Final Report

2004 ANNUAL MONITORING AND INSPECTION REPORT
Former USS Duluth Works Site

Prepared for:

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This Annual Monitoring and Inspection Report was prepared for the United States Steel Corporation (USS) former Duluth Works facility (Site) located in Duluth, Minnesota. The report was prepared in accordance with the following documents:

- December 6, 1996 Minnesota Pollution Control Agency (MPCA) letter to Mr. David Moniot of USS (MPCA, 1996).
- Monitoring, Maintenance and Contingency Plan, Wire Mill Pond Response Action. May 1997, Barr Engineering Company (Barr, 1997).
- Response Action Contingency Plan Operable Unit J. June 1997, Geraghty & Miller, Inc. (Geraghty & Miller, 1997).
- Monitoring Plan. April 10, 2000, URS Greiner Woodward Clyde (URS, 2000).
- May 26, 2000 MPCA letter to Mr. Tony Nuzzo of USS approving the Monitoring Plan revisions (MPCA, 2000).
- June 20, 2001 MPCA letter to Mr. Tony Nuzzo of USS commenting on the 2000 Annual Monitoring and Inspection Report (MPCA, 2001).

Surface water sampling was performed during two sampling events in May and November 2004 and consisted of the collection and analysis of surface water samples from eight locations. Surface water samples were analyzed for total metals, polynuclear aromatic hydrocarbons (PAHs), cyanide, pH, total hardness, and specific conductance. One surface water sample was also analyzed for gasoline range organic compounds (GRO) and diesel range organic compounds (DRO) in both sampling events. Groundwater monitoring was performed during May 2004 sampling event and consisted of collection and analysis of groundwater samples from seven monitoring wells. Groundwater samples were analyzed for total metals, dissolved metals, PAHs, cyanide, pH, and specific conductance.

The 2004 analytical results were consistent with historical surface water and groundwater results from the Site. During 2004, at least one groundwater well sample exceeded the evaluation criteria (EC) for the following parameters: lead, zinc, and benzo(a)pyrene. During 2004, no surface water sample exceeded the established EC.

In summary, analytical results for 2004 indicate no significant changes in surface water or groundwater quality. The monitoring program continues to adequately monitor surface and groundwater conditions relative to the site and no changes to the monitoring program are recommended.

1.1 BACKGROUND

The United States Steel Corporation's (USS) FormerDuluth Works Site (Site) is located in Sections 34 and 35, T49N, R15W, and Sections 2 and 3, T48N, R15W in the southern portion of the city of Duluth in St. Louis County, Minnesota. The Site location is shown in Figures 1 and 2. The Site is adjacent to the St. Louis River, which discharges into Lake Superior approximately eight miles downstream of the Site. A small stream, referred to as the Unnamed Creek, flows through the northern portion of the Site and discharges to the St. Louis River. The Site is bounded by Morgan Park to the north, the St. Louis River to the east, and Duluth Missabe and Iron Range Railroad property to the west and south.

The Site was the location of an integrated steel mill consisting of coke production, iron and steel-making, casting, primary rolling and roughing, hot and cold-finishing, and galvanizing. Operations at the Site began in the early 1900's and ceased in May 1979 with the termination of the coke plant operation.

1.2 PURPOSE AND SCOPE

This report discusses the sampling results from two surface water sampling events and one groundwater sampling event performed in 2004, and compares the groundwater quality results to historical site data, and applicable state and federal water quality standards. Surface water samples were collected in May and October 2004. Groundwater samples were collected in May 2004. Sampling was performed in accordance with the April 2000 Monitoring Plan prepared by URS and the subsequent May 26, 2000 Minnesota Pollution Control Agency (MPCA) approval letter.

This report presents the following information:

- A description of the monitoring system and a site plan identifying the monitoring points;
- A discussion of recent and long-term trends in the concentrations of monitored constituents and water level elevations;
- A complete tabulation of analytical results to date;
- A summary of surface water results in 2004;
- A summary of groundwater results in 2004;
- A discussion of the results of semi-annual site visual inspections;
- A discussion of notable or unexpected results and problems; and,
- Recommendations for modifications or maintenance to the current monitoring system.

2.1 HYDROGEOLOGIC SETTING

The Site is located in the Glacial Lake Duluth Area, a lake plain located along the north shore of Lake Superior, resulting in parent materials that consist of lake silt and clay (USGS 1979). The regional geology of this area is the result of lava extruding from a rift in the continental crust during the Keweenawan period of the Precambrian era. Erosion of these lava beds formed red sandstone units that underwent glacial manipulation (UEC 1993).

The bedrock geology of the Site consists of the Duluth Complex; a complex of early Precambrian rocks that include multiple intrusions of gabbroic anorthosite, troctolite, gabbro, anorthosite and felsic rocks (Sims 1970).

Fill material present at the Site consists of gravel, cinders, slag fragments and other materials. The characteristics of the fill material vary throughout the Site. The native soils present beneath the fill material consist of red-brown clay underlain, and at times interbedded with a fine to medium sand (Barr 1986). The clay unit depth varies from 2 to 48 feet (ft.) beneath the ground surface, and the thickness ranges from 2 to 32 ft. Beneath the clay unit are deposits of sand and gravel. Groundwater is generally found at 27 to 31 ft. below the ground surface (UEC 1993).

2.2 GROUNDWATER AND SURFACE WATER MONITORING SYSTEM

2.2.1 Description

The groundwater and surface water monitoring system for the Site consists of seven surface water sites, one seep, and seven groundwater monitoring wells. The sampling locations are shown on Figures 2 and 3.

2.2.2 Surface Water

The surface water data is collected in three areas on the Site: Wire Mill Pond, Unnamed Creek, and the St. Louis River.

Wire Mill Pond

One monitoring area, WM-1, is utilized at Wire Mill Pond. The location of WM-1, at the outlet of the Wire Mill Pond on the east side of the railroad tracks, is shown in Figure 2. Data are collected on a semi-annual basis, in April or May, and again in September or October. The chemical and field parameters measured at WM-1 are listed in Table 1.

Unnamed Creek

Four monitoring areas are present at the Unnamed Creek: CP-1, CP-2, CP-3, and CP-4. The locations of these monitoring areas are shown in Figure 2. Data are collected on a semi-annual basis, in April or May, and again in September or October. The chemical and field parameters measured at the Unnamed Creek monitoring areas are listed in Table 1.

St. Louis River

Two monitoring areas are present at the St. Louis River: SLR-1 and SLR-2. The locations of these monitoring areas are shown on Figure 3. Data are collected from these areas on an annual basis, in April or May. The chemical and field parameters measured at the St. Louis River monitoring areas are listed in Table 1.

2.2.2.1 Seep

One seep, Seep-1, is monitored at the Site. The location of this monitoring area is shown in Figure 2. Data are collected from this area on an annual basis, in April or May. The chemical and field parameters measured at Seep-1 are listed in Table 1.

2.2.2.2 Groundwater Monitoring Wells

Seven groundwater monitoring wells (W-6 through W-11 and W-13) are monitored at the Site. The locations of these monitoring points are shown in Figure 2. Data are collected from these monitoring points on an annual basis, in April or May. The chemical and field parameters measured in the groundwater monitoring wells are listed in Table 1.

2.2.3 Sample Collection Procedures

In 2004, groundwater samples were collected by Northeast Technical Services (NTS) of Virginia, Minnesota. NTS also performed all laboratory analyses except polynuclear aromatic hydrocarbons (PAHs), which NTS subcontracted to Braun Intertec. Prior to sampling the monitoring wells, water levels and total depths were measured for each well. Each monitoring well was stabilized to ensure that samples contain fresh formation water. While the well was being purged, water quality parameters including pH, specific conductance, turbidity, dissolved oxygen, and temperature were recorded after each well volume was removed. Samples for laboratory analysis were collected only after a minimum of three well volumes had been purged and stabilization of field water quality parameters had been demonstrated.

One field blank (rinsate) was collected and analyzed during each sampling event in 2004. One trip blank was also collected and analyzed during each sampling event. Following collection of the samples, sample containers were placed in coolers with ice. NTS personnel delivered samples to the analytical laboratory using standard Chain of Custody procedures.

3.1 WATER ELEVATION AND GROUNDWATER FLOW

Groundwater elevations were measured during the May 2004 sampling event. Water level data are summarized in Appendix A. With monitoring well W-10 excluded due to the anomalous reading in 2002, as indicated in Appendix A, groundwater elevation in the monitoring wells decreased an average of 0.40 feet from April 2003 to May 2004. All groundwater elevations were within 0.44 percent of their average historical elevation.

The water elevation map and calculated groundwater flow direction for the May 2004 sampling event is presented in Figure 4. Groundwater east of monitoring wells W-7 through W-13 appear to flow in an easterly direction towards the St. Louis River. Groundwater north of monitoring well W-8 appears to flow north-northeasterly direction towards the Unnamed Creek. Calculated groundwater flow directions appear to be consistent with surface topography and historical results. A ten-foot difference in elevation between well W-8 and W-6 may be the result of local geology. Well W-8 is screened from 28 to 38 feet below grade within native reddish brown sandy clay, fat clay, and clayey sand; well W-6 is screened from 20 to 30 feet below grade within gravelly sand fill (Barr, 1981; Barr, 1986). Due to the geology and proximity to the Unnamed Creek valley wall, well W-6 may be hydraulically connected to the Unnamed Creek.

3.2 WATER QUALITY ANALYTICAL REVIEW

The 2004 stabilization forms and analytical laboratory reports are included in Appendix B. Appendix C contains a summary of historical analytical data, including tables and graphs.

The water quality data obtained for the Site in 2004 were compared to historical data as well as site specific water quality standards. The pertinent standards are described below:

- Evaluation Criteria (EC) – The ECs are site specific post-removal performance criteria based upon MPCA derived performance limits or upon federal ambient water quality criteria for the protection of human health at a 10^{-6} cancer risk.

3.2.1 Inorganic Results

Laboratory analytical reports for 2004 sampling events are included in Appendix B. A complete summary of current and historical analytical data is provided in Appendix C. Concentration versus time series plots for select inorganic water quality parameters that historically/currently exceed the evaluation criteria are also presented in Appendix C.

3.2.1.1 Surface Water

No inorganic parameters were detected above the EC in 2004.

3.2.1.2 Groundwater

Consistent with historical results, inorganic parameters that have been detected above the EC in 2004 are lead and zinc. The following subsection summarizes the data, trends, and exceedances for these parameters.

Lead

The 51 ug/L EC for lead was exceeded in well W-10 (195 ug/L) during the May 2004 sampling event. Lead has been detected at concentrations above the EC since 2002.

Zinc

The 86 ug/L EC for zinc was exceeded in well W-10 (226 ug/L, total; 72.8 ug/L, dissolved) during the May 2004 sampling event. Zinc has been detected in all of the groundwater monitoring wells and well W-10 has exceeded the EC since April 2001. The laboratory analytical results were compared to available National Uranium Resource Evaluation (NURE) Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) data (USGS, 2001) to determine potential background concentrations of zinc in the groundwater. The median zinc concentration in the 799 wells sampled in the Duluth 1^o by 2^o quadrangle during the NURE HSSR program was 113 ug/L.

3.2.2 Organic Results

Water samples were collected and analyzed for PAHs during the 2004 sampling events according to the parameters and methodologies illustrated in Table 1. A complete summary of current and historical analytical data is provided in Appendix C.

3.2.2.1 Surface Water

No organic parameters were detected above the EC in 2004.

3.2.2.2 Groundwater

Except for well W-6, no organic parameters were detected above the EC in 2004 The 0.31 ug/L EC for benzo(a)pyrene was exceeded in May 2004 with a concentration of 0.400 ug/L. Well W-6 has not had an EC exceedence since April 2000. In 2000, the concentration was 0.75 ug/L.

Well W-6 also had a benzo(b,j,k)fluoranthene concentration of 0.560 ug/L in May 2004. Assuming that the combined reported result of benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene as benzo(b,j,k)fluoranthene will result in an EC (0.62 ug/L) that adds the individual ECs for benzo(b)fluoranthene (0.31 ug/L) and benzo(k)fluoranthene (0.31 ug/L), there is no exceedence of the EC.

3.2.3 Long Term Trends

The 2004 surface water and groundwater monitoring results were compared to historical data. Contaminant graphs have been included in Appendix C for all locations where a contaminant has exceeded the EC for three sampling events. Contaminant levels were within the range of previous results with the following exceptions:

- New maximum concentrations of lead were detected during the May 2004 sampling in W-10 (195 ug/L). The lead concentration in W-10 was the only sampling point to exceed the 51 ug/L EC.

- New maximum concentrations of zinc were detected during the May 2004 sampling in W-10 (226 ug/L).
- Several PAH compounds in W-6, W-7, and CP-4 were detected at new maximum concentrations during the May 2004 sampling event; however, no PAH compounds exceeded the established ECs.
- No new maximum concentrations were detected during the October 2004 sampling.

3.2.4 Unexpected Results and Problems

The May and October 2004 PAH results performed by Braun Intertec contained benzo(b)fluoranthene and benzo(k)fluoranthene as a combined result, reported as benzo(b,j,k)fluoranthene. Braun Intertec and NTS reported that in 2003, MPCA has requested that benzo(j)fluoranthene be added to the PAH list. Since benzo(j)fluoranthene cannot be easily distinguished from benzo(b)fluoranthene and benzo(k)fluoranthene, they are now reported as a combined result. It is assumed that due to this combination, the EC for benzo(b,j,k) fluoranthene combines the ECs for benzo(b)fluoranthene (0.31 ug/L) and benzo(k)fluoranthene (0.31 ug/L) to obtain an EC of 0.62 ug/L.

4.1 SPRING 2004 INSPECTION

On May 9, 2004, URS completed the spring 2004 semi-annual site inspection. The Inspection Form is included in Appendix D. Photographs are also included in Appendix D. The inspection was not completed after a significant rainfall or snowmelt event and the inspection was not hampered by site conditions. The inspection consisted of walking to each sampling point on the Unnamed Creek (CP-1 through CP-4), walking the perimeter of the Wire Mill Pond, walking the perimeter of OU-J, and walking several transects over the top of OU-J.

4.1.1 Unnamed Creek and Operable Unit-J

The berm and cap at OU-J were in excellent condition. As previously documented, possible slumping was observed on the northwest corner of OU-J, due to a tilting of the gabion wall. Otherwise the vegetation appears well established from the previous repairs. Due to lack of recent snow melt or rainfall, the Unnamed Creek was running low and clear. A sheen and balls of tar-like substances were observed in a 50 square foot area on the southeast corner of the pond on the north end of OU-J. No sheen was observed at the other monitoring points.

4.1.2 Wire Mill Pond

The inlet and outlet of the Wire Mill Pond were stable. Most plant species were still dormant. Tree buds have recently opened. The pond inlet and outlet were clear with a low flow.

4.2 FALL 2004 INSPECTION

The fall 2004 semi-annual site inspection was completed by URS during other site activities on October 18 through October 20, 2004. The Inspection Form is included in Appendix D. The inspection period included a low water period and a period after a light rainfall; access was not affected. The inspection consisted of walking to each sampling point on the Unnamed Creek (CP-1 through CP-4), walking the perimeter of the Wire Mill Pond, walking the perimeter of OU-J, and walking several transects over the top of OU-J.

4.2.1 Unnamed Creek and Operable Unit-J

The berm and cap at OU-J were in excellent condition. The previously documented possible slumping was observed on the northwest corner of OU-J, near the gabion wall. Otherwise the vegetation appears well established from the previous repairs. Minor erosion had occurred along the access road to the southwest of the OU-J berm. No sheens were observed on the Unnamed Creek during the inspection. No sheen or balls of tar-like substances were observed in the area on the southeast corner of the pond on the north end of OU-J as observed previously. The creek water was clear to only mildly turbid after the light rain event.

4.2.2 Wire Mill Pond

The inlet and outlet of the Wire Mill Pond were stable. Plant species were going into dormancy. The vegetation that was active appeared very healthy. The pond inlet and outlet were not as

turbid as the Unnamed Creek. A minor amount of sheen was present on the central portion of the pond, but no sheen was observed at the outfall.

The following conclusions can be drawn from the surface and groundwater monitoring results:

1. Evaluation of the 2004 surface water and groundwater data indicates that the monitoring network at the facility is adequate for the continued monitoring of surface water and groundwater from the Site.
2. Monitoring well W-10 exceeded the EC for zinc in the May 2004 sampling. Except for the April 2000 sampling when zinc concentration was 76 ug/L, zinc levels in W-10 have been above the EC since 1994. Zinc concentrations in W-10 have typically been below the median concentration (113 ug/L) detected during the NURE HSSR program.
3. Monitoring well W-10 exceeded the EC for lead in the April 2003 sampling. Lead levels in W-10 have been historically near or below detectable levels until 2002.
4. No new slumping has been observed at OU-J since the OU-J berm repair was completed in August 2001. Potential slumping near the gabion wall will be monitored in 2005 as part of the recommendations resulting from the United States Environmental Protection Agency's (USEPA's) Five Year Review (USEPA, 2003) and subsequent Former Duluth Works Five-Year Review Recommendation Implementation Work Plan (URS, 2004).

The surface water and groundwater monitoring network, sampling schedule, and parameter list adequately monitor water quality at the USS Duluth Works Site. URS does not propose any changes to the monitoring program at the Site at this time. Groundwater exceedances will continue to be monitored in 2005. However, monitoring recommendations proposed in the USEPA Five Year Review will be addressed in upcoming correspondence.

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Appendix A
Historical Water Level Data

Appendix B
2004 Laboratory Analytical Results & Field Forms

May, 2004 Laboratory Analytical Report & Field Forms

October, 2004 Laboratory Analytical Report & Field Forms

Appendix C
Historical Analytical Data

Appendix D
Visual Inspection Logs

Table 1
Parameters and Testing Methods
USS Duluth Works

Analyte	Testing Method	Wire Mill Pond	Unnamed Creek	St. Louis River and SEEP 1	Groundwater Monitoring Wells
Arsenic	EPA 206.2	X	X	X	X
Arsenic (filtered)	EPA 206.2				X
Cadmium	EPA 213.2	X	X	X	X
Chromium	EPA 218.2	X	X	X	X
Chromium (filtered)	EPA 218.2				X
Chromium, hexavalent	EPA 310.1	X			
Copper	EPA 220.2	X	X		
Lead	EPA 239.2	X	X	X	X
Lead (filtered)	EPA 239.2				X
Mercury	1631	X	X		
Nickel	EPA 249.2	X	X	X	X
Nickel (filtered)	EPA 249.2				X
Zinc	EPA 200.7	X	X	X	X
Zinc (filtered)	EPA 200.7				X
Acenaphthene	8270	X	X	X	X
Anthracene	8270	X	X	X	X
Benzo(a)anthracene	8270	X	X	X	X
Benzo(a)pyrene	8270	X	X	X	X
Benzo(b)fluoranthene	8270	X	X	X	X
Benzo(k)fluoranthene	8270	X	X	X	X
Chrysene	8270	X	X	X	X
Dibenzo(a,h)anthracene	8270	X	X	X	X
Fluoranthene	8270	X	X	X	X
Fluorene	8270	X	X	X	X
Indeno(1,2,3-cd)pyrene	8270	X	X	X	X
Naphthalene	8270	X	X	X	X
Phenanthrene	8270	X	X	X	X
Pyrene	8270	X	X	X	X
Cyanide, Weak & Dissociable	ASTM D2036	X	X	X	X
Diesel Range Organics	Wisconsin DRO Method	X			
Gasoline Range Organics	Wisconsin GRO Method	X			
Hardness, Total	EPA 130.2	X	X		
pH	EPA 150.1	X	X	X	X
Specific Conductance	EPA 120.1	X	X	X	X
Dissolved Oxygen	Field	X	X	X	
Temperature	Field	X	X	X	X
Visible Sheen	Visual Estimate	X	X	X	
Flow Rate	Visual Estimate	X	X	X	
Flow Rate	Qualitative Estimate			X	