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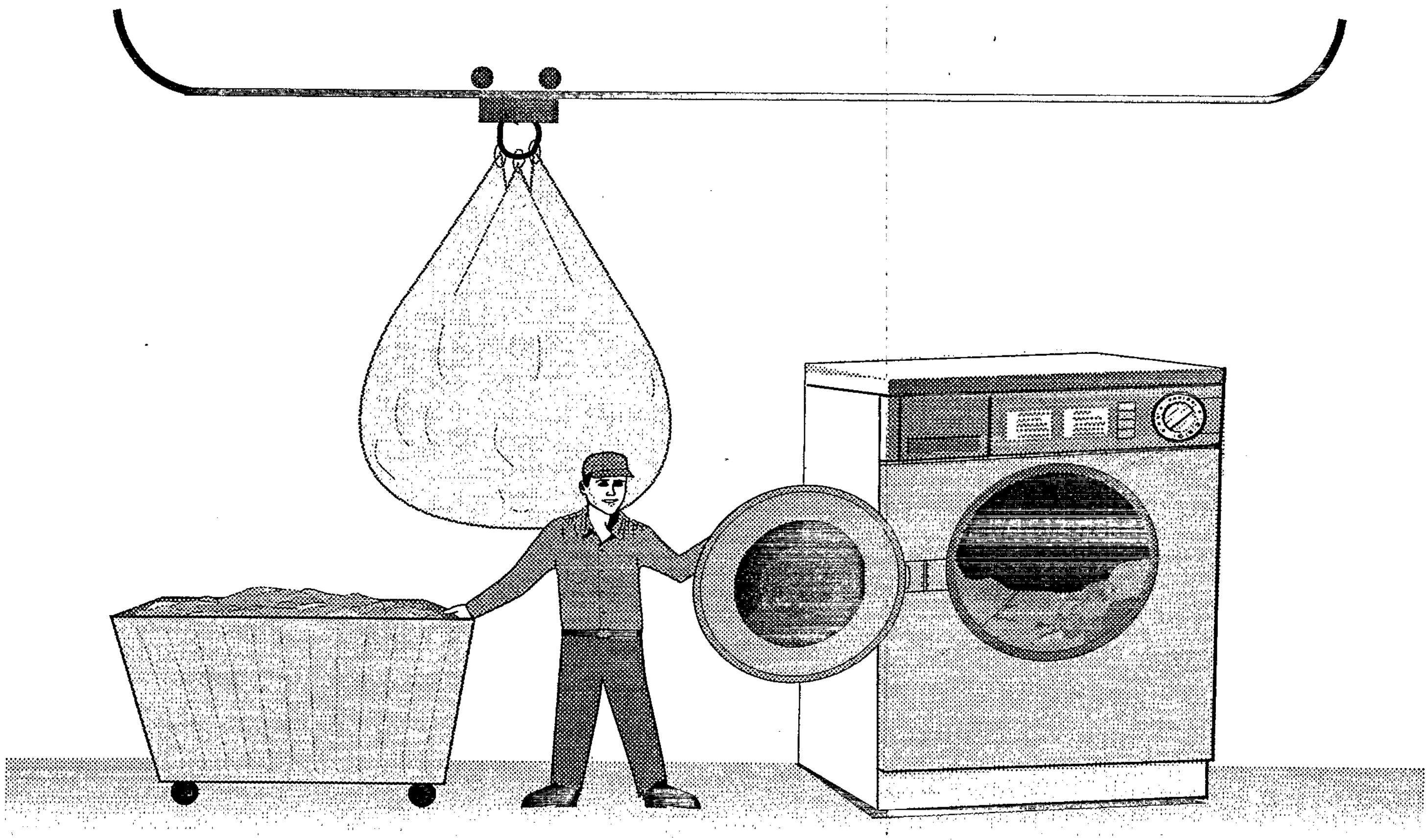
Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category



Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category

(EPA-821-R-97-006)

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ABSTRACT

This document describes the sample design and development of survey weights for the Industrial Laundries questionnaires. It also provides the statistical analyses used in developing the proposed pretreatment standards. A list of the data used in calculating long-term averages, variability factors, and limitations is included.

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CHAPTER 1
OVERVIEW OF ORGANIZATION AND CONTENTS OF DOCUMENT

This document describes the statistical analyses performed for the Effluent Limitations Guidelines and Pretreatment Standards for the Industrial Laundries Point Source Category. These statistical analyses were used in estimating the number of industrial laundry facilities, estimating the number of industrial laundry facilities with particular characteristics of interest, developing the proposed effluent guideline standards and comparing influent pollutant concentrations of linen, industrial laundry, and denim prewash facilities.

This document is organized into nine chapters and five appendices. The following list summarizes the content of each chapter and appendix:

Chapter 1: Overview of Organization and Contents of Document
- Describes the organization of the document and summarizes the contents of each chapter and appendix.

Chapter 2: Survey Design
- Describes the development of the sample frame and selection of facilities to receive the detailed and screener questionnaires.

Chapter 3: Estimation Methodology for National Estimates
- Describes the methodology used in calculating national estimates from the detailed questionnaire and provides some national estimates.

Chapter 4: Analytical Data Collection Efforts and Definition of Options
- Provides an overview of the analytical data collection efforts and defines the technology options.

Chapter 5: Description of Data Conventions
- Describes data conventions and how the data were treated, including aggregation and review.

Chapter 6: Statistical Methodology
- Describes the modified delta-lognormal distribution that was used to derive the proposed limitations.

Chapter 7: Estimation under the Modified Delta-Lognormal Distribution
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Chapter 8: Derivation of the Proposed Limitations
- Describes the derivation of the proposed limitations.

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Appendix A: Listing of Daily Data
- Provides a listing of the concentration data from each facility used to characterize the treatment in the options.

Appendix B: Listing of Summary Statistics for Regulated Pollutants
- Provides summary statistics for the data from each facility used to characterize the treatment in each option.

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- Provides a summary of the facility-specific long-term averages and variability factors for the proposed option.

Appendix D: Listing of Pollutant-Level Long-Term Averages, Variability Factors and Limitations
- Provides the pollutant-level long-term averages, variability factors and the proposed limitations.

Appendix E: Episode, Sample Point and Data Source Used in Industrial Laundry and Linen Comparisons
- Provides the episode, sample point and data source used in the industrial laundry raw wastewater comparisons.

CHAPTER 2
SURVEY DESIGN

The industrial laundry industry screener and detailed questionnaires were sent to a random selection of facilities that were identified from two sources. These two sources of population information were trade association listings and information obtained from Dun & Bradstreet. The trade association listings were compiled from Uniform and Textile Service Association (UTSA, formerly IIL) customer and prospective customer lists, the Textile Rental Service Association (TRSA) mailing list, and the Occupational Safety and Health Administration's (OSHA) list of violations for industrial laundries. Industrial laundry facilities were identified in the Dun & Bradstreet listing by their reported Standard Industry Classification (SIC) codes. Facilities with primary SIC codes of 7218 (industrial laundering) or 7213 (linen supply servicing), and facilities with a secondary SIC code of 7218 were considered to be industrial laundries.

The original screener questionnaires were sent to all facilities in the trade association listing. Detailed questionnaires were sent to a random selection of facilities that reported generating wastewater from the trade association screener responses. After the frame was developed from the trade association listings, it was realized that the entire population of industrial laundries was not covered. Therefore, the Dun & Bradstreet information was used to supplement the trade association listings. Additional screener and detailed questionnaires were sent to a selection of facilities from the Dun & Bradstreet listing in order to capture industrial laundry facilities in the nation that were not originally identified in the trade association listing.

The two population listings initially contained duplicate facilities, due to an overlap between the trade association and Dun & Bradstreet listings. Extensive efforts were used to select only facilities from the Dun & Bradstreet listings that did not appear in the trade association lists. However, due to inconsistent recording of addresses and ownership status, some facilities were included in both sampling frames. After removing duplicate facilities from these two listings, the two populations are mutually exclusive. Different sample selection methods were used to randomly sample facilities within each of these two populations. Because the two populations are mutually exclusive, national estimates are generated within each population separately, and then combined to characterize the entire population of industrial launderers in the nation.

The development of the sampling frames, the sample selection process, and the resulting survey weights is summarized below. The survey weights were developed independently for the screener and detailed questionnaires within each population (trade association and Dun & Bradstreet).

2.1 Trade Association Population

2.1.1 Trade Association Screener Questionnaire

The final mailing list from the trade association listings contained 1,751 industrial laundry facilities. Screener questionnaires were mailed to all 1,751 facilities. Therefore, a census was taken from the trade association listing with a frame size (N) and a sample size (n) equal to 1,751.

Of the 1,751 screeners that were mailed, 1,543 were returned. In addition, three facilities that were not on the original mailing list received copies of the screener from their parent company and completed and returned them to the EPA. Therefore, the frame (N) and sample size (n) are increased to 1,754, and the number of respondents is 1,546. However, 46 of the 1,546 respondents were duplicate facilities (i.e., 46 facilities were sent two screeners and returned both). Two copies of the questionnaire were mistakenly sent to each of these facilities due to inconsistent documentation of the addresses, facility names, and/or ownership status. Despite efforts to remove duplicate facilities before the mailing lists were established, differences in the recorded mailing addresses and physical locations and owner and operator names caused some facilities to be listed twice. After removing the duplications, the frame and sample size is 1,708 and the number of unique respondents is 1,500. There were 208 nonrespondents to the screener questionnaire.

Among the 1,500 screener questionnaires that were returned, 1,127 of the facilities were identified as "in-scope". In-scope facilities are defined as facilities that generated laundry wastewater in 1993[1]. An additional two facilities were later identified as in-scope facilities, which brought the total number of in-scope respondent facilities to 1,129.

During the development of the detailed questionnaire frame from the list of in-scope screener respondents (as documented in Section 2.1.2), there were 15 facilities for which information regarding 1992 revenue, wastewater treatment type, or items laundered was not available. Subsequent telephone calls to these facilities were used to obtain this information. From the responses to these telephone calls, one facility that was originally identified as in-scope was found to be out-of-scope. Therefore, the number of in-scope respondents to the screener questionnaire was reduced by one to 1,128.

The number of in-scope facilities among the 208 nonrespondents to the screener questionnaire is not known because scope was determined from the response to the screener question regarding wastewater generation. The EPA conducted an assessment to characterize the 208 nonrespondents to determine the likeliness that these facilities were in-scope. Characteristics assessed include mail delivery, business status, and laundry wastewater generation.

Efforts to obtain more information about these facilities resulted in the identification of 86 of the 208 nonrespondents as out-of-scope. This was because 65 screener questionnaires were returned by the post office and new addresses were not available, implying that the facilities were out of business, and 21 facilities were excused by the EPA from completing the screener questionnaire because they did not generate laundry wastewater, were out of business, or were duplicates of other facilities. The remaining 122 nonrespondents to the screener questionnaire are possibly in-scope, but the status has not been verified as of this writing. Of these 122 facilities, 3 were excused by the EPA from completing the screener questionnaire but are likely to be in-scope and 119 were not returned by the post office, implying that the facility received the questionnaire, but no completed screener was returned from the facility.

Among the 208 nonrespondents to the screener questionnaire from the trade association listing, five facilities also were sent a screener questionnaire from the Dun & Bradstreet listing (as documented in Section 2.2.2). This duplication was discovered after the screener questionnaire was mailed from the

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[1] "In-scope" at this time includes denim prewash facilities, linen facilities, and all facilities generating laundry wastewater, regardless of production amount.

Dun & Bradstreet listing. These five facilities were retained in the Dun & Bradstreet frame to maintain the probability structure of the Dun & Bradstreet sample. (The Dun & Bradstreet sample was a probability sample, whereas the trade association sample was a census.) Therefore, these five facilities were removed from the trade association frame, and accounted for in the Dun & Bradstreet population only. Of these five facilities, one was from the set of 86 nonrespondents that are believed to be out-of-scope because the screener was returned by the post office and a new address was unavailable. The other four facilities were from the set of 122 nonrespondents that are possibly in-scope because the screeners were not returned by the post office. By removing these four facilities from the trade association population, there were 118 nonrespondents to the screener questionnaire that were possibly in-scope.

Because it was not known if the nonrespondents were in-scope, and because auxiliary information was not available for these facilities, the EPA estimated the number of in-scope nonrespondents in the following way. The EPA assumed that the proportion of the 118 nonrespondents that were estimated to be in-scope is equivalent to the proportion of respondents that were identified as in-scope. There were 1,128 in-scope facilities among the 1,500 respondents, so it was estimated that 89 of the 118 nonrespondents also were in-scope.

Therefore, the estimated total number of in-scope facilities from the trade association population was 1,217 (i.e. the 1,128 in-scope respondents plus the estimated 89 in-scope nonrespondents).

After the trade association list was established, the five largest industrial launderers in the nation were examined to identify facilities that may not have been included in the trade association list. There were 48 facilities identified as belonging to these five industrial launderers (Aratex, Cintas, Omni, Unifirst, and Unitog). Also, mailing addresses were identified for four additional facilities that were not originally included in the trade association list due to lack of address information. Abbreviated versions of the screeners were sent to these 52 facilities to obtain information regarding their operating practices and status. From this information, 29 facilities were identified as being in-scope and did not duplicate facilities originally in the trade association list. These 29 facilities were added to the trade association population.

Therefore, the total number of in-scope industrial laundry facilities in the trade association population was 1,246, of which, information from the screener questionnaire was available from 1,128 in-scope respondents.

2.1.2 Trade Association Detailed Questionnaire

The original trade association frame, from which a random sample of facilities was selected to receive the detailed questionnaire, was based upon the list of in-scope facilities that responded to the screener questionnaire. The original list of in-scope screener respondents contained 1,127 facilities (see Section 2.1.1). Only the in-scope respondent facilities to the screener were used as the sampling frame because information collected from the screener questionnaire responses was used to construct the detailed questionnaire sampling frame strata. The stratification scheme was based on items laundered, 1992 revenues, and wastewater treatment processes, for a total of 48 strata (see **Table 2-1**).

Table 2-1
Trade Association Detailed Questionnaire Strata

	Items Laundered
A:	5% or more printer towels (and possibly anything else)
B:	5% or more shop towels (and possibly less than 5% printer towels or anything else)
C:	10% or more industrial garments (and possibly less then 5% printer towels or less than 5% shop towels or anything else)
D:	Anything not covered by A, B, or C
	1992 Revenues
1:	Less than $1 million
2:	Greater than or equal to $1 million and less than $3.5 million
3:	Greater than or equal to $3.5 million and less than $7 million
4:	Greater than or equal to $7 million
	Wastewater Treatment
I:	Biotreatment, air stripper, centrifuge, membrane filtration, pressure filtration, and/or media filtration, and/or carbon adsorption (and possibly anything else)
II:	Dissolved air flotation, oil/water separation, and/or clarifier (and possibly anything else)
III:	Anything not covered by I or II

At the time that the sampling frame was developed, stratification information was not available for 15 of the in-scope respondent facilities. Therefore, the sampling frame contained 1,112 facilities, divided into the 48 strata. These facilities and strata are summarized in Column (a) of **Table 2-2**.

From the sampling frame of 1,112 facilities, a sample of 214 facilities was randomly selected within the 48 strata. Among the 214 facilities that were randomly sampled, five were facilities that received a pre-test of the detailed questionnaire. Two of these pre-test facilities were replaced by redrawing from the sampling frame within the respective strata. One additional facility, which was not a pre-test facility, was identified during the selection process as being closed, so it was replaced by a facility within the same stratum that was not originally sampled. The other three pre-test facilities were in strata from which all of the facilities were sampled, so there were no alternative facilities to use as replacements. For these three facilities, responses from the pre-test were incorporated into the detailed questionnaire response database wherever possible. Therefore, the sample size remained at 214. All 214 of the sampled facilities for the detailed questionnaire were defined to be in-scope.

Following the selection of the random sample of 214 facilities to receive the detailed questionnaire, 17 additional facilities were selected deliberately by the EPA to receive the detailed questionnaire based upon their wastewater treatment processes. Because these 17 facilities were not randomly selected, they could not be included as part of the random sample. But, because detailed questionnaires were sent to these facilities and responses were available to be used in the calculation of national estimates, they were included in the detailed questionnaire sample. To accommodate this situation, the 17 deliberately-sampled facilities were removed from the appropriate strata in the sampling frame, and were placed in a separate stratum from which it is assumed that all 17 facilities were selected. This adjusted sampling frame, with the additional stratum, is presented in Column (b) of **Table 2-2**.

After the establishment of the sampling frame, the selection of the detailed questionnaire sample, and the mailing of the questionnaires, information was obtained regarding the stratification of the 15 in-scope facilities that were excluded from the sampling frame due to lack of stratum information in the screener responses. One of these facilities was then found to be out-of-scope from the additional information obtained. Therefore, the sampling frame was increased by 14 to a total of 1,126. These additions to the appropriate strata in the sampling frame are reflected in Column (c) of **Table 2-2.**

After the list of in-scope respondents was established for the detailed questionnaire sampling frame, two additional screener respondents were classified as in-scope. Because these two facilities were not included in the original sampling frame and, thus, were not available for selection to receive the detailed questionnaire, the population was increased by two facilities.

The population also was increased to account for the estimated number of in-scope facilities that did not respond to the screener and, thus, were not included in the original sampling frame for the detailed questionnaire. Of the 208 screener nonrespondents, 122 were identified as possibly being in-scope through follow-up telephone calls. Of these 122 facilities, 3 facilities that are likely to be in-scope were excused by the EPA from completing the screener questionnaire, and 119 screener questionnaires were not returned by the post office, implying that the facilities received the questionnaires, but completed screeners were not returned from the facilities. There were 1,128 in-scope facilities among the 1,500 screener respondents, so it is estimated that 92 of the 122 nonrespondents also are in-scope. This assumes that the proportion of the 122 nonrespondents that are estimated to be in-scope is equivalent to the proportion of respondents that were identified as in-scope.

The population was adjusted for these estimated 92 in-scope facilities plus the two facilities that were declared to be in-scope following the establishment of the original sampling frame. Because stratification information was not known for these facilities, the stratum frames were increased in proportion to the frame sizes. For example, the sample frame for stratum A-1-III contained 31 facilities and the total frame size was 1,109 (excluding the 17 deliberately-sampled facilities). Therefore, three (94*31/1109) of the 94 in-scope facilities were apportioned to stratum A-1-III. These adjusted stratum frames, totaling 1,220 facilities, are presented in Column (d) of **Table 2-2**, and were calculated based on the stratum frames under Column (c).

It should be noted that the screener population (in Section 2.1.1) was adjusted by only 89 of the nonrespondents because four of the nonrespondents were duplicated in the Dun & Bradstreet screener sample. However, the detailed questionnaire frame is not affected by these four duplicates because the Dun & Bradstreet screener frame was developed after the Dun & Bradstreet detailed questionnaire frame (as documented in Section 2.2).

Two of the possibly in-scope nonrespondents to the trade association screener questionnaire were also selected to receive a Dun & Bradstreet detailed questionnaire (i.e., the trade association list and the Dun & Bradstreet list duplicated these two facilities, as documented in Section 2.1). These two facilities were accounted for in the Dun & Bradstreet detailed questionnaire sample to retain the probability structure, because they did not respond to the trade association screener questionnaire. Thus, they had no stratification information for the trade association detailed questionnaire sample. Therefore, the estimated number of in-scope facilities from the screener nonrespondents was calculated from only 120 facilities, rather than 122. The revised estimate is 90 in-scope facilities, dictating an increase in the detailed questionnaire of 92 in-scope facilities, rather than the 94 facilities that were added to create Column (d). These adjusted stratum frame sizes, based on Column (c) and the additional 92 in-scope facilities, are presented under Column (e) of **Table 2-2** and result in a total frame size of 1,218 facilities.

After the trade association list and the subsequent detailed questionnaire sampling frame were established, the five largest industrial launderers in the nation were examined to identify facilities that may not have been included in the trade association list. There were 48 facilities identified as belonging to these five industrial launderers (Aratex, Cintas, Omni, Unifirst, and Unitog). Also, mailing addresses were identified for four additional facilities that were not originally included in the trade association list due to lack of address information. Abbreviated versions of the screeners were sent to these 52 facilities to obtain information regarding their operating practices and status. From this information, 29 facilities were identified as being in-scope and did not duplicate facilities originally in the trade association list. These 29 facilities were added to the adjusted sampling frame into the appropriate strata that were identified from the abbreviated screener responses. These final adjusted stratum frames are presented in Column (f) of **Table 2-2**.

The final adjusted frame size is 1,247 facilities, from which 231 facilities were sent detailed questionnaires. The final frame sizes for each stratum are listed under Column (f) of **Table 2-2** and the sample sizes for each stratum are listed in Column (g).

Table 2-2
Trade Association Detailed Questionnaire Sampling Frame Report

Stratum			Original Frame	Intermediate Frames				Final Frame (N_h)	Sample Size (n_h)
Items	Revenue	Treatment	(a)	(b)	(c)	(d)	(e)	(f)	(g)
A	1	I	2	2	2	2	2	2	2
A	1	II	7	7	7	8	8	8	7
A	1	III	31	31	31	34	34	34	4
A	2	I	12	12	12	13	13	13	12
A	2	II	22	22	22	24	24	24	4
A	2	III	71	69	71	77	77	77	4
A	3	I	8	8	8	9	9	9	8
A	3	II	35	33	34	37	37	37	4
A	3	III	44	42	42	46	45	45	4
A	4	I	9	9	9	10	10	10	9
A	4	II	42	40	40	43	43	43	4
A	4	III	30	28	28	30	30	31	4
B	1	I	4	4	4	4	4	4	4
B	1	II	6	6	6	7	7	7	6
B	1	III	57	56	57	62	62	62	4
B	2	I	15	15	15	16	16	16	15
B	2	II	35	35	36	39	39	41	4
B	2	III	109	108	109	118	118	121	4
B	3	I	5	5	5	5	5	5	5
B	3	II	42	41	41	45	44	50	4
B	3	III	90	90	91	99	99	106	4
B	4	I	5	5	5	5	5	5	5
B	4	II	25	25	25	27	27	29	4
B	4	III	21	21	21	23	23	26	4
C	1	I	1	1	1	1	1	1	1
C	1	II	1	1	1	1	1	1	1

Table 2-2
Trade Association Detailed Questionnaire Sampling Frame Report (Continued)

Stratum			Original Frame	Intermediate Frames				Final Frame (N_h)	Sample Size (n_h)
Items	Revenue	Treatment	(a)	(b)	(c)	(d)	(e)	(f)	(g)
C	1	III	21	21	21	23	23	23	4
C	2	I	1	1	1	1	1	1	1
C	2	II	3	3	3	3	3	3	3
C	2	III	34	34	36	39	39	39	4
C	3	I	3	3	3	3	3	3	3
C	3	II	9	9	10	11	11	11	4
C	3	III	26	26	26	28	28	28	4
C	4	I	1	1	1	1	1	1	1
C	4	II	3	3	3	3	3	3	3
C	4	III	15	14	14	15	15	16	4
D	1	I	5	5	5	5	5	5	5
D	1	II	2	2	2	2	2	2	2
D	1	III	80	80	81	88	88	88	4
D	2	I	4	4	4	4	4	4	4
D	2	II	6	6	6	7	7	7	4
D	2	III	69	69	71	77	77	79	4
D	3	I	8	8	8	9	9	9	8
D	3	II	9	9	9	10	10	10	4
D	3	III	51	49	50	54	54	55	4
D	4	I	5	5	5	5	5	5	5
D	4	II	9	9	9	10	10	10	4
D	4	III	19	18	18	20	20	21	4
Deliberate-sample				17	17	17	17	17	17
Total			1112	1112	1126	1220	1218	1247	231

2.2 Dun & Bradstreet Population

The Dun & Bradstreet listing was used to increase the population of industrial laundry facilities to include facilities that were not captured by the trade association lists. Additional screener and detailed questionnaires were sent to a random sample of the facilities that were identified as industrial laundry facilities, but were not included in the trade association lists. From the Dun & Bradstreet listing, 24 facilities were selected to receive the additional detailed questionnaires. Following the selection of the sample for the additional detailed questionnaire, 200 of the facilities in the Dun & Bradstreet listing were chosen to receive additional screener questionnaires. Therefore, the development of the detailed questionnaire frame is discussed prior to the discussion of the additional screener questionnaire frame in this section.

2.2.1 Dun & Bradstreet Detailed Questionnaire

Industrial laundry facilities were identified in the Dun & Bradstreet listing as facilities with primary SIC codes of 7218 (industrial laundering) or 7213 (linen supply servicing), and facilities with a secondary SIC code of 7218. These three SIC code categories were used to define three strata for the sampling design: (1) primary SIC code 7218, (2) primary SIC code 7213, and (3) secondary SIC code 7218.

The Dun & Bradstreet listing was compared with the facilities that responded to the trade association screener questionnaire to avoid duplication of the facilities. Duplicate facilities within the Dun & Bradstreet listing and between the Dun & Bradstreet listing and the trade association respondents were removed from the Dun & Bradstreet sampling frame. This resulted in a sampling frame of 2,249 facilities (714 in D&B Stratum 1; 1,372 in D&B Stratum 2; 163 in D&B Stratum 3).

Twenty-four in-scope facilities were selected by randomly sampling facilities from the sample frame and calling each facility to verify that it was in-scope (i.e., generated wastewater). If a selected facility was not in-scope, another facility was randomly selected. This process was continued until 24 in-scope facilities were identified. To gain 24 in-scope facilities (12 from D&B Stratum 1; 7 from D&B Stratum 2; 5 from D&B Stratum 3), a total of 66 facilities were selected (36 from D&B Stratum 1; 19 from D&B Stratum 2; 11 from D&B Stratum 3). In order to develop survey weights, this selection process is treated as a stratified random sample of 66 facilities, of which 24 were found to be in-scope. During the sampling process, one of the 24 in-scope facilities was identified as a management facility, so it was replaced by a randomly selected facility from the same stratum, thus increasing the total number of facilities sampled to 67. But, because the replacement facility was randomly selected from the sampling frame, the survey weights (66 facilities selected, of which, 24 are in-scope) are not affected; that is, each facility had the same probability of being selected in the sample.

During the development of the Dun & Bradstreet screener frame (as documented in Section 2.2.2), duplicate facilities were found between the Dun & Bradstreet listing and the respondents to the trade association screener questionnaire. The revised sampling frame, adjusted to remove these additional duplicates, is 1,977. However, this adjusted sampling frame also removed the 67 facilities that were selected for the detailed questionnaire, in addition to the duplicate facilities. Therefore, the 66 detailed questionnaire facilities (not including the one management facility that was replaced) should not be removed from the frame. The adjusted sampling frame, after removing only the additional duplicate facilities, is 2,043 facilities (631 in D&B Stratum 1; 1331 in D&B Stratum 2; 81 in D&B Stratum 3).

Duplicate facilities also were found between the Dun & Bradstreet listing and the nonrespondents to the trade association screener questionnaire. There were 73 duplicates found with the trade association nonrespondents that should be removed from the Dun & Bradstreet frame. However, two of these facilities had been previously selected to receive the Dun & Bradstreet detailed questionnaire. Therefore, the Dun & Bradstreet detailed questionnaire frame was reduced by only 71 facilities. The two duplicate facilities that were included in the Dun & Bradstreet detailed questionnaire sample were removed from the trade association detailed questionnaire frame (as documented in Section 2.1.2). The final sampling frame for the Dun & Bradstreet detailed questionnaire is 1,972 (605 in D&B Stratum 1; 1286 in D&B Stratum 2; 81 in D&B Stratum 3).

The final Dun & Bradstreet detailed questionnaire sampling frame (N), sample sizes (n), and the number of sampled facilities that are in-scope (n') are summarized in **Table 2-3**.

2.2.2 Dun & Bradstreet Screener Questionnaire

The sampling frame for the Dun & Bradstreet screener questionnaire was established after the Dun & Bradstreet detailed questionnaire was administered. During the development of this frame, duplicate facilities were found between the Dun & Bradstreet listing and the respondents to the trade association screener questionnaire. This resulted in a different sampling frame than was used for the Dun & Bradstreet detailed questionnaire. This sampling frame contained 1,977 facilities (595 in D&B Stratum 1; 1312 in D&B Stratum 2; 70 in D&B Stratum 3).

This frame does not include the facilities that were selected for the Dun & Bradstreet detailed questionnaire. These facilities should be included in the screener questionnaire frame because they are known to be in the population. Therefore, the frame was adjusted to include the 66 detailed questionnaire facilities (not including the one management facility that was replaced). The resulting frame contains 2,043 facilities (631 in D&B Stratum 1; 1331 in D&B Stratum 2; 81 in D&B Stratum 3).

Duplicate facilities were also found between the Dun & Bradstreet sampling frame for the screener questionnaire and the nonrespondents to the trade association screener questionnaire. There were 60 duplicates found with the trade association nonrespondents that should be removed from the Dun & Bradstreet frame. However, five of these facilities also were selected to receive the Dun & Bradstreet screener questionnaire. Therefore, the Dun & Bradstreet screener questionnaire frame was reduced by only 55 facilities. The five duplicate facilities that were included in the Dun & Bradstreet screener questionnaire sample were removed from the trade association screener questionnaire frame (as documented in Section 2.1.1). The adjusted sampling frame for the Dun & Bradstreet screener questionnaire is 1,988 (613 in D&B Stratum 1; 1294 in D&B Stratum 2; 81 in D&B Stratum 3).

From the Dun & Bradstreet screener questionnaire frame, 200 facilities were randomly selected. This sample was selected from the three SIC code strata and included 100 facilities from D&B Stratum 1, 60 facilities from D&B Stratum 2, and 40 facilities from D&B Stratum 3.

From the 200 screener questionnaires that were mailed, responses were received from 133 facilities. Among these responses, 6 facilities were identified as duplicates because they received a previous screener questionnaire. Therefore, these 6 facilities were removed from the sampling frame and the sample. The final sampling frame for the Dun & Bradstreet screener questionnaire is 1,982 (608 in

D&B Stratum 1; 1293 in D&B Stratum 2; 81 in D&B Stratum 3). The final Dun & Bradstreet screener questionnaire sampling frame (N), sample sizes (n), number of respondents, and number of in-scope respondents are summarized in **Table 2-4**.

Among the 127 unique respondents, 11 facilities were identified as out of scope, because they were sold, out of business, or not an industrial laundry facility. Therefore, the estimated number of in-scope facilities within each stratum has been estimated. **Table 2-3a** summarizes the estimated in-scope sampling frame (N') and number of in-scope respondents (n').

Table 2-3
Dun & Bradstreet Detailed Questionnaire Sampling Frame

Stratum	Sample Frame (N)	Sample Size (n)	Number of In-Scope Sampled Facilities (n')
1. Primary SIC 7218	605	36	12
2. Primary SIC 7213	1268	19	7
3. Secondary SIC 7218	81	11	5
Total	1972	66	24

Table 2-3a
Dun & Bradstreet Detailed Questionnaire Sampling Frame for In-scope Facilities

Stratum	Sample Frame (N')	Number of In-Scope Sampled Facilities (n')
1. Primary SIC 7218	202	12
2. Primary SIC 7213	474	7
3. Secondary SIC 7218	37	5
Total	713	24

Table 2-4
Dun & Bradstreet Screener Questionnaire Sampling Frame

Stratum	Sample Frame (N)	Sample Size (n)	Number of Respondent Facilities	Number of In-scope Respondent Facilities
1. Primary SIC 7218	608	95	58	51
2. Primary SIC 7213	1293	59	41	39
3. Secondary SIC 7218	81	40	28	26
Total	1982	194	127	116

2.3 Hotels, Hospitals and Prisons Screener Questionnaire

In response to comments from industrial laundry and linen supply trade associations, the EPA mailed out screener questionnaires to facilities such as hospitals, hotels, and prisons (HHP's). The trade associations indicated that the HHP's may generate revenues by accepting laundry from off-site, thereby reducing the profits of more traditional industrial laundries and linen supply facilities.

The EPA mailed 100 screener questionnaires to HHP's. HHP's are not traditional industrial laundry facilities, but generate wastewater from laundering. To obtain the 100 facility addresses, the EPA randomly selected 25 facility addresses from each of four lists (see **Table 2-5**). The results of this survey effort cannot be used to estimate a national number of these types of facilities or national estimates of any characteristics of these types of facilities. The purpose of the sampling was to get a snapshot of the activities of nontraditional laundries to help determine whether these facilities should be considered within the scope of the regulation.

Table 2-5
HHP Screener Questionnaire Sampling Frame

List Name	Total Addresses	Complete Addresses	Incomplete Addresses
Textile Rental Services Association of America (TRSA)	2,416	none (0)	All (2,416)
Uniform and Textile Service Association (UTSA)	208	all (208)	none (0)
Responses to Question 25 (Q25) in the Industrial Laundries Detailed Questionnaire (as of 11/18/94)	312	some	some
National Association of Institutional Linen Management (NAILM) Members	1,504	some (1,057)	some (447)

The estimated number of facilities in the mailing that were anticipated to be industrial laundries, prisons, health care facilities, hotels, and miscellaneous industrial facilities are displayed in **Table 2-6**.

Table 2-6
Estimated number of HHP facilities in the mailing by Facility type

List Name	Facility Type					Total in Mailing
	Prisons	Health-care	Hotels	Industrial Laundries	Misc. Industrial	
TRSA	3	8	6	1	7	25
UTSA	0	14	1	4	6	25
Q25	3	7	7	2	6	25
NAILM	0	23	1	0	1	25
Total	6	52	15	7	20	100

2.4 Industrial Laundries Population

The industrial laundries industry was characterized through the use of a screener questionnaire and was distributed a detailed questionnaire. The detailed questionnaire was distributed to a stratified simple random sampling of facilities from two mutually exclusive populations of industrial launderers identified through two sources; trade association listings and information obtained from Dun & Bradstreet.

2.4.1 Final Detailed Questionnaire Design

Through the process of generating national estimates for the industrial laundries industry, an issue was identified with regard to the stratification of the trade association population listing. One basic motivation for designing a stratified sampling design is to reduce variability through the identification of homogeneous strata. That is, stratification is based on the grouping of like sampling elements. The industrial laundries industry trade association population listing was stratified by types of items laundered, revenue range, and type of wastewater treatment.

Table 2-7 displays the trade association detailed questionnaire sampling frame previously described in Section 2.1.2. Notice that four strata, C-1-I, C-1-II, C-2-I, and C-4-I contain only one facility each. Additionally, notice that within several strata all facilities within each stratum eligible to receive a detailed questionnaire were sent a detailed questionnaire. Many of these strata have small sample sizes. Due to the small sample sizes within these strata, it is difficult to assess the presence of homogeneity within strata or heterogeneity between strata.

In addition, since sample unit nonresponse occurs (addressed later in this section) within these small strata, all strata in which all eligible facilities received detailed questionnaires were collapsed into one stratum. By collapsing all of these strata into a single stratum, sample unit nonresponse may be distributed over a larger number of facilities. This will eliminate any one facility or few facilities "over-representing" or "misrepresenting" the nonrespondents.

As indicated, sample unit nonresponse occurred in this sampling effort. Sample unit nonresponse is defined by a sampling unit, i.e., a facility, not returning a detailed questionnaire or not providing enough information in the detailed questionnaire responses to adequately identify a facility as a respondent. If the response rate is considered to be random, then the sample of respondents is considered to be a simple random sample, and it is assumed that there are no differences between the set of respondents and nonrespondents. Due to the presence of sample unit nonresponse, an adjustment was made to the detailed questionnaire sampling design as described below.

Stratum B-1-II contains only one respondent to the detailed questionnaire, as indicated in **Table 2-7**. Since there is only one respondent in stratum B-1-II, this stratum was collapsed with stratum A-1-II. Although the original stratum weights are not identical, the difference is minimal. By collapsing these strata, the sample unit nonresponse adjustment will be distributed across the seven sites in the collapsed stratum (W'_h=2.14) versus retaining the original B-1-II stratum with an adjusted weight of 7.00.

Therefore, all censused strata were collapsed into a single stratum and strata A-1-II and B-1-II were collapsed into a single stratum. Once these strata were collapsed, weights were adjusted for sample unit nonresponse in the following manner:

$$W_h^{\prime} = \frac{N_h}{n_h} * \frac{n_h}{r_h}$$

where r_h = the number of sampled units in stratum h responding to the detailed questionnaire and N_h and n_h are as defined in **Table 2-7**.

Table 2-8 displays the final detailed questionnaire sample design for the combined trade association and Dun & Bradstreet frames with sample unit non-response adjustment. For each stratum, the number of facilities in the population, the number of facilities sampled, the number of respondent facilities, the original weight, and the adjusted weights are presented.

Table 2-7
Trade Association Detailed Questionnaire Sampling Frame

Stratum			Final Frame	Sample Size	Number of Respondents	Stratum Weight
Items	Revenue	Treatment	(N_h)	(n_h)	(r_h)	(W_h)
A	1	I	2	2	2	1.00
A	1	II	8	7	6	1.14
A	1	III	34	4	3	8.50
A	2	I	13	12	10	1.08
A	2	II	24	4	4	6.00
A	2	III	77	4	3	19.25
A	3	I	9	8	8	1.13
A	3	II	37	4	2	9.25
A	3	III	45	4	4	11.25
A	4	I	10	9	9	1.11
A	4	II	43	4	4	10.75
A	4	III	31	4	4	7.75
B	1	I	4	4	3	1.00
B	1	II	7	6	1	1.17
B	1	III	62	4	2	15.50
B	2	I	16	15	12	1.07
B	2	II	41	4	3	10.25
B	2	III	121	4	4	30.25
B	3	I	5	5	4	1.00
B	3	II	50	4	4	12.50
B	3	III	106	4	4	26.50
B	4	I	5	5	4	1.00
B	4	II	29	4	4	7.25
B	4	III	26	4	4	6.50
C	1	I	1	1	0	1.00

Table 2-7
Trade Association Detailed Questionnaire Sampling Frame (Continued)

Stratum			Final Frame	Sample Size	Number of Respondents	Stratum Weight
Items	Revenue	Treatment	(N_h)	(n_h)	(r_h)	(W_h)
C	1	II	1	1	0	1.00
C	1	III	23	4	4	5.75
C	2	I	1	1	1	1.00
C	2	II	3	3	1	1.00
C	2	III	39	4	3	9.75
C	3	I	3	3	2	1.00
C	3	II	11	4	4	2.75
C	3	III	28	4	4	7.00
C	4	I	1	1	1	1.00
C	4	II	3	3	2	1.00
C	4	III	16	4	4	4.00
D	1	I	5	5	4	1.00
D	1	II	2	2	1	1.00
D	1	III	88	4	4	22.00
D	2	I	4	4	3	1.00
D	2	II	7	4	4	1.75
D	2	III	79	4	2	19.75
D	3	I	9	8	7	1.13
D	3	II	10	4	4	2.50
D	3	III	55	4	3	13.75
D	4	I	5	5	3	1.00
D	4	II	10	4	4	2.50
D	4	III	21	4	4	5.25
Deliberate-sample			17	17	14	1.00
Total			1247	231		

Table 2-8
Industrial Laundries Proposed Detailed Questionnaire Sampling Frame with Sample Unit Nonresponse Adjustment and Single PSU Adjustment

Stratum			Final Frame	Sample Size	Number of Respondents	Stratum Weight	Adjusted Stratum Weight
Items	Revenue	Treatment	(N_h)	(n_h)	(r_h)	(W_h)	(W'_h)
Collapsed Census Stratum			62	62	45	1.00	1.38
A,B	1	II	15	13	7	1.15	2.14
A	1	III	34	4	3	8.50	11.33
A	2	I	13	12	10	1.08	1.30
A	2	II	24	4	4	6.00	6.00
A	2	III	77	4	3	19.25	25.67
A	3	I	9	8	8	1.13	1.13
A	3	II	37	4	2	9.25	18.50
A	3	III	45	4	4	11.25	11.25
A	4	I	10	9	9	1.11	1.11
A	4	II	43	4	4	10.75	10.75
A	4	III	31	4	4	7.75	7.75
B	1	III	62	4	2	15.50	31.00
B	2	I	16	15	12	1.07	1.33
B	2	II	41	4	3	10.25	13.67
B	2	III	121	4	4	30.25	30.25
B	3	II	50	4	4	12.50	12.50
B	3	III	106	4	4	26.50	26.50
B	4	II	29	4	4	7.25	7.25
B	4	III	26	4	4	6.50	6.50
C	1	III	23	4	4	5.75	5.75
C	2	III	39	4	3	9.75	13.00
C	3	II	11	4	4	2.75	2.75
C	3	III	28	4	4	7.00	7.00

Table 2-8
Industrial Laundries Proposed Detailed Questionnaire Sampling Frame with Sample Unit Nonresponse Adjustment and Single PSU Adjustment (Continued)

Stratum			Final Frame	Sample Size	Number of Respondents	Stratum Weight	Adjusted Stratum Weight
Items	Revenue	Treatment	(N_h)	(n_h)	(r_h)	(W_h)	(W'_h)
C	4	III	16	4	4	4.00	4.00
D	1	III	88	4	4	22.00	22.00
D	2	II	7	4	4	1.75	1.75
D	2	III	79	4	2	19.75	39.50
D	3	I	9	8	7	1.13	1.29
D	3	II	10	4	4	2.50	2.50
D	3	III	55	4	3	13.75	18.33
D	4	II	10	4	4	2.50	2.50
D	4	III	21	4	4	5.25	5.25
D&B: P7213			474	7	6	67.68	78.96
D&B: P7218			202	12	9	16.81	22.41
D&B: S7218			37	5	2	7.36	18.41
Total			1960	255	208		

CHAPTER 3
ESTIMATION METHODOLOGY

This section presents the general methodology and equations for calculating estimates from the Industrial Laundries detailed questionnaire sampling efforts.

3.1 Detailed Questionnaire

A stratified random sample of 255 industrial laundry facilities (231 in Trade Association, 24 in Dun and Bradstreet) was selected from the 1,960 facilities in the population. Of the 255 facilities that received detailed questionnaires, 208 facilities responded.

3.1.1 Estimation from Complete Data

Many characteristics of interest estimated from the detailed questionnaire responses were provided by every detailed questionnaire respondent (PSU respondent). Therefore, based on a stratified simple random sample with complete response, stratum weights are used to obtain mean estimates from a continuous response variable. The stratum weights are the proportion of available facilities in each stratum ($W_h = N_h/N$), where N_h is the total number of available facilities for the sample from stratum h and N is the total number of available facilities for the sample (N=1,960). The sampling fraction, which is used to estimate totals from a continuous response or the total number of facilities with a given characteristic within each stratum, is the fraction of facilities within each stratum that are sampled ($f_h = n_h/N_h$).

The stratum weights, $W_h = N_h/N$, are used to estimate means according to the following formula:

$$\bar{Y} = \sum_h \left(\frac{N_h}{N} \cdot \bar{y}_h \right) = \sum_h \left(\frac{N_h}{N} \cdot \frac{\sum_{i=1}^{n_h} y_{hi}}{n_h} \right) \tag{3.1}$$

where,
- N = total number of facilities (N=1,960)
- N_h = total number of facilities in stratum h
- n_h = number of facilities sampled in stratum h
- y_{hi} = response from i^{th} facility in stratum h

The variance of the estimated mean is:

$$V(\bar{Y}) = \frac{1}{N^2} \sum_h \left(N_h \cdot (N_h - n_h) \cdot \frac{s_h^2}{n_h} \right) = \sum_h \left(W_h^2 \cdot \frac{s_h^2}{n_h} \cdot [1 - f_h] \right) \tag{3.2}$$

where

$$s_h^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_h} \left(y_{hi} - \bar{y}_h\right)^2$$

The estimated total number of facilities with a given attribute, or the estimated total from a continuous response is:

$$\hat{Y} = \sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{n_h} y_{hi} \right) \tag{3.3}$$

where, N_h = total number of facilities in stratum h
n_h = number of facilities sampled in stratum h
y_{hi} = response from i^{th} facility in stratum h

The estimated number of facilities, within stratum h, with a given attribute assumes
y_{hi} = 1 if the i^{th} facility has the given characteristic
0 if the i^{th} facility does not have the given characteristic.

The variance of the estimated total is:

$$V(\hat{Y}) = \sum_h \left(\frac{N_h^2 \cdot s_h^2}{n_h} \left(1 - \frac{n_h}{N_h} \right) \right) \tag{3.4}$$

where

$$s_h^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_h} \left(y_{hi} - \bar{y}_h\right)^2$$

3.1.2 Estimation with Item-level Non-Response

If responses are available from only m_h of the n_h sampled facilities, then the population can be considered to be divided into two domains: respondents and non-respondents. The estimated mean for the domain of respondents can be used as an estimate of the population mean, assuming that the non-respondent facilities operate at the mean of the responding facilities.[2]

The estimated mean for the respondents is:

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[2] Cochran, W. G., *Sampling Techniques*, 3rd ed., New York: John Wiley and Sons, Inc., 1977.

$$\bar{Y} = \frac{\sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{m_h} y_{hi} \right)}{\sum_h \left(\frac{N_h}{n_h} \cdot m_h \right)} \tag{3.5}$$

where, N_h = total number of facilities in stratum h
n_h = number of facilities sampled in stratum h
m_h = number of respondent facilities to the characteristic of interest in stratum h
y_{hi} = response from i^{th} facility in stratum h.

The estimated variance is:

$$V(\bar{Y}) = \frac{1}{\left(\sum_h \frac{Nh}{n_h} m_h \right)^2} \cdot \sum_h \frac{N_h^2 \left(1 - \frac{n_h}{N_h} \right)}{n_h (n_h - 1)} \cdot \left[\sum_{i=1}^{m_h} (y_{hi} - \bar{y}_h)^2 + m_h \left(1 - \frac{m_h}{n_h} \right) (\bar{y}_h - \bar{Y})^2 \right] \tag{3.6}$$

If responses are available from only m_h of the n_h sampled facilities, then the estimated total is:

$$\hat{Y} = N \cdot \bar{Y} = \sum_h N_h \cdot \frac{\sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{m_h} y_{hi} \right)}{\sum_h \left(\frac{N_h}{n_h} \cdot m_h \right)} \tag{3.7}$$

where, N = total number of facilities ($N=1960$)
N_h = total number of facilities in stratum h
n_h = number of facilities sampled in stratum h
m_h = number of respondent facilities to the characteristic of interest in stratum h
y_{hi} = response from i^{th} facility in stratum h.

This assumes that the proportion of facilities with the given attribute, or the average response, is the same in the set of non-respondents as in the set of respondents.

The estimated variance is:

$$V(\hat{Y}) = V(N \cdot \bar{Y}) = \frac{\left(\sum_h N_h\right)^2}{\left(\sum_h \frac{N_h}{n_h} m_h\right)^2} \cdot \sum_h \frac{N_h^2\left(1 - \frac{n_h}{N_h}\right)}{n_h(n_h - 1)} \cdot \left[\sum_{i=1}^{m_h} (y_{hi} - \bar{y}_h)^2 + m_h\left(1 - \frac{m_h}{n_h}\right)(\bar{y}_h - \bar{Y})^2\right] \tag{3.8}$$

3.1.3 Estimation for Domains with Complete Response

If estimates are to be calculated for a specific subset (domain) of the data other than the strata used in the sample design, then the formulae must be adjusted. An example of a domain estimate would be the estimated number of facilities within ranges of daily water flow, where the ranges of daily water flow are the domains. If there is complete response within each domain, the estimated mean is similar to equation (3.1), except that the responses, y_{hij}, and the number of facilities sampled, are restricted to the j^{th} domain. The estimated domain mean is:

$$\bar{Y}_j = \sum_h \left(\frac{N_h}{N} \cdot \bar{y}_{hj}\right) = \sum_h \left(\frac{N_h}{N} \cdot \frac{\sum_{i=1}^{n_{hj}} y_{hij}}{n_h}\right) \tag{3.9}$$

where, N = total number of facilities (N=1960)
N_h = total number of facilities in stratum h
n_h = number of sampled facilities in stratum h
n_{hj} = number of sampled facilities in stratum h of domain j
y_{hij} = response from i^{th} facility in stratum h of domain j.

The variance of the estimated domain mean is:

$$V(\bar{Y}_j) = \frac{1}{N^2} \sum_h \left(N_h \cdot (N_h - n_h) \cdot \frac{s_{hj}^2}{n_h}\right) = \sum_h \left(W_h^2 \cdot \frac{s_{hj}^2}{n_h} \cdot [1 - f_h]\right) \tag{3.10}$$

where N = total number of facilities (N=1960)
N_h = total number of facilities in stratum h
n_h = number of facilities sampled in stratum h
y_{hij} = response from i^{th} facility in stratum h of domain j.

$$s_{hj}^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_h} \left(y_{hij} - \bar{y}_{hj}\right)^2$$

The estimated total number of facilities in a domain with a given attribute, or the estimated domain total from a continuous response is:

$$\hat{Y}_j = \sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{n_h} y_{hij} \right) \qquad (3.11)$$

where, N_h = total number of facilities in stratum h
n_h = number of facilities sampled in stratum h
n_{hj} = number of facilities sampled in stratum h of domain j
y_{hij} = response from i^{th} facility in stratum h of domain j.

The estimated number of facilities, within stratum h of domain j, with a given attribute assumes
y_{hij} = 1 if the i^{th} facility has the given characteristic
0 if the i^{th} facility does not have the given characteristic.

The variance of the estimated total is:

$$V(\hat{Y}_j) = \sum_h \left(\frac{N_h^2 \cdot s_{hj}^2}{n_h} \left(1 - \frac{n_h}{N_h} \right) \right) \qquad (3.12)$$

where

$$s_{hj}^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_{hj}} \left(y_{hij} - \bar{y}_{hj} \right)^2$$

3.1.4 Estimation for Domains with Item-level Non Response

When there are responses from only m_{hj} of the n_{hj} sampled facilities, each domain is divided into respondents and non-respondents. If, however, a facility does not provide a response to the domain of interest, it is not possible to characterize that facility. Therefore, facilities are excluded from estimates based on a domain to which that facility did not respond. The estimated mean for a given domain is calculated from the set of respondents within that domain. This assumes that the mean of the non-respondents in each domain is equivalent to the mean of the respondents in each domain. The estimated domain mean when item-level non response exists is:

$$\bar{Y}_j = \frac{\sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{m_{hj}} y_{hij} \right)}{\sum_h \left(\frac{N_h}{n_h} \cdot m_{hj} \right)} \qquad (3.13)$$

where, N_h = number of facilities in stratum h of the sample frame
n_h = number of sampled facilities in stratum h
m_{hj} = number of respondent facilities to characteristic of interest in stratum h of domain j
n_{hj}' = number of respondents to domain identification question(s) in domain j
y_{hij} = response from i[th] facility in stratum h of domain j.

The variance of the estimated domain mean is:

$$V(\bar{Y}_j) = \frac{1}{\left(\sum_h \frac{N_h}{n_h} n_{hj}'\right)^2} \cdot \sum_h \frac{N_h^2\left(1-\frac{n_h}{N_h}\right)}{n_h(n_h-1)} \cdot \left[\sum_{i=1}^{m_{hj}} (y_{hij}-\bar{y}_{hj})^2 + m_{hj}\left(1-\frac{m_{hj}}{n_h}\right)(\bar{y}_{hj}-\bar{Y}_j)^2\right] \tag{3.14}$$

where

$$s_{hj}^2 = \frac{1}{n_h - 1} \sum_{i=1}^{n_{hj}} \left(y_{hij} - \bar{y}_{hj}\right)^2$$

The estimated total is calculated from the estimated mean, as in equation (3.13), except that the population size (N) is adjusted for the estimated population size of the j[th] domain (N_j).

$$\hat{Y}_j = \hat{N}_j \cdot \bar{Y}_j = \sum_h \frac{N_h}{n_h} n_{hj}' \cdot \frac{\sum_h \left(\frac{N_h}{n_h} \cdot \sum_{i=1}^{m_{hj}} y_{hij}\right)}{\sum_h \left(\frac{N_h}{n_h} \cdot m_{hj}\right)} \tag{3.15}$$

where, N_h = number of facilities in stratum h of the sample frame
n_h = number of sampled facilities in stratum h
m_{hj} = number of respondent facilities to characteristic of interest in stratum h of domain j
n_{hj}' = number of respondents to domain identification question(s) in domain j
y_{hij} = response from i[th] facility in stratum h of domain j.

The estimated variance for the domain total assumes that the population size for domain j is known. The calculation is similar to equation (3.14). It is noted that this estimate may contain bias due to the assumption that the population size of the domain is known, when, in practice, it must be estimated from the known size of the sample and the fraction of respondents in domain j.

$$V(\hat{Y}_j) = \frac{\left(\sum_h \frac{N_h}{n_h} n'_{hj}\right)^2}{\left(\sum_h \frac{N_h}{n_h} m_{hj}\right)^2} \cdot \sum_h \frac{N_h^2 \left(1 - \frac{n_h}{N_h}\right)}{n_h(n_h - 1)} \cdot \left[\sum_{i=1}^{m_{hj}} (y_{hij} - \bar{y}_{hj})^2 + m_{hj} \left(1 - \frac{m_{hj}}{n_h}\right) (\bar{y}_{hj} - \bar{Y}_j)^2\right] \qquad (3.16)$$

3.2 National Estimates

Using the estimation methodology described above, national estimates were calculated to determine the estimated number of facilities by different domains of interest. National estimates are based on facility responses to the detailed questionnaire in 1993. The following tables present the estimated number of facilities in 1993 by revenue range, total production per year, items laundered, employee range, and annual flow. The number of respondents to the domain of interest, estimated total number of facilities, estimated standard error, and 95% confidence intervals are presented separately for facilities processing less than 100% linen (193 responding facilities), facilities processing at least one million pounds of total laundry per year and/or at least 255,000 pounds of printer and shop towels (172 responding facilities), and facilities processing less than one million pounds total laundry per year and less than 255,000 pounds of printer and shop towels.

Table 3-1
Estimated Number of Facilities in 1993 by Revenue Range

Revenue Range	Number of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 100% Linen				
< $1,000,000	22	198	36.57	126 - 269
$1,000,000 - $3,499,999	51	564	124.63	320 - 809
$3,500,000 - $6,999,999	69	664	114.68	440 - 889
$7,000,000 - $10,499,999	51	321	84.85	155 - 488
Overall*	193	1,747	93.79	1,564 - 1,931
Facilities Processing at least 1 Million lbs Total Laundry per Year and/or at least 255,000 lbs Printer and Shop Towels				
< $1,000,000	11	118	24.56	69 - 166
$1,000,000 - $3,499,999	44	508	122.16	268 - 747
$3;500,000 - $6,999,999	66	659	114.67	434 - 884
$7,000,000 - $10,499,999	51	321	84.85	155 - 488
Overall*	172	1,606	95.63	1,418 - 1,793
Facilities Processing < 1 Million lbs Total Laundry per Year and < 255,000 lbs Printer and Shop Towels				
< $1,000,000	11	80	32.99	15 - 145
$1,000,000 - $3,499,999	7	56	31.19	0 - 117
$3,500,000 - $6,999,999	3	5	2.18	1 - 10
Overall*	21	141	39.79	63 - 219

* Overall estimates may not equate to the sum of the domains due to rounding

Table 3-2
Estimated Number of Facilities in 1993 by Total Production Range

Production Range	Number of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 100% Linen				
< 1,000,000	24	167	42.70	83 - 250
1,000,000 - 1,999,999	25	264	87.17	93 - 435
2,000,000 - 2,999,999	13	211	92.42	30 - 392
3,000,000 - 3,999,999	22	231	56.41	120 - 342
4,000,000 - 4,999,999	18	254	96.37	65 - 443
5,000,000 - 5,999,999	15	144	84.01	0 - 309
6,000,000 - 6,999,999	17	116	35.83	45 - 186
7,000,000 - 7,999,999	24	116	45.26	27 - 204
≥10,000,000	35	245	84.75	79 - 412
Overall*	193	1,747	93.79	1,564 - 1,931
Facilities Processing at least 1 Million lbs Total Laundry per Year and/or at least 255,000 lbs Printer and Shop Towels				
< 1,000,000	3	25	21.92	0 - 68
1,000,000 - 1,999,999	25	264	87.17	93 - 435
2,000,000 - 2,999,999	13	211	92.42	30 - 392
3,000,000 - 3,999,999	22	231	56.41	120 - 342
4,000,000 - 4,999,999	18	254	96.37	65 - 443
5,000,000 - 5,999,999	15	144	84.01	0 - 309
6,000,000 - 6,999,999	17	116	35.83	45 - 186
7,000,000 - 7,999,999	24	116	45.26	27 - 204
≥10,000,000	35	245	84.75	79 - 412
Overall*	172	1,606	95.63	1,418 - 1,793
Facilities Processing < 1 Million lbs Total Laundry per Year and < 255,000 lbs Printer and Shop Towels				
< 1,000,000	21	141	39.79	63 - 219
Overall*	21	141	39.79	63 - 219

* Overall estimates may not equate to the sum of the domains due to rounding

Table 3-3
Estimated Number of Facilities in 1993 by Items Laundered

Item	Number of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 100% Linen				
Industrial Garments	165	1,462	103.85	1,258 - 1,666
Shop Towels, Wipers, etc.	141	1,332	107.60	1,121 - 1,543
Printer Towels	71	480	57.81	367 - 594
Floor Mats	179	1,654	99.62	1,459 - 1,850
Mops, Dust Cloths, etc.	162	1,529	95.24	1,342 - 1,716
Linen Supply Garments	110	942	134.01	679 - 1,205
Linen Flatwork/Flat Dry	129	1,364	109.05	1,150 - 1,577
Health Care Item Types	78	649	126.66	400 - 897
Fender Covers	75	687	117.18	458 - 917
Continuous Roll Towels	98	928	128.59	676 - 1,180
Clean Room Garments	9	28	12.50	4 - 53
Other Item Types	2	31	29.75	0 - 90
Laundry Bags	3	28	25.17	0 - 77
Family Laundry	6	84	44.21	0 - 171
New Item Types	9	74	38.22	0 - 149
Executive Wear	5	43	23.89	0 - 90
Miscellaneous	2	14	12.51	0 - 39
Rewash Item Types	5	39	26.10	0 - 90
Filters	2	7	5.52	0 - 18
Buffing Pads	1	6	5.48	0 - 17

Table 3-3
Estimated Number of Facilities in 1993 by Items Laundered (Continued)

Item	Number of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing at least 1 Million lbs Total Laundry per Year and/or at least 255,000 lbs Printer and Shop Towels				
Industrial Garments	150	1,380	105.61	1,173 - 1,587
Shop Towels, Wipers, etc.	129	1,270	107.48	1,060 - 1,481
Printer Towels	67	464	57.82	351 - 577
Floor Mats	164	1,564	97.11	1,374 - 1,755
Mops, Dust Cloths, etc.	153	1,472	96.97	1,282 - 1,662
Linen Supply Garments	104	925	133.87	663 - 1,188
Linen Flatwork/Flat Dry	120	1,283	106.73	1,073 - 1,492
Health Care Item Types	72	607	124.71	362 - 851
Fender Covers	72	675	117.02	445 - 904
Continuous Roll Towels	93	903	128.45	651 - 1,155
Clean Room Garments	5	22	12.30	0 - 46
Other Item Types	2	31	29.75	0 - 90
Laundry Bags	3	28	25.17	0 - 77
Family Laundry	4	77	43.89	0 - 163
New Item Types	9	74	38.22	0 - 149
Executive Wear	3	15	9.03	0 - 33
Miscellaneous	2	14	12.51	0 - 39
Rewash Item Types	5	39	26.10	0 - 90
Filters	1	6	5.48	0 - 17
Buffing Pads	1	6	5.48	0 - 17

Table 3-3
Estimated Number of Facilities in 1993 by Items Laundered (Continued)

Item	Number of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 1 Million lbs Total Laundry per Year and < 255,000 lbs Printer and Shop Towels				
Industrial Garments	15	82	29.10	25 - 139
Shop Towels, Wipers, etc.	12	61	25.09	12 - 110
Printer Towels	4	16	10.98	0 - 38
Floor Mats	15	90	27.18	37 - 143
Mops, Dust Cloths, etc.	9	57	25.06	8 - 106
Linen Supply Garments	6	17	6.19	5 - 29
Linen Flatwork/Flat Dry	9	81	27.09	28 - 134
Health Care Item Types	6	42	22.14	0 - 85
Fender Covers	3	13	6.08	1 - 25
Continuous Roll Towels	5	26	12.43	1 - 50
Clean Room Garments	4	7	2.28	2 - 11
Family Laundry	2	7	5.28	0 - 17
Executive Wear	2	28	22.12	0 - 71
Filters	1	1	0.72	0 - 3

Table 3-4
Estimated Number of Facilities in 1993 by Employee Range

Employee Range	No. of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 100% Linen				
<10	3	39	24.98	0 - 88
10 - 29	33	316	88.78	142 - 490
30 - 64	47	491	106.49	282 - 700
65 - 99	52	583	128.26	331 - 834
100 - 199	49	296	85.88	127 - 464
≥200	9	23	8.02	7 - 39
Overall*	193	1,747	93.79	1,564 - 1,931
Facilities Processing at least 1 Million lbs Total Laundry per Year and/or at least 255,000 lbs Printer and Shop Towels				
10 - 29	21	244	84.57	78 - 409
30 - 64	41	461	104.27	257 - 665
65 - 99	52	583	128.26	331 - 834
100 - 199	49	296	85.88	127 - 464
≥200	9	23	8.02	7 - 39
Overall*	172	1,606	95.63	1,418 - 1,793
Facilities Processing < 1 Million lbs Total Laundry per Year and < 255,000 lbs Printer and Shop Towels				
<10	3	39	24.98	0 - 88
10 - 29	12	72	31.21	11 - 133
30 - 64	6	30	21.62	0 - 72
Overall*	21	141	39.79	63 - 219

* Overall estimates may not equate to the sum of the domains due to rounding

Table 3-5
Estimated Number of Facilities in 1993 by Annual Flow Ranges (Gallons per Year)

Annual Flow	No. of Respondents	Estimated Total	Estimated Standard Error	95% C.I.
Facilities Processing < 100% Linen				
<1,000,000	4	31	22.54	0 - 75
1,000,000 - 4,999,999	35	319	97.70	128 - 511
5,000,000 - 9,999,999	41	471	108.57	258 - 684
10,000,000 - 19,999,999	59	502	106.99	292 - 711
20,000,000 - 29,999,999	26	244	95.88	56 - 432
≥30,000,000	28	181	81.34	21 - 340
Overall*	193	1,747	93.79	1,564 - 1,931
Facilities Processing at least 1 Million lbs Total Laundry per Year and/or at least 255,000 lbs Printer and Shop Towels				
1,000,000 - 4,999,999	18	209	92.38	27- 390
5,000,000 - 9,999,999	41	471	108.57	258 - 684
10,000,000 - 19,999,999	59	502	106.99	292 - 711
20,000,000 - 29,999,999	26	244	95.88	56 - 432
≥30,000,000	28	181	81.34	21 - 340
Overall*	172	1,606	95.63	1,418 - 1,793
Facilities Processing < 1 Million lbs Total Laundry per Year and < 255,000 lbs Printer and Shop Towels				
<1,000,000	4	31	22.54	0 - 75
1,000,000 - 4,999,999	17	111	35.35	41 - 180
Overall*	21	141	39.79	63 - 219

* Overall estimates may not equate to the sum of the domains due to rounding

CHAPTER 4
ANALYTICAL DATA COLLECTION EFFORTS AND DEFINITION OF OPTIONS

Description of Data Sources

The data used to calculate the proposed pretreatment standards for existing sources (PSES) and pretreatment standards for new sources (PSNS) limitations were collected from the following two sources: (1) the EPA wastewater sampling effort and (2) the self-monitoring data submitted by the facilities in response to the detailed monitoring questionnaire. The EPA wastewater sampling effort resulted in a database containing the results of intensive sampling efforts conducted between February 1993 and April 1997 at 8 facilities. The self-monitoring data were supplied by 37 sites in the 1995 Detailed Monitoring Questionnaire (DMQ).

A listing of the data used to support PSES and PSNS standards development can be found in Appendices A.1 and A.2.

4.1 EPA Wastewater Sampling

The EPA wastewater sampling effort consisted of five 24-hour composite samples collected at each of the 8 facilities. For most EPA-sampled facilities, five analytical data values were available for each pollutant at each sampling point. Extensive documentation of the data quality reviews can be found in Chapter 9 of the *Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category* (EPA Report No. EPA-821-R-97-007, DCN L04197).

4.2 Detailed Monitoring Questionnaire

The EPA requested industrial laundry (IL) facilities to submit wastewater monitoring data in the form of individual daily data points, henceforth referred to as DMQ data. These data were reviewed and, where sufficient requirements were met, included in the calculation of LTAs, VFs, and limitations. Because the EPA labs did not analyze these samples, data points in which inconsistencies existed among the detection limit were excluded from calculations.

4.3 Definition of Proposed Options

During the site visit and field sampling phases of the rule development, and during follow-up to responses in the detailed questionnaire, three major technologies were identified for further evaluation for use in developing regulatory options. These major technologies are Chemical Emulsion Breaking (CEB), Dissolved Air Flotation (DAF), and Chemical Precipitation (CP).

CEB is used primarily to remove oil and grease, as well as other related pollutants, from process wastewater streams. CEB is effective in treating wastewater streams having stable oil-in-water emulsions. CEB is also used for the treatment of heavy industrial wastewater, which consists of wastewater from the washing of heavily soiled items (e.g., shop towels) and wastewater from certain breaks (i.e., wash water, first rinse, etc.) in the washing cycles for other items that contain high concentrations of pollutants. The treatment consists of lowering the pH of the wastewater to break the emulsions, adding chemical flocculents, and skimming the surface of the water to remove the floating substances. Under this option, the heavy industrial wastewater is treated by CEB, combined with the untreated wastewater from the rest of the facility, and discharged.

DAF is used to remove suspended solids, oil, and some dissolved pollutants from process wastewater. DAF treatment involves coagulating and agglomerating the solids and oil and grease and then floating the resulting flocculents to the surface using pressurized air injected into the unit. Then, the floating material is removed. Some DAF systems also have the means to remove material which settles to the bottom of the tank without shutting down for maintenance.

CP is used to remove dissolved pollutants from process wastewater. Precipitation aids, such as lime, work by reacting with the ions (e.g., metals) and some anions to convert them into an insoluble form (e.g., metal hydroxides). The pH of the wastewater also affects how much pollutant mass is precipitated, as pollutants precipitate more efficiently at different pH ranges. Coagulation and flocculation aids are usually added to facilitate the formation of large agglomerated particles that settle more readily and can be removed from the bottom of the clarifiers.

Along with these major technologies, regulatory options were developed utilizing stream splitting, a common practice at some facilities. Stream splitting provides a means of treating a portion of the total wastewater generated at industrial laundries. Stream splitting may be used to isolate and treat a stream with a higher pollutant load, while a stream with a lower load is either recycled and reused or discharged to the Publicly-Owned Treatment Works (POTW) without treatment. A divided trench and sump system is used to split process wastewater streams.

EPA evaluated these technology options (along with splitting the streams for these options) and proposed PSES and PSNS pretreatment standards based on the CP technology option. The proposed technology options are discussed in greater detail in Chapter 9 of the *Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category* (EPA Report No. EPA-821-R-97-007, DCN L04197) along with the justification for selection of this option. Pretreatment standards based on DAF are included here since the EPA is soliciting comment on a combined option where facilities currently using DAF would receive limitations developed using DAF data. All other facilities would receive limitations based on CP.

EPA proposed pretreatment standards for the following pollutants:

- Non Conventionals - Silica Gel Treated - Hexane Extractable Material (SGT-HEM)
- Metals - Copper, Lead, Zinc
- Organics - Bis(2-Ethylhexyl) Phthalate, Ethylbenzene, Naphthalene, Tetrachloroethene, Toluene, M-Xylene, O&P-Xylene

CHAPTER 5
DESCRIPTION OF DATA CONVENTIONS

This section discusses the types of data in the IL analytical database and the hierarchy and procedures for aggregating multiple sampling observations within a sampling day.

5.1 Data Review

The EPA wastewater sampling data in the analytical database were thoroughly reviewed and validated by the EPA's Sample Control Center (further discussions of this data are at times referred to as the "SCC" data for this reason). During this review, the integrity of each sample was assessed to ensure that all specifications of the sampling protocol were met. The reviewers determined that some samples should be excluded from the analyses. Samples with flags of "EXCLUDE" or "DETECTED," which indicate a value was detected but the concentration value was not recorded, were excluded from the analyses.

Also during the data review, several samples were qualified with a greater than (>) sign, indicating the reported concentration value is considered a lower limit of the actual value. This is because the reported concentration was outside the range of the analytical method. When possible, these samples are diluted and reanalyzed. Otherwise these samples were handled as right-censored samples and excluded from all calculations.

An engineering review of the database was also conducted and a few additional data values were excluded from the analyses for the reasons summarized in Chapter 9 of the *Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category* (EPA Report No. EPA-821-R-97-007). One reason for such an exclusion would be if a pollutant was not detected in sufficient concentrations to evaluate treatment effectiveness.

5.2 Data Types

The IL analytical database (from the SCC and DMQ data) contains the following three different types of samples delineated by certain qualifiers in the database:

- **Non-censored (NC):** a measured value, i.e., a sample measured above the level at which the detection decision was made.

- **Non-detect (ND):** samples for which analytical measurement did not yield a concentration above the sample-specific detection limit.

- **Right-censored (RC):** samples qualified with a greater than (>) sign, signifying that the reported value is considered a lower limit of the actual concentration. All RC values were excluded from the analyses because these values could not be quantified with certainty.

5.3 Data Aggregation

Data aggregation for the IL analytical data was performed at two levels. This section discusses the different levels and approaches for data aggregation, including multiple grab samples (one or more samples collected for a particular sampling point over time, assigned different sample numbers, and not physically composited) and field duplicates (one or more samples collected for a particular sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single episode number).

5.3.1 Data Aggregation Across Multiple Grab Samples

The first type of data aggregation performed was for multiple grab samples. Within the SCC database, SGT-HEM was reported as concentrations of multiple grab samples taken during one-day sampling periods. Since long-term averages (LTAs) and limitations were based on daily concentrations, multiple observations on a single day at the same sample point were averaged. When all of the samples in a set were NC, i.e., detected samples, the arithmetic average of the samples was straightforward. However, when one or more of the samples were censored, or ND, multiple grab samples were aggregated within each sampling day/sample point combination using the methods identified in **Table 5-1**.

Table 5-1
Method for Averaging Multiple Grab Samples

If observations are:	Label of "average"	Value of "average" is:
All NC	NC	$\Sigma NC_i/n$
All ND	ND	Maximum Detection Limit
NC and ND 1. Max. NC > Max. Detection Limit 2. Max. NC ≤ Max. Detection Limit	 NC ND	 $(\Sigma NC_i + \Sigma ND_i)/n$ Max. Detection Limit

n=number of grab samples per day.

5.3.2 Aggregation of Field Duplicates

Another type of data aggregation for the IL SCC data was performed due to the identification of field duplicates in the database. The field duplicates are defined as one or more samples collected for a particular sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single episode number/sampling point. Duplicates were collected for purposes of quality assurance/quality control. **Table 5-2** presents the methods used to aggregate duplicates. Note that within the DMQ data no field duplicates were labeled, but for a few sample days, two concentrations were reported. Since there were only two concentrations reported within sample day, the aggregation method would be the same regardless of whether they were treated as grab samples or duplicate samples. Thus, these concentrations were classified as duplicate samples and were aggregated according to the methods outlined in **Table 5.2**.

Listings of summary statistics following aggregation of grabs and field duplicates are presented in **Appendix B.1** for all regulated pollutants in DAF (Option 3A), and in **Appendix B.2** for all regulated pollutants in CP (Option 3B).

Table 5-2
Method for Averaging Field Duplicate Samples

If observations are:	Label of "average"	Value of "average" is:
Both NC	NC	$\Sigma NC_i/2$
Both ND	ND	Maximum Detection Limit
NC and ND 1. NC > Detection Limit 2. NC ≤ Detection Limit	 NC ND	 (NC + ND)/2 Detection Limit

NC = non-censored values
ND = non-detected values

If a sample had both multiple grabs and field duplicates, the multiple grabs were aggregated first.

CHAPTER 6
STATISTICAL METHODOLOGY - MODIFIED DELTA-LOGNORMAL MODEL

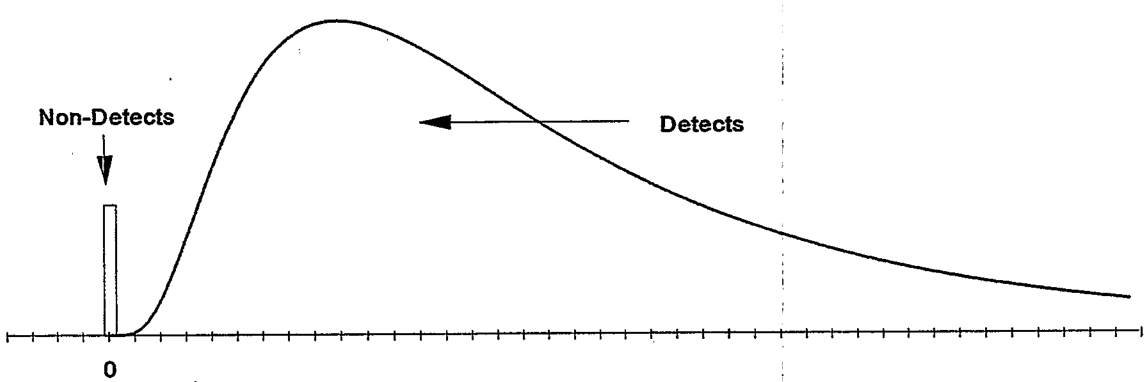
6.1 Basic Overview of Delta-lognormal Distribution

The lognormal distribution is often appropriate for modeling effluent data. However, the presence of ND and very low concentration measurements in the IL effluent data led to the consideration of a modification to the lognormal distribution in modeling such data for several reasons. First, the lognormal model assumes that all concentration values are positively-valued. Second, the actual values of NDs are not known, though each ND has a concentration somewhere between zero and the reported detection limit. In this sense, ND measurements represent, in statistical terms, what are known as censored samples.

In general, censored samples are measurements for which the exact value is not known but are bounded either by an upper or lower numerical limit. Non-detects qualify in this framework as left-censored samples, which have an upper bound at the detection limit and a lower bound at zero. To model NDs as left-censored samples under a strictly lognormal density model, it is necessary to assume that the exact (but unknown) values of these measurements follow the same lognormal distributional pattern as the rest of the detected measurements and that they are positively-valued (i.e., greater than zero).

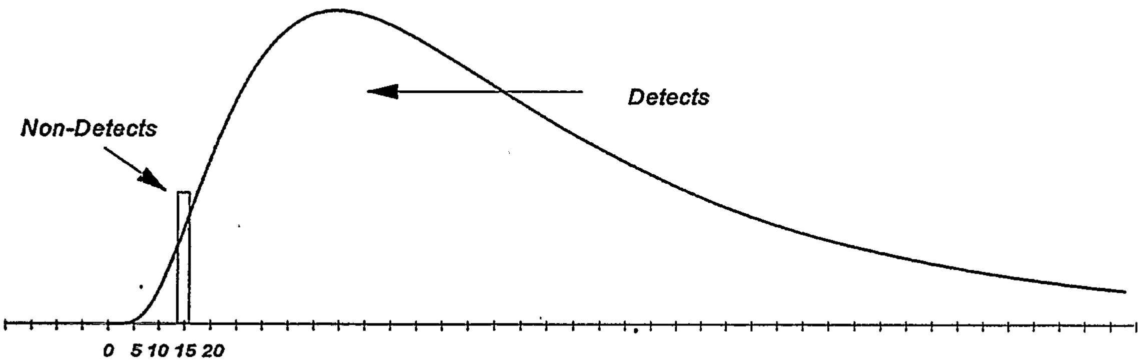
Therefore, two reasonably simple modifications to the lognormal density model have been used by the EPA for several years. The first modification is known as the classical delta-lognormal model (**Figure 6-1**), first used in economic analysis to model income and revenue patterns (see Atchison and Brown, 1955). In this adaptation of the simple lognormal density, the model is expanded to include zero amounts. To do this, all positive (dollar) amounts are grouped together and fit to a lognormal density. Then all zero amounts are segregated into another group of measurements representing a discrete distributional "spike" at zero. The resulting mixed distribution, combining a continuous density portion with a discrete-valued spike, is known as the delta-lognormal distribution. The delta in the name refers to the percentage of the overall distribution contained in the spike at zero, that is, the percentage of zero amounts.

Figure 6-1
Delta-lognormal Model



Researchers at the EPA (see Kahn and Rubin, 1989) further adapted the classical delta-lognormal model ("adapted model") to account for ND measurements in the same fashion that zero measurements were handled in the original delta-lognormal. Instead of zero amounts and non-zero (positive) amounts, the data consisted of NDs and detects. Rather than assuming that NDs represented a spike of zero concentrations, these samples were allowed to have a single positive value, usually equal to the minimum level of the analytical method (**Figure 6-2**). Since each ND was assigned the same positive value, the distributional spike in this adapted model was located not at zero, but at the minimum level. This adaptation is appropriate since it is known that the NDs are some value greater than zero. This adapted model was used in developing limitations for the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) and pesticides manufacturing rulemaking.

Figure 6-2
Adapted Delta-lognormal Model



In the adapted delta-lognormal model, the delta again referred to those measurements contained in the discrete spike, this time representing the proportion of ND values observed within the data set. By using this approach, computation of estimates for the population mean and variance could be done easily by hand, and NDs were not assumed to follow the same distributional pattern as the detected measurements. The adapted delta-lognormal model can be expressed mathematically as follows:

$$Pr\ (U \le u) = \begin{cases} (1-\delta)\ \Phi\ [(\log(u)\ -\ \mu)/\sigma] & if \quad 0 < u < D \\ \delta\ +\ (1-\delta)\ \Phi\ [(\log(D)\ -\ \mu)/\sigma] & if \quad u = D \\ \delta\ +\ (1-\delta)\ \Phi\ [(\log(u)\ -\ \mu)/\sigma] & if \quad u > D \end{cases} \tag{6.1}$$

where δ represents the true proportion of NDs (or the probability that any randomly drawn measurement will be a ND), D equals the minimum level value of the discrete spike assigned to all NDs, $\Phi(\cdot)$ represents the standard normal cumulative distribution function, and μ and σ are the parameters of the lognormal density portion of the model. This model assumes that all non-detected values have a single detection limit D.

It is also possible to represent the adapted delta-lognormal model in another mathematical form, one in which it is particularly easy to derive formulas for the expected value (i.e., LTA) and variance of the model. In this case, a random variable distributed according to the adapted delta-lognormal distribution can be represented as the stochastic combination of three other independent random variables. The first of these variables is an indicator variable, I_u, equal to one when the measurement u is a ND and equal to zero when u is a detected value. The second variable, X_D, represents the value of a ND measurement (discrete). In the adapted delta-lognormal, this variable is always a constant equal to the concentration value assigned to each ND (i.e., equal to D in the adapted delta-lognormal model). In general, however, X_D need not be a constant, as will be seen below in the modified delta-lognormal model. The final random variable, X_C, represents the value of a detected measurement, and is distributed according to a lognormal distribution (continuous) with parameters μ and σ.

Using this formulation, a random variable from the adapted delta-lognormal model can be written as:

$$U = I_u X_D + (1-I_u)X_C \tag{6.2}$$

and the expected value of U is then derived by substituting the expected value of each quantity in the right-hand side of the equation. Because the variables I_u, X_D, and X_C are mutually independent, this leads to the expression

$$E(U) = \delta E(X_D)+(1-\delta)E(X_C) = \delta D + (1-\delta)\exp(\mu + 0.5\sigma^2) \tag{6.3}$$

where again δ is the probability that any random measurement will be ND and the exponentiated expression is the familiar mean of a lognormal distribution. In a similar fashion, the variance of the adapted delta-lognormal model can be established by squaring the expression for U above, taking expectations, and subtracting the square of E(U) to get:

$$Var(U) = E(U^2) - [E(U)]^2 = \delta Var(X_D) + (1-\delta)Var(X_C) + \delta(1-\delta)[E(X_D)-E(X_C)]^2. \tag{6.4}$$

Since, in the adapted delta-lognormal formulation, X_D is a constant, this expression can be reduced to the following:

$$Var(U) = (1-\delta)\exp(2\mu+\sigma^2)[\exp(\sigma^2)-(1-\delta)] + \delta(1-\delta)D[D-2\exp(\mu+0.5\sigma^2)]. \tag{6.5}$$

In order to estimate the adapted delta-lognormal mean and variance from a set of observed sample measurements, it is necessary to derive sample estimates for the parameters δ, μ, and σ. δ is typically estimated by the observed proportion of NDs in the data set. μ and σ are estimated using the log values of the detected samples where μ is estimated using the arithmetic mean of the log detected measurements and σ is estimated using the standard deviation of these same log values; NDs are not included in the calculations. Once the parameter estimates are obtained, they are used in the formulas above to derive the estimated adapted delta-lognormal mean and variance.

To calculate effluent limitations and/or standards, it is also necessary to estimate upper percentiles from the underlying data model. Using the delta-lognormal formulation above in equation (6.1), letting U_α represent the $100^*\alpha^{th}$ percentile of random variable U, and adopting the standard notation of z_s for the s^{th} percentile of the standard normal distribution, an arbitrary delta-lognormal percentile can be expressed as the following:

$$U_\alpha = \begin{cases} \exp(\mu+\sigma\, z_{\alpha/1-\delta}) & \text{if} \quad (1-\delta)\Phi((\log(D)-\mu)/\sigma) \geq \alpha \\ D & \text{if} \quad \delta+(1-\delta)\Phi((\log(D)-\mu)/\sigma) \geq \alpha \\ \exp(\mu+\sigma\, z_{\alpha-\delta/1-\delta}) & \text{if} \quad \delta+(1-\delta)\Phi((\log(D)-\mu)/\sigma) < \alpha \end{cases} \tag{6.6}$$

The daily maximum limitations are established on the basis of an estimated upper 99[th] percentile from the underlying data model, so that 0.99 would be substituted for α in the above expression. To derive the daily VF for the 99[th] percentile based on the adapted delta-lognormal model, divide $U_{.99}$ in the expression above by the previous formula for the LTA, namely $U_{.99}/E(U)$.

6.2 Motivations for Modifications to the Adapted Delta-Lognormal Model

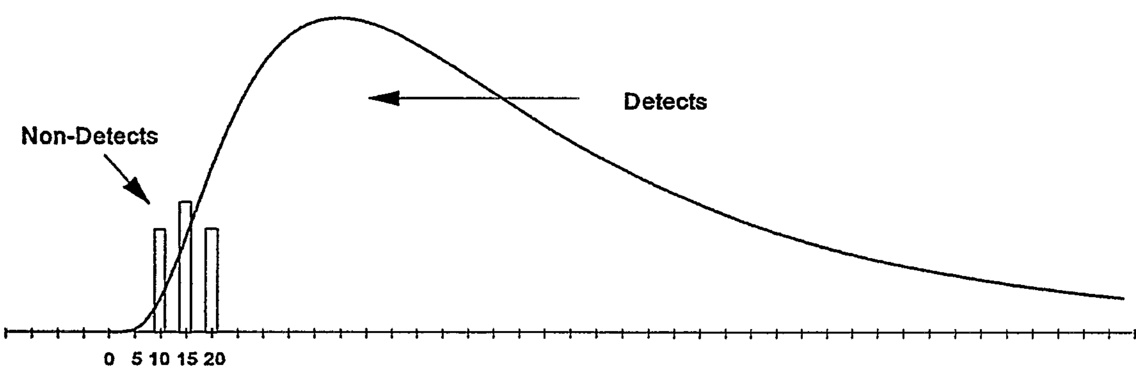
While the adapted delta-lognormal model has been used successfully for years by the EPA in a variety of settings, the model makes two key assumptions about the observed data that are not fully satisfied within the IL analytical database. First, the discrete spike portion of the adapted delta-lognormal model is a fixed, single-valued probability mass associated (typically) with all ND measurements. If all ND samples in the IL database had roughly the same reported detection limit, this assumption would be adequately satisfied. However, the detection limits reported are sample specific and, therefore, varied as a result of factors such as dilution. Because of this variation in detection limits, a single-valued discrete spike could not adequately represent the set of ND measurements observed in the IL database and a modification to the model was considered.

In addition, the adapted delta-lognormal model sets all NC values below the detection to the minimum level of the analytical method. For example, if the minimum level for Toluene was .10 mg/l, then any NC samples reported below .10 mg/l were set to .10 mg/l. There were a few instances in the IL analytical studies where a NC value was reported below the minimum level of the analytical method.

6.2.1 Modification of the Discrete Spike

To appropriately modify the adapted delta-lognormal model for the observed IL database, a modification was made to the discrete, single-valued spike representing ND measurements. Because ND samples have varying detection limits, the spike of the delta-lognormal model has been replaced by a discrete distribution made up of multiple spikes. Each spike in this modification is associated with a distinct detection limit observed in the IL database. Thus, instead of assigning all NDs to a single, fixed value, as in the adapted model, NDs can be associated with multiple values depending on how the detection limits vary (**Figure 6-3**).

Figure 6-3
Modified Adapted Delta-lognormal Model



In particular, because the detection limit associated with a ND sample is considered to be an upper bound on the true value, which could range conceivably from zero up to the detection limit, the modified delta-lognormal model used here assigns each ND sample to its reported detection limit.

Once each ND has been associated with its reported detection limit, the discrete "delta" portion of the modified model is estimated in a way similar to the adapted delta-lognormal distribution, where multiple spikes are constructed and linked to the distinct detection limits observed in the data set. In the adapted model, the parameter δ is estimated by computing the proportion of NDs. In the modified model, δ again represents the proportion of NDs, but is divided into the sum of smaller fractions, δ_i, each representing the proportion of NDs associated with a particular and distinct detection limit. This can be written as:

$$\delta = \sum_i (\delta_i). \tag{6.7}$$

If D_i equals the value of the i^{th} smallest distinct detection limit in the data set, and the random variable X represents a randomly chosen ND sample, then the discrete distribution portion of the modified delta-lognormal model can be mathematically expressed as:

$$Pr(X_D \leq x) = \sum_{i:D_i \leq x} \delta_i. \tag{6.8}$$

The mean and variance of this discrete distribution can be calculated using the following formulas:

$$E(X_D) = \frac{1}{\delta}\sum_i \delta_i D_i \quad and \quad Var(X_D) = \frac{1}{\delta^2}\sum_i \sum_{i<j} \delta_i \delta_j (D_j - D_i)^2. \tag{6.9}$$

It is important to recognize that, while replacing the single discrete spike in the adapted delta-lognormal distribution with a more general discrete distribution of multiple spikes increases the complexity of the model, the discrete portion with multiple spikes plays a role in limitations and standards development identically parallel to the single spike case and offers flexibility for handling multiple observed detection limits.

CHAPTER 7
ESTIMATION UNDER THE MODIFIED DELTA-LOGNORMAL MODEL

Once the modifications to the adapted delta-lognormal distribution are made, it is possible to fit a wide variety of observed effluent data sets to the modified model. Multiple detection limits for NDs can be handled. The same basic framework can be used even if there are no ND values or censored data.

Combining the discrete portion of the model with the continuous portion, the cumulative probability distribution of the modified delta-lognormal model can be expressed as follows, where D_n denotes the largest distinct detection limit observed among the NDs, and the first summation is taken over all those values, D_i, that are less than u.

$$Pr(U \le u) = \begin{cases} \sum_{i:D_i<u} \delta_i + (1-\delta)\Phi\left[(\log(u)-\mu)/\sigma\right] & \text{if } u<D_n \\ \delta + (1-\delta)\Phi\left[(\log(u)-\mu)/\sigma\right] & \text{if } u \ge D_n \end{cases} \tag{7.1}$$

Again combining the discrete and continuous portions of the modified model, the expected value of the random variable U can be derived as a weighted sum of the expected values of the discrete and continuous lognormal portions of the distribution. This follows because the modified delta-lognormal random variable U can be expressed again as a combination of three other independent variables, that is,

$$U = I_u X_D + (1-I_u)X_C \tag{7.2}$$

where this time X_D represents a random ND from the discrete portion of the model, X_C represents a random detected measurement from the continuous lognormal portion, and I_u is an indicator variable signaling whether any particular random measurement is detected or not. Then the expected value and variance of U have forms somewhat similar to the standard delta-lognormal model, namely

$$E(U) = \sum_i \delta_i D_i + (1-\delta)\exp(\mu + 0.5\sigma^2) \tag{7.3}$$

$$\begin{aligned} Var(U) = {} & \frac{\sum_{i<j}\sum_j \delta_i \delta_j (D_i - D_j)^2}{\delta} + (1-\delta)\exp(2\mu+\sigma^2)(\exp(\sigma^2)-1) \\ & + \delta(1-\delta)\left[\frac{\sum_i \delta_i D_i}{\delta} - \exp(\mu+0.5\sigma^2)\right]^2 \end{aligned} \tag{7.4}$$

where the D_i equals the individual detection limits for the NDs, the δ_i are the corresponding proportions of non detected values with detection limit D_i, and $\delta = \Sigma\delta_i$.

7.1 Facility-Specific Estimates

7.1.1 Estimation of Facility-Specific LTAs

For the purposes of estimating facility-specific LTAs (equal to the expected value in the equation (7.3)), the EPA chose to divide the IL data sets into two groups based on their size (number of samples) and the type of samples in the subset because the computations differ for each group. The groups were defined as follows:

Group 1: Less than 2 NC samples or less than 4 total samples.

Group 2: Two or more NC samples or 4 or more total samples.

For Group 1, the LTAs were calculated as the arithmetic average of the samples, since the sample sizes for either the discrete portion or the continuous lognormal portion of the data were too small to allow distributional assumptions to be made. Specifically, Group 1 contained all data subsets with all NDs or only one detect. Sample-specific detection limits were substituted as the values associated with non-detectable samples.

For Group 2, the LTAs were calculated using the procedures outlined in the preceding section using equation (7.3) and the Maximum Likelihood Estimates (MLEs) for μ and σ.

7.1.2 Estimation of Facility-Specific VFs

After determining estimated LTA values for each pollutant, facility, and option combination, the EPA developed 1-day variability factors (VF1) and/or 4-day variability factors (VF4) depending on the proposed frequency of monitoring, as outlined in **Table 7-1**.

Table 7-1
EPA Proposed Monitoring Frequencies

Pollutant Category	Frequency of Monitoring
Metals, Organics	Monthly (VF1)
Classicals	Weekly (VF1, VF4)

Similar to the calculations for the LTAs, the data were divided into the same two computation groups based on the number and type of samples in each data subset for purposes of estimating variability factor. These computation groups are defined as follows:

Group 1: Less than 2 NC samples or less than 4 total samples. Upper percentiles and VFs could not be computed using the modified delta-lognormal methodology.

Group 2: Two or more NC samples and 4 or more total samples. The estimates of the parameters for the modified delta-lognormal distribution of the data were calculated using maximum likelihood estimation in the log-domain. Upper percentiles and VFs were calculated using these estimated parameters.

Several data subsets belong in Group 1, and therefore have missing 99th percentiles and VFs.

7.1.2.1 Estimation of Facility-Specific VF1

The VF1 are a function of the LTA, E(U), and the 99th percentile. An iterative approach was used in finding the 99th percentile of each data subset using the modified delta-lognormal methodology by first defining $D_0=0$, $\delta_0=0$, and $D_{k+1} = \infty$ as boundary conditions, where D_i equals the ith smallest detection limit, and δ_i is the associated proportion of NDs at the ith detection limit. A cumulative distribution function, p, for each data subset was computed as a step function ranging from 0 to 1. The general form, for a given value c, is

$$p = \sum_{i=0}^{m} \delta_i + (1 - \hat{\delta})\ \Phi\left[\frac{\log(c) - \hat{\mu}}{\hat{\sigma}}\right], \quad D_m \le c < D_{m+1},\ m=0,1,\ldots k \tag{7.5}$$

where Φ is the standard normal cumulative distribution function. The following steps were completed to compute the estimated 99th percentile of each data subset:

1. k values of p at $c=D_m$, $m=1,\ldots k$ were computed and labeled p_m.

2. The smallest value of m, such that $p_m \geq 0.99$, was determined and labeled as p_j. If no such m existed, steps 3 and 4 were skipped and step 5 was computed instead.

3. Computed $p^* = p_j - \delta_j$.

4. If $p^* < 0.99$, then $P_{99} = D_j$,
   else if $p^* \geq 0.99$, then

$$\hat{P}99 = \exp\left[\hat{\mu} + \Phi^{-1}\left[\frac{\left(0.99 - \sum_{i=0}^{j-1} \delta_i\right)}{(1 - \hat{\delta})}\right]\hat{\sigma}\right]. \tag{7.6}$$

5. If no such m exists, such that $p_m \geq 0.99$ ($m=1,\ldots k$), then

$$\hat{P}99 = \exp\left[\hat{\mu} + \Phi^{-1}\left[\frac{0.99 - \hat{\delta}}{(1 - \hat{\delta})}\right]\hat{\sigma}\right]. \tag{7.7}$$

The daily variability factor, VF1, was then calculated as

$$VF1 = \frac{\hat{P}99}{\hat{E}(U)} \tag{7.8}$$

7.1.2.2 Estimation of Facility-Specific VF4

Since the EPA is assuming for costing purposes that the Classical Pollutant, SGT-HEM, will be monitored weekly (approximately 4 times a month), the EPA calculated a VF for monthly averages based on the distribution of 4-day averages. In order to calculate the VF4, the assumption was made that the approximating distribution of $\bar{U}_4$, the sample mean for a random sample of 4 independent concentration values, is also derived from this modified delta-lognormal distribution, with the same mean as the distribution of the concentration values. The mean of this distribution of 4-day averages is

$$E(\bar{U}_4) = \delta_4 E(\bar{X}_4)_D + (1-\delta_4)E(\bar{X}_4)_C \tag{7.9}$$

where $(X_4)_D$ denotes the mean of the discrete portion of the distribution of the average of four independent concentration values (i.e., when all observations are not detected), and $(X_4)_C$ denotes the mean of the continuous lognormal portion of the distribution.

First, it is assumed that the probability of detection (δ) on each of the four days is independent of that on the other days, since these samples are not taken on consecutive days and are therefore not correlated such that $\delta_4 = \delta^4$. Also, since

$$E(\bar{X}_4)_D = E(X_D)$$

then

$$E(\bar{U}_4) = \delta^4 \sum_{i=1}^{k} \frac{\delta_i D_i}{\delta} + (1-\delta^4)\exp(\mu_4 + 0.5\sigma^2{}_4) \tag{7.10}$$

and since $E(\bar{U}_4) = E(U)$, then

$$\mu_4 = \log\left[\frac{E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i}{(1-\delta^4)}\right] - 0.5\sigma^2{}_4. \tag{7.11}$$

The expression for σ^2_4 was derived from the following relationship:

$$Var(\bar{U}_4) = \delta_4 Var((\bar{X}_4)_D) + (1-\delta_4)Var((\bar{X}_4)_C) + \delta_4(1-\delta_4)[E(\bar{X}_4)_D - E(\bar{X}_4)_C]^2. \tag{7.12}$$

Since

$$Var((\bar{X}_4)_D) = \frac{Var(X_D)}{4}, \quad E(\bar{X}_4)_D = E(X_D), \quad and \quad \delta_4 = \delta^4 \tag{7.13}$$

then

$$Var(\bar{U}_4) = \delta^4 \frac{Var(X_D)}{4} + (1-\delta^4)Var((\bar{X}_4)_C) + \delta^4(1-\delta^4)[E(X_D) - E(\bar{X}_4)_C]^2. \tag{7.14}$$

This further simplifies to

$$Var(\bar{U}_4) = \frac{\delta^4 \sum_{i=1}^{k} \sum_{i<j,\, j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4\delta^2} + (1-\delta^4)\exp(2\mu_4 + \sigma^2_4)[\exp(\sigma^2_4) - 1] + \delta^4(1-\delta^4)\left[\sum_{i=1}^{k} \frac{\delta_i D_i}{\delta} - \exp(\mu_4 + 0.5\sigma^2_4)\right]^2 \tag{7.15}$$

and furthermore,

$$\exp(\sigma^2_4) - 1 = \frac{\left[Var(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^{k} \sum_{i<j,\, j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2(1-\delta^4)\left[\sum_{i=1}^{k} \delta_i D_i - \delta \exp(\mu_4 + 0.5\sigma^2_4)\right]^2\right]}{(1-\delta_4)\exp(2\mu_4 + \sigma^2_4)}. \tag{7.16}$$

Then, from (7.10) above,

$$\exp(\mu_4 + 0.5\sigma^2_4) = \frac{(E(\bar{U}_4) - \delta^3 \sum_{i=1}^{k} \delta_i D_i)}{(1-\delta^4)} = \frac{(E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i)}{(1-\delta^4)}, \quad \text{since } E(\bar{U}_4) = E(U) \tag{7.17}$$

and letting

$$\eta = E(U) - \delta^3 \sum_{i=1}^{k} \delta_i D_i, \quad \text{then,} \quad \exp(\mu_4 + 0.5\sigma^2_4) = \frac{\eta}{(1-\delta^4)}. \tag{7.18}$$

Furthermore,

$$\sigma^2_4 = \log\left[1 + \frac{\left[Var(\bar{U}_4) - \frac{\delta^2 \sum_{i=1}^{k} \sum_{i<j,\, j=1}^{k} \delta_i \delta_j (D_i - D_j)^2}{4} - \delta^2(1-\delta^4)\left(\sum_{i=1}^{k} \delta_i D_i - \frac{\delta\eta}{(1-\delta^4)}\right)^2\right]}{\frac{(1-\delta^4)\eta^2}{(1-\delta^4)^2}}\right]. \tag{7.19}$$

Since $Var(\bar{U}_4) = Var(U)/4$, then, by rearranging terms,

$$\sigma^2_4 = \log\left[1 + \frac{(1-\delta^4)Var(U)}{4\eta^2} - \frac{(1-\delta^4)\delta^2 \sum_{i=1}^{k}\sum_{i<j,\, j=1}^{k} \delta_i\delta_j(D_i - D_j)^2}{4\eta^2} - \frac{\delta^2\left[\sum_{i=1}^{k}\delta_i D_i(1-\delta^4) - \delta\eta\right]^2}{\eta^2}\right]$$

(7.20)

Thus, estimates of μ_4 and σ_4 were derived by using estimates of $\delta_1,\ldots\delta_k$ (sample proportion of NDs at observed detection limits $D_1,\ldots D_k$), μ (MLE of logged values), and σ^2 (MLE logvariance with sample bias adjustment) in the equations above.

In finding the estimated 95th percentile of the average of four observations (four NDs, not all at the same detection limit), an average can be generated that is not necessarily equal to D_1, D_2,..., or D_k. Consequently, more than k discrete points exist in the distribution of the 4-day averages. For example, the average of four NDs at k=2 detection limits are at the following discrete points with the associated probabilities:

i	D^*_i	δ^*_i
1	D_1	δ_1^4
2	$(3D_1+D_2)/4$	$4\delta_1^3\delta_2$
3	$(2D_1+2D_2)/4$	$6\delta_1^2\delta_2^2$
4	$(D_1+3D_2)/4$	$4\delta_1\delta_2^3$
5	D_2	δ_2^4

In general, when all four observations are not detected, and when k detection limits exist, the multinomial distribution can be used to determine associated probabilities, that is,

$$Pr\left[\bar{U}_4 = \frac{\sum_{i=1}^{k} u_i D_i}{4}\right] = \frac{4!}{u_1!\,u_2!\ldots u_k!}\prod_{i=1}^{k}\delta_i^{u_i}. \tag{7.21}$$

The number of possible discrete points, k^*, for k=1,2,3,4, and 5 are given below:

k	k^*
1	1
2	5
3	15
4	35
5	70

To find the estimated 95th percentile of the distribution of the average of four observations, the same basic steps (described in Section 7.1.2.1) as used for the 99th percentile of the distribution of daily observations were followed with the following changes:

1. Change P_{99} to P_{95}, and 0.99 to 0.95.
2. Change D_m to D_m^*, the weighted averages of the detection limits.
3. Change δ_i to δ_i^*.
4. Change k to k^*, the number of possible discrete points based on k detection limits.
5. Change the estimates of δ, μ, and σ to estimates of δ^4, μ_4, and σ_4, respectively.

Then, the estimate of the 95th percentile 4-day mean VF is:

$$VF4 = \frac{\hat{P}95}{\hat{E}(U)}, \quad since \quad E(\bar{U}_4) = E(U). \tag{7.22}$$

Appendices C.1 and **C.2** display LTAs, VF1, and VF4 by analyte and facility for DAF and CP, respectively.

7.2 Pollutant-Specific Estimates

7.2.1 Estimation of Pollutant-Specific LTAs

After estimating the facility-specific LTA for each pollutant and option, as described in section 7.1.1, pollutant-specific LTAs were calculated. Within each option, the pollutant specific LTAs were calculated as the median of the facility-specific LTAs for that pollutant.

7.2.2 Estimation of Pollutant-Specific VFs

7.2.2.1 Estimation of Pollutant-Specific VF1

After the facility-specific VF1 were estimated for each pollutant and option, as described in section 7.1.2.1, the pollutant-specific VF1 was calculated. The pollutant-specific daily VF was the median of the facility-specific daily VFs for that pollutant in the option.

7.2.2.2 Estimation of Pollutant-Specific VF4

After the facility-specific VF4 were estimated for each pollutant and option, as described in section 7.1.2.2, the pollutant-specific VF4 was calculated. The pollutant-specific VF4 was the median of the facility-specific VF4 for that pollutant in the option.

CHAPTER 8
DERIVATION OF THE PROPOSED STANDARDS

The proposed daily maximum limitations for each pollutant were calculated as the product of the pollutant-specific LTA and the pollutant-specific daily VF. Similarly, the proposed 4-day limitation for SGT-HEM was calculated as the product of the pollutant-specific LTA and the pollutant-specific VF4. Limitations for CP are presented in **Table 8-1**.

Table 8-1
Daily and 4-day Limitations for CP Option 3B

Pollutant	Daily Limit (mg/L)	Monthly Average (mg/L)*
SGT-HEM	27.5	12.7
Copper	.24	NA
Lead	.27	NA
Zinc	.61	NA
O+P Xylene	.95	NA
M-Xylene	1.33	NA
Ethylbenzene	1.64	NA
Naphthalene	.23	NA
Bis (2-Ethylhexyl) Phthalate	.13	NA
Tetrachloroethane	1.71	NA
Toluene	2.76	NA

*Based on an assumption for costing purposes of 4 days of sampling per month.

Appendices D.1 and **D.2** present pollutant-specific LTAs, VF1 and VF4, and daily and 4-day limitations for DAF and CP, respectively.

CHAPTER 9
RAW WASTEWATER CONCENTRATION COMPARISONS

9.1 Comparison of Industrial Laundry Influent and Linen Influent

Statistical analyses were conducted to assess whether the mean influent concentrations of 98 pollutants of concern differed significantly by type of laundry facility. The EPA wanted to compare linen influent concentrations to industrial laundry influent concentrations. Unfortunately, none of the raw wastewater data available was for 100% linen items. Therefore, the EPA used facilities that were mostly linen (i.e. between 60% and 99% linen). The data from these facilities will be referred to as linen wastewater and the wastewater from facilities doing mostly industrial laundry items will be referred to as industrial laundry (IL). **Appendix E.1** lists the facility, sample point, and data source information used in this analysis.

It was observed that not all of the 98 pollutants of concern had both IL and linen information. Also for several pollutants, only one linen facility was reported. Furthermore, only those facilities which reported at least 3 concentrations were included in the analyses. The following pollutants had sufficient data for analyses (at least 2 linen and IL facilities with at least 3 reported concentrations): BOD, Cadmium, COD, Chromium, Copper, Lead, Nickel, Silver, Total Recoverable Oil and Grease, Total Suspended Solids, Zinc, and pH.

For each of the pollutants with sufficient data, a comparison was made between wastewater concentrations reported by facilities within IL and linen supply, respectively. Differences in pollutant wastewater concentrations within IL and linen facilities were observed for some pollutants. These pollutants were not considered further in the analysis to determine if IL wastewater concentrations differ significantly from linen wastewater concentrations. Thus, the list of pollutants for which comparisons would be made was reduced from 14 to 8.

Table 9-1 displays results from the analysis of variance (ANOVA) which was used to compare the mean log concentration (log(conc)) between the linen facilities. Results from this analysis indicated that the mean log(conc) between linen facilities differed significantly for pollutants BOD, COD, Lead, Silver, and Nickel at $\alpha=0.01$.

Table 9-1
ANOVA Results for Linen Comparisons

Analyte	Number of Facilities	Number of Concentration Values	p-value	Significant at $\alpha=0.01$
BOD	3	9	0.0013	Yes
COD	2	7	0.0068	Yes
TPH (as SGT-HEM)	2	5	0.2732	No
Total Recoverable Oil and Grease	3	8	0.0202	No
Total Suspended Solids	3	9	0.1345	No
pH	4	10	0.0713	No
Cadmium	4	15	0.2733	No
Chromium	4	15	0.1567	No
Copper	4	15	0.4553	No
Iron	2	5	0.1776	No
Lead	4	15	0.0054	Yes
Nickel	4	15	0.0017	Yes
Silver	3	13	0.0041	Yes
Zinc	4	17	0.1070	No

Table 9-2 displays results from the ANOVA analysis which was used to compare the mean log(conc) between the IL facilities. Results from this analysis indicated that the mean log(conc) between IL facilities differed significantly for pollutants pH, Nickel, and Silver at $\alpha=0.01$.

Table 9-2
ANOVA Results for IL Comparisons

Analyte	Number of Facilities	Number of Concentration Values	p-value	Significant at $\alpha=0.01$
BOD	6	33	0.0252	No
COD	6	34	0.1084	No
TPH (as SGT-HEM)	5	30	0.3625	No
Total Recoverable Oil and Grease	2	8	0.4317	No
Total Suspended Solids	6	34	0.1543	No
pH	6	33	0.0002	Yes
Cadmium	6	34	0.5284	No
Chromium	6	34	0.0364	No
Copper	6	34	0.1385	No
Iron	6	34	0.1971	No
Lead	6	34	0.1945	No
Nickel	6	34	0.0065	Yes
Silver	6	34	0.0001	Yes
Zinc	6	34	0.7447	No

Pollutants in which the significance level exceeded $\alpha=0.01$ for either linen facilities or IL facilities were excluded from further analysis. Thus, comparisons of wastewater concentrations between IL facilities and linen facilities were conducted for the following pollutants: Total Petroleum Hydrocarbon (TPH), Total Suspended Solids, Total Recoverable Oil and Grease, Cadmium, Chromium, Copper, Iron, and Zinc.

Table 9-3 displays results from the t-test analysis which was used to compare the mean log(conc) of the linen daily wastewater concentrations to the mean log(conc) of the IL daily wastewater concentrations. Results from this analysis indicated that the mean log(conc) of linen wastewater differed significantly from the mean log(conc) of IL wastewater for pollutants Total Petroleum Hydrocarbon, Oil and Grease, Total Suspended Solids, Cadmium, Chromium, Copper, Iron, and Zinc at $\alpha=0.01$.

Table 9-3
Comparison of Mean Pollutant Log Concentrations in Linen Facilities vs. IL Facilities

Analyte	Type of Facility	Sample Size	Mean log(conc)	Mean Conc	p-value	Significant at $\alpha=0.01$
TPH (as SGT-HEM)	Industrial	30	6.05	425	0.0001	Yes
	Linen	5	2.64	14		
Total Recoverable Oil and Grease	Industrial	8	7.18	1310	0.0012	Yes
	Linen	8	4.56	96		
Total Suspended Solids	Industrial	34	7.10	1206	<0.000	Yes
	Linen	9	5.08	161		
Cadmium	Industrial	34	-2.66	.070	0.0001	Yes
	Linen	15	-4.33	.013		
Chromium	Industrial	34	-1.47	.230	<0.000	Yes
	Linen	15	-3.19	.041		
Copper	Industrial	34	0.85	2.32	<0.000	Yes
	Linen	15	-1.54	0.21		
Iron	Industrial	34	3.23	25.2	<0.000	Yes
	Linen	5	1.00	2.71		
Zinc	Industrial	34	1.47	4.16	<0.000	Yes
	Linen	17	1.15	0.32		

Table 9-3 illustrates that for each of the analytes listed, IL wastewater concentrations are significantly different from linen wastewater concentrations. Also, note that the IL mean wastewater concentration is consistently higher than the linen mean wastewater concentration. Although the linen facilities used were not 100% linen, EPA assumes that these results would hold if the proportion of linen items at these facilities were even greater.

9.2 Comparison of Linen Influent to Denim Pre-Wash Influent

Statistical comparisons were conducted between denim prewash wastewater and linen wastewater to determine if pollutant concentrations in untreated denim prewash wastewater were similar to the pollutant concentrations in linen wastewater. **Appendix E.2** lists the facility, sample point, and data source information used in this analysis. Prior to comparing pollutant concentrations from denim facilities to pollutant concentrations from linen facilities, it was first determined whether the pollutant concentrations differed significantly across facilities among the linen facilities. For each pollutant, ANOVA was used to compare the mean log(conc) in each facility that reported two or more concentrations among untreated linen facilities.

Results indicated that the mean log(conc) for each linen facility differed significantly at the $\alpha=0.01$ significance level for pollutants BOD, COD, Nickel, and Lead. Thus, the only pollutants that were used in further analyses included: Cadmium, Chromium, Copper, Iron, Oil and Grease, Total Suspended Solids, and Zinc. Note that the concentrations reported for Total Petroleum Hydrocarbon did not differ significantly among linen facilities, but the denim prewash facility did not report wastewater concentrations for this pollutant.

Influent concentrations were available for only one denim prewash facility. Because of this, EPA was unable to compare concentrations between denim prewash facilities to determine if there were significant differences between influent concentrations for denim prewash facilities. Therefore, the following results from the t-test analysis represent the comparison between linen facilities and the sampled denim facility.

Table 9-4 displays results from the t-test analysis which was used to compare the mean log(conc) from the untreated linen facilities to the mean log(conc) from the untreated denim facility. Results indicated that the mean log(conc) from untreated linen wastewater differed significantly from the mean log(conc) from untreated denim wastewater for pollutants Cadmium, Chromium, and Copper ($p<.01$). There was no significant difference in the mean log(conc) from linen vs. denim wastewater for Oil and Grease, Total Suspended Solids, Iron, and Zinc.

Table 9-4
Comparison of Mean Pollutant Log Concentrations in Linen Facilities vs. Untreated Denim Facilities

Analyte	Type of Facility	Sample Size	Mean log(conc)	Mean conc	p-value	Significant at $\alpha=0.01$
Oil and Grease	Linen Untreated Denim	8 7	4.56 2.96	95 19	.018	No
Total Suspended Solids	Linen Untreated Denim	9 15	5.08 6.15	161 470	.021	No
Cadmium	Linen Untreated Denim	15 13	-4.33 -5.68	0.013 0.003	.0001	Yes
Chromium	Linen Untreated Denim	15 13	-3.19 -4.47	0.04 0.01	.0014	Yes
Copper	Linen Untreated Denim	15 13	-1.54 -2.85	0.21 0.06	.001	Yes
Iron	Linen Untreated Denim	5 12	1.00 -0.69	2.71 0.50	.027	No
Zinc	Linen Untreated Denim	17 8	-1.15 -2.87	0.32 0.06	.114	No

Thus, it was observed that the pollutant log(conc) for the analytes Cadmium, Chromium, and Copper was significantly higher in untreated linen wastewater than in untreated denim prewash wastewater at $\alpha=0.01$. Similar concentrations ($\alpha>0.01$) were reported in untreated linen wastewater and untreated denim prewash wastewater for the analytes Oil and Grease, Total Suspended Solids, Iron, and Zinc.

APPENDICES A.1 and A.2

APPENDIX A.1
Listing of Daily Data for DAF
After Aggregation of Grabs and Duplicates within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Classicals	SHEM	SGT-HEM	C037	MG/L	4506	3,4	DAY 1		NC	9.0000
						3,4	DAY 2		NC	9.0000
						3,4	DAY 3		NC	6.6667
						3,4	DAY 4		NC	26.0000
						3,4	DAY 5		ND	5.0000
Classicals	SHEM	SGT-HEM	C037	MG/L	4610	7,8	DAY 1		NC	9.0000
						7,8	DAY 2		NC	29.1250
						7,8	DAY 3		NC	16.7500
						7,8	DAY 4		NC	10.5000
						7,8	DAY 5		NC	13.2500
Metals	CU	COPPER	7440508	MG/L	4331	B		01/21/93	NC	0.5270
						B		02/09/93	NC	0.6100
						B		03/08/93	NC	0.6680
						B		04/06/93	NC	0.7370
						B		05/04/93	NC	1.0700
						B		05/19/93	NC	1.2600
						B		06/02/93	ND	0.1000
						B		07/16/93	NC	0.2720
						B		08/03/93	NC	0.9480
						B		09/09/93	NC	0.5060
						B		09/13/93	NC	0.2100
						B		11/01/93	NC	0.2280
						B		12/06/93	NC	0.1080
Metals	CU	COPPER	7440508	MG/L	4506	3,4	DAY 1		NC	0.3510
						3,4	DAY 2		NC	0.3900
						3,4	DAY 3		NC	0.5800
						3,4	DAY 4		NC	0.2700
						3,4	DAY 5		NC	0.1330
Metals	CU	COPPER	7440508	MG/L	4610	7,8	DAY 1		NC	0.1510
						7,8	DAY 2		NC	0.2180
						7,8	DAY 3		NC	0.1460
						7,8	DAY 4		NC	0.2060
						7,8	DAY 5		NC	0.1400

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	CU	COPPER	7440508	MG/L	5691	B		03/09/93	NC	0.1980
						B		03/22/93	NC	0.1680
						B		05/27/93	NC	0.5560
						B		06/10/93	NC	0.2450
						B		08/24/93	NC	0.8940
						B		09/08/93	NC	0.2440
						B		11/09/93	NC	0.3840
						B		11/18/93	NC	0.3740
Metals	CU	COPPER	7440508	MG/L	7535	A		01/06/93	NC	0.0900
						A		01/21/93	NC	0.6200
						A		02/03/93	NC	2.3000
						A		03/04/93	NC	0.1700
						A		03/31/93	NC	0.5000
						A		05/05/93	NC	0.5300
						A		06/02/93	NC	0.6500
						A		06/08/93	NC	0.4500
						A		06/16/93	NC	0.0900
						A		06/30/93	NC	0.9200
						A		08/04/93	NC	1.5000
						A		09/08/93	NC	0.1200
						A		09/21/93	NC	1.0000
						A		11/03/93	NC	0.2000
						A		12/01/93	NC	0.1800
Metals	CU	COPPER	7440508	MG/L	8344	A		04/08/93	NC	0.8600
						A		04/30/93	NC	0.8600
						A		09/02/93	NC	0.4200
						A		10/06/93	NC	0.1000
						A		10/31/93	NC	0.1000
Metals	PB	LEAD	7439921	MG/L	4331	B		01/21/93	NC	0.3480
						B		02/09/93	NC	0.2750
						B		03/08/93	NC	0.2990
						B		04/06/93	NC	0.2200
						B		05/04/93	NC	0.3300
						B		05/19/93	ND	0.0100
						B		06/02/93	ND	0.1000

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	PB	LEAD	7439921	MG/L	4331	B		07/16/93	NC	0.2270
						B		08/03/93	NC	0.5180
						B		09/09/93	NC	0.3020
						B		09/13/93	NC	0.1390
						B		11/01/93	NC	0.1410
						B		12/06/93	NC	0.1010
						B		12/26/93	ND	0.2000
Metals	PB	LEAD	7439921	MG/L	4506	3,4	DAY 1		NC	0.0340
						3,4	DAY 2		ND	0.2200
						3,4	DAY 3		ND	0.1100
						3,4	DAY 4		NC	0.1935
						3,4	DAY 5		NC	0.0740
Metals	PB	LEAD	7439921	MG/L	4610	7,8	DAY 1		NC	0.0567
						7,8	DAY 2		NC	0.0690
						7,8	DAY 3		ND	0.0470
						7,8	DAY 4		NC	0.0564
						7,8	DAY 5		ND	0.0470
Metals	PB	LEAD	7439921	MG/L	5691	B		03/09/93	ND	0.1000
						B		03/22/93	ND	0.1000
						B		05/27/93	ND	0.1000
						B		06/10/93	ND	0.1000
						B		08/24/93	ND	0.1000
						B		09/08/93	ND	0.1000
						B		11/09/93	ND	0.1000
						B		11/18/93	ND	0.1000
Metals	PB	LEAD	7439921	MG/L	7535	A		01/06/93	ND	0.0200
						A		01/21/93	NC	0.2600
						A		02/03/93	NC	0.2900
						A		02/17/93	NC	0.1100
						A		03/04/93	NC	0.0700
						A		03/31/93	NC	0.0900
						A		05/05/93	NC	0.2700
						A		06/02/93	NC	0.3500
						A		06/16/93	NC	0.0300

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	PB	LEAD	7439921	MG/L	7535	A		06/30/93	NC	0.1900
						A		08/04/93	NC	0.7400
						A		09/08/93	NC	0.1200
						A		09/21/93	NC	0.2400
						A		11/03/93	NC	0.0700
						A		12/01/93	NC	0.2200
Metals	PB	LEAD	7439921	MG/L	8344	A		04/08/93	NC	0.4900
						A		04/30/93	NC	0.4900
						A		09/02/93	ND	0.2000
						A		10/06/93	ND	0.1000
Metals	ZN	ZINC	7440666	MG/L	4331	B		01/21/93	NC	2.0900
						B		02/09/93	NC	1.2800
						B		03/08/93	NC	1.4100
						B		04/06/93	NC	1.1800
						B		05/04/93	NC	1.8100
						B		05/19/93	NC	1.6800
						B		06/02/93	NC	0.1000
						B		07/16/93	NC	0.4420
						B		08/03/93	NC	1.2900
						B		09/13/93	NC	0.6190
						B		11/01/93	NC	0.5440
						B		12/06/93	NC	0.4970
Metals	ZN	ZINC	7440666	MG/L	4506	3,4	DAY 1		NC	0.2730
						3,4	DAY 2		NC	1.1500
						3,4	DAY 3		NC	0.4100
						3,4	DAY 4		NC	0.3930
						3,4	DAY 5		NC	0.3160
Metals	ZN	ZINC	7440666	MG/L	4610	7,8	DAY 1		NC	0.2200
						7,8	DAY 2		NC	0.3465
						7,8	DAY 3		NC	0.2160
						7,8	DAY 4		NC	0.3020
						7,8	DAY 5		NC	0.2500
Metals	ZN	ZINC	7440666	MG/L	5691	B		03/09/93	NC	1.5350

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	ZN	ZINC	7440666	MG/L	5691	B		03/22/93	NC	0.9250
						B		05/27/93	NC	0.4880
						B		06/10/93	NC	0.5470
						B		08/24/93	NC	0.6460
						B		09/08/93	NC	0.2640
						B		11/09/93	NC	0.7100
						B		11/18/93	NC	0.9630
Metals	ZN	ZINC	7440666	MG/L	7535	A		01/06/93	NC	0.0400
						A		01/21/93	NC	0.4900
						A		02/03/93	NC	3.6000
						A		03/04/93	NC	0.2100
						A		03/31/93	NC	0.1200
						A		05/05/93	NC	0.3900
						A		06/02/93	NC	1.1000
						A		06/08/93	NC	1.2000
						A		06/16/93	NC	0.1900
						A		06/30/93	NC	0.6300
						A		08/04/93	NC	1.7000
						A		09/08/93	NC	0.4700
						A		09/21/93	NC	0.5400
						A		11/03/93	NC	0.2600
						A		12/01/93	NC	1.0600
Metals	ZN	ZINC	7440666	MG/L	8344	A		04/08/93	NC	1.5000
						A		04/30/93	NC	1.5000
						A		09/02/93	NC	0.5500
						A		10/06/93	NC	0.2000
						A		10/31/93	NC	0.2000
Organics	N119	O+P XYLENE	136777612	MG/L	4506	3,4	DAY 1		NC	0.0878
						3,4	DAY 2		NC	0.0939
						3,4	DAY 3		NC	0.2573
						3,4	DAY 4		NC	0.0835
						3,4	DAY 5		NC	0.0573
Organics	N119	O+P XYLENE	136777612	MG/L	4610	7,8	DAY 1		NC	0.1990
						7,8	DAY 2		NC	0.2436

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Organics	N119	O+P XYLENE	136777612	MG/L	4610	7,8	DAY 3		NC	1.1493
						7,8	DAY 4		NC	0.2386
						7,8	DAY 5		NC	0.2902
Organics	N95	M-XYLENE	108383	MG/L	4610	7,8	DAY 1		NC	0.2771
						7,8	DAY 2		NC	0.3928
						7,8	DAY 3		NC	1.4016
						7,8	DAY 4		NC	0.5137
						7,8	DAY 5		NC	0.3526
Organics	T38	ETHYLBENZENE	100414	MG/L	4331	B		01/21/93	NC	0.0080
						B		02/09/93	NC	0.0040
						B		03/08/93	ND	0.0010
						B		04/06/93	ND	0.0005
						B		05/04/93	ND	0.0005
						B		05/19/93	ND	0.0005
						B		06/02/93	ND	0.0005
						B		07/21/93	ND	0.0005
						B		08/03/93	ND	0.0005
						B		09/09/93	ND	0.0100
						B		09/13/93	ND	0.0100
						B		11/01/93	ND	0.0100
						B		12/06/93	NC	0.0100
Organics	T38	ETHYLBENZENE	100414	MG/L	4610	7,8	DAY 1		NC	0.1700
						7,8	DAY 2		NC	0.1753
						7,8	DAY 3		NC	0.6653
						7,8	DAY 4		NC	0.6058
						7,8	DAY 5		NC	0.1622
Organics	T55	NAPHTHALENE	91203	MG/L	4331	B		01/21/93	ND	0.0007
						B		02/09/93	ND	0.0007
						B		03/08/93	ND	0.0014
						B		04/06/93	ND	0.0007
						B		05/04/93	ND	0.0010
						B		05/19/93	ND	0.0010
						B		06/02/93	ND	0.0010
						B		07/21/93	ND	0.0010

APPENDIX A.1
Listing of Daily Data for DAF
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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Organics	T55	NAPHTHALENE	91203	MG/L	4331	B		08/03/93	ND	0.0010
						B		09/09/93	ND	0.0100
						B		09/13/93	ND	0.0100
						B		11/01/93	ND	0.0100
						B		12/06/93	ND	0.0010
Organics	T55	NAPHTHALENE	91203	MG/L	4506	3,4	DAY 1		NC	0.1817
						3,4	DAY 2		NC	0.1028
						3,4	DAY 3		ND	0.0100
						3,4	DAY 4		NC	0.0547
						3,4	DAY 5		ND	0.0100
Organics	T55	NAPHTHALENE	91203	MG/L	4610	7,8	DAY 1		NC	0.1959
						7,8	DAY 2		NC	0.1695
						7,8	DAY 3		NC	0.2468
						7,8	DAY 4		ND	0.1000
						7,8	DAY 5		NC	0.1875
Organics	T66	BIS(2-ETHYLHEXYL) PHTHALATE	117817	MG/L	4506	3,4	DAY 1		NC	0.0563
						3,4	DAY 2		NC	0.0221
						3,4	DAY 3		NC	0.0172
						3,4	DAY 4		NC	0.0418
						3,4	DAY 5		NC	0.0260
Organics	T66	BIS(2-ETHYLHEXYL) PHTHALATE	117817	MG/L	4610	7,8	DAY 1		NC	0.1796
						7,8	DAY 2		NC	0.2065
						7,8	DAY 3		NC	0.1428
						7,8	DAY 4		ND	0.1000
						7,8	DAY 5		NC	0.0633
Organics	T66	BIS(2-ETHYLHEXYL) PHTHALATE	117817	MG/L	7535	A		03/04/93	ND	0.0100
						A		06/03/93	NC	1.0000
						A		09/09/93	ND	0.2000
						A		09/21/93	NC	0.6600
						A		12/02/93	ND	0.2000
Organics	T85	TETRACHLOROETHENE	127184	MG/L	4331	B		01/21/93	NC	0.0190
						B		02/09/93	NC	0.0240

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Organics	T85	TETRACHLOROETHENE	127184	MG/L	4331	B		03/08/93	NC	0.0120
						B		04/06/93	NC	0.0146
						B		05/04/93	NC	0.0600
						B		05/19/93	NC	0.0290
						B		06/02/93	NC	0.0090
						B		07/21/93	ND	0.0002
						B		08/03/93	NC	0.0700
						B		09/09/93	NC	0.0430
						B		09/13/93	ND	0.0100
						B		11/01/93	ND	0.0100
						B		12/06/93	ND	0.0010
Organics	T85	TETRACHLOROETHENE	127184	MG/L	4506	3,4	DAY 1		NC	0.0476
						3,4	DAY 2		NC	0.0262
						3,4	DAY 3		NC	0.0611
						3,4	DAY 4		NC	0.0626
						3,4	DAY 5		NC	0.1198
Organics	T85	TETRACHLOROETHENE	127184	MG/L	4610	7,8	DAY 1		NC	0.1818
						7,8	DAY 2		NC	0.7696
						7,8	DAY 3		NC	0.7717
						7,8	DAY 4		NC	0.1212
						7,8	DAY 5		NC	0.1191
Organics	T85	TETRACHLOROETHENE	127184	MG/L	7535	A		01/21/93	NC	1.6500
						A		03/04/93	NC	10.1000
						A		06/03/93	ND	0.4000
						A		09/09/93	ND	0.4000
						A		09/21/93	NC	66.0000
						A		12/02/93	NC	0.8500
Organics	T86	TOLUENE	108883	MG/L	4331	B		01/21/93	NC	0.0400
						B		02/09/93	ND	0.0006
						B		03/08/93	NC	0.0060
						B		04/06/93	NC	0.0070
						B		05/04/93	NC	0.0100
						B		05/19/93	NC	0.0710
						B		06/02/93	ND	0.0005

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Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Organics	T86	TOLUENE	108883	MG/L	4331	B		07/21/93	ND	0.0005
						B		08/03/93	NC	0.0170
						B		09/09/93	NC	0.4300
						B		09/13/93	ND	0.0100
						B		11/01/93	ND	0.0100
						B		12/06/93	ND	0.0010
Organics	T86	TOLUENE	108883	MG/L	4506	3,4	DAY 1		NC	0.1511
						3,4	DAY 2		NC	0.1294
						3,4	DAY 3		NC	0.3186
						3,4	DAY 4		NC	2.6056
						3,4	DAY 5		NC	0.3068
Organics	T86	TOLUENE	108883	MG/L	4610	7,8	DAY 1		NC	4.7629
						7,8	DAY 2		NC	1.7161
						7,8	DAY 3		NC	3.0087
						7,8	DAY 4		NC	4.9295
						7,8	DAY 5		NC	5.8109

APPENDIX A.2
Listing of Daily Data for CP
After Aggregation of Grabs and Duplicates Within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Classicals	SHEM	SGT-HEM	C037	MG/L	4637	7,8	DAY 1		NC	7.5000
						7,8	DAY 3		NC	18.5000
						7,8	DAY 4		NC	7.0000
						7,8	DAY 5		NC	9.5000
Metals	CU	COPPER	7440508	MG/L	1012	A		02/24/93	NC	0.3710
						A		04/21/93	NC	0.3400
						A		05/04/93	NC	0.3970
						A		07/13/93	NC	0.3400
						A		07/29/93	NC	0.4000
						A		11/04/93	NC	0.3510
						A		11/17/93	NC	0.6000
Metals	CU	COPPER	7440508	MG/L	1486	A		03/22/93	NC	0.1600
						A		03/23/93	NC	0.1100
						A		03/24/93	NC	0.1100
						A		03/25/93	NC	0.1100
						A		06/24/93	NC	0.1400
						A		06/25/93	NC	0.1300
						A		06/28/93	NC	0.1200
						A		06/29/93	NC	0.1000
						A		09/14/93	NC	0.2200
						A		09/15/93	NC	0.1700
						A		09/16/93	NC	0.1800
						A		09/17/93	NC	0.1700
						A		12/13/93	NC	0.1000
						A		12/14/93	NC	0.1500
						A		12/15/93	NC	0.1500
						A		12/16/93	NC	0.1000
Metals	CU	COPPER	7440508	MG/L	4637	7,8	DAY 1		NC	0.0547
						7,8	DAY 3		NC	0.0605
						7,8	DAY 4		NC	0.0748
						7,8	DAY 5		NC	0.0182
Metals	PB	LEAD	7439921	MG/L	1012	A		02/24/93	NC	0.2570
						A		04/21/93	NC	0.3200
						A		05/04/93	NC	0.2790

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Listing of Daily Data for CP
After Aggregation of Grabs and Duplicates within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	PB	LEAD	7439921	MG/L	1012	A		07/13/93	NC	0.1880
						A		07/29/93	NC	0.2700
						A		11/04/93	NC	0.3230
						A		11/17/93	NC	0.3100
Metals	PB	LEAD	7439921	MG/L	1486	A		03/22/93	NC	0.1000
						A		03/23/93	ND	0.1000
						A		03/24/93	ND	0.1000
						A		03/25/93	ND	0.1000
						A		06/24/93	ND	0.1000
						A		06/25/93	ND	0.1000
						A		06/28/93	ND	0.1000
						A		06/29/93	ND	0.1000
						A		09/14/93	ND	0.1000
						A		09/15/93	ND	0.1000
						A		09/16/93	ND	0.1000
						A		09/17/93	ND	0.1000
						A		12/13/93	NC	0.1000
						A		12/14/93	NC	0.1200
						A		12/15/93	NC	0.0800
						A		12/16/93	NC	0.1000
Metals	PB	LEAD	7439921	MG/L	4637	7,8	DAY 1		ND	0.0310
						7,8	DAY 3		NC	0.0411
						7,8	DAY 4		NC	0.1190
						7,8	DAY 5		ND	0.0310
Metals	PB	LEAD	7439921	MG/L	4848	B		01/06/93	NC	0.0330
						B		02/05/93	NC	0.0500
						B		03/05/93	NC	0.0630
						B		04/15/93	ND	0.0100
						B		05/07/93	ND	0.0100
						B		06/03/93	ND	0.0100
						B		07/09/93	ND	0.0100
						B		09/13/93	ND	0.0100
						B		10/13/93	NC	0.0240
						B		11/08/93	NC	0.0160
						B		12/10/93	NC	0.0470

APPENDIX A.2
Listing of Daily Data for CP
After Aggregation of Grabs and Duplicates within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	PB	LEAD	7439921	MG/L	6045	A		05/27/93	NC	0.2500
						A		07/14/93	NC	0.1500
						A		07/22/93	ND	0.0500
						A		09/13/93	NC	0.3100
Metals	ZN	ZINC	7440666	MG/L	1012	A		02/24/93	NC	1.0200
						A		04/21/93	NC	1.1500
						A		05/04/93	NC	1.2300
						A		07/13/93	NC	2.6030
						A		07/29/93	NC	1.9100
						A		11/04/93	NC	1.9040
						A		11/17/93	NC	2.1100
Metals	ZN	ZINC	7440666	MG/L	1486	A		03/22/93	NC	0.1600
						A		03/23/93	NC	0.0480
						A		03/24/93	NC	0.0800
						A		03/25/93	NC	0.0900
						A		06/24/93	NC	0.0400
						A		06/25/93	NC	0.1100
						A		06/28/93	NC	0.1000
						A		06/29/93	NC	0.0400
						A		09/14/93	NC	0.0800
						A		09/15/93	NC	0.4500
						A		09/16/93	NC	0.1200
						A		09/17/93	NC	0.1200
						A		12/13/93	NC	0.0510
						A		12/14/93	NC	0.0330
						A		12/15/93	NC	0.0330
						A		12/16/93	NC	0.0440
Metals	ZN	ZINC	7440666	MG/L	4637	7,8	DAY 1		NC	0.0440
						7,8	DAY 3		NC	0.0714
						7,8	DAY 4		NC	0.0408
						7,8	DAY 5		NC	0.0607
Metals	ZN	ZINC	7440666	MG/L	6045	A		05/27/93	NC	0.0900
						A		07/14/93	NC	0.4300
						A		07/22/93	NC	0.0500

APPENDIX A.2
Listing of Daily Data for CP
After Aggregation of Grabs and Duplicates within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Metals	ZN	ZINC	7440666	MG/L	6045	A		09/13/93	NC	0.4100
Organics	N119	O+P XYLENE	136777612	MG/L	4637	7,8	DAY 1		ND	0.0100
						7,8	DAY 3		NC	0.3532
						7,8	DAY 4		NC	0.1289
						7,8	DAY 5		NC	0.3669
Organics	N95	M-XYLENE	108383	MG/L	4637	7,8	DAY 1		ND	0.0100
						7,8	DAY 3		NC	0.5269
						7,8	DAY 4		NC	0.2097
						7,8	DAY 5		NC	0.5577
Organics	T38	ETHYLBENZENE	100414	MG/L	4637	7,8	DAY 1		NC	0.3228
						7,8	DAY 3		NC	0.2941
						7,8	DAY 4		NC	0.1297
						7,8	DAY 5		NC	0.2966
Organics	T38	ETHYLBENZENE	100414	MG/L	4848	B		04/15/93	NC	0.0060
						B		07/09/93	NC	0.0020
						B		10/13/93	ND	0.1000
Organics	T38	ETHYLBENZENE	100414	MG/L	8011	A		03/17/93	NC	0.2200
						A		06/29/93	NC	0.0170
						A		09/30/93	NC	0.1900
						A		10/15/93	NC	0.4000
Organics	T55	NAPHTHALENE	91203	MG/L	1012	A		06/13/93	ND	0.0016
						A		11/04/93	NC	0.0613
						A		12/01/93	NC	0.1118
Organics	T55	NAPHTHALENE	91203	MG/L	4637	7,8	DAY 1		NC	0.0537
						7,8	DAY 3		NC	0.1605
						7,8	DAY 4		NC	0.0688
						7,8	DAY 5		ND	0.0100
Organics	T55	NAPHTHALENE	91203	MG/L	4848	B		04/15/93	ND	0.0500
						B		07/09/93	ND	0.0250
						B		10/14/93	ND	0.1000

APPENDIX A.2
Listing of Daily Data for CP
After Aggregation of Grabs and Duplicates Within Sampling Date/Day

Analyte Category	Pollutant Code	Analyte Name	CAS Number	Unit	Episode	Sample Point	Sampling Day	Sampling Date	NC/ND	Conc
Organics	T66	BIS(2-ETHYLHEXYL) PHTHALATE	117817	MG/L	4637	7,8	DAY 1		NC	0.0627
						7,8	DAY 3		NC	0.0714
						7,8	DAY 4		NC	0.0662
						7,8	DAY 5		NC	0.0759
Organics	T66	BIS(2-ETHYLHEXYL) PHTHALATE	117817	MG/L	4848	B		04/15/93	ND	0.0500
						B		07/09/93	ND	0.0250
						B		10/14/93	NC	0.3700
Organics	T85	TETRACHLOROETHENE	127184	MG/L	4637	7,8	DAY 1		NC	0.1465
						7,8	DAY 3		NC	1.1063
						7,8	DAY 4		NC	0.2417
						7,8	DAY 5		NC	0.1662
Organics	T85	TETRACHLOROETHENE	127184	MG/L	8011	A		03/17/93	NC	0.0800
						A		06/29/93	NC	0.0380
						A		09/30/93	NC	0.0082
						A		10/15/93	NC	0.1100
Organics	T86	TOLUENE	108883	MG/L	4637	7,8	DAY 1		NC	1.3530
						7,8	DAY 3		NC	2.4007
						7,8	DAY 4		NC	0.8840
						7,8	DAY 5		NC	1.5394
Organics	T86	TOLUENE	108883	MG/L	4848	B		04/15/93	NC	0.0060
						B		07/09/93	NC	0.0050
						B		10/13/93	ND	0.1000
Organics	T86	TOLUENE	108883	MG/L	8011	A		03/17/93	NC	1.2400
						A		06/29/93	NC	0.5400
						A		09/30/93	NC	0.6800
						A		10/15/93	NC	1.6000

APPENDICES B.1 and B.2

APPENDIX B.1
Listing of Summary Statistics for Regulated Pollutants in DAF
By Analyte and Episode

Analyte=BIS(2-ETHYLHEXYL) PHTHALATE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4506	MG/L	5	0	0.03	0.02	0.03	0.03	0.02	0.02	0.06	.	.
SCC	4610	MG/L	5	1	0.14	0.06	0.14	0.15	0.06	0.06	0.21	0.10	0.10
DMQ	7535	MG/L	5	3	0.41	0.41	0.20	0.83	0.24	0.66	1.00	0.01	0.20

Analyte=COPPER Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	13	1	0.56	0.37	0.53	0.60	0.36	0.11	1.26	0.10	0.10
SCC	4506	MG/L	5	0	0.34	0.16	0.35	0.34	0.16	0.13	0.58	.	.
SCC	4610	MG/L	5	0	0.17	0.04	0.15	0.17	0.04	0.14	0.22	.	.
DMQ	5691	MG/L	8	0	0.38	0.24	0.31	0.38	0.24	0.17	0.89	.	.
DMQ	7535	MG/L	15	0	0.62	0.61	0.50	0.62	0.61	0.09	2.30	.	.
DMQ	8344	MG/L	5	0	0.47	0.38	0.42	0.47	0.38	0.10	0.86	.	.

Analyte=ETHYLBENZENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	13	10	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01
SCC	4506	MG/L	5	1	0.05	0.07	0.03	0.07	0.07	0.01	0.17	0.01	0.01
SCC	4610	MG/L	5	0	0.36	0.26	0.18	0.36	0.26	0.16	0.67	.	.

Analyte=LEAD Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	14	3	0.23	0.13	0.22	0.26	0.12	0.10	0.52	0.01	0.20

Listing of Summary Statistics for Regulated Pollutants in DAF
By Analyte and Episode

Analyte=LEAD Unit=MG/L
(continued)

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4506	MG/L	5	2	0.13	0.08	0.11	0.10	0.08	0.03	0.19	0.11	0.22
SCC	4610	MG/L	5	2	0.06	0.01	0.06	0.06	0.01	0.06	0.07	0.05	0.05
DMQ	5691	MG/L	8	8	0.10	0.00	0.10	.	.	.	.	0.10	0.10
DMQ	7535	MG/L	15	1	0.20	0.18	0.19	0.22	0.18	0.03	0.74	0.02	0.02
DMQ	8344	MG/L	4	2	0.32	0.20	0.35	0.49	0.00	0.49	0.49	0.10	0.20

Analyte=M-XYLENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4506	MG/L	5	0	0.06	0.05	0.03	0.06	0.05	0.02	0.15	.	.
SCC	4610	MG/L	5	0	0.59	0.46	0.39	0.59	0.46	0.28	1.40	.	.

Analyte=NAPHTHALENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	13	13	0.00	0.00	0.00	.	.	.	.	0.00	0.01
SCC	4506	MG/L	5	2	0.07	0.07	0.05	0.11	0.06	0.05	0.18	0.01	0.01
SCC	4610	MG/L	5	1	0.18	0.05	0.19	0.20	0.03	0.17	0.25	0.10	0.10

Analyte=O+P XYLENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4506	MG/L	5	0	0.12	0.08	0.09	0.12	0.08	0.06	0.26	.	.
SCC	4610	MG/L	5	0	0.42	0.41	0.24	0.42	0.41	0.20	1.15	.	.

APPENDIX B.1
Listing of Summary Statistics for Regulated Pollutants in DAF
By Analyte and Episode

Analyte=SGT-HEM Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4506	MG/L	5	1	11.13	8.48	9.00	12.67	8.96	6.67	26.00	5.00	5.00
SCC	4610	MG/L	5	0	15.73	8.05	13.25	15.73	8.05	9.00	29.13	.	.

Analyte=TETRACHLOROETHENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	13	4	0.02	0.02	0.01	0.03	0.02	0.01	0.07	0.00	0.01
SCC	4506	MG/L	5	0	0.06	0.03	0.06	0.06	0.03	0.03	0.12	.	.
SCC	4610	MG/L	5	0	0.39	0.35	0.18	0.39	0.35	0.12	0.77	.	.
DMQ	7535	MG/L	6	2	13.23	26.12	1.25	19.65	31.18	0.85	66.00	0.40	0.40

Analyte=TOLUENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	13	6	0.05	0.12	0.01	0.08	0.15	0.01	0.43	0.00	0.01
SCC	4506	MG/L	5	0	0.70	1.07	0.31	0.70	1.07	0.13	2.61	.	.
SCC	4610	MG/L	5	0	4.05	1.65	4.76	4.05	1.65	1.72	5.81	.	.

Analyte=ZINC Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	4331	MG/L	12	0	1.08	0.63	1.23	1.08	0.63	0.10	2.09	.	.
SCC	4506	MG/L	5	0	0.51	0.36	0.39	0.51	0.36	0.27	1.15	.	.
SCC	4610	MG/L	5	0	0.27	0.06	0.25	0.27	0.06	0.22	0.35	.	.
DMQ	5691	MG/L	8	0	0.76	0.39	0.68	0.76	0.39	0.26	1.54	.	.

APPENDIX B.1
Listing of Summary Statistics for Regulated Pollutants in DAF
By Analyte and Episode

Analyte=ZINC Unit=MG/L
(continued)

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	7535	MG/L	15	0	0.80	0.91	0.49	0.80	0.91	0.04	3.60	.	.
DMQ	8344	MG/L	5	0	0.79	0.66	0.55	0.79	0.66	0.20	1.50	.	.

APPENDIX B.2
Listing of Summary Statistics for Regulated Pollutants in CP
By Analyte and Episode

Analyte=BIS(2-ETHYLHEXYL) PHTHALATE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	0	0.07	0.01	0.07	0.07	0.01	0.06	0.08	.	.
DMQ	4848	MG/L	3	2	0.15	0.19	0.05	0.37	.	0.37	0.37	0.03	0.05

Analyte=COPPER Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	1012	MG/L	7	0	0.40	0.09	0.37	0.40	0.09	0.34	0.60	.	.
DMQ	1486	MG/L	16	0	0.14	0.04	0.14	0.14	0.04	0.10	0.22	.	.
SCC	4637	MG/L	4	0	0.05	0.02	0.06	0.05	0.02	0.02	0.07	.	.

Analyte=ETHYLBENZENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	0	0.26	0.09	0.30	0.26	0.09	0.13	0.32	.	.
DMQ	4848	MG/L	3	1	0.04	0.06	0.01	0.00	0.00	0.00	0.01	0.10	0.10
DMQ	8011	MG/L	4	0	0.21	0.16	0.21	0.21	0.16	0.02	0.40	.	.

Analyte=LEAD Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	1012	MG/L	7	0	0.28	0.05	0.28	0.28	0.05	0.19	0.32	.	.
DMQ	1486	MG/L	16	11	0.10	0.01	0.10	0.10	0.01	0.08	0.12	0.10	0.10
SCC	4637	MG/L	4	2	0.06	0.04	0.04	0.08	0.06	0.04	0.12	0.03	0.03
DMQ	4848	MG/L	11	5	0.03	0.02	0.02	0.04	0.02	0.02	0.06	0.01	0.01
DMQ	6045	MG/L	4	1	0.19	0.11	0.20	0.24	0.08	0.15	0.31	0.05	0.05

APPENDIX B.2
Listing of Summary Statistics for Regulated Pollutants in CP
By Analyte and Episode

Analyte=M-XYLENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	1	0.33	0.26	0.37	0.43	0.19	0.21	0.56	0.01	0.01

Analyte=NAPHTHALENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	1012	MG/L	3	1	0.06	0.06	0.06	0.09	0.04	0.06	0.11	0.00	0.00
SCC	4637	MG/L	4	1	0.07	0.06	0.06	0.09	0.06	0.05	0.16	0.01	0.01
DMQ	4848	MG/L	3	3	0.06	0.04	0.05	.	.	.	.	0.03	0.10

Analyte=O+P XYLENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	1	0.21	0.17	0.24	0.28	0.13	0.13	0.37	0.01	0.01

Analyte=SGT-HEM Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	0	10.63	5.36	8.50	10.63	5.36	7.00	18.50	.	.

APPENDIX B.2
Listing of Summary Statistics for Regulated Pollutants in CP
By Analyte and Episode

Analyte=TETRACHLOROETHENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	0	0.42	0.46	0.20	0.42	0.46	0.15	1.11	.	.
DMQ	8011	MG/L	4	0	0.06	0.04	0.06	0.06	0.04	0.01	0.11	.	.

Analyte=TOLUENE Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
SCC	4637	MG/L	4	0	1.54	0.63	1.45	1.54	0.63	0.88	2.40	.	.
DMQ	4848	MG/L	3	1	0.04	0.05	0.01	0.01	0.00	0.01	0.01	0.10	0.10
DMQ	8011	MG/L	4	0	1.02	0.49	0.96	1.02	0.49	0.54	1.60	.	.

Analyte=ZINC Unit=MG/L

Data Source	Episode	Unit	Tot Num Values	Num ND	Episode Mean	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND
DMQ	1012	MG/L	7	0	1.70	0.59	1.90	1.70	0.59	1.02	2.60	.	.
DMQ	1486	MG/L	16	0	0.10	0.10	0.08	0.10	0.10	0.03	0.45	.	.
SCC	4637	MG/L	4	0	0.05	0.01	0.05	0.05	0.01	0.04	0.07	.	.
DMQ	6045	MG/L	4	0	0.25	0.20	0.25	0.25	0.20	0.05	0.43	.	.

APPENDICES C.1 and C.2

APPENDIX C.1

Listing of Facility-level Long-Term Averages and Variability Factors for DAF
Assuming Underlying Delta-lognormal Distribution

------------ Analyte Category=Classicals Analyte Name=TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM) CAS_NO=C037 Pollutant Code=SHEM Unit=MG/L ------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4506	5	1	11.10	11.4000	8.48	8.2700	3.64	1.68
SCC	4610	5	0	15.70	16.0000	8.05	7.7500	2.62	1.44

------------------------------ Analyte Category=Metals Analyte Name=COPPER CAS_NO=7440508 Pollutant Code=CU Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	5691	8	0	0.38	0.3870	0.24	0.2350	3.15	1.56
DMQ	8344	5	0	0.47	0.5690	0.38	0.8570	6.95	2.40
DMQ	4331	13	1	0.56	0.5930	0.37	0.5480	4.52	1.87
DMQ	7535	15	0	0.62	0.6680	0.61	0.9080	6.40	2.28
SCC	4610	5	0	0.17	0.1730	0.04	0.0364	1.59	1.18
SCC	4506	5	0	0.35	0.3600	0.16	0.2120	3.07	1.54

------------------------------ Analyte Category=Metals Analyte Name=LEAD CAS_NO=7439921 Pollutant Code=PB Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	5691	8	8	0.10	0.1000	0.00	0.0000	.	.
DMQ	7535	15	1	0.21	0.2150	0.18	0.2240	5.05	1.99
DMQ	4331	14	3	0.23	0.2330	0.13	0.1450	2.99	1.57
DMQ	8344	4	2	0.32	0.3200	0.20	0.1770	1.55	1.47
SCC	4610	5	2	0.06	0.0553	0.01	0.0087	1.39	1.13
SCC	4506	5	2	0.13	0.1350	0.08	0.1100	3.72	1.75

------------------------------ Analyte Category=Metals Analyte Name=ZINC CAS_NO=7440666 Pollutant Code=ZN Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	5691	8	0	0.76	0.7780	0.39	0.4390	2.96	1.52
DMQ	7535	15	0	0.80	0.8970	0.91	1.4500	7.34	2.49
DMQ	8344	5	0	0.79	0.9110	0.66	1.2100	6.27	2.25

APPENDIX C.1

Listing of Facility-level Long-Term Averages and Variability Factors for DAF

Assuming Underlying Delta-lognormal Distribution

------------------------------ Analyte Category=Metals Analyte Name=ZINC CAS_NO=7440666 Pollutant Code=ZN Unit=MG/L ------------------------------

(continued)

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4331	12	0	1.08	1.2200	0.63	1.2800	5.11	1.99
SCC	4610	5	0	0.27	0.2680	0.06	0.0555	1.58	1.18
SCC	4506	5	0	0.51	0.5130	0.36	0.3150	3.17	1.57

------------------ Analyte Category=Organics Analyte Name=BIS(2-ETHYLHEXYL) PHTHALATE CAS_NO=117817 Pollutant Code=T66 Unit=MG/L ------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	7535	5	3	0.41	0.4210	0.41	0.3930	3.43	1.82
SCC	4506	5	0	0.03	0.0334	0.02	0.0171	2.73	1.47
SCC	4610	5	1	0.14	0.1440	0.06	0.0822	3.06	1.52

-------------------------- Analyte Category=Organics Analyte Name=ETHYLBENZENE CAS_NO=100414 Pollutant Code=T38 Unit=MG/L --------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4331	13	10	0.00	0.0044	0.00	0.0048	3.54	1.90
SCC	4610	5	0	0.36	0.3740	0.26	0.3110	4.16	1.78

--------------------------- Analyte Category=Organics Analyte Name=M-XYLENE CAS_NO=108383 Pollutant Code=N95 Unit=MG/L ---------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4610	5	0	0.59	0.5950	0.46	0.4160	3.55	1.65

APPENDIX C.1

Listing of Facility-level Long-Term Averages and Variability Factors for DAF Assuming Underlying Delta-lognormal Distribution

-------- Analyte Category=Organics Analyte Name=NAPHTHALENE CAS_NO=91203 Pollutant Code=T55 Unit=MG/L --------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4331	13	13	0.00	0.0030	0.00	0.0040	.	.
SCC	4506	5	2	0.07	0.0764	0.07	0.0821	4.73	2.00
SCC	4610	5	1	0.18	0.1800	0.05	0.0494	1.57	1.24

-------- Analyte Category=Organics Analyte Name=O+P XYLENE CAS_NO=136777612 Pollutant Code=N119 Unit=MG/L --------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4506	5	0	0.12	0.1170	0.08	0.0713	3.15	1.56
SCC	4610	5	0	0.42	0.4240	0.41	0.3440	4.07	1.76

-------- Analyte Category=Organics Analyte Name=TETRACHLOROETHENE CAS_NO=127184 Pollutant Code=T85 Unit=MG/L --------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4331	13	4	0.02	0.0239	0.02	0.0254	4.97	2.00
DMQ	7535	6	2	13.20	25.1000	26.10	206.0000	15.40	3.87
SCC	4506	5	0	0.06	0.0656	0.03	0.0388	3.08	1.54
SCC	4610	5	0	0.39	0.4340	0.35	0.5320	5.87	2.16

-------- Analyte Category=Organics Analyte Name=TOLUENE CAS_NO=108883 Pollutant Code=T86 Unit=MG/L --------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4331	13	6	0.05	0.0473	0.12	0.1940	13.50	3.66
SCC	4506	5	0	0.70	0.7110	1.07	1.2700	7.93	2.63
SCC	4610	5	0	4.05	4.2000	1.65	2.2100	2.80	1.48

APPENDIX C.2

Listing of Facility-level Long-Term Averages and Variability Factors for CP
Assuming Underlying Delta-lognormal Distribution

------------ Analyte Category=Classicals Analyte Name=TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM) CAS_NO=C037 Pollutant Code=SHEM Unit=MG/L ------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4637	4	0	10.60	10.8000	5.36	5.0400	2.54	1.42

------------------------------ Analyte Category=Metals Analyte Name=COPPER CAS_NO=7440508 Pollutant Code=CU Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	1486	16	0	0.14	0.1390	0.04	0.0344	1.71	1.22
DMQ	1012	7	0	0.40	0.4000	0.09	0.0804	1.56	1.17
SCC	4637	4	0	0.05	0.0563	0.02	0.0395	3.57	1.65

------------------------------ Analyte Category=Metals Analyte Name=LEAD CAS_NO=7439921 Pollutant Code=PB Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4848	11	5	0.03	0.0264	0.02	0.0221	3.89	1.77
DMQ	1486	16	11	0.10	0.1000	0.01	0.0081	1.29	1.07
DMQ	6045	4	1	0.19	0.1950	0.11	0.1160	2.66	1.55
DMQ	1012	7	0	0.28	0.2790	0.05	0.0531	1.52	1.16
SCC	4637	4	2	0.06	0.0619	0.04	0.0650	5.29	2.00

------------------------------ Analyte Category=Metals Analyte Name=ZINC CAS_NO=7440666 Pollutant Code=ZN Unit=MG/L ------------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	1486	16	0	0.10	0.0968	0.10	0.0764	3.96	1.74
DMQ	6045	4	0	0.25	0.3030	0.20	0.4540	6.94	2.40
DMQ	1012	7	0	1.70	1.7200	0.59	0.6300	2.14	1.33
SCC	4637	4	0	0.05	0.0547	0.01	0.0148	1.79	1.24

APPENDIX C.2

Listing of Facility-level Long-Term Averages and Variability Factors for CP
Assuming Underlying Delta-lognormal Distribution

------------------ Analyte Category=Organics Analyte Name=BIS(2-ETHYLHEXYL) PHTHALATE CAS_NO=117817 Pollutant Code=T66 Unit=MG/L ------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4848	3	2	0.15	0.1480	0.19	0.1920	.	.
SCC	4637	4	0	0.07	0.0691	0.01	0.0058	1.21	1.07

------------------------- Analyte Category=Organics Analyte Name=ETHYLBENZENE CAS_NO=100414 Pollutant Code=T38 Unit=MG/L -------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4848	3	1	0.04	0.0360	0.06	0.0555	.	.
DMQ	8011	4	0	0.21	0.3430	0.16	0.8370	9.68	3.05
SCC	4637	4	0	0.26	0.2690	0.09	0.1210	2.47	1.41

--------------------------- Analyte Category=Organics Analyte Name=M-XYLENE CAS_NO=108383 Pollutant Code=N95 Unit=MG/L ---------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4637	4	1	0.33	0.3470	0.26	0.3060	3.84	1.83

-------------------------- Analyte Category=Organics Analyte Name=NAPHTHALENE CAS_NO=91203 Pollutant Code=T55 Unit=MG/L --------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	1012	3	1	0.06	0.0582	0.06	0.0552	.	.
DMQ	4848	3	3	0.06	0.0583	0.04	0.0382	.	.
SCC	4637	4	1	0.07	0.0768	0.06	0.0660	3.9	1.81

------------------------ Analyte Category=Organics Analyte Name=O+P XYLENE CAS_NO=136777612 Pollutant Code=N119 Unit=MG/L ------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
SCC	4637	4	1	0.22	0.2310	0.18	0.2140	4.12	1.87

APPENDIX C.2

Listing of Facility-level Long-Term Averages and Variability Factors for CP

Assuming Underlying Delta-lognormal Distribution

------------------------ Analyte Category=Organics Analyte Name=TETRACHLOROETHENE CAS_NO=127184 Pollutant Code=T85 Unit=MG/L ------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	8011	4	0	0.06	0.0795	0.05	0.1330	7.56	2.55
SCC	4637	4	0	0.42	0.4380	0.46	0.5150	5.65	2.11

---------------------------- Analyte Category=Organics Analyte Name=TOLUENE CAS_NO=108883 Pollutant Code=T86 Unit=MG/L ----------------------------

Type of Facility	Episode	# Obs	# NDs	Obs Mean	Est. LTA	Obs STD	Est. STD	1-Day V.F.	4-Day V.F.
DMQ	4848	3	1	0.04	0.0370	0.05	0.0546	.	.
DMQ	8011	4	0	1.02	1.0500	0.49	0.5680	2.86	1.49
SCC	4637	4	0	1.54	1.5800	0.63	0.6770	2.39	1.39

APPENDICES D.1 and D.2

APPENDIX D.1

Listing of Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for DAF
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

------------ Analyte Category=Classicals Pollutant Code=SHEM Analyte Name=TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM) CAS_NO=C037 Unit=MG/L ------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	2	13.7	8.01	3.13	42.9	1.56	21.3

------------------------------ Analyte Category=Metals Pollutant Code=CU Analyte Name=COPPER CAS_NO=7440508 Unit=MG/L ------------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	4	0.581	0.702	5.46	3.170	2.08	1.210
SCC	2	0.266	0.124	2.33	0.621	1.36	0.363
SCC / DMQ	6	0.478	0.391	3.83	1.830	1.72	0.820

------------------------------ Analyte Category=Metals Pollutant Code=PB Analyte Name=LEAD CAS_NO=7439921 Unit=MG/L ------------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	4	0.2240	0.1610	2.99	0.670	1.57	0.352
SCC	2	0.0951	0.0592	2.56	0.243	1.44	0.137
SCC / DMQ	6	0.1750	0.1270	2.99	0.524	1.57	0.275

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.1

Listing of Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for DAF
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

------------------------------ Analyte Category=Metals Pollutant Code=ZN Analyte Name=ZINC CAS_NO=7440666 Unit=MG/L ------------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	4	0.904	1.240	5.69	5.140	2.12	1.920
SCC	2	0.390	0.185	2.38	0.928	1.37	0.536
SCC / DMQ	6	0.837	0.823	4.14	3.470	1.78	1.490

------------------------ Analyte Category=Organics Pollutant Code=N119 Analyte Name=O+P XYLENE CAS_NO=136777612 Unit=MG/L ------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	2	0.271	0.208	3.61	0.976	1.66	0.449

--------------------------- Analyte Category=Organics Pollutant Code=N95 Analyte Name=M-XYLENE CAS_NO=108383 Unit=MG/L ---------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	1	0.595	0.416	3.55	2.11	1.65	0.981

------------------------- Analyte Category=Organics Pollutant Code=T38 Analyte Name=ETHYLBENZENE CAS_NO=100414 Unit=MG/L -------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.00438	0.00476	3.54	0.0155	1.90	0.00834
SCC	1	0.37400	0.31100	4.16	1.5500	1.78	0.66600

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.1

Listing of Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for DAF

Assuming Underlying Delta-lognormal Distribution

Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

-------------------------- Analyte Category=Organics Pollutant Code=T38 Analyte Name=ETHYLBENZENE CAS_NO=100414 Unit=MG/L --------------------------
(continued)

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC / DMQ	2	0.189	0.158	3.85	0.727	1.84	0.348

--------------------------- Analyte Category=Organics Pollutant Code=T55 Analyte Name=NAPHTHALENE CAS_NO=91203 Unit=MG/L --------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.00304	0.00397	.	.	.	.
SCC	2	0.12800	0.06570	3.15	0.405	1.62	0.208
SCC / DMQ	3	0.07640	0.04940	3.15	0.241	1.62	0.124

------------------ Analyte Category=Organics Pollutant Code=T66 Analyte Name=BIS(2-ETHYLHEXYL) PHTHALATE CAS_NO=117817 Unit=MG/L ------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.4210	0.3930	3.43	1.440	1.82	0.769
SCC	2	0.0889	0.0496	2.90	0.258	1.49	0.133
SCC / DMQ	3	0.1440	0.0822	3.06	0.443	1.52	0.220

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.1

Listing of Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for DAF
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

------------------------ Analyte Category=Organics Pollutant Code=T85 Analyte Name=TETRACHLOROETHENE CAS_NO=127184 Unit=MG/L ------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	2	12.60	103.000	10.20	128.00	2.94	36.900
SCC	2	0.25	0.285	4.47	1.12	1.85	0.463
SCC / DMQ	4	0.25	0.285	5.42	1.35	2.08	0.519

---------------------------- Analyte Category=Organics Pollutant Code=T86 Analyte Name=TOLUENE CAS_NO=108883 Unit=MG/L ----------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.0473	0.194	13.50	0.637	3.66	0.173
SCC	2	2.4500	1.740	5.37	13.200	2.06	5.050
SCC / DMQ	3	0.7110	1.270	7.93	5.630	2.63	1.870

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.2

Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for CP
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

----------- Analyte Category=Classicals Pollutant Code=SHEM Analyte Name=TOTAL PETROLEUM HYDROCARBON (AS SGT-HEM) CAS_NO=C037 Unit=MG/L ------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	1	10.8	5.04	2.54	27.5	1.42	15.4

------------------------------ Analyte Category=Metals Pollutant Code=CU Analyte Name=COPPER CAS_NO=7440508 Unit=MG/L ------------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	2	0.2700	0.0574	1.63	0.441	1.19	0.322
SCC	1	0.0563	0.0395	3.57	0.201	1.65	0.093
SCC / DMQ	3	0.1390	0.0395	1.71	0.238	1.22	0.169

------------------------------ Analyte Category=Metals Pollutant Code=PB Analyte Name=LEAD CAS_NO=7439921 Unit=MG/L ------------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	4	0.1470	0.0376	2.09	0.308	1.36	0.200
SCC	1	0.0619	0.0650	5.29	0.327	2.00	0.124
SCC / DMQ	5	0.1000	0.0531	2.66	0.266	1.55	0.155

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.2
Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for CP
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

------ Analyte Category=Metals Pollutant Code=ZN Analyte Name=ZINC CAS_NO=7440666 Unit=MG/L ------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	3	0.3030	0.4540	3.96	1.2000	1.74	0.5260
SCC	1	0.0547	0.0148	1.79	0.0978	1.24	0.0676
SCC / DMQ	4	0.2000	0.2650	3.05	0.6100	1.53	0.3060

------ Analyte Category=Organics Pollutant Code=N119 Analyte Name=O+P XYLENE CAS_NO=136777612 Unit=MG/L ------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	1	0.231	0.214	4.12	0.952	1.87	0.432

------ Analyte Category=Organics Pollutant Code=N95 Analyte Name=M-XYLENE CAS_NO=108383 Unit=MG/L ------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC Only	1	0.347	0.306	3.84	1.33	1.83	0.633

------ Analyte Category=Organics Pollutant Code=T38 Analyte Name=ETHYLBENZENE CAS_NO=100414 Unit=MG/L ------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	2	0.189	0.446	9.68	1.830	3.05	0.577
SCC	1	0.269	0.121	2.47	0.666	1.41	0.379

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.2
Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for CP
Assuming Underlying Delta-lognormal Distribution
Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

-------------------------- Analyte Category=Organics Pollutant Code=T38 Analyte Name=ETHYLBENZENE CAS_NO=100414 Unit=MG/L --------------------------
(continued)

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
SCC / DMQ	3	0.269	0.121	6.08	1.64	2.23	0.6

-------------------------- Analyte Category=Organics Pollutant Code=T55 Analyte Name=NAPHTHALENE CAS_NO=91203 Unit=MG/L --------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	2	0.0583	0.0467	.	.	.	.
SCC	1	0.0768	0.0660	3.9	0.300	1.81	0.139
SCC / DMQ	3	0.0583	0.0552	3.9	0.228	1.81	0.105

------------------ Analyte Category=Organics Pollutant Code=T66 Analyte Name=BIS(2-ETHYLHEXYL) PHTHALATE CAS_NO=117817 Unit=MG/L ------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.1480	0.19200	.	.	.	.
SCC	1	0.0691	0.00578	1.21	0.0836	1.07	0.074
SCC / DMQ	2	0.1090	0.09910	1.21	0.1320	1.07	0.116

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDIX D.2

Pollutant-Level Long-Term Averages, Variability Factors, and Limitations for CP

Assuming Underlying Delta-lognormal Distribution

Pollutant-Level Estimates Calculated as the Median of Facility-Level Estimates

------------------------ Analyte Category=Organics Pollutant Code=T85 Analyte Name=TETRACHLOROETHENE CAS_NO=127184 Unit=MG/L ------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	1	0.0795	0.133	7.56	0.601	2.55	0.202
SCC	1	0.4380	0.515	5.65	2.480	2.11	0.925
SCC / DMQ	2	0.2590	0.324	6.61	1.710	2.33	0.603

---------------------------- Analyte Category=Organics Pollutant Code=T86 Analyte Name=TOLUENE CAS_NO=108883 Unit=MG/L ----------------------------

Source	Num of Episodes	Est. Option LTA Median	Est. Option STD Median	1-Day Option V.F. Median	Option(1) Daily Max. Limit ##	4-Day Option V.F. Median	Option(4) Monthly Avg. Limit ##
DMQ	2	0.544	0.312	2.86	1.55	1.49	0.813
SCC	1	1.580	0.677	2.39	3.77	1.39	2.190
SCC / DMQ	3	1.050	0.568	2.63	2.76	1.44	1.510

Indicates Limits Calculated as the Median Facility-level LTA multiplied by the Median Facility-level VF

APPENDICES E.1 and E.2

APPENDIX E.1

Episode, Sample Point, and Data Source
Used in IL and Linen Comparisons

Type of Facility	Source	Episode	Sample Point
Linen	DMQ	0425	B
		5443	A
		6171	B
	SCC	4642	5
IL	SCC	4506	1
		4610	2
		4637	4,6
		4642	4
		4701	3 and 6
		4712	1 and 4

APPENDIX E.2

Episode, Sample Point, and Data Source
Used in Untreated Denim and Linen Comparisons

Type of Facility	Source	Episode	Sample Point
Untreated Denim Prewash	Denim data posted for this analysis	DEN1	A-1, A-2, A-3, A-4
	DMQ	4072	B
Linen Supply	DMQ	0425	B
	DMQ	5443	A
	DMQ	6171	B
	SCC	4642	SP-5