Photograph V-14: Sample G5913 contained elevated concentrations of copper, lead and zinc.

Photograph V-15: The soil in the large black stain immediately south of Pole Vault Building 222 contains PCBs at concentrations in excess of 50 ppm.

Photograph V-16: Soils and vegetation collected from drainage off the northeast corner of Pole Vault Building 222 contained PCBs in excess of the criteria.

Photograph V-17: Soil sample G5925 was collected in this stained seasonal drainage catchment, and contained elevated concentrations of PAHs

ii. Communications Building S-28

Delineation and assessment soil samples were collected in areas around Building S-28. Only one delineation soil sample contained PCBs at a concentration in violation of CEPA (>50 ppm). One assessment soil sample collected near Building S-28 contained concentrations of dioxins in excess of the CCME R/P Remediation Criteria.

a) Inorganic Elements

Six of the eight soils collected in the vicinity of Building S-28 were analyzed for inorganic elements. Mean and maximum concentrations of all analytes were below the DCC (Figure V-5). Mean levels of all analytes were comparable to the mean concentrations calculated for background soils. None of the individual soil samples

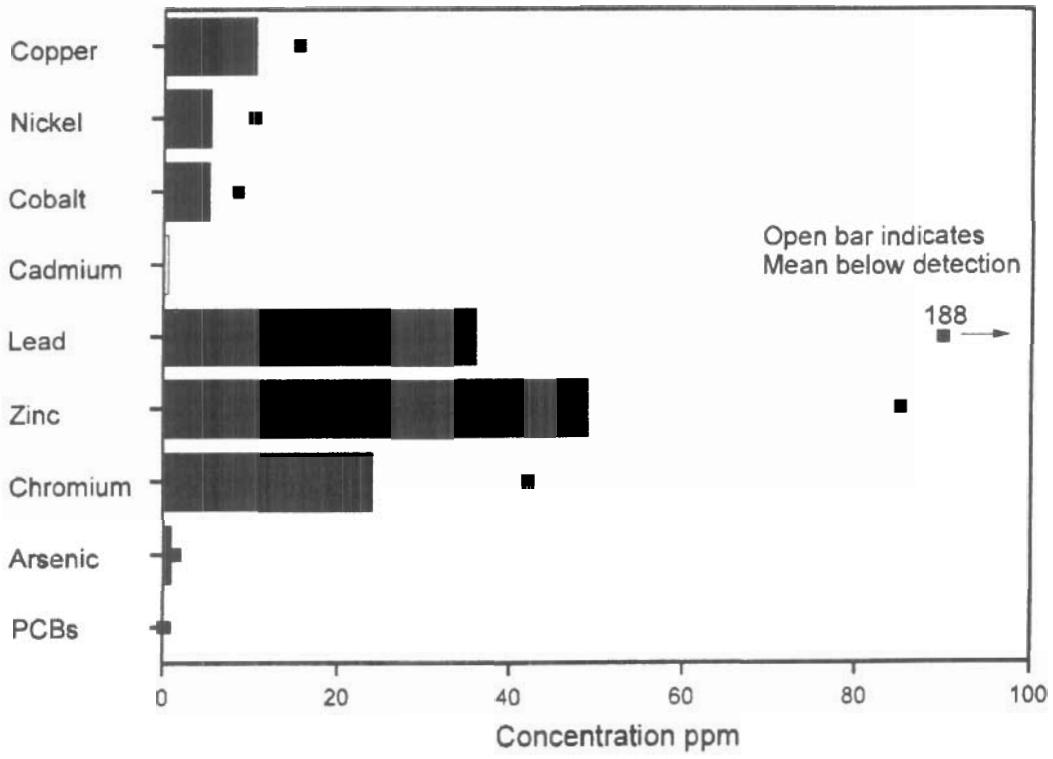


Figure V-5: Mean and Maximum Concentrations of Inorganic Elements and PCBs in Communications Building S-28 Soils.

collected in the vicinity of Building S-28 contained any of the inorganic analytes at a concentration exceeding the criteria. The level of lead (188 ppm) in a sample collected at the base of a creosoted pole stump (G5949) approached DCC Tier I. Due to the low levels of inorganic elements present in the soils collected near Building S-28, none of the corresponding plant samples were analyzed for inorganic elements.

b) Polychlorinated Biphenyls

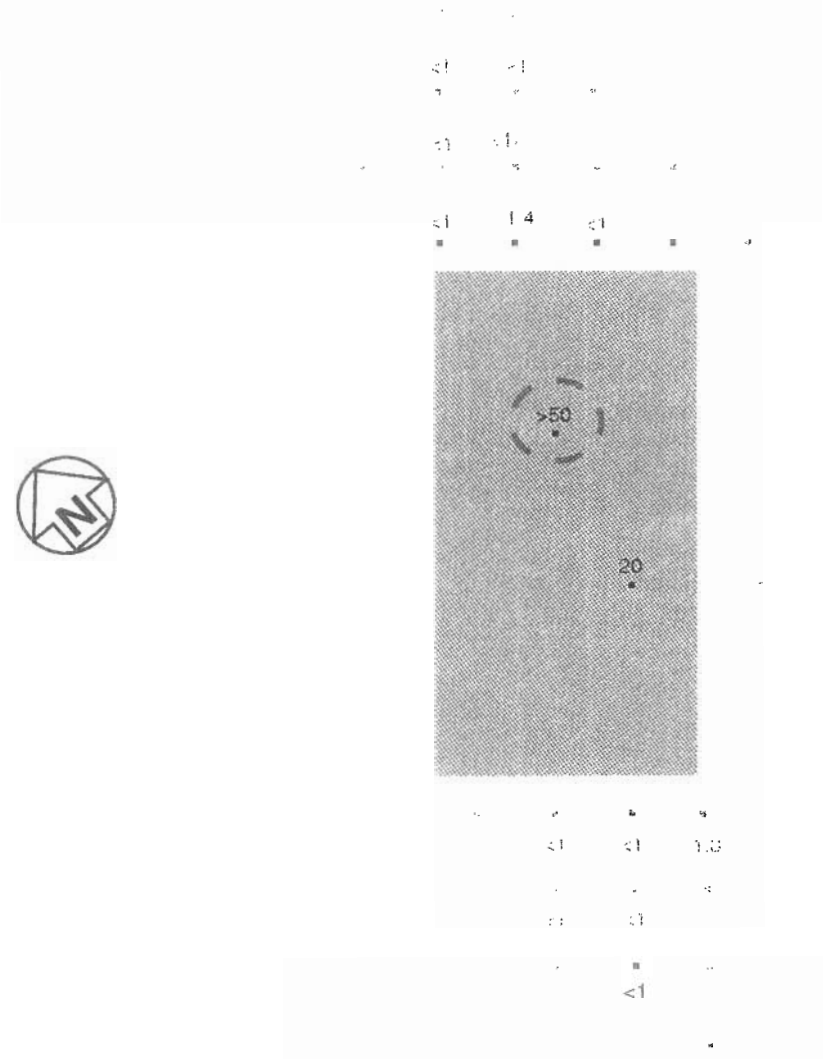
Of the 31 delineation soil samples collected around Building S-28, 13 were analyzed for PCBs by test kit. Confirmatory analysis by GC/ECD was carried out on four of the delineation samples. PCBs were detected at concentrations exceeding the level regulated under CEPA (>50 ppm) in one sample of burned material collected from the floor of the building (Map V-12). The test kit result for a second sample collected from the floor of the building was also greatly elevated (20 ppm) but not over the CEPA-regulated level. PCBs in excess of DCC Tier I were detected in the two delineation soil samples collected outside the doors of Building S-28.

Six of the eight assessment soil samples collected in the vicinity of Building S-28, including a field duplicate, were analyzed for PCBs. Mean (0.042 ppm) and maximum (0.13 ppm) concentrations of PCBs were well below the DCC (Figure V-5). Concentrations of PCBs in some samples (G5949 and G5943) were not significantly elevated above the mean concentration in background soils.

One of the six plant samples collected in the vicinity of Building S-28 was analyzed for PCBs. G5945P (*Salix arctica*), collected in a drainage path 15 m east of the building, contained PCBs (7.9 ppb) at a concentration 13 times the mean calculated for background plants (0.59 ppb).

All three wood samples and the two insulation samples collected from the interior of the building were analyzed for PCBs by GC/ECD. Concentrations of PCBs were elevated above 1 ppm in all but one of these samples; PCBs were undetectable in one insulation sample.

Map V-12: PCB Concentrations (ppm) in Delineation Samples, Building S-28, Upper Base



Three of the six wall swab samples were analyzed for PCBs. Levels of PCBs in these samples did not exceed the US EPA guideline for interior solid surface contamination (10,000 ng/100 cm^2).

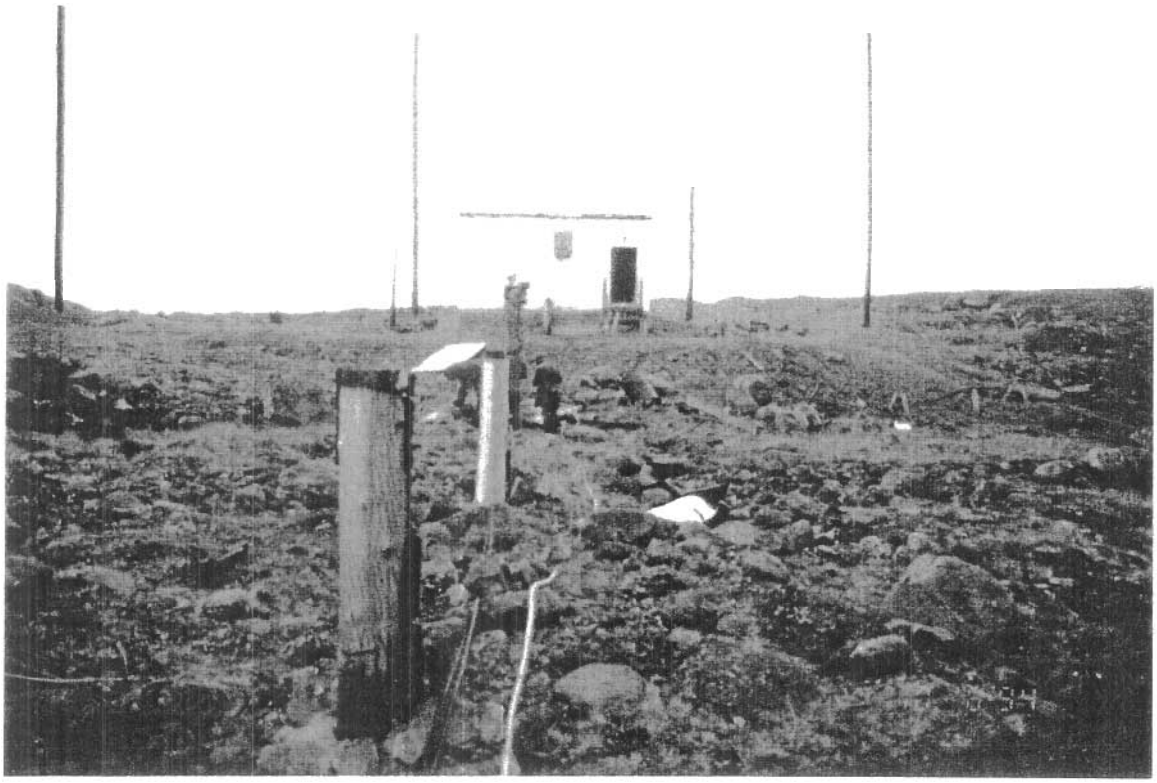
Debris from the floor of Building S-28 contained elevated concentrations of PCBs and some areas of the floor are affected by levels of PCBs in violation of CEPA (>50 ppm). Wood and insulation from inside the building contained PCBs at concentrations greater than 1 ppm. Soil immediately outside the doors of the building was contaminated with PCBs above the DCC Tier I level. A plant in the vicinity of Building S-28 had a PCB concentration significantly higher than the mean background concentration.

c) Other Organic Contaminants

Five assessment soil samples were analyzed for dioxins. Four of the five samples contained very low concentrations of dioxins (3.0 - 5.9 ppt 2,3,7,8-TCDD TEQs) not approaching the CCME R/P Remediation Criterion (1 ppb). One sample, collected 15 m east of Building S-28 (G5945), contained a concentration of dioxins (1.2 ppb) exceeding the CCME R/P Remediation Criterion (Photograph V-18). PCB concentrations in this sample (0.041 ppm) did not approach the DCC.

Four plant samples collected in the vicinity of Building S-28 were analyzed for dioxins. The maximum concentration of dioxins (65.5 ppt) in a plant sample collected near Building S-28 (G5945P, *Salix arctica*) was only 5% of the concentration detected in the corresponding soil sample (1220.4 ppt). Dioxin concentrations in plants ranged from 5 to 46% of the respective soil concentrations.

Soil in one area near Communications Building S-28 contained dioxins in excess of the CCME R/P Remediation Criteria. The affected area is isolated: the concentrations of dioxins in other soil samples collected from around the building were not significantly elevated.



Photograph V-18: Soil on the east side of Building S-28 contains elevated concentrations of dioxins.

iii. Main Site

Six soil samples, collected from five locations at the Main Site, and not including those from the landfill or outfall, contained inorganic elements or PCBs at concentrations that exceed the DCC (Map V-13). One soil sample collected at the Main Site contained pesticides at concentrations in excess of the BCMOE Level B criteria.

a) Inorganic Elements

Twenty-four of the 39 soil samples collected at the Main Site were analyzed for inorganic elements. Mean concentrations of all analytes were below the DCC (Figure V-6). Maximum concentrations of copper (520 ppm), lead (2760 ppm), zinc (2640 ppm) and arsenic (49 ppm) exceeded DCC Tier II levels.

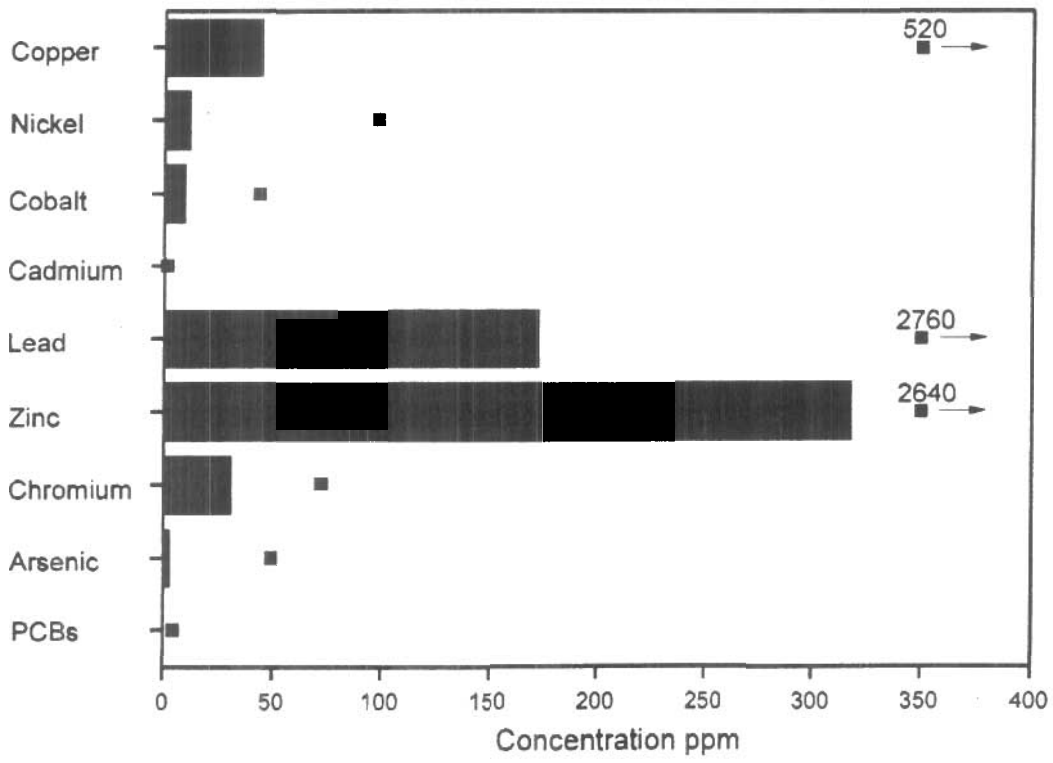
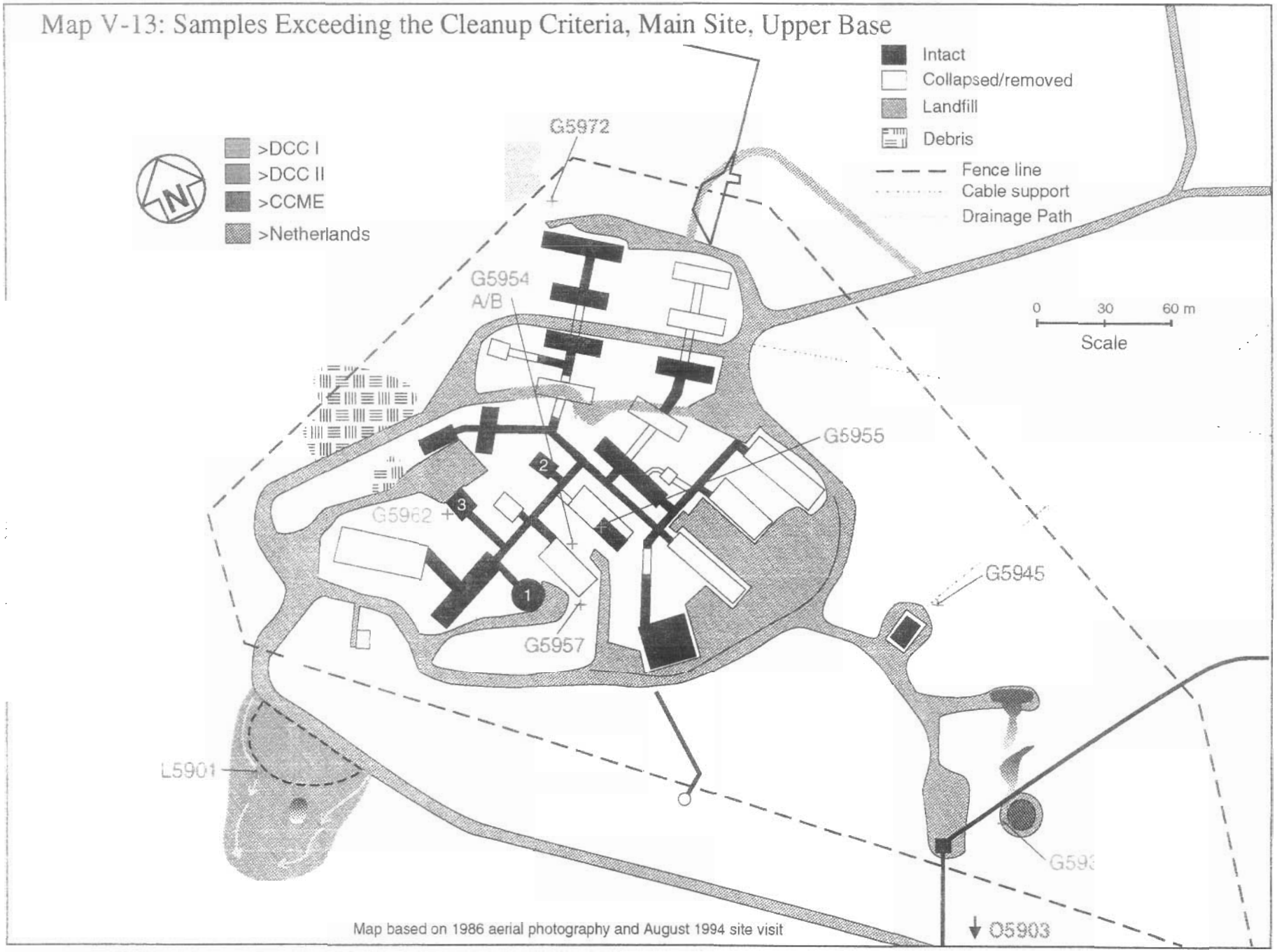


Figure V-6: Mean and Maximum Concentrations of Inorganic Elements and PCBs in Soils Collected at the Main Site.

A total of four samples, including a field duplicate, contained concentrations of at least one inorganic analyte in excess of DCC Tier II. The concentration of lead in two samples exceeded the Tier I level. The maximum concentrations of all four analytes were detected in one sample (G5955) which consisted of rust particles and debris collected from the floor of the Power Plant tank (Photograph V-19). Zinc was detected at levels exceeding the DCC in four samples, including a field duplicate; three of these - G5954A and its duplicate, G5954B - were collected near the Heating Plant under one of the exhaust hoods on the east side of the plant (Photograph V-20), and G5957 was collected on the south side of plant (see Map V-13). Concentrations of zinc were also elevated in the debris from the floor of the Power Plant tank. Concentrations of lead in soils collected on the west side of the POL tank pad (G5939, Photograph V-21) and outside the door to Tower #3 (G5962) exceeded DCC Tier I.

Three plant samples collected at the Main Site were analyzed for inorganic contaminants. Mean concentrations of nickel (7.7 ppm), cadmium (2.7 ppm), lead (39 ppm) and chromium (23 ppm) were more than twice the mean concentrations of these elements in background plants (Figure V-7). Maximum concentrations of nickel (14 ppm), cadmium (6.4 ppm), lead (90 ppm), zinc (660 ppm) and chromium (45 ppm) were significantly elevated above the respective mean concentration of each element calculated for background plants. All three plant samples analyzed contained at least one of the above elements at elevated concentrations. Concentrations of nickel (14 ppm), lead (18 ppm) and chromium (45 ppm) in G5957P (*Trisetum spicatum*), collected south of the Heating Plant, were 4.2, 2.4, and 6.8 times the mean for each element, respectively, in background plants. Soil at the same location contained a zinc concentration exceeding the DCC. The concentration of chromium (19 ppm) in G5971P (*Salix arctica*), collected in drainage from one of the accommodations buildings (BQ6), was 2.9 times the mean concentration calculated for background plants. A plant sample collected between the two electrical poles near the water lake (see Map V-8) contained high levels of cadmium (6.4 ppm) and zinc (660 ppm); the lead concentration in the same sample (90 ppm) was 12 times the mean concentration in background plants.

Map V-13: Samples Exceeding the Cleanup Criteria, Main Site, Upper Base



Map based on 1986 aerial photography and August 1994 site visit

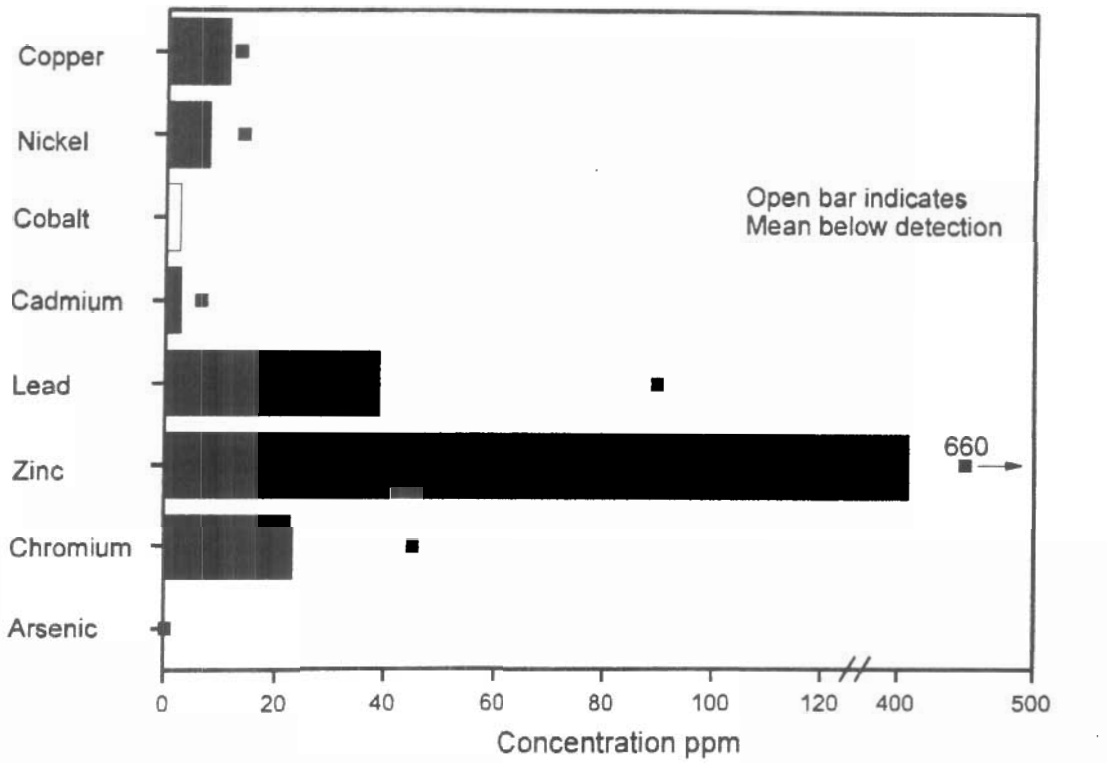


Figure V-7: Mean and Maximum Concentrations of Inorganic Elements and PCBs in Vegetation Collected at the Main Site.

Both water samples collected in the vicinity of the Main Site were analyzed for inorganic elements. Neither sample contained any of the inorganic analytes at concentrations greater than the limits of detection.

Concentrations of zinc, copper, lead and arsenic were elevated above the DCC in soil samples from the Main Site at the Upper Base. In all cases the contamination can be attributed to metallic debris or lead containing-fuels. Vegetation has been impacted to some extent by the presence of elevated concentrations of inorganic elements in the soils at the Main Site. Water, from lakes in the vicinity of the site, was not detectably affected by the inorganic contaminants present in soils.

b) Polychlorinated Biphenyls

Twenty-six of the 39 assessment soil samples collected at the Main Site were analyzed for PCBs, including two field duplicates. The mean concentration of PCBs in soils from around the site (0.25 ppm) did not exceed the DCC (Figure V-6). The maximum concentration of PCBs in soils collected at the Main Site (4.1 ppm) exceeded DCC Tier I. PCBs were present in excess of the criteria in only one soil sample from the Main Site: G5962 was collected outside the door to Tower #3, and also contained concentrations of lead in excess of DCC Tier I (Photograph V-22).

Due to the generally low concentrations of PCBs in soils at the Main Site, none of the plant samples collected were analyzed for PCBs.

The two water samples collected from lakes near the Main Site were analyzed for PCBs. PCBs were not detected in WF5901, collected from the Upper Base Water Supply Lake (see Map V-8); however, WF6007, obtained from a pond approximately 800 m eastnortheast of the Main Site, contained detectable concentrations of PCBs (3 ppt), but did not exceed the CCME FAL Remediation Criterion (1000 ppt).

Two of the six wall swabs collected in Tower #3 were analyzed for PCBs. Neither swab contained concentrations of PCBs in excess of the US EPA guideline for interior solid surface contamination (10,000 ng/100 cm^2).

Overall, contamination of soils by PCBs at the Main Site of the Upper Base is restricted to an area immediately outside one of the radar towers (#3). This pattern of contamination is consistent with the expected use of PCBs around the Main Site.

c) Other Organic Contaminants

One soil sample from the Main Site was analyzed for dioxins. G5974 was collected between two electrical poles situated near the Water Supply Lake for the Upper Base (see Map V-8). The concentration of dioxins in the sample (4.1 ppt 2,3,7,8-TCDD TEQs) did not approach the CCME R/P Remediation Criterion for dioxins in soil (1 ppb). The

concentration of dioxins in the sample of vegetation collected in the same location (G5974P, *Salix fuscescens*) was less than 5% of that detected in the corresponding soil sample.

Two soil samples collected at the Main Site were analyzed for pesticides. The total concentration of pesticides (0.12 ppm) in G5975, collected in drainage from the southwest side of the site (see Map V-8), did not exceed the BC (2 ppm), Québec (2 ppm) or Netherlands (3 ppm) Level B remediation criteria. The total concentration of pesticides (9.3 ppm) detected in G5972, collected in a low wet area near the edge of a pond of water north of an accommodations building (BQ6), exceeded all three criteria (Photograph V-23). Eleven of the 22 pesticide analytes were detected in this sample. The widely used insecticide 2,2-*bis*-(*p*-chlorophenyl)-1,1,1-trichloroethane (DDT) and its metabolites (9.3 ppm), were the principal compounds detected in G5972. The metabolic product *p,p*'-DDD was the dominant DDT compound detected (5.5 ppm) and exceeded the Netherlands Level B criteria for individual chlorinated pesticides (0.5 ppm). Concentrations of *p,p*'-DDT (1.4 ppm) and its metabolic product *o,p*'-DDD (1.8 ppm) also exceeded the Netherlands criteria for individual chlorinated pesticides. Three pesticides from the chlordane group were also detected in G5972, at very low levels. These included *trans*-chlordane (0.0074 ppm), *cis*-chlordane (0.005 ppm) and *trans*-nonachlor (0.002 ppm). Levels of heptachlor, which is also one of the chlordane compounds, were below detection; however its oxidation product, heptachlor epoxide, was detected at a very low concentration (0.00076 ppm). The insecticides mirex and dieldrin were detected in the same sample at very low levels as well.

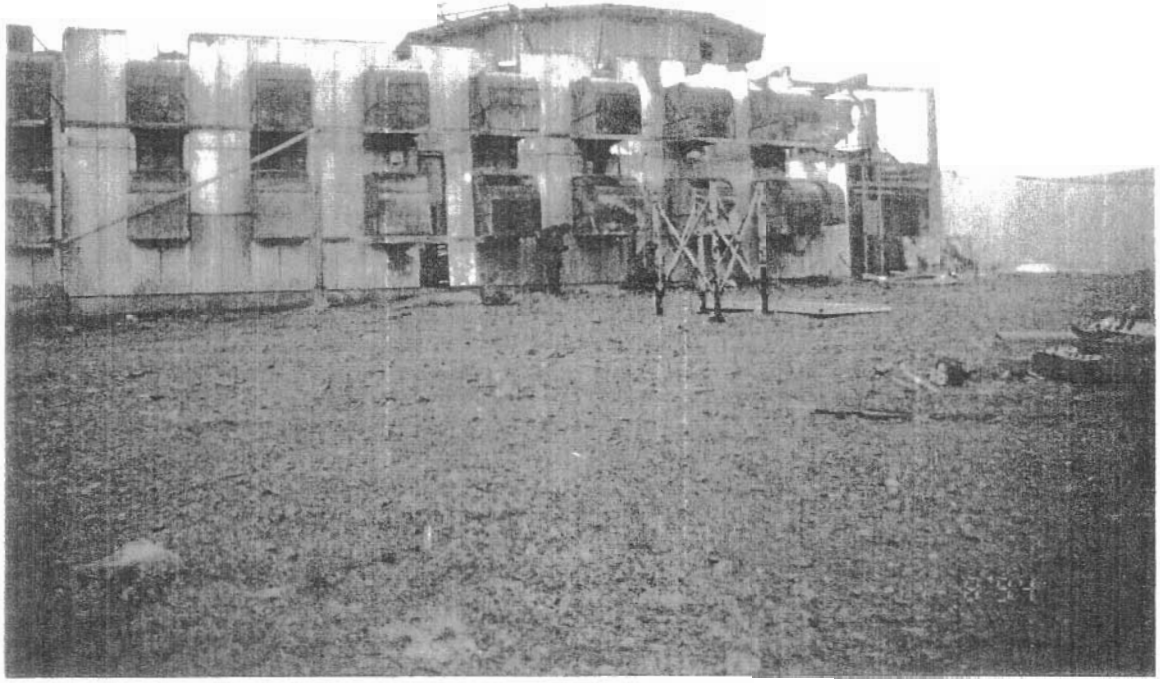
Two soil samples collected at the Main Site were analyzed for the ABN suite of chemicals. Concentrations of all analytes were below the limits of detection in both samples.

Two samples from the Main Site were analyzed specifically for PAHs. None of the analytes were detected at levels exceeding the applicable criteria. The concentrations of alkylated PAHs in sample G5977 were significantly elevated above those in soils collected

from other sites undergoing assessment. The soils at this location, in a low wet area south of the Main Site, had a very strong hydrocarbon odour and a sheen appeared on the water's surface when the sediments were disturbed. Soils collected approximately 100 m east (G5975) and west (G5876) of the location also had a strong hydrocarbon odour. The signature of the results for alkylated PAHs detected in soil sample G5977 is consistent with that expected for soils contaminated with a petroleum product.

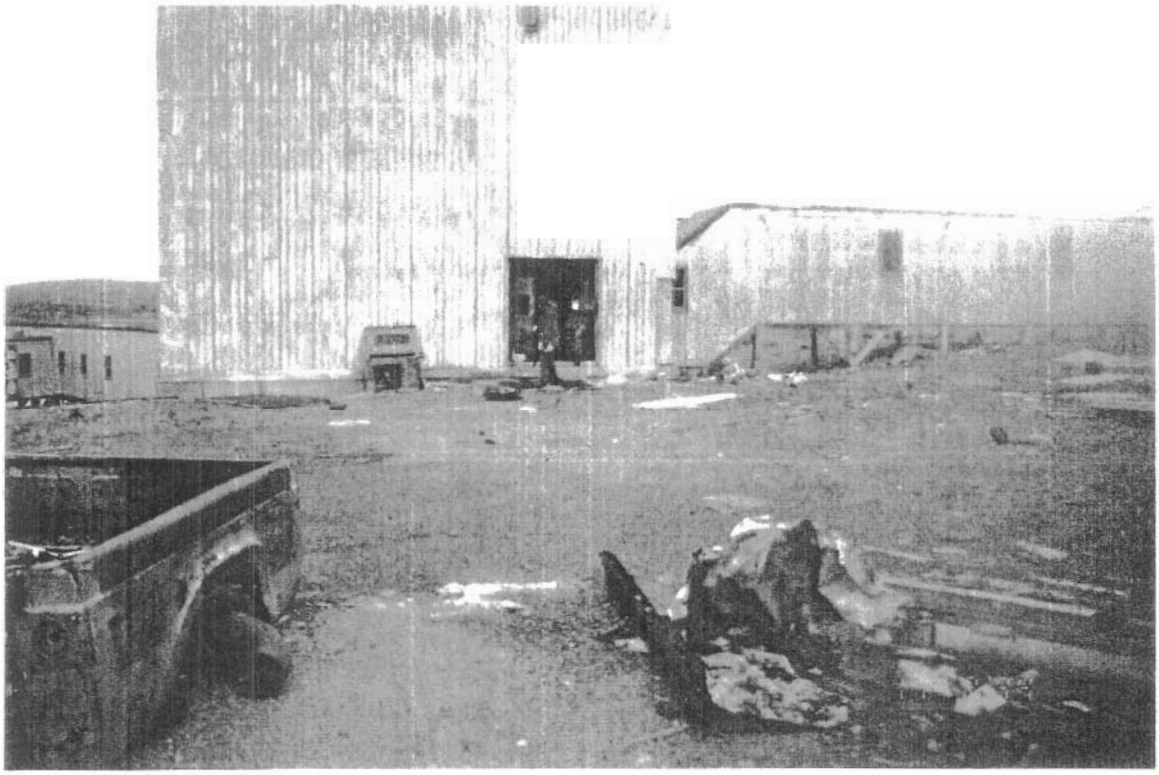
Pesticides detected in soils near the living quarters at the Main Site were significantly elevated above the applicable criteria. Dioxins and PAHs were detected in soils at the Main Site, but not at levels requiring remediation. Compounds in the ABN analytical suite were not detected in soils from the Main Site.

Photograph V-19: High concentrations of copper, lead, zinc and arsenic were found in rust and debris collected from the floor of the Power Plant tank (G5955).



Photograph V-20: G5954A/B collected below the Heating Plant exhaust hoods contained zinc at concentrations exceeding the criteria.

Photograph V-21: Soil sample G5939, collected on the west side of the POL tank pad, contained elevated concentrations of lead.



Photograph V-22: Elevated levels of lead and PCBs were detected outside Tower #3.

Photograph V-23: Elevated concentrations of pesticides were found in soil collected in this low wet area at the north end of the Upper Base (G5972).

iv. Upper Base Landfill

One sample collected in the Upper Base Landfill contained inorganic elements in excess of the DCC (see Map V-13, Section iii., above). No other contaminants were detected at concentrations exceeding the applicable criteria.

a) Inorganic Elements

Eight of the nine soil samples collected in the Upper Base Landfill were analyzed for inorganic elements. Mean concentrations of all analytes were below the DCC (Figure V-8). The maximum concentrations of all analytes, with the exception of zinc, were also below the DCC. The mean concentration of zinc (630 ppm) in duplicate samples collected in a drainage path at the toe of the landfill (L5901A/B) exceeded DCC Tier II.

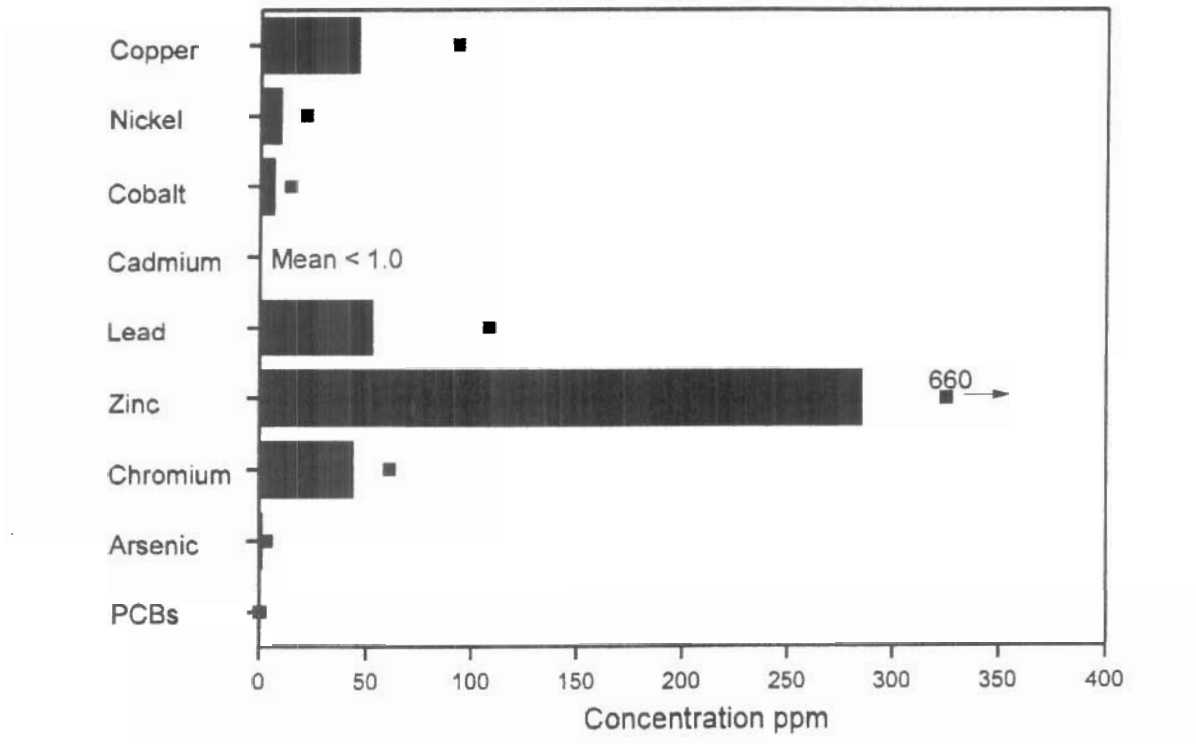


Figure V-8: Mean and Maximum Concentrations of Inorganic Elements and PCBs in Soils Collected at the Upper Base Landfill.

One sample of vegetation from the Upper Base Landfill was analyzed for inorganic elements. Levels of all inorganic analytes in L5901P (*Salix arctica*) were comparable to mean concentrations calculated for background plants.

Zinc was the only inorganic analyte detected in excess of the DCC in soils collected in the Upper Base Landfill. Inorganic element concentrations in soil collected in drainage away from the landfill were comparable to background levels. Vegetation from the landfill had inorganic element concentrations comparable to background plants.

b) Polychlorinated Biphenyls

Six of the nine soil samples collected at the Upper Base Landfill were analyzed for PCBs. Mean (0.050 ppm) and maximum concentrations (0.14 ppm) of PCBs in all samples did not approach the DCC (Figure V-8). The concentration of PCBs in two samples was below the limits of detection.

Of the three plant samples collected in the landfill, none were analyzed for PCBs, due to a lack of detection of any significant PCB contamination in soils collected in the area.

Soils from the Upper Base Landfill are not significantly contaminated with PCBs.

c) Other Organic Contaminants

Two soil samples collected in the Upper Base Landfill were analyzed for pesticides. The total concentration of pesticides in L5903 (0.071 ppm) and L5906 (0.12 ppm) did not exceed the BC (2 ppm), Québec (2 ppm) or Netherlands (3 ppm) Level B remediation criteria. None of the individual analyte concentrations approached the Netherlands Level B criteria for individual chlorinated (0.5 ppm) or non-chlorinated (1 ppm) pesticides.

One soil sample from the Upper Base Landfill, which was collected in a tar stain at its southern end (L5902), was analyzed for the ABN suite of chemicals. The concentrations of all analytes were below the limits of detection.

One sample of soil collected in the landfill (L5901A) was analyzed for PAHs. Although 34 of the 36 analytes were detected in the sample, none were present at levels exceeding or approaching the applicable criteria. The concentrations of alkylated PAHs were also not significantly elevated .

In general, soils from the Upper Base Landfill did not contain inorganic elements, PCBs or other organic contaminants at elevated levels. Only one soil sample from the landfill, which had zinc concentrations elevated above DCC Tier II, requires remediation under the DLCU Protocol.