932001

REVISED IRM COMPLETION REPORT

FOR

CC METALS and ALLOYS, INC.
Witmer Road
Town of Niagara, New York

Volume I of III

Submitted to:

New York State Department of
Environmental Conservation
270 Michigan Avenue
Buffalo, New York 14203

Attn: Regional Environmental Remediation Engineer
Region 9

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ENVIRONMENTAL AND FACILITIES ENGINEERING
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Prepared by:

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LAN Ref. #2.3269.22
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IRM COMPLETION REPORT

For

SKW Metals & Alloys, Inc.

Witmer Road

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REVISED IRM COMPLETION REPORT
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1.0 INTRODUCTION

SKW Metals & Alloys, Inc. (SKW) has completed Interim Remedial Measures (IRM) at a parcel of property owned by SKW known as the "SKW Property". The property is located in the Town of Niagara, New York. The SKW Property represents a 37-acre portion of an Inactive Hazardous Waste Site known as Site No. 932001, and is referred to as the "Vanadium Site". The New York State Department of Environmental Conservation (NYSDEC) classified the Vanadium site as a Class 2 Inactive Hazardous Waste Site. A Class 2 Site is one, as determined by NYSDEC, which hazardous waste constitutes a significant threat to the environment. As a result of the classification, the NYSDEC contacted all known property owners by written Notice Letter dated July 28, 1995, and informed them of potential liability as a responsible party, under ECL Article 27, as an owner of a portion of the site. Also discussed in the NYSDEC Notice Letter was that certain remedial responses including investigations, planning, and removal would need to be performed at the site due to the "Class 2" designation. These remedial measures, in the opinion of the NYSDEC, would be necessary to protect public health and the environment.

After several months of negotiations with the NYSDEC and in conjunction with NYSDEC negotiations with other PRP's, it was determined that a response that could be agreed upon by all parties was not forthcoming. SKW, in concern for public health issues and the environment and without contesting or conceding to the NYSDEC's claim, entered into a voluntary Order of Consent agreement with the NYSDEC.

As a result of the Order of Consent agreement, SKW has completed and submitted to the NYSDEC:

1. A Revised Site Screening Work Plan dated April 24, 1998
2. A Revised IRM Work Plan dated June 18, 1998
3. A Site Screening Report dated February 18, 1999

4. IRM Completion Report dated February 18, 1999

The IRM construction and implementation was completed in accordance with the voluntary Order of Consent (NYSDEC Index #B9-0470-94-12) and the IRM Work Plan submitted to and approved by the NYSDEC. Work on the IRM began June 15, 1998 and ended October 30, 1998. The goal of the IRM was to remediate the area of concern agreed to as the high pH and high hexavalent chromium in the surface water on the southeast portion of the SKW Property.

This report describes:

- pre-IRM investigations and activities that formed the basic scientific understanding of the conditions affecting the SKW surface water
- the process of utilizing that understanding to define the surface water problem and determine appropriate measures to remediate the problem
- provides a narrative of the construction activities, field changes, and quality controls completed during the IRM construction and implementation
- additional site screening investigations completed during and after the IRM construction
- presents the findings of the IRM work and investigations.

Based on the findings determined after the completion of the IRM, SKW concluded that the goals of the IRM had been met and that, in LAN's opinion, the SKW property does not pose a significant threat to public health or environment. There is no longer an off-site discharge of contaminated surface water from the SKW Property. Stormwater is now discharged to the municipal storm sewer system and concentrations of pH and hexavalent chromium in the stormwater are within acceptable discharge limits. Continued monitoring of the stormwater discharge to the municipal storm sewer system will be performed. The monitoring will be performed to ensure that the stormwater quality requirements of the City of Niagara Falls are met. SKW recommends that the SKW Property be delisted from the Registry of Inactive Hazardous Waste Sites.

2.0 PROPERTY OWNERSHIP AND USAGE

SKW Metals & Alloys, Inc. purchased the SKW Property in 1979. A site location map is provided in *Figure 2-1.* A map showing the limits of the SKW Property is provided in *Figure* 2-2. At the time of purchase, the property consisted of approximately 37 acres of industrial land. The property was previously owned by Airco, Inc., which purchased 62 acres in 1964 from the Vanadium Corporation. Historical data and deeds show that the property was purchased by the Vanadium Corporation in 1920.

Vanadium utilized most of its property for the production of metals and alloys. Several large buildings were constructed and/or utilized for production processes. Rail lines and truck routes were also used for the transportation of raw materials, equipment, product, and waste. From review of historical aerial photography, the production operation appears to have occurred mainly on the western portion of the property. Waste disposal appears to have occurred mainly on the eastern portion of the property. Airco's operations were similar to the Vanadium's operation.

When SKW purchased the western 37 acres of the Airco property in 1979, the property was not used for active ferroalloy production. It was utilized as an ancillary facility to the Highlands Avenue ferroalloys plant, which up until that time, was owned and operated by Airco. There were no operational furnaces and associated production equipment at the site. The property was primarily used by SKW for storage of raw materials, equipment storage, off-spec product storage, slag storage, crushing of cast materials, and disposal of baghouse dust in two permitted landfill cells. All production buildings were abandoned at the time that SKW purchased the property. Also abandoned were on-site rails, a scale house, and a former electrical switch-gear building and transformer station.

3.0 SITE HISTORY

The Vanadium Corporation of America owned the Vanadium site from 1920 to 1964 when it was sold to Airco. The extent of total land owned by Vanadium is not known. It was reported that Vanadium used portions of the Vanadium site to produce various metals and alloys. Vanadium is reported to have disposed of approximately 564,000 tons of ferromanganese slag, ferrochromium silicon slag, and ferrochromium silicon dust along with additional waste of wood, brick, ash, and lime slag. The surrounding properties now owned by Niagara Mohawk, PASNY, and Airco contain exposed waste piles reportedly containing ferromanganese slag, calcium hydroxide, and ferrochromium dust.

In 1964, Airco purchased the Vanadium site and continued similar operations at the site as conducted by Vanadium. Airco sold the western 37 acres to SKW in 1979 while retaining the eastern 25 acres of the original site. Upon purchase of this portion of the Vanadium site, SKW ceased the land disposal of dust onto the SKW Property as of July 7, 1979. SKW ceased manufacturing ferrochromium in 1981. All ferrochromium dust was disposed of in Cell #1, a lined permitted landfill. No ferrochromium dust was disposed of by SKW in Cell #2. SKW received a 6 NYCRR Part 360 permit from the Department in 1980 to operate a solid waste disposal facility on the SKW Property. SKW closed the landfill in accordance with Department regulations during late 1992 and early 1993.

Various investigations and site reports were completed for the SKW Property. As early as 1979, an Interagency Task Force listed the site as a "Priority II" site. During 1979, a "Priority II" site was one in which waste disposal areas may have received significant quantities of hazardous waste. The Interagency Task Force document indicated that more than 74,000 tons of various wastes had been disposed of at the site. It was not known from the Task Force document the exact boundaries of the Priority II site, other than it was at that time owned by Airco and located at Witmer Road. Some time between 1979 and 1993, the system evolved from classification as "Priority I, II, III" sites into the present Class 1 through 5 system. The site was originally designated as a Class 3 site. A Preliminary Site Assessment completed by ABB Environmental Services in 1993 resulted in the site being re-classified as a Class 2 site, which it currently is.

In 1995, the NYSDEC sent potential responsible party letters to SKW Metals & Alloys, Inc., Niagara Mohawk Power Corporation, New York Power Authority, Airco

Properties, Inc., and Cyprus Minerals Company (formerly known as or successor company of Vanadium Corporation of America). SKW responded with proposals to complete an IRM and conduct various remediation activities at their property, which were approved by the NYSDEC and completed in October 1998.

4.0 ACTIVITIES ON THE SKW PROPERTY

After SKW purchased the 37 acres from Airco, it conducted several significant investigations and improvements to the property. These include:

1. Construction, operation, and closure of two permitted solid waste landfill cells for the disposal of baghouse dust. These landfills were constructed in accordance with the NYSDEC regulations in 1980, and closed in 1992-93,
2. Removal and/or recycling of derelict equipment, buildings, and unused raw materials in 1995 and 1996,
3. Submittal and subsequent approval by the NYSDEC of a Remedial Investigation and Recommended Interim Remedial Measures Report in March 1997,
4. Submittal and subsequent approval by the NYSDEC of an IRM Work Plan in 1998. The Work Plan included site re-grading and re-contouring with the construction of six cascading detention basins, the control of stormwater with disposal to the municipal storm sewer system, construction of an 18-inch horizontal clay barrier, and the construction of two vertical clay cutoff walls,
5. A voluntary Order of Consent agreement with the NYSDEC to resolve elevated pH and hexavalent chromium in surface water on the SKW Property in June 1998,
6. Construction of the IRM project from June 1998 through October 1998.

These activities by SKW show a history of proactive environmental concern and compliance. During its period of ownership, SKW has always provided the NYSDEC with data, information, and monitoring results associated with this site. SKW has worked with the NYSDEC to protect public health and the environment.

In the late 1980s and early 1990s, several investigations, including groundwater sampling, were also completed at the SKW Property by the NYSDEC in order to re-evaluate the classification of the overall US Vanadium site. Investigations for the NYSDEC were completed by the Gradient Group, E.C. Jordan, and ABB.

The possibility of a joint response by the property owners was investigated, however, a workable agreement was not attainable. As a result, SKW examined the conditions on the SKW Property and determined to respond unilaterally to the concerns of the NYSDEC. SKW examined the conditions on the SKW Property and reached an agreement with the NYSDEC regarding field work to be completed at the SKW Property. SKW submitted to the NYSDEC an IRM Work Plan which was approved in June 1998. The IRM Work plan was approved by the NYSDEC in June 1998. Field work began June 15, 1998 and was completed on October 30, 1998.

5.0 PERTINENT PRE-IRM INVESTIGATIONS

5.1. GENERAL DESCRIPTION OF INVESTIGATIONS

Prior to the start of the IRM, SKW and the NYSDEC completed a series of sampling events and investigations on the SKW Property. The goal of these pre-IRM investigations was to develop an understanding of conditions on the SKW Property and determine the best method of addressing those conditions. The following is a summary of the investigations completed on the SKW Property that was useful in determining the remediation method:

Year	Entity	Investigation	Finding
1979-1998	SKW	Routine Groundwater & Surface Water Monitoring	Parameters of concern were below guidance level
1993	NYSDEC	ABB Report	Recommended site re-classification to Class 2 Inactive Hazardous Waste Site
1995	SKW	Test Pits to Determine Extent of Fill	Most of SKW Property covered by 3-4 feet of industrial fill
1995-1996	SKW	Property Cleanup and Removal of Debris and Scrap	Surface debris contained scrap metal, slag, and raw materials
1997	SKW	Installation of Bedrock Monitoring Well	Parameters of concern are below guidance level
1997	SKW	Remedial Investigation	CaOH waste causes high pH – Recommended remedial measures
1997	NYSDEC	Groundwater Investigation	Bedrock groundwater divide located under Airco site
1998	SKW	Phase I Site Screening Investigation	No K090 or K091 listed waste on SKW Property

These projects show a long and continued process of investigations that culminated in the development of the SKW IRM Work Plan. The investigations served to provide a physical and chemical understanding of the conditions in the surface water, groundwater, and soil on the SKW Property. Once the surface water problem was understood and defined, the appropriate remedial measures were evaluated and chosen.

5.2. PHASE I SITE SCREENING INVESTIGATION

5.2.1. METHODS OF PHASE I SITE SCREENING INVESTIGATION

The field work for the Phase I site screening investigation was conducted from April 28, 1998, to May 1, 1998. Before implementing the Phase I investigation, a Site Screening Work Plan was submitted to and approved by NYSDEC. As described in the approved work plan, the objective of the Phase I investigation was to determine whether ferrochromium and/or ferrochromium silicon dust were present on the SKW property. The investigation results are described in detail in the Site Screening Investigation Report, which was previously submitted to the NYSDEC.

In order to implement the Phase I investigation, 25 test-pit locations were chosen randomly. A greater percentage of test pits were located within the identified area of concern. Some changes in test-pit locations and the completion of 30 additional test pits were made by the NYSDEC engineer (who participated in most of the investigation) and LAN Associates' hydrogeologist. These changes were based on observed field conditions, which indicated potential areas of interest that warranted further investigations.

Generally, soil samples were collected from material that resembled ferrochromium and ferrochromium silicon dust. However, several soil samples were also collected from material that did not resemble ferrochromium and ferrochromium silicon dust. These samples were collected at the NYSDEC's request to better understand site conditions. Samples collected from material that resembled ferrochromium dust, or were suspected of containing ferrochromium dust, were analyzed for total chromium and hexavalent chromium. The analysis was performed to determine if total chromium concentrations in the soil samples were within the range of total chromium concentrations typically found in ferrochromium and ferrochromium silicon dust and to determine whether oxidation of trivalent chromium to hexavalent chromium was occurring.

The function of the site-screening investigation was to determine whether ferrochromium and/or ferrochromium silicon dust were present at SKW's Witmer Road property. The investigation was based on an analysis of particle grain size, crystalline structure, and chromium concentration ranges. Therefore, a comparison of site screening sampling results for chromium analysis with New York State background levels was not completed by SKW nor was it required by NYSDEC.

A definition of ferrochromium and ferrochromium silicon dust was presented in the approved Site Screening Work Plan. The definition stated that ferrochromium and ferrochromium silicon dust contains:

1. total chromium concentrations between 700 and 1,500 milligrams per kilogram (mg/kg).
2. clay-size particles (which typically range from <1.0 to 5.0 microns).

However, a recently completed document review (Appendix A) revealed that the total chromium concentration of ferrochromium and ferrochromium silicon dust actually ranges between 1,560 and 4,450 mg/kg (Table 5-1). The previous range was based on one result of 1,560 mg/kg and the conservative assumption that the concentration range would be approximately 50 percent less than 1,560 mg/kg. After the documents in Appendix A were compiled and reviewed, this initial assumption proved wrong and the higher range correct.

In addition, Appendix A contains independent documentation of three criteria used to define ferrochromium and ferrochromium silicon dust:

1. total chromium concentration,
2. grain size,
3. crystal structure.

Crystal structure was added as a third criteria, because the crystal structure of baghouse dust is unique compared with all other byproducts and/or wastes generated during the production of ferrochromium and ferrochromium silicon dust.

A summary of the determination criteria for ferrochromium and ferrochromium silicon baghouse dust is presented in Table 5-1. The determination criteria indicate that ferrochromium and ferrochromium silicon baghouse dust:

1. contains total chromium at 1,560 to 4,450 mg/kg,
2. has a grain size that is less than 6.0 microns,
3. has a crystal structure that is amorphous.

Based on the criteria for characterizing ferrochromium and ferrochromium silicon dust, 15 soil samples were subjected to total chromium analysis; then, the 5 soil samples that contained the highest total chromium concentrations—and were suspected of containing ferrochromium or ferrochromium silicon dust—were subjected to grain-size analysis and x-ray defraction (XRD) analysis. These analyses were used to determine if the soil samples contained total chromium within the expected concentration range, were composed of dust-size particles, and had the same crystallographic structure as baghouse dust. Once these analyses were completed, a comparison was performed to determine whether the samples met the characteristics of ferrochromium or ferrochromium silicon dust.

During the Phase I investigation, minor amounts of suspected petroleum-contaminated soils were encountered on the SKW property. When encountered, these soils were sampled and analyzed for total volatile organic compounds (VOCs) and total semi-volatile organic compounds (semi-VOCs). In addition, some soil samples, which were collected near a former transformer building, were also analyzed for polychlorinated biphenyls (PCBs).

5.2.2. RESULTS OF PHASE I SITE SCREENING INVESTIGATIONS

Table 5-2 shows that concentrations of total chromium above 1,560 mg/kg were detected in 4 of the 15 soil samples collected on the SKW property. The laboratory report containing analytical results for the soil sample is included in Appendix B. The particle-size results (Attachment 8 in Appendix A) reveal that the five soil samples subjected to particle-size analysis contained 95-99 percent sand-size or larger material (i.e., 50 microns or larger). The particle-size results reveal that the soil samples do not meet the criteria of baghouse dust (i.e., 6 microns or smaller). This conclusion is further supported by the XRD results (Attachment 8 of Appendix A), which determined that the five samples are composed of material that is crystalline rather than amorphous.

Based on the documented characteristics of ferrochromium and ferrochromium silicon dust, Table 5-3 was developed to compare ferrochromium and ferrochromium silicon dust characteristics with the results of site-screening soil samples collected from the SKW Witmer Road property. Table 5-3 indicates that none of the soil samples fit the grain-size or crystallinity criteria used to define ferrochromium and ferrochromium silicon dust. Thus, only one of the three criteria used to define ferrochromium and ferrochromium silicon dust (chromium concentration) was met. Therefore, in LAN Associates' opinion the following can be concluded:

1. the soil samples do not meet the classification criteria for ferrochromium and ferrochromium silicon dust;
2. ferrochromium and ferrochromium silicon dust was not found on SKW's Witmer Road property; and
3. the detected chromium concentrations are a likely result of the presence of various amounts of ferrochromium or ferrochromium silicon slag material.

Chromium-bearing slag is not a listed waste and is not defined as a listed hazardous waste. Chromium-bearing slag is also well documented as having low leachability. This characteristic is supported by a summary of past groundwater monitoring results for the SKW property (Appendix C). The groundwater monitoring results reveal that total chromium concentrations range from non-detect to less than 0.014 mg/l. Therefore, in LAN's opinion, the chromium-bearing slag does not represent a significant threat to public health or the environment.

The oxidation of trivalent chromium to hexavalent chromium was addressed by analyzing the soil samples for hexavalent chromium. Concentrations of hexavalent chromium (above 1 mg/kg) were detected in 2 of the 15 soil samples collected on the SKW property (81.0 mg/kg and 120.0 mg/kg) (*Table 5-2*). Appendix B contains the hexavalent chromium laboratory report and analytical results. Both soil samples with detections greater than 1 mg/kg were located in low-lying areas where surface water accumulated in the past. The issue of surface water accumulation and the associated formation of hexavalent chromium were corrected through the implementation of the IRM. Hexavalent chromium that is formed by surface water interactions is not a listed hazardous waste in the state of New York.

A summary of groundwater monitoring results for the past five years (Appendix C) documents that hexavalent chromium in groundwater at the SKW property ranges from non-detect to less then 0.040 mg/l. The average surface water concentration for hexavalent chromium during the past five years is approximately 0.50 mg/l (Appendix C). Post-IRM sampling of surface water, which was discharged from SKW's property to the municipal storm sewer system, detected hexavalent chromium between non-detect and 0.05 mg/l (Appendix D). The results indicate an order of magnitude reduction in hexavalent chromium surface water concentrations since the completion of the IRM. In LAN's opinion, these results indicate that hexavalent chromium is not a significant threat to public health or the environment.

The analyses of soil samples for VOCs, semi-VOCs, and PCBs (*Table 5-2*) revealed that minor amounts of petroleum products (probably diesel fuel) are present in small isolated areas on the SKW property. PCBs were not detected in the soil samples collected near the former transformer building.

6.0 IRM PROJECT DEFINITION & DEVELOPMENT

Elevated concentrations of hexavalent chromium and pH in the surface water on the Vanadium site was defined as the only area of concern on the SKW Property by the NYSDEC. The cause of the high hexavalent chromium and pH in the surface water was later identified by SKW (APPENDIX E) as the chemical interaction between surface water and sediment with high concentrations of calcium and calcium hydroxide. The chemical interaction causes an increase in surface water pH which, in turn, causes the leaching of oxidized hexavalent chromium from the sediment (*Figure 6-1*).

On the SKW Property, the above condition occurred in a relatively small depression in the southeast portion of the property where surface water seasonally collected. This small depression and part of the surrounding area was identified as the areas of concern on the SKW Property. Once the area of concern and the cause of the problem was determined, five remedial objectives were identified and evaluated. The remedial objectives included:

1. Elimination of off-site surface water discharge,

2. Elimination of the depression where on-site surface water collects,

3. Elimination of the contact between surface water and sediment in the area of concern,

4. Collection and containment of on-site stormwater,

5. Discharge of the collected stormwater to the municipal storm sewer system for treatment and final disposal.

These objectives were incorporated into the IRM design. The design included:

1. Site re-grading and re-contouring to eliminate off-site surface water discharge, approximately 20,000 cubic yards of on-site soils were moved. Approximately 27,000 cubic yards of off-site borrow materials were used to attain final site contours. These off-site materials are inclusive of additional clay, stone, and topsoil.

2. The construction of a series of six cascading stormwater detention basins which would discharge stormwater into the municipal storm sewer system. The potential storage volume of the detention basins is 9.4 million gallons. This is in excess of the total rainfall during a 24-hour 25-year storm event for the SKW Property.

3. The installation of an 18-inch horizontal clay barrier in the area of concern with a specified minimum hydraulic conductivity of 1 X 10^{-5} cm/sec.

4. The completion of two vertical clay cutoff walls along the edges of the area of concern with a specified minimum hydraulic conductivity of 1 X 10^{-6} cm/sec. as required by the NYSDEC,

5. The creation of inter-connected stormwater drainage basins with negligible or no standing water in the area of concern.

The design and development of the IRM Work Plan was completed by SKW and LAN Associates, who acted as SKW's environmental consultant and design engineer. The IRM Work Plan received NYSDEC approval in June 1998. After approval of the IRM Work Plan, SKW hired LAN Associates as the project construction engineer, SLC Constructors as the general contractor charged with project construction, and GZA, Inc. as an independent third party quality control engineer. The project was started June 15, 1998 and completed October 30, 1998.

7.0 DETERMINATION OF REMEDIAL MEASURES

The elevated pH and chromium levels in the surface water was revealed through routine monitoring for SKW's permitted landfill cells. It is important to note that on the SKW Property, routine groundwater monitoring indicates that pH and hexavalent chromium are within drinking water standards. Thus, the investigation to determine the proper remedial measure for the SKW Property centered on determining the cause of the high pH and high hexavalent chromium in the surface water. The investigation revealed that surface soil conditions were adversely affecting surface water quality on the Vanadium site and the SKW portion of the Vanadium site. It was observed that material on the surface of the Vanadium site was dominated by calcium and calcium hydroxide. This material was reported to be placed on the Vanadium site (including the SKW Property) by Vanadium and Airco.

The chemical interaction between surface water and calcium hydroxide is represented in *Figure 6-1*. This figure shows the formation of high pH water when water and air interact with soil containing calcium hydroxide. The high pH water, in turn, causes increased leaching of chromium and oxidized chromium from the near surface soil. Investigations on the SKW Property revealed that high pH and high hexavalent chromium were problematic only in a relatively small low lying area where intermittent surface water collected. Thus, the development of remedial measures for the SKW Property centered around the hypothesis that if surface water was not allowed to collect or interact with the calcium and calcium hydroxide in the near surface soil, then the overall condition of surface water would be improved.

Based on the above hypothesis, the following remedial alternatives were evaluated:

1. Excavation of soil that contained high concentrations of calcium, calcium hydroxide, and hexavalent chromium,

2. Capping of the area of concern in order to eliminate contact between surface water and soils,

3. Construction of vertical barriers to control shallow groundwater and perched groundwater movement,

4. Isolation of surface water from surface and sub-surface materials,

5. Containment and control of stormwater.

Based on the evaluation of the above alternatives, the following remedial measures were recommended:

1. Complete the site re-contouring and re-grading to contain and control stormwater discharge.

2. Eliminate surface water discharge from the SKW Property through re-grading and re-contouring,

3. Reduce or eliminate contact between stormwater and surface soils by eliminating low lying areas where water ponds and by creating positive flow across the site.

4. Construct a compacted horizontal clay barrier in the area of concern to isolate stormwater from surface and near surface soils.

These recommendations were presented to the NYSDEC. Based on their review, the NYSDEC recommended the construction of two vertical clay cutoff walls in the area of concern. The NYSDEC specified that the walls were to be constructed along the western and southern edges of the area of concern. The NYSDEC also specified that the walls would extend through the overburden material and be keyed into the underlying clay unit. SKW agreed to the recommendations made by the NYSDEC.

After the recommended remedial measures were agreed to, SKW developed the final design for the implementation for the remedial measures. The design included:

1. Containment of on-site stormwater,

2. Control of stormwater discharge to a single storm sewer manhole,

3. Stormwater discharged to the municipal storm sewer system with treatment at the municipal treatment plant,

4. Maximum discharge rate to the municipal storm sewer system of 23 cfm,

5. Capacity of on-site retention able to handle a 25-year storm event, and

6. An emergency spillway to provide controlled discharge of stormwater in the event of back-to-back 25-year storms.

The above mentioned design components were incorporated into the IRM Work Plan, which was submitted to and approved by the NYSDEC.

8.0 SUMMARY OF CONSTRUCTION ACTIVITIES

8.1. CONSTRUCTION NARRATIVE

Construction of the IRM Work Plan began on June 15, 1998. The initial work began with the mobilization of equipment on site by the contractor. Additionally, on June 15th, the aerial survey tie-in and establishment of on-site horizontal and vertical controls by the surveyor were commenced by the surveyor laying out 496 grade stakes on a 50-foot grid. The grade stakes were marked with the cut and fill requirements for establishing the subgrade elevations. This work was followed by surface and near-surface clearing which was done in preparation of the site work. The clearing work included the demolition of concrete foundations and partial removal of old structural walls. The demolition was completed with hydraulic hammers and excavators.

Concurrent with the demolition work was the separation and recycling of structural and reinforcement steel. The steel was cut and removed with torches, saws, and an excavator. After the steel was loaded into containers it was transported to a nearby recycling facility. Also completed concurrently was the removal and/or recycling of surface and near-surface railroad ties and vegetation. The removal was completed with trackhoes and dozers. The railroad ties were disposed of off-site in a non-hazardous landfill. The vegetation remained on-site and was used as mulch or spread over the surface prior to the placement of topsoil.

As the surface preparation progressed across the site, the re-contouring and re-grading earthwork began. The re-grading work followed the cut and fill requirements marked on the grade stakes. Excavators and dozers were utilized to establish the final subgrade elevation and the shape of each of the six detention basins. Dozers were used to shape the berms separating the basins, and the exterior slopes. Concurrent with the establishment of sub-grades, the interconnecting piping between the basins were installed. Also, the tie-in to the City of Niagara Falls sewer system was completed, which included the installation of a discharge control valve, interconnecting piping, and new manhole.

After the site grading and re-contouring was completed in the western portion of the property, construction of an 18-inch horizontal compacted clay barrier and two 24-inch thick vertical clay cutoff walls in the area of concern began. The location of these structures is shown in *Figure 8-1*. The horizontal clay was placed in three 6-inch compacted lifts. Also completed at this time were the two compacted clay cut-off walls which were constructed in 9-inch compacted lifts. Proper clay moisture, density, and conductivity were confirmed by a third party quality control engineer. This work was followed by the placement of six inches of topsoil above the horizontal clay barrier and four to six inches of topsoil over the remaining subgrade area. The seeding of the topsoil and the placement of crushed stone along the site access road were the final items completed during construction. A complete set of construction drawings is included as *Figures 8-2* through *8-7*.

8.2. FIELD CHANGES TO ORIGINAL CONSTRUCTION PLANS AND SPECIFICATIONS

8.2.1 Minor Changes in Grading

During the completion of the IRM work, minor field changes were completed. Each field change was discussed between the engineer, contractor, and the NYSDEC. NYSDEC approval of the field changes was obtained prior to implementing the change. Minor variations in site grading due to subsurface conditions were approved directly by the engineer's representative. These variations included slight shifts in the position of basins, and minor changes in basin slopes and berm height. It was also sometimes more practical to work around a large concrete structure as opposed to completely excavating or demolishing it. In all cases, the overall volume of the basin was not significantly changed. These minor changes did not affect the overall IRM performance. Another grading change included the removal and disposal of a railroad ramp in the south-central portion of the property. Its removal eliminated a potential safety hazard and eye-sore. The removal of the railroad ramp did not significantly change the basin volumes or affect the overall IRM performance.

8.2.2 *Discharge from Northeast Basin*

A drain flow change did occur in the basin northeast of the landfill cells. In this basin, the discharge piping was re-directed to the northwest. Flow from the basin discharge then travels along the northern boundary of the landfill cells and into the drainage area to the west of the landfill. This change was approved by the NYSDEC prior to beginning the work.

8.2.3 *Access Road Drainage*

A slight change in the drainage from the south access road into the south central and southeastern basins was also made. The original drawing showed a drainage swale along the northern edge of the access road that would flow towards the west and connect via a pipe to the drainage basins. Upon review of actual field conditions, it was determined that drainage could be better controlled by eliminating the swale and connecting pipe on the north side of the road. This change was discussed with the NYSDEC and approval was obtained prior to implementing the change.

8.2.4 *Tie-In to Existing Storm Sewer*

The field change occurred during the tie-in from the southwest basin outfall to the existing storm sewer manhole. The original design called for a direct routing of new connecting piping. However, the direct routing brought the piping further into potential traffic areas. Therefore, the piping was re-routed closer to the existing fence line to bring it out of the traffic area. This re-routing of the piping was discussed with the NYSDEC and approval was obtained prior to implementing the work.

A change was also made at the tie-in location. In order to accommodate the tie-in piping, the original small concrete catchment basin was replaced with a large concrete manhole. This change was also discussed with the NYSDEC and approval was obtained prior to implementing the work.

Other than the small changes mentioned above, all construction was completed according to the original plans and specifications approved by the NYSDEC. Final completion of the IRM produced a project that was nearly identical to the approved site grading plan. The very slight differences between the proposed and as-built project can be seen by comparing the as-built contour drawing (*Figure 8-8*) to the proposed final contour drawing (*Figure 8-4*). The final as-built drawing was constructed from aerial photography completed in December 1998, after the IRM construction was completed. Before and after IRM photographs of the SKW Property are provided in *Figures 8-9 and 8-10. Figure 8-11* shows the property drainage.

It is important to note that during the construction activities, all construction conformed to the plans and specifications approved by the NYSDEC. Any significant field changes or variations from the plan and specifications were completed after the NYSDEC was notified of the proposed field changes and approval from the NYSDEC was obtained. The notification and approval process usually occurred during weekly site meetings (APPENDIX F) attended by LAN, the contractor, and the NYSDEC. Additional drawings and notes documenting the field changes are included in APPENDIX G).

8.3. QUALITY CONTROL

Quality control was maintained during the IRM construction by the SKW representative and by a third party quality control engineer. LAN Associates functioned as the general construction engineer and ensured that the overall project was constructed according to the plans and specifications approved by the NYSDEC. This work included the establishment of proper sub-grade elevations, the installation of inter-connecting piping between the drainage basins, the demolition of concrete foundations and structures, and the removal of waste from the site. These items are documented in daily field logs (APPENDIX H) completed by LAN Associates, weekly site meeting memos (APPENDIX F) completed by LAN Associates, and both hazardous and non-hazardous waste handling and disposal documentation (APPENDIX I and J) compiled by LAN Associates.

Third party quality control engineering was completed by GZA during the installation of an 18-inch thick horizontal clay barrier and two 24-inch thick vertical clay cutoff walls in the area of concern. GZA's work included moisture density measurements, thickness measurements, shelby tube sampling, and laboratory analysis of hydraulic conductivity. GZA also completed laboratory analysis of clay and topsoil barrow material that was obtained from off site.

During GZA's quality control testing, if a location failed a quality control test, the SKW representative and contractor were notified by GZA. The contractor was then directed to correct the failed test area and the area surrounding the failed test. After the contractor had re-worked each failed area, the failed test location was re-tested (and re-corrected, if necessary) until a passing test was achieved. This ensured that all work met the required specifications.

If necessary, a GZA representative was present during the weekly site meetings to discuss any failed test results with the engineer's representative, the contractor, and the NYSDEC. Mechanisms for correcting the failed areas and re-testing were discussed with the NYSDEC. The NYSDEC, in many cases, observed the actual re-working and re-testing of failed test areas. At the IRM completion, all quality control test locations had passing results and all required quality control specifications were met or exceeded.

The quality control work completed by GZA is recorded in its report completed on November 20, 1998 (APPENDIX K). The report contains the following documentation:

1. daily field summary reports from August 20, 1998 through October 26, 1998,
2. pre-construction laboratory test data for clay barrow source,
3. shelby tube permeability results for cutoff wall A, cutoff wall B, and horizontal clay barrier,
4. shelby tube sample locations,
5. shelby tube sample density and moisture content data,
6. shelby tube sample lift interface observation,
7. top soil barrow source laboratory test data

8.4. SITE SCREENING INVESTIGATIONS COMPLETED DURING IRM

Four times during construction subsurface excavations uncovered potentially hazardous materials. In each case, the materials were handled and removed according to NYSDEC regulations. The NYSDEC was notified each time a problematic material was discovered. The method of handling and disposal was presented to the NYSDEC, and NYSDEC approval was obtained prior to handling and disposal.

8.4.1 Baghouse Bags Removed

During the IRM re-grading and contouring activity, baghouse bags were discovered adjacent to stake #477 (*Figure 8-12*). The baghouse bags were excavated while completing the 2.5 feet cut requirement for this location. Before the contractor or the engineer became aware that baghouse bags had been excavated in this area, some of the material was pushed by a dozer to the east of stake #477. Fortunately, the baghouse bags and associated dust were easily identified. The baghouse dust contained a unique light bluish gray color which was visible when the dust occurred separately and when the dust was mixed with native soil.

Once the material was found and its location identified, it was sampled and analyzed for total metals and toxicity characteristic leaching procedure (TCLP) metals. Three samples (*Figure 8-12*) were collected directly from the dust material contained in the baghouse bags and analyzed for TCLP metals. Twelve mixed soil and dust samples (*Figure 8-13*) were collected in the original source area surrounding stake #477 and along the access route to this area. These samples were analyzed for total metals and TCLP metals.

The results from the three dust samples collected directly from the baghouse bags revealed TCLP lead concentrations of 7.9, 8.6, and 13.5 mg/l (*Table 8-1*) which were above the characteristic of hazardous waste threshold of 5.0 mg/l. The 12 soil and dust samples were all non-hazardous (*Table 8-2*). APPENDIX L contains the laboratory reports for the baghouse dust and surface soil analysis.

Based on this condition, an industrial hygienist was retained by the contractor and brought on site to implement proper worker protection and exposure monitoring. The worker air monitoring results showed that worker exposure was within acceptable OSHA limits and that the proper worker protection level was Level D. However, while the worker exposure evaluation was being completed, all workers were protected at Level B as directed by the industrial hygienist. The complete industrial hygiene report titled Initial Lead Assessment Report is included in APPENDIX M.

When the issue of on-site lead contamination was first discovered, the contractor had a physical completed with blood lead analysis for each worker who may have been exposed. The physicals and blood lead analysis showed no abnormal conditions in the workers. This information, along with the baghouse dust results and soil samples results, led to the conclusion that hazardous concentrations of lead was limited to the three samples collected from the baghouse dust. All soil samples in and around the source area were characteristically non-hazardous.

During the period when worker exposure monitoring was being conducted and while workers were in level B protection, the observed baghouse bags, baghouse dust, and mixed soil and dust were excavated from their known location. The material was placed into five covered hazardous waste roll-off containers and later transported to a hazardous waste landfill. Documentation including hazardous waste manifests and certification of disposal receipts from a hazardous waste landfill are included in APPENDIX I. Worker air monitoring completed during the direct handling of baghouse bag, baghouse dust, and mixed dust and soil did not indicate elevated levels of lead in the personal air monitoring devices worn by each worker completing these tasks. Therefore, even when completing the task with the greatest potential for exposure to hazardous levels of lead, worker exposure was within OSHA acceptable ranges for Level D protection.

After this work was completed, 25 additional test pits (*Figure 8-14*) were dug in order to determine if any additional baghouse bags or baghouse dust were present in areas of potential concern on the SKW Property. The test pit locations were chosen based on gray or bluish-gray coloration in the surface soil. Test pit logs are included in APPENDIX N. A total of 60 samples were collected and analyzed for total metals (APPENDIX O). TCLP metals were analyzed for high total metal results. Based on this criteria, nine samples were analyzed via the TCLP method. These nine samples were all below the parameter threshold. A summary table of total metals results and TCLP results is included in *Table 8-3*.

The additional test pit sampling and analysis led to the conclusion that hazardous concentrations of lead occurred in only the dust contained within three baghouse bags. All other dust and soil samples were not characteristically hazardous.

Based on the surface and subsurface soil investigations completed after the baghouse bags were discovered, it has been shown that all hazardous material identified at the SKW site has been removed and that the materials remaining on site are not characteristically hazardous. Furthermore, TCLP analysis has revealed that the analyzed surface and subsurface soil is not characteristically hazardous. Therefore, no significant quantities of hazardous material remain on site, other than the material contained within the SKW landfill.

8.4.2 UST Removal

While completing the trench excavation for tie-in piping to the municipal storm sewer system, the excavation encountered an underground storage tank. The tank contained what was identified as No. 2 or No. 4 diesel fuel. The liquid contained in the underground storage tank was pumped out and disposed of by Green Environmental Services. On the following day, Green Environmental excavated and disposed of the tank. The tank was observed to be in good condition. There were no observed holes or cracks in the tank. All visually stained contaminated soil was excavated from the tank pit until visually clean soil was encountered. The excavated soil was stockpiled on site and completely encapsulated in plastic until it was hauled off and disposed of at a non-hazardous waste landfill. Documentation for the work completed by Green Environmental, including the soil disposal, is included in APPENDIX P.

8.4.3 Petroleum Contaminated Soil

While completing the grading cut requirements in the southwest basin, a small area of dark petroleum stained soil was observed. The stained soil also had a distinct diesel fuel odor. This material was excavated until visibly clean soil was observed. It was placed in two roll-off containers and covered. Representative samples from both containers were collected and analyzed for benzene and flash point. Based on the low results, the containers were disposed of at a non-hazardous waste landfill. Documentation of the laboratory analysis, waste manifests, and landfill receipts are included in APPENDIX J.

8.4.4 Drum Material

Two drums of what appeared to be metal shot and/or slag were found near stake #473 (*Figure 8-15*). The material was sampled and analyzed for total metals (APPENDIX I). Based on the limited amount of material to be disposed, it was determined that all the shot and/or slag material in and around the drums should be excavated and placed in an on-site hazardous waste container. This container was primarily utilized for the disposal of baghouse bags, baghouse dust, and mixed soil and dust. The shot/slag material was disposed of in a hazardous waste landfill along with the baghouse waste.

8.4.5 Wash Pad Sediment

A wash pad that had been utilized for washing truck tires prior to leaving the site was de-commissioned and de-mobilized. Prior to demobilization, sediment from the wash pad was sampled for TCLP metals to determine how it should be handled and disposed. After the analysis indicated the sediment was non-hazardous, the stone and sediment contained in the wash pad were excavated and placed in a roll-off container. The material was then transported and disposed of at a non-hazardous waste landfill.

Documentation including the analysis, waste manifests, and landfill receipts are included in APPENDIX J.

8.5. COMMUNITY AIR MONITORING

Community air monitoring was completed during most IRM construction activities. Construction activities that required air monitoring were all cut and fill operations and any activity that disturbed surface or subsurface materials. Construction activities that did not require air monitoring were survey work, most quality control testing and activities that occurred on top of the first lift of compacted clay.

The community air monitoring was completed by SLC with three MEI Miniram Model PDM-3 air monitoring instruments. Typically, before work began, the contractor would clean and calibrate the air monitoring device, if necessary. The contractor would then place the air monitors upwind of the work area, downwind of the work area, and in the work area. Time weighted air monitoring results were usually recorded at approximately 9:00 am, 11:00 am, 1:00 pm, and 3:00 pm during normal 7:00 am to 3:30 pm work days.

The air monitoring results compiled by the contractor are included in APPENDIX Q. Technical air monitoring problems did occur. These problems included rain, fog, pollen, and insects interfering with the detection device. Mechanical problems were also encountered with the monitoring device. These included battery and operational failures. This resulted in monitoring results that were obviously erroneous, such as high dust levels at upwind locations when no visible dust was observed. In spite of the technical problems, SKW's representative did not observe excess dust or particulate leaving the SKW Property during the IRM construction. The most important evidence that dust levels were low during the IRM construction is that there were no complaints from the surrounding community regarding airborne dust or particulate. In addition, NYSDEC representatives frequently visited the site to inspect the IRM work and observe site conditions. At no time did the NYSDEC object to the air quality or dust suppression methods.

8.6. PROJECT COMPLETION

The IRM project was substantially completed October 30, 1998. At that time, a final punch list was developed during a walk-through of the site with the SKW representative, the contractor, and the NYSDEC A final inspection of the site followed on November 17, 1998. The final inspection involved a walk-through of the site with representatives of SKW, LAN, SLC, and the NYSDEC.

A photographic flyover of the site was completed on December 10, 1998. During the flyover, an aerial survey was completed and oblique photographs were taken of the site. Based on the aerial photographs, an as-built drawing with final elevation contours was produced. This drawing was constructed with a 1-foot contour interval.

As of December 1998, very little grass had sprouted, and it is anticipated that the grass growth will not be established until Spring 1999. The establishment of grass is a contractual requirement of the contractor, as is the mowing of the grass for a one year period after it has been established. For this reason, it is anticipated that the project will be inspected again in Summer 1999 to assess the site conditions. Erosion repairs and repairs to defects in materials or faulty construction are also required of the contractor for a one-year period.

An additional item that needs to be resolved is the removal of surface monitoring points 6A and 7 from SKW's landfill monitoring requirements. As a result of the IRM, surface water no longer exists at these locations. Therefore, it cannot be monitored. SKW has notified the NYSDEC Solid Waste Branch of the change.

Post-IRM sampling and analysis of stormwater discharge from the SKW Property to the municipal storm sewer system was completed in February 1999. Hexavalent chromium was detected in the stormwater discharge between 0.05 mg/l and non-detect (APPENDIX C). This indicates at least an order of magnitude decrease in hexavalent chromium (averaged from 1993 through 1998) of .500 mg/l. The stormwater discharge results for pH were 6.57 and 7.98. This indicates a decrease of several orders of magnitude from the average surface water concentration between 12.0 and 12.5. These results indicate that hexavalent chromium and pH in the SKW stormwater is not a significant threat to public health or the environment.

9.0 FINDINGS

After completion of the IRM, the following findings were made:

1. The IRM was completed in accordance with the approved IRM work plan.
2. All work (except for minor field changes) was completed in accordance with the required plans and specifications.
3. Field changes made during the completion of the IRM work have been documented.
4. Field changes were approved by the NYSDEC prior to being completed.
5. Quality control documentation has been provided.
6. Additional investigations and remedial measures have been completed beyond the scope of the IRM. These measures include:
    - removal of baghouse bags, baghouse dust, and soil
    - removal of an underground storage tank and contaminated soil surrounding the underground storage tank
    - removal of dark stained soil with fuel odors from the southwestern basin
    - removal of two 55-gallon drums and surrounding soil containing metal shot and/or slag
    - additional surface and subsurface sampling and analysis

Sampling and analysis of surface and subsurface materials showed them to be non-hazardous in nature except for three samples collected directly from dust contained within baghouse bags. All baghouse bags and baghouse dust observed on the SKW Property were removed and disposed of in a hazardous waste landfill.

The post-IRM site conditions reveal that the IRM activities have eliminated off-site surface water discharge. The IRM activities have also directed on-site stormwater to a single discharge to the municipal storm sewer system. Post-IRM stormwater sampling indicated a pH concentration between 6.57 and 7.98, and hexavalent chromium concentrations of 0.05 mg/l and non-detect. These conditions show that the original goals of the IRM (to remediate high pH and high hexavalent chromium on the SKW Property) have been met.

10.0 CONCLUSIONS AND RECOMMENDATIONS

A series of investigations, site cleanups and interim remedial measures have been completed on the SKW Property, culminating with the completion of the IRM in November 1998. SKW has completed this work in a cooperative and proactive manner. The IRM work was completed as part of a voluntary Order of Consent agreement with the NYSDEC.

The area of concern, identified by the NYSDEC and SKW, was described in the IRM Work Plan as high pH and high hexavalent chromium in the surface water on the southeast portion of the SKW Property. The appropriate remedial measures were proposed in the IRM Work Plan along with detailed construction plans and specifications. The IRM Work Plan remediated the identified area of concern and the overall SKW Property. Surface water elimination, stormwater containment and control, along with the isolation of subsurface materials, were the primary methods of remediating and improving surface water quality.

The IRM Work Plan was reviewed and approved by the NYSDEC. A narrative of how the IRM was completed is contained in this report. Construction quality control and off-site waste disposal documentation are also contained in this report, as well as post-IRM surface water conditions and stormwater quality.

The issues to be addressed in this conclusion are whether or not the work leading up to and during the IRM has answered the following three questions required to delist the SKW Property from the Registry of Inactive Hazardous Waste Disposal Sites:

- Question #1–Is there K090 or K091 listed hazardous waste on the SKW Property (outside of the closed landfill)?
- Question #2–Is there a significant amount of characteristically hazardous waste on the SKW Property (outside of the closed landfill)?
- Question #3–Does the SKW Property pose a significant threat to public health or the environment?

<u>Question #1–</u>Is there K090 or K091 listed hazardous waste on the SKW Property (outside of the closed landfill)?

Answer: No

Explanation:
The site screening investigation completed in April and May 1998, and the additional investigations completed during the IRM between June 15 and October 30, 1998 included:

- The completion of over 70 test pits
- The collection and analysis of over 115 soil samples
- The analysis of four different waste streams

These analyses, which included total chromium, grain size, and XRD, resulted in no identified K090 or K091 listed waste. These analyses did detect elevated chromium concentrations in the soil. The elevated chromium was attributed to slag material because of the samples' grain size analysis and XRD results. Chromium containing slag is not a listed hazardous waste in the state of New York.

Question #2–Is there a significant amount of characteristically hazardous waste on the SKW Property (outside of the closed landfill)?

Answer: No

Explanation:
The same 70 test pits, 115 soil samples, and 4 waste stream analyses cited above also reveal that all surface and subsurface soils tested for TCLP metals were non-hazardous. On the entire SKW Property, only three samples of dust collected directly from baghouse bags exceeded the characteristically hazardous threshold for lead. The TCLP lead results for these three samples were 7.9 mg/l, 8.6 mg/l, and 13.5 mg/l, while the TCLP lead threshold is 5.0 mg/l. The baghouse bags, from which the three samples were collected, were located in the identified area of concern. Those bags, and all other observed baghouse bags and dust, were excavated and disposed of in a hazardous waste landfill.

The area of concern was isolated with a horizontal barrier constructed with 18 inches of compacted clay and 6 inches of top soil. This area no longer is exposed to or in contact with surface water, stormwater, surface soil, or the atmosphere. Therefore, even if there were any de minimous quantity of hazardous waste or hazardous substances remaining in the isolated area of concern, it will not significantly affect public health or the environment via the surface water, stormwater, surface soil, or the atmosphere.

Similarly, there is no significant threat to pubic health or the environment via groundwater. The past five years of groundwater monitoring results demonstrate that lead, chromium, hexavalent chromium, and pH concentrations in the groundwater below the SKW Property are predominately below drinking water standards. Two exceedences (one in the 2nd quarter 1995 and one in the 2nd quarter 1996) of the pH standard have been recorded at monitoring well 5-R. The lead standard was exceeded once in well 3-R in 4th quarter 1998. However, the lead result was biased by large amounts of sediment in well 3-R, as evidenced by the extremely high turbidity level (209 NTU). In addition, filtered groundwater collected from the well 3-R contained no detectable soluble lead. Therefor, the above exceedences are inconsequential and are insignificant in terms of their threat to public health and the environment.

Question #3–Does the SKW Property pose a significant threat to public health or the environment?

Answer: No

Explanation:
The completion of the IRM has addressed all of the NYSDEC's concerns that the SKW Property poses a significant threat to public health or the environment because:

1. There is no off-site discharge of contaminated surface water. Therefore, human exposure cannot occur via contaminated surface water contact and there is no off-site environmental threat from surface water.

2. There will be little or no on-site surface water retention at the SKW property because the area of surface water accumulation have been filled and re-contoured. The minor amount of surface water that temporarily accumulates after a storm event will not be in contact with on-site waste material. Therefore, LAN believes that human exposure to on-site contaminated surface water will not occur and there is no environmental threat.

3. Stormwater from the SKW Property is discharged to the municipal storm sewer system where it is treated prior to discharge. Therefore, human exposure cannot occur and there is no environmental threat from stormwater. Monitoring of

SKW's surface water discharge to the combined municipal stormwater and domestic wastewater system will be performed. The monitoring will help ensure that the stormwater quality requirements of the City of Niagara Falls are met.

4. The SKW Property is covered with 18 inches of imported clay and 6 inches of imported top soil in the area of concern. All other areas of the site are covered with 4 to 6 inches of imported top soil. Therefore, human exposure to hazardous waste or hazardous substances cannot occur. Neither the surface soils nor the subsurface soils pose a significant threat to public health or the environment.

5. Groundwater at the SKW Property meets or in three cases is slightly above (two pH exceedences and one unconfirmed lead exceedence) drinking water standards for parameters of concern: pH, hexavalent chromium, chromium, and lead. Therefore, there is no significant threat to public health or the environment from groundwater parameters of concern.

6. There are no downgradient drinking water receptors, so there can be no public health threat from groundwater regardless of parameter concentration.

7. The SKW Property is fenced and locked. Therefore, direct human exposure cannot occur other than to those trained professionals who inspect and monitor the property.

Based on the successful completion of remedial measures, the SKW Property should be delisted from the Registry of Inactive Hazardous Waste Disposal Sites. A petition will be submitted by SKW to facilitate the delisting of the SKW Property.

11.0 CERTIFICATION

Re: IRM Completion Report for SKW
Metals & Alloys, Inc.
Town of Niagara, New York

I certify that the IRM construction was completed according to the approved plans and specifications unless otherwise noted in this document.

Guy D. Van D

Date: 12/6/99

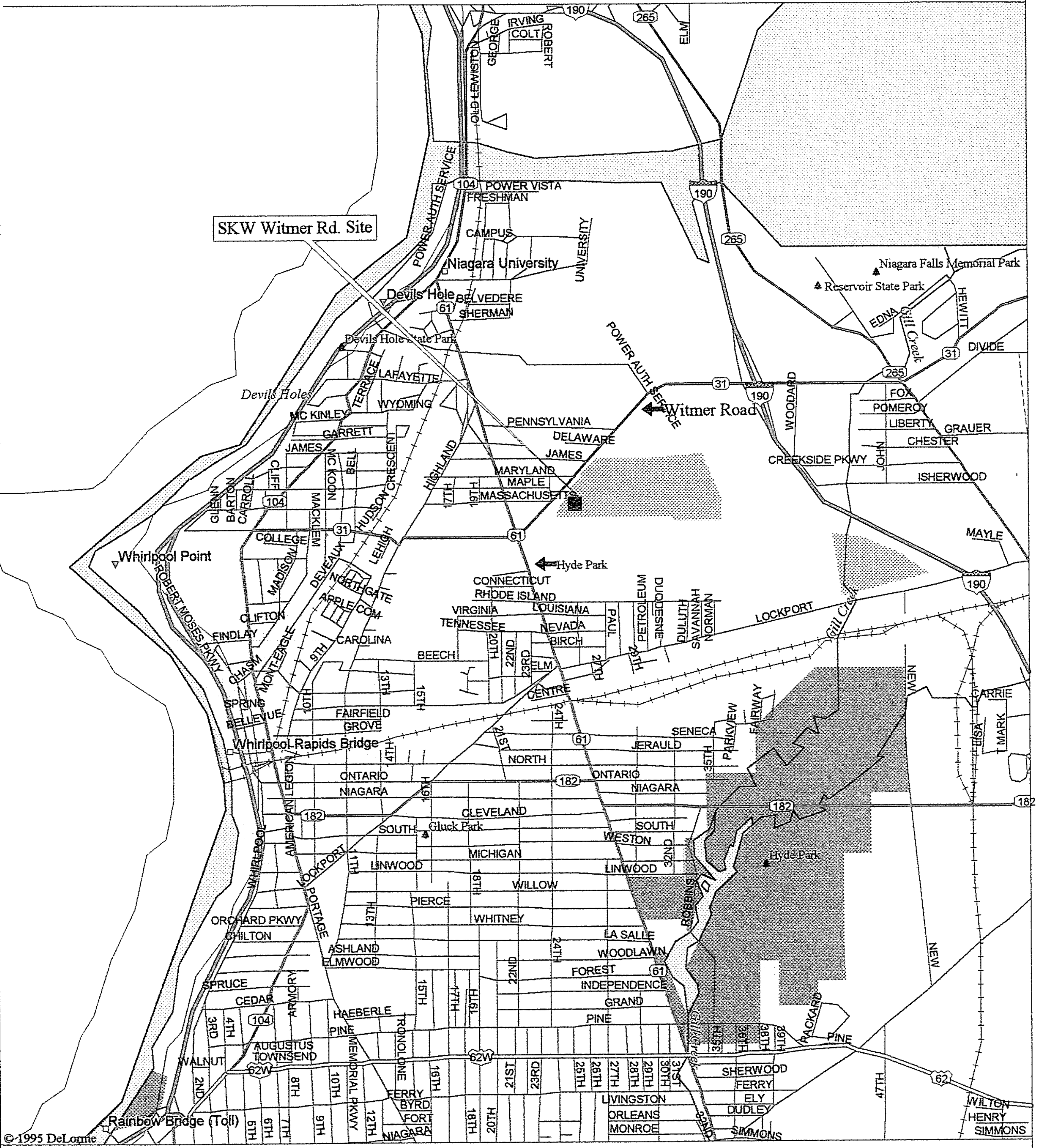
Guy D. Van Doren, P.E.
NY License No. 57203

FIGURES

Figure 2-1

Site Location Map

SKW Property Location Map



Mag 14.00

Tue Nov 02 13:00 1999

Scale 1:31,250 (at center)

2000 Feet

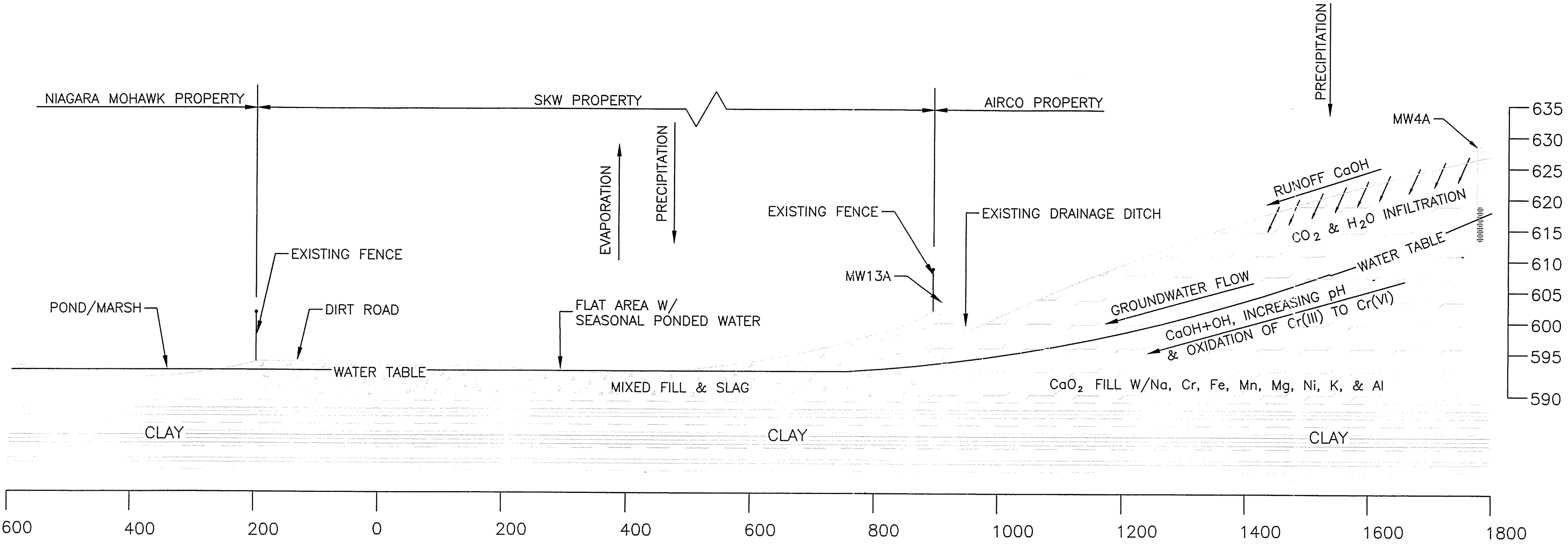
1000 Meters

— Secondary SR, Road, Hwy Ramp

▬ State Route

Figure 6-1

Conceptual Flow of Shallow Groundwater



CONCEPTUAL FLOW OF SHALLOW GROUNDWATER

SCALE – NONE

SKW METALS & ALLOYS, INC., NIAGARA FALLS, NEW YORK

REVISION :

DATE : 02/16/99

CHECKED : HHH

DRAWN : T JONES

SCALE : PLOT 1:200

LAN ASSOCIATES INC.
environmental and facilities engineering
662 GOFFLE ROAD, HAWTHORNE, NJ 07506-3499 (201) 423-0350

JOB NO. 2.3269.22

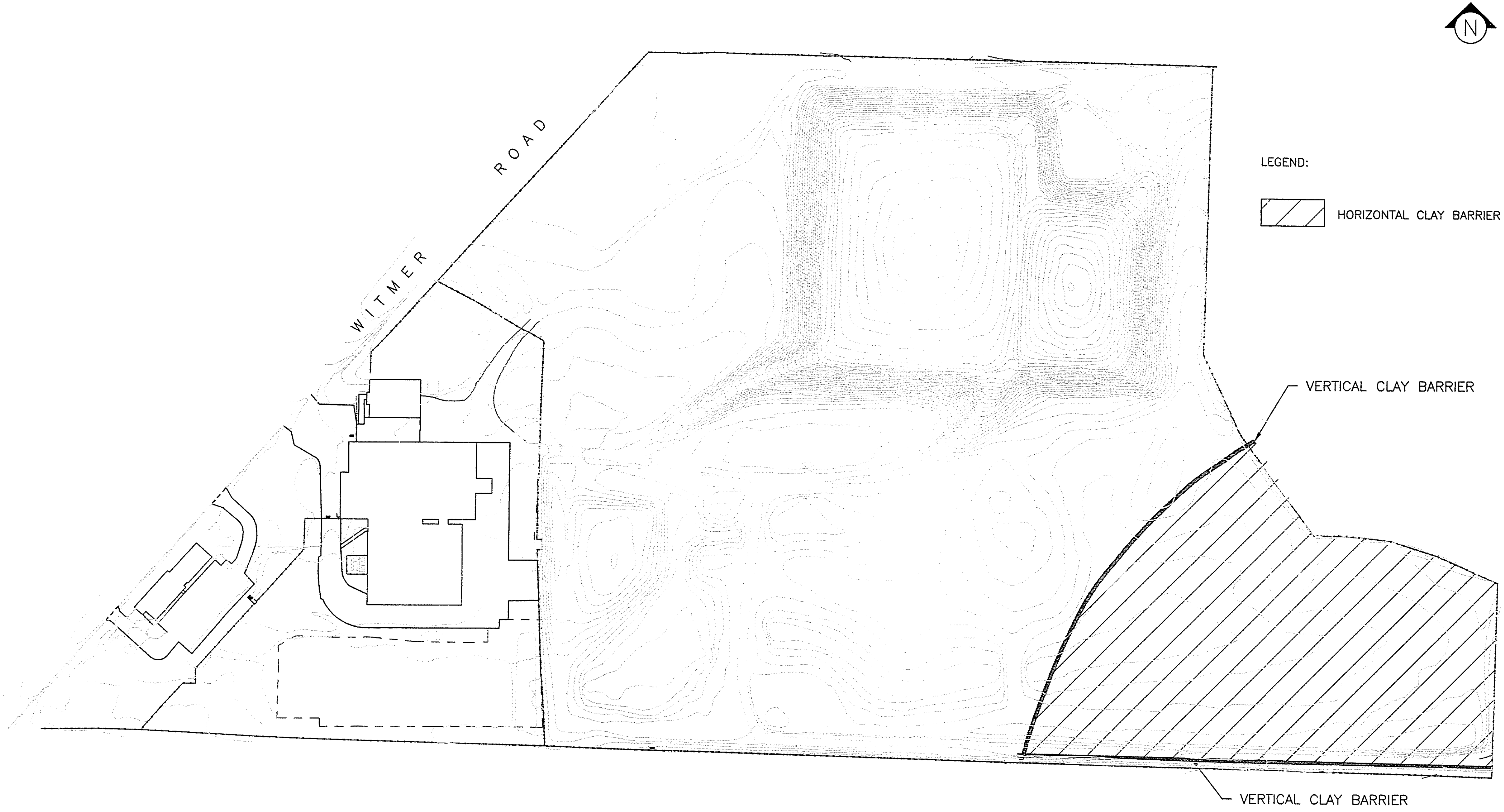
DWG. FILE CODE 326922022

FIGURE NO. 6–1

Sht. 1 of 1

Figure 8-1

Location Map of Clay Barrier & Vertical Clay Walls



SITE PLAN – LOCATION OF CLAY BARRIER & VERTICAL CLAY WALLS

SCALE (FT): 100 0 50 100 200 300

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

NOTE:
DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 7235S1 THRU 7235S4

REVISION :

DATE : 02/16/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1:150

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JOB NO. 2.3269.22
DWG. FILE CODE 326922024
FIGURE NO. 8–1
Sht. 1 of 1

Figure 8-2

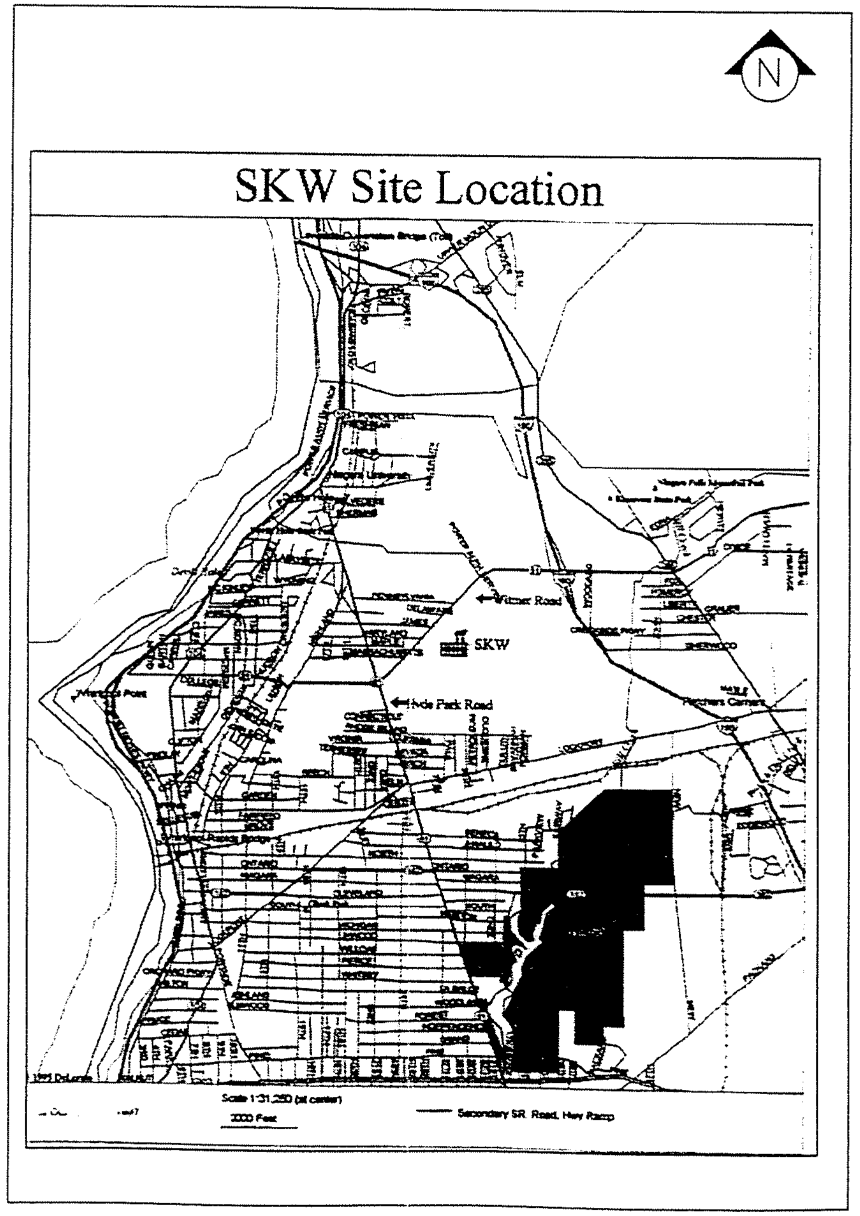
Site Location Map

SKW Metals & Alloys, Inc.

Witmer Road Site – Property Improvements

LIST OF DRAWINGS

SHEET NO.	DRAWING NO.	DESCRIPTION
1	T-1	TITLE SHEET
2	S-1	SITE PLAN – EXISTING TOPOGRAPHY
3	S-2	SITE PLAN – NEW SITE TOPOGRAPHY
4	S-3	SITE PLAN– AREA OF ADDITIONAL SUB-GRADE REMOVAL/RELOCATION
5	S-4	SITE PLAN – DEPTH STAKE LAYOUT
6	D-1	SECTIONS & DETAILS



Revisions :

Date : 09/27/97
Checked : GVD
Drawn : T JONES
Scale : PLOT 1:50

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SKW METALS & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

WITMER ROAD SITE – PROPERTY IMPROVEMENTS
TITLE SHEET

GUY D. VAN DOREN, P.E.
LICENSE NO. NY 57203

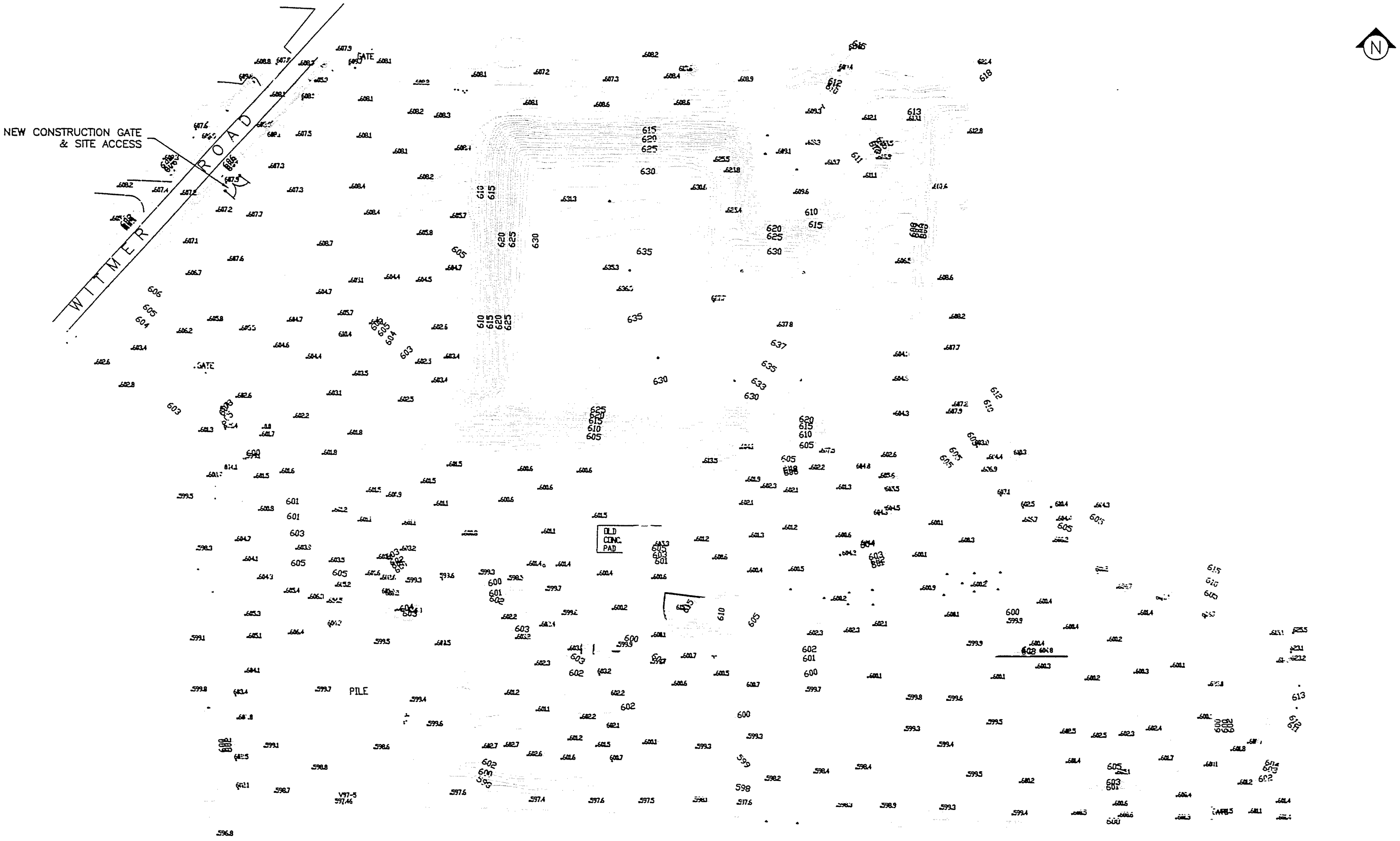
Dwg. File No. 3269641
Job No. 2.3269.6

T–1

Dwg. 1 of 6

Figure 8-3

Existing Topography



SITE PLAN – EXISTING TOPOGRAPHY

SCALE – 0 50 100 200

NOTE:
1) DRAWING BASED ON AERIAL PHOTOGRAPH BY LOCKWOOD MAPPING OF ROCHESTER, NY MARCH 17, 1996
2) DATUM –
VERTICAL = NGVD29
HORIZONTAL = NAD83
3) CONTOUR INTERVALS AT 1'-0", U.N.O.

Revisions :

Date : 08/27/97
Checked : GVD
Drawn : T JONES
Scale : PLOT 1:80

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SKW METAL & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

WITMER ROAD SITE – PROPERTY IMPROVEMENTS
EXISTING TOPOGRAPHY

GUY D. VAN DOREN, P.E.
LICENSE NO. NY 57203

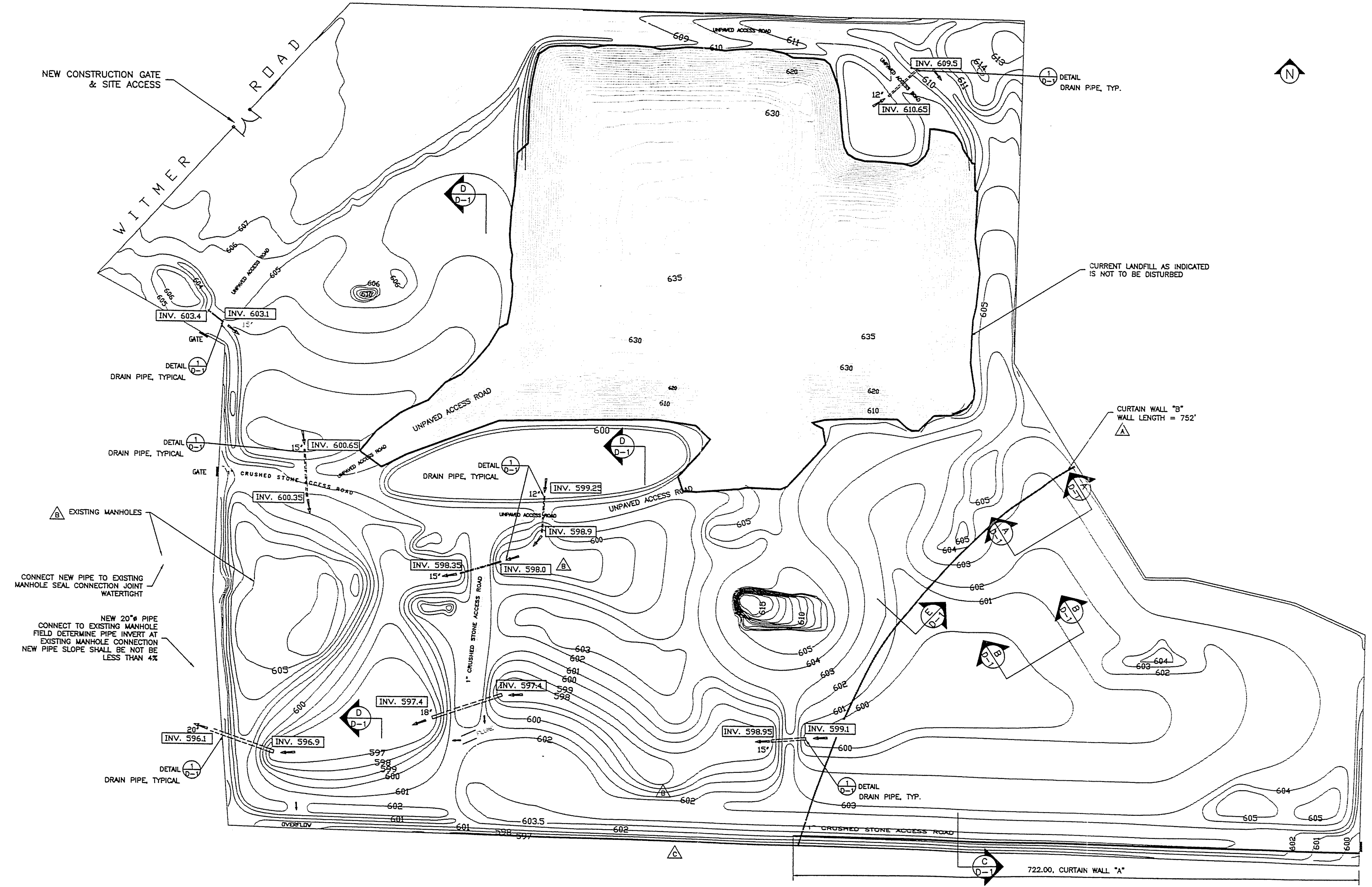
Dwg. File No. 3269636
Job No. 2.3269.6

S–1

Dwg. 2 of 6

Figure 8-4

New Surface Topography



SITE PLAN – NEW SURFACE TOPOGRAPHY

SCALE: 0 50 100

NOTE:
DRAWING BASED ON AERIAL PHOTOGRAPH BY LOCKWOOD MAPPING OF ROCHESTER, NY MARCH 17, 1996

Revisions :
A ADD'D CURTAIN WALL B T JONES 05/19/98
B REMOVED PIPE REVS'D INVERT T JONES 07/08/98
C REVS'D TOPO T JONES 07/08/98

Date : 08/27/97
Checked : GVD
Drawn : T JONES
Scale : PLOT 1:60

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SKW METALS & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

WITMER ROAD SITE – PROPERTY IMPROVEMENTS
NEW SITE TOPOGRAPHY

GUY D. VAN DOREN, P.E.
LICENSE NO. NY 57203

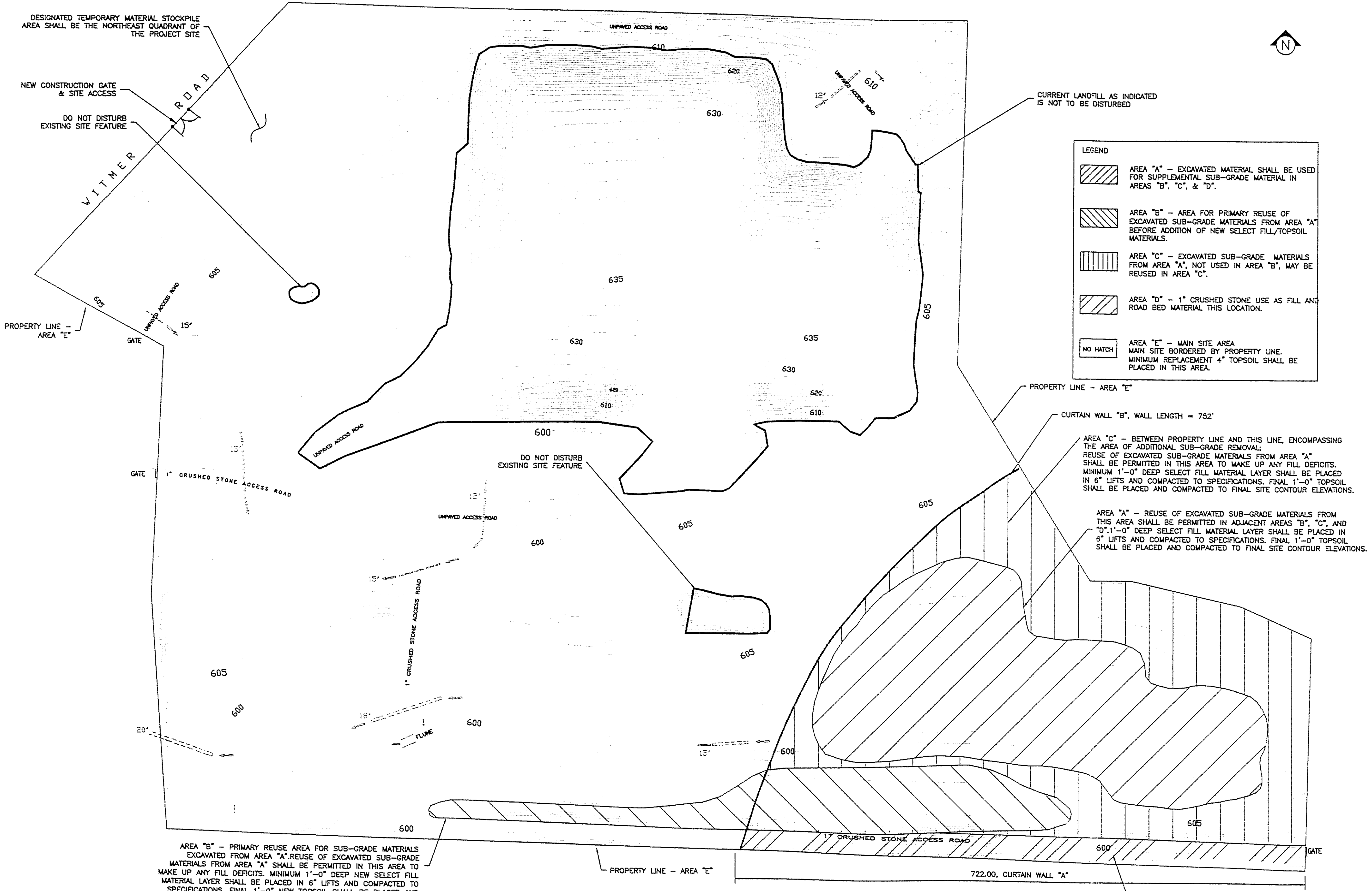
Dwg. File No. 3269637
Job No. 2.3269.6

S–2

Dwg. 3 of 6

Figure 8-5

Areas of Additional Subgrade Removal/Relocation



DESIGNATED TEMPORARY MATERIAL STOCKPILE AREA SHALL BE THE NORTHEAST QUADRANT OF THE PROJECT SITE

NEW CONSTRUCTION GATE & SITE ACCESS

DO NOT DISTURB EXISTING SITE FEATURE

CURRENT LANDFILL AS INDICATED IS NOT TO BE DISTURBED

LEGEND	
▨	AREA "A" - EXCAVATED MATERIAL SHALL BE USED FOR SUPPLEMENTAL SUB-GRADE MATERIAL IN AREAS "B", "C", & "D".
▧	AREA "B" - AREA FOR PRIMARY REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM AREA "A" BEFORE ADDITION OF NEW SELECT FILL/TOPSOIL MATERIALS.
▥	AREA "C" - EXCAVATED SUB-GRADE MATERIALS FROM AREA "A", NOT USED IN AREA "B", MAY BE REUSED IN AREA "C".
▨	AREA "D" - 1" CRUSHED STONE USE AS FILL AND ROAD BED MATERIAL THIS LOCATION.
NO HATCH	AREA "E" - MAIN SITE AREA MAIN SITE BORDERED BY PROPERTY LINE. MINIMUM REPLACEMENT 4" TOPSOIL SHALL BE PLACED IN THIS AREA.

PROPERTY LINE - AREA "E"

CURTAIN WALL "B", WALL LENGTH = 752'

AREA "C" - BETWEEN PROPERTY LINE AND THIS LINE, ENCOMPASSING THE AREA OF ADDITIONAL SUB-GRADE REMOVAL; REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM AREA "A" SHALL BE PERMITTED IN THIS AREA TO MAKE UP ANY FILL DEFICITS. MINIMUM 1'-0" DEEP SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'-0" TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

AREA "A" - REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM THIS AREA SHALL BE PERMITTED IN ADJACENT AREAS "B", "C", AND "D".1'-0" DEEP SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'-0" TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

AREA "B" - PRIMARY REUSE AREA FOR SUB-GRADE MATERIALS EXCAVATED FROM AREA "A".REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM AREA "A" SHALL BE PERMITTED IN THIS AREA TO MAKE UP ANY FILL DEFICITS. MINIMUM 1'-0" DEEP NEW SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'-0" NEW TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

AREA "D" - 1" CRUSHED STONE USED AS FILL AND ROAD BED MATERIAL THIS LOCATION ONLY. MINIMUM 4" DEEP STONE LAYER SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

NOTE:
DRAWING BASED ON AERIAL PHOTOGRAPH BY LOCKWOOD MAPPING OF ROCHESTER, NY MARCH 17, 1996

SITE PLAN - AREAS OF SUBGRADE REMOVAL/RELOCATION

SCALE: 0 50 100

Revisions :
A ADD'D CURT WALL "B" REV. NOTE FOR CURT WALL "A" T JONES 5/19/98
B REMOVED PIPE T JONES 07/08/98

Date : 08/28/97
Checked : GVD
Drawn : T JONES
Scale : 1:60

LAN ASSOCIATES INC.
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SKW METALS & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

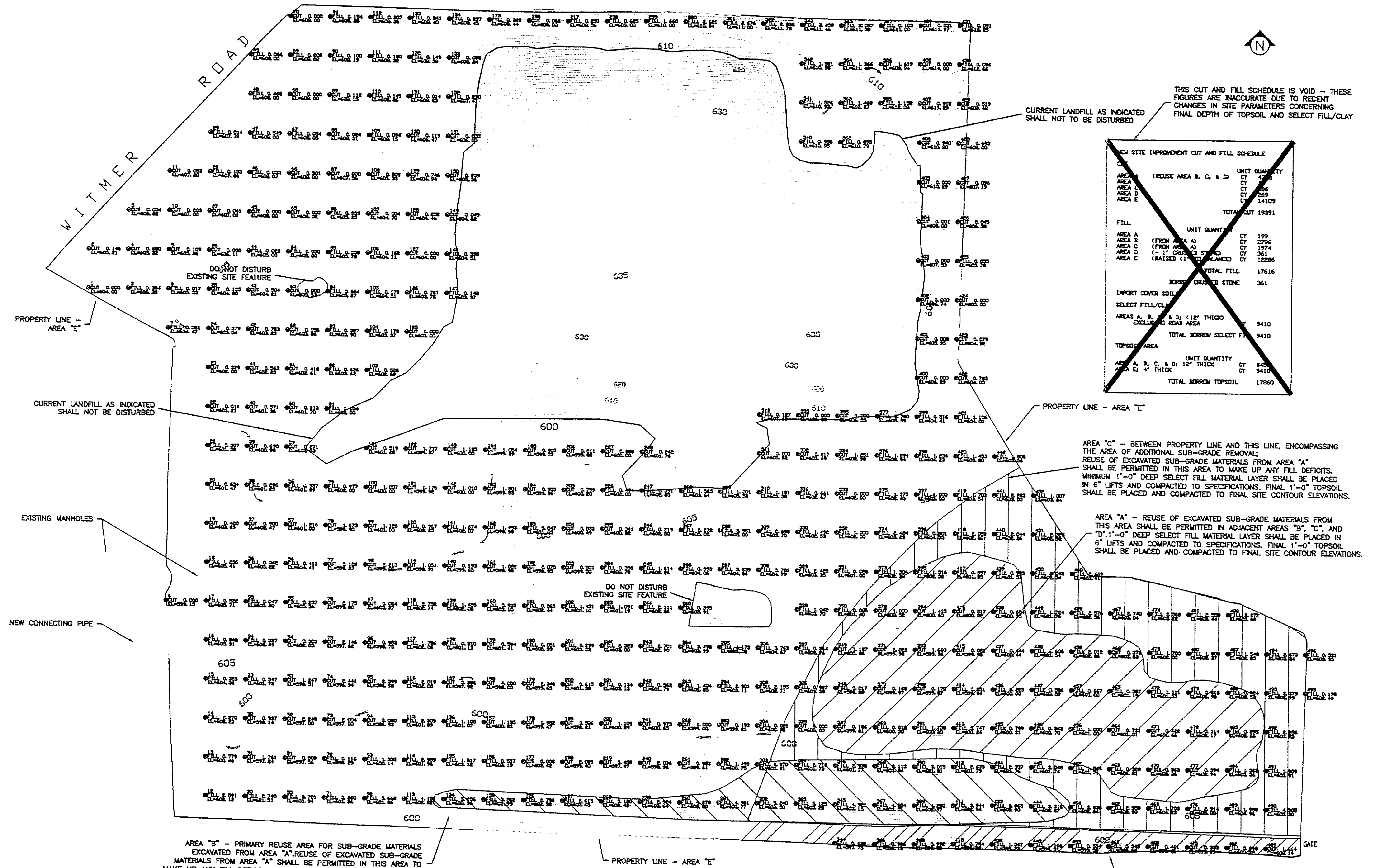
WITMER ROAD SITE - PROPERTY IMPROVEMENTS
AREAS OF ADDITIONAL SUBGRADE REMOVAL/RELOCATION

GUY VAN DOREN, P.E.
LICENSE NO. NY 57203

Dwg. File No. 3269638
Job No. 2.3269.6
S-3
Dwg. 4 of 6

Figure 8-6

Depth Stake Layout



PROPERTY LINE – AREA "E"

CURRENT LANDFILL AS INDICATED SHALL NOT BE DISTURBED

DO NOT DISTURB EXISTING SITE FEATURE

EXISTING MANHOLES

NEW CONNECTING PIPE

CURRENT LANDFILL AS INDICATED SHALL NOT TO BE DISTURBED

THIS CUT AND FILL SCHEDULE IS VOID – THESE FIGURES ARE INACCURATE DUE TO RECENT CHANGES IN SITE PARAMETERS CONCERNING FINAL DEPTH OF TOPSOIL AND SELECT FILL/CLAY

~~NEW SITE IMPROVEMENT CUT AND FILL SCHEDULE~~

~~CUT~~

		UNIT	QUANTITY
~~AREA A~~	~~(REUSE AREA B, C, & D)~~	~~CY~~	~~47[illegible]~~
~~AREA [illegible]~~		~~CY~~	[illegible]
~~AREA C~~		~~CY~~	~~[illegible]86~~
~~AREA D~~		~~CY~~	~~269~~
~~AREA E~~		~~CY~~	~~14109~~
	~~TOTAL CUT~~		~~19391~~

~~FILL~~

		UNIT	QUANTITY
~~AREA A~~		~~CY~~	~~199~~
~~AREA B~~	~~(FROM AREA A)~~	~~CY~~	~~2796~~
~~AREA C~~	~~(FROM AREA A)~~	~~CY~~	~~1974~~
~~AREA D~~	~~(– 1" CRUSHED STONE)~~	~~CY~~	~~361~~
~~AREA E~~	~~(RAISED <1' [illegible] BALANCED)~~	~~CY~~	~~12286~~
	~~TOTAL FILL~~		~~17616~~
	~~BORROW CRUSHED STONE~~		~~361~~

~~IMPORT COVER SOIL~~

~~SELECT FILL/CLAY~~

~~AREAS A, B, [illegible] & D; (12" THICK) EXCLUDING ROAD AREA~~		~~CY~~	~~9410~~
	~~TOTAL BORROW SELECT FILL~~		~~9410~~

~~TOPSOIL AREA~~

		UNIT	QUANTITY
~~AREA A, B, C, & D; 12" THICK~~		~~CY~~	~~845[illegible]~~
~~AREA E; 4" THICK~~		~~CY~~	~~9410~~
	~~TOTAL BORROW TOPSOIL~~		~~17860~~

AREA "C" – BETWEEN PROPERTY LINE AND THIS LINE, ENCOMPASSING THE AREA OF ADDITIONAL SUB-GRADE REMOVAL: REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM AREA "A" SHALL BE PERMITTED IN THIS AREA TO MAKE UP ANY FILL DEFICITS. MINIMUM 1'–0" DEEP SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'–0" TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

AREA "A" – REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM THIS AREA SHALL BE PERMITTED IN ADJACENT AREAS "B", "C", AND "D".1'–0" DEEP SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'–0" TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

AREA "B" – PRIMARY REUSE AREA FOR SUB-GRADE MATERIALS EXCAVATED FROM AREA "A".REUSE OF EXCAVATED SUB-GRADE MATERIALS FROM AREA "A" SHALL BE PERMITTED IN THIS AREA TO MAKE UP ANY FILL DEFICITS. MINIMUM 1'–0" DEEP NEW SELECT FILL MATERIAL LAYER SHALL BE PLACED IN 6" LIFTS AND COMPACTED TO SPECIFICATIONS. FINAL 1'–0" NEW TOPSOIL SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

PROPERTY LINE – AREA "E"

AREA "D" – 1" CRUSHED STONE USED AS FILL AND ROAD BED MATERIAL THIS LOCATION ONLY. MINIMUM 4" DEEP STONE LAYER SHALL BE PLACED AND COMPACTED TO FINAL SITE CONTOUR ELEVATIONS.

NOTE:
DRAWING BASED ON AERIAL PHOTOGRAPH BY LOCKWOOD MAPPING OF ROCHESTER, NY MARCH 17, 1996

SITE PLAN – DEPTH STAKE LAYOUT

SCALE: 0 50 100

Revisions :
A REVISED NOTES AREAS A–E TJ 12/19/97
B VOID SCHEDULE TJ 05/19/98
C REMOVED PIPE TJ 07/08/98

Date : 08/27/97
Checked : GVD
Drawn : T JONES
Scale : PLOT 1:60

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SKW METALS & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

WITMER ROAD SITE– PROPERTY IMPROVEMENTS
DEPTH STAKE LAYOUT

GUY D. VAN DOREN, P.E.
LICENSE NO. NY 57203

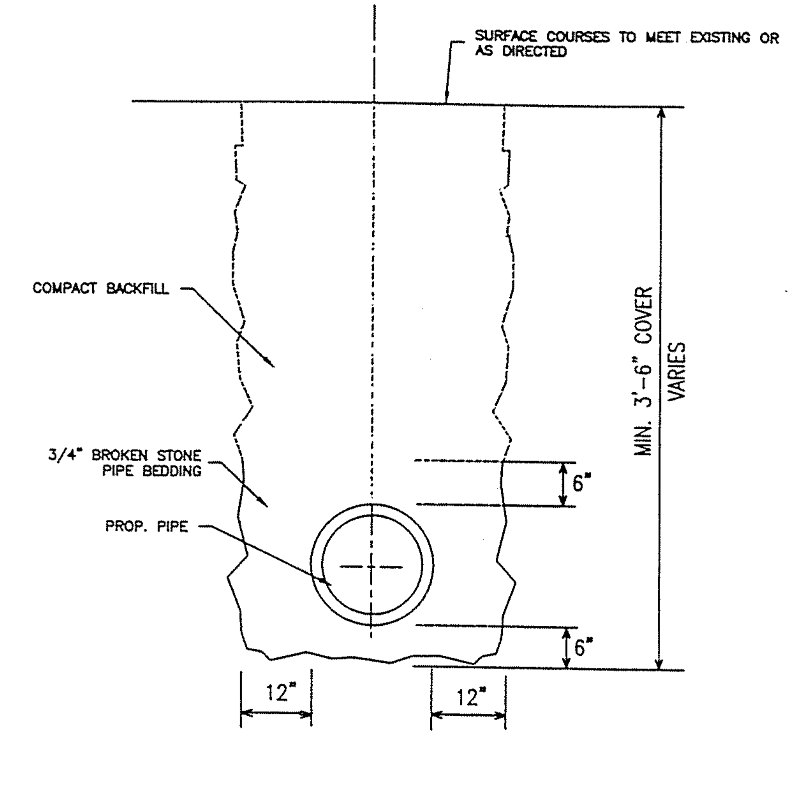
Dwg. File No. 3269639
Job No. 2.3269.6

S–4

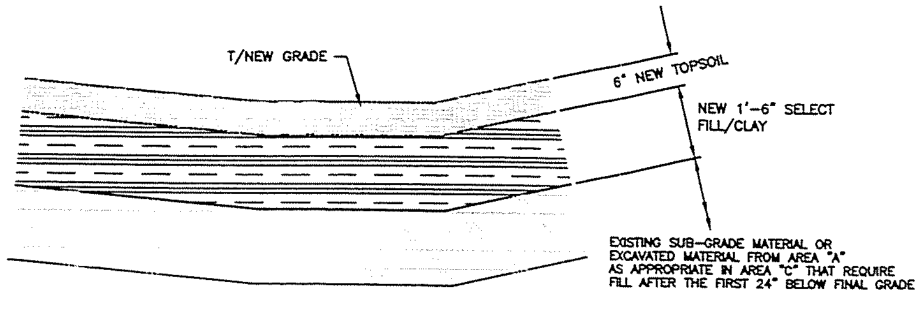
Dwg. 5 of 6

Figure 8-7

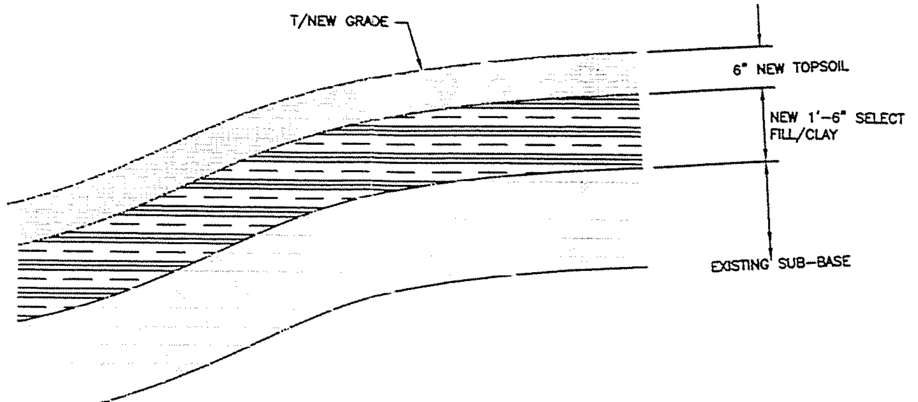
Section Detail



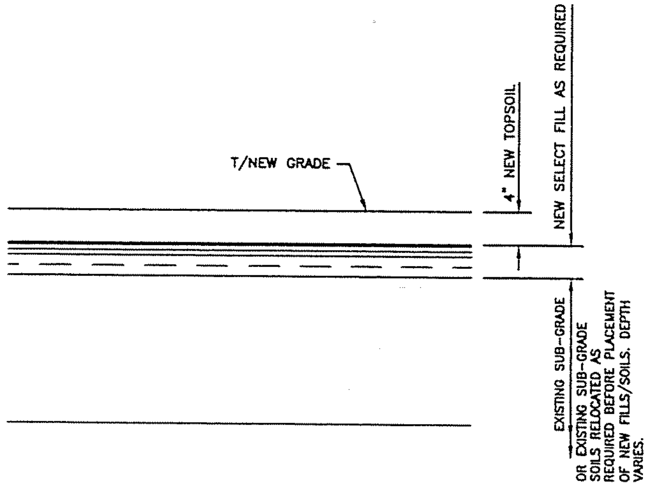
1 / S-2 DETAIL – PIPE TRENCH
SCALE – NONE



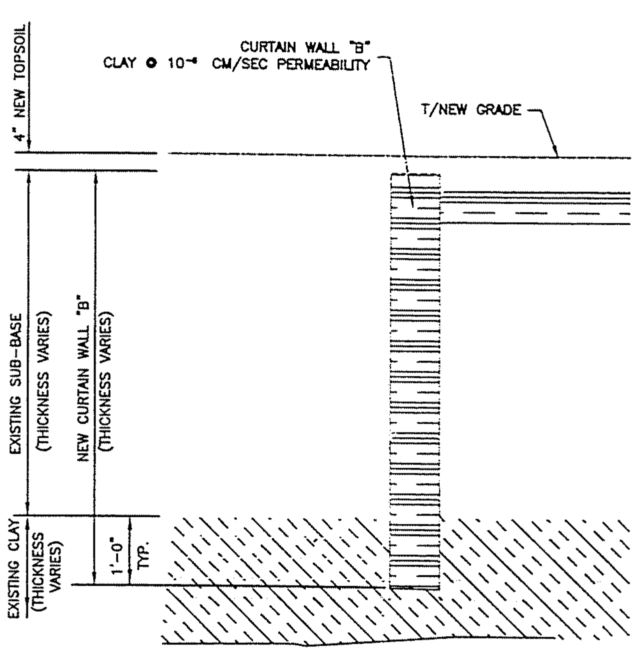
A–A / S-2 SECTION VIEW
SCALE – NONE



B–B / S-2 SECTION VIEW
SCALE – NONE



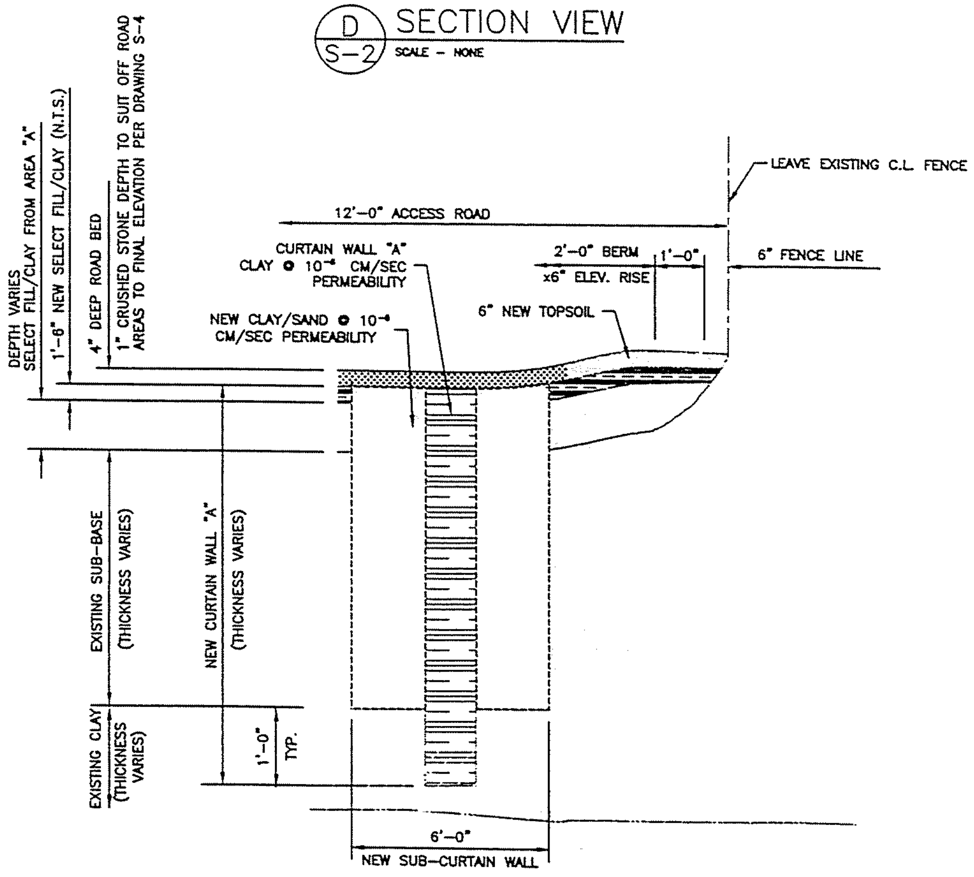
D / S-2 SECTION VIEW
SCALE – NONE



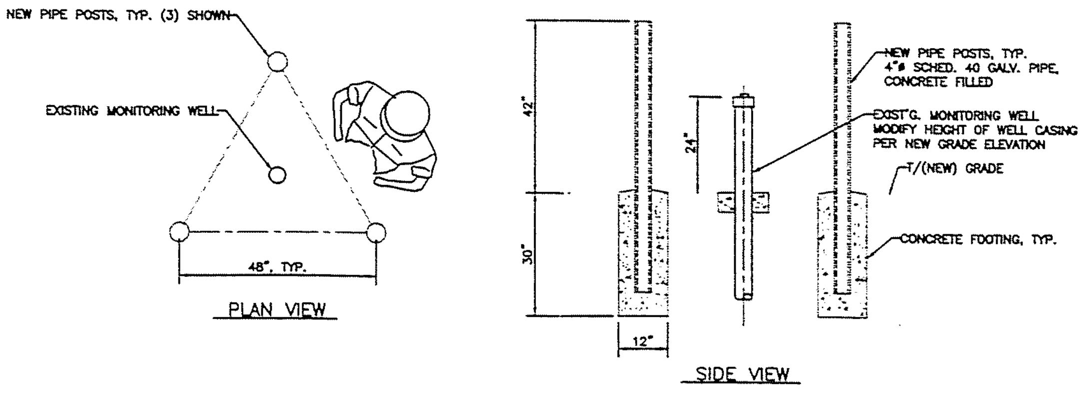
E / S-2 SECTION VIEW
SCALE – NONE

GENERAL NOTES:

1. ALL WORK SHALL COMPLY WITH THE RULES AND REGULATIONS OF ALL GOVERNMENTAL AGENCIES HAVING JURISDICTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VISITING THE SITE AND FAMILIARIZING HIMSELF WITHE THE EXISTING CONDITIONS PRIOR TO BIDDING.
3. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL SAFE WORKING CONDITIONS AND SHALL OBSERVE ALL SAFETY REQUIREMENTS ESTABLISHED BY JURISDICTIONAL AGENCIES AND THE OWNER. WHERE CONFLICTS EXIST, THE MORE STRINGENT REQUIREMENT SHALL APPLY. CARE SHALL BE EXERCISED TO AVOID ENDANGERING PERSONNEL OR STRUCTURES.
4. FURNISH ALL EQUIPMENT THAT MAY BE REQUIRED TO PERFORM THE WORK INDICATED IN A SAFE, ORDERLY, AND PROFESSIONAL MANNER.
5. ELEVATIONS AND DIMENSIONS SHOWN ARE FOR ENGINEERING PURPOSES; CONTRACTOR SHALL VERIFY ALL DIMENSIONS, CONDITIONS, AND ELEVATIONS IN THE FIELD.
6. THE CONTRACTOR SHALL REPAIR, AT NO ADDITIONAL COST TO THE OWNER, ANY AND ALL DAMAGE CAUSED DURING OR RESULTING FROM HIS OPERATION.
7. ALL WORK SHALL BE SCHEDULED IN COMPLIANCE WITH THE OWNER'S REQUIREMENTS FOR THE USE OF THE EXISTING FACILITY.
8. UPON COMPLETION OF WORK, ALL EXCESS MATERIAL, DEBRIS, ETC. SHALL BE REMOVED AND THE WORK AREA SHALL BE LEFT CLEAN TO THE OWNER'S SATISFACTION.
9. CONTRACTOR SHALL BE RESPONSIBLE TO COMPLY WITH ANY AND ALL PERMITS ASSOCIATED WITH THIS WORK. THE CONTRACTOR SHALL COORDINATE AND ASSIST THE ENGINEER AND AUTHORIZING AGENCIES IN PERFORMING INSPECTIONS AS REQUIRED.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE RELOCATION AND TEMPORARY SUPPORT OF ANY UTILITIES ENCOUNTERED.
11. THE UTILITY LOCATIONS, IF SHOWN, ON THE DRAWINGS ARE TAKEN FROM THE BEST AVAILABLE INFORMATION. ACTUAL LOCATIONS OF ALL UNDERGROUND UTILITIES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. WITH THE COOPERATION OF THE PUBLIC UTILITIES, SHALL LOCATED AND MARK OUT ANY UTILITY SERVICES OR MAINS WITHIN TWENTY (20') FEET OF THE PROPOSED EXCAVATION.
12. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR ALL EXCAVATION AND BACKFILL REQUIRED FOR THE PROJECT.



C / S-2 SECTION VIEW
SCALE – NONE



MONITORING WELL BOLLARD DETAIL

Revisions :
A 2/19/98
B REV SECT C/S2 ADD'D SECT E/S2 T JONES 5/18/98

Date : 08/28/97
Checked : GVD
Drawn : T JONES
Scale : PLOT 1/2=1'-0"

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SKW MEATAL & ALLOYS, INC.
NIAGARA FALLS, NEW YORK

WITMER ROAD SITE- PROPERTY IMPROVEMENTS
SECTIONS & DETAILS

GUY VAN DOREN, P.E.
LICENSE NO. NY 57203

Dwg. File No. 32696S40
Job No. 2.3269.6

D-1

Dwg. 6 of 6

Figure 8-8

As-Built Drawing

SITE PLAN – AS BUILT CONTOUR MAP

SCALE (FT): 100 0 50 100 200 300

NOTE:
DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 7235S1 THRU 7235S4

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

REVISION :

DATE : 02/16/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1"=150'

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JOB NO. 2.3269.22
DWG. FILE CODE 326922025
FIGURE NO. 8–8
Sht. 1 of 1

Figure 8-9

Before IRM Photograph

Vanadium Site - SKW Property

March 1995

Figure 8-10

After IRM Photograph

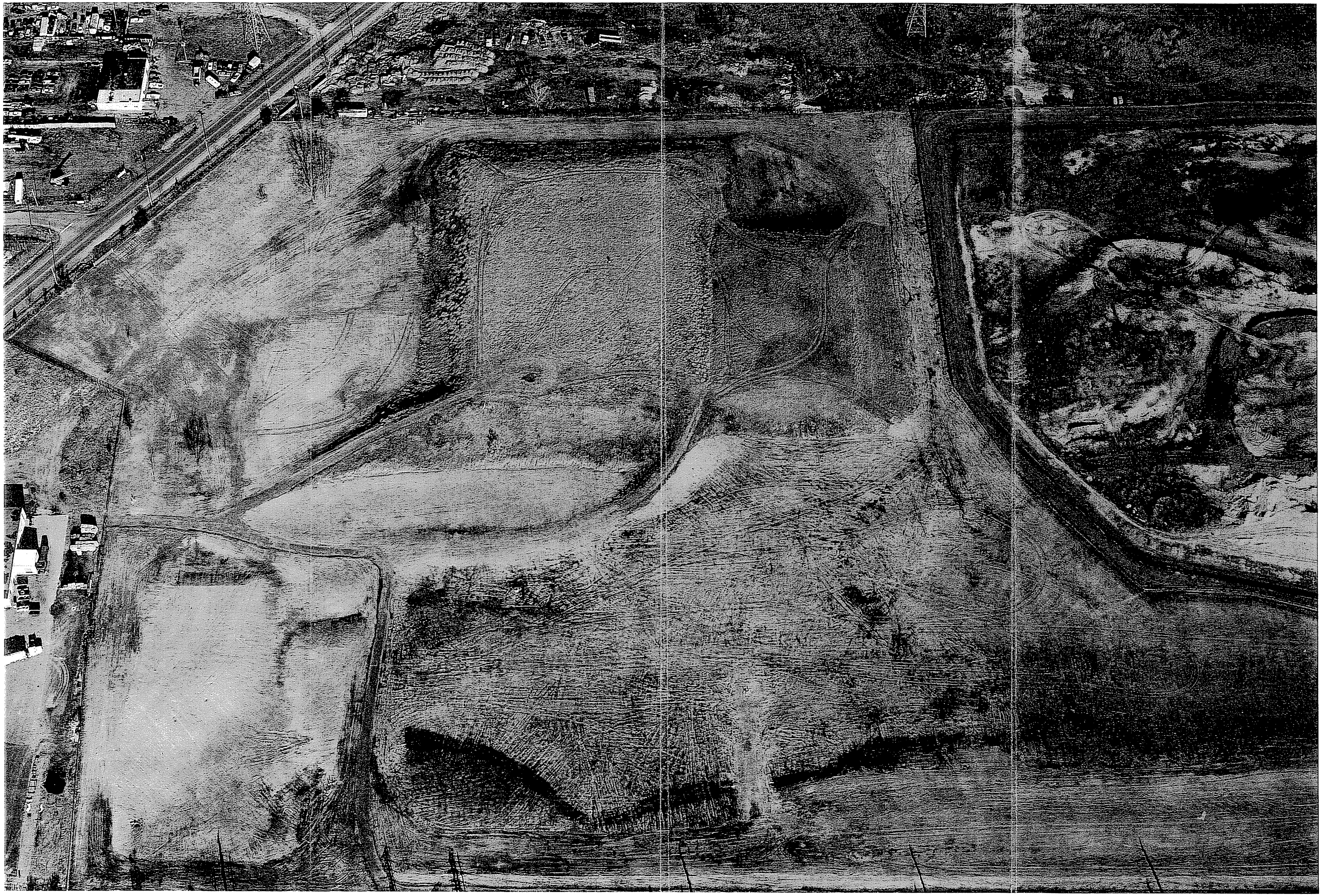
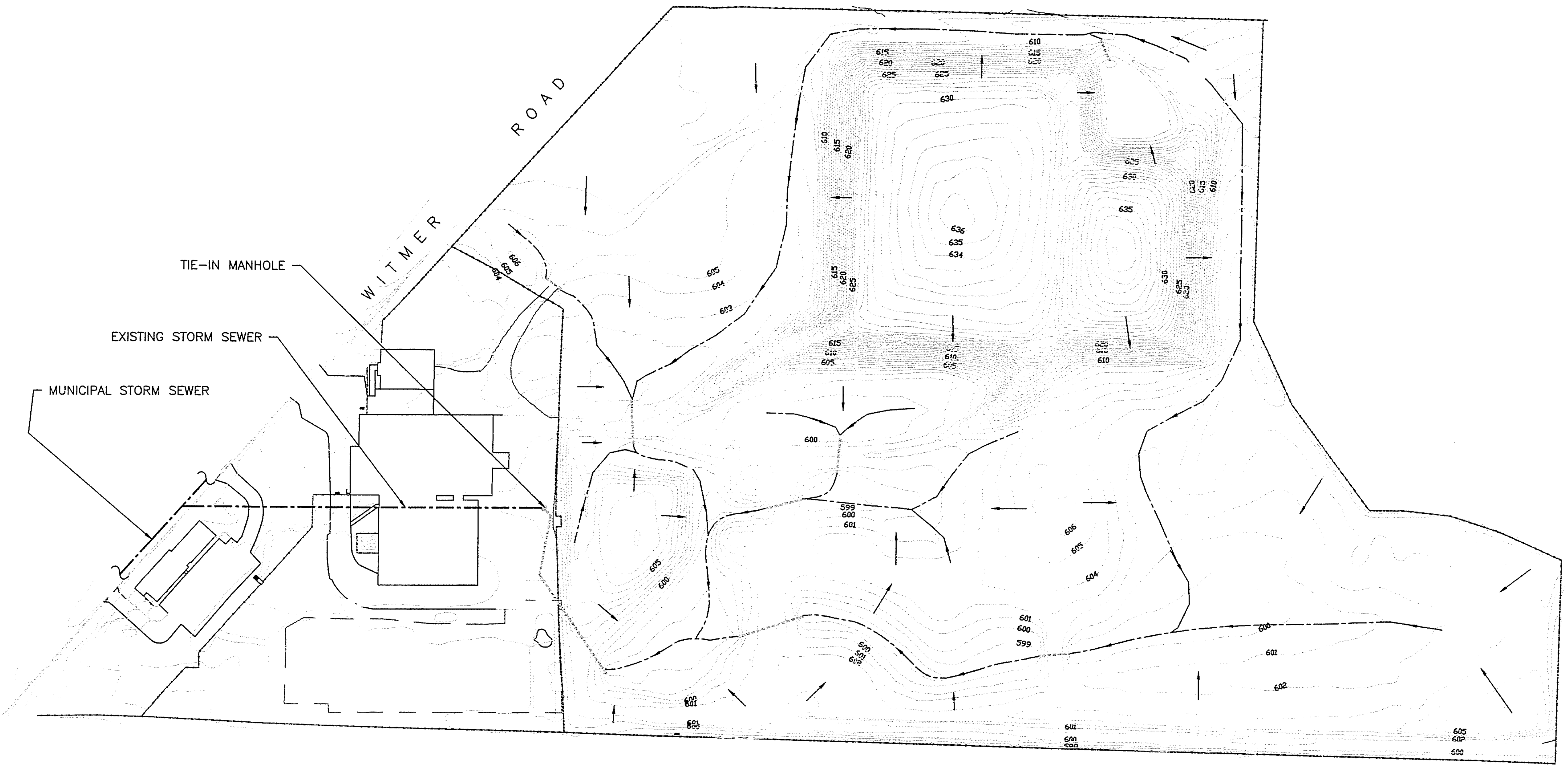


Figure 8-11

As Built Drainage Map



SITE PLAN – AS BUILT DRAINAGE MAP

SCALE (FT): 100 0 50 100 200 300

NOTE:
DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 6781S1 THRU 6781S11

REVISION :

DATE : 02/13/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1:150

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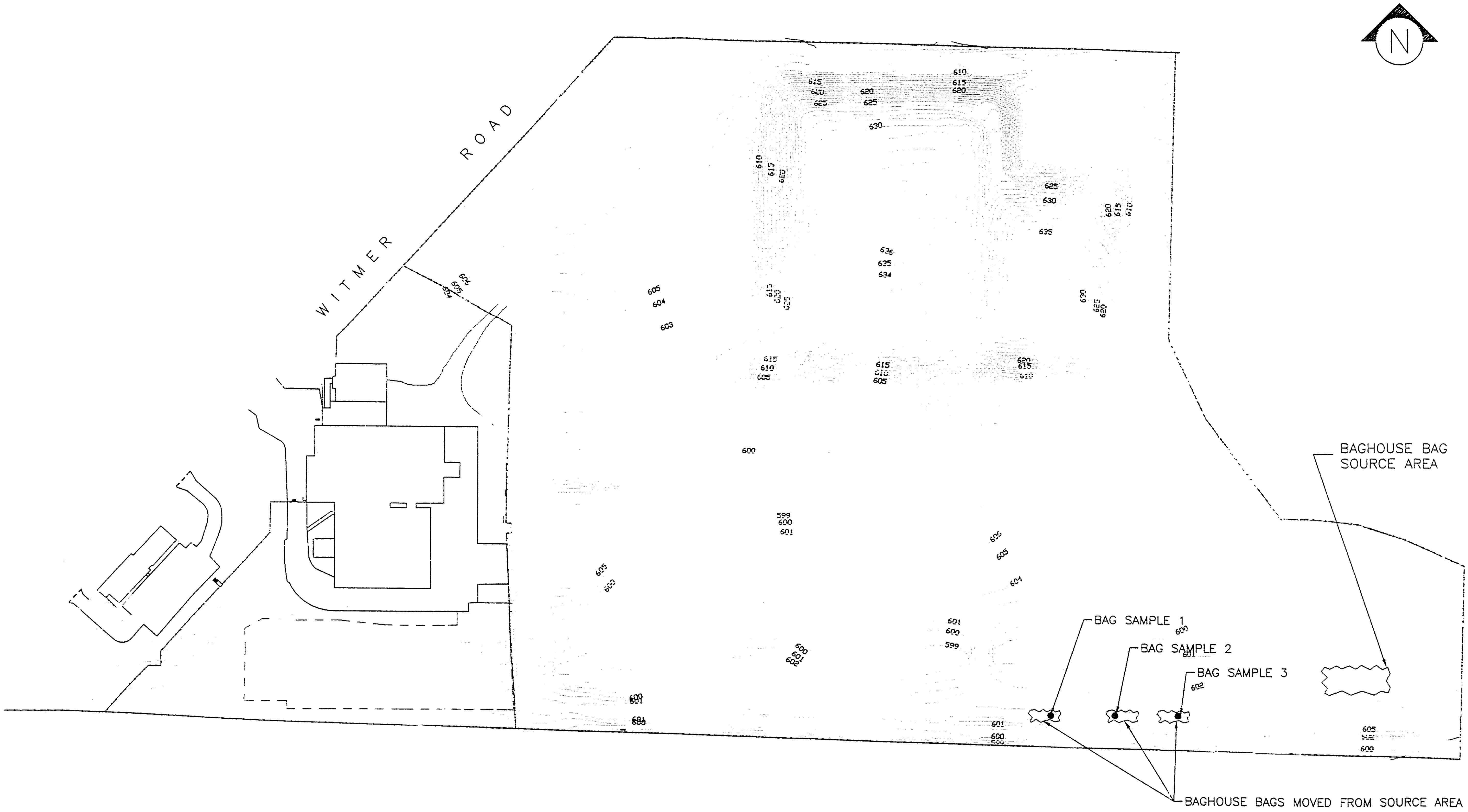
662 GOFFLE ROAD, HAWTHORNE, NJ 07506-3499 (201) 423-0350

JOB NO. 2.3269.22
DWG. FILE CODE 326922013
FIGURE NO. 8–11
Sht. 1 of 1

Figure 8-12

Phase II Baghouse Bag Location Map



SITE PLAN – PHASE II BAGHOUSE BAG LOCATION MAP

SCALE (FT): 100 0 50 100 200 300

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

NOTE:
1) DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 7235S1 THRU 7235S4

REVISION :

DATE : 02/16/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1"=150'

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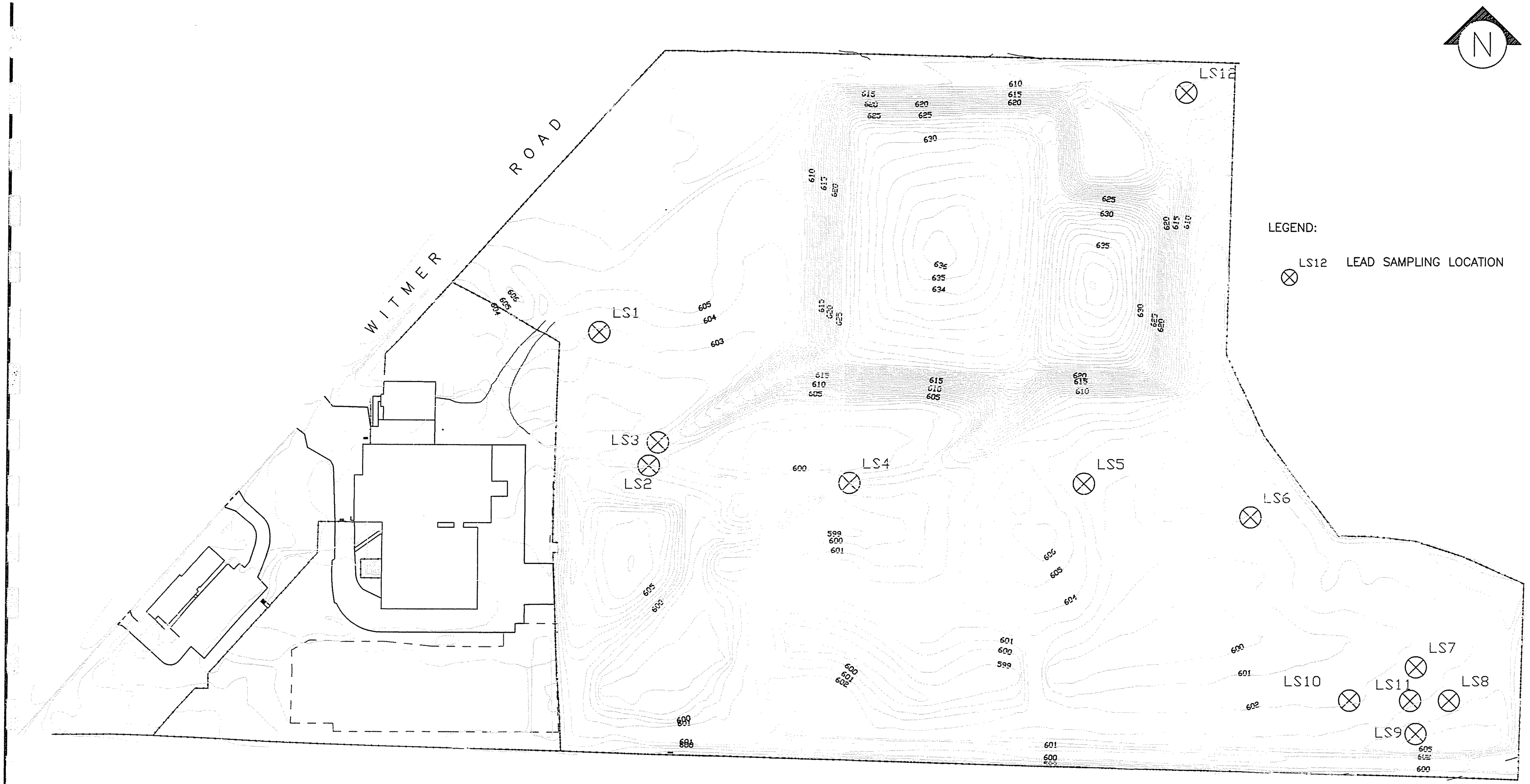
JOB NO. 2.3269.22
DWG. FILE CODE 326922026
FIGURE NO. 8-12
Sht. 1 of 1

Figure 8-13

Phase II Surface Soil Sampling Locations



SITE PLAN – PHASE II SURFACE SOIL SAMPLING LOCATIONS

SCALE (FT): 100 0 50 100 200 300

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

NOTE:
DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 6781S1 THRU 6781S11

REVISION :

DATE : 02/16/99

CHECKED : HHH

DRAWN : T JONES

SCALE : PLOT 1:150

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JOB NO. 2.3269.22

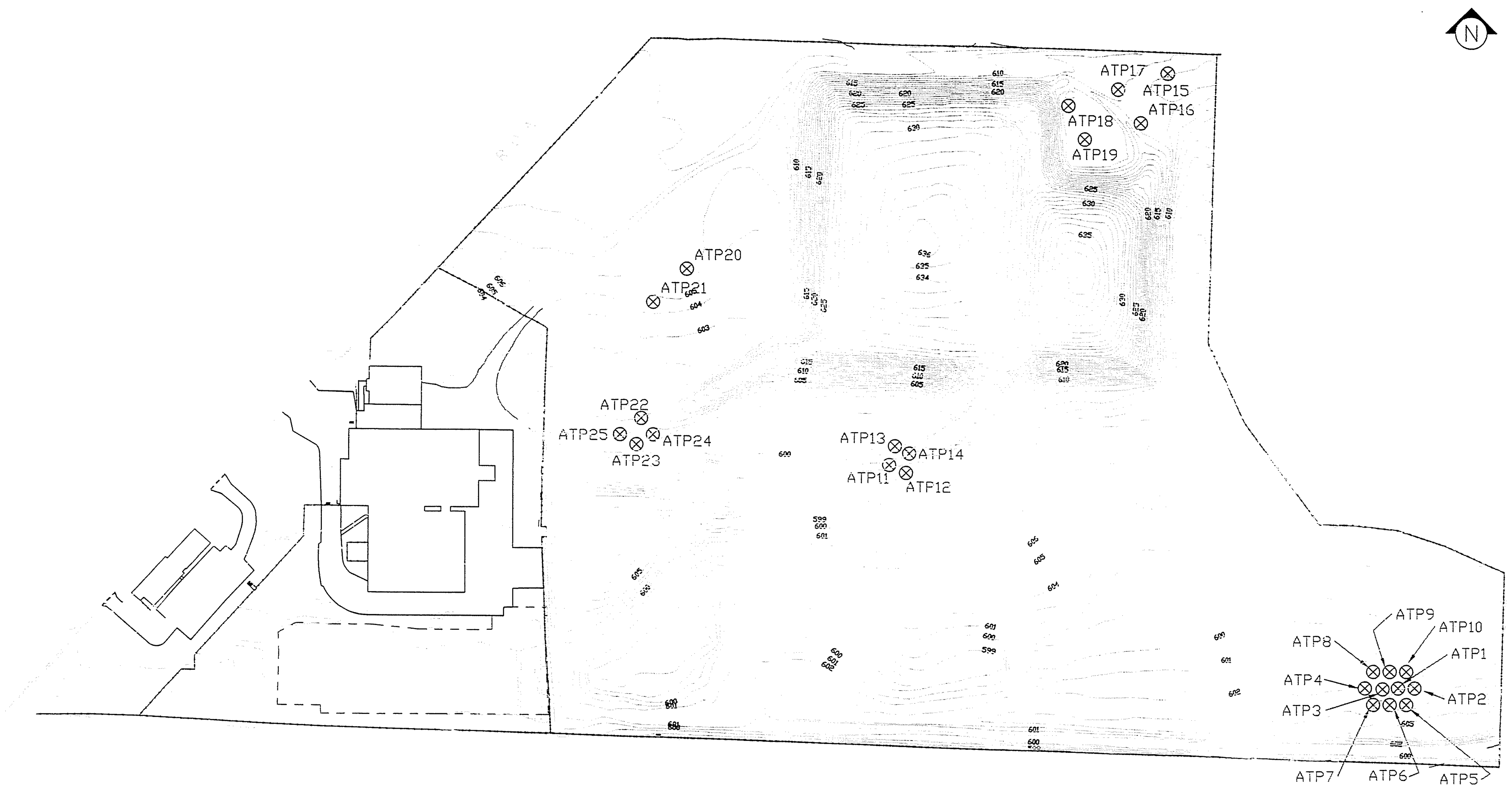
DWG. FILE CODE 326922027

FIGURE NO. 8–13

Sht. 1 of 1

Figure 8-14

Phase II Test Pit Location Map



SITE PLAN – PHASE II TEST PIT LOCATION MAP

SCALE (FT): 100 0 50 100 200 300

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NOTE:
DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 6781S1 THRU 6781S11

REVISION :

DATE : 02/16/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1:150

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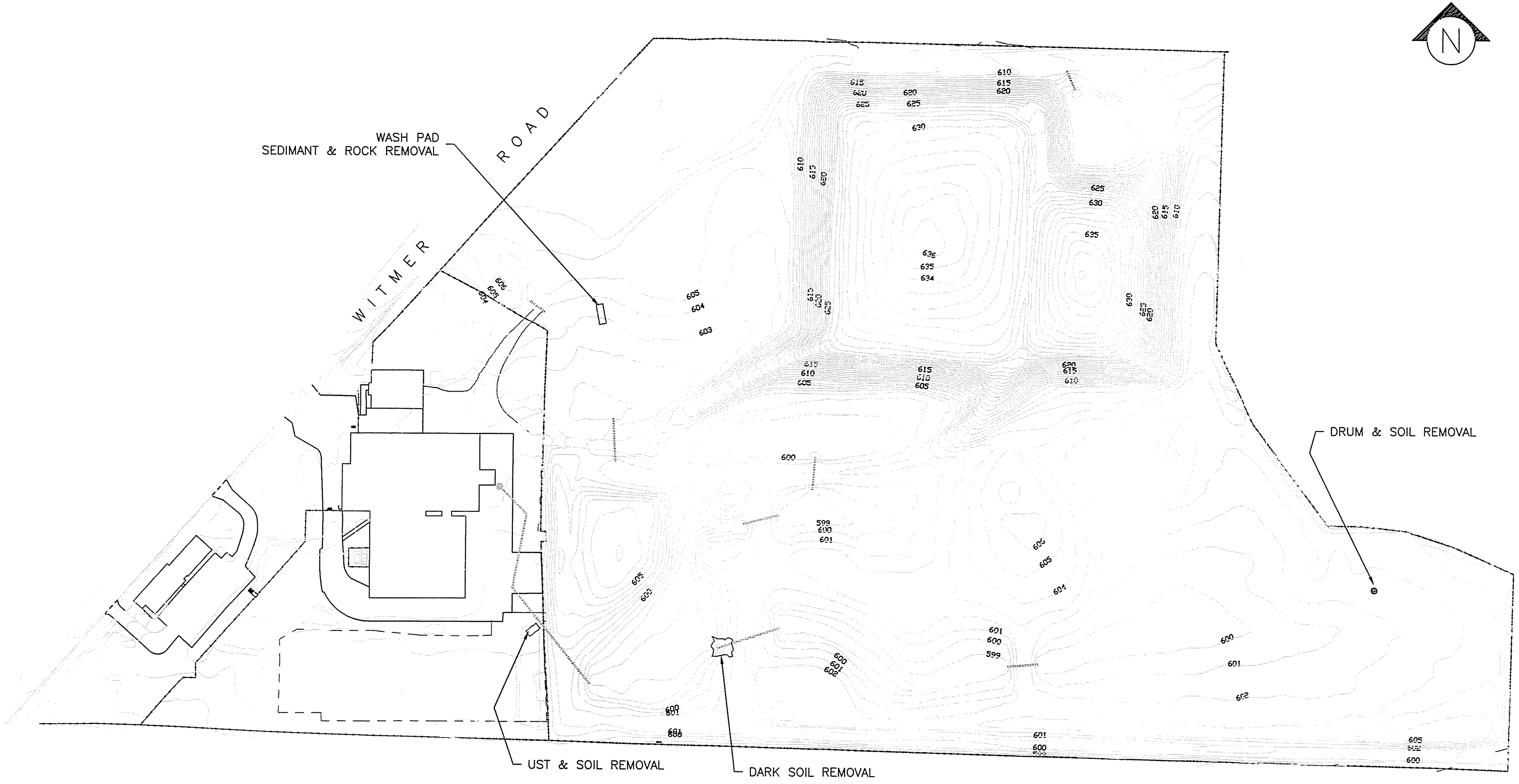
JOB NO. 2.3269.22
DWG. FILE CODE 326922008
FIGURE NO. 8–14
Sht. 1 of 1

Figure 8-15

Phase II Areas of Additional Investigations Location Map



SITE PLAN – PHASE II AREAS OF ADDITIONAL INVESTIGATIONS LOCATION MAP

SCALE (FT): 100 0 50 100 200 300

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

NOTE:
1) DRAWING BASED ON LOCKWOOD MAPPING, INC.
TOPOGRAPHIC SERIES 7235S1 THRU 7235S4

REVISION :

DATE : 02/16/99
CHECKED : HHH
DRAWN : T JONES
SCALE : PLOT 1"=150'

LAN ASSOCIATES INC.
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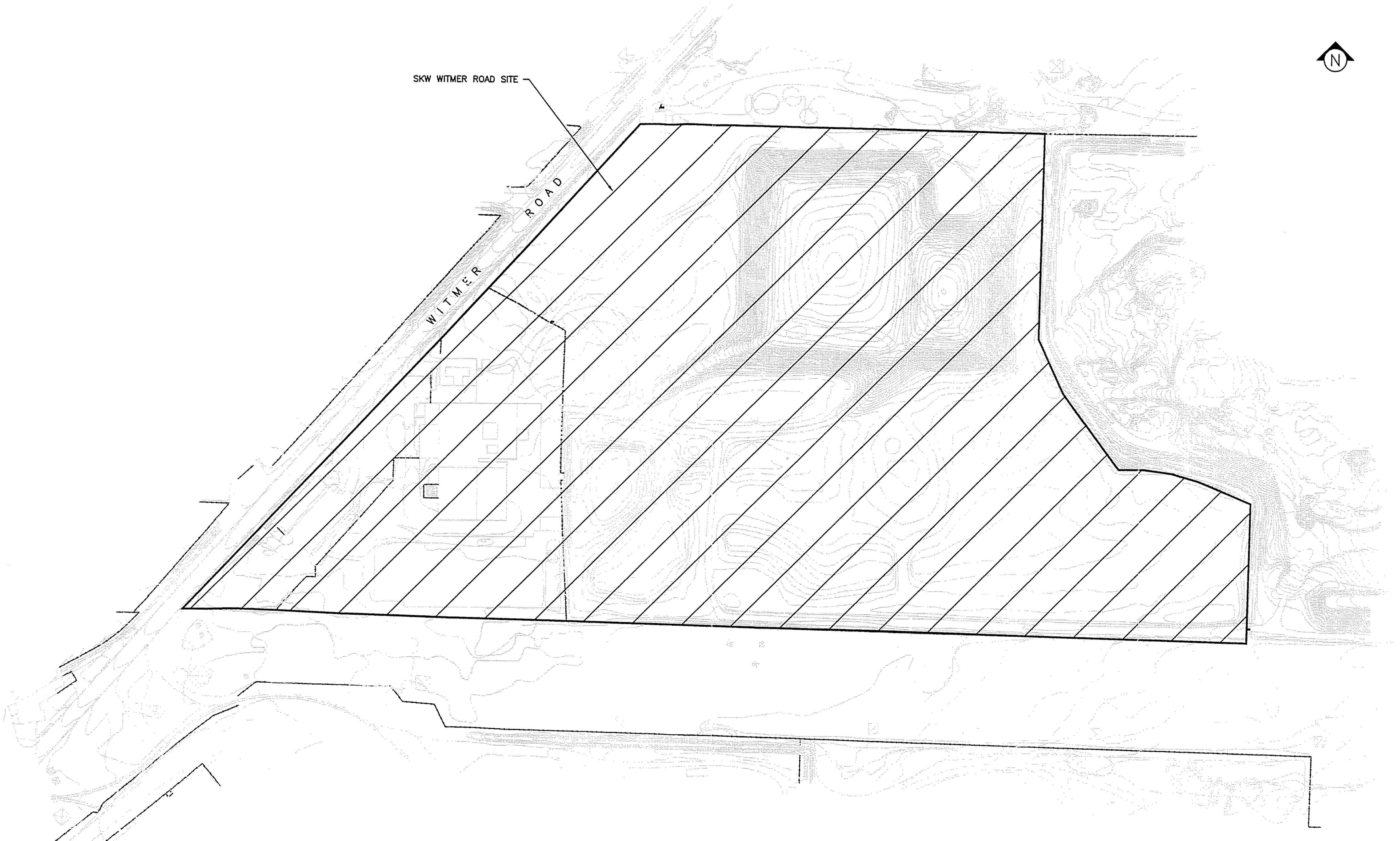
662 GOFFLE ROAD, HAWTHORNE, NJ 07506-3499 (201) 423-0350

JOB NO. 2.3269.22
DWG. FILE CODE 326922029
FIGURE NO. 8–15
Sht. 1 of 1

Figure 2-2

CCMA Property Map



SITE PLAN – PROPERTY LOCATION MAP

SCALE (FT): 100 0 50 100 200 300

SKW METALS & ALLOYS, INC – NIAGARA FALLS, NEW YORK

REVISION :

DATE : 02/15/99

CHECKED : HHH

DRAWN : T JONES

SCALE : PLOT 1:200

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environmental and facilities engineering
662 GOFFLE ROAD, HAWTHORNE, NJ 07506-3499 (201) 423-0350

JOB NO. 2.3269.22

DWG. FILE CODE 326922021

FIGURE NO. 2–2

Sht. 1 of 1

TABLES

Table 5-1

Ferrochromium and Ferrochromium Silicon Baghouse Dust Determination Criteria

Table 5-1

Ferrochromium & Ferrochromium Silicon Baghouse Dust Determination Criteria

Criteria 1. Documented Total Chromium Concentration (mg/kg)

Entity	Total Cr	Average Cr	Comments	Determination
EPA[1]	41 to 4,400	2,220	EPA found 41 ppm result erroneous	FeCr & FeCrSi dust conatins total chromium at 1,560 to 4,450 mg/kg.
EPA[2]	-	-	no data	
SAIC	1,560	-	lab documentation provided	
Macalloy	4,450	-	lab documentation provided	
Norchem	-	-	no data	
Lafarge	-	-	no data	

Criteria 2. Documented Grain Size (micron)

Entity	Grain Size	Average Size	Comments	Determination
EPA[1]	-	<1.0	statement / no lab documentation	FeCr & FeCrSi dust is <6.0 microns and average is 0.1 to 0.55 microns.
EPA[2]	< 6.0	-	statement / no lab documentation	
CCMA	<5.0	0.39 to 0.55	lab documentation provided	
SFA	-	-	no data	
Norchem	-	0.1 to 0.3	statement / no lab documentation	
Lafarge	-	0.1	statement / no lab documentation	

Criteria 3. Documented Crystallinity

Entity	Crystalline	Amorphous	Comments	Determination
EPA[1]	-	-	no data	FeCr & FeCrSi dust is composed of amorphous material.
EPA[2]	-	-	no data	
CCMA	no	yes	lab documentation provided	
SFA	no	yes	statement / no lab documentation	
Norchem	no	yes	statement / no lab documentation	
Larfarge	no	yes	statement / no lab documentation	

Notes: EPA[1] - 1980 K090 and K091 Listing Background Document
EPA[2] - 1995 Compilation of Air Pollution Emission Factors
CCMA - Calvert City Metals and Alloys, Inc. (formally known as SKW Metals & Alloys, Inc.)
SAIC - Science Application International Corporation (Engineers/Consultant)
SFA - Silica Fume Association (Trade Organization)
Macalloy - Macalloy, Corporation (Ferroalloy Producer)
Norchem, Inc. (Silica Fume User)
Lafarge, Corporation (Silica Fume User)

Table 5-2

Phase I Test Pit Results

Table 5-2

Phase I Test Pit Results

CC Metals and Alloys, Inc.
Witmer Road Site

Sample Location	Sample Depth	Date Sampled	Chromium	Total Hexavalent Cr	Total Volatiles (8021)	Total Semi-Volatiles (8270)	Petroleum Products	PCB's	Comments
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
A071	44-46"	4/28/98	1740	0.51					
A031	4-6"	4/28/98	9570	0.68					
A055		4/28/98	1800	0.48					
A082	24-30"	4/28/98	1070	120.00					
A012	12-14"	4/28/98	741	ND					
A064	12-17"	4/28/98	1230	ND					
A048	28-30"	4/28/98	1310	ND					
A049	12-24"	4/29/98	97	ND					
033	8-12"	4/29/98	147	ND					
033	36"	4/29/98	164	ND					
114	16-21"	4/29/98	823	ND					
270	36-48"	4/29/98	14	0.60					
092	20"	4/29/98	2160	81.00					
155	12-16"	4/30/98	7	ND					
181	9'	4/30/98	6.9	ND					
Field Equipment Blank		4/28/98	ND						
Field Equipment Blank		4/29/98	ND						
154 A&B	30"	4/30/98			ND	ND	ND		
266 A&B	20"	4/30/98			9.627	ND	ND		
281 B&C	6-16"	5/1/98			13.135	ND	-		
281 E&F	21"	5/1/98			1.040	1.56	-		
265 A	16"	5/1/98			ND	ND	-		
267 A	6"	5/1/98			3.064	ND	-		
251 A&B	24"	5/1/98			0.362	ND	-		
A048	Soil Pile A	4/28/98			1626.000	-	13		
A048	Soil Pile B	4/28/98			-	33.5	-		
281 A	6-16"	5/1/98						ND	
281 D	21"	5/1/98						ND	
265 B	16"	5/1/98						ND	
267 B	16"	5/1/98						ND	
251 C	24"	5/1/98						ND	

Table 5-3

Ferrochromium and Ferrochromium Silicon Baghouse Dust Compared to Witmer Road Soil Samples

Table 5-3

Ferrochromium & Ferrochromium Silicon Baghouse Dust Criteria Compared To Witmer Road Soil Samples

Criteria 1. **FeCr & FeCrSi dust contains total chromium at 1,560 to 4,450 mg/kg.**

Soil Sample	Total Cr (mg/kg)	Fits Criteria
A071	1740	yes
A031	9570	yes
A048	1310	no
A064	1230	no
92	2160	yes

Criteria 2. **FeCr & FeCrSi dust is <6.0 microns and average is 0.1 to 0.55 microns.**

Soil Sample	Grain Size (microns)	Fits Criteria
A071	>50	no
A031	>50	no
A048	>50	no
A064	>50	no
92	>50	no

Criteria 3. **FeCr & FeCrSi dust is composed of amorphous material.**

Soil Sample	Amorphous	Fits Criteria
A071	no	no
A031	no	no
A048	no	no
A064	no	no
92	no	no

Conclusion: **Witmer Road soil samples are not composed of FeCr & FeCrSi dust because soil samples do not fit criteria for size and crystallinity.**

Notes: See Appendix B for total chromium results.
See Appendix A for grain size and crystallinity results.

Table 8-1

Summary of Phase II Baghouse Dust Results

Summary of Phase II Baghouse Dust Results
CC Metals and Alloys, Inc.
Niagara Falls, New York

July 29, 1998

Location	Total Chromium	Total Lead	TCLP Arsenic	TCLP Barium	TCLP Cadmium	TCLP Chromium	TCLP Lead	TCLP Mercury	TCLP Selenium	TCLP Silver
	mg/kg		mg/l							
Bag #1	110	1940	0.25	ND	0.05	0.12	7.91	ND	0.17	ND
Bag #2	126	2200	0.31	ND	0.06	0.12	8.6	ND	0.23	ND
Bag #3	111	2210	0.16	ND	0.04	0.19	13.5	ND	ND	ND

Table 8-2

Phase II Surface Soil Sampling Results

Table 8-2

Phase II Surface Soil Sampling Results
Total Metals and TCLP Metals

CC Metals and Alloys, Inc.
Witmer Road

Sample Location	Date Sampled	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Lead	Total Mercury	Total Selenium	Total Silver	TCLP Arsenic	TCLP Barium	TCLP Cadmium	TCLP Chromium	TCLP Lead	TCLP Mercury	TCLP Selenium	TCLP Silver
Limit										5.0	100	1.0	5.0	5.0	0.2	1.0	5.0
LS-1	8/16/98		276	ND	1640	79.8			ND								
LS-2	8/16/98		435	1.94	1690	464			ND	**0.23**	ND	ND	**0.09**	ND	ND	ND	ND
LS-3	8/16/98		182	1.81	510	777			ND	**0.23**	ND	ND	**0.04**	**0.09**	ND	ND	ND
LS-4	8/16/98		1080	2.46	642	262			ND	ND	ND	ND	**0.08**	ND	ND	ND	ND
LS-5	8/16/98		46	ND	87	18			ND								
LS-6	8/16/98		512	5.1	1750	550			ND	**0.24**	ND	ND	ND	ND	ND	ND	ND
LS-7	8/16/98		220	3.1	398	142			ND								
LS-8	8/16/98		136	2.7	807	322			ND								
LS-9	8/16/98		51	2.3	403	280			ND								
LS-10	8/16/98		237	3.0	953	143			ND								
LS-11	8/16/98		104	3.1	598	322			ND	ND	**1.0**	**0.05**	**0.10**	**0.07**	ND	ND	ND
LS-12	8/16/98		63	ND	3300	890			ND	**0.18**	ND	ND	**0.24**	**0.06**	ND	ND	ND

LAN Associates, Inc.
Ref. #2.3269.22
Surface Soil Results
October 10, 1999

Table 8-3

Phase II Test Pit Results

Table 8-3

Phase II Test Pit Results
Total Metals and TCLP Metals
CC Metals and Alloys, Inc.
Witmer Road

Test Pit #	Depth	Date Sampled	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Lead	Total Mercury	Total Selenium	Total Silver	TCLP Arsenic	TCLP Barium	TCLP Cadmium	TCLP Chromium	TCLP Lead	TCLP Mercury	TCLP Selenium	TCLP Silver
Limit											5.0	100	1.0	5.0	5.0	0.2	1.0	5.0
1	1-3'	9/25/98	53	30	ND	870	150	ND	ND	ND								
1	3-3.5'	9/25/98	56	57	3.5	800	410	ND	ND	ND								
1	4-4.5'	9/25/98	96	110	ND	78	34	ND	ND	ND								
2	1-3'	9/25/98	72	87	ND	88	29	ND	ND	ND								
2	3-5'	9/25/98	71	150	ND	930	150	ND	ND	ND								
3	1-2.5'	9/25/98	41	46	ND	1030	160	ND	ND	ND								
3	2.5-2.7'	9/25/98	70	60	1.7	59	30	ND	ND	ND								
3	2.7-4.5'	9/25/98	86	34	ND	1140	290	ND	ND	ND								
4	0-16"	9/25/98	72	55	ND	670	220	ND	ND	ND								
4	16-48"	9/25/98	38	47	ND	980	60	ND	ND	ND								
4	48-60"	9/25/98	58	93	ND	110	23	ND	ND	ND								
5	1-3'	9/26/98	140	120	ND	100	39	ND	ND	ND	ND							
5	3-5'	9/26/98	57	180	ND	800	38	ND	ND	ND								
5	5-7'	9/26/98	82	190	2.8	1350	170	ND	ND	ND								
6	1-3'	9/26/98	61	89	2.8	680	310	ND	ND	ND								
6	3/5'	9/26/98	80	80	ND	68	47	ND	ND	ND								
7	1-2'	9/26/98	72	57	2.1	1000	380	ND	ND	ND								
7	32-60"	9/26/98	100	110	ND	85	37	ND	ND	ND								
8	1-2'	9/26/98	70	150	1.8	1000	150	ND	ND	ND								
8	24-41"	9/26/98	54	70	ND	1200	27	ND	ND	ND								
9	12-27"	9/26/98	79	73	ND	21	25	ND	ND	ND								
9	27-51"	9/26/98	32	54	ND	1150	37	ND	ND	ND								
9	54-72"	9/26/98	58	220	3.3	200	410	ND	ND	ND								
10	12-27"	9/26/98	66	110	ND	920	140	ND	ND	ND								
10	27-51"	9/26/98	35	25	ND	12	12	ND	ND	ND								
11	12-36"	9/26/98	90	530	2	560	170	ND	ND	ND								
11	36-60"	9/26/98	77	74	ND	19	27	ND	ND	ND								
12	12-31"	9/26/98	95	82	ND	22	27	ND	ND	ND								
12	3-5'	9/26/98	74	140	ND	490	140	ND	ND	ND								
13	0-12"	9/26/98	110	130	ND	26	42	ND	ND	ND								
13	12-36"	9/26/98	63	277	ND	1000	550	ND	ND	ND					ND			
14	1-3'	9/26/98	98	86	ND	77	31	ND	ND	ND								
14	3-5'	9/26/98	75	180	2.5	480	130	ND	ND	ND								
15	0-1'	9/26/98	59	21	ND	2000	510	ND	ND	ND								
15	1-3'	9/26/98	110	86	ND	28	29	ND	ND	ND								
16	0-28"	9/26/98	14	28	20	260	53	ND	ND	ND								
16	28-40"	9/26/98	87	53	ND	2300	49	ND	ND	ND								
16	40-60"	9/26/98	110	94	ND	21	33	ND	ND	ND								
17	1-3'	9/28/98	130	100	ND	25	34	ND	ND	ND	ND							
17	3-5'	9/28/98	70	93	ND	1900	70	ND	ND	ND								
18	27-32"	9/28/98	91	52	ND	3900	17	ND	ND	ND				0.694				
18	32-41"	9/28/98	100	95	ND	22	26	ND	ND	ND								
18	41-65"	9/28/98	31	22	ND	1600	750	ND	ND	ND					ND			
19	24-30"	9/28/98	72	58	ND	930	66	ND	ND	ND								
19	30-38"	9/28/98	37	85	ND	490	770	ND	ND	ND					0.057			
19	38-62"	9/28/98	90	110	ND	22	35	ND	ND	ND								
20	0-6"	9/28/98	52	91	ND	2000	37	ND	ND	ND								
20	6-72"	9/28/98	110	200	ND	22	29	ND	ND	ND	ND							
20	72-96"	9/28/98	47	35	ND	2200	15	ND	ND	ND				0.924				
21	0-6"	9/28/98	98	66	ND	22	24	ND	ND	ND								
21	6-52"	9/28/98	47	76	ND	1600	31	ND	ND	ND								
21	52-76"	9/28/98	70	100	ND	1700	59	ND	ND	ND								
22	12-36"	9/28/98	120	130	2.2	25	32	ND	ND	ND								
22	37-62"	9/28/98	55	100	ND	700	87	ND	ND	ND								
23	12-35"	9/28/98	74	200	3.7	700	88	ND	ND	ND								
23	36-60"	9/28/98	130	130	ND	28	39	ND	ND	ND								
24	12-36"	9/28/98	98	200	1.8	3200	140	ND	ND	ND				ND				
24	36-60"	9/28/98	100	110	ND	25	35	ND	ND	ND								
25	12-36"	9/28/98	120	100	ND	28	34	ND	ND	ND								
25	36-60"	9/28/98	85	420	2.8	1200	47	ND	ND	ND								

Notes:
1. Total results in mg/kg.
2. TCLP results in mg/l.
3. TCLP completed on 3 highest arsenic, chromium, and lead results.

LAN Associates, Inc.
Ref. #2.3269.22
Test Pit Results
October 8, 1999

APPENDICES

A

Appendix A

Documentation
Ferrochromium & Ferrochromium Silicon Characteristics

CHARACTERISTICS Of FERROCHROMIUM AND FERROCHROMIUM SILICON

Independent documentation of the total chromium concentration of ferrochromium dust (Attachment 1) was obtained from Science Applications International Corporation (SAIC). The SAIC documentation was submitted by CCMA to the New York State Department of Environmental Conservation (NYSDEC) as an attachment to the Site Screening Work Plan. In its cover letter, SAIC thanked SKW (CCMA) on behalf of the U.S. Environmental Protection Agency (EPA) for helping SAIC obtain samples of ferrochromium dust from emissions at CCMA's Niagara Falls ferroalloy production facility. The total chromium content of the SAIC ferrochromium dust sample was 1,560 milligram per kilogram (mg/kg).

A second independent documentation of ferrochromium dust was obtained for the Macalloy Corporation located in Charleston, South Carolina. Total metal analysis of ferrochromium fume dust collected at the Macalloy facility was conducted by General Engineering Laboratories (Attachment 2). The analytic results reveal that the total chromium content of the Macalloy ferrochromium fume dust is 4,450 mg/kg. This concentration is well above the level obtained by SAIC at the CCMA facility.

A third independent documentation of total chromium concentration in ferrochromium dust was obtained from an EPA background document for the listing of K090 and K091 waste (Attachment 3). The background document included two ferrochromium baghouse dust sample results. Table 2 of the background document indicates that a ferrochromium silicon baghouse dust sample contained 41 parts per million (ppm) total chromium. Table 3 of the background document records the total chromium concentration of one sample of ferrochromium silicon dust collected at a furnace baghouse inlet at 4,400 ppm.

The results contained in the EPA background document indicate that ferrochromium silicon baghouse dust ranges in concentration from 41 ppm to 4,400 ppm. However, the 41 ppm result was determined to be an error by the EPA. (If the error is disregarded, the average concentration for the two dust samples is 2,220 ppm.)

In the EPA's response to comments from the Ferroalloy Association (see Attachment 3 page 303), the EPA states that the 41 ppm concentration for total chromium in the baghouse dust sample was in error and that:

> *"data from another source indicates that chromium concentrations in ferrochromium silicon emission control dust/sludges might be much higher. For this reason, EPA believes that the value of 41 ppm is understated and will continue to list this waste as hazardous."*

The reason for this determination is because the same baghouse dust sample that produced a total chromium concentration of 41 ppm had a leaching concentration in distilled water of 190 ppm. Thus, the EPA determined that the 41 ppm result for the baghouse dust must be an error. With this understanding, the EPA results for total chromium concentrations in ferrochromium silicon dust are interpreted to range between 2,220 and 4,400 ppm. This range is similar to both the SAIC results (1,560 mg/kg) and the Macalloy results (4,450 mg/kg). A tabulation of the three independent total chromium results is provided in Attachment 4.

During the site-screening investigation, a total chromium concentration of 700 to 1,500 mg/kg was originally set as one of three criteria to determine if onsite materials contained ferrochromium or ferrochromium silicon dust. This range of concentration was underestimated given the now documented range of 1,560 to 4,450 mg/kg for total chromium concentrations in ferrochromium and ferrochromium silicon dust. For this report, the documented higher total chromium concentration will be utilized as one criteria of defining ferrochromium and ferrochromium silicon dust. Two additional criteria for defining ferrochromium and ferrochromium silicon dust are particle size (fume dust generally being <1.0 to 5.0 micron or less) and crystal form (fume dust is amorphous rather than crystalline).

A study of the particle-size distribution of fume dust generated from the CCMA furnace operation (Attachment 5) was completed in 1992 by Dr. Wojciech Z. Misiolek, a materials engineering consultant and professor at Rensselaer Polytechnic Institute in Troy, New York. Dr. Misiolek's investigation revealed that the average particle size of the CCMA fume dust ranged from 0.39 to 0.55 microns and that 70 to 88 percent of the particles were less than 5 microns. Clay-sized particles are defined by the American Society of Testing and Materials (ASTM) as occurring between 1.0 and 5.0 microns. Therefore, the CCMA baghouse dust is clearly dominated by clay-size and smaller particles.

Independent particle-size distribution for ferrochromium fume dust is provided in the EPA's 1995 *Manual on The Metallurgical Industry* (Attachment 6). The EPA manual documents that 88 percent of ferrochromium fume dust has a particle size of less than 6 microns. A second independent particle-size determination for ferrochromium fume dust is provided by the EPA background document for the listing of K090 and K091 waste. This document states that ferroalloy emission control dust consists primarily of submicron size particles. Attachment 3, page 291, contains the EPA's determination of fume-dust particle size.

Norchem, Inc., and the Lafarge Corporation also provide additional independent documentation of silica fume-dust particle size. Norchem states that silica fume dust contains an average particle size of 0.1 to 0.3 microns, and Lafarge states that silica fume dust contains an average particle size of approximately 0.1 microns (Attachment 7). The above particle-size documentation clearly shows that ferrochromium, ferrochromium silicon, and silica fume dust are dominated by clay-size or smaller particles. A summary of the documented particle-size data is compiled in Attachment 4.

The final criteria for determining if materials encountered during the site-screening investigations are classified as ferrochromium or ferrochromium silicon dust is crystallinity or lack of crystallinity (amorphous structure). The formation of crystalline versus amorphous solids is dependent on the rate of cooling during condensation (the phase change from vapor to liquid) and solidification (the phase change from liquid to solid). The formation of crystal structure (the regularly repeated arrangement of atoms, ions, or molecules into identifiable geometric shapes and patterns) requires a slow cooling rate with sufficient time for crystals to form and grow. If the cooling rate occurs rapidly, the crystallization process will be incomplete or not occur. The result of very rapid cooling is a glassy structure that is amorphous (without a crystal structure or form).

At the CCMA facility, fume (vaporized dust) is generated during the ferroalloy melting process, which occurs in a submerged electric arc furnace where temperatures range from 2000°C to over 3000°C. Fume emissions from the furnace are conveyed into a ventilated ductwork above the furnace. The ventilation causes the very rapid cooling of the fume vapor first into liquid and then into a solid (particulate dust). This process occurs so rapidly that the fume vapor and liquid do not have sufficient time to form or grow into a crystalline solid. Instead, the fume vapor is cooled to form an amorphous solid without crystal form. Therefore, the cooled fume dust is classified as a non-crystalline (amorphous) solid.

Dr. Willie Harris of the University of Florida's Soil Science Department provided documentation of the amorphous structure of CCMA's fume dust. Dr. Harris completed X-ray diffraction analysis on CCMA's fume-dust samples and samples collected during the site-screening investigation to determine their crystallinity. X-ray diffraction is an analytic method that examines the lattice pattern of the crystal structure. This method is typically used to identify minerals but can also distinguish between amorphous and crystalline materials. Crystalline materials generate a distinct pattern of diffraction peaks, whereas amorphous materials generate small humps but no distinct diffraction peaks.

Graphical output of diffraction peaks from Dr. Harris's X-ray analysis reveal that CCMA's fume dust lacks the distinct defraction peaks. Therefore, the CCMA fume-dust samples are defined as being dominated by a non-crystalline, amorphous material. All X-ray diffraction analysis of soil samples collected from CCMA's Witmer Road property produced a distinct pattern of diffraction peaks. Therefore, the soil samples are defined as being dominated by crystalline material. A summary of Dr. Harris' investigations and results, plus additional particle-size analysis, is included in a memo completed by Dr. Handi Wang of LAN Associates (Attachment 8). In his memo, Dr. Wang concluded that all soil samples are composed of slag material because:

1. the samples are dominated by sand-size, or larger, material;
2. chemically, the soil samples are similar to slag; and
3. mineralogically, the soil samples are similar to slag, because they are dominated by crystalline material.

Dr. Wang's and Dr. Harris' separate determinations that CCMA's fume-dust samples are dominated by amorphous material are supported by independent reports obtained from the Silica Fume Association (SFA), Norchem, Inc. and the Lafarge Corporation (Attachment 7). All of the above sources report that silica fume consists primarily of amorphous (non-crystalline) silicon dioxide (SiO2).

ATTACHMENTS

Attachment No.	Title
1	SAIC Letter dated January 11, 1999 with Documentation
2	Macalloy Total Metal Results
3	EPA Background Document
4	Summary Table of Determination Criteria
5	Particle Size Study by Dr. Misiolek
6	EPA Manual on Metallurgical Industry (portion)
7	Independent Documentation of Fume Dust Particle Size & Amorphous Structure
8	LAN Associates' Memo by Dr. Handi Wang

Attachment 1

SAIC Letter dated January 11, 1999 with Documentation

SAIC

Science Applications International Corporation
An Employee-Owned Company

January 11, 1991

Mr. Russ G. Trivedi
SKW Alloys, Inc.
P.O. Box 368
Niagara Falls, NY 14392-0368

RE: Results of Analysis of Ferrochromium-silicon Baghouse Dust Samples

Dear Mr. Trivedi:

I would like to thank you on behalf of EPA for providing us with valuable information concerning the generation and treatment of ferrochromium-silicon emission control dust. We sincerely appreciate your willingness to take time out of your busy schedule to help us obtain samples of the emission control dust. Our efforts to establish reasonable treatment methods and achievable standards for the waste are enhanced by your support.

For your information, I have enclosed a copy of the analytical results generated from the samples provided at your facility. If you have any question regarding these analyses or questions on the project, please feel free to call me at (703) 734-3136 or Ron Turner of EPA RREL at (513) 569-7775.

Sincerely,

Henry Huppert
Chemical Engineer

enclosure

cc: Ron Turner, EPA RREL
Ed McNicholas, SAIC
Tom Wagner, SAIC
Mark Colangelo, SAIC

8400 Westpark Drive, McLean, Virginia 22102
Other SAIC Offices: Albuquerque, Boston, Colorado Springs, Dayton, Huntsville, Las Vegas, Los Angeles, Oak Ridge, Orlando, Palo Alto, San Diego, Seattle, and Tucson

Versar INC

Data Qualifier Flags

J	For Target Compounds: This flag is used when mass spectral data indicates the presence of a compound but the result is less than the specified detection limit but still greater than zero. For Non Target Compounds: This flag indicates that the concentration is an estimated value, assuming a 1 to 1 response with the internal standard.
B	This flag is used when the analyte is found in the blank as well as in the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.
U	This flag states that the compound was analyzed for but was not detected. The number is the minimum attainable detection limit for the sample.
X or T	This flag states that the mass spectrum does not meet EPA CLP criteria for confirmation, but compound presence is strongly suspected.
E	This flag is used to indicate that the quantitation of the analyte is outside the linear calibration of the curve and that dilution was required in order to properly quantitate.
D	This flag is used to indicate the value for the target analyte was calculated from a dilution (see "E" flag above).
Y	This flag is used when a matrix spike compound is also confirmed present in the unspiked sample.

Flags excerpted from and established by the US EPA Contract Lab Program (CLP) protocol.

Metais

RGANIC ANALYSES DATA SHE.

FIELD SAMPLE NO.

SKW-01

ient : VERSAR_DIV._24

Site: SAIC_MIN._PROC.

Name: VERSAR_INC.

Control No.: 3312

Code: SAIC3DAT

Batch: 11

rix : SOIL

Lab Sample ID: 28867

vel (low/med):

Date Received: 08/16/90

Concentration Units (ug/L or mg/kg wet weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12100			P
7440-36-0	Antimony	1.2	U		P
7440-38-2	Arsenic	100	U	E	P
7440-39-3	Barium	138			P
7440-41-7	Beryllium	0.52			P
7440-43-9	Cadmium	0.29	U		P
7440-70-2	Calcium	7420			P
7440-47-3	Chromium	1560			P
7440-48-4	Cobalt	1.0			P
7440-50-8	Copper	3.5			P
7439-89-6	Iron	1270			P
7439-92-1	Lead	273			P
7439-95-4	Magnesium	121000			P
7439-96-5	Manganese	1510			P
7439-97-6	Mercury	0.098	U		CV
7440-02-0	Nickel	16.1			P
7440-09-7	Potassium	2720			P
7782-49-2	Selenium	5.5			P
7440-22-4	Silver	0.29	U		P
7440-23-5	Sodium	778			P
7440-28-0	Thallium	23.9			P
7440-62-2	Vanadium	1.5			P
7440-66-6	Zinc	3270			P
	Molybdenum	0.29	U		P
	Lithium	1.3			P
	Strontium	107			P
	Tin	240	U		A
	ChromiumVI	121			A

olor Before: GREY

Clarity Before:

Texture: FINE

lor After : YELLOW

Clarity After: CLEAR

Artifacts:

omments:

"E" - SEVERE MATRIX INTERFERENCE

1

ORGANIC ANALYSES DATA SHE

FIELD SAMPLE NO.

SKW-FB

ient : VERSAR_DIV._24

Site: SAIC_MIN._PROC.

ab Name: VERSAR_INC.

Control No.: 3312

Code: SAICBDAT

Batch: 11

trix : SOIL

Lab Sample ID: 28868

vel (low/med):

Date Received: 08/16/90

Concentration Units (ug/L or mg/kg wet weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6.8			P
7440-36-0	Antimony	1.3	U		P
7440-38-2	Arsenic	1.1	U		P
7440-39-3	Barium	0.43			P
7440-41-7	Beryllium	0.10	U		P
7440-43-9	Cadmium	0.30	U		P
7440-70-2	Calcium	0.70	U		P
7440-47-3	Chromium	0.25			P
7440-48-4	Cobalt	0.30	U		P
7440-50-8	Copper	0.46			P
7439-89-6	Iron	1.2			P
7439-92-1	Lead	2.3	U		P
7439-95-4	Magnesium	1.0			P
7439-96-5	Manganese	0.23			P
7439-97-6	Mercury				NR
7440-02-0	Nickel	0.74			P
7440-09-7	Potassium	37.6	U		P
7782-49-2	Selenium	2.4	U		P
7440-22-4	Silver	0.30	U		P
7440-23-5	Sodium	5.2			P
7440-28-0	Thallium	9.7			P
7440-62-2	Vanadium	0.20	U		P
7440-66-6	Zinc	0.59			P
	Molybdenum	0.30	U		P
	Lithium	0.20	U		P
	Strontium	0.10	U		P
	Tin	250	U		A
	ChromiumVI	1.0	U		A

olor Before: COLORLESS

Clarity Before: CLEAR_

Texture:

olor After : COLORLESS

Clarity After: CLEAR_

Artifacts:

omments:

FIELD_BLANK_HANDLED_AS_A_SOLID

CC[illegible]

3

BLANKS

Client : VERSAR_DIV._24______

Lab Name: VERSAR_INC. Control No.: 3312____

Site: SAIC_MIN._PROC. ______

Code: SAICBDAT Batch: 11______

Preparation Blank Matrix: SOIL______________

Preparation Blank Concentration Units (ug/L or mg/kg): MG/KG

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	
Aluminum											N
Antimony											N
Arsenic											N
Barium											N
Beryllium											N
Cadmium											N
Calcium											N
Chromium											N
Cobalt											N
Copper											N
Iron											N
Lead											N
Magnesium											N
Manganese											N
Mercury											N
Nickel											N
Potassium											N
Selenium											N
Silver											N
Sodium											N
Thallium											N
Vanadium											N
Zinc											N
Molybdenum											N
Lithium											N
Strontium											N
Tin											N
ChromiumVI											N
									0.100	U	A

3
BLANKS

ient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC._____

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11_____

eparation Blank Matrix: SOIL______________

eparation Blank Concentration Units (ug/L or mg/kg): MG/KG

nalyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
uminum											
timony									5.807		P
senic									1.396		P
rium									1.100	U	P
ryllium									0.100	U	P
admium									0.100	U	P
lcium									0.300	U	P
romium									1.124		P
balt									0.540		P
pper									0.300	U	P
on									0.300	U	P
ead									1.931		P
gnesium									2.339		P
nganese									0.679		P
rcury									0.200	U	P
ckel									0.100	U	CV
tassium									0.955		P
lenium									37.600	U	P
ilver									2.400	U	P
dium									0.300	U	P
allium									6.697		P
anadium									5.700	U	P
nc									0.200	U	P
lybdenum									0.413		P
thium									0.300	U	P
rontium									0.200	U	P
n									0.100	U	P
romiumVI									250.000	U	A
									0.100	U	A

3
BLANKS

ient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.______

b Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11______

eparation Blank Matrix: HOH________________

eparation Blank Concentration Units (ug/L or mg/kg): UG/L_

nalyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
luminum	11.0	U	14.7		11.0	U	20.0		25.7		P
ntimony	13.0	U	13.0	U	13.0	U	13.0	U	64.7		P
senic	11.0	U	11.0	U	11.0	U	11.0		11.0	U	P
arium	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	P
eryllium	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	P
admium	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U	P
alcium	7.0	U	7.0	U	7.0	U	7.0	U	7.0	U	P
hromium	2.0	U	2.0	U	2.0	U	2.0	U	2.3		P
obalt	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U	P
opper	3.0	U	4.0		3.0	U	3.9		12.9		P
ron	4.0	U	4.0	U	36.2		9.7		29.6		P
ead	23.0	U	23.0	U	23.0	U	23.0	U	23.0	U	P
agnesium	1.0	U	1.0	U	22.5		1.8		3.8		P
anganese	2.0	U	2.0	U	2.0	U	2.0	U	2.8		P
ercury	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	CV
ickel	5.0	U	6.3		5.0	U	6.4		5.0	U	P
otassium	376.0	U	376.0	U	376.0	U	341.2		376.0	U	P
elenium	24.0	U	24.0	U	24.0	U	24.0	U	24.0	U	P
ilver	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U	P
odium	14.0	U	14.0	U	14.0	U	14.0	U	70.7		P
hallium	57.0	U	57.0	U	57.0	U	57.0	U	57.0	U	P
anadium	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	P
inc	2.0	U	2.0	U	2.0	U	2.0	U	11.8		P
olybdenum	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U	P
ithium	2.0	U	2.0	U	2.0	U	2.0	U	7.2		P
trontium	1.0	U	1.0	U	1.0	U	1.0	U	1.0		P
in	2500.0	U	2500.0	U	2500.0	U			2500.0	U	A
hromiumVI	10.0	U	10.0	U	10.0	U					A

FORM III - IN

5A
SPIKE SAMPLE RECOVERY

FIELD SAMPLE NO.

SKW-01 S

Client : VERSAR_DIV._24

Site: SAIC_MIN._PROC.

Lab Name: VERSAR_INC. Control No.: 3312 Code: SAIC3DAT Batch: 11

atrix : SOIL

Level (low/med):

Concentration Units (ug/L or mg/kg wet weight): MG/KG

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Aluminum	75-125	18007.77		12134.55		2427.18	242.0		P
Antimony	75-125	124.16		1.25	U	388.35	32.0		P
Arsenic	75-125	200.27		100	U	388.35	51.6		P
arium	75-125	354.65		138.26		194.17	111.4		P
Beryllium	75-125	147.16		0.52		194.17	75.5		P
Cadmium	75-125	133.60		0.29	U	194.17	68.8		P
alcium	75-125	11405.09		7424.18		1941.75	205.0		P
Chromium	75-125	2256.23		1562.03		194.17	357.5		P
Cobalt	75-125	142.28		1.02		194.17	72.8		P
opper	75-125	304.63		3.53		388.35	77.5		P
Iron	75-125	3170.49		1265.65		1941.75	98.1		P
Lead	75-125	636.83		272.59		388.35	93.8		P
agnesium	75-125	174019.41		121456.73		1941.75	2706.9		P
anganese	75-125	2323.71		1514.33		388.35	208.4		P
Mercury	75-125	1.06		0.10	U	0.97	109.3		CV
ickel	75-125	298.60		16.05		388.35	72.8		P
otassium	75-125	5205.22		2716.92		1941.75	128.1		P
Selenium	75-125	309.04		5.51		388.35	78.2		P
Silver	75-125	138.60		0.29	U	194.17	71.4		P
odium	75-125	3957.70		777.67		3533.98	90.0		P
Thallium	75-125	232.91		23.93		388.35	53.8		P
Vanadium	75-125	151.28		1.50		194.17	77.1		P
inc	75-125	4529.43		3269.19		388.35	324.5		P
molybdenum	75-125	134.84		0.29	U	194.17	69.4		P
Lithium	75-125	172.73		1.28		194.17	88.3		P
trontium	75-125	312.30		107.37		194.17	105.5		P
in	75-125	452.94		240.38	U	388.35	116.6		A
ChromiumVI		1.98		120.79		0.49	-24246		A

mments:

FORM V (PART 1) - IN

6
DUPLICATES

FIELD SAMPLE NO.

SKW-01 D

ient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

b Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11______

atrix : SOIL____________

Level (low/med): ______

Concentration Units (ug/L or mg/kg wet weight): MG/KG

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum		12134.55		18238.74		40.2		P
Antimony		1.25	U	1.27	U			P
Arsenic		100	U	100	U			P
Barium		138.26		212.09		42.1		P
Beryllium		0.52		0.67		25.2		P
Cadmium		0.29	U	0.29	U			P
Calcium		7424.18		11109.12		39.8		P
Chromium		1562.03		2325.33		39.3		P
Cobalt		1.02		1.52		39.4		P
Copper		3.53		4.25		18.5		P
Iron		1265.65		1966.57		43.4		P
Lead		272.59		401.60		38.3		P
Magnesium		121456.73		188367.60		43.2		P
Manganese		1514.33		2256.19		39.4		P
Mercury		0.10	U	0.10	U			CV
Nickel		16.05		26.33		48.5		P
Potassium		2716.92		4121.00		41.1		P
Selenium		5.51		5.47		0.7		P
Silver		0.29	U	0.29	U			P
Sodium		777.67		1142.95		38.0		P
Thallium		23.93		14.44		49.5		P
Vanadium		1.50		2.02		29.5		P
Zinc		3259.19		4757.14		37.1		P
Molybdenum		0.29	U	0.85				P
Lithium		1.28		2.82		75.1		P
Strontium		107.37		162.00		40.6		P
Tin		240.38	U	245.10	U			P
ChromiumVI		120.79		125.33		3.7		A

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____

Code: SAICBDAT Batch: 11______

nitial Calibration Source: VARIOUS_________

ontinuing Calibration Source: VARIOUS_______

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	%R(1)	Continuing Calibration True	Found	%R(1)	Found	%R(1)	M
luminum__	___500.0	__486.59	_97.3	___500.0	__484.09	_96.8	__520.77	104.2	P_
ntimony__	___500.0	__509.51	101.9	___500.0	__512.94	102.6	__536.49	107.3	P_
rsenic___	___500.0	__515.15	103.0	___500.0	__493.95	_98.8	__509.92	102.0	P_
arium_____	___500.0	__515.41	103.1	___500.0	__516.87	103.4	__533.67	106.7	P_
eryllium_	___500.0	__506.85	101.4	___500.0	__511.55	102.3	__528.71	105.7	P_
admium___	___500.0	__519.18	103.8	___500.0	__520.10	104.0	__533.33	106.7	P_
alcium___	_20000.0	19879.57	_99.4	_20000.0	19657.87	_98.3	20301.93	101.5	P_
hromium__	___500.0	__525.82	105.2	___500.0	__524.43	104.9	__538.20	107.6	P_
obalt_____	___500.0	__523.43	104.7	___500.0	__525.02	105.0	__541.57	108.3	P_
opper_____	___500.0	__512.65	102.5	___500.0	__519.93	104.0	__536.13	107.2	P_
ron_______	___500.0	__499.62	_99.9	___500.0	__499.41	_99.9	__510.18	102.0	P_
ead_______	__1000.0	_1050.80	105.1	__1000.0	_1024.83	102.5	_1046.99	104.7	P_
agnesium_	___500.0	__507.16	101.4	___500.0	__513.65	102.7	__535.78	107.2	P_
anganese_	___500.0	__508.13	101.6	___500.0	__510.90	102.2	__531.67	106.3	P_
ercury___	_____5.0	____4.70	_94.0	_____5.0	____4.76	_95.2	____4.58	_91.6	CV
ickel_____	___500.0	__525.50	105.1	___500.0	__526.53	105.3	__544.87	109.0	P_
otassium_	_20000.0	19292.34	_96.5	_20000.0	18646.10	_93.2	18953.73	_94.8	P_
elenium__	__2000.0	_1961.63	_98.1	__2000.0	_1949.50	_97.5	_2010.45	100.5	P_
ilver_____	___500.0	__512.59	102.5	___500.0	__500.16	100.0	__523.76	104.8	P_
Sodium_____	_20000.0	20307.73	101.5	_20000.0	20043.53	100.2	20504.95	102.5	P_
hallium__	__2000.0	_1863.56	_93.2	__2000.0	_2066.29	103.3	_1825.27	_91.3	P_
anadium__	___500.0	__501.87	100.4	___500.0	__502.16	100.4	__523.90	104.8	P_
inc_______	___500.0	__506.36	101.3	___500.0	__497.85	_99.6	__517.21	103.4	P_
olybdenum	__2000.0	_1940.87	_97.0	__2000.0	_1922.88	_96.1	_1989.87	_99.5	P_
ithium___	__2000.0	_2080.94	104.0	__2000.0	_2064.49	103.2	_2117.12	105.9	P_
trontium_	__2000.0	_2056.68	102.8	__2000.0	_2094.61	104.7	_2179.57	109.0	P_
in________	_25000.0	24667.38	_98.7	_25000.0	25369.21	101.5	25369.21	101.5	A_
hromiumVI	___100.0	__110.85	110.8	___100.0	__111.99	112.0	__111.99	112.0	A_

) Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

FORM II (PART 1) - IN

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

lient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC. ______

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11______

nitial Calibration Source: VARIOUS__________

ontinuing Calibration Source: VARIOUS______

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	%R(1)	Continuing Calibration True	Continuing Calibration Found	%R(1)	Found	%R(1)	
Aluminum				500.0	496.87	99.4	489.45	97.9	P
Antimony				500.0	530.68	106.1	527.68	105.5	P
Arsenic				500.0	517.86	103.6	521.06	104.2	P
arium				500.0	513.90	102.8	513.12	102.6	P
eryllium				500.0	507.10	101.4	509.77	102.0	P
admium				500.0	527.13	105.4	510.21	102.0	P
alcium				20000.0	20256.98	101.3	20003.02	100.0	P
hromium				500.0	530.33	106.1	523.68	104.7	P
obalt				500.0	530.44	106.1	526.83	105.4	P
opper				500.0	526.57	105.3	516.45	103.3	P
ron				500.0	498.74	99.7	490.03	98.0	P
ead				1000.0	1039.38	103.9	1031.54	103.2	P
Magnesium				500.0	511.04	102.2	506.71	101.3	P
anganese				500.0	516.87	103.4	510.58	102.1	P
ercury				5.0	4.82	96.4	4.88	97.6	C
Nickel				500.0	533.88	106.8	520.93	104.2	P
otassium				20000.0	19855.51	99.3	18843.50	94.2	P
elenium				2000.0	2063.99	103.2	1977.24	98.9	P
Silver				500.0	530.61	106.1	519.96	104.0	P
odium				20000.0	20327.56	101.6	19802.08	99.0	P
Thallium				2000.0	2145.41	107.3	1966.46	98.3	P
Vanadium				500.0	506.08	101.2	498.87	99.8	P
inc				500.0	509.66	101.9	499.95	100.0	P
Molybdenum				2000.0	1945.99	97.3	1916.77	95.8	P
Lithium				2000.0	2074.12	103.7	2047.51	102.4	P
trontium				2000.0	2004.62	100.2	2001.01	100.1	P
Tin	25000.0	25526.70	102.1	25000.0	25870.75	107.5	24854.67	99.4	A
ChromiumVI	50.0	50.69	101.4	50.0	49.65	99.3	50.69	101.4	A

1) Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

ient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

.ab Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11______

.itial Calibration Source: VARIOUS_________

ntinuing Calibration Source: VARIOUS______

Concentration Units: ug/L

nalyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	%R(1)	Found	%R(1)	M
uminum__				___500.0	__489.30	_97.9	__497.74	_99.5	P_
timony__				___500.0	__521.72	104.3	__518.36	103.7	P_
rsenic___				___500.0	__518.11	103.6	__511.42	102.3	P_
rium_____				___500.0	__518.38	103.7	__512.51	102.5	P_
ryllium_				___500.0	__514.62	102.9	__510.78	102.2	P_
admium___				___500.0	__524.23	104.8	__524.06	104.8	P_
lcium___				_20000.0	20201.22	101.0	20141.73	100.7	P_
romium__				___500.0	__525.00	105.2	__527.00	105.4	P_
balt_____				___500.0	__528.37	105.7	__529.92	106.0	P_
pper____				___500.0	__518.01	103.6	__519.57	103.9	P_
on_______				___500.0	__498.14	_99.6	__500.97	100.2	P_
ead_______				__1000.0	_1039.34	103.9	_1014.70	101.5	P_
agnesium_				___500.0	__511.57	102.3	__510.89	102.2	P_
nganese_				___500.0	__510.25	102.0	__512.90	102.6	P_
rcury___	_____5.0	____4.78	_95.6	_____5.0	____4.97	_99.4	____4.97	_99.4	CV
ickel_____				___500.0	__522.89	104.6	__538.43	107.7	P_
tassium_				_20000.0	19033.60	_95.2	19316.04	_96.6	P_
lenium__				__2000.0	_2009.85	100.5	_1992.92	_99.6	P_
ilver_____				___500.0	__519.48	103.9	__520.20	104.0	P_
dium_____				_20000.0	20264.36	101.3	19825.56	_99.1	P_
allium__				__2000.0	_2041.82	102.1	_1858.56	_92.9	P_
anadium__				___500.0	__499.88	100.0	__503.20	100.6	P_
nc_______				___500.0	__504.09	100.8	__505.55	101.1	P_
lybdenum				__2000.0	_1928.56	_96.4	_1920.97	_96.0	P_
thium___				__2000.0	_2073.49	103.7	_2041.80	102.1	P_
rontium_				__2000.0	_2026.35	101.3	_2006.43	100.3	P_
n_______				_25000.0	24518.66	_98.1	25190.68	100.8	A_
romiumVI	___100.0	__105.34	105.3	___100.0	__108.40	108.4	__109.42	109.4	A_

Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

FORM II (PART 1) - IN

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____

Code: SAICBDAT Batch: 11______

nitial Calibration Source: VARIOUS__________

ontinuing Calibration Source: VARIOUS______

Concentration Units: ug/L

Analyte	Initial Calibration True	Found	%R(1)	Continuing Calibration True	Found	%R(1)	Found	%R(1)	M
luminum									
ntimony									NR
rsenic									NR
arium									NR
eryllium									NR
admium									NR
alcium									NR
hromium									NR
obalt									NR
opper									NR
ron									NR
ead									NR
Magnesium									NR
anganese									NR
ercury									NR
ickel				5.0	4.84	96.8	5.03	100.6	CV
otassium									NR
elenium									NR
ilver									NR
odium									NR
hallium									NR
anadium									NR
inc									NR
olybdenum									NR
ithium									NR
Strontium									NR
in									NR
hromiumVI									NR
									NR

) Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Client : VERSAR_DIV._24______

Site: SAIC_MIN._PROC. ______

Lab Name: VERSAR_INC. Control No.: 3312____

Code: SAIC3DAT Batch: 11______

Initial Calibration Source: VARIOUS_________

Continuing Calibration Source: VARIOUS______

Concentration Units: ug/L

Analyte	Initial Calibration True	Initial Calibration Found	Initial Calibration %R(1)	Continuing Calibration True	Continuing Calibration Found	%R(1)	Found	%R(1)	M
Aluminum									NR
Antimony									NR
Arsenic									NR
Barium									NR
Beryllium									NR
Cadmium									NR
Calcium									NR
Chromium									NR
Cobalt									NR
Copper									NR
Iron									NR
Lead									NR
Magnesium									NR
Manganese									NR
Mercury				5.0	4.97	99.4			CV
Nickel									NR
Potassium									NR
Selenium									NR
Silver									NR
Sodium									NR
Thallium									NR
Vanadium									NR
Zinc									NR
Molybdenum									NR
Lithium									NR
Strontium									NR
Tin									NR
ChromiumVI									NR

(1) Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

lient : VERSAR_DIV._24

ab Name: VERSAR_INC. Control No.: 3312

Site: SAIC_MIN._PROC.

Code: SAIC3DAT Batch: 11

nitial Calibration Source: NBS

ontinuing Calibration Source: NBS

Concentration Units: ug/L

Analyte	Initial Calibration True	Found	%R(1)	Continuing Calibration True	Found	%R(1)	Found	%R(1)	M
luminum									NR
ntimony									NR
rsenic									NR
arium									NR
eryllium									NR
admium									NR
alcium									NR
hromium									NR
obalt									NR
opper									NR
ron	150000.0	144209.5	96.1	150000.0	153640.1	102.4	159207.2	106.1	P
ead									NR
agnesium	50000.0	47511.29	95.0	50000.0	49430.42	98.9	50667.63	101.3	P
anganese									NR
ercury									NR
ickel									NR
otassium									NR
elenium									NR
ilver									NR
odium									NR
hallium									NR
anadium									NR
inc									NR
lybdenum									NR
thium									NR
rontium									NR
in									NR
romiumVI									NR
									NR

Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

FORM II (PART 1) - IN

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

ient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____

Code: SAIC3DAT Batch: 11______

nitial Calibration Source: NBS____________

ontinuing Calibration Source: NBS__________

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	M
luminum__									NR
ntimony__									NR
rsenic___									NR
arium____									NR
eryllium_									NR
admium___									NR
alcium___									NR
hromium__									NR
obalt____									NR
opper____									NR
ron______				150000.0	155939.1	104.0	154414.1	102.9	P_
ead______									NR
agnesium_				_50000.0	50899.05	101.8	49796.98	_99.6	P_
anganese_									NR
ercury___									NR
ickel____									NR
otassium_									NR
elenium__									NR
ilver____									NR
odium____									NR
hallium__									NR
anadium__									NR
inc______									NR
olybdenum									NR
ithium___									NR
trontium_									NR
in_______									NR
hromiumVI									NR

Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Client : VERSAR_DIV._24______

Lab Name: VERSAR_INC. Control No.: 3312____ Site: SAIC_MIN._PROC.______

Initial Calibration Source: NBS____________ Code: SAIC3DAT Batch: 11______

Continuing Calibration Source: NBS__________

Concentration Units: ug/L

Analyte	Initial Calibration True	Found	%R(1)	Continuing Calibration True	Found	%R(1)	Found	%R(1)	M
luminum									NR
ntimony									NR
rsenic									NR
arium									NR
eryllium									NR
admium									NR
alcium									NR
Chromium									NR
obalt									NR
pper									NR
ron				150000.0	154343.9	102.9	155443.9	103.6	P
ead									NR
gnesium				50000.0	49988.54	100.0	50208.74	100.4	P
anganese									NR
ercury									NR
ckel									NR
tassium									NR
elenium									NR
lver									NR
dium									NR
hallium									NR
nadium									NR
nc									NR
lybdenum									NR
thium									NR
ontium									NR
in									NR
romiumVI									NR

Control Limits: Mercury and Furnace AA Metals 80-120; ICP Metals 90-110;

ICP INTERFERENCE CHECK SAMPLE

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11______

CP ID Number: 4-JA_1140___

ICS Source: I.V.____

Concentration Units: ug/L

Analyte	True Sol. A	True Sol. AB	Initial Found Sol. A	Initial Found Sol. AB	Initial Found %R	Final Found Sol. A	Final Found Sol. AB	Final Found %R
Aluminum		500000		486061.4	97.2		492322.2	98.5
Antimony								
Arsenic								
Barium		500		500.6	100.1		512.1	102.4
Beryllium		500		439.3	87.9		454.1	90.8
Cadmium		1000		911.5	91.2		914.7	91.5
Calcium		500000		453735.5	90.7		469440.2	93.9
Chromium		500		506.1	101.2		519.4	103.9
Cobalt		500		443.8	88.8		460.9	92.2
Copper		500		438.7	87.7		448.0	89.6
Iron		200000		176401.9	88.2		180486.3	90.2
Lead		1000		934.7	93.5		944.7	94.5
Magnesium		500000		462475.2	92.5		471794.1	94.4
Manganese		500		453.1	90.6		468.9	93.8
Mercury								
Nickel		1000		904.4	90.4		922.1	92.2
Potassium								
Selenium								
Silver		1000		894.4	89.4		924.9	92.5
Sodium								
Thallium								
Vanadium		500		455.6	91.1		468.1	93.6
Zinc		1000		911.0	91.1		924.0	92.4
Molybdenum								
Lithium								
Strontium								
Tin								
ChromiumVI								

7
LABORATORY CONTROL SAMPLE

Client : VERSAR_DIV._24______

Lab Name: VERSAR_INC. Control No.: 3312____

Site: SAIC_MIN._PROC. ______

Code: SAICBDAT Batch: 11______

Solid LCS Source: ____________

Aqueous LCS Source: METH_SPK__

Analyte	Aqueous (ug/L) True	Aqueous (ug/L) Found	Aqueous (ug/L) %R	Solid (mg/kg) True	Solid (mg/kg) Found	Solid (mg/kg) C	Solid (mg/kg) Limits		%R
Aluminum__	20000.0	18553.47	_92.8						
Antimony__	_4000.0	_3754.13	_93.9						
Arsenic___	_4000.0	_3753.98	_93.8						
Barium____	_2000.0	_1938.24	_96.9						
Beryllium_	_2000.0	_1821.68	_91.1						
Cadmium___	_2000.0	_1801.84	_90.1						
Calcium___	20000.0	18551.81	_92.8						
Chromium__	_2000.0	_1930.97	_96.5						
Cobalt____	_2000.0	_1828.14	_91.4						
Copper____	_4000.0	_3661.75	_91.5						
Iron______	20000.0	18186.42	_90.9						
Lead______	_4000.0	_3547.81	_88.7						
Magnesium_	20000.0	18640.15	_93.2						
Manganese_	_4000.0	_3627.55	_90.7						
Mercury___	____2.0	____2.00	100.0						
Nickel____	_4000.0	_3625.00	_90.6						
Potassium_	20000.0	17758.18	_88.8						
Selenium__	_4000.0	_3605.31	_90.1						
Silver____	_2000.0	_1683.95	_84.2						
Sodium____	36400.0	35482.25	_97.5						
Thallium__	_4000.0	_3365.77	_84.1						
Vanadium__	_2000.0	_1846.55	_92.3						
Zinc______	_4000.0	_3477.68	_86.9						
Molybdenum	_2000.0	_1722.50	_86.1						
Lithium___	_2000.0	_1955.29	_97.8						
Strontium_	_2000.0	_1956.56	_97.8						
Tin_______	_4000.0	_3963.40	_99.1						
ChromiumVI	___50.0	___52.76	105.5						

FORM VII - IN

LABORATORY CONTROL SAMPLE

lient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.______

b Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11______

olid LCS Source: ____________

queous LCS Source: METH_SPK__

Analyte	Aqueous (ug/L)			Solid (mg/kg)					
	True	Found	%R	True	Found	C	Limits		%R
uminum__	20000.0	18070.79	_90.4						
ntimony__	_4000.0	_3644.11	_91.1						
senic___	_4000.0	_3634.48	_90.9						
rium____	_2000.0	_1907.09	_95.4						
eryllium_	_2000.0	_1870.05	_93.5						
admium___	_2000.0	_1796.10	_89.8						
alcium___	20000.0	18179.14	_90.9						
hromium__	_2000.0	_1918.19	_95.9						
obalt____	_2000.0	_1822.63	_91.1						
pper____	_4000.0	_3644.77	_91.1						
on______	20000.0	18093.26	_90.5						
ead______	_4000.0	_3519.00	_88.0						
agnesium_	20000.0	18509.09	_92.5						
anganese_	_4000.0	_3605.74	_90.1						
Mercury___	_____2.0	_____2.02	101.0						
ckel_____	_4000.0	_3647.50	_91.2						
tassium_	20000.0	16606.78	_83.0						
Selenium__	_4000.0	_3604.95	_90.1						
ilver_____	_2000.0	_1655.60	_82.8						
dium_____	36400.0	34654.31	_95.2						
hallium__	_4000.0	_3069.50	_76.7						
anadium__	_2000.0	_1823.62	_91.2						
inc______	_4000.0	_3503.19	_87.6						
olybdenum	_2000.0	_1655.99	_82.8						
Lithium___	_2000.0	_1900.71	_95.0						
rontium_	_2000.0	_1925.18	_96.3						
in_______	_4000.0	_4357.86	108.9						
ChromiumVI	___50.0	___52.73	105.5						

INORGANIC ANALYSES DATA SHEET

FIELD SAMPLE NO.

SKW-01

Client : VERSAR_DIV._24 Site: SAIC_MIN._PROC.

Lab Name: VERSAR_INC. Control No.: 3312 Code: SAIC3DAT Batch: 11

Matrix : TCLP EXTRACT

Lab Sample ID: T28867

Level (low/med):

Date Received: 08/16/90

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum		_		__
7440-36-0	Antimony	1390	_		P
7440-38-2	Arsenic	22.6	_		P
7440-39-3	Barium	800	U	E	P
7440-41-7	Beryllium	598	_		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	3.0	U		P
7440-47-3	Chromium	56200	_		P
7440-48-4	Cobalt	2070	_		P
7440-50-8	Copper	3.0	U		P
7439-89-6	Iron	3.0	U		P
7439-92-1	Lead	4.0	U		P
7439-95-4	Magnesium	30.2	_		P
7439-96-5	Manganese	354000	_		P
7439-97-6	Mercury	5080	_		P
7440-02-0	Nickel	0.20	U		CV
7440-09-7	Potassium	33.2	_		P
7782-49-2	Selenium	26300	_		P
7440-22-4	Silver	68.6	_		P
7440-23-5	Sodium	3.0	U		P
7440-28-0	Thallium	10500	_		P
7440-62-2	Vanadium	57.0	U		P
7440-66-6	Zinc	10.9	_		P
	Molybdenum	1630	_		P
	Lithium	8.2	_		P
	Strontium	54.5	_		P
	Tin	698	_		P
	ChromiumVI	2500	U		A
		470	_		A
			_		__

Color Before: YELLOW Clarity Before: CLEAR Texture:

olor After : COLORLESS Clarity After: CLEAR Artifacts:

omments:

TCLP_EXTRACT_RESULTS;_"E" - SEVERE MATRIX INTERFERENCE

3
BLANKS

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC._____

Name: VERSAR_INC. Control No.: 3312____

Code: SAICBDAT Batch: 11______

eparation Blank Matrix: TCLP EXTRACT______

reparation Blank Concentration Units (ug/L or mg/kg): UG/L_

nalyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
uminum			11.0	U					60.7		P
timony			13.0	U					16.0		P
rsenic			11.0	U					11.0	U	P
rium			1.0	U					150.7		P
ryllium			1.0	U					1.0	U	P
admium			3.0	U					3.0	U	P
alcium			7.0	U					66.7		P
romium			2.0	U					6.6		P
obalt			3.0	U					3.0	U	P
opper			3.9						8.9		P
on			4.8						70.4		P
ead			23.0	U					23.0	U	P
agnesium			2.9						33.4		P
anganese			2.0	U					4.5		P
ercury			0.2	U					0.2	U	CV
Nickel			5.0	U					13.4		P
otassium			447.5						376.0	U	P
elenium			24.0	U					24.0	U	P
ilver			3.0	U					3.0	U	P
odium			14.0	U					364.7		P
hallium			57.0	U					57.0	U	P
anadium			2.0	U					2.0	U	P
Zinc			2.0	U					34.1		P
olybdenum			3.0	U					3.0	U	P
ithium			2.0	U					2.0	U	P
Strontium			1.0	U					3.3		P
in	2500.0	U	2500.0	U	2500.0	U	2500.0	U	2500.0	U	A
romiumVI	10.0	U	10.0	U	10.0	U			10.0	U	A

FORM III - IN

3
BLANKS

Client : VERSAR_DIV._24______ Site: SAIC_MIN._PROC. ______

Lab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11______

Preparation Blank Matrix: TCLP FILTRATION BLANK

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L_

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Aluminum			11.0	U	28.9				34.0		P
ntimony			13.0	U	13.0	U			57.8		P
Arsenic			11.0	U	11.0	U			11.0	U	P
Barium			1.0	U	1.0	U			79.3		P
Beryllium			1.6		1.3				1.0	U	P
Cadmium			3.0	U	3.0	U			3.0	U	P
Calcium			7.0	U	7.0	U			7.0	U	P
Chromium			2.0	U	3.7				6.1		P
Cobalt			3.0	U	3.0	U			3.0	U	P
Copper			3.0	U	3.0	U			7.3		P
Iron			28.3		20.6				29.8		P
Lead			23.0	U	23.0	U			23.0	U	P
Magnesium			10.7		6.2				31.8		P
Manganese			2.3		2.0	U			2.8		P
Mercury	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	C
Nickel			5.0	U	12.5				9.8		P
Potassium			768.8		1636.4				376.0	U	P
Selenium			24.0	U	24.0	U			24.0	U	P
Silver			3.0	U	3.0	U			3.0	U	P
Sodium			14.0	U	19.9				2171.2		P
Thallium			57.0	U	57.0	U			57.0	U	P
Vanadium			2.0	U	3.2				2.0	U	P
Zinc			2.0	U	2.0	U			72.7		P
Molybdenum			3.0	U	3.0	U			3.0	U	P
Lithium			2.0	U	2.0	U			2.0	U	P
Strontium			1.0	U	1.0	U			5.8		P
Tin			2500.0	U					2500.0	U	A
ChromiumVI	10.0	U	10.0	U	10.0	U			10.0	U	A

FORM III - IN

5A
SPIKE SAMPLE RECOVERY

FIELD SAMPLE NO.

SKW-01 S

ient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11_____

trix : TCLP EXTRACT___

Level (low/med): _____

Concentration Units (ug/L or mg/kg dry weight): UG/L_

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
uminum	75-125	19559.21		1392.13		25000.00	72.7		P
Antimony	75-125	3632.03		22.60		4000.00	90.2		P
senic	75-125	2897.58		800	U	4000.00	72.4		P
rium	75-125	2587.39		598.43		2000.00	104.4		P
Beryllium	75-125	1900.58		1.00	U	2000.00	95.0		P
Cadmium	75-125	1651.58		3.00	U	2000.00	82.5		P
lcium	75-125	76880.43		56154.44		20000.00	103.6		P
romium	75-125	4022.11		2069.42		2000.00	97.6		P
Cobalt	75-125	1729.61		3.00	U	2000.00	86.4		P
pper	75-125	3567.54		3.00	U	4000.00	89.2		P
on	75-125	17285.09		4.00	U	20000.00	86.4		P
Lead	75-125	3383.33		30.19		4000.00	83.8		P
gnesium	75-125	216720.00		353571.71		20000.00	-3684.3		P
nganese	75-125	8912.08		5075.49		4000.00	95.9		P
Mercury	75-125	1.96		0.20	U	2.00	98.0		CV
ckel	75-125	3478.48		33.16		4000.00	86.1		P
tassium	75-125	45238.63		26347.01		20000.00	94.5		P
Selenium	75-125	3824.35		58.56		4000.00	93.9		P
Silver	75-125	1623.74		3.00	U	2000.00	81.2		P
dium	75-125	46437.08		10525.04		36400.00	98.7		P
allium	75-125	3004.47		57.00	U	4000.00	75.1		P
Vanadium	75-125	1819.82		10.90		2000.00	90.4		P
nc	75-125	5034.35		1634.89		4000.00	85.0		P
lybdenum	75-125	1679.48		8.16		2000.00	83.6		P
Lithium	75-125	2065.29		54.54		2000.00	100.5		P
ontium	75-125	2738.59		597.98		2000.00	102.0		P
	75-125	4021.85		2500.00	U	4000.00	100.5		A
ChromiumVI	75-125	527.28		470.29		50.00	114.0		A

mments:

CLP_EXTRACT_RESULTS

FORM V (PART 1) - IN

6

DUPLICATES

FIELD SAMPLE NO.

SKW-01 D

Client : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

Lab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11____

Matrix : TCLP EXTRACT____

Level (low/med): ______

Concentration Units (ug/L or mg/kg dry weight): UG/L_

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum		1332.10		1761.80		23.4		P
Antimony		22.60		13.40		51.1		P
Arsenic		800	U	800	U			P
Barium		598.40		798.40		28.6		P
Beryllium		1.00	U	1.00	U			P
Cadmium		3.00	U	3.00	U			P
Calcium		56154.40		62662.80		11.0		P
Chromium		2063.40		2307.40		10.9		P
Cobalt		3.00	U	3.00	U			P
Copper		3.00	U	3.00	U			P
Iron		4.00	U	4.00	U			P
Lead		30.20		28.20		6.8		P
Magnesium		953571.70		1136300.00		17.5		P
Manganese		5076.50		5661.50		10.9		P
Mercury		0.20	U	0.20	U			CV
Nickel		33.20		36.10		8.4		P
Potassium		26347.00		29511.40		11.3		P
Selenium		68.60		47.00		37.4		P
Silver		3.00	U	3.00	U			P
Sodium		10525.00		12367.00		16.1		P
Thallium		57.00	U	57.00	U			P
Vanadium								NR
Zinc		1634.90		1840.10		11.8		P
Molybdenum		8.20		12.20		39.2		P
Lithium		54.50		62.40		13.5		P
Strontium								NR
Tin		2500.00	U	2500.00	U			A
ChromiumVI		470.30		493.10		4.7		A

9

ICP SERIAL DILUTION

FIELD SAMPLE NO.

SKW-01

Client : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

Lab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11____

Matrix : TCLP EXTRACT___

Level (low/med): ____

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Aluminum	1392.10		1417.80		1.80		P
Antimony	22.60		65.20		188.5		P
Arsenic	11.00	U	55.00	U			NR
Barium	598.40		596.20		0.40		P
Beryllium	1.00	U	5.00	U			NR
Cadmium	3.00	U	15.00	U			NR
Calcium	56154.40		58851.70		4.80		P
Chromium	2069.40		2142.00		3.50		P
Cobalt	3.00	U	15.00	U			NR
Copper	3.00	U	15.00	U			NR
Iron	4.00	U	20.00	U			NR
Lead	30.20		115.00	U			NR
Magnesium	953571.70		953494.60		0.00		P
Manganese	5076.50		5273.40		3.90		P
Mercury							CV
Nickel	33.20		43.50		31.00		P
Potassium	26347.00		28262.20		7.30		P
Selenium	68.60		120.00	U			NR
Silver	3.00	U	15.00	U			NR
Sodium	10525.00		10484.10		0.40		P
Thallium	57.00	U	285.00	U			NR
Vanadium	10.90		17.00		56.00		P
Zinc	1634.90		1753.00		7.20		P
Molybdenum	8.20		15.00	U			NR
Lithium	54.50		36.10		33.80		P
Strontium	698.00		691.40		0.90		P
Tin							P
ChromiumVI							A

00037

1

ORGANIC ANALYSES DATA SHEET

FIELD SAMPLE NO.

SKW-01

lient : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11_____

atrix : APLP EXTRACT___

Lab Sample ID: A28867___

evel (low/med): ________

Date Received: 08/16/90_

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	109	_		P
7440-36-0	Antimony	51.6	_		P
7440-38-2	Arsenic	11.0	U		P
7440-39-3	Barium	254	_		P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	3.0	U		P
7440-70-2	Calcium	41400	_		P
7440-47-3	Chromium	1550	_		P
7440-48-4	Cobalt	3.0	U		P
7440-50-8	Copper	3.0	U		P
7439-89-6	Iron	40.9	_		P
7439-92-1	Lead	23.0	U		P
7439-95-4	Magnesium	21500	_		P
7439-96-5	Manganese	2.0	U		P
7439-97-6	Mercury	0.20	U		CV
7440-02-0	Nickel	7.2	_		P
7440-09-7	Potassium	38000	_		P
7782-49-2	Selenium	53.4	_		P
7440-22-4	Silver	3.0	U		P
7440-23-5	Sodium	10100	_		P
7440-28-0	Thallium	57.0	U		P
7440-62-2	Vanadium	3.9	_		P
7440-66-6	Zinc	62.0	_		P
	Molybdenum	10.8	_		P
	Lithium	155	_		P
	Strontium	646	_		P
	Tin	2500	U		A
	ChromiumVI	1350	_		A

olor Before: YELLOW___ Clarity Before: CLEAR_ Texture: ______

olor After : COLORLESS Clarity After: CLEAR_ Artifacts: ______

omments:

APLP_EXTRACT_RESULTS

3
BLANKS

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11______

eparation Blank Matrix: APLP EXTRACT______

eparation Blank Concentration Units (ug/L or mg/kg): UG/L_

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
luminum									58.5		P
ntimony									13.0	U	P
rsenic									11.0	U	P
arium									64.9		P
eryllium									1.0	U	P
admium									3.0	U	P
alcium									140.3		P
hromium									2.0	U	P
obalt									3.0	U	P
opper									14.0		P
ron									42.7		P
ead									23.0	U	P
agnesium									110.4		P
anganese									4.3		P
ercury			0.2	U	0.2	U			0.2	U	CV
Nickel									9.0		P
otassium									376.0	U	P
elenium									24.0	U	P
Silver									3.0	U	P
odium									494.8		P
hallium									101.5		P
anadium									2.0	U	P
inc									63.7		P
olybdenum									3.0	U	P
ithium									2.0	U	P
Strontium									2.4		P
in									2500.0	U	A
hromiumVI									10.0	U	N

3

BLANKS

lient : VERSAR_DIV._24______

Site: SAIC_MIN._PROC.______

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11_____

reparation Blank Matrix: APLP FILTRATION BLANK

reparation Blank Concentration Units (ug/L or mg/kg): UG/L_

nalyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
luminum									30.9		P
ntimony									13.0	U	P
rsenic									11.0	U	P
arium									15.8		P
eryllium									1.1		P
admium									3.0	U	P
alcium									73.5		P
romium									2.5		P
obalt									3.0	U	P
opper									3.1		P
on									22.2		P
ead									23.0	U	P
agnesium									12.3		P
anganese									2.0	U	P
ercury									0.2	U	CV
ickel									5.0	U	P
otassium									602.1		P
elenium									24.0	U	P
ilver									3.0	U	P
odium									502.0		P
hallium									106.5		P
anadium									2.0	U	P
inc									30.8		P
olybdenum									3.0	U	P
thium									2.0	U	P
rontium									1.0	U	P
n									2500.0	U	A
romiumVI									10.0	U	NR

ICP SERIAL DILUTION

FIELD SAMPLE NO.

SKW-01

lient : VERSAR_DIV._24

Site: SAIC_MIN._PROC.

ab Name: VERSAR_INC. Control No.: 3312 Code: SAIC3DAT Batch: 11

Matrix : SOIL

Level (low/med):

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Aluminum	126199.40		132648.40				
Antimony	13.00	U	65.00	U	5.10		P
Arsenic	11.00	U	55.00	U			NR
Barium	1437.90		1520.00				NR
Beryllium	5.40		7.70		5.70		P
Cadmium	3.00	U	15.00	U	42.60		P
Calcium	77211.50		85237.40				NR
Chromium	16245.10		17957.10		10.40		P
Cobalt	10.60		15.00	U	10.50		P
Copper	36.80		53.00				NR
Iron	13162.80		14533.30		44.00		P
Lead	2835.00		3281.80		10.40		P
Magnesium	252530.00		254678.00		15.80		P
Manganese	15749.00		17393.60		0.80		P
Mercury					10.40		P
Nickel	167.00		200.20				CV
Potassium	28255.90		27414.70		19.90		P
Selenium	57.30		120.00	U	3.00		P
Silver	3.00	U	15.00	U			NR
Sodium	8087.70		8474.70				NR
Thallium	248.90		563.60		4.80		P
Vanadium	15.60		22.00		167.4		P
Zinc	33399.60		38693.50		41.00		P
Molybdenum	3.00	U	15.00	U	13.80		P
Lithium	13.30		22.70				NR
Strontium	1116.70		1174.30		70.70		P
Tin					5.20		P
ChromiumVI							P
							A

5A
SPIKE SAMPLE RECOVERY

FIELD SAMPLE NO.

SKW-01 S

Client : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

Lab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11____

Matrix : APLP EXTRACT___

Level (low/med): ____

Concentration Units (ug/L or mg/kg dry weight): UG/L_

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	
Aluminum	75-125	17801.25		109.00		25000.00	70.8		P
Antimony	75-125	3681.18		51.56		4000.00	90.7		P
Arsenic	75-125	3653.92		11.00	U	4000.00	91.3		P
Barium	75-125	2135.71		253.86		2000.00	94.1		P
Beryllium	75-125	1800.28		1.00	U	2000.00	90.0		P
Cadmium	75-125	1736.31		3.00	U	2000.00	86.8		P
Calcium	75-125	55396.86		41409.75		20000.00	69.9		P
Chromium	75-125	3274.78		1550.57		2000.00	86.2		P
Cobalt	75-125	1794.08		3.00	U	2000.00	89.7		P
Copper	75-125	3634.00		3.00	U	4000.00	90.8		P
Iron	75-125	17567.19		40.88		20000.00	87.6		P
Lead	75-125	3396.14		23.00	U	4000.00	84.9		P
Magnesium	75-125	37796.41		21491.53		20000.00	81.5		P
Manganese	75-125	3552.29		2.00	U	4000.00	88.8		P
Mercury	75-125	2.08		0.20	U	2.00	104.0		CV
Nickel	75-125	3534.63		7.16		4000.00	88.2		P
Potassium	75-125	53095.03		37970.15		20000.00	75.6		P
Selenium	75-125	3691.65		53.43		4000.00	91.0		P
Silver	75-125	1688.80		3.00	U	2000.00	84.4		P
Sodium	75-125	43506.44		10117.73		36400.00	91.7		P
Thallium	75-125	3032.38		57.00	U	4000.00	75.8		P
Vanadium	75-125	1803.59		3.86		2000.00	90.0		P
Zinc	75-125	3429.03		61.97		4000.00	84.2		P
Molybdenum	75-125	1675.83		10.85		2000.00	83.2		P
Lithium	75-125	2065.03		155.46		2000.00	95.5		P
Strontium	75-125	2447.60		646.07		2000.00	90.1		P
Tin	75-125	3349.82		2500.00	U	4000.00	83.7		A
ChromiumVI	75-125	1464.84		1350.88		50.00	227.9		A

mments:
APLP_EXTRACT_RESULTS

FORM V (PART 1) - IN

6
DUPLICATES

FIELD SAMPLE NO.

SKW-01 D

C .ent : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

ab Name: VERSAR_INC. Control No.: 3312____ Code: SAIC3DAT Batch: 11____

atrix : APLP EXTRACT____

Level (low/med): ______

Concentration Units (ug/L or mg/kg dry weight): UG/L_

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum		109.00		49.20		75.6		P
Antimony		51.60		49.50		4.2		P
Arsenic		11.00	U	11.00	U			P
Barium		253.90		210.80		18.5		P
Beryllium		1.00	U	1.00	U			P
Cadmium		3.00	U	3.00	U			P
Calcium		41409.80		34466.70		18.3		P
Chromium		1550.60		1291.90		18.2		P
Cobalt		3.00	U	3.00	U			P
Copper		3.00	U	3.00	U			P
Iron		40.90		51.50		22.9		P
Lead		23.00	U	23.00	U			P
Magnesium		21491.60		18012.80		17.6		P
Manganese		2.00	U	3.00				P
Mercury		0.20	U	0.20	U			CV
Nickel		7.20		5.00	U			P
Potassium		37570.20		32062.40		15.9		P
Selenium		53.40		72.70		30.6		P
Silver		3.00	U	3.00	U			P
Sodium		10117.70		8353.50		19.1		P
Thallium		57.00	U	57.00	U			P
Vanadium		3.90		3.50		10.8		P
Zinc		62.00		59.40		4.3		P
Molybdenum		10.80		8.40		25.0		P
Lithium		155.50		129.90		17.9		P
Strontium		546.10		538.80		18.1		P
Tin		2500.00	U	2500.00	U			A
ChromiumVI		1350.90		1396.50		3.3		A

ICP SERIAL DILUTION

FIELD SAMPLE NO.

SKW-01

ent : VERSAR_DIV._24______ Site: SAIC_MIN._PROC.

Name: VERSAR_INC. Control No.: 3312____ Code: SAICBDAT Batch: 11______

ix : APLP EXTRACT___

Level (low/med): ______

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Aluminum	109.00		116.20		6.60		P
Antimony	51.60		70.00		35.70		P
Arsenic	11.00	U	55.00	U			NR
Barium	253.90		257.20		1.30		P
Beryllium	1.00	U	5.00	U			NR
Cadmium	3.00	U	18.00				NR
Calcium	41409.80		43118.70		4.10		P
Chromium	1550.60		1618.40		4.40		P
Cobalt	3.00	U	15.00	U			NR
Copper	3.00	U	16.50				NR
Iron	40.90		41.20		0.70		P
Lead	33.00	U	115.00	U			NR
Magnesium	21491.60		22929.80		6.70		P
Manganese	2.00	U	10.00	U			NR
Mercury							CV
Nickel	7.20		25.00	U			NR
Potassium	37970.20		42406.70		11.70		P
Selenium	53.40		120.00	U			NR
Silver	3.00	U	15.00	U			NR
Sodium	10117.70		10166.40		0.50		P
Thallium	57.00	U	503.70				NR
Vanadium	3.90		10.00	U			NR
Zinc	52.00		75.20		21.30		P
Molybdenum	10.80		15.00	U			NR
Lithium	155.50		140.00		10.00		P
Strontium	646.10		653.40		1.10		P
Tin							P
ChromiumVI							A

2

Attachment 2

Macalloy Total Metal Results

Page

U.S. NELS, INC.

SOURCE SAMPLING FOR HEXAVALENT CHROME EMISSIONS

MACALLOY CORPORATION

FURNACE NO. 15

CHARLESTON, SOUTH CAROLINA

OCTOBER 1991

Dated: November 12, 1991

Submitted By:

W. Brockel

Steven W. Brockel, P.E.
Senior Consultant

1.0 PROCESS DESCRIPTION

Macalloy Corporation of Charleston, South Carolina, is a smelting facility that manufactures ferrochrome. The raw material used in this process are chromite ores, by-product coke, and gravel, which are received by rail, ship or barge.

Macalloy has two electric smelting furnaces numbered 14 and 15. Emissions from the furnaces are controlled by two electrostatic precipitators. Originally (1976), two 50,000 acfm baghouses were used to collect emissions during tapping operations which occur fifteen times per day and last approximately 30 - 40 minutes each tap.

In 1988 a third baghouse was installed, the furnace canopy hoods were extended, and auxiliary dust hoods were added to capture emissions escaping from the main furnace canopy hoods. Each furnace has two auxiliary hood segments. The two segments for one furnace are located on opposite sides of the furnace. The hood opening consists of slots which extend around the edge of the canopy hood (see attached schematic diagram).

The three baghouses provided a total of 150,000 acfm of capacity for the two furnaces, or 75,000 acfm for each furnace. The distribution of flow for one of the furnaces is 25,000 acfm total for the auxiliary hood segments and 50,000 acfm for the tap hood. With only one furnace in operation and three baghouses in operation, the hoods will have higher air flows than with two furnaces operating. The air flows through the hoods and baghouses were recently measured with only one No. 15 furnace in operation. Based on these tests, it was determined that the flow through each of the baghouses was significantly lower than the design flow. Operating with only two baghouses would achieve essentially the same flow as operating with three baghouses. With one furnace and two baghouses operating, the flow through the auxiliary hoods will be 30,000 acfm and the flow through the tap hoods will be 70,000 acfm. These hood flows are effective in controlling the emissions from the furnace.

To upgrade the fume collection system for a two furnace operation, two additional

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baghouses of 50,000 acfm each are to be installed to operate with the No. 14 furnace. Two of the existing baghouses will be used for control on No. 15 furnace. Each furnace will have two dedicated baghouses with a total air flow of 100,000 acfm per furnace.

	Existing Two Furnace Operation	Proposed Two Furnace Operation	Increase
Auxiliary Hoods per Furnace	25,000	30,000	20%
Tap Hood per Furnace	50,000	70,000	40%
Flow per Furnace	75,000	100,000	33%
Total Both Furnaces	150,000	200,000	33%

2.0 DUST CHARACTERISTICS

A typical chemical analysis of the dust collected by the present system is attached. Unlike the dust collected in the main furnace system, i.e. the electrostatic precipitators, this secondary dust contains no hexavalent chromium and is not considered to be a hazardous waste. Recent TCLP tests (3 on 1/12/90 and 3 on 12/10/90) indicated less than 0.1 mg/l for hexavalent chromium.

3.0 EMISSION ESTIMATES

The present system of three baghouses collect approximately 2100 lbs of dust per day when two furnaces are operating. After installation of two baghouses for No. 14 furnace along with the operations of two existing baghouses for No. 15 furnace, the increased flow into the hoods will increase the amount of fumes and therefore the amount of particulate collected. An increase of dust collection of 40% is assumed.

The increased dust collected is therefore:

1.4 x 2100 lbs/day = 2940 lbs/day

The amount of dust collected per hour is:

$$\frac{2940 \text{ lbs/day}}{24 \text{ hrs}} = 122.5 \text{ lbs/hr}$$

Assume the collection efficiency of the baghouses is 98%. The emissions after controls would be:

$$122.5 \text{ lbs} \times .02 = 2.45 \text{ lbs/hr}$$

The emissions associated with the two new baghouses for No. 14 furnace is:

$$\text{before controls emissions} = \frac{122.5 \text{ lbs/hr}}{2} = 61.25 \text{ lbs/hr}$$

$$\text{after controls emissions} = \frac{2.45}{2} \text{ lbs/hr} = 1.23 \text{ lbs/hr}$$

No. 7480

9-17-81

Pag

TABLE 1

SUMMARY OF TEST RESULTS FOR HEXAVALENT CHROME EMISSIONS FURNACE NO. 15

MACALLOY CORPORATION
CHARLESTON, SOUTH CAROLINA

Date of Test	10/9/91	10/9/91	10/9/91
Sampling Location	Furnace No. 15 Stack		
Test Run Number	M-15-1HC	M-15-2HC	M-15-3HC
Operating Data (1):			
Megawatt Load, MW	33.9	34.0	33.75
Temp. into ESP, degrees F	183	178	180
Temp. into Cond. Tower, degrees F	555	583	627
I.D. Fan Opening, %	95	84	83
Opacity, %	4.7	5.2	5.7
Flue Gas Characteristics:			
Gas Flow, dscfm	152,012	139,616	144,400
Gas Flow, acfm	200,054	184,004	191,523
Temperature, degrees F	172	173	177
Moisture Content, % by vol.	10.0	9.9	10.0
O2 at Sampling Location, %	16.2	16.1	16.5
Measured Particulate Emissions (2)			
lbs/hr	0.0064	0.0028	0.0050
lbs/MWH	0.00019	0.00008	0.00015
Average lbs/MWH		0.00014	

.0048 #

1). See Appendix 3 for additional operating data.

Page 6
ATT. No. 2

CC. J. Cumb
T. Nelson
BAGHOUSE Dus

GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

Molly F. Greene
President

George C. Greene, P.E., Ph.D.
Vice President
SC Registration No. 9103

Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
VA	00151
TN	02934
WI	999887790

CERTIFICATE OF ANALYSIS

Client: MacAlloy Corporation
P.O. Box 130
Charleston, South Carolina 29402
Contact: Mr. Tim Nelson

Date: 08/17/92

Released by:
QA/QC Officer

cc: MALY00131 Project Manager: Tammi Fitzgerald Page No.: 1

Sample ID : Baghouse Dust
Lab ID : 9207610-02
Matrix : Misc.
Date Collected : 07/30/92
Date Received : 07/30/92
Priority : Routine
Collector : Client

Metals Analysis

Aluminum	15500 ppm	Al_2O_3	~~[illegible]%~~	5.10%
Calcium	3760 ppm	CaO	0.53%	
Chromium	4450 ppm	Cr_2O_3	0.65%	
Iron	14300 ppm	FeO	1.84%	
Magnesium	105000 ppm	MgO	17.57%	
Manganese	1730 ppm	MnO	0.22%	
Lead	803 ppm	PbO	865 ppm	
Silicon	193 ppm	SiO_2	303 ppm	

General Chemistry

Total Carbon	59500 ppm	5.95%
Solids, Volatile	41800 ppm	4.18%

The following preparation procedures were performed:
Acid Digestion Prep for Metals

3

Attachment 3

EPA Background Document

LAN ASSOCIATES INC

Memo to: File #2.3269.22
CCMA/Witmer Road Construction

Date: September 22, 1999

Copies to: Ed Bredniak

From: Skip Hutton 10/4/99

Subject: Review of K090 and K091 Regulations

On August 30, 1999, the writer was asked by Mr. Guy Van Doren to review documents obtained by Sheila Harty from the RCRA Information Center's Hotline. Copies of the documents are included as Attachment 1. The documents include:

1) *Federal Register,* Volume 46, No. 11, U.S. Environmental Protection Agency (EPA), 40 CFR Part 261, Friday, January 16, 1981;

2) *Federal Register,* Volume 50, No. 191, EPA, 40 CFR Part 261, Wednesday, October 2, 1985; and

3) *Federal Register,* Volume 53, No. 177, EPA, 40 CFR Parts 261 and 302, Tuesday, September 13, 1988.

4) Undated and untitled material, which appears to be background documentation for listing K090, K091, and K092 as hazardous waste. The document appears to have been generated in 1980 and is probably a background document for the EPA rules and regulations drafted on January 16, 1981.

The four documents record the rulemaking history by the EPA, leading up to the listing of ferrochromium silicon, control dust, or sludge as a hazardous waste (K090), and ferrochromium emission control dust or sludge as a hazardous waste (K091). These wastes are listed in the 1988 document as hazardous for the following factors:

1. They contain high concentrations of chromium;
2. Chromium is toxic and is recorded in the list of hazardous constituents; and
3. Chromium has been shown to leach from the waste, thus, groundwater contamination could occur if the wastes are mismanaged;

"*These and other factors considered by the Agency are further explained in the listing background documents for ferroalloys.*" The RCRA Information Center said that it would send the background listing document. The undated and untitled document provided does describe the physical size, chemical nature, and hazardous properties of the listed wastes. However, whether this unidentified material is the background documentation is uncertain and the photocopy provided is very poor quality. The writer has requested that Ms. Harty contact the RCRA Information Center again and try to obtain a background listing document for the 1988 rule or obtain a clearer copy of the document in hand and verify its date, title, and source as the listing documentation.

The writer has reviewed what appears to be the 1980 background document for listing ferromanganese, ferrochromium, and ferrochromium silicone dust and sludges as hazardous waste. Ferromanganese was later dropped from the recommended listing of hazardous wastes, and ferrochromium and ferrochromium silicone were later listed as K090 and K091 hazardous wastes. On page 288, the unidentified document lists eight companies that produce ferrochromium, ferrochromium silicone, and ferromanganese in electric furnaces. These companies and the products they produce are included in Attachment 2. Please note that the poor quality of the photocopy provided by the RCRA Information Center makes the attachments taken from this document very hard to read. On page 291 of the document, the hazardous properties of the waste are described. The physical size and chemical nature of the waste are as follows:

> "*Ferroalloy production emission control dust and sludges consist primarily of sub-micron particles composed of oxides of various elements, including lead and chromium. The agency has data from two sources which indicate substantial amounts of lead and chromium are contained in ferromanganese and ferrochromium dust sludges. Dust and sludges from ferrochromium silicone production contain substantial concentration of chromium. These data are presented in Table 2 and 3.*" (See Attachment 3.)

Table 2 indicates that ferrochromium silicon samples collected from baghouse dust contain 41 parts per million (ppm) chromium. Table 2 also indicates that a sample of ferromanganese baghouse dust contained 32 ppm chromium. Table 3 records the chromium concentration of one sample of ferrochromium silicon dust collected at the furnace baghouse inlet at 4,400 ppm. The data contained in this document indicate that ferrochromium silicone baghouse dust ranges in concentration from 41 ppm to 4,400 ppm. The writer calculated the average concentration for the two dust samples at 2,220 ppm. This calculation is only based on two samples and a very large range of concentration exists between the two samples. In addition, the 41 ppm result is suspect.

In the EPA's response to comments from the Ferroalloy Association (page 303, Attachment 4), the EPA states that the 41 ppm concentration for chromium for baghouse dust sample was in error and that:

> "*data from another source indicates that chromium concentrations in ferrochromium silicone emission control dust/sludges might be much higher. For this reason, EPA believes that the value of 41 ppm is understated and will continue to list this waste as hazardous.*"

The reason for this determination is because the same baghouse dust sample that produced a total chromium concentration of 41 ppm had a leaching concentration in distilled water of 190 ppm. Thus, the EPA determined that the 41 ppm for the baghouse total chromium was in error.

Based on the information provided in what appears to be the 1980 EPA background document, the writer believes that the definition provided in the CCMA Witmer Road, Revised Site-

Screening Work Plan (Attachment 5), is accurate. Ferrochromium dust is defined in the Revised Site-Screening Work Plan as containing clay size (1.0 to 5.0 microns) particles. This definition is conservative compared to the EPA background document, which states that a ferroalloy emission control dust consists primarily of sub-micron particles. The Revised Site-Screening Work Plan also stated that the ferrochromium dust contained total chromium concentrations of approximately 700 to 1,500 milligrams per kilogram (mg/kg). This range is conservative compared to the calculated average (2,220 ppm) from the 1980 EPA background document results for of total chromium.

In summary, the writer has completed a review of the documents from the RCRA Information Center, which included a review of what is presumed to be the1980 background document for the listing of K090 and K091 hazardous waste. This document contains a description of the properties of ferrochromium and ferrochromium silicone control dust and sludges. The description contained in the EPA document supports the Revised Site-Screening Work Plan definition of ferrochromium dust. The EPA background document reveals the dust consists of sub-micron size particles; the average total chromium concentration in the dust is approximately 2,220 ppm. Compared to the EPA background document, the Revised Site-Screening Work Plan is conservative because it states that the average particle size of ferrochromium dust occurs within the 1.0 to 5.0 micron size range and that the dust contains a total chromium concentration of approximately 700 to 1,500 milligrams per kilogram.

HHH/sth
2.3269.22-M-K090 Review-990901-hhh

Attachments: #1–*Federal Register,* Vol. 46, No. 11, EPA, 40 CFR Part 261, Jan. 16, 1981;
Federal Register, Vol. 50, No. 191, EPA, 40 CFR Part 261, Oct. 2, 1985;
Federal Register, Vol. 53, No. 177, EPA, 40 CFR Parts 261 & 302, Sept. 13, 1988;
background listing document (no title, date, or source)
#2–Companies that produce ferrochromium, ferrochromium silicone, and ferromanganese and their products.
#3–Tables 2 and 3 listing physical size and chemical properties of ferrochromium, ferrochromium silicone, and ferromanganese from EPA background listing document (no title, date, or source).
#4–EPA Comments in Response to Ferroalloy Association.
#5–Site-Screening Work Plan for SKW Metals and Alloys, Inc., Witmer Road site.

ATTACHMENT 1

cc

EPA said are exactly the same for K090 + K091

THANK YOU FOR YOUR CONCERN ABOUT THE ENVIRONMENT

THE ENCLOSED MATERIALS ARE PROVIDED BY:

U.S. Environmental Protection Agency
Office of Solid Waste
RCRA Information Center (RIC)
401 M Street, SW (Mail Code 5305)
Washington, DC 20460

The RCRA Information Center (RIC) provides information about the proper management of hazardous and nonhazardous solid waste. Information is available from RIC on documents used in writing regulations to implement the Resource Conservation and Recovery Act as well as EPA publications produced for public guidance on the various aspects of recycling, treatment, and disposal of hazardous and solid waste.

For additional publications, call the RCRA/SF/OUST Hotline at 1-800-424-9346.

K090

OSWFR88017

federal register

Tuesday
September 13, 1988

Part II

Environmental Protection Agency

40 CFR Parts 261 and 302

Hazardous Waste Management System; Identification and Listing of Hazardous Waste; and Designation, Reportable Quantities, and Notification; Final Rule sections 8002 (f) and (p) by the statutory deadline. *Concerned Citizens of Adamstown* v. *EPA*, Civ. No. 84-3041. (D.D.C.). As a result, the District Court ordered EPA to complete the studies and to take action on a planned proposed rulemaking reinterpreting the scope of the mining waste exclusion.

On October 2, 1985, under the court order in *Adamstown*, EPA proposed to narrow the scope of the mining waste exclusion (50 FR 40292). In preparing this proposed reinterpretation, EPA was unable to find any accepted standard definitions, *ie.*, plain meanings, for the terms of the mining waste exclusion, particularly the term "processing." Therefore, EPA next looked to the legislative history to aid in defining the intended scope of the mining waste exclusion. The Agency's review indicated that the exclusion was intended to cover the category of wastes that were designated as "special wastes" in the proposed hazardous waste regulations at 43 FR 58946 (December 18, 1978). These "special wastes" included "solid wastes from the extraction, beneficiation, and processing of ores and minerals." As mentioned earlier, EPA interpreted "special wastes" to be those that are generated in large volumes and pose less of a hazard than other hazardous wastes. EPA adopted this "high volume, low hazard" concept as the basis for the proposed reinterpretation. Specifically, EPA proposed to reinterpret the exclusion so that red and brown bauxite refining muds, phosphogypsum, slag from phosphorous reduction, and slag from primary metal smelters would be the only processing wastes covered by the mining waste exclusion because EPA believed these were the only processing wastes that met the "special waste" criteria. However, EPA requested that commenters identify any other processing wastes that met the "special waste" criteria and, therefore, should remain within the mining waste exclusion.

Under this proposed reinterpretation, the suspension of the six smelter waste listings would be removed since they would no longer be considered "special wastes". Therefore, the notice proposed to relist the six smelter wastes.[1]

Subsequently, on October 9, 1986, the Agency announced that it was withdrawing its proposed reinterpretation (51 FR 36233). The Agency explained that it was withdrawing the reinterpretation because the terms "high volume" and "low hazard" had not been quantified in the proposal and, therefore, the Agency was unable to determine the status of additional wastes nominated by commenters as "special wastes" (51 FR 36234). While it did not view the "high volume, low hazard" standard as inherently unsound, EPA pointed to various definitional problems it faced in determining how to group and classify these wastes. The Agency concluded that its proposal had to be withdrawn because it failed to set out "practically applicable criteria for distinguishing processing from non-processing wastes" and because there was insufficient time to repropose a rule in light of the *Adamstown* deadline. The withdrawal of the proposed reinterpretation effectively continued the suspension of the six smelter waste listings.

Subsequently, two suits were filed against EPA challenging the Agency's decision to withdraw its proposed reinterpretation of the mining waste exclusion. The cases, *Environmental Defense Fund* v. *EPA*, No. 86-1584 (D.C. Cir.) ("*EDF*") and *Hazardous Waste Treatment Council* v. *EPA*, No. 86-1691 (D.C. Cir.) were decided on July 29, 1988.

B. Court Decision

The U.S. Court of Appeals for the D.C. Circuit ruled in *EDF* that EPA's decision to withdraw the proposed reinterpretation and failure to relist the six smelting and refining wastes was arbitrary and capricious. The Court found that EPA's inclusion of all smelting and refining wastes in the "Bevill" exclusion for ore processing wastes was "impermissibly overbroad" and contrary to Congressional intent. *EDF v. EPA*, No. 86-1584 (D.C. Cir. July 29, 1988), slip op. at 20. While the court conceded that the statutory term "processing" is ambiguous, the Court nonetheless found EPA's interpretation to be unreasonable in light of "clear" legislative history that suggested that Congress had intended the Bevill Amendment to be limited to those ore processing wastes which meet EPA's 1978 "special waste" concept, *i.e.*, those solid wastes which are high volume and low hazard. *Id.* at 22, 25-26.

The Court also rejected EPA's justification for withdrawal of the proposed reinterpretation. The Court noted that EPA could have asked the district court for additional time to refine its 1985 proposal. By withdrawing the proposed reinterpretation in its entirety, including the relisting of the six smelter wastes, EPA failed to meet its statutory obligation either to study smelting and refining wastes under 8002(p) or to reinterpret the scope of the exclusion. Slip op. at 28-29.

In its order for relief, the Court directed EPA to relist the six smelter wastes by August 31, 1988. The Court noted that, regardless of the status of any additional processing wastes, the six smelter wastes clearly would not fit any definition of "high volume, low hazard." Slip op. at 30. In summary, the Court found that the six wastes cannot, as a matter of law, be excluded from regulation under the Bevill amendment and must be regulated under Subtitle C if they meet the listing or identification criteria for hazardous wastes under 40 CFR 261.10 and 261.11.

In addition to relisting the six wastes, EPA must, by October 15th, propose which "high volume, low hazard" wastes from ore processing it will study under section 8002(p) of RCRA. EPA must finalize that proposal by February 15, 1989, and submit a Report to Congress on the large-volume processing wastes on the final February 15th list by July 31, 1989.[2] In a forthcoming Federal Register notice, EPA will propose new criteria for determining which ore processing wastes are "high volume, low hazard" and will designate those wastes which meet the criteria for study under section 8002(p).

II. Description of and Rationale for Today's Action

A. 1981 Suspensions are Lifted

As directed by court order, EPA . today reinstating the hazardous waste listing for six wastes associated with smelting operations (see Table 1).[3] These wastes were originally listed on May 19, 1980, and July 16, 1980, but were suspended from the listing regulations after the Bevill Amendment was enacte (see 45 FR 76618, November 19, 1980, 46 FR 4615, January 16, 1981, and 46 FR 27473, May 20, 1981). As a result of today's action, the six wastes are again

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[1] The two other waste streams suspended in 1981 (K067 and K068), were not proposed for relisting in 1985 and are not relisted here today. As explained in 1985, these two waste streams do not meet EPA's current definition of solid waste (see 50 FR 40296-97).

[2] In its July 29 opinion, the Court initially mandated deadlines of August 31, 1988; December 31, 1988; and January 31, 1989, respectively. On August 23, the Court granted in part EPA's petition for rehearing and modified the schedule to the one listed above.

[3] In a letter dated August 25, 1988 from counsel for Phelps Dodge Corporation, they suggested that the Agency could meet the recent order of the United States Court of Appeal ordering EPA to regulate six mineral processing wastes as hazardous wastes under Subtitle C of RCRA by simply removing these wastes from the Bevill exclusion and not relisting the wastes. The Agenc wishes to clarify that its decision to list these wastes today is based on its evaluation of the list criteria (*i.e.*, these wastes are hazardous) as well the court finding that these wastes are not Bevill wastes. For further discussion, see Section III of preamble.

There is a further question relating to relisting these surface impoundment solids—whether they can be classified as "solid wastes" when they are destined for recycling by being reclaimed to recover contained lead values. Based on information compiled in 1985, it appears that large percentages of these surface impoundment solids are eventually removed from surface impoundments and reclaimed, albeit the period between generation and reclamation often extended for years. (50 FR 40297, October 2, 1985.) The Agency also anticipated that the percentage of surface impoundment solids being reclaimed could decrease due to declining lead demand. Id.

In response to the court's opinion in *American Mining Congress* v. *EPA*, 824 F. 2d 1177 (D.C. Cir. 1987), EPA has tentatively interpreted its jurisdiction over hazardous secondary material recycling activities to exclude those materials that are reused within an industry's on-going production process. Recycling activities involving elements of discarding, on the other hand, can continue to involve solid wastes. (53 FR 519, January 8, 1988.) EPA also proposed that in evaluating whether sludges (such as the primary lead surface impoundment solids at issue here) and by-products being reclaimed can be considered to be solid wastes, it would evaluate the following factors bearing on whether the material was being discarded or was being used as part of a continuous on-going manufacturing process: (a) Whether the sludge or by-product is typically recycled on an industry-wide basis; (b) whether the material is replacing a raw material and the degree to which it is similar in composition to the raw material; (c) the relation of the recovery practice to the principal activity of the facility; and (d) whether the secondary material is managed in a way designed to minimize loss, plus other relevant factors. (53 FR 528.) EPA had previously proposed use of these same factors in its discussion of whether to list the primary lead surface impoundment solids in the October, 1985 rulemaking. (50 FR 40, 296–297.)

It seems clear that surface impoundments in the primary lead industry are not part of the primary lead production process, and that the solids in these impoundments are not in-process materials but rather are generated incidentally in the course of wastewater treatment. The purpose of surface impoundments in the primary lead industry is to provide quiescent settling to remove pollutants from wastewater before discharge. (Ponds are sometimes used to equalize wastewater flow into treatment units as well.) Indeed, industry characterized its impoundments as wastewater treatment units in all of its submittals to the Agency during the rulemaking to develop effluent limitations guidelines for the industry. (The industry's argument, in fact, was that surface impoundments are *essential* wastewater treatment devices in the primary lead industry, and could not even be replaced with tanks.) Any recovery of the solids that settle out, or are precipitated out of the wastewater routed to these surface impoundments, is thus incidental to the principal purpose of wastewater treatment. Consequently, these wastewater treatment impoundments are RCRA subtitle C regulated units.[4]

Another way of ascertaining whether these surface impoundment solids (*i.e.*, wastewater treatment solids) are in-process materials or wastes is to compare the mode of handling and storage of these solids with the way raw materials to the primary lead process are handled and stored before smelting. The surface impoundment solids are stored for long periods of time (often years) under tens of millions of gallons of water. The surface impoundments in which they are generated and stored are not designed to hold these solids securely. In fact, as has long been documented, surface impoundments are inherently insecure storage units with a high potential for contaminating groundwater. (See, *e.g.*, 50 FR 40297.) In contrast, normal lead ores are stored securely for short periods of time before being charged to the smelter; to the Agency's knowledge they are never stored underwater. Materials held insecurely underwater for long periods of time in a manner completely unlike the way raw materials are normally handled in the industry are not in-process materials and are being discarded, in the Agency's view.[5] Indeed, these surface impoundment solids might also be covered by the speculative accumulation provisions in 40 CFR 261.2(c)(4) simply due to the length of time they are accumulated.

Given that the purpose of surface impoundments in this industry is to trea wastewater and not to serve as an adjunct to the lead smelting process, EPA does not need to base its decision on the proposed factors discussed in the October 2, 1985 and January 8, 1988 proposals. However, the Agency notes that its decision to list would be the same were it to rely on these factors. The method in which a material is handled before recycling is a relevant decision factor (and was a basis for EPA's proposed decision in 1985), and a discussed above, storage of long duration in insecure surface impoundments is not commensurate with calling a material a valuable in-process material which is not being discarded.[6]

Other issues relating to whether the materials being listed today can be classified as solid wastes when they ar recycled are addressed in a separate background document entitled "Background Information for Listing of Smelting Wastes—Solid Waste Determination." This document is contained in the public docket for today's notice.

D. Primary Zinc Smelting and Refining: EPA Hazardous Waste No. K066—Sludge from Treatment of Process Wastewater and/or Acid Plant Blowdown (T)

In primary zinc smelting and refining processes, cadmium and lead contaminants present in the raw materials are carried through numerou processes. These contaminants are subsequently found in sludges generat by treatment of process wastewater and/or acid plant blowdown. It is thes sludges (*i.e.*, not the process wastewaters) that is the subject of this listing. The Agency's decision to subje these wastes to RCRA Subtitle C requirements includes consideration o the following factors:

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[4] See letter from Douglas McAllister to James Berlow, dated May 27, 1983, and the memorandum from Mark Hereth to James Berlow, dated November 21, 1983. These documents are available in the public docket for today's notice.

[5] Once these wastes are actually removed from the impoundment and smelted, they would no longer be subject to RCRA, assuming they are resmelted in a primary lead process. (See, *e.g.*, 53 FR 31182, August 17, 1988, explaining the principle that a listed sludge or by-product can be indigenous to certain processes and so cease being waste when it actually is reclaimed.) Surface impoundments in which these wastes are generated and stored, however, remain regulated units.

[6] EPA notes that in its 1985 decision, it distinguished carefully between the lead surface impoundment wastes and two other materials (electrolytic anode slimes/sludges and cadmium plant leach residue) from primary zinc smelting, both of which EPA determined would not be soli wastes when they are recycled. This is because material are recycled (normally in the process f which they were generated) a short time after be generated, and are stored in a manner to avoid discarding (storage in bins or concrete basins) before they are recycled. The Agency found tha these were indeed in-process materials that are more commodity-like than waste-like and thus determined not to list them. (50 FR 40297.) EPA believes the distinction between these materia and the primary lead surface impoundment soli remains valid.

III. Future Action on These Listings

As explained above, today's action removes the suspension on the 1980 listings of these six wastes. As a result, EPA's determination that these wastes are hazardous is based on its evaluation of the hazardousness of these wastes in 1980. Since that time, EPA has received additional information regarding these six wastes. Some of these data were received as comments to EPA's 1985 proposed reinterpretation. Other data were received more recently as EPA was preparing an 8002(p) study and Report to Congress on these wastes and other waste streams from the lead, copper, zinc, aluminum, and bauxite sectors.[8] The post-1980 data submitted to EPA are relevant primarily to issues other than the inherent hazardousness of these six wastes. They include revised waste generation rates, current waste management practices (including the extent to which the wastes are recycled), and industry economic data. To a lesser degree, EPA has received data on the physical/chemical properties of these wastes and their hazardousness.

Since the issuance of the Court's opinion, EPA has conducted a review of some of the waste characterization data received since 1980. While EPA did not, in light of the short time-frame for publication of this rule, exhaustively evaluate all of the post-1980 waste characterization data submitted, the review that was conducted tends to corroborate and confirm that the six waste streams meet the criteria for hazardousness found in section 3001(a) of RCRA. EPA's review suggests that no data have been submitted which would clearly contradict EPA's 1980 decision to list the six smelter wastes, *i.e.*, no data are available to refute the basic conclusion that these wastes contain significant concentrations of toxic constituents and that the constituents are mobile and persistent. Therefore, EPA continues to believe that each of these wastes meets the criteria for listing as hazardous waste found at 40 CFR 261.11 and sees no reason not to resume the 1980 listings of these six wastes at this time.

EPA nevertheless intends to thoroughly evaluate all information and comments submitted since 1980 regarding the hazardousness of these six wastes. Responses to a number of the comments are included in the docket for today's notice. The Agency will respond to the remainder of the comments within the next few months. EPA will treat any post-1980 submissions as a petition for rulemaking to reconsider these listings. EPA will publish a subsequent Federal Register notice on the results of its more detailed evaluation of these six wastes pursuant to 40 CFR 260.20. That evaluation will consider new data received in a timely manner as well as the currently available data.

IV. State Authority

A. Applicability of Rules in Authorized States

Under section 3006 of RCRA, EPA may authorize qualified States to administer and enforce the RCRA program within the State. (See 40 CFR Part 271 for the standards and requirements for authorization.) Following authorization, EPA retains enforcement authority under sections 3008, 7003, and 3013 of RCRA, although authorized States have primary enforcement responsibility.

Prior to HSWA, a State with final authorization administered its hazardous waste program entirely in lieu of EPA administering the Federal program in that State. The Federal requirements no longer applied in the authorized State, and EPA could not issue permits for any facilities in the State that was authorized to permit. When new, more stringent Federal requirements were promulgated or enacted, the State was obliged to enact equivalent authority within specified time frames. New Federal requirements did not take effect in an authorized State until the State adopted the requirements as State law.

In contrast, under section 3006(g) of RCRA, 42 U.S.C. 6926(g), new requirements and prohibitions imposed by HSWA take effect in authorized States at the same time that they take effect in non-authorized States. EPA is directed to implement those requirements and prohibitions in authorized States, including the issuance of permits, until the State is granted authorization to do so. While States must still adopt HSWA-related provisions as State law to retain final authorization, the HSWA provisions apply in authorized States in the interim.

B. Effect on State Authorizations

Today's final listings are not effective in authorized States since the listings are not being issued pursuant to the HSWA. Thus, RCRA hazardous waste management standards for the wastes listed today will be applicable only in those States that do not have interim or final authorization by the effective date of this regulation. In authorized States, the standards will not be applicable until the State revises its program to adopt equivalent requirements under State law.

40 CFR 271.21(e)(2) requires that States that have final authorization mus modify their programs to reflect Federa program changes and must subsequen submit the modifications to EPA for approval. The deadline by which the State must modify its program to adopt today's rule is July 1, 1990, if no statutory change is needed or is July 1, 1991, if a statutory change is needed. These deadlines can be extended in certain cases (40 CFR 271.21(e)(3)). Onc EPA approves the modification, the State requirements become Subtitle C RCRA requirements.

States with authorized RCRA programs already may have regulations similar to those in today's rule. These State regulations have not been assessed against the Federal regulation being promulgated today to determine whether they meet the tests for authorization. Thus, a State is not authorized to carry out these requirements in lieu of EPA until the State program modification is submitted to EPA and approved. Of course, States with existing standards may continue to administer and enforce their standards as a matter of State law.

States that submit official application for final authorization less than 12 months after the effective date of these standards are not required to include standards equivalent to these standard in their application. However, the State must modify its program by the deadlines set forth in § 271.21(e). States that submit official applications for fina authorization 12 months after the effective date of these standards must include standards equivalent to these standards in their application. 40 CFR 271.3 sets forth the requirements a Stat must meet when submitting its final authorization application.

V. CERCLA Designation and Reportab Quantities

The wastes listed as hazardous in today's rule will, on the effective date, automatically become hazardous substances under section 101(14) CERCLA, as amended. CERCLA secti 103(a) requires that persons in charge o vessels or facilities from which a hazardous substance has been release in a quantity that is equal to or greater than its reportable quantity (RQ) immediately notify the National Response Center (at (800) 424–8802 or (202) 426–2675) of the release.

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[8] In light of the Court's order to relist the six smelter wastes, EPA does not plan to complete and submit this Report to Congress. However, some of the information collected will be used to develop a new Report, as required by the Court's order.

2. Capital Investment and Rates of Return

In its revised 1986 estimates, the Agency projected the average initial investment cost for compliance as a percent of normal annual capital expenditures to range from nominal (three to seven percent) in the aluminum, copper and lead sectors, to very large (40 to 65 percent) in the zinc and ferroalloys sectors. This result may be partly due to the abnormally depressed state of capital expenditures in the 1979–85 base period for some of these sectors. Non-growth or declining sectors generally can be expected to show very high ratios in this column due to low base capital investment figures. These estimates were also based on the extreme assumption of zero passthrough of costs to prices, a worst-case assumption that also tends to increase these ratios somewhat.

Similar reasoning may in part explain the 1986 estimates regarding the impact of this rule on rates of return on investment. In general, results here fell into two categories: The majority of sectors with maximum impacts on profit in the range of 1 to 3 percent, with zinc and ferroalloys showing compliance costs in the range of 8 to 36 percent of reductions in rate of return on investment. In part, these high percentages were due to higher than average RCRA compliance costs and in part due to lower than average baseline rates of return. Again, these results reflect the effect of all small volume processing wastes and not just the listed wastes for the five sectors.

Due to many of the Agency's estimating assumptions, these impact conclusions should be regarded as conservative on the high side.

3. Plant Closures and Employment Losses

Based on the Agency's 1986 analysis, plants in the ferroalloy subcategory might close as a result of removal of the Bevill Amendment exemption for these waste streams. However, all or most of these closures would be in ferroalloy segments other than those subject to today's listing for K090 (which the Agency estimates to have only two affected facilities), and none would be associated with K091 (which we believe would not be significantly affected by this rule). Most of the closures predicted in the 1986 analysis were associated with wastes (other than those being relisted today) that would be expected to be hazardous by virtue of the hazardous waste characteristics.

4. Compliance With Executive Order 12291

Sections 2 and 3 of Executive Order 12291 (46 FR 13193, February 9, 1981) require that a regulatory agency determine whether a new regulation will be "major" and, if so, that a Regulatory Impact Analysis be conducted. A major rule is defined as a regulation which is likely to result in:

1. An annual effect on the economy of $100 million or more;
2. A major increase in costs or prices for consumers; individual industries; Federal, State, and local government agencies; or geographic regions; or
3. Significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

Today's rule will have none of the above effects. Therefore, the Agency is not conducting a Regulatory Impact Analysis. This rule has been reviewed by the Office of Management and Budget (OMB).

VII. Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) of 1980 (Pub. L. 96–354) requires Federal regulatory agencies to consider "small entities" throughout the regulatory process. The RFA requires an initial screening analysis to be performed to determine whether a substantial number of small entities will be significantly affected by a regulation. If so, regulatory alternatives that eliminate or mitigate the impacts must be considered.

This section presents the results of the Agency's small business screening analysis, based on a review of industry plant ownership patterns and estimated compliance costs, as revised in 1986 following the October 1985 proposed rule. Based on this analysis, EPA concludes that there will not be a significant impact on a substantial number of small businesses.

In the nonferrous metals smelting and refining industry, the Small Business Administration (SBA) defines small entities based on employment levels. For most primary metal sectors, the criterion for a small entity is fewer than 750 employees; however, a higher threshold of 1,000 is used for some sectors. Based on the appropriate definitions for each sector, the Agency screened all the facilities in the ten industry sectors that were studied in detail and determined that, among these, only the ferroalloy sector contained facilities owned by small business enterprises. The 1985 analysis indicated further that none of the ferroalloy facilities owned by small businesses were among those projected to incur costs due to this reinterpretation. Since the 1986 revision did not significantly alter the list of plants or waste streams included in the EPA data file, this conclusion should remain valid.

VIII. Effective Date

A. Notice and Comment Requirements

Today's rule is being issued without additional prior notice and opportunity for comment. EPA is issuing this rule directly as final for a number of reason First, in light of the extremely short, on month time period allowed by the cour to relist these six wastes, EPA determined that a public comment period would be impracticable and would prevent EPA from meeting the explicit deadline set by the court's order. Furthermore, EPA believes that public comment is unnecessary. By today's action, EPA is merely removing the suspension from the listings that were finalized in 1980. These listings have already been through full notice and comment procedures. When the listings were suspended, EPA explaine that the only reason for suspension wa EPA's belief that these wastes fell within the scope of the Bevill exemptio EPA reiterated this view when it proposed its reinterpretation in 1985. F the most part, the appropriateness of listing of these wastes under the crite of section 3001(a) of RCRA was not issue in the 1985 rulemaking, only whether the wastes were Bevill wastes The Court of Appeals has now ruled th the six wastes are "clearly" not Bevill wastes. Thus, EPA's original 1980 decisions to list these six wastes is reinstated by today's action. EPA need not take public comment prior to reinstating the six listings. However, a described above in section III, EPA wil treat any information on the hazards posed by these wastes submitted after 1980 as a petition for rulemaking on th listings, and will publish the results of its more detailed review of this information in the Federal Register.

B. Notification

All persons who generate, transport, treat, store, or dispose of wastes which are covered by today's regulation must notify EPA or a State authorized by EP to operate the hazardous waste progra of their activities under Section 3010 o RCRA not later than December 12, 198 unless these persons previously have notified EPA or an authorized State th they generate, transport, treat, store, o dispose of hazardous wastes and have

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Ferroalloys:		
K090	Emission control dust or sludge from ferrochromium-silicon production.	(T)
K091	Emission control dust or sludge from ferrochromium production.	(T)
*	* *	* *

4. In Appendix VII—Basis for Listing Hazardous Waste, add the following in the appropriate numerical sequence:

Appendix VII—Basis for Listing Hazardous Waste

EPA hazardous waste number	Hazardous constituents for which listed
* *	* * *
K064	Lead, cadmium.
K065	Do.
K066	Do.
K088	Cyanide (complexes).
K090	Chromium.
K091	Do.
* *	* * *

PART 302—DESIGNATION, REPORTABLE QUANTITIES, AND NOTIFICATION

1. The authority citation for Part 30 continues to read as follows:

Authority: 42 U.S.C. 9602; secs. 311 and 501(a) and 33 U.S.C. 1321 and 1361.

2. In § 302.4(a), amend Table 302.4 adding the hazardous substances K06 K065, K066, K088, K090, and K091.

§ 302.4 Designation of hazardous substances.

(a) * * *

TABLE 302.4.—LIST OF HAZAROUS SUBSTANCES AND REPORTABLE QUANTITIES

Hazardous substance	CASRN	Regulatory synonyms	Statutory			Final RQ	
			RQ	Code	RCRA waste No.	Category	Pounds
*	*	*	*	*	*	*	
K064							
Acid plant blowdown slurry/sludge resulting from thickening of blowdown slurry from primary copper production			*1	4	K064	X	[illegible]
K065							
Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities			*1	4	K065	X	[illegible]
K066							
Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production			*1	4	K066	X	[illegible]
*	*	*	*	*	*	*	
K088							
Spent potliners from primary aluminum reduction			*1	4	K088	X	[illegible]
K090							
Emission control dust or sludge from ferrochromiumsilicon production			*1	4	K090	X	[illegible]
K091							
Emission control dust or sludge from ferrochromium production			*1	4	K091	X	[illegible]

* * * * *

[FR Doc. 88-20780 Filed 9-12-88; 8:45 am]

BILLING CODE 6560-50-M

K090

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ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 261

[SWH-FRL 2871-7]

Mining Waste Exclusion

AGENCY: Environmental Protection Agency.

ACTION: Notice of proposed rulemaking.

SUMMARY: On October 21, 1980, Congress enacted Pub. L. 96-482 which included various amendments to the Resource Conservation and Recovery Act (RCRA). Section 7 of these revisions (the "Bevill Amendment") excluded "solid waste from the extraction, beneficiation, and processing of ores and minerals" from regulation under Subtitle C of RCRA pending completion of studies called for in Sections 8002 (f) and (p) of RCRA. On November 19, 1980, EPA amended its regulations to reflect this exclusion (45 FR 76618). In the preamble to that rulemaking, EPA tentatively interpreted the exclusion to encompass "solid waste from the exploration, mining, milling, smelting, and refining of ores and minerals" (45 FR 76619). Today's proposed rulemaking, if promulgated as a final rule, would eliminate from the mining waste exclusion many wastes from processing ores and minerals (other than phosphogypsum, bauxite refining muds, primary metal smelting slags, and slag from elemental phosphorus reduction) and would relist six smelting wastes previously listed as hazardous. EPA believes that this revised interpretation more accurately represents the intent of Congress when it enacted the mining waste exclusion and best serves the policy objectives of RCRA.

DATE: EPA will accept public comments on this proposal until December 2, 1985.

The Agency will hold a public hearing on November 14, 1985; see "**SUPPLEMENTARY INFORMATION**" section for details.

ADDRESSES: Comments should be sent to the Docket Clerk, Office of Solid Waste (WH-565A), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460. The public docket for this proposal is available in Room S212 at the above address for viewing from 9:00 a.m. to 4:00 p.m., Monday through Friday, excluding holidays. The public hearing is in Washington, DC at the Department of Health and Human Services, North Auditorium, 330 Independence Avenue SW. Attendees should use the "C" Street entrance.

FOR FURTHER INFORMATION CONTACT: RCRA/Superfund Hotline at (800) 424-9346 or 382-3000. For technical information contact Dr. Dexter Hinckley, U.S. Environmental Protection Agency, Office of Solid Waste (WH-565), 401 M St. SW., Washington, DC 20460, (202) 382-2791.

SUPPLEMENTARY INFORMATION:

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I. History of Mining Waste Exclusion

In Section 8002(f) of the Resource Conservation and Recovery Act (ACRA) of October 21, 1976, Congress instructed the Administrator to conduct, in consultation with the Secretary of the Interior, "a detailed and comprehensive study on the adverse effects of solid wastes from active and abandoned surface and underground mines on the environment, including, but not limited to, the effects of such wastes on humans, water, air, health, welfare, and natural resources."

On December 18, 1978 (43 FR 58,946), EPA proposed regulations for hazardous waste management under Subtitle C of RCRA. These proposed regulations, among other things, had fewer requirements for a universe of so-called "special waste" that are generated in large volumes, were thought to pose less of a hazard than other hazardous wastes, and were not thought to be amenable to the control techniques proposed for hazardous waste treatment, storage and disposal facilities. EPA identified waste materials from the "extraction, beneficiation, and processing of ores and minerals" as special wastes under the proposed regulations.

On May 19, 1980 and July 16, 1980, EPA listed as hazardous eight waste streams from primary metal smelters. Also on May 19, 1980, when it promulgated the final hazardous waste management regulations, EPA stated that a "special waste" category was unnecessary because: (1) the EP toxicity and corrosivity characteristics of hazardous waste had been narrowed, thus excluding most "special wastes" from control, and (2) the Agency intended to promulgate tailored standards for land disposal, as needed, in future regulations.

On October 21, 1980, Congress enacted Pub. L. 96-482 which included various amendments to RCRA. Section 8002 was amended to include subsection (p), which requires the Administrator to study the adverse effects on human health and the environment, if any, of the disposal and utilization of "solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore." Section 7 of these amendments (the "Bevill Amendment") amended Section 3001 of RCRA to exclude these wastes from regulation under Subtitle C of RCRA pending completion of the studies called for in Sections 8002(f) and (p).

On November 19, 1980, EPA published an interim final amendment to its hazardous waste regulations to reflect the mining waste exclusion. The regulatory language incorporating the exclusion is identical to the statutory language (except the phrase "including coal" was added). In the preamble to the amended regulation, however, EPA tentatively interpreted the exclusion to include "solid waste from the exploration, mining, milling, *smelting*, and *refining* of ores and minerals" (emphasis added), (45 FR 76118, 76619).

For consistency with this interpretation in the November 19, 1980 amendment, the Agency also amended 40 CFR Part 261 to suspend the listings of specific waste streams associated with smelting as hazardous wastes (46 FR 4614, January 16, 1981 and 46 FR 27473, May 20, 1981). These waste streams are associated with the primary copper, lead, zinc, aluminum, and ferroalloy industries (see Table 1).

In the November 19, 1980 notice, EPA made it clear that it intended to reconsider ("over the next 90 days") its interpretation of the exclusion:

> The Agency fully intends to consider the appropriate scope of the statutory exclusion and may well take rulemaking action to lessen the scope of the exclusion. . . . In particular, EPA questions whether Congress actually intended to exclude . . . wastes generated in the smelting, refining, and other processing of ores and minerals that are further removed from the mining and beneficiation of such ores and minerals.

wastes" in regulations proposed by the Agency under Subtitle C on December 18, 1978. S. Rep. No. 96–1010, 96th Cong. 2d Sess. 32 (1980) (Conference Committee Report). In addition, Rep. Santini stated that he believed the amendment would "defer regulation of 'special waste' until after EPA studies the need to do so." 126 *Cong. Rec.* H 1089 (daily ed. February 20, 1980).

- In the preamble to the 1978 regulations, EPA explained that it intended to treat special wastes differently because they were generally thought to be high volume, low toxicity materials, and not amenable to management under the proposed standards for hazardous waste treatment, storage, and disposal facilities. While EPA listed several smelting wastes as hazardous wastes, only a few listed smelting wastes were included in the "special waste" category. Section 250.46–3 of the 1978 proposal, which was titled "Phosphate rock mining, beneficiation, and processing waste," listed "slag . . . from elemental phosphorus production" as one of the wastes subject to special waste regulations.[1]
- In the legislative history accompanying the 1984 amendments to RCRA, the Senate Committee on Environment and Public works stated:

> Solid wastes from mining and mineral beneficiation and processing are primarily waste rock from the extraction process and crushed rock, commonly called tailings, produced from concentrating steps such as grinding, crushing, sorting, sizing, classification, washing, dewatering, amalgamation, gravity treatment, flotation, agglomeration and cyanidation. The 1980 amendments covered wastes from the initial stages of mineral processing, where concentrations of minerals of value are greatly increased through physical means, before applying secondary processes. Smelter slag might also be included. Massive volumes of this waste ore are produced annually by mining and mineral processing facilities—roughly estimated by the American Mining Congress (AMC) to be approximately 1.75 billion tons in a typical year, which is clearly significantly greater in volume than the solid waste generated by all other industries combined. These wastes were considered "special wastes" under the 1978 proposed regulations as being of large volume and relatively low hazard.

Each of the options is evaluated below in light of these indications of Congressional intent:

Option 1—Retain current interpretation and conduct a Section 8002 study on wastes that are currently excluded, but are not part of the current Section 8002 mining waste study.

EPA believes that this option does not reflect either the special waste concept or the intent of Congress as described above. This option would entail studying many low volume wastes, some of them hazardous, generated by facilities processing ores. It would dilute resources available for studies on large volume wastes of interest to Congress.

Option 2—Narrow the exclusion to include only large volume wastes from processing ores.

This interpretation is most consistent with Congressional intent because it leaves large volume processing wastes (i.e., phosphogypsum from phosphoric acid plants, slag from primary smelting of metallic ores or phosphorous reduction, and muds from bauxite refining) within the exclusion, deferring their possible regulation under Subtitle C until completion of studies required for the Report to Congress on mining waste. Annual phosphogypsum disposal is approximately 47 million metric tons; slag disposal from primary metal smelters is over 4 million metric tons; slag from phosphorous reduction is over 3 million metric tons; and mud from bauxite refining is about 2 million metric tons. By limiting the mining waste exclusion to these high volume wastes, this option takes into account the references in the legislative history to high volume, relatively low toxicity wastes, *i.e.*, "special wastes." In fact, this approach constitutes the most rigorous application of the special waste concept.

Option 3—Narrow exclusion to include only large volume wastes from processing *metallic* ores.

This option represents the narrowest possible reinterpretation of the mining waste exclusion, but it reflects only Rep. Williams's specific remarks about slag from copper smelting in Israel. It would maintain the excluded status of red and brown muds (2 million metric tons/year) produced by refining bauxite ore. However, a very large volume processing waste, the 47 million metric tons of phosphogypsum produced each year by phosphoric acid plants, would no longer be within the exclusion. This option also would remove another large volume waste from the exclusion: slag produced by the facilities extracting elemental phosphorus from phosphate ore, because phosphorus is not a metal.

Based on the above analysis of Congressional intent, EPA believes that it was incorrect in interpreting the mining waste exclusion as encompassing all wastes from primary smelting and refining. Therefore, EPA is proposing to reinterpret the mining waste exclusion so that red and brown muds, phosphogypsum, and primary processing slags are the only processing wastes that remain excluded from regulation under Subtitle C of RCRA. All other wastes from processing ores and minerals would be subject to Subtitle C regulation if the wastes are hazardous.

EPA is aware that there are a large number of wastes that could arguably be viewed as wastes from the "processing" of minerals or ores. However, we believe the term "processing" must be interpreted in light of the criteria outlined above. Based on these criteria, we conclude that not all such wastes are properly excluded from regulation under the mining waste exclusion primarily because they do not meet the "special waste" criteria, i.e., high volume, relatively low toxicity. For instance, as mentioned earlier, the listings of certain smelting wastes as hazardous waste were suspended after the Bevill Amendment was enacted even though the rulemaking records for these listings show they are hazardous and these listings were not challenged.

In addition, many of the wastes excluded by EPA's 1980 interpretation of the mining waste exclusion are not high volume wastes.[2] The processing wastes we are proposing for retention within the exclusion range in volume from 2 to 47 million metric tons per year. These volumes are comparable to the other special waste categories proposed December 18, 1978. See 43 FR 58992. For example, utility waste was estimated at 66 million metric tons per year and cement kiln dust at 12 million metric tons per year. The volumes of wastes that would be removed from the exclusion as a consequence of the reinterpretation are substantially smaller in volume than the wastes that would remain within the exclusion. In fact, these waste volumes are generally smaller than the volumes already subject to Subtitle C regulation in other (non-mining) industrial sectors.

EPA requests public comment on the proposed reinterpretation of the mining waste exclusion. Commenters should

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[1] Although the process for obtaining elemental phosphorus from phosphate is called phosphorus reduction, rather than smelting, both processes have the same purpose (i.e., separating the desired element from the ore) and comparable wastes (e.g., slag).

[2] Based on the various indications of Congressional intent described in the text, EPA believes it is reasonable to rely primarily on volumes of waste generated to determine which wastes should have been excluded by the Bevill Amendment. However, it may well be appropriate to consider additional factors in making regulatory decisions regarding waste with hazard characteristics similar to those of the high volume wastes covered by the Bevill Amendment.

- Multiple extraction testing for all of the EP toxic metals and nickel on a representative number of samples;[4]
- Techniques used in managing these wastes (i.e., unlined piles, lined surface impoundments); in providing this information, commenters should be as specific as possible;
- Volume of waste generated;
- Ground-water monitoring data (if available);
- Percentage of wastewaters treated with 10 percent excess lime which is the basis for BAT guidelines for nonferrous smelting and refining wastewaters;
- Percentage of wastestreams treated using other precipitants;
- The amount of excess lime as a percentage of dry sludge.

Based on this information, we may conclude that the wastewater treatment sludges generated using 10 percent excess lime are in fact non-hazardous and therefore may narrow the scope of the listing accordingly.

C. Wastes That Are Recycled

1. Introduction

EPA recently promulgated a rule which, among other things, specifies which materials are solid and hazardous wastes when they are recycled. See 50 FR 614, January 4, 1985. (This rulemaking also specified general and specific management standards for most types of hazardous waste recycling activities.) A large percentage of the wastes that would be relisted under this proposal are land disposed. These include 69 percent of the acid plant blowdown from primary copper production, 97 percent of the sludge from treatment of wastewaters and/or acid plant blowdown from primary zinc production, 72 percent of the spent potliners from primary aluminum production, and 100 percent of the emission control dust/sludges from ferrochromium-silicon and ferrochromium production. However, three of the wastes are primarily recycled by being reclaimed. These include 100 percent of the surface impoundment solids from primary lead production; 100 percent of the electrolytic anode slimes/sludges from primary zinc production; and 100 percent of the cadmium leach residue treatment sludge from primary zinc production. (see Table 3).

TABLE 3.—GENERATION OF HAZARDOUS WASTES IN THE PRIMARY NONFERROUS SMELTING AND REFINING INDUSTRIES

EPA Number (when listed) and hazardous waste	Tons/yr 1984	Immediately recycled (percent)	Recycle after storage (percent)	Land disposal (percent)
Primary copper—K064. Acid plant blowdown slurry/sludge	32,864	0	31	69
Primary lead—K065.				
Surface impoundment solids	46,193	50	50	
Air pollution control dusts	82,350	100		
Total	128,541			
Primary zinc and ZnO$_2$:				
K066. Wastewater treatment sludge	32,380	3	0	97
K067. Electrolytic anode slimes	N/A	57	43	
K068:				
Cadmium plant leach residue	N/A	12	[1] 88	
Saleable leach residue	2,400	87	13	0
Non-saleable leach residue	31,400	53	0	47
Clinker	54,000	0	17	83
Furnace residue	180,000	0	13	87
Total	297,780			
Primary aluminum—K088:				
Spent potliners	130,000	3	25	72
Wet sludges	92,750	1	7	92
Pot skims	11,911	19	0	81
Shot blast dusts	11,300	1	0	99
Total	245,966			
Primary titanium and TiO$_2$.				
Chloride process sludges [2]	350,000		[3] 10	90
Sulfate process sludges	100,000		100	0
Metal sludges	5,000			100
Total	455,000			
Ferroalloys:				
K090. FeCr/Si emission control dust	3,300			100
K091:				
FeCr emission control dust	6,500			100
Other dusts, sludges, and residues	180,200			
Total	190,000			
Magnesium, zirconium/hafnium—Dusts, sludges and other residues	22,000			

[1] 72 percent sold.

[2] Another 2,000,000 tons/year of chloride process acids are disposed of by deep-well injection.

[3] Sold as product.

Source: "Hazardous Waste Management Costs in Selected Primary Smelting and Refining Industries" (June 1985) and "Overview of Solid Waste Generation, Management, and Chemical Characteristics" for aluminum, copper, zinc, ferroalloys, titanium dioxide, zinc oxide, and zirconium/hafnium sectors. (Published as draft reports by PEI and Radian in 1984.)

In the January 4, 1985 rulemaking, we indicated that certain materials being reclaimed[5] are solid wastes only when they are listed as hazardous waste. We also indicated that materials being reclaimed can be listed as solid wastes; however, in doing so, a number of factors must be considered which would demonstrate whether the material is handled as a commodity or a waste. In evaluating these three residues, we believe that the surface impoundment solids from primary lead production are solid wastes and therefore should be relisted, while the electrolytic anode slimes/sludge and cadmium plant leach residue from primary zinc production are not solid wastes and should not be relisted.

2. EPA's Basis for Listing/Not Listing Surface Impoundment Solids from Primary Lead Production, and Electrolytic Anode Slimes/Sludges, and Cadmium Plant Leach Residue from Primary Zinc Production

As described above, the January 4 rules define which materials are solid and hazardous wastes when they are recycled. Among other things, the rules indicate that all spent materials[6] (whether they are listed or exhibit one or more of the hazardous waste characteristics) are defined as solid wastes when they are reclaimed.[7]

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[4] The Agency has developed and is using the multiple extraction procedure (MEP) in evaluating certain delisting petitions to evaluate the long-term stability of wastes. The Agency believes it appropriate to also use it in evaluating listing decisions. See the public docket for this proposed rule which describes the methodology.

[5] A material is reclaimed if it is processed to recover a usable product or if it is regenerated. See 40 CFR 261.1(c)(4); see also preamble discussion in 50 FR at 633, January 4, 1985.

[6] A spent material is any material that has been used and as a result of contamination can no longer serve the purpose for which it was produced without processing. See 40 CFR 261.1(c)(1); see also preamble discussion in 50 FR at 624, January 4, 1985.

[7] Based on our initial survey, 28 percent of the spent potliners are recycled by being reclaimed. It could be argued that this percentage is significant and, thus, these materials are more product-like than waste-like and should not be listed. However,

Continued

Analysis of Proposed Reinterpretation of Solid Waste Exemption for the Primary Smelting and Refining Industry (two volumes, hereafter referred to as the Economic Impact Report), and *Overview of Solid Waste Generation, Management, and Chemical Characteristics* (hereafter referred to as the Technical Studies). These documents are available in the public docket for this rulemaking.

A. Scope and Coverage of Economic Analysis

The Agency's economic impact analysis was conducted in two parts. The first part consisted of a detailed compliance cost and economic impact analysis covering ten major primary metal smelting and refining sectors containing a total of 110 operating facilities producing 97 percent of total U.S. nonferrous and ferroalloy product tonnage in 1983. These ten sectors include all of the large volume sectors with previously listed smelting wastes (aluminum, copper, lead, zinc, and ferroalloys) as well as a broad sampling of five additional nonferrous metal industries shown by previous studies to generate potentially hazardous wastes (magnesium, titanium metal, titanium dioxide, zinc oxide, and zirconium/hafnium). According to U.S. Bureau of Mines and EPA survey data, the remaining three percent of nonferrous production is contributed by 21 metals sectors (400 facilities) not covered in the detailed impact assessment.

The second part of EPA's impact analysis involved a much less detailed screening study of these 21 sectors to isolate those sectors most likely to be significantly affected. Based on this screening, EPA believes that the major part of the total national cost impacts are accounted for by the 97 percent of the total production covered in our detailed analysis, and that the impact patterns in the covered sectors will generally be similar in the additional sectors.

B. Methodology and Data Gathering for the Ten-Sector Study

EPA first conducted a series of technical survey and sampling studies covering ten major ore-processing industries to determine the volume of wastes generated, identify those wastes which could be hazardous because they exhibit one of the characteristics defined in 40 CFR 261.2, estimate the volume of these hazardous wastes, and delineate the practices currently used to manage these wastes. The major findings are summarized in Table 3 above. Based on the technical survey and sampling results, a plant-by-plant waste management assessment was then made for all 110 facilities in the sectors studied, utilizing plant survey data from over 80 individual facilities and waste sampling results from 50 facilities.

Where data were incomplete for surveyed plants or absent entirely for non-surveyed facilities, the types and quantities of hazardous and non-hazardous waste, current waste management practices, and production relationships were estimated from survey data at similar processing facilities. In the absence of site-specific information, EPA erred on the conservative side by assuming that all non-surveyed facilities did produce hazardous waste streams comparable in quantity and type to those found in the sample survey for other facilities with similar products.

EPA then estimated waste management costs for both current baseline practices (observed or assumed) and RCRA Subtitle C requirements at each of the 110 individual facilities. The difference between current baseline costs and total RCRA compliance costs is the incremental compliance cost for this regulation, providing the basis for evaluating economic impacts.

In selecting RCRA Subtitle C compliance practices for facilities, EPA assumed that companies would adopt a least-cost, conventional waste management option consistent with technical considerations relating to the facility's current practices and waste characteristics. All RCRA compliance options involving surface impoundments or landfills were based on a double synthetic liner technology consistent with the requirements of the Hazardous and Solid Waste Amendments of 1984. The analysis did not consider in-plant process changes, innovative recycling activities, or by-product options that might reduce compliance costs or turn net compliance costs into net savings.

The Agency estimated incremental compliance costs for storing, treating, transporting, and disposing of a waste stream. Costs include initial capital investment, annual operation and maintenance (O&M), capital investment for waste facility closure, and annual O&M costs for postclosure maintenance for a period of 30 years. Compliance costs were converted to an annualized cost form to provide the uniform annual cost that would be equivalent to the incurred cost stream. Initial investment costs were amortized over a 20-year lifetime, using the companies' weighted average cost of capital.

As part of the economic analysis, EPA also assembled extensive historical information on plant capacity and production levels, investment, prices, and financial conditions in order to base the impacts on more accurate projections. Where possible, EPA collected financial information for individual metals (for example, primary aluminum and primary copper). In some cases, lack of data forced consolidation of the financial characteristics of several metal subcategories (for example, lead with zinc and zirconium/hafnium with titanium).

Historical data from 1978 to 1983 were then used to estimate projected metal prices. In estimating rates of return, investment levels, production, and operating income, EPA used data from the three-year span of 1979 to 1981, on the assumption that this period provided the best indication of the performance of these plants under expected future conditions, and that 1982 and 1983 data reflected an atypically severe period of economic recession.

The plant closure methodology focuses only on specific plants having annualized compliance costs greater than one percent of sales. Previous Agency studies in support of effluent guidelines regulations under the Clean Water Act have shown few impacts with compliance costs below this level, but show occasional impacts when costs are more than one percent of sales. For plants with costs above this level, EPA then employed two plant closure tests: a net present value test and a liquidity test. The net present value test focuses on long-term profitability, with the viability of the plant being judged by a comparison of the net present value of its cash flow to its liquidation value. The liquidity test addresses short-term viability and focuses on affordability during the first few years of compliance. The closure analysis also assumes zero pass-through of compliance costs: that is, to avoid overlooking potential closures, plants are assumed to absorb all of the compliance costs as a direct increase in production costs (decrease in profit).

C. Costs of Compliance for Ten Major Sectors

EPA identified 67 manufacturing facilities (out of 110) in the ten sectors that will likely incur increased costs to comply with this regulation. Based on its industry survey, EPA concluded that certain facilities were not generating hazardous wastes, while others were either utilizing immediate recycling or were probably already in compliance with current RCRA management lower than average baseline rates of return.

Plant Closures and Employment Losses

Based on its analysis, EPA concluded that one plant in the ferroalloy subcategory may close as a result of this reinterpretation (Table 6). If realized, this closure would involve a loss of about 80 jobs at the closed facility. The potential production loss associated with closure represents approximately three percent of the total ferroalloy capacity.

TABLE 6.—SUMMARY OF PLANT CLOSURE ANALYSIS

Sector	Number of plants				Potential employment loss
	Total	Incurring costs	Failing screen	Potential closures	
Primary aluminum	29	19	0	0	0
Primary copper	20	11	0	0	0
Primary lead	8	4	0	0	0
Primary zinc	5	4	1	0	0
Primary zinc oxide	3	2	1	0	0
Ferroalloys	29	13	3	1	80
Primary magnesium and zirconium/hafnium	5	4	0	0	0
Primary titanium	6	5	0	0	0
Primary titanium dioxide	9	8	4	0	0
Industrial total	110	67	9	1	80

Source: "Economic Impact Analysis of Proposed Reinterpretation of Solid Waste Exemption for the Primary Smelting and Refining Industry" (June, 1985).

E. Screening Study Conclusions for 21 Other Metal Sectors

In addition to the ten sectors surveyed in detail for this rulemaking, EPA also conducted a more general screening study of the 21 remaining primary metal processing sectors. These 21 sectors include about 400 facilities that together produce just under 200,000 metric tons of metal per year. Of these 400 facilities, 309 (over three-fourths) are primary refiners of gold and/or silver. Few of these 400 facilities produce more than 5,000 tons of metal production per year, and the majority produce under 100 tons each.

The Agency's methodology for evaluating these sectors included a literature review, evaluation of EPA file data from previous EPA nonferrous industry surveys, and a general comparative cost analysis for average facilities in each sector based on current product cost. Where necessary, conservative waste generation parameters derived from our ten-sector survey analysis were employed to estimate a maximum RCRA impact for specific sectors. These extreme case assumptions included a proxy waste generation rate of one ton of hazardous waste per ton of metal production and an incremental waste management (compliance) cost of $200 per ton of hazardous waste.

Results of this screening analysis suggest that, at most, five out of the 21 sectors could potentially incur moderate-to-significant impacts from this regulation. These five sectors—tungsten, vanadium, rare-earth metals, columbium, and mercury—could incur incremental RCRA compliance costs in the range of one to six percent of total production costs under the extreme costing assumptions used for this analysis. Even at these maximum cost levels, EPA's plant closure analysis projects that plant closures would be highly unlikely for tungston, rare-earth metals or mercury. For columbium and vanadium, it is not possible to rule out possible closures on the basis of the Agency's screening analysis; however, no closures can be projected from this analysis.

More definitive impact conclusions for any of these five sectors would require more detailed survey data for individual facilities on waste generation, waste characteristics (especially EP toxicity), and waste management practices (including current or potential recycling and by-product recovery opportunities).

EPA would appreciate further comment regarding the technical operation and possible RCRA impacts for facilities in any of the 31 sectors identified in the primary nonferrous metals industry. In particular, current data on total waste generation, physical and chemical properties of significant wastestreams, current management practices, and recycling or other by-product use of process residuals is requested for facilities producing primary tungsten, vanadium, rare-earth metals, columbium, and mercury.

V. Public Participation

Requests to participate in the public hearings should be directed on or before November 7, 1985 to Ms. Geraldine Wyer, Public Participation Officer, Office of Solid Waste, (WH-562), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. The hearing will begin at 9:00 a.m. with registration beginning at 8:30 a.m. The hearings will end at 4:30 p.m. unless concluded earlier. Oral and written statements may be submitted at the public hearings. Persons who wish to make oral presentations must restrict these to 20 minutes, and are requested to provide written copies of their complete comments for inclusion in the official record.

VI. Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) of 1980 (Pub. L. 96-354), which amends the Administrative Procedures Act, requires Federal regulatory agencies to consider "small entities" throughout the regulatory process. The RFA requires an initial screening analysis to be performed to determine whether a substantial number of small entities will be significantly affected by a regulation. If so, regulatory alternatives that eliminate or mitigate the impacts must be considered.

This section presents the results of the Agency's small business screening analysis, based on a review of industry plant ownership patterns and estimated compliance costs. Based on this analysis, EPA has determined that there will not be a significant impact on a substantial number of small businesses.

In the nonferrous metals smelting and refining industry, the Small Business Administration (SBA) defines small entities based on employment levels. For most primary metal sectors, the employment criterion is fewer than 750; however, a higher threshold of 1,000 is used for some sectors. Based on the appropriate definition for each sector, the Agency screened all 110 facilities in the ten sectors that were studied in detail and determined that, among these, only the ferroalloy sector contained facilities owned by small business enterprises. However, none of the ferroalloy facilities owned by small businesses were among those projected to incur costs due to this reinterpretation.

The remaining 400 nonferrous facilities not covered in our detailed impact analysis were also subjected to this detailed small business ownership screening. It appears that there are small business facilities in the primary silver and gold refining sectors; however, this sector is not expected to incur significant cost effects. Facilities in all of the remaining sectors all appear to be owned by large businesses or conglomerates and therefore would not be subject to the Regulatory Flexibility Act.

4. In Appendix VII—Basis for Listing Hazardous Waste, add the following in the appropriate alphabetical and numerical sequence:

Appendix VII—Basis for Listing Hazardous Waste

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EPA hazardous waste number	Hazardous constituents for which listed
K064	Lead, Cadmium
K065	Lead, Cadmium
K066	Lead, Cadmium
K088	Cyanide (Complexes)
K090	Chromium
K091	Chromium, Lead

* * * * *

[FR Doc. 85-23622 Filed 10-1-85; 8:45 am]

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5,0046

BACKGROUND DOCUMENT

RESOURCE CONSERVATION AND RECOVERY ACT

SUBTITLE C - IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

§§261.31 and 261.32 - Listing of Hazardous Wastes (Phase IB)

July 7, 1980

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SOLID WASTE

78

K090

LISTING BACKGROUND DOCUMENT

PRIMARY SMELTING AND REFINING OF FERROALLOYS*

K090 Emission control dust/sludge from ferromanganese (FeMn) production in electric furnaces (T)

K091 Emission control dust/sludge from ferrochromium (FeCr) production in electric furnaces (T)

K092 Emission control dust/sludge from ferrochromium-silicon (FeCrSi) production in electric furnaces (T)

I. Summary of Basis for Listing

The emission control dusts/sludges from the production of ferromanganese, ferrochromium and ferrochromium-silicon are generated when particulates entrained in the reaction gases given off by electric furnaces during the smelting process are removed by air pollution control equipment. Dry collection methods generate dust; wet collection methods result in sludge. The Administrator has determined that these dusts/sludges are solid wastes which may pose a present or potential hazard to human health and the environment when improperly transported, treated, stored, disposed of or otherwise managed and therefore should be subject to appropriate management requirements under Subtitle C of RCRA. This conclusion is based on the following considerations:

1) The emission control dusts/sludges from ferromanganese and ferrochromium production contain significant concentrations of the toxic heavy metals chromium and lead, and emission control dusts/sludges from production of ferrochromium silicon contain significant concentrations of chromium.

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*The Agency has recently obtained information indicating that wastes generated by the ferroalloys industry are likely to contain substantial concentrations of polycyclic organic several carcinogenic compounds (5). For this reason, EPA will expand the listing for the ferroalloys industry if further studies show that such wastes pose a hazard to human health and the environment.

2) Significant concentrations of chromium and lead have been shown to leach from various samples of ferromanganese and ferrochromium wastes subjected to extraction procedures, while significant concentrations of chromium have been shown to leach from samples of ferrochromium/silicon waste subjected to the same extraction procedures.

3) A large quantity (a combined total of approximately 120,000 tons) of these wastes is generated annually. There is thus a risk of large scale contamination of the environment if the wastes are mismanaged. Lead and chromium persist virtually indefinitely in the environment, posing the further threat of long-term contamination.

4) The wastes typically are disposed of by dumping in the open, in landfills or in unlined lagoons. Thus, the possibility exists for the migration in harmful concentrations of lead and chromium to groundwater or surface water.

II. Sources of the Waste and Typical Disposal Practices

A. Industry Profile and Manufacturing Process

The ferroalloys industry produces a variety of ferroalloys for use in the manufacture of iron, steel and non-ferrous metals (1). In May, 1980, eight companies produced ferrochromium, ferrochromium-silicon or ferromanganese in electric furnaces. Those producers are listed in Table 1 (5). It should be noted that companies may frequently change their product lines and put furnaces in or out of service according to product demand or operating requirements.

Ferrochromium, ferrochromium-silicon and ferromanganese are generally produced by carbothermal smelting in electric submerged-arc furnaces (some ferromanganese is also produced in blast furnaces). The raw materials used most often include

Table 1 - Producers of FeMn, FeCr or FeCrSi in
in the United States May, 1980 (5)

Producer	Products
CHROMASCO Woodstock, TN.	FeCr
INTERLAKE Beverly, OH.	FeCrSi, FeCr
MACALLOY Charleston, SC	FeCr
OHIO FERROALLOYS Philo, OH.	FeMn
SAMANCOR Rockwood, TN.	FeMn
SATRALLOY Steubenville, OH.	FeCr, FeCrSi
SKW ALLOYS Calvert City, KY.	FeMn
Niagara Falls, NY.	FeCrSi
UNION CARBIDE Marietta, OH.	FeMn, FrCr
Portland, OR.	FeMn

mineral ores and concentrates of manganese, chromium and silicon, steel turnings and reducing agents such as coke, coal and wood chips (2). Feed materials are charged to the furnace on either a continuous or intermittent basis. The molten alloy collects at the bottom of the furnace and is removed to a cooling area.

B. Waste Generation

The process of reducing metallic ores to a metallic state generates large quantities of carbon monoxide along with other gases from moisture in the charge materials, reducing agent volatile matter, thermal decomposition products of the raw ore and intermediate products of the reaction (1). The gases carry fumes from the high temperature regions of the furnace and entrain fine particles of the charge materials. Particulate matter, which contains lead and chromium originally present in the charge materials, is removed from the gases by baghouse collection systems, electrostatic precipitators, or scrubbers. Wastes are collected from baghouses and precipitators as dusts and from scrubbers as sludges (2). These emission control dusts/sludges are the waste streams of concern. The Ferroalloys Association estimates that approximately 120,000 tons of these wastes are generated annually (2).

C. Current Disposal Practices

Dusts typically are dumped directly on land or disposed of in landfills (2,3). Dusts from the production of different ferroalloys are generally mixed and disposed of together. (Comments of the Ferroalloys Association, January 9, 1979.) Sludges usually are sent to unlined lagoons for settling; the sediments are dredged periodically and dumped on land (3). Waste piles in disposal areas can approach 250 feet in places, and the depth of disposal lagoons may approach 25 feet (2).

III. Hazardous Properties of the Waste

Ferroalloy production emission control dusts and sludges consist primarily of sub-micron particles composed of oxides of various elements, including lead and chromium (3). The Agency has data from two sources which indicate that substantial amounts of lead and chromium are contained in ferromanganese and ferrochromium dusts/sludges, while dusts and sludges from ferrochromium-silicon production contain substantial concentrations of chromium. The data are presented in Tables 2 and 3.

Table 2. Concentrations of Lead and Chromium in Ferroalloys Dusts/Sludges (3).

Product	Sample Source	Cr(ppm)	Pb(ppm)
Ferromanganese	Baghouse (dust)	32	6000
	Scrubber (sludge)	18	5000
Ferrochromium	Electrostatic precipitator (dust)	3,390	300
Ferrochromium-silicon	Baghouse (dust)	41	--

Table 3. Concentrations of Lead and Chromium in Particulate Matte
Generated During Production of Ferroalloys† (1).

Product	Sample Source	Cr(ppm)	Pb(pp
Ferromanganese	Scrubber stack outlet	<80	1,130
Ferrochromium	Furnace	140,000	--
	Electrostatic precipitator (dust)	40,000	1,000
Ferrochromium-silicon	Furnace	14,100	<10
	Baghouse inlet	4,400	--

†Most of the samples are of particulate matter collected from the furnace emissions prior to cleaning in an air pollution control device. These samples should be similar to the dust or sludge generated by these types of furnaces since emission control equipment removes 95-99% of these contaminants prior to air emission. (Comments of Ferroalloys Association, June 7, 1977, App. 3.) The sample of particulate matter from the FeMn scrubber stack outlet should indicate which pollutant species are present in the sludge or dust, although relative quantities may be different from those in the solid waste.

Simulated leaching data also indicate that lead and chromium are capable of leaching from these wastes in concentrations sufficient to create a potential for substantial hazard. Table 6 below shows distilled water and acetic acid extraction data supplied by the Ferroalloys Association for selected emission control dusts. In most cases, contaminant levels in leachate are one to two orders of magnitude in excess of drinking water standards.

The Agency also has extraction data showing high concentrations of the constituents of concern in a distilled water extract of the waste:

Table 6 - Waste Extraction Data for Ferroalloys Waste (2)

		Extract Concentrations	
	Drinking Water Standard	Cr	Pb
Waste from FeMn Production			
EPA EP Using H_2O			
Emissions Control Dust (Sx #1)	.05	1.4	2.0
Emissions Control Dust (Sx #2)		1.0	7.6
EPA EP per 9/12/78 Draft (Acetic Acid Extractant)			
Emissions Control Dust		.40	14.0
Waste from FeCr Production			
EPA EP Using H_2O			
Emissions Control Dust (Sx #1)		.65	<.10
Scrubber Dust (Sx #2)		<.10	<.10
EPA EP per 9-12-78 Draft (Acetic Acid Extractant)			
Scrubber Dust (Sx #2)		<.10	<.10
Waste from FeCrSi Production			
EPA EP Using H_2O Only			
Emissions Control Dust		2.0	<.10
EPA EP per 9-12-78 Draft (Acetic Acid Extractant)			
Emissions Control/Dust		2.4	.30

Association, January 9, 1979.

Table 7 (3)

Product	Sample	ppm in distilled water extract Cr	 Pb
FeMn	Baghouse dust	0.2	560
FeCr	ESP dust	710	0.7
FeCrSi	Baghouse dust	190	1.5

The Agency frankly entertains some doubts as to the probity of the data in Table 7. For example, the chromium value for the FeCrSi baghouse dust waste extract exceeds the value given for the raw waste sample in Table 2 above (which was obtained during the same study.) Such a discrepancy can only be attributable to an error in the calculation or in the recording of data, or to the use of faulty analytical techniques. Since high concentrations (14,000 and 4,400 ppm) of chromium in the particulate matter given off during the production of ferrochromium-silicon are reported in Table 3, the Agency believes it likely that the 41 ppm chromium value shown in Table 2 is grossly understated. In any case, the Agency views this data, while hardly determinative, as at least corroborative of other data submitted by industry showing waste constituents capable of migration in potentially harmful concentrations.

Furthermore, groundwater monitoring performed by an independent laboratory for the Ferroalloys Association indicates that lead, one of the two waste constituents of concern, can migrate from ferroalloy waste disposal sites and reach groundwater in harmful concentrations. Thus, groundwater monitoring in the vicinity of an "unlined disposal lagoon" on the site of an unidentified ferroalloy company revealed lead concentrations in groundwater exceeding the National Interim Primary Drinking Water Standard of .05 mg/l, as shown in Table 4. In the second test, apparently only one well was measured; no contamination was detected.

Table 4 - Monitoring Data From Groundwater Wells Surroundin
An Unlined Disposal Lagoon Showing Lead Concentrations In
Groundwater (Reference: Comments of Ferroalloys Associati
June 29, 1979.)

Monitoring Location Test #1	Distance from Lagoons, (Ft.)	Pb Concentratio
Lagoon Analysis	---	.03
#1 Well	100	.085
#2 Well	500	.105
#3 Well	200	.190
#4 Well	100	.085
#4 Well	1600	.090
Test #2		
Lagoon Analysis	---	.160
#8 Well	375	----

Without groundwater background monitoring data, it cannot be said with assurance that the disposal lagoon is the source of lead contamination. However, the comments do not indicate any other source of contamination, and the fact that monitored lead levels in groundwater levels appreciably exceeded levels in the lagoon could indicate that concentrated solids from the lagoon are leaching into groundwater.* Certainly, this data fails to support the Ferroalloys Association's claim that of an absence of environmental problems from current disposal practice. (Comments of Ferroalloys Association, June 29, 1979, p.3).

Ferroalloys Association also supplied monitoring data obtained from wells in the vicinity of a ferroalloy waste landfill (2). These data are shown in Table 5.

Although the monitoring results might indicate that this landfill does not contribute substantially to groundwater contamination (measurements from wells located downgradient from the landfill are similar to background levels), the Agency is unable to determine whether this is a valid interpretation of the data without considerably more information on the hydrogeological characteristics of the site, the placement, construction and operation of the monitoring wells, the types and compositions of the wastes in the landfill and the protocols utilized to obtain and analyze the groundwater samples. Sampling over a longer period is probabl

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*Thus, the unexplained "lagoon analysis" could be of liquid in the lagoon rather than settled solids.

Table 5 - Monitoring Data from Groundwater Wells Surrounding a "Typical Landfill" Showing Lead Concentrations in Groundwater

Location Test Test #1	
Upgradient Groundwater Background	Pb in Groundwater (mg/l)
Well #3	<.03
Well #4	.08
Downgradient of Landfill	
Well #1	.08
Well #2	.06
Well #5	.03
Test #2 (1 month after #1)	
Upgradient	
Well #3	.07
Well #4	.05
Downgradient	
Well #1	.08
Well #2	.10
Well #5	<.03
Test #3 (2 months after #1)	
Upgradient	Pb in Groundwater (mg/l)
Well #3	.08
Well #4	.08
Downgradient	
Well #1	.05
Well #2	.03
Well #5	.04

Note: Chromium was also monitored at these locations (although not at the wells surrounding the lagoon in Table 4), but chromium concentrations did not exceed the National Interim Primary Drinking Water Standard.

also necessary. Based on the information provided, the Agency can only observe that lead concentrations in groundwater in the vicinity of this landfill frequently exceed the National Interim Primary Drinking Water Standard of 0.05 mg/l. Therefore a potential hazard appears to exist unless proper management of these wastes is assured.*

It should be noted that some of the wastes included in this listing may not fail the toxicity characteristic (even though leachate data indicates that lead and chromium in these wastes have substantial migratory potential). This does not preclude listing of the wastes. The Agency believes that there are factors in addition to metal concentrations in leachate which justify this listing. As indicated above, these wastes are generated in very substantial quantities and may contain high concentrations of lead and chromium. Industry data indicate that groundwater contamination from ferroalloy waste disposal may already have occurred. In addition, large amounts of these metals are available for potential environmental release. The large quantities of these contaminants pose the danger of polluting large areas of ground or surface waters if waste mismanagement occurs. Contamination could also occur over long periods of time since large amounts of pollutants, which, as heavy metals, persist virtually indefinitely are available for environmental release. Attenuative capacity

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* The Ferroalloys Association indicated that the waste dusts are believed to exhibit sealant properties when wetted, thereby reducing leaching. This data (particularly that in Table 4), however, suggests that any sealant properties of the waste are insufficient to prevent waste constituent migration.

also be reduced or exhausted due to the large quantities of pollutants available.

Furthermore, current management practices may not be adequate to prevent leachate migration and subsequent groundwater and/or surface water contamination. Industry submissions indicate that disposal lagoons and landfills are generally unlined, and that no special steps are taken to impede leachate formation (although the dusts are reported to exhibit a sealant effect when wetted, this appears insufficient to prevent leachate formation and migration). As a result, these waste management practices may have the potential to allow release of harmful concentrations of contained toxicants, particularly if disposal occurs in areas with highly permeable soils, or where waste is directly exposed to groundwater due to the height of the water table. If wastes are disposed of where acid rain is prevalent, solubilization of toxic heavy metals is even more likely to occur. Uncontrolled surface run-off from the waste piles and overflow from lagoons might disperse the wastes and/or their toxic constituents in the surrounding area. If control practices are nonexistent or inadequate, contaminant-bearing leachate, run-off or impoundment overflow may reach ground and surface waters, polluting valuable drinking water supplies.

IV. Hazards Associated With Constituents of Concern

Ingestion of drinking water from ground and surface waters contaminated by lead and chromium threatens human health; aquatic species exposed to the heavy metals may also be adversely affected. Chromium is toxic to man and lower forms of aquatic life. Lead is poisonous in all forms, and is one of the most hazardous of the toxic metals because it bioaccumulates in many organisms.

The hazards of human exposure to lead include neurological damage, renal damage and adverse reproductive effects. In addition, lead is carcinogenic to laboratory animals and relatively toxic to freshwater organisms. (see Appendix A) It also bioaccumulates in many species.

Contact with chromium compounds can cause dermal ulceration in humans. Data also indicate that there may be a correlation between worker exposure to chromium and development of hepatic lesions. Additional information on the adverse health effects of these elements can be found in Appendix A.

The hazards associated with lead and chromium-containing compounds have been recognized by other regulatory programs. Lead and chromium are listed as priority pollutants in accordance with §307 of the Clean Water Act, and National Interim Primary Drinking Water Standards have been established pursuant to the Safe Drinking Water Act. The Occupational Health and Safety Administration has a final standard for occupational exposure to lead and a draft technical standard for occupational exposure to chromium. In addition, a national ambient air quality standard for lead has been announced under the Clean Air Act. Final or proposed regulations of the States of California, Maine, Massachusetts, Minnesota, Missouri, New Mexico, Oklahoma and Oregon define lead and chromium compounds as hazardous wastes or components of hazardous wastes (4).

References

1. Dealy, James O., and A. M. Killin. Engineering and Cost Study of the Ferroalloy Industry. EPA-450/2-74-008, May, 1974.

2. U.S. EPA, RCRA Section 3001 Docket, Attachment to Communication from George A. Watson to Claire Welty, June 29, 1979.

3. U.S. EPA, Office of Solid Waste. Assessment of Hazardous Waste Practices in the Metal Smelting and Refining Industry. Calspan Corporation. EPA Contract No. 68-01-2604. April, 1977. Volumes III and IV.

4. U.S. EPA States Regulations Files, January 1980.

5. Westbrook, C.W. and D.P. Daugherty. Environmental Assessment of Electric Submerged Arc Furnaces for Production of Ferroalloys (DRAFT). USEPA, RTI/1434/04-02F, March 1980.

Comments and Responses

- One comment stated that ferrochromium-silicon emission control dusts/sludges should not be listed because a discrepancy between the chromium concentrations reported in the original sample and the extract of that sample exists; 190 ppm were found in leachate but only 41 ppm in the original waste sample.

The Agency agrees that an error was made. The error might be due to faulty analytical techniques or to a mistake in calculating or recording data. As stated in the background document, however, data from another source indicates that chromium concentrations in ferrochromium silicon emission control dusts/sludges might be much higher. For this reason, EPA believes that the value of 41 ppm is understated and will continue to list this waste as hazardous.

- The Ferroalloys Association stated that the extracts of ferroalloys emission control dusts/sludges which they obtained by performing the proposed extraction procedure were only slightly above the limits defined as hazardous in the proposed regulations and therefore the wastes should not be classified as hazardous.

It is unusual that the data supplied by the Ferroalloys Association shows significantly less leaching using the proposed Extraction Procedure than other data from a distilled water extraction since the EP is the more rigorous of the two methods. Because such large quantities of these wastes are generated and samples of the wastes leached chromium in excess of 100 times the National Interim Primary Drinking Water Standard when subjected to a distilled water extraction, the Agency has decided that the wastes pose a potential threat to

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January 16, 1981

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Part XIX

Environmental Protection Agency

Identification and Listing of Hazardous Waste; Final Rule and Temporary Suspension of Interim Final Rule

Table I.—*Summary of the Agency's Disposition of Each Waste Stream Listed in Interim Final Form or Proposed for Listing on July 16, 1980* —Continued

EPA hazardous waste No.	Hazardous waste	Effective date and disposition
	§ 261.32 Hazardous Waste From Specific Sources	
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used.	Jan. 16, 1981.
K106	Wastewater treatment sludge from the mercury cell process in chlorine production.	(6 months after publication.)
K073	Chlorinated hydrocarbon wastes from the purification step of the diaphragm cell process using graphite anodes in chlorine production.	Jan. 16, 1981.
K074	Wastewater treatment sludges from the production of TiO_2 pigment using chromium bearing ores by the chloride process.	Deleted (see 46 FR 72034, Oct. 30, 1980).
K078	Solvent cleaning wastes from equipment and tank cleaning from paint manufacturing.	Suspended temporarily.
K079	Water or caustic cleaning wastes from equipment and tank cleaning from paint manufacturing.	Suspended temporarily.
K081	Wastewater treatment sludges from paint manufacturing	Suspended temporarily.
K082	Emission control dust or sludge from paint manufacturing	Suspended temporarily.
K083	Distillation bottoms from aniline production	Jan. 16, 1981.
K103	Process residues from aniline extraction from the production of aniline.	(6 months after publication.)
K104	Combined wastewater streams generated from nitrobenzene/aniline production.	(6 months after publication.)
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	Jan. 16, 1981.
K101	Distillation tar residues from the distillation of aniline compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	(6 months after publication.)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.	(6 months after publication.)
K085	Distillation or fractionation column bottoms from the production of chlorobenzenes.	Jan. 16, 1981.
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.	(6 months after publication.)
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.	Jan. 16, 1981.
K087	Decanter tank tar sludge from coking operations	Jan. 16, 1981.
K088	Spent potliners from primary aluminum production	Suspended temporarily.
K090	Emission control dust or sludge from ferrochromium-silicon production.	Suspended temporarily.
K091	Emission control dust or sludge from ferrochromium production	Suspended temporarily.
K092	Emission control dust or sludge from ferromanganese production	Deleted.
(Proposed)	Emission control dust from gray and ductile iron foundry cupola furnaces.	Deferred.

II. Finalization of §§ 261.31 and 261.32 Hazardous Waste Lists

On July 16, 1980, EPA amended Subpart D of Part 261 by adding eighteen wastes to EPA's hazardous waste list (§§ 261.31 and 261.32, 45 FR 47833–47834). These lists were published in interim final form to allow the public an opportunity to comment on additional data the Agency had collected on these wastes since the close of the initial public comment period on the proposed Subtitle C regulations (43 FR 58957–58959, December 18, 1978).

At the same time, the Agency also proposed for comment seven additional hazardous waste listings (45 FR 47835–47838, July 16, 1980). All of these wastes were identified by the Agency in the course of developing the necessary technical data to support the July 16, 1980, interim final hazardous waste list.

The Agency received a number of comments on both the interim final and proposed hazardous waste listings. We have evaluated these comments carefully and responded in detail in the respective listing background documents. We are setting forth in this preamble our disposition of the listings published in interim final and proposed form on July 16, 1980, summarizing the basis for our actions as to each of these listings. We also are responding to comments criticizing the Agency's decision to defer temporarily the listing of wastes from the woven fabric dyeing and finishing industry.

A. Wastes for Which No Comments Were Received and No Changes Were Made to the Hazardous Waste Listings or to the Respective Background Documents

No comments were received on four of the hazardous waste listings published on July 16, 1980. In addition, the Agency is not making any substantive changes to either the hazardous waste listings or to the respective background documents as a result of its evaluation of these listings. Included in this category are certain wastes from the production of veterinary pharmaceuticals (EPA Hazardous Waste Nos. K084, K101 and K102), and wastes from ink formulation (EPA Hazardous Waste No. K086). We therefore are promulgating all of these listings as final regulations.

B. Waste for Which No Comments Were Received and No Changes Were Made to the Hazardous Waste Listing or Respective Background Document, But Final Implementation Has Been Temporarily Suspended

The Agency also received no comment on the hazardous waste listing of "spent potliners from primary aluminum production" (EPA Hazardous Waste No. K088). The Agency has no doubt that this waste should be listed as a hazardous waste, since it contains high concentrations of cyanide and has been involved in damage incidents. The lack of comment on the listing reflects further consensus that these wastes are indeed hazardous. However, the waste is excluded temporarily from control under Subtitle C under § 261.4(b) of the regulations. This provision implements Section 7 of the recently enacted Solid Waste Disposal Act Amendments of 1980 (Pub. L. 94–482, October 21, 1980), and states that solid wastes from the extraction, beneficiation and processing of ores and minerals (including coal) are excluded from regulation under Subtitle C of RCRA. For the time being, the Agency interprets the language of this exclusion to include solid wastes generated during the smelting and refining of ores and minerals, and so would exclude the waste streams from primary aluminum production. (See 45 FR 76618–76620 (November 19, 1980)). After reviewing the applicable legislative history and receiving public comment, the Agency may amend this exclusion to bring this waste (and others already promulgated) back under Subtitle C control.

C. Wastes for Which Comments Were Received But No Changes Were Made to the Hazardous Waste Listings

The Agency received comments disputing the hazardousness of, or challenging aspects of the Agency's rationale for listing, certain wastes from the production of chlorine (EPA Hazardous Waste No. K073), aniline/nitrobenzene (EPA Hazardous Waste Nos. K083, K103 and K104), and coking operations (EPA Hazardous Waste No. K087). In evaluating these comments, the Agency did not agree with the substantive criticisms, and did not modify the listing descriptions or the number of wastes from both gray and ductile iron foundries, namely lead bearing wastewater treatment sludges from gray iron foundries, and emission control dust from gray and ductile iron foundry cupola furnaces (see discussion in 45 FR 47835, July 16, 1980). These wastes were proposed for listing since they were shown in certain cases to contain or release significant concentrations of the toxic metals lead or cadmium. However, as a result of industry comment, the Agency undertook further study of these wastes, beginning last summer, to determine their hazardousness. The report of this study is expected to be available for public comment in the near future. After evaluating this data and the public comments received, the Agency will consider the hazards posed by various wastes from foundry operations. We are, accordingly, deferring final action on these wastes. (All of these wastes are hazardous, of course, if they exhibit any of the characteristics of hazardous waste, and generators of these wastes are obligated to make this determination.)

(3) *Wastes From the Use and Manufacture of Paints (EPA Hazardous Waste Nos. F017, F018, K078, K079, K081, and K082).*

Many comments were received from various trade organizations and interested individuals, who objected to the listing of these paint wastes.

In general, most commenters criticized the waste listings as overly broad, resulting in regulation of both hazardous and non-hazardous paint wastes. In re-evaluating the data, the Agency agrees that further study of these wastes is needed before a final listing can be promulgated. We anticipate that our re-examination of paint wastes will be completed by the Spring of 1981. The Agency therefore has decided to suspend temporarily the interim final listings of these paint wastes. Paint wastes which exhibit any of the hazardous waste characteristics remain subject to Subtitle C controls.

G. Response to Comments Criticising the Agency's Decision to Defer Temporarily Listings of Waste Streams from the Woven Fabric Dyeing and Finishing Industry

The Agency indicated in the preamble to the July 16, interim final regulations that it was deferring temporarily listing of wastewater treatment sludges from the woven fabric dyeing and finishing industry (45 FR at 47832–47833).

One commenter objected to this decision, arguing that the Agency had improperly relied on EP protocol test data to evaluate the migratory potential of organic contaminants in these wastes. The commenter further stated that there is no documentation for the Agency's determination that chromium (which had been cited as a waste constituent of concern) is used in the manufacturing process in insignificant amounts. The commenter also felt that data submitted by industry sufficiently supports listing of these wastes as hazardous.

The Agency agrees with the commenter that the EP test may not be an appropriate measure of the potential for migration of all organic contaminants. Therefore, in evaluating the potential mobility of organic contaminants in textile waste, the Agency did not nor will it rely on the EP test to determine the potential mobility of possible organic waste constituents. In evaluating all the data currently in its possession, the Agency believes that it does not have sufficient data to assess the potential hazard to human health and the environment that would be presented by these wastes if improperly managed. The Agency, however, is still very concerned with the potential hazards that may be presented by these wastes, and therefore still intends to study further the wastes generated by the textile industry, paying particular attention to the many toxic organic constituents used in the production process such as dyes and pigments derived from benzidine, *o*-dianisidine, *o*-tolidine, and 3,3'-dichlorobenzidine, as well as acrylonitrile, trichlorobenzene, bis-(2-ethyl hexylphthalate), flame retardants and other additives.

With respect to the commenter's concern as to the lack of documentation on the use of chromium compounds in the textiles industry, the Agency not only was provided this information by industry, but possessed corroborating data in its own files. However, the Agency will reevaluate this information when further studying these wastes.

III. Finalization of Appendix VII to Part 261

Appendix VII to Part 261 sets forth the hazardous constituents for which each of the wastes in §§ 261.31 and 261.32 are listed. This appendix has been amended to reflect changes made in the underlying listings, and is being finalized in this revised form.

IV. Economic, Environmental and Regulatory Impacts

In accordance with Executive Order 11821, as amended by Executive Order 11949 and Executive Order 12044, EPA has prepared an Economic Impact Analysis of the hazardous waste program promulgated on May 19, 1980. The net effect of today's action reduces the overall cost, economic impact, and reporting and recording impact of EPA's hazardous waste management regulations, since the overall scope of Subtitle C jursidiction is being reduced. Since this action will decrease the regulatory impact of the Subtitle C regulatory program, we have not prepared a new Economic Impact Analysis or Regulatory Analysis. The Agency has also voluntarily prepared an Environmental Impact Statement on the program under the National Environmental Policy Act, 42 U.S.C. 4321 et seq.

(Sec. 3001 of the Resource Conservation and Recovery Act)

Dated: January 13, 1981.

Douglas M. Costle,
Administrator.

For the reasons and as set out in the preamble, 40 CFR Part 261 is amended as follows:

1. The authority citation for Part 261 reads as follows:

Authority: Secs. 1006, 2002(a), 3001, and 3002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912, 6921 and 6922).

2. Revise § 261.31 to read as follows:

§ 261.31 Hazardous waste from nonspecific sources.

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Generic:		
F001	The following spent halogenated solvents used in degreasing: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; and sludges from the recovery of these solvents in degreasing operations.	(T)
F002	The following spent halogenated solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, and trichlorofluoromethane; and the still bottoms from the recovery of these solvents.	(T)
F003	The following spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; and the still bottoms from the recovery of these solvents.	(I)
F004	The following spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; and the still bottoms from the recovery of these solvents.	(T)

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K041	Wastewater treatment sludge from the production of toxaphene	(T)
K098	Untreated process wastewater from the production of toxaphene	(T)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	(T)
K043	2,6-Dichlorophenol waste from the production of 2,4-D	(T)
K099	Untreated wastewater from the production of 2,4-D	(T)
Explosives:		
K044	Wastewater treatment sludges from the manufacturing and processing of explosives	(R)
K045	Spent carbon from the treatment of wastewater containing explosives	(R)
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds	(T)
K047	Pink/red water from TNT operations	(R)
Petroleum Refining:		
K048	Dissolved air flotation (DAF) float from the petroleum refining industry	(T)
K049	Slop oil emulsion solids from the petroleum refining industry	(T)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry	(T)
K051	API separator sludge from the petroleum refining industry	(T)
K052	Tank bottoms (leaded) from the petroleum refining industry	(T)
Iron and Steel:		
K061	Emission control dust/sludge from the primary production of steel in electric furnaces	(T)
K062	Spent pickle liquor from steel finishing operations	(C, T)
Primary Copper:		
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production	(T)
Primary Lead:		
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities	(T)
Primary Zinc:		
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production	(T)
K067	Electrolytic anode slimes/sludges from primary zinc production	(T)
K068	Cadmium plant leachate residue (iron oxide) from primary zinc production	(T)
Secondary Lead:		
K069	Emission control dust/sludge from secondary lead smelting	(T)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting	(T)
Veterinary Pharmaceuticals:		
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
Ink Formulation:		
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	(T)
Coking:		
K060	Ammonia still lime sludge from coking operations	(T)
K087	Decanter tank tar sludge from coking operations	(T)

Part 281, Appendix [Amended]

4. Revise Appendix VII to Part 261 to read as follows:

Appendix VII—Basis for Listing Hazardous Waste

EPA hazardous waste No.	Hazardous constituents for which listed
F001	Tetrachloroethylene, methylene chloride trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, chlorinated fluorocarbons.
F002	Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane.
F003	N.A.
F004	Cresols and cresylic acid, nitrobenzene.
F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine.
F006	Cadmium, hexavalent chromium, nickel, cyanide (complexed).
F007	Cyanide (salts).
F008	Cyanide (salts).
F009	Cyanide (salts).
F010	Cyanide (salts).
F011	Cyanide (salts).
F012	Cyanide (complexed).
F014	Cyanide (complexed).
F015	Cyanide (salts).
F019	Hexavalent chromium, cyanide (complexed).
K001	Pentachlorophenol, phenol, 2-chlorophenol, p-chloro-m-cresol, 2,4-dimethylphenyl, 2,4-dinitrophenol, trichlorophenols, tetrachlorophenols, 2,4-dinitrophenol, creosote, chrysene, naphthalene, fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benz(a)anthracene, dibenz(a)anthracene, acenaphthalene.
K002	Hexavalent chromium, lead
K003	Hexavalent chromium, lead.
K004	Hexavalent chromium.
K005	Hexavalent chromium, lead.
K006	Hexavalent chromium.
K007	Cyanide (complexed), hexavalent chromium.
K008	Hexavalent chromium.
K009	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid.
K010	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid, chloroacetaldehyde.
K011	Acrylonitrile, acetonitrile, hydrocyanic acid.
K013	Hydrocyanic acid, acrylonitrile, acetonitrile.
K014	Acetonitrile, acrylamide.
K015	Benzyl chloride, chlorobenzene, toluene, benzotrichloride.
K016	Hexachlorobenzene, hexachlorobutadiene, carbon tetrachloride, hexachloroethane, perchloroethylene.
K017	Epichlorohydrin, chloroethers [bis(chloromethyl) ether and bis (2-chloroethyl) ethers], trichloropropane, dichloropropanols.
K018	1,2-dichloroethane, trichloroethylene, hexachlorobutadiene, hexachlorobenzene.
K019	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K020	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K021	Antimony, carbon tetrachloride, chloroform.
K022	Phenol, tars (polycyclic aromatic hydrocarbons).
K023	Phthalic anhydride, maleic anhydride.
K024	Phthalic anhydride, 1,4-naphthoquinone.
K025	Meta-dinitrobenzene, 2,4-dinitrotoluene.
K026	Paraldehyde, pyridines, 2-picoline.
K027	Toluene diisocyanate, toluene-2, 4-diamine.
K028	1,1,1—trichloroethane, vinyl chloride.
K029	1,2-dichloroethane, 1,1,1-trichloroethane, vinyl chloride, vinylidene chloride, chloroform.
K030	Hexachlorobenzene, hexachlorobutadiene, hexachloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, ethylene dichloride.
K031	Arsenic.
K032	Hexachlorocyclopentadiene
K033	Hexachlorocyclopentadiene.
K034	Hexachlorocyclopentadiene.
K035	Creosote, chrysene, naphthalene, fluoranthene benzo(b) fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd) pyrene, benzo(a)anthracene, dibenzo(a)anthracene, acenaphthalene.
K036	Toluene, phosphorodithioic and phosphoro-thioic acid esters.
K037	Toluene, phosphorodithioic and phosphoro-thioic acid esters.
K038	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K039	Phosphorodithioic and phosphorothioic acid esters.
K040	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K041	Toxaphene.
K042	Hexachlorobenzene, ortho-dichlorobenzene.
K043	2,4-dichlorophenol, 2,6-dichlorophenol, 2,4,6-trichlorophenol.
K044	N.A.
K045	N.A.
K046	Lead.

ATTACHMENT 2

Table 1 - Producers of FeMn, FeCr or FeCrSi in The United States May, 1980 (5)

Producer	Products
CHROMASCO Woodstock, TN.	FeCr
INTERLAKE Beverly, OH.	FeCrSi, FeCr
MACALLOY Charleston, SC	FeCr
OHIO FERROALLOYS Philo, OH.	FeMn
SAMANCOR Rockwood, TN	FeMn
SATRALLOY Steubenville, OH.	FeCr, FeCrSi
SKW ALLOYS (CCMA)	
Calvert City, KY.	FeMn
Niagara Falls, NY.	FeCrSi
UNION CARBIDE	
Marietta, OH.	FeMn, FrCr
Portland, OR.	FeMn

ferroalloys are generally mixed and disposed of together. (Comments of the Ferroalloys Association, January 6, 1979.) Sludges usually are sent to unlined lagoons for settling; the sediments are dredged periodically and dumped on land (3). Waste piles in disposal areas can approach 250 feet in places, and the depth of disposal lagoons may approach 25 feet (2).

III. Hazardous Properties of the Waste

Ferroalloy production emission control dusts and sludges consist primarily of sub-micron particles composed of oxides of various elements, including lead and chromium (3). The Agency has data from two sources which indicate that substantial amounts of lead and chromium are contained in ferromanganese and ferrochromium dusts/sludges, while dusts and sludges from ferrochromium-silicon production contain substantial concentrations of chromium. The data are presented in Tables 2 and 3.

Table 2. Concentrations of Lead and Chromium in Ferroalloys Dusts/Sludges (3).

Product	Sample Source	Cr (ppm)	Pb (ppm)
Ferromanganese	Baghouse (dust	32	6000
	Scrubber (sludge)	18	5000
Ferrochromium	Electrostatic precipitator (dust)	3,390	300
Ferrochromium-silicon	Baghouse (dust	41	--

Table 3. Concentrations of Lead and Chromium in Particulate Matter Generated During Production of Ferroalloys† (1).

Product	Sample Source	Cr (ppm)	Pb (ppm)
Ferromanganese	Scrubber stack outlet	<80	1,130
Ferrochromium	Furnace	140,000	--
	Electrostatic precipitator (dust)	40,000	1,000
Ferrochromium-silicon	Furnace	14,000	<10
	Baghouse inlet	4,400	--

Most of the samples are of particulate matter collected from the furnace emissions prior to cleaning in an air pollution control device. These samples should be similar to the dust or sludge generated by these types of furnaces since emission control equipment removes 95-99% of these contaminants prior to air emission. (Comments of Ferroalloys Association, June 7, 1977, App. B.) The sample of particulate matter from the FeMn scrubber stack outlet should indicate which pollutant species are present in the sludge or dust, although relative quantities may be different from those in the solid waste.

Simulated leaching data also indicate that lead and chromium are capable of leaching from these wastes in concentrations sufficient to create a potential for substantial hazard. Table 6 below shows distilled water and acetic acid extraction data supplied by the Ferroalloys Association for selected emission control dusts. In most cases, contaminant levels in leachate are one to two orders of magnitude in excess of drinking water standards.

The Agency also has extraction data showing high concentrations of the constituents of concern in a distilled water extract of the waste:

- One comment stated that ferrochromium-silicon emission control dusts/sludges should not be listed because a discrepancy between the chromium concentrations reported in the original sample and the extract of that sample exists; 190 ppm were found in leachate but only 41 ppm in the original waste sample.

The Agency agrees that an error was made. The error might be due to faulty analytical techniques or to a mistake in calculating or recording data. As stated in the background document, however, data from another source indicates that chromium concentrations in ferrochromium silicon emission control dusts/sludges might be much higher. For this reason, EPA believes that the value of 41 ppm is understated and will continue to list this waste as hazardous.

- The Ferroalloys Association stated that the extracts of ferroalloys emission control dusts/sludges which they obtained by performing the proposed extraction procedure were only slightly above the limits defined as hazardous in the proposed regulations and therefore the wastes should not be classified as hazardous.

It is unusual that the data supplied by the Ferroalloys Association shows significantly less leaching using the proposed Extraction Procedure than other data from a distilled water extraction since the EP is the more rigorous of the two methods. Because such large quantities of these wastes are generated and samples of the wastes leached chromium in excess of 100 times the National Interim Primary Drinking Water Standard when subjected to a distilled water extraction, the Agency has decided that the wastes pose a potential threat to

ATTACHMENT 5

REVISED SITE SCREENING WORK PLAN

SKW Metals & Alloys, Inc.
Witmer Road Site

1.0 INTRODUCTION

Prior to the start of the proposed IRM work plan. SKW Metals & Alloys intends to complete site screening work to determine if ferrochromium dust was deposited on the SKW property. The site screening work will be limited to areas outside the closed landfill cells. The purpose of the investigation is to establish worker safety requirements and to determine if ferrochromium dust removal and/or containment will be a necessary component of the IRM work plan. This condition is important to determine before the start of the IRM work plan because of the added worker safety issues and waste handling requirements.

2.0 DEFINITION OF FERROCHROMIUM DUST

A key component of the site screening work is the definition of ferrochromium dust. Physically, it is a dark gray to black dust with clay size particles. The dust may occur as a loose material or as a relatively compacted layered deposit. Chemically, the ferrochromium dust is 85 to 95 percent silica and contains total chromium at approximately 700 to 1500 mg/kg (Attachment 2).

3.0 SCREENING OF INDUSTRIAL FILL

Based on the above definition, surface and subsurface material on the SKW property will be probed via a series of 25 randomly chosen test pits. Fill material occurs irregularly over parts of the SKW site. It is typically found from 0 to 8 feet below ground surface. While the test pits are being advanced, suspect fill material (dark grey to black dust. either compacted into layers or loose) will be described, sampled, and analyzed to determine the total chromium concentration. If necessary particle size determinations will

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Attachment 4

Summary Table of Determination Criteria

Attachment 4

Ferrochromium & Ferrochromium Silicon
Baghouse Dust Determination Criteria

Criteria 1. Documented Total Chromium Concentration (mg/kg)

Entity	Total Cr	Average Cr	Comments	Determination
EPA [1]	41 to 4,400	2,220	EPA found 41 ppm result erroneous	FeCr & FeCrSi dust conatins total chromium at 1,560 to 4,450 mg/kg.
EPA [2]	-	-	no data	
SAIC	1,560	-	lab documentation provided	
Macalloy	4,450	-	lab documentation provided	
Norchem	-	-	no data	
Lafarge	-	-	no data	

Criteria 2. Documented Grain Size (micron)

Entity	Grain Size	Average Size	Comments	Determination
EPA [1]	-	<1.0	statement / no lab documentation	FeCr & FeCrSi dust is <6.0 microns and average is 0.1 to 0.55 microns.
EPA [2]	< 6.0	-	statement / no lab documentation	
CCMA	<5.0	0.39 to 0.55	lab documentation provided	
SFA	-	-	no data	
Norchem	-	0.1 to 0.3	statement / no lab documentation	
Lafarge	-	0.1	statement / no lab documentation	

Criteria 3. Documented Crystallinity

Entity	Crystalline	Amorphous	Comments	Determination
EPA [1]	-	-	no data	FeCr & FeCrSi dust is composed of amorphous material.
EPA [2]	-	-	no data	
CCMA	no	yes	lab documentation provided	
SFA	no	yes	statement / no lab documentation	
Norchem	no	yes	statement / no lab documentation	
Larfarge	no	yes	statement / no lab documentation	

Notes: EPA[1] - 1980 K090 and K091 Listing Background Document
EPA[2] - 1995 Compilation of Air Pollution Emission Factors
CCMA - Calvert City Metals and Alloys, Inc. (formally known as SKW Metals & Alloys, Inc.)
SAIC - Science Application International Corporation (Engineers/Consultant)
SFA - Silica Fume Association (Trade Organization)
Macalloy - Macalloy, Corporation (Ferroalloy Producer)
Norchem, Inc. (Silica Fume User)
Lafarge, Corporation (Silica Fume User)

5

Attachment 5

Particle Size Study by Dr. Misiolek

Dr. Wojciech Z. Misiolek
Materials Engineering Consultant
17 Glen Drive
Troy, New York 12180

PHONE (518) 276-6099, (518) 276-5634, FAX (518) 276-8554

November 14, 1992

RECEIVED
NOV 16 1992

Guy D. Van Doren, P.E.
Vice President
Lan Associates Inc.
Environmental and Facilities Engineering
20 Cordova Street
St. Augustine, FL 32084-3619

Dear Mr. Van Doren,

Enclosed is the Progress Report I on **The Particle Size Distribution of the Fume Dust** together with the invoice for this project. After sorting out some technical difficulties we were able to perform these measurements for you.

In my personal opinion we need an additional scanning electron microscopy (SEM) analysis to be able to completely understand the fume dust morphology. I will contact you in a couple of days to discuss these eventual measurements with you.

If you have any questions related to the performed tests and their analysis do not hesitate to call me at (518) 276-6099. Please note change of my home address and phone number as indicated above.

Sincerely,

Wojciech Z. Misiolek, Sc.D.
Materials Engineering Consultant

WZM/consult/lan.2

INVOICE I

TO: LAN Associates Inc.
Environmental and Facilities Engineering
20 Cordova Street
St. Augustine, FL 32084-3619

Attn: Guy D. Van Doren, Vice President

FROM: Dr. W. Z. Misiolek
Materials Engineering Consultant
17 Glen Drive
Troy, NY 12180

DATE: November 14, 1992

EQUIPMENT FEE			
	Microtrac	12 x $15	$180.00
LABOR			
Nick Sopchak		9 x $20	$180.00
Wojciech Misiolek		4 x $100	$400.00
TOTAL			$760.00

Dr. Wojciech Z. Misiolek
Materials Engineering Consultant
17 Glen Drive
Troy, New York 12180

PHONE: 518/276-6099, 518/283-3806, FAX: 518/276-8554

PROGRESS REPORT I

THE PARTICLE SIZE DISTRIBUTION OF THE FUME DUST

prepared for

LAN Associates Inc.
Environmental and Facilities Engineering
20 Cordova Street
St. Augustine, FL 32084-3619

November 1992

Dr. Wojciech Z. Misiolek
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PARTICLE SIZE DISTRIBUTION OF THE FUME DUST

Introduction

The particle size distribution is one of the measurements of the whole characterization package for the fume dust. The goal of this project was to measure and analyze particle size and its distribution in twelve provided fume dust samples. The overall objective is to understand formation of the dust particles and it eventual consolidation for the further processing.

Methodology

The laser scattering method was implemented for these measurements and the state-of-the art particle size analyzer, the Microtrak FRA, was used. The laser scattering method is the most common due to its high precision and high speed. However, the measured laser diffraction data are used for the calculation of particle size and its distribution based on an assumption of the particles spherical shape. It is the source of the eventual error, but the same assumption of particle spherical shape is made in all alternative methods except scanning electron microscopy.

First measurements obtained for the analyzed fume dust were quite inconsistent. Leeds & Northrup, equipment manufacturer, was consulted and they informed us that SiO_2 based powders are extremely difficult to disperse. Sodium metaphosphate was also suggested as a surfactant for these powders. It was decided to use recommended surfactant and to repeat all of the previously performed measurements.

Each sample was prepared in the form of suspended powder in water and then tested. To minimize an agglomeration, sodium metaphosphate surfactant was used, and all the samples were exposed to the ultrasound vibration for one minute prior testing. Samples prepared in this fashion were tested and three measurements were taken for each powder.

Results

The results for each measurement are presented in the form of table followed by the histogram plot; frequency v. particle size (based on a logarithmic scale). At the end the average values for the performed three tests on a given powder sample are provided in the same form of table and histogram plot. The data for all tested twelve samples are provided in an Appendix A. A summary table allows a direct comparison of most typical values like particle size for 50% frequency and average particle size.

TABLE I

Particle Size Summary Table

Sample No.	"50%" Particle Size (μm)	Average Particle Size (μm)	The same Sample Measurements
1	0.38	0.39	Inconsistent
2	0.50	0.52	Consistent
3	0.39	0.38	Inconsistent
4	0.40	0.40	Consistent
5	0.47	0.47	Consistent
6	0.48	0.50	Consistent
7	0.51	0.53	Consistent
8	0.47	0.48	Inconsistent
9	0.38	0.38	Consistent
10	0.39	0.41	Consistent
11	0.47	0.50	Consistent
13	0.52	0.55	Consistent

Discussion

The comparison of measurements indicated that they were quite consistent for each powder with the exception of samples number 1, number 3, and number 8, where one out of three test provided different results. The fact that particle size for 50% frequency is so close to average value is an indication of typical powder size distribution. However, more detailed analysis, especially using histogram plot, pointed out the additional peaks for larger particle diameter. These secondary peaks appears to be agglomerates or aggregates.

Agglomerate is defined as a collection of fine particles bonded together by secondary bonds, and appears as large particle. This kind of particle cluster can be usually relatively easy broken into individual particles during processing. The second type of large diameter particle cluster, which is build from the fine particles bonded together by the primary bonds is called aggregate. It is almost impossible to separate each individual particle from the aggregate during processing. This causes additional technological difficulties in terms of lower density, declined powder flow, and difficulties with powder compaction.

All tested powders have their average particle size in the 0.38 to 0.55 μm size range. There are relatively small differences, especially taking into account fact that all the powders exhibited the multi-modal size distribution. The major difficulty with this data is a fact that both 50% and average size values do not represent tested powders well. The majority of the powders is smaller that 50% size in each batch. It is necessary to perform an additional investigation in order to evaluate true particle size distribution.

It would be very beneficial for this project to exam and evaluate the nature of the particle collections, and the character of the present inter-particle bonds. The best method for this kind of analysis seems to be scanning electron microscopy (SEM). This technique provides sufficient information about particle size and shape, its surface texture, and kind of inter-particle bonding.

Summary and Recommendation

As indicated above all tested fume dust samples exhibited multi-modal distribution with average particle size between 0.38 and 0.55 μm. Due to this multi-modal character the whole particle size distribution is shifted toward the high end. To evaluate the particle size distribution of the fume dust in an explicit way, the precise characterization of large particles responsible for the secondary peeks is necessary. It is recommended to perform additional powder characterization analysis for particle size and shape using SEM technique.

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Attachment 6

EPA Manual on Metallurgical Industry (portion)

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

AP-42
Fifth Edition
January 1995

Air

EPA

COMPILATION OF AIR POLLUTANT EMISSION FACTORS

VOLUME I: STATIONARY POINT AND AREA SOURCES

FIFTH EDITION

Office of Air Quality
Clean Air
OAQPS
Planning and Standards

12.4 Ferroalloy Production

12.4.1 General

Ferroalloy is an alloy of iron with some element other than carbon. Ferroalloy is used to physically introduce or "carry" that element into molten metal, usually during steel manufacture. In practice, the term ferroalloy is used to include any alloys that introduce reactive elements or alloy systems, such as nickel and cobalt-based aluminum systems. Silicon metal is consumed in the aluminum industry as an alloying agent and in the chemical industry as a raw material in silicon-based chemical manufacturing.

The ferroalloy industry is associated with the iron and steel industries, its largest customers. Ferroalloys impart distinctive qualities to steel and cast iron and serve important functions during iron and steel production cycles. The principal ferroalloys are those of chromium, manganese, and silicon. Chromium provides corrosion resistance to stainless steels. Manganese is essential to counteract the harmful effects of sulfur in the production of virtually all steels and cast iron. Silicon is used primarily for deoxidation in steel and as an alloying agent in cast iron. Boron, cobalt, columbium, copper, molybdenum, nickel, phosphorus, titanium, tungsten, vanadium, zirconium, and the rare earths impart specific characteristics and are usually added as ferroalloys.

United States ferroalloy production in 1989 was approximately 894,000 megagrams (Mg) (985,000 tons), substantially less than shipments in 1975 of approximately 1,603,000 megagrams (1,770,000 tons). In 1989, ferroalloys were produced in the U. S. by 28 companies, although 5 of those produced only ferrophosphorous as a byproduct of elemental phosphorous production.

12.4.2 Process Description

A typical ferroalloy plant is illustrated in Figure 12.4-1. A variety of furnace types, including submerged electric arc furnaces, exothermic (metallothermic) reaction furnaces, and electrolytic cells can be used to produce ferroalloys. Furnace descriptions and their ferroalloy products are given in Table 12.4-1.

12.4.2.1 Submerged Electric Arc Process -

In most cases, the submerged electric arc furnace produces the desired product directly. It may produce an intermediate product that is subsequently used in additional processing methods. The submerged arc process is a reduction smelting operation. The reactants consist of metallic ores (ferrous oxides, silicon oxides, manganese oxides, chrome oxides, etc.) and a carbon-source reducing agent, usually in the form of coke, charcoal, high- and low-volatility coal, or wood chips. Limestone may also be added as a flux material. Raw materials are crushed, sized, and, in some cases, dried, and then conveyed to a mix house for weighing and blending. Conveyors, buckets, skip hoists, or cars transport the processed material to hoppers above the furnace. The mix is then gravity-fed through a feed chute either continuously or intermittently, as needed. At high temperatures in the reaction zone, the carbon source reacts with metal oxides to form carbon monoxide and to reduce the ores to base metal. A typical reaction producing ferrosilicon is shown below:

$$Fe_2O_3 + 2SiO_2 + 7C \rightarrow 2FeSi + 7\ CO \qquad (1)$$

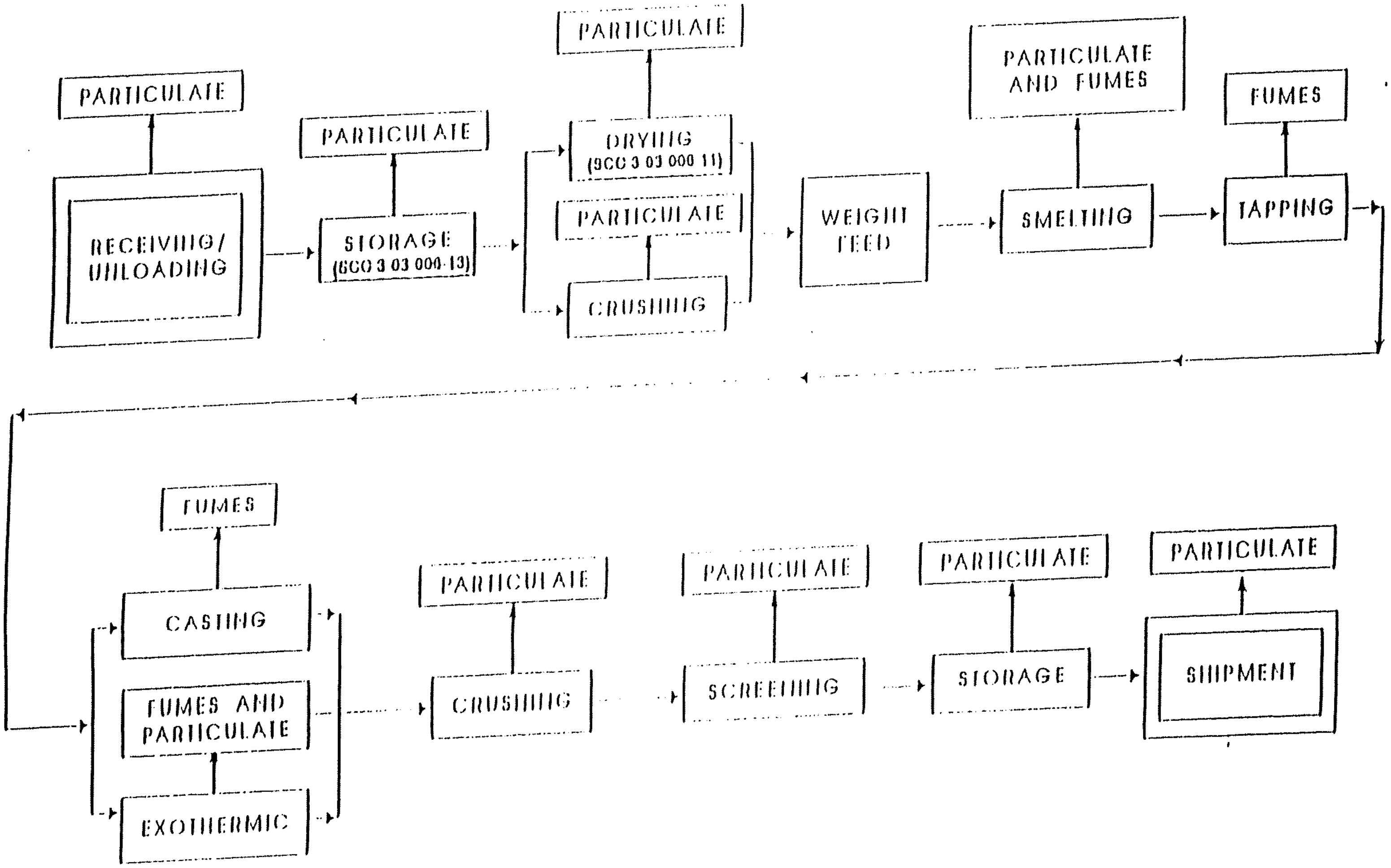

Figure 12.4-1. Typical ferroalloy production process. (Source Cla[illegible]

Table 12.4-1. FERROALLOY PROCESSES AND RESPECTIVE PRODUCT GROUPS

Process	Product
Submerged arc furnace[a]	Silvery iron (15-22% Si) Ferrosilicon (50% Si) Ferrosilicon (65-75% Si) Silicon metal Silicon/manganese/zirconium (SMZ) High carbon (HC) ferromanganese Siliconmanganese HC ferrochrome Ferrochrome/silicon FeSi (90% Si)
Exothermic[b]	
Silicon reduction	Low carbon (LC) ferrochrome, LC ferromanganese, medium carbon (MC) ferromanganese
Aluminum Reduction	Chromium metal, ferrotitanium, ferrocolumbium, ferovanadium
Mixed aluminothermal/silicothermal	Ferromolybdenum, ferrotungsten
Electrolytic[c]	Chromium metal, manganese metal
Vacuum furnace[d]	LC ferrochrome
Induction furnace[e]	Ferrotitanium

[a] Process by which metal is smelted in a refractory-lined cup-shaped steel shell by submerged graphite electrodes.

[b] Process by which molten charge material is reduced, in exothermic reaction, by addition of silicon, aluminum, or a combination of the 2.

[c] Process by which simple ions of a metal, usually chromium or manganese in an electrolyte, are plated on cathodes by direct low-voltage current.

[d] Process by which carbon is removed from solid-state high-carbon ferrochrome within vacuum furnaces maintained at temperatures near melting point of alloy.

[e] Process that converts electrical energy into heat, without electrodes, to melt metal charges in a cup or drum-shaped vessel.

Smelting in an electric arc furnace is accomplished by conversion of electrical energy to heat. An alternating current applied to the electrodes causes current to flow through the charge between the electrode tips. This provides a reaction zone at temperatures up to 2000°C (3632°F). The tip of each electrode changes polarity continuously as the alternating current flows between the tips. To maintain a uniform electric load, electrode depth is continuously varied automatically by mechanical or hydraulic means.

A typical submerged electric arc furnace design is depicted in Figure 12.4-2. The lower p of the submerged electric arc furnace is composed of a cylindrical steel shell with a flat bottom or hearth. The interior of the shell is lined with 2 or more layers of carbon blocks. The furnace shell may be water-cooled to protect it from the heat of the process. A water-cooled cover and fume collection hood are mounted over the furnace shell. Normally, 3 carbon electrodes arranged in a triangular formation extend through the cover and into the furnace shell opening. Prebaked or self-baking (Soderberg) electrodes ranging from 76 to over 100 cm (30 to over 40 inches) in diameter ar typically used. Raw materials are sometimes charged to the furnace through feed chutes from above the furnace. The surface of the furnace charge, which contains both molten material and unconverted charge during operation, is typically maintained near the top of the furnace shell. The lower ends of the electrodes are maintained at about 0.9 to 1.5 meters (3 to 5 feet) below the charge surface. Three-phase electric current arcs from electrode to electrode, passing through the charge material. The charge material melts and reacts to form the desired product as the electric energy is converted into heat. The carbonaceous material in the furnace charge reacts with oxygen in the metal oxides of the charge and reduces them to base metals. The reactions produce large quantities of carbon monoxide (CO) that passes upward through the furnace charge. The molten metal and slag are removed (tapped) through 1 or more tap holes extending through the furnace shell at the hearth level. Feed materials may be charged continuously or intermittently. Power is applied continuously. Tapping can be intermittent or continuous based on production rate of the furnace.

Submerged electric arc furnaces are of 2 basic types, open and covered. Most of the submerged electric arc furnaces in the U. S. are open furnaces. Open furnaces have a fume collection hood at least 1 meter (3.3 feet) above the top of the furnace shell. Moveable panels or screens are sometimes used to reduce the open area between the furnace and hood, and to improve emissions capture efficiency. Carbon monoxide rising through the furnace charge burns in the area between the charge surface and the capture hood. This substantially increases the volume of gas the containment system must handle. Additionally, the vigorous open combustion process entrains finer material in the charge. Fabric filters are typically used to control emissions from open furnaces.

Covered furnaces may have a water-cooled steel cover that fits closely to the furnace shell. The objective of covered furnaces is to reduce air infiltration into the furnace gases, which reduces combustion of that gas. This reduces the volume of gas requiring collection and treatment. The cover has holes for the charge and electrodes to pass through. Covered furnaces that partially close these hood openings with charge material are referred to as "mix-sealed" or "semi-enclosed furnaces". Although these covered furnaces significantly reduce air infiltration, some combustion still occurs under the furnace cover. Covered furnaces that have mechanical seals around the electrodes and sealing compounds around the outer edges are referred to as "sealed" or "totally closed". These furnaces have little, if any, air infiltration and undercover combustion. Water leaks from the cover into the furnace must be minimized as this leads to excessive gas production and unstable furnace operation. Products prone to highly variable releases of process gases are typically not made in covered furnaces for safety reasons. As the degree of enclosure increases, less gas is produced for capture by the hood system and the concentration of carbon monoxide in the furnace gas increases. Wet scrubbers are used to control emissions from covered furnaces. The scrubbed, high carbon monoxide content gas may be used within the plant or flared.

The molten alloy and slag that accumulate on the furnace hearth are removed at 1 to 5-hour intervals through the tap hole. Tapping typically lasts 10 to 15 minutes. Tap holes are opened with pellet shot from a gun, by drilling, or by oxygen lancing. The molten metal and slag flow from the tap hole into a carbon-lined trough, then into a carbon-lined runner that directs the metal and slag into a reaction ladle, ingot molds, or chills. (Chills are low, flat iron or steel pans that provide rapid

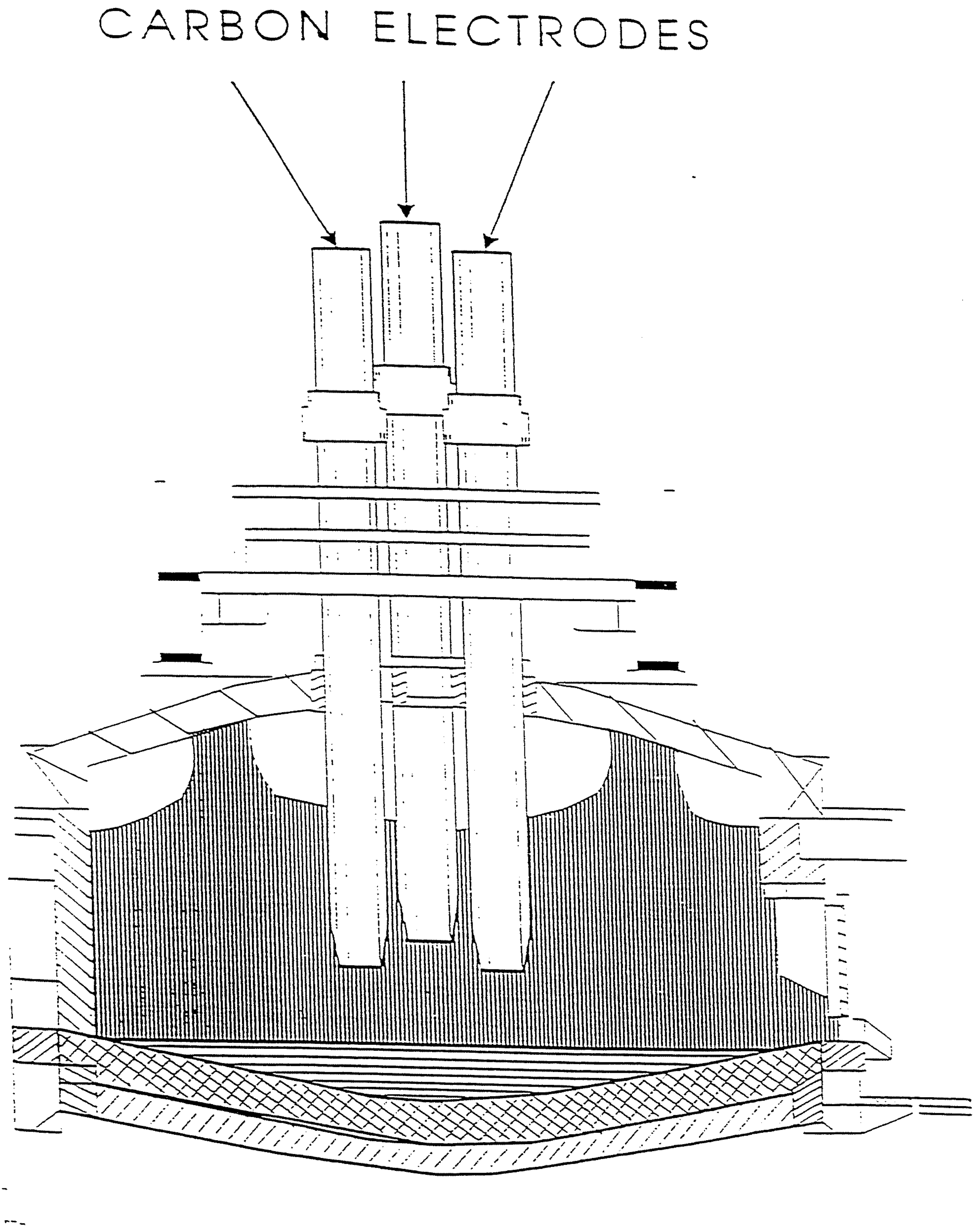

Figure 12.4-2. Typical submerged arc furnace design.

cooling of the molten metal.) After tapping is completed, the furnace is resealed by inserting a carbon paste plug into the tap hole.

Chemistry adjustments may be necessary after furnace smelting to achieve a specified product. Ladle treatment reactions are batch processes and may include metal and alloy additions.

During tapping, and/or in the reaction ladle, slag is skimmed from the surface of the molten metal. It can be disposed of in landfills, sold as road ballast, or used as a raw material in a furnace or reaction ladle to produce a chemically related ferroalloy product.

After cooling and solidifying, the large ferroalloy castings may be broken with drop weights or hammers. The broken ferroalloy pieces are then crushed, screened (sized), and stored in bins until shipment. In some instances, the alloys are stored in lump form in inventories prior to sizing for shipping.

12.4.2.2 Exothermic (Metallothermic) Process -

The exothermic process is generally used to produce high-grade alloys with low-carbon content. The intermediate molten alloy used in the process may come directly from a submerged electric arc furnace or from another type of heating device. Silicon or aluminum combines with oxygen in the molten alloy, resulting in a sharp temperature rise and strong agitation of the molten bath. Low- and medium-carbon content ferrochromium (FeCr) and ferromanganese (FeMn) are produced by silicon reduction. Aluminum reduction is used to produce chromium metal, ferrotitanium, ferrovanadium, and ferrocolumbium. Mixed alumino/silico thermal processing is used for producing ferromolybdenum and ferrotungsten. Although aluminum is more expensive than carbon or silicon, the products are purer. Low-carbon (LC) ferrochromium is typically produced by fusing chromium ore and lime in a furnace. A specified amount is then placed in a ladle (ladle No. 1). A known amount of an intermediate grade ferrochromesilicon is then added to the ladle. The reaction is extremely exothermic and liberates chromium from its ore, producing LC ferrochromium and a calcium silicate slag. This slag, which still contains recoverable chromium oxide, is reacted in a second ladle (ladle No. 2) with molten high-carbon ferrochromesilicon to produce the intermediate-grade ferrochromesilicon. Exothermic processes are generally carried out in open vessels and may have emissions similar to the submerged arc process for short periods while the reduction is occurring.

12.4.2.3 Electrolytic Processes -

Electrolytic processes are used to produce high-purity manganese and chromium. As of 1989 there were 2 ferroalloy facilities using electrolytic processes.

Manganese may be produced by the electrolysis of an electrolyte extracted from manganese ore or manganese-bearing ferroalloy slag. Manganese ores contain close to 50 percent manganese; furnace slag normally contains about 10 percent manganese. The process has 5 steps: (1) roasting the ore to convert it to manganese oxide (MnO), (2) leaching the roasted ore with sulfuric acid (H_2SO_4) to solubilize manganese, (3) neutralization and filtration to remove iron and aluminum hydroxides, (4) purifying the leach liquor by treatment with sulfide and filtration to remove a wide variety of metals, and (5) electrolysis.

Electrolytic chromium is generally produced from high-carbon ferrochromium. A large volume of hydrogen gas is produced by dissolving the alloy in sulfuric acid. The leachate is treated with ammonium sulfate and conditioned to remove ferrous ammonium sulfate and produce a chrome-alum for feed to the electrolysis cells. The electrolysis cells are well ventilated to reduce ambient hydrogen and hexavalent chromium concentrations in the cell rooms.

12.4.3 Emissions And Controls

Particulate is generated from several activities during ferroalloy production, including raw material handling, smelting, tapping, and product handling. Organic materials are generated almost exclusively from the smelting operation. The furnaces are the largest potential sources of particulate and organic emissions. The emission factors are given in Tables 12.4-2 and 12.4-3. Size-specific emission factors for submerged arc ferroalloy furnaces are given in Tables 12.4-4 and 12.4-5.

Particulate emissions from electric arc furnaces in the form of fumes account for an estimated 94 percent of the total particulate emissions in the ferroalloy industry. Large amounts of carbon monoxide and organic materials also are emitted by submerged electric arc furnaces. Carbon monoxide is formed as a byproduct of the chemical reaction between oxygen in the metal oxides of the charge and carbon contained in the reducing agent (coke, coal, etc.). Reduction gases containing organic compounds and carbon monoxide continuously rise from the high-temperature reaction zone, entraining fine particles and fume precursors. The mass weight of carbon monoxide produced sometimes exceeds that of the metallic product. The heat-induced fume consists of oxides of the products being produced and carbon from the reducing agent. The fume is enriched by silicon dioxide, calcium oxide, and magnesium oxide, if present in the charge.

In an open electric arc furnace, virtually all carbon monoxide and much of the organic matter burns with induced air at the furnace top. The remaining fume, captured by hooding about 1 meter above the furnace, is directed to a gas cleaning device. Fabric filters are used to control emissions from 85 percent of the open furnaces in the U. S. Scrubbers are used on 13 percent of the furnaces, and electrostatic precipitators on 2 percent.

Two emission capture systems, not usually connected to the same gas cleaning device, are necessary for covered furnaces. A primary capture system withdraws gases from beneath the furnace cover. A secondary system captures fumes released around the electrode seals and during tapping. Scrubbers are used almost exclusively to control exhaust gases from sealed furnaces. The scrubbers capture a substantial percentage of the organic emissions, which are much greater for covered furnaces than open furnaces. The gas from sealed and mix-sealed furnaces is usually flared at the exhaust of the scrubber. The carbon monoxide-rich gas is sometimes used as a fuel in kilns and sintering machines. The efficiency of flares for the control of carbon monoxide and the reduction of VOCs has been estimated to be greater than 98 percent. A gas heating reduction of organic and carbon monoxide emissions is 98 percent efficient.

Tapping operations also generate fumes. Tapping is intermittent and is usually conducted during 10 to 20 percent of the furnace operating time. Some fumes originate from the carbon lip liner, but most are a result of induced heat transfer from the molten metal or slag as it contacts the runners, ladles, casting beds, and ambient air. Some plants capture these emissions to varying degrees with a main canopy hood. Other plants employ separate tapping hoods ducted to either the furnace emission control device or a separate control device. Emission factors for tapping emissions are unavailable due to lack of data.

After furnace tapping is completed, a reaction ladle may be used to adjust the metallurgy by chlorination, oxidation, gas mixing, and slag metal reactions. Ladle reactions are an intermittent process, and emissions have not been quantified. Reaction ladle emissions are often captured by the tapping emissions control system.

Table 12.4-2 (Metric Units). EMISSION FACTORS FOR PARTICULATE FROM SUBMERGED ARC FERROALLOY FURNACES[a]

Product[b]	Furnace Type	Particulate Emission Factors Uncontrolled[c]	EMISSION FACTOR RATING	Control Device[d]	Particulate Emission Factors Controlled[c]	EMISSION FACTOR RATING
FeSi (50%) (SCC 3-03-006-01)	Open[e,f,g]	35	B	Baghouse[e,f]	0.9	B
	Covered[h]	46	B	Scrubber[h,j]		
				High energy	0.24	B
				Low energy	4.5	B
FeSi (75%) (SCC 3-03-006-02)	Open[k]	158	B	Scrubber[h,j]		
				Low energy	4.0	B
	Covered[h,j]	103	B	ND	ND	NA
FeSi (90%) (SCC 3-03-006-03)	Open[m]	282	B	ND	ND	NA
Si metal (98%) (SCC 3-03-006-04)	Open[n,p]	436	B	Baghouse[n,p]	16	B
FeMn (80%) (SCC 3-03-006-06)	Open[q,r]	14	B	Baghouse[q,r]	0.24	B
				Scrubber[h,s]		
				High energy	0.8	B
FeMn (1% Si) (SCC 3-03-007-01)	Covered[h,t]	6	B	Scrubber	0.25	C
				High energy[h,s,w]		
	Sealed[u,v]	17	B	ND	ND	NA
FeCr (high carbon) (SCC 3-03-006-07)	Open[x,y]	78	C	ESP[x,y]	1.2	C
SiMn (SCC 3-03-006-05)	Open[z,aa]	96	C	Scrubber[aa,bb]	2.1	C
	Sealed			Scrubber[v,w]		
				High energy	0.15	C

[a] Emission factors are expressed as kg of pollutant/Mg alloy produced. Factors are for main furnace dust collection system before and after control device. Where other emissions, such as leaks or tapping, are included or quantified separately, such is noted. Particulate sources not included: raw material handling, storage, and preparation; and product crushing, screening, handling, and packaging. SCC = Source Classification Code. ND = no data. NA = not applicable.

[b] Percentages are of the main alloying agent in product.

Table 12.4-2 (cont.).

[c] In most source testing, fugitive emissions are not measured or collected. Where tapping emissions are controlled by primary system, their contribution to total emissions could not be determined. Fugitive emissions may vary greatly among sources, with furnace and collection system design and operating practices.

[d] Low-energy scrubbers are those with $\Delta P < 20$ inches of H_2O; high-energy with $\Delta P > 20$ inches of H_2O.

[e] Includes fumes captured by tapping hood (efficiency estimated at near 100%).

[f] References 4,10,21.

[g] Factor is average of 3 sources, fugitive emissions not included. Fugitive emissions at 1 source measured an additional 10.5 kg/Mg alloy, or 2.7 kg/MW-hr.

[h] References 4,10.

[j] Does not include emissions from tapping or mix seal leaks.

[k] References 25-26.

[m] Reference 23.

[n] Estimated 60% of tapping emissions captured by control system (escaped fugitive emissions not included in factor).

[p] References 10,13.

[q] Estimated 50% of tapping emissions captured by control system (escaped fugitive emissions not included in factor).

[r] References 4,10,12.

[s] Includes fumes only from primary control system.

[t] Includes tapping fumes and mix seal leak fugitive emissions. Fugitive emissions measured at 33% of total uncontrollable emissions.

[u] Assumes tapping fumes not included in emission factor.

[v] Reference 14.

[w] Does not include tapping or fugitive emissions.

[x] Tapping emissions included.

[y] References 2,15-17.

[z] Factor is average of 2 test series. Tests at 1 source included fugitive emissions (3.4% of total uncontrolled emissions). Second test insufficient to determine if fugitive emissions were included in total.

[aa] References 2,18-19.

[bb] Factors developed from 2 scrubber controlled sources, 1 operated at $\Delta P = 47\text{-}57$ inches of H_2O, the other at unspecified ΔP. Uncontrolled tapping operations emissions are 2.1 kg/Mg alloy.

Table 12.4-3 (English Units). EMISSION FACTORS FOR PARTICULATE FROM SUBMERGED ARC FERROALLOY FURNACES[a]

Product[b]	Furnace Type	Particulate Emission factors Uncontrolled[c]	EMISSION FACTOR RATING	Control Device[d]	Particulate Emission factors Controlled[c]	EMISSION FACTOR RATING
FeSi (50%) (SCC 3-03-006-01)	Open[c,f,g]	70	B	Baghouse[c,f]	1.8	B
	Covered[h]	92	E	Scrubber[h,j]		
				High energy	0.48	E
				Low energy	9.0	E
FeSi (75%) (SCC 3-03-006-02)	Open[k]	316	E	Scrubber[h,j]		
				Low energy	8.0	E
	Covered[h,j]	206	E	ND	ND	NA
FeSi (90%) (SCC 3-03-006-03)	Open[m]	564	E	ND	ND	NA
Si metal (98%) (SCC 3-03-006-04)	Open[n,p]	872	B	Baghouse[n,p]	32	B
FeMn (80%) (SCC 3-03-006-06)	Open[q,r]	28	B	Baghouse[q,r]	0.48	B
				Scrubber[h,s]		
				High energy	1.6	E
FeMn (1% Si) (SCC 3-03-007-01)	Covered[h,t]	12	E	Scrubber		
				High energy[h,t,w]	0.5	C
	Sealed[u,v]	74	E	ND	ND	NA
FeCr (high carbon) (SCC 3-03-006-07)	Open[x,y]	157	C	ESP[x,y]	2.3	C
SiMn (SCC 3-03-006-05)	Open[z,aa]	192	C	Scrubber[aa,bb]	4.2	C
	Sealed	...	...	Scrubber[v,w]		
				High energy	0.30	C

[a] Emission factors expressed as lb of pollutant/ton of Alloy produced. Factors are for main furnace dust collection system before and after control device. Where other emissions, such as leaks or tapping, are included or quantified separately, such is noted. Particulate sources not included: raw material handling, storage, and preparation; and product crushing, screening, handling, and packaging. SCC = Source Classification Code. ND = no data. NA = not applicable.

[b] Percentages are of the main alloying agent in product.

Table 12.4-3 (cont.).

[c] In most source testing, fugitive emissions are not measured or collected. Where tapping emissions are controlled by primary system, their contribution to total emissions could not be determined. Fugitive emissions may vary greatly among sources, with furnace and collection system design and operating practices.

[d] Low-energy scrubbers are those with $\Delta P < 20$ inches of H_2O; high-energy with $\Delta P > 20$ inches of H_2O.

[e] Includes fumes captured by tapping hood (efficiency estimated at near 100%).

[f] References 4,10,21.

[g] Factor is average of 3 sources, fugitive emissions not included. Fugitive emissions at 1 source measured an additional 21 lb/ton alloy, or 5.9 lb/MW-hr.

[h] References 4,10.

[j] Does not include emissions from tapping or mix seal leaks.

[k] References 25-26.

[m] Reference 23.

[n] Estimated 60% of tapping emissions captured by control system (escaped fugitive emissions not included in factor).

[p] References 10,13.

[q] Estimated 50% of tapping emissions captured by control system (escaped fugitive emissions not included in factor).

[r] References 4,10,12.

[s] Includes fumes only from primary control system.

[t] Includes tapping fumes and mix seal leak fugitive emissions. Fugitive emissions measured at 33% of total uncontrollable emissions.

[u] Assumes tapping fumes not included in emission factor.

[v] Reference 14.

[w] Does not include tapping or fugitive emissions.

[x] Tapping emissions included.

[y] References 2,15-17.

[z] Factor is average of 2 test series. Tests at 1 source included fugitive emissions (3.4% of total uncontrolled emissions). Second test insufficient to determine if fugitive emissions were included in total.

[aa] References 2,18-19.

[bb] Factors developed from 2 scrubber controlled sources, 1 operated at $\Delta P = 47\text{-}57$ inches of H_2O, the other at unspecified ΔP. Uncontrolled tapping operations emissions are 4.2 lb/ton alloy.

Table 12.4-4 (Metric Units). SIZE-SPECIFIC EMISSION FACTORS FOR SUBMERGED ARC FERROALLOY FURNACES

Product	Control Device	Particle Size[a] (µm)	Cumulative Mass % ≤ Stated Size	Cumulative Mass Emission Factor (kg/Mg alloy)	EMISSION FACTOR RATING
50% FeSi Open furnace (SCC 3-03-006-01)	None[b,c]	0.63	45	16	B
		1.00	50	18	
		1.25	53	19	
		2.50	57	20	
		6.00	61	21	
		10.00	63	22	
		15.00	66	23	
		20.00	69	24	
		—[d]	100	35	
	Baghouse	0.63	31	0.28	B
		1.00	39	0.35	
		1.25	44	0.40	
		2.50	54	0.49	
		6.00	63	0.57	
		10.00	72	0.65	
		15.00	80	0.72	
		20.00	85	0.77	
			100	0.90	
80% FeMn Open furnace (SCC 3-03-006-06)	None[e,f]	0.63	30	4	B
		1.00	46	7	
		1.25	52	8	
		2.50	62	9	
		6.00	71	10	
		10.00	86	12	
		15.00	96	13	
		20.00	97	14	
		—[d]	100	14	
	Baghouse[e]	0.63	20	0.048	B
		1.00	30	0.070	
		1.25	35	0.085	
		2.50	49	0.120	
		6.00	67	0.160	
		10.00	83	0.200	
		15.00	92	0.220	
		20.00	97	0.235	
		—[d]	100	0.240	

Table 12.4-4 (cont.).

Product	Control Device	Particle Size[a] (µm)	Cumulative Mass % ≤ Stated Size	Cumulative Mass Emission Factor (kg/Mg alloy)	EMISSION FACTOR RATING
Si Metal[g]					
Open furnace (SCC 3-03-006-04)	None[h]	0.63	57	249	B
		1.00	67	292	
		1.25	70	305	
		2.50	75	327	
		6.00	80	349	
		10.00	86	375	
		15.00	91	397	
		20.00	95	414	
		—[d]	100	436	
	Baghouse	1.00	49	7.8	
		1.25	53	8.5	
		2.50	64	10.2	
		6.00	76	12.2	
		10.00	87	13.9	
		15.00	96	15.4	
		20.00	99	15.8	
			100	16.0	
FeCr (HC)					
Open furnace (SCC 3-03-006-07)	None[b,j]	0.5	19	15	C
		1.0	36	28	
		2.0	60	47	
		2.5	63[k]	49	
		4.0	76	59	
		6.0	88[k]	67	
		10.0	91	71	
		—[d]	100	78	
	ESP	0.5	33	0.40	C
		1.0	47	0.56	
		2.0	67	0.80	
		2.5	80	0.96	
		4.0	86	1.03	
		6.0	90	1.08	
		10.0	100	1.2	
		—[d]			

Table 12.4-5 (English Units). SIZE-SPECIFIC EMISSION FACTORS FOR SUBMERGED ARC FERROALLOY FURNACES

Product	Control Device	Particle Size[a] (µm)	Cumulative Mass % ≤ Stated Size	Cumulative Mass Emission Factor (lb/ton alloy)	EMISSION FACTOR RATING
50% FeSi Open furnace (SCC 3-03-006-01)	None[b,c]	0.63	45	32	B
		1.00	50	35	
		1.25	53	37	
		2.50	57	40	
		6.00	61	43	
		10.00	63	44	
		15.00	66	46	
		20.00	69	48	
		—[d]	100	70	
	Baghouse	0.63	31	0.56	B
		1.00	39	0.70	
		1.25	44	0.80	
		2.50	54	1.0	
		6.00	63	1.1	
		10.00	72	1.3	
		15.00	80	1.4	
		20.00	85	1.5	
			100	1.8	
80% FeMn Open furnace (SCC 3-03-006-06)	None[e,f]	0.63	30	8	B
		1.00	46	13	
		1.25	52	15	
		2.50	62	17	
		6.00	72	20	
		10.00	86	24	
		15.00	96	26	
		20.00	97	27	
		—[d]	100	28	
	Baghouse[e]	0.63	20	0.10	B
		1.00	30	0.14	
		1.25	35	0.17	
		2.50	49	0.24	
		6.00	67	0.32	
		10.00	83	0.40	
		15.00	92	0.44	
		20.00	97	0.47	
		—[d]	100	0.48	

Table 12.4-5 (cont.).

Product	Control Device	Particle Size[a] (µm)	Cumulative Mass % ≤ Stated Size	Cumulative Mass Emission Factor (lb/ton alloy)	EMISSIO FACTO RATING
Si Metal[g]					
Open Furnace (SCC 3-03-006-04)	None[b]	0.63	57	497	B
		1.00	67	584	
		1.25	70	610	
		2.50	75	654	
		6.00	80	698	
		10.00	86	750	
		15.00	91	794	
		20.00	95	828	
		—[d]	100	872	
	Baghouse	1.00	49	15.7	B
		1.25	53	17.0	
		2.50	64	20.5	
		6.00	76	24.3	
		10.00	87	28.0	
		15.00	96	31.0	
		20.00	99	31.7	
			100	32.0	
FeCr (HC)					
Open furnace (SCC 3-03-006-07)	None[b,j]	0.5	19	30	C
		1.0	36	57	
		2.0	60	94	
		2.5	63[k]	98	
		4.0	76	119	
		6.0	88[k]	138	
		10.0	91	143	
		—[d]	100	157	
	ESP	0.5	33	0.76	C
		1.0	47	1.08	
		2.0	67	1.54	
		2.5	80	1.84	
		4.0	86	1.98	
		6.0	90	2.07	
		10.0	100	2.3	
		—[d]			

Table 12.4-5 (cont.).

Product	Control Device	Particle Size[a] (µm)	Cumulative Mass % ≤ Stated Size	Cumulative Mass Emission Factor (lb/ton alloy)	EMISSION FACTOR RATING
SiMn					
Open furnace (SCC 3-05-006-05)	None[b,m]	0.5	28	54	C
		1.0	44	84	
		2.0	60	115	
		2.5	65	125	
		4.0	76	146	
		6.0	85	163	
		10.0	96[k]	177[k]	
		—[d]	100	192	
	Scrubber[m,n]	0.5	56	2.36	C
		1.0	80	3.34	
		2.0	96	4.03	
		2.5	99	4.16	
		4.0	99.5	4.18	
		6.0	99.9[k]	4.20[k]	
		10.0	100	4.3	

[a] Aerodynamic diameter, based on Task Group On Lung Dynamics definition. Particle density = 1 g/cm^3.

[b] Includes tapping emissions.

[c] References 4,10,21.

[d] Total particulate, based on Method 5 total catch (see Tables 12.4-2 and 12.4-3).

[e] Includes tapping fumes (estimated capture efficiency 50%).

[f] References 4,10,12.

[g] References 10,13.

[h] Includes tapping fumes (estimated capture efficiency 60%).

[j] References 1,15-17.

[k] Interpolated data.

[m] References 2,18-19.

[n] Primary emission control system only, without tapping emissions.

Available data are insufficient to provide emission factors for raw material handling, pretreatment, and product handling. Dust particulate is emitted from raw material handling, storage, and preparation activities (see Figure 12.4-1). These activities include unloading raw materials from delivery vehicles (ship, railway car, or truck), storing raw materials in piles, loading raw materials from storage piles into trucks or gondola cars, and crushing and screening raw materials. Raw materials may be dried before charging in rotary or other types of dryers, and these dryers can generate significant particulate emissions. Dust may also be generated by heavy vehicles used for loading, unloading, and transferring material. Crushing, screening, and storage of the ferroalloy product emit particulate matter in the form of dust. The properties of particulate matter emitted as dust are similar to the natural properties of the ores or alloys from which they originated, ranging in size from 3 to 100 micrometers (µm).

Approximately half of all ferroalloy facilities have some type of control for dust emissions. Dust generated from raw material storage may be controlled in several ways, including sheltering storage piles from the wind with block walls, snow fences, or plastic covers. Occasionally, piles [illegible] sprayed with water to prevent airborne dust. Emissions generated by heavy vehicle traffic may be reduced by using a wetting agent or paving the plant yard. Moisture in the raw materials, which [illegible] be as high as 20 percent, helps to limit dust emissions from raw material unloading and loading. Dust generated by crushing, sizing, drying, or other pretreatment activities may be controlled by [illegible] collection equipment such as scrubbers, cyclones, or fabric filters. Ferroalloy product crushing and sizing usually require a fabric filter. The raw material emission collection equipment may be connected to the furnace emission control system. For fugitive emissions from open sources, see Section 13.2 of this document.

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7

Attachment 7

Independent Documentation of Fume Dust Particle Size & Amorphous Structure

SFA

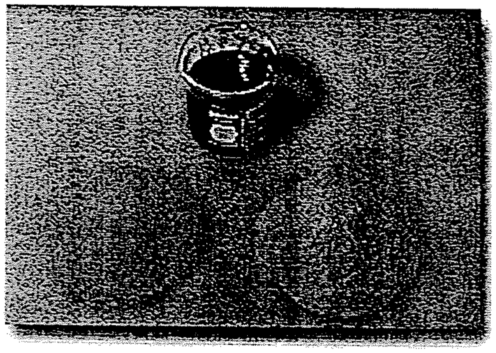
WELCOME TO THE SILICA FUME ASSOCIATION

Silica Fume

Building a durable future into our nation's infrastructure

General Information

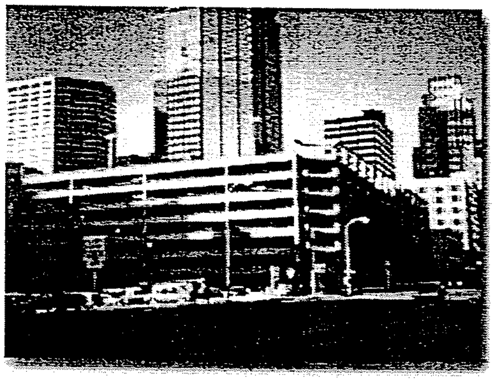
- What is the SFA?
- What is Silica Fume?
- Silica Fume Producers



Specifiers/ Engineers Area

Concrete Producers/ Contractors Area

News and Press Releases



Related Links

Contact Us

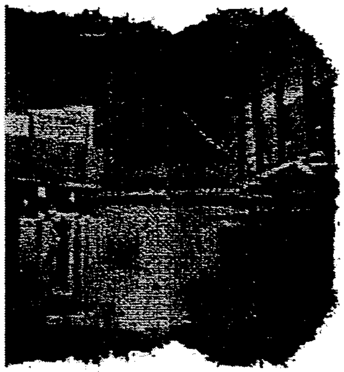
The Silica Fume Association (SFA) was formed in 1998 to assist the producers of silica fume in promoting its usage in concrete. Silica fume, a by-product of silicon and ferro-silicon metal production, is a highly-reactive pozzolan and a key ingredient in high-performance concrete, dramatically increasing the service-life of structures.

Keywords are: silica fume, silica, condensed silica fume, microsilica, pozzolan, pozzolanic, concrete, shotcrete, high strength concrete, high performance concrete, concrete admixture, blended silica fume cement, reactive powder concrete, oil well grout, and durable concrete.

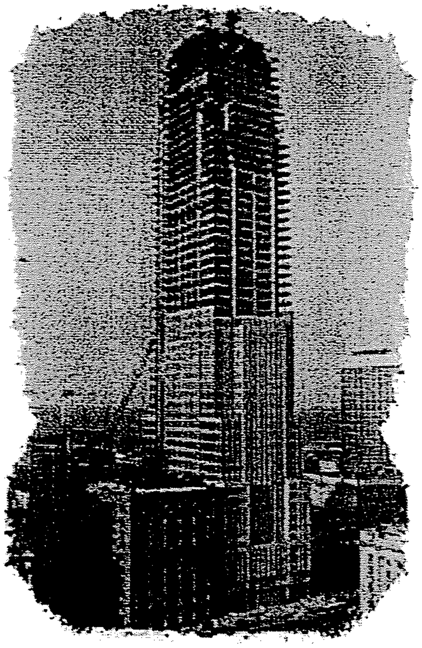
GENERAL INFORMATION

What is Silica Fume?

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolan. Concrete containing silica fume can have very high strength and can be very durable. Silica fume is available from suppliers of concrete admixtures and, when specified, is simply added during concrete production. Placing, finishing, and curing silica-fume concrete require special attention on the part of the concrete contractor.



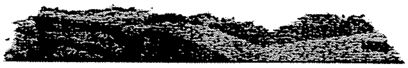
Silicon metal and alloys are produced in electric furnaces as shown in this photo. The raw materials are quartz, coal, and woodchips. The smoke that results from furnace operation is collected and sold as silica fume, rather than being landfilled. Perhaps the most important use of this material is as a mineral admixture in concrete.



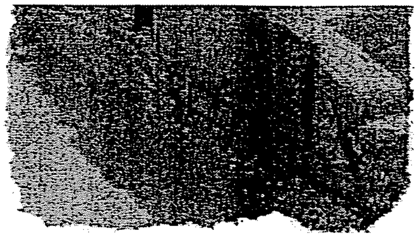
High-strength silica fume concrete was used to stiffen the Key Bank Tower in Cleveland, Ohio.

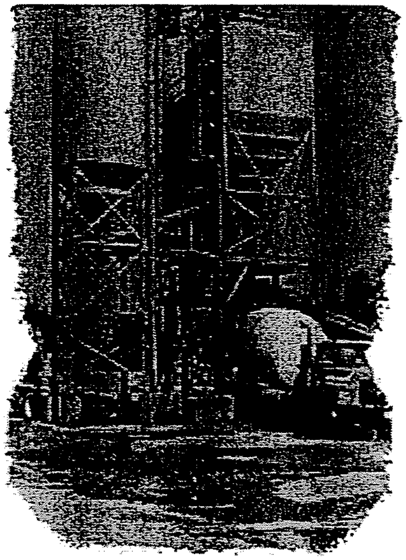
Silica fume consists primarily of amorphous (non-crystalline) silicon dioxide (SiO_2). The individual particles are extremely small, approximately 1/100th the size of an average cement particle. Because of its fine particles, large surface area, and the high SiO_2 content, silica fume is a very reactive pozzolan when used in concrete. The quality of silica fume is specified by ASTM C 1240 and AASHTO M 307.

High-strength concrete is a very economical material for carrying vertical loads in high-rise structures. Until a few years ago, 6,000 psi concrete was considered to be high strength. Today, using silica fume, concrete with compressive strength in excess of 15,000 psi can be readily produced. The structure shown at the above right used silica-fume concrete with a specified compressive strength of 12,000 psi in columns reaching from the ground through the 57th story.



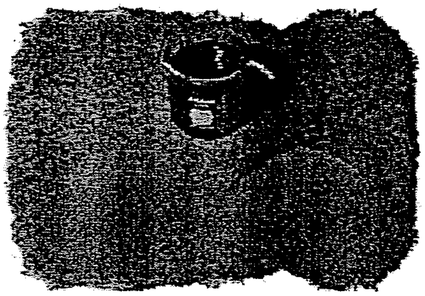
The greatest cause of concrete





deterioration in the US today is corrosion induced by deicing or marine salts. Silica-fume concrete with a low water content is highly resistant to penetration by chloride ions. More and more transportation agencies are using silica fume in their concrete for construction of new bridges or rehabilitation of existing structures.

Silica-fume concrete does not just happen. A specifier must make a conscious decision to include it in concrete to achieve desired concrete properties. Assistance in specifying silica-fume concrete for high strength or increased durability can be obtained from the SFA or from major admixture suppliers.



Silica fume for use in concrete is available in wet or dry forms. It is usually added during concrete production at a concrete plant as shown in the photo. Silica fume-concrete has been successfully produced in both central-mix and dry-batch plants. Assistance is readily available on all aspects of handling silica fume and using it to produce consistent, high-quality concrete.

Silica-fume concrete should be transported, placed, finished, and cured following the good concreting practices outlined by the American Concrete Institute. Flatwork containing silica fume concrete generally requires less finishing effort than conventional concrete. The photo shows the "one-pass" finishing process in which the silica-fume concrete is placed, consolidated, and textured with little or no waiting time between operations. To gain the most benefits from using silica fume, the concrete must be cured effectively. The SFA or your concrete supplier can provide any necessary assistance concerning construction operations.

[Specifiers/Engineers | Concrete Producers/Contractors]
[General Information | News and Press | Links | Contact Us | Home]

NORCHEM

Silica fume mineral admixture products for concrete, mortars, grouts and cement.

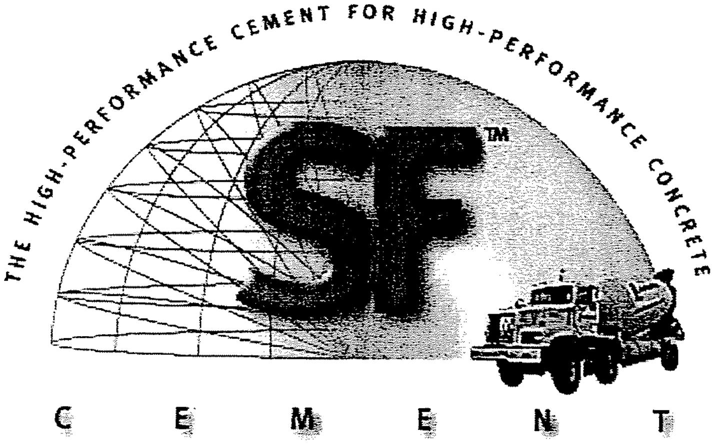
Silica Fume Manufacturers. Norchem is the the largest North American manufacturer of silica fume, a mineral admixture that has many benefits for ready mix and precast concrete. Keywords are silica fume, silica, condensed silica fume, microsilica, pozzolan, pozzolanic, concrete, shotcrete, high strength concrete, high performance concrete, concrete admixture, blended silica fume cement, reactive powder concrete, oil well grout, and durable concrete

Silica Fume... Exactly what is it?

Silica fume, a co-product of the silicon and ferrosilicon metal industry, is an amorphous silicon dioxide (SiO_2) which is generated as a gas in submerged electrical arc furnaces during the reduction of very pure quartz. This gas vapor is condensed in bag house collectors as very fine gray to off-white powder of spherical particles that average 0.1 to 0.3 microns in diameter with a surface area of 17 to 30 m^2/g. Silica fume is used in a variety of cementitious (concrete, grouts and mortars), elastomer, polymer, refractory and ceramic applications.

Product Links:

- **Undensified (uncompacted) silica fume**
- **Densified (compacted) silica fume**
- **CORROCHEM (mineral & chemical admixture)**
- **NORAD (superplasticizer)**
- **Silica Fume...Exactly what is it?**



freeze/thaw resistance

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the history of

SF™ Cement

SF™ CEMENT TIMELINE

EARLY USE

INITIAL FIELD STUDIES

1982: LAFARGE PRODUCES SF™ CEMENT

HIGH STRENGTH CONCRETE (HSC)

DURABILITY=HIGH PERFORMANCE CONCRETE (HPC)

MT'S AND DOT'S

FUTURE DEVELOPMENTS

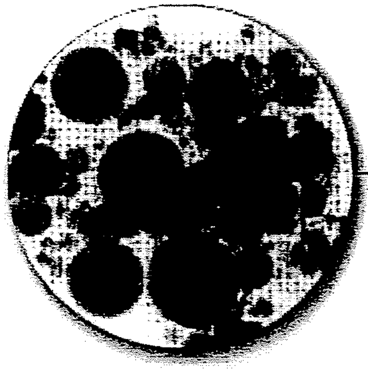
Initial interest in the use of silica fume sprung from air-pollution enforcement. Silica fume is a by-product of metallurgical processes used in the production of silicon metal and ferro-silicon metal. It is called "fume" because it is an extremely fine particulate material found in the emissions of the silicon metal production process. Concerns about the release of these particles in the atmosphere through smoke stacks lead to its collection and analysis.

Silica fume is essentially composed of very fine spherical particles of amorphous silica with a high surface area. As such, silica fume is a highly-reactive pozzolan and may be used to considerable advantage as a supplementary cementing material in Portland cement concrete. For more information about silica fume and its effect on cement and concrete, click here.

Silica fume has been used in the North American cement and concrete industry for over 20 years. Early use was driven by economy since concrete of a given strength grade could be produced at lower cementitious material content (and cost) if silica fume was incorporated in the mix due to the initial low selling price of the material. The construction boom of the mid to late 1980's saw the exploitation of high-strength silica fume concrete for high-rise construction. By the 1990's, concerns over the deteriorating infrastructure had shifted the focus to concrete durability and silica fume was finding applications in "high-performance" concrete. Today, silica fume is perhaps the material of choice for engineers designing concrete to withstand aggressive exposure conditions.

Early use of silica fume products in North America

Although the first North American research studies on silica fume lagged its initial application in structural concrete in Norway by more than 10 years, silica fume has steadily gained acceptance as a performance-enhancing admixture for concrete to the extent that it has been specified as a principal component of the concrete in the two most recent mega-projects in Canada (Hibernia Oil Platform and the P.E.I. Fixed Link Bridge). Click here to see a time line of silica fume cement applications in construction in North America.



what it is

What it Does

WHAT IS SF™ CEMENT?
WHAT DOES IT DO TO CONCRETE?
APPLICATIONS

What is SF™ cement?

Silica fume is a by-product of the manufacture of silicon metals and ferro-silicon metals. It is created by heating quartz, coal and iron and wood chips to approximately 1800 degrees C (3272 F) and collecting the tiny particulate present in the emissions from this combustion process.

Silica fume is an extremely fine powder having particles with an average diameter of about 0.10 microns and a bulk density of 150 to 250 kg/m3.

The particles are perfectly spherical in shape, a consequence of their origin (condensation-vapor). Silica fume varies in color from white to pale grey to black with a specific surface area in the order of 20,000 m2/kg. In relative terms, silica fume is about 100 times finer than cement particles, or about the same fineness as cigarette smoke.

Other terms for silica fume include: condensed silica fume, microsilica, ferrosilicon dust, silica flue dust, and amorphous silica. Some of the end uses of silica fume include:

cement and concrete applications
refractories
fertilizer
rubber and plastic fillers
oilwell cementing
cosmetics

There are currently 13 plants in North America producing silicon and ferro-silicon silica fume. Of the 13, 2 are in Eastern Canada and 11 are in the United States. Because of the high consumption of electricity for the electric arc furnaces that manufacture these metals, virtually all the plants are located in areas where there are abundant and cheap sources of electricity.

Lafarge's SF™ cement is an integral blend of Portland cement and 8% silica fume produced at our manufacturing facilities in Canada and the United States. Uniformity of SF™ cement is assured through the addition of silica fume at the cement plant and monitored with a quality assurance program ensuring consistently high quality. Users of Lafarge SF™ cement can depend on a product with a constant ratio of silica fume to cement.

Lafarge SF™ cement is handled like regular Portland cements and requires no special equipment. Concrete made with Lafarge SF™ cement can be batched with as much ease as ordinary concrete. At Lafarge we believe that SF™ cement is truly the most efficient way to introduce silica fume into concrete in terms of handling, homogeneity and cost.

What does it do to concrete?

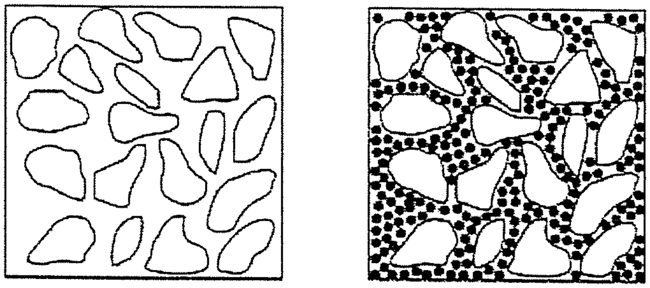
Silica fume creates two major effects which improve the properties of cement paste which leads to better concrete.

1. Microfiller Effect
2. Pozzolanic Effect

MICROFILLER EFFECT

Silica fume particles are 100 times smaller than cement grains and are, therefore easily introduced into the spaces between the cement grains, thus reducing the space available for water and acting as nucleation sites for hydration products.

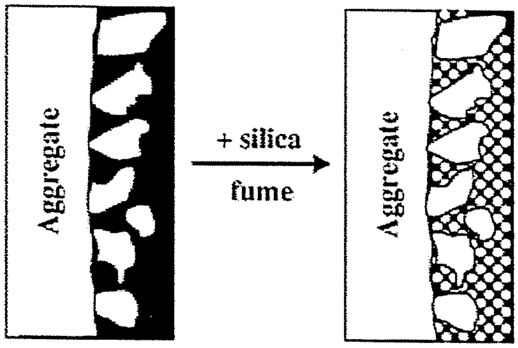
For example, it has been found that in a blend of 85% cement/15% silica fume, there are approximately 2,000,000 silica fume particles for each grain of cement! This leads to dense packing of the silica fume particles between the cement particles - minimizing porosity.



i.) Cement Only ii.) With Silica Fume

Dense Packing

This phenomenon also leads to improved packing at the cement-aggregate interface, wall effect, which increases bond between the mortar and aggregates.

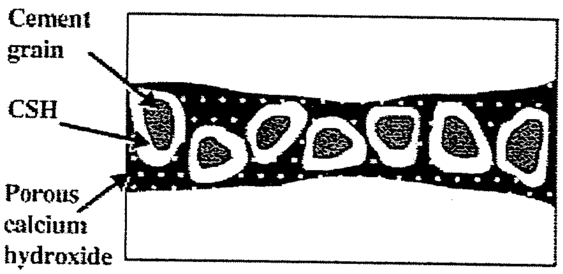


Wall Effect

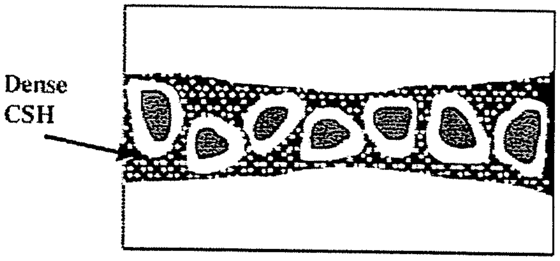
POZZOLANIC EFFECT

As the particles are amorphous silica (+85%SiO_2) with an extremely high surface area, they react chemically with the calcium hydroxide from the cement to form calcium silicate hydrates or CSH. CSH is the hydration product found in hardened cement paste.

Increased CSH leads to higher strength and a pore-blocking effect which reduces the permeability of concrete.



i.) cement only



ii.) with silica fume

CONCRETE BENEFITS

Increase compressive strength

Silica fume addition can be used to produce concrete with a significantly higher compressive strength than normal concrete.

Silica fume combined with a superplasticizer and low w/c produce concrete in the range of 85 - 100 MPa.

Reduce concrete permeability

With silica fume it is possible to reduce the permeability of the cement paste considerably as well as the porosity of the transition zone between the paste and the aggregates.

These improvements together with a reduction in internal bleeding are primarily due to the pozzolanic and filler effects of the silica fume.

Improve freeze / thaw resistance

Experience shows that silica fume concretes have very good freeze / thaw durability when they have a satisfactory air-void system.

Spacing factor to follow ACI or CSA standards regardless of type of cement.

Improve sulphate resistance
The chemical reaction between the silica fume and the calcium hydroxide from the cement produces secondary CSH which densifies the paste. This chemical reaction is believed to be the principal reason for sulphate resistance

Reduce concrete bleeding
Because the paste is considerably denser there are fewer capillary paths for the mix water to migrate to the surface in the form of bleed water.

Improve concrete pumpability
The pumpability of concrete is significantly improved when using silica fume because of the ball bearing effect produced by the very fine spherical particles.

SF Cement Home | Structures | History | Technical Data | Sales Info

Manufacturer, custom toll processor, and global distributor of higher tech inorganic specialty chemical raw materials (powders, foils, and wires). Fax: 1-401-433-7001.

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Reade Advanced Materials offers:

Silica Powders

- Key Words:

  Silica dioxide, silicon dioxide, crystalline silica, quartz, amorphous fumed silica, hydrophobic fumed silica, treated fumed silica, untreated fumed silica, amorphous fused silica, precipitated amorphous silica, microcrystalline silica, foundry sand, utility sand, fracturing sand, silica sand, silica, flint, glass sand, melting sand, engine sand, blasting sand, traction sand, hydraulic fracing sands, filter sand, soft silica, condensed silica fume, cristobalite, tridymite, synthetic fused silica, hydrated precipitated silica, colloidal silica, silica dispersion, and silica aerogels.

- Designations:

  Chemical Name: Silicon dioxide

  Chemical Formula: SiO_2

- Description:

  Silica is noncombustible, colorless or white, tasteless "crystals". It occurs naturally in the crystalline and amorphous forms. The specific gravity and melting point depend on the crystalline form. Silica is known to occur in 17 crystalline phases or modes and five amorphous phases.

- Types Available:

  Natural, Amorphous, Diatomaceous, Precipitated, Hydrophobic and Aerogel

- Physical Properties Available:

  Powder

- Typical Applications:

Filler for paints, plastic, epoxy, glassmaking, papers, seed germination, cosmetics, automotive, storage, wood & metal primer, water retardation, powder coating, structural concrete forms, masonry treatment, chromatographic column treatment, wood treatment, powder metal molding, etc.

- Packaging:

  Jars, pails, drums, multiply paper bags, bulk bags and fiberboard containers. For further information on packaging options Contact READE

- TSCA (SARA Title III) Status:

  Yes. For further information please call the E.P.A. at 1.800.535.0202 or the National Institute for Occupational Safety and Health at 1.800.35-NIOSH.

- CAS Number:

  Crystalline (quartz)=14808-60-7 and Amorphous= 7631-86-9

- UN Number:

  ###

East Coast: (401) 433-7000 West Coast: (775) 352-1000

Silica dioxide, silicon dioxide, crystalline silica, quartz, amorphous fumed silica, hydrophobic fumed silica, treated fumed silica, untreated fumed silica, amorphous fused silica, precipitated amorphous silica, microcrystalline silica, foundry sand, utility sand, fracturing sand, silica sand, silica, flint, glass sand, melting sand, engine sand, blasting sand, traction sand, hydraulic fracing sands, filter sand, soft silica, condensed silica fume, cristobalite, tridymite, synthetic fused silica, hydrated precipitated silica, colloidal silica, silica dispersion, silica aerogels, silica dioxide, silicon dioxide, crystalline silica, quartz, amorphous fumed silica, hydrophobic fumed silica, treated fumed silica, untreated fumed silica, amorphous fused silica, precipitated amorphous silica, microcrystalline silica, foundry sand, utility sand, fracturing sand, silica sand, silica, flint, glass sand, melting sand, engine sand, blasting sand, traction sand, hydraulic fracing sands, filter sand, soft silica, condensed silica fume, cristobalite, tridymite, synthetic fused silica, hydrated precipitated silica, colloidal silica, silica dispersion, and silica aerogels

Attachment 8

LAN Associates' Memo by Dr. Handi Wang

LAN ASSOCIATES INC

Memo to: File #2.3269.6
SKW/Witmer Road

Date: June 26, 1998

Copies to: Ed Bredniak

From: Handi Wang

Subject: Characterization of Selective
Landfill Site Samples

The writer selected five landfill samples for the physical, chemical, and mineralogical analyses. These samples are from the SKW/Witmer Road landfill in Niagara Falls sent from Advanced Environmental Inc. The ID number of these samples are:

1. A071, 44-48 inches;
2. A031, 4-8 inches;
3. A048, 28-30 inches;
4. A064, 12-17 inches;
5. 092, 20 inches.

These samples are found to contain total chromium in the range of 1,000 to 2,000 ppm, except sample A031 that contains over 9,000 ppm of total chromium. All five samples contain hard aggregate particles. The samples were wet to moist with light brown to dark brown color. These samples were characterized for one (1) particle size analysis using sieve; two (2) total elemental analysis using x-ray fluorescence spectrometry; and three (3) mineralogical analysis with x-ray diffraction.

1. Particle Size Analysis

The samples were transferred from the sample jar into a Teflon coated pan and air dried in the laboratory. A portion of the sample (about 100 g) was pretreated with 0.5 M Na-acetate solution (pH 5) to remove free carbonate that may have coated the sample. The sample was then oven dried at 102°C. A portion of 20 to 30 g of Na-acetate pretreated sample was passed through a stack of stainless steel sieves with sizes of 4, 2, 1, 0.5, 0.25, 0.1, and 0.05 mm, respectively. Soil samples for each particle size fraction are indicated (Attachment #1). The results show that all samples are dominated by sand size and larger particle size (>0.05 mm). Less than 6% of the material is silt and clay for all the samples. The color of material for different particle size fractions are the same. The results indicates that it is not likely that the samples are fume dust samples because fume dust samples are dominated by clay and silt size particles (<0.05 mm).

2. Total Elemental Analysis

Both Na-acetate pretreated and non-pretreated soil samples were analyzed for total elemental content using x-ray fluorescence spectrometry analysis. The data is presented in Attachment #2. The difference in Ca content reflects the presence of $CaCO_3$ that is formed by reacting

CaO with CO_2 in the landfill. For the non-pretreated samples, both fine material and pebble were analyzed for two samples (A071 and A048). The purpose was to determine if the fine material and pebble material are from the same source. If we are correct this should be pursued further to demonstrate that the material is not fume dust. **Overall, the SiO_2 content of all five samples were ranged from 48% to 56% which is much lower than that of the fume dust. The materials also contain variable ranges of CaO (5% to 30%) and Al_2O_3 (5% to 22%). The ranges of Ca and Al contents are too high for fume dust. However, the range of SiO_2, CaO, and Al_2O_3 contents are more reasonable for slag materials.** CaO, and Al_2O_3 tend to be more concentrated in the slag material rather than the fume dust fraction due to three reasons: (1) the melted Ca and Al metals tend to be more easily oxidized than Si metal; (2) the melting points of CaO, and Al_2O_3 are much higher than their metal counterparts; and (3) boiling points for CaO (2850°C), and Al_2O_3 (2980°C) are much higher than SiO_2 (2230°C). The temperature of melted ferroalloys ranges from1500°C to 2400 °C. At this temperature range, the CaO, and Al_2O_3 are in solid form while SiO_2 can be in solid, liquid, or vapor forms. The variation in contents of Al and CaO in the slag materials is due to their contents in raw materials used to produce ferroalloys. The melting point and boiling point data for metals an oxides are presented in Attachment 3.The chemical makeup of the pebble material is similar to that of the fine materials. However, total Cr content is higher in the fine material than in the pebble for both samples A048 and A071.

3. Mineralogical Analysis.

Fume dust can be differentiated from slag material through their mineralogical properties. Fume dust is in non-crystalline or poorly crystalline form, while slag material is dominated by crystalline minerals such as quartz, lime, and ferroalloys. The difference in mineralogy is due to the difference in cooling processes. Fume dust is formed by condensation of fume evaporated from the furnace in which the fume is cooled rapidly from gas form into liquid/solid form. It takes seconds to a few minutes to finish the transformation. Slag material is consists of a mixture of raw material impurity, oxidation products of the molten metals, and ferroalloys. The slag is cooled down more slowly allowing crystallization of the material to form well structured minerals.

X-ray diffraction technique is the most common method to determine the crystallography of material. The diffraction curve will show diffraction peaks of diffraction for crystalline material. The sharpness of the diffraction peak demonstrates how well crystalline in the material. For fume dust that is non-crystalline or poorly crystalline, the diffraction curve will show no peak or broad diffraction peak. This is because diffraction occurs as x-rays interact with a regular structure whose repeat distance is about the same as the wavelength. It happens that x-rays have wavelengths on the order of a few angstroms, the same as typical interatomic distances in crystalline solids. That means x-rays can be diffracted from minerals which by definition, are crystalline and have regularly repeating atomic structures. Diffraction will not occur when the mineral is not crystalline.

The five air-dried soil samples were ground into powder form and submitted to Dr. Willie Harris at the University of Florida in Gainesville for mineralogical analysis using x-ray diffraction (Attachment #4). X-ray diffraction displays the mineralogical phase of the samples (whether the material is crystalline or amorphous). All five samples contain dominantly crystalline materials as indicated by sharp peaks on the x-ray diffraction curves. The patterns of the curves indicate that none of the samples contain fume dust. Fume dust is mostly non-crystalline material with a broad peak at 2 theta, 15 to 30 degrees. All five samples contain quartz (d = 3.34 Å and 4.26 Å) and lime that are the characteristics of slag materials. The peaks (d = 3.02 to 3.04 Å and 3.85 Å) indicate the presence of calcium carbonate mineral. In addition, the metallic material exists in the samples indicated by peaks at d = 5.1 Å, 2.39 Å, 2.23 Å, 1.92 Å, 1.87 Å, and 1.83 Å (Attachment #4).

4. Conclusion

All five samples are unlikely fume dust materials, which are proved via particle size, elemental content, and mineralogical analyses. All the analyses indicated that all the samples are slag materials.

HW:jw
2.3269.6-M-Samples-980625-hw

Attachments: #1-Particle size analysis
#2-Total Chemical Data-X-Ray Fluorescence
#3-Melting point and boiling point data for metals and their oxides.
#4-XRD-Minerological Data
#5-XRD Standard for Quartz & $CaCO_3$

7/8/98 07:54
SKW METALS & ALLOYS INC.

Noddross

Results quantitative

Seq.	Sample name 1 - 20	Sum of conc. (%)	Result type	Al Al (%)	Si Si (%)	Cr Cr (%)	Ce Ce (%)	La La (%)	Mg Mg (%)	Ti Ti (%)	Ca Ca (%)	Ba Ba (%)	Fe Fe (%)
2	**10827**	**101.303**	**Concentration**	**1.89**	**55.10**	**0.10**	**0.37**	**0.17**	**4.31**	**0.032**	**3.90**	**0.05**	**35.37**
1	**10756**	**91.501**	**Concentration**	**2.84**	**53.16**	**0.27**	**0.28**	**0.06**	**2.23**	**0.079**	**5.44**	**0.07**	**27.08**

ATT

Table 1
Particle Size Analysis
Selective Witmer Road Landfill Samples, after Na-Acetate Pretreatment
File # 3269.6
27-May-98

Sample ID	Particle Size								Sum	Comments
	>4 mm	>2 mm	>1 mm	>0.5 mm	>0.25 mm	>0.1 mm	>0.05 mm	<0.05 mm		
	gram									
A031	8 29.4	5.94 21.8	4.17 15.3	2.34 6.7	1.82 8.6	2 7.3	1.45 5.3	1.51 5.5	27.23 %	Dark color, Pebbles are friable. Possibly ferrochrome slag.
A071	14.56 52.6	3.11 11.2	2.73 9.9	1.89 6.4	1.77 6.8	2.03 7.3	1.03 3.7	0.54 2.0	27.66 %	Yellowish gray fine material, pebbles are gray color with holes, possibly slag material.
A064	18.95 65.2	3.7 12.7	2.23 7.7	1.69 4.0	1.16 5.8	0.8 2.8	0.33 1.1	0.21 0.7	29.07 %	Light yellowish gray fine material, slag pebbles
A048	5.59 25.3	3.75 17.0	3.9 17.6	3.02 10.6	2.34 13.7	2.01 9.1	1.03 4.7	0.47 2.1	22.11 %	Yellowish gray fine material, Some rock gravels and slag pebbles.
092	14.18 62.9	2.08 9.2	3.35 14.9	1.69 3.3	0.75 7.5	0.3 1.3	0.1 0.4	0.08 0.4	22.53 %	Whitish gray material for both fine and pebbles.

May 27, 1998

Landfill Sample particle size After NaOAC
2.3269.6.

~~Original After NaOAC~~
Treatment

~~ID~~	original weight	After NaOAC Treatment	>4.0	>2.0	>1.0	>0.5	>0.25	>0.1	>0.05	<
A031 4-8'	30	27.1	8.00	5.94	4.17	2.34	1.82	2.00	1.45	1.5
pebble friable - like ferrochrome dust										
A071 44-48" (2A048)	30	26.49+0.37	14.56	3.41	2.73	1.89	1.77	2.03	1.33	0.54
Hard pebble with holes. some white pebbles - hard.										
A064 12-17"	30.0	29.39+0.13	18.95	3.70	2.23	1.69	1.15	0.80	0.33	0.21
Slag sample with alloy present.										
(or A071) A048 28-30"	30	28.76-0.48	5.59	3.75	3.90	3.02	2.34	2.0	1.03	0.47
Has rock gravel (removed) / Like soil material / No fume or slag.										
092 20"	30.0	21.09	14.18	2.08	3.35	1.69	0.75	0.30	0.40	0.08

White to gray, chalk, large pebble

ATTACHMENT

5/27/98 14:51
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Page 1
LAU

Skip Do we ~~[illegible]~~ have any Fe Ox data

Results quantitative

Seq.	Sample name Lab ID	1-6 Sample ID	Sum of conc. (%)	Result type	Na2O Na (%)	Al2O3 Al (%)	SiO2 - (%)	K2O K (%)	Cr Cr (%)	Mn Mn (%)	MgO Mg (%)	TiO2 Ti (%)	CaO Ca (%)	Ba Ba (%)
1	2993	092-AA	96.630	Concentration	0.56	9.189	38.17	-0.04	2.58	1.22	11.15	0.247	31.41	0.11
2	2994	A071-AA	96.630	Concentration	0.40	13.026	55.52	0.61	2.51	1.84	6.08	0.402	7.54	0.12
3	2995	A064-AA	96.630	Concentration	0.28	8.720	44.85	0.02	1.51	1.91	2.45	0.220	4.46	0.13
4	2996	A031-AA	96.630	Concentration	0.50	5.758	42.53	-0.03	5.74	3.03	7.47	0.276	11.11	0.11
5	2997	A048-AA	96.630	Concentration	0.46	17.289	52.41	0.96	3.23	1.88	7.77	0.591	3.75	0.10
6	3000	A071- Fine	96.630	Concentration	0.33	9.172	51.17	0.91	3.37	2.42	4.62	0.509	11.99	0.13
7	3001	A071-Pebble	96.630	Concentration	0.46	10.881	49.28	0.11	0.71	0.45	10.05	0.174	12.13	0.12
8	3002	A031 4-8"	96.630	Concentration	0.53	4.629	40.58	-0.01	5.18	2.61	11.29	0.245	16.77	0.11
9	3003	A048 Pebble	96.630	Concentration	0.33	22.504	48.31	0.34	1.69	0.99	7.05	0.298	5.55	0.14
10	3004	A048 Fine	96.630	Concentration	0.31	13.633	56.33	1.27	2.71	1.63	4.73	0.581	6.86	0.11
11	3005	A064	96.630	Concentration	0.36	8.477	42.68	0.09	3.64	3.40	5.73	0.315	8.31	0.11
12	3006	092	96.630	Concentration	0.39	8.273	41.70	-0.01	2.36	1.17	9.13	0.234	30.59	0.11
				Mean Concentration	0.408	10.963	46.960	0.352	2.936	1.879	7.292	0.341	12.540	0.117
				Min. Concentration	0.276	4.629	38.168	-0.035	0.713	0.452	2.449	0.174	3.753	0.102
				Max. Concentration	0.556	22.504	56.326	1.265	5.743	3.396	11.289	0.591	31.409	0.137
				RMS Concentration	0.091	5.015	6.958	0.468	1.443	0.867	2.750	0.145	9.384	0.012
				RMS rel. Concentration (%)	22.196	45.743	12.899	132.178	49.156	46.173	37.719	42.495	74.831	10.029
				Used Concentration	12	12	12	12	12	12	12	12	12	12

Note: -AA - Pretreated with ~~[illegible]~~ Acetic Acid.

Seq.	Pb Pb (%)	Zn Zn (%)	Fe2O3 Fe (%)
1	-0.068	0.030	2.09
2	-0.026	0.106	8.51
3	-0.076	0.031	32.13
4	-0.051	0.071	20.11
5	-0.055	0.053	8.18
6	0.076	0.107	11.82
7	-0.058	0.037	12.29
8	-0.040	0.097	14.64
9	-0.075	0.027	9.48
10	-0.048	0.058	8.47
11	-0.062	0.055	23.53
12	-0.065	0.032	2.73
	-0.046	0.059	12.830
	-0.076	0.027	2.090

Post-it™ Fax Note 7671

To Guy		Date	# of pages ▸
Co./Dept.		From Handi	
Phone #		Co.	
Fax #		Phone #	
		Fax #	

Attachment 3

Melting Point & Boiling Point Data for Metals & Oxides

SKW Metals & Alloys, Inc.
Witmer Road

Metal or Oxide	Melting Point	Boiling Point
Al	659.7	2,057
Al_2O_3	2015 +/- 15	2980+/-60
Ca	848 +/- 0.5	1,240
CaO (lime)	2,580	2,850
Fe	1,535	3,000
Fe_2O_3	1,565	—
Mg	651	1,107
MgO	2,800	3,600
Si	1,410	2,355
SiO_2 (quartz)	1,610	2,230

LAN Associates, Inc.
Ref. #2.3269.6
Melting/Boiling Data
July 7, 1998

2.3269.6

ATTACHMENT 4

Guy
Skip
cc: Ed
Bobby

Witmer Rd Landfill.

UNIVERSITY OF
FLORIDA

Institute of Food and Agricultural Sciences
Soil and Water Science Department

2169 McCarty Hall
PO Box 110290
Gainesville FL 32611-0290
(352) 392-1951
Fax (352) 392-3902

7.1

Dr. Handi Wang
Lan Associates, Inc.
66 Cuna Street
St. Augustine, FL 32084

Dear Handi:

Enclosed are the x-ray scans for the 5 powders that you sent for analysis. All samples definitely contain crystalline materials, as evidenced by well defined diffraction peaks. You did not request that specific crystalline phases be identified. However, quartz and carbonate minerals appear to be present in all samples. Other minerals are present as well, particularly in sample 631.

Hopefully, these data will suffice for your purposes. Let me know if you have questions.

Sincerely,

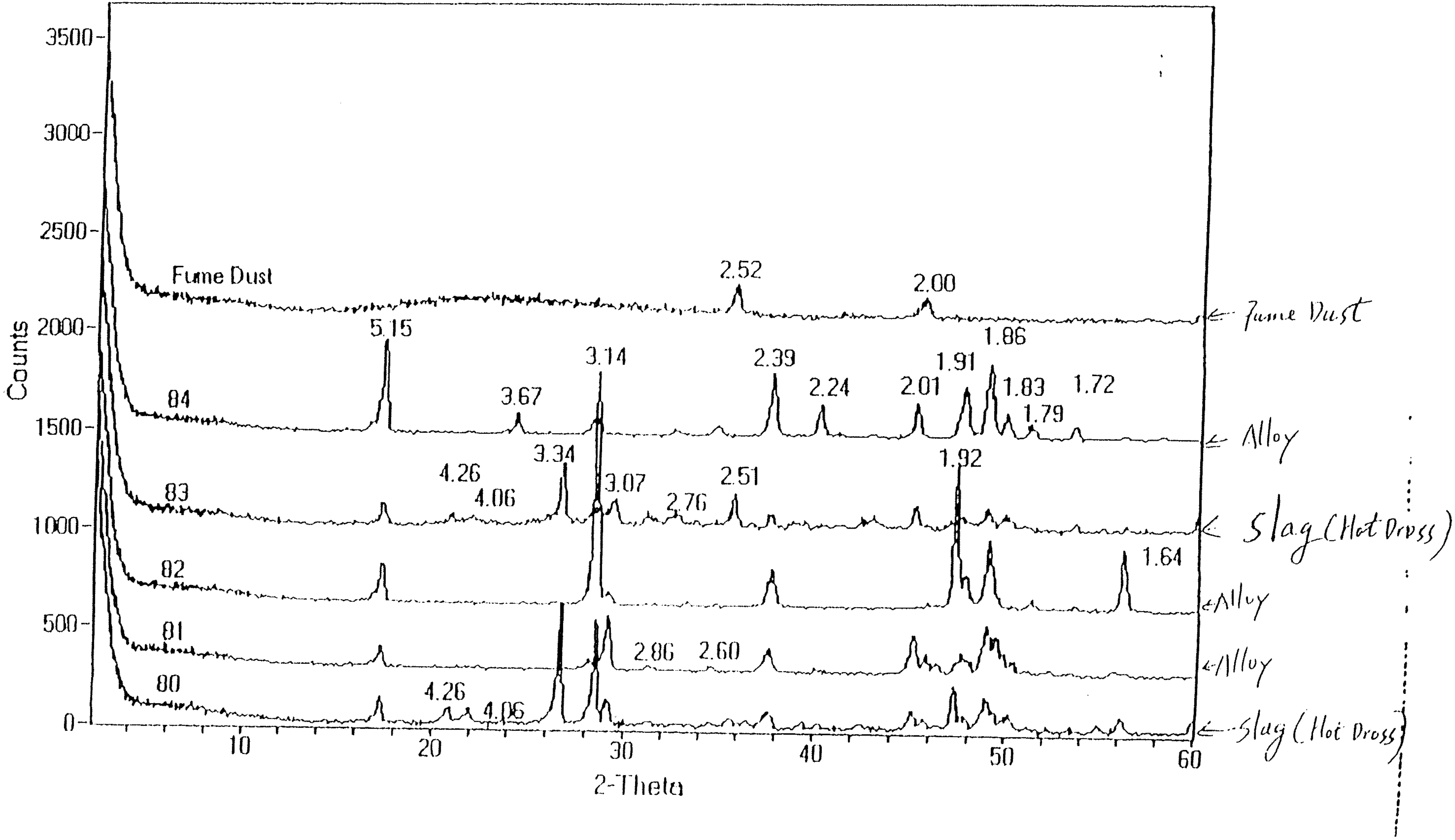
Willie

Willie Harris
Professor

Comment: All samples tested are slag samples as indicated by the presence of quartz and lime. These sam
contain high Cr - Total. Handi

Standard Samples

ID: LAN(H. Wang)#2700(Si Dross) (plexiglass powder mt.) (35kV, 20mA)
File: 0603.MDI Scan: 2-59.99/.03/1/#1934, Anode: CU 2T(0)= .08



Att. #4

ATTACHMENT 5

5-586

d	3.04	2.29	2.10	3.86	$CaCO_3$
I/I_1	100	18	18	12	Calcium Carbonate (Calcite) ★

Rad. Cu$K\alpha_1$ λ 1.5405 Filter Ni Dia.
Cut off I/I_1 Diffractometer I/I
Ref. Swanson and Fuyat, NBS Circular 539, Vol. II, 51 (1953)

Sys. Hexagonal S.G. R3c (167)
a_0 4.989 b_0 c_0 17.062 A C 3.420
α β γ Z 6 Dx 2.711
Ref. Ibid.

εα 1.487 nωβ 1.659 εγ Sign -
2V D mp Color Colorless
Ref. Ibid.

Specimen from Mallinckrodt Chem. Works. Spect. anal: <0.1% Sr; <0.01% Ba; <0.001% Al, B, Cs, Cu, K, Mg, Na, Si, Sn; <0.0001% Ag, Cr, Fe, Li, Mn.
X-Ray pattern at 26°C.
Other form: aragonite.
Merck Index, 8th Ed., p. 190.
Calcite group.

d A	I/I_1	hkl	d A	I/I_1	hkl
3.86	12	102	1.297	2	218
3.035	100	104	1.284	1	306
2.845	3	006	1.247	1	220
2.495	14	110	1.235	2	1112
2.285	18	113	1.1795	3	2110
2.095	18	202	1.1538	3	314
1.927	5	204	1.1425	1	226
1.913	17	108	1.1244	<1	2111
1.875	17	116	1.0613	1	2014
1.626	4	211	1.0473	3	404
1.604	8	212	1.0447	4	138
1.587	2	1010	1.0352	2	0116,1115
1.525	5	214	1.0234	<1	1213
1.518	4	208	1.0118	2	3012
1.510	3	119	0.9895	<1	231
1.473	2	215	.9846	1	322
1.440	5	300	.9782	1	1017
1.422	3	0012	.9767	3	2114
1.356	1	217	.9655	2	234
1.339	2	2010	Plus 4	reflections.	

145

CALCULATED PATTERN-PEAK HEIGHT

C

24-27A

CAL

24-27

3.03	1.87	3.85	100	34	29

$CaCO_3$

Calcium Carbonate Calcite

Ref. Smith et al., Annual Report to the Joint Committee on Powder Diffraction Standards (1973)

Sys. Hexagonal S.G. R3c (167) Dx 2.722 Z 6
a_0 4.990 b_0 c_0 17.002
α β γ
Ref. Chessin et al., Acta Cryst., 18 689 (1965)

Scale factor (Integrated Intensities)
λ 1.54060 Calcite group.

d A	I/I_0	h k l	d A	I/I_0	h k l
3.852	29	012	2.094	27	202
3.030	100	104	1.9261	4	024
2.834	2	006	1.9071	17	018
2.495	7	110	1.8726	34	116
2.284	18	113	1.6259	2	211

d A	I/I_0	h k l	d A	I/I_0	h k l
1.6040	12	122			
1.5821	7	1010			
1.5247	3	214			
1.5061	2	119			
1.4405	5	300			
1.4168	3	0012			
1.3361	3	0210			
1.1772	3	2110			
1.1536	3	134			
1.1417	3	226			
1.0471	2	404			
1.0440	2	318			

5-0490

d	3.34	4.26	1.82	4.26	α-SiO_2
I/I_1	100	35	17	35	Silicon Oxide Quartz, low ★

Rad. Cu$K\alpha_1$ λ 1.5405 Filter Ni Dia.
Cut off I/I_1 Diffractometer I/I cor. =3.6
Ref. Swanson and Fuyat, NBS Circular 539, Vol. 3, 24 (1954)

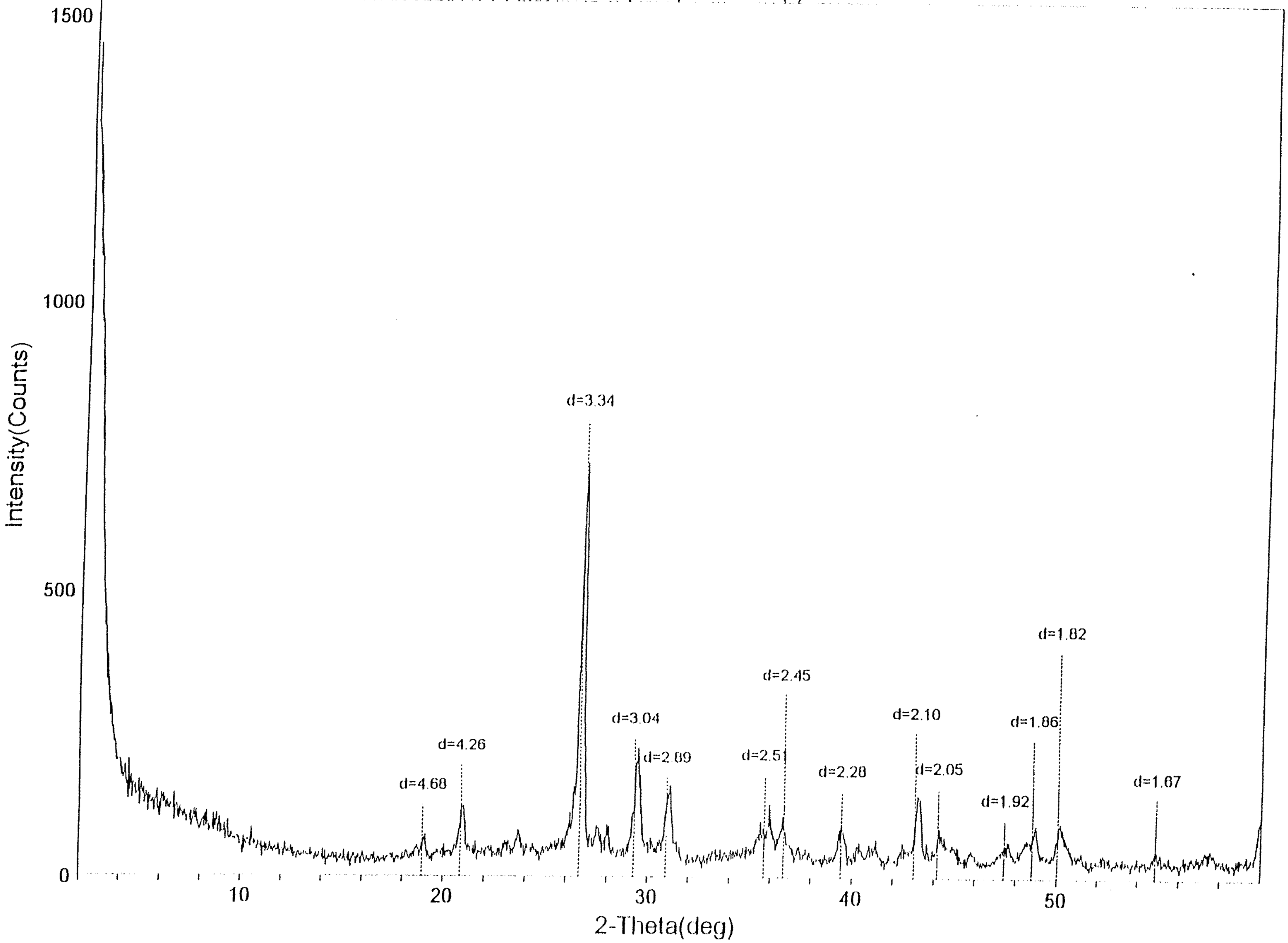
Sys. Hexagonal S.G. P3₁21 (152,154)
a_0 4.913 b_0 c_0 5.405 A C 1.10
α β γ Z 3 Dx 2.647
Ref. Ibid.

εα nωβ 1.544 εγ 1.553 Sign +
2V D 2.6556 mp Color Colorless
Ref. Ibid.

Sample from Lake Toxaway, N.C. Spect. anal.: <0.01% Al; <0.001% Ca, Cu, Fe, Mg.
Low quartz is form stable at room temperature.
There are many other polymorphs.
Merck Index, 8th Ed., p. 946.
X-ray pattern at 25°C.

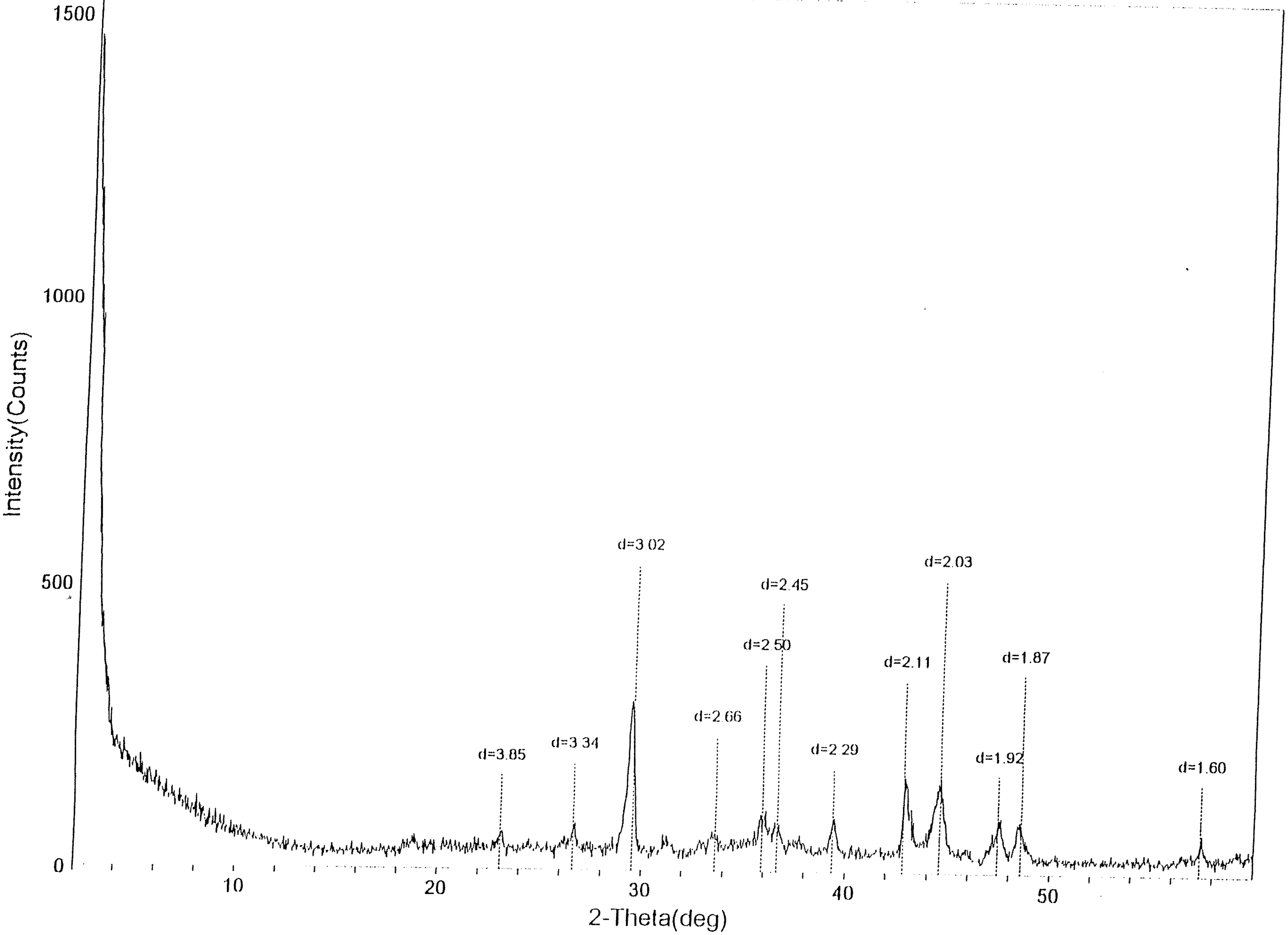
d A	I/I_1	hkl	d A	I/I_1	hkl
4.26	35	100	1.228	2	220
3.343	100	101	1.1997	5	213
2.458	12	110	1.1973	2	221
2.282	12	102	1.1838	4	114
2.237	6	111	1.1802	4	310
2.128	9	200	1.1530	2	311
1.980	6	201	1.1408	<1	204
1.817	17	112	1.1144	<1	303
1.801	<1	003	1.0816	4	312
1.672	7	202	1.0636	1	400
1.659	3	103	1.0477	2	105
1.608	<1	210	1.0437	2	401
1.541	15	211	1.0346	2	214
1.453	3	113	1.0149	2	223
1.418	<1	300	0.9896	2	402,115
1.382	7	212	.9872	2	313
1.375	11	203	.9781	<1	304
1.372	9	301	.9762	1	320
1.288	3	104	.9607	2	321
1.256	4	302	Plus 23	reflections.	

<0627.MDI> LAN(Handi Wang) #3000(A071-Fine(44-48")) plex. pd. mt. <2T(0)=0.185>



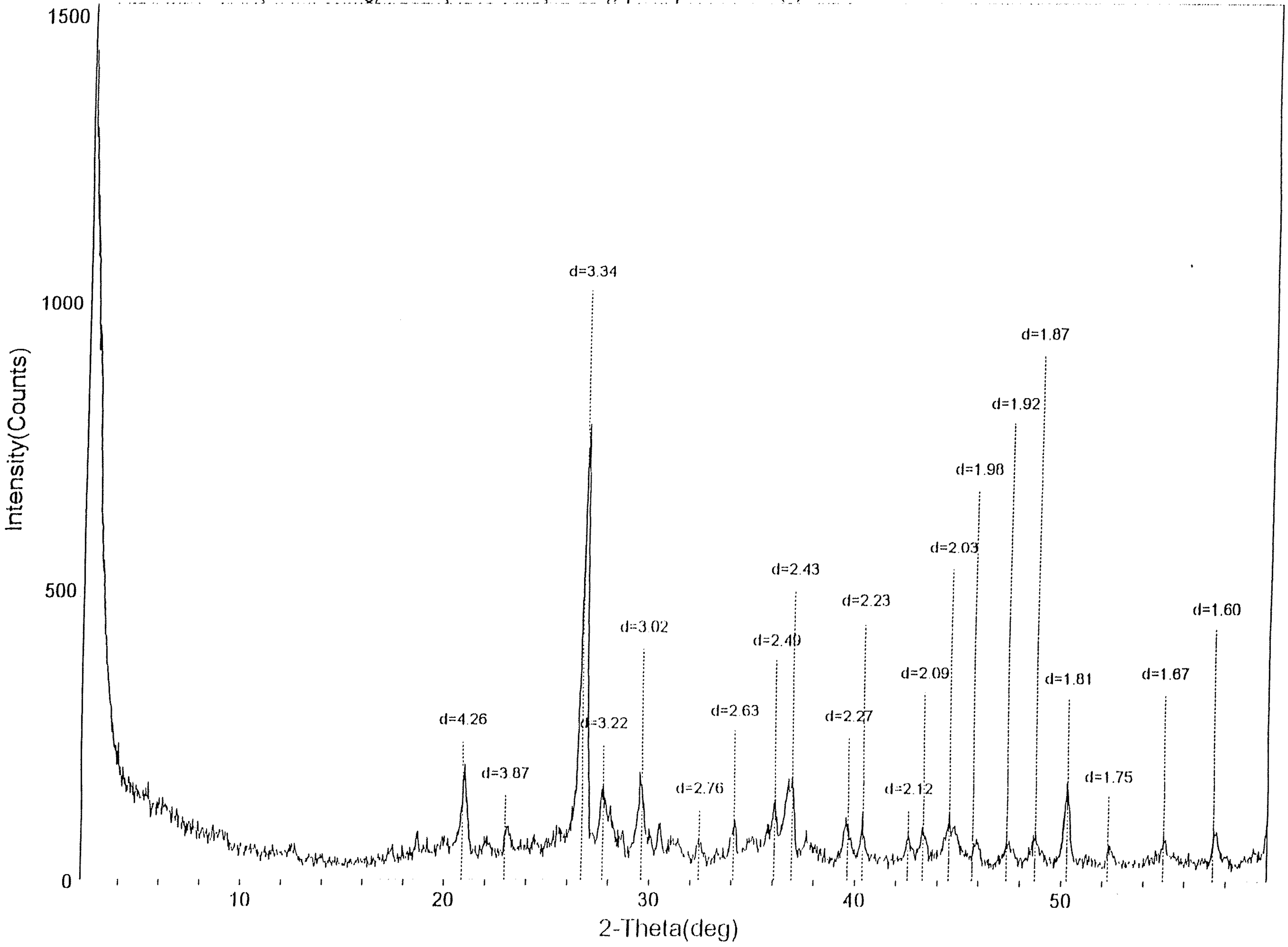
Thursday, Jun 11, 1998 @00:01a

<0628.MDI> LAN(Handi Wang) #3002(A031-Fine(4-8")) plex. pd. mt. <2T(0)=0.135>

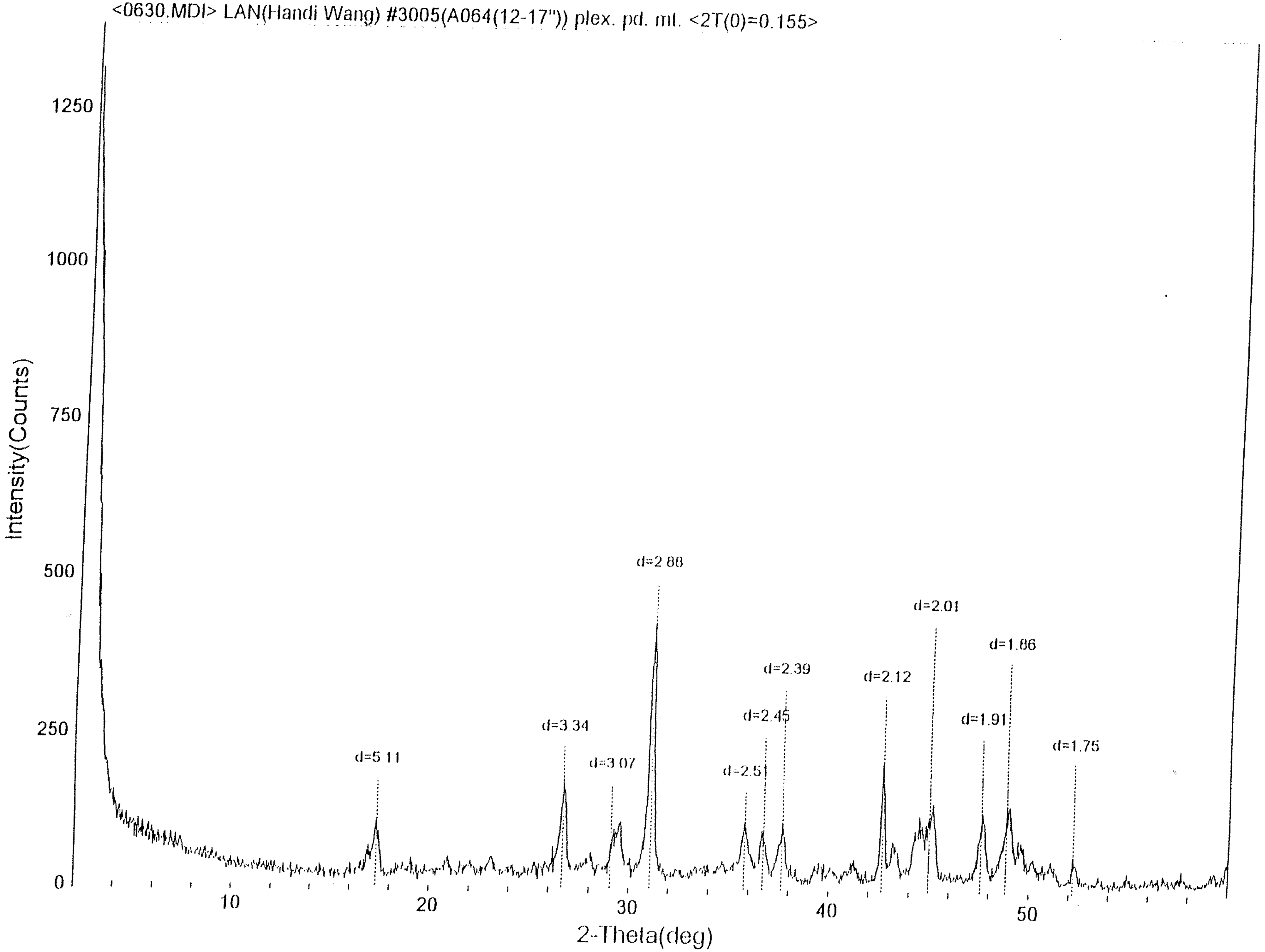


Thursday, Jun 11, 1998 @00 20

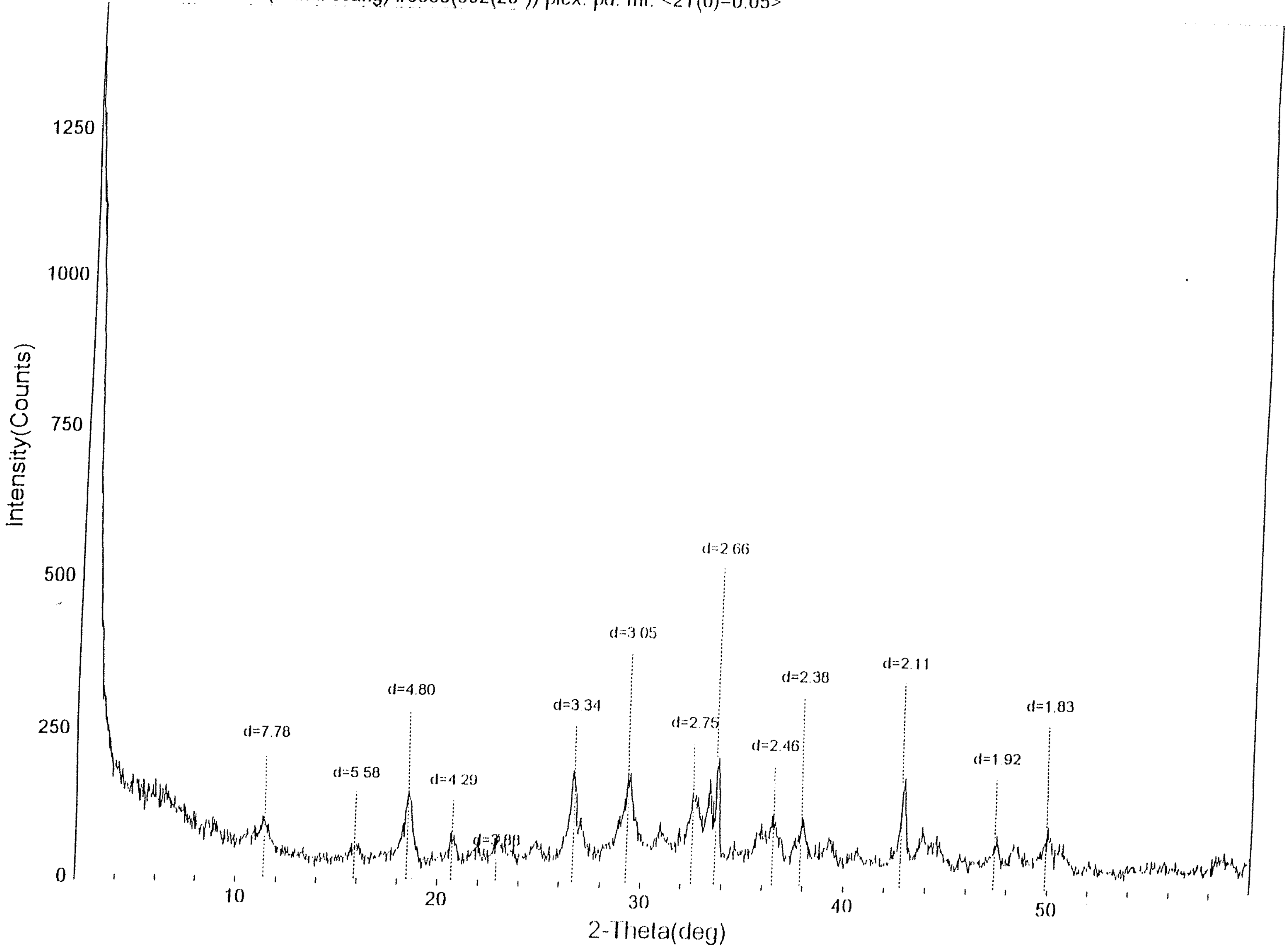
<0629.MDI> LAN(Handi Wang) #3004(A048-Fine(28-30")) plex. pd. mt. <2T(0)=0.24>



Thursday Jun 11 1998 @00:17a

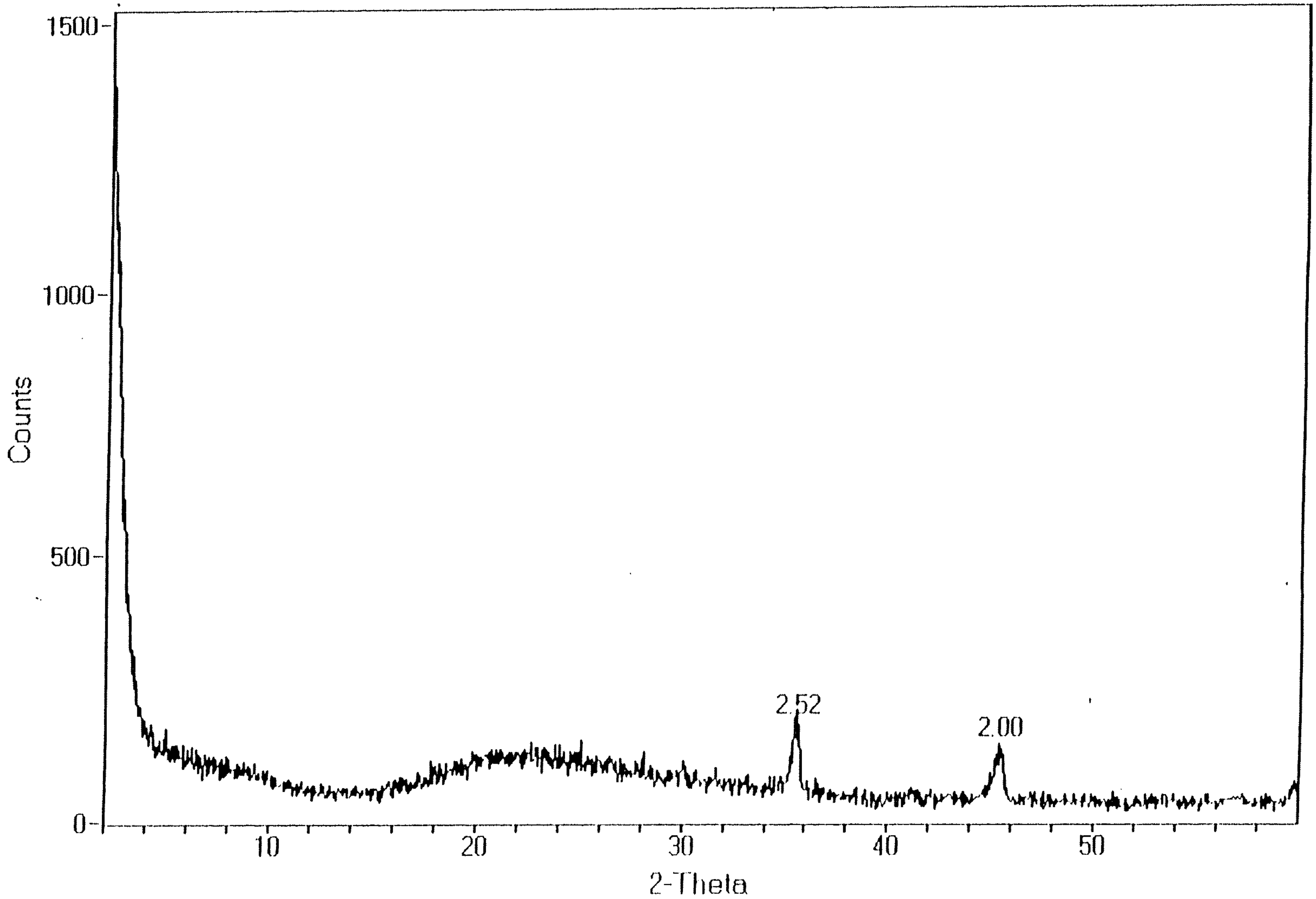
<0630.MDI> LAN(Handi Wang) #3005(A064(12-17")) plex. pd. mt. <2T(0)=0.155>
Intensity(Counts)
1250
1000
750
500
250
0
10
20
30
40
50
2-Theta(deg)
d=5.11
d=3.34
d=3.07
d=2.88
d=2.51
d=2.45
d=2.39
d=2.12
d=2.01
d=1.91
d=1.86
d=1.75

<0631.MDI> LAN(Handi Wang) #3006(092(20")) plex. pd. ml. <2T(0)=0.05>



Thursday, Jun 11, 1998 [illegible]

ID: LAN(H. Wang) 50% FeSi fume dust (plexiglass pd. mt.) (35kV, 20mA
File: 0609.MDI Scan: 2-59.99/.03/ 1/#1934, Anode: CU



7/8/98 07:54
SKW METALS & ALLOYS INC.

Si Dross

Results quantitative

Seq.	Sample name 1 - 20	Sum of conc. (%)	Result type	Al Al (%)	Si Si (%)	Ca Ca (%)	Ba Ba (%)	Ce Ce (%)	Cr Cr (%)	Cu Cu (%)	Fe Fe (%)	La La (%)	Mg Mg (%)	Mn Mn (%)	Ni Ni (%)	P P (%)
54	10879	50.619	Concentration	5.26	37.89	7.46										
53	92002	91.852	Concentration	5.40	60.68	9.65			0.02	0.08	15.74			0.22	0.03	0.031
52	92002	52.433	Concentration	3.30	40.70	8.44										
51	10841	91.540	Concentration	5.20	58.98	5.65			0.05	0.09	21.18			0.25	0.03	0.032
50	3023B	92.069	Concentration	5.11	57.51	7.09			0.07	0.10	21.89			0.20	0.04	0.030
49	3023A	92.056	Concentration	5.06	57.43	7.05			0.07	0.10	22.06			0.20	0.03	0.028
48	10823	87.760	Concentration	4.82	62.07	7.26			0.01	0.07	13.14			0.32	0.02	0.022
47	10818	101.845	Concentration	1.63	70.46	1.63			0.14	0.14	27.02			0.57	0.04	0.035
46	10816	93.345	Concentration	6.01	62.23	6.89			0.04	0.09	17.86			0.15	0.03	0.027
45	10815	93.138	Concentration	4.80	64.89	6.23			0.01	0.07	15.42			1.63	0.02	0.025
44	10803	93.857	Concentration	6.17	63.29	11.22			0.01	0.08	13.00			0.03	0.02	0.024
43	10777 COMP	88.824	Concentration	5.39	55.12	7.28			0.70	0.09	19.48			0.61	0.04	0.040
42	10796	97.102	Concentration	3.82	69.92	5.32			0.01	0.08	17.83			0.06	0.02	0.021
41	10781	87.636	Concentration	5.84	59.88	4.81			0.05	0.09	16.53			0.19	0.03	0.065
40	2976	90.462	Concentration	7.00	60.05	8.60			0.02	0.07	14.44			0.16	0.02	0.022
39	2977	89.114	Concentration	5.86	54.29	8.51			0.64	0.09	19.32			0.23	0.04	0.058
38	2978	84.706	Concentration	3.70	49.37	9.15	0.08	0.20	0.30		19.55	0.04	2.22			
37	2978	86.198	Concentration	4.02	48.87	12.42			0.23	0.10	19.88			0.52	0.05	0.045
36	2975	88.930	Concentration	5.21	56.68	7.29			0.69	0.09	18.34			0.47	0.04	0.035
35	10774	91.137	Concentration	6.17	62.89	8.93			0.00	0.06	12.52			0.50	0.02	0.023
34	10764	91.340	Concentration	7.38	61.07	7.59			0.02	0.07	14.79			0.35	0.02	0.023
33	10754	91.245	Concentration	7.86	61.10	8.42			0.01	0.06	13.62			0.11	0.02	0.023
32	10739	82.033	Concentration	8.77	53.08	10.23			0.03	0.04	9.37			0.42	0.03	0.026
31	10736	94.174	Concentration	8.79	63.57	8.55			0.05	0.07	12.96			0.11	0.03	0.025
30	10711	92.624	Concentration	5.50	65.86	8.50			0.48	0.05	11.87			0.28	0.04	0.021
29	10709	96.558	Concentration	4.95	70.26	4.94			0.05	0.08	15.72			0.46	0.05	0.022
28	10700	89.293	Concentration	5.68	56.91	8.74			0.05	0.10	17.59			0.13	0.05	0.025
27	10683	94.320	Concentration	5.95	69.25	7.14			0.03	0.06	11.74			0.07	0.04	0.019
26	2887B	87.491	Concentration	5.54	56.14	7.49			0.89	0.08	16.80			0.38	0.04	0.033
25	2887A	87.586	Concentration	5.56	56.28	7.48			0.87	0.08	16.77			0.38	0.04	0.033
24	10665 BRG.COMP.	89.080	Concentration	5.52	56.98	5.98			0.96	0.08	18.65			0.73	0.05	0.036
23	10671	92.544	Concentration	6.90	65.04	7.65			0.03	0.08	12.69			0.08	0.03	0.021
22	10665	85.572	Concentration	5.31	54.00	7.99			1.39	0.07	15.96			0.66	0.05	0.038
21	10664	90.019	Concentration	8.58	61.00	8.53			0.03	0.05	11.66			0.08	0.04	0.020
20	10652	95.873	Concentration	7.47	67.29	7.53			0.04	0.07	13.30			0.09	0.03	0.023
19	10644	102.489	Concentration	1.93	73.08	1.81			0.08	0.13	24.11			0.93	0.04	0.028
18	10606	91.600	Concentration	5.48	65.49	6.64			0.03	0.08	13.73			0.09	0.03	0.021
17	10566	90.908	Concentration	7.36	63.54	8.00			0.03	0.08	11.63			0.18	0.03	0.023
16	10548	96.831	Concentration	8.16	67.43	7.44			0.03	0.11	13.49			0.11	0.03	0.023

Si Dross

Results quantitative

Seq.	Sample name 1 - 20	Sum of conc. (%)	Result type	Al Al (%)	Si Si (%)	Ca Ca (%)	Ba Ba (%)	Ce Ce (%)	Cr Cr (%)	Cu Cu (%)	Fe Fe (%)	La La (%)	Mg Mg (%)	Mn Mn (%)	Ni Ni (%)	P P (%)
15	10531	95.957	Concentration	9.99	63.50	8.79			0.04	0.06	13.32			0.19	0.03	0.023
14	10513	94.575	Concentration	5.85	67.03	7.97			0.03	0.06	13.13			0.44	0.03	0.026
13	10497	84.736	Concentration	8.65	56.27	10.23			0.02	0.04	9.40			0.06	0.03	0.019
12	10460	90.100	Concentration	5.76	57.72	7.95			0.14	0.07	17.38			0.96	0.04	0.026
11	10460	89.537	Concentration	5.57	56.58	7.09			0.19	0.08	18.88			1.00	0.04	0.037
10	10459	90.140	Concentration	8.96	61.07	9.33			0.03	0.05	10.54			0.08	0.03	0.021
9	10420	90.693	Concentration	6.63	64.88	8.05			0.02	0.05	10.93			0.07	0.03	0.020
8	10403	90.183	Concentration	7.48	60.47	8.38			0.04	0.06	13.57			0.10	0.04	0.022
7	10371	92.111	Concentration	6.92	62.28	9.12			0.03	0.07	13.52			0.10	0.03	0.023
6	10312	93.337	Concentration	7.70	63.80	9.22			0.03	0.05	12.39			0.09	0.03	0.021
5	10237	86.307	Concentration	8.28	56.30	9.54			1.06	0.04	10.80			0.18	0.04	0.024
4	19639	30.765	Concentration	7.43		8.33	0.27		0.04		14.16			0.33		0.022
3	19593	89.341	Concentration	8.50	57.89	12.02			0.03	0.04	10.72			0.08	0.03	0.018
2	19555	100.028	Concentration	6.539	71.793	9.784			0.028	0.051	11.651			0.110	0.027	0.019
1	19525	97.097	Concentration	5.624	71.568	8.709			0.019	0.054	10.982			0.077	0.026	0.017

Seq.	Pb Pb (%)	Si* -- (%)	Ti Ti (%)	Zr Zr (%)
54				
53			0.020	
52				
51			0.074	
50			0.035	
49			0.035	
48			0.024	
47			0.174	
46			0.037	
45			0.037	
44			0.014	
43			0.073	
42			0.011	
41			0.144	
40			0.070	
39			0.090	
38			0.078	
37			0.060	
36			0.094	