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Scenario Selection for Attenuation Processes Presentation

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Prepared by
KRCEE TCE Fate and Transport Working Group

Presentation to
PGDP TCE Fate and Transport Project Team

October 2006

Draft Analysis for PGDP Groundwater Plumes Utilizing the Scenarios Evaluation Tool for Chlorinated Solvent MNA, WSRC-STI-2006-00096, Rev. 1

Scenario Selection

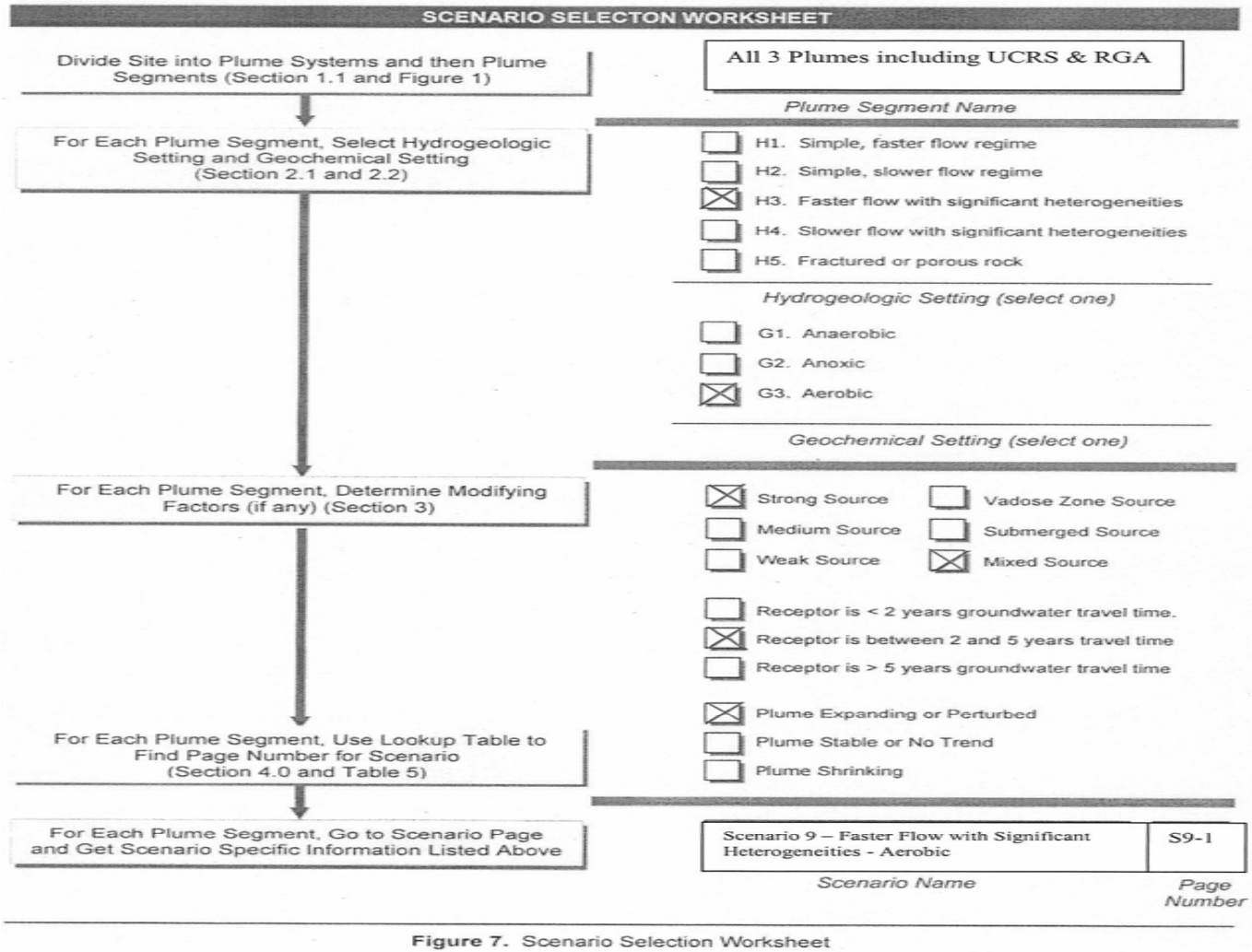


Figure 7. Scenario Selection Worksheet

Scenario Selection: Primary Factor

- Hydrogeological Setting

TABLE 2. Hydrogeologic Settings in Scenarios Approach

Hydrogeologic Setting	Description
H1. Simple, faster flow regime	Sandy or gravelly aquifers where the plume is primarily in one hydrologic unit (simple geology)
H2. Simple, slower flow regime	Silty or silty sand aquifers where the plume is primarily in one hydrologic unit (simple geology)
X H3. Faster flow with significant heterogeneities	Layers of sand or gravel and aquitards of silt or clay/outwash and till geology (alluvial, glacial, river basin)
H4. Slower flow with significant heterogeneities	Layers of silt or silty sand and aquitards of silt or clay/till geology (alluvial, glacial, river basin)
H5. Fractured or porous rock	Plumes where the primary migration is through consolidated material

Five hydrogeologic units composing the UCRS and RGA have been identified by previous investigations. The RGA also exhibits zones of high and low contaminant concentrations indicating preferential flow paths exist within it. Flow velocities of 1' - 3'/day.

Scenario Selection: Primary Factor

- Geochemical Settings

TABLE 3. Geochemical Settings in Scenarios Approach

Geochemical Environment	Description (see note below about use of these values)
G1. Anaerobic	Average dissolved oxygen concentration < ~1 mg/L (if meter) or < ~0.5 mg/L (if test kit); **AND** Sulfate concentration < ~ 50 mg/L; (value applies to most but not all sites) **AND** Nitrate < ~1 mg/L; **AND** Methane OR ferrous iron OR sulfide must be detected in most of the wells; **AND** TOC > ~5 mg/L; **AND** Dechlorination products must be present in the plume
G2. Anoxic	Average dissolved oxygen concentration < ~2 mg/L (by meter or by test kit); **AND** Plume doesn't meet all of the anaerobic indicators
G3. Aerobic	Average dissolved oxygen concentration > ~2 mg/L (by meter or by test kit); **AND** Plume doesn't meet ANY of the anaerobic indicators

X

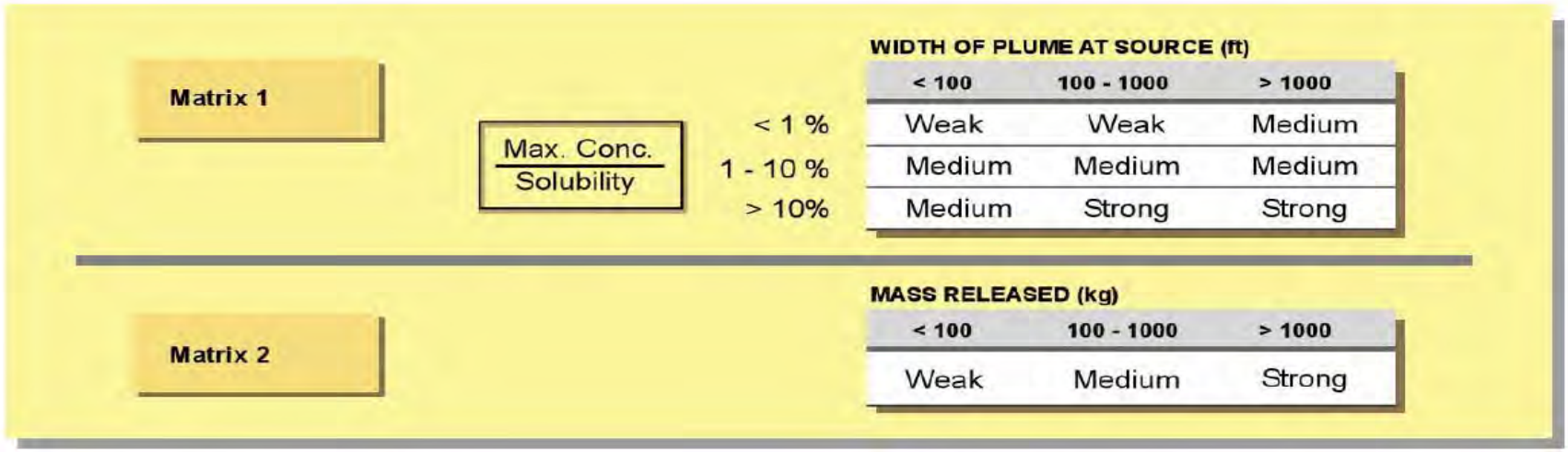
- Dissolved Oxygen – Average 4.5 mg/L*
- Anaerobic Outliers: Sulfate – Average 17 mg/L*

  Total Organic Carbon – Average 1.2 mg/L*

* Data obtained from TCE Biodegradation – Initial Site Screening, August 2006 (B. Phillips Presentation)

Scenario Selection: Modifying Factors

- Source Strength
  - Strong



•Matrix 1: 701 ppm/1100ppm *100 = 64%

NW Plume is ~180' wide at northwest corner of C-400 Building

•Matrix 2: Estimated at 70,000 gallons or 385,000kg

Scenario Selection: Modifying Factors

- Source Type: Mixed Source
- Possible Source Types:
  - Vadose Zone Sources
  - Submerged Sources
  - X – Mixed Vadose/Submerged Sources
- Validation
  - TCE source at the C-400 area exists in both the UCRS and the RGA.

Scenario Selection: Modifying Factors

- Location of Receptors/Travel Time
  - Receptor is < 2 years groundwater travel time
  - **X** – Receptor is between 2 and 5 years travel time
  - Receptor is >5 years travel time
- Validation:
  - RGA groundwater velocity 1’ to 3’ per day
  - Distance to DOE property boundary: 5250’
  - Distance to Wildlife Management Office: 7650’
  - Travel time to DOE property boundary @ 3’/day: ~4.8 years
  - Travel time to Wildlife Management Office @ 3’/day: ~7 years

Scenario Selection: Modifying Factors

- Plume Stability
  - **X** – Plume Expanding or Perturbed
  - – Plume Stable or No Trend
  - – Plume Shrinking
- Validation: Two pump & treat operations have been ongoing for approximately 10 years. The operations remove mass from the high concentration zones of the Northwest and Northeast plumes.

Scenario Selection

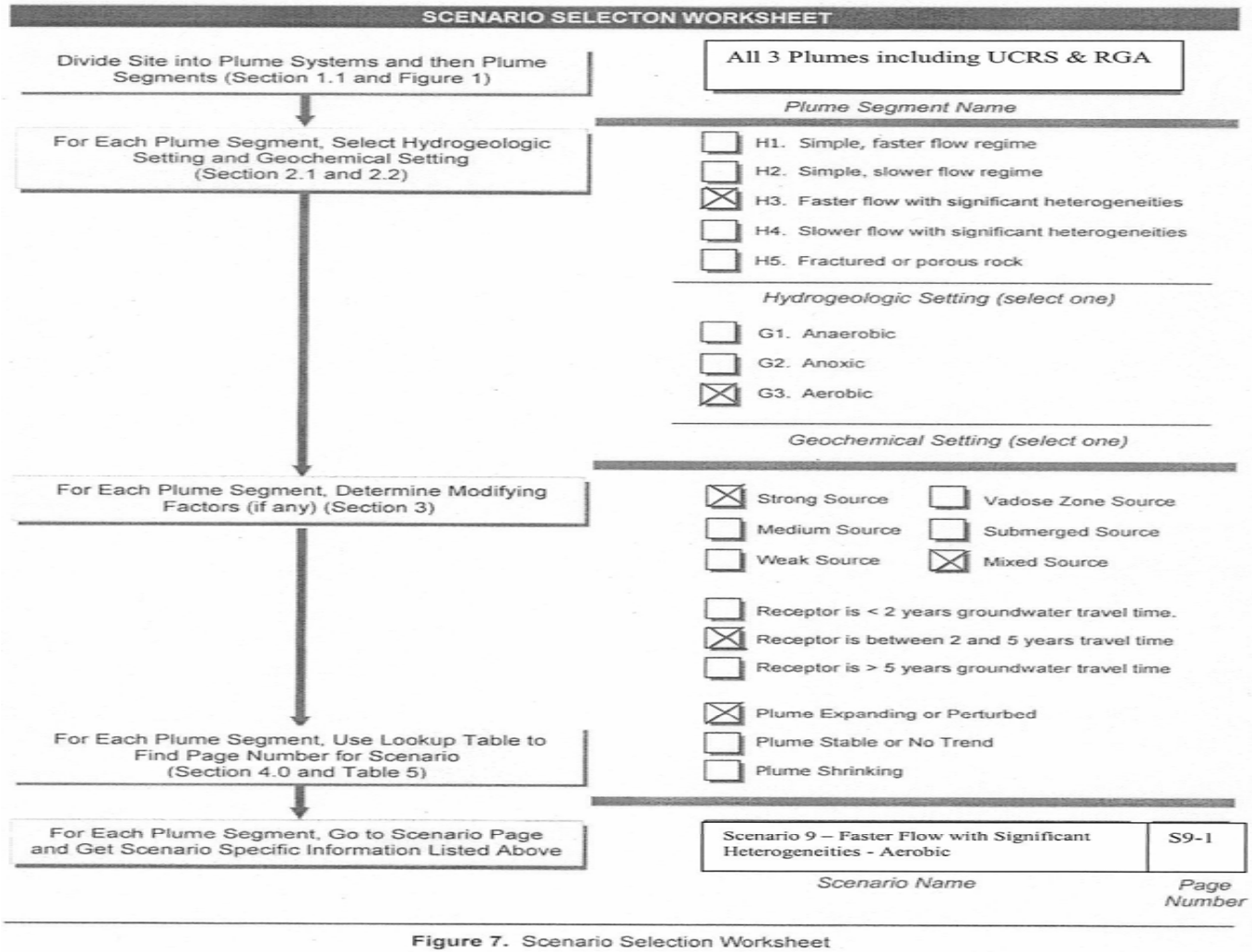
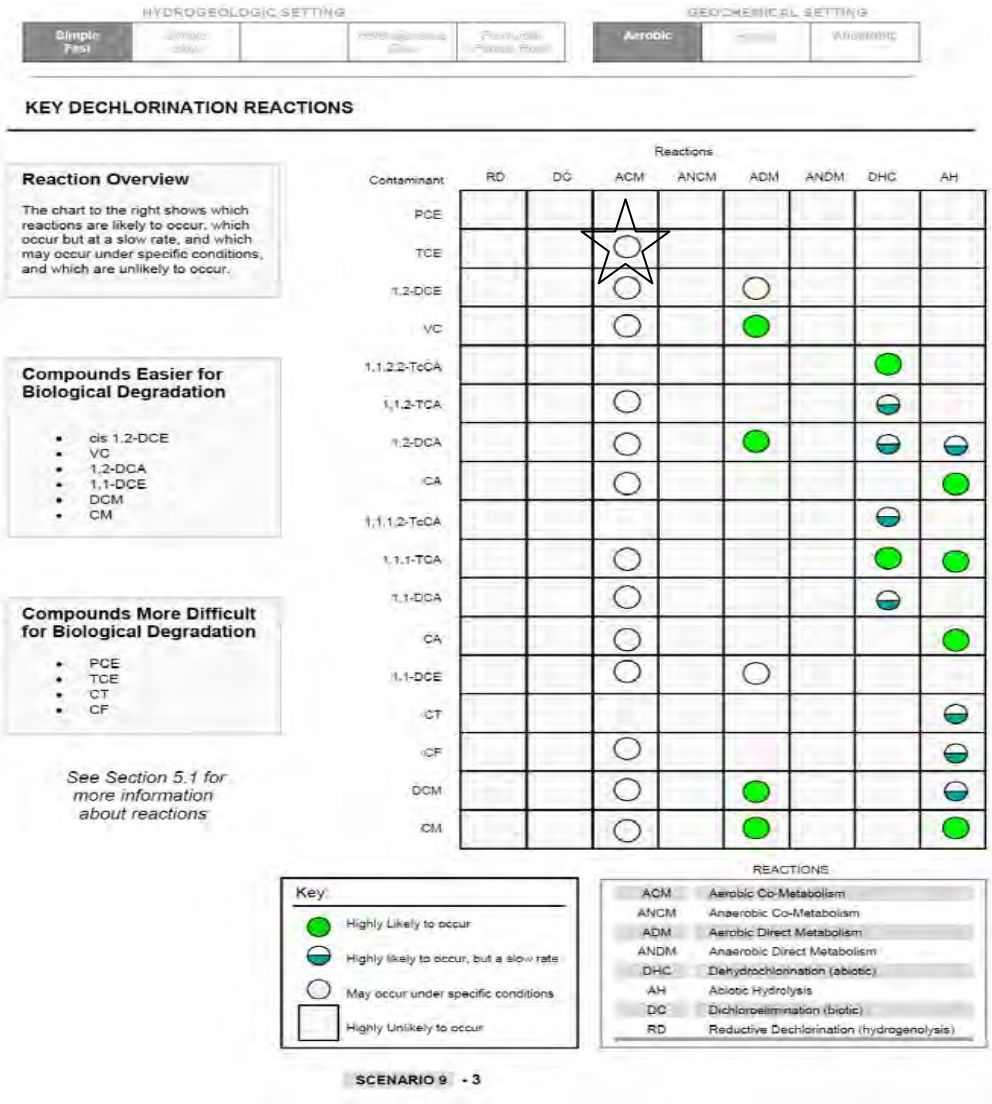


Figure 7. Scenario Selection Worksheet

Scenario 9:



PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Scenario 9:

•Plume Analysis from Page: Scenario 9-8

To demonstrate mass loss construct these graphics:
- Concentration vs. time plots at individual wells;
- Concentration vs. distance plots, with multiple lines for different sampling events through time
- Plume maps showing plume extent at different times (i.e., either panel maps, or one map with for different times).

To show geochemical footprints make tables or figures that show:
- Daughter product production from abiotic reactions;
- Presence of primary substrate for co-metabolic reactions;
- Chloride product (this may not work at many sites, however, due to background chloride);
- Moderate to high dissolved oxygen concentrations (shows geochemical conditions area OK);
- No or limited methane production (shows geochemical conditions area OK).

To perform modeling, typical tools include the following:
- Simple transport model (analytical model, e.g., BIOCHLOR, BIOBALANCE[1]);
- Comprehensive transport model (numerical model, e.g., RT3D).

If a special study is needed, some of the following may be applicable:
- Carbon/chlorine isotope analysis (indicator of degradation processes)
- Molecular probes (indicators of microbial activity)
- Microcosm tests (determine the reaction processes occurring at the site).

Scenarios Evaluation Tool for Chlorinated Solvent MNA, WSRC-STI-2006-00096, Rev. 1

Available by Download at:

www.osti.gov

Click on the "Information Bridge" button on the left hand side of the screen. Click on the "basic search" at the top of the page. Type in WSRC-STI-2006-00096R1.