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United States Department of Energy

Savannah River Site

Scoping Summary for the M-Area Inactive Process Sewer Lines Operable Unit (U)

(SB/PP)

ERD-EN-2003-0130

September 2005

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Prepared for the U. S. Department of Energy Under Contract No. DE-AC09-96SR18500

1.0 Project Phase/Status of Scoping Summary

This summary supports the development of the Statement of Basis/Proposed Plan (SB/PP) for the M-Area Inactive Process Sewer Line (MIPSL) OU. Accordingly it identifies the status of the preferred response strategies discussed at the scoping meeting held on August 31, 2005 and September 15, 2005. The combined Work Plan (WP)/Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI)/Baseline Risk Assessment (BRA) and Corrective Measures Study (CMS)/ Feasibility Study (FS) was revised and submitted to the regulators on September 21, 2005.

2.0 Background

M-Area, located at the Savannah River Site (SRS) in Aiken, South Carolina, was a fuel and target fabrication facility located in the northwest portion of the SRS (Figure 1). Historically, effluents from M-Area were transported through two separate networks of vitrified clay pipes (Figure 2). One network (M-Area IPS) discharged to the M-Area Settling Basin and the other network (313-MIPS) discharged to a tributary of Tims Branch formally known as the A-014 Outfall. Effluents from M-Area included chlorinated solvents, acids, caustics, heavy metals, and minor amounts of radionuclides. Specific constituents include: aluminum, copper, iron, lead, magnesium, manganese, mercury, nickel, uranium, zinc, tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichlorethane (1,1,1-TCA).

The M-Area Settling Basin and the inactive sewer lines were part of the RCRA program in the 1980s. At that time, due to active operations and the security level of the area, work inside the fence could not be executed. The M-Area Settling Basin and a portion of the sewer line outside the security fence were removed from service in 1985, and officially closed in 1990. Since that time other portions of the sewer network have also been taken out of service.

Three sections of the M-Area IPS system (approximately 1630 feet) were included in the February 1992 RCRA RFI/RI Work Plan. The purpose of the work plan was to delineate the areal extent of potential hazardous constituents released to the soil surrounding the sewer pipes. The work plan was submitted in March 1992 and a portion of the investigation (shallow soil gas samples) was completed in 1992.

In May 2003 additional sections of M-Area IPS (approximately 1600 feet) inside the fence were incorporated into this OU due to the deactivation of additional M-Area facilities. In June 2003, a second process sewer line network in M-Area, the 313-MIPS, was moved from the Site Evaluation Program to Appendix C. This sewer system includes approximately 6700 feet of pipe that historically discharged to the A-014 Outfall. During August 2003, the 313-MIPS was added to the project scope.

The background information on the pipeline between Building 322-M and Manhole 6A is included in Appendix A.

The groundwater contamination in M-Area is being addressed under the RCRA corrective action program for A/M Area as documented in the SRS RCRA Part B Permit, and is therefore not a part of this OU.

3.0 Land Use

The MIPSL OU is located within an industrially developed area, and future industrial land use is anticipated. Remedial Action Objectives (RAOs) and likely response actions will be developed with the expectation that future land use will be industrial. However, land use controls will be part of any remedial action to ensure protection against unrestricted uses (e.g., residential). These land use controls will include restrictions to access points (e.g., manholes and pipes).

4.0 MIPSL OU

Problems Warranting Action

- PCE concentrations at MIPS-SB012 near the 321-M Building indicate a dense non-aqueous phase liquid (DNAPL) component.
- The PCE concentration in soil at station MIPS-SB012 near the 321-M Building (18 to 20 feet below grade) and TCE concentration in soil at station SB034 near the 320-M Building (25 to 27 feet below grade) exceeded the 10^{-3} risk and have been identified as principal threat source material (PTSM) due to toxicity. The maximum concentrations were 12,300 mg/kg PCE and 110 mg/kg TCE.
- Subsurface contaminants (PCE and TCE) adjacent to the M-Area IPS have been predicted to leach through the soil column to groundwater. The primary mechanism of VOC contamination to the groundwater is gas diffusion. Concentrations of these contaminants have been predicted to exceed the Maximum Contaminant Levels (MCLs) in groundwater in less than 1000 years and have been identified as contaminant migration (CM) contaminants of concern (COCs).
- Uranium is present in sludge at PTSM-toxicity concentrations in the pipeline between the edge of 322-M (M-Area Metallurgical Lab) and manhole 6A (Figure A-1). The maximum concentration of U-238 is 3,200 pCi/g, which is approximately twice the PTSM concentration of 1,790 pCi/g (Figure A-2).

Remedial Action Objectives

- Remove or treat PCE to below DNAPL concentrations in subsurface soils to the extent practicable.

- Remove or treat TCE and PCE exceeding PTSM criteria based on toxicity in subsurface soils to the extent practicable.

- Prevent TCE and PCE from leaching to groundwater above MCLs.

- Remove or treat PTSM Uranium-contaminated sludge to the extent practicable within the pipeline from Building 322-M to manhole 6A.

Scope of Problem Warranting Action

- Soils containing DNAPL have been identified at depth. The estimated volume of soil with concentrations of PCE greater than 61 mg/kg (DNAPL) is 183 yd^3. This estimate was arrived at using radial volume at depth. Note that this volume does not include the overlying soils.

- The estimated volume of soils with VOC concentrations exceeding the PTSM criteria based on toxicity is approximately 87 yd^3. This includes approximately 58 yd^3 west of Building 321-M (a subset of the 183 yd^3 of DNAPL) and approximately 29 yd^3 west of Building 320-M. These estimates were arrived at using radial volume at depth. Note that these volumes do not include the overlying soils.

- Soils with VOC concentrations exceeding the calculated protocol CM remedial goal options (RGOs), which are protective of groundwater to MCLs, are typically in the 8 to 10 and 18 to 20 foot interval (below pipe). The estimated volume of the soils exceeding these criteria is approximately 6000 yd^3. This estimate was arrived at using radial volume at depth. Note that this volume does not include the overlying soils.

- Uranium contaminated sludge, exceeding the PTSM-toxicity criteria in the pipeline between 322-M and manhole 6A (~100 feet), is addressed under the MIPSL OU. The pipeline is composed of 8" diameter vitrified clay, sliplined with 6" diameter High Density Polyethylene. (This project excludes the portion of the pipeline under 322-M, which will be included under the M-Area OU closure project.)

Likely Response Actions

The MIPSL OU can be characterized by five distinct and separate problem areas: (1) DNAPL/PTSM west of 321-M, (2) PTSM west of 320-M, (3) shallow soil contamination southwest of 313-M, (4) contaminant migration at discrete locations at MIPSL, and (5) radiologically contaminated sludge within the 322-M/manhole 6A pipe section. To identify a preferred alternative for the MIPSL OU, a preferred action for the five problem areas must be identified. To identify the preferred action for each problem area, the detailed analysis and comparative analysis in the CMS/FS will be reorganized by problem area. Each problem area was evaluated separately to identify the preferred action for

that area. With the exception of the No Action alternative, the alternatives retained all meet the Threshold Criteria, Balancing Criteria and Modifying Criteria and represent a range of remedial actions to address the five problem areas. Table 3 lists the retained response actions from the Combined Document (Revision 0), and Table 4 shows a comparative ranking of those actions. A qualitative comparative ranking is shown in Tables 5 through 9 for response actions based on problem areas. Table 10 shows the project team recommendations for the remedial response actions for the MIPSL OU.

- Active soil vapor extraction enhanced with soil fracturing for treatment of VOC contamination (DNAPL and PTSM) in the vadose zone west of Building 321-M.
- Active soil vapor extraction enhanced with soil fracturing for treatment for VOC contamination (PTSM) in the vadose zone west of Building 320-M.
- Low energy/passive SVE enhanced with soil fracturing for the shallow contamination (CM RGO) area adjacent to Building 313-M.
- Low energy/passive SVE enhanced with soil fracturing for the remaining areas exceeding CM RGOs.
- Grout pipe section between 322-M and manhole 6A and install an intruder barrier.
- Institutional controls will be a part of any response action taken and will include in-place closure of pipe by filling the manholes with inert material (e.g., grout slurry) and implementation of land use controls.

Uncertainties

- There is an uncertainty on the effectiveness of fracturing to provide increased permeability within the fine grained material. Furthermore, a pilot test on fracturing technology within the fine grained material (Upland Unit) is being conducted to define the effectiveness before and after fracturing with respect to SVE. Information from this pilot test will address this uncertainty.
- There is uncertainty whether uranium contamination is present in the vadose zone surrounding the pipeline from Building 322-M to manhole 6A. This uncertainty impacts the scope of the remedial action and can be managed through implementing institutional controls and installing an intruder barrier to prevent access to the potential contamination along the pipeline. Furthermore, four soil borings will be advanced along the length of this pipeline at approximately 20 foot centers to investigate whether any leaks occurred from this section of pipe.

5.0 Operable Unit Strategy

The project team recommends the remedial response actions for the MIPSL OU unit as shown in Table 10.

In support of the accelerated closure initiative for M-Area, the Core Team approved a streamlined strategy that will allow completion of the remedial action in 2008. The accelerated administrative path-forward that remains follows:

- Statement of Basis/Proposed Plan (SB/PP): scoping August 2005; submittal September 2005; approval January 2006,
- Record of Decision: submittal March 2006; approval July 2006; issue October 2006
- Corrective Measures Implementation/Remedial Action Implementation Plan (CMI/RAIP): submittal June 2006; approval December 2006,
- Remedial Action start date: January 2007,
- Mechanical complete: January 2008,
- Post Construction Report (PCR): submittal June 2008.

Table 1. Key Changes

Section	Description of Change	Rationale for Change	Meeting Date/Type
1.0 Project Phase/Status of Scoping Summary	Updated paragraph to indicate the dates for the two SB/PP Scoping Meetings; included date for submittal of the Combined Document	Additional text added for clarity.	August 31, 2005 and September 15, 2005 SB/PP Scoping Meetings
Problems Warranting Action	Updated the 4th bullet to discuss the amount of Uranium-contaminated sludge present in the pipeline between 322-M and Manhole 6A	Additional text added for clarity.	September 15, 2005 SB/PP Scoping Meeting
Remedial Action Objectives	Updated the 4th bullet to add the word "contaminated" after "uranium"	Additional text added for clarity.	August 31, 2005 SB/PP Scoping Meeting
Scope of Problem Warranting Action	Revised the text in the 4th bullet to better delineate the portions of the uranium-contaminated pipeline that are included in the MIPSL OU as opposed to the M Area OU.	Additional text added for clarity.	September 15, 2005 SB/PP Scoping Meeting
Likely Response Actions	In the 5th bullet, included installation of the intruder barrier over the section of pipeline between 322-M and Manhole 6A.	Depth of the section of pipeline between 322-M and Manhole 6A required additional remedial action.	September 15, 2005 SB/PP Scoping Meeting
Uncertainties	In the 2nd bullet, clarified the uncertainty associated with the pipeline between 322-M and Manhole 6A.	Additional text added for clarity.	September 15, 2005 SB/PP Scoping Meeting

Table 1. Key Changes (continued)

Section	Description of Change	Rationale for Change	Meeting Date/Type
Tables 3 -4 and 9- 10	Revised to include Intruder Barrier as part of the Remedial Action for the pipeline between 322-M and Manhole 6A.	Depth of the section of pipeline between 322-M and Manhole 6A required additional remedial action.	September 15, 2005 SB/PP Scoping Meeting
Appendix A	Provided background information and figures for the pipeline between 322-M and Manhole 6A.	Additional text needed to describe the details of the pipeline between 322-M and Manhole 6A.	September 15, 2005 SB/PP Scoping Meeting

Table 2. Record of Key Agreements

Agreement	Meeting Date/Type
The USDOE FFA project manager will prepare an OU strategy letter to include the 313-MIPS with the M-Area IPS scope.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
The streamlined approach and accelerated schedule will be implemented. The schedule presented is for illustration purposes only and it will be finalized when the 313-MIPS is added to the M-Area IPS.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
The conceptual site model indicates that the piping is at such a depth (greater than 1 foot) that the pathway for human exposure does not exist	07/08/2003 Pre-Characterization Scoping Strategy Meeting
An ecological assessment checklist has been performed and was included in Attachment B of the Pre-characterization Scoping Summary. Given the depth of the pipe and the fact that the pipeline exists in a highly industrial area, the exposure potential for burrowing animals to come into contact with subsurface soils in the immediate vicinity of the pipe is minimal. No further ecological evaluation is necessary.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
A Baseline Risk Assessment (human health and ecological) will be included in the Work Plan/RFI/RI Report; however it will be 'scaled back' to include the conceptual site model, ecological checklist and a brief description of conditions.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
The characterization strategy is sufficient.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
An engineering evaluation will be completed to determine the potential for manhole overflow.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
SRS will present a proposal to the Core Team for concurrence before implementing an early action for the vadose zone VOC contamination. SRS will be tasked to develop the remediation criteria for VOC contamination.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
The CMS/FS will be combined with the WP/RFI/RI/BRA.	07/08/2003 Pre-Characterization Scoping Strategy Meeting

Agreement	Meeting Date/Type
The WP/RFI/RI/BRA with CMS/FS will integrate the RCRA Closure Plan requirements. Preston Campbell (SCDHEC) will serve as the RCRA contact.	07/08/2003 Pre-Characterization Scoping Strategy Meeting
The M-Area Inactive Process Sewer Line (MIPS) and 313-M-Area Inactive Process Sewer (313-MIPS) Manhole Overflow Evaluation (U) (ERD-EN-2003-0169) has been completed and presented to the Core Team. The conclusion of the evaluation was that a process wastewater overflow through any of the M-Area Process sewer manholes was unlikely to have occurred.	11/05/2003 M-Area Data Status Meeting
The Core Team agreed with the Presumptive Remedy Strategy (including decision criteria).	11/05/2003 M-Area Data Status Meeting
The Core Team tentatively agreed (pending review of the data disk within 30 days) that the Field Sampling Plan has been adequately implemented and that the performed sampling established the nature and extent of contamination.	04/21/2004 Post Characterization Scoping Strategy Meeting
The Core Team agreed with the proposed format/outline for the Combined Document (WP/RFI/RI/BRA with CMS/FS). USEPA stated they would like for the Nature and Extent section of the report to a have Conclusion/Summary section.	04/21/2004 Post Characterization Scoping Strategy Meeting
The Core Team agreed to postpone discussion of the Likely Response Section for in-place closure of pipe and/or manholes with inert material until the Combined Document Scoping Meeting in August 2004.	04/21/2004 Post Characterization Scoping Strategy Meeting
The SCDHEC Core Team members agreed that the Field Sampling Plan has been adequately implemented and that the performed sampling established the nature and extent of contamination.	07/22/04 Email from R. Coffey (SCDHEC) to S. McFalls (SRS)
The USDOE, USEPA, and SCDHEC Core team members agreed that inorganic constituents and radionuclides were not COCs at the MIPSL site. The USDOE, USEPA, and SCDHEC Core team members agreed that PCE and TCE were the only COCs at the MIPSL site.	08/18/04 Problem Identification Scoping Meeting
The USEPA Core Team members agreed that the nature and extent of contamination have been established.	08/18/04 Problem Identification Scoping Meeting
The USDOE, USEPA, and SCDHEC core team members agreed on the updated Problems warranting Action and the Scope of the Problem.	08/18/04 Problem Identification Scoping Meeting

Agreement	Meeting Date/Type
The Team agreed to document that USEPA and SCDHEC are working with SRS to shorten the MIPSL schedule by approximately 3 years	08/18/04 Problem Identification Scoping Meeting
The USDOE, USEPA, and SCDHED agreed on the technologies to be evaluated (Table A-1)	10/06/04 Feasibility Study Scoping Meeting
The USDOE, USEPA, and SCDHEC core team members agreed in principle to the responses to comments received in April/May 2005 and the corresponding revisions to the combined document.	8/3/2005 Combined Document Comment Resolution Teleconference
The USDOE, USEPA, and SCDHEC core team members agreed on the remedial actions for the MIPSL OU.	08/31/2005 and 09/15/2005 SB/PP Scoping Meetings

Table 3. Retained MIPSL OU Response Actions from the Combined Document

Alternative	DNAPL and PTSM (West of 321-M)	PTSM (West of 320-M)	Shallow Soil Contamination (Southwest of 313-M)	Contaminant Migration (MIPSL)	Pipe Section from 322-M to Manhole 6A
S-1	No Action	No Action	No Action	No Action	No Action
S-2	Phased Soil Vapor Extraction (SVE) Enhanced with Soil Fracturing	Soil Fracturing with Active SVE	Soil Fracturing with Low Energy/Passive SVE	Soil Fracturing with Low Energy/Passive SVE	Grout Pipe Section, Intruder Barrier
S-3	Electrical Resistance Heating (ERH) with Active SVE, Portable Steam Heating with Microblower SVE	Portable Steam Heating with Low Energy/Passive SVE	Soil Fracturing with Low Energy/Passive SVE	Soil Fracturing with Low Energy/Passive SVE	Grout Pipe Section, Intruder Barrier
S-4	ERH with Active SVE, Portable Steam Heating with Microblower SVE	Portable Steam Heating with Low Energy/Passive SVE	Geosynthetic Cover	Soil Fracturing with Low Energy/Passive SVE	Grout Pipe Section, Intruder Barrier
S-5	ERH with Active SVE, Active SVE Enhanced with Soil Fracturing	Soil Fracturing with Active SVE	Soil Fracturing with Low Energy/Passive SVE	Soil Fracturing with Low Energy/Passive SVE	Grout Pipe Section, Intruder Barrier
S-6	Ozone Treatment Enhanced with Soil Fracturing	Soil Fracturing with Ozone Treatment	Soil Fracturing with Ozone Treatment	Soil Fracturing with Ozone Treatment	Grout Pipe Section, Intruder Barrier
S-7	Methane Treatment Enhanced with Soil Fracturing	Soil Fracturing with Methane Treatment	Soil Fracturing with Methane Treatment	Soil Fracturing with Methane Treatment	Grout Pipe Section, Intruder Barrier
S-9b	Limited Excavation for Ex-Situ Thermal Treatment, Active SVE Enhanced with Soil Fracturing	Limited Excavation for Ex-Situ Thermal Treatment	Limited Excavation for Ex-Situ Thermal Treatment	Soil Fracturing with Low Energy/Passive SVE	Removal and Disposal
S-10	Limited Excavation for Off-SRS Disposal, Active SVE Enhanced with Soil Fracturing	Limited Excavation for Off-SRS Disposal	Limited Excavation for Off-SRS Disposal	Soil Fracturing with Low Energy/Passive SVE	Removal and Disposal
S-11	Removal and Off-SRS Disposal	Removal and Off-SRS Disposal	Removal and Off-SRS Disposal	Removal and Off-SRS Disposal	Removal and Disposal
S-12	Oil Partioning	Oil Partioning	Low Energy/Passive SVE	Low Energy/Passive SVE	Grout Pipe Section, Intruder Barrier

Note: For non-DNAPL/PTSM areas, SVE could be conducted with or without fracturing. Each alternative with the exception of Alternative S-11 will include institutional controls.

Table 4. Comparative Ranking of Alternatives Retained in the Rev. 0 Combined Document

Response Action		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectives	Implementability	Cost
S – 1	No Action	No	NA	NA	NA	NA	NA	$0
S – 2	Phased Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	4	3	5	$5,661,074
S – 3	Electrical Resistance Heating, Portable Steam Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	5	5	4	$7,744,163
S – 4	Geosynthetic Cover Over Shallow Contaminated Areas, Electrical Resistance Heating, Portable Steam Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier Institutional Controls	Yes	Yes	3	3	3	3	$8,641,123
S – 5	Electrical Resistance Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	5	4	4	$7,108,632
S – 6	Ozone Treatment Enhanced with Soil Fracturing, Baro Ball Soil Vapor Extraction, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	4	4	4	$4,201,878
S – 7	Methane Treatment Enhanced with Soil Fracturing, Soil Vapor Extraction, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	4	4	4	$6,279,178
S – 9b	Limited Excavation, Ex Situ Thermal Treatment, Soil Vapor Extraction Enhanced with Soil Fracturing, Removal and Disposal of Pipe Section, Institutional Controls	Yes	Yes	4	5	4	2	$7,126,608
S – 10	Limited Excavation and Off-SRS Disposal, Soil Vapor Extraction Enhanced with Soil Fracturing, Removal and Disposal of Pipe Section, Institutional Controls	Yes	Yes	4	3	4	2	$40,259,491
S – 11	Removal and Off-SRS Disposal, Removal and Disposal of Pipe Section	Yes	Yes	5	1	4	1	$73,892,957
S – 12	Oil Partioning, Soil Vapor Extraction, Grout Pipe Section, Intruder Barrier, Institutional Controls	Yes	Yes	4	3	4	5	$3,140,854

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

Table 5. Qualitative Comparative Ranking of Actions for the DNAPL and PTSM Area West of 321-M

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Ranking (range 1 - 25)
No Action	No	NA	1	1	1	5	5	13
Active Soil Vapor Extraction (SVE) Enhanced with Soil Fracturing	Yes	Yes	3	3	3	5	4	18
Portable Steam Heating with Low Energy/Passive SVE	Yes	Yes	5	5	5	3	3	21
ERH with Active SVE, Active SVE Enhanced with Soil Fracturing	Yes	Yes	5	5	5	3	3	21
Ozone Treatment Enhanced with Soil Fracturing	Yes	Yes	3	3	3	4	4	17
Methane Treatment Enhanced with Soil Fracturing	Yes	Yes	3	3	3	4	4	17
Limited Excavation for Ex-Situ Thermal Treatment, Active SVE Enhanced with Soil Fracturing	Yes	Yes	5	5	5	3	3	21
Limited Excavation for Off-SRS Disposal, Active SVE Enhanced with Soil Fracturing	Yes	Yes	5	2	5	3	2	17
Removal and Off-SRS Disposal	Yes	Yes	5	1	5	3	1	15
Oil Partitioning	Yes	Yes	4	4	4	5	5	22

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

Table 6. Qualitative Comparative Ranking of Actions for the PTSM Area West of 320-M

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Ranking (range 1 - 25)
No Action	No	NA	1	1	1	5	5	13
Active SVE Enhanced with Soil Fracturing	Yes	Yes	3	4	3	5	4	19
Portable Steam Heating with Low Energy/Passive SVE	Yes	Yes	4	4	4	4	4	20
Ozone Treatment Enhanced with Soil Fracturing	Yes	Yes	3	4	3	4	3	17
Methane Treatment Enhanced with Soil Fracturing	Yes	Yes	3	4	3	4	3	17
Limited Excavation for Ex-Situ Thermal Treatment, Low Energy/Passive SVE	Yes	Yes	5	5	5	3	2	20
Limited Excavation for Off-SRS Disposal, Low Energy/Passive SVE	Yes	Yes	5	1	5	3	1	15
Removal and Off-SRS Disposal	Yes	Yes	5	1	5	3	1	15
Oil Partitioning	Yes	Yes	4	4	4	5	5	22

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

Table 7. Qualitative Comparative Ranking of Actions for the Shallow Soil Contamination Area Southwest of 313-M

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Ranking (range 1 - 25)
No Action	No	NA	1	1	1	5	5	13
Low Energy/Passive SVE Enhanced with Soil Fracturing	Yes	Yes	4	4	4	5	4	21
Geosynthetic Cover	Yes	Yes	3	1	3	5	4	16
Ozone Treatment Enhanced with Soil Fracturing	Yes	Yes	4	4	4	4	3	19
Methane Treatment Enhanced with Soil Fracturing	Yes	Yes	4	4	4	4	3	19
Excavation for Ex-Situ Thermal Treatment	Yes	Yes	5	5	5	4	2	21
Removal and Off-SRS Disposal	Yes	Yes	5	1	5	4	1	16
Oil Partitioning	Yes	Yes	4	4	4	5	5	22

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

Table 8. Qualitative Comparative Ranking of Actions for Remaining Areas Exceeding CM RGOs

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Ranking (range 1 - 25)
No Action	No	NA	1	1	1	5	5	13
Low Energy/Passive SVE Enhanced with Soil Fracturing	Yes	Yes	4	4	4	5	4	21
Ozone Treatment Enhanced with Soil Fracturing	Yes	Yes	4	4	4	4	3	19
Methane Treatment Enhanced with Soil Fracturing	Yes	Yes	4	4	4	4	3	19
Removal and Off-SRS Disposal	Yes	Yes	5	1	5	3	1	15
Oil Partitioning	Yes	Yes	4	4	4	5	5	22

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

Table 9. Qualitative Comparative Ranking of Actions for the 322-M/Manhole 6A Pipeline

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost	Overall Ranking (range 1 - 25)
No Action	No	NA	1	1	1	5	$0	8
Institutional Controls	Yes	Yes	3	1	5	5	$0 (1)	14
Grout Pipe Section and Intruder Barrier (2)	Yes	Yes	4	5	5	4	$300,834	18
Removal and Onsite Disposal	Yes	Yes	5	1	4	3	$677,618	13

Note: Numeric range 1 - 5, where 1 = worst and 5 = best

(1) The cost incurred from implementing institutional controls will be negligible because institutional controls will be implemented as part of the final remedy for other parts of the MIPSL OU.

(2) Grouting would include stabilization of the annular area between the liner and the outer pipe to the extent practicable.

Table 10. Recommended MIPSL OU Response Action

Problem Areas	Response Action	Locations
DNAPL and PTSM	Phased Soil Vapor Extraction Enhanced with Soil Fracturing	West of 321-M
PTSM	Phased Soil Vapor Extraction Enhanced with Soil Fracturing	West of 320-M
Shallow Soil Contamination	Low energy/Passive SVE Enhanced with Soil Fracturing	Southwest of 313-M
Contaminant Migration	Low energy/Passive SVE Enhanced with Soil Fracturing	All remaining areas along MIPSL that exceed CM RGOs
Pipeline from 322-M to Manhole 6A	Grout Pipe Section and Intruder Barrier	Southwest of 322-M

Note: All MIPSL manholes will be grouted as an Institutional Control measure to prevent access.

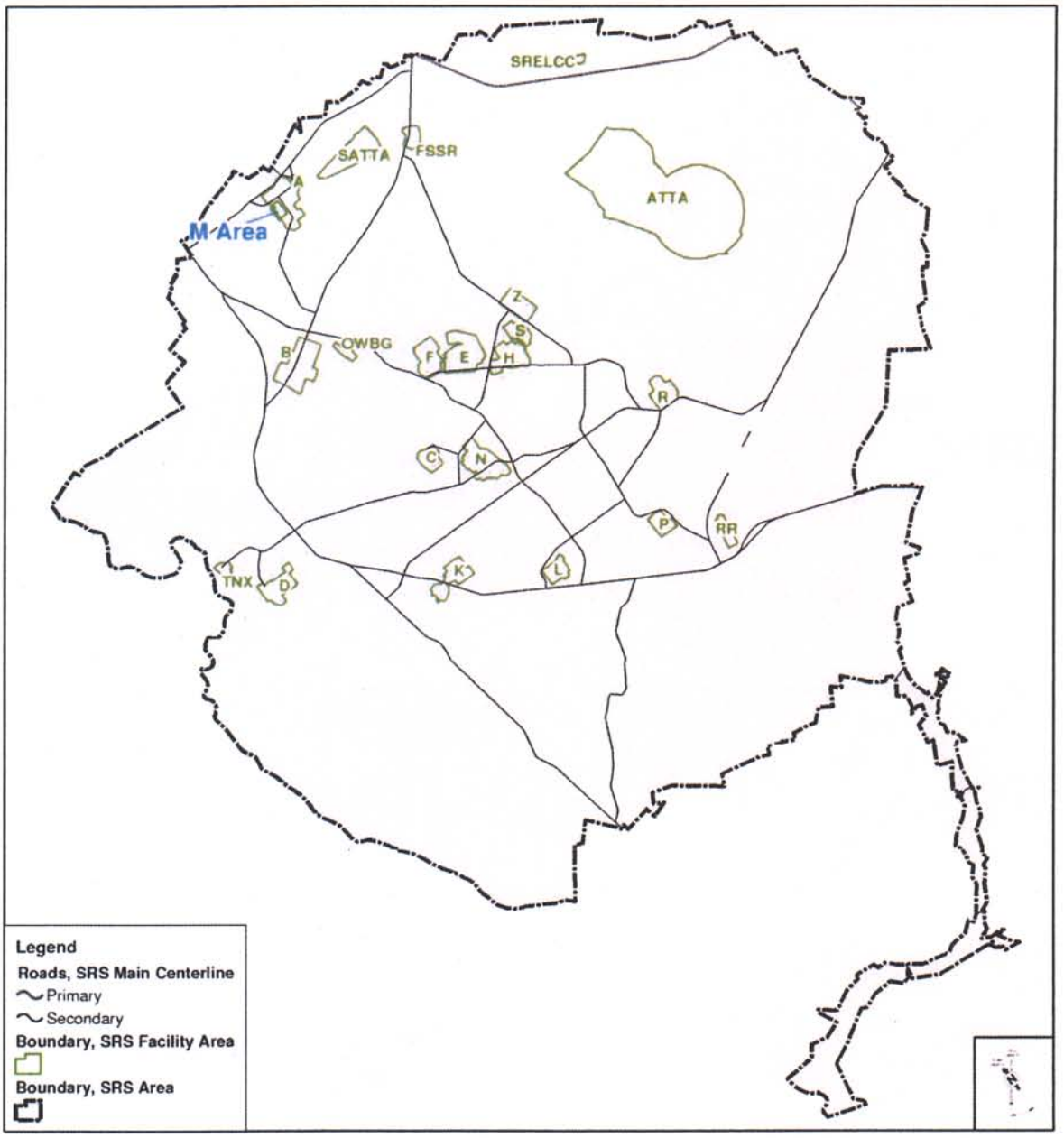

Figure 1. M-Area Location Map

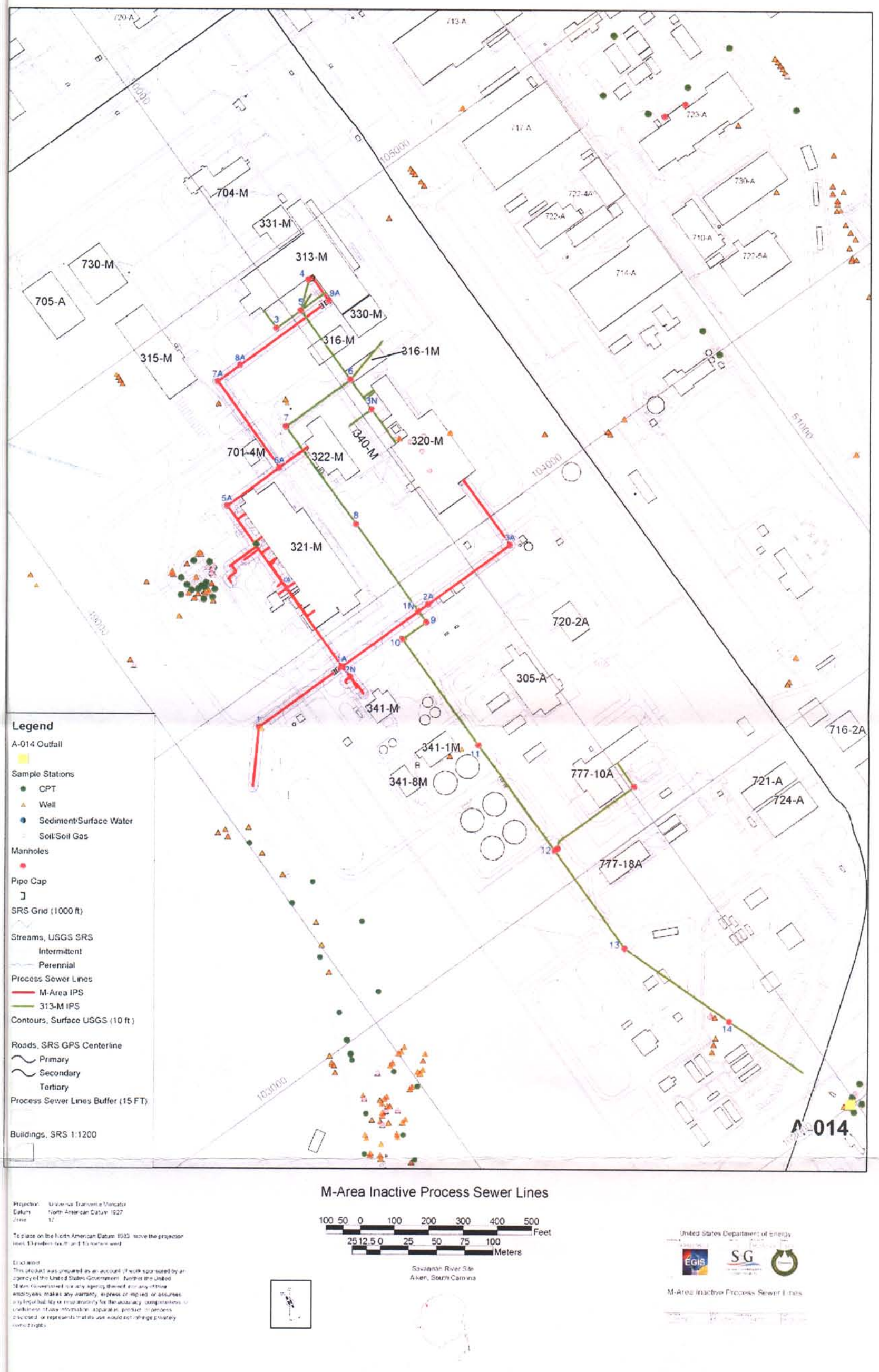

Figure 2. Layout of the MIPSL OU

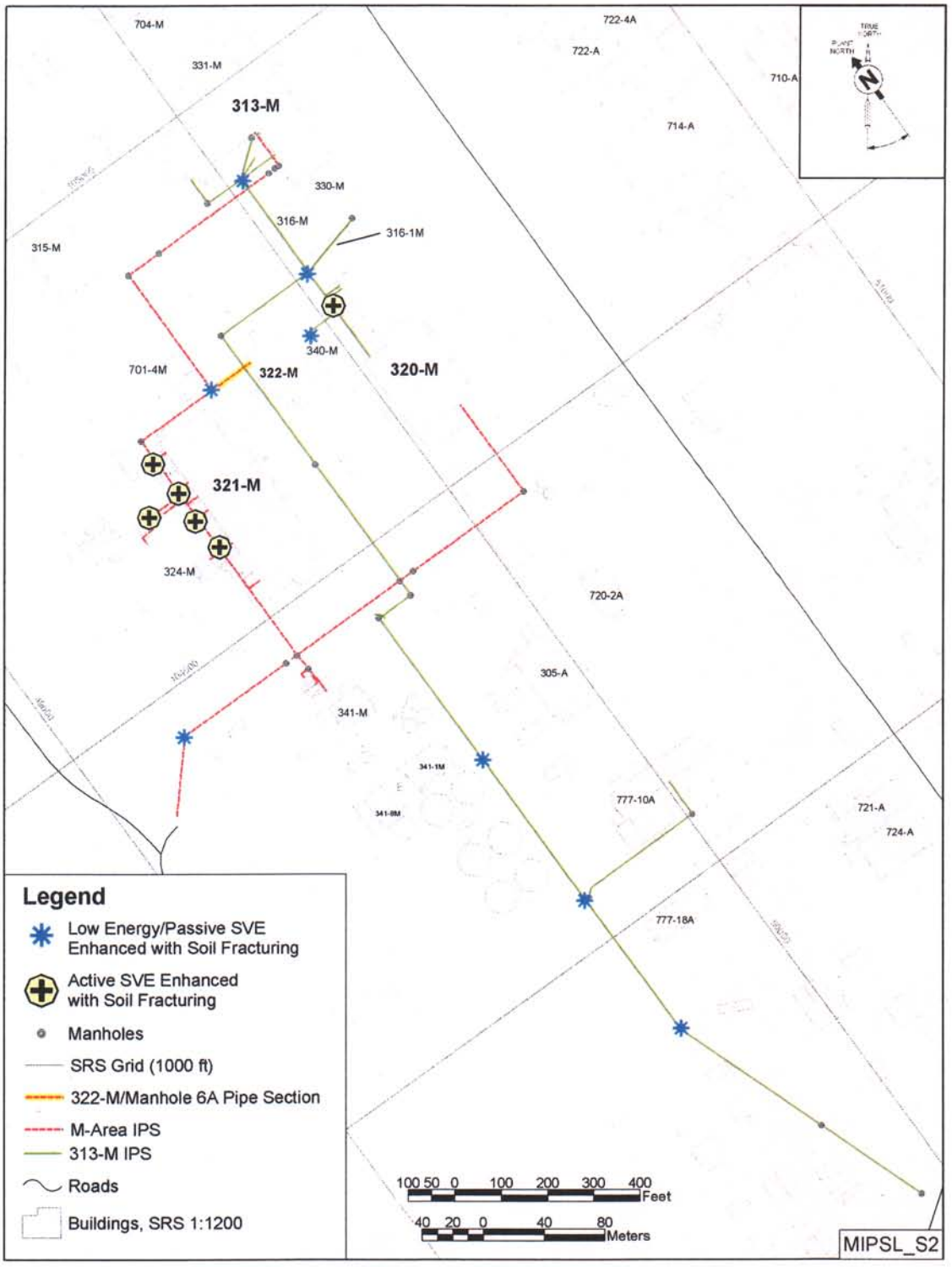

Figure 3. Alternatives S-2 –Active Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls

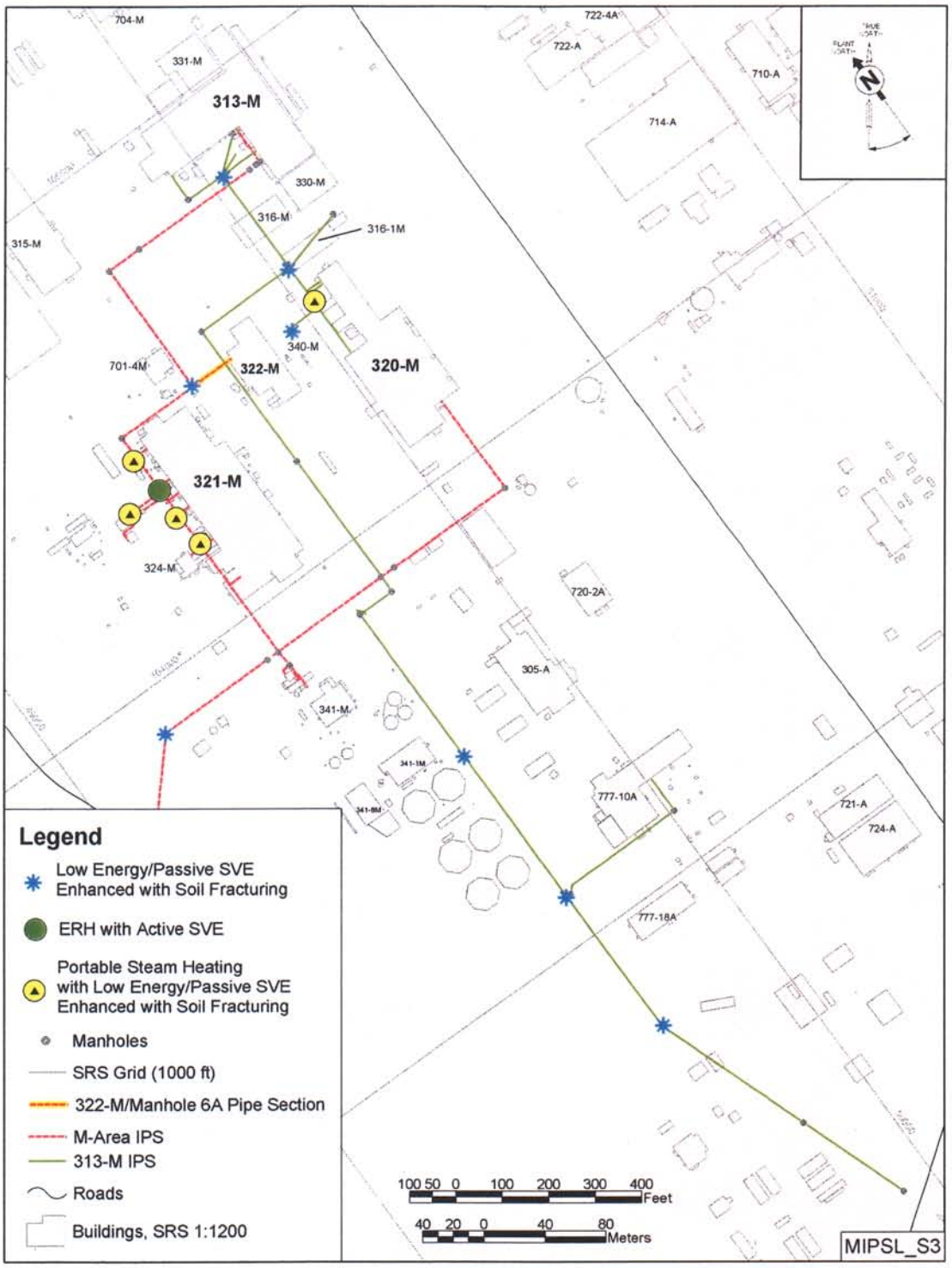

Figure 4. Alternative S-3- Electrical Resistance Heating, Portable Steam Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls

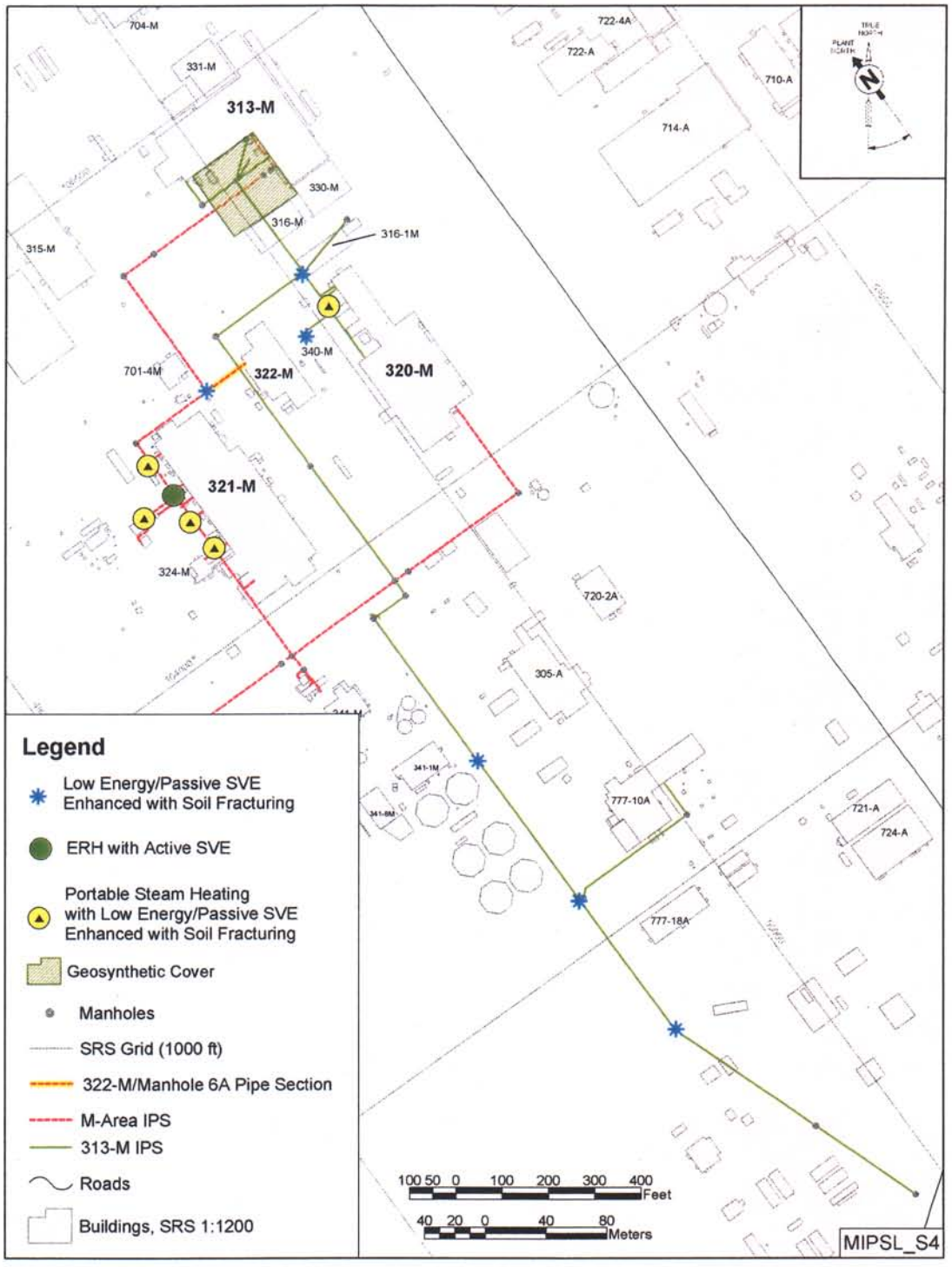

Figure 5. Alternative S-4 – Geosynthetic Cover Over Shallow Contaminated Areas, Electrical Resistance Heating, Portable Steam Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls

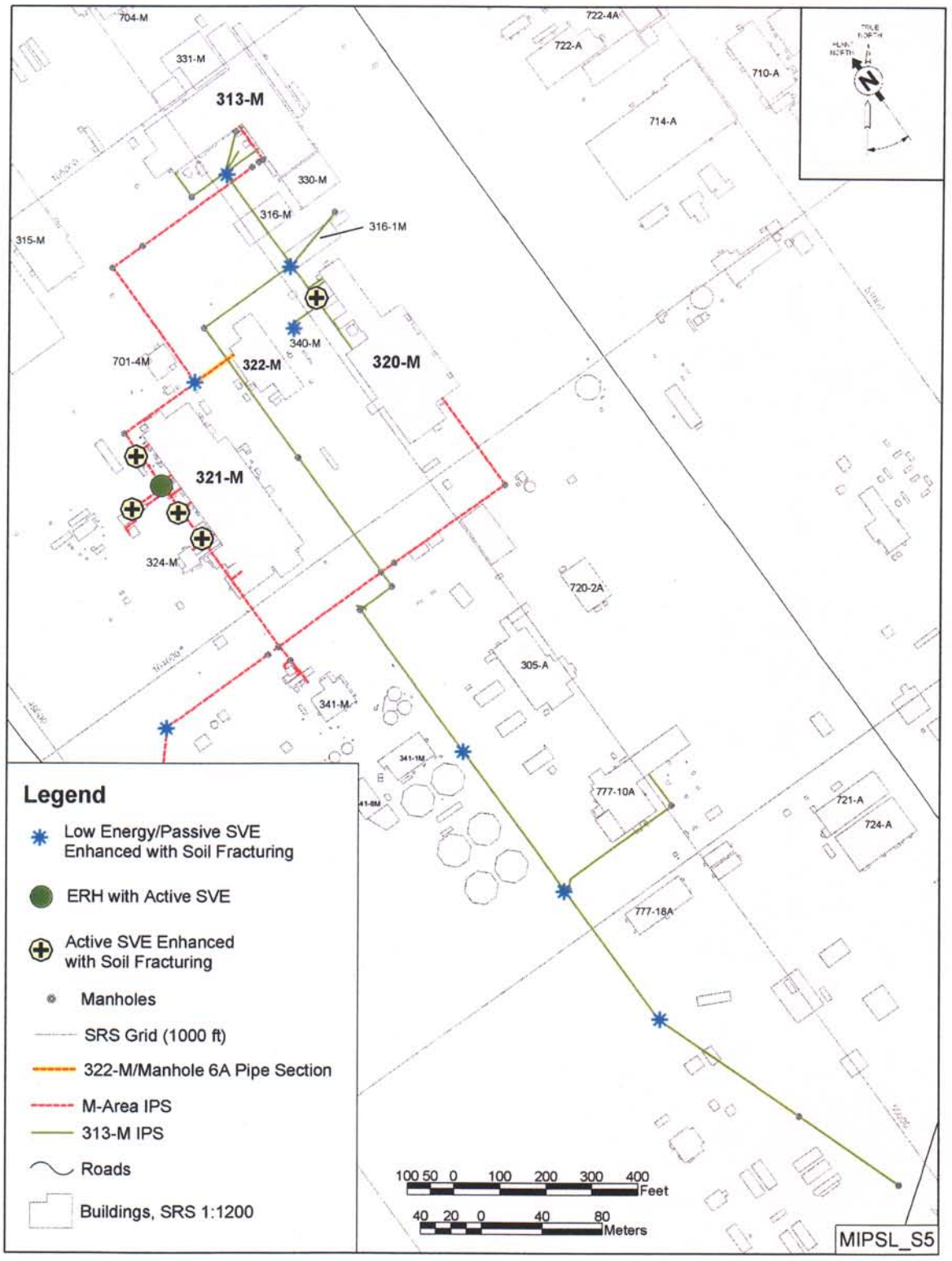

Figure 6. Alternative S-5- Electrical Resistance Heating, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls

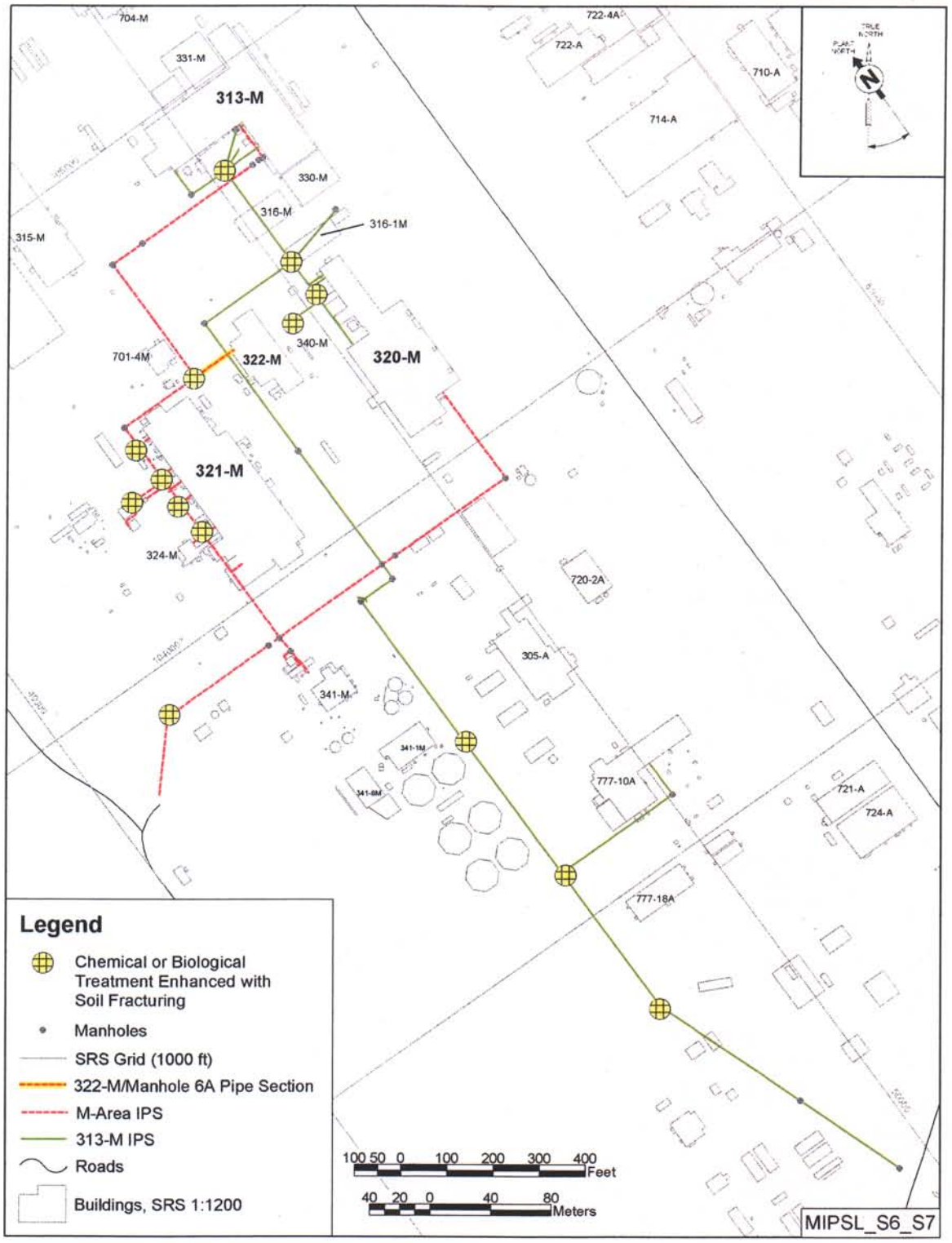

Figure 7. Alternatives S-6 and S-7 –Ozone or Methane Treatment, Soil Vapor Extraction Enhanced with Soil Fracturing, Grout Pipe Section, Intruder Barrier, Institutional Controls

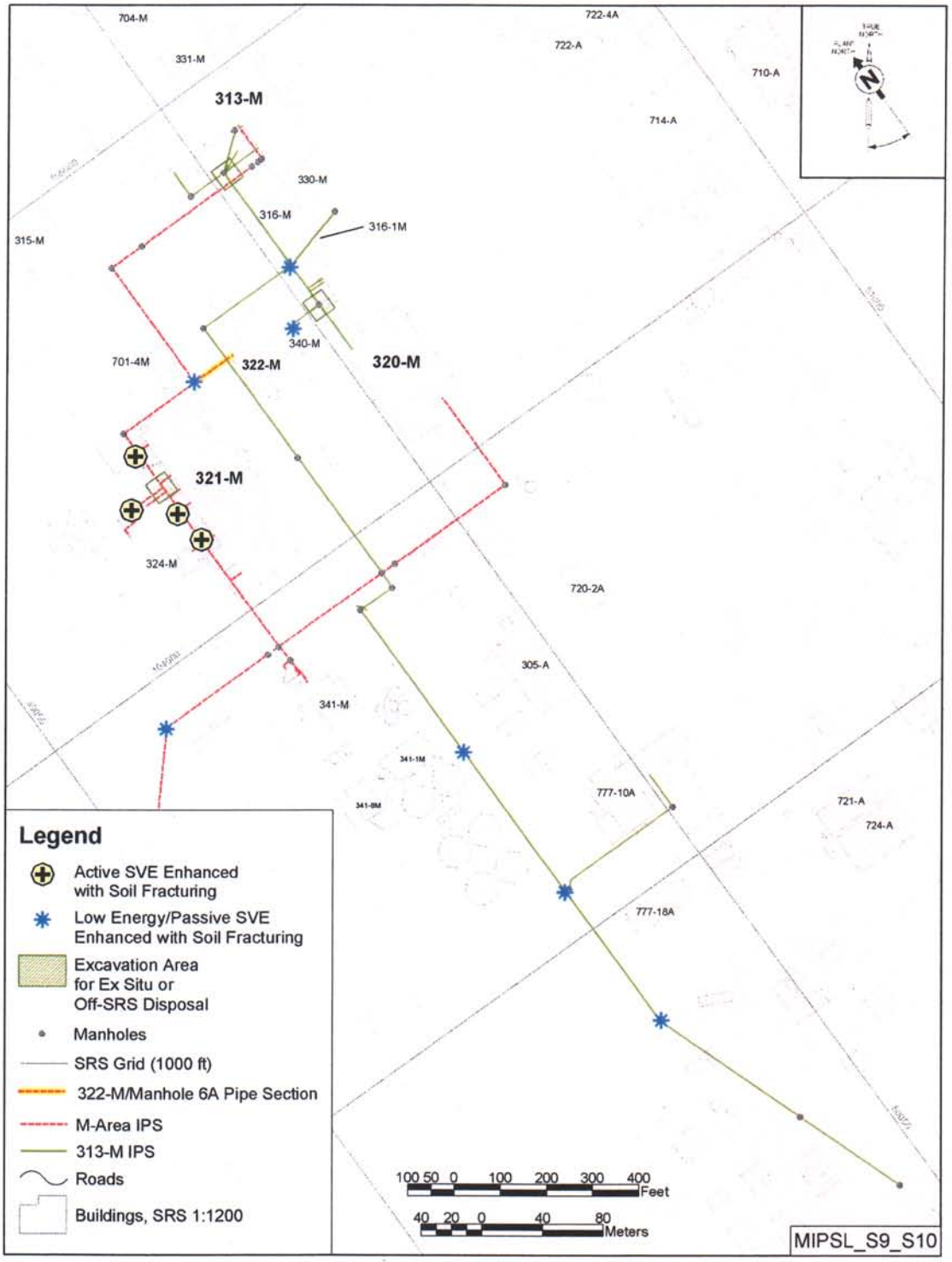

Figure 8. Alternatives S-9 and S-10 - Limited Excavation for Ex Situ Treatment or Off-SRS Disposal, Soil Vapor Extraction Enhanced with Soil Fracturing, Removal and Disposal of Pipe Section, Institutional Controls

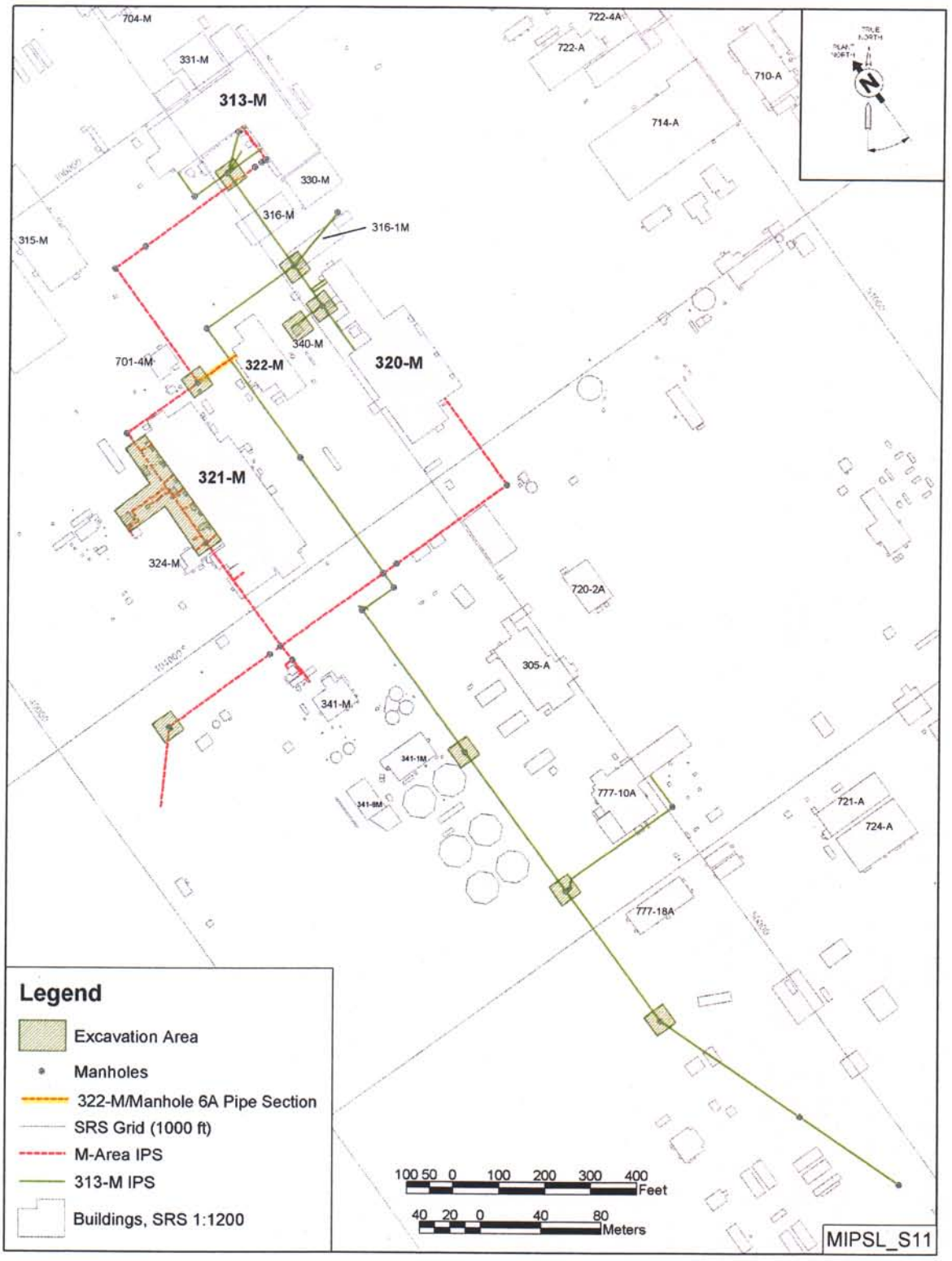

Figure 9. Alternative S-11 – Removal and Off-SRS Disposal, Removal and Disposal of Pipe Section

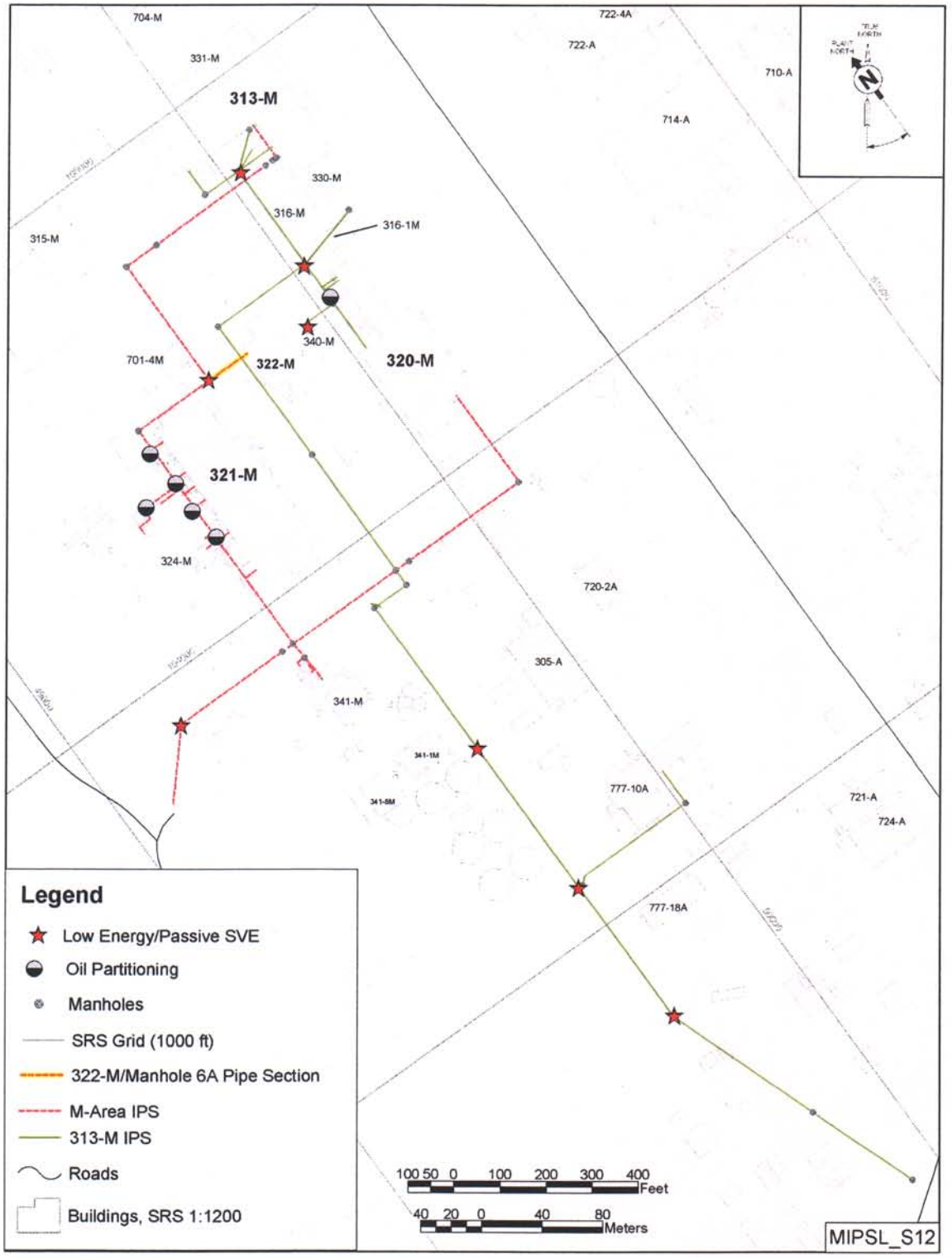

Figure 10. Alternative S-12 – Oil Partitioning, Soil Vapor Extraction, Grout Pipe Section, Intruder Barrier, Institutional Controls

Appendix A

Pipeline between Building 322-M and Manhole 6A

Background

Sludge Sampling (1992) - In 1985, the M-Area Inactive Process Sewer Lines (MIPSL) was tied into the Liquid Effluent Treatment Facility (LETF) via piping from manhole 1A to the LETF. The MIPSL Operable Unit (OU) consists of the M-Area Settling Basin Inactive Process Sewer to Manhole 1 (MIPS) and the 313-M and 320-M Inactive Clay Process Sewers to Tims Branch (313-MIPS). As part of an investigation of the LETF drain line, a gamma survey was completed and sludge samples were collected from several drains and manholes. Samples were collected during 1992 from manholes 1A, 5A, and 6A along the MIPS, and from manhole 6 along the 313-MIPS, for uranium analysis (Figures 2 and 3). Results ranged from 6.07 milligrams per liter (mg/L) to 29.31 mg/L total uranium with 0.27 to 0.77 weight percent (wt%) uranium-235 (U-235). This investigation demonstrated that there was no significant buildup of uranium within the MIPSL network except in the pipeline from 322-M (M-Area Metallurgical Laboratory) to manhole 6A. It further verified that the U-235 isotopic abundance was less than that of natural uranium and that there was no nuclear criticality safety hazard in the sewer systems. The data from this investigation was used to support the characterization of process waste that may have leaked from the pipe to the vadose zone and to develop the analyte list for the 2003/2004 investigation.

A review of process history of the MIPSL has indicated that little to no residuals are likely to exist within the majority of the pipelines. The pipelines were designed for gravity flow and were periodically washed with acid rinse solutions in the production buildings. Field inspections of the MIPSL manholes including traps, indicates that sediment has not accumulated in the base of the manholes. However, it is recognized that solids are present under 322-M and in the pipeline between 322-M and manhole 6A.

In 2003 the MIPSL was evaluated for design and flow characteristics. The process sewers were determined to be properly designed to transport process wastewater without the potential for overflow. The evaluation also determined that the nature of the wastewater flow characteristics does not lend itself to accumulation of solids from the processing facilities. However, the flow

rate from 322-M was very low due to the nature of the work being performed, and the settling of heavy waste within the discharge piping is not unexpected. The source of uranium sludge in the pipeline between 322-M and manhole 6A is the 322-M and not other process facilities within M Area.

Contaminant migration analysis using VZCOMML© for residual uranium in the process sewers indicated no threat to groundwater.

Figure A-1 provides a schematic of the pipeline network under 322-M to Manhole 6A. Figure A-2 provides the pipeline and sump contamination results for 322-M. Figure A-3 provides the sample results for uranium for the MIPSL OU.

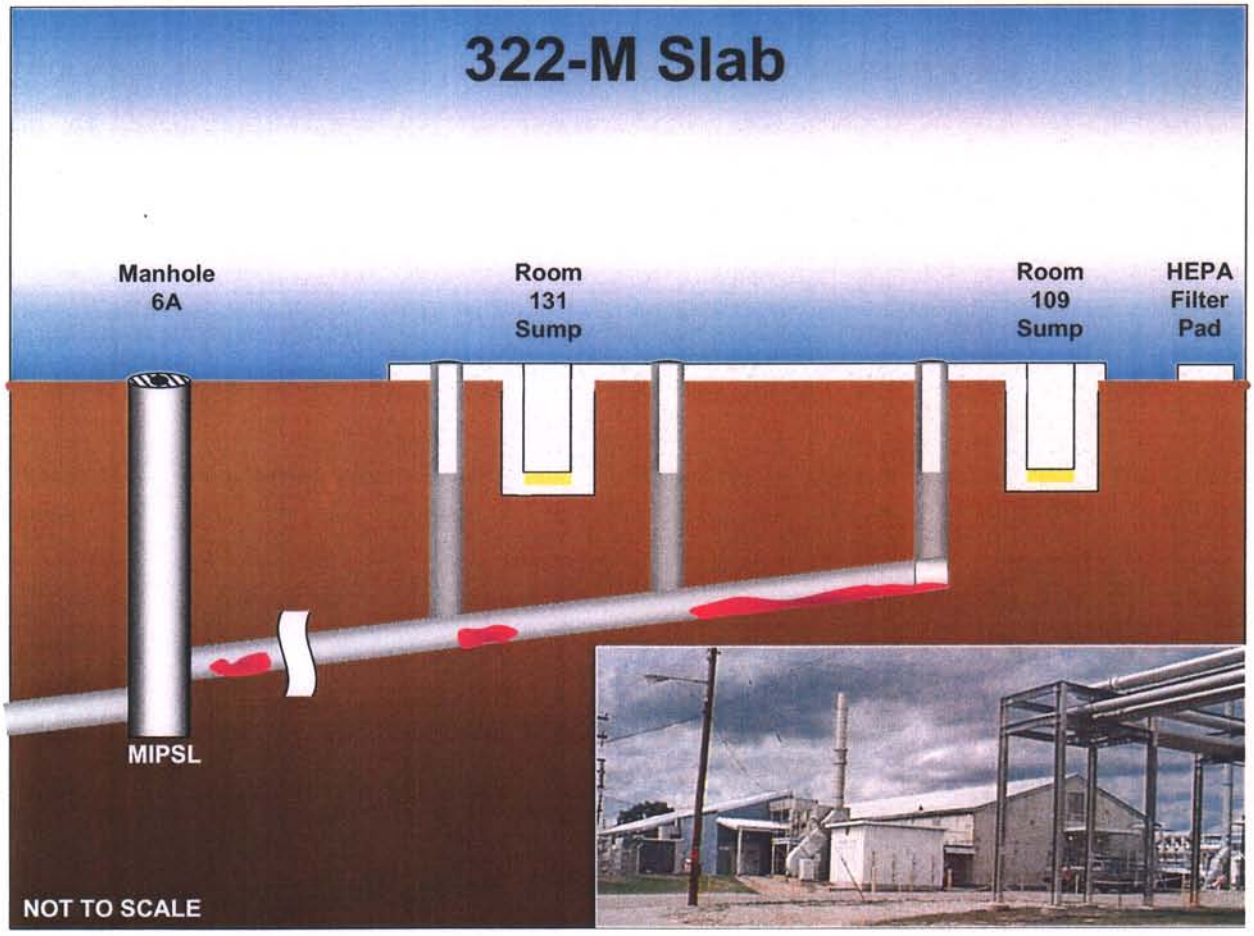

Figure A-1. Schematic of Pipeline Network Under 322-M Slab to Manhole 6A

Subsurface uranium contamination under 322-M remains in two sumps, under Rooms 108 and 109, and as sludge in process sewers beneath the slab. The contamination under the 322-M will be addressed as part of the M-Area OU.

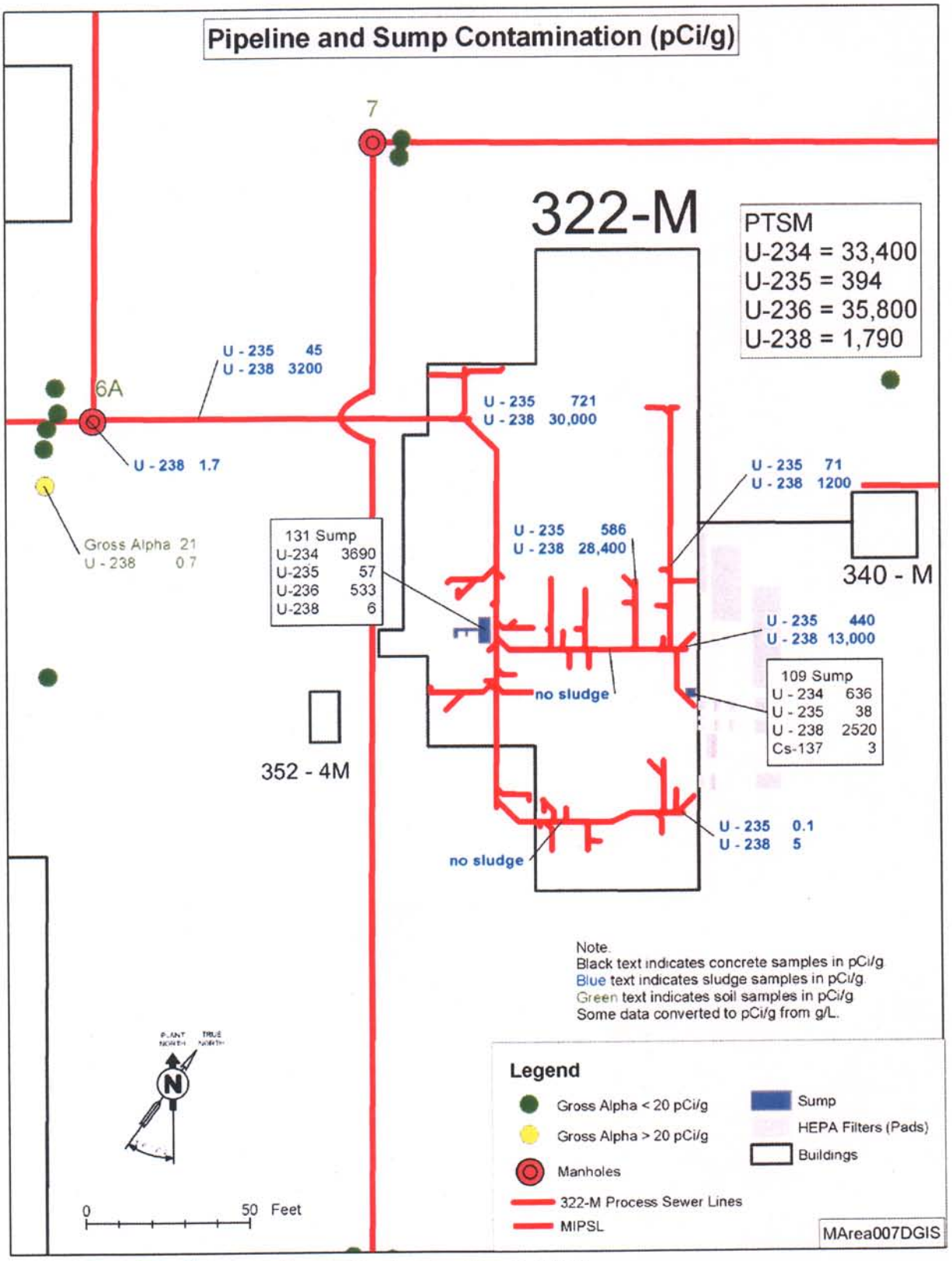

Figure A-2. Pipeline and Sump Contamination (pCi/g)

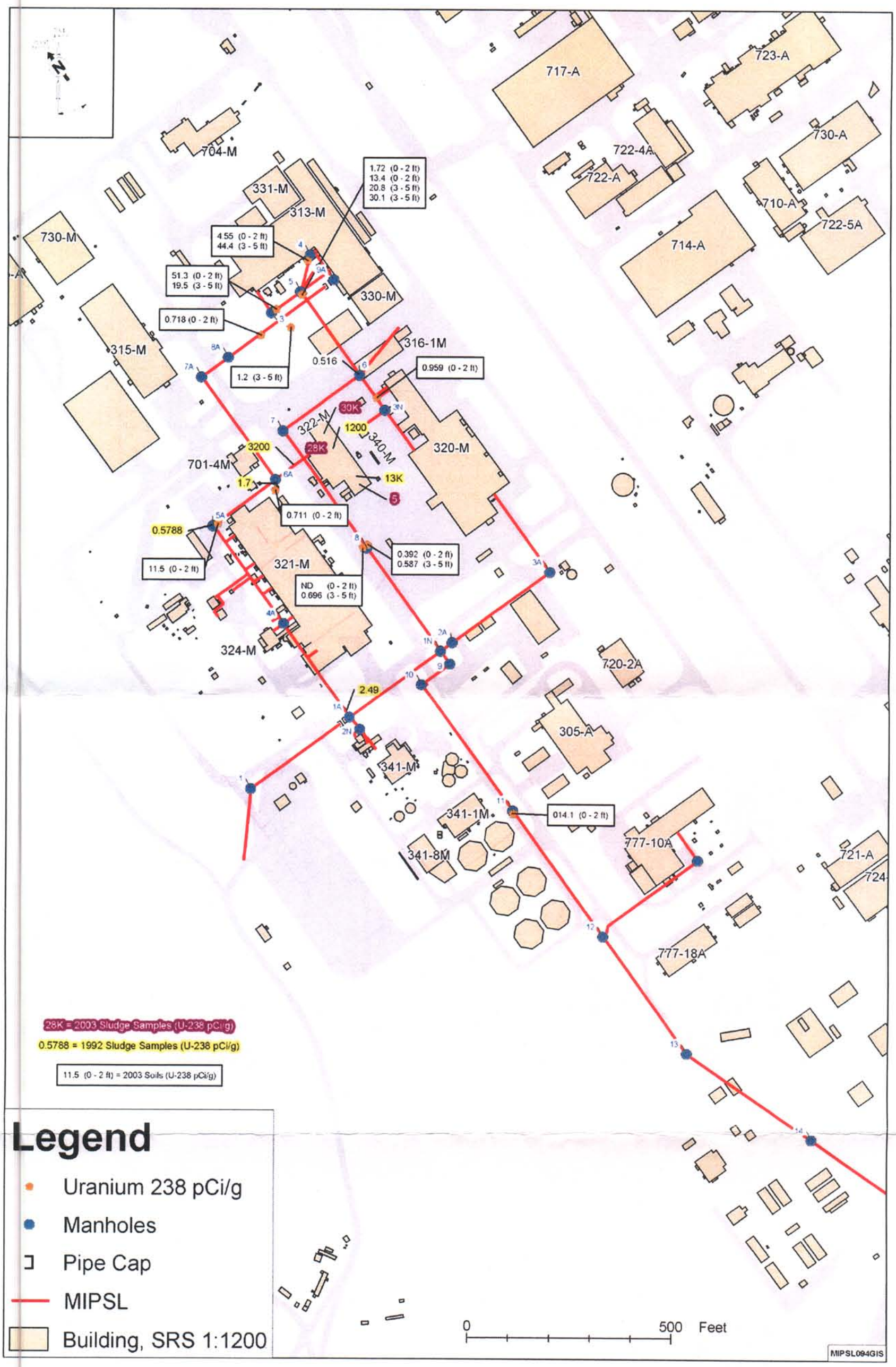

Figure A-3. MIPSL Sample Results for Uranium

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