Botany Groundwater Cleanup Project: Arguably the Largest and Most Complex in Australia

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Background/Objectives. The Botany Industrial Park (BIP) is located about 6 miles south of downtown Sydney and about 1 mile hydraulically upgradient (north east) of Botany Bay. Its manufacturing history dates back to 1942, and since that time a large number of industrial chemicals have been produced, stored and handled on the site. Most notable of these are a range of chlorinated solvents, including carbon tetrachloride (CTC), tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA) and vinyl chloride, as well as a number of intermediate and byproduct volatile and semi-volatile chlorinated hydrocarbons (CHCs).

Environmental investigations in the 1980s and 1990s identified significant contamination on and off the site, which prompted some initial remedial steps and a large suite of research projects to try to find suitable technologies to employ to clean up the contamination. In 2003, to protect Botany Bay and nearby sensitive receptors, the state Environment Protection Authority (EPA) issued a Notice of Clean Up Action, which required Orica Australia Pty Ltd to install hydraulic containment and ex situ treatment of the groundwater extracted from the sand aquifer.

Approach/Activities. The resultant pump and treat system is the largest in Australia, and the groundwater treatment plant (GTP), which was commissioned in 2006, is designed to remove almost all man-made and naturally-occurring substances in the groundwater. This requires several stages of treatment, including air stripping, thermal oxidation and combustion gas quenching and scrubbing, iron removal, activated carbon and biological aerated filter treatment, and multiple stages of filtration including reverse osmosis. The resultant high purity water is sold to nearby chemical manufacturing plants for use in various process applications. In the order of 1.1 to 1.6 million US gallons of groundwater is extracted and treated each day. In the early stages of the system's operation there were many challenges – particularly related to biological fouling and corrosion – that had to be overcome by adapting and optimizing the operations. Since then consistent hydraulic containment and treatment has been achieved. By the end of June 2017 almost 5.5 billion US gallons had been treated, and more than 3 million lb of CHCs had been destroyed.

To date a significant amount of investigation and research has focused on the dissolved phase plumes. There are nine inferred dense non-aqueous phase liquid (DNAPL) source areas and four large plumes spanning more than half a mile wide. Research efforts have included field trials of reactive iron barriers, in situ biological enhancement and augmentation (using cultures derived from the site), and investigation of other natural processes affecting the fate and transport of the contaminants. A three-yearly independent review process ensures that the technologies being researched and applied are the best available for the circumstances.

Results/Lessons Learned. Monitoring and modelling of the aqueous contamination has indicated significant mass losses – above what can be attributed to pump and treat alone. Ongoing investigations continue to reveal more about the physical, biological and abiotic processes involved. As the groundwater conditions change, further opportunities to adapt both the ex situ and in situ processes arise, and the remediation strategy continues to be reviewed and adapted accordingly.