IN-SITU BIOLOGICAL PERCOLATING SYSTEM FOR THE TREATMENT OF HYDROCARBON IMPACTED GROUNDWATER

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Outline

- Site History
- Geology/Contaminant Situation
- Remediation System
- BPS Design
- BPS Installation
- BPS Performance Data

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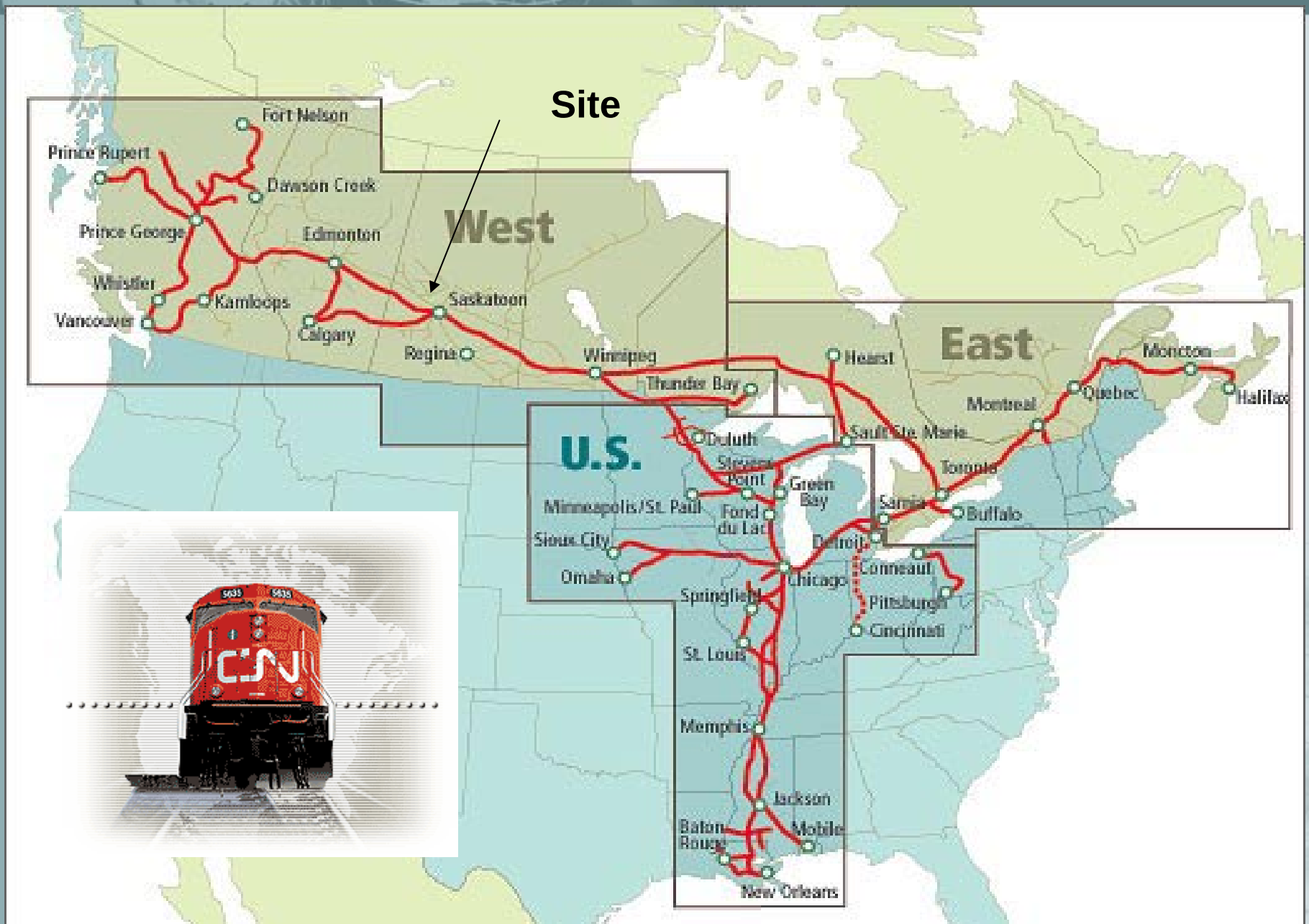
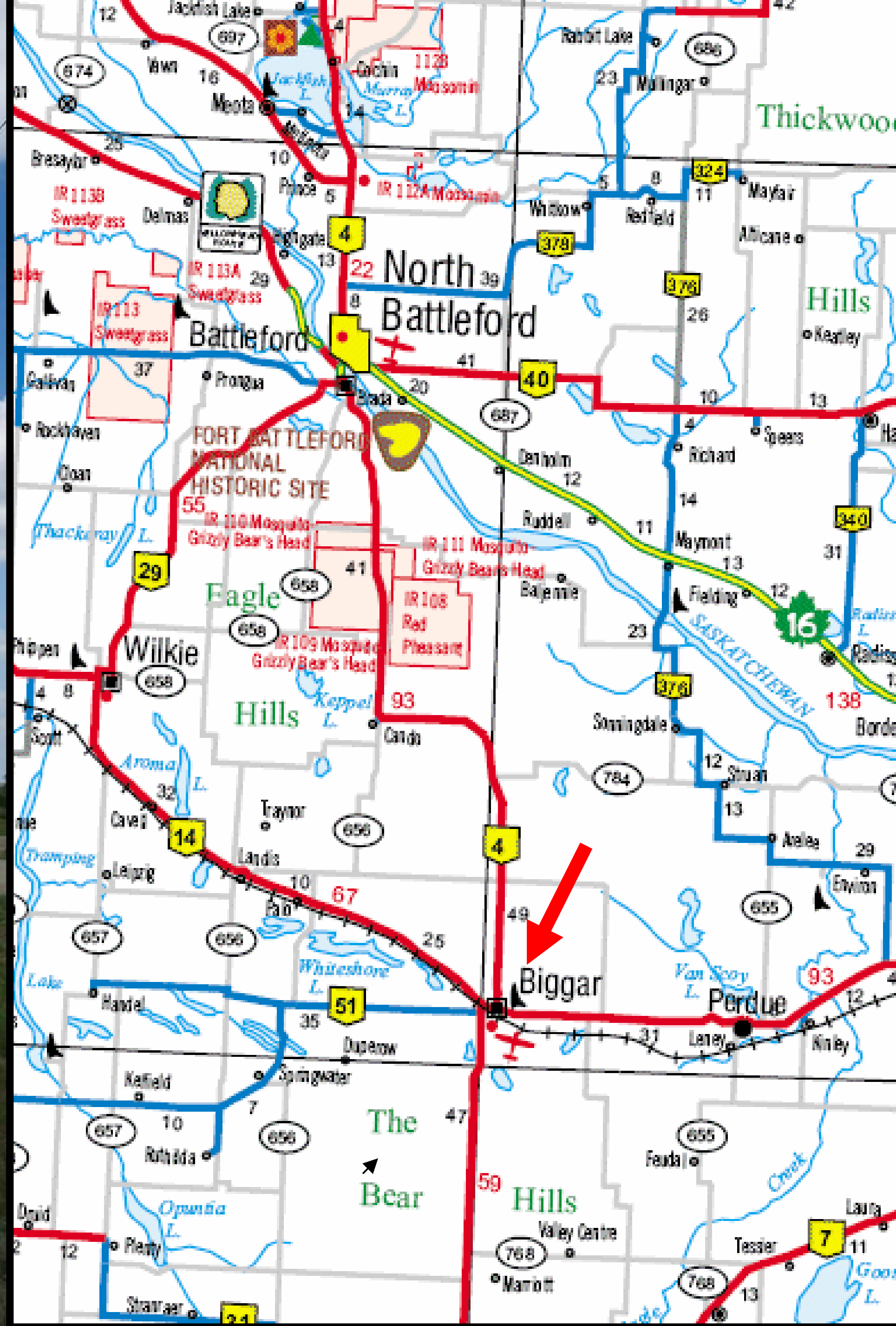
CN Operating Regions

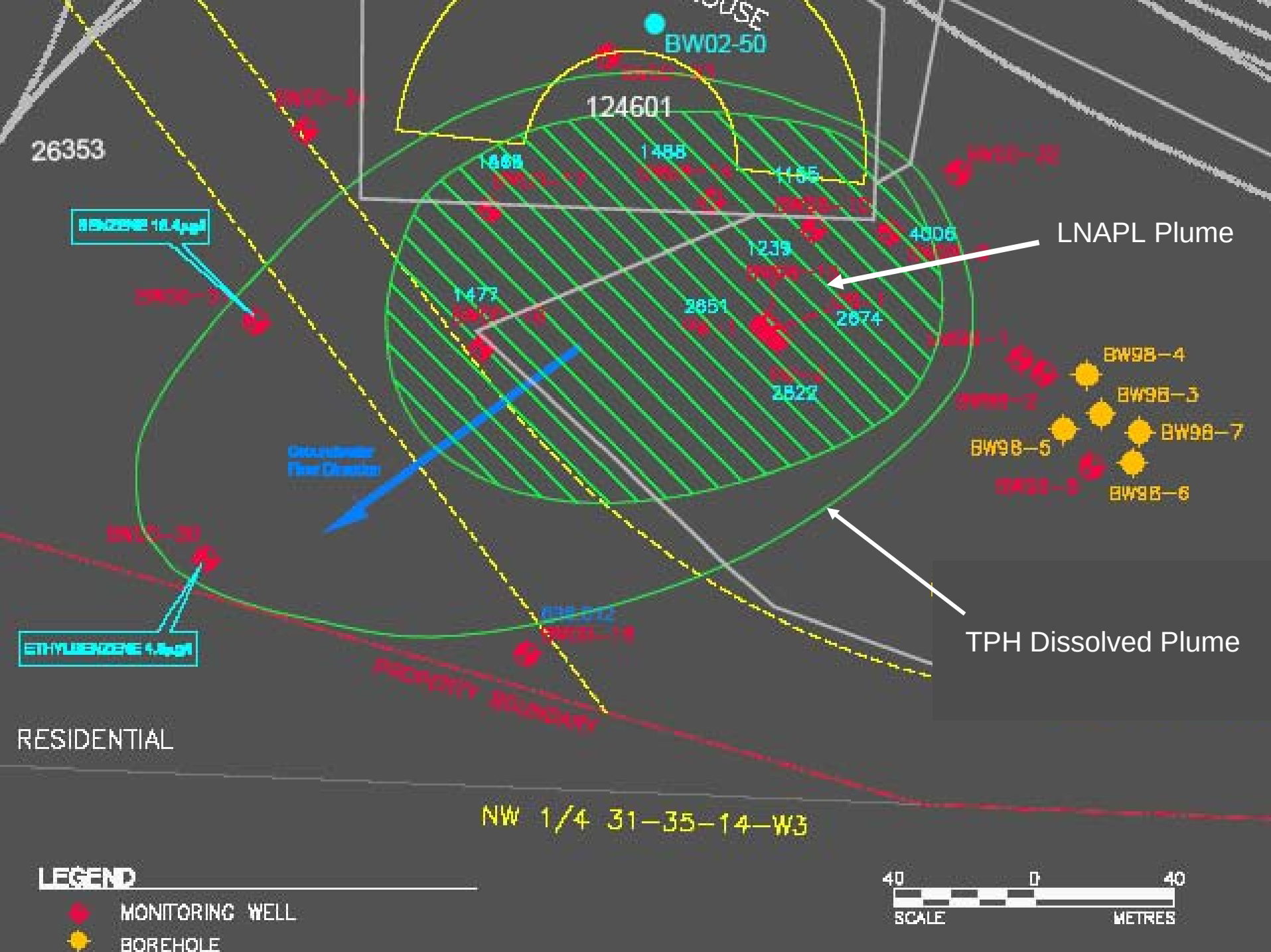



NEW YORK IS BIG...
BIGGAR
SASKATCHEWAN
BUT THIS IS BIGGAR
BIGGAR MUSEUM &GALLERY
PAST & PRESENTS
GIFT SHOP
105 3rd AVE WEST


North
Battleford
Battleford
FORT BATTLEFORD
NATIONAL
HISTORIC SITE
Wilkie
Eagle
Hills
Biggar
Perdue
The
Bear
Hills
Thickwood
Hills
SASKATCHEWAN
Meota
Delmas
Denholm
Ruddell
Maymont
Fielding
Richard
Sonningdale
Landis
Traynor
Cando
Cavell
Leipzig
Scott
Handel
Duperow
Springwater
Kelfield
Rutherfield
Valley Centre
Marriott
Feudal
Tessier
Keppel L.
Aroma L.
Whiteshore L.
Van Scoy L.
Opuntia L.

History

- Former Roundhouse (locomotive maintenance activities)
- CN’s main above ground fuel storage tanks from 1960’s to 1980’s
- Now a poultry rearing operation
- Phase I & II investigations between 1997 to 2001


BW02-50
124601
26353
1868
1488
1135
4006
1239
1473
2651
2674
2822
BW98-4
BW98-3
BW98-7
BW98-5
BW98-6
LNAPL Plume
TPH Dissolved Plume
RESIDENTIAL
NW 1/4 31-35-14-W3
LEGEND
MONITORING WELL
BOREHOLE
40
0
40
SCALE
METRES

Geology/Contaminant Situation

- > than 24 m of clayey silt (till) with alternating beds of sand, silt and gravel.
- water table between 15 and 18 m belowground surface.
- hydraulic conductivity of 1.6×10^{-5} m/s.
- approximately 500,000 liters of light non-aqueous phase liquid (LNAPL) in the form of diesel fuel is present in the subsurface over an area of 16,000 m^2.
- Groundwater recovered on-site for livestock watering
- Dissolved BTEX groundwater plume migrating toward property boundary

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Assessment of Remedial Options

- Two insitu remediation options were considered
  - Conventional pumping
  - Vacuum Enhanced Recovery (VER)
- Pilot Testing in 2002 determined that both technologies were feasible but higher recovery rates were predicted for the VER option
- A VER System was installed in 2003/2004

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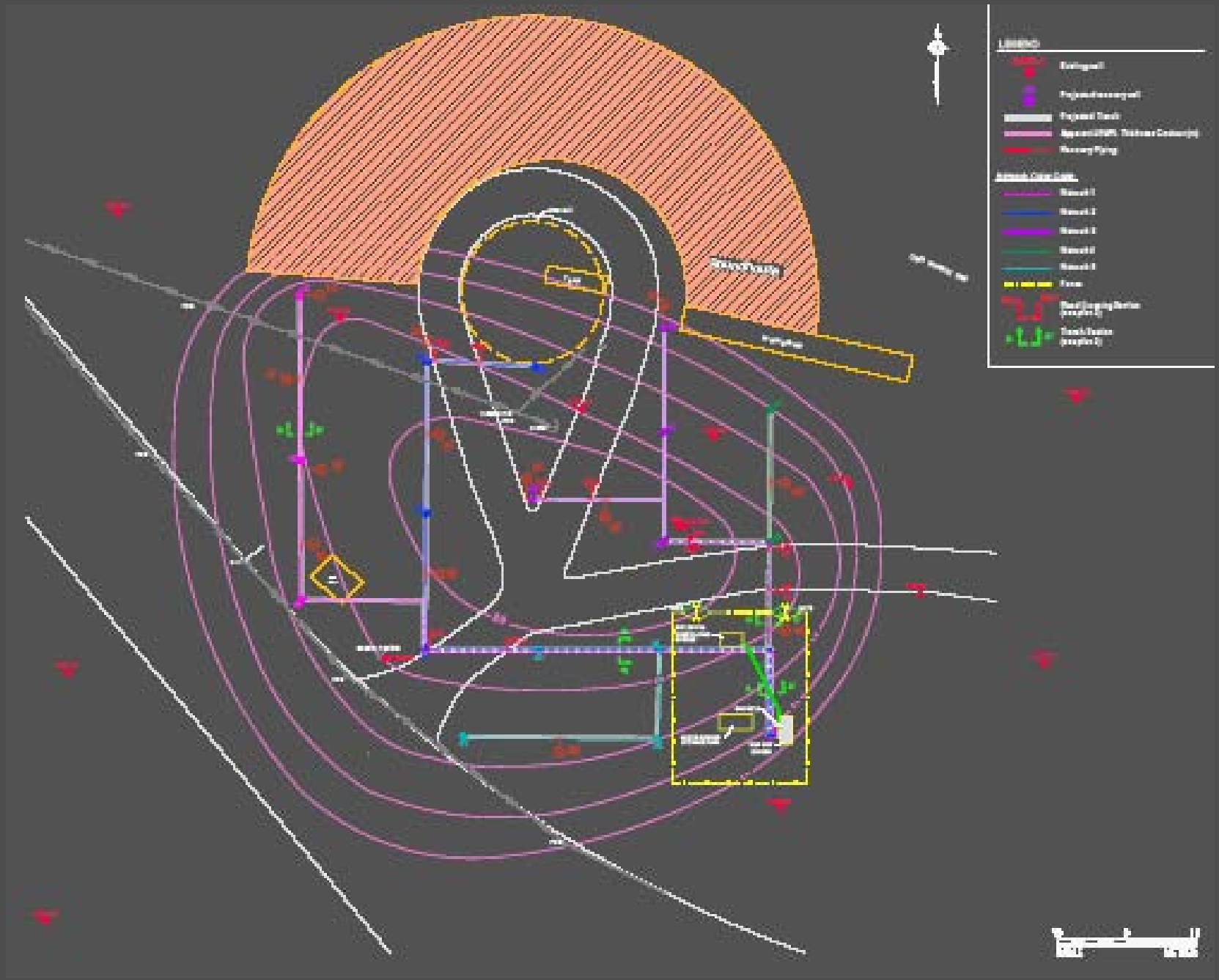
LEGEND:

VER System Components

- 40 Hp Liquid ring vacuum pump
- Inlet manifold air/water and diesel
- Air/liquid separator
- Settling Tank
- Oil/water separator
- Air compressor
- Diesel AST
- Biological Percolating System

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VER System Installation

Non winterized system
7 months/year

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SLOP
OIL


KIMRI
EYE WASH

Biological Percolating Filter (BPS)

- A BPS was selected as the preferred effluent treatment and became operational in May 2004. The advantages of biofiltration are:
  - Less expensive than treating effluent water with activated carbon;
  - Reduced energy and maintenance costs; and
  - Ideal for remote locations and provides a “close loop” operating system.

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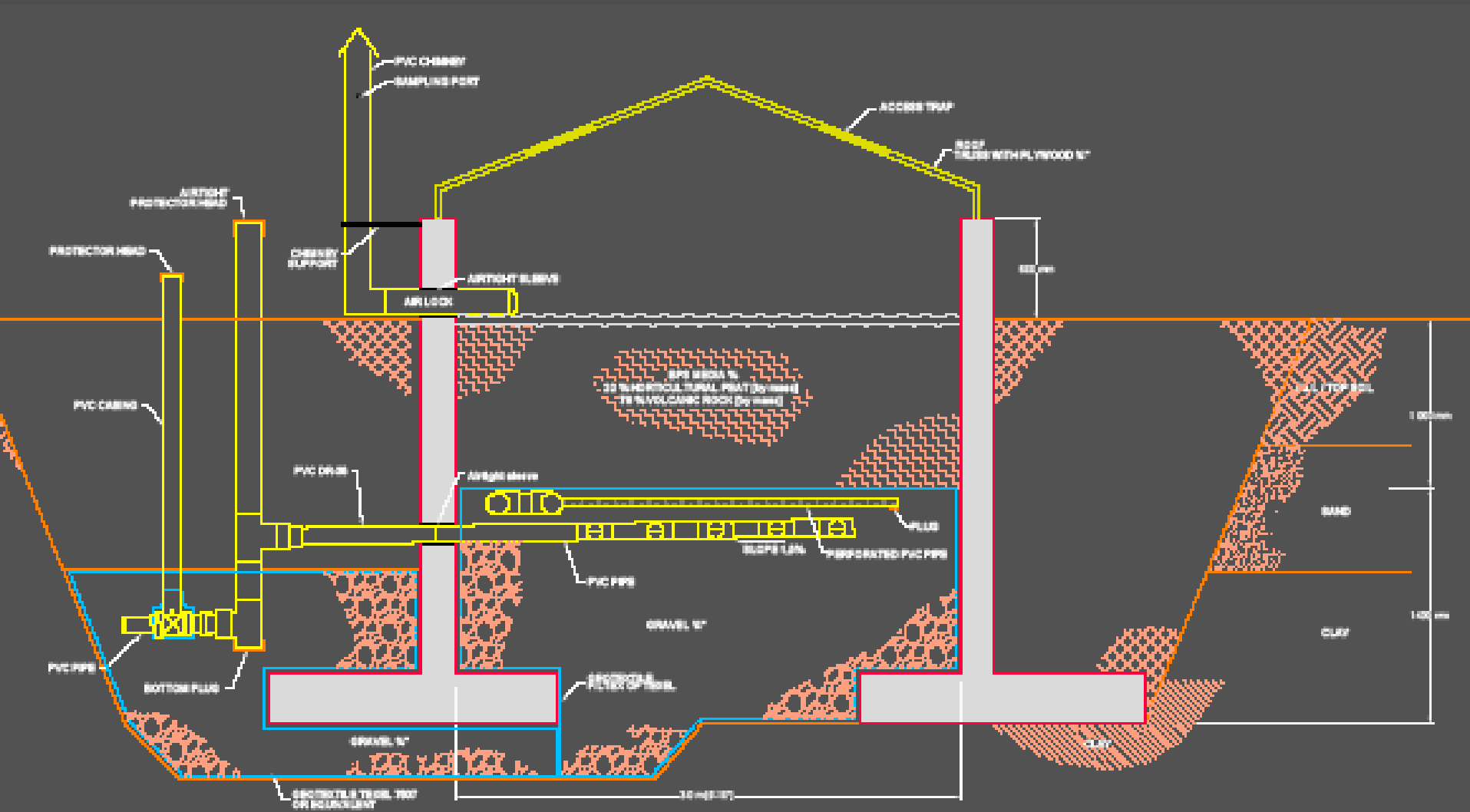
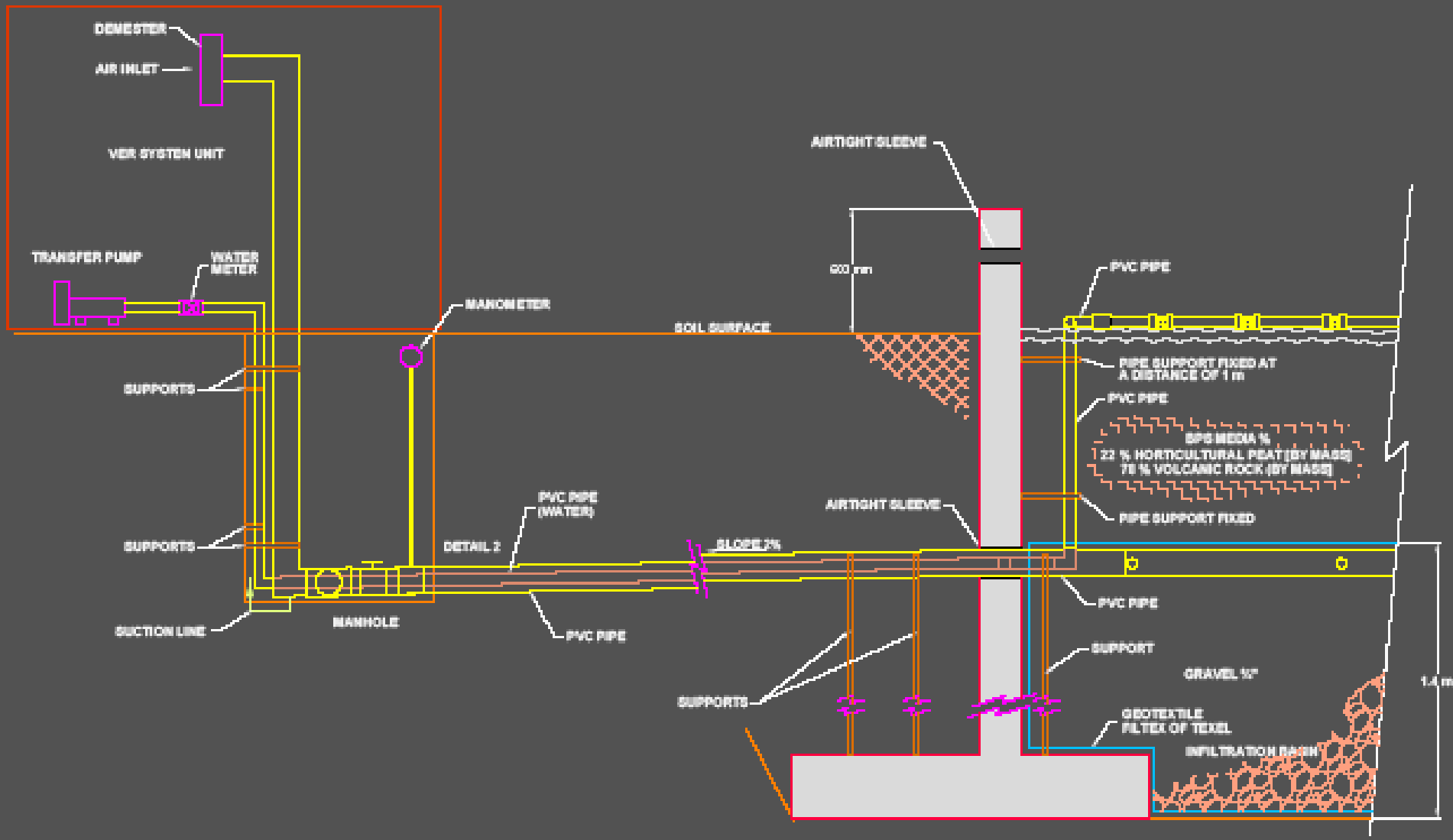
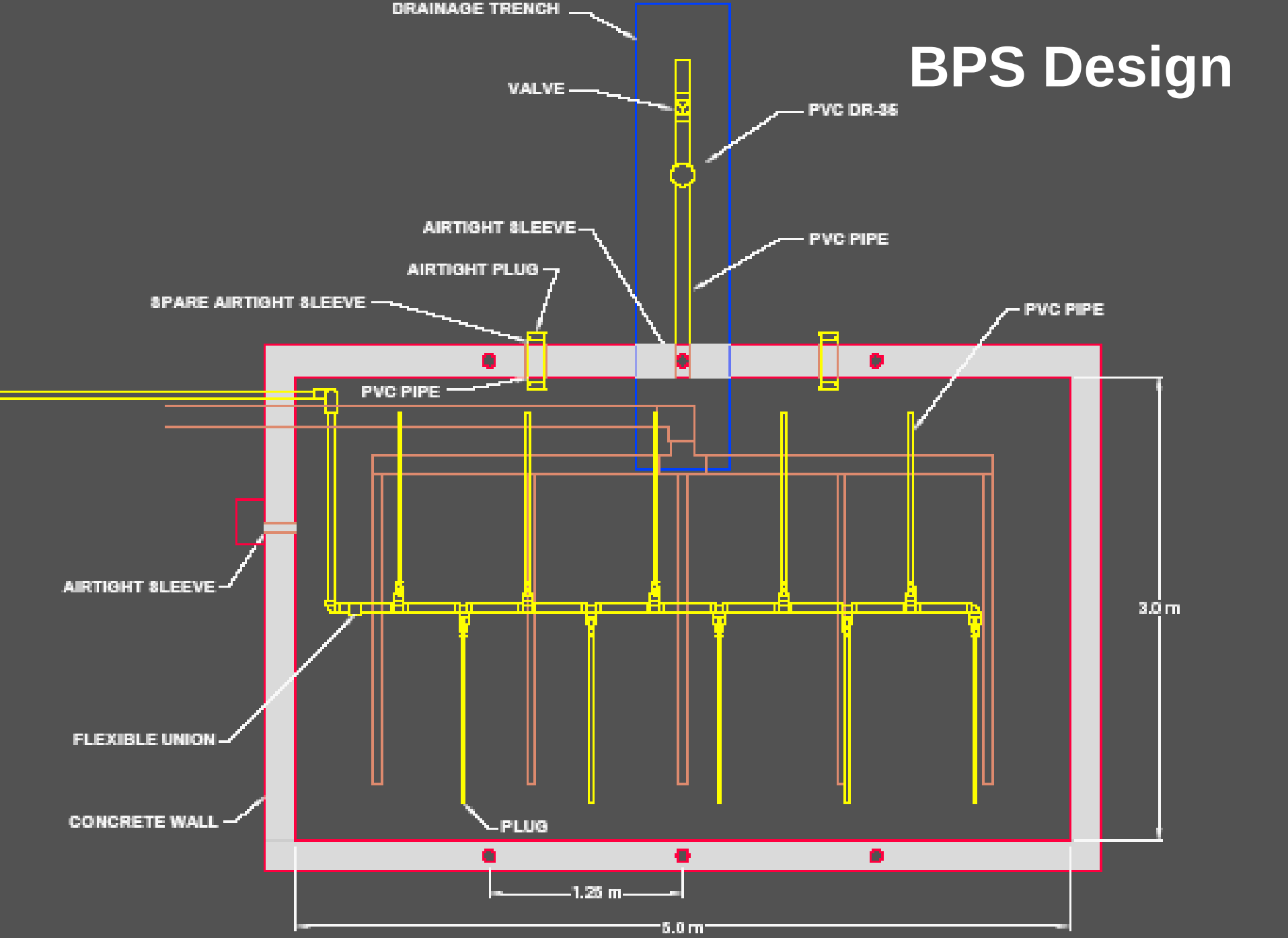
BPS Design


PVC CHIMNEY
SAMPLING PORT
ACCESS TRAP
AIRTIGHT PROTECTOR HEAD
PROTECTOR HEAD
CHIMNEY SUPPORT
AIRTIGHT SLEEVE
AIR LOCK
PVC CASING
PVC DRUM
Airtight sleeve
PLUG
SLOPE 1.5%
PERFORATED PVC PIPE
PVC PIPE
GRAVEL
SAND
CLAY
PVC PIPE
BOTTOM PLUG
GRAVEL

BPS Design


DEMESTER
AIR INLET
VER SYSTEM UNIT
TRANSFER PUMP
WATER METER
MANOMETER
SOIL SURFACE
SUPPORTS
SUPPORTS
SUCTION LINE
MANHOLE
DETAIL 2
PVC PIPE (WATER)
PVC PIPE
SLOPE 2%
AIRTIGHT SLEEVE
AIRTIGHT SLEEVE
PVC PIPE
PIPE SUPPORT FIXED AT A DISTANCE OF 1 m
PVC PIPE
BPS MEDIA %
22 % HORTICULTURAL PEAT (BY MASS)
78 % VOLCANIC ROCK (BY MASS)
PIPE SUPPORT FIXED
PVC PIPE
SUPPORT
GRAVEL ½"
SUPPORTS
GEOTEXTILE FILTEX OF TEXEL
INFILTRATION BASIN
1.4 m

BPS Design


DRAINAGE TRENCH
VALVE
PVC DR-35
AIRTIGHT SLEEVE
PVC PIPE
AIRTIGHT PLUG
SPARE AIRTIGHT SLEEVE
PVC PIPE
PVC PIPE
AIRTIGHT SLEEVE
FLEXIBLE UNION
CONCRETE WALL
PLUG
3.0 m
1.25 m
5.0 m

BPS Installation

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BPS Installation

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Percolating Filter System For Treatment of Extracted Vapours and Water

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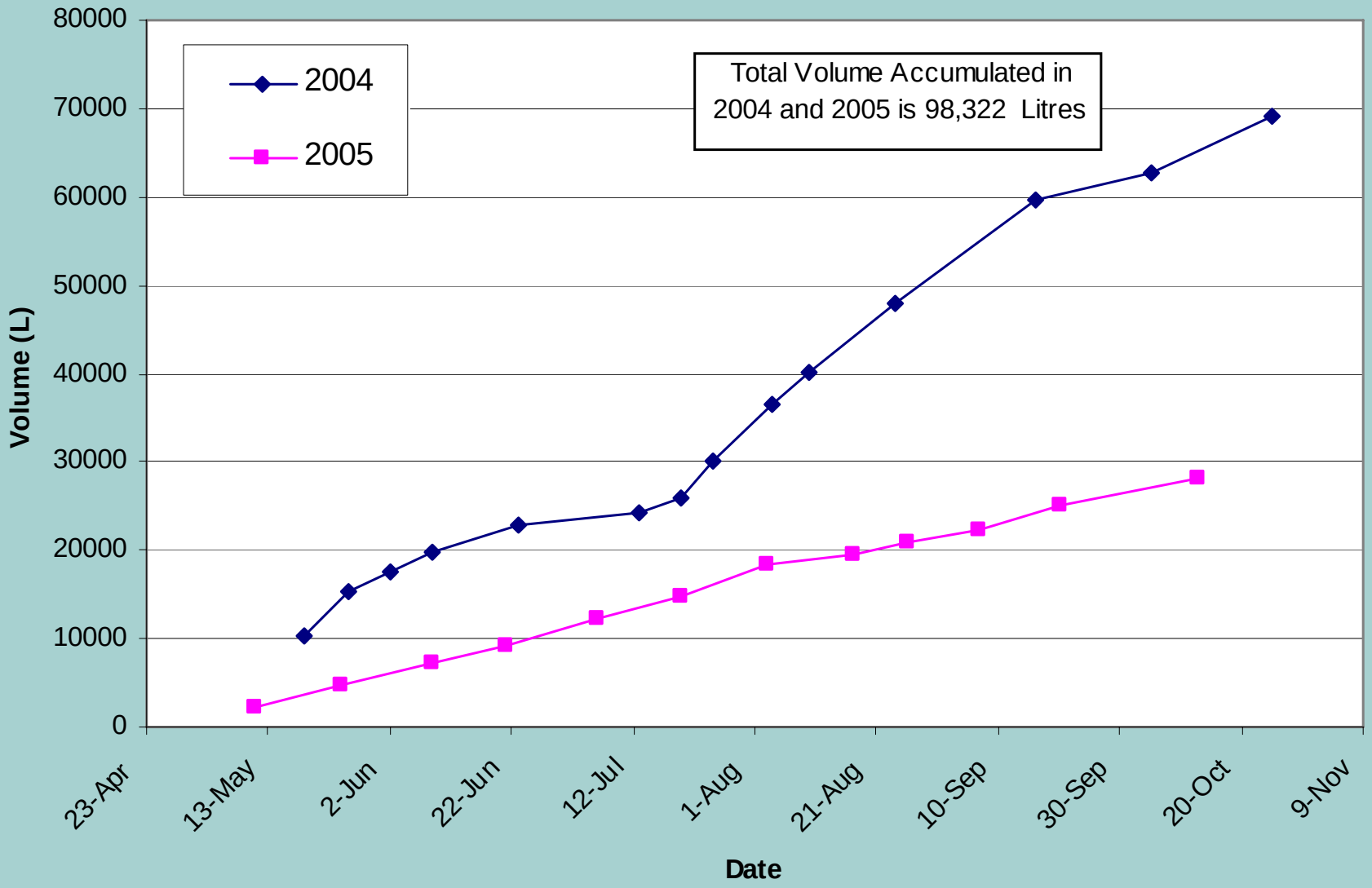
Cumulated Product Volume Versus Time



VER Performance

Year	Vapour (L)	Aqueous (L)	Product (L)	Total (L)
2004	666	24.9	69,065	69,756
2005	413	44.8	28,089	28,566
Total	1079	69.7	97,154	98,322

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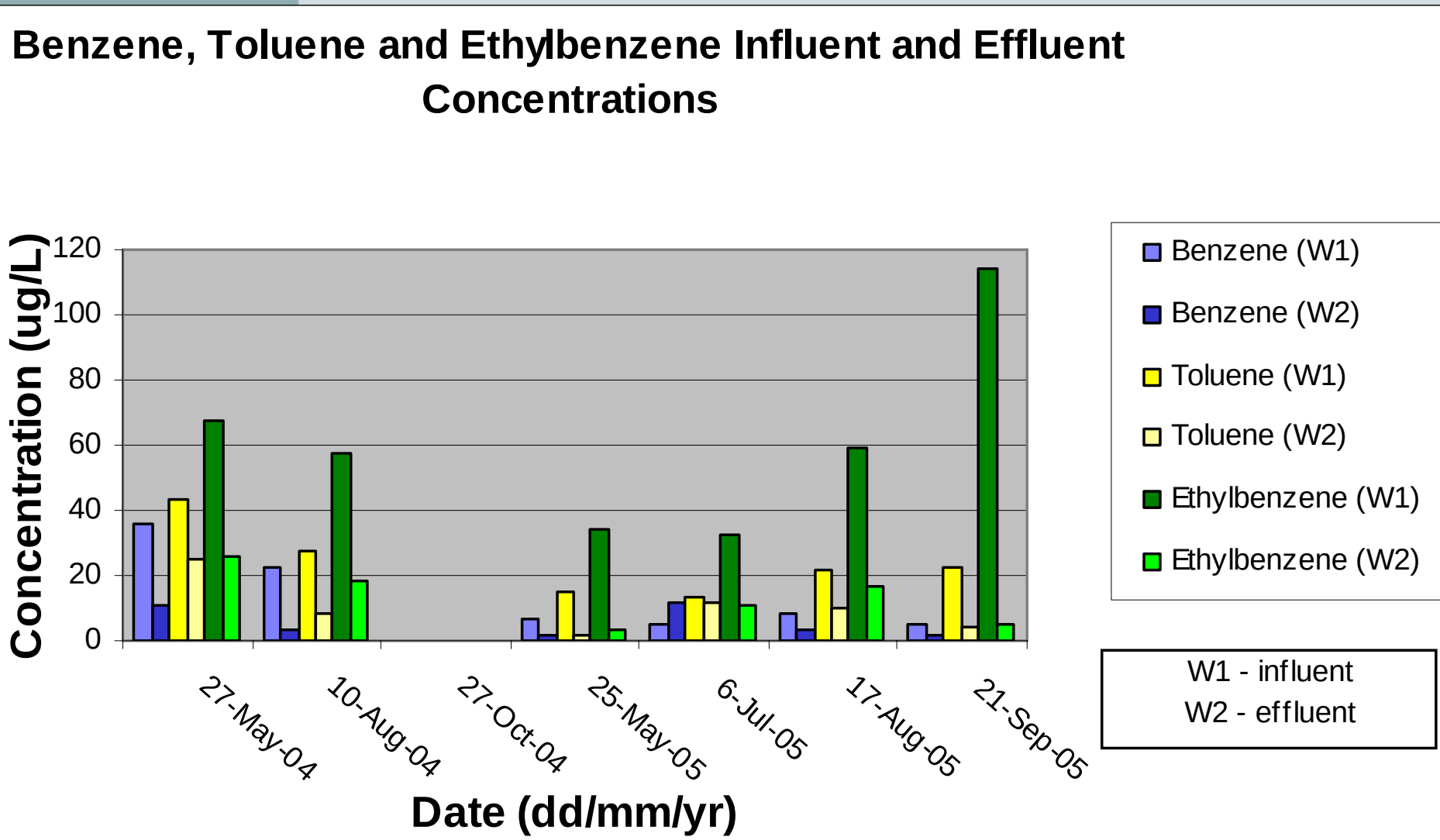
BPS Performance



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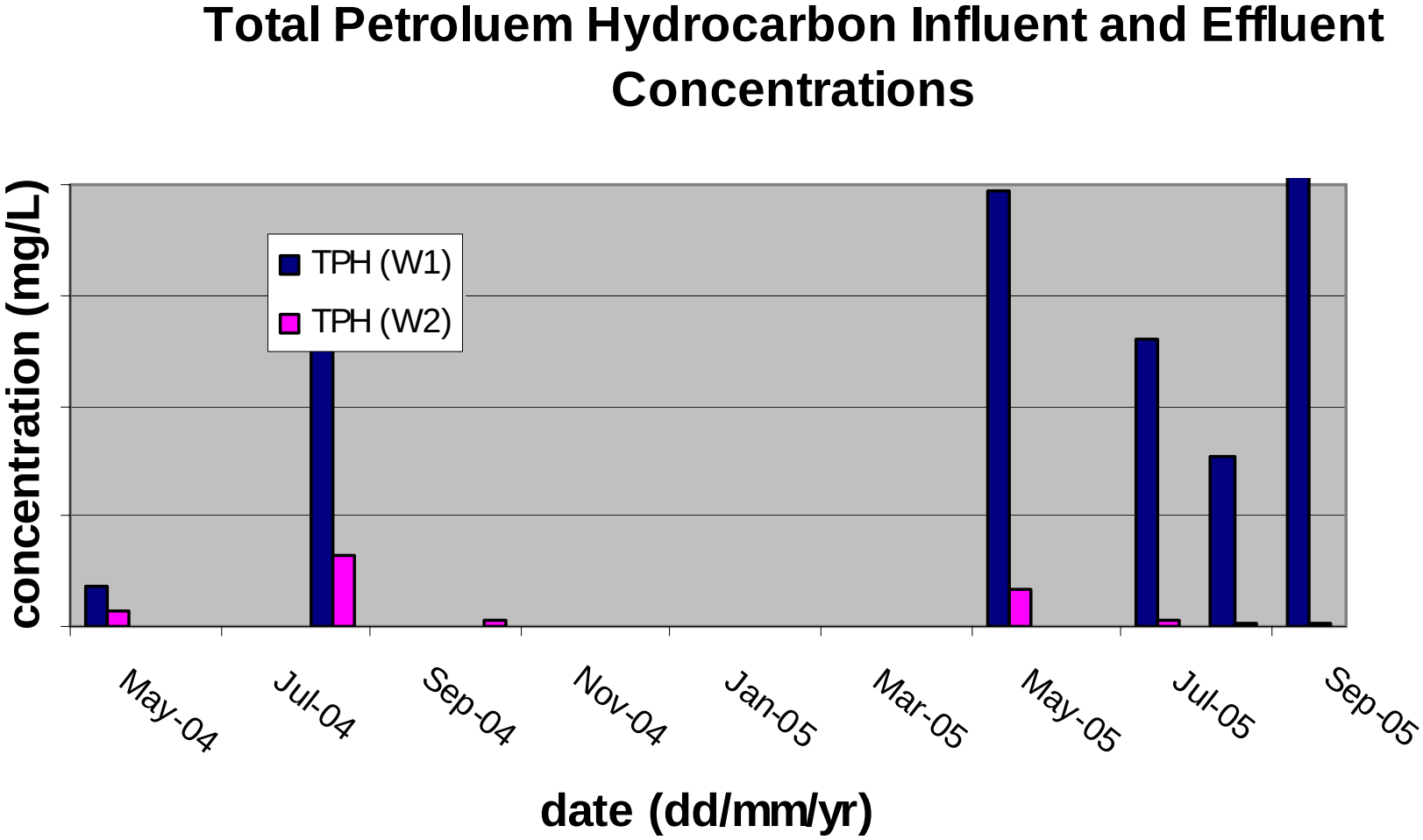
BPS Performance



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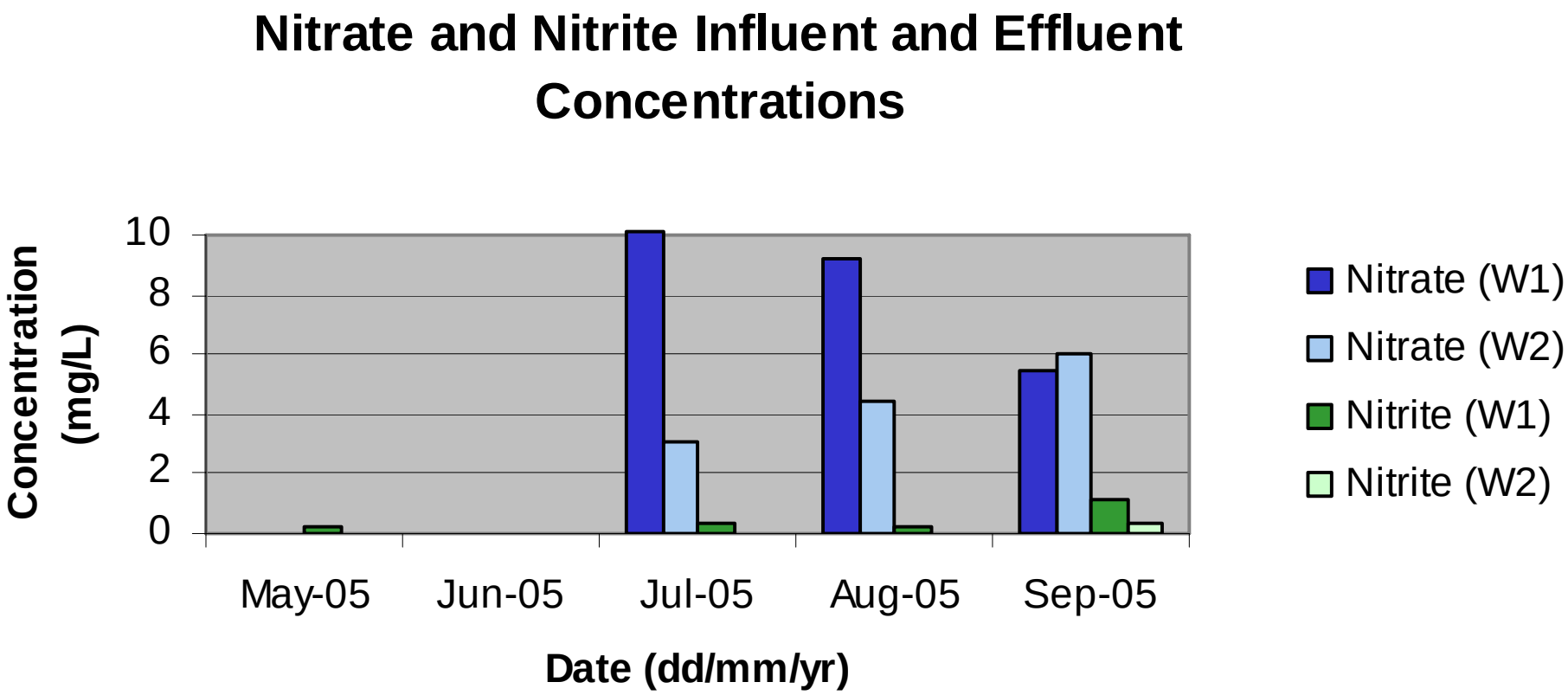
Nutrient Concentrations



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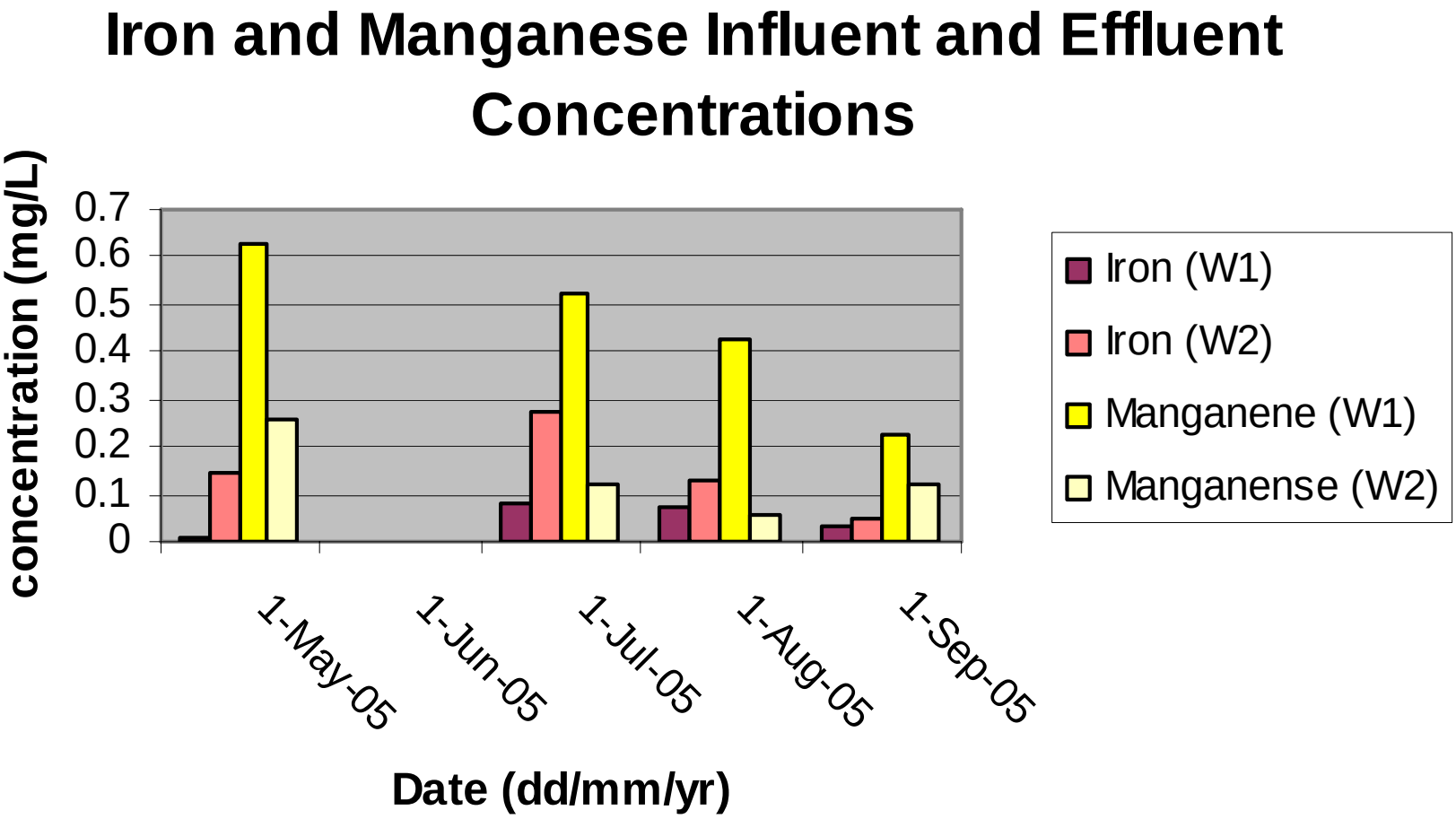
Iron and Manganese Concentrations



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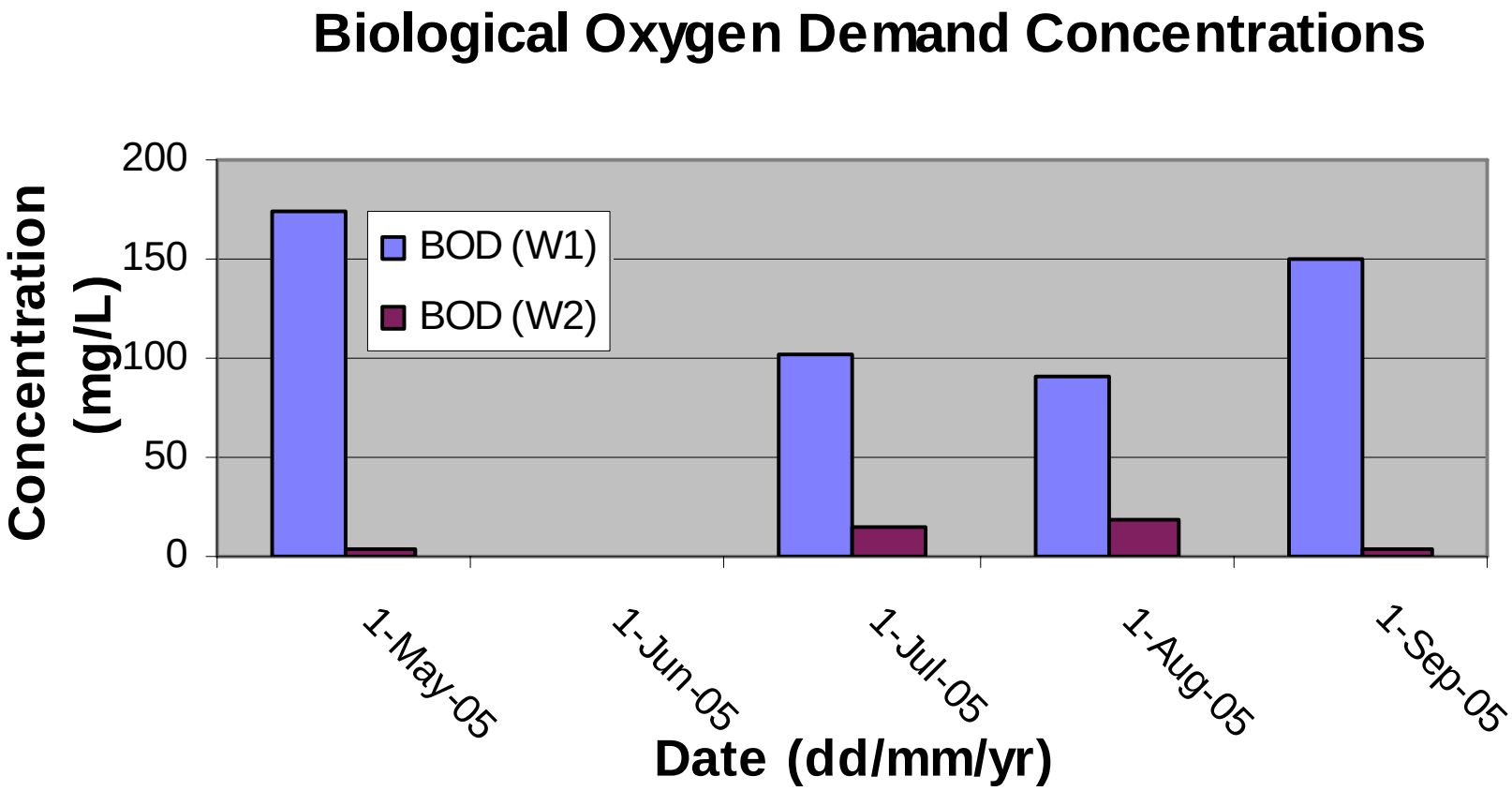
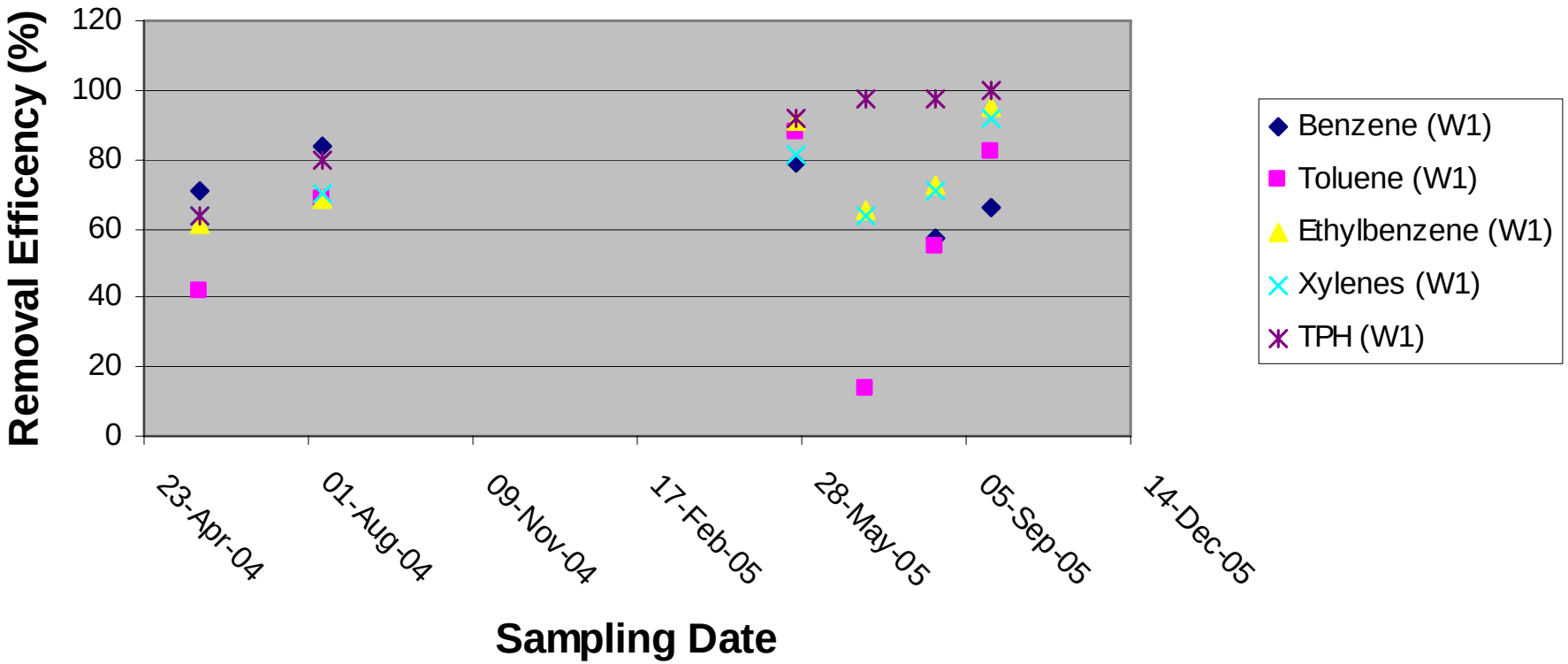
Biological Oxygen Deman



BPS Performance



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Conclusions

- The VER system continued to recover approximately 10,000 litres per month in 2004 and 5000 litres per month in 2005 of diesel from the subsurface during the operating period
- Approximately 85% of the recovered diesel was sold locally as heating fuel
- The results for the 2004/2005 operating period showed that the treatment level of the BPS steadily improved over a six month operating period as biomass grew and acclimatized in the filter matrix.
- Chemical concentrations of pH, conductivity, alkalinity, total dissolved solids, sulphate, chloride, sodium, calcium, potassium did not change during treatment
- Nitrate/Nitrite concentration were reduced

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Conclusions

- Iron concentrations increased, manganese concentration decreased
- Results in 2004/2005 demonstrated an average 80% mass removal of dissolved hydrocarbons by the BPS and suggests that a fully acclimatized BPS is capable of meeting the potable groundwater or groundwater ingestion guidelines for benzene, toluene, xylenes and petroleum hydrocarbon fractions at this Site.
- Ethylbenzene potable guideline was not achieved
- BPS has offered a cost effective treatment option for this Site

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QUESTIONS