DESIGNING A SAMPLING AND ANALYSIS PLAN FOR HAZARDOUS MATERIAL CHARACTERIZATION OF A SNM FACILITY UNDERGOING DECOMMISSIONING: MEETING MULTIPLE PROJECT OBJECTIVES

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ABSTRACT

Designing a Sampling and Analysis Plan to incorporate several project objectives into one work plan is the topic of this paper. Hazardous Material characterization of radiologically contaminated soil was guided by this plan. The characterization program was part of an overall project to Decommission a SNM Facility licensed by the U.S. Nuclear Regulatory Commission. Before the Sampling and Analysis Plan could be written the following tasks had to be completed: (1) develop analytical program, (2) establish sample spacing, (3) establish sample density, and (4) select sampling methods. Once these tasks were completed they were resource loaded to establish the cost and schedule of the program. Once cost and schedule were agreed upon, the work plan was written and implemented.

INTRODUCTION

An in-situ soil characterization program for hazardous materials was implemented at The Babcock & Wilcox Company (B&W) Apollo, Pennsylvania facility. To optimize project resources, multiple project objectives were incorporated into the design of the Sampling and Analysis Plan (SAP). The project objectives consisted of both primary and secondary objectives.

The primary objectives were:

- Characterize in-situ soil exhibiting radiological contamination equal to or in excess of the NRC Branch Technical Position (BTP) limits for free release. Characterization was required to assess the presence of chemicals which exceeded the acceptance criteria (AC) of Low Level Radioactive Waste (LLRW) disposal site(s).
- Characterize in-situ soil exhibiting radiological contamination below the BTP limits for release. Characterization was required to assess the presence of regulated chemicals which have been determined to pose a potential human health or environmental risk, and evaluate treatment or disposal options.

The secondary objectives were:

- Obtain a high degree of confidence in the characterization data.
- Achieve a low margin of error concerning the volume of soil that would not be characterized sufficiently to meet AC.
- Optimize project resources.

BACKGROUND

The SAP was developed for and implemented at the site of a U.S. Nuclear Regulatory Commission (NRC) licensed Special Nuclear Material facility. The facility is located in the Borough of Apollo, Pennsylvania and is operated by The Babcock & Wilcox Company (B&W). The site is currently undergoing decommissioning pursuant to a plan filed with the NRC under the management of B&W Nuclear Environmental Services (NES). These operations are anticipated to lead to the eventual termination of the NRC license and release of the site for unrestricted use. See Fig. 1.

The primary business conducted at the site has been the manufacture of uranium oxide fuels for Federal contracts and the commercial nuclear power industry. Before nuclear fuel manufacturing operations commenced steel mill operations, which started in the mid 1800's, were housed at the site. Nuclear operations were housed in two buildings, a two story Manufacturing plant and a one story Laundry building. The remainder of the facility consists of approximately 10,118 square meters of open property. See Fig. 2.

Operations conducted at the facility consisted primarily of the chemical conversion of both low enriched uranium (LEU) and high enriched uranium (HEU) hexafloride gas into uranium dioxide powder. Production of both HEU and LEU began in 1958 with production of HEU terminated in 1978 and LEU terminated in 1983. These operations were housed in the Manufacturing plant. In addition both the decontamination of protective apparel and submarine control rod drive mechanisms occurred between 1960 and 1984. These operations were housed in the Laundry building.

The site is located on the floodplain of the Kiskiminetas River and was developed through fill placement, including steel mill slag on alluvium. The alluvium rests on weathered sedimentary bedrock. Depth to bedrock increases towards the river; the depth to bedrock ranges from about 4.6 to 15.3 meters below ground surface. See Fig. 3.

Previous characterization efforts consisted of radiological characterization of the entire site, chemical characterization of shallow subsurface soils in the open areas for EP Toxicity characteristics, and a site-wide subsurface soil and groundwater assessment.

DESIGNING THE SAMPLING AND ANALYSIS PLAN

To meet the project objectives, four tasks had to be completed before the SAP could be written. These tasks will be discussed in the following order: (1) developing an analytical program, (2) establishing sample spacing, (3) establishing sample density, and (4) selecting of sampling methods.

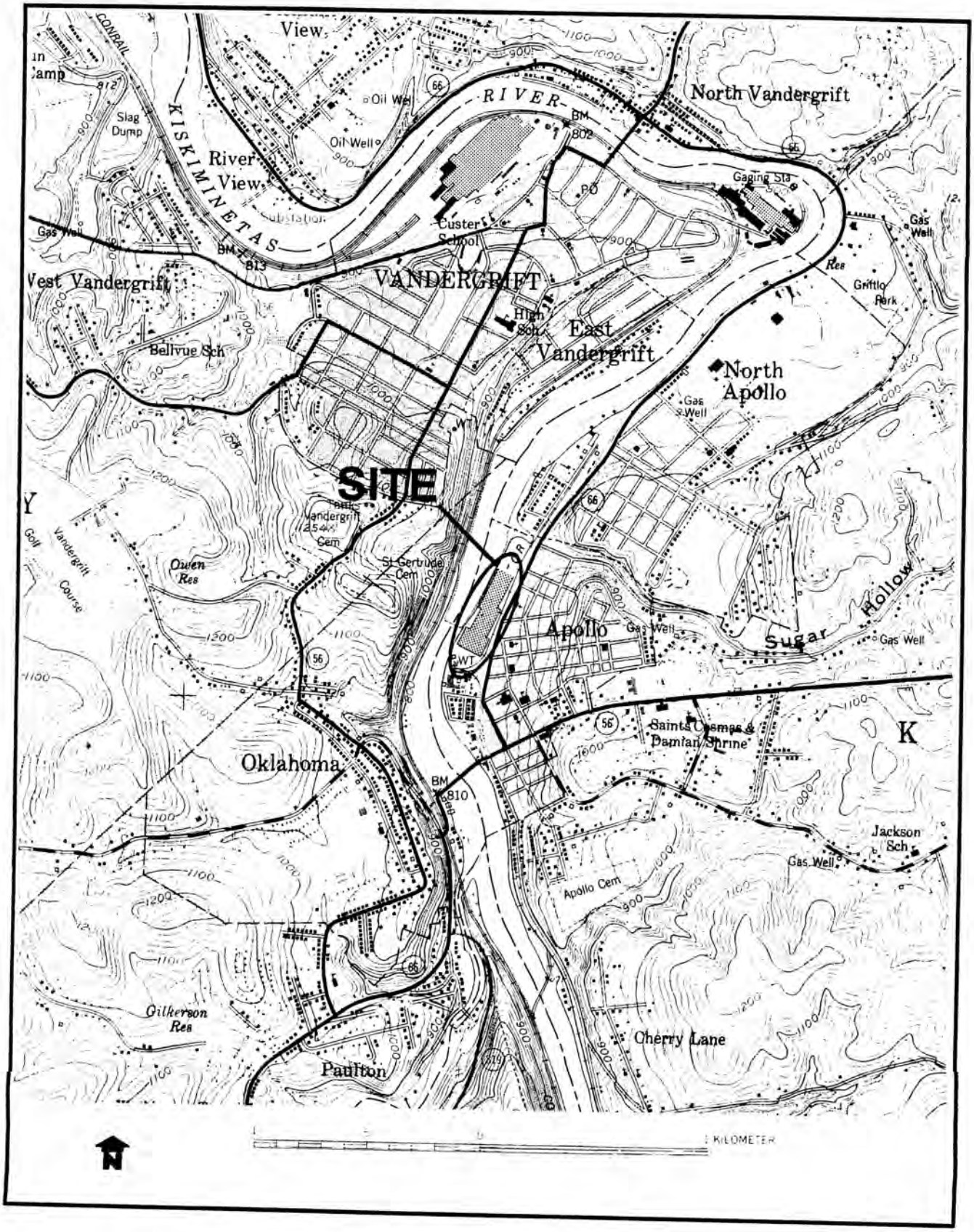

Fig. 1. Location map of Apollo Facility.

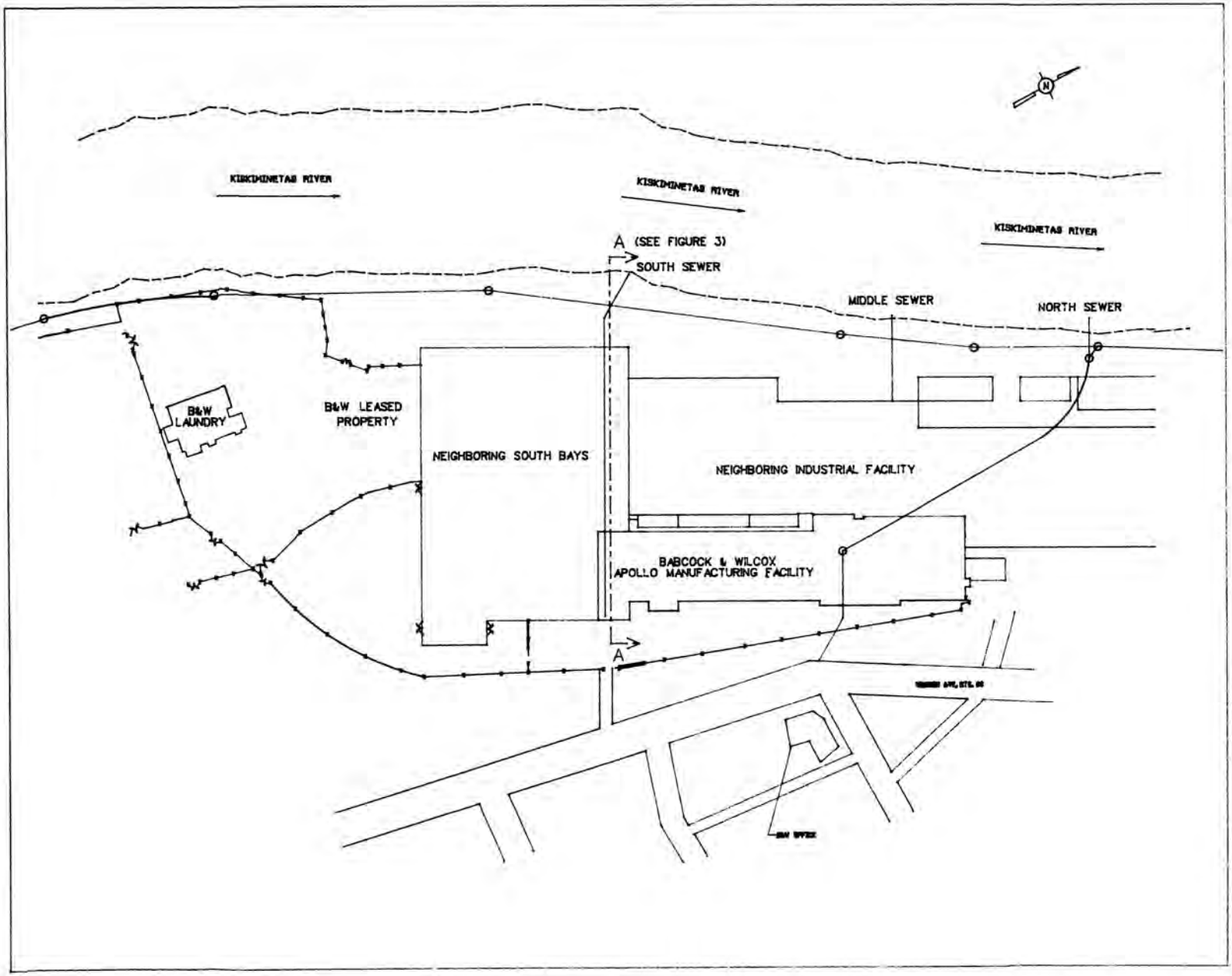

Fig. 2. Site plan.

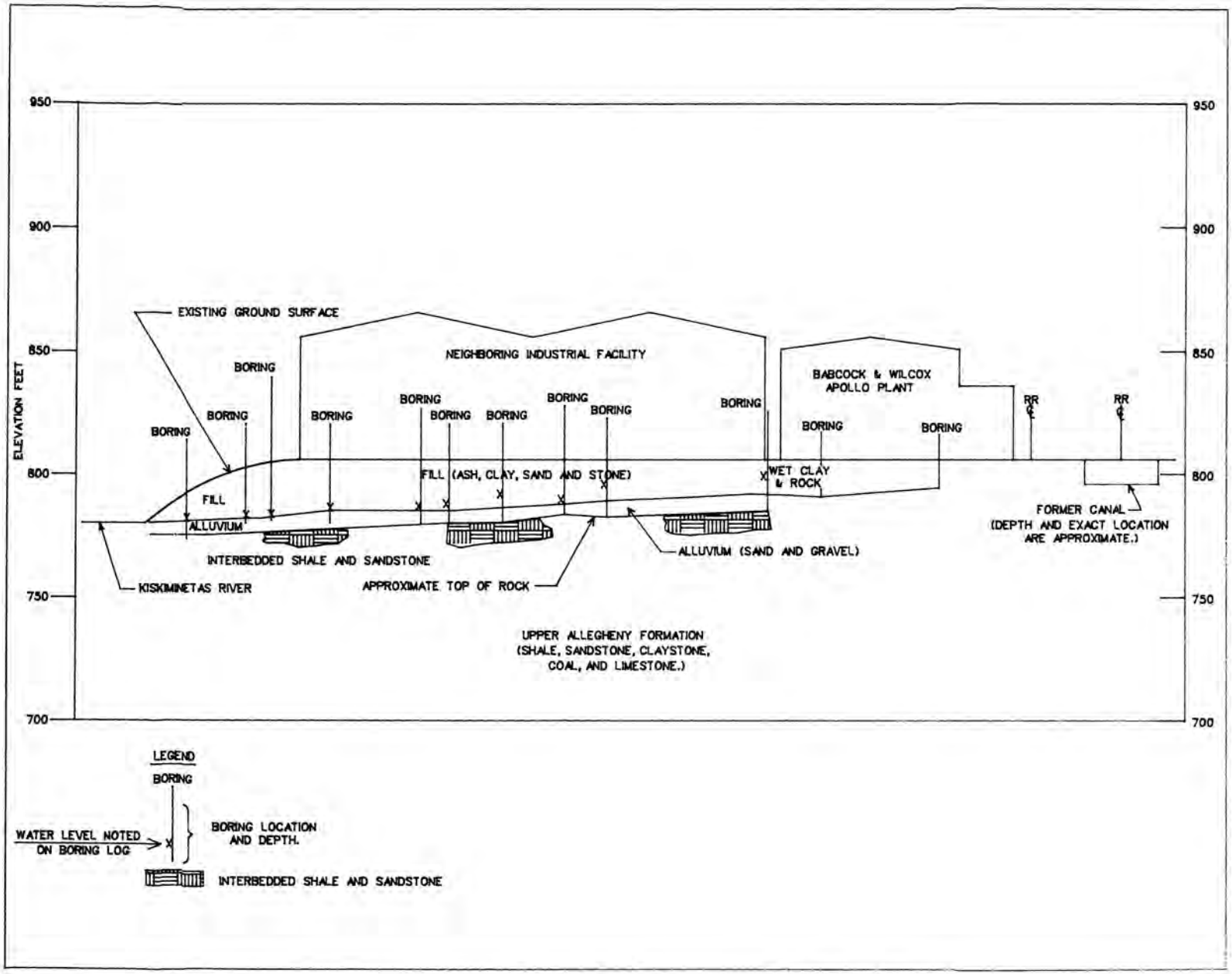

Fig. 3. Cross section A-A, "Subsurface site condition".

Analytical Program

An analytical program to accomplish the primary objectives was developed. Four areas were incorporated into the program.

1. Process related compounds, (indicator parameters), were used to determine the area which had been contaminated by process materials. See Table I.
2. A site specific modification to the Environmental Protection Agency's Target Compound List and Target Analyte List was used to assess human health and environmental risk. This analytical suite was developed by evaluating earlier preliminary site-wide chemical characterization results. For example, specific Volatile Organic Compounds (VOC's), Polycyclicaromatic Hydrocarbons, Priority Pollutant Metals, and PCB's were included in this portion of the analytical program.
3. AC of the LLRW disposal facility(s) were obtained and an analytical program was designed to ensure that soil above the BTP limits would be analyzed for the AC. For example, VOC's Reactive Cyanide and Sulfide, Moisture Content, pH, and Free Liquids were included in this portion of the analytical program.
4. The Toxicity Characteristic Leaching Procedure (TCLP) was used to evaluate disposal options. It was used to determine if the soil was a characteristically hazardous waste (i.e., Corrosive, Reactive, Toxic, or Ignitable). Several tests were performed.

Sample Spacing

Horizontal spacing between sample locations was based on a systematic plan in order to establish statistical confidence limits. Three types of sampling strategies: judgmental, systematic, and random, were evaluated to determine the best option. The systematic approach was selected because it requires fewer samples than the random approach and has a lower bias than the judgmental approach. A major factor in the design of the statistically based systematic sampling was the high degree of confidence required by the first secondary project objective. Project objectives dictated a 90 percent confidence level.

Another factor influencing the sample spacing was the low margin of error required by the second secondary project objective. Margin of error is defined as the volume of areas potentially missed by the sample spacing expressed as a percentage of the total area. In order to optimize project resources; different sample spacings were evaluated. The cost, range of potential volume missed, and the range of margin of error were compared for several sample spacings. The plan spacing was selected at 70 foot centers. Seventy foot centers optimized the objectives of high confidence level and low margin of error against the cost of obtaining the data. See Fig. 4.

Sampling Density

Density of the samples was based on a bias approach developed by site specific knowledge, analytical method detection limit versus end use (i.e., risk assessment versus AC evaluation), and established sample collection protocols. The density was established at 2 or 3 samples per sample location with the number of samples dependent on the depth to bedrock. The samples were composited over a 10 to 15 foot depth dependent on sample location and depth to bedrock.

Sampling Methods

Sampling methods were developed from standard protocols modified by site specific conditions (i.e., radioactivity, in or out side buildings, presence of hazardous constituents, and analytical parameters). In addition data quality and data management requirements were established.

After completion of these four tasks the tasks were resource loaded to determine the overall cost and schedule. The cost and schedule were then compared to the overall project objectives. Cost and schedule were then brought into balance by revisiting objectives and priorities through additional scoping. Once this integration was completed the objectives were cast-in-stone. The objectives were cast-in-stone in order to properly manage the project, and remind project personnel of the objectives and how they were to be obtained.

After completion of the four tasks the SAP was written. NRC, Office of Solid Waste and Emergency Response, American Society for Testing Material, Occupational Safety and Health Administration, and state guidance were used as guidance documents when writing the plan. These regulations were used to insure that the plan would stand public scrutiny and meet the standards of the industry.

Once the plan reached general acceptance and was funded, both schedule and cost controls were developed. The plan was then implemented from subcontractor selection through final reporting.

LESSONS LEARNED

All the objectives were met or exceeded, but with the benefit of "20/20 hindsight" some areas could be improved so that future SAPs would guide the most effective characterization programs. Based on our experience the following are areas which should be incorporated into all SAP or characterization programs:

- Planning to identify correct problems early and evaluate situations to optimize the schedule should be done on a daily basis. Daily planning played a key role in meeting the objectives in a timely and cost effective manner.
- Use existing protocols, and standard operating procedures and guidance when developing sampling methods. Even though three different soil conditions were encountered during the characterization efforts, standard sampling methods met or exceeded the needs of the program. Also, using standard methodologies rather than developing new ones was very cost effective.
- Site specific geological conditions should be incorporated into the SAP. Three different sampling methodologies had to be used due to variable soil characteristics.
- When soils above and below the BTP for release are located in the same borehole location, the boundaries of the composite sample should be coordinated with the edges of the different levels of contaminated soil. For example, if the soil which is contaminated above the BTP limits starts at the surface and stops

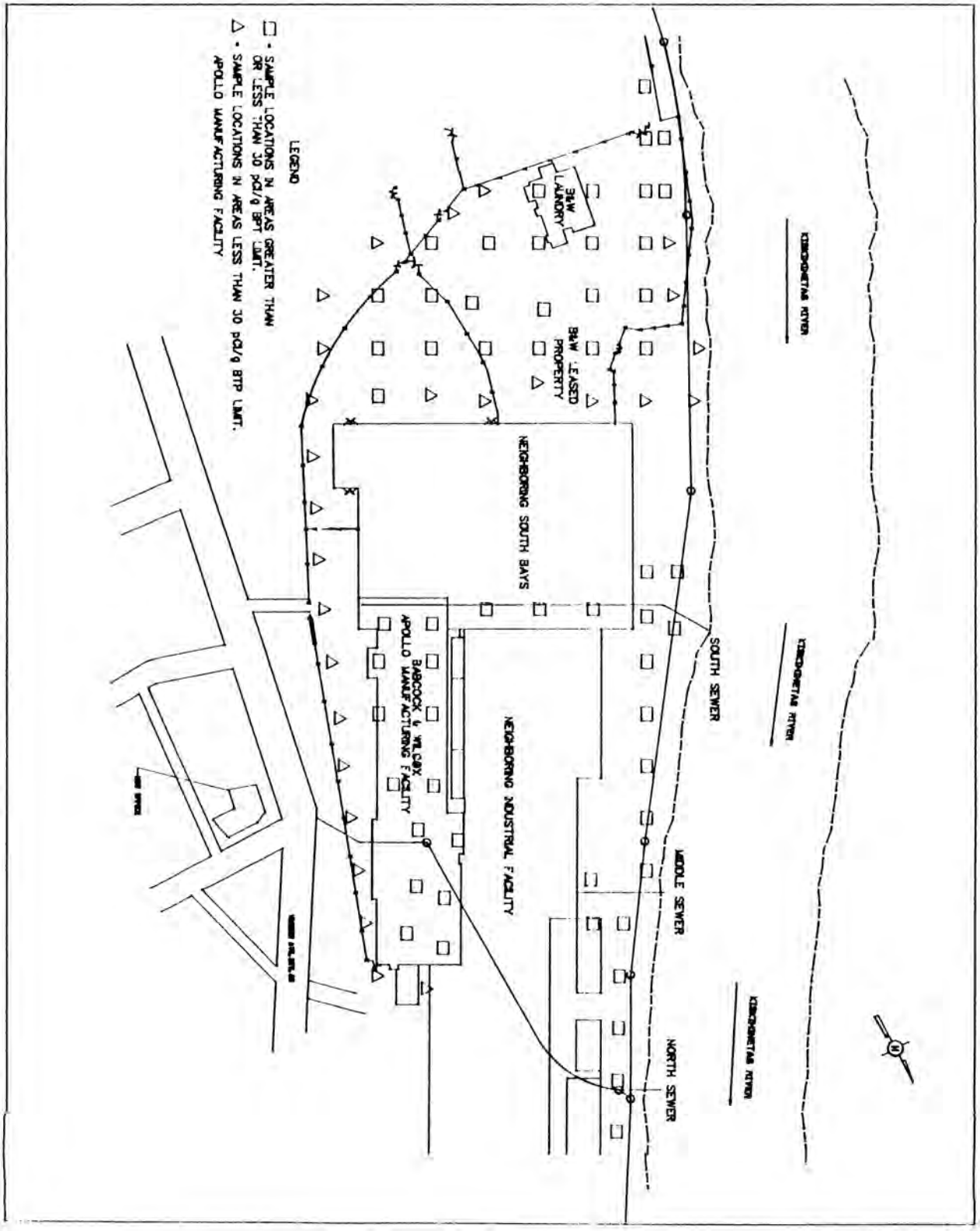

Fig. 4. Sample location plan.

TABLE I

Chemicals/ Compounds Used In Manufacturing Process

Process	Chemicals/Compounds
Chemical Process	Hydrofluoric Acid
	Nitric Acid
	Amonium Hydroxide
	Thloroethylene
	Trichloroethane
	Kerosene
	8-Hydroxyquinoline
	Acetic Acid
	Tributyl Phosphate
Scrap Recovery	Hydrofluoric Acid
	Nitric Acid
	Sodium Fluoride
	Magnesium Fluoride
	Potassium Hydroxide
Process Coating	Nitric Acid
	Thloroethylene
	Trichloroethane

at the 1.5 meters level then the first composite should cover this range not the 0 to 3.0 or 4.6 meters range.

- Compositing samples over a large interval, 3.0 to 4.6 meters, vs a small interval, 0.6 to 1.2 meters, is an extremely effective way to reduce costs while obtaining the required data.
- Sampling operations, which are to begin after data is collected from this sampling program, should be included in the scheduling for this program.

CONCLUSION

Designing a Sampling and Analysis Plan to meet multiple project objectives for the characterization of soil is critical. This up-front planning and documentation insures that the characterization program fits the overall project objectives. Developing a SAP is a very time consuming project, but the front end costs are typically less than one percent of the project. Scheduling and budgeting time for SAP preparation is invaluable in meeting multiple project objectives.

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