ARCADIS

Appendix A

Surface Soil Sample Log

ARCADIS

Soil Sampling Field Log

Site   Ford TCAP   Sampler   Melissa Meeuwsen

Project Number   MN000593.0003   PID Calibration   100 Isobutylene

                                                          PID Lamp Size   10.6 eV

ID	Interval (ft. - ft.)	Date	Time	PID (ppm)	Soil Type	Comment
AGM-SS-004	0-0.5	9/17/2007	12:30	0.2	IM	
AGM-SS-005	0-0.5	9/17/2007	12:33	1.9	IM	
AGM-SS-006	0-0.5	9/17/2007	12:37	3.7	IM	
AGM-SS-007	0-0.5	9/17/2007	12:43	5.7	IM	MS/MSD
AGM-SS-008	0-0.5	9/17/2007	12:46	5.7	IM	
AGM-SS-009	0-0.5	9/17/2007	12:50	4	T	
AGM-SS-010	0-0.5	9/17/2007	12:55	3.3	T	
AGM-SS-011	0-0.5	9/17/2007	12:57	5.8	T	
AGM-SS-012	0-0.5	9/17/2007	13:00	2.9	IM/T	
AGM-SS-013	0-0.5	9/17/2007	13:42	2.1	IM	
AGM-SS-014	0-0.5	9/17/2007	13:44	3.4	IM	
AGM-SS-015	0-0.5	9/17/2007	13:46	3.7	IM	
AGM-SS-016	0-0.5	9/17/2007	13:48	5.3	IM	
AGM-SS-017	0-0.5	9/17/2007	13:50	3.9	IM	
AGM-SS-018	0-0.5	9/17/2007	13:53	3.7	T	
AGM-SS-019	0-0.5	9/17/2007	13:55	5.7	T	
AGM-SS-020	0-0.5	9/17/2007	13:58	4.7	T	
AGM-SS-021	0-0.5	9/17/2007	14:03	2.8	IM/T	MS/MSD
AGM-SS-022	0-0.5	9/17/2007	15:28	6.4	IM	
AGM-SS-023	0-0.5	9/17/2007	15:29	1.7	IM	
AGM-SS-024	0-0.5	9/17/2007	15:36	1.6	T	
AGM-SS-025	0-0.5	9/17/2007	15:38	5.6	IM	
AGM-SS-026	0-0.5	9/17/2007	15:41	3.4	IM	
AGM-SS-027	0-0.5	9/17/2007	15:44	5	T	
AGM-SS-028	0-0.5	9/17/2007	16:00	4.2	T	
AGM-SS-029	0-0.5	9/17/2007	16:05	5.7	T	
AGM-SS-030	0-0.5	9/17/2007	16:10	2.6	IM	
AGM-SS-031	0-0.5	9/17/2007	16:48	2.5	T	
AGM-SS-032	0-0.5	9/17/2007	16:42	3	T	
AGM-SS-033	0-0.5	9/17/2007	16:39	2.5	SG	
AGM-SS-034	0-0.5	9/17/2007	17:01	2.4	SG	
AGM-SS-035	0-0.5	9/17/2007	17:18	2.4	T	
AGM-SS-036	0-0.5	9/17/2007	17:12	2.7	T	
AGM-SS-037	0-0.5	9/17/2007	17:09	1.7	SG	
AGM-SS-038	0-0.5	9/17/2007	17:05	1.4	SG	
AGM-SS-039	0-0.5	9/17/2007	16:56	2.2	IM	

Note: Soil type is generalized to the following:

Topsoil (T)   Organic rich soil

Infield mix (IM)   A mix of Red/Brown sand and clay or gravelized clay typical of baseball infields

Sand & Gravel (SG)   Fill material of typical sand and gravel parking areas

MS   Matrix Spike

MSD   Matrix Spike Duplicate

ARCADIS

Appendix B

Soil Boring Logs

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-071**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION		DRILLING INFORMATION	
CLIENT:	**Ford Motor Company**	DRILLING CO.:	**Matrix Environmental, LLC**
PROJECT:	**Twin Cities Assembly Plant**	DRILLER:	**Dan**
SITE LOCATION:	**St. Paul Minnesota**	DRILLING METHOD:	**Direct Push**
LOGGED BY:	**MM**	COORDINATES:	ELEVATIONS (feet MSL):
DATE STARTED:	**9/19/2007**	Northing: **144654.02778**	Surface: **854.58**
DATE COMPLETED:	**9/19/2007**	Easting: **550680.15173**	

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			6.1	24	OH	(0.0 - 2.0) OH: ORGANIC SOIL, dark brown, some very fine to medium grained sand, subangular, little fine gravel, subangular, little plant roots, soft, moist.
2			0.4	20	CH	(2.0 - 3.0) CH: FAT CLAY, olive brown, some very fine to coarse grained sand, subangular, little fine gravel, subangular, hard, moist, orange and black mottling.
					CH	(3.0 - 4.0) CH: FAT CLAY, orange mottling.
4			0.2	24	CH	(4.0 - 6.0) CH: FAT CLAY, hard, moist, orange mottling, trace plant particles.
6			0.1	24	CH	(6.0 - 8.0) CH: FAT CLAY, olive, hard, moist, cohesive, high plasticity, orange mottling.
8			0.0	24	CH	(8.0 - 10.0) CH: FAT CLAY, olive, trace cobbles, subrounded, hard, moist, orange mottling.
10			0.0	24	CH	(10.0 - 12.0) CH: FAT CLAY, olive green, trace cobbles, up to 2.5", subrounded, hard, moist, orange mottling. End of boring.
12						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   MW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-072**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/21/2007**	Northing: **144545.23655** Surface: **840.53**
DATE COMPLETED: **9/21/2007**	Easting: **550688.9269**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.1) SM: FILL (SILTY SAND), brown, very fine to coarse grained sand, angular, some silt, very soft, moist, ballfield sand.
			0.2	24	CL	(0.1 - 0.8) CL: FILL (SANDY LEAN CLAY), brown, clay and very fine to coarse grained sand, stiff, medium plasticity, cohesive.
					CH	(0.8 - 1.9) CH: FILL (FAT CLAY), greenish gray, clay, little very fine to fine grained sand, soft, moist, cohesive, high plasticity.
2					CL	
					CL	(1.9 - 2.3) CL: LEAN CLAY, brown, clay and very fine to coarse grained sand, trace fine gravel, subround to round, stiff, moist, medium plasticity.
			0.4	23	CL	(2.3 - 3.3) CL: FILL (LEAN CLAY) olive, clay and very fine to fine grained sand, trace fine gravel, hard, moist, subangular to subround, cohesive, low plasticity, orange mottling.
4					CL	(3.3 - 4.0) CL: LEAN CLAY greenish gray clay, trace very fine grained sand, hard, low plasticity, moist, orange mottling.
			0.4	24		(4.0 - 6.0) CL: LEAN CLAY greenish gray clay, trace very fine grained sand, hard, low plasticity, moist, orange mottling, crumbly.
6					CL	(6.0 - 6.7) CL: LEAN CLAY greenish gray clay, trace very fine grained sand, hard, low plasticity, moist, orange mottling, crumbly.
			0.6	24	BEDROCK	(6.7 - 8.0) BEDROCK: SHALE, gray. End of boring.
8						

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-073**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/21/2007**	Northing: **144446.74327** Surface: **838.32**
DATE COMPLETED: **9/21/2007**	Easting: **550687.05714**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.3	24	SW	(0.0 - 1.5) SW: FILL (WELL GRADED SAND WITH GRAVEL), greenish gray, very fine to coarse grained sand, some fine to coarse gravel, up to 1.5", stiff, angular to subround, orange mottling, soft, moist.
					OH	(1.5 - 2.0) OH: FILL (ORGANIC SOIL), dark brown organic rich clay and very fine to fine grained sand, low plasticity, stiff, moist.
2			0.4	5	OH	(2.0 - 4.0) OH: FILL (ORGANIC SOIL), dark brown organic rich clay and very fine to fine grained sand, low plasticity, stiff, moist.
4					OH	(4.0 - 4.3) OH: FILL (ORGANIC SOIL), dark brown organic rich clay and very fine to fine grained sand, low plasticity, stiff, moist.
			0.4	24	SM	(4.3 - 6.0) SM: SILTY SAND WITH GRAVEL, brown, very fine to coarse grained sand, some clay, some fine to coarse gravel, angular to subangular, soft, moist, orange mottling.
6			0.6	22	SW-SC	(6.0 - 8.0) SW-SC: WELL GRADED SAND WITH CLAY, brown, very fine to medium grained sand, little fine to coarse gravel, subangular to subround, up to 1.25", soft, moist.
8					SW-SC	(8.0 - 8.5) SW-SC: Slough.
			0.6	24	SW-SC	(8.5 - 10.0) SW-SC: WELL GRADED SAND WITH CLAY, brown, very fine to medium grained sand, little fine to coarse gravel, subangular to subround, up to 1.25", soft, moist.
10			0.7	10	SW-SC	(10.0 - 12.0) SW-SC: WELL GRADED SAND WITH CLAY, brown, very fine to medium grained sand, little fine to coarse gravel, subangular to subround, up to 1.25", soft, moist. End of boring.
12						

Notes:
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch   Date: 10/24/2007
bgs: below ground surface   TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector   Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-074**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: **ELEVATIONS (feet MSL):**
DATE STARTED: **9/21/2007**	Northing: **144353.39015** Surface: **837.33**
DATE COMPLETED: **9/21/2007**	Easting: **550677.57909**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.8) SM: FILL (SILTY SAND), brown, very fine to coarse grained sand, angular, some silt, non-plastic, non-cohesive, soft, moist, ballfield sand.
			0.3	24	CL	(0.8 - 1.3) CL: FILL (LEAN CLAY WITH SAND), greenish gray, clay, some very fine to coarse grained sand, some fine gravel, subround, some organic nodules, orange mottling, cohesive, low plasticity, moist.
					SC	
2					SC	(1.3 - 2.0) SC: FILL (CLAYEY SAND WITH GRAVEL), brown, very fine to coarse grained sand, some clay, little fine gravel, subangular to subround, soft, moist, non-plastic.
			0.3	7	CL	(2.0 - 2.1) SC: FILL (CLAYEY SAND WITH GRAVEL), brown, very fine to coarse grained sand, some clay, little fine gravel, subangular to subround, soft, moist, non-plastic.
4					CL	(2.1 - 4.0) CL: FILL (LEAN CLAY), brown, clay, some very fine to medium grained sand, soft, moist, low plasticity.
			0.4	24	SW	(4.0 - 4.7) CL: Slough.
						(4.7 - 6.0) SW: WELL GRADED SAND, brown, very fine to fine grained sand, trace fine to coarse gravel, subrounded, well-sorted, orange and black mottling, non-plastic, soft, moist.
6					SW	(6.0 - 8.0) SW: WELL GRADED SAND WITH GRAVEL, very fine to coarse grained sand, and fine to coarse gravel, angular to subround, soft, dry.
			0.6	22		
8					SW	(8.0 - 10.0) SW: WELL GRADED SAND WITH GRAVEL, very fine to coarse grained sand, and fine to coarse gravel, angular to subround, soft, dry.
			0.8	16		
10					SW	(10.0 - 12.0) SW: WELL GRADED SAND WITH GRAVEL, very fine to coarse grained sand, and fine to coarse gravel, angular to subround, soft, dry. End of boring.
			0.4	14		
12						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
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SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-075**

TOTAL DEPTH: **16.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Matrix**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/19/2007**	Northing: **144245.60725** Surface: **835.34**
DATE COMPLETED: **9/19/2007**	Easting: **550679.29202**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.0	24	SM	(0.0 - 0.5) SM: FILL (SILTY SAND WITH GRAVEL), very fine to coarse grained sand, and fine gravel, angular, some silt, non-cohesive, moist.
					OH	(0.5 - 2.0) OH: ORGANIC SOIL, dark brown, organic rich clay, and very fine to coarse grained sand, medium plastic, soft, moist.
2			0.1	12	OH	(2.0 - 2.5) OH: ORGANIC SOIL, dark brown, organic rich clay, and very fine to coarse grained sand, medium plastic, soft, moist.
					CL	(2.5 - 4.0) CL: LEAN CLAY, brown, very fine to coarse grained sand, some fine gravel, subangular to subround, cohesive, medium plastic, hard, moist, orange mottling.
4			0.0	24	SM	(4.0 - 4.4) SM: SILTY SAND WITH GRAVEL, brown, very fine to coarse grained sand, some silt, some fine to coarse gravel, subangular to subround, up to 1.5", non-cohesive, non-plastic, wet, orange mottling.
					CH	(4.4 - 6.0) CH: SANDY FAT CLAY WITH GRAVEL, gray clay, and very fine to coarse grained sand, some fine to coarse gravel, angular to subangular, up to 1.75", cohesive, highly plastic, stiff, moist.
6			0.0	15	CH	(6.0 - 8.0) CH: SANDY FAT CLAY WITH GRAVEL, gray clay, and very fine to coarse grained sand, some fine to coarse gravel, angular to subangular, up to 1.75", cohesive, highly plastic, stiff, moist.
8			0.0	24	CH	(8.0 - 10.0) CH: SANDY FAT CLAY WITH GRAVEL, gray clay, and very fine to coarse grained sand, some fine to coarse gravel, angular to subangular, up to 1.75", cohesive, highly plastic, stiff, moist.
10			0.0	15	SP	(10.0 - 12.0) SP: POORLY GRADED SAND WITH GRAVEL, light brown, very fine to coarse grained sand, some fine to coarse gravel, rounded, up to 1.5", well sorted, soft, moist, non-cohesive.
12						

Notes:
bgs: below ground surface

MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector

Date: 10/24/2007
Page: 1 of 2

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-075**

TOTAL DEPTH: **16.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Matrix**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/19/2007**	Northing: **144245.60725** Surface: **835.34**
DATE COMPLETED: **9/19/2007**	Easting: **550679.29202**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
12			0.1	24	SP	(12.0 - 13.4) SP: POORLY GRADED SAND WITH GRAVEL, light brown, very fine to coarse grained sand, some fine to coarse gravel, rounded, up to 1.5", well sorted, soft, moist, non-cohesive.
					CH	(13.4 - 14.0) CH: SANDY FAT CLAY WITH GRAVEL, gray, very fine to coarse grained sand, some fine to coarse gravel, up to 1.75", subangular to subround, cohesive , highly plastic ,stiff, moist.
14			0.1	24	SP	(14.0 - 14.8) SP: POORLY GRADED SAND WITH GRAVEL, light brown, very fine to coarse grained sand, some fine gravel, rounded, up to 1.5", well sorted, soft, moist, non-cohesive.
					CL	(14.8 - 15.3) CL: LEAN CLAY, greenish gray, clay, orange mottling, stiff, moist.
					SM	(15.3 - 16.0) SM: SILTY SAND WITH GRAVEL, brown, very fine to coarse grained sand, some fine to coarse gravel, subangular to subround, up to 1.5", some silt, non-cohesive, non-plastic, stiff, wet.
16						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 2 of 2

SOIL BORING LOG

![ARCADIS logo]

WELL NO.: ASB-076

TOTAL DEPTH: 20.00 feet bgs

PROJECT INFORMATION

CLIENT:	**Ford Motor Company**
PROJECT:	**Twin Cities Assembly Plant**
SITE LOCATION:	**St. Paul Minnesota**
LOGGED BY:	**MM**
DATE STARTED:	**9/19/2007**
DATE COMPLETED:	**9/19/2007**

DRILLING INFORMATION

DRILLING CO.:	**Matrix Environmental, LLC**
DRILLER:	**Dan**
DRILLING METHOD:	**Direct Push**

COORDINATES: **ELEVATIONS (feet MSL):**

Northing: **144156.21776** Surface: **834.54**

Easting: **550692.50291**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			14.4	24	OH	(0.0 - 1.6) OH: FILL (ORGANIC SOIL), dark brown, organic rich clay, and very fine to coarse grained sand, some fine gravel, subangular to subround, cohesive, medium to high plasticity, plant root, soft, moist.
					SW-SM	(1.6 - 2.0) SW-SM: WELL GRADED SAND WITH SILT AND GRAVEL, strong brown, very fine to coarse grained sand, some fine to coarse gravel, subangular to subround, up to 1.5", little silt, non-plastic, soft.
2			13.0	15	SW-SM	(2.0 - 4.0) SW-SM: WELL GRADED SAND WITH SILT AND GRAVEL, strong brown, very fine to coarse grained sand, some fine to coarse gravel, subangular to subround, up to 1.5", little silt, non-plastic, soft.
4			9.0	24	SW-SM	(4.0 - 8.0) SW-SM: Slough.
6			20.9	24		
8			1.5	24	SP	(8.0 - 8.6) SP: Slough.
					SP	(8.6 - 10.0) SP: POORLY GRADED SAND, light brown, very fine to medium grained, moist.
10			0.3	20	SP	(10.0 - 12.0) SP: POORLY GRADED SAND, light brown, very fine to medium grained, well-sorted, brown, sand, non-cohesive, moist.
12					SP	(12.0 - 12.6) SP: Slough.

Notes:
bgs: below ground surface

MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector

Date: 10/24/2007
Page: 1 of 2

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-076**

TOTAL DEPTH: **20.00** feet bgs

PROJECT INFORMATION		DRILLING INFORMATION	
CLIENT:	**Ford Motor Company**	DRILLING CO.:	**Matrix Environmental, LLC**
PROJECT:	**Twin Cities Assembly Plant**	DRILLER:	**Dan**
SITE LOCATION:	**St. Paul Minnesota**	DRILLING METHOD:	**Direct Push**
LOGGED BY:	**MM**	COORDINATES:	ELEVATIONS (feet MSL):
DATE STARTED:	**9/19/2007**	Northing: **144156.21776**	Surface: **834.54**
DATE COMPLETED:	**9/19/2007**	Easting: **550692.50291**	

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
			0.2	24	SP	(12.6 - 14.0) SP: POORLY GRADED SAND, light gray, very fine to medium grained, non-cohesive, moist.
14			0.2	24	SP	(14.0 - 16.0) SP: POORLY GRADED SAND, light gray, very fine to medium grained, non-cohesive, moist. End of boring. Water at 15.5' feet.
16					UNKNOWN	(16.0 - 20.0) UNKNOWN: No recovery. End of boring. Water at 15.5'.
18						
20						

Notes:
bgs: below ground surface   MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch   Date: 10/24/2007
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector   Page: 2 of 2

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-077**

TOTAL DEPTH: **8.00** **feet bgs**

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/21/2007**
DATE COMPLETED: **9/21/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: **ELEVATIONS (feet MSL):**
Northing: **144658.45893** Surface: **846.67**
Easting: **550580.41017**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					OH	(0.0 - 0.6) OH: FILL (ORGANIC SOIL WITH SAND), dark brown, very fine to fine grained sand, very soft, plant roots, moist.
			0.2	24	CH	(0.6 - 2.0) CH: FAT CLAY, olive gray, trace very fine sand, high plasticity, hard, orange mottling, moist.
2			0.2	22	CH	(2.0 - 4.0) CH: FAT CLAY, olive gray, hard, trace very fine grained sand, high plasticity, orange mottling, moist, (7-24") trace coarse gravel, up to 1.5", subround.
4			0.3	24	CH	(4.0 - 6.0) CH: FAT CLAY, olive gray, hard, trace very fine grained sand, high plasticity, orange mottling, moist, (7-24") trace coarse gravel, up to 1.5", subround.
6			0.5	24	CH	(6.0 - 8.0) CH: FAT CLAY, olive gray, hard, trace very fine grained sand, high plasticity, orange mottling, moist, (7-24") trace coarse gravel, up to 1.5", subround. End of boring.
8						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-078**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION

CLIENT:	**Ford Motor Company**
PROJECT:	**Twin Cities Assembly Plant**
SITE LOCATION:	**St. Paul Minnesota**
LOGGED BY:	**MM**
DATE STARTED:	**9/21/2007**
DATE COMPLETED:	**9/21/2007**

DRILLING INFORMATION

DRILLING CO.:	**Matrix Environmental, LLC**
DRILLER:	**Dan**
DRILLING METHOD:	**Direct Push**

COORDINATES: ELEVATIONS (feet MSL):

Northing: **144553.15208**   Surface: **839.01**

Easting: **550573.96215**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.2	17	OH	(0.0 - 0.9) OH: FILL (ORGANIC SOIL WITH SAND), dark brown, very soft, some very fine to fine grained sand, plant roots, moist.
					CL	(0.9 - 2.0) CL: FILL (LEAN CLAY WITH SAND), greenish gray, stiff, medium plasticity, some very fine to fine grained sand, trace fine gravel, angular to subangular, orange mottling, moist.
2			---	0	CL	(2.0 - 4.0) CL: No recovery.
4			0.2	24	CL	(4.0 - 4.5) CL: Slough.
					CL	(4.5 - 5.3) CL: FILL (LEAN CLAY WITH SAND), greenish gray, stiff, medium plasticity, some very fine to fine grained sand, trace fine gravel, angular to subangular, orange mottling, moist.
					SW	(5.3 - 6.0) SW: WELL GRADED SAND WITH GRAVEL, brown, very fine to coarse grained, some fine gravel, subround to round, moist.
6			0.3	20	SW	(6.0 - 8.0) SW: WELL GRADED SAND WITH GRAVEL, brown, very fine to coarse grained, some fine gravel, subround to round, moist, some clay at 18-20".
8			0.3	24	SW	(8.0 - 8.8) SW: Slough.
					SC	(8.8 - 10.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.5", some clay nodules, orange mottling, moist.
10			0.3	20	SC	(10.0 - 12.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.5", some clay nodules, orange mottling, moist. End of boring.
12						

ARCADIS

SOIL BORING LOG

WELL NO.: **ASB-079**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/20/2007**	Northing: **144353.35188** Surface: **836.06**
DATE COMPLETED: **9/20/2007**	Easting: **550578.92444**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.1) SM: FILL (SILTY SAND), brown, very fine to coarse grained, soft, moist.
			1.5	24	OH	(0.1 - 1.6) OH: ORGANIC SOIL WITH SAND, dark brown, some very fine to fine grained sand, very soft, high plasticity, moist.
2					CL	(1.6 - 2.0) CL: SANDY FAT CLAY WITH GRAVEL, olive brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.25", high plasticity, moist.
			1.8	10	SM	(2.0 - 4.0) SM: SILTY SAND WITH GRAVEL, brown, very fine to coarse grained, some silt, some fine to coarse gravel, up to 1.25", subround to round, moist, native.
4			1.8	24	SM	(4.0 - 6.0) SM: SILTY SAND, brown, very fine to coarse grained, little silt, some fine to coarse gravel, up to 1.80", subround to round, moist, native.
6			1.9	21	CL	(6.0 - 8.0) CL: LEAN CLAY WITH SAND, olive brown, hard, some very fine to fine grained sand, trace coarse gravel, up to 1.25", subrounded, medium plasticity, moist, native.
8			0.9	24	CL	(8.0 - 9.7) CL: LEAN CLAY WITH SAND, olive brown, hard, some very fine to fine grained sand, trace coarse gravel, up to 1.25", subrounded, medium plasticity, moist, native.
					SW-SM	(9.7 - 10.0) SW-SM: WELL GRADED SAND WITH SILT AND GRAVEL, brown, very fine to coarse grained, some fine to coarse gravel, up to 1.25", subround to round, little silt, non-cohesive, orange mottling, moist, native.
10			0.7	24	SW-SM	(10.0 - 12.0) SW-SM: LEAN CLAY WITH SAND, olive brown, hard, some very fine to fine grained sand, trace coarse gravel, up to 1.25", subrounded, medium plasticity, moist, native. End of boring.
12						

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-080**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION

CLIENT:	**Ford Motor Company**
PROJECT:	**Twin Cities Assembly Plant**
SITE LOCATION:	**St. Paul Minnesota**
LOGGED BY:	**MM**
DATE STARTED:	**9/20/2007**
DATE COMPLETED:	**9/20/2007**

DRILLING INFORMATION

DRILLING CO.:	**Matrix Environmental, LLC**
DRILLER:	**Dan**
DRILLING METHOD:	**Direct Push**

COORDINATES: ELEVATIONS (feet MSL):

Northing: **144249.86479**   Surface: **835.18**

Easting: **550581.52688**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0–2			0.9	24	OH	(0.0 - 1.8) OH: FILL (ORGANIC SOIL WITH SAND), dark brown, soft, some fine to coarse grained sand, subround to round, trace fine gravel, moist, high plasticity.
					CL	(1.8 - 2.0) CL: SANDY LEAN CLAY, stiff, brown, very fine to coarse grained sand, little fine to coarse gravel, up to 1.25", sub-round, low plasticity, orange mottling, moist, native.
2–4			1.1	18	CL	(2.0 - 4.0) CL: SANDY LEAN CLAY, stiff, brown, very fine to coarse grained sand, little fine to coarse gravel, up to 1.25", sub-round, low plasticity, orange mottling, moist, native.
4–6			1.2	24	CL	(4.0 - 6.0) CL: LEAN CLAY WITH SAND, hard, olive gray, some very fine to fine grained sand, little fine gravel, subround to round, medium plasticity, orange mottling, crumbly.
6–8			0.9	24	SW-SM	(6.0 - 8.0) SW-SM: WELL GRADED SAND WITH SILT, brown, very fine to coarse grained, some fine to coarse gravel, up to 1.25", subround to round, little silt, orange mottling, dry.
8–10			0.1	24	SW-SM	(8.0 - 10.0) SW-SM: WELL GRADED SAND WITH SILT, brown, very fine to coarse grained, some fine to coarse gravel, up to 1.25", subround to round, little silt, orange mottling, dry.
10–12			0.6	14	SW-SM	(10.0 - 12.0) SW-SM: WELL GRADED SAND WITH SILT, brown, very fine to coarse grained, some fine to coarse gravel, up to 1.25", subround to round, little silt, orange mottling, dry. Bedrock at bottom. End of boring.

Notes:
bgs: below ground surface   MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch   Date: 10/24/2007
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector   Page: 1 of 1

ARCADIS

SOIL BORING LOG

WELL NO.: **ASB-081**

TOTAL DEPTH: **8.00** **feet bgs**

PROJECT INFORMATION		DRILLING INFORMATION	
CLIENT:	**Ford Motor Company**	DRILLING CO.:	**Matrix Environmental, LLC**
PROJECT:	**Twin Cities Assembly Plant**	DRILLER:	**Dan**
SITE LOCATION:	**St. Paul Minnesota**	DRILLING METHOD:	**Direct Push**
LOGGED BY:	**MM**	**COORDINATES:**	**ELEVATIONS (feet MSL):**
DATE STARTED:	**9/20/2007**	**Northing: 144155.71276**	**Surface: 833.65**
DATE COMPLETED:	**9/20/2007**	**Easting: 550579.90114**	

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.5	24	OH	(0.0 - 1.1) OH: FILL (ORGANIC SOIL WITH SAND), dark brown, very soft, some very fine to fine grained sand, high plasticity, plant roots, moist.
					CL	(1.1 - 1.3) CL: SANDY LEAN CLAY WITH GRAVEL, very soft, brown, very fine to coarse grained, some fine gravel, subround, medium plasticity, orange mottling, moist, native.
2					CL	
			0.6	24	CH	(1.3 - 2.0) CL: LEAN CLAY WITH SAND, stiff, gray, some very fine to medium grained sand, some fine to coarse gravel, subround to round, up to 1.25", medium plasticity, orange mottling, moist, native.
						(2.0 - 4.0) CH: FAT CLAY, stiff, greenish gray, trace very fine grained sand, high plasticity, trace silt, fissile, very fine sand pockets at 11' and 15', moist, native.
4					CH	(4.0 - 4.8) CH: Slough.
			0.9	24	CL	(4.8 - 6.0) CL: LEAN CLAY, very hard, crumbly, low plasticity, orange mottling, fissle, dry.
6					CL	(6.0 - 7.3) CL: LEAN CLAY, very hard, crumbly, low plasticity, trace coarse gravel, up to 1.25", orange mottling, fissle, dry.
			1.1	24		
8					BEDROCK	(7.3 - 8.0) BEDROCK: SHALE. End of boring.

Notes:
bgs: below ground surface   MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch   Date: 10/24/2007
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector   Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-082**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/20/2007**	Northing: **144054.01678** Surface: **832.14**
DATE COMPLETED: **9/20/2007**	Easting: **550561.55571**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.5	24	SM	(0.0 - 0.6) SM: FILL (SILTY SAND), brown, soft, very fine to coarse grained, some silt, moist.
					OH	(0.6 - 1.1) OH: FILL (ORGANIC SOIL), soft, dark brown, very fine to fine grained sand, high plasticity, plant roots, trace wood particle.
					SM	
2					SM	(1.1 - 2.0) SM: FILL (SILTY SAND), soft, brown, very fine to coarse grained sand, some silt, some fine to coarse gravel, up to 1.5",subround to angular, moist, 21-24' sandy clay:gray, orange mottling, stiff.
			0.6	11	SW	
					CL	(2.0 - 2.3) SW: WELL GRADED SAND, soft, light gray, very fine to coarse grained, trace fine to coarse gravel, up to 1.25", angular to subangular, trace silt, dry, native.
4						(2.3 - 4.0) CL: LEAN CLAY, hard, greenish gray, trace very fine grained sand, crumbly, orange mottling, moist, native.
			0.8	24	CL	(4.0 - 4.2) CL: LEAN CLAY, hard, greenish gray, trace very fine grained sand, crumbly, orange mottling, moist, native.
					SM	
					CL	(4.2 - 4.8) SM: SILTY SAND, soft, light brown, very fine to coarse grained, some silt, little fine to coarse gravel, up to 1.25", subround to round, very moist, native.
6					BEDROCK	(4.8 - 6.0) CL: LEAN CLAY, hard, greenish gray, trace very fine grained sand, crumbly, orange mottling, moist, native.
			---	14		(6.0 - 8.0) BEDROCK: SHALE, fractured. End of boring.
8						

Notes:
bgs: below ground surface   MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
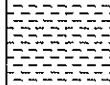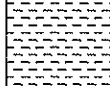Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-083**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/21/2007**
DATE COMPLETED: **9/21/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: ELEVATIONS (feet MSL):
Northing: **144660.65898** Surface: **841.41**
Easting: **550480.30757**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.2	24	OH	(0.0 - 1.7) OH: FILL (ORGANIC SOIL WITH SAND), brown, very soft, some very fine to fine grained sand, high plasticity, plant roots, moist.
					CL	(1.7 - 2.0) CL: SANDY LEAN CLAY, hard, olive brown, very fine to fine grained, medium plasticity, orange mottling, moist, native.
2			0.2	24	CL	(2.0 - 4.0) CL: SANDY LEAN CLAY, hard, olive brown, very fine to fine grained, medium plasticity, orange mottling, moist, native.
4			0.3	24	CL	(4.0 - 5.2) CL: SANDY LEAN CLAY, hard, olive brown, very fine to fine grained, medium plasticity, trace coarse gravel, up to 2", subround, orange mottling, moist, native.
					SC	(5.2 - 6.0) SC: CLAYEY SAND, soft, brown, very fine to coarse grained, moist.
6			0.3	19	SC	(6.0 - 8.0) SC: CLAYEY SAND, soft, brown, very fine to coarse grained, trace coarse gravel, up to 1.5", sub-round, moist. End of boring.
8						

Notes:
bgs: below ground surface
MSL: Mean Sea Level AMW: ARCADIS Monitoring Well in.: inch
TOC: Top of Casing ppm: parts per million PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-084**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/21/2007**
DATE COMPLETED: **9/21/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: ELEVATIONS (feet MSL):
Northing: **144557.80776** Surface: **837.16**
Easting: **550479.54029**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.2	24	OH	(0.0 - 0.8) OH: FILL (ORGANIC SOIL WITH SAND), stiff, dark brown, some very fine to fine grained sand, trace fine gravel, subrounded, high plasticity, moist.
					CL	(0.8 - 1.4) CL: LEAN CLAY WITH SAND, hard, greenish gray, some very fine to fine grained sand, trace fine to coarse gravel, subangular, up to 1.25", medium plasticity, moist.
					OH	
2			0.2	4	CL	(1.4 - 2.0) OH: ORGANIC SOIL WITH SAND, very soft, dark brown, some very fine to fine grained sand, trace fine to coarse gravel, subangular, up to 1.25", high plasticity, moist.
						(2.0 - 4.0) CL: SANDY LEAN CLAY, soft, brown, very fine to medium grained, medium plasticity, moist.
4			0.2	24	CL	(4.0 - 4.5) CL: Slough.
					SC	(4.5 - 6.0) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some fine gravel, subangular to subround, moist.
6			0.2	24	SC	(6.0 - 7.1) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some fine gravel, subangular to subround, moist.
					SP	(7.1 - 8.0) SP: POORLY GRADED SAND, soft, light brown, very fine to fine grained, well sorted, moist.
8			---	24	SP	(8.0 - 10.0) SP: Slough.
10			0.2	24	SP	(10.0 - 12.0) SP: POORLY GRADED SAND, soft, light brown, very fine to fine grained, well sorted, coarsening downward, moist. End of boring.
12						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well
TOC: Top of Casing   ppm: parts per million
in.: inch
PID: Phot-ionization Detector
Date: 10/24/2007
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SOIL BORING LOG

ARCADIS

WELL NO.:	**ASB-085**
TOTAL DEPTH:	**8.00** feet bgs

PROJECT INFORMATION

CLIENT:	**Ford Motor Company**
PROJECT:	**Twin Cities Assembly Plant**
SITE LOCATION:	**St. Paul Minnesota**
LOGGED BY:	**MM**
DATE STARTED:	**9/21/2007**
DATE COMPLETED:	**9/21/2007**

DRILLING INFORMATION

DRILLING CO.:	**Matrix Environmental, LLC**
DRILLER:	**Dan**
DRILLING METHOD:	**Direct Push**

COORDINATES: **ELEVATIONS (feet MSL):**
Northing: 144458.93998   Surface: 835.92
Easting: 550477.4137

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.2	24	OH	(0.0 - 0.4) OH: FILL (ORGANIC SOIL WITH SAND), very soft, dark brown, very fine to coarse grained, high plasticity, plant roots, moist.
					CH	(0.4 - 0.8) CH: FILL (FAT CLAY WITH SAND), hard, greenish gray, some very fine to fine grained sand, high plasticity, bone fragment at 0.75", moist.
					OH	(0.8 - 2.0) OH: ORGANIC SOIL WITH SAND, very soft, dark brown, very fine to coarse grained, high plasticity, moist.
2			0.3	7	SP	(2.0 - 2.8) SP: POORLY GRADED SAND, brown, very fine to fine grained, well sorted, trace coarse gravel, up to 1.75", moist.
					CL	(2.8 - 4.0) CL: SANDY LEAN CLAY, soft, brown, very fine grained sand, orange mottling, moist.
4			0.3	24	SP	(4.0 - 4.3) SP: Slough.
					SC	(4.3 - 6.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.5", some clay nodules, orange mottling, moist.
6			0.4	24	SC	(6.0 - 8.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.5", some clay nodules, orange mottling, moist. End of boring
8						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
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SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-086**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/20/2007**	Northing: **144361.00958** Surface: **834.55**
DATE COMPLETED: **9/20/2007**	Easting: **550481.23651**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.8) SM: FILL (SILTY SAND), very soft, brown, very fine to coarse grained, trace silt, moist, ballfield sand.
			1.8	24	OH	(0.8 - 2.0) OH: FILL (ORGANIC SOIL), dark brown, high plasticity, trace fine grained sand, moist.
2						(2.0 - 2.4) CH: SANDY FAT CLAY, stiff, olive green, very fine to fine grained, high plasticity, orange mottling, moist.
					CH	
			2.7	11	SM	(2.4 - 4.0) SM: SILTY SAND WITH GRAVEL, very fine to coarse grained, some silt, some fine to coarse gravel, subangular to subround, up to 0.75", moist.
4					SM	(4.0 - 4.5) SM: Slough.
			2.4	24	SC	(4.5 - 6.0) SC: CLAYEY SAND WITH GRAVEL, dark brown, very fine to medium grained, some clay, little fine to coarse gravel, up to 1.25", sub-angular to sub-round, moist.
6					SC	(6.0 - 8.0) SC: CLAYEY SAND WITH GRAVEL, strong brown, very fine to medium grained, some fine to coarse gravel, subangular to subround, up to 1.25", some clay, moist. Refusal at 7.7'. End of boring.
			0.9	8		
8						

Notes:
bgs: below ground surface

MSL: Mean Sea Level
TOC: Top of Casing

AMW: ARCADIS Monitoring Well
ppm: parts per million

in.: inch
PID: Phot-ionization Detector

Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

WELL NO.: **ASB-087**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION

CLIENT:	**Ford Motor Company**
PROJECT:	**Twin Cities Assembly Plant**
SITE LOCATION:	**St. Paul Minnesota**
LOGGED BY:	**MM**
DATE STARTED:	**9/20/2007**
DATE COMPLETED:	**9/20/2007**

DRILLING INFORMATION

DRILLING CO.:	**Matrix Environmental, LLC**
DRILLER:	**Dan**
DRILLING METHOD:	**Direct Push**

COORDINATES: **ELEVATIONS (feet MSL):**

Northing: **144160.88041** Surface: **831.55**

Easting: **550459.72489**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			1.7	24	OH	(0.0 - 1.8) OH: FILL (ORGANIC SOIL), very soft, dark brown, some very fine to medium grained sand, trace fine gravel, subround to round, high plasticity, some plant roots, moist.
2					SW	(1.8 - 2.0) SW: WELL GRADED SAND WITH GRAVEL, very fine to coarse grained sand, coarse gravel, subround, up to 1.75", moist.
			---	0	SW	(2.0 - 4.0) SW: NO RECOVERY.
4			0.8	24	SM	(4.0 - 7.3) SM: SILTY SAND, soft, brown, very fine to coarse grained, some silt, trace fine gravel, subround to round, moist.
6			1.0	24		
8					BEDROCK	(7.3 - 8.0) BEDROCK: WEATHERED SHALE, gray. Water at 7'. End of boring.

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-088**

TOTAL DEPTH: **12.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	**COORDINATES:** **ELEVATIONS (feet MSL):**
DATE STARTED: **9/21/2007**	Northing: **144663.9696** Surface: **837.85**
DATE COMPLETED: **9/21/2007**	Easting: **550380.55026**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			0.6	24	OH	(0.0 - 2.0) OH: FILL (ORGANIC SOIL), very soft, dark brown, some very fine to fine grained sand, high plasticity, plant roots, moist.
2			10.2	9	SP-SC	(2.0 - 4.0) SP-SC: FILL (POORLY GRADED SAND WITH CLAY AND GRAVEL), brown, very fine to fine grained, well sorted, little clay, some fine to coarse gravel, subangular to subround, up to 1.25", moist.
4					SP-SC	(4.0 - 4.7) SP-SC: Slough.
			8.5	24	SP-SC	(4.7 - 6.0) SP-SC: POORLY GRADED SAND WITH CLAY AND GRAVEL, brown, very fine to medium grained, well sorted, little clay, some fine to coarse gravel, subangular to subround, up to 1.25", moist.
6			6.3	20	SP-SC	(6.0 - 7.1) SP-SC: POORLY GRADED SAND WITH CLAY AND GRAVEL, brown, very fine to fine grained, well sorted, little clay, some fine to coarse gravel, subangular to subround, up to 1.25", moist.
					SC	(7.1 - 8.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, some greenish gray clay, some fine to coarse gravel, subangular to subround, up to 1.25", some orange mottling, moist.
8			3.4	24	SC	(8.0 - 10.0) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, some greenish gray clay, some fine to coarse gravel, subangular to subround, up to 1.25", some orange mottling, moist.
10					SC	(10.0 - 10.8) SC: CLAYEY SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, some greenish gray clay, some fine to coarse gravel, subangular to subround, up to 1.25", some orange mottling, moist.
			4.6	15	CH	(10.8 - 12.0) CH: FAT CLAY, very hard, greenish gray, trace very fine grained sand, moist. End of boring.
12						

Notes:
bgs: below ground surface

MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector

Date: 10/24/2007
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SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-089**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/21/2007**	Northing: **144552.11495** Surface: **834.72**
DATE COMPLETED: **9/21/2007**	Easting: **550376.59556**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.3) SM: FILL (SILTY SAND), soft, brown, very fine to coarse grained, some silt, moist.
			0.1	24	OH	(0.3 - 1.1) OH: FILL (ORGANIC SOIL), dark brown, some very fine to fine grained sand, high plasticity, moist.
					SC	(1.1 - 1.9) SC: FILL (CLAYEY SAND WITH GRAVEL), brown,very fine to coarse grained, some fine to coarse gravel, angular to subangular, up to 1.25", some clay, moist,
2					SP	
			0.1	15	SP	(1.9 - 2.0) SP: FILL (POORLY GRADED SAND), brown, very fine to fine grained, well sorted, orange mottling, moist.
						(2.0 - 4.0) SP: POORLY GRADED SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, fine to coarse gravel, sub-angular to sub-round, up to 1.25", orange mottling, moist.
4					SP	
			0.5	24		(4.0 - 6.0) SP: POORLY GRADED SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, fine to coarse gravel, sub-angular to sub-round, up to 1.25", orange mottling, moist.
6					SP	(6.0 - 7.8) SP: POORLY GRADED SAND WITH GRAVEL, brown, very fine to fine grained, well sorted, fine to coarse gravel, sub-round to round, up to 1.5", orange mottling, moist.
			0.9	24		
8					BEDROCK	(7.8 - 8.0) BEDROCK: SHALE. End of boring.

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 11/2/2007
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SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-090**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/20/2007**
DATE COMPLETED: **9/20/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: ELEVATIONS (feet MSL):
Northing: **144361.43553** Surface: **833.38**
Easting: **550391.09682**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					SM	(0.0 - 0.6) SM: FILL (SILTY SAND), soft, brown, very fine to coarse grained, some silt, moist.
			2.8	24	CH	(0.6 - 1.4) CH: SANDY FAT CLAY, soft, dark gray, high plasticity, trace fine gravel, angular, moist.
					CH	(1.4 - 2.0) CH: SANDY FAT CLAY, stiff, olive gray, some very fine to coarse grained sand, orange mottling, moist.
2					CH	(2.0 - 4.0) CH: SANDY FAT CLAY, stiff, olive gray, some very fine to coarse grained sand, orange mottling, moist.
			4.4	7		
4			5.9	24	CH	(4.0 - 6.0) CH: SANDY FAT CLAY, stiff, olive gray, some very fine to coarse grained sand, orange mottling, trace fine gravel, sub-angular, moist.
6			---	24	BEDROCK	(6.0 - 8.0) BEDROCK: SHALE. End of boring.
8						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-091**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/21/2007**
DATE COMPLETED: **9/21/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: ELEVATIONS (feet MSL):
Northing: **144660.94899** Surface: **835.16**
Easting: **550285.47287**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					OH	(0.0 - 1.3) OH: FILL (ORGANIC SOIL), dark brown, very soft, high plasticity, some very fine to fine grained sand, plant roots, moist.
			1.1	24	CH	(1.3 - 1.8) CH: FILL (FAT CLAY WITH SAND), soft, olive brown, little very fine to fine grained sand, high plasticity, moist.
2					CH	(1.8 - 2.0) CH: SANDY FAT CLAY, very soft, yellow brown, very fine to fine grained, low plasticity, moist.
			1.0	13	SC	(2.0 - 4.0) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some clay, some fine to coarse gravel, subangular to subround, up to 1.5", moist.
4					SC	(4.0 - 4.4) SC: Slough.
			1.5	24	SC	(4.4 - 6.0) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some clay, some fine to coarse gravel, subangular to subround, up to 1.5", moist.
6					SC	(6.0 - 6.5) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some clay, some fine to coarse gravel, subangular to subround, up to 1.5", moist.
			1.0	21	BEDROCK	(6.5 - 8.0) BEDROCK: SHALE. End of boring.
8						

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-092**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION	DRILLING INFORMATION
CLIENT: **Ford Motor Company**	DRILLING CO.: **Matrix Environmental, LLC**
PROJECT: **Twin Cities Assembly Plant**	DRILLER: **Dan**
SITE LOCATION: **St. Paul Minnesota**	DRILLING METHOD: **Direct Push**
LOGGED BY: **MM**	COORDINATES: ELEVATIONS (feet MSL):
DATE STARTED: **9/21/2007**	Northing: **144558.47885** Surface: **833.13**
DATE COMPLETED: **9/21/2007**	Easting: **550280.40441**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0					OH	(0.0 - 1.0) OH: FILL (ORGANIC SOIL), very soft, brown, very fine to fine grained, high plasticity, plant roots, moist.
			0.3	24	CH	(1.0 - 2.0) CH: GRAVELLY FAT CLAY soft, olive green, fine gravel, subangular to subround, some very fine to fine grained sand, high plasticity, orange mottling, moist.
2			0.4	24	CH	(2.0 - 4.0) CH: GRAVELLY FAT CLAY, hard, olive, stiff to hard orange mottling, high plasticity, moist.
4			0.6	24	CH CH	(4.0 - 4.3) CH: Slough. (4.3 - 6.0) CH: FAT CLAY, hard, olive, stiff to hard orange mottling, high plasticity, moist.
6			0.3	24	CH	(6.0 - 8.0) CH: FAT CLAY, olive, stiff to hard, trace fine gravel, angular, orange mottling, high plasticity, moist. End of boring.
8						

Notes:
bgs: below ground surface   MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch   Date: 10/24/2007
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector   Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-093**

TOTAL DEPTH: **8.00** feet bgs

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/20/2007**
DATE COMPLETED: **9/20/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: ELEVATIONS (feet MSL):
Northing: **144546.95966** Surface: **830.72**
Easting: **550170.76493**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			1.6	24	OH	(0.0 - 1.0) OH: FILL (ORGANIC SOIL), very soft, dark brown, some very fine grained sand, high plasticity, moist.
					SC	(1.0 - 2.0) SC: CLAYEY SAND WITH GRAVEL, soft, brown, very fine to coarse grained, some fine to coarse gravel, subangular to subround, up to 1.75", some clay, moist.
2			1.2	15	CH	(2.0 - 4.0) CH: FAT CLAY, hard, high plasticity, orange mottling, plant particles, moist.
4			---	24	CH	(4.0 - 5.8) CH: Slough.
6			---	24	CH	(5.8 - 6.0) CH: FAT CLAY, hard, high plasticity, orange mottling, plant particles, moist.
					CH	(6.0 - 6.8) CH: FAT CLAY, hard, high plasticity, orange mottling, plant particles, moist.
8			---	24	BEDROCK	(6.8 - 8.0) BEDROCK: SHALE, gray. End of boring.

Notes:
bgs: below ground surface
MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector
Date: 10/24/2007
Page: 1 of 1

SOIL BORING LOG

ARCADIS

WELL NO.: **ASB-094**

TOTAL DEPTH: **8.00** **feet bgs**

PROJECT INFORMATION

CLIENT: **Ford Motor Company**
PROJECT: **Twin Cities Assembly Plant**
SITE LOCATION: **St. Paul Minnesota**
LOGGED BY: **MM**
DATE STARTED: **9/20/2007**
DATE COMPLETED: **9/20/2007**

DRILLING INFORMATION

DRILLING CO.: **Matrix Environmental, LLC**
DRILLER: **Dan**
DRILLING METHOD: **Direct Push**
COORDINATES: **ELEVATIONS (feet MSL):**
Northing: **144425.85282** Surface: **830.51**
Easting: **550222.72539**

DEPTH (feet)	SOIL SYMBOLS	BLOWS (\6 inches)	PID (ppm)	RECOVERY (in.)	USCS/ STRATIGRAPHIC UNITS	SOIL DESCRIPTION
0			1.5	24	OH	(0.0 - 1.3) OH: FILL (ORGANIC SOIL), soft, dark brown, very fine to fine grained, high plasticity, plant roots, moist.
					CH	(1.3 - 1.8) CH: FAT CLAY, very soft, some grainy silt, high plasticity, moist.
2					SM	(1.8 - 2.0) SM: SILTY SAND, soft, gray, some silt, well sorted, moist.
			2.0	13	CH	(2.0 - 4.0) CH: FAT CLAY, hard, greenish gray, high plasticity, coarse gravel and very fine to coarse grained sand from 4-8', orange mottling, moist.
4			1.1	24	SC	(4.0 - 5.1) SC: CLAYEY SAND, brown, very fine to fine grained, some clay, very moist.
					CH	(5.1 - 6.0) CH: FAT CLAY, dark brown, little very fine grained sand, high plasticity, moist.
6			---	24	BEDROCK	(6.0 - 8.0) BEDROCK: WEATHERED SHALE. End of boring.
8						

Notes:
bgs: below ground surface

MSL: Mean Sea Level   AMW: ARCADIS Monitoring Well   in.: inch
TOC: Top of Casing   ppm: parts per million   PID: Phot-ionization Detector

Date: 10/24/2007
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ARCADIS

Appendix C

Analytical Laboratory Reports

ARCADIS

Appendix D

Summary of Background Soil Data
for Arsenic, Copper and Iron

Appendix D:
Summary of Background Soil Data for Arsenic, Copper and Iron, Twin Cities Assembly Plant, St. Paul, Minnesota

Chemical Analyses of Soils and Other Surficial Materials of the Conterminous United States. By JG Boerngen and HT Shacklette, 1981, Open-File Report 81-197.
The proposed sampling intensity consisted of one sample of soil and one of plants collected at sites about 50 miles along routes of travel to areas of other types of field study. Sampling sites selected, insofar as possible, represented soil in its natural condition.
Most samples were collected at a depth of about 8 inches which reduced or avoided the effects of surface contamination.
Bismuth, cadmium, praseodymium, and silver were found infrequently in measurable concentrations in the samples. [No measureable concentrations were reported in Minnesota].

Sample No.	County	Latitude	Longitude	Date Collected (mon/yr)	Site and Soil Description	As (mg/kg)	Cu (mg/kg)	Fe (mg/kg)
GC247050	Aitkin	47 0	93 0	Aug-66	US Highway 7 at State Route 34 junction. Soil not described	2.6	10	15000
GC027550	Anoka	45 12	93 7	Jun-72	Interstate Highway 35W and US Highway 8 near Lino Lakes. Soil - dark brown loam	1.7	5	10000
GC086250	Benton	45 45	93 58	May-75	County Road 25 one mile northwest of Gilman. Soil - milan fine sandy loam.	9.6	15	20000
GC055450	Brown	43 57	94 42	May-70	US Highway 14 two miles east of Sleepy Eye. Soil - black prairie.	4.6	15	15000
GC2247150	Cass	46 25	93 50	Aug-66	State Route 34 in Remer. Soil not described.	2	15	10000
GC247250	Cass	46 30	94 45	Aug-66	State Route 34 0.7 miles west of the center of Walker. Soil not described.	2.2	10	20000
GC084650	Chippewa	45 7	95 45	May-75	Junction of County Roads 29 and 40 nine miles east of Milan. Soil - neque silty clay loam.	10.4	20	20000
GC056150	Chisago	45 24	92 55	May-70	1.5 miles north of Lindstrom. Soil - brown sandy.	2.9	7	15000
GC247350	Clay	46 55	96 35	Aug-66	US Highway 10 one mile west of Glyndon in beet field. Soil not described.	10	15	15000
GC087950	Cook	47 56	90 18	Jul-75	On Gunflint Trail 17 miles north of Grand Marais. Soil - light brown loam.	3.1	20	50000
GC035950	Crow Wing	45 58	94 6	May-70	US Highway 210 three miles east of Brainerd. Soil - yellow sand.	2.8	3	10000
GC047050	Fillmore	43 35	92 4	Jul-62	County Road 1.2 miles west of Junction with US Highway 52 1.4 miles north of Harmony. Soil - dark friable.	7.1	10	30000
GC027350	Freeborn	43 48	93 19	Jun-72	Interstate Highway 35 north of Clarks Grove south end of Geneva Lake. Soil - black prairie.	3.6	30	20000
GC048051	Houston	43 46	91 18	Jul-61	US Highway 16 three miles east of Hokah. Soil - light yellowish, sandy.	5.8	NA	7000
GC087350	Kittson	48 46	96 52	Jun-75	Northeast of Hallock; Section 16, 2.5 miles east of T161N, R37W. Soil - black organic.	4.6	15	15000
GC084750	Koochiching	47 55	94 12	May-75	At Mizpah. Soil - poorly drained loam.	4	5	15000
GC084850	Koochiching	48 37	92 54	May-75	Two miles west of Birchdale. Soil - very poorly drained organic soil.	0.5	2	500
GC087850	Lake	47 50	91 40	Jul-75	Off State Route 1 sixteen miles southeast of Ely. Soil - light brown loam.	2	700	50000
GC055350	Lyon	43 53	96 4	May-70	US Highway 14 three miles east of Florence. Soil - dark prairie over till.	9.7	15	20000
GC087250	Mahnomen	47 7	95 34	Jun-75	Little Elbow Lake on the White Earth Indiam Reservation. Soil - brownish gray clay.	6.4	15	30000
GC067750	Martin	43 39	94 44	Jun-72	US Highway 16 one-quarter mile west of Sherburn. Soil - dark prairie loam.	5.1	30	20000
GC095550	McLeod	44 13	94 20	May-70	State Route 15 three miles north of McLeod county line. Soil - black prairie.		10	15000
GC055650	Meeker	44 45	94 45	May-70	US Highway 12 three miles west of Grove City. Soil - black prairie.	15	15	20000
GC067850	Nobles	43 33	95 40	Jun-72	State Route 60 four miles north of Bigelow. Soil - dark brown prairie loam	11	50	30000
GC266850	Norman	47 25	96 45	Aug-68	Five miles east of US Highway 75 and 2 miles south of Shelly. Soil - lacustrine gray clay 8 - 10 inch depth.	13	70	30000
GC087750	Pennington	47 58	95 42	Jun-75	Three miles east of Roland. Soil - organic and sandy soil, Roliss series	2.7	7	15000
GC087650	Pine	46 5	92 44	Jul-75	County road eight miles east of Sandstone. Soil - yellow loam	3.4	10	20000
GC266750	Red Lake	47 54	96 30	Aug-68	County road two miles southwest of Dorothy. Soil - sandy with abundant organic matter.	7.3	7	15000
GC027450	Rice	44 27	93 16	Jun-72	County road 19 near Northfield exit Interstate Highway 35. Soil - brown forest soil.	4.6	30	20000
GC087450	Roseau	48 47	95 20	Jun-75	Eight miles south of Warroad. Soil - gray sandy soil, Spooner series.	0.9	5	7000
GC084950	St. Louis	47 32	92 54	May-75	County road northwest of Chisholm. Soil - moderately well drained loamy soil.	1.1	7	20000
GC087750	St. Louis	47 14	92 0	Jul-75	County road ten miles west of Brimson. Soil - reddish-brown blocky loam.	3.2	20	30000
GC055750	Stearns	45 4	95 0	May-70	US Higway 71 two miles north of Belgrade. Soil - dark brown sandy soil.	3.8	10	20000
GC086350	Steele	44 3	93 14	May-75	One mile south of Owatonna. Soil - Loess, Hapludalf	4.2	10	13000
GC055850	Todd	45 42	94 56	May-70	US Highway 71 two miles north of Browerville. Soil - yellow sandy soil.	2.4	7	15000
GC088050	Traverse	46 0	96 24	Jul-75	Two miles west of Tintah. Soil - dark blocky clay loam.	1.4	30	15000
GC086550	Wright	40 29	93 12	Aug-69	County road one mile north of US Highway 136, four and a-half miles east of Lucerne. Soil - prairie soil at 12 inch depth.	5.6	15	30000

Total number of samples	37	36	37
Number of samples with detectable levels	36	36	37
Number of non-detects	0	0	0
Percent Non-detects	0.00%	0.00%	0.00%
Minimum **DETECTED** Value	0.5	2	500
Maximum **DETECTED** Value	15	700	50000
Average **DETECTED** Value	5.01	35.00	19527.03
Geometric Mean **DETECTED** Value	3.85	13.67	16464.31

NA - Not analyzed
ND - Not detected

Use of detect values only will overestimate average

Stats using MTCASTAT (Used 1/2 DL for nondetect values)

Mean	5.495	35	19527.027
Lognormal Mean	5.655	22.646	21620.062
Median	4	15	20000
UCL Mean	7.62	33.54	22355.26
Type of distribution	lognormal	? Used log	? Used norm

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Appendix E

Statistical Analysis of Surface Soil
Samples

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Appendix E
Statistical Analysis of Surface Soil
Samples

Twin Cities Assembly Plant (TCAP)
966 South Mississippi Boulevard
St. Paul, Minnesota

Statistical Analysis of Surface Soil Samples

Overview of Statistical Evaluation of Feature 139 and Background Soil Data

A statistical evaluation of Feature 139 and background soil data was performed using methods consistent with guidance from the Minnesota Pollution Control Agency (MPCA) (1999) and the United States Environmental Protection Agency (USEPA) (1989; 1992; 2000; 2002; 2006). Background data sets were compiled from soil samples collected from 37 counties in Minnesota between 1961 and 1975 from sites that, to the extent possible, represented soil in its natural condition (Boerngen and Shacklette 1981).

Summary Statistics

Summary statistics for metal concentrations in Feature 139 and background soils are presented in Table 8 of the main report and include frequency of detection (FOD), minimum, maximum, median, arithmetic mean, standard deviation, geometric mean, geometric standard deviation, coefficient of variation, distribution of the data, 95 percent upper confidence limit (UCL) on the mean concentration (95% UCL), 95 percent upper prediction limit (95% UPL), 95 percent upper tolerance limit (for the 95th percentile) (95/95 UTLs), and potential outliers. Data sets evaluated in this analysis did not include nondetects (i.e., FOD =100%). Upper tolerance limits (UTLs) were also calculated for metal concentrations in background soils. A tolerance limit is a confidence limit on a percentile of the data. The one-sided UTL is a value that is larger than a proportion of the population with a specified level of confidence. For example, a 95 percent one-sided confidence limit for 95 percent coverage (95/95 UTL) represents the value below which 95 percent of the population is expected to fall with 95 percent confidence. A 95 percent upper prediction limit (UPL) is sometimes referred to as yet another alternative for representing a high-end concentration for background data (United States Environmental Protection Agency 2007a). A prediction limit is a concentration that is unlikely to be exceeded if additional samples were collected in the future. For this assessment, the most relevant summary statistic for point-by-point comparisons of site data to background is the 95/95 UTL. The 95% UCL and 95% UPL are also presented for information purposes only. Summary statistics were calculated using ProUCL 4.0 (United States Environmental Protection Agency 2007b) and the recommendations provided in the associated technical documentation (United States Environmental Protection Agency 2007a,c). Exhibit E-1 provides the output from ProUCL 4.0 for the calculations of 95% UCLs. Exhibit E-2 provides the output from ProUCL 4.0 for the calculations of 95/95 UTLs and 95% UPLs.

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Parametric and nonparametric procedures can be used to calculate both 95% UCLs and 95/95 UTLs. Parametric methods available in ProUCL 4.0 are specific to data that are consistent with normal, lognormal, or gamma distributions. Distributions were evaluated with both graphical methods (quantile-quantile [Q-Q] plots) and standard goodness-of-fit (GOF) tests, performed with a 95 percent confidence level ($\alpha = 0.05$), according to the following hierarchy:

1. Normal distribution, pending results of the Shapiro-Wilk test (n<50 for all Feature 139 and background data sets).

2. Gamma distribution, pending results of the Kolmogorov-Smirnov test, and evidence that data are not normally distributed.

3. Lognormal distribution, pending results of Shapiro-Wilk test (n<50 for all Feature 139 and background data sets), and evidence that data are not normally or gamma distributed.

Nonparametric methods for calculating 95% UCLs and 95/95 UTLs are available for data that do not follow a discernable distribution. The most appropriate 95% UCLs and 95/95 UTLs for each data set were selected using criteria provided by the USEPA (2007b,c).

Outliers and Multiple Populations

Two underlying assumptions of many statistical evaluations are that measurements are accurate, and a sample (data set) is representative of a single population. To determine if these assumptions are reliable, the initial exploratory data analysis generally includes an evaluation of potential outliers and multiple populations (United States Environmental Protection Agency 2000; 2002; 2006; 2007a).

Outlier tests indicate if one or more extreme values are unusually large relative to the remaining data. Plausible reasons for outliers in a data set include data entry errors, sampling errors, and highly heterogeneous conditions. A large number of outliers can suggest that data consist of multiple populations. However, outliers should only be excluded from the data set in cases where there is compelling evidence that the concentrations are not representative of Feature 139 or background conditions (United States Environmental Protection Agency 2006, 2007a).

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Appendix E
Statistical Analysis of Surface Soil
Samples

Twin Cities Assembly Plant (TCAP)
966 South Mississippi Boulevard
St. Paul, Minnesota

Potential outliers were identified using ProUCL 4.0, which performs statistical tests (Dixon, Rosner, or Walsh's test) and generates Q-Q and box plots. Figure 1, Figure 2, and Figure 3 of this appendix present side-by-side (i.e., background and Feature 139 data) Q-Q plots and box plots for arsenic, copper, and iron, respectively. When potential outliers are identified in a data set based on visual inspection of Q-Q and box plots, GOF tests are conducted on the subset of data excluding the outlier to determine the appropriate statistical test for outliers. The results of these evaluations indicate the presence of statistical outliers in the Feature 139 data set of arsenic (16.4 milligrams per kilogram [mg/kg]) and the background data sets of copper (50 mg/kg, 70 mg/kg, and 700 mg/kg) and iron (50,000 mg/kg and 50,000 mg/kg).

Q-Q plots were also used to evaluate the presence of multiple populations within each data set. There appears to be an inflection point (i.e., change in slopes) near 9 mg/kg in the Feature 139 data set for copper (see Figure 2 of this appendix). Based on sample locations and trends in the data, there is no additional evidence to suggest the presence of multiple populations in the Feature 139 data set for copper. In addition, the Q-Q plots for the background data sets reveal a single inflection point for arsenic (approximately 8 mg/kg) (see Figure 1 of this appendix) and multiple inflection points for copper and iron (see Figure 2 and Figure 3 of this appendix, respectively).

Although the results of the graphical evaluation methods and statistical outlier tests discussed above suggest heterogeneity within the background data set, these observations are not unexpected given the background data set is a compilation of samples collected from 37 locations representing a range of soil types and ambient conditions in Minnesota (Boerngen and Shacklette, 1981). Guidance from Minnesota (Minnesota Pollution Control Agency 1999) and the USEPA (1989; 2002) indicated that background levels are intended to represent ambient conditions in which constituents may be present as a result of anthropogenic inputs unrelated to site activities or naturally occurring constituents in the earth's crust. Most samples were collected 8 inches bgs to minimize inputs from surface deposition. In addition, any anthropogenic inputs would be limited to activities prior to 1976. Therefore, the full background data set is considered suitable for a comparison to Feature 139 concentrations.

Comparison of Feature 139 and Background Metals Concentrations

A variety of statistical approaches have been developed to determine if Feature 139 concentrations in soil are comparable to background concentrations. Two general categories of methods are comparisons of distributions and point-by-point comparisons of Feature 139 data to a background screening level (BSL). The USEPA (2007a)

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indicates that methods that compare the distributions, and in particular hypothesis tests, are preferred provided sufficient sample sizes (e.g., 8 to 10 detected observations) are available in both the Feature 139 and background data sets. For this analysis, sample sizes are sufficient (n ≥ 36) for both Feature 139 and background data sets to use hypothesis tests to perform the statistical comparison. Minnesota guidance (Minnesota Pollution Control Agency 1999) recommends an alternative method to compare distributions based on comparisons of summary statistics (i.e., the median and maximum concentrations). Results of this analysis along with a point-by-point comparison to 95/95 UTLs are presented below.

Hypothesis Testing

A robust statistical analysis (i.e., two-sample hypothesis testing) was conducted to evaluate if on-site metal concentrations are within the range of background metal concentrations. Statistical comparisons were conducted using ProUCL 4.0 (United States Environmental Protection Agency 2007b) and the recommendations provided in the associated technical documentation (United States Environmental Protection Agency 2007a,c). One-sided hypothesis testing was conducted to assess whether metal concentrations in on-site soils are statistically greater than background soil metal concentrations at a 95 percent confidence level (α = 0.05) (United States Environmental Protection Agency 2000; 2002).

The appropriate statistical test was chosen based on the distribution of both the on-site and background data. The distribution of the data for each metal in each data set was tested using the Shapiro-Wilk test (United States Environmental Protection Agency 2000; 2007a,c).

For data sets that are normally or lognormally distributed in both on-site and background soils, the t-test was used for the comparisons (United States Environmental Protection Agency 2000; 2002). Student's t-test was used in cases where the on-site and background data sets have equal variances, whereas the Satterthwaite's t-test was used in cases where variances were unequal. For data sets that did not fit a normal or lognormal distribution in either on-site or background soils, the analogous nonparametric WMW test was used.

The results of the t-test and WMW test suggest that concentrations of arsenic, copper, and iron in on-site soils are not statistically greater than background concentrations. Detailed results of the background metals evaluation are provided in Table 9 of the main report. Statistical comparisons for arsenic were conducted both with and without

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the potential outlier in the on-site data set. The presence of this potential outlier does
not change the results of the hypothesis test (i.e., concentrations are similar in on-site
and background soils). Similarly, removal of statistical outliers from the background
data sets for copper and iron does not affect the outcome of the hypothesis testing.

Comparison of Medians and Maximums

In accordance with draft MPCA guidance (1999), median and maximum concentrations
in the on-site data sets were compared to median and maximum concentrations in the
background data sets. Median concentrations of arsenic, copper, and iron in on-site
soils are less than the respective concentrations in background soils. Maximum
concentrations of copper and iron are also less than the respective concentration in
background soils.

For arsenic, the maximum detected concentration in on-site soils (16.4 mg/kg) is
slightly higher than the maximum concentration in background soils (15 mg/kg). As
previously discussed, the maximum concentration of arsenic in on-site soils is a
statistical outlier. The second highest concentration of arsenic in on-site soils is 7.1
mg/kg, which corresponds to approximately the 75th percentile of the concentrations in
background soils. In addition, the results of more robust statistical methods for
comparing the full distribution of on-site concentrations to background levels
(i.e., hypothesis testing) provide strong evidence that on-site concentrations are not
elevated above background levels. These results suggest that, while there may be a
localized area of elevated concentrations of arsenic in on-site soils, the majority of the
site has concentrations that are consistent with (and generally lower than) ambient
levels in Minnesota.

Point-by-Point Comparison to 95/95 Upper Tolerance Limits (UTLs)

Sometimes a single summary statistic representing a relatively high-end concentration
in the background data set is used to perform a point-by-point comparison with
concentrations measured on-site (United States Environmental Protection Agency
2002; 2006; 2007a). This is generally done when the data sets are relatively small (i.e.,
n < 8) (United States Environmental Protection Agency 2007a). The USEPA commonly
refers to a 95/95 UTL as an appropriate statistic for determining BSLs for soil and
groundwater (United States Environmental Protection Agency 1992; 2002), although
UTLs can be calculated for any coverage (percentile) and confidence level. The 95/95
UTLs were calculated using ProUCL 4.0 (United States Environmental Protection

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Agency 2007b), and the BSL was identified based on the method appropriate for the distribution of the background data set for each metal.

The normal UTL is calculated using the following equation:

$$UTL = \bar{x} + K \times s$$

Where $\bar{x}$ is the sample mean, s is the sample standard deviation, and $K=K(n, \alpha, p)$ is the tolerance factor that depends upon the sample size (n), confidence coefficient ($1 - \alpha$), and coverage proportion (p).

The lognormal UTL is calculated using the same equation, except the sample mean and sample standard deviation are calculated for the log-transformed data.

In ProUCL 4.0, the gamma UTL is calculated from the nonparametric percentile bootstrap method. An alternate parametric approach is provided by Guenther (1972). Both approaches were applied to data that fit a gamma distribution (i.e., arsenic) for purposes of comparison.

For background data sets that do not follow a discernable distribution, nonparametric 95/95 UTLs are determined by Kaplan Meier statistics, as implemented by using ProUCL 4.0 (United States Environmental Protection Agency 2007a,b). An alternative approach is to rely on rank-ordered statistics, whereby the rank that corresponds to the desired coverage (i.e., 95%) is determined using methods recommended by Conover (1990). With rank-ordered approaches, the 95/95 UTL is estimated by the maximum detected concentration for data sets with sample sizes less than n=91. For the nonparametric data sets evaluated in this assessment (copper and iron), the difference in UTLs has no effect on the results of the comparison of site data to UTLs (see below).

The results of the UTL calculations are presented in Table 8 of the main report. The background data set for arsenic follows both gamma and lognormal distributions; therefore, 95/95 UTLs calculated by both of these methods are reported. Given that both methods yield essentially the same result (15 mg/kg), the uncertainty associated with the choice of methods is low for this data set.

A comparison of 95/95 UTLs to on-site metal concentrations indicates no exceedances for copper or iron. However, the results of a comparison of both the gamma and lognormal 95/95 UTLs to on-site metal concentrations for arsenic are mixed. While the

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on-site metal concentrations for arsenic do not exceed the lognormal UTL (20.4 mg/kg), the maximum on-site concentration (16.4 mg/kg) does exceed the gamma 95/95 UTL (15 mg/kg). As previously discussed, this concentration was identified as a potential outlier and may not be representative of the overall distribution of arsenic in on-site surface soil.

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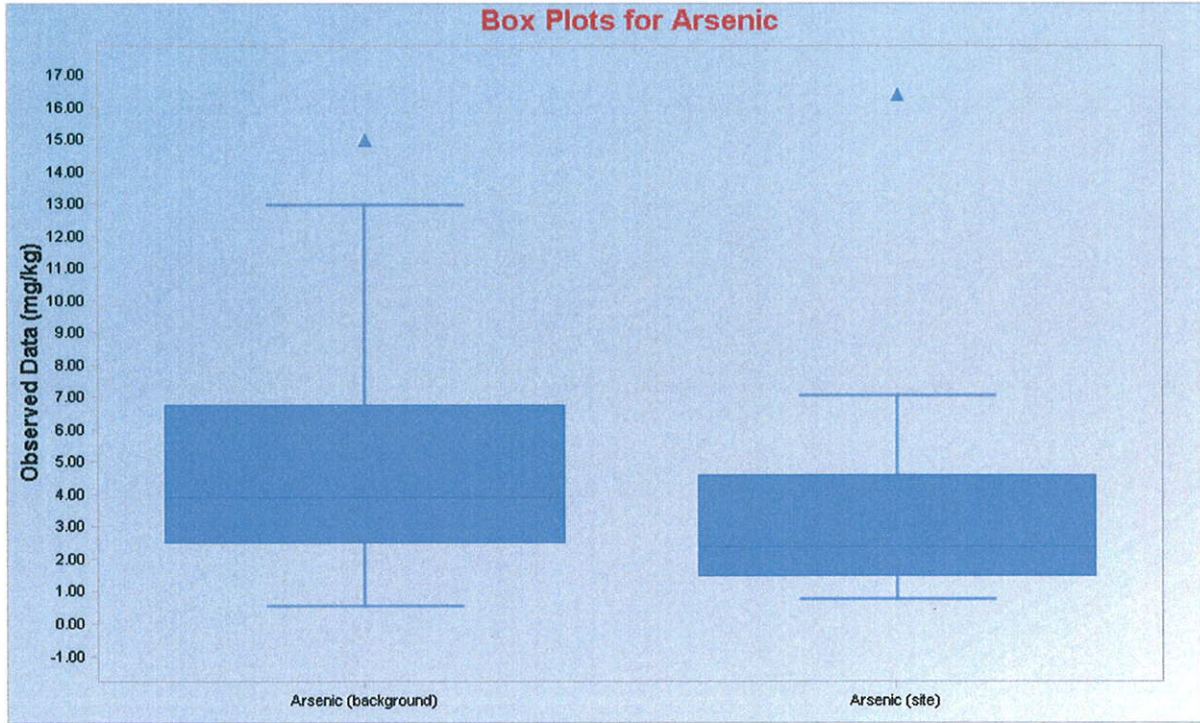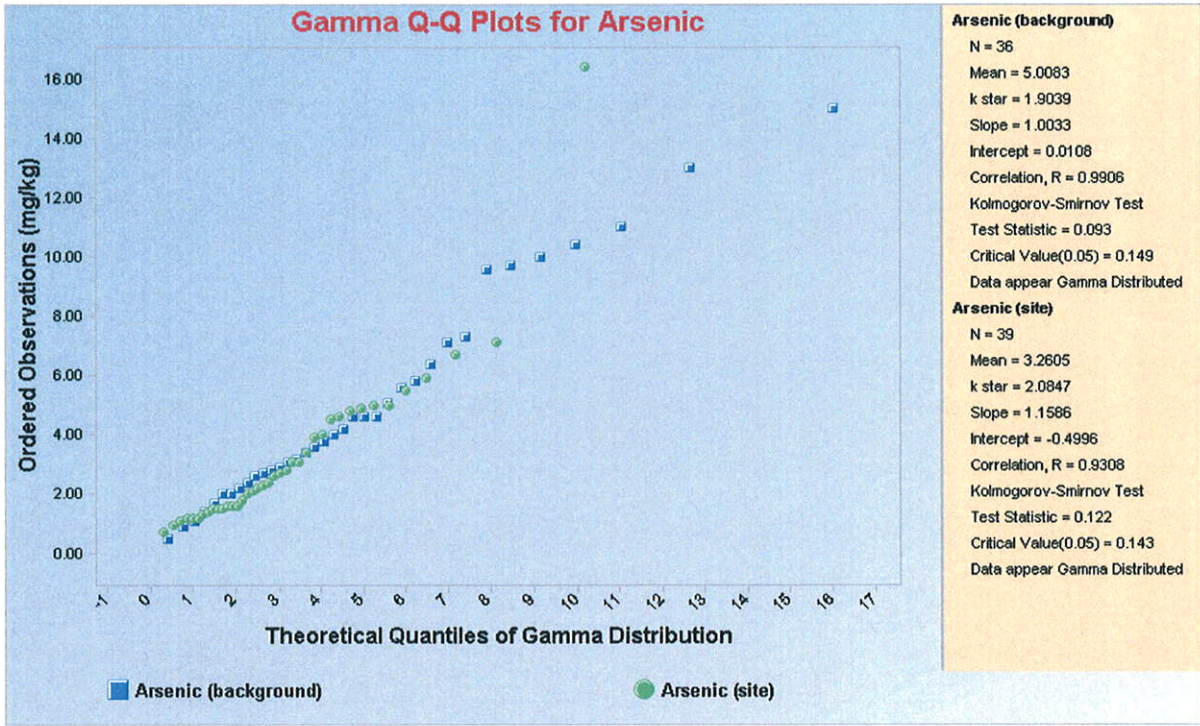
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Figures

Gamma Q-Q Plots for Arsenic

Arsenic (background)
N = 36
Mean = 5.0083
k star = 1.9039
Slope = 1.0033
Intercept = 0.0108
Correlation, R = 0.9906
Kolmogorov-Smirnov Test
Test Statistic = 0.093
Critical Value(0.05) = 0.149
Data appear Gamma Distributed

Arsenic (site)
N = 39
Mean = 3.2605
k star = 2.0847
Slope = 1.1586
Intercept = -0.4996
Correlation, R = 0.9308
Kolmogorov-Smirnov Test
Test Statistic = 0.122
Critical Value(0.05) = 0.143
Data appear Gamma Distributed
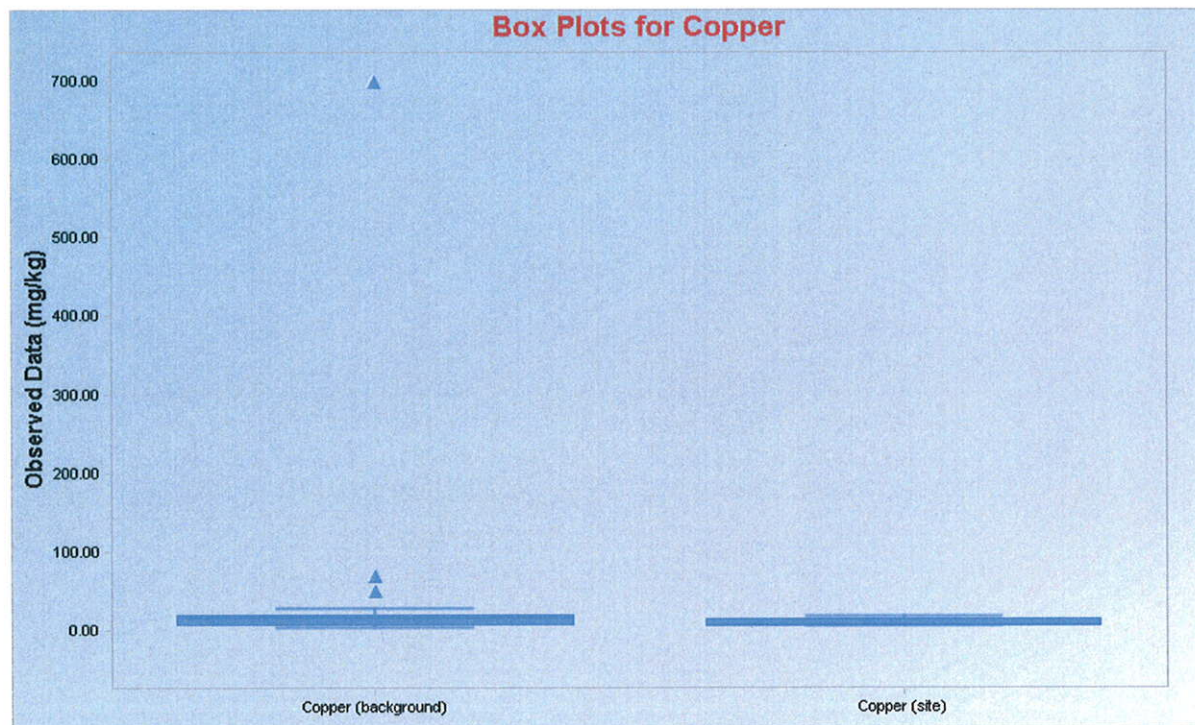
Box Plots for Arsenic

Figure 1. Side-by-side Q-Q plot and box plot for arsenic in on-site soils and background soils.

Lognormal Q-Q Plots for Copper

Ordered Observations (mg/kg) — Theoretical Quantiles (Standard Normal)

■ Copper (background)   ● Copper (site)

Copper (background)
N = 36
Mean = 2.6151
Sd = 0.9968
Slope = 0.9406
Intercept = 2.6151
Correlation, R = 0.9212
Shapiro-Wilk Test
Test Statistic = 0.878
Critical Value(0.05) = 0.935
Data not Lognormal

Copper (site)
N = 39
Mean = 2.0997
Sd = 0.5267
Slope = 0.5249
Intercept = 2.0997
Correlation, R = 0.9742
Shapiro-Wilk Test
Test Statistic = 0.930
Critical Value(0.05) = 0.939
Data not Lognormal

Box Plots for Copper

Observed Data (mg/kg)

Copper (background)   Copper (site)

Figure 2. Side-by-side Q-Q plot and box plot for copper in on-site soils and background soils.
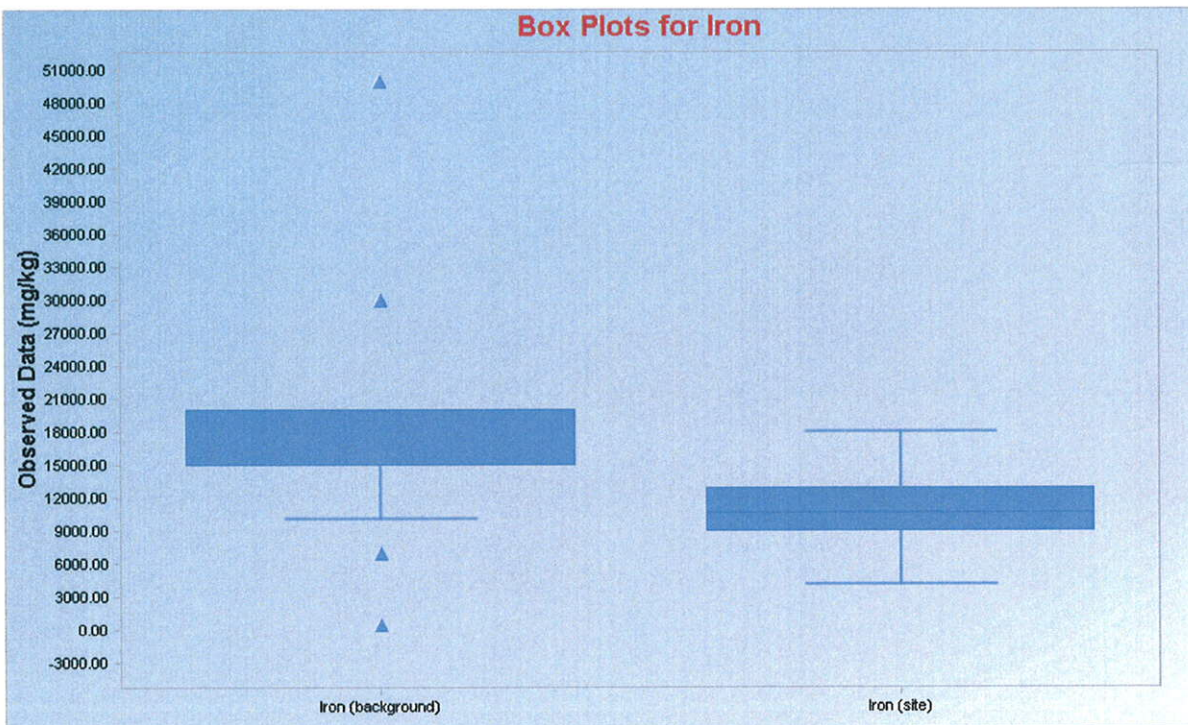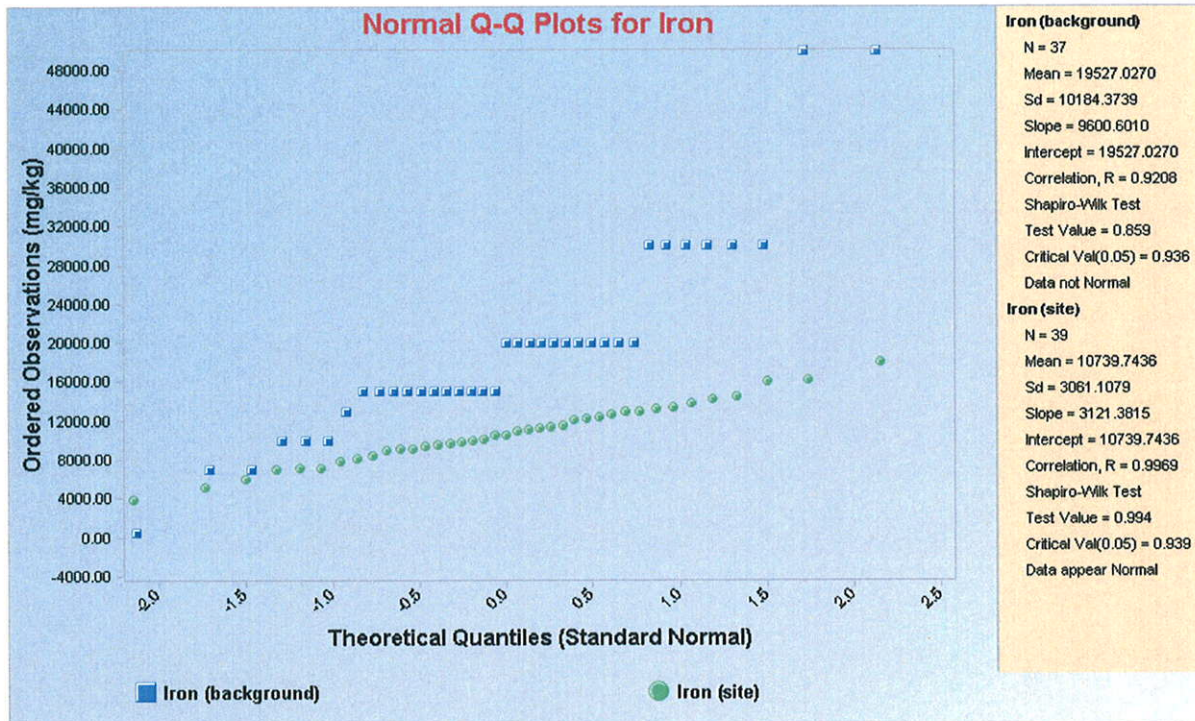
Figure 3. Side-by-side Q-Q plot and box plot for iron in on-site soils and background soils.

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Exhibits

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs),
Twin Cities Assembly Plant, St. Paul, Minnesota

General UCL Statistics for Full Data Sets

User Selected Options

From File   C:_FY2008\Ford TCAP - Locey\ProUCL input.wst
Full Precision   OFF
Confidence Coefficient   95%
Number of Bootstrap Operations   2000

Result (bkgd_arsenic)

General Statistics

Number of Valid Samples 36   Number of Unique Samples 33

Raw Statistics		Log-transformed Statistics	
Minimum	0.5	Minimum of Log Data	-0.693
Maximum	15	Maximum of Log Data	2.708
Mean	5.008	Mean of log Data	1.349
Median	3.9	SD of log Data	0.776
SD	3.602		
Coefficient of Variation	0.719		
Skewness	1.14		

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.884
Shapiro Wilk Critical Value 0.935
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.977
Shapiro Wilk Critical Value 0.935
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 6.023
95% UCLs (Adjusted for Skewness)
95% Adjusted-CLT UCL 6.118
95% Modified-t UCL 6.042

Assuming Lognormal Distribution

95% H-UCL 6.903
95% Chebyshev (MVUE) UCL 8.352
97.5% Chebyshev (MVUE) UCL 9.738
99% Chebyshev (MVUE) UCL 12.46

Gamma Distribution Test

k star (bias corrected) 1.904
Theta Star 2.631
nu star 137.1
Approximate Chi Square Value (.05) 111
Adjusted Level of Significance 0.0428
Adjusted Chi Square Value 110

Anderson-Darling Test Statistic 0.257
Anderson-Darling 5% Critical Value 0.759
Kolmogorov-Smirnov Test Statistic 0.0928
Kolmogorov-Smirnov 5% Critical Value 0.149
Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 5.996
95% Jackknife UCL 6.023
95% Standard Bootstrap UCL 5.973
95% Bootstrap-t UCL 6.171
95% Hall's Bootstrap UCL 6.127
95% Percentile Bootstrap UCL 6
95% BCA Bootstrap UCL 6.05
95% Chebyshev(Mean, Sd) UCL 7.625
97.5% Chebyshev(Mean, Sd) UCL 8.757

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs).

Twin Cities Assembly Plant, St. Paul, Minnesota

Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL 10.98
95% Approximate Gamma UCL 6.183	
95% Adjusted Gamma UCL 6.243	

Potential UCL to Use   Use 95% Approximate Gamma UCL 6.183

Result (bkgd_copper)

General Statistics

Number of Valid Samples 36   Number of Unique Samples 11

Raw Statistics	Log-transformed Statistics
Minimum 2	Minimum of Log Data 0.693
Maximum 700	Maximum of Log Data 6.551
Mean 35	Mean of log Data 2.615
Median 15	SD of log Data 0.997
SD 114.8	
Coefficient of Variation 3.28	
Skewness 5.874	

Relevant UCL Statistics

Normal Distribution Test	Lognormal Distribution Test
Shapiro Wilk Test Statistic 0.247	Shapiro Wilk Test Statistic 0.878
Shapiro Wilk Critical Value 0.935	Shapiro Wilk Critical Value 0.935
Data not Normal at 5% Significance Level	Data not Lognormal at 5% Significance Level

Assuming Normal Distribution	Assuming Lognormal Distribution
95% Student's-t UCL 67.32	95% H-UCL 33.6
95% UCLs (Adjusted for Skewness)	95% Chebyshev (MVUE) UCL 40.5
95% Adjusted-CLT UCL 86.48	97.5% Chebyshev (MVUE) UCL 48.5
95% Modified-t UCL 70.45	99% Chebyshev (MVUE) UCL 64.21

Gamma Distribution Test	Data Distribution
k star (bias corrected) 0.614	Data do not follow a Discernable Distribution (0.05)
Theta Star 57.01	
nu star 44.21	
Approximate Chi Square Value (.05) 29.96	Nonparametric Statistics
Adjusted Level of Significance 0.0428	95% CLT UCL 66.47
Adjusted Chi Square Value 29.42	95% Jackknife UCL 67.32
	95% Standard Bootstrap UCL 66.54
Anderson-Darling Test Statistic 4.788	95% Bootstrap-t UCL 305.2
Anderson-Darling 5% Critical Value 0.798	95% Hall's Bootstrap UCL 189.9
Kolmogorov-Smirnov Test Statistic 0.298	95% Percentile Bootstrap UCL 72.53
Kolmogorov-Smirnov 5% Critical Value 0.154	95% BCA Bootstrap UCL 109.9
Data not Gamma Distributed at 5% Significance Level	95% Chebyshev(Mean, Sd) UCL 118.4
	97.5% Chebyshev(Mean, Sd) UCL 154.5
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL 225.4
95% Approximate Gamma UCL 51.65	

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs).

Twin Cities Assembly Plant, St. Paul, Minnesota

95% Adjusted Gamma UCL 52.58

Potential UCL to Use   Use 95% Chebyshev (Mean, Sd) UCL 118.4

Result (bkgd_iron)

General Statistics

Number of Valid Samples 37   Number of Unique Samples 8

Raw Statistics	Log-transformed Statistics
Minimum 500	Minimum of Log Data 6.215
Maximum 50000	Maximum of Log Data 10.82
Mean 19527	Mean of log Data 9.709
Median 20000	SD of log Data 0.738
SD 10184	
Coefficient of Variation 0.522	
Skewness 1.356	

Relevant UCL Statistics

Normal Distribution Test	Lognormal Distribution Test
Shapiro Wilk Test Statistic 0.859	Shapiro Wilk Test Statistic 0.73
Shapiro Wilk Critical Value 0.936	Shapiro Wilk Critical Value 0.936
Data not Normal at 5% Significance Level	Data not Lognormal at 5% Significance Level

Assuming Normal Distribution	Assuming Lognormal Distribution
95% Student's-t UCL 22354	95% H-UCL 28044
95% UCLs (Adjusted for Skewness)	95% Chebyshev (MVUE) UCL 33844
95% Adjusted-CLT UCL 22680	97.5% Chebyshev (MVUE) UCL 39218
95% Modified-t UCL 22416	99% Chebyshev (MVUE) UCL 49776

Gamma Distribution Test	Data Distribution
k star (bias corrected) 2.855	Data do not follow a Discernable Distribution (0.05)
Theta Star 6839	
nu star 211.3	
Approximate Chi Square Value (.05) 178.6	Nonparametric Statistics
Adjusted Level of Significance 0.0431	95% CLT UCL 22281
Adjusted Chi Square Value 177.3	95% Jackknife UCL 22354
	95% Standard Bootstrap UCL 22249
Anderson-Darling Test Statistic 1.585	95% Bootstrap-t UCL 22924
Anderson-Darling 5% Critical Value 0.754	95% Hall's Bootstrap UCL 23177
Kolmogorov-Smirnov Test Statistic 0.212	95% Percentile Bootstrap UCL 22216
Kolmogorov-Smirnov 5% Critical Value 0.146	95% BCA Bootstrap UCL 22541
Data not Gamma Distributed at 5% Significance Level	95% Chebyshev(Mean, Sd) UCL 26825
	97.5% Chebyshev(Mean, Sd) UCL 29983
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL 36186
95% Approximate Gamma UCL 23095	
95% Adjusted Gamma UCL 23264	

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs).

Twin Cities Assembly Plant, St. Paul, Minnesota

Potential UCL to Use   Use 95% Chebyshev (Mean, Sd) UCL 26825

Result (site_arsenic)

General Statistics

Number of Valid Samples 39   Number of Unique Samples 31

Raw Statistics		Log-transformed Statistics	
Minimum	0.71	Minimum of Log Data	-0.342
Maximum	16.4	Maximum of Log Data	2.797
Mean	3.261	Mean of log Data	0.942
Median	2.4	SD of log Data	0.674
SD	2.761		
Coefficient of Variation	0.847		
Skewness	3.032		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.719	Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.939	Shapiro Wilk Critical Value	0.939
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	4.006	95% H-UCL	4.03
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.829
95% Adjusted-CLT UCL	4.217	97.5% Chebyshev (MVUE) UCL	5.535
95% Modified-t UCL	4.042	99% Chebyshev (MVUE) UCL	6.921

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.085	Data appear Gamma Distributed at 5% Significance Level
Theta Star	1.564	
nu star	162.6	
Approximate Chi Square Value (.05)	134.1	Nonparametric Statistics
Adjusted Level of Significance	0.0437	95% CLT UCL 3.988
Adjusted Chi Square Value	133.1	95% Jackknife UCL 4.006
		95% Standard Bootstrap UCL 3.984
Anderson-Darling Test Statistic	0.725	95% Bootstrap-t UCL 4.37
Anderson-Darling 5% Critical Value	0.758	95% Hall's Bootstrap UCL 7.146
Kolmogorov-Smirnov Test Statistic	0.122	95% Percentile Bootstrap UCL 4.038
Kolmogorov-Smirnov 5% Critical Value	0.143	95% BCA Bootstrap UCL 4.251
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 5.187
		97.5% Chebyshev(Mean, Sd) UCL 6.021
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 7.659
95% Approximate Gamma UCL	3.953	
95% Adjusted Gamma UCL	3.983	

Potential UCL to Use   Use 95% Approximate Gamma UCL 3.953

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs).
Twin Cities Assembly Plant, St. Paul, Minnesota

Result (site_copper)

General Statistics

Number of Valid Samples 39   Number of Unique Samples 33

Raw Statistics	Log-transformed Statistics
Minimum 3.1	Minimum of Log Data 1.131
Maximum 19.4	Maximum of Log Data 2.965
Mean 9.321	Mean of log Data 2.1
Median 6.8	SD of log Data 0.527
SD 4.806	
Coefficient of Variation 0.516	
Skewness 0.6	

Relevant UCL Statistics

Normal Distribution Test	Lognormal Distribution Test
Shapiro Wilk Test Statistic 0.892	Shapiro Wilk Test Statistic 0.93
Shapiro Wilk Critical Value 0.939	Shapiro Wilk Critical Value 0.939
Data not Normal at 5% Significance Level	Data not Lognormal at 5% Significance Level

Assuming Normal Distribution	Assuming Lognormal Distribution
95% Student's-t UCL 10.62	95% H-UCL 11.06
95% UCLs (Adjusted for Skewness)	95% Chebyshev (MVUE) UCL 12.96
95% Adjusted-CLT UCL 10.67	97.5% Chebyshev (MVUE) UCL 14.52
95% Modified-t UCL 10.63	99% Chebyshev (MVUE) UCL 17.59

Gamma Distribution Test	Data Distribution
k star (bias corrected) 3.646	Data do not follow a Discernable Distribution (0.05)
Theta Star 2.556	
nu star 284.4	
Approximate Chi Square Value (.05) 246.4	Nonparametric Statistics
Adjusted Level of Significance 0.0437	95% CLT UCL 10.59
Adjusted Chi Square Value 245	95% Jackknife UCL 10.62
	95% Standard Bootstrap UCL 10.58
Anderson-Darling Test Statistic 1.112	95% Bootstrap-t UCL 10.77
Anderson-Darling 5% Critical Value 0.753	95% Hall's Bootstrap UCL 10.69
Kolmogorov-Smirnov Test Statistic 0.192	95% Percentile Bootstrap UCL 10.62
Kolmogorov-Smirnov 5% Critical Value 0.142	95% BCA Bootstrap UCL 10.63
Data not Gamma Distributed at 5% Significance Level	95% Chebyshev(Mean, Sd) UCL 12.67
	97.5% Chebyshev(Mean, Sd) UCL 14.13
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL 16.98
95% Approximate Gamma UCL 10.76	
95% Adjusted Gamma UCL 10.82	

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 12.67

Result (site_iron)

Exhibit E.1 Output from ProUCL Version 4 - 95 Percent Upper Confidence Limit for the Mean (95% UCLs),
Twin Cities Assembly Plant, St. Paul, Minnesota

General Statistics

Number of Valid Samples 39   Number of Unique Samples 37

Raw Statistics		Log-transformed Statistics	
Minimum	3950	Minimum of Log Data	8.281
Maximum	18100	Maximum of Log Data	9.804
Mean	10740	Mean of log Data	9.237
Median	10600	SD of log Data	0.315
SD	3061		
Coefficient of Variation	0.285		
Skewness	0.098		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.994	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.939	Shapiro Wilk Critical Value	0.939
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	11566	95% H-UCL	11826
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13194
95% Adjusted-CLT UCL	11554	97.5% Chebyshev (MVUE) UCL	14239
95% Modified-t UCL	11567	99% Chebyshev (MVUE) UCL	16290

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	10.57	Data appear Normal at 5% Significance Level	
Theta Star	1016		
nu star	824.2		
Approximate Chi Square Value (.05)	758.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0437	95% CLT UCL	11546
Adjusted Chi Square Value	756.1	95% Jackknife UCL	11566
		95% Standard Bootstrap UCL	11542
Anderson-Darling Test Statistic	0.243	95% Bootstrap-t UCL	11533
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL	11558
Kolmogorov-Smirnov Test Statistic	0.0835	95% Percentile Bootstrap UCL	11533
Kolmogorov-Smirnov 5% Critical Value	0.141	95% BCA Bootstrap UCL	11567
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	12876
		97.5% Chebyshev(Mean, Sd) UCL	13801
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	15617
95% Approximate Gamma UCL	11669		
95% Adjusted Gamma UCL	11707		

Potential UCL to Use   Use 95% Student's-t UCL 11566

Exhibit E.2 Output from ProUCL Version 4 for Background Screening Levels - 95/95 Upper Tolerance Limits and 95% Upper Prediction Limits.
Twin Cities Assembly Plant, St. Paul, Minnesota

General Background Statistics for Full Data Sets

User Selected Options

From File	C:_FY2008\Ford TCAP - Locey\ProUCL input.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Result (bkgd_arsenic)

General Statistics

Total Number of Samples 36   Number of Unique Samples 33

Raw Statistics		Log-Transformed Statistics	
Minimum	0.5	Minimum	-0.693
Maximum	15	Maximum	2.708
Second Largest	13	Second Largest	2.565
First Quartile	2.45	First Quartile	0.895
Median	3.9	Median	1.361
Third Quartile	6.925	Third Quartile	1.934
Mean	5.008	Mean	1.349
SD	3.602	SD	0.776
Coefficient of Variation	0.719		
Skewness	1.14		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.884	Shapiro Wilk Test Statistic	0.977
Shapiro Wilk Critical Value	0.935	Shapiro Wilk Critical Value	0.935
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	12.75	95% UTL with 95% Coverage	20.39
95% UPL (t)	11.18	95% UPL (t)	14.54
90% Percentile (z)	9.624	90% Percentile (z)	10.41
95% Percentile (z)	10.93	95% Percentile (z)	13.8
99% Percentile (z)	13.39	99% Percentile (z)	23.4

Gamma Distribution Test   Data Distribution Test

Exhibit E.2 Output from ProUCL Version 4 for Background Screening Levels - 95/95 Upper Tolerance Limits and 95% Upper Prediction Limits.
Twin Cities Assembly Plant, St. Paul, Minnesota

k star	1.904	Data appear Gamma Distributed at 5% Significance Level
Theta Star	2.631	
nu star	137.1	

		Nonparametric Statistics	
A-D Test Statistic	0.257		
5% A-D Critical Value	0.759	90% Percentile	10.58
K-S Test Statistic	0.0928	95% Percentile	13.3
5% K-S Critical Value	0.149	99% Percentile	15

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution			
		95% UTL with 95% Coverage	15
90% Percentile	9.854	95% Percentile Bootstrap UTL with 95% Coverage	15
95% Percentile	12.07	95% BCA Bootstrap UTL with 95% Coverage	15
99% Percentile	16.99	95% UPL	13.3
		95% Chebyshev UPL	20.92
		Upper Threshold Limit Based upon IQR	13.64

Note: UPL (or upper percentile for gamma distributed data) represents a preferred estimate of BTV

Result (bkgd_copper)

General Statistics

Total Number of Samples	36	Number of Unique Samples	11

Raw Statistics		Log-Transformed Statistics	
Minimum	2	Minimum	0.693
Maximum	700	Maximum	6.551
Second Largest	70	Second Largest	4.248
First Quartile	7	First Quartile	1.946
Median	15	Median	2.708
Third Quartile	20	Third Quartile	2.996
Mean	35	Mean	2.615
SD	114.8	SD	0.997
Coefficient of Variation	3.28		
Skewness	5.874		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.247	Shapiro Wilk Test Statistic	0.878
Shapiro Wilk Critical Value	0.935	Shapiro Wilk Critical Value	0.935
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Exhibit E.2 Output from ProUCL Version 4 for Background Screening Levels - 95/95 Upper Tolerance Limits and 95% Upper Prediction Limits. Twin Cities Assembly Plant, St. Paul, Minnesota

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	281.6	95% UTL with 95% Coverage	116.4
95% UPL (t)	231.6	95% UPL (t)	75.38
90% Percentile (z)	182.1	90% Percentile (z)	49.04
95% Percentile (z)	223.8	95% Percentile (z)	70.44
99% Percentile (z)	302	99% Percentile (z)	138.9

Gamma Distribution Test		Data Distribution Test
k star	0.614	Data do not follow a Discernable Distribution (0.05)
Theta Star	57.01	
nu star	44.21	

A-D Test Statistic	4.788	Nonparametric Statistics	
5% A-D Critical Value	0.798	90% Percentile	36
K-S Test Statistic	0.298	95% Percentile	164.5
5% K-S Critical Value	0.154	99% Percentile	700

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution			
90% Percentile	90.56	95% UTL with 95% Coverage	700
95% Percentile	124.9	95% Percentile Bootstrap UTL with 95% Coverage	700
99% Percentile	207.8	95% BCA Bootstrap UTL with 95% Coverage	700
		95% UPL	164.5
		95% Chebyshev UPL	542.2
		Upper Threshold Limit Based upon IQR	39.5

Note: UPL (or upper percentile for gamma distributed data) represents a preferred estimate of BTV

Result (bkgd_iron)

General Statistics

Total Number of Samples	37	Number of Unique Samples	8

Raw Statistics		Log-Transformed Statistics	
Minimum	500	Minimum	6.215
Maximum	50000	Maximum	10.82
Second Largest	50000	Second Largest	10.82
First Quartile	15000	First Quartile	9.616
Median	20000	Median	9.903
Third Quartile	20000	Third Quartile	9.903
Mean	19527	Mean	9.709

Exhibit E.2 Output from ProUCL Version 4 for Background Screening Levels - 95/95 Upper Tolerance Limits and 95% Upper Prediction Limits.

Twin Cities Assembly Plant, St. Paul, Minnesota

SD 10184   SD 0.738

Coefficient of Variation 0.522

Skewness 1.356

Background Statistics

Normal Distribution Test	Lognormal Distribution Test
Shapiro Wilk Test Statistic 0.859	Shapiro Wilk Test Statistic 0.73
Shapiro Wilk Critical Value 0.936	Shapiro Wilk Critical Value 0.936
Data not Normal at 5% Significance Level	Data not Lognormal at 5% Significance Level

Assuming Normal Distribution	Assuming Lognormal Distribution
95% UTL with 95% Coverage 41322	95% UTL with 95% Coverage 79906
95% UPL (t) 36952	95% UPL (t) 58214
90% Percentile (z) 32579	90% Percentile (z) 42401
95% Percentile (z) 36279	95% Percentile (z) 55442
99% Percentile (z) 43219	99% Percentile (z) 91686

Gamma Distribution Test	Data Distribution Test
k star 2.855	Data do not follow a Discernable Distribution (0.05)
Theta Star 6839	
nu star 211.3	

A-D Test Statistic 1.585	Nonparametric Statistics
5% A-D Critical Value 0.754	90% Percentile 30000
K-S Test Statistic 0.212	95% Percentile 50000
5% K-S Critical Value 0.146	99% Percentile 50000
Data not Gamma Distributed at 5% Significance Level	

Assuming Gamma Distribution	
	95% UTL with 95% Coverage 50000
90% Percentile 35020	95% Percentile Bootstrap UTL with 95% Coverage 50000
95% Percentile 41570	95% BCA Bootstrap UTL with 95% Coverage 50000
99% Percentile 55806	95% UPL 50000
	95% Chebyshev UPL 64516
	Upper Threshold Limit Based upon IQR 27500

Note: UPL (or upper percentile for gamma distributed data) represents a preferred estimate of BTV

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Appendix F

Calculation of Soil Reference
Values (SRVs)

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Calculation of Soil Reference Values

Three constituents were identified as constituents of potential concern (COPCs) based on a comparison of the maximum detected concentrations and the Tier 2 Recreational Soil Reference Values (SRVs). ARCADIS calculated additional risk-based, pathway-specific criteria to provide perspective on risks and hazards at the site.

The maximum concentrations of three COPCs (arsenic at 16.4 milligrams per kilogram [mg/kg]), copper at 19.4 mg/kg), and iron at 18,100 mg/kg exceed the generic Tier 2 Recreational SRVs of 5.0 mg/kg, 11.0 mg/kg, and 12,000 mg/kg, respectively. The generic Tier 2 Recreational SRVs for arsenic and copper are based on acute exposures (ingestion of a 10-gram bolus of soil) to a 1- to 2-year-old child weighing 11 kilograms.

Tier 2 Recreational SRVs were calculated following the procedures outlined in the Minnesota Pollution Control Agency's (MPCA's) 1999 Draft Guidelines, *Risk-Based Guidance for the Soil – Human Health Pathway*, Volume 2. Technical Support Document (Guidance Document). These include the following:

- Chronic Recreational SRVs based on an excess cancer risk of one-in-a-hundred-thousand (1×10^{-5}) based on an age-adjusted exposure duration of 33 years for the carcinogenic arsenic (only COPC regulated as a carcinogen), consistent with the MPCA guidance.

- Chronic Recreational SRVs protective of noncancer effects based on a hazard quotient (HQ) of 0.2 and an exposure duration of 6 years, consistent with the MPCA guidance.

- Chronic Recreational SRVs based on a HQ of 0.2 and an age-adjusted exposure duration of 33 years. These are referred to "alternative" chronic criteria in the text.

- Acute Tier 2 Child SRV calculated for iron based on a 1- to 2-year old child ingesting a 10-gram bolus of soil, consistent with the MPCA guidance.

These values are all included in Table 7 of the report.

Toxicity Values

Toxicity values were available in the 2006 Tier 2 Excel file associated with the

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Guidance Document for all three COPCs (arsenic, copper, and iron). The MPCA toxicity values were used to calculate chronic and acute risk-based criteria. The toxicity values used in the calculations are listed below:

- Chronic reference doses (RfDs):

    - Arsenic: 3.0×10^{-4} milligrams per kilogram per day (mg/kg-d)
    - Copper: 3.7×10^{-2} mg/kg-d
    - Iron: 0.3 mg/kg-d

- Chronic reference concentration (RfC):

    - Arsenic: 4.5×10^{-4} milligrams per cubic meter (mg/m^3)

- Oral Slope Factor (SF):

    - Arsenic: 1.5 per mg/kg-d (mg/kg-d)$^{-1}$

- Inhalation Unit Risk Factor (IURF):

    - Arsenic: 4.3×10^{-3} per micrograms per cubic meter (μg/m^3)$^{-1}$

- Acute RfD:

    - Iron: 60 mg/kg-d

Exposure Parameters

The exposure parameters used to calculate chronic Tier 2 SRVs were those provided in the 1999 MPCA Guidance Document unless updates were noted in the 2006 version of the associated Tier 2 calculation spreadsheets. The exposure factors used to calculate SRVs and the alternate criteria are provided in Table 1 of this appendix.

Tier 2 Chronic Recreational SRVs were calculated for each of the three COPCs. In the case of arsenic (the only carcinogenic COPC), the lowest of criteria protective of carcinogenic or non-carcinogenic effects was selected as the final Tier 2 Chronic Recreational SRV.

Estimation of Average Daily Exposure

These exposure parameters were used with the maximum on-site surface soil concentrations to calculate a chronic average daily dose (ADD) for non-carcinogens

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ingested or absorbed through dermal contact, a chronic average daily concentration (ADC) for inhaled non-carcinogens, a lifetime ADD (LADD) for carcinogens ingested or absorbed, and a lifetime ADC for carcinogens inhaled. The equations used to calculate the ADD/LADDs, ADC/LADCs, and acute dose (AD) for each pathway are provided below:

Chronic Incidental Ingestion of Soil

$$\text{LADD or ADD}_{\text{soil ingestion}} = \frac{Csoil \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where all parameters are defined in Table 1 of this Appendix. The calculated LADDs or ADDs for soil ingestion are summarized in Tables 2 (generic recreational parameters) and 3 (alternative recreational parameters) of this Appendix.

Chronic Dermal Contact with Soil

$$\text{LADD or ADD}_{\text{dermal contact}} = \frac{Csoil \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where all parameters are defined in Table 1 of this appendix. In 2005, the default ABS for copper and iron were changed from 0.01 to 0.00 in the Tier 2 spreadsheets associated with the Guidance Document. Therefore, the ADDs for dermal contact for copper and iron are 0.0 mg/kg-d. The LADD and ADD for dermal contact for arsenic are summarized in Table 2 (generic approach) and Table 3 (alternative approach) of this appendix.

Chronic Inhalation of Vapors or Particulate from Soil

$$\text{LADC or ADC}_{\text{air}} = \frac{Cair \times EF \times ED \times CF}{AT}$$

where all parameters are defined in Table 1 of this appendix. The calculated LADCs or ADCs for the inhalation pathway are summarized in Table 2 (generic approach) and Table 3 (alternative approach) of this appendix.

Acute Incidental Ingestion of Soil

$$AD_{\text{soil ingestion}} = \frac{Csoil \times IR \times CF}{BW}$$

where the exposure parameters are defined in Table 1 of this appendix. Because the Guidance Document has already calculated Tier 2 Acute Child SRVs for arsenic and copper, only the iron acute dose (AD) (16.5 mg/kg-d) was determined.

Estimation of Risk

Total chronic risk for each COPC and total acute risk for iron were calculated following the procedures outlined in the Guidance Document. A pathway-specific non-carcinogenic hazard (HQ) for each of the three COCs was determined by dividing the ADD or ADC by the chronic RfD or RfC, respectively, and a total HQ for each COPC was calculated by adding the HQs for each individual pathway. The acute HQ for iron was calculated by dividing the AD for iron by the acute RfD for iron.

$$HQ_{\text{pathway-specific}} = \frac{ADD}{RfD} \text{ or } \frac{ADC_{air}}{RfC}$$

where all parameters are defined as above. The Guidance Document does not provide RfCs for copper and iron. Therefore, an HQ was not determined for the inhalation pathway for copper or iron.

The total HQ for each COPC was calculated by adding the pathway-specific HQs. The HQs for each pathway and total HQs for each COC are summarized in Table 2 (generic chronic approach), Table 3 (alternative chronic approach), and Table 4 (acute exposure) of this appendix.

The total chronic carcinogenic risk for the site was determined by calculating the pathway-specific excess lifetime cancer risks (ELCRs) for arsenic (the only carcinogen detected above the generic Tier 1 Residential SRV) and adding them together. The ELCR is calculated using the following equation:

$$ELCR_{\text{pathway-specific}} = LADD \times SF \text{ or } LADC_{air} \times IURF$$

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where all parameters are defined as above. The calculated site ELCRs for arsenic are summarized in Table 2 (generic approach) and Table 3 (alternative approach) of this appendix.

Calculation of Tier 2 Soil Reference Values and Criteria

The Tier 2 Chronic Recreational SRVs, Chronic Recreational Criteria, and Acute Child SRVs were calculated by solving the following ratio for the SRV (or criteria):

$$\frac{HQ_{site}}{C_{soil}} = \frac{HQ_{acceptable}}{SRV} \quad \text{or} \quad \frac{ELCR_{site}}{C_{soil}} = \frac{ELCR_{acceptable}}{SRV}$$

where the HQ_{site} is the total HQ for each COPC (individually); C_{soil} is the maximum on-site surface soil concentration; $HQ_{aceptable}$ is the acceptable HQ of 0.2 for chronic exposures or 1.0 for acute exposures; $ELCR_{site}$ is the total ELCR for arsenic; C_{soil} is the maximum on-site surface soil concentration; $ELCR_{acceptable}$ is the acceptable ELCR of 1 x 10^{-5} for chronic exposures; and the SRV is the calculated Tier 2 Recreational SRV. The calculated Tier 2 Chronic Recreational SRVs are summarized in Table 2 of this appendix; the calculated alternative Chronic Recreational Criteria are summarized in Table 3 of this appendix; and the calculated Tier 2 Acute Child SRV for iron is summarized in Table 4 of this appendix.

Because SRVs for arsenic were calculated based on both non-carcinogenic and carcinogenic effects, the lower of the two was selected as the final Tier 2 Chronic Recreational SRV or alternative Chronic Recreational Criterion.

Summary of All Calculated Values

Constituent mg/kg	Calculated Tier 2 Acute SRV	Calculated Tier 2 Chronic Recreational SRVs	Calculated Alternative Chronic Recreational Criteria
Arsenic	NC	11.4	14.8
Copper	NC	1,500	9,600
Iron	66,000	12,400	78,000

NC – Not calculated

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Reference

Minnesota Pollution Control Agency. 1999. Draft Guidelines, *Risk-Based Guidance for the Soil – Human Health Pathway*, Volume 2. Technical Support Document. Site Remediation Section. January.

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Tables

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Table 1. Summary of Exposure Parameters Used to Calculate Tier 2 SRVs and Chronic Recreational Lifetime Criteria.
Twin Cities Assembly Plant, St. Paul, Minnesota

Parameter	Symbol	Units	Default Value	Group/Comments
Concentration in Soil	Csoil	mg/kg		
Arsenic			16.4	Maximum Surface Soil Concentration
Copper			19.4	Maximum Surface Soil Concentration
Iron			18,100	Maximum Surface Soil Concentration
Concentration in Air	Cair	mg/m^3 or ug/m^3	Calculated	See Equations.
Ingestion Rate	IR	mg/day	250	<6 years
			175	6-18 years
			100	18-33 years
			155	Age-adjusted
			10,000	Acute Ingestion Rate
Conversion factor (ingestion and dermal)	CF_{i-d}	kg/mg	1.00E-06	
Conversion factor (LADC only)	CF_a	µg/mg	1.00E+03	
Fraction of ingested soil from contaminated soil	FI	unitless	1	
Exposure Frequency	EF	days/yr	106	<6 years
			106	6-18 years
			74	18-33 years
			92	Age-adjusted
Exposure duration	ED	yrs	6	<6 years
			12	6-18 years
			15	18-33 years
			33	Age-adjusted default (90th percentile for Minneapolis/St. Paul area)
Body Weight	BW	kg	15	<6 years
			43	6-18 years
			70	18-33 years
			51	Age-adjusted
			11	Body weight for 1- to 2-year old (Acute)
Averaging time	AT	days	2,190	<6 years
			4,380	6-18 years
			5,475	18-33 years
			12,045	Age-adjusted (33 years)
			25,550	lifetime (70 yrs for carcinogens)
Skin Surface Area	SA	cm^2	2,000	<6 years
			3,300	6-18 years
			4,500	18-33 years
			3,609	Age-adjusted
Skin Adherence Factor	AF	mg/cm^2	0.35	All Ages
Absorption Factor	ABS	unitless		
Arsenic			0.03	
Copper			0.00	Adjusted in 2005
Iron			0.00	Adjusted in 2005
Particulate Emission Factor	PEF	m^3/kg	4.41E+08	Default, but see Equations for Calculation
Inverse of the mean concentration at the center of the source	Q/C	g/m^2-s per kg/m^3	45.93	Default for Recreational, 5 acres.
Fraction of vegetative cover	V		0.25	
Mean annual windspeed	U_m	m/s	4.7	
Equivalent threshold value of windspeed at 7 meters	U_t	m/s	11.32	
Function dependent upon U_m/U_t	F(x)	unitless	0.194	

Notes:

mg/kg	milligram per kilogram.
mg/m^3	milligram per cubic meter.
$µg/m^3$	microgram per cubic meter.
mg/day	milligram per day.
kg/mg	kilogram per milligram.
µg/mg	microgram per milligram.
days/yr	days per year.
yrs	years.
kg	kilogram.
cm^2	square centimeter.
mg/cm^2	milligram per square centimeter.
m^3/kg	cubic meters per kilogram.
g/m^2-s per kg/m^3	grams per square meters per second per kilogram per cubic meter.
m/s	meters per second.
SRV	Soil Reference Values.

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Table 2. Summary of Calculations for the Chronic Tier 2 Recreational Soil Reference Value.
Twin Cities Assembly Plant, St. Paul, Minnesota

Constituent	Units	Arsenic	Copper	Iron
Average Daily Dose				
ADD - Ingestion	mg/kg-day	7.94E-05	9.39E-05	8.76E-02
LADD - Ingestion	mg/kg-day	5.92E-06	NA	NA
ADD - Dermal	mg/kg-day	6.67E-06	0.00E+00	0.00E+00
LADD - Dermal	mg/kg-day	1.45E-06	NA	NA
ADC - Inhalation	mg/m^3	1.08E-08	1.28E-08	1.19E-05
LADC - Inhalation	ug/m^3	4.42E-06	NA	NA
Toxicity Values				
Reference Dose	mg/kg-day	3.00E-04	3.70E-02	3.00E-01
Reference Concentration	mg/m^3	4.50E-04	NA	NA
Cancer Slope Factor	(mg/kg-d)$^{-1}$	1.50E+00	NA	NA
Inhalation Unit Risk Factor	(ug/m^3)$^{-1}$	4.00E-03	NA	NA
Non-Cancer Risk (HQ = 0.2)				
HQ - Ingestion	unitless	2.65E-01	2.54E-03	2.92E-01
HQ - Dermal	unitless	2.22E-02	0.00E+00	0.00E+00
HQ - Inhalation	unitless	2.40E-05	NA	NA
HQ - Total	unitless	2.87E-01	2.54E-03	2.92E-01
Cancer Risk (ELCR = 1 x 10^{-5})				
ELCR - Ingestion	unitless	8.88E-06	NA	NA
ELCR - Dermal	unitless	2.17E-06	NA	NA
ELCR - Inhalation	unitless	1.77E-08	NA	NA
ELCR - Total	unitless	1.11E-05	NA	NA
Calculated Chronic Tier 2 Recreational Lifetime Criteria				
SRV (based on HQ)	mg/kg	1.14E+01	1.53E+03	1.24E+04
SRV (based on ELCR)	mg/kg	1.48E+01	NA	NA
Final Chronic Tier 2 Recreational SRV	**mg/kg**	**11.4**	**1,500**	**12,400**

Notes:

NA	Not Applicable.
SRV	Soil Reference Value.
ADD	Average Daily Dose.
LADD	Lifetime Average Daily Dose.
ADC	Average Daily Concentration.
LADC	Lifetime Average Daily Concentration.
HQ	Hazard Quotient.
ELCR	Excess Lifetime Cancer Risk.
mg/kg-day	Milligrams per kilogram per day.
mg/m^3	Milligrams per cubic meter.
ug/m^3	Micrograms per cubic meter.
(mg/kg-d)$^{-1}$	Per milligrams per kilogram per day.
(ug/m^3)$^{-1}$	Per micrograms per cubic meter.
mg/kg	Milligrams per kilogram.

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Table 3. Summary of Calculations for the Chronic Recreational Lifetime Criteria.
Twin Cities Assembly Plant, St. Paul, Minnesota

Constituent	Units	Arsenic	Copper	Iron
Average Daily Dose				
ADD - Ingestion	mg/kg-day	1.26E-05	1.49E-05	1.39E-02
LADD - Ingestion	mg/kg-day	5.92E-06	NA	NA
ADD - Dermal	mg/kg-day	3.07E-06	0.00E+00	0.00E+00
LADD - Dermal	mg/kg-day	1.45E-06	NA	NA
ADC - Inhalation	mg/m^3	9.37E-09	1.11E-08	1.03E-05
LADC - Inhalation	ug/m^3	4.42E-06	NA	NA
Toxicity Values				
Reference Dose	mg/kg-day	3.00E-04	3.70E-02	3.00E-01
Reference Concentration	mg/m^3	4.50E-04	NA	NA
Cancer Slope Factor	$(mg/kg-d)^{-1}$	1.50E+00	NA	NA
Inhalation Unit Risk Factor	$(ug/m^3)^{-1}$	4.00E-03	NA	NA
Non-Cancer Risk				
HQ - Ingestion	unitless	4.19E-02	4.02E-04	4.62E-02
HQ - Dermal	unitless	1.02E-02	0.00E+00	0.00E+00
HQ - Inhalation	unitless	2.08E-05	NA	NA
HQ - Total	unitless	5.21E-02	4.02E-04	4.62E-02
Cancer Risk				
ELCR - Ingestion	unitless	8.88E-06	NA	NA
ELCR - Dermal	unitless	2.17E-06	NA	NA
ELCR - Inhalation	unitless	1.77E-08	NA	NA
ELCR - Total	unitless	1.11E-05	NA	NA
Calculated Chronic Tier 2 Recreational Lifetime Criteria				
SRV (based on HQ)	mg/kg	6.29E+01	9.66E+03	7.83E+04
SRV (based on ELCR)	mg/kg	1.48E+01	NA	NA
Final Chronic Tier 2 Recreational Lifetime Criteria	**mg/kg**	**14.8**	**9,600**	**78,000**

Notes:
NA	Not Applicable.
SRV	Soil Reference Value.
ADD	Average Daily Dose.
LADD	Lifetime Average Daily Dose.
ADC	Average Daily Concentration.
LADC	Lifetime Average Daily Concentration.
HQ	Hazard Quotient.
ELCR	Excess Lifetime Cancer Risk.
mg/kg-day	Milligrams per kilogram per day.
mg/m^3	Milligrams per cubic meter.
ug/m^3	Micrograms per cubic meter.
$(mg/kg-d)^{-1}$	Per milligrams per kilogram per day.
$(ug/m^3)^{-1}$	Per micrograms per cubic meter.
mg/kg	Milligrams per kilogram.

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Table 4. Summary of Calculations for the Tier 2 Acute Child Soil Reference Value.
Twin Cities Assembly Plan, St. Paul, Minnesota

Constituent	Units	Iron
Dose		
Acute Dose (AD)	mg/kg-day	1.65E+01
Toxicity Values		
Acute Reference Dose	mg/kg-day	6.00E+01
Non-Cancer Risk		
HQ - Ingestion	unitless	2.74E-01
Calculated Tier 2 Acute Child SRV		
SRV (based on HQ)	mg/kg	**66,000**

Notes:
SRV   Soil Reference Value.
HQ   Hazard Quotient.
mg/kg-day   Milligrams per kilogram per day.
mg/kg   Milligrams per kilogram.