EVALUATION OF ANALYTICAL DATA CHARACTERIZING STREET SWEEPINGS, STORMWATER SEDIMENTS AND CATCH BASIN SEDIMENTS

FINAL
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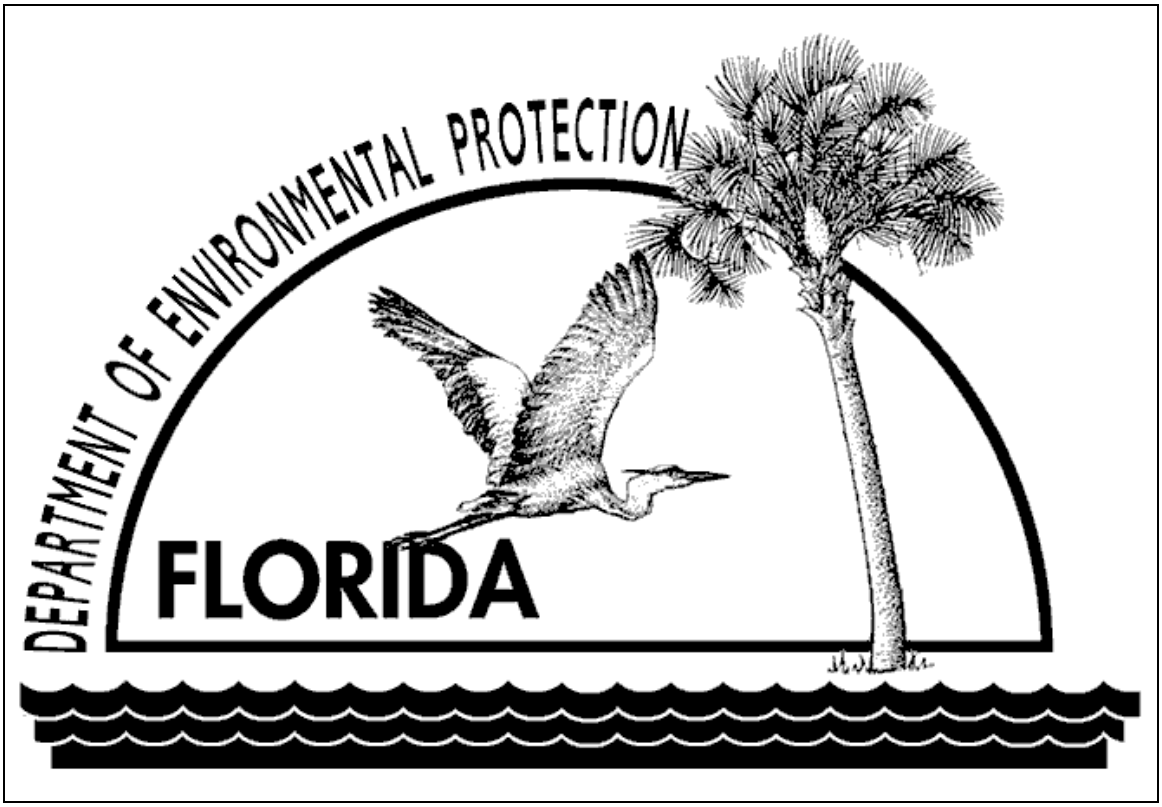

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1.0 BACKGROUND

Historically, street sweepings in Florida were disposed of at Class III landfills. These landfills are allowed to receive wastes which "are not expected to produce leachate which poses a threat to public health or the environment," Rule 62-701.200(14), Florida Administrative Code (F.A.C.). Prior to January 6, 1993, Chapter 62-701, F.A.C. allowed trash to be disposed of at Class III landfills and the term "trash" was defined to include street sweepings. Because of concerns about misuse of the term "trash," the Department removed this term from the rule in 1993. As a result, street sweepings could no longer be disposed of in Class III landfills, without approval by the Department, and had to go to permitted, lined landfills (i.e., usually Class I landfills).

Within a few years after this rule change, the Department began to find large piles of street sweepings stored by municipalities. In some cases this practice required permits as solid waste management facilities. Several municipalities began expressing frustration to the Department over increased disposal costs of street sweepings at Class I landfills. Concerns were also expressed about the proper management of other wastes such as catch basin sediments and stormwater pond sediments. At a Contaminated Soils Forum meeting in 1998, the Department agreed to form a Focus Group to study these wastes (i.e., street sweepings, stormwater and catch basin sediments) and evaluate possible disposal and management options for them.

Three Focus Group planning meetings were held in 1999. Some research on stormwater sediments and street sweepings had already been conducted and was considered by the Focus Group (Cox, 1998 and Brinkmann, 1999). It was decided that before disposal and management options could be determined, a more comprehensive chemical characterization of these wastes would be required. Dr. Tim Townsend, University of Florida, was selected to conduct this research. The Department, through Eric Livingston, contributed $100,000 from EPA Section 319 Grant Funds to this research. In addition, eleven municipalities, counties or other organizations contributed another $75,000 to this project. These extra contributors were:

- St. Lucie County Public Works
- Reedy Creek Improvement District
- City of Fort Myers
- Sarasota County Public Works
- City of Winter Park
- Palm Beach County Solid Waste Authority
- Brevard County Surface Water Management
- Seminole County Stormwater Division
- City of Orland
- City of Lake Worth
- Florida Association of Stormwater Utilities

Dr. Townsend began this research in September 2000. Approximately 300 separate samples of street sweepings, catch basin sediments and stormwater pond sediments were collected over a period of 15 months from 20 different sampling locations. These samples were analyzed for a number of chemical parameters including volatile and semi-volatile organic compounds, pesticides, herbicides, metals and leachable inorganic ions. Results from both total analysis and analysis of leaching tests using the Synthetic Precipitation Leaching Procedure (SPLP), EPA Method 1312, were presented. The individual total analysis results were compared with the

Department's soil cleanup target levels and the leachability results were compared with the Department's groundwater cleanup target levels to identify potential chemicals of concern. These cleanup target levels are found in Chapter 62-777, F.A.C. and were used as guidance in determining which constituents in the waste might pose human health risks. The results of this research were presented in draft form on September 2002 (Townsend, 2002).

2.0 PURPOSE

The purpose of this report is to calculate the 95% Upper Confidence Levels (UCLs) for all chemicals of concern identified in the Townsend report (Townsend, 2002) and to evaluate any other chemicals that are potential concerns for direct exposure or leachability. It is hoped that this evaluation will help the Department, in consultation with the Focus Group, determine and select appropriate options for management of these wastes.

3.0 METHOD

This report provides a statistical analysis of the data related to those chemicals of concern identified in the Townsend study. The methodology in this report generally follows the guidance offered by the U.S. Environmental Protection Agency (EPA, 2000). The general approach used to evaluate the data was to first decide if the data were normally distributed. This was accomplished by calculating the mean, variance, and standard deviation for the data. Two tests were then applied. If the mean was greater than the variance and greater than the standard deviation, the data were assumed to be normally distributed and a 95% UCL of the mean was calculated and compared to the appropriate criteria. If the mean was less than the variance and/or less than the standard deviation, then the data were not likely to be normally distributed and a lognormal transformation was attempted.

When the lognormal transformation was successful in converting the data to a normal distribution, a 95% UCL was calculated. When the lognormal transformation resulted in negative values, due to detection limits being less than 1 mg/kg for example, the data usually failed one or both of the tests for normality. This was remedied by converting the data set from units of mg/kg to ug/kg and recalculating the lognormal transformations. This procedure was generally successful in converting the data to a normal distribution.

The 95% UCL concentrations were calculated using both the reported detection limit and ½ the detection limit for those values reported at less than their detection limits (BDL). Tables 3 through 11 summarize the results of these procedures. When the results were examined, it was decided to base UCLs only on those calculations where the actual detection limit (as opposed to ½ the detection limit) was substituted for BDL values.

The raw data were divided into three groups for each parameter: street sweepings only, catch basins only and stormwater sediments only. UCLs were calculated for each chemical of concern in each of these groups. These groups were

then combined into a single data set (all sources) for each parameter and UCL calculations were made for this data set containing the combined data. This evaluation should help in determining appropriate management options for each waste.

4.0 TOTAL METALS

The Townsend study identified several metals as being chemicals of concern because their concentrations exceeded the direct exposure criteria during one or more sampling events. These direct exposure criteria for residential settings from 62-777, F.A.C., indicate some potential for human health impacts if the material had unlimited distribution. These metals included arsenic, barium, copper, lead, and chromium. The following sections summarize the evaluation of the analytical results.

4.1 Arsenic

All Sources: Out of 356 samples analyzed for arsenic, there were 178 (50%) results above the detection limit of 0.5 mg/kg. The mean concentration of arsenic in these samples was 0.758 mg/kg. The 95% UCL of the mean was calculated to be 0.811 mg/kg, using the detection limit, and 0.589 mg/kg using ½ the detection limit. Lognormal transformations were necessary in order to perform these calculations.

Street Sweepings Only: Out of 204 samples analyzed for arsenic, there were 97 (48%) results above the detection limit of 0.5 mg/kg. The mean concentration of arsenic in these samples was 0.675 mg/kg. The 95% UCL of the mean was calculated to be 0.722 mg/kg, using the detection limit, and 0.521 mg/kg using ½ the detection limit. Lognormal transformations were necessary in order to perform these calculations.

Catch Basins Only: Out of 78 samples analyzed for arsenic, there were 38 (49%) results above the detection limit of 0.5 mg/kg. The mean concentration of arsenic in these samples was 0.818 mg/kg. The 95% UCL of the mean was calculated to be 0.963 mg/kg, using the detection limit, and 0.717 mg/kg using ½ the detection limit. Lognormal transformations were necessary in order to perform these calculations.

Stormwater Sediments Only: Out of 74 samples analyzed for arsenic, there were 43 (58%) results above the detection limit of 0.5 mg/kg. The mean concentration of arsenic in these samples was 0.964 mg/kg. The 95% UCL of the mean was calculated to be 1.165 mg/kg, using the detection limit, and 0.980 mg/kg using ½ the detection limit. Lognormal transformations were necessary in order to perform these calculations.

4.2 Barium

All Sources: Out of 306 samples analyzed for barium, there were 279 (91%) results above the detection limit of 1.35 mg/kg. The mean concentration of barium in these samples was 15.33 mg/kg. The 95% UCL of the mean was calculated to be 17.35 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Street Sweepings Only: Out of 174 samples analyzed for barium, there were 155 (89%) results above the detection limit of 1.35 mg/kg. The mean concentration of barium in these samples was 11.48 mg/kg. The 95% UCL of the mean was calculated to be 13.25 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Catch Basins Only: Out of 63 samples analyzed for barium, there were 62 (98%) results above the detection limit of 1.35 mg/kg. The mean concentration of barium in these samples was 19.71 mg/kg. The 95% UCL of the mean was calculated to be 24.01 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Stormwater Sediments Only: Out of 69 samples analyzed for barium, there were 62 (90%) results above the detection limit of 1.35 mg/kg. The mean concentration of barium in these samples was 25.25 mg/kg. The 95% UCL of the mean was calculated to be 35.29 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

4.3 Copper

All Sources: Out of 354 samples analyzed for copper, there were 353 (99%) results above the detection limit of 1.84 mg/kg. The mean concentration of copper in these samples was 13.32 mg/kg. The 95% UCL of the mean was calculated to be 14.42 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Street Sweepings Only: Out of 202 samples analyzed for copper, there were 201 (99%) results above the detection limit of 1.84 mg/kg. The mean concentration of copper in these samples was 11.40 mg/kg. The 95% UCL of the mean was calculated to be 12.59 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Catch Basins Only: Out of 78 samples analyzed for copper, there were 78 (100%) results above the detection limit of 1.84 mg/kg. The mean concentration of copper in these samples was 19.32 mg/kg. The 95% UCL of the mean was calculated to be 23.21 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110

mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Stormwater Sediments Only: Out of 74 samples analyzed for copper, there were 74 (100%) results above the detection limit of 1.84 mg/kg. The mean concentration of copper in these samples was 13.78 mg/kg. The 95% UCL of the mean was calculated to be 16.11 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 110 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

4.4 Lead

All Sources: Out of 354 samples analyzed for lead, there were 246 (69%) results above the detection limit of 1.43 mg/kg. The mean concentration of lead in these samples was 9.73 mg/kg. The 95% UCL of the mean was calculated to be 11.35 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 400 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Street Sweepings Only: Out of 203 samples analyzed for lead, there were 147 (72%) results above the detection limit of 1.43 mg/kg. The mean concentration of lead in these samples was 8.90 mg/kg. The 95% UCL of the mean was calculated to be 10.63 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 400 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Catch Basins Only: Out of 78 samples analyzed for lead, there were 53 (68%) results above the detection limit of 1.43 mg/kg. The mean concentration of lead in these samples was 12.11 mg/kg. The 95% UCL of the mean was calculated to be 17.85 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 400 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Stormwater Sediments Only: Out of 73 samples analyzed for lead, there were 46 (63%) results above the detection limit of 1.43 mg/kg. The mean concentration of lead in these samples was 9.85 mg/kg. The 95% UCL of the mean was calculated to be 14.42 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 400 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

4.5 Chromium

All Sources: Out of 306 samples analyzed for chromium, there were 225 (74%) results above the detection limit of 1.34 mg/kg. The mean concentration of chromium in these samples was 7.42 mg/kg. The 95% UCL of the mean was calculated to be 8.5 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 210 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Street Sweepings Only: Out of 175 samples analyzed for chromium, there were 122 (70%) results above the detection limit of 1.34 mg/kg. The mean concentration of chromium in these samples was 6.20 mg/kg. The 95% UCL of the mean was calculated to be 7.5 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 210 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Catch Basins Only: Out of 63 samples analyzed for chromium, there were 53 (84%) results above the detection limit of 1.34 mg/kg. The mean concentration of chromium in these samples was 9.86 mg/kg. The 95% UCL of the mean was calculated to be 12.7 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 210 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Stormwater Sediments Only: Out of 68 samples analyzed for chromium, there were 50 (74%) results above the detection limit of 1.34 mg/kg. The mean concentration of chromium in these samples was 9.04 mg/kg. The 95% UCL of the mean was calculated to be 12.5 mg/kg. Lognormal transformations were necessary in order to perform these calculations. This value is less than the residential direct exposure criteria of 210 mg/kg in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

5.0 LEACHABLE LEAD

In addition to the direct exposure risks, the potential leachability risks to groundwater were estimated by conducting a SPLP test on a significant number of the samples. One of the primary metals, lead, was reported with results exceeding its groundwater standard in several samples. The following sections summarize the evaluation of the analytical results.

All Sources: Out of 184 samples analyzed for leachable lead, there were 51 (28%) results above the detection limit of 0.0025 mg/L. The mean concentration of leachable lead in these samples was 0.0035 mg/L. The 95% UCL of the mean was calculated to be 0.004 mg/L. Lognormal transformations were necessary in order to perform these calculations. This value is less than the groundwater standard of 0.015

mg/L in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Street Sweepings Only: Out of 97 samples analyzed for leachable lead, there were 24 (25%) results above the detection limit of 0.0025 mg/L. The mean concentration of leachable lead in these samples was 0.0033 mg/L. The 95% UCL of the mean was calculated to be 0.0037 mg/L. Lognormal transformations were necessary in order to perform these calculations. This value is less than the groundwater standard of 0.015 mg/L in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Catch Basins Only: Out of 49 samples analyzed for leachable lead, there were 18 (37%) results above the detection limit of 0.0025 mg/L. The mean concentration of leachable lead in these samples was 0.0045 mg/L. The 95% UCL of the mean was calculated to be 0.0056 mg/L. The raw data were normally distributed; therefore, no lognormal transformation was required to perform these calculations. This value is less than the groundwater standard of 0.015 mg/L in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit.

Stormwater Sediments Only: Out of 38 samples analyzed for leachable lead, there were 9 (24%) results above the detection limit of 0.0025 mg/L. The mean concentration of leachable lead in these samples was 0.0031 mg/L. The 95% UCL of the mean was calculated to be 0.0036 mg/L. Lognormal transformations were necessary in order to perform these calculations along with removal of two outliers identified from the same storm pond source, which could indicate an impacted source. This value is less than the groundwater standard of 0.015 mg/L in 62-777, F.A.C.; therefore, no further analysis was performed using ½ the detection limit. While this value is less than the groundwater standard of 0.015 mg/L in 62-777, F.A.C., the presence of outliers may limit the application of this data in the evaluation of various management options.

6.0 LEACHABLE ORGANOCHLORINE PESTICIDES

Two of the leachable organochlorine pesticides were reported with results exceeding their respective groundwater standards or minimum criteria in several samples. The following sections summarize the evaluation of the analytical results.

6.1 Leachable beta BHC (Hexachlorocyclohexane)

All sources: Out of 166 samples analyzed for leachable beta BHC, there were 7 (4%) results above the detection limit of 0.05-0.1 ug/L. The mean concentration of leachable beta BHC in these samples was 0.060 ug/L. The 95% UCL of the mean was calculated to be 0.065 ug/L, using the detection limit, and 0.039 ug/L using ½ the detection limit; both values exceed the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C.

Street Sweeping Only: Out of 93 samples analyzed for leachable beta BHC, there were no results above the detection limit of 0.05-0.1 ug/L. The mean

concentration of leachable beta BHC in these samples was 0.053 ug/L. The 95% UCL of the mean was calculated to be 0.055 ug/L, using the detection limit, and 0.027 ug/L using ½ the detection limit; both values exceed the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C. All street sweeping samples were below detection limit, and the 95% UCL using various detection limits are in the same range as the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C. University personnel indicated the detection limit used was the best available detection limit; therefore, consistent with previous Department decisions in other program areas, in these circumstances the best available detection limit may be used in place of the 62-777 criteria, which means the 95% UCL meets the criteria.

Catch Basin Only: Out of 38 samples analyzed for leachable beta BHC, there were no results above the detection limit of 0.05-0.1 ug/L. The mean concentration of leachable beta BHC in these samples was 0.051 ug/L. The 95% UCL of the mean was calculated to be 0.054 ug/L, using the detection limit, and 0.027 ug/L using ½ the detection limit; both values exceed the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C. All catch basin samples were below detection limit and the 95% UCL using various detection limits are in the same range as the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C. University personnel indicated the detection limit used was the best available detection limit; therefore, consistent with previous Department decisions in other program areas, in these circumstances the best available detection limit may be used in place of the 62-777 criteria, which means the 95% UCL meets the criteria.

Stormwater Sediments Only: Out of 35 samples analyzed for leachable beta BHC, there were 7 (20%) results above the detection limits of 0.05-0.1 ug/L. The mean concentration of leachable beta BHC in these samples was 0.091 ug/L. The 95% UCL of the mean was calculated to be 0.109 ug/L, using the detection limit, and 0.084 ug/L using ½ the detection limit; both values exceed the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C.

6.2 Leachable 4,4-DDT

All sources: Out of 166 samples analyzed for leachable 4,4 DDT, there were 13 (8%) results above the detection limit of 0.05 ug/L. The mean concentration of leachable 4,4-DDT in these samples was 0.064 ug/L. The 95% UCL of the mean was calculated to be 0.069 ug/L. The raw data appeared normally distributed at the detection limit. This value is less than the groundwater cleanup target level of 0.1 ug/L in 62-777, F.A.C.

Street Sweepings Only: Out of 93 samples analyzed for leachable 4,4 DDT, there were 7 (8%) results above the detection limit of 0.05 ug/L. The mean concentration of leachable 4,4-DDT in these samples was 0.059 ug/:L. The 95% UCL of the mean was calculated to be 0.065 ug/L. The raw data appeared normally distributed at the detection limit. This value is less than the groundwater cleanup target level of 0.1 ug/L in 62-777, F.A.C.

Catch Basin Only: Out of 38 samples analyzed for leachable 4,4 DDT, there was one (3%) results above the detection limit of 0.05 ug/L. The mean concentration of leachable 4,4-DDT in these samples was 0.052 ug/L. The 95% UCL of the mean was calculated to be 0.057 ug/L. The raw data appeared normally distributed at the detection limit. This value is less than the groundwater cleanup target level of 0.02 ug/L in 62-777, F.A.C.

Stormwater Sediments Only: Out of 35 samples analyzed for leachable 4,4 DDT, there were 5 (14%) results above the detection limit of 0.05 ug/L. The mean concentration of leachable 4,4-DDT in these samples was 0.088 ug/L. The 95% UCL of the mean was calculated to be 0.104 ug/L. The raw data appeared normally distributed at the detection limit. This value is greater than the groundwater cleanup target level of 0.1 ug/L in 62-777, F.A.C.

7.0 EVALUATION OF OTHER PARAMETERS

7.1 Other Total Metals

During review of the Townsend data, cadmium, mercury, nickel, silver, selenium, and zinc were detected. Since none were above the direct exposure criteria, they did not appear to warrant further evaluation.

7.2 Other Total Organics

During review of the Townsend data several volatile organic parameters were detected but none were above the direct exposure criteria. Therefore, they did not appear to warrant further evaluation.

Several semi-volatile organic parameters were detected at levels above their direct exposure criteria based on the detection limit that was used (5 mg/kg). These parameters were evaluated individually, and it was determined that benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-c,d)pyrene were not considered chemicals of concern for disposal but may require additional study for some reuse applications. Several other semi-volatile organic parameters were detected, but none exceeded their respective residential or commercial direct exposure criteria.

Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene, were each detected in two samples out of 300 and these samples exceeded both the residential and commercial direct exposure criteria. One sample was from street sweepings; it was the only detect out of 13 street sweeping samples collected from the same location. The other sample was from a catch basin; it was the only detect out of 17 catch basin samples from the same location. No other samples exceeded the commercial direct exposure criteria for benzo(a)anthracene and benzo(b)fluoranthene. Based on the preponderance of non-detects for these parameters across the dataset and at these particular locations, they did not appear to warrant further evaluation for disposal considerations. However, based on the detection limit that was used (5 mg/kg), no determination could be made for benzo(a)pyrene with respect to both the residential

and commercial direct exposure criteria. In addition, no determination could be made for benzo(a)anthracene and benzo(b)fluoranthene with respect to the residential direct exposure criteria for the remainder of the samples. Therefore, these parameters may require additional study for some reuse applications.

Benzo(k)fluoranthene was detected in only one out of 300 samples, and this sample exceeded the residential, but not the commercial, direct exposure criteria. This sample was from a catch basin; it was the only detect out of 17 catch basin samples collected from the same location. Based on the preponderance of non-detects for this parameter across the dataset and at this particular location, it did not appear to warrant further evaluation for disposal considerations or other reuse applications.

Indeno(1,2,3-c,d)pyrene was detected in only one out of 300 samples, and this sample exceeded both the residential and commercial direct exposure criteria. This sample was from a catch basin; it was the only detect out of 17 catch basin samples collected from the same location. In no other samples did this parameter exceed the commercial direct exposure criteria. Therefore, based on the preponderance of non-detects for this parameter across the dataset and at this particular location, it did not appear to warrant further evaluation for disposal considerations. However, based on the detection limit that was used (5 mg/kg), no determination could be made with respect to the residential direct exposure criteria for the remainder of the samples. Therefore, indeno(1,2,3-c,d)pyrene may require additional study for some reuse applications.

All nitrogen-phosphorus pesticides, N-methylcarbamates, and chlorinated herbicides reported non-detects for all total analyses; therefore, they did not appear to warrant further evaluation.

Several other organochlorine pesticides were detected but only one, dieldrin, exceeded the direct exposure criteria. Dieldrin was detected in 9 out of 323 samples, and 4 of these samples exceeded the direct exposure criteria. Of these four samples, two were from street sweepings, one was from a stormwater pond, and one was from a catch basin. A check of the location that the street sweeping samples were collected from reported four positive detects out of 34 street sweeping samples collected from the same location, with two exceedances. The stormwater pond location reported three positive detects out of 26 samples collected from the same location, with one exceedance. The catch basin location reported one positive detect out of 17 samples collected from the same location, with one exceedance. Based on the preponderance of non-detects for this pesticide across the dataset and at these particular locations, it did not appear to warrant further evaluation.

7.3 Other Leachable Metals

During review of the Townsend data, two other leachable metals, nickel and cadmium, were detected at levels above the groundwater standards and criteria; however, these chemicals were evaluated individually and it was determined that they were not considered chemicals of concern.

Out of 184 samples for nickel, only three had positive detects and each of these samples exceeded the groundwater standard. Two of these samples were from street sweeping and one was from a stormwater pond. A check of the locations that these samples were collected found one location reported one positive detect out of six street sweeping samples and another reported one positive detect out of 14 street sweeping samples. The stormwater pond location reported one positive detect out of five samples collected from the same location. Based on the preponderance of non-detects for this metal across the dataset and at these particular locations, it did not appear to warrant further evaluation.

Out of 178 samples for cadmium, only three had positive detects, and only one of these samples exceeded the groundwater standard. The one sample was from a stormwater pond location and five other samples from the same stormwater pond location were non-detect. Based on the preponderance of non-detects for this metal across the dataset and at this particular location, it did not appear to warrant further evaluation.

While the leachable metals arsenic, barium, chromium, copper, and zinc were detected, they were not found at levels above the relevant groundwater standards. The leachable metals mercury, silver, and selenium were not detected in any samples. These parameters did not appear to warrant further evaluation.

7.4 Other Leachable Organics

During review of the Townsend data, several volatile organic compounds reported exceedances of the groundwater standards or criteria. However, these were evaluated individually and it was determined that 1,4 dichlorobenzene, naphthalene, 1,3,5 trimethylbenzene, o-xylene, acetone, and methylene chloride were not considered chemicals of concern.

For 1,4 dichlorobenzene, out of 155 samples, only two samples had positive detects and these two samples exceeded the groundwater standard. These samples were from two different locations and no other volatile organic compounds were identified in these samples. Based on the preponderance of non-detects for this parameter across the dataset, it did not appear to warrant further evaluation.

For naphthalene, 1,3,5 trimethylbenzene, and o-xylene, out of 155 samples, only one sample had a positive detect for each parameter and this sample exceeded the groundwater criteria for each parameter. This sample was from a catch basin and several volatile organic compounds were identified in the same sample indicating this may be an impacted site. Since the rest of the naphthalene, 1,3,5 trimethylbenzene, and o-xylene results were non-detects, these parameters did not appear to warrant further evaluation.

For acetone and methylene chloride, the report indicated these parameters were most likely artifacts of laboratory practices since the laboratory blanks also contained these parameters; therefore, they were most likely not representative of the samples and did not appear to warrant further evaluation.

All semi-volatile organic compounds were reported as non-detects for 147 samples; however, the detection limit (10 ug/L) used was greater than the groundwater criteria for five parameters; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-c,d)pyrene. These parameters reported elevated results under the total analyses for one sample, and that sample was also tested for leachability. This one sample out of 147 demonstrated the potential for leaching based on the total analyses but did not report any positive detects in the leaching test at the detection limit used. Based on the preponderance of non-detects for these parameters across the dataset, it appeared this sample may have been an impacted sample and therefore did not appear to warrant further evaluation.

All nitrogen-phosphorus pesticides and N-methylcarbamates were reported as non-detects in all leaching samples; therefore, these parameters did not appear to warrant further evaluation.

One other leachable organochlorine pesticide, endosulfan II, was detected in one out of 166 samples. Since no groundwater standard or criteria exists for this parameter, it did not appear to warrant further evaluation.

7.5 Leachable Secondary Parameters

The potential leachability to groundwater was also evaluated for several secondary drinking water parameters. Three of the secondary parameters reported results exceeding their respective groundwater standard in several samples. The following sections summarize the evaluation of the analytical results for aluminum, iron, and pH.

7.5.1 Leachable Aluminum

All sources: Out of 70 samples analyzed for leachable aluminum, there were 58 (83%) results above the detection limit of 0.20 mg/L. The mean concentration of leachable aluminum in these samples was 0.406 mg/L. The 95% UCL of the mean for aluminum was calculated as 0.521 mg/L, using the detection limit, and as 0.482 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.2 mg/L. Lognormal transformation was necessary in order to perform these calculations.

Street Sweepings Only: Out of 41 samples analyzed for leachable aluminum, there were 31 (76%) results above the detection limit of 0.20 mg/L. The mean concentration of leachable aluminum in these samples was 0.385 mg/L. The 95% UCL of the mean for aluminum was calculated as 0.518 mg/L, using the detection limit, and as 0.458 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.2 mg/L. Lognormal transformation was necessary in order to perform these calculations.

Catch Basins Only: Out of 13 samples analyzed for leachable aluminum, there were 13 (100%) results above the detection limit of 0.20 mg/L. The mean concentration of leachable aluminum in these samples was 0.43 mg/L. The 95% UCL of the mean for

aluminum was calculated as 0.58 mg/L, using the detection limit, and no evaluation was performed for ½ the detection limit since all values were greater than the detection limit. The raw data appeared normally distributed. The 95% UCL using the detection limit is greater than the secondary standard 0.2 mg/L.

Stormwater Sediments Only: Out of 16 samples analyzed for leachable aluminum, there were 14 (88%) results above the detection limit of 0.20 mg/L. The mean concentration of leachable aluminum in these samples was 0.528 mg/L. The 95% UCL of the mean for aluminum was calculated as 1.086 mg/L, using the detection limit, and as 1.067 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.2 mg/L. Lognormal transformation was necessary in order to perform these calculations.

7.5.2 Leachable Iron

All sources: Out of 70 samples analyzed for leachable iron, there were 46 (66%) results above the detection limit of 0.30 mg/L. The mean concentration of leachable iron in these samples was 0.44 mg/L. The 95% UCL of the mean for iron was calculated as 0.53 mg/L, using the detection limit, and as 0.49 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.3 mg/L. Lognormal transformation was necessary in order to perform these calculations.

Street Sweepings Only: Out of 41 samples analyzed for leachable iron, there were 22 (54%) results above the detection limit of 0.30 mg/L. The mean concentration of leachable iron in these samples was 0.332 mg/L. The 95% UCL of the mean for iron was calculated as 0.412 mg/L, using the detection limit, and as 0.310 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.3 mg/L. Lognormal transformation was necessary in order to perform these calculations.

Catch Basins Only: Out of 13 samples analyzed for leachable iron, there were 11 (85%) results above the detection limit of 0.30 mg/L. The mean concentration of leachable iron in these samples was 0.36 mg/L. The 95% UCL of the mean for iron was calculated as 0.45 mg/L, using the detection limit, and as 0.44 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.3 mg/L. The raw data appeared normally distributed.

Stormwater Sediments Only: Out of 16 samples analyzed for leachable iron, there were 13 (81%) results above the detection limit of 0.30 mg/L. The mean concentration of leachable iron in these samples was 0.30 mg/L. The 95% UCL of the mean for iron was calculated as 0.499 mg/L, using the detection limit, and as 0.481 mg/L using ½ the detection limit, both of which are greater than the secondary standard of 0.3 mg/L. Lognormal transformation was necessary in order to perform these calculations.

7.5.3 Leachable pH

All sources: A total of 30 samples were analyzed for leachable pH. The mean concentration of leachable pH in these samples was 7.99 S.U. Nine values exceeded a pH of 8.5 S.U. The maximum value reported was 9.11 S.U. The minimum value reported was 7.0 S.U. The raw data appeared normally distributed. The 95% UCL of the mean was calculated as 8.24 S.U. which is within the range of 6.5-8.5, the secondary standard for pH.

During review of the data, several other secondary drinking water compounds were detected. None were found at levels above the relevant secondary groundwater standards.

7.6 Background Soils

Since aluminum and iron are both naturally occurring metals in soils, a determination of their potential contribution to groundwater by leaching was also investigated for comparison with the above results. Six "background" soil samples were obtained from four different sites around the state and analyzed for total and leachable aluminum and iron. The following sections summarize the analytical results for leachable aluminum and iron in narrative form.

7.6.1 Leachable Aluminum

Background soils: Leachable aluminum was found in six samples from four different locations above the detection limit of 0.20 mg/L. The mean concentration of leachable aluminum in these samples was 1.163 mg/L. The 95% UCL of the mean for leachable aluminum was calculated as 2.56 mg/L. This value is greater than the secondary standard of 0.2 mg/L. Lognormal transformation was necessary in order to perform these calculations.

7.6.2 Leachable Iron

Background soils: Leachable iron was found in six samples from four different locations above the detection limit of 0.30 mg/L. The mean concentration of leachable iron in these samples was 0.678 mg/L. The 95% UCL of the mean for leachable iron was calculated as 0.992 mg/L. This value is greater than the secondary standard of 0.3 mg/L. Lognormal transformation was necessary in order to perform these calculations.

When comparing the 95% UCL for leachable aluminum and iron from street sweepings with the 95% UCL for leachable aluminum and iron from background soils, it appears that street sweepings may leach less aluminum and iron than do background soils. The difference is displayed in TABLE 1.

8.0 RESULTS AND RECOMMENDATIONS

Summaries of the statistical analyses for the chemicals of concern reported in the Townsend study are presented in TABLES 3 through 11. TABLE 2 presents a summary of the calculated 95% UCL values for the mean concentrations of the chemicals of concern that were calculated for this report. The Street Sweepings Focus Group should evaluate the results of this report and make recommendations to the Department concerning the disposal and beneficial use options for street sweepings, catch basin sediments and stormwater sediments.

9.0 EPILOGUE

As was recommended in Section 8.0, on October 28, 2003 the Department conducted a meeting with the Street Sweepings Focus Group to discuss the data evaluation results of this report. The Focus Group made recommendations to the Department on the disposal and beneficial use of the three waste streams: street sweepings, catch basin sediments and stormwater sediments. The Focus Group also recommended the Department prepare a guidance memorandum or document summarizing these recommendations.

Prior to the meeting on October 28, 2003, the Department made a limited comparison of the Cox data and the Townsend data for total metals in street sweepings. A summary of the data between these two reports is shown in TABLE 12. It was concluded that the data in the two reports appeared to be similar even though the size of the data sets were significantly different.

Also prior to the October 28th meeting, the Department calculated the 95% UCL average concentrations for leachable arsenic using the Townsend data for the three waste streams. The purpose of this calculation was to evaluate the likelihood that arsenic will leach above 10 ug/L which will be the new groundwater standard for arsenic effective January 1, 2005. The Townsend study compared arsenic leaching results to the current groundwater standard of 50 ug/L. The 95% UCL values for leachable arsenic in street sweepings, stormwater pond sediments and catch basin sediments were 3.6 ug/L, 4.3 ug/L and 3.1 ug/L respectively. None of the calculated 95% UCL average concentrations exceeded the future groundwater standard for arsenic of 10 ug/L. The UCL calculations used the detection limit of 0.0025 mg/L for the values that were reported below their detection limits. The results of these calculations are shown in TABLE 13.

Finally, on February 6, 2004 the Department distributed a draft guidance document on the management of these wastes. During the review period, the comment was made that the detection limit of 5 mg/kg was higher than the direct exposure criteria for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-c,d)pyrene. Consequently, for these chemicals decisions on direct exposure risks are less clear (the department, however, does not believe these chemicals would be a leaching concern to groundwater). Of the five chemicals, benzo(a)pyrene causes the highest direct exposure concern. Section 7.2 of this report was revised to incorporate this concern. These changes are reflected in Revision 1 to

this report. It was recommended that the Department include testing for benzo(a)pyrene when evaluating beneficial use options for these wastes.

REFERENCES

Brinkmann, Robert, et al., 1999, Chemical and Physical Characteristics of Street Sweeping Sediments in Tampa, Florida, Report # 98-12, Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida, May.

Cox, J. H., et al., 1998, Characterization of Stormwater Contaminated Sediment and Debris for Determining Proper Disposal Methods, Final Report, Florida Department of Environmental Protection, Division of Water Facilities, Tallahassee, Florida, August 13.

EPA (U.S. Environmental Protection Agency), 2000, Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA Publication QA/G-9, July.

Townsend, T. G., et al., 2002, Characterization of Stormwater Sediments, Catch Basin Sediments, and Street Sweepings in Florida for Disposal and Reuse, Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida, September.

TABLE 1. Comparison of 95% UCLs for Leachable Aluminum and Iron (mg/L)

Parameter	Street Sweepings		Background Soils	
	Using DL	Using ½ DL	Using DL	Using ½ DL
Aluminum	0.518	0.458	2.56	2.56
Iron	0.412	0.310	0.99	0.98

DL = Detection Limit

TABLE 2. Summary of Chemicals of Concern That Exceed Criteria

Chemicals of Concern	FDEP RES. SCTL (mg/kg)	FDEP LEACH. SCTL (mg/L)	All Sources		Street Sweepings		Catch Basins		Storm Ponds	
			95 % UCL	Decision	95 % UCL	Decision	95 % UCL	Decision	95 % UCL	Decision
Total Metal (mg/kg)										
Arsenic	0.8		0.811	Exceeds	0.722	OK	0.963	Exceeds	1.165	Exceeds
Barium	110		17.35	OK	13.25	OK	24.01	OK	35.29	OK
Copper	110		14.42	OK	12.59	OK	23.21	OK	16.11	OK
Lead	400		11.35	OK	10.63	OK	17.85	OK	14.42	OK
Chromium	210		8.5	OK	7.5	OK	12.7	OK	12.5	OK
Leachable Parameters (mg/L)										
Lead		0.015	0.004	OK	0.0037	OK	0.0056	OK	0.0036	OK[2]
Beta-BHC		0.00002	0.000065	Exceeds	0.000055	OK[1]	0.000054	OK[1]	0.000109	Exceeds
4-4 DDT		0.0001	0.000069	OK	0.000065	OK	0.000057	OK	0.000104	Exceeds
Aluminum		0.2	0.52	Exceeds	0.52	Exceeds	0.58	Exceeds	1.09	Exceeds
Iron		0.3	0.53	Exceeds	0.41	Exceeds	0.45	Exceeds	0.499	Exceeds
Leachable Background (mg/L)										
Aluminum		0.2	2.56	Exceeds						
Iron		0.3	0.99	Exceeds						

BADL = Best Available Detection Limit
[1] = OK when using BADLs.
[2] = OK without the outliers.

TABLE 3. Total Arsenic Summary

	Arsenic, All Sources (mg/kg) DL = 0.5				Arsenic, Street Sweeping (mg/kg) DL = 0.5				Arsenic, Catch Basins (mg/kg) DL = 0.5				Arsenic, Storm Ponds (mg/kg) DL = 0.5			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	178	178	356	356	97	107	204	204	38	40	78	78	43	31	74	74
Maximum	**24.83**		24.83	24.83	**13.57**		13.57	13.57	**12.72**		12.72	12.72	**24.83**		24.83	24.83
Average	1.66		1.08	0.96	1.18		0.82	0.69	2.04		1.25	1.12	2.43		1.62	1.52
Variance	6.52		3.59	3.75	2.14		1.13	1.23	6.96		3.94	4.15	15.18		9.65	9.90
Std. Deviation	2.55		1.89	1.94	1.46		1.06	1.11	2.64		1.99	2.04	3.90		3.11	3.15
Confidence Interval	0.38		0.20	0.20	0.29		0.15	0.15	0.84		0.44	0.45	1.16		0.71	0.72
95% UCL	2.04		1.28	1.16	1.47		0.97	0.84	2.88		1.69	1.57	3.59		2.33	2.23
SCTL-Res	0.8		0.8	0.8	0.8		0.8	0.8	0.8		0.8	0.8	0.8		0.8	0.8
	Not normally distributed				Not normally distributed				Not normally distributed				Not normally distributed			

	Arsenic, All Sources (ug/kg) DL = 500				Arsenic, Street Sweeping (ug/kg) DL = 500				Arsenic, Catch Basins (ug/kg) DL = 500				Arsenic, Storm Ponds (ug/kg) DL = 500			
Number of Samples	178	178	356	356	97	107	204	204	38	40	78	78	43	31	74	74
Maximum, Lognormal			10.1198	10.1198			9.5156	9.5156			9.4509	9.4509			10.1198	10.1198
Average, Lognormal			6.6306	6.2840			6.5141	6.1505			6.7068	6.3514			6.8714	6.5810
Variance, Lognormal			0.4195	0.8291			0.2432	0.5824			0.5417	1.0177			0.6896	1.1948
Std. Dev., Lognormal			0.6477	0.9106			0.4931	0.7632			0.7360	1.0088			0.8304	1.0931
Conf. Int., Lognormal			0.0673	0.0946			0.0677	0.1047			0.1633	0.2239			0.1892	0.2490
95% UCL, Lognormal			6.6979	6.3786			6.5818	6.2553			6.8702	6.5752			7.0606	6.8300
SCTL-Res			800	800			800	800			800	800			800	800
95% UCL Transformed			**811**	589			722	521			**963**	717			**1165**	980
	Normally distributed				Normally distributed				Normally distributed				Normally distributed			

TABLE 4. Total Barium Summary

	Barium, All Sources (mg/kg) DL = 1.35				Barium, Street Sweeping (mg/kg) DL = 1.35				Barium, Catch Basins (mg/kg) DL = 1.35				Barium, Storm Ponds (mg/kg) DL = 1.35			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	279	27	306	306	155	19	174	174	62	1	63	63	62	7	69	69
Maximum	1019		1019	1019	130.47		130.47	130.47	98.3		98.3	98.3	1019		1019	1019
Average	32.47		29.72	29.67	19.05		17.12	17.05	26.60		26.20	26.19	71.89		64.73	64.66
Variance	5243.59		4857.57	4860.98	318.99		314.61	316.98	418.45		421.82	422.37	20601.71		18941.15	18949.93
Std. Deviation	72.41		69.70	69.72	17.86		17.74	17.80	20.46		20.54	20.55	143.53		137.63	137.66
Confidence	8.50		7.81	7.81	2.81		2.64	2.65	5.09		5.07	5.07	35.73		32.47	32.48
95% UCL	40.97		37.53	37.48	21.86		19.75	19.69	31.69		31.27	31.27	107.61		97.20	97.14
SCTL-Res	110		110	110	110		110	110	110		110	110	110		110	110
	Not normally distributed				Not normally distributed				Not normally distributed				Not normally distributed			

	Barium, All Sources (mg/kg) DL = 1.35				Barium, Street Sweeping (mg/kg) DL = 1.35				Barium, Catch Basins (mg/kg) DL = 1.35				Barium, Storm Ponds (mg/kg) DL = 1.35			
Number of Samples			306				174				63				69	
Maximum, Lognormal			6.9266				4.8711				4.5880				6.9266	
Average, Lognormal			2.7299				2.4409				2.9811				3.2290	
Variance, Lognormal			1.2219				0.9286				0.6380				2.0114	
Std. Dev., Lognormal			1.1054				0.9637				0.7988				1.4182	
Conf. Int., Lognormal			0.1239				0.1432				0.1972				0.3346	
95% UCL, Lognormal			2.8537				2.5841				3.1783				3.5636	
SCTL-Res			110				110				110				110	
95% UCL Transformed			17.35				13.25				24.01				35.29	
	Normally distributed				Normally distributed				Normally distributed				Normally distributed			

TABLE 5. Total Copper Summary

	Copper, All Sources (mg/kg) DL = 1.84				Copper, Street Sweeping (mg/kg) DL = 1.84				Copper, Catch Basins (mg/kg) DL = 1.84				Copper, Storm Ponds (mg/kg) DL = 1.84			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	353	1	354	354	201	1	202	202	78	0	78	78	74	0	74	74
Maximum	**398.4**		398.4	398.4	**372.4**		372.4	372.4	**398.4**		398.4	398.4	90.44		90.44	90.44
Average	20.19		20.14	20.13	17.34		17.26	17.26	29.36		29.36	29.36	18.26		18.26	18.26
Variance	1126.23		1124.00	1124.09	1004.71		1000.90	1001.05	2157.17		2157.17	2157.17	286.64		286.64	286.64
Std. Deviation	33.56		33.53	33.53	31.70		31.64	31.64	46.45		46.45	46.45	16.93		16.93	16.93
Confidence	3.50		3.49	3.49	4.38		4.36	4.36	10.31		10.31	10.31	3.86		3.86	3.86
95% UCL	23.69		23.63	23.63	21.72		21.63	21.62	39.67		39.67	39.67	22.12		22.12	22.12
SCTL-Res	110		110	110	110		110	110	110		110	110	110		110	110
	Not normally distributed				Not normally distributed				Not normally distributed				Not normally distributed			

	Copper, All Sources (mg/kg) DL = 1.84				Copper, Street Sweeping (mg/kg) DL = 1.84				Copper, Catch Basins (mg/kg) DL = 1.84				Copper, Storm Ponds (mg/kg) DL = 1.84			
Number of Samples			354				202				78				74	
Maximum, Lognormal			5.9875				5.9200				5.9875				4.5047	
Average, Lognormal			2.5894				2.4335				2.9609				2.6232	
Variance, Lognormal			0.5870				0.5191				0.6840				0.4717	
Std. Dev., Lognormal			0.7661				0.7205				0.8270				0.6868	
Conf. Int., Lognormal			0.0798				0.0994				0.1835				0.1565	
95% UCL, Lognormal			2.6692				2.5329				3.1445				2.7797	
SCTL-Res			110				110				110				110	
95% UCL Transformed			14.42				12.59				23.21				16.11	
	Normally distributed				Normally distributed				Normally distributed				Normally distributed			

TABLE 6. Total Lead Summary

	Lead, All sources (mg/kg) DL = 1.43				Lead, Street Sweeping (mg/kg) DL = 1.43				Lead, Catch Basins (ug/kg) DL = 1430				Lead, Storm Ponds (ug/kg) DL = 1430			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	246	108	354	354	147	56	203	203	53	25	78	78	46	27	73	73
Maximum	**1060**		1060	1060	385.5		385.5	385.5	**1060**		1060	1060	196.2		196.2	196.2
Average	40.79		28.78	28.56	25.05		18.54	18.34	79.19		54.26	54.04	46.83		30.04	29.77
Variance	8094.81		5947.53	5959.52	1271.11		1030.74	1037.58	30359.90		21836.61	21861.08	2282.44		1913.50	1928.86
Std. Deviation	89.97		77.12	77.20	35.65		32.11	32.21	174.24		147.77	147.85	47.77		43.74	43.92
Confidence	11.24		8.03	8.04	5.76		4.42	4.43	46.91		32.79	32.81	13.81		10.03	10.07
95% UCL	52.03		36.81	36.60	30.82		22.95	22.77	126.10		87.06	86.85	60.63		40.07	39.85
SCTL-Res	400		400	400	400		400	400	400		400	400	400		400	400
	Not normally distributed				Not normally distributed				Not normally distributed				Not normally distributed			

	Lead, All sources (mg/kg) DL = 1.43				Lead, Street Sweeping (mg/kg) DL = 1.43				Lead, Catch Basins (ug/kg) DL = 1430				Lead, Storm Ponds (ug/kg) DL = 1430			
Number of Samples	246	108	354		147	56	203		53	25	78		46	27	73	
Maximum, Lognormal			6.9660				5.9545				13.8738				12.1869	
Average, Lognormal			2.2752				2.1865				9.4018				9.1957	
Variance, Lognormal			2.1942				1.6619				3.0558				2.7529	
Std. Dev., Lognormal			1.4813				1.2892				1.7481				1.6592	
Conf. Int., Lognormal			0.1543				0.1773				0.3879				0.3806	
95% UCL, Lognormal			2.4295				2.3638				9.7898				9.5763	
SCTL-Res			400				400				400000				400000	
95% UCL Transformed			11.35				10.63				17850				14420	
	Normally distributed				Normally distributed				Normally distributed				Normally distributed			

TABLE 7. Total Chromium Summary

	Chromium, All sources (mg/kg) DL=1.34				Chromium, Street Sweeping (mg/kg) DL=1.34				Chromium, Catch Basins (mg/kg) DL = 1.34				Chromium, Storm Ponds (mg/kg) DL = 1.34			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	225	81	306	306	122	53	175	175	53	10	63	63	50	18	68	68
Maximum	**552**		552	552	**552**		552	552	50.79		50.79	50.79	174.5		174.5	174.5
Average	23.67		17.76	17.58	25.44		18.14	17.94	16.83		14.37	14.27	26.59		19.91	19.73
Variance	2825.79		2172.67	2178.60	4797.63		3459.58	3466.53	104.18		119.94	122.82	893.08		779.10	785.88
Std. Deviation	53.16		46.61	46.68	69.26		58.82	58.88	10.21		10.95	11.08	29.88		27.91	28.03
Confidence	6.95		5.22	5.23	12.29		8.71	8.72	2.75		2.70	2.74	8.28		6.63	6.66
95% UCL	30.61		22.98	22.81	37.73		26.85	26.66	19.58		17.08	17.00	34.87		26.54	26.39
SCTL-Res	210		210	210	210		210	210	210		210	210	210		210	210
		Not normally distributed				Not normally distributed				Not normally distributed				Not normally distributed		

	Chromium, All sources (mg/kg) DL=1.34				Chromium, Street Sweeping (mg/kg) DL=1.34				Chromium, Catch Basins (mg/kg) DL = 1.34				Chromium, Storm Ponds (mg/kg) DL = 1.34			
Number of Samples			306				175				63				68	
Maximum, Lognormal			6.314				6.314				3.928				5.162	
Average, Lognormal			2.004				1.824				2.289				2.202	
Variance, Lognormal			1.550				1.566				1.021				1.843	
Std. Dev., Lognormal			1.245				1.251				1.011				1.358	
Conf. Int., Lognormal			0.139				0.185				0.250				0.323	
95% UCL, Lognormal			2.143				2.009				2.539				2.525	
SCTL-Res			210				210				210				210	
95% UCL Transformed			8.5				7.5				12.7				12.5	
		Normally distributed				Normally distributed				Normally distributed				Normally distributed		

TABLE 8. Leachable Lead Summary

	Leaching Lead, All Sources (mg/L) DL = .0025				Leaching Lead, Street Sweep(mg/L) DL=.0025				Leaching Lead, Catch Basins(mg/L) DL=.0025				Leaching Lead, Storm Pond(mg/L) DL=.0025			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	51	133	184	184	24	73	97	97	18	31	49	49	9	29	38	38
Maximum	**3.295**		3.295	3.295	**0.0636**		0.0636	0.0636	**0.0205**		0.0205	0.0205	**3.295**		3.295	3.295
Average	0.1170		0.0342	0.0333	0.0113		0.0047	0.0037	0.0079		0.0045	0.0037	0.6170		0.1481	0.1471
Variance	0.3019		0.0851	0.0852	0.0002		0.0001	0.0001	0.0000		0.0000	0.0000	1.5449		0.4041	0.4044
Std. Deviation	0.5495		0.2918	0.2919	0.0146		0.0081	0.0084	0.0050		0.0040	0.0044	1.2429		0.6357	0.6359
Confidence	0.1508		0.0422	0.0422	0.0058		0.0016	0.0017	0.0023		0.0011	0.0012	0.8120		0.2021	0.2022
95% UCL	0.2678		0.0764	0.0755	0.0172		0.0063	0.0054	0.0102		**0.0056**	0.0049	1.4291		0.3502	0.3493
MCL - Groundwater	0.015		0.015	0.015	0.015		0.015	0.015	0.015		0.015	0.015	0.015		0.015	0.015
	Not normally distributed				Not normally distributed				Normally distributed				Not normally distributed			

	Leaching Lead, All Sources (ug/L) DL = 2.5				Leaching Lead, Street Sweep(ug/L) DL=2.5								Leaching Lead, Storm Pond(ug/L) DL=2.5			
Number of Samples	51	133	184		24	73	97						9	29	38	
Maximum, Lognormal			8.1002				4.152613								8.1002	
Average, Lognormal			1.2590				1.190906								1.4105	
Variance, Lognormal			0.8083				0.381355								2.5173	
Std. Dev., Lognormal			0.8990				0.61754								1.5866	
Conf. Int., Lognormal			0.1299				0.122893								0.5045	
95% UCL, Lognormal			1.3889				1.313799								1.9150	
MCL - Groundwater			15				15								15	
Transformed 95% UCL			4.01				3.72								6.78	
	Normally distributed				Normally distributed								Not normally distributed due to 2 outliers			

													Leaching Lead, Storm Pond(ug/L) DL=2.5			
Number of Samples													7	29	36	
Maximum															9.5	
Average															3.08	
Variance															2.59	
Std. Deviation															1.61	
Confidence															0.53	
95% UCL															3.6	
MCL - Groundwater															15	
													Normally distributed w/o 2 outliers			

TABLE 9. Leachable Organochlorine Pesticides Summary

	Leaching Beta-BHC, All Sources (ug/L) DL=.05				Leaching Beta-BHC, Street Sweeping(ug/L) DL=.05				Leaching Beta-BHC, Catch Basin(ug/L) DL=.05				Leaching Beta-BHC, Storm Pond(ug/L) DL=.05			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	7	159	166	166	0	93	93	93	0	38	38	38	7	28	35	35
Maximum	0.24		0.24	0.24			0.1	0.05			0.1	0.05			0.24	0.24
Average	0.177		0.060	0.034			0.053	0.026			0.051	0.026			0.091	0.063
Variance	0.003		0.001	0.001			0.000	0.000			0.000	0.000			0.003	0.004
Std. Deviation	0.054		0.031	0.033			0.011	0.006			0.008	0.004			0.054	0.063
Confidence	0.040		0.005	0.005			0.002	0.001			0.003	0.001			0.018	0.021
95% UCL	0.217		**0.065**	**0.039**			**0.055**	**0.027**			**0.054**	**0.027**			**0.109**	**0.084**
Min. Criteria - GW	0.02		0.02	0.02			0.02	0.02			0.02	0.02			0.02	0.02
	Normally distributed				Normally distributed				Normally distributed				Normally distributed			

NOTE: Since detection limit reported for Beta-BHC is greater than groundwater criteria, a demonstration of best available detection limit may justify using detection limit as criteria for street sweepings and catch basins only.

	Leaching 4,4 DDT, All Sources (ug/L) DL=.05				Leaching 4,4 DDT, Street Sweeping(ug/L) DL=.05				Leaching 4,4 DDT, Catch Basin(ug/L) DL=.05				Leaching 4,4 DDT, Storm Pond(ug/L) DL=.05			
	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL
Number of Samples	13	153	166	166	7	86	93	93	1	37	38	38	5	30	35	35
Maximum	0.22		0.22	0.22			0.22	0.22			0.14	0.14			0.22	0.22
Average	0.173		0.064	0.039			0.059	0.036			0.052	0.028			0.088	0.058
Variance	0.001		0.001	0.002			0.001	0.002			0.000	0.000			0.002	0.003
Std. Deviation	0.036		0.036	0.041			0.033	0.039			0.015	0.019			0.049	0.056
Confidence	0.020		0.005	0.006			0.007	0.008			0.005	0.006			0.016	0.019
95% UCL	0.193		0.069	0.045			0.065	0.044			0.057	0.034			**0.104**	0.076
Min. Criteria – GW	0.1		0.1	0.1			0.1	0.1			0.1	0.1			0.1	0.1
	Normally distributed at detection limit				Normally distributed at detection limit				Normally distributed				Normally distributed			

TABLE 10. Leachable Aluminum Summary

	Leaching Alum., All Sources(mg/L) DL=.2				Leaching Alum., Street Sweep(mg/L) DL=.2				Leaching Alum., Catch Basins(mg/L) DL=.2				Leaching Alum., Storm Pond(mg/L) DL=.2			
	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL	Detected	Non-detects	Using DL	Using ½ DL
Number of Samples	58	12	70	70	31	10	41	41	13	0	13	same	14	2	16	16
Maximum	**11.86**		11.86	11.86	**11.86**		11.86	11.86	**1.02**		1.02		**4.58**		4.58	4.58
Average	1.00		0.86	0.84	1.04		0.83	0.81	0.43		0.43		1.44		1.27	1.26
Variance	3.43		2.93	2.95	5.11		3.97	4.00	0.08		0.08		2.65		2.52	2.53
Std. Deviation	1.85		1.71	1.72	2.26		1.99	2.00	0.28		0.28		1.63		1.59	1.59
Confidence	0.48		0.40	0.40	0.80		0.61	0.61	0.15		0.15		0.85		0.78	0.78
95% UCL	1.47		1.26	1.25	1.83		1.44	1.42	0.58		**0.58**		2.29		2.04	2.04
MCL-Groundwater	0.2		0.2	0.2	0.2		0.2	0.2	0.2		0.2		0.2		0.2	0.2
	Not normally distributed & lognormal not normal				Not normally distributed & lognormal not normal				normal				Not normally distributed & lognormal not normal			

	Leaching Alum., All Sources (ug/L) DL=200				Leaching Alum., Street Sweep(ug/L) DL=200								Leaching Alum., Storm Pond(ug/L) DL=200			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL					Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples			70	70			41	41							16	16
Maximum, Lognormal			9.381	9.381			9.381	9.381							8.429	8.429
Average, Lognormal			6.008	5.909			5.953	5.784							6.269	6.182
Variance, Lognormal			1.125	1.327			0.938	1.256							2.168	2.598
Std. Dev., Lognormal			1.061	1.152			0.968	1.121							1.473	1.612
Confidence, Lognormal			0.248	0.270			0.296	0.343							0.722	0.790
95% UCL, Lognormal			6.256	6.179			6.249	6.127							6.991	6.972
MCL-Groundwater			200	200			200	200							200	200
95% UCL Transformed			**521**	482			**518**	458							**1086**	1067
			normal	normal			Normal	normal							normal	normal

TABLE 11. Leachable Iron Summary

	Leaching Iron, All Sources (mg/L) DL=.3				Leaching Iron, Street Sweep(mg/L) DL=.3				Leaching Iron, Catch Basins(mg/L) DL=.3				Leaching Iron, Storm Ponds(mg/L) DL=.3			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples	46	24	70	70	22	19	41	41	11	2	13	13	13	3	16	16
Maximum	**2.22**		2.22	2.22	**2.22**		2.22	2.22	**0.65**		0.65	0.65	**1.76**		1.76	1.76
Average	0.52		0.44	0.39	0.56		0.44	0.37	0.37		0.36	0.34	0.56		0.48	0.47
Variance	0.26		0.18	0.20	0.34		0.20	0.22	0.03		0.03	0.04	0.31		0.28	0.28
Std. Deviation	0.51		0.43	0.45	0.58		0.44	0.47	0.19		0.17	0.19	0.55		0.53	0.53
Confidence	0.15		0.10	0.10	0.24		0.14	0.14	0.11		0.09	0.10	0.30		0.26	0.26
95% UCL	0.66		**0.53**	0.49	0.81		0.58	0.52	0.48		**0.45**	0.44	0.86		0.74	0.73
MCL-Groundwater	0.3		0.3	0.3	0.3		0.3	0.3	0.3		0.3	0.3	0.3		0.3	0.3
			normal	not normal	Not normally distributed & lognormal not normal						normal	normal	Not normally distributed & lognormal not normal			

	Leaching Iron, All Sources (ug/L) DL=300				Leaching Iron, Street Sweep(ug/L) DL=300								Leaching Iron, Storm Ponds(ug/L) DL=300			
	Detected	Non-detects	Using DL	Using 1/2 DL	Detected	Non-detects	Using DL	Using 1/2 DL					Detected	Non-detects	Using DL	Using 1/2 DL
Number of Samples				70			41	41							16	16
Maximum, Lognormal				7.705			7.705	7.705							7.473	7.473
Average, Lognormal				5.549			5.804	5.482							5.704	5.661
Variance, Lognormal				0.737			0.499	0.687							1.077	1.107
Std. Dev., Lognormal				0.858			0.706	0.829							1.038	1.052
Confidence, Lognormal				0.201			0.216	0.254							0.509	0.516
95% UCL, Lognormal				5.751			6.020	5.736							6.212	6.176
MCL-Groundwater				300			300	300							300	300
95% UCL Transformed				314			**412**	310							**499**	481
				normal			normal	normal							normal	normal

TABLE 12. Comparison of Cox Street Sweeping Total Analysis Data With Townsend Data

		DEP	Cox Study Data - 1998					Townsend Study Data - 2002					
Parameter	Units	Residential SCTLs	No. Samples	Mean	Max	Min	Stand. Dev.	No. Samples	No. Detects	Ave. of Detects	Max	Min	Stand. Dev.
Arsenic	mg/kg	0.8	8	3.3	11	1	3.2	199	94	1.2	13.6	0.5	1.49
Cadmium	mg/kg	75	10	0.27	0.48	0.2	0.09	199	3	49.8	54.1	46	4.06
Chromium	mg/kg	210	11	7.8	11.5	3.5	2.5	171	118	25.6	552	2.4	70.42
Copper	mg/kg	110	11	14.9	60.2	3.1	17.2	199	198	17.1	372.4	2.5	31.57
Lead	mg/kg	400	11	24.4	55.3	4.6	16.7	199	144	25	386	2.7	36.02
Nickel	mg/kg	110	8	4.8	14	2	3.9	199	195	8.9	69.9	2.4	7.82
Zinc	mg/kg	23000000	11	61.5	118	28	32	199	199	65.1	1080	4.3	86.51

TABLE 13. Townsend Arsenic Leaching Data

	All Sources		Street Sweepings	Storm Pond Sediments		Catch Basin Sediments	
	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(ug/L)	(mg/L)	(ug/L)
Lognormal Transformed?	No	Yes	No	No	Yes	No	Yes
Normal Data Set?	No	Yes	Yes	No	Yes	No	Yes
Number of Samples	185	185	98	38	38	49	49
Number of Detects	27	27	14	10	10	3	3
Maximum Detect	0.0452	45.2	0.016	0.0188	18.8	0.0452	45.2
Average (all samples)	0.0035	2.9	0.0031	0.0046	3.5	0.0035	2.7
Variance	0.00002	1.2	0.000005	0.00002	1.5	0.00004	1.2
Standard Deviation	0.0041	1.6	0.0022	0.0046	1.9	0.0062	1.6
Confidence Interval	0.0006	1.1	0.0004	0.0015	1.2	0.0017	1.1
95% UCL	0.0041	3.1	0.0036	0.0061	4.3	0.0053	3.1