Optimising a Complex Remediation Project in an Evolving Environment

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Context of this presentation

To share with you how the approach to the remediation of a complex site in Australia has been adapted and optimised over the years to changes in regulatory policy, developments in the science, increased understanding of remedial technologies, and a greater awareness of the need for sustainable approaches.

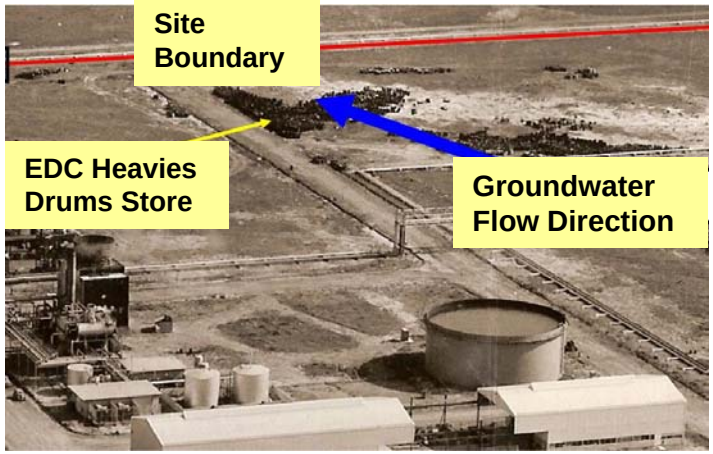
The project is still underway and is still progressing towards closure.

Industrial site in Australia

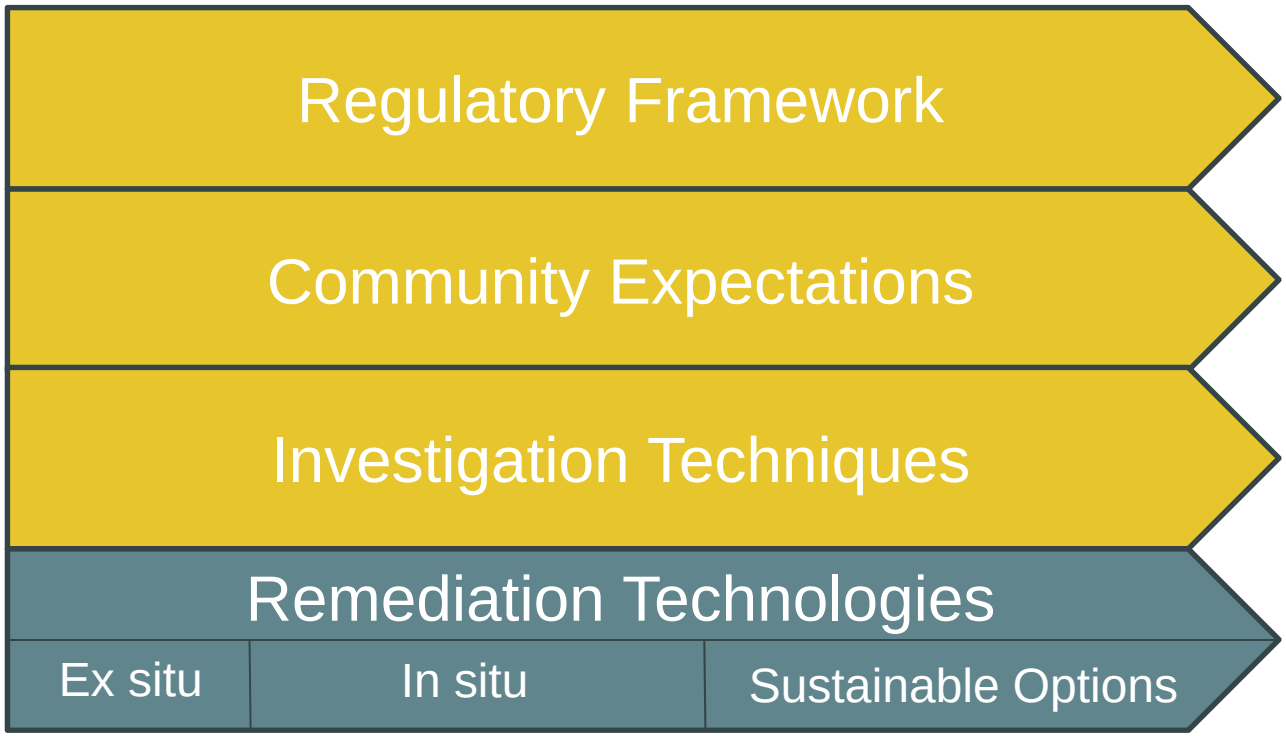
Industrial site since 1961 located within a Chemical Complex, west of Melbourne

Legacy soil and groundwater contamination from historical activities and 1969 grassfire Involves a variety of chlorinated hydrocarbons (eg 1,1,2 TCA, TCE, 1,2 DCA, VCM)

Fractured rock aquifer; groundwater brackish and not used for drinking, irrigation or stock



- **The project has been taking place over decades – with significant evolution in:**



Early stages – emerging environmental awareness in Australia

The community at large becomes aware of environmental issues:

- 1989 - a community consultative group was established to cover the whole chemical complex
- 1990 - EPA Victoria establishes audit system – soon after one of the first audits is undertaken at the site, on a voluntary basis, initiating soil and groundwater investigations
- 1995 - Public notified of groundwater contamination

Initial approach – 1990s

Pump & Treat

- Unresolved Concerns
  - Disposal of treated groundwater (onsite disposal considered infeasible due to high salinity)
  - Apparent that a very long time required to complete remediation

“Risk Assessment”; Groundwater Management Plan

- To understand, monitor, manage and maintain risks at acceptable level
- Stakeholders satisfied that the issue was being addressed appropriately

Late 1990s - In-situ Technologies - physical methods

Need to achieve better solution to addressing contamination in source areas and reducing offsite migration

1998 - Pilot Air Sparging / Soil Vapour Extraction (AS/SVE) trials

2000 - Pilot AS/SVE trials with blast-fracturing

2006 – Blast fracturing of 400 m of boundary and installation of AS/SVE boundary control system

Major undertaking!

2000s In-situ Technologies – bioremediation methods

Ongoing search for more effective, lower energy and lower cost solutions to reduce contaminant mass on site and hence reduce off-site migration

2007 – evidence of natural biodegradation accidentally discovered on site

2009 – laboratory (microcosm) trials to understand bioremediation and its possible application

2012 – application of full scale Enhanced In-Situ Bioremediation System (EISB) to reduce mass of chlorinated organics on site

Major technical advance!

2010s Towards faster more sustainable remediation

2014 – EPA subject to external review of its regulatory processes

– issues new Clean Up Notice requiring review of approach being taken

– review risks and assess options for remediation and management – "risk-based audit" with oversight by an auditor

2015 - Technology review:

- Identifies options for increasing the rate of reduction of Dense Non-Aqueous Phase Liquids (DNAPL) and reducing operating costs

2016 – New Clean Up Plan prepared

The new Clean Up Plan – further optimisation

- Developed adopting sustainable remediation principles
- Consistent with ISO 18504:2017 Sustainable Remediation
- Endorsed by an EPA-appointed Auditor, approved by EPA
- Includes Specific Measurable Attainable Relevant and Time Bounded (SMART) interim goals to more quickly meet long-term goals that do not require management controls, involving:
  1. More rapidly reduce off site contamination by increasing effectiveness of boundary control
  2. More rapidly reduce contaminant mass on site by further enhancing in-situ treatment technologies
  3. Develop treatment and control strategies that can be applied if necessary for widely distributed off site contamination

Component 1: Reduce off-site contamination more rapidly and provide increased safety factor for volatiles

- Improved barrier at site boundary: Permeable Reactive Barrier along boundary to increase effectiveness of existing boundary system
- Trial underway: 20 m deep trench in fractured rock filled with ZVI

Major undertaking!

Component 2: Improve and optimise rate of in-situ reduction of on-site contaminant mass – ultimately to allow stopping boundary treatment

- Continued application of EISB – optimising injection of Propylene Glycol amendment
  Using Radio Frequency heating to increase temperature in-situ in treatment zone to increase rate of hydrolysis and biodegradation.

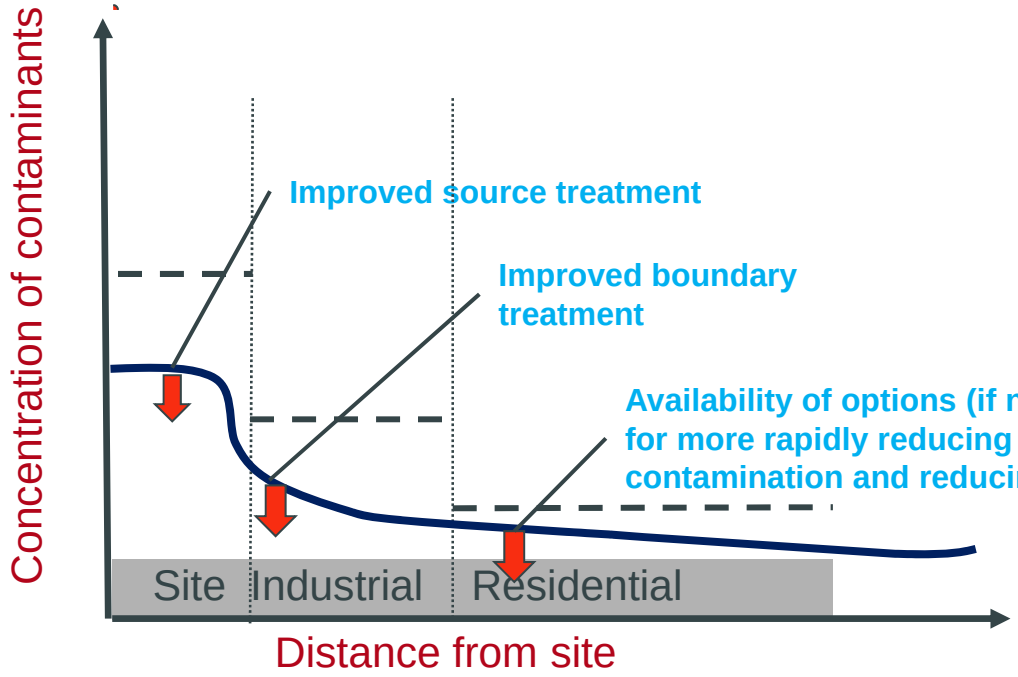
First application of RF in Australia!

Component 3: Develop treatment and control strategies that can be applied if necessary to provide greater factors of safety for distributed off-site contamination

- Trial application of EISB along off-site transects
- Consider and possibly trial application of a non-contaminated water blanket on the surface of contaminated groundwater (if needed)

These strategies haven't been applied in Australia!

Illustration of Strategy



Risk-based levels (dependent on land use)
Interim goal: 90% reduction

Increased rate of reduction in concentration

Conclusions

- Program of active improvement and optimisation of the remedial strategy for a complex site involving chlorinateds
- Strategy and program has evolved with the evolving regulatory and scientific environment
- Innovative new technologies and strategies are being applied, with considerable investment, to provide more rapid attainment of long term clean up objectives and to increase safety factors
- Stakeholders are being consulted; approach accords with ISO18504: 2017 Sustainable Remediation

Approach reflects importance Dow attaches to sustainability and innovation

Acknowledgements

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Consultation with regulators

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- AECOM
- GHD