



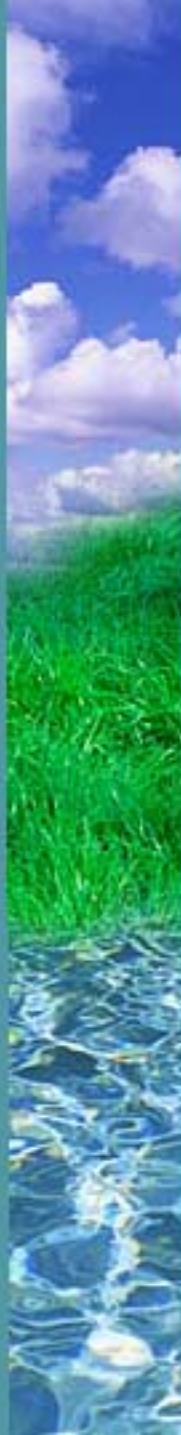
Ya Can't Compare NAPLs to Oranges

Michael Wilczynski, CPG
Senior Geologist

Remediation and Redevelopment Division

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Purpose

- Clarify nomenclature
- Overview of NAPL behavior
- Why be concerned with NAPL
- Why we may want to know the residual saturation or when NAPL become mobile



Nomenclature

- NAPL – non-aqueous phase liquid
- LNAPL or DNAPL – based on specific gravity of the liquid. < 1.0 or > 1.0
- Soil Saturation Concentration or C_{sat} – Theoretical concentration above which NAPL will start to form. Applies to one compound not to mixtures as defined in Part 201



Nomenclature con't

- Residual Saturation Concentration or $C(\text{res})$ is the concentration necessary for a NAPL to become mobile. Below this concentration the NAPL is not able to migrate.
- $C(\text{res})$ is always higher than $C(\text{sat})$ for any given soil type and NAPL. This is one reason why the absence of NAPL in a monitoring well alone is not acceptable proof that NAPL is not present
- Therefore, NAPL can be divided into the mobile and non mobile (or residual) phases.



Nomenclature con't

- The residual phase concentrations are significant. Approximately 1 gallon of NAPL/cu.yd for gravel to 10 gallons of NAPL/cu.yd or more for silty sand. (Fetter)
- Free phase – Can be a confusing term. It has been used in the literature to refer to any NAPL that is present (non-mobile and mobile). It has also been used to refer to only the mobile phase. Need to clarify with the user of the term.
- The MDEQ considers the presence of any NAPL to be free phase. Free phase theoretically occurs above $C(\text{sat})$ for a single compound.



Nomenclature con't

- Effective Solubility – Theoretical concentration that NAPL will begin to form when a mixture is present. The GRO/DRO method used by the DEQ as an indicator that NAPL may be present is based on the calculated effective solubility for gasoline and diesel.
- Free Product – Defined in Part 201 as 1/8 inch of NAPL.



NAPL Behavior

- As NAPL migrates it leave behind some NAPL ...this is residual NAPL. The NAPL left behind is less than $C(\text{res})$...it can not migrate.
- The residual phase NAPL can occupy up to 20% to 60% of the pore space depending on the soil and composition of the NAPL
- Residual water is also present in the pore spaces. Most soil is water wet.
- This residual water can form a barrier to NAPL movement....This is another reason the absence of NAPL in a monitoring well is not a demonstration of the absence of NAPL in the soil



Why be Concerned with NAPL

- Generic Criteria developed under Part 201 are calculated under the assumption that NAPL is not present
- NAPL is considered a source and source control is a requirement



Importance of Residual Saturation Concentration

- Residual Saturation Concentration or $C(\text{res})$ may be useful to evaluate NAPL recovery.
- Method of recovery may be limited due to the presence of non mobile NAPL
- In Michigan this is not the end point of NAPL removal



Summary

- NAPL can be composed of non-mobile and mobile phases
- Lack of NAPL in a well is not a demonstration that NAPL is not present
- Gravity drainage or pumping will leave residual NAPL behind
- MDEQ considers free phase to include the non-mobile or residual phase NAPL