

Source Estimation for Large-Scale PFOS and PFOA Contaminated Groundwater and River Areas in Japan

TETSUO YASUTAKA¹, NOBUKO MURAI², KOJI MORI²
AND TSUKASA FUJITA¹

¹National Institute of Advanced Industrial Science and
Technology

²Bule Earth Security Co., Ltd.

Presenting Author: t.yasutaka@aist.go.jp

Groundwater contamination by PFOS and PFOA is a major problem on a regional scale. In Japan, a provisional guideline value of 50 ng/L has been set for PFOS and PFOA in 2020. The detection of PFOS and PFOA in public waters and groundwater in Japan has become a major issue, as 14 groundwater sites have been found to exceed the provisional guideline values.

In this study, we modeled the three-dimensional subsurface structure of the target area and estimated the source of PFOS and PFOA contamination by land and groundwater flow simulations and mass transport simulations, targeting large-scale PFOS and PFOA contamination of groundwater and surface water, for which the provisional standard (50 ng/L) has been confirmed to be exceeded in a wide area. This report describes the results of this study.

The target area is an island that uses a certain percentage of groundwater and surface water as a source of drinking water. In the groundwater flow simulation, the target river basin (8 km x 8 km) was used to (1) create a 3-D grid model, (2) examine and determine the analysis conditions, and (3) perform a simulation to reproduce the current conditions. In this study, three packages, SFR2, LAK3, and UZF, were used in MODFLOW, and steady-state analysis was performed with constant external meteorological forces. The 3D lattice model for groundwater flow simulation was created by spatially dividing the planar lattice as a 50m x 50m structural lattice and then dividing it into a multi-layered structural form with different layer thicknesses by considering layer boundary surfaces. The modeling range in the depth direction was set to -200 m in elevation as a sufficient depth that the basement rock is estimated to reach. The total number of lattices in the model is 635,475. Validation was performed using groundwater observation data.

The mass transport simulation used measured PFOS and PFOA in groundwater and river water at more than 20 sites. Twenty hypothetical contamination sources were randomly set up within the target area and compared with the actual measurements to examine hypothetical contamination sources and discuss contamination mechanisms.