

**Characterization and Assessment of Options
For Managing Materials Generated During Street Cleaning Activities
In Anchorage, Alaska**

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and
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CHARACTERIZATION AND ASSESSMENT OF OPTIONS FOR MANAGING MATERIALS GENERATED DURING STREET CLEANING ACTIVITIES IN ANCHORAGE, ALASKA

EXECUTIVE SUMMARY

The Alaska Department of Transportation & Public Facilities (ADOT&PF), in cooperation with the Municipality of Anchorage (MOA) contracted with Hart Crowser, Inc. (HCI), to conduct a feasibility study on the management of materials generated during street cleaning activities. More specifically, ADOT&PF and MOA requested HCI to:

- Characterize street cleaning materials (SCM) from storm drainage sediment basins, oil/grit separators, street sweepings, and associated wastewater; and
- Recommend cost effective options for the management of SCM.

Street cleaning materials are generated primarily from the routine cleaning of street surfaces and storm drainage system collection boxes. Similar materials are generated from snow removal operations and cleaning storm drainage sediment catchment basins. ADOT&PF and MOA estimate they generate approximately 16,000 tons (10,000 cubic yards) of SCM annually.

SCM Characterization. To characterize the material generated during street cleaning operations, HCI developed a database of historical chemical testing results obtained from ADOT&PF and MOA, and collected 10 composite samples from existing ADOT&PF and MOA stockpiles in September 1999. The analytical results were compared with the Alaska Department of Environmental Conservation (ADEC) 18 AAC 75 Method Two cleanup levels for the “under 40 inches of rainfall” zone. Highlights from the evaluation are:

- **Diesel Range Organics.** Historical results indicate that diesel range organics (DRO) can exceed the ADEC Method Two migration to groundwater cleanup level of 250 mg/kg. September 1999 sampling results were generally near or below the ADEC cleanup criteria for migration to groundwater. Leachability testing of September 1999 samples indicated that the DRO was not leachable. Additional future sample analysis for DRO aliphatic and aromatic fractions can be performed to confirm that the migration to groundwater pathway is not a concern for SCM. Based on existing data, it appears that the ADEC

cleanup levels for DRO aliphatic and aromatic fractions (7,200 mg/kg and 100 mg/kg, respectively) will not be exceeded.

- **Residual Range Organics.** Historical and September 1999 sample analytical results indicate that in general, the residual range organic (RRO) concentration in the SCM is well below the most conservative ADEC Method Two cleanup level. Further, leachability testing of the September 1999 samples indicated the RRO is not leachable.
- **Polynuclear Aromatic Hydrocarbons.** One of 16 polynuclear aromatic hydrocarbons (PAH) slightly exceeded the ADEC Method Two cleanup level in one of six samples collected in September 1999. Benzo(a)pyrene, at a concentration of 1.1 mg/kg, slightly exceeded cleanup level of 1 mg/kg. However, statistical analysis indicated that the average, median, and upper 95% confidence interval for this and other PAH compounds were well below cleanup levels.
- **Arsenic.** Although SCM arsenic concentrations generally exceeded Method Two cleanup levels, they were well within the expected background concentration for Alaska soils. Historical Toxicity Characteristic Leaching Procedure (TCLP) analyses have shown that the arsenic in SCM is not readily leachable.
- **Chromium.** SCM total chromium concentrations were generally in the range of the ADEC Method Two cleanup level of 26 mg/kg. However, the sample total chromium concentrations were below the average background total chromium concentration for Alaska soils. Further, the conservative Method Two cleanup level for total chromium is based on the toxicity of hexavalent chromium – and it is unlikely that much of the chromium in the SCM samples is composed of hexavalent chromium. In addition, historical TCLP analyses have shown that the chromium in SCM has a low leachability.
- **Lead.** SCM lead concentrations, while slightly elevated above the background average, were well below the standard cleanup level for lead in residential soil of 400 mg/kg. Historical TCLP analyses have shown that the lead in SCM typically has a low leachability.

In summary, the data suggest that SCM typically does not need to be managed as a contaminated media. Additional sampling and analyses needs to be performed to further document this assessment.

Management Options. Based on consideration of SCM management practices in other locales, a subsequent assessment of possible management alternatives for Anchorage was developed. Broad categories of alternatives considered included:

- Incineration;
- Reuse, with or without processing to remove litter (e.g., for asphalt/concrete production, composting, or as fill);
- Use as landfill cover; and
- Disposal as a solid waste.

Alternatives were considered from a broad perspective, including appropriateness, implementability, and cost.

Recommendations. Based on the strong indication that the SCM is not a contaminated environmental media, it is recommended that ADOT&PF and MOA develop an ongoing program for the sampling and analysis, and reuse of the SCM generated in the Anchorage area. Basic components of this program could include:

- **Accumulation.** Accumulate collected SCM in areas approved by MOA and ADOT&PF to minimize impacts to the environments. Dispose of excess water collected with the SCM in the municipal wastewater system and minimize run-on and runoff at accumulation stockpiles. Further, personnel need to be conscious of potential spills or other chemical releases that could impact contaminant concentrations in the SCM.
- **Sampling and Analysis Program.** Develop an ongoing sampling and analysis program, and associated analytical database, to further document that the SCM is not a contaminated environmental media and to gain further knowledge of the chemical composition and characteristics of the various types of SCM. Based on the consistency of the future results, the scope and magnitude of the sampling program should be re-evaluated periodically, and modified appropriately.
- **SCM Reuse or Disposition.** If the sampling data continue to indicate that the SCM is below cleanup levels, the material could be reused for a variety of purposes such as fill, road subgrade, and top dressing. In selecting appropriate reuse or disposition alternatives, ADOT&PF and MOA should keep in mind several associated issues including: the predictability of a market for SCM reuse; possible physical hazards (e.g., sharp objects, glass) in the SCM; potential chemical risks from unexpected contaminants (e.g., from an unknown spill) in the SCM; and

potential ADOT&PF and MOA liability associated with future use of the SCM by others. If appropriate reuses cannot be implemented, disposition of the SCM as an “inset” solid waste may be required.

CHARACTERIZATION AND ASSESSMENT OF OPTIONS FOR MANAGING MATERIALS GENERATED DURING STREET CLEANING ACTIVITIES IN ANCHORAGE, ALASKA

1.0 INTRODUCTION

1.1 *Background*

Historically, street maintenance organizations cleaned streets for cosmetic purposes. Within the past decade, greater emphasis has been placed on cleaning streets and storm drainage systems to pick up sediments before potential contaminants in these materials contribute to the pollution of local waterways via stormwater runoff. Consequently, the organizations that clean streets now face a dilemma: the better that streets are cleaned of potentially contaminated sediments to protect water quality, the more the collected material begins to resemble potentially contaminated soil or even hazardous waste, and the more difficult and expensive it becomes to dispose of it. The Alaska Department of Transportation & Public Facilities (ADOT&PF) and the Municipality of Anchorage Department of Public Works Street Maintenance Section (MOA) are attempting to develop a long-term, cost-efficient, and environmentally responsible solution for the management of material generated during street cleaning activities in the Anchorage area.

Street cleaning materials (SCM) are primarily generated from the routine cleaning of street surfaces and storm drainage system collection boxes. Similar materials are generated from snow removal operations and cleaning storm drainage sediment catchment basins. The MOA, ADOT&PF, and their contractors conduct street and storm drainage system cleaning within the Municipality of Anchorage. Private contractors and other parties also generate similar wastes from cleaning commercial parking lots and private facilities. The MOA and ADOT&PF estimate that they and their contractors currently pick up approximately 16,000 tons (or 10,000 cubic yards, assuming approximately 1.6 tons per cubic yard) of dirt containing some vegetation and litter from Anchorage area streets and roads each year. Much of this material comes from the approximately 25,000 tons of sand that the agencies place on Anchorage area streets and roads each winter. Additional materials tracked onto roads or lost from vehicles and wind-blown or water-eroded materials also end up as SCM. Currently, ADOT&PF, MOA, and their contractors all manage SCM somewhat differently and without an overall long-term plan.

1.2 Project Scope

ADOT&PF, in cooperation with the MOA, contracted with Hart Crowser, Inc. (HCI), to conduct a feasibility study on the management of SCM. More specifically, ADOT&PF and MOA requested HCI to:

- Characterize wastes from storm drainage sediment basins, oil/grit separators, street sweepings, and associated wastewater; and
- Recommend cost effective options for the management of SCM.

1.3 Work Conducted

HCI reviewed and tabulated historical analytical results of SCM samples obtained from ADOT&PF and MOA. HCI searched for and obtained guidance documents and studies from other areas of the country concerning the characterization and management of SCM. HCI compared the historical Anchorage analytical results with SCM analytical results from other areas, primarily Washington State. Based on the historical analytical data and the data from other locations that HCI reviewed, and with consideration toward potential management alternatives, HCI subsequently collected ten samples of accumulated Anchorage area SCM and had the samples analyzed for a variety of parameters.

HCI interviewed ADOT&PF and MOA staff, and operators of Anchorage area concrete, asphalt, and commercial composting facilities to discuss the suitability and potential use of SCM in their operations. HCI was able to interview the authors of some of the obtained SCM management reports and representatives of some manufacturers whose equipment could be used to process SCM. HCI also discussed potential SCM management alternatives with Alaska Department of Environmental Conservation (ADEC) Solid Waste and Contaminated Site Program representatives.

1.4 Report Organization

Aside from this **Introduction**, this report is comprised of four sections:

- Section 2.0 Characterization of Anchorage Area SCM;
- Section 3.0 Alternatives for Managing Anchorage Area SCM;
- Section 4.0 Summary and Recommendations; and
- Section 5.0 References.

In addition, there are three appendices:

- Appendix A September 1999 Sampling Memorandum;
- Appendix B Summary of Historical SCM Analytical Testing Results; and
- Appendix C SCM Analytical Results from Other Locations.

2.0 CHARACTERIZATION OF ANCHORAGE AREA SCM

The section presents a discussion of the contaminants potentially encountered in SCM. Initially, analytical results from HCI's September 1999 sampling effort are discussed. Subsequently, historical data results are considered based on analytical information received from ADOT&PF and MOA. Since there are no specific regulatory criteria for SCM, ADEC's 18 AAC 75 Method Two, Tables B1 and B2 are used for comparative purposes. The Method Two cleanup levels for the "Under 40 Inch Zone" in ADEC's contaminated site cleanup regulations provide a good guide for evaluating potential public health risks from these materials.

2.1 *September 1999 Analytical Data Results*

To help develop a chemical characterization of the SCM, in September 1999 HCI collected eight composite samples from MOA street sweep, vactor, and oil/water separator piles and two composite samples from ADOT&PF street sweep and storm drain piles. All or some of the composite samples were analyzed for:

- Particle size distribution;
- Diesel range and residual range organics (DRO and RRO);
- Synthetic Precipitation Leaching Procedure (SPLP), DRO, and RRO;
- Total metals, including arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc;
- Chloride; and
- Polynuclear aromatic hydrocarbons (PAH), including naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-CD)pyrene, dibenzo(a,h) anthracene, benzo(g,h,i)perylene.

Tables 1 and 2 present the results of the chemical analyses. Appendix A contains a sampling memorandum that includes sketches of sampling sites along with the sample collection procedures.

TABLE 1

Table 1 - September 1999 Analytical Results

Sample No.	Location	Type	DRO (AK 102)	RRO (AK 103)	SPLP DRO** (mg/L) (EPA 1312/AK102)
ADOT-1-9/99	Tudor Rd.	Storm Drain	130	1,000	0.24 U
ADOT-2-9/99	Tudor Rd.	Street Sweep	140	1,300	0.24 U

MOA-1-9/99	Klatt	Street Sweep	150 J	1,300	
MOA-2A-9/99	Northwood	Street Sweep	170 J	1,900	0.24 U
MOA-2B-9/99	Northwood	Street Sweep	230	2,100	
MOA-3-9/99	Northwood	Vactor	270	2,100	
MOA-4-9/99	Northwood	Oil Separator	180 J	1,500	0.25 U
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	220	1,900	0.24 U
MOA-7-9/99	Sitka	Street Sweep	210 J	2,200	
MOA-8-9/99	Commercial	Street Sweep	210 J	2,000	0.24 U

Chloride (EPA 300.0)	Percent Moisture (CLP SOW ILM04.0)
42	7.7
330 D3	3.4

	8.4
67	7.7
	14
	7.8
4.0	7.1
18	11
	12
13	8.5

Sample No.	Location	Type	Total Arsenic (EPA 7060)	Total Barium (EPA 6010)	Total Cadmium (EPA 6010)	Total Chromium (EPA 6010)	Total Copper (EPA 6010)	Total Lead (EPA 6010)	Total Mercury (EPA 7471A)	Total Selenium (EPA 7740)	Total Silver (EPA 6010)	Total Zinc (EPA 6010)
ADOT-1-9/99	Tudor Rd.	Storm Drain	2.70	49.6	0.259	23.4	25 E	35.4	0.162	2.01 U	0.0403 U	240 E
ADOT-2-9/99	Tudor Rd.	Street Sweep	1.89	20.6	0.142	21.9	29 E	24.7	0.0252	0.209 U	0.0854	74 E
MOA-1-9/99	Klatt	Street Sweep	3.7	49	0.27 U	20	21	8.5 E	0.11 U	0.29 U	1.1 U	60 E
MOA-2A-9/99	Northwood	Street Sweep	2.8	56	0.28 U	26	26	15 E	0.11 U	0.28 U	1.1 U	65 E
MOA-2B-9/99	Northwood	Street Sweep	4.1	47	0.31 U	23	22	34 E	0.12 U	0.31 U	1.2 U	140 E
MOA-3-9/99	Northwood	Vactor	3.8	40	0.28 U	17	56	16 E	0.11 U	0.28 U	1.1 U	110 E
MOA-4-9/99	Northwood	Oil Separator	14	54	0.27 U	19	21	20 E	0.11 U	0.27 U	0.54 U	430 E
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	4.4	44	0.28 U	22	41	12 E	0.11 U	0.58 U	1.1 U	120 E
MOA-7-9/99	Sitka	Street Sweep	2.5 S	43	0.30 U	20	23	17 E	0.11 U	0.28 U	0.60 U	66 E
MOA-8-9/99	Commercial	Street Sweep	3.5	54	0.26 U	21	24	19 E	0.11 U	0.26 U	0.53 U	67 E

Notes: All results in mg/kg except where noted.

D3 = Value from a 5-fold dilution analysis

E = Serial dilution outside of required control limits

J = Estimated value

S = Value determined from Method of Standard Additions (MSA)

U = Undetected at the reported concentration

** = The laboratory also evaluated the RRO in the leachate and determined that it was undetectable at the reporting limit of 0.75 mg/L

DRO = Diesel range organics

RRO = Residual range organics

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TABLE 2

Table 2: September 1999 Polynuclear Aromatic Hydrocarbon Analytical Results

Sample #	Location	Type	Naphthalene		Acenaphthylene		Acenaphthene		Fluorene	
ADOT-1-9/99	Tudor Rd.	Storm Drain	0.180	U	0.180	U	0.045	J	0.044	J
ADOT-2-9/99	Tudor Rd.	Street Sweep	0.170	U	0.170	U	0.170	U	0.170	U
MOA-2A-9/99	Northwood	Street Sweep	0.360	U	0.360	U	0.110	J	0.110	J
MOA-4-9/99	Northwood	Oil Separator	0.360	U	0.360	U	0.110	J	0.120	J
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	0.390	U	0.390	U	0.180	J	0.230	J
MOA-8-9/99	Commercial	Street Sweep	0.360	U	0.360	U	0.120	J	0.120	J

Sample #	Location	Type	Phenanthrene		Anthracene		Fluoranthene		Pyrene	
ADOT-1-9/99	Tudor Rd.	Storm Drain	0.140	J	0.034	J	0.190		0.190	
ADOT-2-9/99	Tudor Rd.	Street Sweep	0.070	J	0.016	J	0.120	J	0.140	J
MOA-2A-9/99	Northwood	Street Sweep	0.390		0.100	J	0.460		0.370	
MOA-4-9/99	Northwood	Oil Separator	0.860		0.170	J	1.300		0.930	
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	2.200		0.420		3.200		2.000	
MOA-8-9/99	Commercial	Street Sweep	0.630		0.130	J	0.870		0.660	

Sample #	Location	Type	Benzo(a)anthracene		Chrysene		Benzo(b)fluoranthene		Benzo(k)fluoranthene	
ADOT-1-9/99	Tudor Rd.	Storm Drain	0.080	J	0.160	J	0.180	JT	0.180	JT
ADOT-2-9/99	Tudor Rd.	Street Sweep	0.050	J	0.150	J	0.072	J	0.038	J
MOA-2A-9/99	Northwood	Street Sweep	0.180	J	0.260	J	0.330	TJ	0.330	TJ
MOA-4-9/99	Northwood	Oil Separator	0.520		0.650		0.510		0.440	
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	1.200		1.400		2.600	T	2.600	T
MOA-8-9/99	Commercial	Street Sweep	0.350	J	0.500		0.780	T	0.780	T

Sample #	Location	Type	Benzo(a)pyrene		Indeno(1,2,3-CD)pyrene		Dibenzo(a,h) anthracene		Benzo(g,h,i)perylene	
ADOT-1-9/99	Tudor Rd.	Storm Drain	0.085	J	0.042	J	0.016	J	0.065	J
ADOT-2-9/99	Tudor Rd.	Street Sweep	0.044	J	0.030	J	0.026	J	0.045	J
MOA-2A-9/99	Northwood	Street Sweep	0.180	J	0.092	J	0.040	J	0.097	J
MOA-4-9/99	Northwood	Oil Separator	0.470		0.190	J	0.360	U	0.180	J
MOA-5-9/99	Tudor Snow	Street Sweep & Vactor	1.100		0.390	J	0.190	J	0.360	J
MOA-8-9/99	Commercial	Street Sweep	0.360	J	0.130	J	0.055	J	0.120	J

Notes: All results in mg/kg

J = Estimated value

U = Undetected at the reported concentration

T = Sum of benzo (b) and benzo (k) fluoranthene

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The remainder of this subsection presents an evaluation of the September 1999 sampling results. To assist in this evaluation, Table 3 provides statistical analyses for those analytes whose concentrations approached ADEC cleanup levels and/or are generally considered a potential concern with material generated during street cleaning operations. For comparative purposes, Table 3 also presents the most conservative ADEC 18 AAC 75 Method Two cleanup level for the Under 40 Inch Zone.

Diesel Range Organics. In general, the DRO sample results were fairly consistent. The maximum detected DRO concentration of 270 mg/kg was collected from a MOA vactor waste pile at the Northwood Snow Site. It was the only DRO concentration to exceed the most conservative ADEC Method Two cleanup level of 250 mg/kg for the migration to groundwater pathway. The DRO concentration of the other nine samples ranged from 130 to 230 mg/kg.

Statistically, the average and median DRO concentrations were 191 mg/kg and 195 mg/kg, respectively. The 95 percent upper confidence level (UCL) for the 10 DRO samples was 217 mg/kg. These three statistics are below the 250 mg/kg ADEC Method Two cleanup level.

SPLP DRO. The SPLP DRO results provide an assessment of the leachability of the DRO associated with the SCM. As presented in Table 3, DRO was not detected (<0.25 mg/L) in the six samples that underwent the leaching procedure. This indicates that the DRO within the sample matrix is not readily leachable to groundwater.

Residual Range Organics. The RRO sample results were also fairly consistent, ranging from 1,000 mg/kg to 2,200 mg/kg. The most conservative ADEC Method Two cleanup level is 10,000 mg/kg. Statistically, the average and median RRO concentration were 1,730 mg/kg and 1,900 mg/kg, respectively, and the UCL was 1,976 mg/kg.

SPLP RRO. The SPLP RRO results provide an assessment of the leachability of the RRO associated with the SCM. As presented in Table 3, RRO was not detected (<0.75 mg/L) in the six samples that underwent the leaching procedure. This indicates that the RRO within the sample matrix is not readily leachable to groundwater.

Chloride. With one exception, the chloride concentrations were relatively consistent and less than 50 mg/kg. At ADOT&PF's Tudor Road Facility the chloride concentration in the street sweeping pile was 330 mg/kg. There is no

TABLE 3

Table 3 - Statistical Values for September 1999 Sampling Results

Statistic	DRO (AK 102)	RRO (AK 103)	Chloride (EPA 300.0)	Total Arsenic (EPA 7060)	Total Chromium (EPA 6010)	Total Lead (EPA 6010)	Benzo(a) anthracene (EPA 8270)	Benzo(a) pyrene (EPA 8270)	Dibenzo(a,h) anthracene (EPA 8270)
Number of Samples	10	10	6	10	10	10	6	6	6
Average	191	1,730	79	4.3	21.3	20.2	0.40	0.37	0.11
Median	195	1,900	30	3.6	21.5	18.0	0.27	0.27	0.05
Standard Deviation	42	398	114	3.3	2.4	8.4	0.39	0.36	0.12
95% Confidence	26	246	91	2.0	1.5	5.2	0.32	0.29	0.10
Lower Confidence Level	165	1,484	0	2.3	19.8	15.0	0.08	0.09	0.02
Upper Confidence Level	217	1,976	170	6.4	22.8	25.4	0.71	0.66	0.21
ADEC Method Two Cleanup Level (1)	250	10,000	N/A	2	26*	400**	6	1	1

Notes: All values in mg/kg

(1) Most conservative value listed in the Under 40 Inch Zone

* - This cleanup level is for chromium +6. The cleanup level for chromium +3 is 100,000 mg/kg.

** - Residential soil cleanup level.

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ADEC 18 AAC 75 soil cleanup level for chloride. Statistically, the average was 79 mg/kg, the median was 30 mg/kg, and the UCL was 170 mg/kg.

Metals. The metal sampling results presented in Table 1 are generally unremarkable and with two exceptions (i.e., arsenic and chromium) are well below ADEC Method Two conservative cleanup levels. The following discussion and Table 3 addresses arsenic and chromium along with lead, which is sometimes considered a potential issue in SCM.

- **Arsenic.** The average and median arsenic concentrations are 4.3 mg/kg and 3.6 mg/kg. The maximum detected concentration is 14 mg/kg and the 95 percent UCL is 6.4 mg/kg. The most conservative ADEC Method Two cleanup level is 2 mg/kg for the migration to groundwater pathway. However, background soil arsenic concentrations are also often above the ADEC cleanup level.

According to a U.S. Geological Survey study (USGS, 1988), entitled *Element Concentrations in Soils and other Surficial Materials of Alaska*, arsenic background concentrations range from less than 10 mg/kg to 750 mg/kg, with an arithmetic mean of 9.6 mg/kg. Consequently, based on this background information and the collected data it does not appear that arsenic concentrations are a concern in SCM.

- **Chromium.** The average and median total chromium concentrations are 21.3 mg/kg and 21.5 mg/kg. The maximum detected concentration is 26 mg/kg and the 95 percent UCL is 22.8 mg/kg. ADEC Method Two cleanup levels are provided for hexavalent chromium (chromium +6; 26 mg/kg – migration to groundwater) and trivalent chromium (chromium +3; 100,000 mg/kg - ingestion), based on differences in toxicity between these two element species. To be conservative, the ADEC has set the Method Two cleanup level for total chromium using the chromium +6 concentration.

The maximum detected concentration of total chromium equaled the conservative ADEC Method Two cleanup level for chromium +6. However, it is very unlikely that the chromium sample concentrations are comprised primarily of chromium +6. It is probable that chromium +6 makes up only a small, if any, part of the total chromium detected in the samples. Further, USGS (1988) found that total chromium background concentrations in Alaska ranged from 5 mg/kg to 390 mg/kg, with an arithmetic mean of 64 mg/kg. Based on this and the sample results, it does not appear that chromium concentrations are a concern in SCM.

- **Lead.** The average and median total lead concentrations are 20.2 mg/kg and 18 mg/kg. The maximum detected concentration is 35.4 mg/kg and the 95 percent UCL is 25.4 mg/kg. Due to the difficulty of assessing lead toxicity, ADEC does not provide a specific Method Two cleanup level in Table B1 of 18 AAC 75, but states in the associated notes that the residential land use soil cleanup level for lead is 400 mg/kg.

The USGS study (USGS, 1988) found that total lead background concentrations in Alaska range from less than 4 mg/kg to 310 mg/kg, with an arithmetic mean of 14 mg/kg. The September 1999 sample results appear to slightly exceed the USGS arithmetic mean, but are well below the cleanup standard. As such, based on this data, lead does not appear to be a concern in the SCM.

Polynuclear Aromatic Hydrocarbons. Fourteen of the 16 PAH analytes were detected in one or more of the September 1999 samples (Table 2). For the most part, the detections were low (<1.0 mg/kg) and with one exception, did not exceed ADEC Method Two cleanup levels. Benzo(a)pyrene at a concentration of 1.2 mg/kg in one sample collected from MOA's Tudor Snow Site street sweeping and vector pile exceeded the ADEC Method Two cleanup level of 1 mg/kg for the ingestion pathway.

Table 3 provides statistical results for the three PAH compounds that have the lowest cleanup levels: benzo(a)anthracene – cleanup level of 6 mg/kg; benzo(a)pyrene – cleanup level of 1 mg/kg; and dibenzo(a,h)anthracene – cleanup level of 1 mg/kg. As indicated, the averages, medians, and 95% UCL are well below the cleanup levels.

2.2 Historical Analytical Data

HCI reviewed and evaluated historical analytical data from 1986 to 1998 that were provided by MOA and ADOT&PF for SCM in the Anchorage area. Results from HCI's 1999 sampling and analysis of SCM also were included. The data were generated from the sampling and laboratory analysis of *in-situ* storm drainage systems and accumulated SCM conducted for a variety of reasons, including treatment and disposal proposals for particular accumulations of SCM and studies to characterize storm drainage system materials and plan for a soils remediation facility.

Most of the data were recorded on laboratory analytical reports; although, in some cases, the data came from a table or summary in a report. Much of the

data did not include information concerning the collection of the samples, so HCI had to assume that representative samples were collected and that proper sample collection protocols were followed. In one case, for 11 samples collected along DeBarr Road in 1995, HCI understands that sample locations were selected on the basis of having the potential to be more highly contaminated than might be normally expected.

Data for all of the solids were reviewed together, and for comparison, separate reviews of collected street sweeping and *in situ* storm drainage system sediments also were conducted. Data for SCM-related liquids also were reviewed.

A summary of Anchorage area SCM data, including historical data and 1999 analytical data generated by HCI's sampling and analyses, is presented in Appendix B. The table in Appendix B includes:

- Analytes that have been tested for;
- Analytical methods used;
- Type of material sampled and tested;
- Number of sample detections versus the number of total samples analyzed for each analyte;
- Average and median concentration of the analyte in each type of sample tested;
- The expected concentration range of each analyte, based on the 95 percent confidence interval, calculated using the number of samples analyzed and the standard deviation of the analytical results; and
- Method Two cleanup levels for locations with less than 40 inches of precipitation per year, from ADEC's contaminated site cleanup regulations (see 18 AAC 75, Article 3).

Note: To be conservative, statistics were developed using the reported detection limit for samples in which the analyte was not detected. Consequently, statistical results in many cases are biased high since actual analyte concentrations were below the detection limit – the high bias is especially misleading if elevated detection limits are reported.

With three exceptions, the Appendix B information shows that Anchorage area SCM meets the ADEC Method Two contaminated site cleanup levels. The exceptions are that the average, median, or the expected high (e.g., 95th percentile) concentrations for DRO, total arsenic, and total chromium exceed the ADEC Method Two cleanup level for protection of contaminant migration to groundwater. These three analytes were also noted as possible

contaminants of concern from the September 1999 sampling effort and are discussed in the previous section (Section 2.1).

In addition, benzene, due to its low migration to groundwater ADEC Method Two cleanup level (0.02 mg/kg) warrants further discussion. The historical data shows that benzene was not detected in any of the 15 samples analyzed. However, the detection limit was below the cleanup level in only three of those analyses. For the majority of the samples the detection limit was approximately <0.05 mg/kg - slightly above the current migration to groundwater cleanup level.

2.3 Conclusions

HCI believes that the data from the September sampling in Appendix B, together with supplemental information concerning sources of petroleum hydrocarbons in SCM and background metals levels in Alaska, can be used to demonstrate that Anchorage area SCM do not need to be managed as a contaminated environmental media. For example:

- Vegetative matter in the SCM can cause “biogenic” interference in the analysis for petroleum hydrocarbons, thus causing a SCM sample to appear to have a higher petroleum content than it actually does.
- Particles of asphalt, tires, and other similar materials in SCM also contribute to the apparent petroleum hydrocarbon contamination of SCM; particularly in analyses of RRO and PAHs.
- The form of chromium in the SCM is likely to be different (and far less toxic) than the form of the metal used by ADEC to establish the Method Two cleanup levels.
- The levels of arsenic and chromium in the Anchorage area SCM are within the ranges of the naturally occurring concentrations for these metals in soils in Alaska.
- Analytical data from leaching tests conducted on samples of Anchorage area SCM for Synthetic Precipitation Leaching Procedure (SPLP) DRO, Toxicity Characteristic Leaching Procedure (TCLP) arsenic, and TCLP chromium show that Anchorage SCM is not readily leachable for these chemicals. Although TCLP benzene has not been analyzed in any of the Anchorage samples to date, HCI expects the results would also be very low because benzene is relatively soluble. Therefore most available leachable benzene would have been washed away before adsorbing on

to the material; either while the material was originally in place on the streets or in the storm drainage system.

Finally, using the new ADEC approved methods for analyzing the aromatic and aliphatic fractions of the DRO may further support the concept that the petroleum hydrocarbons in the SCM is below ADEC Method Two cleanup levels and not readily leachable. The ADEC Method Two cleanup levels for DRO aliphatic and aromatic fractions are 7,200 mg/kg and 100 mg/kg, respectively. Because the aromatic fraction is more volatile and soluble, it is less likely to be available to adsorb onto the street sweeping material and is also less likely to stay adsorbed. Consequently, it is anticipated that the majority of the DRO will be made up of the aliphatic fraction.

HCI compared the Anchorage area SCM analytical results to other SCM analytical testing results that have been reported. Summaries of analytical data from other areas are presented in Appendix C. There are a limited number of reports on the characteristics of SCM. The most studies available are for SCM in Washington State, where it appears that the most attention, nationwide, has been given to SCM. Anchorage area SCM is very similar in composition to other SCM that have been studied.

3.0 ALTERNATIVES FOR THE MANAGEMENT OF ANCHORAGE AREA SCM

The different types of solid and liquid SCM have different volumes, characteristics, and composition, which can mean that different management methods may be needed. Differences in where and how a street sweeping material is generated, the types and concentrations of contaminants in the SCM, and the volume of the material, influence what may be the most cost-effective and environmentally responsible alternatives available to manage a particular type of SCM.

Liquids. Based on HCI's review of available Anchorage area analytical testing data and interviews, liquids derived from street and storm drainage system cleaning operations do not appear to pose a problem for discharge to the Anchorage municipal wastewater (sanitary sewer) system – but are not appropriate for discharge to the storm sewer system. Contaminant levels in the liquids are below the maximum levels allowed for discharge of wastewater into the system. Separation of liquids and solids in SCM typically is accomplished by gravity separation, usually by allowing the waste to sit for a period of time in the collection truck and then decanting as much liquid as possible before removal of the solids.

Solids. From a review of available information located by HCI on the management of SCM elsewhere, the potential management alternatives discussed below were identified for further assessment. Other alternatives identified and studied elsewhere were discarded from consideration for management of Anchorage SCM because they did not appear to be easily implemented in the Anchorage area. An example of a potential alternative that was not investigated is the establishment of a dedicated SCM processing facility.

3.1 *SCM Management Alternatives and Guidance From Outside Alaska*

In searching for potential SCM management alternatives, it was apparent that few states or municipalities have published information concerning the management of SCM. HCI could find no information on the management of SCM elsewhere in Alaska.

3.1.1 *Washington Department of Ecology*

The Washington Department of Ecology (WDOE) adopted best management practices (BMPs) for street sweeping material. In their BMPs, WDOE concluded that most SCM should be managed as municipal solid waste and the BMPs encourage the disposal of SCM in municipal solid waste landfills. The BMPs identify the potential for certain reuses of SCM, such as blending into certain topsoil mixes and as landfill cover. The BMPs also identifies certain potential problems, such as further concentrating contaminants and creating material that is more difficult to dispose, which may occur when SCM is processed.

3.1.2 *Kitsap County, Washington*

Since 1994, Kitsap County has used processed SCM in the production of two-ton concrete “ecology blocks.” The County uses these blocks in bank stabilization, stormwater detention pond construction, and road construction projects. The County determined that they realized a net savings over the cost of disposing of unprocessed SCM and the purchase cost of similar blocks. However, the County reportedly generates only about 250 cubic yards of SCM that are used in the block production.

3.1.3 *Clean Washington Center*

In 1997, the Clean Washington Center (CWC) completed a study on the reprocessing and reuse of street cleaning solids. The study was prompted by the County of Snohomish Health District (SHD), which adopted a policy

requiring, if possible, the recycling of SCM and the removal of litter and vegetative matter for all potential end uses. In 1993, the WDOE included SCM in their definition of municipal solid waste, causing significant economic effects on the organizations responsible for SCM collection and management. Solid waste landfill tipping fees in Snohomish County were \$89 per ton, and average more than \$80 per ton in Washington State. In 1995, the SHD decided to promote waste generation reduction and the recycling of SCM.

The CWC determined that the solution to the problem of SCM reutilization was to economically process the materials to remove litter and pieces of organic material and to separate the mineral constituents into specified size fractions to produce useable or marketable end products. (Note: The term “process”, as used in this report, broadly refers to the cleaning of SCM to prepare the mineral fraction for further use. For example, SCM “processing” can involve screening of SCM to remove litter and organic material, washing in an aggregate wash plant, or other means of preparing the SCM for future use.) The CWC study identified and evaluated the following five alternatives, in the following order of preference, for processing and using SCM:

- Haul SCM to an existing aggregate wash plant equipped with wood removal equipment, and blend the processed SCM with daily process materials for use as aggregate in concrete;
- Seek an interested public or private party to develop a dedicated facility for the processing of street cleaning solids;
- Have individual street cleaning generators purchase equipment and process street material for use at their respective facilities;
- Seek an interested party to develop a mobile processing plant (leaving the generator responsible for sand and gravel reuse and disposal of unsuitable materials); and
- Haul SCM to an asphalt plant retrofitted to burn organic materials and hydrocarbons.

The CWC study reviewed the advantages and disadvantages of mechanical screening coupled with wet, dry, and combustion separation technologies and concluded that the easiest option for generators would be to haul the material to an existing concrete batch plant or asphalt plant that could use the aggregate portion in their products.

An economic evaluation of the five alternatives was conducted, based on the assumption that approximately 5,500 to 7,500 tons per year of SCM would need to be managed. These quantities were based on estimates of annual SCM generation in Snohomish and Whatcom Counties. The economic evaluation results for the estimated costs of the alternatives are presented in Table 4.

Table 4 - CWC Estimated Costs for Management Alternatives

Alternative	Low cost per ton	High cost per ton
Existing Aggregate Wash Plant and Concrete Batch Plant	\$5	\$45
Dedicated Receiving and Processing Site	\$25	\$60
Dedicated Generator Processing Site	\$17	\$25
Mobile Processing Plant	\$25	\$50
Existing Retrofitted Asphalt Plant	\$45	\$75

3.1.4 Metropolitan Council, Minnesota

In 1994, the Metropolitan Council published a set of best practices for street sweeping management. One portion of these best practices includes a description of a project implemented in the Bloomington, Minnesota, area to recover and reuse sand for winter ice control aggregate. Details of this project are discussed in Subsection 3.2.2.

3.1.5 Contacts With Other Municipalities

Based on a internet search, we also contacted several Midwestern and Canadian municipalities to see how they are handling SCM. The following provides a synopsis of our discussions:

- **Duluth, Minnesota – Bob Troolin, Public Works Department (218-723-3875).** Duluth generates approximately 5,000 to 9,000 cubic yards of SCM per year. Typically they process it through a 1-inch screen and use it as fill for ball fields, landscaping, and soccer fields.
- **Grand Forks, North Dakota – Allan Koop, Street Maintenance Department (701-746-2570).** Indicated the SCM is stockpiled, sometimes mixed with leaves, and generally sent to the landfill as cover material. The volume generated annually was unknown.
- **Pittsburgh, Pennsylvania – Perry Smith, City of Pittsburgh (412-741-1272).** An estimated 5,000 tons is collected annually. The material is reused as street sanding material the following year.
- **Sault Saint Marie, Ontario – Monti Bender, City of Sault Saint Marie (705-541-7000).** Approximately 10,000 to 15,000 tons of SCM collected annually is used for landfill capping and city construction projects such as backfill for sewer pipelines.
- **Calgary, Alberta – Bill Bench, Street Maintenance (403 268-1098).** Seventy to 80 percent of SCM is given away to private citizens for use as

fill. These users must sign a release waiver. Much of the remaining SCM is used for landfill capping.

- **Thunder Bay, Ontario – John Bodnar, City of Thunder Bay (807-474-4800).** Approximately 13,000 tons of SCM is collected annually and used as industrial fill.

3.2 *SCM Management Alternatives Considered for Anchorage*

As is evident from the studies and guidance from other locations, there are a variety of potential methods that might be employed in managing SCM in Anchorage. HCI concentrated its assessment of management alternatives for the Anchorage area on those alternatives that appeared to be the most cost-effective and have the greatest potential to be successfully implemented.

3.2.1 Incineration

Incineration has been occasionally used for Anchorage area SCM in the past when petroleum contamination levels exceeded ADEC petroleum contamination cleanup levels under earlier ADEC regulations. Incineration is an expensive alternative. Currently, Anchorage Soil Recycling charges \$50 per cubic yard for contaminated soil – which does not include hauling or sampling charges, nor processing time. Considering that Anchorage generates an estimated 10,000 cubic yards of material each year, the cost of processing all SCM in this manner could range between half and three-quarters of a million dollars annually.

3.2.2 Alternatives Involving SCM Processing

Some alternatives for the management of SCM would require that the material be processed to remove litter, other debris, and rocks. These alternatives include use of the material in concrete or asphalt manufacturing, prefabricated concrete, composting, topsoil mixes, and potentially as landfill cover. Except for concrete aggregate processing, processing for SCM could be conducted by mechanical separation of litter and other debris or oversize rocks. A variety of material separation technologies are readily available for this task. The following provides brief overviews of two mechanical separation options - trommel screen and grizzly screen – and an overview of SCM process washing to recover the coarser portion. Subsequently, several management alternatives involving processing are considered.

Trommel Screen. The use of a trommel screen appears to be a potential choice because a trommel can effectively separate wetter and agglomerated materials, are easily unclogged, have relatively high production rates, come

in a variety of sizes, and are relatively inexpensive to purchase, operate, and maintain.

Trommels can be sized for portability or production rates. They range in price from approximately \$75,000 for a small, easily portable unit typically used in landscaping work, to upwards of \$200,000 for the largest, highest production rate units. Conveyor systems would add to the price. Depending on the size of the unit, a trommel is expected to process from 20 to 200 cubic yards of SCM per hour. A small trommel could be moved from site to site where the materials are accumulated, thus eliminating hauling costs but increasing processing labor costs. Alternatively, a high production rate trommel would likely be used at a single processing site and require more street material handling and hauling prior to processing, assuming that the materials are accumulated at multiple snow disposal sites around the Municipality.

In 1993, Bloomington, Minnesota, obtained a \$100,000 solid waste abatement grant from the Metropolitan Council to purchase a mechanical screen/shredder conveyor system that has been used to reclaim ice-control aggregate, seal-coating aggregate, and some soils from city projects. Based on a demonstration project the city estimated a cost savings of \$4,600 over the costs to purchase approximately 5,700 tons of new materials of the same types, even with municipal solid waste landfill tipping fees of \$6.00 to \$11.00 per ton. To facilitate reuse of the ice-control aggregate, Bloomington began using coarser sand and mixed the processed, recovered aggregate 50-50 with new sand.

There are several potential disadvantages of processing SCM. These include:

- Potential costs to:
 - Handle, haul, and process the SCM;
 - Handle and haul the processed material to its point of use; and
 - Handle, haul, and dispose of separated unusable components of the SCM (litter and unusable debris is estimated by ADOT&PF and MOA to comprise less than 1 percent of SCM);
- Need to obtain approvals from one or more regulatory agencies for uses of the processed material; and
- Long-term availability of uses for the usable portion of the processed SCM.

A preliminary calculation for the annual cost to process 10,000 cubic yards of SCM in Anchorage was made based on the following assumptions:

• Purchase of a small trommel (amortized over five years).	\$20,000
• 1,000 hours of processing time (assumed 20 cubic yard/hour production) using a crew of two people at \$50/hour each.	\$50,000
• 500 hours of loader time at \$50/hour to load trommel, handle processed material and litter, and load materials onto trucks.	\$25,000
• 475 hours of equipment and labor to haul 9,500 cubic yard of processed material to use location (assuming use of 10-yard trucks and two trips/hour) at \$100/hour.	\$47,500
• Hauling and disposal of 10 tons of waste to landfill (assuming 1 percent litter by volume, a waste density of 200 lb/cubic yard, a tipping fee of \$45/ton, and five trips of 1 hour each at \$100/hour).	\$600
• Move trommel between snow disposal sites (assuming 16 hours time for two people at \$50/hour each).	\$1,600
TOTAL	\$144,700

With some contingency costs added, it is hard to see how it would cost less than about \$15 per cubic yard to process SCM in Anchorage; assuming that there is and will be a use for the processed material, which is available at no cost other than hauling it to the location.

Grizzly Screen. A less intensive option for the screening of street cleaning solids would be the use of a “grizzly.” A grizzly is a static, inclined screen on top of a raised frame. Typically, the screen is constructed of parallel lengths of heavy steel pipe or bars. When material is dropped onto the platform, material smaller than the screen openings passes through the grizzly onto a stockpile below, while the larger material rolls or slides off the grizzly onto a second stockpile. Grizzlies are commonly used in many types of mining operations to separate larger rocks and debris from finer materials.

The use of a grizzly for separation of materials from street cleaning solids could have several advantages, including that it:

- Is relatively inexpensive to purchase or construct;

- Is inexpensive to operate because no operator is required and there are no moving parts to maintain; and
- Produces no wastewater requiring treatment and disposal.

A grizzly also appears to have several disadvantages, including that:

- They do not tend to work well with wet material that clumps such as wet vector material;
- Once constructed, the screen size normally is not adjustable; and
- The screen openings may be too large for removing small litter and debris from street cleaning solids.

The effectiveness of a grizzly in processing street cleaning materials will depend primarily on the amount of moisture in the material and the final use for the processed street cleaning material. If the street cleaning material is dry, and removal of only larger debris is desired, then a grizzly should be effective in producing an acceptable final product at a lower cost than other types of mechanical separators. However, if the material is wet and clumps together, or removal of small debris is needed, a grizzly may not be able to produce the desired result as well as a trommel or other mechanical separation process.

Washing. Washing street cleaning material to recover the coarser portion of the material for use in concrete aggregate or for other purposes has several disadvantages. Washing typically is done using either a static tank or flow-through system. Tank systems use less water, but flow-through systems produce better results. A small commercial flow-through washing system would use more than 50 gallons of water per minute. Recycling of wash water, to reduce water use, is possible. Typically a treatment system would consist of one or more clarifier tanks, sometimes with the addition of polymers, to remove sediments from the wash water prior to reuse. Removal of hydrocarbons from the treatment system also may be needed.

Ultimately wash water will need to be disposed. This may be accomplished by discharge to the AWWU wastewater system, provided the wastewater meets the system's pretreatment standards. Depending on the characteristics of the waste wash water, discharge directly to the environment also may be possible, but would likely require a wastewater discharge permit from ADEC.

The washing of street cleaning materials should result in the recovery of fine and coarse sand, pea gravel, and small rock for reuse. Washing also would generate potentially unusable fines requiring disposal. No studies have been

conducted on Anchorage street cleaning material to estimate the percentages of potentially usable and unusable portions in the street cleaning material, so the potential quantity of material requiring disposal is unknown at this time. Contaminants in street waste tend to be tied to the finer-grained particles. Many of the contaminants seen in street cleaning material as a whole are expected to concentrate in the unusable fines, which could require them to be managed as contaminated media.

HCI explored the following potential uses of processed SCM in Anchorage. A discussion of each use is presented below.

3.2.2.1 Use in Asphalt or Concrete Production

HCI discussed the potential for using SCM in concrete or asphalt production with Anchorage Sand and Gravel. HCI also discussed the use of this material in asphalt production with Central Paving in Anchorage. Anchorage Sand and Gravel reported that they had investigated the use of SCM a few years ago and had concluded that it contained too much debris to use in either concrete or asphalt without first processing it. Central Paving expressed the same reservations. Based on the current cost of aggregate, both companies said they would not be interested in trying to process SCM for use. Both companies were also concerned that the concentration of fines in processed SCM may be too high to use. Consequently, both were noncommittal about its use without further information and consideration.

For use in either concrete or asphalt production, the SCM would first need to be processed to remove unwanted materials: primarily litter, debris, and oversize stones in the case of concrete. For concrete production, an aggregate wash plant with wood removal equipment is generally used for processing and water quality is typically a primary issue of concern.

For asphalt production, mechanical separation could be used to remove the unwanted materials from the SCM. Materials destined for asphalt production are not typically processed by combustion only in the asphalt plant because of the threat of fire in the plant's bag house from embers (originating from litter or other combustible materials in the SCM) carried in from the plant. In addition, because of the particle size of the SCM, the processed material would most likely be useable only in Asphalt Treated Base (ATB), a lower quality asphalt that is placed under a wearing course.

The potential advantages to the use of SCM in concrete or asphalt production are that the material would be beneficially used and disposal costs for most of the material could be avoided. HCI assumes that aggregate from processed

material could be sold to a concrete or asphalt producer, thus recovering at least a portion of the processing and hauling costs.

The potential disadvantages to this alternative are the capital and operating costs to process the street materials and dispose of the unusable portions and the need to rely on the availability of a market for the processed aggregate.

3.2.2.2 Composting

HCI contacted the Anchorage Compost Center (ACC) and discussed the potential for using SCM in their compost process. The organic contaminants in the SCM would be amenable to the biological degradation ongoing in the composting process. ACC expressed concern over the stones and litter present in the SCM and were not interested in processing SCM to clean it up for composting. ACC also expressed concern over the presence of metals, which would not be changed or decreased by the composting process, except through dilution with other composted material. (Note: Per Section 2.0 of this document, sampling results suggest that metals concentrations are not a significant issue with the SCM.) Finally, ACC did not believe that they could handle the potential volume of SCM from ADOT&PF, MOA, and their contractors.

There would likely be mutual benefits from composting a mixture of SCM with the organic materials that are accepted for composting. However, heavy residual petroleum, including the PAH are not expected to be significantly degraded because of the relative short composting time and metals found in SCM will not be degraded or altered by the composting process.

3.2.2.3 Use as Fill, Subgrade Fill, or Top Dressing

SCM has been used in Alaska and elsewhere for various types of fill activities. Typically it is suitable for use only as subgrade fill because of its small particle size. ADOT&PF has used SCM for subgrade fill on at least one Kenai Peninsula road construction project. Snohomish County, Washington, has reported successfully using it as top dressing on reclamation slopes and to build a berm. In both of the Snohomish County projects, the material was encapsulated by hydroseeding.

ACC suggested that SCM cleaned of litter might be able to be used as fill in the construction of a berm being constructed for the MOA at the compost facility. The berm is 12 feet tall by several hundred feet long. Use as fill or as top dressing in this berm or other construction projects may be a viable

alternative for SCM under certain conditions, including the type of site and whether the SCM needs to be processed prior to use.

The Washington Department of Ecology (WDOE) has encouraged the reuse of screened SCM as part of topsoil mix to be used in industrial areas and transportation corridors (i.e., low traffic areas such as airport infields and road shoulders and infields).

The advantages to using SCM as subgrade fill are that the material may require little or no processing before it is used and there would likely be no disposal fees associated with its use. Even if no processing were required for use as a fill, ADOT&PF and MOA would still accrue material handling and hauling costs. The primary disadvantages with these uses of SCM are:

- Handling, hauling and processing costs (assuming the SCM would need to be processed); and
- Volumes of material that could be used annually in the Anchorage area do not appear to be predictable.

3.2.3 Alternatives Not Requiring Processing

Use as Municipal Solid Waste Landfill Cover. SCM is used as cover material at some municipal solid waste landfills. Other landfills feel that the material is too fine for this use. The WDOE reports that several landfills in Washington State receive SCM either for free or at a discounted tipping fee for use as cover.

SCM used as landfill cover may need to be screened to remove litter and debris. The WDOE recommends screening SCM to remove debris and litter prior to using it as landfill cover. Whether to screen SCM before using it as cover needs to be negotiated with the landfill operator and the need for screening would likely depend on how much and what kind of litter and debris the SCM contains. Landfill operators typically are required to minimize the potential for windblown litter from their facilities.

Discussions in the past between MOA Street Maintenance and Solid Waste Services personnel have explored the use of SCM at the Hiland Road Landfill. MOA Solid Waste Services reported that they have sufficient, readily available cover material and do not need SCM. Consequently, they are not interested in accepting the material either for free or at a discounted tipping fee.

3.2.4 Disposal as Solid Waste

If SCM cannot be used in a beneficial manner, it may need to be disposed as a solid waste. The potential exists to have SCM excepted from the solid waste regulations under the provisions of 18 AAC 60.005(c)(16) in ADEC's solid waste regulations. To have an exception approved for SCM, ADOT&PF and the MOA would need to demonstrate to ADEC's satisfaction that SCM:

- Will not create harmful leachates when disposed of under a management plan that is proposed for the material;
- Is not a regulated hazardous waste;
- Is not combustible;
- Will not cause a threat to public health, safety, or welfare, or the environment; and
- Does not meet the definition of any of 13 categories of waste, including "commercial solid waste" and "inert waste," which appear to most closely apply to SCM.

ADOT&PF and MOA could likely satisfy the first four conditions. Meeting the final condition may be difficult because these definitions are broad and open to considerable interpretation. Consequently, if ADEC wanted to regulate the disposal of SCM as solid waste, they probably could do so.

Assuming regulation of SCM as solid waste if it cannot be reused and/or ADEC determines that it is regulated as a solid waste, HCI briefly explored two solid waste disposal options: disposal in the existing Hiland Road landfill, and disposal under a specific SCM permit.

3.2.5 Disposal in Hiland Road Landfill

ADOT&PF and MOA Street Maintenance representatives reported that disposal of SCM in the Hiland Road Landfill has been attempted in the past and has been problematic, primarily for two reasons:

- The landfill has a 2,000 milligram per kilogram (mg/kg) upper limit for petroleum hydrocarbon concentration in material accepted for disposal. Petroleum concentrations (largely RRO) in Anchorage area SCM frequently have exceeded the landfill's acceptance level.
- Landfill managers have not been interested in using SCM as landfill cover and consequently have offered no discount from the normal solid waste tipping fee for SCM that otherwise meet landfill acceptance criteria, making landfill disposal an expensive option; an estimated \$720,000 per

year, assuming 16,000 tons of SCM at \$45/ton – and this does not include hauling costs.

SCM-Specific Solid Waste Permit. In preliminary discussions between HCI and ADEC Solid Waste Program staff, ADEC was receptive to the idea of permitting one or more sites for the management of SCM. A single site would have a site-specific permit and multiple sites would be permitted under a general permit. SCM then could be placed at the site or sites under conditions defined in the permit. As a solid waste, SCM could likely be regulated as an “inert solid waste,” which has less stringent disposal standards than most other types of solid waste. Conditions in the permit would likely include requirements concerning the type of material accepted (including levels of contamination allowed), testing, site operations, site monitoring, and site closure.

Currently, neither ADOT&PF nor MOA have identified one or more specific sites to propose for permitting and use as a SCM site. It is likely that property would need to be purchased. HCI has discussed using existing Anchorage area snow disposal sites with ADO&TPF and MOA street maintenance staff. The snow disposal sites may offer good locations to accumulate SCM over the summer and fall, but they do not have the capacity to accommodate long-term disposal of the large quantities of SCM that may need to be managed.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 *SCM Characterization*

The September 1999 and historical sampling data provide a good indication of potential contaminants in SCM that could be an issue. Possible compounds of concern include DRO, PAHs, arsenic, and chromium. Each of these are discussed individually below:

- **DRO.** Historical DRO data suggests the potential for exceedences of the migration to groundwater pathway cleanup level of 250 mg/kg. On the other hand, the September 1999 data indicates material concentrations near or below the cleanup level. Neither of these takes into account the potential for concentrations being bias high due to biogenic impacts. Furthermore, the 250 mg/kg cleanup level is based on the potential for DRO migration to groundwater – but the SPLP leachability testing performed in September 1999 indicated that the DRO in the street sweeping materials is not readily leachable.

Future DRO analyses should use the AK 102AA methods that consider the aliphatic and aromatic DRO fractions. Based on past experience with other soil analyses, it is speculated that in most cases the DRO in the street sweeping material will be primarily of the aliphatic fraction – and that the ADEC cleanup levels for these two fractions (7,200 mg/kg aliphatic and 100 mg/kg aromatic) will likely be met in most cases.

- **PAH.** September 1999 sampling results indicated that one PAH analyte slightly exceeded the ADEC Method Two cleanup level. Statistical evaluation of the data indicated that in most instances PAH concentrations in the SCM should not be an contaminant issue.
- **Arsenic.** As discussed in Section 2.1, arsenic does not appear to be a concern for the SCM. Although some of the detections exceed the 2 mg/kg ADEC Method Two cleanup level for migration to groundwater – the detected concentrations appear to be well within the range of background concentrations.
- **Chromium.** Chromium also does not appear to be a concern for the SCM, as the detected chromium concentrations are generally within the expected background levels. Also, the ADEC Method Two chromium cleanup level of 26 mg/kg is based on chromium +6, and it is doubtful that the chromium in the SCM is primarily composed of this chromium ion. If necessary to demonstrate this assumption, samples could be collected and analyzed for total chromium and chromium +6.

In summary, it is likely that in most cases the potential contaminant concentrations in the SCM will not exceed ADEC cleanup levels, and thus this material should not be considered a contaminated environmental media.

4.2 Management Options

Several possible management options for Anchorage area SCM were considered from a broad perspective, including appropriateness, implementability, and cost.

Incineration. Incineration is a potential method for handling SCM if the petroleum hydrocarbon levels significantly exceed ADEC cleanup levels and there are no other options for the material. The primary drawback is cost. Anchorage Soil Recycling currently charges \$50/cubic yard – which does not include any sampling or hauling costs. With approximately 10,000 cubic yards of SCM generated per year, this could amount to more than \$500,000 annually.

Processing. Processing involves activities associated with cleaning the SCM in preparation for future use. Examples include washing and the removal of litter, other debris, and large rocks from the materials generated during street cleaning operations. Litter removal could be potentially done using labor or with mechanized separation equipment such as a trommel screen. Based on rough calculations, it was estimated that the cost to process 10,000 cubic yards of material with a trommel would be approximately \$15/cubic yard, or \$150,000 annually. This does not include any additional hauling costs after processing.

Processing street waste using a grizzly is expected to be much less expensive than using a trommel because a grizzly would be far less expensive to purchase, operate, and maintain. However, the suitability of using a grizzly for processing street cleaning material depends on the ultimate use intended for the processed material.

Several management options were considered for processed SCM, including:

- **Use in Asphalt or Concrete Production.** Anchorage Sand and Gravel and Central Paving both indicated that they were not interested in using the SCM due to the potential for debris and the concentration of fines (small particle size).
- **Composting.** The Anchorage Compost Center expressed concern over the potential for contaminants and litter in the SCM. They also did not believe they could handle the large potential volume of SCM from the Anchorage area.
- **Use as a Fill or Top Dressing.** Reuse as a fill is a potential option that hinges to some extent upon the specific use and upon the predictability of the need for this type of material in the Anchorage area. For some uses, unprocessed SCM may be acceptable.

Municipal Solid Waste Landfill Cover. MOA Solid Waste Services report that they have sufficient cover material available. Consequently, they are not interested in accepting SCM either for free or at a discounted tipping fee.

Disposal as Solid Waste. Disposal of SCM as a solid waste should be considered if no options for reuse of the SCM are appropriate, feasible, or can be implemented. Aside from possible exceedences of the landfill 2,000 mg/kg petroleum hydrocarbon limit – at \$45/ton, the annual cost for disposing of the Anchorage area SCM, not including hauling costs, would be approximately \$720,000.

A dedicated SCM landfill or multiple disposal sites would require permitting and likely ongoing site operations, monitoring, and closure. Additionally, at this time a specific site could not be identified so it is probable that this option could require purchase of an appropriate piece of property.

4.3 Recommendations

Based on the strong indication that the SCM is not a contaminated environmental media, we recommend that the ADOT&PF and MOA develop an ongoing sampling and reuse (e.g., fill, top dressing, etc.) program for the SCM. Other considered options appear to be either unnecessary given the SCM characterization (e.g. landfilling), not implimentible (e.g., composting, asphalt/concrete production), and/or too expensive (e.g., incineration). The general components of the sampling and reuse program are discussed below.

4.3.1 SCM Accumulation

Based on the characteristics of the material, the following actions are recommended as good management practices that could be implemented during SCM accumulation:

- Accumulate collected SCM in areas approved by MOA and ADOT&PF to minimize impacts to the environment.
- Water collected with street cleaning materials should be handled in either of two ways, depending on the material: 1) Water from vector trucks may be gravity separated, as discussed in Section 3, and discharged directly into the AWWU wastewater system, if possible. If discharge directly into the AWWU system is not possible, vector wastes could be placed on an impermeable pad that drains into the AWWU wastewater system or that drains back into a storm drainage system treatment device, such as a sedimentation basin, where the material originated. 2) Water from collected street sweeping materials could be allowed to infiltrate through storage pads or drain to storm drainage system sedimentation basins or oil/water separators. These materials typically are low in moisture and contain few soluble contaminants. Most contaminants are adsorbed onto street cleaning material particles.
- Accumulate SCM in areas that minimize runoff and runoff water from precipitation or water remaining in SCM and avoid violations of ADEC's water quality standards. Earthwork at a site could be used to control water flow.

- At least initially, segregate material in piles according to where and/or how they were collected: street sweepings; vactor/storm drains; oil separator; and sedimentation basins.

Note: ADOT&PF and MOA street maintenance managers also should monitor the occurrence of incidents that result, or could result, in a release of petroleum products or other chemical contaminants into streets and storm drainage systems, which could cause higher contaminant levels. ADOT&PF and MOA street maintenance personnel should work closely with agencies such as the Anchorage Police, Alaska State Troopers, EPA, and ADEC to identify extraordinary potential SCM contamination sources and:

- Have the parties responsible for an oil or hazardous substance release clean up the release, including street or storm drainage system cleanup, so the release does not affect the composition of the SCM generated during subsequent normal maintenance activities; or
- Pick up, test, and manage separately, the SCM from the vicinity of a known contaminant release, so that more highly contaminated SCM is not mixed with other SCM, complicating material management.

4.3.2 Sampling Program

Develop an ongoing sampling program to further show that in general the SCM is not a contaminated environmental media and to gain further knowledge of the chemical composition and characteristics of the SCM. Possible guidelines for this sampling program could include:

- Develop a sampling and analysis plan for collection of SCM samples. This plan could be used for all future routine sampling events.
- Develop a SCM analytical database to manage sampling results and provide periodic checks for any changes in SCM characterization. The database could serve as the basis for any reporting requirements.
- Periodically, the sampling program should be re-evaluated and modified as appropriate. For instance, if analytical results prove to be relatively consistent over a period of time, and below ADEC cleanup levels, sampling frequency could be reduced,, certain analytes could be dropped from the program, and the number of samples could be reduced. Collected data would continue to be added to the street sweeping database.

4.3.3 SCM Reuse or Disposition

If the sampling data continue to indicate that the material is below ADEC Method Two cleanup levels, a variety of reuse and disposition alternatives can be developed to handle the volume of the material. These could include use as a fill, use as a road subgrade, and use as top dressing. In selecting appropriate reuse or disposition alternatives, ADOT&PF and MOA should keep in mind the following issues:

- **Predictability of the market for any particular use.** For instance, one year there may be a large market for industrial fill and all the SCM material could be used for this purpose. However, the next year there might not be a large demand for industrial fill and thus the ADOT&PF and MOA could be left with a surplus of SCM. As a corollary to this, SCM may need to be stored at the accumulation areas for a period of time.
- **Physical Hazards.** Depending on the way litter is removed from the material, if it is removed at all, some physical hazards could remain in the SCM, which could preclude certain uses. For instance, sharp objects (e.g., glass, nails) could pose a physical risk if people or animals come in direct contact with the material.
- **Chemical Risks.** Despite the ongoing sampling program, it is possible that some SCM may contain high levels of a potentially harmful chemical (e.g., as the result of an unknown release of an unexpected compound or unexpectedly elevated concentrations of compounds traditionally found in SCM), which could pose a risk to people or animals coming in direct contact with the material.
- **Liability.** ADOT&PF and MOA may want to give some consideration to whom or for what use the SCM material is provided, and under what conditions. For example, potentially the material could be provided to a large industrial fill operation that also accepts contaminated fill from another source. Once contamination is discovered at the site where the fill has been placed, unless ADOT&PF/MOA can show that their particular fill was not contaminated – they could become a potentially responsible party for remediation of the site. ADOT&PF and MOA may want to consider some sort of “waiver” form to be signed by parties using the SCM.

5.0 REFERENCES

Clean Washington Center, 1997. *Reprocessing and Reuse of Street Waste Solids*. Clean Washington Center, Seattle, WA, IBP-97-5, 46 pages.

Martin, Craig, 1991. *Total Petroleum Hydrocarbons in Highway Maintenance Wastes*. M.S. thesis, Washington State University, August 1991, 52 pages.

Metropolitan Council, 1994. *Metropolitan Council's Best Practices for Street Sweeping*. Metropolitan Council, St. Paul, MN, February 1994, 53 pages.

Personal communication with Earl Polan, Anchorage Sand and Gravel, September 16, 1999.

Personal communication with Terry Kayser, Metropolitan Council, MN. October 4, 1999.

Personal communication with Dan Schact, Ramsey County, Minnesota Public Works Department, October 4, 1999.

Personal communication with Michael Hepp, Washington Department of Ecology, September 14, 1999.

USGS, 1988. *Element Concentrations in Soils and Other Surficial Materials of Alaska*. By L.P. Gough, R.C. Severson, and H.T. Shacklette. U.S. Geological Survey Professional Paper 1458.

Washington State Department of Ecology, 1995. *Best Management practices for Management and Disposal of Street Wastes*. Washington State Department of Ecology, Olympia, WA.

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Appendix A

MEMORANDUM

DATE: February 24, 2000

TO: Gerald Reed – ADOT&PF

FROM: Jeff Mach and Tom Noyes – Hart Crowser, Inc.

RE: Sampling Report – Street Sweepings Characterization
A-8611

CC: Dan Breeden – ADOT&PF
Bill Fowler – MOA
Scott Wheaton - MOA

This memorandum provides a summary of the analytical results for samples collected from Alaska Department of Transportation & Public Facilities (ADOT&PF) and Municipality of Anchorage (MOA) street sweeping piles. In September of 1999 two samples were collected from two ADOT&PF piles at their Tudor Road facility and eight samples were collected from MOA's piles at Klatt Station, Northwood, Tudor, Sitka, and Commercial Snow Disposal sites (Attachment 1: Figure 1).

The purpose of this sampling effort was to develop a characterization of the street sweepings collected by MOA and ADOT&PF to help with development of disposal options. In addition to Figure 1, Attachment 1 contains sketch maps showing sample locations at the various MOA street sweeping pile sites. Attachment 2 contains a summary of analytical results.

SAMPLING LOCATIONS

Specific MOA sampling efforts were coordinated with Lynette Nickens at MOA's Northwood facility who provided descriptions and locations of the piles. Piles were sampled on September 14, 1999 at the following locations:

- Klatt Station street sweepings pile (one composite sample: Figure 2);

- Northwoods Snow Site street sweeping pile (two composite samples), regular vector pile (one composite sample), and oil separator vector pile (one composite sample: Figure 3);
- Tudor Road Snow Site street sweeping/vector pile (one composite sample: Figure 4);
- Sitka Snow Site street sweeping pile (one composite sample: Figure 5); and
- Commercial Snow Site sweeping pile (one composite sample: Figure 6).

ADOT&PF sampling efforts at the Tudor Road facility were coordinated with Mr. Gerald Reed. One composite sample each was taken from a pile of street sweepings and a pile of storm drain material on September 9, 1999 (Figure 7).

SAMPLING METHODS

The following methods were used to collect composite samples at each of the piles:

- At each site an estimate of the pile size was noted.
- Five-spot composite samples were collected at the ADOT&PF piles and four- to six-spot composites were collected at the MOA piles. Specific composite sample locations were selected based on field observations to obtain a representative composite sample for each pile. Samples were collected from different sides of each pile and at different heights on the pile. The sample depths within the pile were between 1 to 3 feet.
- Each composite sample was collected using a decontaminated stainless steel spoon and bowl. Composite samples were collected directly into a stainless steel bowl. Once all the composite locations were sampled, the soil in the bowl was homogenized and then placed in appropriate sample containers.
- Each sample container was marked with the date, time, location, sample number, project name, analysis to be performed, and sampler's initials. Sample numbers were:
 - Klatt Station – MOA-1-9/99;
 - Northwoods Snow Site: MOA-2A-9/99, MOA-2B-9/99, MOA-3-9/99, and MOA-4-9/99;
 - Tudor Road Snow Site: MOA-5-9/99;
 - Sitka Snow Site: MOA-6-9/99;
 - Commercial Snow Site: MOA-7-9/99;
 - ADOT&PF Tudor Road Facility: ADOT-1-9/99 and ADOT-2-9/99.
- Sample containers were placed in a cooler to maintain a temperature of approximately 4o C – as possible given the temperature of the soil at the time of sampling.

- The composite samples were recorded on a chain-of-custody form and transported to the project laboratory – MultiChem Analytical Services (MultiChem) of Anchorage, Alaska.

SAMPLE ANALYSES

The samples were submitted to MultiChem for the following analyses:

- Diesel-range organics (DRO) – AK Method 102;
- Residual-range organics (RRO) – AK Method 103;
- Synthetic Precipitation Leaching Procedure (SPLP)/DRO – EPA Method 1312/AK Method 102;
- Chloride – EPA Method 300.0;
- Total metals including barium, cadmium, chromium, copper, lead, silver, and zinc – EPA Method 6010;
- Total arsenic – EPA Method 7060;
- Total mercury - EPA Method 7471A;
- Total selenium – EPA Method 7740; and
- Polynuclear aromatic hydrocarbons (PAHs) – EPA Method 8270.

In addition, particle size mechanical (sieve) and hydrometer analyses were performed on select samples.

ANALYTICAL RESULTS

Analytical results were tabularized and are presented in Attachment 2.

Attachment 3 contains the laboratory certificates of analysis.

Appendix B

APPENDIX B

SUMMARY OF HISTORICAL SCM ANALYTICAL TESTING RESULTS

Appendix B presents a tabular summary of available historical street cleaning material (SCM) analytical data for the Anchorage area collected between 1986 and 1999. For the most part, the data were provided by the Municipality of Anchorage (MOA) and the Alaska Department of Transportation and Public Facilities (ADOT&PF). Hart Crowser's Fall of 1999 SCM analytical results are also included with the historical data in this summary.

These data are provided to help further the SCM characterization effort – but are not considered definitive given the limitations discussed below. The remainder of this section addresses the following:

- Table organization;
- Data quality limitations; and
- Limitations of statistical presentation.

TABLE ORGANIZATION

Data are presented in the table according to the analysis performed on the samples (e.g., diesel range organics, total arsenic, etc.). As available, data are further broken down for each analytical procedure in accordance with where the samples were collected. For instance, results for diesel range hydrocarbons are provided in three “Material Type” categories: 1) all sample results; 2) collected SCM (i.e., samples obtained after the SCM has been collected and accumulated); and 3) *in situ* sediment (i.e., sample obtained directly from the street or catch basin, prior to any SCM collection efforts).

Table rows contain the results of the various analyses performed on the samples, as discussed above. Table columns include the following:

- Analytes that have been tested for;
- Analytical methods used;
- Type of material sampled and tested;
- Number of sample detections versus the number of total samples analyzed for each analysis;
- Average and median concentration of the analyte in each type of sample tested;

- The expected concentration range of each analyte, based on the 95 percent confidence interval, calculated using the number of samples analyzed and the standard deviation of the analytical results; and
- ADEC Method Two cleanup levels for locations with less than 40 inches of precipitation per year, from ADEC's contaminated site cleanup regulations (see 18 AAC 75, Article 3).

DATA QUALITY LIMITATIONS

As mentioned, the data in the summary table came from a variety of sampling events, sources, and purposes, and often without sufficient background information - consequently, the data quality and data representativeness cannot be strictly attested to. In general, the data were generated from the sampling and laboratory analysis of *in-situ* storm drainage systems and accumulated SCM conducted for a variety of reasons (e.g., treatment and disposal proposals for particular accumulations of SCM, studies to characterize storm drainage system materials and plan for a soils remediation facility, etc).

Most of the data transferred to the summary table were recorded on laboratory analytical reports; although, in some cases, the data came from a table or summary in a report. Much of the data did not include information concerning why or how the samples were collected - so it is not always known if representative samples were collected or that proper sample collection protocols were followed.

For instance, Hart Crowser understands that the sampling locations for 11 samples collected along DeBarr Road in 1995 were selected on the basis of having the potential to be more highly contaminated than might be normally expected. Thus, these samples are likely bias high, as opposed to being representative of SCM in general.

LIMITATIONS OF STATISTICAL PRESENTATION

The historical summary table presents the data using several statistics, including:

- Number of detections versus number of samples analyzed;
- Average concentration;
- Median concentration; and

- Estimated concentration range between the lower confidence level (5th percentile) and the upper confidence level (95th percentile).

Please note that these statistics are provided only as a means of presenting the general trends within the data sets, and are not intended to be a strict analysis of the data as would be done for research purposes. Given that, the distribution of the data points was not considered in developing the statistics, nor was any sort of evaluation conducted for assessing the impact of non-detect results. For instance, to provide a conservative approach, the statistics were developed using the reported detection limits (i.e., instead of half the detection limit or some other approach) for samples in which the analyte was not detected. Consequently, the statistical results are biased high in many cases since actual analyte concentrations were below the detection limit. This high bias is especially misleading if elevated detection limits were reported due to matrix interference, etc.

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Summary of Anchorage Area Street Waste Analyses Page (1 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5 th to 95 th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Total Petroleum Hydrocarbons (TPH)	EPA 418.1	All samples ¹	53/53	6,586	4,600	4,934 – 8,238	None established – see GRO, DRO, and RRO levels
		Collected SCM ²	14/14	3,126	2,950	2,659 – 3,593	
		<i>In situ</i> sediment ³	39/39	7,829	6,540	5,721 – 9,934	
Extractable Petroleum Hydrocarbons (EPH)	EPA 3510/ 3550/8100M	Collected SCM	2/2	300	300	290 – 310	None established – see GRO, DRO, and RRO levels
Volatile Petroleum Hydrocarbons (VPH)	EPA 5030/ 8015M	Collected SCM	0/2	<0.90	<0.90	NA	None established – see GRO, DRO, and RRO levels
Gasoline Range Organics (GRO)	AK101/8021B	Collected SCM	4/4	16	1.0	0 – 41	1,400 – ingestion ⁵ 1,400 – inhalation ⁶ 300 – migration ⁷
Diesel Range Hydrocarbons (DRO), no cleanup	AK 102	All samples	21/21	836	220	0 – 1,924	10,250 – ingestion 12,500 – inhalation 250 – migration
		Collected SCM	17/17	936	210	0 – 2,275	
		<i>In situ</i> sediment	4/4	413	422	351 – 474	
DRO, w/ silica cleanup	AK 102	<i>In situ</i> sediment	4/4	275	262	225 – 325	
Residual Range Organics (RRO)	AK 103	Collected SCM	14/14	1,721	1,700	1,480 – 1,962	10,000 – ingestion 22,000 – inhalation 11,000 – migration

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5 th to 95 th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Synthetic Precipitation Leaching Procedure, Diesel Range Organics (SPLP DRO)	EPA 1312/ AK 102	Collected SCM	0/6	<0.25 mg/L ⁴	<0.25 mg/L	NA	None established – see GRO, DRO, and RRO levels
Synthetic Precipitation Leaching Procedure, Residual Range Organics (SPLP RRO)	EPA 1312/ AK 103	Collected SCM	0/6	<0.75 mg/L	<0.75 mg/L	NA	None established – see GRO, DRO, and RRO levels
Benzene	EPA 8020 or AK101/8021B	All samples	0/15	NA	NA	NA	290 – ingestion 9 – inhalation 0.02 – migration
		Collected SCM	0/4	NA	NA	NA	
		<i>In situ</i> sediment	0/11	NA	NA	NA	
Toluene	EPA 8020 or AK101/8021B	All samples	4/15	0.09	<0.05	0 - 0.17	20,300 – ingestion 180 – inhalation 5.4 – migration
		Collected SCM	3/4	0.19	0.02	0.043 - 0.049	
		<i>In situ</i> sediment	1/11	0.09	<0.05	0.01 - 0.16	
Ethylbenzene	EPA 8020 or AK101/8021B	All samples	1/15	0.12	<0.05	0.007 - 0.242	10,000 – ingestion 89 – inhalation 5.5 - migration
		Collected SCM	1/4	0.23	<0.05	0 - 0.60	
		<i>In situ</i> sediment	0/11	NA	NA	NA	

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5th to 95th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Total Xylenes	EPA 8020 or AK101/8021B	All samples	8/15	0.32	0.09	0 - 0.78	203,000 – ingestion 81 – inhalation 78 - migration
		Collected SCM	4/4	0.94	0.03	0 – 2.53	
		<i>In situ</i> sediment	4/11	0.09	<0.09	0.07 - 0.11	
Halogenated Volatile Organics	EPA 8010	Collected SCM	0/2	All compounds undetected	All compounds undetected	NA	Compound-specific
Volatile Organic Compounds	EPA 8240A	Collected SCM	0/2	All compounds undetected	All compounds undetected	NA	Compound-specific
Semivolatile Organics	EPA 8270	<i>In situ</i> sediment	0/3	All compounds <3.0	All compounds <3.0	NA	Compound-specific
Volatile Priority Pollutants	Not Specified	<i>In situ</i> sediment	0/2	All compounds <0.5	All compounds <0.5	NA	Compound-specific
Volatile Non-Priority Pollutants	Not Specified	<i>In situ</i> sediment	0/1	All compounds <1.0 or less	All compounds <1.0 or less	NA	Compound-specific
PCBs	EPA 8080AM	Collected SCM	0/1	<0.53	<0.53	NA	10 – ingestion 10 – inhalation 10 - migration
Toxicity Characteristic Leaching Procedure (TCLP) Arsenic	SW846 1311/ EPA 6010 or 200.9 ICP	All samples	2/21	0.01 mg/L	<0.01 mg/L	0.00- 0.02 mg/L	None established – see total arsenic
		Collected SCM	0/7	NA	NA	NA	
		<i>In situ</i> sediment	2/14	0.004 mg/L	<0.005 mg/L	0.003 - 0.005 mg/L	
TCLP Barium	SW846 1311/ EPA 6010 ICP	Collected SCM	0/6	<0.5 mg/L	<0.05 mg/L	NA	None established – see total barium

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5th to 95th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
TCLP Cadmium	SW846 1311/ EPA 6010 ICP	All samples	1/13	0.30 mg/L	<0.05 mg/L	0.17 - 0.43 mg/L	None established – see total cadmium
		Collected SCM	1/8	0.49 mg/L	<0.28 mg/L	0.47 - 0.52 mg/L	
		<i>In situ</i> sediment	0/3	<0.003 mg/L	<0.003 mg/L	NA	
TCLP Chromium	SW846 1311/ EPA 6010 or 200.9 ICP	All samples	2/22	0.22 mg/L	<0.014 mg/L	0.10 - 0.34 mg/L	None established – see total chromium
		Collected SCM	1/8	0.57 mg/L	<0.5 mg/L	0.44 - 0.71 mg/L	
		<i>In situ</i> sediment	1/14	0.02 mg/L	<0.014 mg/L	0.01 - 0.02 mg/L	
TCLP Lead	SW846 1311/ EPA 7421 GF	All samples	1/22	0.59 mg/L	<0.041mg/L	0.03 – 1.15 mg/L	None established – see total lead
		Collected SCM	1/8	1.55 mg/L	<1.0 mg/L	0.27 - 2.84 mg/L	
		<i>In situ</i> sediment	0/14	<0.041 mg/L	<0.041 mg/L	NA	
TCLP Mercury	SW846 1311/ EPA 7470	Collected SCM	0/6	<0.0002 mg/L	<0.0002 mg/L	NA	None established – see total mercury
TCLP Selenium	SW846 1311/ EPA 7740	Collected SCM	0/6	<0.005 mg/L	<0.005 mg/L	NA	None established – see total selenium
TCLP Silver	SW846 1311/ EPA 7760	Collected SCM	0/6	<0.1 mg/L	<0.1 mg/L	NA	None established – see total silver
TCP Zinc	SW846 1311/ EPA 6010 or 200.7 ICP	All samples	12/15	4.9 mg/L	3.5 mg/L	3.1 - 6.7 mg/L	None established – see total zinc
		Collected SCM	1/1	1.20 mg/L	1.2 mg/L	NA	
		<i>In situ</i> sediment	11/14	5.2 mg/L	4.65 mg/L	3.3 - 7.0 mg/L	

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5 th to 95 th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Total Arsenic	EPA 7060	All samples	19/19	9.1	5.09	6.3 – 12.0	5.5 – ingestion 2 – migration
		Collected SCM	11/11	4.4	3.7	2.5 - 6.3	
		<i>In situ</i> sediment	8/8	15.6	14.5	13.7 - 17.5	
Total Barium	EPA 6010	Collected SCM	10/10	45.7	48	39.7 - 51.7	7,100 – ingestion 1,100 - migration
Total Cadmium	EPA 3050/ 7131 GF or 6010 ICP	All samples	14/22	0.33	0.28	0.28 - 0.38	100 – ingestion 5 – migration
		Collected SCM	3/11	0.27	<0.28	0.24 - 0.30	
		<i>In situ</i> sediment	11/11	0.39	0.45	0.30 - 0.48	
Total Chromium	EPA 3050/ 7191 GF or 6010 ICP	All samples	30/30	24.4	21.9	21.9 - 26.8	510 – ingestion 26 – migration
		Collected SCM	11/11	22.6	21.9	19.9 - 25.3	
		<i>In situ</i> sediment	19/19	25.4	23	21.8 - 28.9	
Total Copper	EPA 6010 ICP	Collected SCM	10/10	28.8	24.5	22.2 - 35.4	None established
Total Lead	EPA 3050/ 7421 GF or 6010 ICP	All samples	29/32	41.8	25.35	20.6 - 62.9	400 – residential land use 1,000 – commercial and industrial land uses
		Collected SCM	13/13	53.3	20	4.6 – 102.0	
		<i>In situ</i> sediment	16/19	34	30	23 – 45	
Total Mercury	EPA 7471A	Collected SCM	2/10	0.11	<0.11	0.09 - 0.13	18 – inhalation
Total Selenium	EPA 7740	Collected SCM	0/10	NA	NA	NA	510 – ingestion 3.5 – migration

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5th to 95th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Total Silver	EPA 6010	Collected SCM	1/10	0.74	<0.85	0.48 - 1.00	510 – ingestion 21 – migration
Total Zinc	EPA 3050/ 6010 ICP	All samples	29/29	289.2	120	187.6 - 390.9	30,000 – ingestion 9,100 – migration
		Collected SCM	10/10	137.2	92	68.6 – 205.8	
		<i>In situ</i> sediment	19/19	369.3	160	231.3 - 507.2	
Chlorides	EPA 300.0	Collected SCM	6/6	79	30	0 – 170	None established
Acenaphthene	EPA 8270	Collected SCM	5/6	0.12	.12	0.09 - 0.16	6,100 – ingestion 210 – migration
Acenaphthylene	EPA 8270	Collected SCM	0/6	<0.39	<0.39	NA	None established
Anthracene	EPA 8270	Collected SCM	6/6	0.15	0.12	0.04 - 0.25	30,000 – ingestion 4,300 – migration
Benzo(a)anthracene	EPA 8270	Collected SCM	6/6	0.40	0.27	0.082 - 0.71	11 – ingestion 6 – migration
Benzo(a)pyrene	EPA 8270	Collected SCM	6/6	0.37	0.27	0.09 - 0.66	1 – ingestion 3 – migration
Benzo(b)fluoranthene	EPA 8270	Collected SCM	6/6	0.75	0.42	0.06 - 1.43	11 – ingestion 20 – migration
Benzo(g,h,i)perylene	EPA 8270	Collected SCM	6/6	0.15	0.11	0.06 - 0.23	None established
Benzo(k)fluoranthene	EPA 8270	Collected SCM	6/6	0.73	0.39	0.03 - 1.42	110 – ingestion 200 – migration
Chrysene	EPA 8270	Collected SCM	6/6	0.52	0.38	0.17 - 0.87	1,100 – ingestion 620 – migration

Summary of Anchorage Area Street Waste Analyses Page (7 of 7)

Analyte	Analytical Method	Material Type	No. of Detections /No. of Samples	Average Concentration (mg/kg except where noted)	Median Concentration (mg/kg except where noted)	5 th to 95 th Percentile Concentration Range (mg/kg except where noted)	ADEC Method Two Cleanup Level (mg/kg)
Dibenzo(a,h)anthracene	EPA 8270	Collected SCM	5/6	0.12	0.05	0.02 – 0.21	1 – ingestion 6 – migration
Fluoranthene	EPA 8270	Collected SCM	6/6	1.02	0.67	0.18 – 1.87	4,100 – ingestion 2,100 – migration
Fluorene	EPA 8270	Collected SCM	5/6	0.13	0.12	0.09 – 0.18	4,100 – ingestion 210 – migration
Indeno(1,2,3-c,d)pyrene	EPA 8270	Collected SCM	6/6	0.15	0.11	0.05 – 0.24	11 – ingestion 54 – migration
Naphthalene	EPA 8270	Collected SCM	0/6	<0.39	<0.39	NA	4,100 – ingestion 43 – migration
Phenanthrene	EPA 8270	Collected SCM	6/6	0.72	0.51	0.14 – 1.29	None established
Pyrene	EPA 8270	Collected SCM	6/6	0.72	0.52	0.21 – 1.22	3,000 – ingestion 1,500 – migration

Notes:

If an analyte was not detected in a particular sample, the detection limit for that sample was used in calculating the statistics, so the average and expected concentration range could be biased high.

1. "All samples" refers to the combined results of the collected SCM and *in situ* sediment samples.
2. "Collected SCM" refers to samples of stockpiled street sweeping and "vector" SCMs.
3. "*In situ* sediment" refers to samples collected in storm drainage system collection boxes and sediment basins.
4. The symbol "<" means less than.
5. "Ingestion" means the ADEC Method Two cleanup level in 18 AAC 75 that is based on potential ingestion of the contaminant by humans in areas of Alaska with less than 40 inches of precipitation annually.
6. "Inhalation" means the ADEC Method Two cleanup level that is based on potential inhalation of the contaminant by humans in areas of Alaska with less than 40 inches of precipitation annually.
7. "Migration" means the ADEC Method Two cleanup level based on potential migration of the contaminant to groundwater in areas of Alaska with less than 40 inches of precipitation annually.

Appendix C

APPENDIX C

SCM ANALYTICAL RESULTS FROM OTHER LOCATIONS

The following summaries are excerpted from reports of other projects that characterized street wastes in other locations. HCI obtained and reviewed these reports in the course of investigating potential management strategies for Anchorage area street wastes.

Analyses of sediments in storm water drainage system catch basins conducted by Serdar (1993) and Herrera (1995), as cited in the WDOE *Best Management Practices For Management and Disposal of Street Wastes* showed the following general characteristics of the material:

Analyte	Concentration Range	Median Concentration
	(mg/kg)	(mg/kg)
Arsenic	4 – 56	3.5
Cadmium	0.5 – 5	0.5
Chromium	13 – 241	25.8
Copper	12 – 730	29
Lead	4 – 850	80
Nickel	14 – 86	23
Zinc	50 – 2,000	130
Total Polycyclic Aromatic Hydrocarbons (PAHs)	0.36 – 417	10.6

Analyses of nine street sweeping samples from Snohomish County, Washington, also as cited in WDOE's Best Management Practices showed the following characteristics:

Analyte	Concentration Range (mg/kg)
Cadmium	0.35 – 0.8
Copper	16 – 32
Chromium	30.8 – 51
Lead	35 – 109
Mercury	<0.05
Nickel	18 – 46
Zinc	59.7 – 109
Total Petroleum Hydrocarbons (TPH)	163 – 1,000

Martin (1991) investigated the concentrations of TPH in street wastes and roadside storm drainage ditches in Washington, with the following results:

Material Type	Number of Samples	TPH Concentration (mg/kg)		
		Arithmetic Mean	Geometric Mean	Range
Fresh roadside sweepings	5	3,307	3,215	2,410 – 4,157
Fresh sweeping at maintenance yard	9	4,560	2,870	825 – 16,966
Well-weathered sweepings	12	671	312	2 – 2,009
Wet Vactor sludge	5	2,503	1,604	251 – 5,787
Dry Vactor sludge	3	1,070	2,412	553 – 7,690