

# E1981: Multiple systems combine to maximise removal of PFAS from storm and groundwater at RAAF Base Williamtown, NSW

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## Introduction

Historical use of aqueous film-forming foam (AFFF) at the Royal Australian Air Force (RAAF) Base Williamtown (the Site) in New South Wales has resulted in per- and polyfluoroalkyl substances (PFAS) contamination of ground and storm water, both of which migrate off base. After defining the nature and extent of PFAS contamination, the Australian Department of Defence (Defence) retained ECT2 to supply and operate a PFAS water treatment system that would manage contaminated stormwater flowing offsite.



Photo 1: The 3 L/sec treatment system established on site in July 2017

ECT2 implemented an accelerated timeline to complete design, fabrication, transportation, startup, and commissioning of a 3 L/sec (50 gpm) stormwater treatment system.

The treatment system was upgraded to 8 L/sec in April 2019 and ECT2 continues to operate the system.

Following the successful installation and operations of this treatment system, ECT2 provided two additional treatment systems on the Site as well as a central resin regeneration system that services all three treatment systems.

## Results & Discussion

**Moors Drain** - The 3 L/sec Moors Drain system was installed in July 2017 to treat stormwater flowing off base. It consists of sand filtration to remove solids and turbidity; pretreatment resin to remove colloidal and dissolved TOC and iron; regenerable SORBIX™ resin to remove PFOS, PFHxS and PFOA, and single-use SORBIX resin to remove shorter-chain PFAS. In late April 2019, the system was upgraded to an 8 L/sec system with only one week of downtime required to effect the transition.

**Former Fire Training Area** - The former FTA treatment system is targeting the most significant source area on the Site through a network of 15 extraction wells. The treatment system manages 12.5 L/sec of PFAS-contaminated groundwater and has been operating since July 2018.

**Southern Area Plume** - A similarly sized treatment system to that at the former FTA was installed to manage a PFAS plume to the south of the Site.

**Central Resin Regeneration System** - A regeneration system was installed in 2018 to service all three water treatment systems. Vessels containing spent resin are temporarily removed from service and transported to the central regeneration system. The SORBIX resin remains in the vessel as a regenerant solution is pumped through the vessel, stripping PFAS from the resin beads. The proprietary regenerant solution is then reclaimed for reuse through distillation and a super-loading process that ultra-concentrates PFAS compounds into a small volume of solid waste.

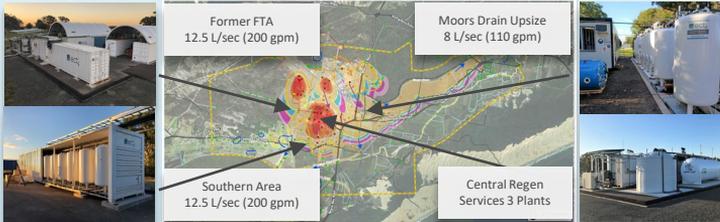


Figure 1: ECT2's Treatment Sites at RAAF Base Williamtown

The source water includes high iron, suspended solids, and TOC; which are removed in the pretreatment stages. PFAS removal occurs using lead/lag configurations with SORBIX polish resin completing the PFAS removal process.

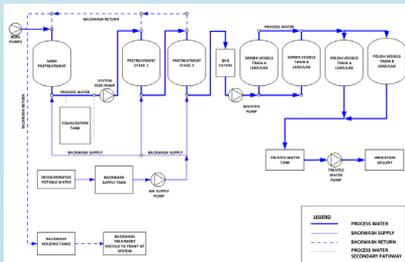


Figure 2: WLM FTA System - Block Flow Diagram

Since commissioning in July 2018, the FTA system has been treating groundwater with influent concentrations ranging up to almost 70µg/l PFAS to below Health Based Guidance Values (HBGV) of 0.07µg/l for PFOS+PFHxS and 0.56µg/l for PFOA.

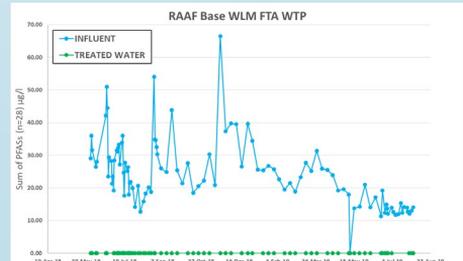


Figure 3: Zero exceedances in 13 months of continuous operations

## Conclusions

- Almost 600 million litres of surface and groundwater had been treated by the end of July 2019
- All three treatment systems operate 24/7, achieving 97% uptime
- Real-time data from SCADA system enables remote operation and system optimisation
- Modular treatment systems enable accelerated installation timelines

- Central resin regeneration maximises treatment capacity and minimises waste generation and operating costs
- Flexible systems are highly adaptable to varying site needs
- Pre-treatment is effectively used for high solids/metals loading
- Polish stage for management of short chain PFAS
- Capacity to increase flow rate with minimal increase in footprint
- Capacity to draw contaminated groundwater from multiple well fields to maximise treatment outcomes
- No exceedances of HBGVs with treated water consistently below the limit of reporting

# The treatment systems

## Project timeline – original 3 L/sec system

Contract to commissioning in just **4 months** – around the world



Figure 4: Original 3 L/sec Moors Drain system timeline

Following the successful implementation of the Moors Drain 3 L/sec system, ECT2 installed the former FTA treatment system in 2018.

This 12.5 L/sec system contains two, 53 ft (16.2m) containers and supporting outdoor equipment.

The system includes sand filtration pre-treatment vessels, additional pre-treatment vessels, bag filter pre-treatment, SORBIX primary treatment and SORBIX polish treatment vessels.



Photo 2: Former FTA treatment system

The Southern Area system is similar to the FTA system with a flow rate of 12.5 L/sec. This system was installed alongside the FTA treatment system for efficient use of equipment that did not need to be duplicated to meet the operating and performance requirements.

The treatment system draws water from the Southern Area but also has the ability to draw water from the FTA extraction well network, providing the greatest flexibility possible during remediation.



Photo 3: Southern Area Pre treatment Vessels

The centralised resin regeneration system was installed in 2018 and contains one, 53 ft (16.2m) container and additional ancillary equipment.

The system regenerates the vessels from all three treatment systems at the Site.



Photo 4: Central Resin Regeneration System

In late 2018, Defence requested that ECT2 increase the treatment capacity of the Moors Drain treatment system to 8 L/sec.

The treatment system includes multi-media sand filters, followed by a series of pre-treatment media, followed by regenerable SORBIX and SORBIX polish.

The system also includes supporting backwash equipment.

The upsized treatment system has increased the ability to treat stormwater flowing offsite by 2.6 times.



Photo 5: Moors Drain upsized treatment system

# Performance of the water treatment systems

The treatment systems installed at RAAF Base Williamtown continue to remove PFAS from water on and beneath the Site.

ECT2 water treatment activities at the Site have been occurring for over two years and treated water analysis demonstrates the effectiveness of the treatment systems with all treated water being below the HBGVs and consistently showing PFAS concentrations below the limit of reporting.

At the end of July 2019, almost 600 million litres of surface and groundwater had been treated.

With all three treatment systems fully installed and operating almost 20 million litres of water per week from two groundwater source areas and one surface water location can now be treated.

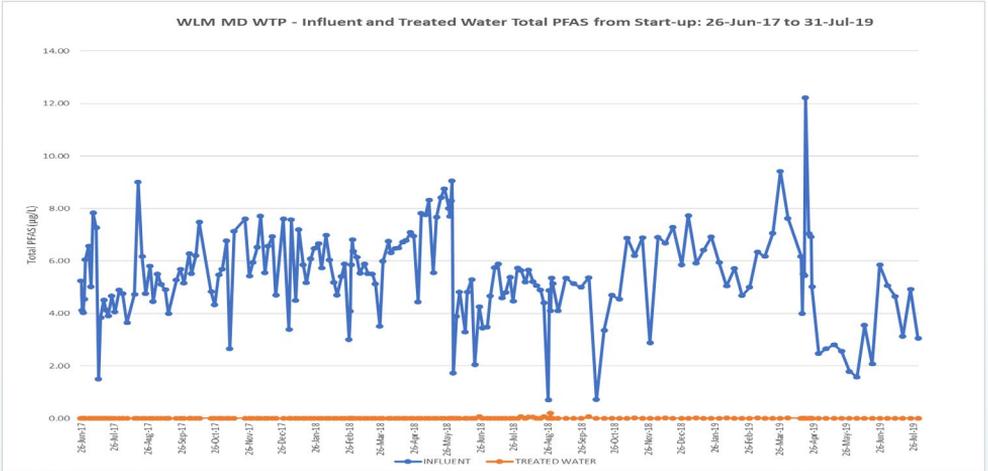


Figure 5: Moors Drain treatment system performance

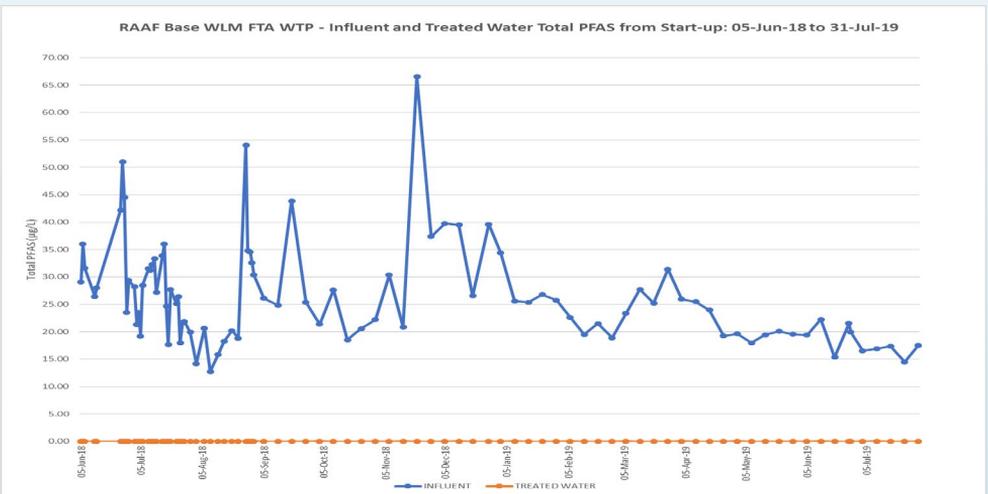


Figure 6: Former FTA treatment system performance

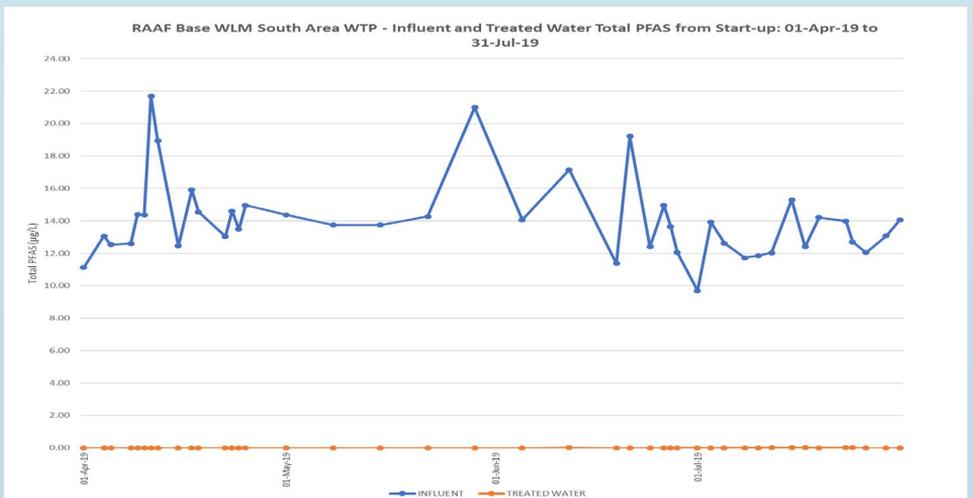


Figure 7: Southern Area treatment system performance

## SORBIX ION EXCHANGE TECHNOLOGY

ECT2's proprietary SORBIX resin blends, remove a broad range of PFAS compounds from water through dual mechanisms of removal; ion exchange and adsorption. The dual mechanisms of removal means ECT2 resins outperform carbon-based treatment systems where only a single mechanism, adsorption, of PFAS removal is utilised.

Two types of IX resin are used; single use – SORBIX PURE and regenerable – SORBIX RePURE.

**SORBIX PURE** has at least 13 times the capacity of carbon and is best suited to applications where it is not practical to use the regeneration technology or where average PFAS concentrations are less than approximately 20 µg/l.

**SORBIX RePURE** also has approximately 13 times the capacity of carbon and is best suited to applications where a treatment system will be required for a longer period; highly concentrated water is expected; and/or management of short chain or precursor PFAS is important.

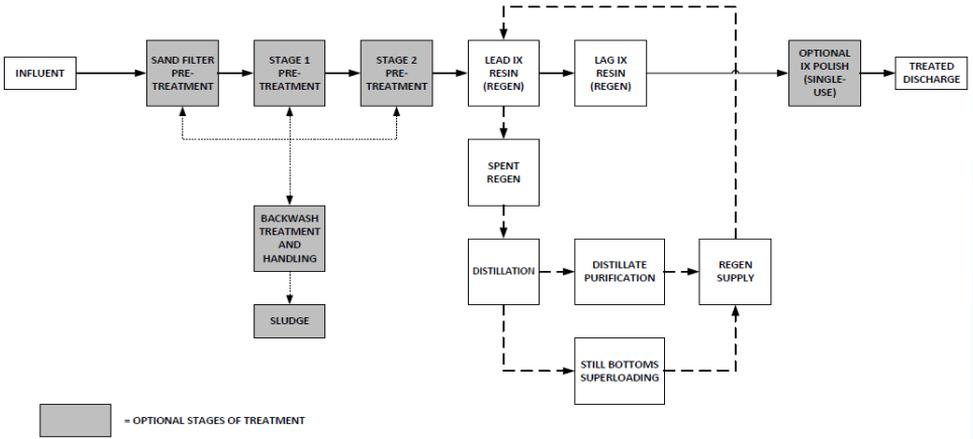


Figure 8: Process flow diagram showing the various stages of water treatment using SORBIX

## MODULAR TREATMENT SYSTEM DESIGN

ECT2 used containerised systems to accelerate the design, fabrication and implementation of the treatment systems at RAAF Base Williamtown. Modular treatment systems also allowed for upgrades and interlinks between treatment systems without unnecessary duplication.

Upgraded Moors Drain treatment system with the container from the original 3 L/sec treatment system remaining in the centre.



The FTA and Southern Area treatment systems providing a combined treatment capacity of 25 L/sec and located within a footprint of approximately 500 square metres.