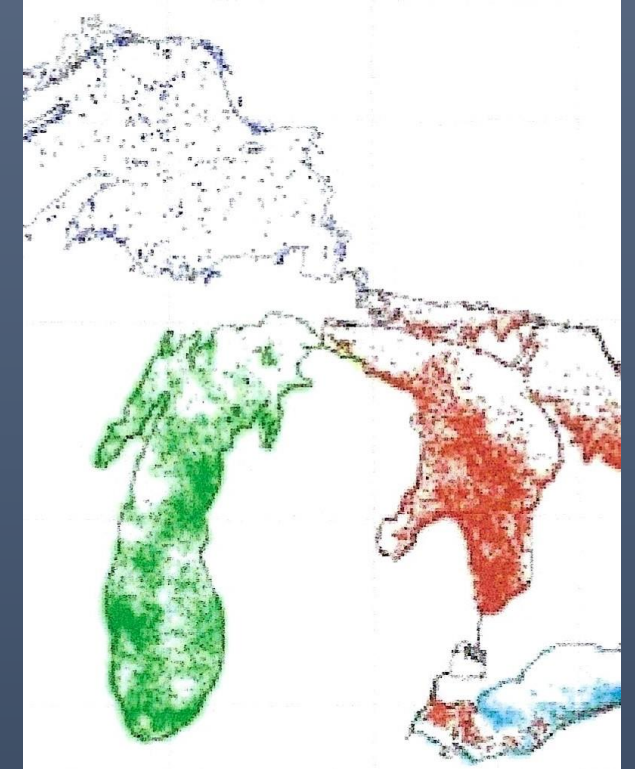


* Exact time varies by product type and marine conditions. Cigarette butts and grocery bags are an upper estimate.

Sources: NOAA, Woods Hole Sea Grant

Plastic Loading into Great Lakes

- *22,000,000 pounds of plastic into Great Lakes/year (yr)
 - Lake Michigan- 11,000,000 (11M) pounds/yr
 - Lake Erie- 5.5 M pounds/yr
 - Lake Ontario-3 M pounds/yr
 - Lake Huron-1.3 M pounds/yr
 - Superior- 0.7M pounds/yr
-
- 80 percent of the litter found on beaches is plastic
 - Chicago, Toronto, Cleveland, and Detroit are the worst contributors to plastic pollution in Great Lakes

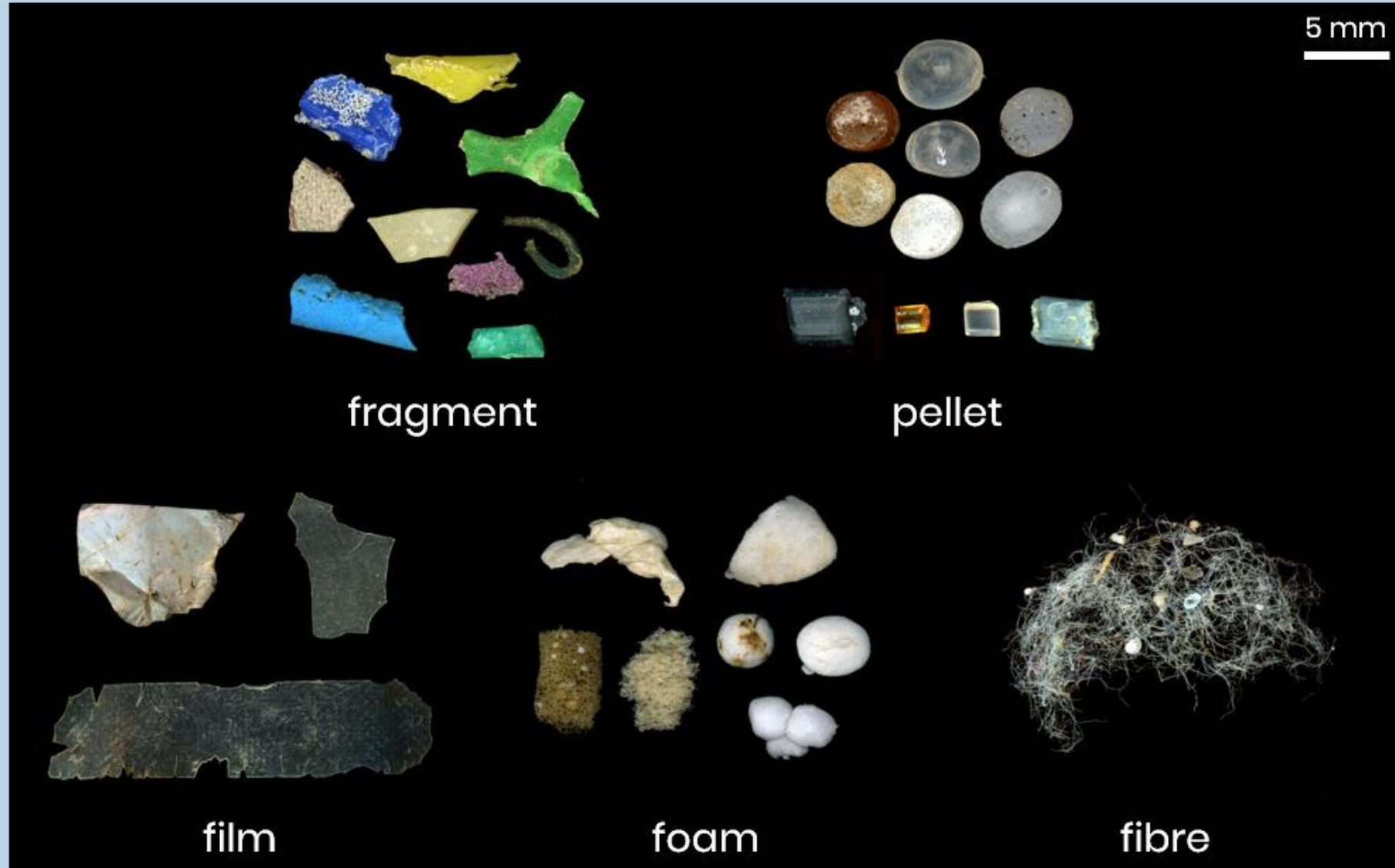


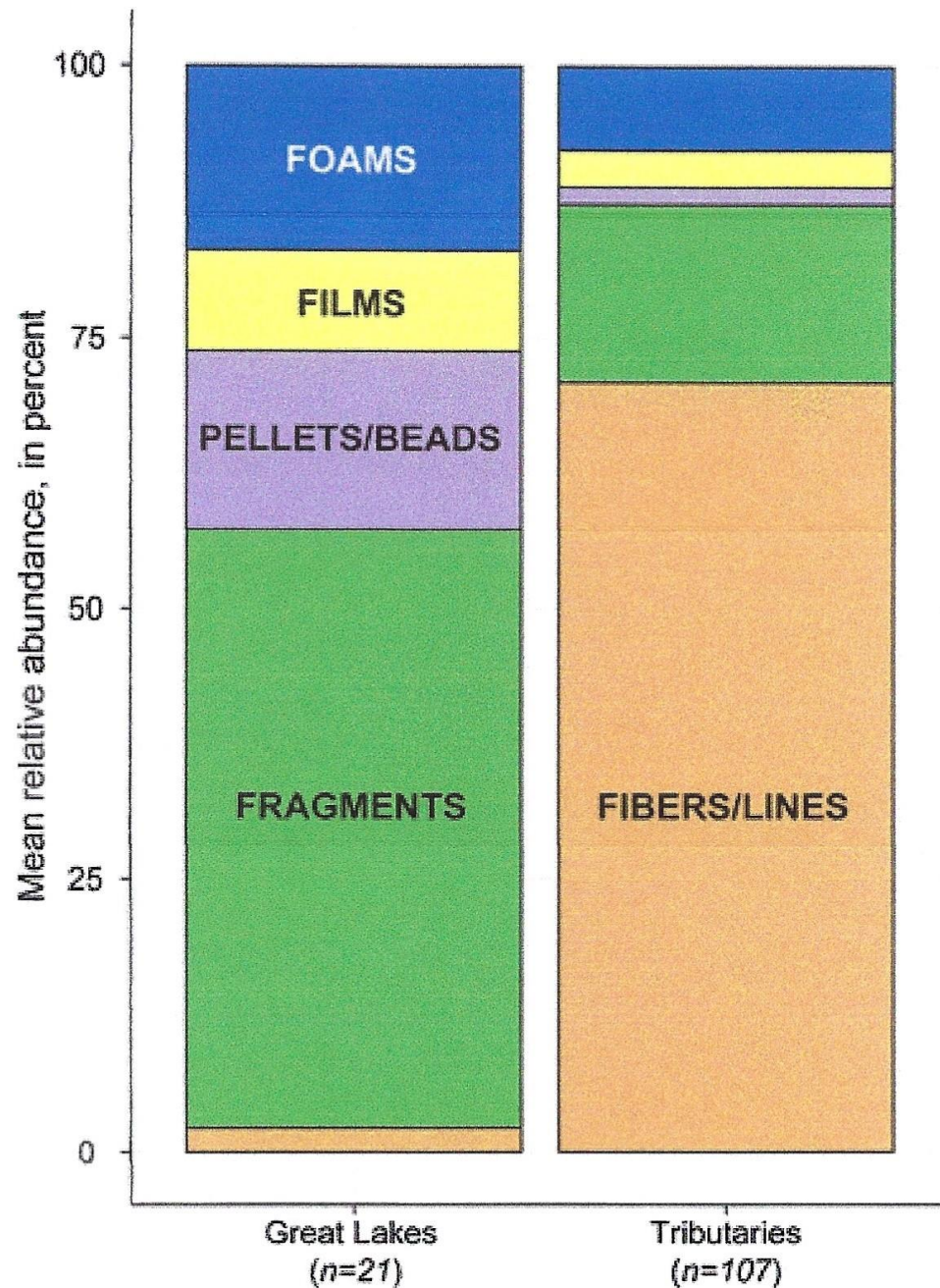
What Are Microplastics?

- Plastics that are <5mm in size (3/16 in)
- Microplastics (Primary)
 - Produced/manufactured as products
 - Plastic pellets called nurdles
 - Microbeads in cosmetics/toothpaste
 - Industrial paint/rust removal (microbeads)
- Microplastics (Secondary)
 - Degraded from large pieces of plastic
 - UV sun, weathering, wave erosion and abrasion into micro sizes
 - Microfibers from synthetic clothes
- Nano Plastics (Primary & Secondary)
 - Plastic size equal to or less than 0.001mm (1um)



Types of microplastic

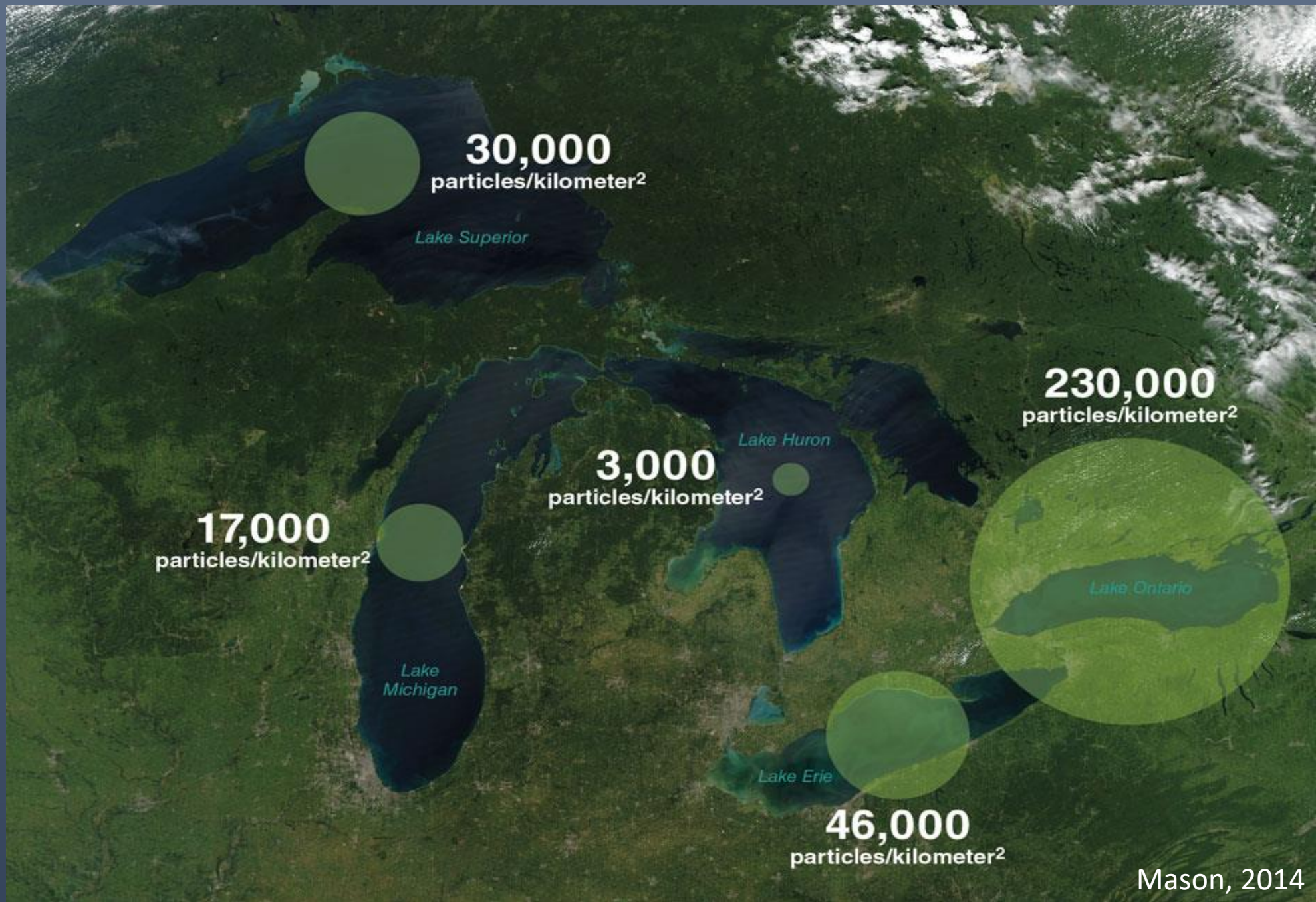




Dominate Microplastic Type

Great Lakes Open Water- 60% fragments

Great Lakes Tributaries -72% microfibers



Mason, 2014

Sources-Tires



Tires
#1 Source in California



Sources-Textiles

Microfibers from Washing
Synthetic and Non Synthetic
Clothes

Clothes Washer-700,000 fibers/load



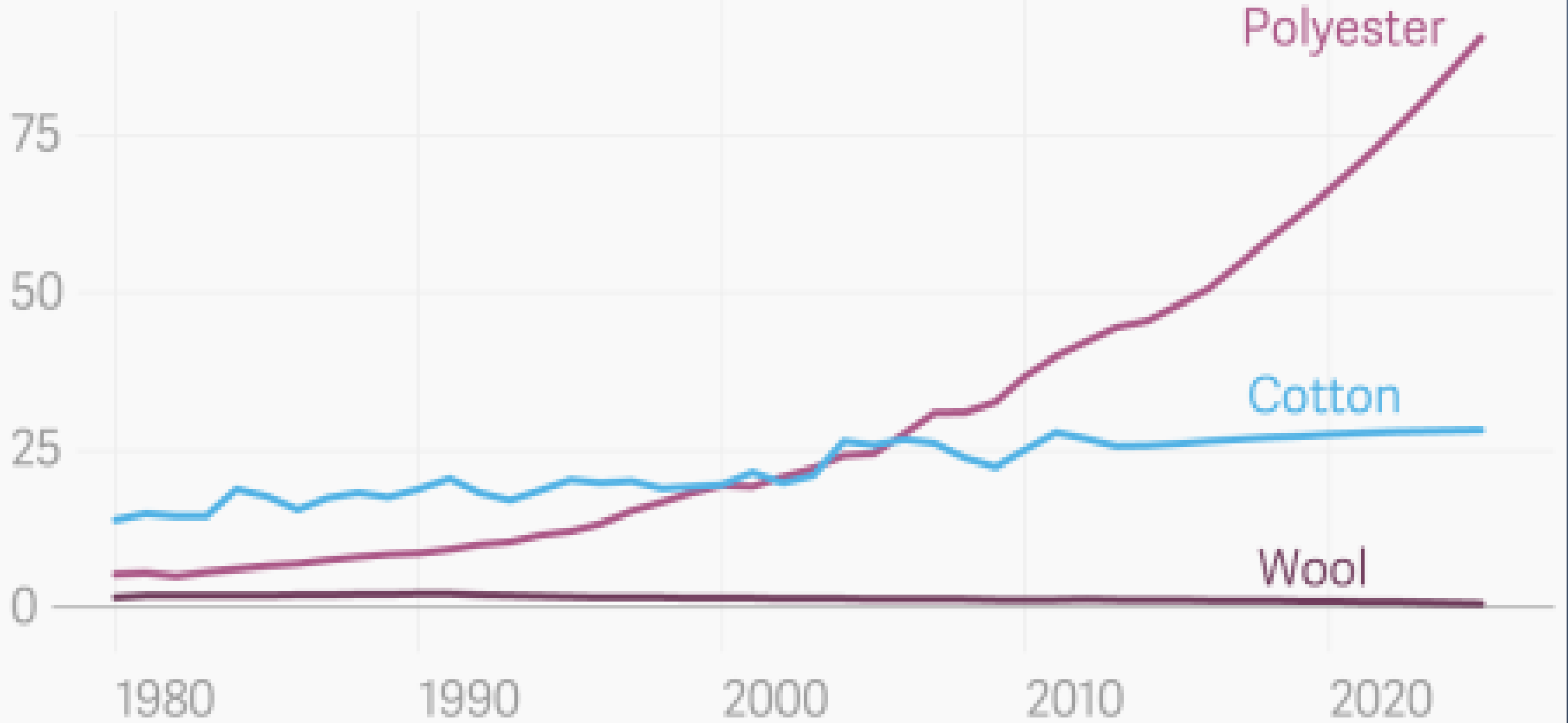
178,000 microbeads in one milliliter of detergent



Clothes dryers 433,128–561,810 microfibers/load

World fiber production

100 million metric tons



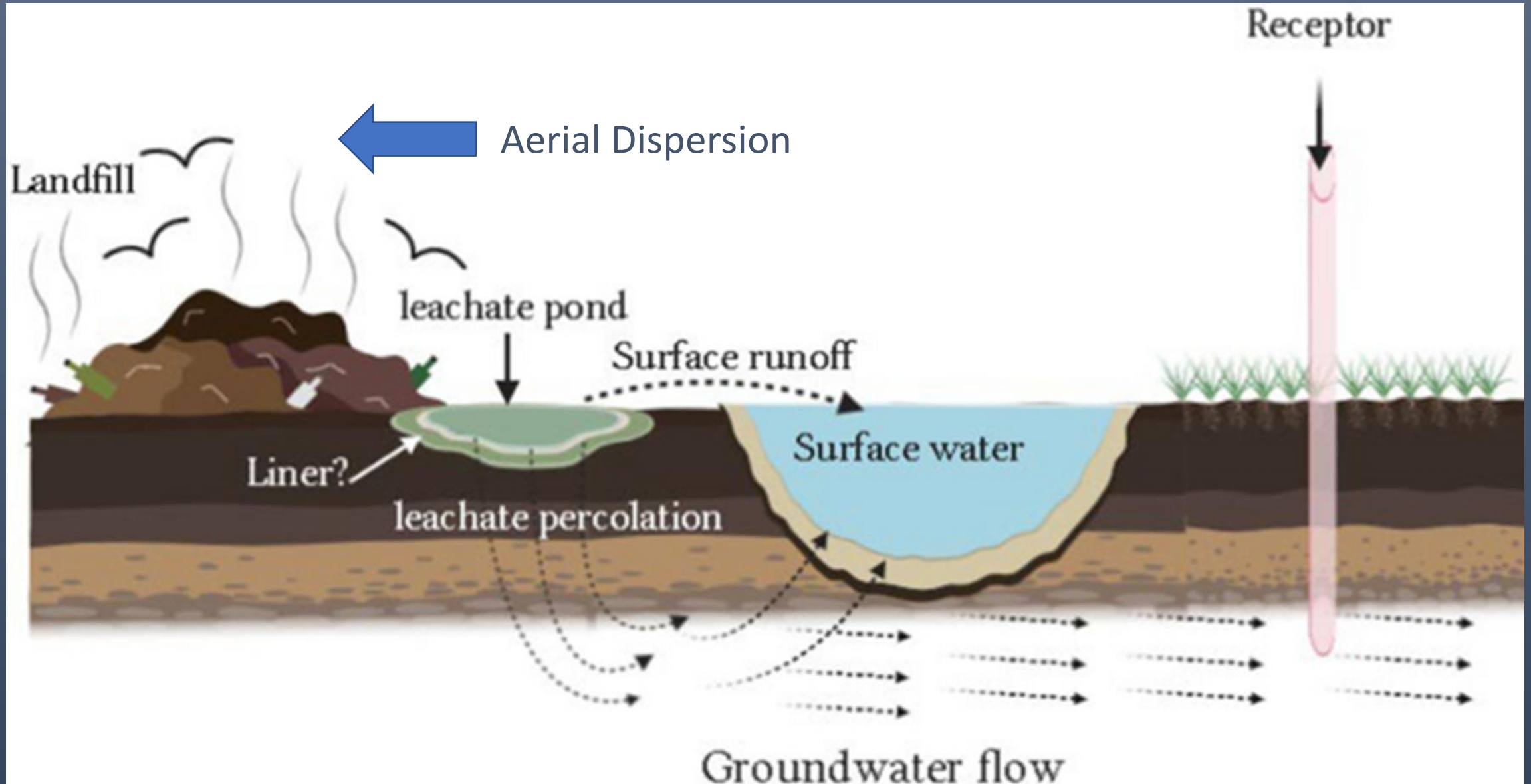
Sources-Landfills and Textile Waste- Fast Fashion



11.3 million tons of textile waste – equivalent to 85% of all textiles – end up in landfills on a yearly basis.

Many items are worn only seven to ten times before being tossed

Sources-Landfills



Sources-Microbeads



Polyethylene or Polypropylene



*Cosmetics



Industrial Cleaning Operations
Paint and Rust Removal

*2022 House Bill No. 6122 Representatives Pohutsky, Steckloff – ban in personal care products

Sources-Single Use Packaging



#1 Use of Plastics



Sources-Agriculture



Biosolids for fertilizer



Sources-Agriculture



Plastic Mulch

230#/acre

10,000 acres/yr

Encapsulated fertilizers,
pesticides and seeds



Sources-Industrial Plastic- Nurdle Production



- Pre-production plastics are the raw material used to make most plastic products.
- End product of petrochemical manufacturing to plastic molding
- The pellets are manufactured by petrochemical companies and transported by train, ship, or truck to plastic facilities
- Spillage from transport, storage and production handling
- Found on 70% beaches on all five Great Lakes



Pathway- Municipal- Industrial



Wastewater Treatment Systems



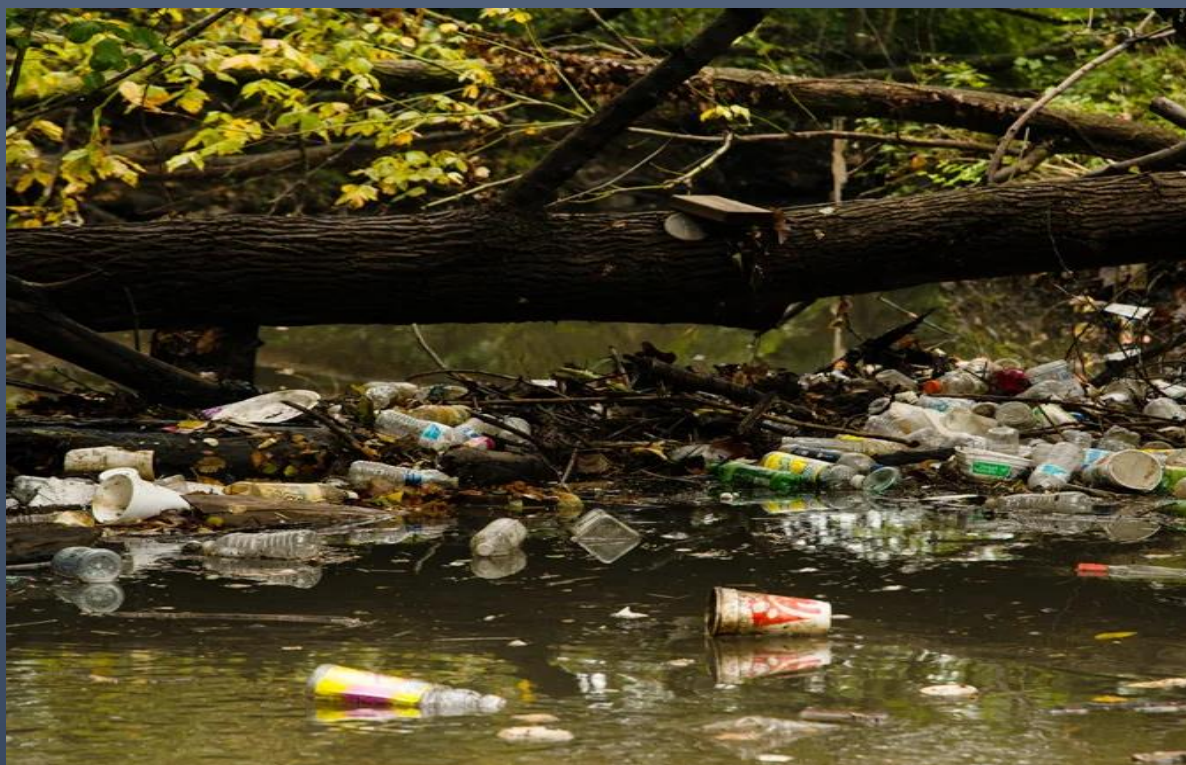
Industrial Discharges

Pathway-Stormwater



Stormwater Discharges-
Major Microplastic
Pathway in San Francisco
Bay- 3X WTPs

Pathway- Tributaries



EarthJustice

Pathway-Agriculture Non Point Source



Pathway-CSO



Milwaukee 8/13/21 380M gallons
released into Lake Michigan (6" rain)



Combined Stormwater Discharges (Stormwater and Sanitary)

Pathway- Beach Litter



Pathway

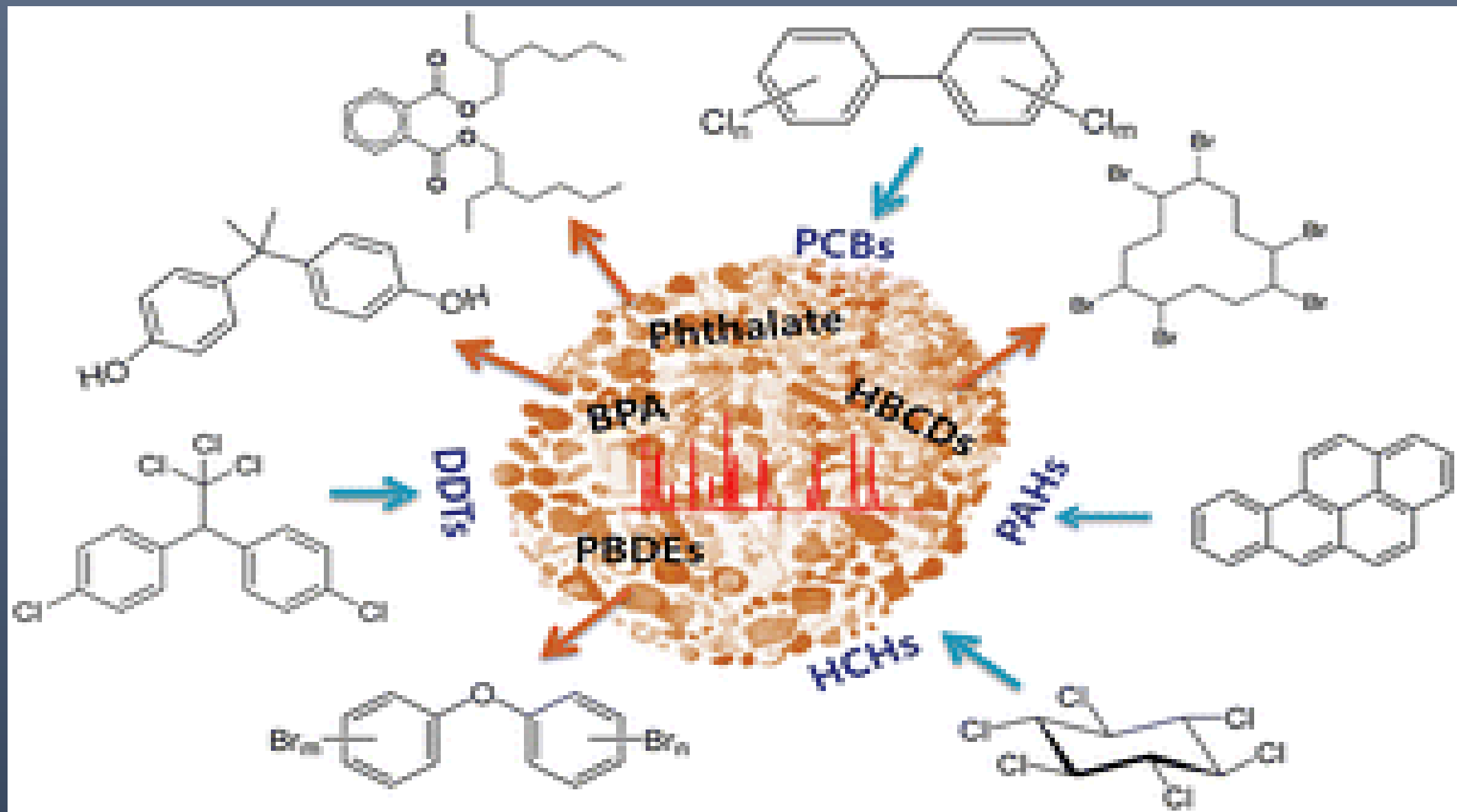
Aerial Deposition

1000 tons of microplastics, the equivalent of 300 million plastic bottles, settle on 11 western national parks and wilderness areas (approx. 100 million acres)

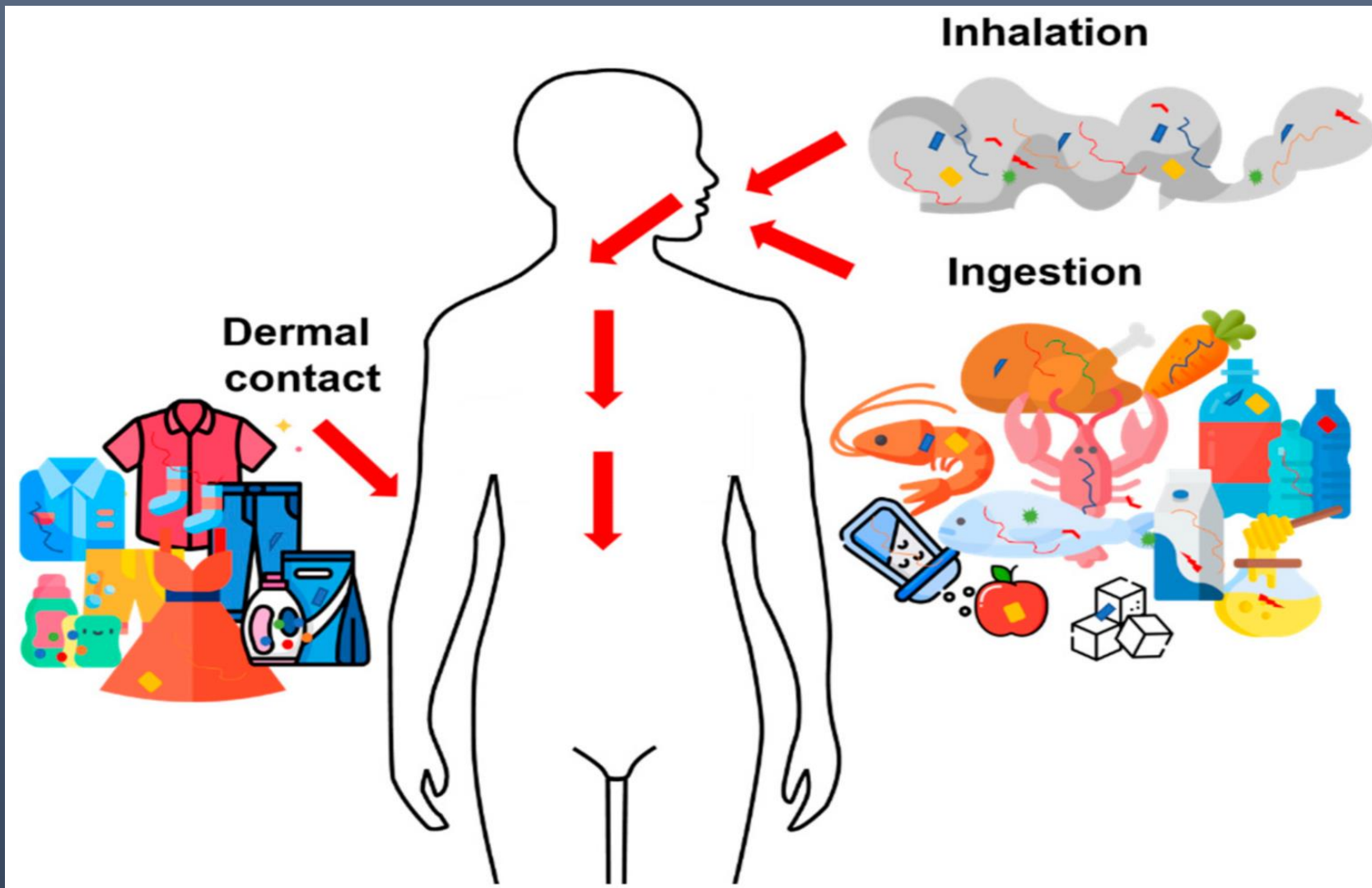


Utah State University/USGS
Brahney, 2021





Microplastic Chemical Toxicity



325 plastic particles were found in a liter of bottled water as compared to 5.5 plastic particles per liter of tap water

Mason

It took
you up to

1 WEEK

to eat this
credit card



We all ingest 5 grams of
plastic per week from
water, food and air



Potential Microplastic Human Impacts

Human System

- Endocrine System
- Circulatory System
- Reproduction System



The Planet Voice

Potential Health Impacts

- Placentas/infant meconium
- Infant fecal concentrations > adult
- Blood system
- Found in lungs
- Immune system
- Endocrine disruption
- Sperm concentration/mobility
- Cell inflammation

Potential Microplastic Ecological Impacts

- Zooplankton
- Avian
- Fish
- Base of food chain
- Reproduction/development
- Plastosis
- Starvation
- Reproduction
- Viability
- Bioaccumulation



More Research is Needed



Michigan State University

50 high quality streams in Pennsylvania contained microplastics; 6 of 20 trout contained microplastics

Great Lakes Now/Alliance of the Great Lakes





Microplastic Control

- Difficult to impossible to remediate once released
- Improve stormwater management
- Agriculture controls and alternative practices
- Industrial controls and best practices
- Stop human littering on beaches
- Improve wastewater treatment facilities
- Source control of plastics (stop single use)





Waste Treatment Systems

- 90-95% removal
- Expensive treatment
- Not designed for microplastics
- Biosolids generation

Microfiber Upstream Controls

- Synthetic Material Substitution
 - Natural fibers (cotton/wood)
 - Biodegradable (kelp, proteins)
 - Graphene non shedding fabric
 - Patagonia research
- Washing Machine Filters
 - Grundig integrated filter system (90% removal)
 - PlanetCare Filter (90% removal)
 - Lint LUV-R (87% removal)
 - Guppyfriend (54% removal)
 - Cora Balls (26% removal)
- Filter regulations being proposed in California



Drinking Water Controls



- **Activated Carbon Blocks faucet filters:** granulated carbon
- **Reverse Osmosis filters:** filter down to to 0.001 micron
- **Distillation filters:** filter 100% of known microplastics.
- **Filtration:** microfiltration, ultrafiltration, nanofiltration,



California Microplastic Regulations

- Nurdle Law (2007)
- Microplastic Strategy (2018)
 - Surface Waters
 - Drinking Water
- Microbeads Ban (2020)
- Microfiber filtration (proposed 2023)



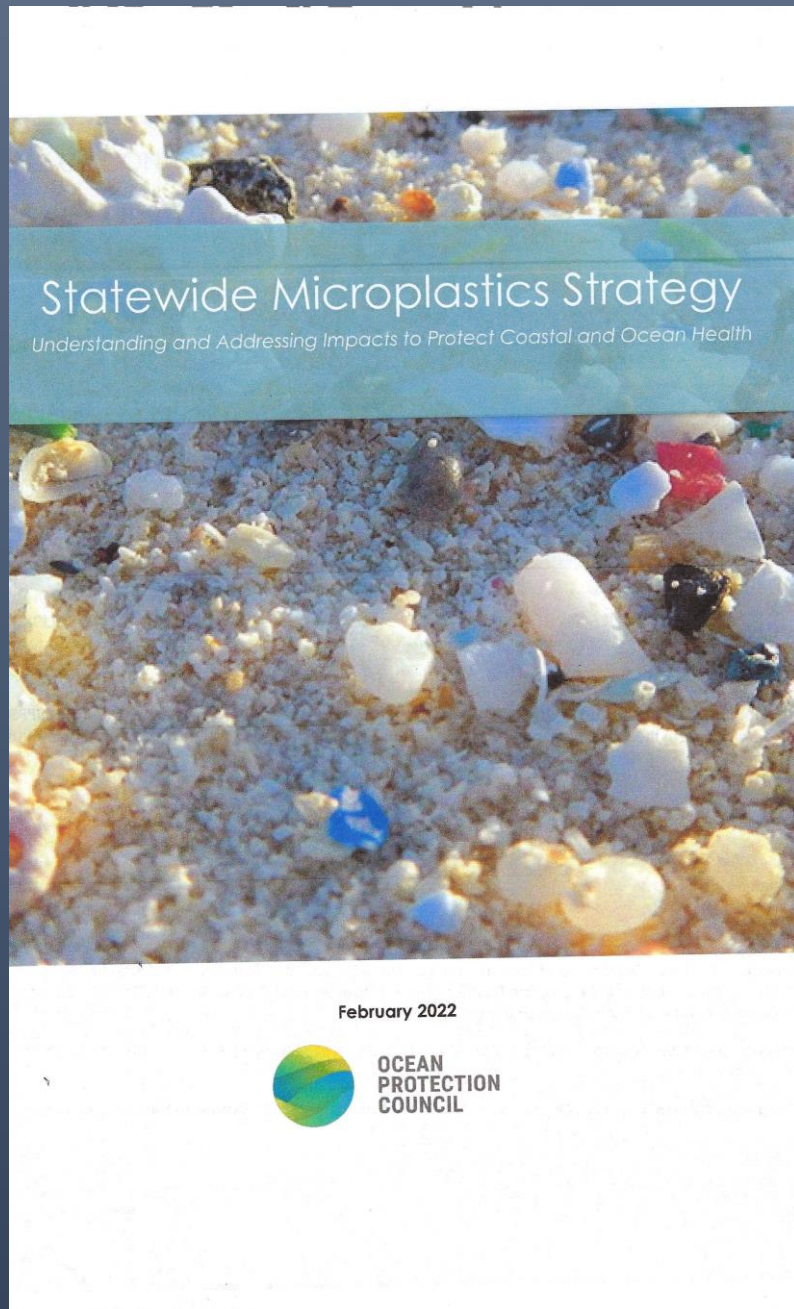
Statewide Microplastic Strategy

California Senate Bill 1263 in 2018

Scientific Based Approach
Precautionary Approach

Identify early actions to reduce microplastics

- 1) Surface water monitoring
- 2) description of the sources, pathways, and impacts of microplastics
- 3) a risk assessment framework based on the best available science on exposure of microplastics to organisms
- 4) standardized methods for sampling, detecting, characterizing, and monitoring microplastics
- 5) policy recommendations and management actions



2021/2022-Plastic Pellet Free Waters Act To Address Pollution in Great Lakes (Senator Dick Durbin-(D) Illinois)

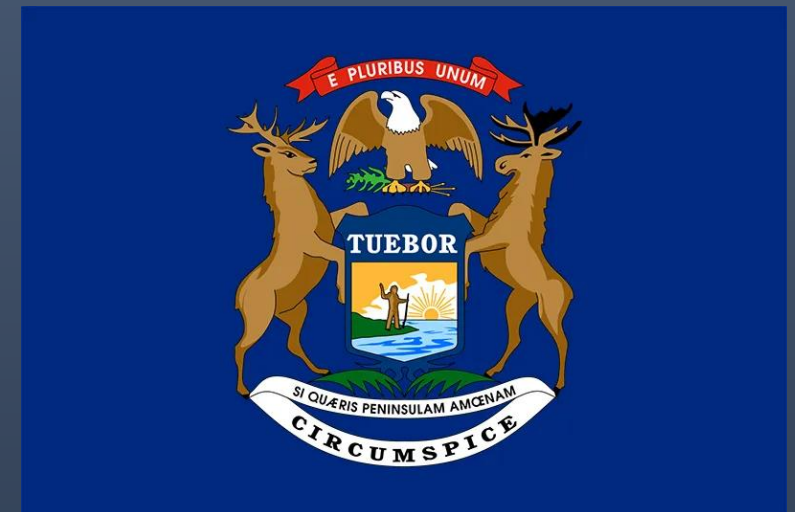
- Senate Bill 1507 (Plastic Free Waters Act)
- Environmental and Public Works Committee (April 29, 2021)
- Plastic considered a pollutant and associated with a point discharge
- EPA prohibit discharge of pellets (nurdles) into waterways
- Leverage off of Clean Water Act Permits
 - Stormwater
 - Wastewater
- Plastic transportation, storage and manufacturing facilities



Conceptual State of Michigan Legislation

Plastics Environmental Coalition

- Representative Pohutsky-Lead Natural Resources, Environmental, Tourism and Outdoor Recreation Committee
- Banning microbeads in hygiene and cleaning materials
- Precautionary Management Approach
- Develop a statewide microplastics strategy (surface waters)
 - Monitoring
 - Risk assessment/fill data gaps
 - Prioritize high risk areas
 - Mitigate sources and pathways
 - Evaluate success



Big Picture Recommendations

International Joint Commission-Great Lakes

- Develop a Great Lakes Microplastic Strategy Plan
- Monitor the Great Lakes for microplastics
- Create consistent sampling and testing methods
- Promote communication between researchers and political leaders to promote management action
- Promote public knowledge and awareness
- Institute human/ecological risk assessment studies
- Develop source-plastic and pathway controls



How You Can Reduce Your Exposure

- Vacuum or dust mop floors (small children)
- Do not store food in plastic
- Avoid drinking from plastic bottles and containers
- Use reusable water containers (metal)
- Avoid plastic food packaging
- Avoid cosmetics/toothpastes with microbeads
- Filter or treat drinking water
- Avoid/reduce shell fish consumption
- **Plastic Soup Foundation's Beat the Microbead app**
[productshttps://apps.apple.com/us/app/beat-the-microbead/id573546717](https://apps.apple.com/us/app/beat-the-microbead/id573546717)





So what can you and I do to stop microplastics?

- Support the global United Nations Treaty to reduce plastics
- Contact representatives to support/co-sponsor plastic bills
- Promote plastic source control legislation (federal/state)
- Avoid using single use plastics (bottles/bags)
- Use reusable canvas bags at stores
- Modify personal decisions to not buy certain plastics/synthetics
- Purchase microfiber filters on washing machines
- Select natural fiber clothes; more biodegradable than synthetic

So what can you and I do to stop microplastics?

- Use microplastic free laundry and cleaning detergents
- Stop the fast fashion
- Avoid plastic utensils/straws/styrofoam containers
- Promote public outreach and education on plastics/microplastics
- Teach your kids and friends about plastics/microplastics
- **Recognize we cannot recycle our way out of this plastic problem**
- **Join or start an environmental campaign against microplastics**

In Summary

- Plastics are made from toxic materials
- Numerous sources and pathways
- Plastics needs to be controlled at the source/recycling will not get us out of the pollution problem
- Plastics represent a risk to the environment
- Currently no regulations to control microplastics
- Michigan can act on their own to control microplastics/nurdles
- More research is needed to understand the full risk
- This is a human based problem that can be stopped by humans



“Unless Someone Like You Cares A Whole Awful
Lot Nothing Is Going To Get Better. Its Not”

Doctor Seuss (The Lorax)



Contact Me If You Want to Get Involved with Protecting the Great Lakes

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Non Plastic Laundry/Dishwashing Detergents

- Seventh Generation
- Ecover
- The Laundress
- Meliora Cleaning Products
- Tur Earth
- Method
- Dropps
- Cleancult

Pods-Polyvinyl Alcohol Is Plastic



Wikipedia

Non Plastic Cosmetics

- Lush
- Ethique
- Plaine Products
- OSEA
- Axiology
- Elate Cosmetics

Non Plastic Shampoos

Shampoos

- The Body Shop
- Lush
- Aveda
- Briogeo
- Pureology

Toothpaste

- Note: Crest and Aquafresh use microbeads
- Other producers have stopped using microbeads

Non Plastic Facial Rinses/soaps

- The Body Shop
- Burts Bees
- Dr. Hauschka
- Avalon Organics
- Ren Clean Skincare
- The Seaweed Bath Company
- Dr. Bronners

- Environmental Working Group-skin deep database