

Insights on Risk-Reduction Mechanisms from 12 Years of Operation of a Pump-and-Treat System at the Botany Chlorinated Hydrocarbon "Mega-Site"

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Background

- Botany Industrial Park (BIP)
 - 20 shallow/deep bores on 2nd Street
 - 40 shallow/intermediate/deep bores on 1st Street
- Primary Containment Area (PCA)
 - 12 deep bores
 - Originally included 2 bores in C1 plume core to accelerate mass removal
- Secondary Containment Area (SCA)
 - 27 Shallow bores
 - 14 Deep bores





Hydraulic Containment Performance

- Low Rate Extraction (up to 1 ML/day) Commenced in 2004.
- System fully operational (approximately 6 ML/day) in 2007.
- Operation of extraction system is reviewed regularly:
 - Fortnightly review of individual pump operation
 - Quarterly/Biannual/Annual review of aquifer water levels
- Detailed review of hydraulic containment undertaken in accordance with “*A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems*” (USEPA 2008) in 2012 and 2017



Hydraulic Containment Performance

- Six Step Process:
- Step 1: Review site data, site conceptual model, remedy objectives
- Step 2: Define “Target Capture Zones”
- Step 3: Water Level Maps
- Step 4: Simple Horizontal Capture Zone Analysis
- Step 5: Particle Tracking and Concentration Trends
- Step 6: Interpret Actual Capture and Compare to Target Capture Zone

Wellfield Operational Issues

- Well fouling/rehabilitation
- Well Failure
- Corrosion
- Salinity
- Accessibility (SCA)
- Pump/pipe fouling



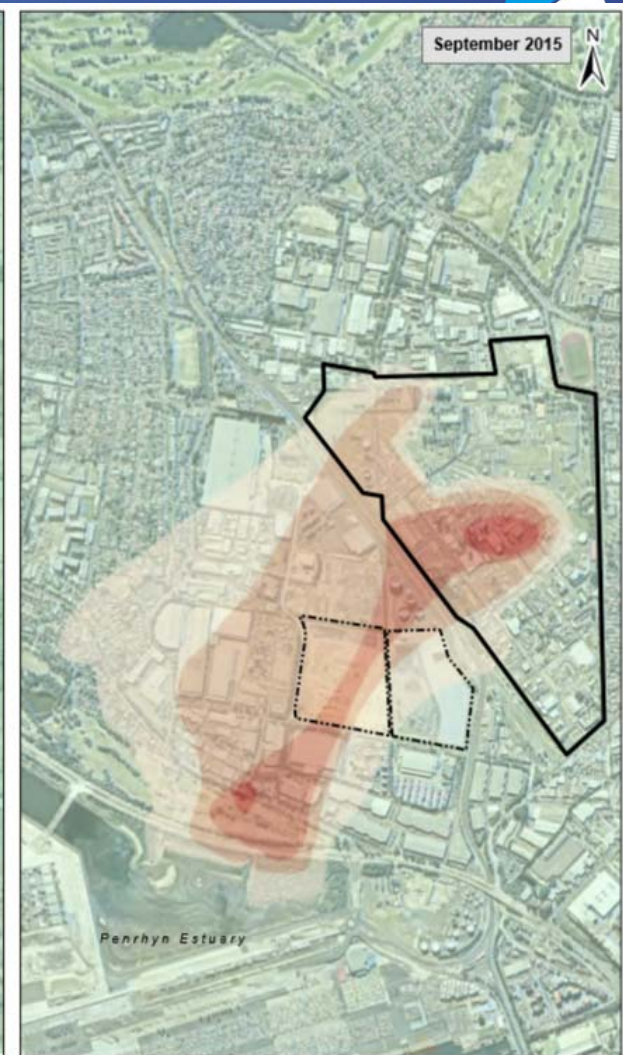
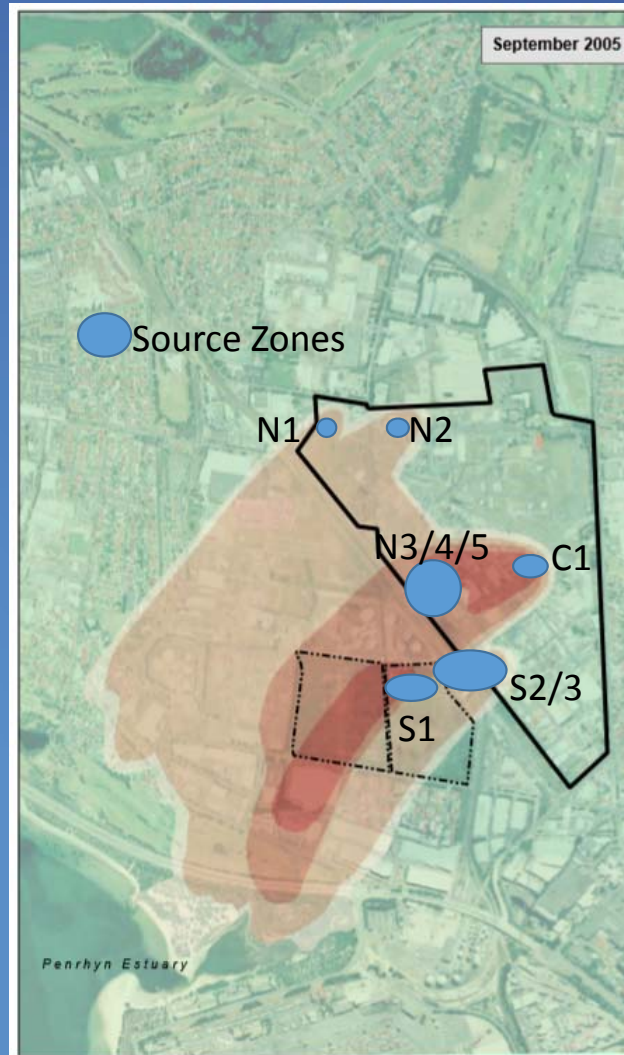


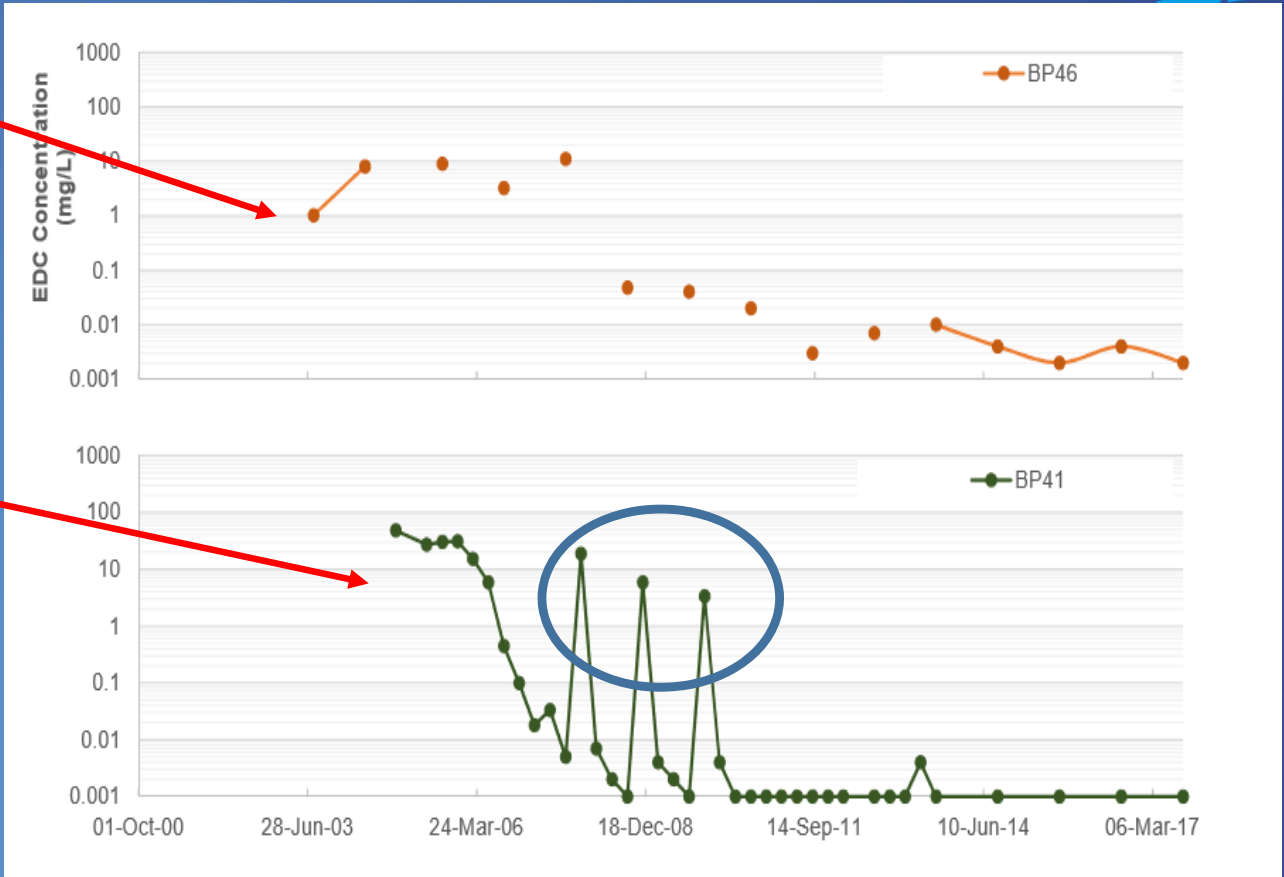
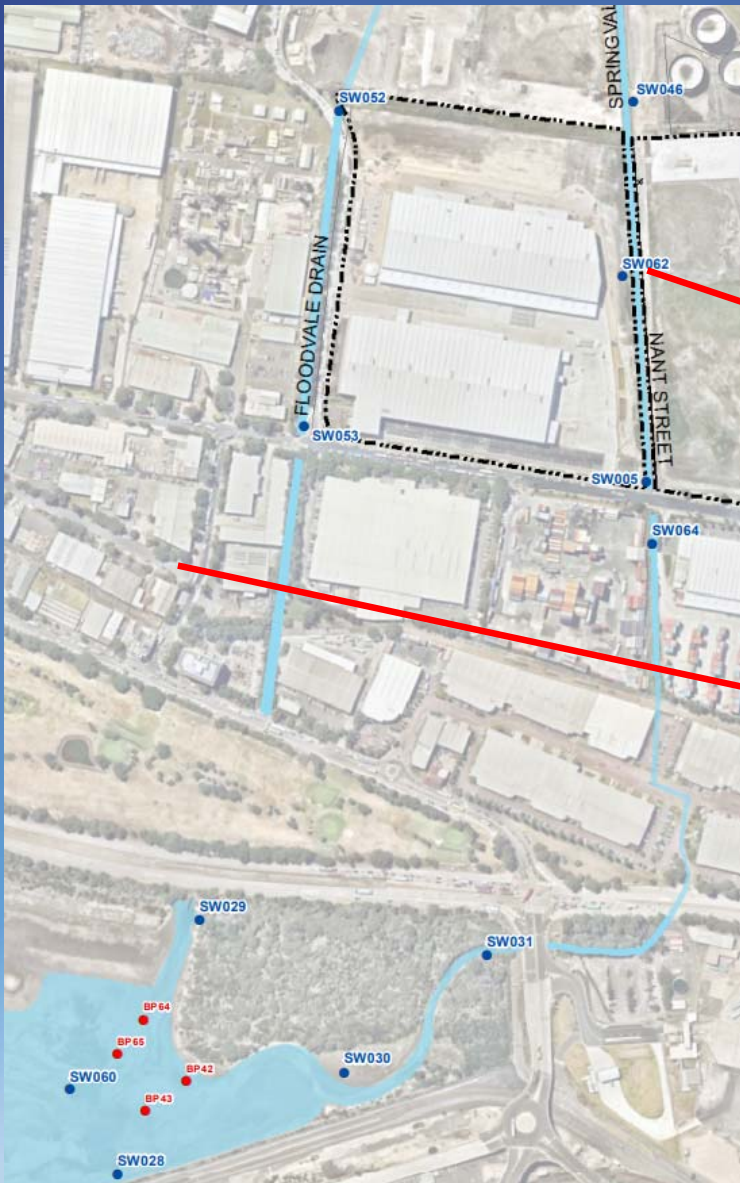
Risk Reduction Mechanisms

- Regulatory/administrative controls
- Decreased vapour risk due to improved shallow groundwater quality
- Decreased risks associated with significantly improved surface water quality in Springvale Drain
- Direct groundwater discharge - past or current?

Plume Distribution

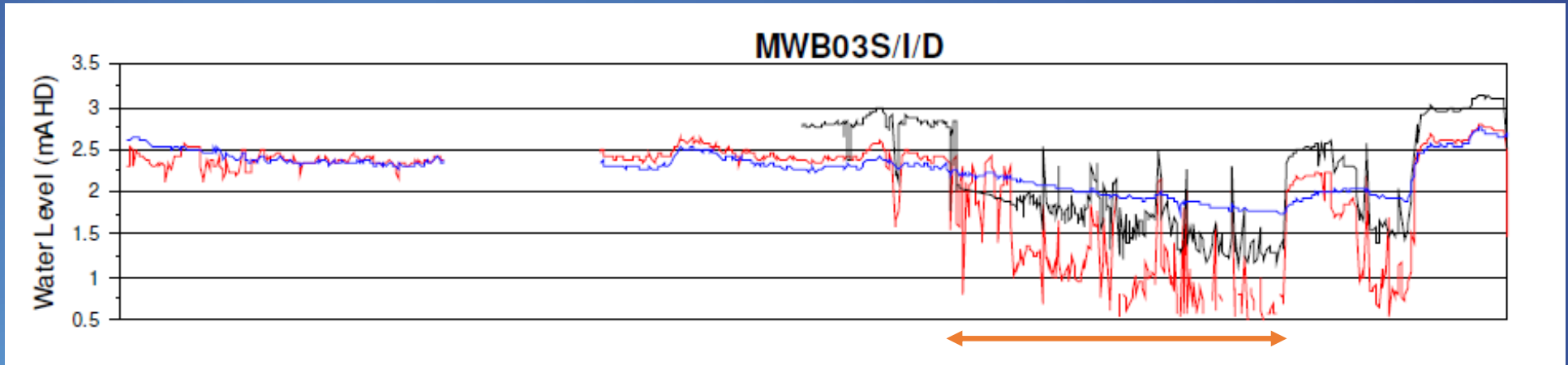
- Plume maps show maximum concentration at any depth
- Significant changes over ten years
- Concentrations in the upper 4 m of the aquifer largely non-detect







Vertical Gradients

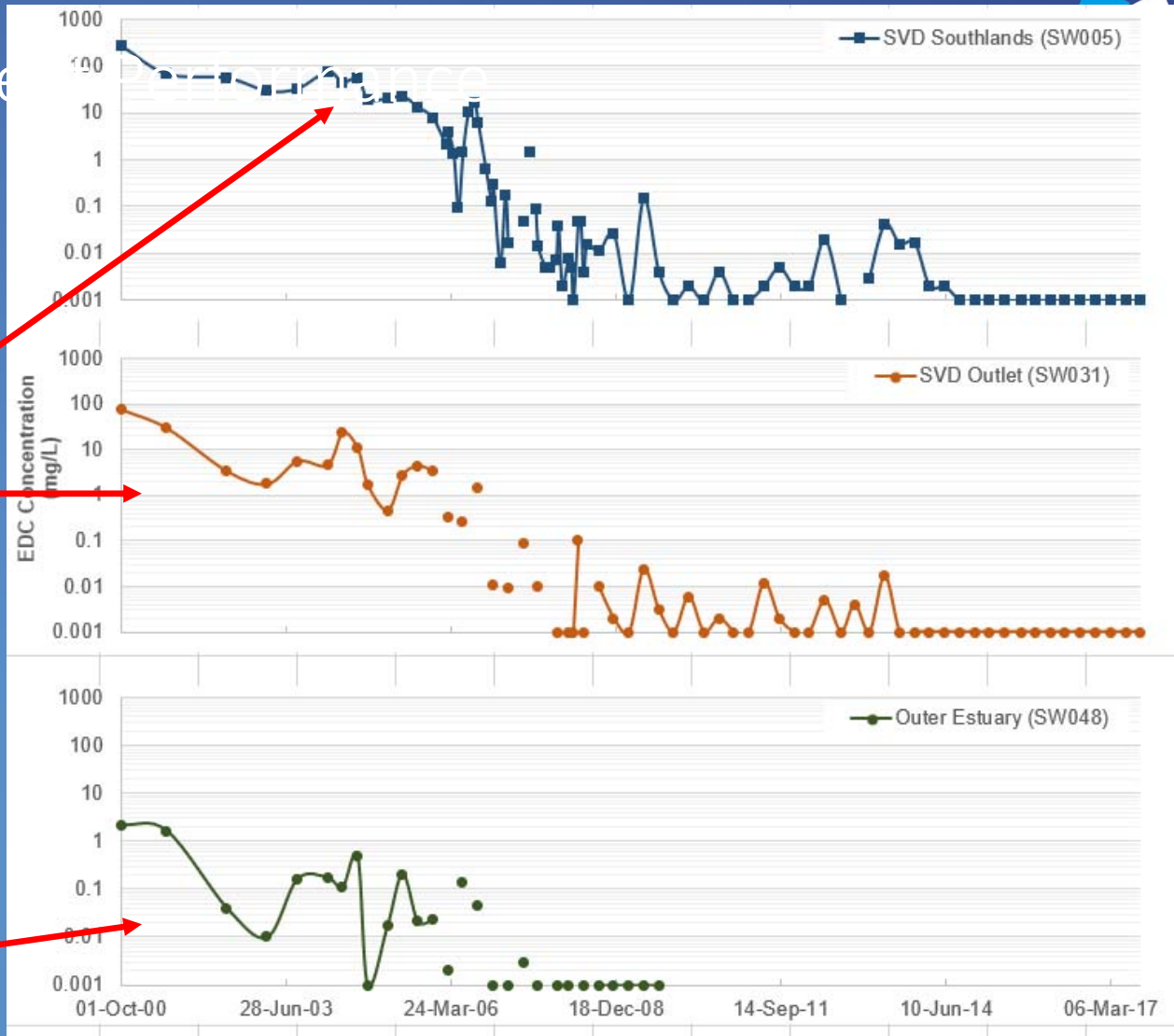
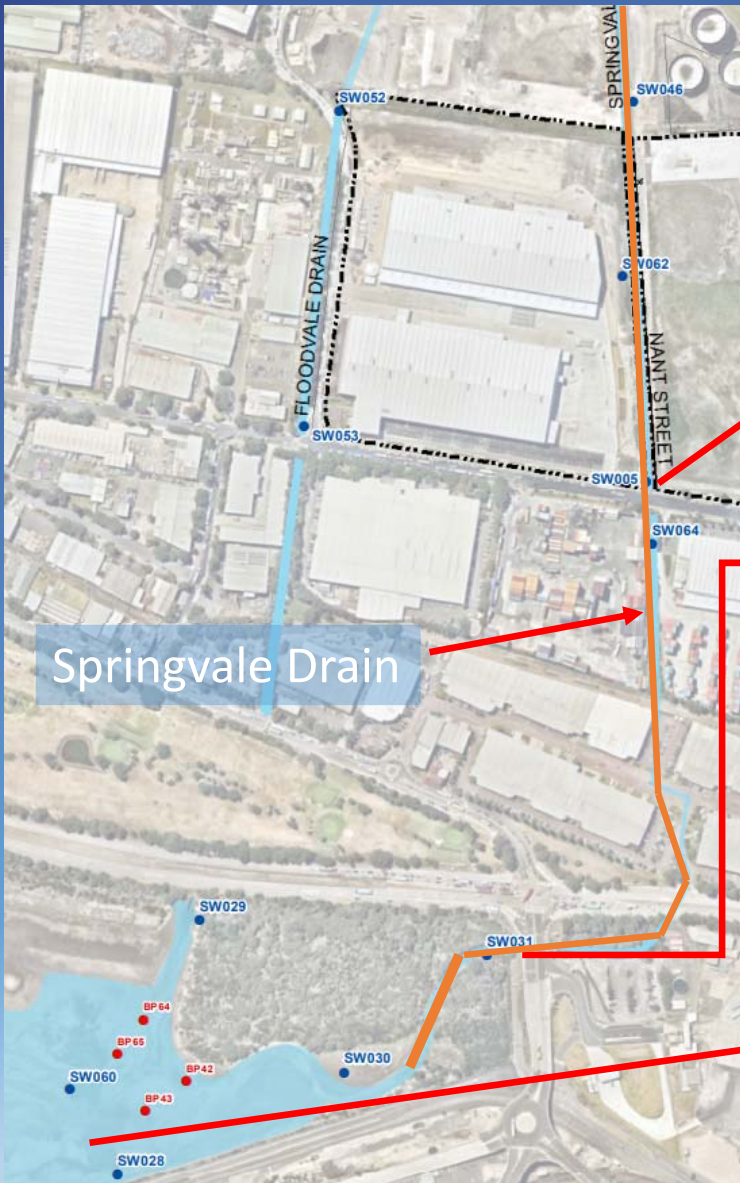


Commencement of pumping at southlands



Springvale Drain Water Quality Improvement

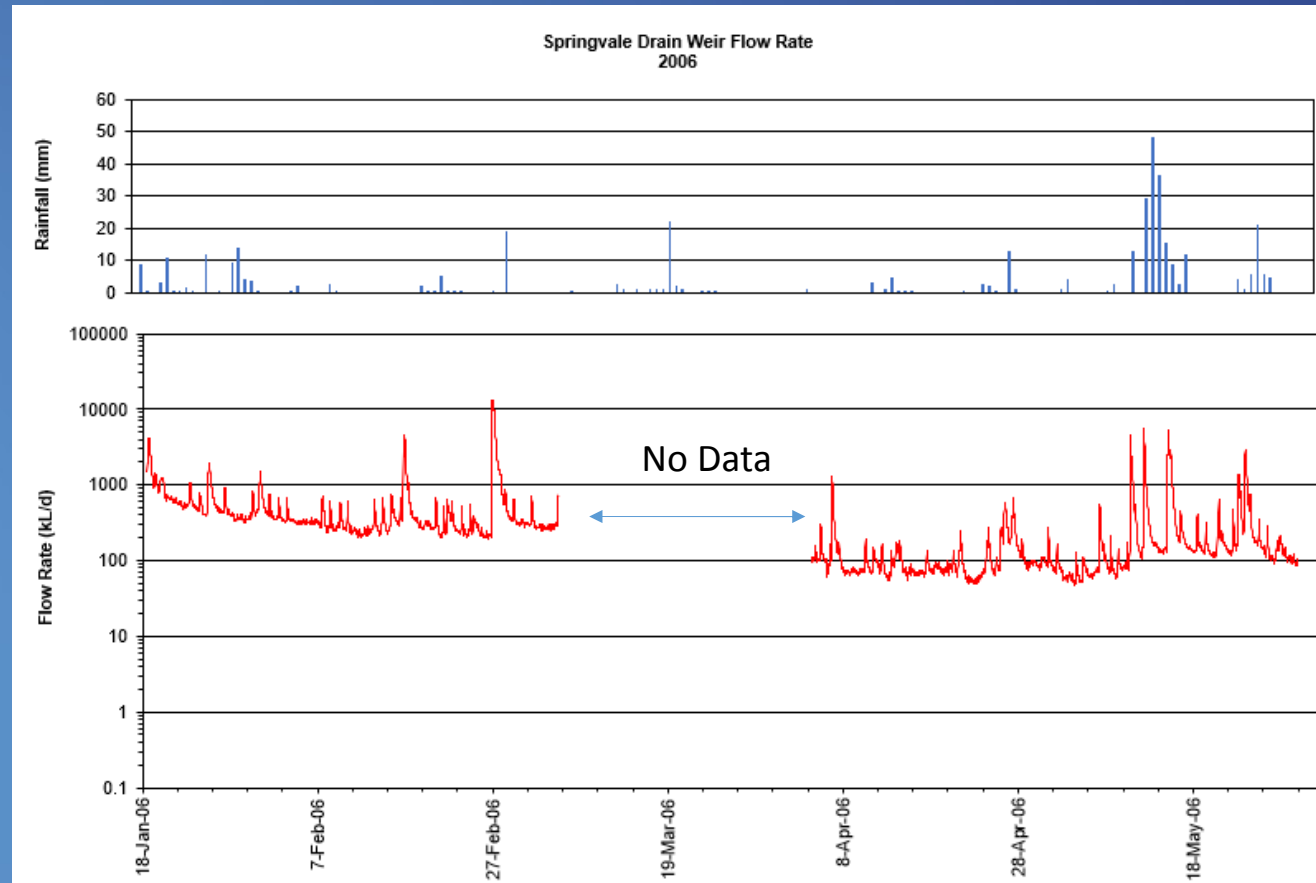
- Springvale Drain is a man made drainage channel
- Constructed to drain swampland (i.e. intercept groundwater)
- Significant decreases in contaminant concentrations have occurred since the commencement of GTP operation.





Springvale Drain Flows Early 2006

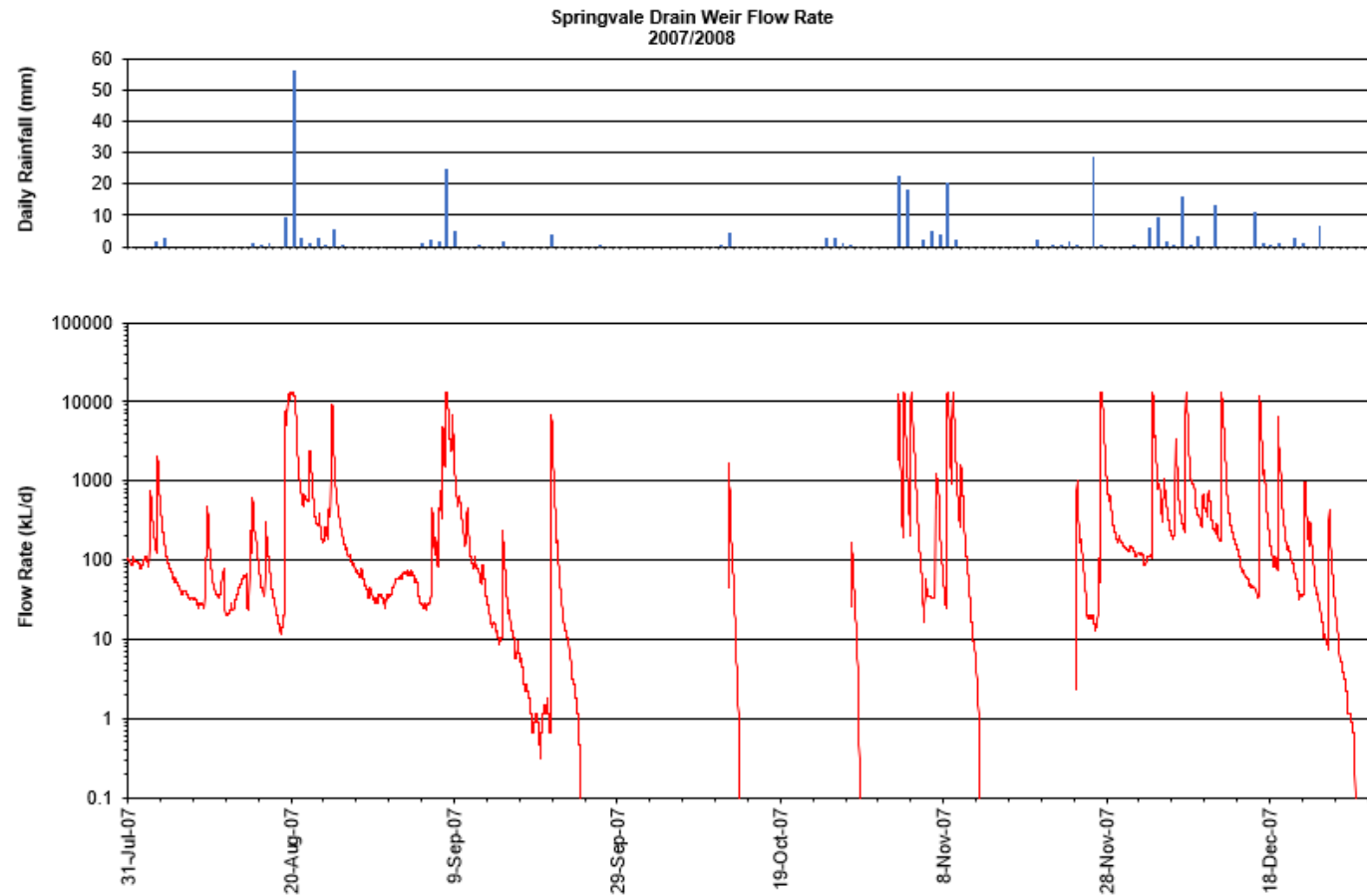
- Flows measured prior to full extraction
- V-notch weir
- Significant baseflow
- Implies mass flux of >3 tonnes per year of EDC

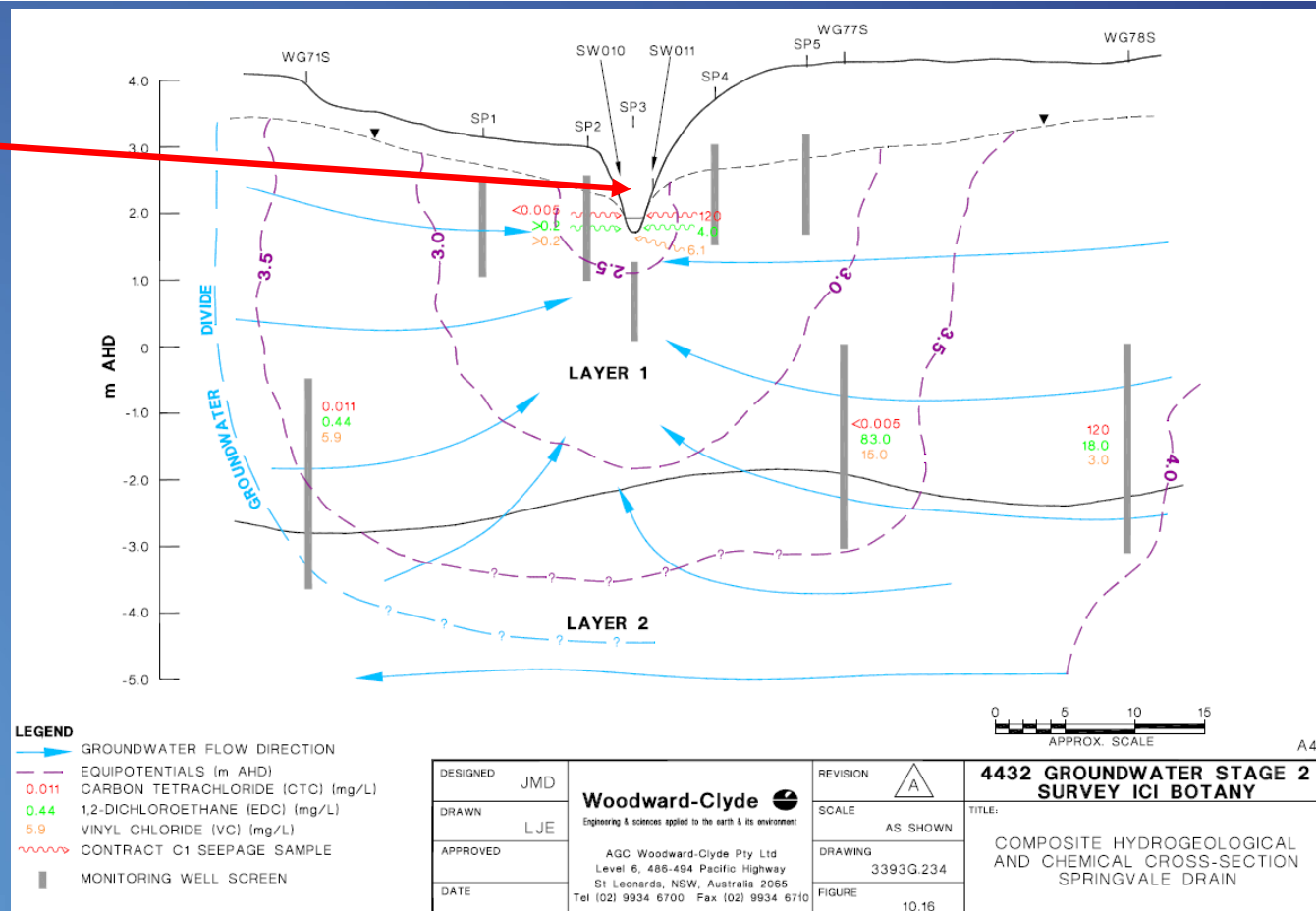


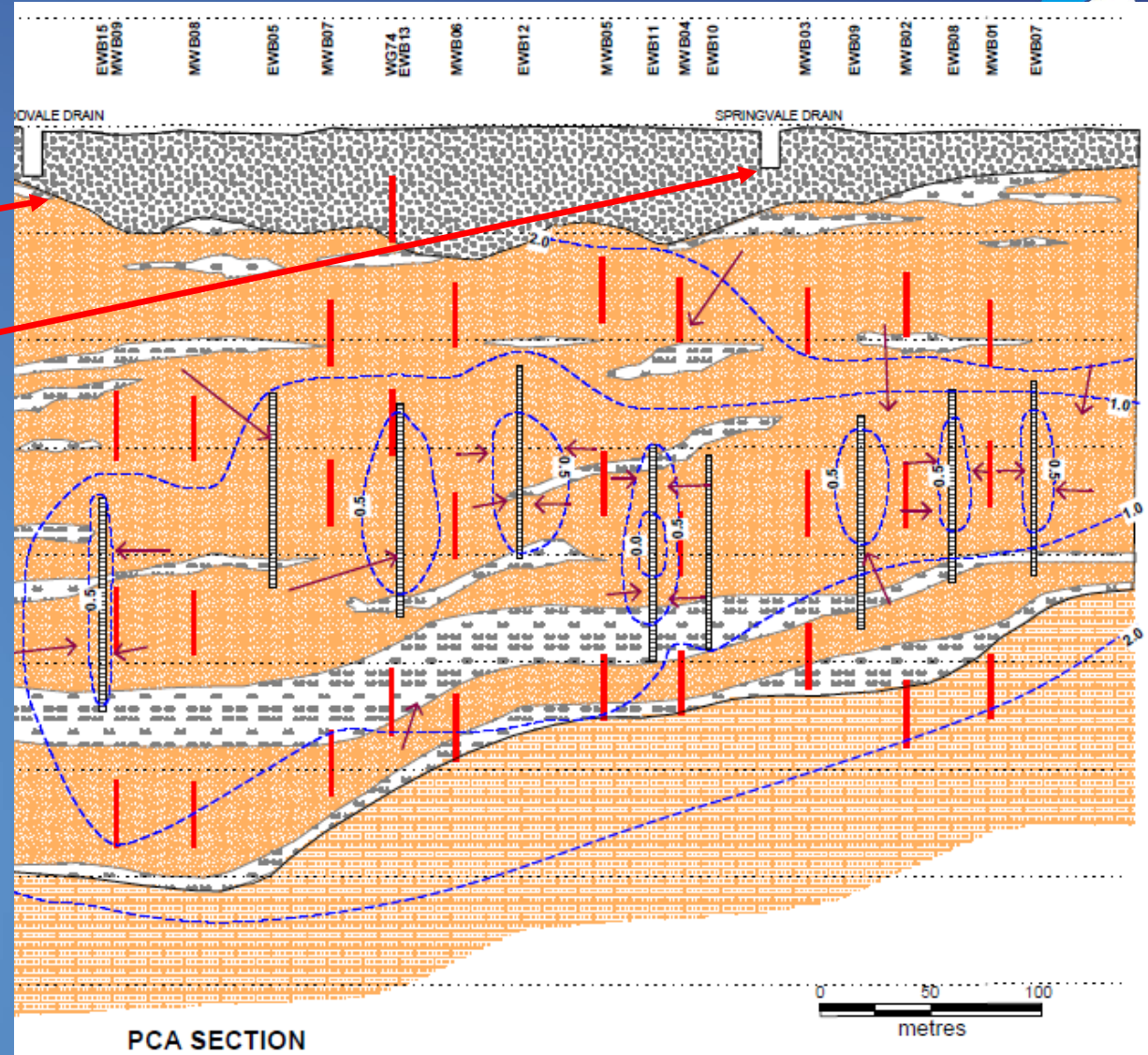
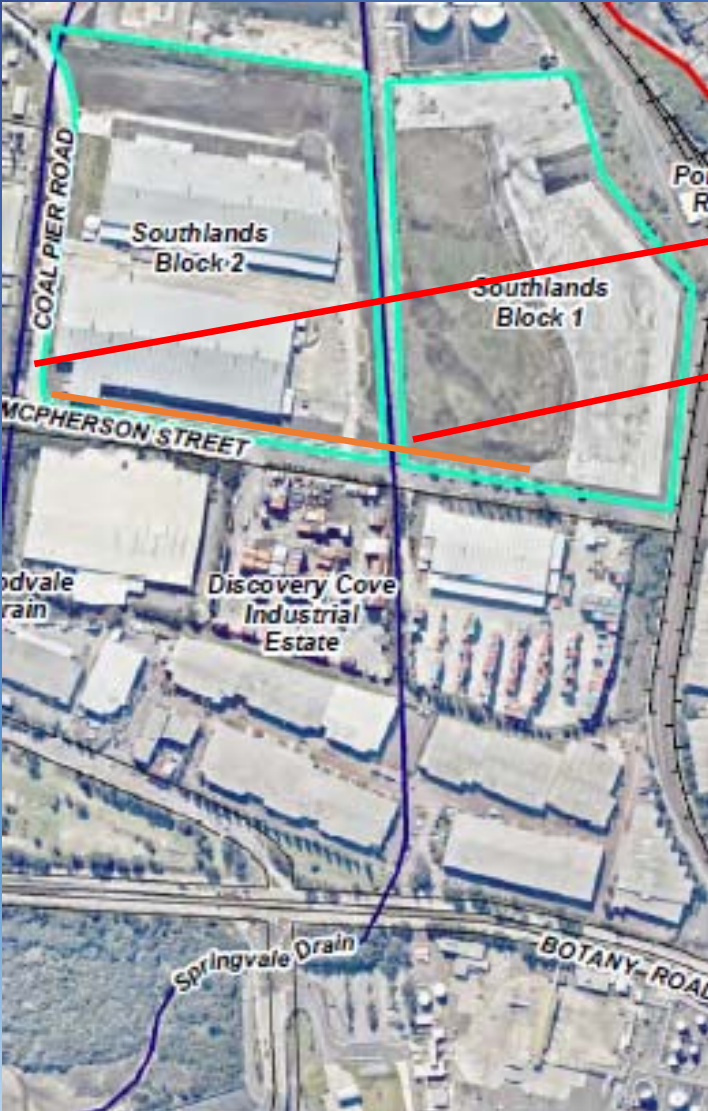


Springvale Drain Flows 2007

- Flows reassessed following commencement of full extraction









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- The graph displays the concentration of Total Volatile CHCs in $\mu\text{g}/\text{m}^3$ over time. The data points are as follows:
- | Date | Concentration ($\mu\text{g}/\text{m}^3$) |
|-----------|--|
| 9/02/2005 | 30 |
| 9/02/2006 | 105 |
| 9/02/2007 | 5 |
| 9/02/2007 | 35 |
| 9/02/2007 | 58 |
| 9/02/2007 | 140 |
| 9/02/2007 | 24 |
| 9/02/2007 | 38 |
| 9/02/2008 | 5 |
| 9/02/2008 | 1 |
| 9/02/2008 | 8 |
| 9/02/2008 | 1 |
| 9/02/2008 | 2 |
| 9/02/2008 | 1 |
| 9/02/2008 | 3 |
| 9/02/2008 | 1 |
| 9/02/2009 | 2 |
| 9/02/2010 | 1 |
| 9/02/2011 | 0 |
| 9/02/2012 | 0 |
| 9/02/2013 | 0 |
| 9/02/2013 | 11 |
| 9/02/2013 | 7 |
| 9/02/2014 | 5 |
| 9/02/2015 | 3 |
| 9/02/2016 | 0 |
| 9/02/2017 | 0 |



Summary

- The hydraulic containment system has satisfied the requirements of the regulatory notice
- The comprehensive monitoring program has identified reductions in risks to ecological and human receptors
- Key reductions are the result of improved shallow groundwater quality and improved water quality in Springvale Drain
- These reductions have occurred more rapidly than expected or were not predicted/considered by the regulatory notice or design of the wellfields/GTP