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

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Abstract

This project examines how improving the health of riparian zones and soil can reduce contamination from run-off and PFAS as a pollutant in source drinking water. The use of PFAS has increasingly been a cause of concern for several decades because of their detrimental impacts to human health and the environment. Various studies are used to explore how water quality is impacted by landscape, the relationship of differing contaminants in soil, as well as using phytoremediation through plant species in order to clean soil and water. Results showed that urban expansion and activity degrade water quality. Riparian buffer zones with a width of 300 m and a length of 8 km are critical areas where landscape has a large impact on water quality metrics. Soil testing data showed that the highest concentrations of PFAS were found in the first 0-10cm. Long-chain PFAS, such as PFOA were the majority found within the topsoil and retention can be credited to low mobility. Anthropocentric activity enriched the soil and deposited contaminants which contributed to both PFAS and other metal concentrations. Red Fescue, River Birch, Sweetgum, Black Willow, Sycamore, Tulip Poplar, Amaranth, Tall Fescue, Bermudagrass, Mustard and Horsetail were all found to useful in accumulating of PFAS from soil through phytoremediation. Various plant species found as accumulators can be planted and used along bodies of water in order to intake PFAS pollution. Using the knowledge from the studies reviewed in this paper, plans for remediation of riparian and green zones can be completed in order to ensure better water quality prior to reaching point water sources.

## 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.

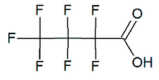
Since the early 2000s different types of PFAS chemicals were produced to meet industrial needs, giving lead to the production of short-chain PFAS.

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.

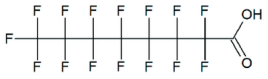
PFAS has a range of negative impacts on human and environmental health. This includes increased rates of cancer, decreased immune response, pre-eclampsia, low birth weights in infants, hazardous water and soil.

PFBS

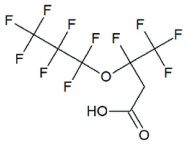


PFBA

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

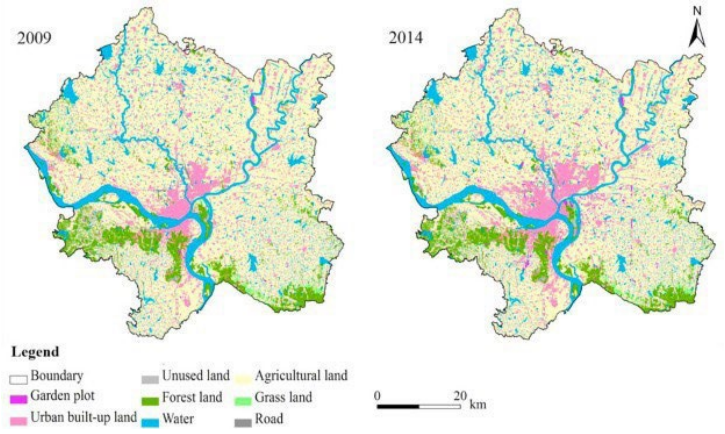
### Study 1:

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.



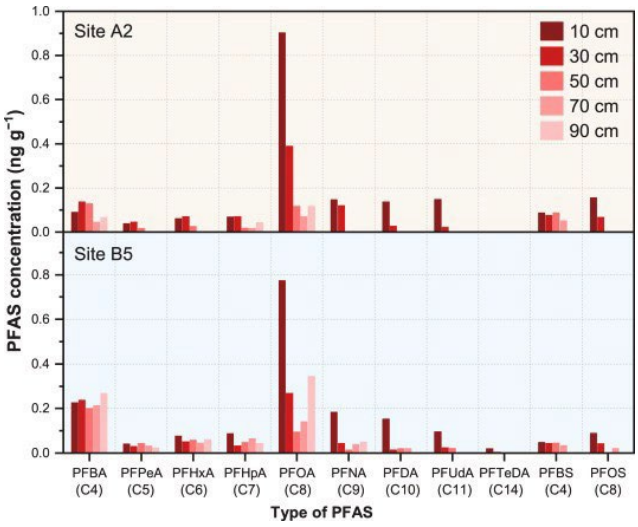

### Study 2:

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 cm3 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.