Improving Riparian Zones and Soil Health at the Watershed Scale to Reduce Contamination from Run-Off and PFAS in Drinking Water Sources

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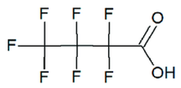
History

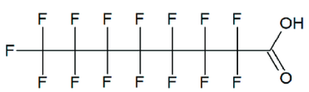
- PFOA has been in production since the early 1940s. In the early 2000s, long chain PFAS products began to phase out of production world-wide
- Since the early 2000s different types of PFAS chemicals were produced to meet industrial needs, giving lead to the production of short-chain PFAS
- PFAS as a broad term to cover a group of man-made chemicals, often used in cookware, fire retardant items and water-resistant material
- Made of carbon-fluorine linked chains that create bonds that cannot be broken down naturally in the environment
- PFAS has a range of negative impacts on human and environmental health. This includes increased rates of cancer, decreased immune response, pre-eclampsia, low birth weights in infants, hazardous water and soil

PFBS

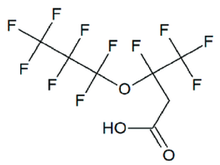


PFBA

PFOS



PFOA



GenX

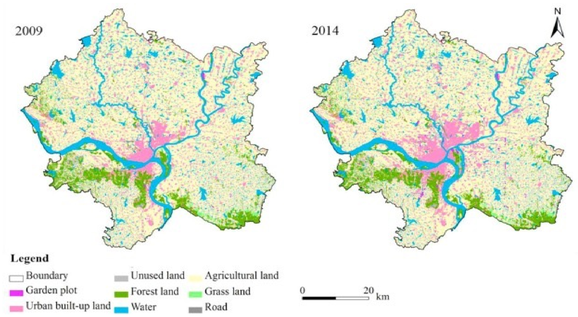
Remediation

- Decrease use of PFAS heavy products that directly run into water ways.
- Larger and healthier riparian zones along river systems and bodies of water to reduce pollution found in and carried by water
- Phytoremediation is the process of plants intaking pollutants through their roots.
- Phytoremediation using both plants and herbaceous tree species can be used in combination with seasons to maximize intake of pollutants

Methods

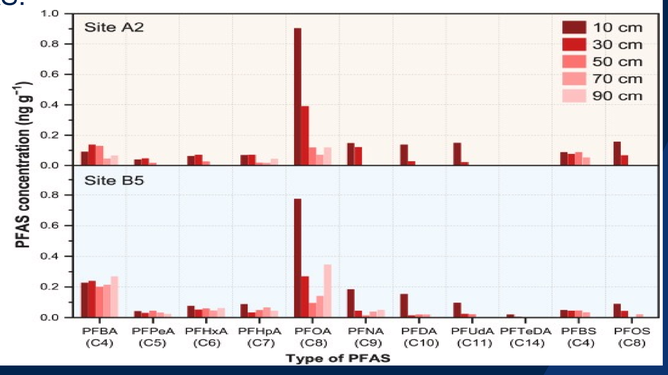
Study 1:

- The experiment by Li, K et al. (2018) studies the riparian zones in relation to water quality in urban areas
- Eight sample sites within Xiangyang, China. Four sites were in urban areas, and the four were along tributaries of the Hanjiang River.
- Eight land use types were identified, using class and landscape level metrics to detect each. Land use types and landscape metrics were measured in seven riparian zones.



Study 2:

- Gan et al. (2020) performed a study in Shifang City, China to monitor the PFAS levels in soil. This study focuses on PFAS, fluorine and other metal levels in relation to anthropocentric activity.
- Soil samples were collected in fall of 2018 from three locations. Site A was near a road. Site B was in a residential area. Site C was near a mountainous.
- Two PFAS solutions were used as controls for comparison against samples. Negative ion electrospray ionization and multiple reaction monitoring were used to analyze target PFAS.



Study 3:

- A study performed by Nutter and Associates Inc. (2021) focused on phytoremediation of plants to remediate soil and water sources impacted by PFAS contamination.
- 16 types of seedlings were planted in columns made of PVC pipes, with a valve and clear tube to control water levels, and 6000 cm^3 of washed sand. Four plant species were treated in separate units to test salinity intake at higher levels. 100 mL dosing occurred once a week with a syringe, evenly distributed across soil.
- Fertilizer was added weekly to supply nutrients. Contaminants and fertilizer were applied to control soil, as well. Application began after seedlings started to show healthy growth

Discussion

- Water quality is highly subjective to landscape patterns in riparian zones.
- Riparian buffer zones with a width of 300 m and a length of 8 km are critical areas. Species richness was highest at 100m, decreasing with length.
- There was a strong link between higher amounts of pollution in areas that are cultivated, compared to uncultivated land
- The highest concentrations of PFAS were found in the first 0-10cm of soil. PFOA accounted for 17%-51% of PFAS in all samples. There was a negative correlation found with soil depth, explained by the large amount PFOA found in the topsoil since long-chain PFAS does not move easily downwards.
- Bioconcentration Factor (BCF) was used to measure the health of plant species which help plants during phytoremediation.
- Super accumulators include Red Fescue, Sweetgum, and Black grass.