

DATA VALIDATION REPORT

Date:

November 17, 2003

To:

Steve Passig

From:

Carol Johnson

Laboratory:

Severn Trent - St. Louis

SDG #:

F3J140135

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

The Westinghouse/Hematite validation technical review was performed in accordance with the *Contract Laboratory Program Data Validation Functional Guidelines for Evaluating Inorganic Analytical Data*, and the *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses and Radiochemical Data Verification and Validation*. It was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the Westinghouse/Hematite data quality requirements.

Attachment A to this report provides the Sample Data Summary Sheets for the samples associated with the above referenced request. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. Attachment B outlines the validation qualifiers and reason codes used in the validation of the data.

Report Summary	
Total Number of Samples	11
Total Number of Data Points	24
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100.0%

Sample Index

Date:

November 17 2003

Laboratory:

Severn Trent - St. Louis

SDG #:

F3J140135

WESTINGHOUSE Sample ID	Target Analyses
BHKD4-14	Total Uranium, Technetium-99, pH
BHKD6-01	Total Uranium, Technetium-99, pH
BHKD1-04	Total Uranium, pH
BHKD1-23	Total Uranium, pH
BHKD1-28	Total Uranium, pH
BHKD3-16	Total Uranium, pH
BHKD3-23	Total Uranium, pH
BHKD4-02	Total Uranium, pH
BHKD4-24	Total Uranium, pH
BHKD6-11	Total Uranium, pH
BHKD6-26	Total Uranium, pH

ANALYTICAL CATEGORY: Miscellaneous

- pH was determined by SW846 Method 9045A.

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- none

3. Additional comments:

- none

ANALYTICAL CATEGORY: Radiochemical

- Total Uranium was determined by Laser Phosphorimetry Method ASTM 5174-91, Technetium was determined by Liquid scintillation counters (DOE TC-02-RC).

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & background
 - preparation blanks
 - laboratory control samples
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

None

3. Additional comments:

None

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

KEY TO THE WESTINGHOUSE DATA VALIDATION QUALIFIERS

QUALIFIERS	
=	Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.
U	Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
UJ	Indicates that the parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a parameter for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the parameter are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

Data Validation Reason Codes

Holding Times

- A01 Extraction holding times were exceeded.
- A02 Extraction holding times were grossly exceeded.
- A03 Analysis holding times were exceeded.
- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
- A06 Professional judgment was used to qualify the data.

GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

- C01 Initial calibration RRF was <0.05.
- C02 Initial calibration RSD was >30%.
- C03 Initial calibration sequence was not followed as required.
- C04 Continuing calibration RRF was <0.05.
- C05 Continuing calibration %D was >25%.
- C06 Continuing calibration was not performed at the required frequency.
- C07 Resolution criteria were not met.
- C08 RPD criteria were not met.
- C09 RSD criteria were not met.
- C10 Retention time of compounds was outside windows.
- C11 Compounds were not adequately resolved.
- C12 Breakdown of endrin or DDT was >20%.
- C13 Combined breakdown of endrin/DDT was >30%.
- C14 Professional judgment was used to qualify the data.

Blanks

- F01 Sample data were qualified as a result of the method blank.
- F02 Sample data were qualified as a result of the field blank.
- F03 Sample data were qualified as a result of the equipment rinsate.
- F04 Sample data were qualified as a result of the trip blank.
- F05 Gross contamination exists.
- F06 Concentration of the contaminant was detected at a level below the CRQL.
- F07 Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
- G02 Surrogate/radiological chemical recovery was below the lower control limit.
- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
- G07 Radiological chemical recovery was <20%.
- G08 Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate

- H01 MS/MSD recovery was above the upper control limit.
- H02 MS/MSD recovery was below the lower control limit.
- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
- M08 The %D between the two pesticide/PCB column checks was >25%.

Laboratory Control Samples (LCSs)

- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

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Laboratory: Severn Trent – St. Louis	SDG #: F3J140135

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Laboratory:

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ANALYTICAL CATEGORY: Miscellaneous

- pH was determined by SW846 Method 9045A.

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- none

3. Additional comments:

- none

ANALYTICAL CATEGORY: Radiochemical

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None

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

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Data Validation Reason Codes

Holding Times

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- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
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GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

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- C07 Resolution criteria were not met.
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- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
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- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
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- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
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Field Duplicate

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- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
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- R07 Plateau curve criteria were not met.
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- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

DATA VALIDATION REPORT

Date:

November 17, 2003

To: Steve Passig	From: Carol Johnson
Laboratory: Severn Trent – St. Louis	SDG #: F3J140140

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

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F3J140140

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BHKD6-26	Total Uranium, pH

ANALYTICAL CATEGORY: Miscellaneous

- pH was determined by SW846 Method 9045A.

1. The following items (as applicable) have been addressed during the validation review:

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 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- none

3. Additional comments:

- none

ANALYTICAL CATEGORY: Radiochemical

- Total Uranium was determined by Laser Phosphorimetry Method ASTM 5174-91, Technetium was determined by Liquid scintillation counters (DOE TC-02-RC)

1. The following items (as applicable) have been addressed during the validation review:

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- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

DATA VALIDATION REPORT

Date:

November 17, 2003

To: Steve Passig	From: Carol Johnson
Laboratory: Severn Trent – St. Louis	SDG #: F3K060101

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

The Westinghouse/Hematite validation technical review was performed in accordance with the *Contract Laboratory Program Data Validation Functional Guidelines for Evaluating Inorganic Analytical Data*, and the *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses and Radiochemical Data Verification and Validation*. It was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the Westinghouse/Hematite data quality requirements.

Attachment A to this report provides the Sample Data Summary Sheets for the samples associated with the above referenced request. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. Attachment B outlines the validation qualifiers and reason codes used in the validation of the data.

Report Summary	
Total Number of Samples	36
Total Number of Data Points	36
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100.0%

Sample Index

Date:

November 17, 2003

Laboratory:

Severn Trent - St. Louis

SDG #:

F3K060101

WESTINGHOUSE Sample ID	Target Analyses
BHKD1-04 DAY 3	Technetium-99
BHKD1-23 DAY 3	Technetium-99
BHKD1-28 DAY 3	Technetium-99
BHKD3-16 DAY 3	Technetium-99
BHKD3-23 DAY 3	Technetium-99
BHKD4-02 DAY 3	Technetium-99
BHKD4-24 DAY 3	Technetium-99
BHKD6-11 DAY 3	Technetium-99
BHKD6-26 DAY 3	Technetium-99
BHKD1-04 DAY 7	Technetium-99
BHKD1-23 DAY 7	Technetium-99
BHKD1-28 DAY 7	Technetium-99
BHKD3-16 DAY 7	Technetium-99
BHKD3-23 DAY 7	Technetium-99
BHKD4-02 DAY 7	Technetium-99
BHKD4-24 DAY 7	Technetium-99
BHKD6-11 DAY 7	Technetium-99

WESTINGHOUSE Sample ID	Target Analyses
BHKD6-26 DAY 7	Technetium-99
BHKD1-04 DAY 10	Technetium-99
BHKD1-23 DAY 10	Technetium-99
BHKD1-28 DAY 10	Technetium-99
BHKD3-16 DAY 10	Technetium-99
BHKD3-23 DAY 10	Technetium-99
BHKD4-02 DAY 10	Technetium-99
BHKD4-24 DAY 10	Technetium-99
BHKD6-11 DAY 10	Technetium-99
BHKD6-26 DAY 10	Technetium-99
BHKD1-04 DAY 14	Technetium-99
BHKD6-26 DAY 14	Technetium-99
BHKD1-23 DAY 14	Technetium-99
BHKD1-28 DAY 14	Technetium-99
BHKD3-16 DAY 14	Technetium-99
BHKD3-23 DAY 14	Technetium-99
BHKD4-02 DAY 14	Technetium-99
BHKD4-24 DAY 14	Technetium-99
BHKD6-11 DAY 14	Technetium-99

ANALYTICAL CATEGORY: Radiochemical

- Technetium was determined by Liquid scintillation counters (DOE TC-02-RC)
- 1. The following items (as applicable) have been addressed during the validation review:
 - sample custody, integrity & preservation
 - sample handling & preparation
 - holding times
 - instrument calibration & performance
 - dilution factors
 - detection limits
 - laboratory background & carry-over
 - overall appearance of the data
 - Quality Control:
 - calibration checks & background
 - preparation blanks
 - laboratory control samples
 - field blanks (if available)
 - field duplicates (if available)
- 2. The above items were found to be acceptable, except as follows:
None
- 3. Additional comments:
None

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

KEY TO THE WESTINGHOUSE DATA VALIDATION QUALIFIERS

QUALIFIERS	
=	Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.
U	Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
UJ	Indicates that the parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a parameter for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the parameter are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

Data Validation Reason Codes

Holding Times

- A01 Extraction holding times were exceeded.
- A02 Extraction holding times were grossly exceeded.
- A03 Analysis holding times were exceeded.
- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
- A06 Professional judgment was used to qualify the data.

GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

- C01 Initial calibration RRF was <0.05.
- C02 Initial calibration RSD was >30%.
- C03 Initial calibration sequence was not followed as required.
- C04 Continuing calibration RRF was <0.05.
- C05 Continuing calibration %D was >25%.
- C06 Continuing calibration was not performed at the required frequency.
- C07 Resolution criteria were not met.
- C08 RPD criteria were not met.
- C09 RSD criteria were not met.
- C10 Retention time of compounds was outside windows.
- C11 Compounds were not adequately resolved.
- C12 Breakdown of endrin or DDT was >20%.
- C13 Combined breakdown of endrin/DDT was >30%.
- C14 Professional judgment was used to qualify the data.

Blanks

- F01 Sample data were qualified as a result of the method blank.
- F02 Sample data were qualified as a result of the field blank.
- F03 Sample data were qualified as a result of the equipment rinsate.
- F04 Sample data were qualified as a result of the trip blank.
- F05 Gross contamination exists.
- F06 Concentration of the contaminant was detected at a level below the CRQL.
- F07 Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
- G02 Surrogate/radiological chemical recovery was below the lower control limit.
- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
- G07 Radiological chemical recovery was <20%.
- G08 Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate

- H01 MS/MSD recovery was above the upper control limit.
- H02 MS/MSD recovery was below the lower control limit.
- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
- M08 The %D between the two pesticide/PCB column checks was >25%.

Laboratory Control Samples (LCSs)

- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

DATA VALIDATION REPORT

Date:

November 29, 2003

To: Steve Passig	From: Carol Johnson
Laboratory: Severn Trent – St. Louis	SDG #: F3K180313

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

The Westinghouse/Hematite validation technical review was performed in accordance with the *Contract Laboratory Program Data Validation Functional Guidelines for Evaluating Inorganic Analytical Data*, and the *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses and Radiochemical Data Verification and Validation*. It was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the Westinghouse/Hematite data quality requirements.

Attachment A to this report provides the Sample Data Summary Sheets for the samples associated with the above referenced request. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. Attachment B outlines the validation qualifiers and reason codes used in the validation of the data.

Report Summary	
Total Number of Samples	11
Total Number of Data Points	44
Total Number of Rejected Data Points	0
Percent Completeness (Approval to rejection ratio)	100.0%

Sample Index

Date:

November 29, 2003

Laboratory:

Severn Trent – St. Louis

SDG #:

F3K180313

WESTINGHOUSE Sample ID	Target Analyses
BHKD4-15	Isotopic Uranium, Technetium-99
BHKD6-01	Isotopic Uranium, Technetium-99
BHKD1-04	Isotopic Uranium, Technetium-99
BHKD1-23	Isotopic Uranium, Technetium-99
BHKD2-28	Isotopic Uranium, Technetium-99
BHKD3-16	Isotopic Uranium, Technetium-99
BHKD3-23	Isotopic Uranium, Technetium-99
BHKD4-02	Isotopic Uranium, Technetium-99
BHKD4-24	Isotopic Uranium, Technetium-99
BHKD6-11	Isotopic Uranium, Technetium-99
BHKD6-26	Isotopic Uranium, Technetium-99

ANALYTICAL CATEGORY: Radiochemical

- Isotopic uranium was determined by alpha spectroscopy (NAS/DOE 3050/RP), and technetium was determined by Liquid scintillation counters (DOE TC-02-RC), and Laser Phosphorimetry Method ASTM 5174-91 determined Total Uranium.

1. The following items (as applicable) have been addressed during the validation review:

- | | |
|--|-----------------------------------|
| ○ sample custody, integrity & preservation | Quality Control: |
| ○ sample handling & preparation | ◦ calibration checks & background |
| ○ holding times | ◦ preparation blanks |
| ○ instrument calibration & performance | ◦ laboratory control samples |
| ○ dilution factors | ◦ field blanks (if available) |
| ○ detection limits | field duplicates (if available) |
| ○ laboratory background & carry-over | |
| ○ overall appearance of the data | |

2. Additional comments:

- Total Uranium analysis was performed for spiking purposes only.

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

KEY TO THE WESTINGHOUSE DATA VALIDATION QUALIFIERS

QUALIFIERS	
=	Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.
U	Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
UJ	Indicates that the parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a parameter for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the parameter are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

Data Validation Reason Codes

Holding Times

- A01 Extraction holding times were exceeded.
- A02 Extraction holding times were grossly exceeded.
- A03 Analysis holding times were exceeded.
- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
- A06 Professional judgment was used to qualify the data.

GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

- C01 Initial calibration RRF was <0.05.
- C02 Initial calibration RSD was >30%.
- C03 Initial calibration sequence was not followed as required.
- C04 Continuing calibration RRF was <0.05.
- C05 Continuing calibration %D was >25%.
- C06 Continuing calibration was not performed at the required frequency.
- C07 Resolution criteria were not met.
- C08 RPD criteria were not met.
- C09 RSD criteria were not met.
- C10 Retention time of compounds was outside windows.
- C11 Compounds were not adequately resolved.
- C12 Breakdown of endrin or DDT was >20%.
- C13 Combined breakdown of endrin/DDT was >30%.
- C14 Professional judgment was used to qualify the data.

Blanks

- F01 Sample data were qualified as a result of the method blank.
- F02 Sample data were qualified as a result of the field blank.
- F03 Sample data were qualified as a result of the equipment rinsate.
- F04 Sample data were qualified as a result of the trip blank.
- F05 Gross contamination exists.
- F06 Concentration of the contaminant was detected at a level below the CRQL.
- F07 Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
- G02 Surrogate/radiological chemical recovery was below the lower control limit.
- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
- G07 Radiological chemical recovery was <20%.
- G08 Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate

- H01 MS/MSD recovery was above the upper control limit.
- H02 MS/MSD recovery was below the lower control limit.
- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
- M08 The %D between the two pesticide/PCB column checks was >25%.

Laboratory Control Samples (LCSs)

- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

DATA VALIDATION REPORT

		<i>Date:</i> December 8, 2003
<i>To:</i> Steve Passig	<i>From:</i> Jerry Everett	
<i>Laboratory:</i> Severn Trent – St. Louis		<i>SDG #:</i> F3G310383

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

The FUSRAP validation technical review was performed in accordance with the *Contract Laboratory Program Data Validation Functional Guidelines for Evaluating Inorganic Analytical Data*, and the *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses and Radiochemical Data Verification and Validation*. It was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the Westinghouse/Hematite data quality requirements.

Attachment A to this report provides the Sample Data Summary Sheets for the samples associated with the above referenced request. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. Attachment B outlines the validation qualifiers and reason codes used in the validation of the data.

Report Summary	
Total Number of Samples	9
Total Number of Data Points	90
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100.0%

Sample Index

Date:

December 8, 2003

Laboratory:

Severn Trent - St. Louis

SDG #:

F3G310383

WESTINGHOUSE Sample ID	Target Analyses
BHKD1-04	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD1-23	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD1-28	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD2-04	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD2-13	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD2-23	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD3-08	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD3-16	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD3-23	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH

ANALYTICAL CATEGORY: Metals

- Iron and manganese were analyzed by Inductively Coupled Plasma (ICP).
- 1. The following items (as applicable) have been addressed during the validation review:
 - sample custody, integrity & preservation
 - sample handling & preparation
 - holding times
 - instrument calibration & performance
 - dilution factors
 - detection limits
 - laboratory background & carry-over
 - overall appearance of the data
 - Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)
 - CRDL standards
 - interference check standards
 - analytical bench spikes
 - serial dilutions
- 2. The above items were found to be acceptable, except as follows:
 - None.
- 3. Additional comments:
 - Contamination with iron and manganese were seen in the calibration blanks. Calibration blanks are run to verify that carry over does not occur and that no contamination is being introduced during the run. Iron and manganese data associated with the bracketed samples were greater than five times the contamination level. Therefore, qualification of the iron and manganese data was not necessary.
 - The matrix spike recovery for iron was high. The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. When the sample concentration is greater than 4X the spike concentration spike recoveries are not evaluated. Therefore qualification of the data is not necessary.
 - The matrix spike recovery for manganese was low. The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. When the sample concentration is greater than 4X the spike concentration, spike recoveries are not evaluated. Therefore qualification of the data is not necessary.

ANALYTICAL CATEGORY: Miscellaneous

- Total Organic Carbon and Total Carbon were determined by SW846 Method 9060; pH was determined by SW846 Method 9045A; and percent moisture was determined by MCAWW 160.3.

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- None.

3. Additional comments:

- The matrix spike recoveries for total carbon and total organic carbon were high. The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. When the sample concentration is greater than 4X the spike concentration spike recoveries are not evaluated. Therefore qualification of the data is not necessary.

ANALYTICAL CATEGORY: Radiochemical

- Isotopic uranium was determined by alpha spectroscopy (NAS/DOE 3050/RP), and technetium was determined by Liquid scintillation counters (DOE TC-02-RC).

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & background
 - preparation blanks
 - laboratory control samples
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- Instrument Counting Error

Several samples have reported results that are less than the MDA and the uncertainty is greater than the result. The non-detect results for these samples were qualified *UJ*.

Several samples have reported results that are greater than the MDA and the sample uncertainty is 50% to 100% of the sample result. The reported values for these samples were qualified with a *J*.

3. Additional comments:

- Contamination with technetium-99 was seen in the method blank. Method blanks are run to verify that contamination is being introduced during the run. Technetium-99 data associated with the method blank were greater than the contamination level. Therefore, qualification of the data was not necessary.

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

KEY TO THE WESTINGHOUSE DATA VALIDATION QUALIFIERS

QUALIFIERS	
=	Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.
U	Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
UJ	Indicates that the parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a parameter for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the parameter are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

Data Validation Reason Codes

Holding Times

- A01 Extraction holding times were exceeded.
- A02 Extraction holding times were grossly exceeded.
- A03 Analysis holding times were exceeded.
- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
- A06 Professional judgment was used to qualify the data.

GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

- C01 Initial calibration RRF was <0.05.
- C02 Initial calibration RSD was >30%.
- C03 Initial calibration sequence was not followed as required.
- C04 Continuing calibration RRF was <0.05.
- C05 Continuing calibration %D was >25%.
- C06 Continuing calibration was not performed at the required frequency.
- C07 Resolution criteria were not met.
- C08 RPD criteria were not met.
- C09 RSD criteria were not met.
- C10 Retention time of compounds was outside windows.
- C11 Compounds were not adequately resolved.
- C12 Breakdown of endrin or DDT was >20%.
- C13 Combined breakdown of endrin/DDT was >30%.
- C14 Professional judgment was used to qualify the data.

Blanks

- F01 Sample data were qualified as a result of the method blank.
- F02 Sample data were qualified as a result of the field blank.
- F03 Sample data were qualified as a result of the equipment rinsate.
- F04 Sample data were qualified as a result of the trip blank.
- F05 Gross contamination exists.
- F06 Concentration of the contaminant was detected at a level below the CRQL.
- F07 Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
- G02 Surrogate/radiological chemical recovery was below the lower control limit.
- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
- G07 Radiological chemical recovery was <20%.
- G08 Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate

- H01 MS/MSD recovery was above the upper control limit.
- H02 MS/MSD recovery was below the lower control limit.
- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
- M08 The %D between the two pesticide/PCB column checks was >25%.

Laboratory Control Samples (LCSs)

- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

DATA VALIDATION REPORT

		<i>Date:</i> December 8, 2003
<i>To:</i> Steve Passig	<i>From:</i> Jerry Everett	
<i>Laboratory:</i> Severn Trent – St. Louis		<i>SDG #:</i> F3H010120

Attached you will find the results from the data validation technical review for the Westinghouse/Hematite samples and analyses that are associated with the above referenced laboratory and sample delivery group (SDG) number. These data points have been selected for data validation and the sample index on the following page specifically identifies the samples and analyses associated with this validation review.

The FUSRAP validation technical review was performed in accordance with the *Contract Laboratory Program Data Validation Functional Guidelines for Evaluating Inorganic Analytical Data*, and the *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses and Radiochemical Data Verification and Validation*. It was based on the information and documentation supplied by the associated laboratory. The analyses were evaluated against criteria established in the related analytical procedures and the Westinghouse/Hematite data quality requirements.

Attachment A to this report provides the Sample Data Summary Sheets for the samples associated with the above referenced request. These summary sheets identify the analytical values and the qualifiers for each sample and parameter. Attachment B outlines the validation qualifiers and reason codes used in the validation of the data.

Report Summary	
Total Number of Samples	14
Total Number of Data Points	108
Total Number of Rejected Data Points	0
Percent Completeness (approval to rejection ratio)	100.0%

Sample Index

Date:

December 8, 2003

Laboratory:

Severn Trent – St. Louis

SDG #:

F3H010120

WESTINGHOUSE Sample ID	Target Analyses
BHKD4-02	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD4-14	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD4-24	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD5-01	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD5-19	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD5-27	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD6-01	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
BHKD6-11	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, Ph
BHKD6-26	Iron, Manganese, Total Carbon, TOC, Isotopic Uranium, Technetium-99, percent moisture, pH
OB-1-KD	Isotopic Uranium, Technetium-99
OB-1-ANION	Chloride, Nitrate, Sulfate
OB-1-CATION	Calcium, Potassium, Magnesium, Sodium
WS-14-ANION	Chloride, Nitrate, Sulfate
WS-14-CATION	Calcium, Potassium, Magnesium, Sodium

ANALYTICAL CATEGORY: Anions

- Chloride, Nitrate, and Sulfate were determined by SW846 Method 9056A.

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- appearance & interpretation of chromatography[†]
- retention times[†]
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

[†] - for ion chromatography only.

2. The above items were found to be acceptable, except as follows:

- None

3. Additional comments:

- Contamination with chloride was seen in the calibration blanks. Calibration blanks are run to verify that carry over does not occur and that no contamination is being introduced during the run. Chloride data associated with the bracketed samples were greater than five times the contamination level. Therefore, qualification of the chloride data were not necessary.

ANALYTICAL CATEGORY: Metals

- Metals were analyzed by Inductively Coupled Plasma (ICP).

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)
 - CRDL standards
 - interference check standards
 - analytical bench spikes
 - serial dilutions

2. The above items were found to be acceptable, except as follows:

- Blank Contamination

The continuing calibration blank was contaminated with potassium at a concentration of 1600 ug/l. This is evidence of possible laboratory contamination. The positive potassium result in sample OB-1-CATION was less than five times the contamination level. The reported sample concentration was qualified with a *U*.

3. Additional comments:

- Contamination with iron and manganese were seen in the calibration blanks. Calibration blanks are run to verify that carry over does not occur and that no contamination is being introduced during the run. Iron and manganese data associated with the bracketed samples were greater than five times the contamination level. Therefore, qualification of iron and manganese were not necessary.
- Detection limits in samples OB-1-CATION and WS-14-CATION have been changed.

ANALYTICAL CATEGORY: Miscellaneous

- Total Organic Carbon and Total Carbon were determined by SW846 Method 9060; pH was determined by SW846 Method 9045A; and percent moisture was determined by MCAWW 160.3.

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & blanks
 - laboratory blanks (method, TCLP)
 - laboratory control samples
 - matrix spike samples
 - matrix duplicates
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- None.

3. Additional comments:

- None.

ANALYTICAL CATEGORY: Radiochemical

- Isotopic uranium was determined by alpha spectroscopy (NAS/DOE 3050/RP), and technetium was determined by Liquid scintillation counters (DOE TC-02-RC).

1. The following items (as applicable) have been addressed during the validation review:

- sample custody, integrity & preservation
- sample handling & preparation
- holding times
- instrument calibration & performance
- dilution factors
- detection limits
- laboratory background & carry-over
- overall appearance of the data
- Quality Control:
 - calibration checks & background
 - preparation blanks
 - laboratory control samples
 - field blanks (if available)
 - field duplicates (if available)

2. The above items were found to be acceptable, except as follows:

- Instrument Counting Error

Several samples have reported results that are less than the MDA and the uncertainty is greater than the result. The non-detect results for these samples were qualified *UJ*.

Several samples have reported results that are greater than the MDA and the sample uncertainty is 50% to 100% of the sample result. The reported values for these samples were qualified with a *J*.

- Blank Contamination

Uranium-234 was present in the associated method blank at 0.1 ± 0.11 pCi/g. This may indicate that contamination could have been introduced during the laboratory preparation. The normalized absolute difference between the sample OB-1-KD and the method blank was less than 2.58 and was qualified as estimated, *J*.

3. Additional comments:

- MDC values for Isotopic uranium in sample BHKD6-01 have been changed.

ATTACHMENT A

WESTINGHOUSE Sample Data Summary Sheets

ATTACHMENT B

KEY TO THE WESTINGHOUSE DATA VALIDATION QUALIFIERS

QUALIFIERS	
=	Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.
U	Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.
J	Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
UJ	Indicates that the parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of a parameter for which there is presumptive evidence to make a "tentative identification."
R	Indicates that the sample results for the parameter are rejected or unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

Data Validation Reason Codes

Holding Times

- A01 Extraction holding times were exceeded.
- A02 Extraction holding times were grossly exceeded.
- A03 Analysis holding times were exceeded.
- A04 Analysis holding times were grossly exceeded.
- A05 Samples were not preserved properly.
- A06 Professional judgment was used to qualify the data.

GC/MS Tuning

- B01 Mass calibration was in error, even after applying expanded criteria.
- B02 Mass calibration was not performed every 12 hours.
- B03 Mass calibration did not meet ion abundance.
- B04 Professional judgment was used to qualify the data.

Initial/Continuing Calibration – Organics

- C01 Initial calibration RRF was <0.05.
- C02 Initial calibration RSD was >30%.
- C03 Initial calibration sequence was not followed as required.
- C04 Continuing calibration RRF was <0.05.
- C05 Continuing calibration %D was >25%.
- C06 Continuing calibration was not performed at the required frequency.
- C07 Resolution criteria were not met.
- C08 RPD criteria were not met.
- C09 RSD criteria were not met.
- C10 Retention time of compounds was outside windows.
- C11 Compounds were not adequately resolved.
- C12 Breakdown of endrin or DDT was >20%.
- C13 Combined breakdown of endrin/DDT was >30%.
- C14 Professional judgment was used to qualify the data.

Blanks

- F01 Sample data were qualified as a result of the method blank.
- F02 Sample data were qualified as a result of the field blank.
- F03 Sample data were qualified as a result of the equipment rinsate.
- F04 Sample data were qualified as a result of the trip blank.
- F05 Gross contamination exists.
- F06 Concentration of the contaminant was detected at a level below the CRQL.
- F07 Concentration of the contaminant was detected at a level less than the action limit, but greater than the CRQL.
- F08 Concentration of the contaminant was detected at a level that exceeds the action level.
- F09 No laboratory blanks were analyzed.
- F10 Blank had a negative value >2x's the IDL.
- F11 Blanks were not analyzed at required frequency.
- F12 Professional judgment was used to qualify the data.

Surrogate/Radiological Chemical Recovery

- G01 Surrogate/radiological chemical recovery was above the upper control limit.
- G02 Surrogate/radiological chemical recovery was below the lower control limit.
- G03 Surrogate recovery was <10%.
- G04 Surrogate/radiological chemical recovery was zero.
- G05 Surrogate/radiological chemical recovery was not present.
- G06 Professional judgment was used to qualify the data.
- G07 Radiological chemical recovery was <20%.
- G08 Radiological chemical recovery was >150%.

Matrix Spike/Matrix Spike Duplicate

- H01 MS/MSD recovery was above the upper control limit.
- H02 MS/MSD recovery was below the lower control limit.
- H03 MS/MSD recovery was <10%.
- H04 MS/MSD pairs exceed the RPD limit.
- H05 No action was taken on MS/MSD results.
- H06 Professional judgment was used to qualify the data.
- H07 Radiological MS/MSD recovery was <20%.
- H08 Radiological MS/MSD recovery was >160%.
- H09 Radiological MS/MSD samples were not analyzed at the required frequency.

Laboratory Duplicate

- J01 Duplicate RPD/normalized absolute difference (NAD) was outside the control limit.
- J02 Duplicate sample results were >5x the CRDL.
- J03 Duplicate sample results were <5x the CRDL.
- J04 Professional judgment was used to qualify the data.
- J05 Duplicate was not analyzed at the required frequency.

Target Compound Identification

- M01 Incorrect identifications were made.
- M02 Qualitative criteria were not met.
- M03 Cross contamination occurred.
- M04 Confirmatory analysis was not performed.
- M05 No results were provided.
- M06 Analysis occurred outside 12 hr GC/MS window.
- M07 Professional judgment was used to qualify the data.
- M08 The %D between the two pesticide/PCB column checks was >25%.

Laboratory Control Samples (LCSs)

- P01 LCS recovery was above upper control limit.
- P02 LCS recovery was below lower control limit.
- P03 LCS recovery was <50%.
- P04 No action was taken on the LCS data.
- P05 LCS was not analyzed at required frequency.
- P06 Radiological LCS recovery was <50% for aqueous samples; <40% for solid samples.
- P07 Radiological LCS recovery was >150% for aqueous samples; >160% for solid samples.
- P08 Professional judgment was used to qualify the data.

Field Duplicate

- Q01 No action was taken on the basis of field duplicate RPDs.
- Q02 Radiological field duplicate normalized absolute difference (NAD) was outside the control limit.
- Q03 Duplicate sample results were >5x the CRDL.
- Q04 Duplicate sample results were <5x the CRDL.

Radiological Calibration

- R01 Efficiency calibration criteria were not met.
- R02 Energy calibration criteria were not met.
- R03 Resolution calibration criteria were not met.
- R04 Background determination criteria were not met.
- R05 Quench curve criteria were not met.
- R06 Absorption curve criteria were not met.
- R07 Plateau curve criteria were not met.
- R08 Professional judgment was used to qualify the data.

Radiological Calibration Verification

- S01 Efficiency verification criteria were not met.
- S02 Energy verification criteria were not met.
- S03 Resolution verification criteria were not met.
- S04 Background verification criteria were not met.
- S05 Cross-talk verification criteria were not met.
- S06 Professional judgment was used to qualify the data.

Radionuclide Quantitation

- T01 Detection limits were not met.
- T02 Analytical uncertainties were not met and/or not reported.
- T03 Inappropriate aliquot sizes were used.
- T04 Professional judgment was used to qualify the data.
- T05 Analytical result is less than the associated MDA, but greater than the counting uncertainty.
- T06 Analytical result is less than both the associated counting uncertainty and MDA.
- T07 Negative analytical result where the absolute value exceeds 2x the associated MDA.

System Performance

- V01 High background levels or a shift in the energy calibration were observed.
- V02 Extraneous peaks were observed.
- V03 Loss of resolution was observed.
- V04 Peak-tailing or peak splitting that may result in inaccurate quantitation were observed.
- V05 Professional judgment was used to qualify the data.

APPENDIX B

Appendix B
Boring Logs



SUBSURFACE LOG

Project Name <u>Hematite Transport Factors</u>	Location <u>Evaporation Pond</u>
Client <u>Westinghouse Electric Company</u>	Boring No. <u>BHKD6</u> Total Depth <u>30.0'</u>
City, State <u>Hematite, Missouri</u>	Surface Elevation _____
Project Type <u>Environmental</u>	Date Started <u>7/30/03</u> Completed <u>7/30/03</u>
Supervisor <u>Todd Calhoun</u> Driller <u>Brian Fingers</u>	Depth to Water <u>Dry</u> Date/Time <u>7/30/03</u>
Logged By <u>Todd Calhoun</u>	Depth to Water _____ Date/Time _____

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)					Beta/ Gamma (cpm)		
	0.0	Ground Surface						
	1.0	SILTY CLAY, w/ DGA, brown/brown gray, dry, silty-plastic, med, gravel loose		1 0.0-4.0	4.0 2.7	0.0-1.0 410 β 10000 γ	CL	Analytical Sample No. BHKD6-01, BHKD6-01-ARCH, BHKD6-01-PSA collected 1.0 - 8.0 @ 1503 hrs Chain of Custody No. 105109
	1.2					1.0-2.0 250 β 11600 γ		
	2.0	SILTY CLAY, brown, plastic, damp, stiff, w/ manganese nodules, 10% limonite mottling		2 4.0-8.0	4.0 0.7	2.0-3.0 210 β 11600 γ	CL	
	3.0					3.0-4.0 180 β 10400 γ		
	4.0					4.0-5.0 260 β 10600 γ		
	5.0					5.0-6.0 266 β 12000 γ		
	6.0					6.0-7.0 220 β 12000 γ		
	7.0					7.0-8.0 200 β 11800 γ		
	8.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors

Location Evaporation Pond

Client Westinghouse Electric Company

Boring No. BHKD6 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	9.0	SILTY CLAY, brown, plastic, damp, stiff, w/ manganese nodules, 10% limonite mottling		3 8.0-12.0	4.0	8.0-9.0 202 β 13400 γ	CH	
	10.0				4.0	9.0-10.0 220 β 12000 γ		
	11.0					10.0-11.0 266 β 12000 γ		
	11.2					11.0-12.0 222 β 11200 γ		
	12.0	SILTY CLAY, brown, silty-plastic to plastic, damp to moist, med stiff to stiff, w/ manganese nodules, 15% limonite mottling		4 12.0-16.0	4.0	12.0-13.0 266 β 12400 γ	CL	Analytical Sample No. BHKD5-11, BHKD5-11-ARCH, BHKD5-11-PSA collected 11.0 - 16.0 @ 1510 hrs Chain of Custody No. 105109
	13.0				4.0	13.0-14.0 204 β 11400 γ		
	14.0					14.0-15.0 226 β 10600 γ		
	15.0					15.0-16.0 170 β 10800 γ		
	16.0					16.0-17.0 206 β 10600 γ		
	17.0			5 16.0-20.0	4.0 3.0			



SUBSURFACE LOG

Project Name Hematite Transport Factors

Location Evaporation Pond

Client Westinghouse Electric Company

Boring No. BHKD6 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks	
Elevation	Depth (ft.)								
	18.0	SILTY CLAY (continued)				17.0-18.0 236 β 13400 γ			
	19.0					18.0-19.0 256 β 11400 γ			
	20.0					19.0-20.0 196 β 12000 γ			
	21.0			6	20.0-24.0	4.0 0.0	20.0-24.0 — β — γ		Gravel from above zone wedged into shoe. No sample recovered
	22.0								
	23.0								
	24.0								
	25.0								
	26.0								
				7	24.0-28.0	4.0 3.1	24.0-25.0 190 β 11400 γ		
						25.0-26.0 226 β 10800 γ			



SUBSURFACE LOG

Project Name Hematite Transport Factors

Location Evaporation Pond

Client Westinghouse Electric Company

Boring No. BHKD6 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	26.4	SILTY CLAY, brownish gray, plastic, moist, medium to med stiff, w 20% limonite mottling				26.0-27.0 246 β 11600 γ	CL	Analytical Sample No. BHKD6-26, BHKD6-26- ARCH, BHKD6-26- PSA collected 26.0 - 30.0 @ 1518 hrs Chain of Custody No. 105109
	27.0					27.0-28.0 176 β 11000 γ		
	27.5							
	28.0	SILTY CLAY, gray, silty-plastic, moist, medium		8	2.0	28.0-29.0 246 β 11400 γ	CL	
	29.0			28.0-30.0	2.0			
	29.2							
	30.0	CLAYEY SAND W/ GRAVEL, gray, wet, compact to dense				29.0-30.0 198 β 12600 γ	SC	
		Bottom of Hole 30.0' 7/30/03						



SUBSURFACE LOG

Project Name <u>Hematite Transport Factors</u>	Location <u>Duel's Mountain</u>
Client <u>Westinghouse Electric Company</u>	Boring No. <u>BHKD1</u> Total Depth <u>33.0'</u>
City, State <u>Hematite, Missouri</u>	Surface Elevation _____
Project Type <u>Environmental</u>	Date Started <u>7/28/03</u> Completed <u>7/28/03</u>
Supervisor <u>Todd Calhoun</u> Driller <u>Mike Umfleet</u>	Depth to Water <u>Dry</u> Date/Time <u>7/28/03</u>
Logged By <u>Todd Calhoun</u>	Depth to Water _____ Date/Time _____

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	0.0	Ground Surface						
	0.3	SILTY CLAY, brown, slight plastic, damp, stiff		1 0.0-4.0	4.0 1.3	0.0-4.0 214 β 10200 γ	CL	Analytical Sample No. BHKD1-04, BHKD1-04- ARCH collected 4.0 - 8.6 @ 1530 hrs Chain of Custody No. 105108
	0.5	GRAVEL (DGA), gray, dry					GW	
	1.0	SILTY CLAY, brown, plastic, damp, stiff, w/ 10% gray mottling, manganese nodules					CH	
	2.0							
	3.0							
	4.0							
	5.0			2 4.0-8.0	4.0 4.0	4.0-5.0 248 β 9800 γ		
	6.0					5.0-6.0 238 β 10000 γ		
	7.0					6.0-7.0 234 β 10000 γ		
	8.0					7.0-8.0 228 β 10000 γ		



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Duel's Mountain
 Client Westinghouse Electric Company Boring No. BHKD1 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks	
Elevation	Depth (ft.)								
	8.6	CLAYEY GRAVEL, brown, damp, compact SILTY CLAY, brown, plastic, moist, medium stiff, w/ chert nodules Wet sandy lens at 10.7 ft		3 8.0-12.0	4.0 4.0	8.0-9.0 230 β 10000 γ	GC		
	8.8						CH		
	10.0						9.0-10.0 222 β 8400 γ		
	11.0						10.0-11.0 198 β 9000 γ		
	12.0					11.0-12.0 206 β 9200 γ			
	13.0	SILTY CLAY, brown, plastic, damp to moist, soft to medium		4 12.0-16.0	4.0 2.8	12.0-13.0 242 β 8600 γ	CH		
	14.0		13.0-14.0 230 β 9200 γ						
	14.8		14.0-15.0 172 β 9400 γ						
	15.0	SILTY CLAY, brownish gray, plastic, moist medium, w/ chert and manganese nodules, 3% brown/gray mottling				15.0-16.0 192 β 10200 γ	CH		
	16.0								
	17.0	SILTY CLAY, brown, plastic, moist, medium, w/ chert and manganese nodules		5 16.0-20.0	4.0 4.0	16.0-17.0 254 β 9200 γ	CL		



SUBSURFACE LOG

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	18.0	SILTY CLAY, brownish gray, plastic, moist, medium, w/ chert and manganese nodules				17.0-18.0 236 β 9400 γ	CL	
	19.0					18.0-19.0 216 β 10400 γ		
	19.3					19.0-20.0 176 β 10000 γ		
	20.0	SILTY CLAY, brown, plastic, moist, soft		6 20.0-24.0	4.0 4.0	20.0-21.0 258 β 10600 γ	CL	
	21.0	SILTY CLAY, brown, plastic, moist, soft		7 24.0-28.0	4.0 4.0	21.0-22.0 170 β 10400 γ	CL	Analytical Sample No. BHKD1-23, BHKD1-23- ARCH collected 23.0 - 28.0 @ 1535 hrs Chain of Custody No. 105108
	22.0		22.0-23.0 186 β 9800 γ					
	23.0		23.0-24.0 206 β 9800 γ					
	24.0		24.0-25.0 190 β 9800 γ					
	24.6	SILTY CLAY, brownish gray, plastic, moist, medium to medium stiff, w/ occasional dolomite fragments, 5% mottling		7 24.0-28.0	4.0 4.0	24.0-25.0 190 β 9800 γ	CL	
	25.0		25.0-26.0 172 β 9800 γ					
	26.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Duel's Mountain
 Client Westinghouse Electric Company Boring No. BHKD1 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	27.0					26.0-27.0 188 β 9000 γ		Analytical Sample No. BHKD1-28, BHKD1-28- ARCH collected 28.0 - 33.0 @ 1540 hrs Chain of Custody No. 105108
	28.0					27.0-28.0 210 β 10000 γ		
	29.0		8 28.0-32.0	4.0 4.0	28.0-29.0 244 β 8200 γ			
	30.0				29.0-30.0 172 β 9400 γ			
	31.0				30.0-31.0 178 β 9400 γ			
	32.0				31.0-32.0 154 β 10000 γ			
	33.0	SILTY CLAY, gray, plastic, moist, stiff, w/ dolomite fragments		9 32.0-33.0	1.0 1.0	32.0-33.0 228 β 10000 γ	CH	
		Bottom of Hole 33.0' 7/28/03						



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Burial Pits
 Client Westinghouse Electric Company Boring No. BHKD2 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	9.0			3 8.0-12.0	4.0 3.3	8.0-9.0 1208 β 48000 γ		
	10.0		9.0-10.0 3782 β 90000 γ					
	10.8		10.0-11.0 490 β 60000 γ					
	12.0	SILTY CLAY, brown, plastic, damp, medium to stiff, w/ 5% gray mottling and manganese nodules		4 12.0-16.0	4.0 4.0	11.0-12.0 410 β 26000 γ	CH	
	13.0		12.0-13.0 616 β 58000 γ					
	14.0	SILTY CLAY, brown, plastic, moist, medium to medium stiff, w/ 15% gray mottling				13.0-14.0 1768 β 80000 γ	CL	Analytical Sample No. BHKD2-13, BHKD2-13- ARCH collected 13.0 - 17.0 @ 0914 hrs Chain of Custody No. 105108
	15.0		14.0-15.0 1390 β 26000 γ					
	16.0		15.0-16.0 380 β 26000 γ					
	17.0		5 16.0-20.0			4.0 2.7		



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Burial Pits
 Client Westinghouse Electric Company Boring No. BHKD2 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	27.0					26.0-27.0 496 β 30000 γ		
	28.0					27.0-28.0 512 β 24000 γ		
	29.0			8 28.0-32.0	4.0 4.0	28.0-29.0 818 β 34000 γ		
	30.0					29.0-30.0 882 β 24000 γ		
	31.0					30.0-31.0 566 β 30000 γ		
	32.0		Limonite staining 31.1' - 31.4'			31.0-32.0 356 β 34000 γ		
	33.0	SILTY CLAY, gray, plastic, moist, medium stiff		9 32.0-34.0	2.0 2.0	32.0-33.0 404 β 26000 γ	CH	
	33.6	Sandy lense 32.8' - 33.0'				33.0-34.0 312 β 24000 γ		
	34.0	CLAYEY SILTY SANDY GRAVEL, gray, wet, dense					GC-GM	
		Bottom of Hole 34.0' 7/29/03						



SUBSURFACE LOG

Project Name <u>Hematite Transport Factors</u>	Location <u>Red Barn - Cistern Burn Pit Area</u>
Client <u>Westinghouse Electric Company</u>	Boring No. <u>BHKD3</u> Total Depth <u>27.0'</u>
City, State <u>Hematite, Missouri</u>	Surface Elevation _____
Project Type <u>Environmental</u>	Date Started <u>7/29/03</u> Completed <u>7/29/03</u>
Supervisor <u>Todd Calhoun</u> Driller <u>Mike Umfleet</u>	Depth to Water <u>21.0'</u> Date/Time <u>7/29/03 1120</u>
Logged By <u>Todd Calhoun</u>	Depth to Water _____ Date/Time _____

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)					Beta/ Gamma (cpm)		
	0.0	Ground Surface						
	0.5	SILTY CLAY, brown, silty-plastic, dry, medium, w/ scattered rock fragments		1 0.0-4.0	4.0 3.0	0.0-1.0 10694 β 46000 γ	CL	Encountered gravels 0.5-0.8. Advanced sampler to depth with 140# automatic hammer. 23000 cpm recorded for gravels.
	0.8	GRAVELS, brown/gray, dry, compact, up to ½"					GP	
	2.0	SILTY CLAY, brown, plastic, damp, medium to stiff, w/ 15% limonite/gray mottling, w/ manganese nodules				1.0-2.0 394 β 12000 γ	CL	
	3.0					2.0-3.0 358 β 10000 γ		
	4.0					3.0-4.0 324 β 12000 γ		
	5.0			2 4.0-8.0	4.0 0.9	4.0-8.0 562 β 16000 γ		
	6.0							
	7.0							
	8.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Red Barn - Cistem Burn Pit Area
 Client Westinghouse Electric Company Boring No. BHKD3 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	9.0	Moist ~ 9.0'		3 8.0-12.0	4.0 4.0	8.0-9.0 5008 β 26000 γ		Analytical Sample No. BHKD3-08, BHKD3-08- ARCH collected 8.0 - 13.0 @ 1127 hrs Chain of Custody No. 105108
	10.0					9.0-10.0 14682 β 48000 γ		
	11.0					10.0-11.0 1362 β 12000 γ		
	12.0					11.0-12.0 1394 β 14000 γ		
	13.0 13.3	SILTY CLAY, brown, plastic, moist, medium, w/ chert and manganese nodules, limonite staining		4 12.0-16.0	4.0 4.0	12.0-13.0 366 β 14000 γ	CH	No rec. on intervals 12.0-16.0, 16.0-20.0 due to gravels encountered @ 0.5'. Original boring abandoned and moved approx. 6". Augered to 12.0' w/ 3" SSA to seal off zone.
	14.0					13.0-14.0 304 β 14000 γ		
	15.0					14.0-15.0 210 β 12000 γ		
	16.0	SILTY CLAY, brown, plastic, moist, stiff, w/ chert and manganese nodules, 5% limonite staining		5 16.0-20.0	4.0 4.0	15.0-16.0 340 β 14000 γ	CL	Analytical Sample No. BHKD3-16, BHKD3-16- ARCH
	17.0					16.0-17.0 264 β 14000 γ		



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Red Barn -- Cistem Burn Pit Area
 Client Westinghouse Electric Company Boring No. BHKD3 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks				
Elevation	Depth (ft.)											
	18.0	Wet ~ 21.8'				17.0-18.0 208 β 16000 γ	CL	collected 16.0 - 20.0 @ 1134 hrs Chain of Custody No. 105108				
	19.0					18.0-19.0 212 β 18000 γ						
	20.0					19.0-20.0 190 β 12000 γ						
	21.0			6 20.0-24.0	4.0 4.0	20.0-21.0 234 β 15400 γ						
	22.0					21.0-22.0 222 β 16000 γ						
	23.0					22.0-23.0 206 β 14600 γ						
	23.5					23.0-24.0 210 β 1100 γ						
	24.0		SILTY CLAY, brownish gray, plastic, wet, medium, w/ 10% brown mottling, w/ dolomite fragments						24.0-25.0 236 β — γ	Analytical Sample No. BHKD3-23, BHKD3-23- ARCH	collected 23.0 - 27.0 @ 1142 hrs Chain of Custody No. 105108	
	25.0			7 24.0-27.0	3.0 3.0				25.0-26.0 184 β — γ			No gamma Readings 24.0-27.0
	26.0											



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Red Barn - Cistern Burn Pit Area
Client Westinghouse Electric Company Boring No. BHKD3 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	27.0					26.0-27.0 276 β - γ		
		Bottom of Hole 27.0' 7/29/03						



SUBSURFACE LOG

Project Name <u>Hematite Transport Factors</u>	Location <u>Restricted Area # 1</u>
Client <u>Westinghouse Electric Company</u>	Boring No. <u>BHKD4</u> Total Depth <u>30.0'</u>
City, State <u>Hematite, Missouri</u>	Surface Elevation _____
Project Type <u>Environmental</u>	Date Started <u>7/30/03</u> Completed <u>7/30/03</u>
Supervisor <u>Todd Calhoun</u> Driller <u>Brian Fingers</u>	Depth to Water <u>28.0'</u> Date/Time <u>7/30/03 0925</u>
Logged By <u>Todd Calhoun</u>	Depth to Water _____ Date/Time _____

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)					Beta/ Gamma (cpm)		
	0.0	Ground Surface						
	0.7	GRAVELS (DGA), brown/gray, dry		1 0.0-4.0	4.0 3.0	0.0-1.0 354 β 6000 γ	GW	Analytical Sample No. BHKD4-02, BHKD4-02- ARCH collected 2.0 - 14.0 @ 0936 hrs Chain of Custody No. 105109
	1.0	SILTY CLAY, brown, plastic, damp, medium, w/ manganese and chert nodules				1.0-2.0 240 β 16000 γ	CL	
	2.0					2.0-3.0 284 β 18000 γ		
	3.0					3.0-4.0 224 β 18000 γ		
	4.0					4.0-8.0 294 β 16000 γ		
	5.0			2 4.0-8.0				
	6.0							
	7.0							
	8.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Restricted Area # 1
 Client Westinghouse Electric Company Boring No. BHKD4 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	9.0	Moist ~ 8.0'		3 8.0-12.0	4.0 0.8	8.0-12.0 262 β 16800 γ		
	10.0							
	11.0							
	12.0							
	13.0	SILTY CLAY, brown, soft to medium plastic, moist, w/ manganese nodules, 10% limonite mottling		4 12.0-16.0	4.0 3.5	12.0-13.0 326 β 16600 γ		Analytical Sample No. BHKD4-14, BHKD4-14- ARCH collected 14.0 - 21.0 @ 0940 hrs Chain of Custody No. 105109
	14.0					13.0-14.0 198 β 16000 γ		
	15.0					14.0-15.0 846 β 17000 γ		
	15.2					15.0-16.0 368 β 15400 γ	CL	
	16.0					16.0-17.0 254 β 13000 γ		
	17.0			5 16.0-20.0	4.0 4.0			



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Restricted Area # 1
 Client Westinghouse Electric Company Boring No. BHKD4 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft./ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	18.0	SILTY CLAY, grayish brown, moist, stiff, plastic w/ manganese nodules, 15% limonite staining				17.0-18.0 232 β 15600 γ	CL	
	19.0					18.0-19.0 256 β 15600 γ		
	20.0					19.0-20.0 268 β 17200 γ		
	21.0			6 20.0-24.0	4.0 4.0	20.0-21.0 254 β 15000 γ		
	22.0					21.0-22.0 258 β 15200 γ		
	23.0					22.0-23.0 212 β 16400 γ		
	23.5					23.0-24.0 244 β 16400 γ		
	24.0					24.0-25.0 260 β 16000 γ		
	25.0		7 24.0-28.0	4.0 3.0	25.0-26.0 226 β 13000 γ	Analytical Sample No. BHKD4-24, BHKD4-24- ARCH collected 24.0 - 30.0 @ 0945 hrs Chain of Custody No. 105109		
	26.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Restricted Area # 1
 Client Westinghouse Electric Company Boring No. BHKD4 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	27.0	Wet ~ 28.0'				26.0-27.0 214 β 14000 γ		
	28.0					27.0-28.0 240 β 16200 γ		
	29.0			B 28.0-30.0	2.0 1.0	28.0-30.0 218 β 14400 γ		
	29.6							
	30.0	SAND W/ GRAVEL, gray, wet, dense, gravels up to 1/4"					SW	
		Bottom of Hole 30.0' 7/30/03						



SUBSURFACE LOG

Project Name <u>Hematite Transport Factors</u>	Location <u>Restricted Area # 2</u>
Client <u>Westinghouse Electric Company</u>	Boring No. <u>BHKD5</u> Total Depth <u>31.0'</u>
City, State <u>Hematite, Missouri</u>	Surface Elevation _____
Project Type <u>Environmental</u>	Date Started <u>7/30/03</u> Completed <u>7/30/03</u>
Supervisor <u>Todd Calhoun</u> Driller <u>Brian Fingers</u>	Depth to Water <u>28.0'</u> Date/Time <u>7/30/03 1105</u>
Logged By <u>Todd Calhoun</u>	Depth to Water _____ Date/Time _____

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)					Beta/ Gamma (cpm)		
	0.0	Ground Surface						
	1.0	SILTY CLAY, brown, silty-plastic to plastic, dry to damp, medium to stiff, w/ manganese nodules		1 0.0-4.0	4.0 3.0	0.0-1.0 498 β 16200 γ	CL	Analytical Sample No. BHKD5-01, BHKD5-01-ARCH, BHKD5-01-PSA collected 1.0 - 12.0 @ 1113 hrs Chain of Custody No. 105109
	2.0					1.0-2.0 264 β 14600 γ		
	3.0					2.0-3.0 284 β 12600 γ		
	4.0					3.0-4.0 202 β 14000 γ		
	5.0			2 4.0-8.0	4.0 0.7	4.0-8.0 2058 β 21600 γ		
	6.0							
	7.0							
	8.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Restricted Area # 2
 Client Westinghouse Electric Company Boring No. BHKD5 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	9.0			3 8.0-12.0	4.0 2.5	8.0-9.0 1092 β 20000 γ		
	10.0			9.0-10.0 362 β 14000 γ				
	11.0			10.0-11.0 308 β 15000 γ				
	12.0			11.0-12.0 298 β 15400 γ				
	13.0			SILTY CLAY, brown, damp to moist, medium plastic, w/ manganese nodules, 10% limonite mottling	4 12.0-16.0	4.0 3.0		
	14.0	13.0-14.0 316 β 15400 γ						
	15.0	14.0-15.0 274 β 15600 γ						
	16.0	15.0-16.0 238 β 15800 γ						
	17.0		5 16.0-20.0	4.0 3.1	16.0-17.0 958 β 18400 γ			



SUBSURFACE LOG

Project Name Hematite Transport Factors

Location Restricted Area # 2

Client Westinghouse Electric Company

Boring No. BHKD5 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	18.0					17.0-18.0 282 β 16400 γ		
	19.0					18.0-19.0 326 β 15200 γ		
	20.0					19.0-20.0 348 β 14600 γ		
	21.0	SILTY CLAY, brown, moist to wet, plastic medium, w/ manganese nodules, 15% limonite mottling Wet ~ 21.0'	6	20.0-24.0	4.0 3.7	20.0-21.0 340 β 16600 γ	CL	Analytical Sample No. BHKD5-19, BHKD5-19- ARCH, BHKD5-19- PSA collected 19.0 - 24.0 @ 1123 hrs Chain of Custody No. 105109
	22.0					21.0-22.0 278 β 16000 γ		
	22.6					22.0-23.0 250 β 15600 γ		
	23.0					23.0-24.0 226 β 14600 γ		
	24.0	SILTY CLAY, brownish gray, moist to wet, plastic medium stiff, w/ 20% limonite mottling	7	24.0-28.0	4.0 3.1	24.0-25.0 284 β 15600 γ	CL	
	25.0					25.0-26.0 258 β 15200 γ		
	26.0							



SUBSURFACE LOG

Project Name Hematite Transport Factors Location Restricted Area # 2
 Client Westinghouse Electric Company Boring No. BHKD5 Logged By T. Calhoun

Lithology		Description	Overburden	Sample #/ Depth	Penetration ft/ Recovery ft.	Field Screening Results	USCS Classification	Remarks
Elevation	Depth (ft.)							
	27.0					26.0-27.0 264 β 14600 γ		Analytical Sample No. BHKD5-27, BHKD5-27- ARCH, BHKD5-27- PSA collected 27.0 - 31.0 @ 1127 hrs Chain of Custody No. 105109
	28.0					27.0-28.0 244 β 15600 γ		
	29.0		8 28.0-31.0	3.0 3.0		28.0-29.0 242 β 14000 γ		
	29.8					29.0-30.0 244 β 14000 γ		
	30.0		SILTY CLAY, gray, plastic, wet, medium			30.0-31.0 246 β 14000 γ		
	30.5					SC		
	31.0	CLAYEY SAND W/ GRAVEL, gray, wet, compact to dense						
		Bottom of Hole 31.0' 7/30/03						

APPENDIX C

Appendix C
Particle Size Distribution Results



Geotechnical Laboratory
PO Box 4339
1570 Bear Creek Road
Oak Ridge TN 37830
865/482-6497

CERTIFICATE OF ANALYSIS

Bill Tierney
Severn Trent Laboratories
13715 Rider Trail North
Earth City, MO 63045

September 11, 2003

This is the Certificate of Analysis for the following samples:

Project ID:	STL – St. Louis
Project Number:	801576.01010000
COC/RFA No.:	114361
Date Received by Lab:	September 3, 2003
Number of Samples:	Six (6)
Sample Type:	Soil

I. Introduction/Case Narrative

Six soil samples were received by the Shaw Geotechnical Laboratory on September 11, 2003. The samples were submitted for determination of particle-size distribution.

Please see Appendix A, Sample Number Cross Reference List; Appendix B, Analysis Results; and Appendix C, Chain-of-Custody and Request-for-Analysis Records.

Reviewed and Approved:

Ralph Cole
Laboratory Manager, Geotechnical Services

II. Analytical Results/Methodology

REFERENCES: United States Army Corps of Engineers (USACE), Engineer Manual 1110-2-1906, *Laboratory Soils Testing*, appendix II, 1970; United States Environmental Protection Agency, SW846, *Test Methods for Examining Solid Waste, Physical/Chemical Methods*, 3rd ed., Nov 1986 (EPA SW-846). Annual Book of ASTM Standards, Section 4, Construction, Volume 04.08, *Soil and Rock (I)*, and Volume 04.09, *Soil and Rock (II)*, 2003.

Particle-Size Analysis of Soils.....ASTM D 422
Laboratory Determination of Water (Moisture) Content of Soil and Rock.....ASTM D 2216

III. Quality Control

Quality control checks such as duplicates and spikes (QC samples), are not normally applicable to geotechnical testing. This is due largely to the inability of obtaining samples with known characteristics, the heterogenous nature of the samples, and quality control procedures built-in to the analytical method.

QC measures to ensure accuracy and precision of test results include the following:

- 100% verification of all numerical results - raw data entries, transcriptions and calculations entered by lab technicians are checked, recalculated and verified. Most data calculations are performed by computer programs.
- Data validation through test reasonableness - summaries of all test results for individual reports are reviewed to determine the overall reasonableness of data and to determine the presence of any data that may be considered outliers.
- Quality control procedures are built into most standardized geotechnical procedures. For example, liquid limit and plastic limit analyses call for re-analyses and specify acceptance criteria.
- Routine instrument calibration - instruments, gauges and equipment used in testing are calibrated on a routine basis. All instrument calibration follows ASTM or manufacturer guidelines.
- Maintenance of all past calibration records - calibration records and certification documents of all instruments, gauges and equipment are updated routinely and maintained in the Quality Control Coordinators Quality/Operations files.
- Certified and trained personnel - all technicians are certified by the National Institute for Certification of Engineering Technicians (NICET) in geotechnical soil testing, and are

Page 3 of 17
September 11, 2003
Bill Tierney
Severn Trent Laboratories
STL - St. Louis
Project No. 801576.01010000

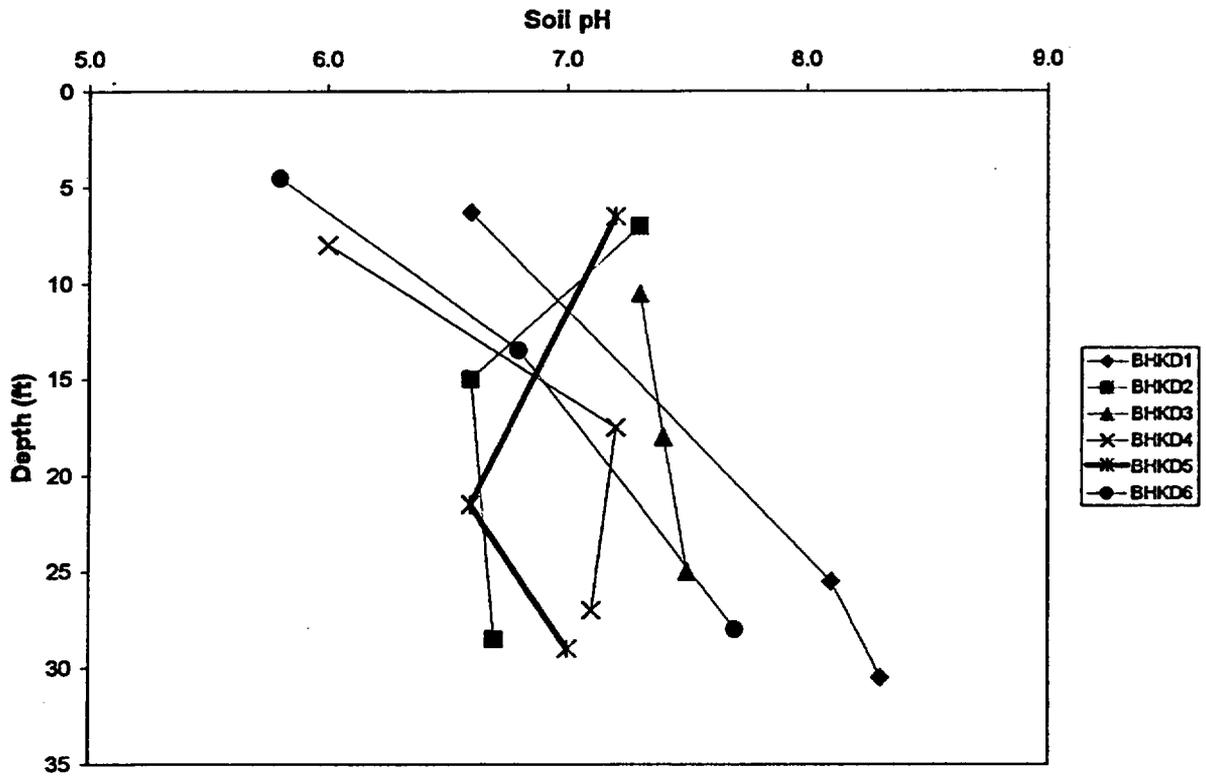
**Shaw Geotechnical
Laboratory
Oak Ridge TN
865/482-6497**

trained in the application of standard laboratory procedures for geotechnical analyses as well as the quality assurance measures implemented by Shaw.

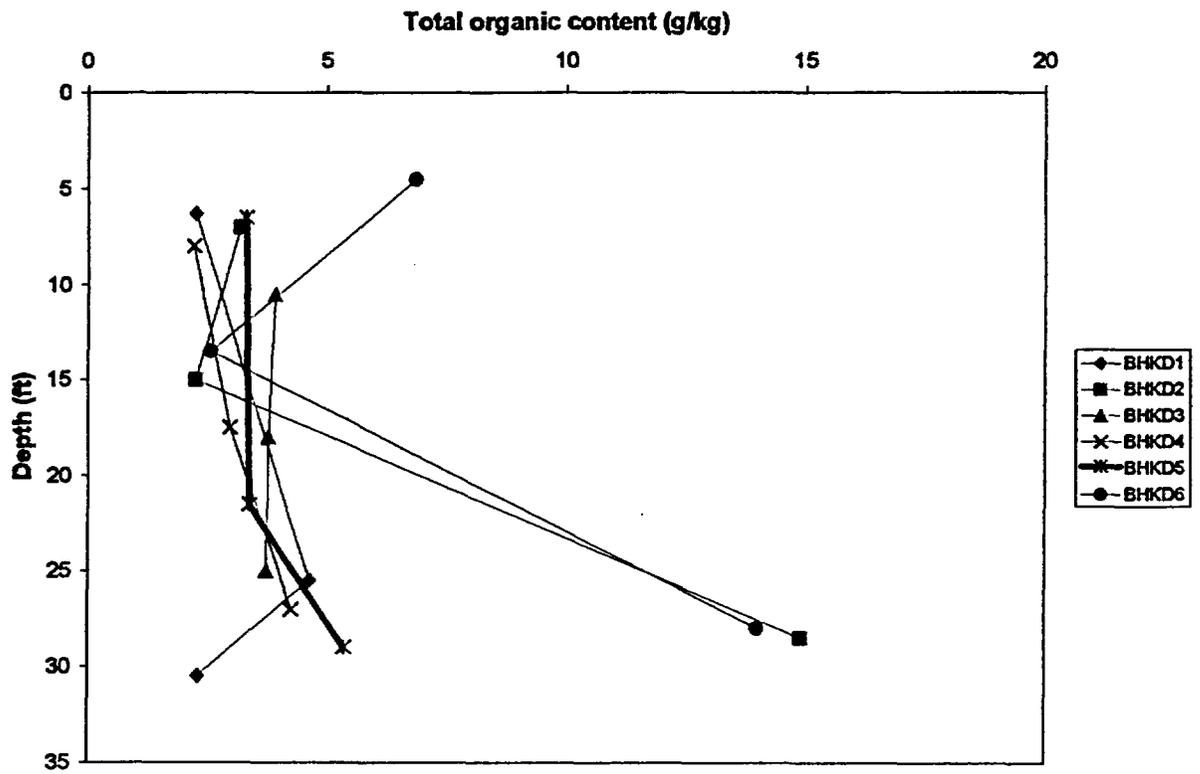
IV. Data Qualification

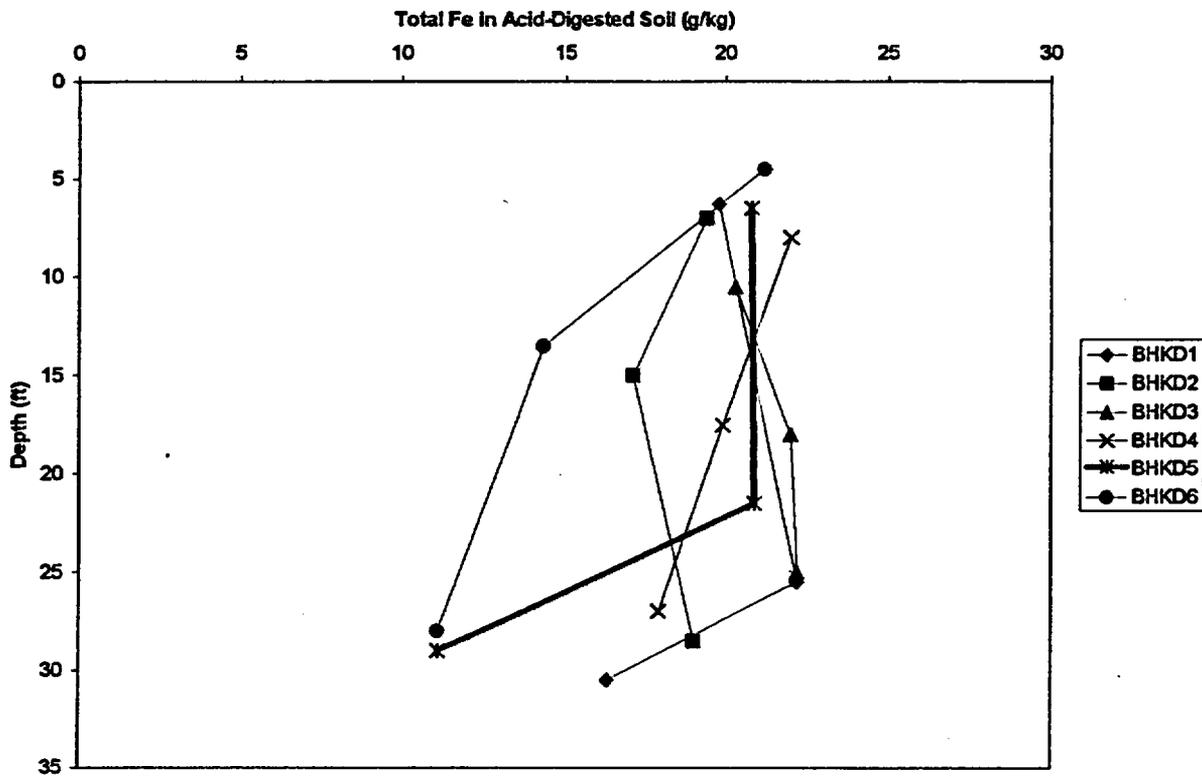
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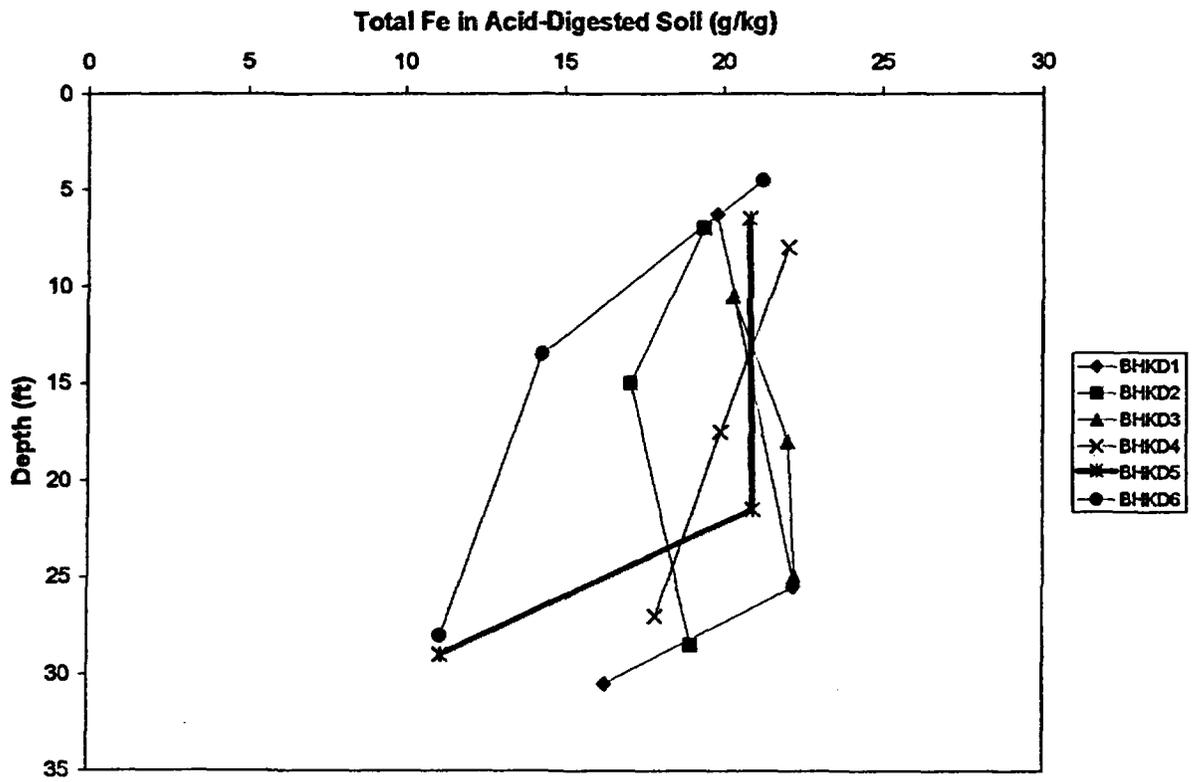
Appendix D
Soil Properties vs. Depth



Soil pH vs depth in samples collected from the Hematite site for Kd measurements







Gamma Survey Data Evaluation Report

Rev 1

prepared for



WESTINGHOUSE ELECTRIC COMPANY
Hematite, Missouri

prepared by



SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
St. Louis, Missouri

MAY 2004

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ACRONYMS	
⁹⁹ Tc	Technicium-99
AOC	Area of concern
ATV	All terrain vehicle
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cm	Centimeter
cpm	Counts per minute
DQOs	Data quality objectives
ft	Feet
GIS	Geographic information system
GPS	Global positioning system
GWS	Gamma walkover survey
HSA	Historical Site Assessment
HEU	High enriched uranium
HF	Hydrogen fluoride gas
LEU	Low enriched uranium
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDNR	Missouri Department of Natural Resources
QA	Quality assurance
QC	Quality control
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
UF ₆	Uranium hexafluoride

1.0 INTRODUCTION

The Westinghouse Electric Corporation, LLC (Westinghouse) nuclear fuel manufacturing facility at Hematite, Missouri ceased operation in June 2001 after nearly 47 years under various owners and operators. Westinghouse now seeks to decommission the plant and release the property. The United States Nuclear Regulatory Commission (NRC) is the primary agency for the plant decommissioning. The Missouri Department of Natural Resources (MDNR) is the primary regulatory agency for the remedial investigation/feasibility study (RI/FS) that is being performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Both agencies are expected to provide critical roles in defining the regulatory path to decontamination and decommissioning, site assessment and remediation, and eventual release.

This gamma walkover survey was conducted as an initial phase of the RI/FS at the site and, as such, MDNR provided oversight for this work. MDNR representatives were on-site on a daily basis, attended the daily meetings, and observed work being performed. Typically there was only one representative present at a time and there were times when activities were occurring in more than one location.

The plant is located on approximately 228 acres of property (Property) that is currently owned by Westinghouse. The plant and production related activities are located on approximately 8 acres of the Property.

1.1 SURVEY PURPOSE

Science Applications International Corporation (SAIC) performed a Gamma Walkover Survey (GWS) at the Hematite Facility (Figure 1) during the period April 7-24, 2003 in accordance with the *Gamma Survey Plan for the Hematite Site* (Survey Plan (Rev 0)). The purpose of the GWS was to identify the presence of low level gamma radiation that could indicate the presence of uranium including natural uranium, low enriched uranium (LEU), high enriched uranium (HEU), and thorium 232 (Th-232) and progeny in surface soils. For the purposes of this report, surface soils are defined as the thickness of soil that can be measured using direct measurement or scanning techniques (MARSSIM). Typically, this layer is represented as the top 15cm (6 inches) of soil (40 CFR 192). This information will be used to aid in area classification and future characterization planning at the site.

The survey was conducted with the intent of maximizing the use of all data collected in future site evaluations, specifically the Remedial Investigation/Feasibility study (RI/FS). The GWS has been designed to follow the guidance for scoping surveys presented in Section 5.2 of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Although this survey was conducted to aid in classification of site areas as impacted or non-impacted, all available data must be evaluated prior to classification of the site. The GWS detection ability is limited to the gamma signature of site specific radionuclides and is typically limited to surface soils.

1.2 SURVEY SCOPE

The GWS data will assist Westinghouse in verifying the conclusions of previous Historical Site Assessments (HSA) and provide input for identifying potential sample locations as part of the Remedial Investigation (RI). Other uses of the survey data include:

1. Determining the magnitude of surface contamination in the soils immediately surrounding the plant area.
2. Determining the lateral extent of surface contamination extending out from the plant.

U:\GPS\GPS Westinghouse\Projects\Westinghouse Figure 1.mxd

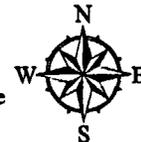
583-100



Legend:

 Westinghouse Property

MO-East State Plane
(NAD 83, Feet)



290 0 290 Feet

Westinghouse Electric Company
Gamma Walkover Survey
Hematite, Missouri

SAIC Science Applications
International Corporation
An Employee-Owned Company

DRAWN BY: David Lawson	REV: 1	DATE: 06/09/03
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Figure 1. Westinghouse Property Map

3. Detecting, as is possible with surface gamma detectors, the presence of any burial pits and other areas of concern known or unknown to exist at this time.
4. Determining the extent, if any, of the spread of surface contamination by the existing natural migration pathways (ditches, streams, low points, surface water flow, etc.).
5. Identifying non-impacted areas that may be appropriate for obtaining reference areas samples to be used to estimate the background soil concentration for contaminants of concern at the site.
6. Providing input to future site evaluations to determine the risk posed by the uranium, and/or thorium contamination by locating areas and media impacted by the spread of contamination and determining the magnitude of the contamination present on the site.

2.0 SURVEY DESIGN AND METHODOLOGY

The survey was designed to cover 100% of the areas directly adjacent to the plant as shown on Figure 2, which includes the areas surrounding the buildings and other obstructions. It was expected that 70% of this area would be surveyed using a multi-pass conveyance and 30% by technician-conveyed global positioning system (GPS)/gamma detector assemblies. The multi-pass conveyance was planned for use over most of the grass-covered areas located outside the fence line. Technician-conveyed detectors were planned to survey the evaporation ponds, ditches, mounds, sedimentation pond, and drainages along or through the rail line, and in the densely wooded areas outside the fence line.

The survey was designed to cover approximately 10% of the remaining areas as shown on Figure 2. The survey was originally designed to be a roughly systematic survey of the remaining areas of the site. In densely wooded areas, the surveys were planned to maximize peak periods of satellite availability. The survey in the 10% coverage areas focused on locations with higher potential for detection of elevated gamma radiation levels, such as in drainage ditches, pond banks, and disturbed areas. It was expected that approximately 30% of these areas would be surveyed using a multi-pass conveyance and 70% by technician-conveyed GPS/gamma detector assemblies. The multi-pass conveyance was planned for use over the open farmland located on the eastern side of the site and the semi-open hilly site terrain located north of State Road P. The technician-conveyed GPS/gamma detector assemblies would be used to survey the remainder of these areas.

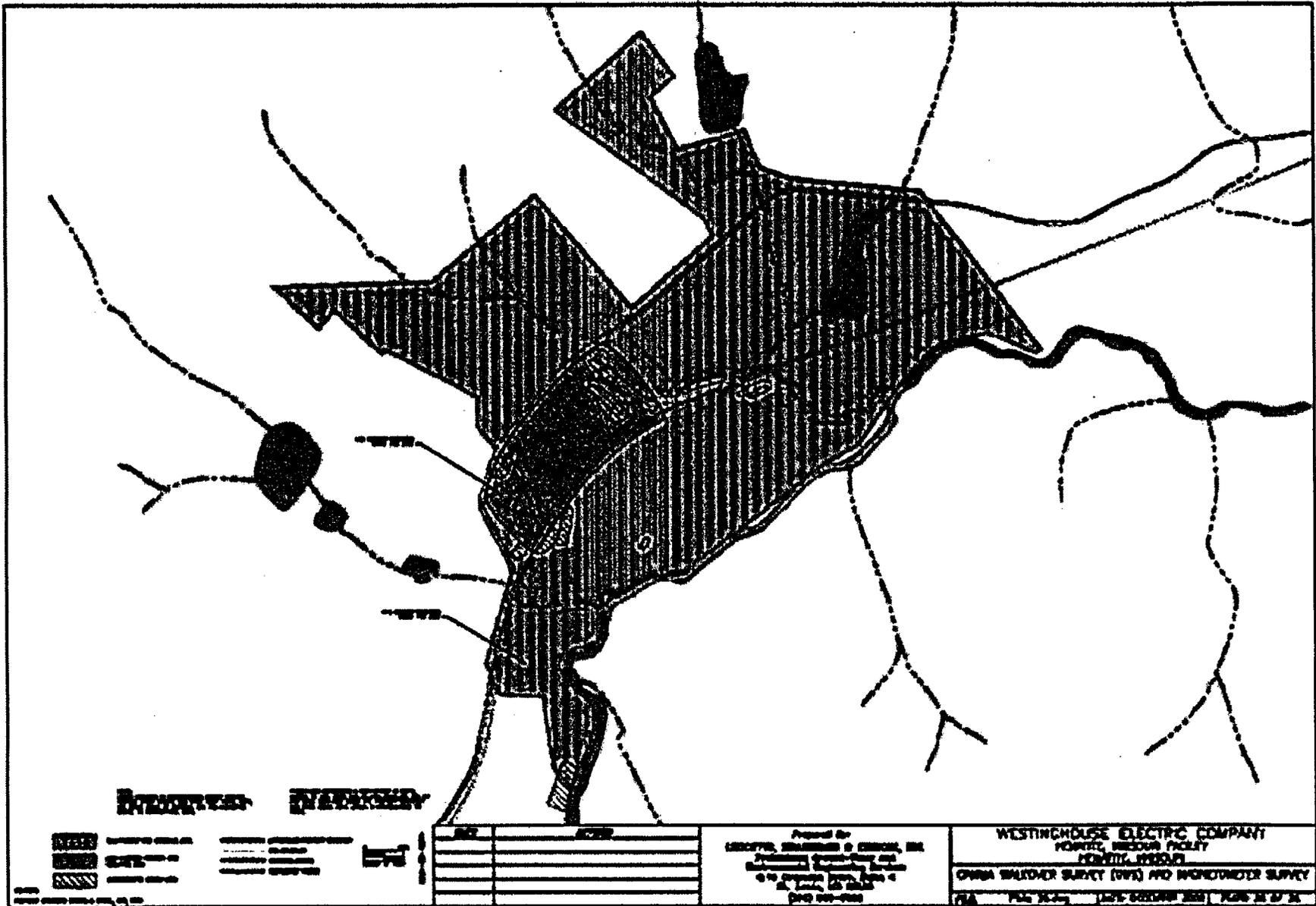


Figure 2. Initial Survey Plan

Uranium and its short-lived daughters (e.g., Th-234, Pa-234m, Th-231), as well as Thorium 232 (Th-232) short-lived daughters (e.g. Ac-228, Th-228) have associated gamma radiation. A sodium iodide scintillation detector (NaI 2"x2") was selected to detect the gamma radiation. The NaI 2"x2" was coupled to a rate meter, which transfers detector count-rate data to a Trimble XRS (or equivalent) global positioning system (GPS) data logger. In addition, the scaler/ratemeter combinations were upgraded with Ludlum's "one-second count microchip" to achieve a gamma count for every one-second GPS position location. The 2"x2" NaI detector was selected over other radiological instrumentation for the following reasons:

- It is a multi-purpose detector capable of low and high energy gamma ray detection with no appreciable loss of low level gamma ray detection ability;
- It is rugged and durable and requires less instrument maintenance or surveyor downtime;
- It is a lighter detector resulting in less surveyor fatigue that would otherwise produce a less efficient survey;
- It can be equipped with Ludlum's "one-second count microchip" to achieve a gamma count for every one-second GPS position location;
- It allows an increased ability to pin point the source of elevated gamma signal;
- It is cost effective, less expensive to procure and maintain.

The 2"x2" NaI detector detects gamma levels from surface sources and indicates the presence of these levels in corresponding "cpm" (counts per minute) readings. The 2"x2" NaI detector has varying sensitivities to different gamma ray energies and does not distinguish the "cpm" readings for the various energies. The inability to discriminate between the different energies does not allow a direct correlation of "cpm" readings to activity in a mixed radionuclide field. Therefore, the results of the GWS are reported in "cpm".

Prior to site mobilization, Westinghouse and SAIC, with MDNR in attendance, conducted a kickoff meeting. The scope of the walkover was slightly modified as a result of the meeting in that the Property would be assessed as seven areas identified by surface water drainage boundaries or other physical features. The original 100% coverage area was slightly increased to provide coverage in areas that may have been affected by past activities at the plant. The 10% systematic coverage of the remaining portion of the Property was modified to allow for more investigational coverage. In those areas where plant related contamination was not expected, the area perimeter, disturbed areas, and any internal drainage ways were surveyed to provide data to verify the assumption that the areas were not impacted. In some areas, closer to the plant site, more systematic coverage was performed to provide data to assess potential impacts.

The modified survey areas are described below and are identified along with approximate property lines on Figure 3.

- Area A – 100% Inside Fence
- Area B – 100% Outside Fence
- Area C – 10% South of Southern Drainage
- Area D – 10% South of Rail
- Area E – 10% South State Road P Between Drainages
- Area F – 10% East Farm Area
- Area G – 10% North of State Road P

U:\GPS\GPS Westinghouse\Projects\Westinghouse Figure 3.mxd

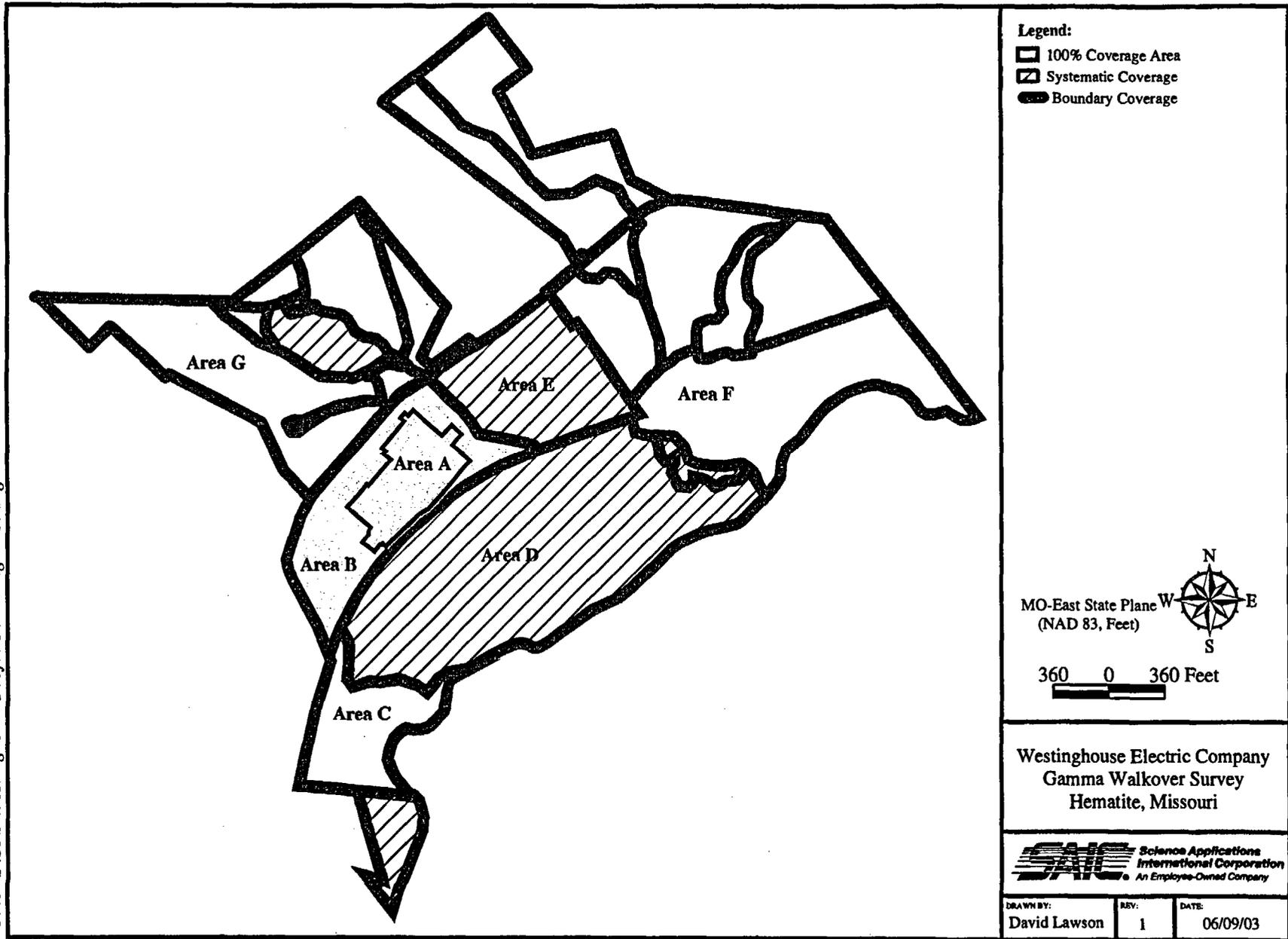


Figure 3. Final Survey Plan

During the kickoff meeting a decision was made to implement the survey by concentrating the technician-conveyed GPS/gamma detector assemblies in areas with pending overhead tree canopies. The survey team decided to conduct the technician-conveyed GPS/gamma detector survey in areas C, D, E, and G and, finally, A. This would concentrate most of the survey crew in densely wooded areas before the tree canopy developed. In addition, the survey was modified to concentrate the survey in the areas covered with the densest vegetation during times when the most satellites were available to minimize the need for manual recording of data. The all terrain vehicle- (ATV) mounted GPS/gamma detector assemblies would begin in Area B and the 100% coverage area outside the controlled area fence, followed by Areas F, G, and, finally, A.

The ATV-mounted GPS/gamma walkover was conducted by mounting three individual detectors with independent GPS assemblies to the front of the ATV. The detectors were mounted 10 centimeters (cm) from the surface, and 70 cm apart to allow for sufficient overlap of each detector's viewing window of 82 cm at the top of the detector crystal. The viewing window is defined as the area capable of contributing gamma levels to the detector in a specific geometry within acceptable scan minimum detectable concentrations. The viewing window of the 2"x2" NaI detector was based on a detector height of 10 cm, crystal dimension of 5 cm x 5 cm with the ability to accurately detect gamma radiation at a 70 degree angle to the source. The scan minimum detectable concentrations presented in the Survey Plan (Rev 0) were calculated on a postulated hotspot with a radius of 28 cm or diameter of 56 cm. If the postulated hotspot was located directly between any two detectors, each detector could detect or view the elevated gamma radiation. For the purposes of this report "hot spot" is defined as areas that have significantly different count rates than the surrounding area and require additional investigation. The data collected during this investigation will be reevaluated after a determination of the site specific radionuclide ratios. The collective gamma contributions from the site specific radionuclides will be evaluated, modeled and correlated to a site specific scan minimum detectable concentration (MDC). Once the scan MDC and gamma contributions from site specific radionuclides are known, a qualitative concentration to count rate comparison can be made. The ATV was driven at a speed that would roughly equate to 0.5 meter/second or less. The operator continuously monitored at least one of the instrument readouts with frequent monitoring/comparison of all instrument responses.

The technician-conveyed GPS/gamma walkover was conducted by the technician maintaining the detector approximately 10 cm from the surface progressing at a speed of 0.5 meters/second or less. The technicians moved the detectors in a slightly serpentine pattern, where possible, taking care to maintain the 10 cm distance from surface to detector. Frequently, the technicians substituted a controlled side-to-side pattern so the serpentine motion could maintain correct detector alignment with the survey surface. The technicians continuously monitored the audible instrument response.

Outside the 100% coverage area, the survey team was instructed on the general location of the required survey coverage and areas of interest. Technicians were instructed to use their experience to investigate the areas of highest contamination potential encountered in each area. The team used the Trimble mapping tool to maintain roughly parallel paths in areas requiring systematic coverage. Within the 100% coverage area, the survey team attempted to use the ATV-mounted GPS assemblies wherever possible. When technician-conveyed GPS assemblies

were necessary, the survey team used constant communication and the Trimble mapping tool to ensure adequate survey coverage.

Daily tailgate safety/planning meetings were held. The previous day's events, issues, and progress were discussed, in addition to the areas to be surveyed that day. Each technician was assigned to a specific area with coverage instructions, expected progress, and relative background, with an associated investigation level (a scanning response which is detectable above the background level) depending on the area to be surveyed. Upon completion of the survey, the survey team and Westinghouse conducted a daily debrief meeting. The daily debrief consisted of the survey progress, anomalies, issues, concerns, and a discussion of survey progress and areas to be surveyed the following day.

3.0 SURVEY QUALITY CONTROL

3.1 DATA QUALITY OBJECTIVES

Table 3-1 Data Quality Objectives

DQOs	DQO Attainment
The initial mean background count-rate for each NaI 2"x 2" will be within 10% of the mean background count-rate (at the same location) for all instruments used for the survey.	All instruments used for the survey were within 10% of the mean background count-rate (at the same location). Instrumentation QA records are included in Attachment 1.
All survey instruments will be calibrated at least annually using calibration sources traceable to the National Institute of Standards and Technology (NIST).	All instruments were calibrated at least annually in accordance with ANSI N323A, Radiation Protection Instrumentation Test and Calibration-Portable Survey Instruments (ANSI, 1997). Instrumentation QA records are included in Attachment 1.
All survey instruments will be performance checked at the beginning of each survey day to determine the usability of data collected. The established acceptance criteria for background and source response will be $\pm 20\%$ of the mean value determined during the initial instrument setup procedure.	All radiological field instruments were performance checked at the beginning and end of each day. All acceptance criteria checks for all field instruments were met as required by the plan. Instrumentation QA records are included in Attachment 1.

3.2 INSTRUMENTATION QUALITY ASSURANCE

Each GPS instrument was paired with a survey meter/detector and assigned a pack number. This was accomplished by giving all the GPS packs a letter from A to G and doing the same for the radiological instruments. The GPS packs were then matched up with the radiological instrument that had the same letter. The exception was GPS Pack A. It was paired with Meter H.

3.2.1 Radiological Instrumentation Quality Assurance/Quality Control

Gamma walkover survey instrumentation was calibrated annually in accordance with ANSI N323A, *Radiation Protection Instrumentation Test and Calibration – Portable Survey Instruments* (ANSI, 1997) for the spectrum of radiation energies expected at the Hematite facility.

Gamma walkover survey instrumentation was operated by qualified personnel in accordance with SAIC's Health Physics Procedure HP-30, *Radiological Instrumentation*, and Health Physics Instruction HPI-001, *Performance of a GPS Gamma Walkover Survey*.

All instruments were initially processed to determine if the general area gamma radiation levels would interfere with the initial instrument setup and the acceptance criteria determined prior to arrival. All instruments were within tolerance of the acceptance range. All instruments were verified to meet the established site-specific background acceptance criteria with the exception of instrument "A". Instrument "A" exceeded the background and source values on the high end during the initial on-site instrument check in. This instrument was tagged out of service and removed from the site. No data was collected with Instrument "A".

Table 3-2 Instrument Background Comparison

Instrument	Mean Background cpm
B	5,493
C	5,135
D	5,418
E	5,315
F	5,263
G	5,322
H	5,405
Site Mean	5,343
10% range	4,809-5,877

Daily performance checks were conducted on each instrument as defined in HP-30 and as summarized in the Survey Plan (Rev 0). Only data obtained using instruments that satisfied these performance requirements were accepted for use in this investigation.

3.2.2 Global Positioning System Quality Assurance/Quality Control

The daily QC check of the GPS units was performed and recorded for use post-survey. The accuracy of the GPS system is dependent on many factors, mainly the number of visible satellites, which will vary throughout the day. The manufacturer's stated accuracy is sub-meter; the actual accuracy or Position Dilution of Precision (PDOP) of the GPS units varies and is dependent on satellite visibility. Each data point collected has a PDOP value attached as a measurement of the coordinate accuracy. PDOP simply provides an indication of the expected accuracy of GPS positions based on the relative positions of the satellites. Lower PDOP values provide more accurate data. The accuracy of single data point can be determined by the PDOP value associated with the point.

The daily positions check on a known or identified location assists the project in determining if data files collected on a given day require post processing. The northern most monitoring well located just west of the Building 231 was used as the known location for this survey.

The data collected from each pack at the beginning and the end of each survey day is collected for use post-survey while the data is evaluated. The relative differences between the

pre- and post-survey check, the drift during check, and the relative differences between GPS units are all evaluated. This evaluation helps to quantify the degree of confidence in the reported coordinates for each data point across the project. In addition, the check pinpoints suspect coordinate data associated with a particular GPS unit, a particular GPS unit on a given survey day, or all GPS units on a given survey day.

If one of the GPS units indicates a significant difference in reported locations when compared to known or other GPS units, all position data collected that day with that unit is suspect and is evaluated. The evaluation will inspect the position of all data points in relation to property boundaries, known areas covered that day, and in relation to data points collected on other packs in the general vicinity. In addition, the corresponding radiological count rate for a reported area will be compared to known or collected radiological count rates from other instruments in the same area. If the above data checks indicate an unreasonable amount of error in the reported coordinate data, the specific data files are post-processed to increase coordinate position accuracy.

3.3 SURVEY QUALITY ASSURANCE

The survey team performed numerous performance, operation, and continuity quality checks during implementation of the survey. Instrument response is continuously checked in the field by referencing adjacent meter responses. The technicians, constantly monitoring the instrument response, periodically verify abnormal (either relatively high or low count rates) by comparing their instrument output with other instruments in the general vicinity. This check occurred frequently as the observed "relative background" count rate decreased as the technicians moved from the plant site toward the Joachim Creek. The technicians also perform an additional instrument response check during data evaluation. Instruments within the same general proximity should have recorded relatively similar count rates. All data were checked for erroneous data patterns that would suggest a faulty instrument response.

Position accuracy is checked upon completion of each day's survey. The collected data is downloaded and the data plotted on the site map. The site map, which was based on a February 2003 aerial flight by Sanborn and included a State plane grid prepared by Metropolitan Engineering, was provided by Westinghouse. Each technician verified that all the data they collected were captured and that the data were in the correct general area. The position is further verified during data evaluation by comparing data collected by adjacent technicians and instruments. This check is easily accomplished for the data collected with the ATV-mounted GPS assemblies. The three data streams are plotted and the plots are evaluated for erroneous or out-of-place data points. This check is more difficult to quantify for the data collected by the technician-conveyed GPS assemblies. The check, in this case, is performed by having the technician who collected the data review a plot of all collected data. Technicians check the location of their plotted data in relation to other data collected at the same time by other technicians. Technicians note the position of their data streams in relation to the adjacent data streams to determine if data is missing or erroneous coordinates have been recorded.

Data accuracy/reproducibility is checked during data evaluation. If relatively low or high-count rates that do not adhere to the surrounding data are identified in the data, additional

investigation is warranted in these areas. These areas are identified during data evaluation and performance of an additional gamma walkover to verify the abnormality is conducted.

Survey accuracy is checked by evaluating the entire data set for gamma radiation trends and patterns. If the patterns or trends do not make sense considering the topography, known operating history, field observations, or experience of the field team, additional investigation is warranted. For instance, high gamma radiation levels adjacent to a drainage ditch should indicate a high potential for elevated gamma radiation levels within the ditch. Conversely, small areas of elevated gamma radiation levels surrounded by large areas of background or near background gamma radiation levels with no obvious transport mechanism are suspect and are further investigated.

3.4 DATA MANAGEMENT

Pre-Survey

- Prior to the start of the survey, the site was divided into seven survey areas with common geographic features, such as roads, railroads, creeks, and drainages, which provide easily recognized boundaries. The survey areas are described below and are shown on Figure 3.

A-Inside Fence
B-100% Area Outside Fence
C-South of Southern Drainage
D-South of Rail
E-South State Road P East of Drain
F-East Farm Area
G-North of State Road P

- Once the survey areas were designated and the equipment was labeled, the format for the file naming system was established. File names consisted of seven digits that included GPS pack letter (A-G), (W) for Westinghouse, Survey area letter (A-G), Media type letter, example (S) for soil and (G) for gravel, and a three-digit file number, example (001). An example of a filename follows:

BWDS002

B-GPS Pack 'B'
W-Westinghouse
D-Survey Area 'D'
S-Soil
002-File number

Post-Survey

- At the end of each day of field activities, all gamma walkover data was downloaded from the TDC1 data collector flash memory card to a site computer via Pathfinder software.
- The Pathfinder software was also used to export the raw field data into Microsoft Access. Microsoft Access was used to convert the data into a format that can be imported into Arc View Geographic Information System (GIS) software.
- Once formatted, the survey data was placed into an Arc View project file, and a survey map was created to be presented in the daily post-survey briefing.

Following each day of surveying, the GWS survey files were backed up by copying the data to CD-R disks. After each week, the data was copied to SAIC's St. Louis office server.

4.0 SURVEY RESULTS

Due to various backgrounds, as described below, encountered across the site, it is difficult to provide an accurate visual display of all the data on one map. Figure 4 shows the survey coverage of the entire Property with the data color-coded at 2,000 counts per minute (cpm) increments, starting with 10,000 cpm for soil and 5,000 cpm for gravel and asphalt. This map provides the greatest amount of detail for examining trends and general gamma radiation levels across the Property. Figure 5 shows the survey coverage for the entire Property with the data color-coded at 2,000 cpm increments, starting with 11,000 cpm for soil and 6,000 cpm for gravel and asphalt. This figure, when used in conjunction with Figure 4, provides evidence of a gradual decrease in count rate from the railroad south to Joachim Creek. Figure 6 shows the survey coverage for the entire Property with data color-coded at 3,000 cpm increments, starting with 10,000 cpm for soil and 5,000 cpm for gravel and asphalt. The figure proves that the majority of the collected data is between 10,000 – 13,000 cpm. The reference area average was approximately 10,500 cpm. Figure 7 shows the survey coverage of the entire Property in two colors, with the discriminator at 16,000 cpm. This figure is designed to show the areas of the Property that are significantly above background.

4.1 BACKGROUND VALUE DETERMINATION

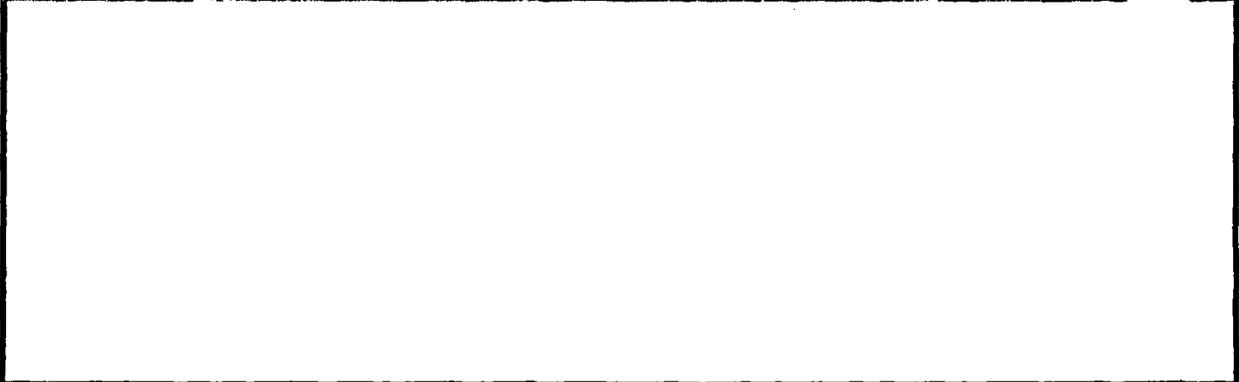
SAIC used three types of background values: instrument, reference, and relevant, to fulfill the objectives of the survey. SAIC evaluated all the collected data to determine the background value to be applied during data evaluation.

Individual instrument background values were determined to verify that the gamma detectors being used for the survey are responding similarly to low gamma flux levels. All individual instrument mean background values were within 10% of the mean for all detectors, ensuring all data collected could be evaluated and depicted on one color-coded map without data misrepresentations resulting from variations in detector response.

SAIC performed this background check by collecting individual instrument background values prior to mobilization to the site. The average or mean value of all the individual instrument values was calculated, in addition to the 10% range around the mean. All instruments

were checked upon arrival at the site to verify not only that the instruments were still within 10% of each other but also to verify that the "site" instrument background was not significantly different than initial instrument background calculation. The "site" background was not significantly different upon initial check and all instruments were well within the 10% range of the mean, with the exception of Instrument "A", which was removed from service. The individual instrument background values were on average 1.67% of the mean with the largest deviation individual instrument background being 3.89% below the mean. All of the instruments were determined to be responding similarly within tolerance to low level gamma flux radiation, and as such, were acceptable for use on this project.

583-100



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STACK:

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