A CASE STUDY: GEOLOGY, INVESTIGATION AND REMEDIATION AT A RAILROAD ENGINE REPAIR SHOP BROWNFIELD SITE ST. PAUL, MINNESOTA

BY
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BROWNFIELD VS GREENFIELD

- BROWNFIELD SITE - Old abandoned or under utilized industrial or commercial site with contamination, usually located within the inner city, but can be found in small towns

- GREENFIELD SITE - Raw undeveloped farm field or woodland


Lake Como
SITE
CALVARY CEMETERY
Base Map Source: USGS 7.5' Quadrangles, St. Paul East and St. Paul West, MN. Provided by MNDNR
0
750
1500 Feet
AMERICAN ENGINEERING TESTING, INC.
Figure 1
Site Location Map
Great Northern Business Center
Phase II Site

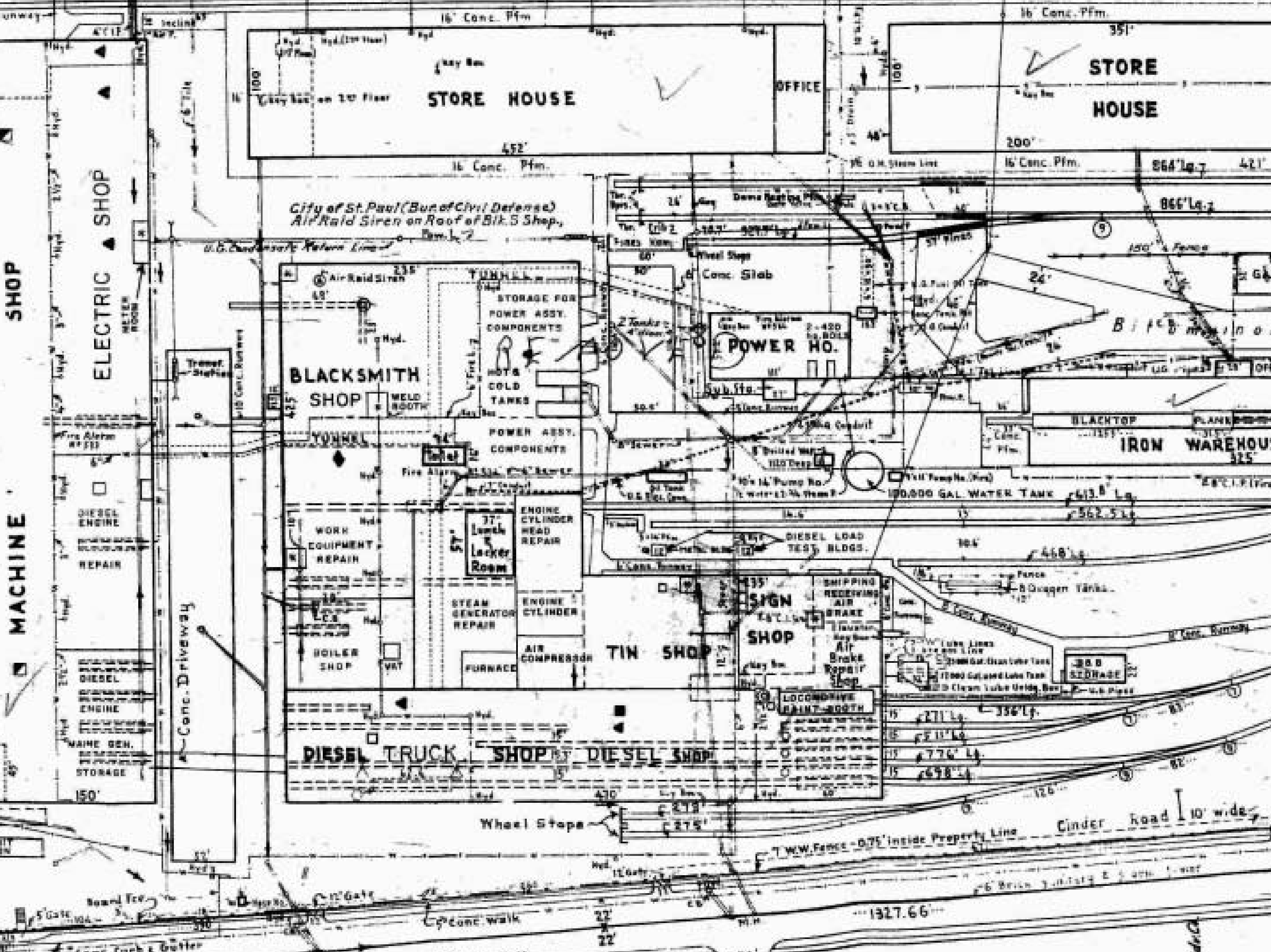
SITE HISTORY AND GEOLOGY

- REVIEW LOCAL HISTORICAL REFERENCES
  - Aerial Photos
  - Fire Insurance Maps
  - Old RR maps

REVIEW LOCAL GEOLOGIC REFERENCES

- Surficial Geology
- Bedrock Geology
- Hydrogeology
- Water Well Logs

1945 Aerial Photo



STORE HOUSE
OFFICE
16' Conc. Pfm.
452'
STORE HOUSE
351'
200'
ELECTRIC SHOP
MACHINE SHOP
City of St. Paul (Bur. of Civil Defense) Air Raid Siren on Roof of Blk. S Shop.
Air Raid Siren
TUNNEL
BLACKSMITH SHOP
WELD BOOTH
STORAGE FOR POWER ASSY. COMPONENTS
HOT & COLD TANKS
POWER ASSY. COMPONENTS
Toilet
Lunch & Locker Room
ENGINE CYLINDER HEAD REPAIR
WORK EQUIPMENT REPAIR
STEAM GENERATOR REPAIR
ENGINE CYLINDER
BOILER SHOP
VAT
FURNACE
AIR COMPRESSOR
TIN SHOP
SIGN SHOP
SHIPPING RECEIVING AIR BRAKE
Air Brake Repair Shop
LOCOMOTIVE PAINT BOOTH
DIESEL TRUCK SHOP
DIESEL SHOP
DIESEL ENGINE REPAIR
DIESEL ENGINE
MAINE GEN. STORAGE
150'
Conc. Driveway
POWER HO.
Conc. Slab
Wheel Stops
100,000 GAL. WATER TANK
DIESEL LOAD TEST BLDGS.
IRON WAREHOUSE
BLACKTOP
325'
613.8' Lg.
562.5' Lg.
468' Lg.
864' Lg.
866' Lg.
336' Lg.
271' Lg.
511' Lg.
776' Lg.
498' Lg.
8 Oxygen Tanks
B.B. STORAGE
Cinder Road 10' wide
7' W.W. Fence 0.75' Inside Property Line
1327.66'
Conc. walk
Wheel Stops
470'

Figure 4
Location of Former ASTs, USTs, and Buildings

Response Action Plan
Dale Street Shops Site

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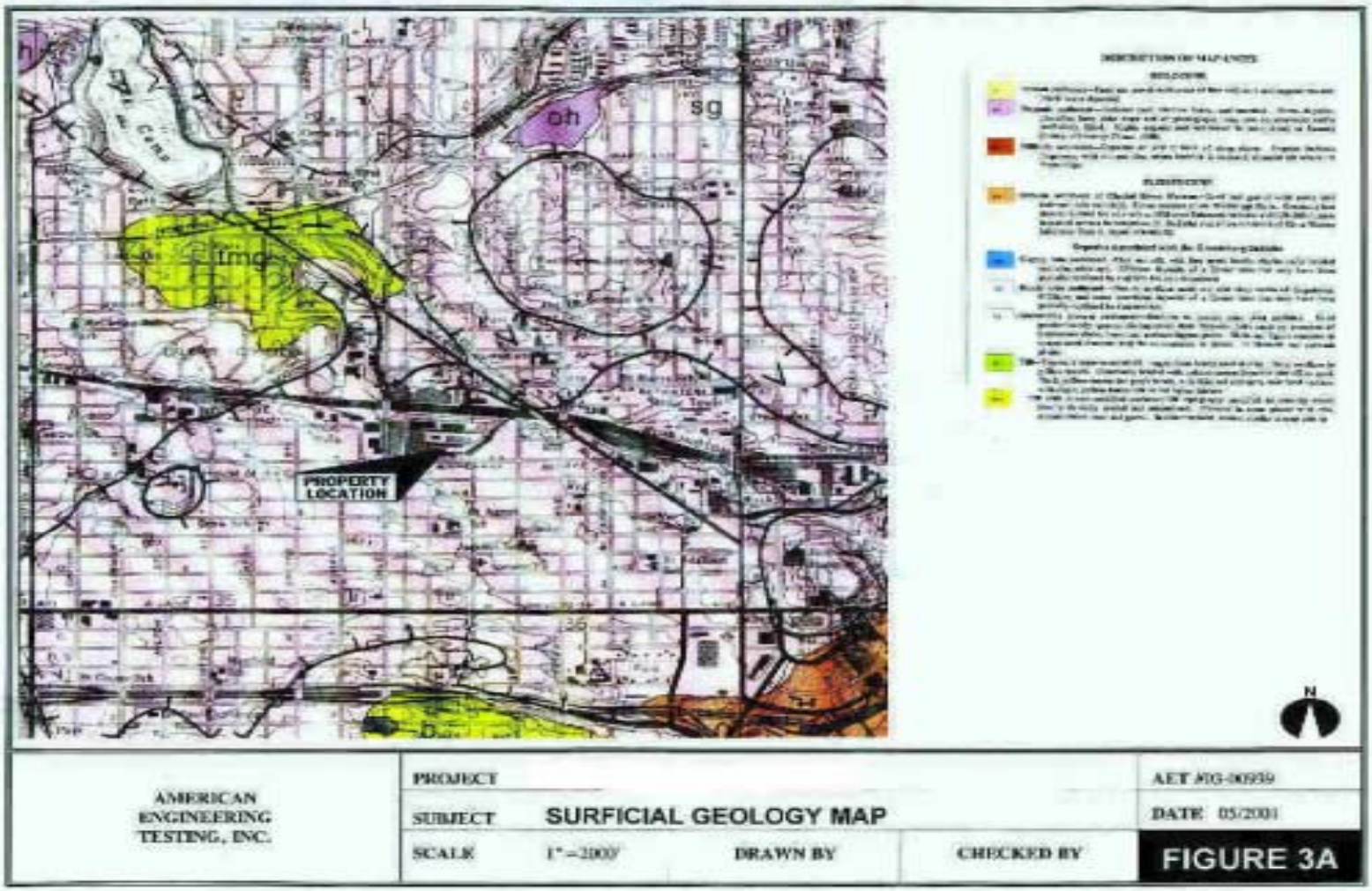
St. Paul Flats Region
60 to 70 feet Grantsburg Sublobe meltwater stream deposits overlying bedrock



DESCRIPTION OF BEDROCK UNITS

Decorah Shale—Green, calcareous shale; thin limestone interbeds. In a few places capped by thin (less than 20 feet) erosional remnants of limestone of overlying Galena Group (not shown on map). Largely restricted to south half of county. Unit crops out in bluffs of Mississippi River in south and west St. Paul. Formerly mined in south St. Paul above Pickerel Lake for clay to make brick and tile.

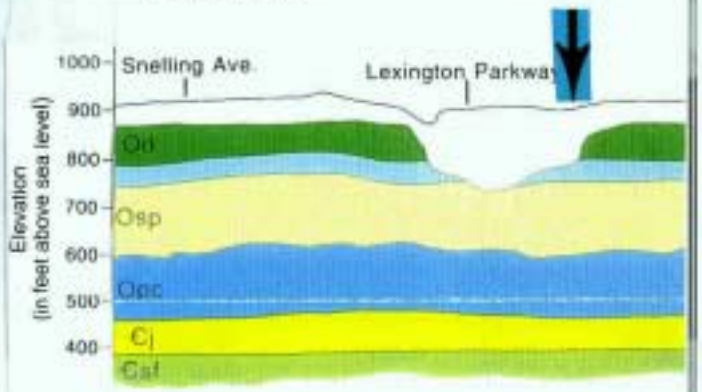
Platteville and Glenwood Formations—Fine-grained dolostone and limestone of Platteville underlain by thin, green, sandy shale (3–5.5 feet thick) of Glenwood. Extensive outcrops in bluffs along Mississippi River in St. Paul. Platteville formerly quarried for rock aggregate and building stone in bedrock terraces of south St. Paul.

St. Peter Sandstone—Upper half to two-thirds: fine- to medium-grained, quartz sandstone; generally massive to thick bedded. Lower part: multicolored beds of sandstone, siltstone, and shale; interbeds of very coarse sandstone. Basal contact is erosional surface. Unit crops out in bluffs along Mississippi River. Formerly mined for glass sand for the Ford Motor Company plant in west St. Paul. Man-made caves in St. Peter, within the bluffs along Mississippi River in south St. Paul, formerly used for raising mushrooms.

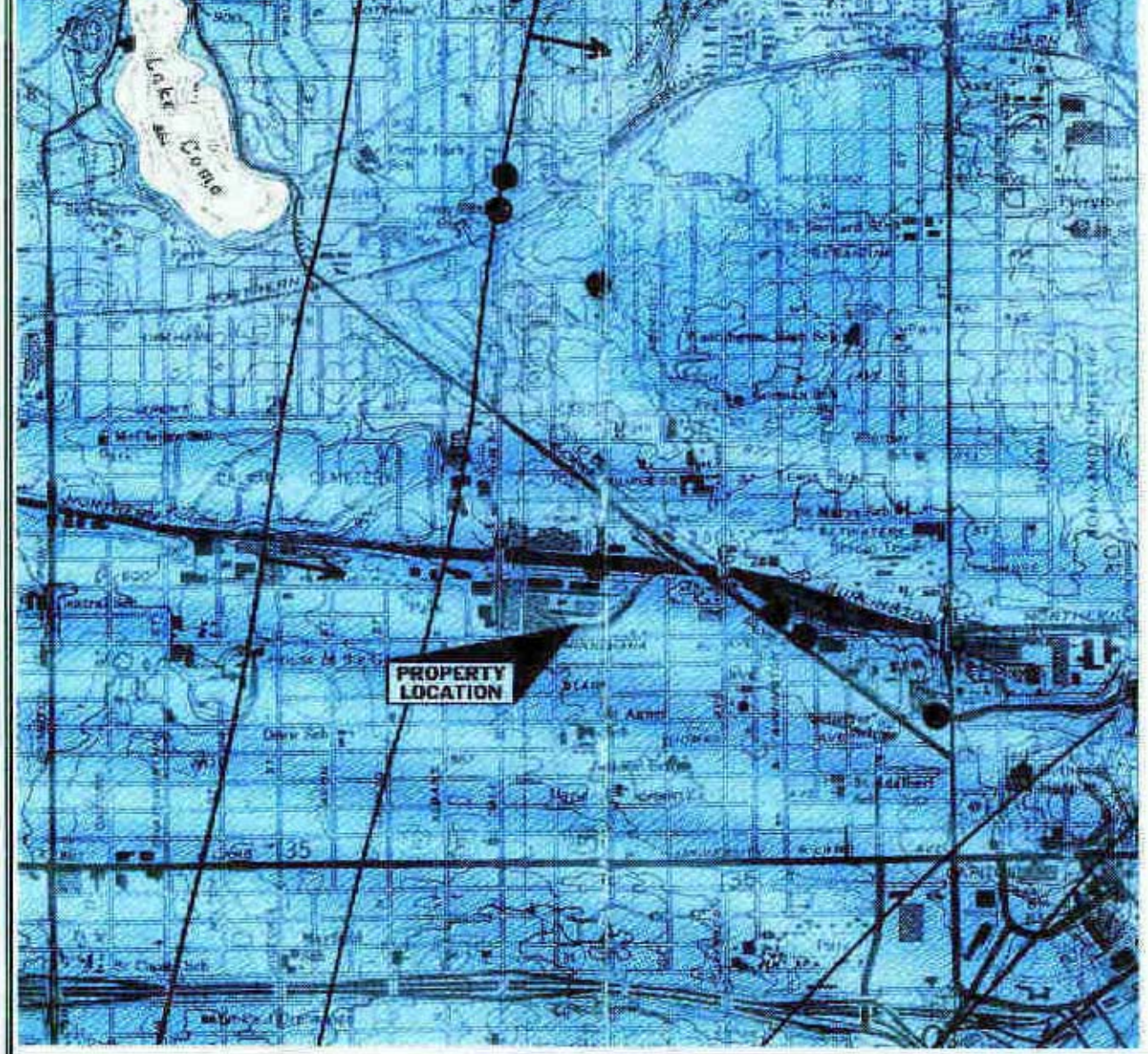
Prairie du Chien Group—Upper half to two-thirds: commonly sandy or oolitic and thin-bedded dolostone; thin beds of sandstone and chert; thin beds of limestone (conglomeratic) dolostone. Lower part: generally massive or thick bedded dolostone; not oolitic or sandy, except for thin, sandy, transitional zone at base. Upper part of Prairie du Chien dolostone may contain karst solution cavities, particularly where overlying St. Peter Sandstone removed by erosion. No outcrops of Prairie du Chien Group in county; however, it is first bedrock encountered beneath Quaternary deposits over large part of county; extensive outcrops found in adjacent northern Dakota and southern Washington Counties.

Jordan Sandstone—Upper part: medium- to coarse-grained, friable, quartzose sandstone. Lower part: primarily fine-grained, feldspathic sandstone. Sharp upper contact with Prairie du Chien Group. No outcrops of Jordan in county; subcrops beneath Quaternary deposits along some buried valleys.

St. Lawrence and Franconia Formations—St. Lawrence: dolomitic shale and siltstone. Contact between it and overlying Jordan Sandstone gradational. Underlying Franconia: very fine-grained, feldspathic sandstone, generally well cemented with dolomite. Commonly contains abundant glauconite, imparting green color to sandstones; some sandstone beds in upper part nonglauconitic. Mapped as one unit, owing to difficulty of differentiating them on drillers' and gamma-ray logs. No outcrops in county; subcrops along some of deeper buried valleys in northern Ramsey County.



AMERICAN ENGINEERING TESTING, INC.	PROJECT			AET #03-00939
	SUBJECT	BEDROCK GEOLOGY MAP		DATE 05/2001
	SCALE 1"=2000'	DRAWN BY	CHECKED BY	FIGURE 3B



WATER-TABLE SYSTEM

EXPLANATION

●	Water well or soil boring—Used for control. May be combined with symbol for water sample for chemical analysis
—889—	Water-table contour—Shows elevation in feet above mean sea level, contour interval 25 feet
→	General direction of ground-water movement
△	Water sample for chemical analysis—From water wells, surface water and precipitation (Minn. Geol. Survey file data, 1991; see Table
	Approximate extent of aquifer—Excluded where water table occurs in materials that do not yield significant quantities of water to wells, large lakes and the Mississippi River

AMERICAN ENGINEERING TESTING, INC.	PROJECT			AET #03-00939
	SUBJECT	SURFICIAL HYDROGEOLOGY MAP		DATE 05/2001
	SCALE 1"=2000'	DRAWN BY	CHECKED BY	FIGURE

TYPICAL RR SITE CONTAMINANTS

- Petroleum – tanks, spills, asphalt plant
- Polynuclear Aromatic Hydrocarbons (PAHs) – cinders, burned oils
- Lead – painting and soldering activities
- Asbestos – soldering activities
- Tar with Chlorinated Volatile Organic Compounds (VOCs)
- Degreasing Solvents – Chlorinated VOCs
- Other
  - Grease pits, sumps, holding tanks
  - Concrete, debris
  - RR Ties

INVESTIGATION STEPS

- BORINGS
- MONITORING WELL INSTALLATIONS
- TRENCHING AND TEST PITS
- GEOPHYSICAL EXPLORATIONS
- SAMPLE SCREENING WITH FIELD INSTRUMENTS
- SAMPLE COLLECTION FOR LAB ANALYSIS

AUGER BORINGS

DRILL RIG

GEOPROBE® BORINGS

REMOTE TESTING

- GLOBAL POSITIONING SYSTEMS & MAPPING

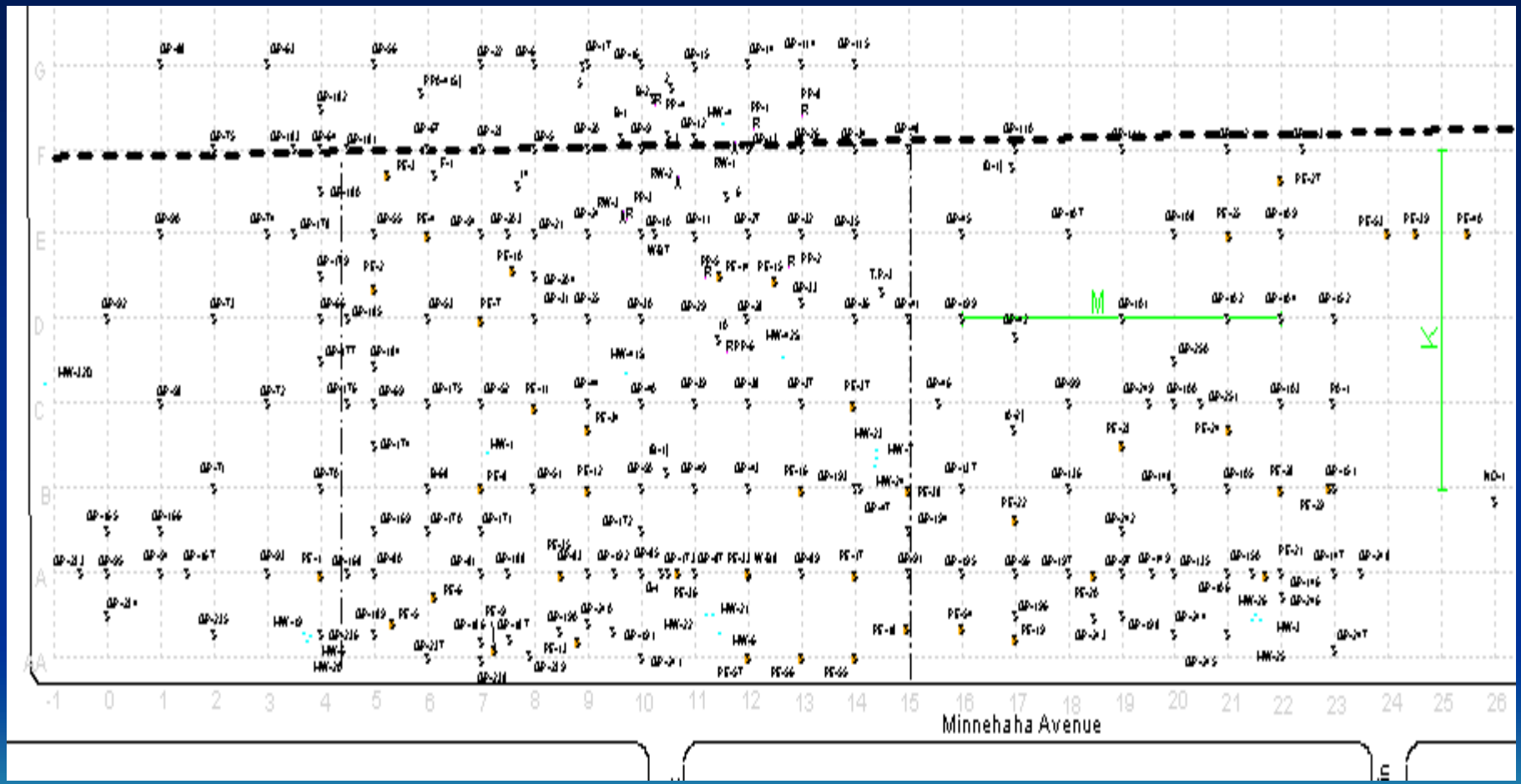
SEDIMENT FIELD SCREENING INSTRUMENTS

GROUNDWATER SAMPLING & MONITORING WELLS

INVESTIGATION STEPS

- PREPARE SUMMARY TABLES, MAPS AND CROSS SECTIONS
- DEFINE SOURCE, DEGREE, AND EXTENT OF CONTAMINATION
- COMPARE RESULTS TO CLEANUP GOALS
- CONDUCT MORE BORINGS, ETC. ETC.

Sample Locations



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SUBSURFACE BORING LOG

AET JOB NO: 03-00939 LOG OF BORING NO. PA-11 (p. 1 of 2)

PROJECT: MN

SURFACE ELEVATION 861.7

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS: PID (ppm)	DEN	LL	PL	XRF (ppm)
	Concrete Pavement		--	--	AUG	--	0.0				<100
1			13	M	SS	18					<100
2	Fill, mixture of ashes, cinders, silty sand, wood, a little gravel, and clinkers, black and dark brown										
3			5	M	SS	15	1.0				<100
4											
5		FILL	2	M	SS	12	61.0				<100
6											
7	Fill, mixture of sandy lean clay and silty sand, a little gravel, petroleum-type odor and sheen on samples, dark brown and black										
8			4	M	SS	10	81.0				<100
9											
10											
11	Sand with silt, fine grained, grayish brown, petroleum-type odor and sheen (SP-SM) (May be fill)	COARSE ALLUVIUM OR FILL	11	M	SS	16	128.0				<100
12				▼							
13	Sand with silt and gravel, fine to medium grained, grayish brown, moist to about 12.2 feet then waterbearing, petroleum-type odor and sheen (SP-SM)		14	W	SS	16	103.0				<100
14											
15			8	W	SS	16	81.0				--
16											
17		COARSE ALLUVIUM									
18	Sand with a little gravel, fine to medium grained, grayish brown, waterbearing, loose, petroleum-type odor and sheen (SP)		10	W	SS	14	132.0				<100
19											
20			0	--	SS	0	--				--
21											

DEPTH	DRILLING METHOD
0-14½'	3.25" HSA
14½-39½'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/10/01	11:20	14.0	12.0	12.8	--	12.8

BORING COMPLETED: 5/10/01

CC: SS CA: BL Rig: 33R

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

2/99

AMERICAN ENGINEERING TESTING, INC.

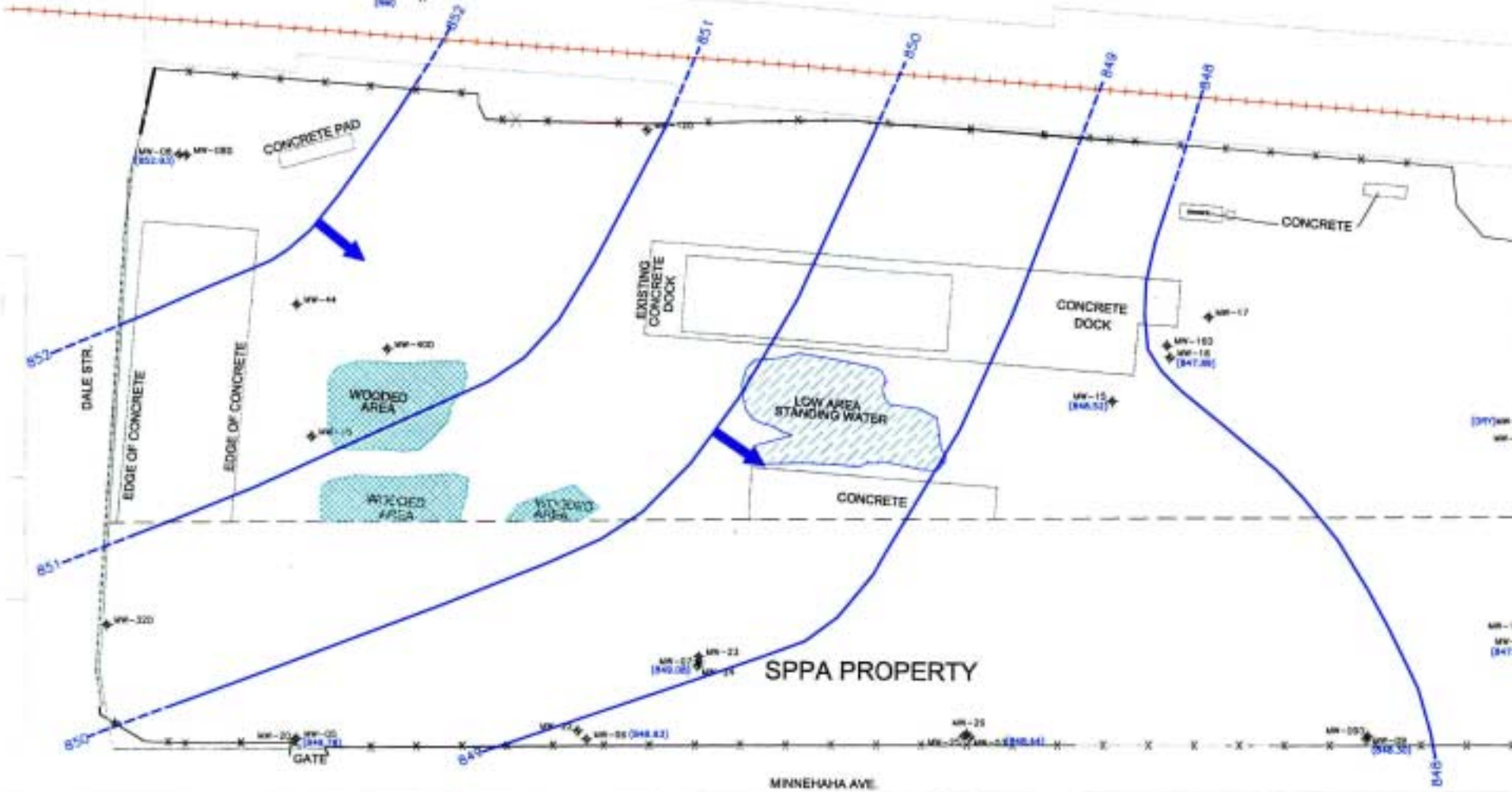
SUBSURFACE BORING LOG

AET JOB NO: 03-00939 LOG OF BORING NO. PA-11 (p. 2 of 2)

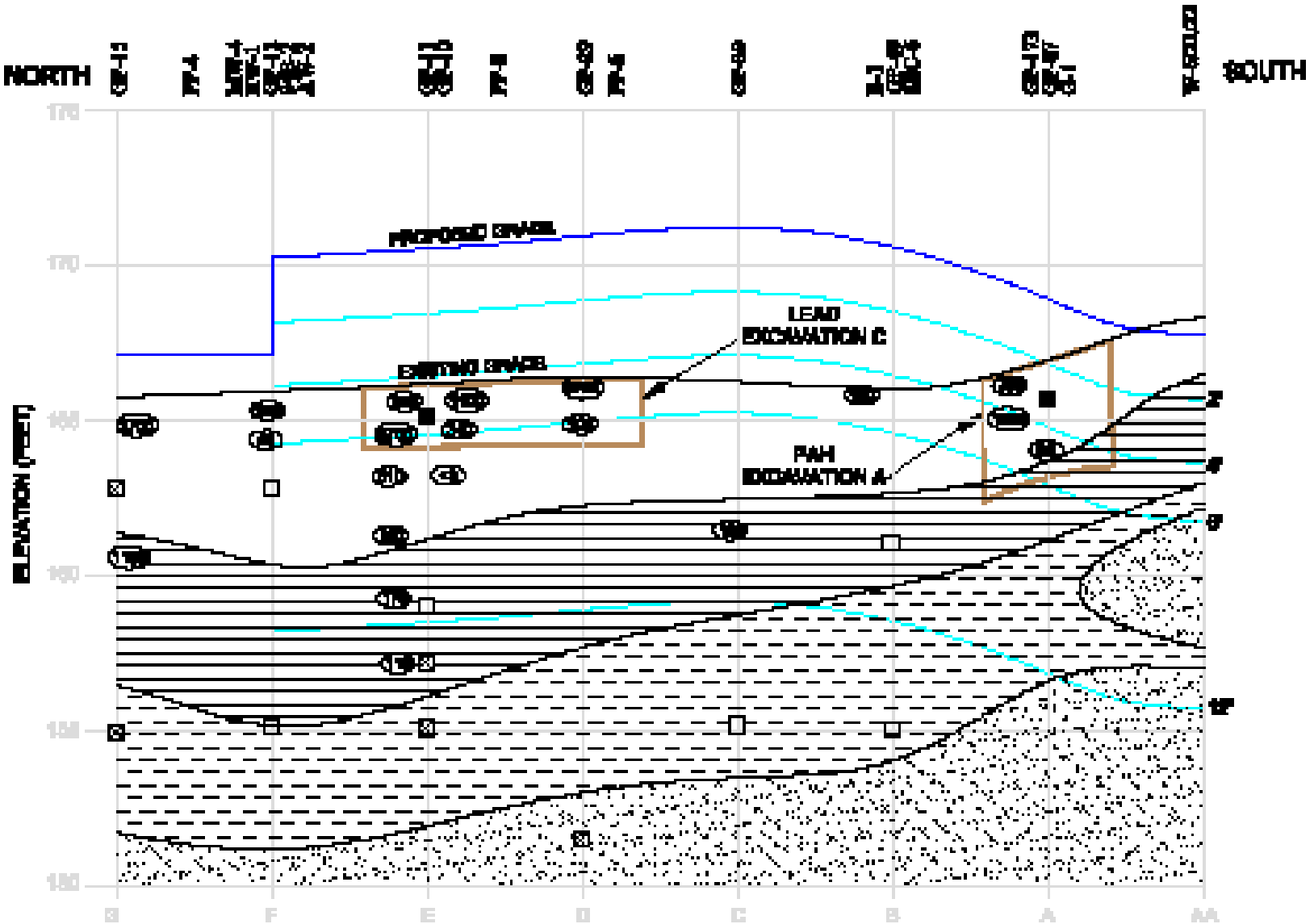
PROJECT: MN

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS PID (ppm)	DEN	LL	PL	XRF (ppm)
23			8	W	SS	10	7.0				<100
24	Sand with gravel, medium to coarse grained, brown, waterbearing, loose, lens of fine grained sand at about 23 feet										
25			7	W	SS	4	4.0				<100
26											
27											
28			7	W	SS	10	7.0				<100
29	Sand with gravel, medium to fine grained, brown, waterbearing, loose (SP)										
30		COARSE ALLUVIUM	7	W	SS	8	22.0				<100
31											
32											
33			7	W	SS	12	7.0				<100
34	Sand with a little gravel, fine to medium grained, brown, waterbearing, loose (SP)										
35			17	W	SS	0.5	—				—
36											
37											
38	Silty sand with a little gravel, fine grained, brown, waterbearing, medium dense, laminations of sand and lens of clayey sand at about 38.5 feet (SM)	MIXED ALLUVIUM OR COARSE ALLUVIUM	20	M/W	SS	16	5.0				<100
39											
40	Sandy lean clay with a little gravel, grayish brown, very stiff (CL)	TILL	22	M	SS	20	0.0				<100
41											
	END OF BORING										

2/99



From: 2004 Monitoring Report, The RETEC Group, Inc., March 2005, MPCA


NORTH
SOUTH
PROPOSED GRADE
EXISTING GRADE
LEAD
EXCAVATION C
PAH
EXCAVATION A
ELEVATION (feet)
170
160
150
140
130
G
F
E
D
C
B
A
AA

RESULTS LEAD TO REMEDIATION DECISIONS

- CONTAMINANT CHARACTER
- MAGNITUDE/QUANTITY
- EXTENT OF IMPACT
- MIGRATION POTENTIAL
- HEALTH OR ENVIRONMENTAL RISK TO POTENTIAL RECEPTORS!!

MPCA CLEANUP GOALS

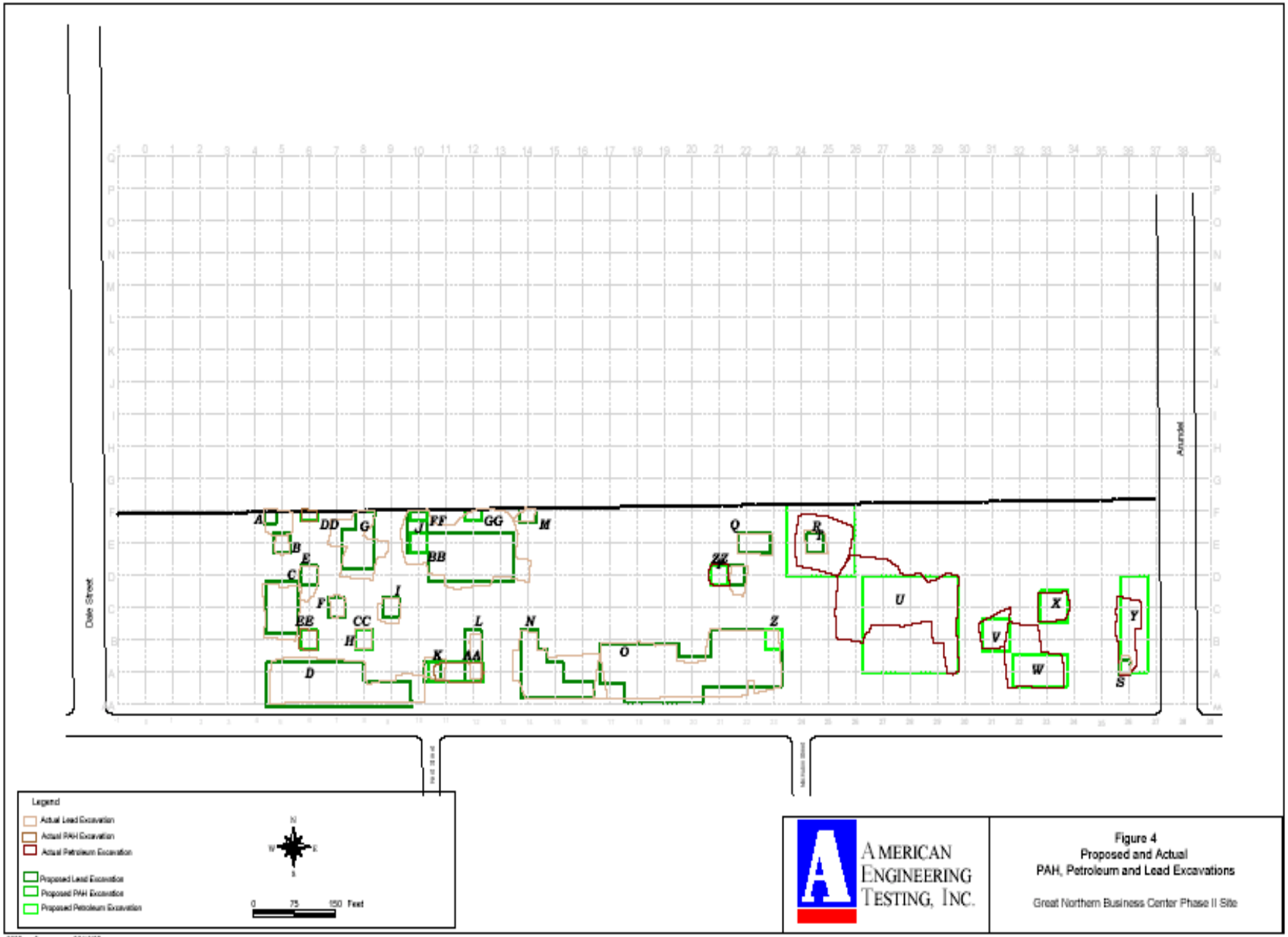
- PETROLEUM – 10 PPM ORGANIC VAPORS
- LEAD – 700 PPM
- PAHs – 4 PPM
- ASBESTOS – 0 PPM

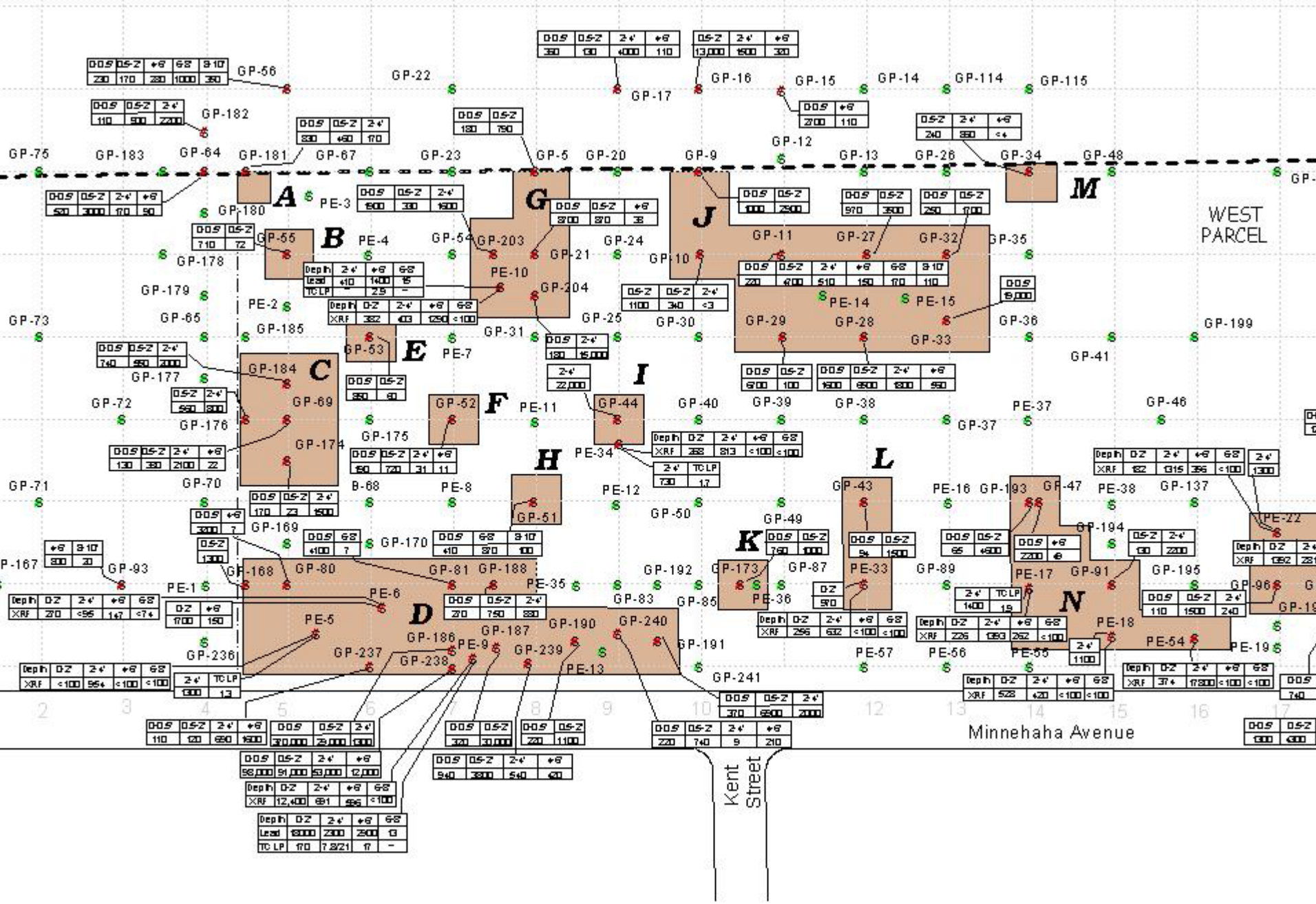
REMEDIATION TECHNOLOGIES

- Install recovery wells to pump petroleum product floating on the water table
- Air sparging and soil vapor extraction wells to reduce dissolved petroleum and solvent in sediments and groundwater
- Excavation of tar, lead, PAH, asbestos and petroleum contaminated sediments
- Natural attenuation of groundwater contamination

REMEDIATION OF SOUTHERN PART OF SITE FOR REDEVELOPMENT

- Excavation of lead, PAH, asbestos and petroleum contaminated sediments
- Lead stabilization treatment then landfill
- Natural attenuation of groundwater contamination


Dale Street
Arundel
A
DD
G
FF
GG
M
B
E
BB
C
F
I
EE
CC
H
L
N
K
AA
D
O
Q
ZZ
Z
R
U
V
X
W
Y
S
Legend
Actual Lead Excavation
Actual PAH Excavation
Actual Petroleum Excavation
Proposed Lead Excavation
Proposed PAH Excavation
Proposed Petroleum Excavation
N
W
E
S
0
75
150 Feet
AMERICAN ENGINEERING TESTING, INC.
Figure 4
Proposed and Actual
PAH, Petroleum and Lead Excavations
Great Northern Business Center Phase II Site
0205-ex-figures.apr 02/16/05

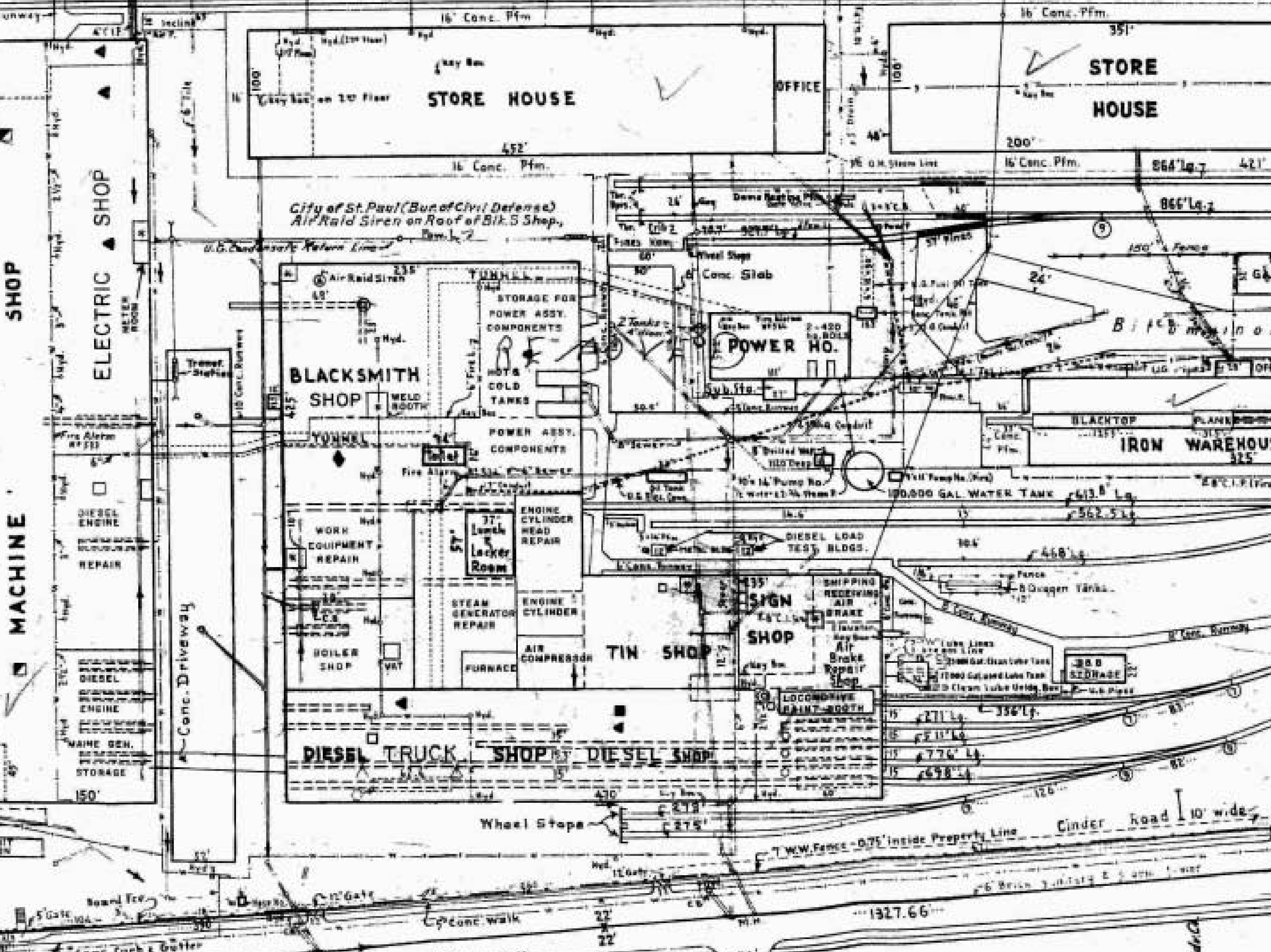

WEST PARCEL
Minnehaha Avenue
Kent Street
A
B
C
D
E
F
G
H
I
J
K
L
M
N

REMEDIATION STEPS

- Excavate to limits then stockpile
- Screen soils with field instruments while digging
- Segregate stockpiles based on screening levels
- Keep digging until meet cleanup goals
- Take confirmation samples for laboratory analysis
- Fill and compact after meeting cleanup goals
- Haul to landfill


MULTI-PURPOSE
HOMER
PAINT
BUCKET


CAT
CAT
330C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COMPONENTS
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REPAIR
Lunch
&
Locker
Room
ENGINE
CYLINDER
HEAD
REPAIR
BOILER
SHOP
VAT
STEAM
GENERATOR
REPAIR
FURNACE
ENGINE
CYLINDER
AIR
COMPRESSOR
TIN
SHOP
SIGN
SHOP
SHIPPING
RECEIVING
AIR
BRAKE
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468' Lg.
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271' Lg.
511' Lg.
776' Lg.
498' Lg.
275'
275'
STORAGE


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