

REDUCING COSTS USING XRF ANALYSER



ASSESSMENT, REMEDIATION AND VALIDATION OF ORCHARD IN HASTINGS, HAWKES BAY

Drs. Ben Keet
Geo & Hydro – K8 Ltd

e-mail: ben@benkeet.com

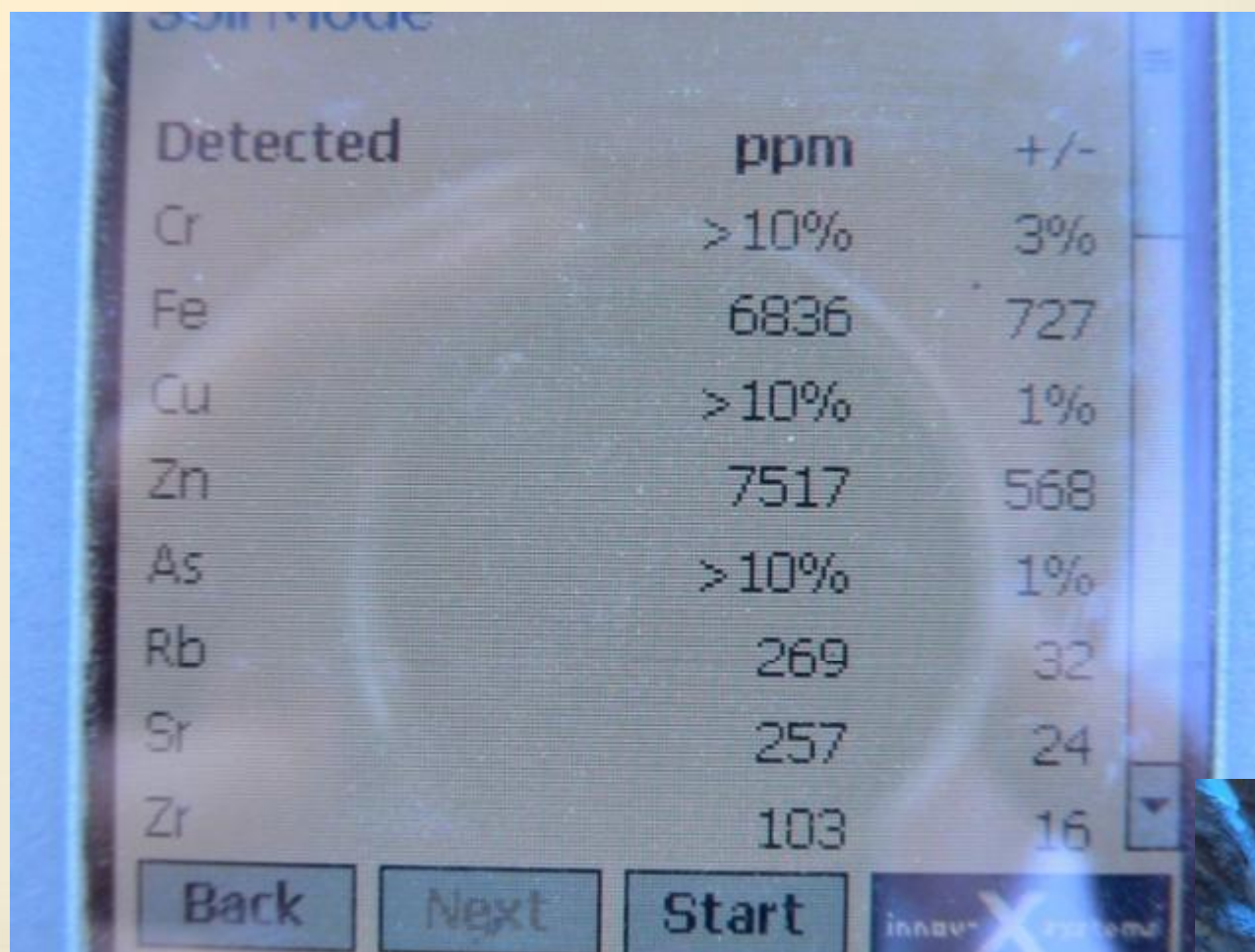
XRF development



Up to 2000, mainly bench top models available (low ppm analysis), some requiring curve matching
Analysis of 30 samples / day



Now field portable XRF with direct readout of 25 metals analyses soil in 20 seconds allowing over 600 analysis per day (LOD 10 ppm)



Detected	ppm	+/-
Cr	>10%	3%
Fe	6836	727
Cu	>10%	1%
Zn	7517	568
As	>10%	1%
Rb	269	32
Sr	257	24
Zr	103	16

Back Next Start innov-X systems



Detection limit 10 mg / kg w.w.
For : As Cr Cu Ni Pb Zn

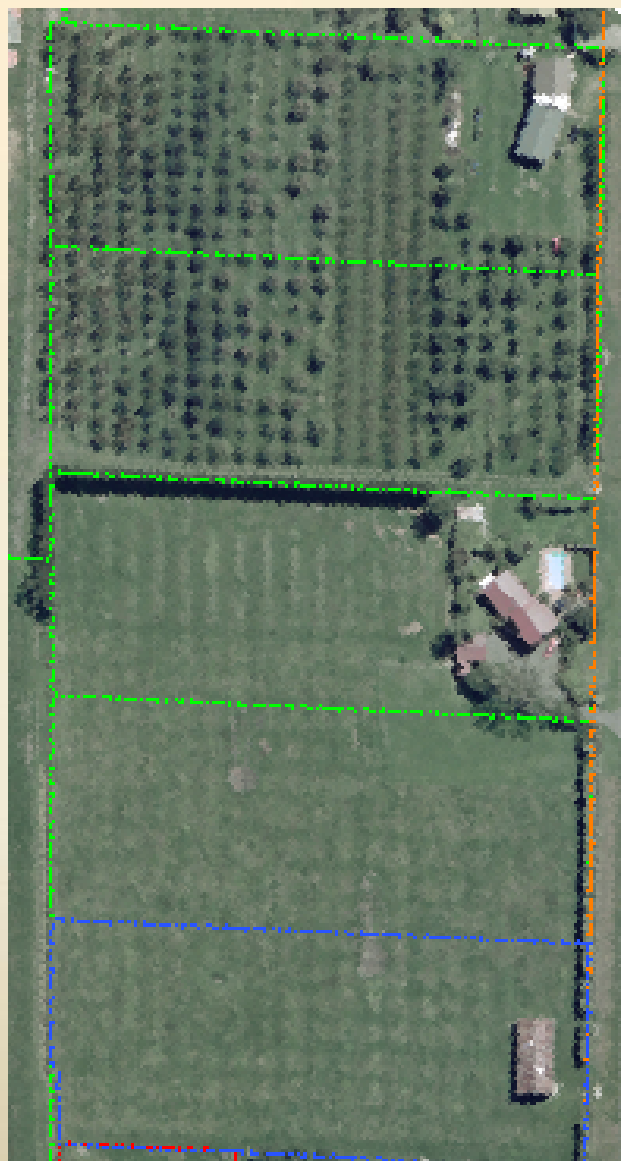


Case:

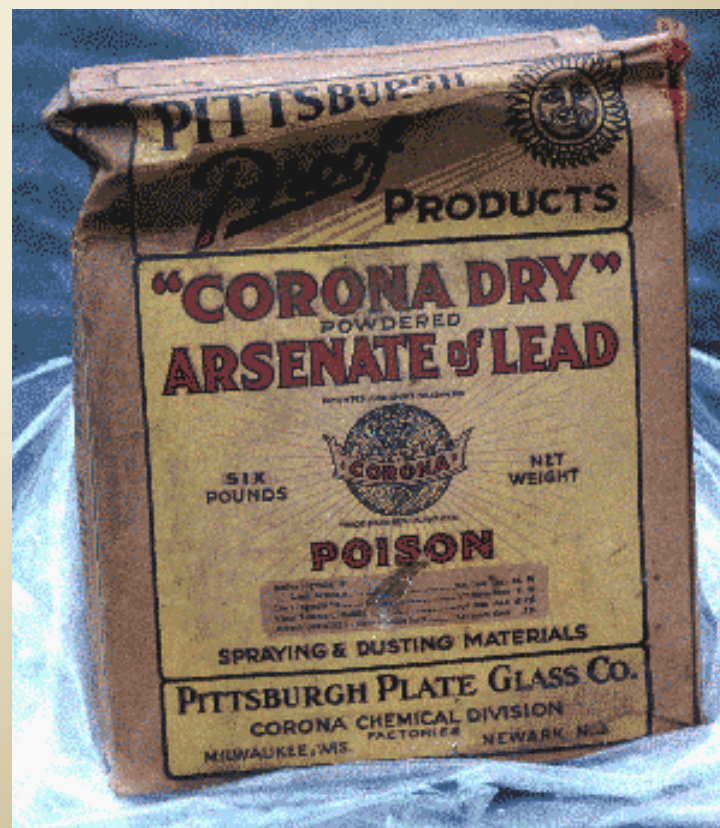
3 ha Orchard, Hastings

Subdivide into 34 lots

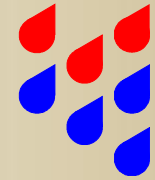
Main contaminant Arsenic



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Environmental Site Assessment (ESA)



Maximum budget ESA \$ 30,000.- ex GST.

Initial budget calculation :

Time and mileage etc.	\$ 1,000.-
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Hist. Search, meetings	\$ 3,000.-
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Reporting	\$ 6,000.-
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Sampling objects / hot spots

10 Lab analysis (Metals, OCPNsc)	\$ 4,000.-
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Remaining to characterise the diffuse

contamination on 3 ha	\$ 16,000.-
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Conceptual Site Model -1

-5 sheds / structures

-2 pear tree blocks

For remediation by soil mixing
Important questions are:

- > Where are further 'hidden' hotspots?
- > What size is important?
- > How deep are they?
- > What volume / concentration?



Conventional Approach

Cost for more data gathering

	per sample
Sample taking, COC, courier to lab	\$ 22.50
Analysis (3 metals)	<u>\$ 57.50 +</u>
total	\$ 80.-

For \$ 16.000.-

We can get 200 samples taken and analysed

Sampling 2 layers → 100 data points / layer

3 ha/ 100 = 1 data point/ 300 m² (grid size 18x18 m)



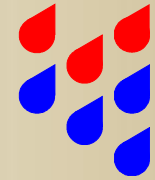
A 18x18 m 200 ppm hotspot requires 945 m³ 'background' soil to dilute to < 25 mg/kg

Calculation of potential contamination capacity of a hotspot when mixed into soil at 'background' concentration

				grid size :	6 x 6	12 x 12	18 x 18	24 x 24	30 x 30	(m)
				grid area :	36	144	324	576	900	(m2)
hotspot	background concentration	final conc.	mixing	5.4	21.6	48.6	86.4	135	grid volume at 150 mm	
mg/kg	mg/kg	mg/kg	factor	volume of background soil required to dilute hotspot to 'below guideline / final concentration' in m3 ?etc						
200	4	25	8	45	180	405	720	1125		
200	8	25	10	56	222	500	889	1390		
200	12	25	13	73	291	654	1163	1817		
200	16	25	19	105	420	945	1680	2625		
200	20	25	35	189	756	1701	3024	4725		
200	24	25	175	945	3780	8505	15120	23625		

945 m³ at 200mm topsoil thickness requires 5000 m²

Conventional sampling – analysis



Conclusions

- Minimum grid size 18 x 18 m
- **Undetected** hotspots up to 300 m²
- Requires about 1000 m³ to dilute
- Topsoil of 200 mm: this requires area of 5000 m²
- If more than 6 hotspots →

soil mixing would be a failure

- Need to identify hot spots more accurately

Extra problem: in parts topsoil on site up to 600 mm thick



Alternative method

Cost for more data gathering

2 man site team + XRF \$ 200.-/hr

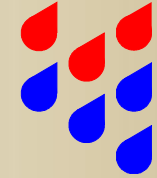
Sample 4 layers (0 – 75 – 200 – 400 – 700mm)

AND analysing each takes 4 minutes / borehole

At a cost of: \$ 13.50 / borehole (\$ 3.50 /sample)

→ 3696 samples were taken and analysed from
924 grid points, reducing **grid size to 6 x 6 m**

With \$ 3,500.- left over for QA/QC analysis



Conceptual Site Model -2

9 hot spot areas

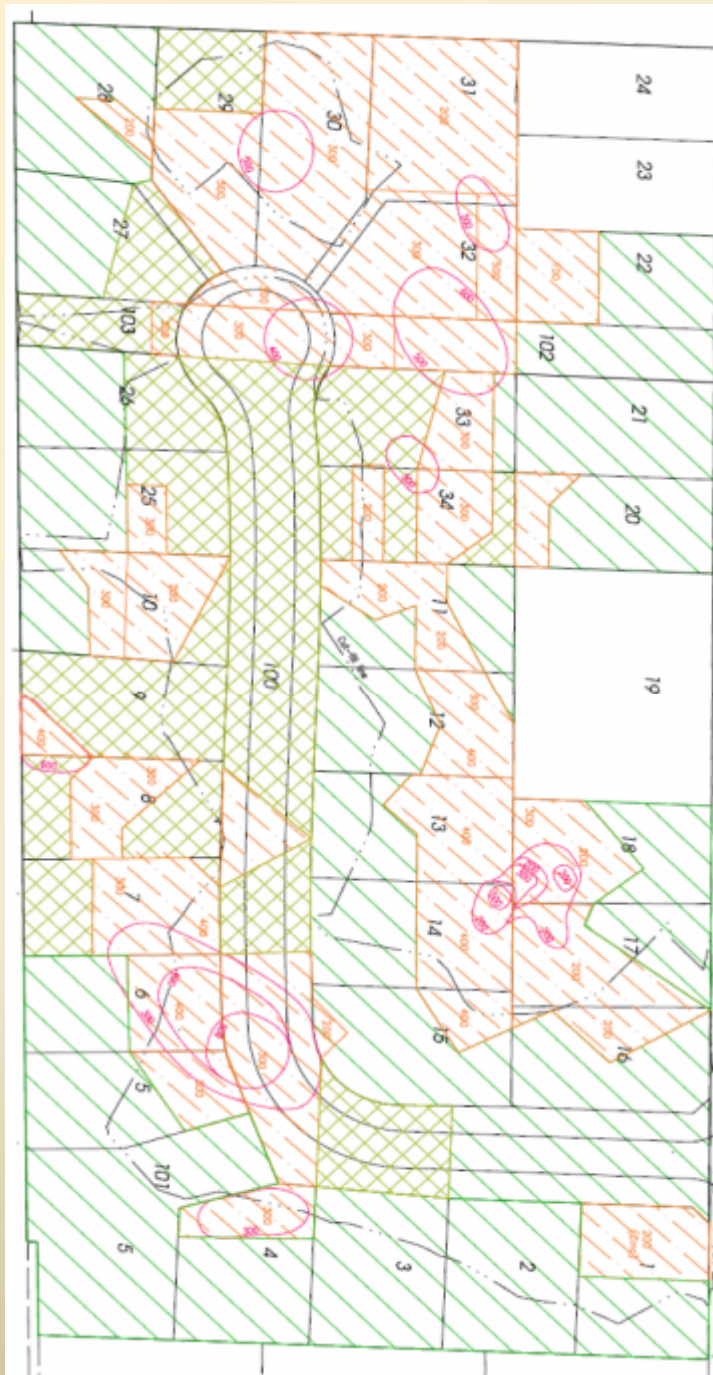
2 associated with 'objects'

7 not related to objects

Hotspots to depth of 600 mm

Based on hot spot removal
BEFORE mixing final As
concentration is calculated to
become 24 mg/kg

**Mixing without hotspot removal
gives As conc. 36 mg/kg**





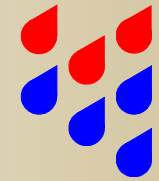
Setting out Hot Spots



Hot Spot removal



H = too Hot — bury in Reserve



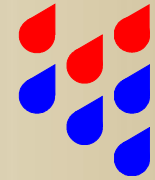
X = OK to MiX

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After burial of hot spot soil
in reserves..



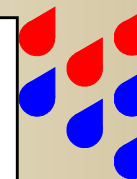
all remaining top soil is stripped and laid
on a mix pile in 50 mm layers

Mixing by disking

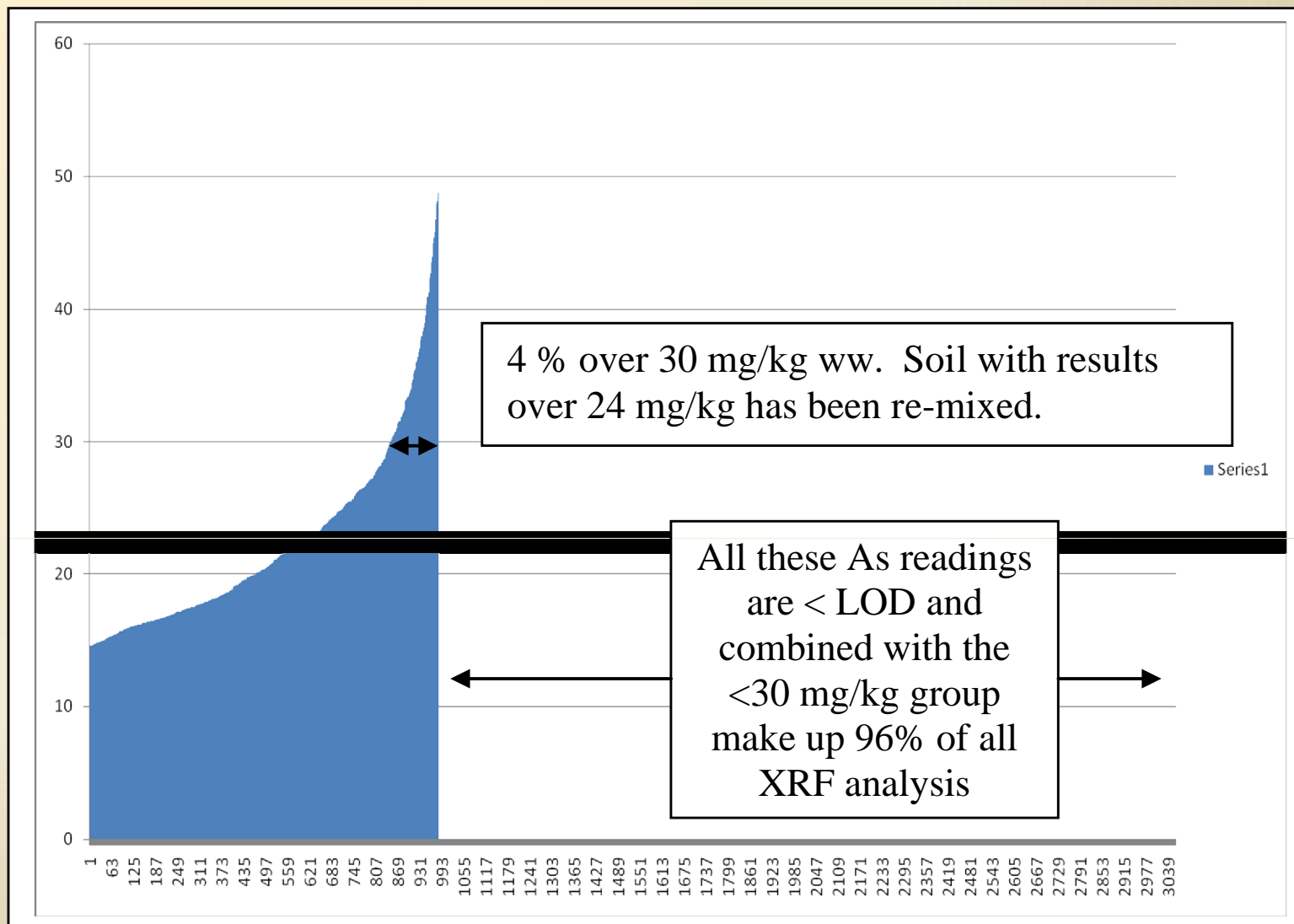




Over 3000 XRF
analysis
performed during
soil mixing



As concentration in mg/kg w.w.



Number of XRF measurements taken during mix-pile (no. 2) construction

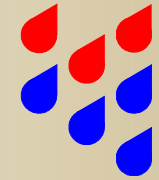


Vertical mixing
before final lay-out
on sections



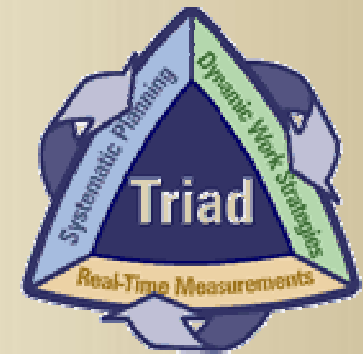
Result of XRF site checks

- 4 more hotspots detected
and separated from mix-pile soil
- No hold-up for contractor
- All laboratory analysis of soil laid out on sections
had concentrations below guideline levels
- No re-mixing required !



Conclusion: **Better & Cheaper**

- Greatly improved data quality
- Very cost effective
- Fits perfectly in TRIAD approach
- XRF saved a costly re-mix (\$ 85,000.-)



Suited to clients who like you to:

“do it right; do it once” & save money !

Questions - Discussion

