Tasman District Council

Site Investigation of Sheep Dips and Slipways using a Portable X-ray Fluorescence Meter (XRF)

Contaminated Site Remediation Fund Contract Number 20369

October 2013

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1. The project

This project set out to undertake the investigation of the nature and extent of contamination at ten historic sheep dip sites throughout the Tasman Bay and Golden Bay area using a hand held X-ray fluorescence (XRF) meter supplemented by limited laboratory sampling for arsenic and dieldrin. The dips included both plunge and spray sites representing both private and community dips.

Parallel with the sheep dip site investigations the project also included the investigation of nine formal and informal boat maintenance areas which again were sampled using the XRF to characterise the nature and extent of contamination present and to provide information to council managers regarding these sites. The distribution of the dip and slip sites throughout Tasman District are shown on Figure 1 below.

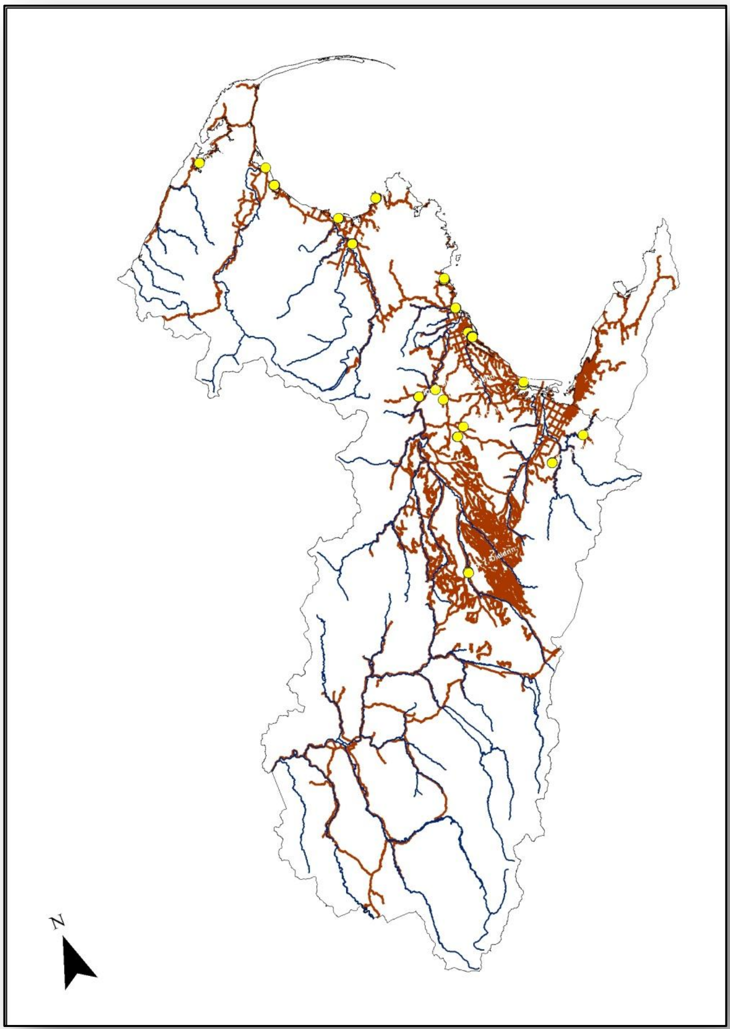

Figure 1: Sample locations for Sheep Dip and Slipways Sampled as part of this Project

2. Background

Late in 2006 the Ministry for the Environment released a guidance document to local authorities regarding “Identifying, Investigating, and Managing Risks Associated with Former Sheep-dip Sites”. During the following two years Tasman District Council (along with Nelson City Council) began projects to locate and categorise historic sheep dip sites. During 2009 the Ministry for the Environment Contaminated Sites Remediation Fund (CSRF) assisted Tasman District Council (TDC) to undertake a screening programme visiting and sampling a range of dip sites. This work provided a measure of the type of dip sites present and the extent of contamination associated with those dips. Due to limited resources only some dip sites could be included in this sampling programme leaving many not sampled.

During October 2011 TDC undertook a further programme of identifying and testing historic sheep dip sites, advertising free testing of sites as an incentive for landowners to declare the existence of their dips and to become involved with testing and future site management recommendations. However again not all dip sites could be included in this work so during mid 2012 TDC again applied to CSRF for assistance to provide this sampling service so that the remaining known sites could be visited (if landowners agreed) or in some cases revisited to characterise them. Again CSRF agreed to support this investigative work and this report summarises that project.

Tasman District has an extensive coastal margin comprising parts of Tasman Bay, Golden Bay and the northern west coast of the South Island. During early European settlement sea transport was critical (before road networks were developed) and has remained an important feature of the district. Today small commercial and recreational craft are in significant numbers within the many inlets and tidal river mouths throughout the district.

Vessel maintenance usually includes cleaning down marine fouling organisms and old paint and repainting with new antifouling paints intended to inhibit marine growth on the vessel. Antifouling paints usually contain toxic metals such as copper or zinc along with other co biocides intended to boost their performance in the marine environment. Most marine antifouling paints are therefore intentionally toxic to marine organisms. Unless the old paint removed from vessels is carefully collected and safely disposed of and the new paint is applied in a controlled manner, then there is a risk of elevated contamination around maintenance areas.

The XRF was used at a number of formal and informal mooring and maintenance areas to assess the extent of metal contamination present. The XRF is not able to directly measure the booster co-biocides that may be present (and highly toxic) but does provide a measure of the metal levels which are likely to have a similar pattern of distribution to the co-biocides.

3. Methodology

3.1 Sheep dips

Contact was made with sheep dip site owners to arrange a suitable time to visit each dip site. Owners were encouraged to be present so their dip along with its associated risks and its future management could be discussed. The presence of landowners also helped council staff locate some more cryptic old dip sites and to better understand their history of use.

Once the sites had been located and a general understanding of the dip layout and operation had been achieved (not always possible), sampling commenced using the XRF in the following general sequence:

a. Initial samples were taken along the edge of the dip itself; followed by
b. drainage and splash areas close to the dip usually in a close grid or semi grid; followed by
c. races and pens likely to have held stock soon after dipping usually sampled in the centre of the race or yard; followed by
d. a course grid or long section through run out paddocks and usually extending out to the nearest fence lines.

A laboratory sample was taken at the location of the highest arsenic concentration as measured by the XRF. It was found that the highest arsenic concentration was usually located in the immediate splash zone adjacent to the dip or in the dips drainage area. The sample was sent to Hill laboratories in Hamilton for analysis of arsenic and dieldrin concentrations. The laboratory arsenic result provided a comparison against the XRF results for that sampling location and the diedrin result provided an indication of the presence of dieldrin and its likely maximum concentration based on the assumption that the dip operation would have distributed different dip chemical in a similar overall pattern irrespective of the chemical type used.

In general the dip sites visited could be separated into community and private dips. Community dips were exclusively plunge dips, located close to a road where the surrounding farm properties could more easily drive stock for dipping. They were not always associated with farm dwellings or farm sheds. It is likely that the community dips were more intensively used than were private dips and may also have been subject to a wider variety of chemicals used. An example of a community dip is shown in Photo 1.

The private dips sampled included some older plunge dips and some more recent shower dips. They were generally internal within a farm property and reasonably close to dwelling houses or other farm buildings. An example of a private spray dip which is still in use is shown in Photo 2.

Photo 1: Old Communal dip site

Photo 2: Private Shower Dip

3.2 Slipways

The Tasman District Council Harbour Master (Steve Hainstock) provided a series of maps showing the location of areas where he had observed vessels being moored or maintained within the Tasman District area. The sites were distributed throughout the entire coastal area of the district and including locations within Tasman Bay, Golden Bay and the Whanganui Inlet on the northern west coast of the South Island.

The sites varied in both nature and the intensity of use. They ranged from formal slipways with extensive associated hard stand areas which were regularly used for the maintenance of a significant number of vessels (such as at Port Motueka and Waitapu Bay slipways, Photo 4) to very low density swing mooring sites in isolated bays, for example in the Otuwhero Inlet area near Marahau (See Photo 3|).

Generally the larger sites catered for larger vessels and for more frequent and extensive maintenance and included formed slipways or rails, hard stand areas and the use of maintenance cradles. The smaller sites catered for smaller vessels and usually relied on beach trailers or opportunist maintenance on the beach itself when the tide was out.

Sampling of these sites usually followed the following sequence:

a. Sampling in and around ramps and rails including the middle bottom and sides along the water's edge; followed by
b. sampling of any other in water structure where vessels may be maintained in particular alongside wharves or on intertidal grid areas; followed by
c. general inter tidal beach areas near the ramp where opportunistic maintenance may have occurred or where contamination from maintenance activities could have spread; followed by
d. hard stand areas adjoining the haul out commencing where there were obvious signs of contamination (for example paint flakes) followed by general grid sampling for the remainder of the area.

Photo 3: Swing Moorings Otuwhero Inlet

Photo 4: Waitapu Slipway

4. Results Sheep Dips

4.1 Community Dips

Two historic community dips were sampled during this project. Both were plunge type dips and both were located close to roads. Neither dip had been used for a considerable period of time and the associated timber structures such as races, fence lines and yards had rotted away only leaving the concrete dip structure and drainage pads as evidence that they had existed.

4.2.1 Community Dip 1

The dip showed in Photo 5 below had been completely missed during the last sheep dip sampling project. During the previous visit an old set of yards had been identified on the property and the area in and around those yards had been sampled showing very low contamination levels with no sign of the dip structure itself indicated that the site would meet environmental and human health standards. On this visit a previous owner of the property, now long since retired offered to accompany us to the site to point out the location of the dip and to explain how it operated.

Photo 5: Cryptic community plunge dip

With the help of the previous owner it was found that the dip itself was located on the opposite side of a stream which flowed past the yards. Once the sheep were within the yards they were driven over a wooden bridge crossing the stream into a plunge dip at the far end. The sheep then exited the dip into a small holding paddock on the far bank. XRF samples around the dip showed high arsenic levels with a maximum concentration of 494 mg/kg in the immediate splash zone of the dip. (See Figure 2 below). The arsenic was spread throughout the holding paddock area on that far side of the creek. The arsenic was also present on what is now an adjoining property located downhill of the dip structure.

Sampling within the stream bed itself did not reveal significant concentrations of arsenic and it was assumed that over the decades flood flows had scoured any contaminated sediment away from the stream bed itself.

Figure 2: XRF Arsenic levels in mg/kg old Community Dip 1

A laboratory arsenic sample was taken at the location of the highest XRF result to compare against the XRF results. The arsenic concentration of the laboratory sample was over twice that of the XRF arsenic (1150 mg/kg). This difference highlights the variation which can occur between two different analysis methodologies but does confirm that both methods indicate very high levels of arsenic contamination. Arsenic results in the immediate vicinity of the dip greatly exceed the human health standards under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (NES) of 17mg/kg for rural residential/lifestyle use. The results also exceed the Health and Environmental Guidelines for Selected Timber Treatment Chemicals (Ministry for the

Environment and Ministry of Health, 1997) recommendations for stock health of 38mg/kg (see Table 1).

The laboratory sample was also analysed for Dieldrin with a result of 4.8 mg/kg. The dieldrin result exceeds the NES human health standard of 1.1mg/kg for a rural residential/lifestyle property and the recommended maximum stock guideline of 0.01mg/kg (Sheep Dip Factsheet No 2 Organochlorine Pesticides).

Historic sheep dip sites are also commonly associated with elevated zinc levels. Zinc was often used to treat stock health problems such as foot rot. This activity often occurred at the time of dipping and therefore foot baths were often close to sheep dips. The NES does not include zinc as a priority contaminant for the protection of human health and therefore does not include a maximum human health concentration. In the absence of a New Zealand standard overseas guidelines or standards are usually referred to, in particular Dutch and Canadian guidelines.

The Canadian guidelines establish a maximum zinc concentration for the protection of human health of 200 mg/kg while the Dutch Limit/β value is set at 500 mg/kg. The maximum zinc value recorded at Community Dip Site 1 was 427 mg/kg which exceeded Canadian but not Dutch maximum zinc values. Zinc contamination was generally found in the holding paddock area, however the area containing the maximum concentrations was located near an old shed to the west of the historic dip structure suggesting that a foot bath may have been nearer to that location rather than to the dip itself.

The landowner involved has been advised of the results of soil testing and the need to exclude people and stock from this area.

4.2.2 Community Dip 2

The second historic community dip visited was also a very old dip structure where the associated yards and races had long since gone (See Photo 6) and a certain degree of guess work was necessary to interpret the original layout and operation of the site.

Photo 6: Old Community Dip 2

Initial sampling began with what was taken to be the disposal pit which showed very low arsenic concentrations. With the benefit of hindsight it is likely that the old disposal pit had been filled in with cleaner material following a tidy up around the site. However further testing around the splash zone of the structure soon showed highly elevated arsenic concentrations with a maximum XRF concentration of 1053 mg/kg (see Figure 3). High arsenic concentration extended for nearly 50 metres from the dip structure along the western boundary fence line which was assumed to have been the historic fence line in the days the dip operated as it is along a road frontage. A water course culverted under the road was also tested at both ends of the culvert to provide an indication of any contaminated sediment migrating off site. There was little indication of any such migration although it is likely that the culvert has been replaced since the dip was last operated.

The area of land where arsenic concentrations exceed stock grazing guideline values (38 mg/kg) is approximately 650 m^2 while the area of land which breaches the NES for rural residential human health standard (17 mg/kg) is approximately 850 m^2.

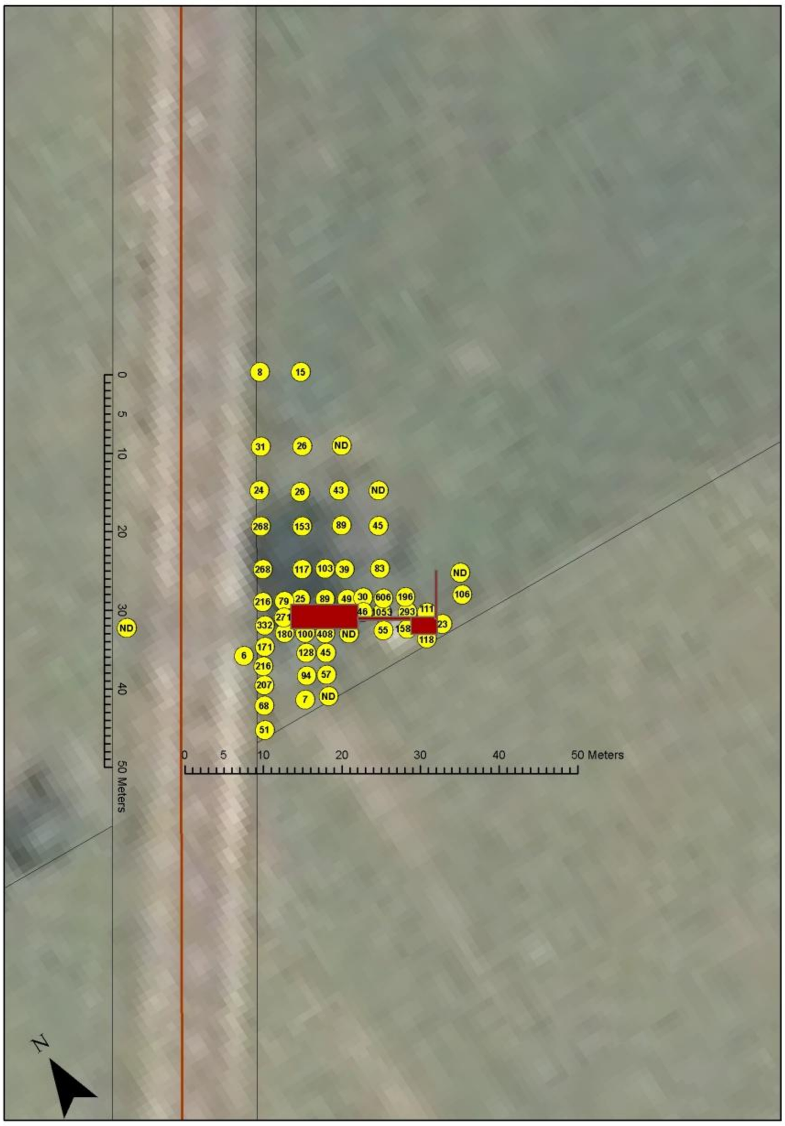

Figure 3: XRF Arsenic levels in mg/kg old Community Dip 2

A laboratory arsenic sample was taken at the location of the highest XRF concentration (1053 mg/kg) with a result of 380 mg/kg. Once again both samples confirmed that the soil was in a highly contaminated state but in this case the laboratory sample result was less than half that of the XRF result.

A dieldrin sample taken at the location of the highest XRF arsenic returned a 25 mg/kg concentration which was by far the highest dieldrin result recorded during the survey. The result substantially breaches the stock grazing guideline value of 0.01mg/kg and also the human health standard for rural residential and residential uses (1.1 mg/kg).

The maximum zinc concentration recorded was 1860 mg/kg greatly exceeding the Dutch Limit/β values. The distribution of zinc was very similar to that of arsenic however the area of highest concentration was located near the eastern end of the dip site suggesting this was the likely location of a foot bath.

The landowner has been advised that this area of the property should be fenced off and retired.

Site Maximum	Deildrin (Lab)	Arsenic (lab)	Arsenic (XRF)	Zinc (XRF)	NES Dieldrin (Lifestyle)	NES Arsenic (Lifestyle)	Stock Dieldrin	Stock Arsenic	Dutch Limit/β Zinc
Community Dip 1	4.8	1150	494	427	1.1	17	0.01	38	500
Community Dip 2	25	380	1053	1860	1.1	17	0.01	38	500

Table 1: Maximum Arsenic and Dieldrin Concentrations Community Dip Sites in mg/kg

4..2 Private Dips

Nine other historic private dip sites were visited during the course of the project. They were distributed between plunge dips (3), shower dips (4) and unknown structures (2).

The plunge dips tended to be older with two of them being pot dips. Three of the shower dip sites were comparatively modern with one of them still in use, while the fourth was very old and disused. The two unknown structures were both highly modified concrete footings of unknown history however both were associated with historic woolsheds and yards.

4..3 Private plunge dips

All the private plunge dips visited were disused (see Photo 7 below). The degree and distribution of contamination present varied with the age of the dip, the size of the property and decisions made by various landowners (a long time ago) regarding the type and concentration of dip chemicals.

Photo 7 disused private plunge dip

Arsenic contamination varied from a maximum of 29 mg/kg at one site to a maximum of 270 mg/kg at another site, however it was found that where low arsenic results were low, dieldrin results were found to be high. Once again these variations probably reflect the age of the dip and the decisions made regarding the use of dip chemicals. The private plunge dip with the lowest arsenic concentration (29mg/kg) had the highest dieldrin result (13.2 mg/kg) for this dip type. However, to further confuse matters another plunge dip with a modest arsenic maximum (91mg/kg) had dieldrin concentrations below detection limits, suggesting either a low intensity of use or use of some other dip chemical.

At those sites where metal contaminations levels were low, the XRF was of little use to characterise the extent of the site apart from within the immediate vicinity of the dip itself. In other parts of the site the XRF recorded non detects. Also, on sites where metal contamination levels were low and dieldrin was high, the landowners present at the time of sampling got a quite misleading understanding of the nature and extent of site contamination and of its implications for future management. It was not until the laboratory results became available and they received the written report from the council that they became aware of the true nature of contamination. Even then they did not receive much guidance on the spatial extent of the contamination as the low metal levels meant that the XRF was unable to delineate the extent of the site.

Maximum contamination concentrations for the private plunge dips sampled are contained in Table 2 below.

Site Maximum	Dieldrin (Lab)	Arsenic (lab)	Arsenic (XRF)	Zinc (XRF)	NES Dieldrin (Lifestyle)	NES Arsenic (Lifestyle)	Stock Dieldrin	Stock Arsenic	Dutch Limit/β Zinc
Plunge Dip 1	13.2	29	18	476	1.1	17	0.01	38	500
Plunge Dip 2	6.8	270	157	3360	1.1	17	0.01	38	500
Plunge Dip 3	<0.005	91	115	3153	1.1	17	0.01	38	500

Table 2: Maximum Arsenic and Dieldrin Concentrations Private Plunge Dip Sites in mg/kg

Two of the plunge dips had foot baths associated with them (2 and 3). In both cases the exit from the foot bath was in a different location to the exit from the dip itself. In and around the foot bath exit zinc concentrations were very high (>1000). Away from the foot bath location the zinc distribution mirrored arsenic concentrations within the holding paddock area. The zinc distribution associated with Private Plunge Dip 2 is shown in Figure 4 below. While the maximum zinc concentration measured at this site was a massive 3360 mg/kg, site investigations subsequently undertaken by a suitably qualified and experienced person engaged by the landowner identified zinc levels at nearly twice this concentration (5826 mg/kg) below the grate floor of the woolshed. The footbath for this site is shown in Photo.8 below.

Photo 8: Footbath at Private Plunge Dip with High Zinc Levels

Figure 4: Zinc Concentrations (XRF) Associated with a Footbath at Private Plunge Dip 2 (mg/kg)

4..4 Private Shower dips

Of the four shower dips sampled at least one was still operational with the farmer concerned commenting that he got far better control of external parasites using a dip type application than he did with a pour on application. That dip is shown in Photo 2 above. It is of interest to note that dieldrin was below detection limits for this site and arsenic levels were also comparatively low (max 53 mg/kg XRF). The details are contained in Table 3 below.

The oldest shower dip tested (Photo 9 below) had been disused for many years yet showed the highest concentration of all the contaminants tested for. In general shower dip sites showed lower concentrations of arsenic and dieldrin than did private plunge dip sites and much lower than community dip sites. In terms of extent spray dip sites tended to be smaller and more confined See Figure 5 below. The maximum contaminant concentrations for spray dip sites are given in Table 3 below.

Figure 5: Arsenic Contamination Spray Dip Site in mg/kg

Site Maximum	Dieldrin (Lab)	Arsenic (lab)	Arsenic (XRF)	Zinc (XRF)	NES Dieldrin (Lifestyle)	NES Arsenic (Lifestyle)	Stock Dieldrin	Stock Arsenic	Dutch Limit/β Zinc
Shower Dip 1	<0.005	44	53	250	1.1	17	0.01	38	500
Shower Dip 2	0.4	10	13.5	320	1.1	17	0.01	38	500
Shower Dip 3	0.01	24	27	444	1.1	17	0.01	38	500
Shower Dip 4	0.81	280	209	1324	1.1	17	0.01	38	500

Table 3: Maximum Arsenic and Dieldrin Concentrations Private Shower Dip Sites in mg/kg

Photo: 9 Old Shower Dip Site 4

4..5 XRF Arsenic results v/s Laboratory Results

A laboratory sample was taken and analysed for arsenic at the sampling location of the highest XRF arsenic result.

As previously commented in 4.2.1 and 4.2.2 above, at high arsenic concentrations there were some significant variations between the results of the XRF and from analysis of laboratory samples. Relationships between XRF vs. laboratory results also varied site by site with the XRF being both higher and lower at different sites.

At lower concentrations the XRF and laboratory results tended to be closer together with the XRF result tending to be slightly higher than the lab result. A comparison of XRF results and corresponding laboratory results is contained within Table 4 below.

A review of literature associated with XRF use suggests the difference in results between methods may be attributable to a number of factors.

- Interaction between metals during the X-ray fluorescence process can impact on reported results. Newer XRF instruments tend to have more sophisticated quality assurance routines to manage this effect but it is probably still present where contaminant concentrations are high.
- Laboratory analysis of contamination concentrations are reported as dry weight while an XRF used to analyse insitu soil has no correction for the variable soil moisture content. Therefore, even in a soil with homogeneous contamination levels, variations in soil moisture content can lead to apparent variations in contamination readings.
- A XRF uses a very small soil sample volume during its analysis when compared to the larger soil volume taken for a laboratory analysis. In a non homogeneous soil this could also lead to variable results.

As a general observation where the XRF recorded high arsenic levels so too did the laboratory results. Where the XRF indicated low arsenic levels so too did the Laboratory results. At lower arsenic concentrations there tended to be lower variability between the XRF and laboratory results.

Lab	XRF	Percentage Difference (absolute)
10	13.5	35%
24	27	12%
26	26	0%
29	18	-38%
44	53	20%
91	115	26%
270	157	-42%
280	209	-25%
380	1053	177%
1150	494	-57%

Table 4: Comparison of Arsenic Results for XRF and Laboratory Analysis

5 Slipways

5.1 Informal Maintenance of Smaller Recreational Vessels

Five of the mooring and boat maintenance areas visited during the survey comprised of mooring and wharf structures without any associated hard stand area above the high tide mark. Vessels were generally maintained on their moorings, on beaches, pulled up close to the high tide mark, or tied up alongside wharves, piles or grids. Maintenance work tended to occur during the low tide period and was limited to cleaning and repair. Stripping of paint and repainting is limited in this situation.

The XRF was used to sample obvious beach locations of where a vessel was moored or had been worked on as well as sampling general intertidal areas where antifouling paint or other material from vessel maintenance may have settled. In general the survey concentrated on copper and zinc as both are common bases in antifouling paint preparations.

Figure 6 below shows the Otuwhero inlet in the Marahau area with small recreational vessels on swing moorings. Within the Otuwhero Inlet measured copper levels were all below the detection limits of the XRF. The zinc levels while detectable were also at very low and probable background levels for the area.

Across all five sites sampled zinc concentrations were well below the ANZECC 2000 Interim Sediment Quality Guidelines (ISQG) Low levels of 200 mg/kg

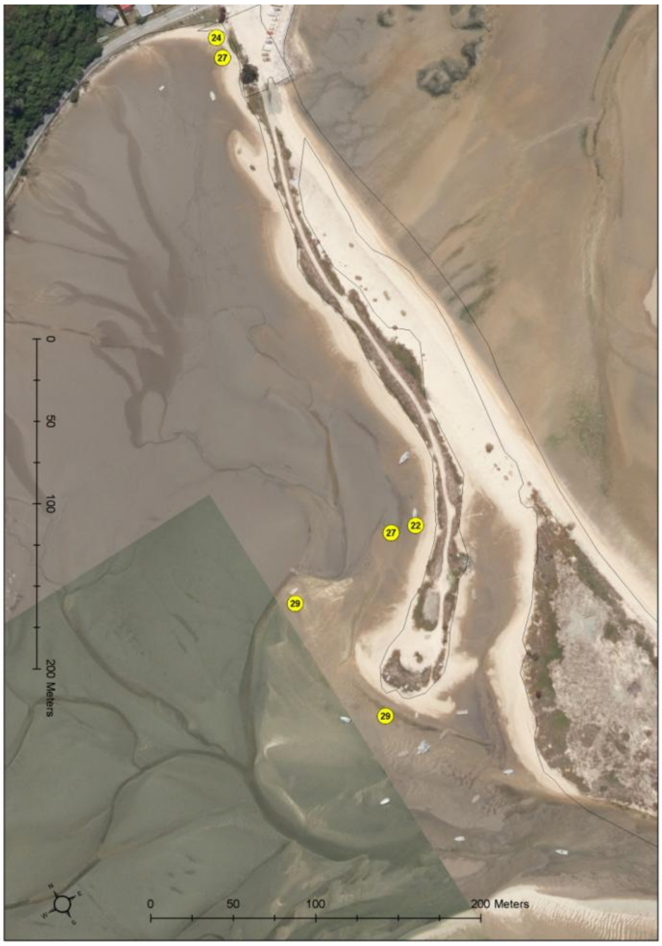

Figure 6: Zinc levels Otuwhero Inlet (Marahau) in mg/kg

With the exception of one site where a vessel was undergoing maintenance at the time of sampling, maximum copper concentrations were lower than the ISQG Low limits indicating a low probability of biological effects for areas where vessel maintenance activity is of low intensity. The maximum copper and zinc results for each site sampled are contained within Table 4 below.

Location	Maximum Copper	Maximum Zinc	ISQG Low Copper	ISQG High Copper	ISQG Low Zinc	ISQG High Zinc	NES Copper
Milnthorpe	30	49	65	270	200	410	>10,000
Collingwood	13	58	65	270	200	410	>10,000
Marahau	ND	29	65	270	200	410	>10,000
Riwaka	22	169	65	270	200	410	>10,000
Mapua Wharf**	283	102	65	270	200	410	>10,000

Table 4: XRF Results for Small Informal Boat Maintenance Areas Compared to ANZECC 2000 Sediment Quality Guidelines in mg/kg

The one site where copper levels exceeded both ISQG low and ISQG high guidelines was at the Mapua wharf where a vessel was being maintained at the time of sampling. Paint flakes were clearly visible in the gravels immediately beneath the vessel (See Photo 10). XRF samples taken in the area beneath the hull amongst the paint flakes identified copper levels which just exceeded ISQG high (283 mg/kg) however away from the vessel by only a few metres copper levels had fell below ISQG Low (See Figure 7).

It is likely that the very strong tidal currents occurring at the Mapua Wharf quickly remove any paint material and flush it away diluting contaminant concentrations below possible effects levels.

Photo 10: Paint Flakes below a vessel being maintained at Mapua Wharf

Figure 7: Copper levels Mapua Wharf mg/kg

5.2 Small local slipways

Two small local slipways with associated hardstand areas were sampled as part of this project. One on the upper west coast at Westhaven Inlet and the other within the Mapua Inlet area at Grossi Point. Both of these sites are periodically used to maintain small vessels clear of the water on hardstand areas landwards of the ramp. There was no vessel maintenance occurring at either location at the time of the survey although a beach trailer was present at Grossi Point (see Photo 11).

The intertidal beach area at Grossi Point was sampled using a grid pattern. Zinc levels recorded were all at near background levels. A copper detect was (19 mg/kg) occurred at the seaward end of the launching ramp. All other beach samples were non detects and all results were lower than ISQG Low (See Figure 8).

However sampling of the hard stand area at Grossi Point around the beach trailer revealed modest contamination of both zinc and copper distributed in a pattern which suggested work on a number of small vessels. Contamination levels of zinc were still below ISQG low levels, however, copper slightly exceeded ISQG Low but was well within ISQG High and well below NES standards (See Table 5).

Photo 11: Hard Stand Area Grossi Point Mapua and Beach Trailer

Location	Max Copper	Max Zinc	ISQG Low Copper	ISQG High Copper	ISQG Low Zinc	ISQG High Zinc	NES Copper
Grossi Point	70	85	65	270	200	410	>10,000
Westhaven	605	1531	65	270	200	410	>10,000

Table 5: XRF Results for Small Local Slipways Compared to ANZECC 2000 Sediment Quality Guidelines and NES in mg/kg

Sampling at the Westhaven Slipway and hard stand showed a very similar pattern to that found at Grossi Point although generally contaminant concentrations were much higher at Westhaven. Around the ramp and along the water's edge both copper and zinc concentrations were slightly elevated above background levels but below ISQG Low.

However, to the landward side of the ramp on the parking and hard stand area, two comparatively small areas were identified with discolouration amongst the gravels including the occasional paint flake. Within these discoloured areas both zinc and copper levels were quite elevated exceeding ISQG High copper levels for probable ecological effect but still below NES standards for human health protection. While no vessels were present on the hardstand at the time of sampling, it appears that from time to time maintenance activity occurs at Westhaven inlet and at least some of the resulting contamination is left in the gravels beneath the work area. This may be a reflection of the relative isolation of the area.

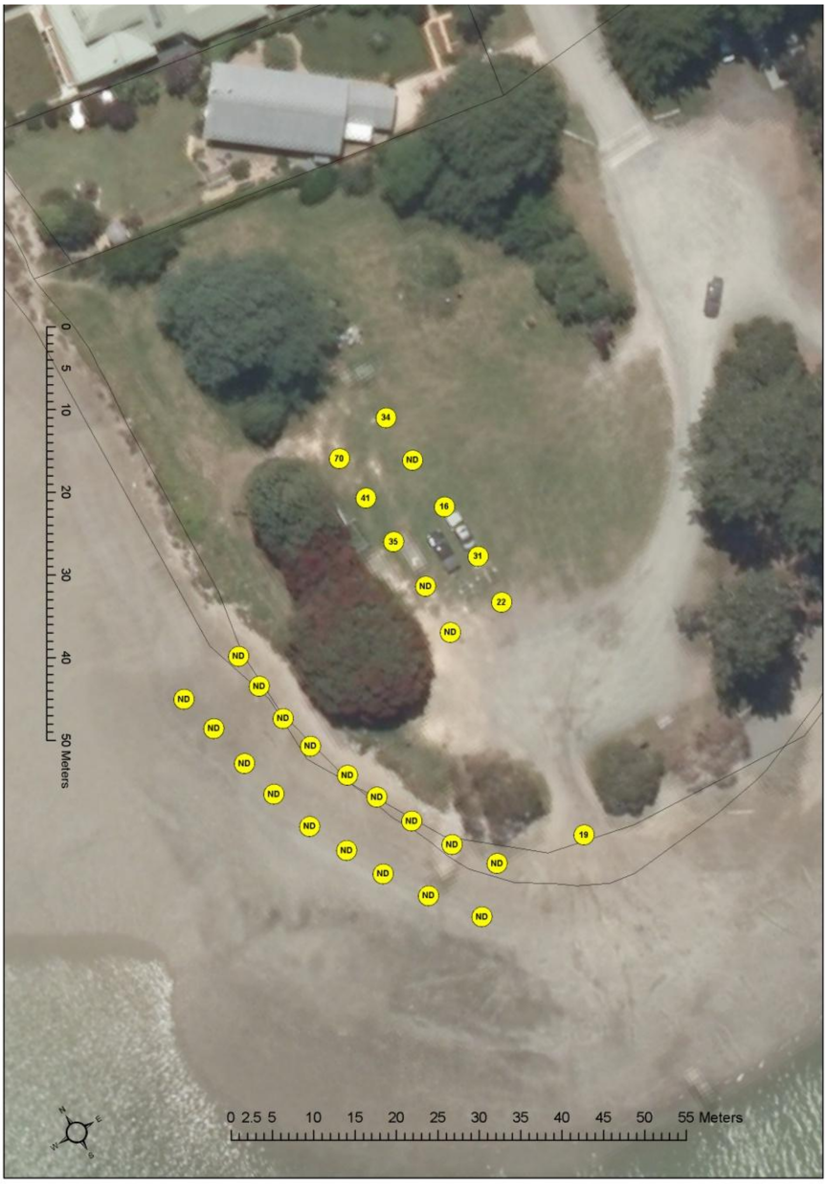

Figure 8: Copper Concentrations Grossi Point Mapua in mg/kg

5.3 Larger community Slipways

Two larger slipways were also sampled during the project. Both these slipways are regularly used for maintenance of local recreational and inshore fishing vessels. The slipways are located at Port Motueka in Tasman Bay and the other is at Waitapu Bay in Golden Bay in a relatively isolated area. Both of these slipways had active vessel maintenance activity occurring at the time of sampling. See Photos 12 and 13 below.

Photo 12: Motueka Slipway showing Paint Fragments in the Gravels and Paint Spray on Adjoining Rocks

Photo 13: Waitapu Bay Slipway with Paint from Vessel Water Blasting Shown Near the Beach Cradle and on the Ramp and Beach

Both slipways showed areas of extremely elevated copper and zinc concentrations well in excess of ISQC High levels indicating probable ecological effect. Both slipways also exceeded the NES standards for protection of human health indicating potential human health risks. The maximum concentrations of copper and zinc recorded at these two slipways are contained within Table 6 below.

Location	Max Copper	Max Zinc	ISQG Low Copper	ISQG High Copper	ISQG Low Zinc	ISQG High Zinc	NES Copper
Port Motueka	76000	22000	65	270	200	410	>10,000
Waitapu	19700	9578	65	270	200	410	>10,000

Table 6: XRF Results Larger Slipways Compared to ANZECC 2000 Sediment Quality Guidelines and NES in mg/kg

Sampling results from Port Motueka were highly variable. Much of the site had recently been resurfaced with fresh gravel and as a result some ramp and hardstand areas which otherwise may have show high contamination levels only showed low contamination levels, below the detection limits of the XRF. See Figures 9 and 10 below.

Figure 9 Port Motueka Copper levels Port Motueka in mg/kg

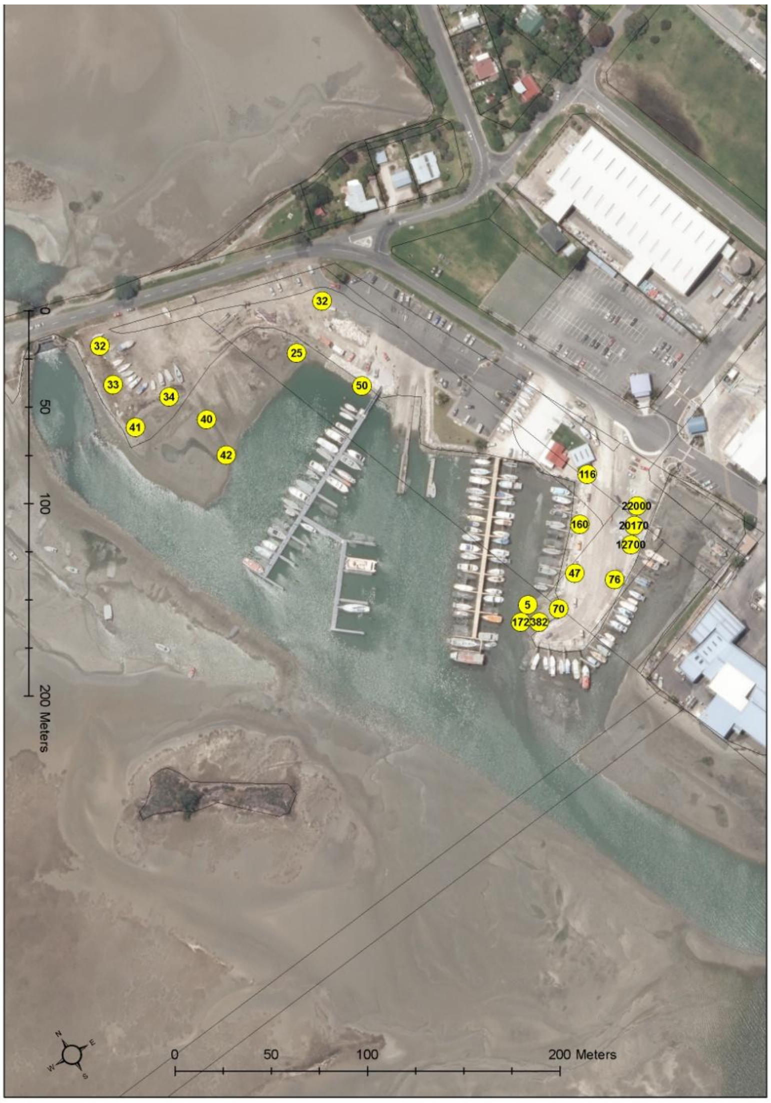

Figure 10 Port Motueka Zinc levels in mg/kg

The resurfaced areas included most of the western port area which had vessels present at the time of sampling but neither copper nor zinc was detectable around the water's edge or on the hardstand.

By contrast the eastern Port Motueka area showed areas of extremely elevated copper and zinc where obvious vessel maintenance had recently taken place.

Paint flakes were visible on parts of the launching ramp and testing with the XRF showed high copper and zinc levels associated with these flakes. This suggested that vessels had been cleaned down on the ramp itself or close to it allowing wash water including antifouling paint to discharge back into the Inlet.

Most of the eastern hardstand area appeared to be capped with recently imported gravel, however around a vessel cradle present were areas of very recent paint flakes and evidence that a spray gun had been patterned on adjoining rocks (See Photo 12 above). XRF results for this area were at the highest levels recorded during the survey. Copper levels reaching

76000 mg/kg and zinc levels 22000 mg/kg both well in excess of ISQC High indicating probable ecological effects and in excess of NES levels for human health protection.

While most of the hardstand area comprised fresh hard fill, recent landscaping of the area comprising a number of palm trees had been undertaken. Excavations through the hard fill for these palms provided the opportunity to sample below the surface of the fresh gravels. The sampling results at these locations showed that at depth both copper and zinc levels were elevated above background levels however they were still below ISQG low and NES levels

The other larger community slip sampled was at Waitapu Bay within Golden Bay near Takaka (See Photo 13 above). At the time of sampling an inshore fishing vessel was in the process of being maintained on a cradle located at the top of the slipway rails. A number of smaller vessels were also present on the adjoining hardstand area. There was strong evidence of paint material around the slip rails and also in parts of the hardstand area. Empty antifouling paint containers were present in a rubbish drum beside the slipway. Sampling was undertaken along the intertidal margin, around the slip rails, and in a grid pattern across the hardstand area. The sampling results are shown in Figures 11 and 12 below.

Figure 11: Waitapu Bay Copper levels in mg/kg

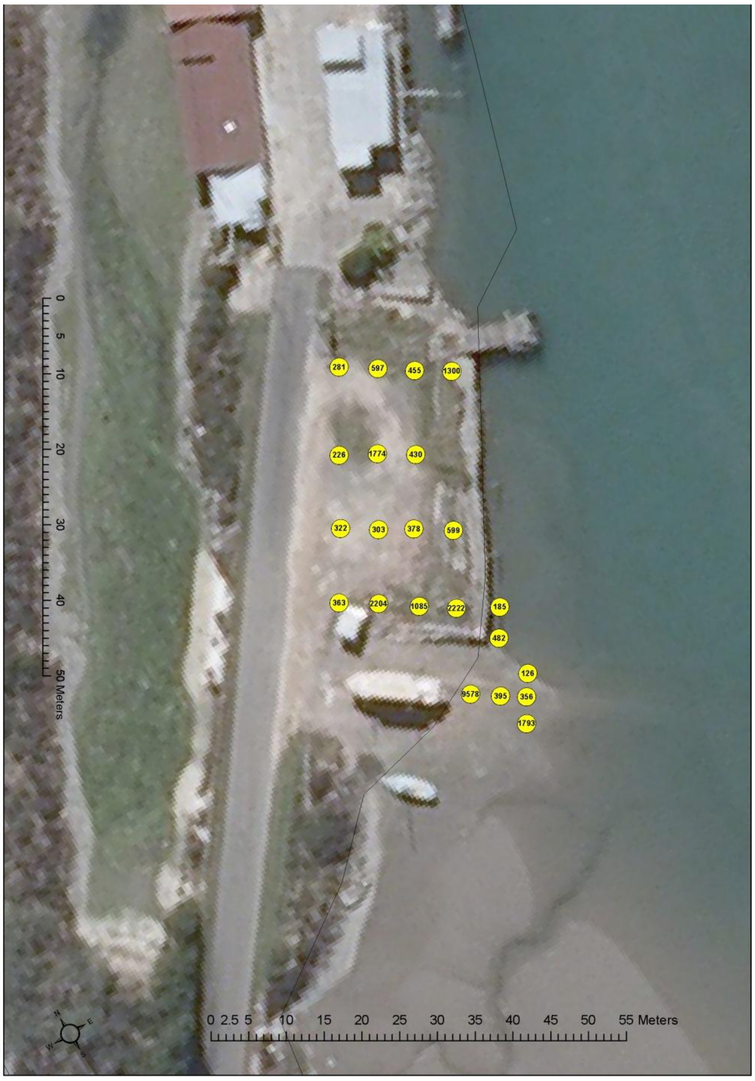

Figure 12: Waitapu Bay Zinc levels in mg/kg

Within the slip rails area both copper and zinc concentrations exceeded both ISQG High and NES levels. The maximum copper and zinc levels were close to or under the vessel being maintained on the slipway at the time.

Within the hardstand area ISQG high levels for both copper and zinc were also exceeded, in places by substantial margins, however NES levels were not breached.

6 Conclusions

6.1 Dip Sites

- The XRF proved to be a very convenient and useful tool to undertake this type of survey allowing great flexibility to sample any suspect areas and to delineate areas of elevated contamination.
- While a significant difference existed between some XRF results and the corresponding laboratory results, in general where the metal levels recorded by the XRF were low, so were the corresponding laboratory results. Conversely where the XRF results were high so were the laboratory results.
- Both the percentage difference and absolute difference between the XRF and laboratory results tended to be lower at lower concentrations.
- Where sites were mainly contaminated with dieldrin rather than arsenic, the XRF survey was of limited value to profile the extent of the site as apart from the immediate dip area, the XRF recorded “Non Detects”.
- With sites mainly contaminated with dieldrin it was difficult to provide the landowner with immediate and accurate feedback concerning the nature and extent of contamination. At the time of XRF testing these sites appeared to be relatively clean with few long term management implications, however when the laboratory results for dieldrin became available (some weeks later) the degree of contamination became better known but the extent of the site was still unknown.
- Old community plunge dips showed the highest levels of contamination and the greatest extent of contamination. Metal contamination levels were recorded of up to 1000 mg/kg for arsenic and 25 mg/kg for dieldrin.
- Areas surrounding old community dips breached both human health and stock health standards and guidelines for both metals and dieldrin. The degree and extent of the contamination at these community dip sites suggest that the most practical management approach is to fence them off and retire them.
- Areas surrounding private plunge dips usually breached both human health and stock health standards but contaminant concentrations were lower than those found around community dip sites and the sites were not always contaminated with both metals and dieldrin. They tended to be contaminated with one or the other.
- Both community and private plunge dip sites were associated with elevated zinc levels possibly from footbaths. In some cases maximum zinc levels were above measured 3000 mg/kg. In the absence of New Zealand zinc limits these results were compared with Canadian and Dutch guidelines which they substantially exceeded.
- Private shower dips tended to be the least contaminated dip type with some meeting the stock heath guidelines for arsenic and/or dieldrin. Private shower dips also tended to be associated with a smaller extent of contamination than did plunge dips

- Older shower dips tended to be associated with the higher and more extensive levels of contamination than were more recent or currently used shower dips.

6.2 Slipways

- As with sheep dip sites the XRF proved to be a very useful tool to quickly delimitate the extent of contamination associated with slipway areas. While the XRF only records metals and not the booster chemicals (co-biocides) present, most antifouling paints have a metal base.
- The metals with the highest concentrations in and around slipway areas were copper and zinc. These are commonly present in antifouling paint preparations.
- Within swing moorings and informal maintenance areas without hardstand areas, levels of metal contamination were generally very low with results at around background levels. The exception to this was where a vessel was being cleaned down or repainted at the time of sampling. In that situation there were localised elevated metal concentrations present.
- The evidence of contamination from a vessel being actively maintained compared to the overall low background levels suggests that contamination from the limited maintenance occurring at these informal maintenance sites is quickly redistributed throughout the sediments by natural coastal processes.
- Vessel maintenance activity at sites without associated hardstand areas appears to be limited by the window of opportunity between tides and as a consequence is likely to be mainly vessel cleaning rather than full stripping and repainting.
- Where hardstand areas are associated with low intensity informal vessel maintenance, the intertidal areas still meet sediment guidelines but there is variable evidence of sediment contamination found on the hardstands.
- In the case of the frequently used and very public areas such as at Grossi Point, contamination of the hard stand only just exceeded ISQG Low levels for copper and was less than ISQG Low levels for Zinc. By comparison at the isolated hardstand at Westhaven both the copper and zinc levels substantially exceeded ISQG High levels.
- There may also be contamination of the intertidal areas occurring at areas where small vessel maintenance is associated with hardstands, but it appears that removal or dilution of this contamination by natural coastal processes keeps levels at or around background levels.
- At larger more commercial slipway sites contamination including both ramps and hardstand areas, can be very high, substantially exceeding ISQG High and human health guidelines and standards.
- At commercial slipway sites larger vessels appear to be cleaned down and repainted on both ramps and hardstand area. Work on ramps tends to be associated with uncontrolled discharge of paint flakes and wash water straight back into the sea resulting in high contamination levels in the intertidal area.

- While it is likely that there is some removal/dilution of this material from ramps by natural coastal processes, contaminant loading are high enough to leave high levels of residual contamination around the ramps. It is also likely that extensive areas of more dilute contamination are present in the surrounding marine sediments.
- On larger commercial hardstand areas contamination levels can be extremely high exceeding both ISQG High and human health guidelines and standards by many times. There appears to be a culture of “leave it where it lies” with only limited collection of paint from cleaning of vessels and the main management practice being the introduction of new hard fill to freshen the area up.

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