6.0 Conclusions

6.1 Surface Soil Samples

2,3,7,8-TCDD was detected in 35 surface soil samples (0 – 75 mm) at concentrations ranging from 0.71 to 92 ng/kg. The majority of the results (31 out of 35) had TCDD concentrations less than 10 ng/kg and 23 results were less than 5 ng/kg. Based on a correlation between 2,3,7,8-TCDD and TEQ from the full dioxin profile analysis, the TEQ range for the surface samples is estimated to be 2.7 to 99 ng/kg. The TEQ value is dominated by the 2,3,7,8-TCDD concentration and for practical purpose the two are interchangeable

The distribution of 2,3,7,8-TCDD reflects the prevailing wind direction from the west and the topography. Concentrations to the east of the Dow plant, towards Mount Moturoa, are higher than to the south of the plant. In addition, land that slopes towards the plant, in particular Mount Moturoa, shows higher concentrations relative to flat or away-sloping areas. The steep-sided valley running between Ngamotu and Pioneer roads shows distinctly lower concentrations.

Concentrations are higher at the plant boundary and drop off rapidly within 800 – 1000 m from the plant. However, to the east, 2,3,7,8-TCDD can still be detected 2.5 km from the plant. A few anomalies exist in the results, in particular, Sample SS#27 is considerably elevated over its neighbours, with no obvious reason from topographic or wind considerations. Sample SS#27 is not expected to be generally representative of the area.

Profiles of the seventeen 2,3,7,8-substituted dioxin congeners, using the results of the eight full dioxin profile analyses from this study, showed a close similarity with profiles from MfE data for other urban areas in New Zealand. All profiles are dominated by OCDD, with lesser contributions from OCDF, 1,2,3,4,6,7,8-HpCDD and 1,2,3,4,7,8,9-HpCDF. However, 2,3,7,8-TCDD was detected in the current study and in the two New Plymouth samples from the MfE study, but not in any of the other MfE urban samples. It would appear that the Paritutu results (and other New Plymouth results) are typical of other towns and cities in New Zealand except there is an “overlay” of 2,3,7,8-TCDD and to a lesser extent 1,2,3,7,8-PeCDD. The 2,3,7,8-TCDD detected is consistent with deposition of emissions from the 2,4,5-T production process at the Dow plant.

6.2 Deeper Samples

The concentration of 2,3,7,8-TCDD in deeper samples (75 – 150 mm) ranged from 0.71 to 17 ng/kg. There is a good relationship between the surface and corresponding deeper samples, with the 2,3,7,8-TCDD concentration in the deeper samples being about 70% of the surface samples. A rapid drop-off in TCDD concentration with depth is expected, as TCDD binds very strongly to soil and has a low solubility. However, the results indicate vertical migration has occurred to at least 150 mm. The extent of deeper migration is not clear from this study.

6.3 Garden Samples

Concentrations of 2,3,7,8-TCDD in six soil samples taken from gardens ranged from 2 to 7.3 ng/kg. The garden samples also show a good relationship with corresponding surface samples, with one exception, Site 09. Ignoring Site 09, the garden results averaged approximately 80% of the corresponding lawn-soil samples.

The garden soil concentrations are higher than would be expected to result from garden cultivation mixing in deeper "clean" soil. Possible factors include:

- Soil mixing has been relatively shallow, perhaps less than 200 mm.
- 2,3,7,8-TCDD has reached deeper in the soil column than expected.
- Deposition of 2,3,7,8-TCDD onto lawns has been added to gardens as grass clippings, either directly or as compost.

6.4 Comparison with Previous Paritutu Studies

Results from many of the earlier studies in the Paritutu area are difficult to compare with the current study because of differences in the sampling techniques employed, uncertain locations, uncertain basis for reporting and different analytical techniques. However, the recent sampling carried out by TRC in 2001 and MfE in 1996, for which location, sampling and analytical details are known, are consistent with the current study.

Both community group samples are also consistent with the current data, falling within the range of 2,3,7,8-TCDD concentrations measured. The locations for these samples are not known.

Making comparison with samples taken in 1985 and 1986 by Dow and the then Department of Health is of uncertain validity, because of the uncertainties associated with these data. Overall, samples from residential areas are the same order of magnitude as the current study, but some results are higher than the current study.

While the earlier studies provide additional confidence in the results of the current study, they do not allow a definitive assessment of whether residents may, in the past, have been exposed to higher average concentrations. However, based on a half life for 2,3,7,8-TCDD of the order of 25 – 100 years for soil below the top few millimetres, it is not expected that soil concentrations in residential areas would have been markedly higher than those currently measured.

6.5 Comparison with International Guidelines

All but one of the results (including the deeper and garden samples) fell within the most conservative residential guidelines used for comparison in this study (USEPA Region 6 and 9 screening level). All values fell within the New Zealand, German and Federal US criteria by large margins. The single result that fell outside the USEPA Region 6 and 9 screening level is the sample from high on the west-facing slope of Mount Moturoa Domain.

It is concluded that residential properties of Paritutu, with the possible exception of a few properties on the north-west slopes of Mount Moturoa, will have 2,3,7,8-TCDD soil concentrations (and TEQ values) less than the most conservative of the international risk-based residential guidelines currently in force. This is on the assumption that soil concentrations will not be markedly different between sample locations.

Within the Mount Moturoa Domain, and on the north-west slopes of Mount Moturoa, 2,3,7,8-TCDD concentrations could be between about 20 and 90 ng/kg. Concentrations will be lowest on the lower slopes. Considering the likely exposure of recreational users of the Domain, a screening level of at least an order of magnitude greater than the residential guideline is considered appropriate. The likelihood of having 2,3,7,8-TCDD concentrations (or TEQ) on Mount Moturoa in excess of 390 ng/kg is extremely remote, and consequently there is no need to investigate the Domain further.

Similarly, the standard residential guideline is not appropriate for the high-density residential properties on the north-west side of Mount Moturoa, given the amount of paving on these properties. A screening level of at least twice the residential value is appropriate. On this basis, further investigation of these properties is also not warranted.

6.6 Summary

The results demonstrate that 2,3,7,8-TCDD is present at detectable but generally low concentrations in surface soil over the complete study area. The soil concentrations generally reflect distance from the Dow plant and the prevailing wind directions, with some variation apparent as a result of the topography. Comparatively higher concentrations were found on and around Mount Moturoa, immediately to the east of the Dow plant.

All soil sample results were below the New Zealand soil guideline for 2,3,7,8-TCDD, and with one exception, complied with all risk-based international guidelines. The exception, in Mount Moturoa Domain, is considered acceptable for the expected recreational use of that land. The results indicate further investigation of soil in residential areas of Paritutu is not warranted.

Previous studies have not found 2,3,7,8-TCDD in other urban areas elsewhere in New Zealand. The profile of dioxin contamination in Paritutu, and in particular the detection of 2,3,7,8-TCDD, is consistent with the nature of contamination associated with 2,4,5-T production. The findings of this study corroborate earlier investigations of the Dow plant being the source of 2,3,7,8-TCDD in the area.