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Environmental Restoration Program

CHARACTERIZATION OF MAIN HILL SEEPS AND FOUNDATION DRAINS OPERABLE UNIT 2, MAIN HILL OU-2 PHASE I TECHNICAL MEMORANDUM

MOUND PLANT
MIAMISBURG, OHIO

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FINAL

(Revision 0)

Department of Energy
Ohio Field Office

Environmental Restoration Program
EG&G Mound Applied Technologies

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LIST OF ACRONYMS
MOUND PLANT, ER PROGRAM

AEC	Atomic Energy Commission
BVA	Buried Valley aquifer
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DOE	U.S. Department of Energy
EG&G	EG&G Mound Applied Technologies
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration (Program)
FFA	Federal Facility Agreement
FS	Feasibility Study
IR	infrared
MRC	Monsanto Research Corporation
NPL	National Priorities List
OU	operable unit
RI	remedial investigation
SM/PP	Special Metallurgical/Plutonium Processing
SW	solid waste
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

Mound Plant is a research and manufacturing facility for the production of radioactive power sources and military detonators. It is located in Miamisburg, Ohio and is operated by EG&G Mound Applied Technologies (EG&G) for the Department of Energy (DOE). Mound Plant was placed on the Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) National Priority List (NPL) in November of 1989 and a Federal Facility Agreement (FFA) was signed between the DOE and the U.S. Environmental Protection Agency (EPA) in October of 1990. In response to being placed on the NPL, Mound Plant was divided into Operable Units (OU) to simplify program management. The Main Hill of Mound Plant is Operable Unit 2 (OU-2).

A Remediation Investigation of OU-2 was started in April 1994. The first part of the investigation, Phase I, was conducted to collect information to help in preparing the scope of work for the remaining phases of the investigation.

As part of Phase I, an evaluation of the existing, and reconnaissance for additional, seeps was performed. The seep reconnaissance of OU-2 was performed during the spring and summer of 1994. The objective of the reconnaissance was to search the hillsides within the OU-2 boundary looking for the presence of additional seeps. Infrared aerial photographs were taken to help identify potential seep locations. Mound Plant drawings were reviewed to locate foundation drains, or other drains, that could potentially leak to the underlying soils. In addition, plant personnel were interviewed to gain insight on the location of subsurface utilities and foundation drains that may not be shown on engineering drawings or building plans.

The infrared (IR) aerial photography was taken on April 4, and July 11, 1994 by Woolpert, Inc. of Dayton, Ohio. A review of the IR photographs suggest the presence of enhanced vegetation rather than stressed vegetation. Several seeps (0601, 0602, 0608, and 0625) were identified using the IR photographs. The remaining seeps were not apparent in the photographs.

The IR photographs are only a moderate discriminator of the seep. In non-wooded areas, seeps appear to be associated with a mottled gray spectral signature due to increased moisture associated with the seep. However, not all areas displaying this feature can be associated with seepage. Wooded areas in the summer presented a problem for the identification of seeps using the IR photographs.

The monitoring results indicate that the flow of two seeps (0601 and 0607) is directly influenced by rainfall, while the flow in the other seeps is only slightly influenced by a significant rainfall event. The seeps that appear to be directly influenced by rainfall respond within one day of each rainfall event and then return

to normal flow within another day. Foundation drains show only a slight response to rainfall and appear to be more influenced by subsurface utilities that may be leaking.

Future investigation of the seeps in upcoming phases will help clarify the response to rainfall and assess how fractures in the bedrock contribute to their flows.

SECTION 1

1. INTRODUCTION

1.1. SITE BACKGROUND

Mound Plant originated as part of the Manhattan Engineer District in 1943; its purpose was to determine the chemical and metallurgical properties of polonium. The work was performed for the U.S. Army at several locations in Dayton, Ohio, by Monsanto Research Corporation (MRC 1985). In 1946, 182 acres were purchased for the permanent Mound Plant site on the outskirts of the city of Miamisburg, in Montgomery County, Ohio (Figure 1.1). The site is approximately 10 miles south-southwest of Dayton and 45 miles north of Cincinnati. In 1948, work being performed at the Dayton units was moved to this site, and in January 1949, operations involving radionuclides began.

Mound Plant occupies 306 acres within the southern city limits of Miamisburg, Ohio (Figure 1.1). The northern boundary of Mound Plant is approximately 0.13 mile south of Mound Avenue in Miamisburg. Mound Avenue curves south, becomes Mound Road, and runs southward along the western boundary of the plant. Benner Road forms the southern boundary of Mound Plant, and the Conrail Railroad, formerly the Penn-Central, roughly parallels the western boundary at distances of about 50 to 200 feet (MRC 1985). A railroad siding enters the plant from the west and services the lower plant valley.

There are currently more than 100 buildings on the site and total floor space exceeds 925,000 square feet (ft^2) (MRC 1985). Most of the buildings are located on the northwest high area known as Main Hill. Building uses are described in the Mound Site Development Plan (MRC 1985). Buildings on the northwest hill include administrative offices, machine tool and maintenance shops, nuclear and advanced device production and development facilities, a cafeteria, a library, a powerhouse, and other utilities (MRC 1985). The southern part of the property is undeveloped except for an unpaved parking lot.

Early Mound Plant programs investigated the chemical and metallurgical properties of polonium-210 and its applications, particularly the fabrication of neutron and alpha sources for weapon and nonweapon use. Investigations involving uranium, protactinium-231, and plutonium-239 were performed from 1950 to 1963 as part of the national civilian power reactor program. In 1954, separation of the stable isotopes of noble gases began. Development of plutonium-238 heat sources started at Mound Plant in 1961 because of its high specific activity and relatively short half-life (87.74 years). Since that time, heat sources fueled with plutonium-238 have been developed and fabricated.

The first of several programs requiring tritium-handling technology was initiated in 1958. Today, Mound Plant has an extensive capability for handling and studying tritium and tritium compounds for weapons or nonweapons applications. A facility also exists for the recovery and purification of tritium from all types

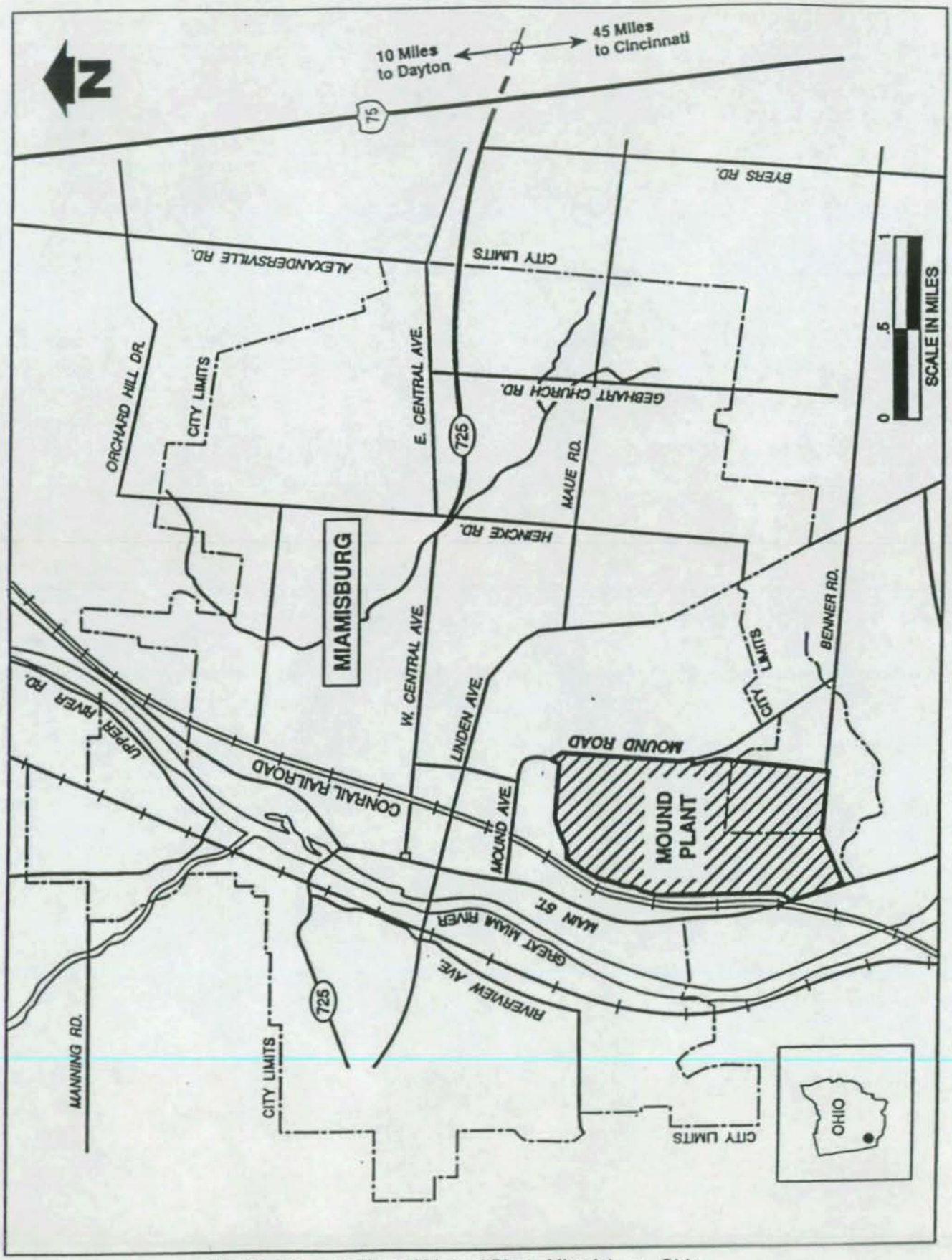

Figure 1.1. Location of Mound Plant, Miamisburg, Ohio

of wastes generated at DOE sites which handle tritium. Facilities also exist for the development of tritium-containing materials and processes for weapons applications and possible manufacture (MRC 1985).

Mound Plant uses a wide variety of chemicals and in the past generated approximately 20,000 gallons of hazardous wastes per year, including organic solvents, waste oils, corrosives, spent plating bath solutions, explosive wastes, and laboratory wastes. There is no current storage of either chemical products or hazardous wastes in underground storage tanks (USTs). USTs at Mound Plant are used for storage of fuel oil, diesel fuel, low-level radiological wastewater, and sanitary/industrial wastewater (EG&G 1989).

In the early 1970s, as national concerns about the environment and the conservation of resources grew, Mound Plant expanded its comprehensive programs in environmental control, waste management, and energy conservation. In January 1975, Mound Plant formally came under the jurisdiction of the Energy Research and Development Administration upon dissolution of the Atomic Energy Commission (AEC). In October 1977, Mound Plant was incorporated into the DOE complex.

Mound Plant was placed on the CERCLA (Superfund) NPL in November, 1989. Pursuant to that status, a CERCLA Section 120 FFA was signed between DOE and EPA (Administrative Docket Number V-W-90-C-075), and became effective October 12, 1990. The Ohio EPA (OEPA) became a signatory to the agreement in July 1993. A Remedial Investigation/Feasibility Study (RI/FS) was initiated at Mound to characterize the nature and extent of risks faced by uncontrolled hazardous waste and for evaluating potential remedial options.

There are three large surface tanks on the plant. Two large water towers, one on the Main Hill and one on the SM/PP Hill, provide the potable water supply to the plant. These two water tanks hold 100,000 and 250,000 gallons, respectively, and are supplied through the water treatment system that obtains water from the plant supply wells. These water towers deliver 50% of their capacity for domestic and process uses and the other 50% is retained for fire protection. Additional fire protection is provided by a 350,000-gallon tank located in the lower plant valley. The tank is surrounded by an asphalt-lined berm capable of holding 150 percent of the tank contents. All water supply piping is underground to protect it from freezing. All of the fuel oil piping in use is aboveground, but older underground pipes may remain abandoned in place. Details of the tanks and piping are contained in the Site Scoping Report, Volume 4 - Engineering Map Series (DOE 1991) and the Subsurface Utility Technical Memorandum (DOE 1994).

Mound Plant has a system of underground piping used, or formerly used, to transmit a variety of wastewaters, including low-level alpha radiation waste, low-level beta radiation waste, sanitary sewage,

and storm drainage. Leaks in storm and sanitary sewers have been identified in the past as a problem and were surveyed internally using a television camera. Those identified leaking sections were replaced or lined. Operational data indicates that groundwater infiltrates into some of the sewers through cracks, while in other sections water leaks out of the pipes.

The investigation for seeps on the Main Hill was initiated in the spring of 1986. The investigation stemmed from the discovery of a groundwater seep on the western hillside below the Solid Waste (SW) Building. The seep was sampled and a laboratory analysis showed elevated concentrations of tritium. A thorough search and sampling program was initiated to find other seeps that may exhibit elevated tritium concentrations. Emphasis was placed on searching the off-site areas along the western and northern plant boundaries. Eight seeps were identified including three on site and five off site. Elevated tritium and low levels of uranium-233 were detected in two of the previously identified off-site seeps (DOE 1989). The location of the Main Hill seeps suggest they are part of the shallow groundwater; these seeps have a history of volatile organic compound (VOC) and tritium contamination (DOE 1992).

Conceptually, the site hydrogeology can be divided into two hydrostratigraphic units: the Buried Valley Aquifer (BVA) and groundwater in the bedrock system. The seeps are believed to be associated with the shallow groundwater in the bedrock. Although groundwater discharges through the seeps along the hillslopes, it is probable that groundwater moves vertically downward through the fractures directly to the BVA and that groundwater discharges below the hillside colluvial veneer (DOE 1989).

Groundwater flow within the bedrock system is probably along the interface between the overlying glacial tills, fill materials, and the bedrock; along fractures within the bedrock; and along the fractures between limestone and shale beds. Flow paths within this system are complex and may be locally enhanced by permeable sand and gravel fill around utility trenches.

Spills and leaks from source areas in OU-2 are assumed to have migrated to bedrock. The bedrock fractures provide a likely transport mechanism for contaminants migrating to the seeps. Near-surface contamination has likely been mobilized by recharge water and transmitted through the fracture system in the bedrock. Trench backfill areas associated with underground utilities and other building drains can provide permeable conduits that allow infiltration of contaminants into pipe chases and transmission lines, as well as through the soil to bedrock (DOE 1989).

A domestic water line break on April 18, 1994, beneath the SW Building is believed to have transported tritium contamination from soil moisture beneath the building into the groundwater. It is believed that the tritium has migrated within the bedrock and subsurface utilities, with a release of two curies over a two day period.

1.2. OBJECTIVE

The objective of the OU-2 RI/FS is to define the nature and extent of the contamination found on the Main Hill, characterize the risks to human health and the environment posed by exposure to the various affected medium, and to evaluate the potential remedies that could reduce these risks to acceptable levels.

The objective of this task is to confirm the existence of the known seeps and identify the presence of additional seeps. This task will also assess the impact of foundation drains on the seeps by monitoring the flows in both the seeps and foundation drains.

1.3. OVERVIEW

A location survey was performed to identify all present seeps and thoroughly search OU-2 for areas of potential seeps. The identified seeps were monitored before and after significant rainfall events. The seeps were monitored for pH, specific conductivity, temperature, and flow. A licensed surveyor horizontally and vertically located the current seeps and potential seeps. The survey data tie the locations into the existing Mound Plant coordinate system.

Building plans were reviewed to locate foundation drains, floor drains, sumps, or other drains that could be potential source leaks contributing to the groundwater flow. The drawings were verified in the field for completeness and accuracy.

Mound Plant personnel were interviewed to gain insight on the location of existing hazardous waste lines, sewer lines, and foundation drains that may not be shown on the engineering drawings or building plans. This information will support other sources to produce a map showing all subsurface utilities.

Color IR aerial photography was used to aid in characterizing surface features and conditions. Color IR photography is an effective method for defining surface vegetation and water patterns. These features are more prominent on IR photography when compared to conventional aerial photographs. IR photography assisted in assessing stressed vegetation and spill areas, as well as soil moisture and the location of additional seeps. The IR photographs were taken in early spring and in mid-summer. The early spring photographs were useful in evaluating soil moisture areas before vegetation and trees leafed out and the mid-summer photographs for the presence of stressed vegetation.

SECTION 2

2. INFRARED AERIAL PHOTOGRAPHY

Color IR aerial photography was proposed to help identify seeps either through (1) stressed vegetation that might surround the seeps, or (2) direct identification.

2.1. SUMMARY OF ACTIVITIES

Two sets of IR aerial photographs were taken over OU-2 in the spring and summer of 1994, as shown in Table II.1, by Woolpert, Inc. of Dayton, Ohio. The April photographs were taken at a scale of 1/4800. The July photographs were shot at a scale of 1/2400 to increase resolution. The photographs were taken at approximately mid-day to minimize shadows.

Both sets of photographs provide 100 percent coverage of OU-2. The photographs had sufficient overlap to be viewed stereoscopically.

Table II.1. Infrared Aerial Photography

Set	Number of Photos Taken	Date	Photo ID Number	Frame Number	Scale	Confirming Site Visit
Spring	6	April 4, 1994	Flight 1, Photos 1-6	1468-1473	1/4800	May 16, 1994
Summer	18	July 11, 1994	Flight 1, Photos 1-9 Flight 2, Photos 1-9	0726-0734 0752-0760	1/2400	August 9, 1994

The site was visited about six and four weeks after of the dates on which the photographs were taken, respectively, to provide "ground truth" for the imagery.

2.2. INFRARED AERIAL PHOTOGRAPHY ANALYSIS

The IR photographs obtained for this investigation are of high quality and in general show four dominant spectral signatures:

red - vegetation
blue - black/blue - open water
green - barren trees and shrubs
gray/blue - civil structures

The IR images record a spectral wavelength of 0.9 micrometer (μm). The electromagnetic wavelength recorded in the images is outside the spectrum of 0.4 to 0.7 μm visible to the human eye, and falls within the short wavelength portion of the IR band representing reflected solar radiation. The images contain

no information about the thermal properties of the materials photographed. The spectral reflectance for vegetation increases abruptly in the photographic IR region and is registered as red on IR film. In particular, the red signature recorded in the photographs represents IR energy that is reflected predominantly by healthy vegetation and has no thermal significance. Because vegetation has a wider range of reflectance values in the photographic IR spectral region than in the visible green region, it is easier to discriminate vegetation on IR color film than normal color film (F. Sabins 1978).

As a basis for investigating Mound Plant with IR imagery, it was hypothesized that VOCs or other contaminants may be causing vegetation stress. In normal vegetation, the high IR reflectance of leaves is not caused by chlorophyll but is due to multiple internal reflections from the interfaces between hydrated cell walls and intercellular air spaces of spongy mesophyll tissue. When vegetation is stressed, the internal cell structure of the leaves may begin to collapse and the IR reflectance drops. This causes the red color to be darker than normal on IR color photographs.

Clear water absorbs IR radiation readily and thus has a dark blue or black signature on IR color photographs, and contrasts markedly with the red signature of vegetation. Ponds at Mound Plant and the Great Miami River show these signatures. Damp ground may be recognized on IR color photographs by its relatively darker signature, (typically a mottled gray) which is caused by absorption of the IR energy. Although brown or gray in the visible spectrum, barren trees, as on the spring IR photographs, appear green on IR film.

2.2.1. Spring

The initial set of IR photographs were taken on April 4, 1994 (Figures 2.1 and 2.2). Because they were taken in early Spring, the photographs do not show intense vegetation; however, some grasses are present as evidenced by their red signature especially in the residential areas surrounding Mound Plant. In the three days prior to when the photographs were taken, 0.34 inches of rainfall were recorded; presumably flow from the seeps could be expected to be increased.

The photographs were reviewed for presently known seeps and potential seeps. In the photographs, it appears that known seeps are not particularly associated with vegetative cover, but in some instances can be associated with a darkening of the ground (a mottled gray) in the IR spectrum due to the presence of moisture. A map of the "sites of interest" was generated based on the photographs which provided total coverage of OU-2 and its surrounding area (Figure 2.3). The map is marked with selected cultural features for reference. Sites of interest are denoted as "A" through "K." These sites circumscribe Main Hill.

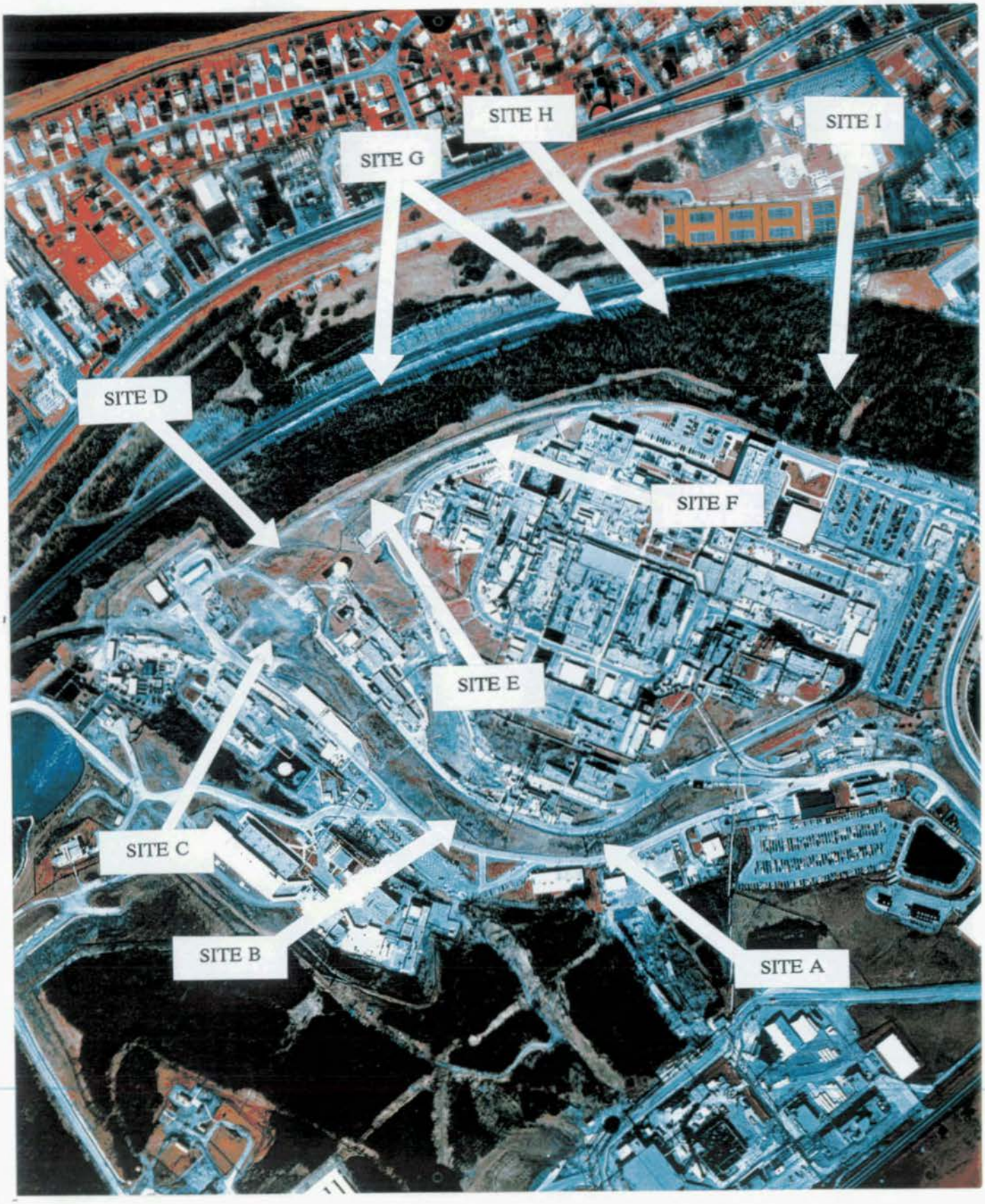

Figure 2.1 Spring Number 1 - Infared Aerial Photograph With Overlay

Figure 2.2 Spring Number 2 - Infared Aerial Photograph With Overlay

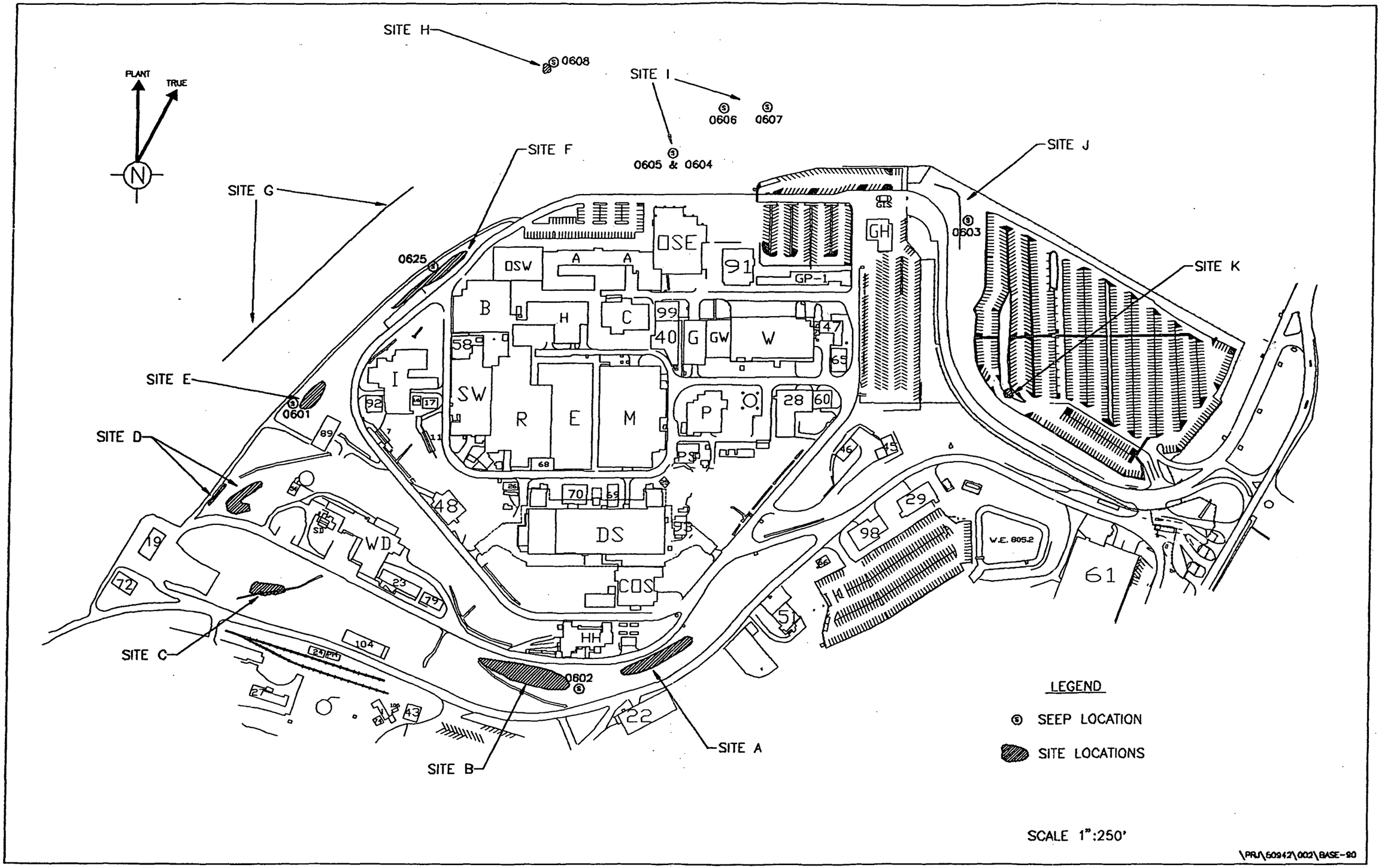

Figure 2.3. Sites of Interest

Main Hill (outside the secured area) was visited on May 16, 1994 to investigate the seeps, provide "ground truth" for the IR photographs, and calibrate the spectral signature of the seeps. During the visit, seeps previously identified were examined as were other seeps. In the three days prior to the site visit it had rained a total of 0.30 inches. In addition, during the intervening six weeks from the date of the IR photography, the vegetation growth was significant (i.e., grasses were tall and the trees sprouted leaves.) In general, the site visit confirmed that seeps can be correlated with a mottled gray spectral signature rather than a red signature associated with vegetation. The sites of interest are shown in Figure 2.3 and are described in detail below.

- Site A - This site is evidenced by a mottled gray signature on the IR photographs. It is located on the southeast side of Main Hill and is an area of seepage as evidenced by abundant soil moisture and vegetation. An open drainage culvert in this area is an indication that this site has been recognized in the past as an area of high soil moisture. No discrete seeps were located, however, due to the dense vegetation. However, Mound Plant personnel have indicated that there has been a problem with the underground fire line at HH Building resulting in the installation of an aboveground bypass for the fire line. This is considered to be the likely source of soil moisture at Site A and seeps at Site B.

- Site B - This site is located on the south side of OU-2. It has been identified as seep 0602 and on the IR imagery shows a mottled gray signature. This site actually has numerous discrete seeps, some with freely trickling water, occurring on the north side of an open drainage culvert. The seepage tends to form a line running east-west across the hill at approximate elevations of 770-790 feet mean sea level (msl). The presence of reeds (growing out of the steep hillside) indicates this is an area of sustained moisture. The volume of seepage at this site appeared to be the greatest examined during the site visit.

- Site C - On the IR imagery, this location shows a gray/black signature indicative of water. In the field this site is the location of ponded water with reeds present. This water likely collects as runoff from the adjacent hillside. It could represent groundwater seepage, however, the water did not appear to be actively flowing.

- Site D - This site displays seepage as evidenced by a mottled gray signature on the IR photography, and increased vegetative cover (but no reeds), soil moisture, and algal scum in the rim of the adjacent open culvert. The volume of seepage did not appear to be great. The approximate elevation of this seep is about 770-790 feet msl.

- Site E - On the IR photographs, this area shows a mottled gray signature. Seep 0601 is located at this site. The seep has a sump and weir installed on it. Flow was significant on the day of the site visit and there was increased vegetation noted in the immediate area of the seeps.

- Site F - This is the site of seep 0625. It was first considered to be run off after a rainfall event, however, discrete seepage was observed later in the summer along the west side of the roadway. Its presence is not obvious from the IR photograph. The area between sites E and F is an area of increased vegetation (which shows up on the IR imagery) and may be the site of increased moisture in the hillside.

- Site G - The darker, linear spectral signature on the IR imagery in this location is indicative of seepage. During the field visit on May 16, this site along the Conrail tracks provided the best view of the bedrock stratigraphy underlying the Main Hill. The strata consist of

alternating shales and limestones and appear to be flat lying. Notably, about two-thirds of the way up the exposure (at an approximate elevation of 780 feet msl), a line of seepage could be seen. The seepage appeared to occur at a point where a layer of limestone overlies a relatively thick (~ 8 feet) shale sequence forming a more resistant and steeper hill slope. Groundwater appears to be migrating down through the limestone but discharges along the hill face as it encounters the less permeable shales.

- Site H - This is the site of seep 0608 and shows evidence of moisture on the IR imagery. In the field, it appears to be similar hydrogeologically to that described at Site G (above) but with greater flow.

- Site I - This site is the location of at least four discrete seeps: 0604, 0605, 0606, and 0607. None of the seeps at this location show any characteristic spectral signature on the IR photographs largely due to the presence of the extensive tree cover. The location of seep 0607 is most easily identified on the IR photographs due to triangular-shaped fence around it and a small structure, sump, and weir over it. Seeps 0604/0605 were actively flowing and appear to have been dug out into a sump; the sump was dug into limestone. Seep 0606 was also located and was slightly flowing.

- Site J - The IR photograph indicates that there may be a line of seepage along the hillside at this site where the intersection of the horizontal strata and the hillside form a line of mottled gray. During the site visit, this site (seep 0603) showed only minor seepage. Vegetation was only moderately greater than the surrounding hillside.

- Site K - This site, located in gravel at the west end of a parking lot was visually identified in the field to be seeping water. No obvious signature of the seep can be seen in the IR photographs.

2.2.2. Summer

The summer set of IR photographs (Figures 2.4 through 2.8) were taken on July 11, 1994 and show a dominant, intensive, red spectral signature due to the extensive vegetative growth that had taken place since the initial IR imagery. The same 11 sites of interest shown on Figure 2.3 were identified by the summer IR photographs. Figures 2.4 through 2.8 are marked with sites of interest.

Main Hill was visited on August 9, 1994 to verify locations of moisture that had been identified on the IR imagery. The same 11 sites of interest are annotated in the same manner as Section 2.2.1. From the photographs, the seeps are difficult to identify independently, but do confirm some of the seepage locations.

- Site A - In the summer IR photographs this site shows a greater vegetative signature than the surrounding hillside. No obvious signs of moisture are seen on the photographs. In the field, no obvious moisture was seen, although the dense vegetative cover precluded thorough investigation of the location.

a relatively thick (~ 8 feet) shale sequence forming a more resistant and steeper hill slope. Groundwater appears to be migrating down through the limestone but discharges along the hill face as it encounters the less permeable shales.

- Site H - This is the site of seep 0608 and shows evidence of moisture on the IR imagery. In the field, it appears to be similar hydrogeologically to that described at Site G (above) but with greater flow.

- Site I - This site is the location of at least four discrete seeps: 0604, 0605, 0606, and 0607. None of the seeps at this location show any characteristic spectral signature on the IR photographs largely due to the presence of the extensive tree cover. The location of seep 0607 is most easily identified on the IR photographs due to triangular-shaped fence around it and a small structure, sump, and weir over it. Seeps 0604/0605 were actively flowing and appear to have been dug out into a sump; the sump was dug into limestone. Seep 0606 was also located and was slightly flowing.

- Site J - The IR photograph indicates that there may be a line of seepage along the hillside at this site where the intersection of the horizontal strata and the hillside form a line of mottled gray. During the site visit, this site (seep 0603) showed only minor seepage. Vegetation was only moderately greater than the surrounding hillside.

- Site K - This site, located in gravel at the west end of a parking lot was visually identified in the field to be seeping water. No obvious signature of the seep can be seen in the IR photographs.

2.2.2. Summer

The summer set of IR photographs (Figures 2.4 through 2.8) were taken on July 11, 1994 and show a dominant, intensive, red spectral signature due to the extensive vegetative growth that had taken place since the initial IR imagery. The same 11 sites of interest shown on Figure 2.3 were identified by the summer IR photographs. Figures 2.4 through 2.8 are marked with sites of interest.

Main Hill was visited on August 9, 1994 to verify locations of moisture that had been identified on the IR imagery. The same 11 sites of interest are annotated in the same manner as Section 2.2.1. From the photographs, the seeps are difficult to identify independently, but do confirm some of the seepage locations.

- Site A - In the summer IR photographs this site shows a greater vegetative signature than the surrounding hillside. No obvious signs of moisture are seen on the photographs. In the field, no obvious moisture was seen, although the dense vegetative cover precluded thorough investigation of the location.

- Site B - This is the location of seep 0602. The IR photographs show a mottled gray at this location and black signature in the culvert which may indicate the presence of moisture. Water was flowing from at least three discrete seeps at this site. The adjacent culvert had water in it, although the amount was small.

Figure 2.4. Summer Number 1 - Infared Aerial Photograph With Overlay

Figure 2.5. Summer Number 2 - Infared Aerial Photograph With Overlay

Figure 2.6. Summer Number 3 - Infared Aerial Photograph With Overlay

Figure 2.7. Summer Number 4 - Infared Aerial Photograph With Overlay

Figure 2.8. Summer Number 5 - Infared Aerial Photograph With Overlay

- Site B - This is the location of seep 0602. The IR photographs show a mottled gray at this location and black signature in the culvert which may indicate the presence of moisture. Water was flowing from at least three discrete seeps at this site. The adjacent culvert had water in it, although the amount was small.

- Site C - On the IR photographs, this location shows a mottled gray pattern that is indicative of moisture. During the subsequent site visit ponded water was noted. No flow into the pond was observed during this site visit.

- Site D - This location near a culvert shows a slight mottled gray signature which may be indicative of moisture. Vegetation does not appear to be increased compared to the immediate surrounding area. During the field visit, moisture was observed to be seeping into the culvert on its west side. This moisture may be associated with downhill flow from seep 0601 or seep 0625. No moisture was observed on the east side of the culvert.

- Site E - This is the location of seep 0601. No distinguishing feature can be observed on the IR photographs of this seep. Water was observed to flow from the weir at this seep.

- Site F - This is the location of seep 0625. The seep observed during the May 16, 1994 site visit was considered to be run off from a recent rainfall event. Observations in June noted discrete seepage. The seep is not distinguishable on the summer IR photographs. The area between sites E and F shows increased vegetation, noted in both the field and on the summer IR photographs.

- Site G - This site lies along the exposed roadcut next to the Conrail tracks. At the higher resolution of the summer set of photographs, moisture can be seen seeping from the exposure in numerous locations. The seepage appears to be at approximately the 780 feet msl elevation discussed in Section 2.2.1 above. The field visit confirmed the presence of seepage at this location.

- Site H - This is the site of seep 0608. Figure 2.6 shows apparent moisture with this location as evidenced by a dark spectral signature. Moisture was observed at this location.

- Site I - This is the location of seeps 0604, 0605, 0606, and 0607. None of the seeps can be identified by spectral signature on the summer IR photographs. During the site visit, all of the seeps were observed to have slight to moderate flow. The location of seep 0607 can be identified by the fence and structure around it on the IR photograph.

- Site J - This is the location of seep 0603. The summer IR photographs show no obvious origins of the seep itself although the area shows a slight mottled gray appearance which may be indicative of moisture. Slight moisture, but no flow, was observed at this location.

- Site K - On the IR photograph (Figure 2.8), this site shows apparent seepage as evidence by flow patterns from the adjacent landscaped area of the parking lot. The seep was observed to have a slight amount of flow. Soil from the landscaped area had obviously been eroded onto the asphalt by the flow.

2.3. RESULTS

After examining the IR photographs and making two site visits, the following observations were made:

- Vegetation does not appear to be stressed in the areas near the identified seeps. On the contrary, in many locations where the seeps appear to be constantly flowing, vegetation appears to be vigorous, especially as observed during the spring site visit.

- The IR photography is only a moderate discriminator of areas of seepage. In non-wooded areas, seeps seem to be associated with a mottled gray spectral signature due to moisture, especially in the spring photographs. However, not all areas displaying this signature were associated with seepage. In the wooded areas circumscribing the Main Hill, unique identification of seeps is not possible. The spring photographs were taken under optimal conditions to identify such seeps; IR photographs taken at other times of the year when the trees have leaves, as on the summer photographs, preclude identification of the seeps.

- Because the bedrock strata are essentially flat lying, seeps appear to be occurring in a linear fashion along specific bedrock outcrops. Notably, a number of sites examined (B, C, and G) lie at an approximately similar elevation suggesting that groundwater is percolating downward until less permeable strata are encountered. On the south and west sides of the OU-2 area, this occurs at an elevation of approximately 770-790 feet msl indicating that the shale sequence described at Site G may act to retard the downward flow of groundwater.

SECTION 3

3. PLANT INTERVIEWS

3.1. SUMMARY OF ACTIVITIES

Plant personnel were interviewed to gain additional information on the location of foundation drains, or other subsurface utilities that may not be shown on engineering drawings or building plans (Table III.1). Of the twenty plus personnel that were selected for interviews, approximately half were interviewed, the remaining personnel were unavailable due to the closing of the Mound Plant. Personnel were selected for interviewing based on their knowledge of the seeps and their participation in environmental and construction activities at Mound Plant. Two of the personnel were interviewed in person with the remaining interviews completed via telephone conversations. Scheduling face-to-face interviews proved very difficult and the telephone interviews were more efficient. Each interviewed person was presented a standard list of questions (Appendix A). The questions were specific to the OU-2 seeps and foundation drains. Questions included: are seeps seasonal?; are they monitored?; what analysis were performed?; and have they been surveyed? Questions concerning foundation drains included: what is considered a foundation drain?; are any of the drains monitored?, if so for which parameters?; to where do foundation drains flow?; and are there other personnel who we should talk to?

3.2. RESULTS

The information collected from the interviews was useful in finding that two of the OU-2 buildings have foundation drains that are monitored daily for tritium. Building 48 and T Building have foundation drains that flow into the storm sewer system. The Building 48 foundation drain flows into a catch basin on the northwest corner of the building; the drain system around Building 48 was reportedly repaired approximately three years ago. The T Building foundation drain flows to an outfall pipe on the south hillside, west of HH building. The Building 48 foundation drain is sampled at the catch basin and T Building foundation drain is sampled downhill in an open unlined channel. Results of this sampling are discussed in Section 5. The outfall for the T Building foundation drain is in a D&D exclusion zone which prevents monitoring for flow and other parameters. The sampling is part of the internal Mound Tritium Groundwater Assessment Program conducted by Mound (DOE 1989). No other foundation drains are sampled or confirmed to be present within the OU-2 area. A Mound Plant engineer stated that most of the buildings with basements experience some type of leakage during the wet seasons and some are equipped with sump pumps which discharge into storm or sanitary sewers. The engineer also stated that any building built into a hillside, or with a basement, would have some type of footer or foundation drain that probably discharges into the storm or sanitary system.

Table III.1. Personnel Interviewed

Mound Personnel Interviewed	Building/Group	Interview Date
Gary Coons *	OSE/ER	6/7/94
Dan Carfagno *	OSE/ER	6/7/94
Dennis Gault	OSE/ER	5/20/94
Bill Farmer	E/Env Sampling	6/23/94
Bill Herald	OSE/Facilities Eng.	6/8/94
Randy Brewer	E/Envir. Sampling	6/28/94
Lowell Hopkins	GH/Environmental	6/27/94
Jerry Coons	B/Building Manager	6/27/94
Larry Baygents	W/	6/27/94
Chris Kinard	E/	6/27/94
Dave Heitz	Fire Chief	9/16/94

* - Denotes face-to-face interview

Other interview information concerned the state of fire fighting water lines. According to Mound, these water lines leak at a rate of approximately 4.5 gallons per minute. This can be extrapolated to approximately 6,480 gallons a day or over 2.3 million gallons a year. The Subsurface Utility Technical Memorandum (DOE 1994) provides additional information on the fire fighting water lines.

SECTION 4

4. REVIEW DRAWINGS/PLANS

4.1. SUMMARY OF ACTIVITIES

Building drawings and plans were compiled from the drawing control office at Mound Plant. Some of the drawings were simply copied and others were obtained through Mound Plant's electronic data base. The copied drawings were of buildings within the OU-2 boundary and consisted of as-built construction drawings that displayed foundations, cross-sections, and internal utilities. The electronic data was of the Main Hill civil engineered utilities, including sanitary, storm, water, hazardous waste, and electric lines. The utility drawings were decreased in scale to help in identifying foundation drains and other features that were undistinguishable at the larger scale.

The drawings and plans for the buildings and structures on the Main Hill were reviewed for drainage system details. The review was performed systematically by dividing the site into 11 sections. Each section was reviewed by two investigators to help ensure that all drains were identified. Foundation drains that were identified are shown in Figure 4.1.

4.2. RESULTS

The drawing review produced little information useful in locating foundation drains. The drawings showed that most of the floor drains in the buildings discharge into the storm sewer system. The construction drawings gave little detail on the foundation system, and the utility drawings detailed the foundation drains of only a few buildings (GP-1, Building 40, OSE, T Building). Because of the shallow bedrock, it is believed that many foundations were allowed to drain directly into the bedrock and may not contain a drainage system. Through review of the utility drawings and discussions with Mound personnel, foundation drains were discovered around T Building and Building 48. Both drains are sampled daily for tritium and the discharges probably include groundwater intercepted by the foundation drainage system.

The foundation drain at T Building encompasses DS Building because DS Building was constructed directly on top of T Building, making T Building's foundation drains also DS Building's.

The locations of water, sewer, and hazardous waste lines, and utility trenches (Figure 4.2, 4.3, 4.4 and 4.5, respectively) were plotted to assess whether the lines or trenches could be contributing fluids to the seeps. Their approximately closest distance to the seeps are summarized in Table IV.1. All of the seeps have subsurface utilities upgradient from them and could be affected by the utilities. Seeps 0601 and 0625 are located relatively close to water and sewer lines.

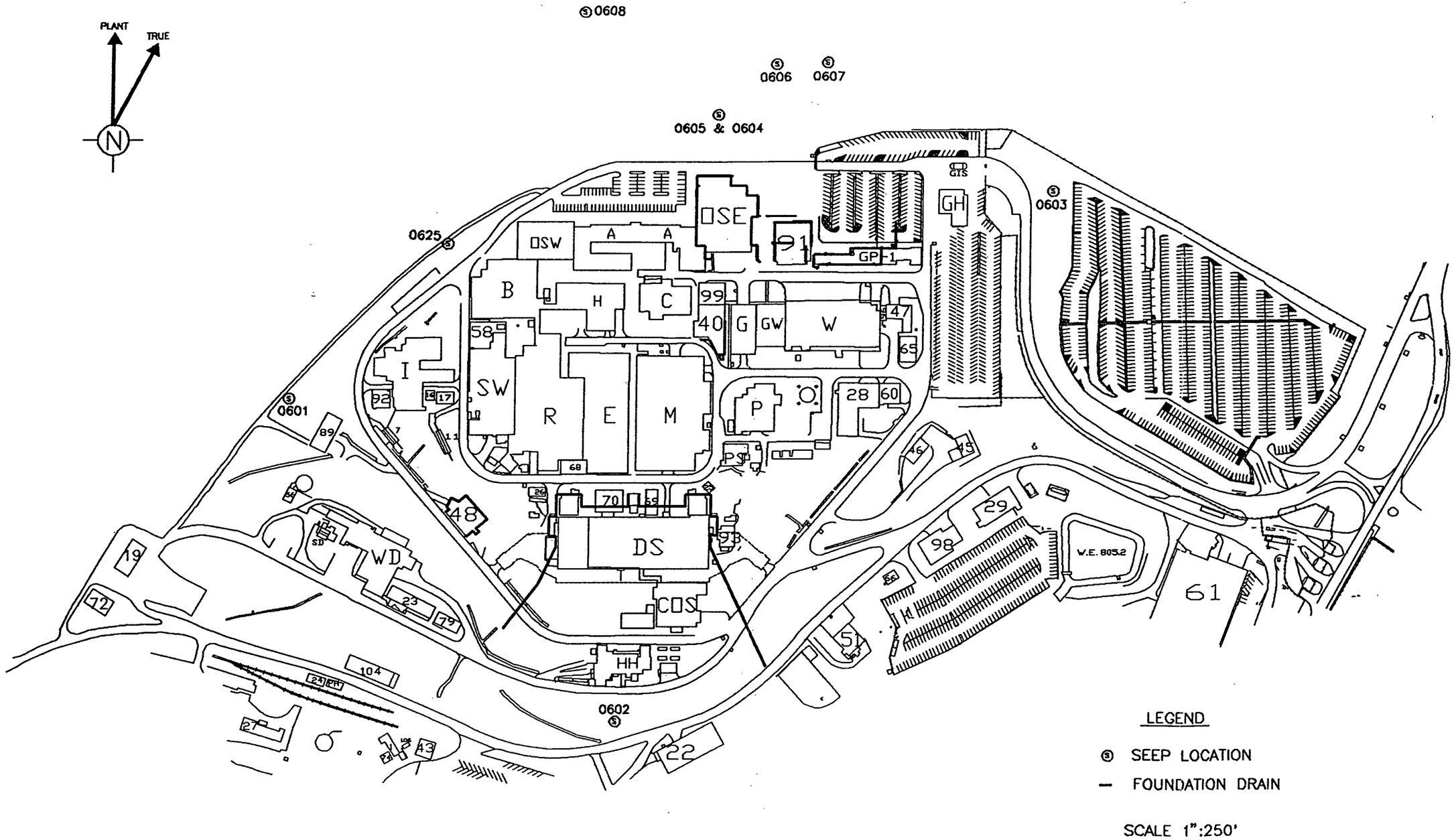

Figure 4.1. Proximity of Foundation Drains to Seeps \PRJ\50942\002\BASE-90

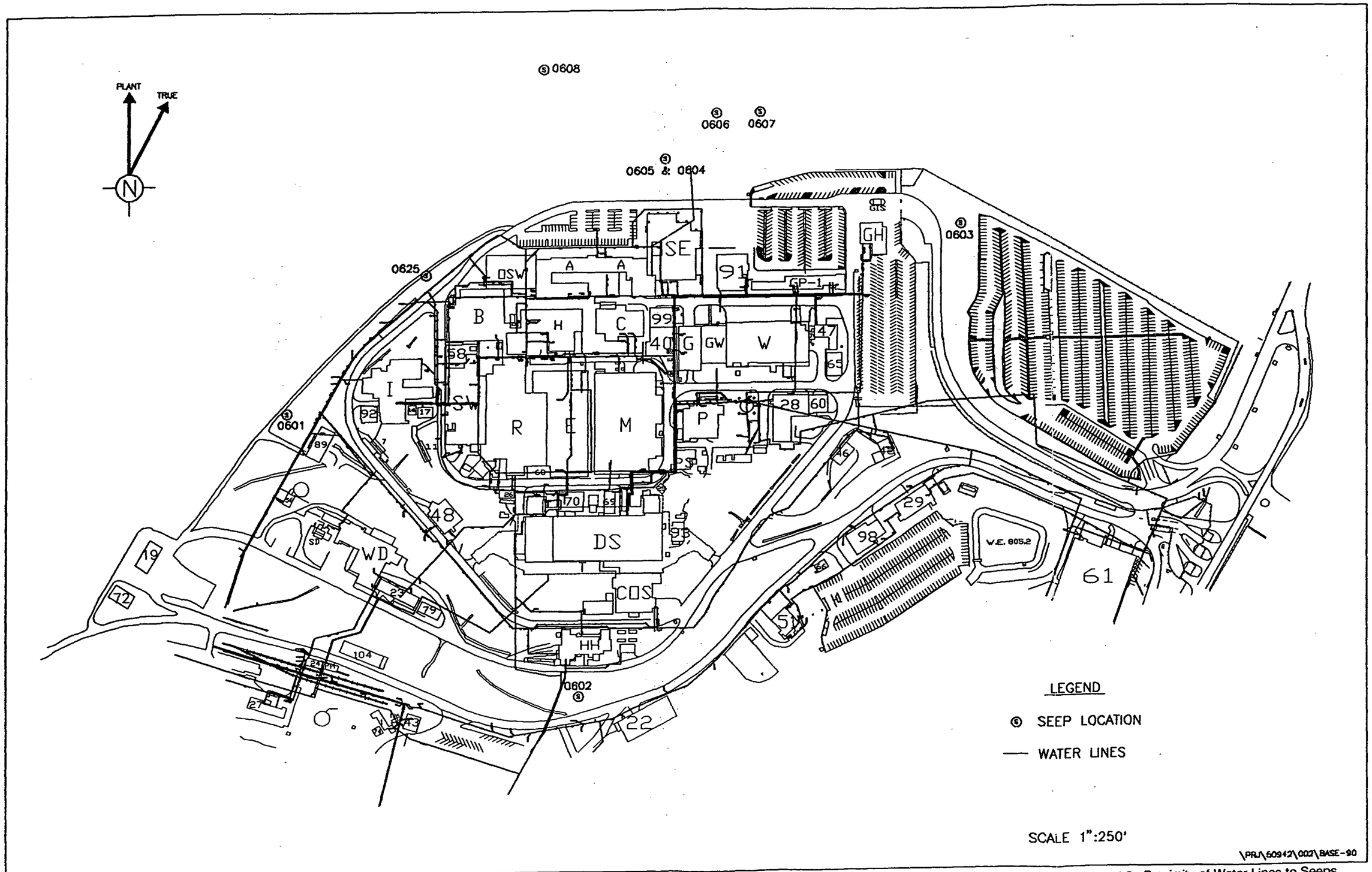

Figure 4.2. Proximity of Water Lines to Seeps

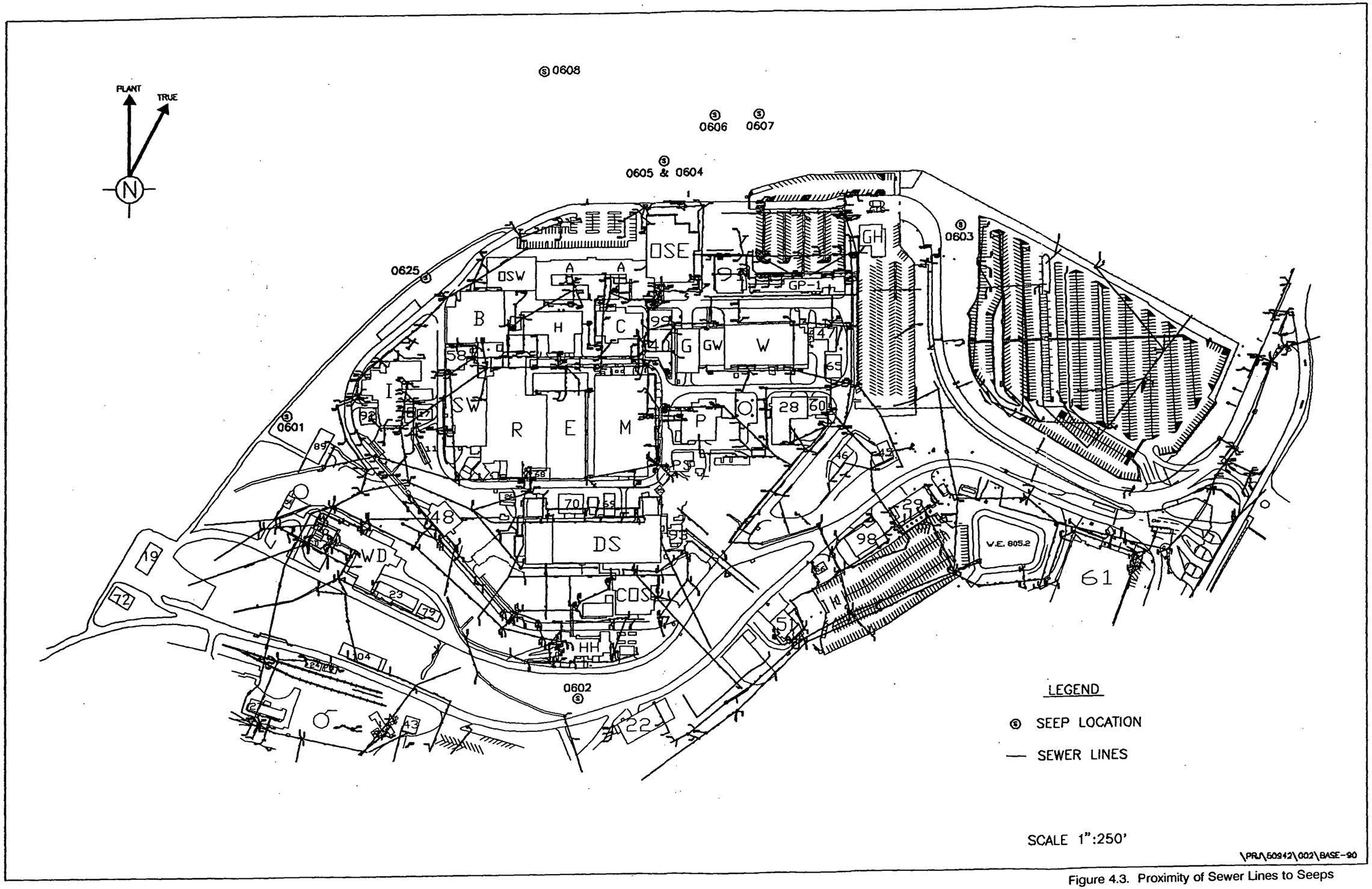

Figure 4.3. Proximity of Sewer Lines to Seeps

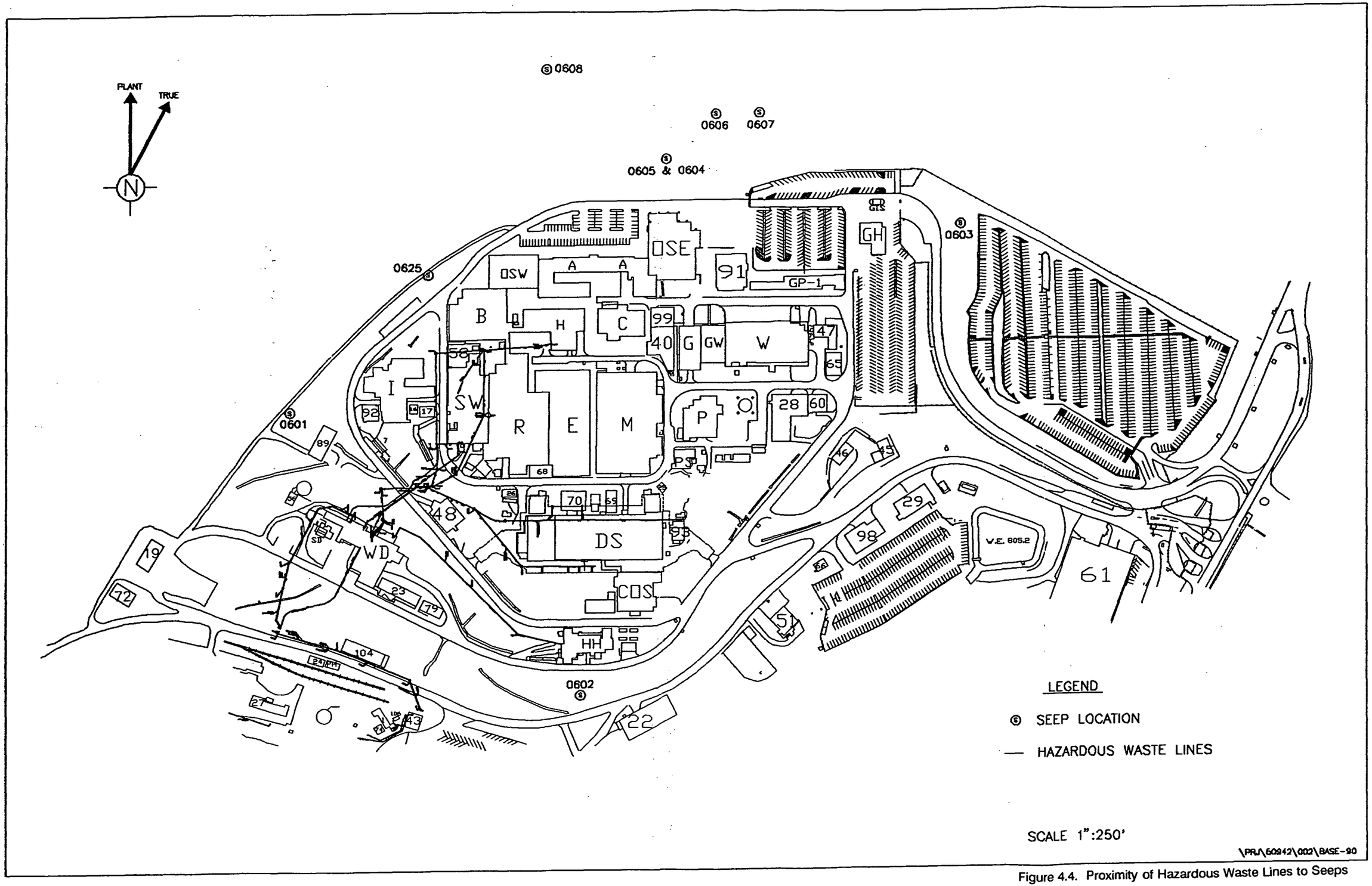

Figure 4.4. Proximity of Hazardous Waste Lines to Seeps

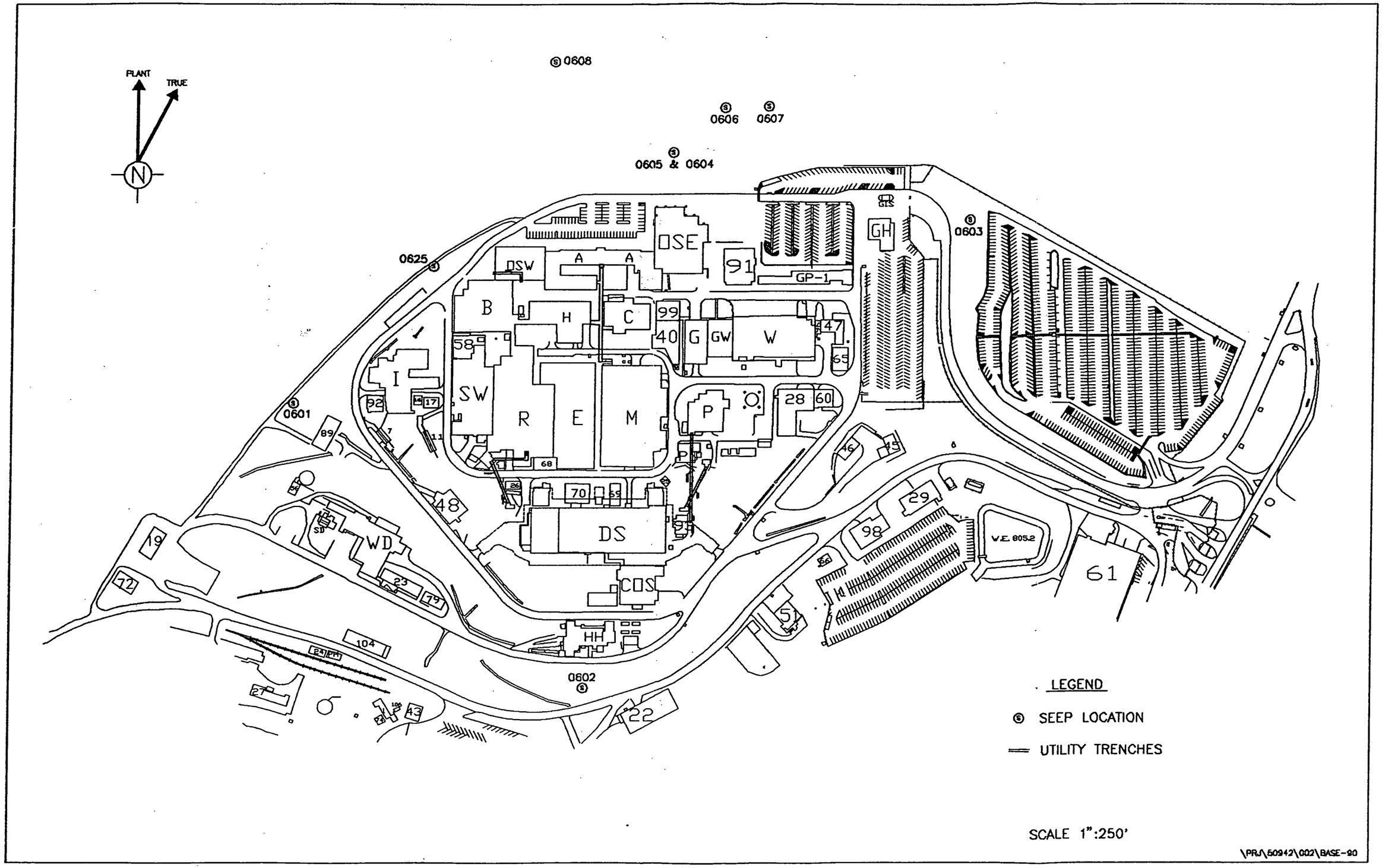

Figure 4.5. Proximity of Utility Trenches to Seeps

Table IV.1. Summary of Subsurface Utility Lines in Proximity to Seeps

Seep No.	Approximate Distance To Closet:			
	Sanitary Sewer Lines	Storm Sewer Lines	Water Lines	Hazrdous Waste Lines
0601	110 ft	150 ft	60 ft	330 ft
0602	150 ft	100 ft	170 ft	250 ft
0603	330 ft	100 ft	300 ft	1250 ft
0604/0605	360 ft	160 ft	170 ft	650 ft
0606	480 ft	260 ft	270 ft	800 ft
0607	550 ft	330 ft	380 ft	920 ft
0608	600 ft	410 ft	480 ft	760 ft
0625	310 ft	80 ft	30 ft	210 ft

SECTION 5

5. SITE RECONNAISSANCE

5.1. SUMMARY OF ACTIVITIES

5.1.1. Seep Investigation

The hillsides surrounding the Main Hill were investigated with a representative of EG&G who identified several possible seep locations and also the known seeps. The possible seep locations on the northern hillside were areas with vigorous vegetation without visible seepage (Site I, Figure 2.8), while another possible seep was located near the top of the railroad cut where seepage was visible but not measurable (Site G, Figure 2.9). The entire OU-2 area was investigated after review of the IR photographs to confirm the presence or absence of additional seeps. An additional ten potential seep locations were identified from the IR photographs. One of the new locations was labelled seep 0625 by EG&G and is located northwest of B Building. The other potential seeps were identified in areas where storm drain outfalls, drains from chiller units, and roof drains discharge to the ground and are not considered seeps. The remaining areas appear to be seasonal seeps with little or no measurable flow. The location of identified seeps are shown on Figure 5.1.

Seeps 0601 through 0608 and 0625 were monitored at random intervals, approximately twice per week, during the month of June. The seeps were monitored for pH, specific conductivity, temperature, and flow (Table V.1). A new seep (0625) was located at the end of June, and was only monitored four times. Seeps 0604 and 0605 are considered the same seep because the locations are very close together on the north hillside and were covered with soils and debris when the perimeter fence was cleared of vegetation. Neither seep was visible for a few months, and when seepage was again visible it was only from one location.

Each monitored seep was fitted with a 1-inch diameter length of pipe approximately 18 inches long. Before the pipe was set, a small reservoir was dug into the hillside to temporarily hold the seeping water. The pipe was then set into the side wall of the reservoir acting as a drain, allowing the water to flow freely out its end. This allowed access for monitoring by raising the outfall a few inches off the ground. This was done on all seeps except seeps 0601, 0603 and 0607. Seeps 0601 and 0607 have automatic samplers that were installed to monitor the previously discussed parameters. These seeps are fitted with V-notch weirs, and all monitoring was done at the weir outfall. Seep 0603 was fitted with a pipe from a previous sampling event; modification was unnecessary.

When the seeps were monitored, the flow was measured first, followed by temperature, specific conductance, and pH measurements (Table V.1). The flow was measured by recording the amount of

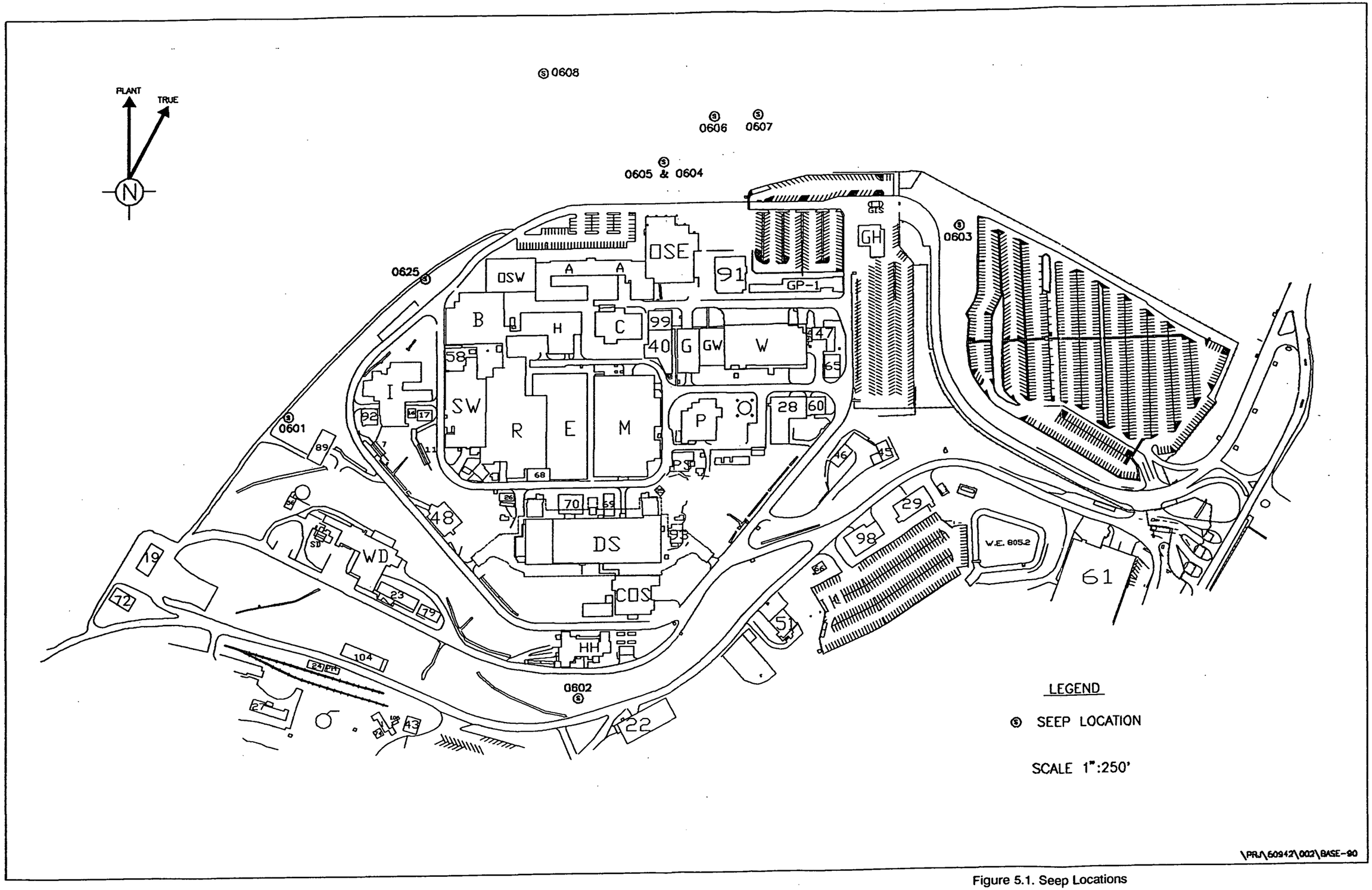

Figure 5.1. Seep Locations

Table V.1. Seep Monitoring Results

Seep No.	Date	pH	Conductivity (µmhos/cm)	Temperature (°F)	Flow (gpm)
0601	6/6/94	7.45	1710	58.5	1.08
	6/7/94	7.43	1570	58.9	1.50
	6/9/94	7.30	1610	58.5	0.39
	6/14/94	7.20	1776	60.5	0.98
	6/22/94	7.10	1810	60.2	1.80
	6/27/94	7.30	1560	61.1	3.60
	6/28/94	7.19	1780	60.8	2.16
	6/30/94	7.20	1780	60.5	1.80
0602	6/6/94	8.08	1227	61.9	1.80
	6/7/94	7.77	1283	61.2	2.0
	6/9/94	7.65	1270	59.8	1.80
	6/14/94	7.81	6420	62.3	1.80
	6/22/94	7.40	2140	64.8	0.30
	6/27/94	7.49	2390	64.0	0.42
	6/28/94	7.30	2340	64.6	0.32
	6/30/94	7.32	2110	65.2	0.25
0603	6/6/94	Dry	N/A	N/A	N/A
	6/7/94	Dry	N/A	N/A	N/A
	6/9/94	Dry	N/A	N/A	N/A
	6/14/94	Dry	N/A	N/A	N/A
	6/22/94	Dry	N/A	N/A	N/A
	6/27/94	7.55	5910	63.6	0.07
	6/28/94	Dry	N/A	N/A	N/A
	6/30/94	Dry	N/A	N/A	N/A
0604/0605	6/6/94	N/A	N/A	N/A	N/A
	6/7/94	7.5	3390	60.5	0.012
	6/9/94	7.30	3410	59.5	0.004
	6/14/94	Dry	N/A	N/A	N/A
	6/22/94	7.97	3170	66.0	0.003
	6/27/94	7.69	2900	60.6	0.018
	6/28/94	7.90	3010	63.5	0.007
	6/30/94	7.92	3000	63.6	0.006

Table V.1. Seep Monitoring Results (continued)

Seep No.	Date	pH	Conductivity (µmhos/cm)	Temperature (°F)	Flow (gpm)
0606	6/6/94	N/A	N/A	N/A	N/A
	6/7/94	7.10	3605	63.2	0.0006
	6/9/94	7.10	3530	61.5	0.007
	6/14/94	7.30	4120	65.4	0.013
	6/22/94	7.60	3920	64.8	0.013
	6/27/94	7.49	4040	63.1	0.009
	6/28/94	7.64	3850	65.6	0.007
	6/30/94	7.52	4040	64.9	0.005
0607	6/6/94	7.6	3870	54.7	0.450
	6/7/94	7.35	4140	53.6	0.74
	6/9/94	7.42	3930	54.1	1.20
	6/14/94	7.38	4110	55.4	0.77
	6/22/94	7.37	3670	55.0	1.54
	6/27/94	7.38	3580	55.4	2.70
	6/28/94	7.64	3850	55.5	2.70
	6/30/94	7.59	4010	56.1	2.70
0608	6/6/94	6.79	2006	57.1	0.00
	6/7/94	7.6	2010	57.7	0.063
	6/9/94	7.20	2000	57.2	0.06
	6/14/94	7.13	2050	62.3	0.07
	6/22/94	7.48	2110	60.3	0.06
	6/27/94	7.50	2110	59.0	0.054
	6/28/94	7.63	2240	61.1	0.06
	6/30/94	7.52	2020	61.2	0.054
0625	6/22/94	7.56	1190	63.5	0.09
	6/23/94	N/A	N/A	N/A	0.09
	6/27/94	7.75	1210	62.3	0.098
	6/28/94	7.73	1270	62.5	0.102
	6/30/94	7.71	1270	62.4	0.098

umhos/cm - micromhos per centimeter
°F - Degrees Farenheit
gpm - gallons per minute
N/A - Not Available

time to fill a graduated vessel with the water seeping from the outfall pipe. Temperature, specific conductance, and pH were measured using a Hydac combination meter. The outfall water was allowed to flow directly into the sampling cup on the meter. Temperature was checked first, followed by specific conductance, and then pH. The results were recorded in the log book along with the time of sampling, type of vessel used, and any other observations of seep conditions. The Hydac instrument was calibrated daily.

Daily rainfall was collected from the Mound Plant rain gauge located on the Main Hill. The rain gauge is automatic with daily readings recorded at twelve midnight for the previous 24 hours. When no precipitation falls for a given day the gauge records this as zero, and when a rain event does occur the gauge records the amount in inches (Appendix B).

5.1.2. Foundation Drain Investigation

When information about foundation drain sampling was obtained during the Mound Plant personnel interviews, a meeting was set up with a representative of EG&G who conducts the sampling program. The monitoring point for Building 48 is at the bottom of a catch basin on the northwest corner of the building. The monitoring point for T Building is in an unlined open drainage ditch southwest of the building. The collected samples are a composite of the water flowing into the sampling location. Mound Plant personnel indicated that in the past the foundation drain on the east side of T Building may have been sampled but the information is not available. However, the hillside where the east drain is shown to discharge was thoroughly investigated without locating the drain. Temperature, conductivity, pH, and flow were not measured because the sample would not have been representative of only the foundation drain. The tritium results from these locations are summarized in Table V.2 and graphed versus rainfall on Figure 5.2.

5.2. RESULTS

5.2.1. Seep Monitoring

Of the eight seeps, 0601 and 0607 flow at consistent rates of approximately one to three gallons per minute, with fluctuations after rainfall events (Figure 5.3). The other seeps flow at rates well below half a gallon per minute (gpm), with seep 0603 dry except after a rainfall event of over one inch (Figure 5.4). Seep 0601 located on the western hillside is equipped with an automatic sampling station that was recently upgraded. This seep flows at rates above 1.0 gpm with pH averaging 7.27, conductivity averaging 1700 micromhos (μmhos), and temperature average at 59.9° F (Table V.3).

Table V.2. Summary of Foudation Drain Sampling Results for Tritium

Date	Building 48 (nCi/L)	T Buildling (nCi/L)
1/11/94	98.36	79.38
1/12/94	103.88	59.67
1/13/94	106.08	81.01
1/26/94	56.08	1.27
2/7/94	100.53	64.01
2/8/94	--	59.43
2/25/94	65.89	18.17
4/4/94	135.69	32.32
4/18/94	371.2	74.79
4/19/94	756.15 (grab)	146.99
4/20/94	906.05 (grab)	177.5
4/20/94	914.35 (grab)	--
4/21/94	1083.48 (grab)	187.88
4/22/94	1147.1	42.86
4/23/94	1187.3	209.55
4/24/94	1187.19	232.58
4/25/94	1172.83	251.47
4/26/94	1010.95	274.14
4/27/94	335.83	338.23
4/27/94	901.57	--
4/28/94	1016.11	381.83
4/29/94	689.96	313.26
4/30/94	411.65	318.19
5/1/94	252.15	208.8
5/5/94	542.13	310.67
5/7/94	487.87	163.93
5/9/94	421.01	315.76
5/11/94	505.93	383.62
5/18/94	460.67	360.2
5/26/94	582.85	676.97
5/31/94	398.47	783.43

Table V.2. Summary of Foudation Drain Sampling Results for Tritium (continued)

Date	Building 48 (nCi/L)	T Buildling (nCi/L)
6/1/94	453.11	780.72
6/2/94	464.33	728.78
6/6/94	473.95	796.08
6/8/94	448.2	623.31
6/8/94	560.52	698.21
6/8/94	551.67	655.08
6/8/94	367.09	506.16
6/8/94	469.58	460.33
6/9/94	455.78	566.66
6/13/94	435.51	575.15
6/14/94	472.1	614.11

nCi/L - nanocuries per liter

Rainfall vs. Tritium

Bldgs. T and 48 Foundation Drains

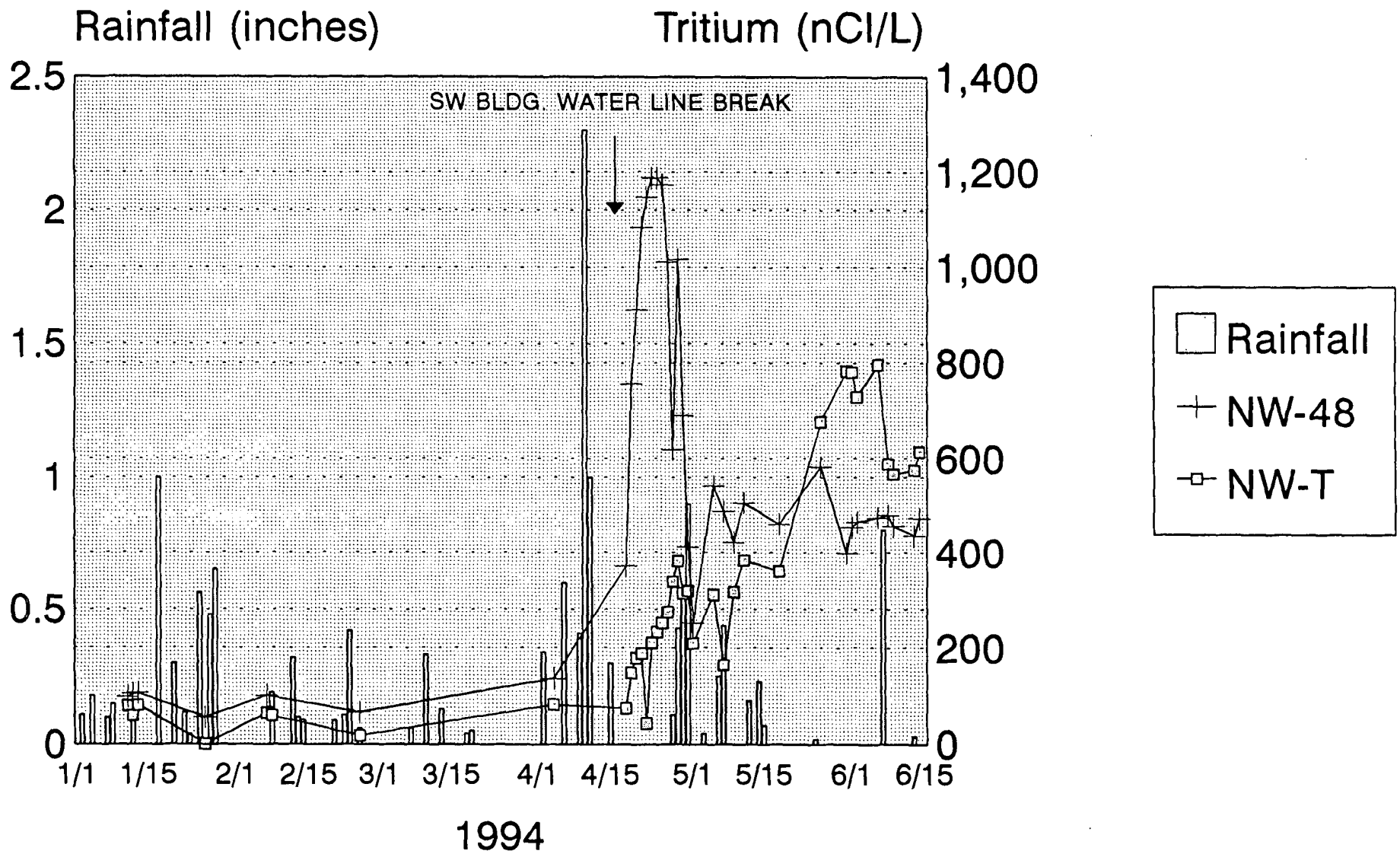

Figure 5.2. Rainfall vs. Tritium (Building T and 48 Foundation Drains)

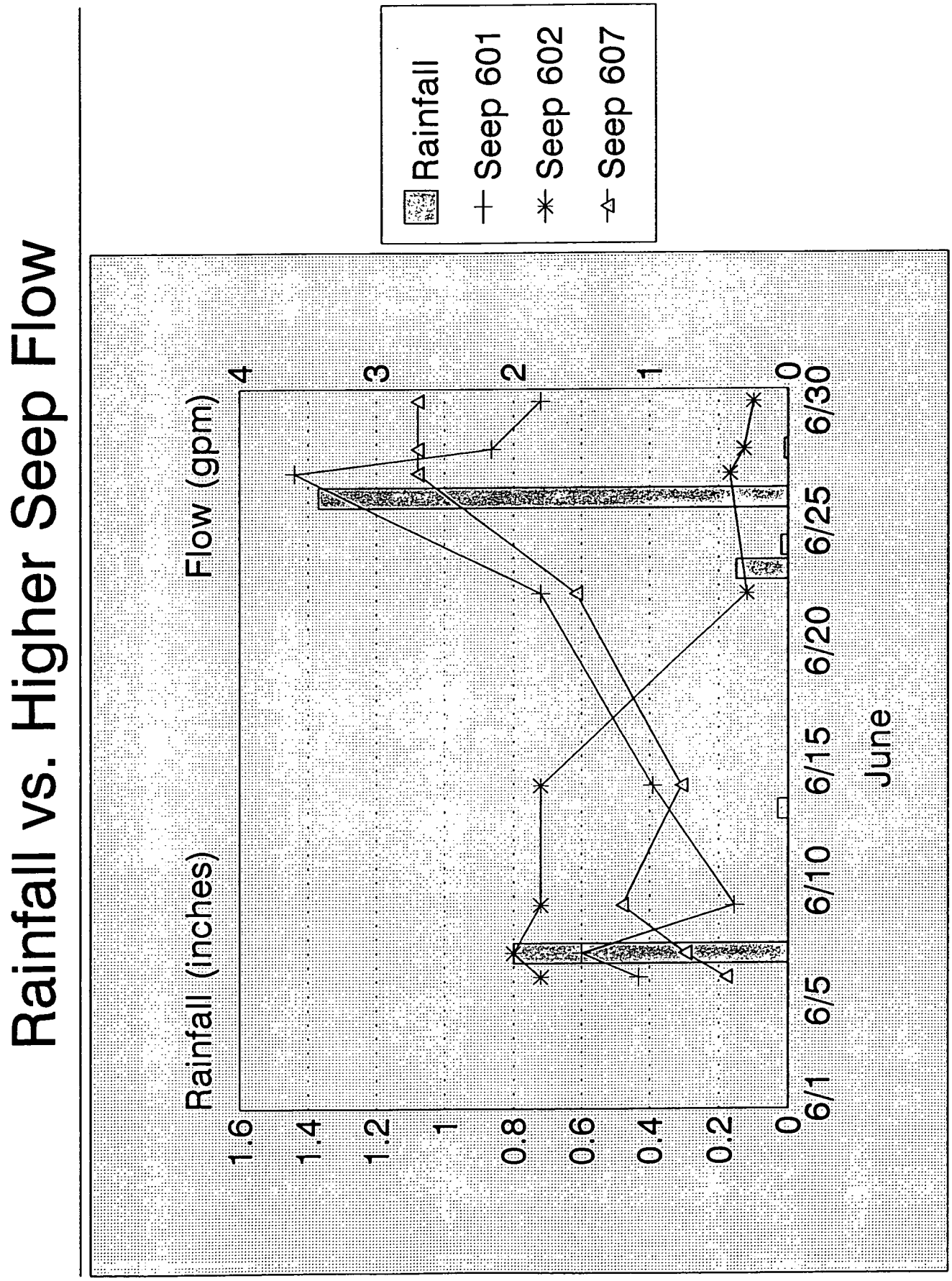

Figure 5.3. Rainfall vs. Higher Seep Flow

Rainfall vs. Lower Seep Flow

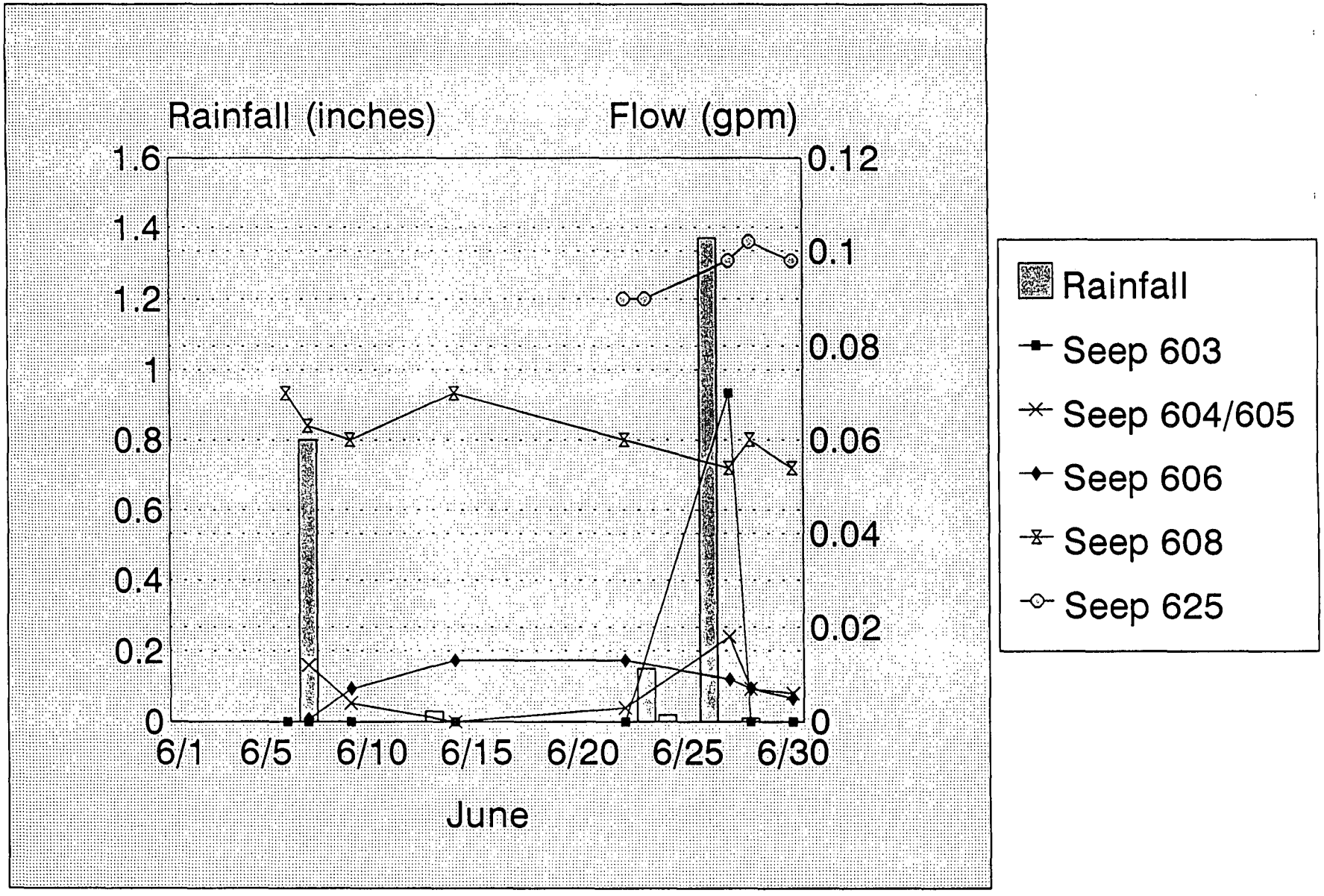

Figure 5.4. Rainfall vs. Lower Seep Flow

Table V.3. Summary of Seep Sampling Results

Seep No.	Average pH	pH Range	Average Conductivity (µmhos/cm)	Conductivity Range (µmhos/cm)	Average Temp (°F)	Temp Range (°F)	Average Flow (gpm)	Flow Range (gpm)
0601	7.27	7.10-7.45	1700	1560-1810	59.9	58.5-61.1	1.66	0.39-3.60
0602	7.60	7.30-8.08	2398	1227-6420	63.0	59.8-65.2	1.08	0.25-2.0
0603	7.55	7.55-7.55	5910	5910-5910	63.6	63.6-63.6	0.07	0.07
0604/ 0605	7.71	7.30-7.97	3147	2900-3410	62.3	59.5-66.0	0.008	0.003-0.018
0606	7.39	7.10-7.64	3872	3530-4120	64.1	61.5-65.6	0.007	0.0006-0.013
0607	7.46	7.35-7.64	3895	3580-4140	55.0	53.6-56.1	1.6	0.450-2.70
0608	7.35	6.79-7.63	2068	2000-2240	59.5	57.1-62.3	0.06	0.054-0.070
0625	7.70	7.56-7.75	1235	1190-1270	62.7	62.3-63.5	0.096	0.09-0.102

Seep 0602 consists of numerous discrete seeps and is located on the southern hillside below HH Building. The reservoir and outfall pipe was installed in the seep with the highest flow. Because of the numerous discrete seeps, the flow value is only an estimate and will need to be refined in future phases. Specific conductivity, pH, and temperature averaged 2398 μmhos, 7.6, and 63.0°F, respectively (Table V.3). The estimated flow was 2.0 gpm in the beginning of the month, but slowed to below 0.5 gpm near the end of the month. This could be attributed to the numerous seep locations within the seep, with increased flow at another location.

Flow from seep 0603, located on the eastern hillside above the lower parking lot, was observed only once during the field reconnaissance. A length of pipe was already installed at this seep from a previous monitoring effort. The flow was observed after an rainfall event of 1.37 inches and for only the one site reconnaissance; the measured flow was 0.07 gpm. Specific conductivity, pH, and temperature averaged 5,910 μmhos, 7.55 and 63.6°F, respectively (Table V.3).

Seep 0604/0605, located on the northern hillside, was considered two separate seeps until disturbed during vegetation removal along the Mound Plant fence. As a result of the fencing activities, the seep did not flow for several months and when seepage did reappear it was only at a single location. The seep flows at an average rate of 0.008 gpm, and was dry during one monitoring event. Specific conductivity, pH, and temperature averaged 3145 μmhos, 7.71, and 62.3°F, respectively (Table V.3).

Seep 0606 is located on the northern hillside between seeps 0604/0605 and 0607, on the uphill side of an old roadway cut. The seep was fitted with a length of pipe after a small reservoir was dug into the roadway cut. This seep also flows at an average rate of 0.008 gpm. Specific conductivity, pH, and temperature averaged 3872 μmhos, 7.39, and 64.1°F, respectively (Table V.3).

Seep 0607, also located on the northern hillside, is fitted with a recently upgraded automatic sampling station. When monitoring first began, water from the seep was leaking around the weir outlet, therefore, a length of pipe was installed downgradient of the seep to capture the full amount of flow. After a few monitoring events the leak was repaired and monitoring was conducted at the weir outfall. This may explain the increase in the flow from the beginning to the end of the month with an average flow of 1.6 gpm. Specific conductivity, pH, and temperature averaged 3,895 μmhos, 7.46, and 55.0°F, respectively (Table V.3).

The flow from seep 0608 is from a few discrete locations at the far eastern end of the railroad cut along the northern hillside. The reservoir was located in the area with the highest visible flow of all the discrete seeps. The flow averaged 0.06 gpm, with specific conductance, pH, and temperature averaging 2068 μmhos, 7.35, and 59.5°F, respectively (Table V.3).

Seep 0625, located northwest of B Building along a gravel perimeter road, was first observed on May 16, 1994. It was first considered to be runoff from a recent rain event, but after a detailed investigation of the surrounding hillside, seepage from a discreet location was discovered near the end of June. The flow averaged 0.096 gpm, while specific conductivity, pH, and temperature averaged 1,235 μmhos, 7.7, and 62.7°F respectively (Table V.3).

5.2.2. Foundation Drain Monitoring

The two foundation drains monitored at Mound Plant are at Building 48 and T Building. Tritium sampling by EG&G show similar results except during April of 1994 when concentrations increased. This could be contributed to the water line break under SW Building on April 18th. The tritium concentration increase in the samples collected at Building 48 and T Building occurred one day after the water line break, and slowly declined in the following months. Building 48 appears to have been affected more due to being directly downgradient of SW Building. The changes in tritium concentrations do not appear to correspond with rainfall (Figure 5.2), which is diverted off the Main Hill in storm sewers. The available recharge area for rainfall to percolate to the groundwater is reduced because of the relatively small area on the Main Hill that is not covered with pavement or buildings.

The amount of groundwater in contact with tritium varies; as the amount of groundwater increases, due to rainwater recharge, the concentration of tritium is shown to decrease. Figure 5.2 demonstrates that concentrations of tritium decreased during increased rainfall between the dates of January 15 and February 1, February 15 and March 1, May 1 and May 15, and June 1 and June 15. When rainwater recharge decreases, the tritium concentration at the foundation drains increase because there is less groundwater to dilute the tritium bound to the soil. Figure 5.2 also shows that tritium concentrations increase during periods of reduced rainfall between the dates of February 1 and February 15, and May 15 and June 1.

Therefore it is believed that rainfall at the sites does not cause any additional releases of tritium to the groundwater. There is no direct relationship between tritium concentrations and rainfall. However, there may be an indirect inverse relationship that is caused by the changes in volume of the groundwater as a result of the precipitation events.

SECTION 6

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the seep investigation indicate that seeps 601 and 607 have an immediate response to a rainfall event, and may be directly related to fractures in the bedrock. The response to rainfall in the other seeps is not as fast, indicating they are on smaller fractures or influenced by leaking subsurface utilities. Conductivity, pH, and temperature do not appear to be influenced by rainfall. However the temperature of the lower flow rate seeps is usually above 60°F. All parameters, except flow in some of the seeps, remain stable before and after a rainfall event, fluctuations are minimal and a direct relationship between seeps is not evident. Because the seeps were monitored infrequently only in June, additional conclusions can not be drawn from the this investigation.

Because the foundation drains on most of the buildings discharge into the storm or sanitary sewer system, its difficult to fully characterize their flows and their contribution to the groundwater, if any. The foundation drains that are monitored by EG&G are only sampled for tritium, and because the samples are not discrete, modifications to the current drainage structures would be required to fully monitor the drainage discharge. The tritium results suggest that rainfall has little, to no, effect on the reported tritium concentrations, but that leaking subsurface utilities (i.e., water line break under SW Building) can affect the tritium concentrations. The T Building foundation drains are well below the ground surface and their slower response is probably due to the time lag of the downward moving water.

Upcoming phases of the RI will include continuous monitoring of the seeps with data loggers and a dye trace study. This phase should also include the development of a water budget on the domestic and fire water lines. After more data are collected, the assessment of the seep and foundation drain conditions can be refined.

SECTION 7

7. REFERENCES

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APPENDIX A

APPENDIX A

STANDARD INTERVIEW FORM

APPENDIX A

SEEPS

How many seeps are on the Main Hill and fall within the OU-2 Boundary?

- 8 seeps (601, 602, 603, 604, 605, 606, 607, and 608)
- 6 active seeps (601, 602, 604/605, 606, 607, and 608)

Are any of the seeps seasonal? If so which ones?

- 601 - flows well
- 602
- 603 - dry
- 604/605 - flow as one
- 606 - seasonal
- 607 - flows well
- 608

What seeps are currently monitored? Who has the results?

- Seeps 601, 604/605, 606 and 607
- Monitored for Tritium and gross alpha
- We got copies of the results

What analysis is performed on the seeps that are currently monitored?

-

What analysis has been performed in the past on the seeps?

- Tritium and gross alpha
- VOA
- General parameters

Have any of the seeps been surveyed for horizontal, vertical, and elevation? If so which ones?

If a seep is not currently monitored, has it ever been sampled? If so when?

Are the analytical results summarized for all the monitored seeps?

Are there any other people you think we should talk to? If so who?

Where are the arterial sampling stations located throughout the Mound Plant?

Are the 0600 series the seeps? Where are 0620, 0621, 0622, 0623, and 0624 located?

FOUNDATION DRAINS

What would we consider a foundation drain? Is it any drain that diverts groundwater or runoff water away from the building? Is it any drain leaving a building?

Are there any foundations drains that are known to contribute a significant amount of water to the Mound Plant drainage system? If so which ones?

Are any of the effluent from the foundation drains monitored? If so how are they monitored?

Where does the runoff from foundation drains go? Do they all go to the storm sewers? Do any go to surface drains?

Are there any other people you think we should talk to? If so Who?

Do the building managers know where the foundation drains are? If so, who are the building managers and where is the foundation drain information?

APPENDIX B

APPENDIX B

1994 RAINFALL

APPENDIX B

1994 RAINFALL

Date	January	February	March	April	May	June	July
1							
2	0.11			0.34			
3					0.04		
4	0.18						0.47
5							
6				0.60	0.25		
7	0.10		0.06		0.44	0.80	
8	0.15	0.19					
9				0.41			
10			0.33	2.30			
11				1.00			
12	0.15	0.32			0.16		
13		0.10	0.13			0.03	
14		0.09			0.23		
15				0.30	0.07		
16							
17	1.00						
18		0.04					
19		0.05					
20	0.30	0.09					0.42
21							
22	0.12	0.11					
23	0.04	0.42				0.15	
24						0.02	
25	0.56	0.06			0.02		
26						1.37	
27	0.48			0.11			
28	0.65			0.43		0.01	1.22
29				0.55			0.09
30				0.90			
31							

Note: Blocks without data are days when perceipitation did not fall.