ODOUR AND VAPOUR ASSESSMENT DURING SOIL STABILISATION TRIALS ON A HYDROCARBON CONTAMINATED SITE

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ABSTRACT

Policies aimed at protecting greenfield sites to enhance the urban environment have led to increased prioritisation of the redevelopment of brownfield sites. This in turn has led to increased pressure to develop new solutions to deal with the potential nuisance and risks to health and the environment that such redevelopment can bring.

As part of the redevelopment of the Auckland waterfront, a trial of both in-situ and ex-situ soil stabilisation techniques has been carried out on land previously used as an oil storage depot. Soils and groundwater beneath the site have been significantly contaminated by petroleum and gasworks derived hydrocarbons. The presence of sensitive receptors nearby and a history of odour complaints for nearby developments have emphasised the importance of assessing odour and the levels of contaminants likely to be observed during the redevelopment work.

During the stabilisation trials, regular odour assessments were carried out to determine the extent and the intensity of odours. These assessments included walkovers to identify the differences in odour generation during different stages of the works, the influence of the odour suppressant and to quantify the effectiveness of mitigation measures.

Collection of whole air samples, using canister methods, was carried out periodically during the stabilisation trials for analysis of volatile organic compounds (VOC) while simultaneous measurements of total VOC concentrations were undertaken at different distances downwind using photoionization detectors. The results when compared with relevant health-based criteria, confirmed the extent of the required separation distance and the threshold action level for the redevelopment work.

The odour and vapour assessment carried out during the trial allowed the stakeholders to choose the most appropriate soil stabilisation method to reduce the risk of odour complaints and ensure compliance with heath-based criteria. The trial also enabled initial mitigation measures to be tailored to the proposed work to further reduce the effects of the redevelopment.

CONTEXT AND OBJECTIVES

The trials of both in-situ and ex-situ soil stabilisation were proposed to collect information to assist in evaluating potential odour and vapour emissions from the redevelopment works and confirm whether the control measures would adequately mitigate any effects.

TRIAL METHODOLOGIES

The trial was undertaken in two stages comprising the following activities:

IN-SITU

- In-situ mixing of cement at a dosage of 150 and 50 kg/m^3 using a mixing head.
- Trench size: 10m x 6m x 7m (L x W x D)
- Working area: 200m^2
- Duration : ≈ 3 days
- Frequent cement dust emissions observed
- Blue smoke / haze observed.

EX-SITU

- Excavation and mixing of cement at a dosage of 50 kg/m^3 using a Reterra before backfilling the trench.
- Trench size: 10m x 3m x 7m (L x W x D)
- Working area: 600m^2
- Duration : ≈ 0.5 day
- Occasional largecement dust emissions.

During the trial, odour suppressant was used over selected periods to assess the efficiency of the product in reducing odours effects and its application method.

IN-SITU

Application via a water blaster during the in-situ trial due to the coincidental emission of cement dust.

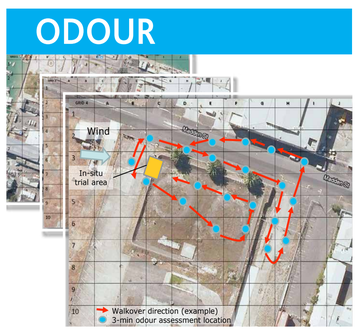
EX-SITU

Backpack mist blower used during the ex-situ trial due to reduced dust emission.

ODOUR AND VAPOUR ASSESSMENTS

Odours (intensity, type) were recorded, at various distances from the trial area, throughout the different stages of the in-situ and the ex-situ trials. Air concentration measurements were undertaken around the trial works using two different methods.

ODOUR



Regular odour surveys based on the FIDOL factors.

VAPOUR SAMPLING

Canister whole air sampling with laboratory analysis of VOCs and TPHs.

CONTINUOUS MONITORING

Continuous monitoring of VOCs, LEL, O_2, CO, H_2S at various distances.

RESULTS OF THE VAPOUR MONITORING

Monitoring carried out downwind at different distances from the trial area indicated that the VOCs were greatly diluted between the trial area and the downwind receptors. Based on one minute average measurements during the trial:

IN-SITU

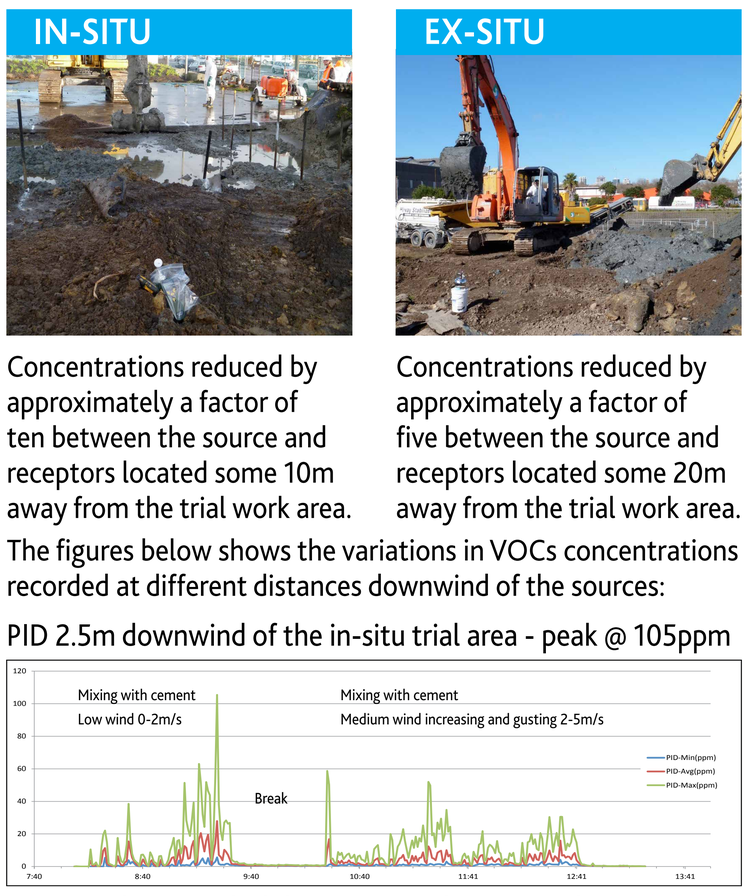
Concentrations reduced by approximately a factor of ten between the source and receptors located some 10m away from the trial work area.

EX-SITU

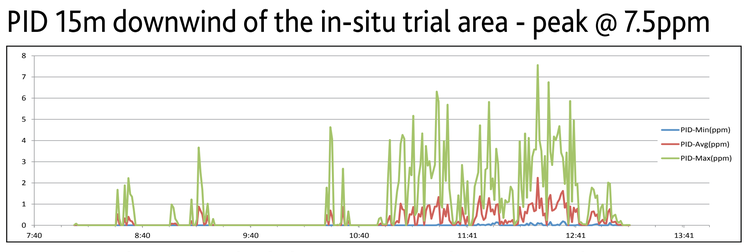
Concentrations reduced by approximately a factor of five between the source and receptors located some 20m away from the trial work area.

The figures below shows the variations in VOCs concentrations recorded at different distances downwind of the sources:

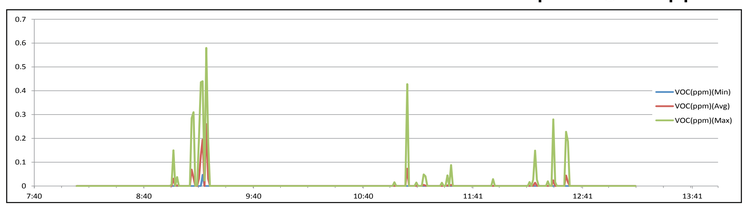
PID 2.5m downwind of the in-situ trial area - peak @ 105ppm



PID 15m downwind of the in-situ trial area - peak @ 7.5ppm



PID 30m downwind of the in-situ trial area - peak @ 0.6ppm

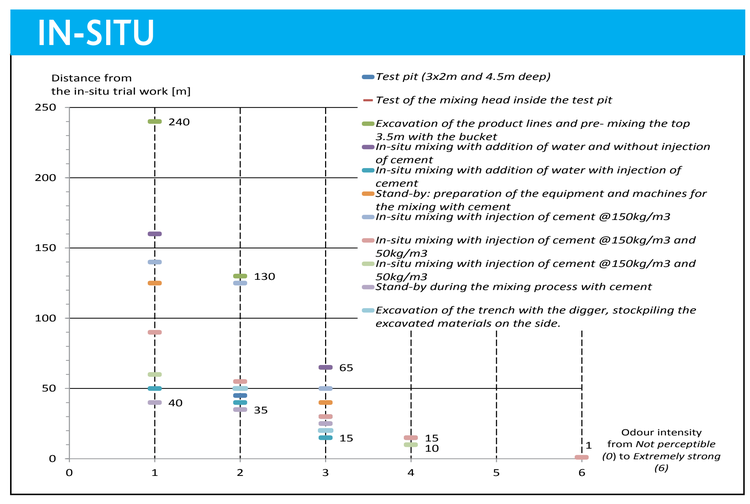


Concentrations of VOCs were generally three or four orders of magnitude below the relevant assessment criteria. Only benzene (between 6 and 19 µg/m^3) and m,p-xylene (between 13 and 280 µg/m^3) were reported in the immediate vicinity of the ex-situ trial area at significant levels.

RESULTS OF THE ODOUR ASSESSMENT

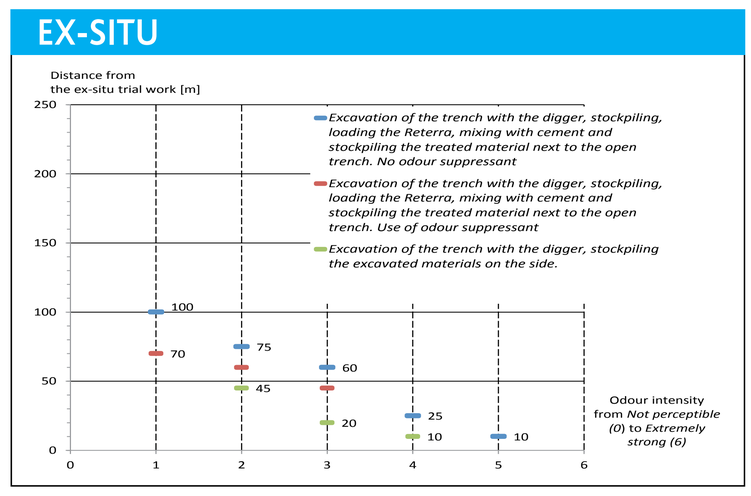
Odour intensities were recorded, at various distances from the trial area, throughout the different stages of the in-situ and the ex-situ trial.

IN-SITU



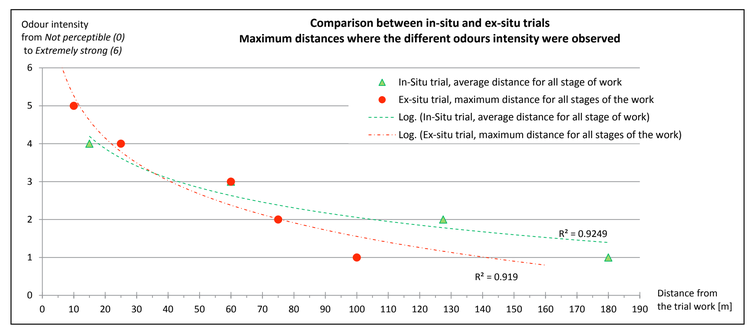
Weak odours were recorded over a wide range of distances (between 40 and 240m). For more intense odours, the range of distances recorded was reduced (between 10 and 15m).

EX-SITU

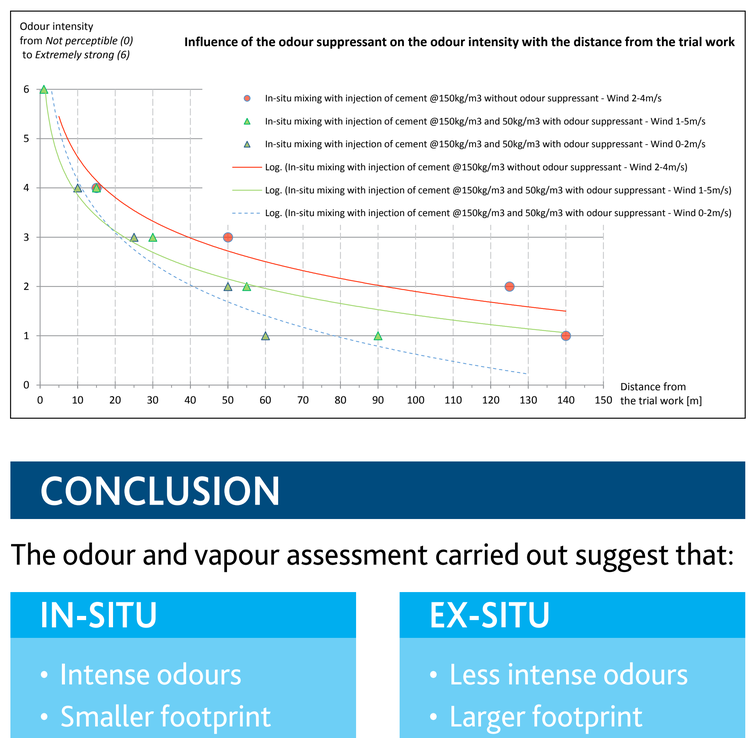


Weak odours were recorded over a narrower range of distances (between 70 and 100m) when compared with the in-situ trial. However the range of distances did not vary significantly when recorded odours were more intense.

A comparison of the maximum distances recorded during the in-situ and ex-situ trials showed a strong correlation between the distance and the odour intensity.



Irrespective of the application method, the odour suppressant was found to be effective at masking and reducing the odours from the trials.



CONCLUSION

The odour and vapour assessment carried out suggest that:

IN-SITU

- Intense odours
- Smaller footprint
- Longer duration

EX-SITU

- Less intense odours
- Larger footprint
- Shorter duration

Appropriate levels of hazardous air pollutant (compared to relevant health based assessment criteria) for both methods 10m away from the sources.

RECOMMENDATIONS

- Mitigation and control measures were adjusted and refined after the trial;
- Based on the trial, the ex-situ methodology was recommended.

REFERENCE AND ADDITIONAL INFO

Soil stabilisation trial - odour and vapour assessments, Tonkin & Taylor report Ref. 27370.017/v1, October 2012.

Watch the trial in video ►

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