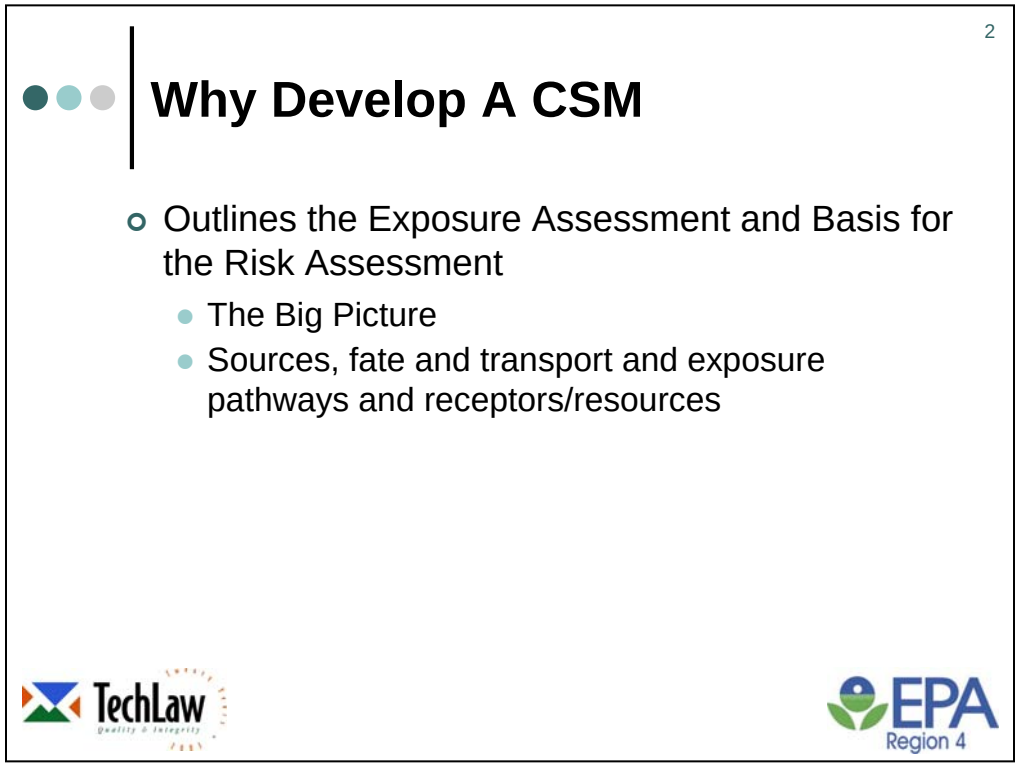
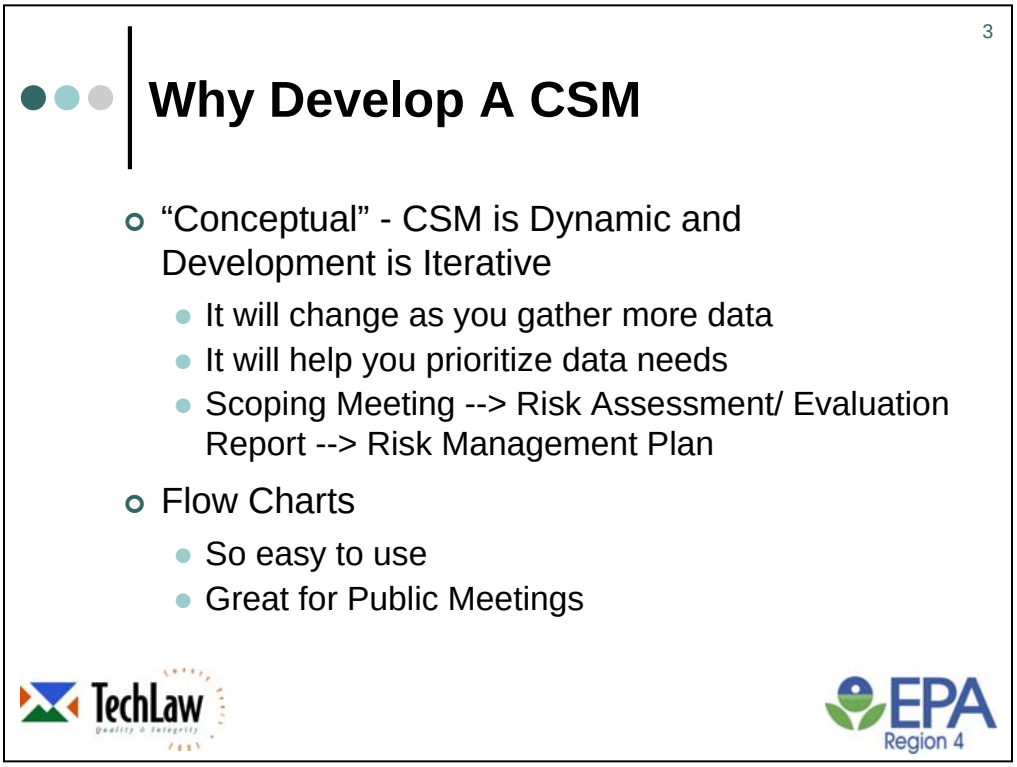
Conceptual Site Model (CSM)

TechLaw

EPA Region 4



Show you all the sources, fate and transport and exposure pathways and receptors/resources you're interested in protecting.



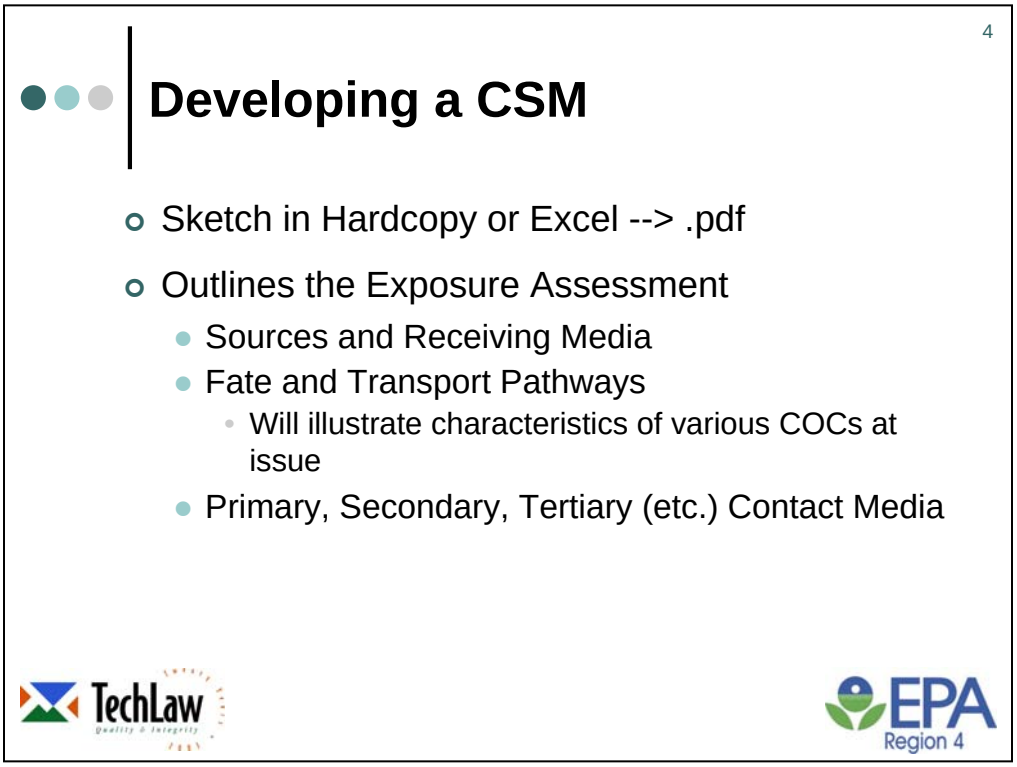
Conceptual": CSM is Dynamic and Development is Iterative - Based on Investigation Findings

Will help you prioritize investigation as it advances and help you target media or specific pathways that appear to drive risk or hazard

Scoping Meeting --> Risk Assessment/Evaluation Report --> Risk Management Plan

The CSM will grow and shrink as it moves through these uses.

Can be reflective of the broader areas, with "grayed out" areas or pathways which are not priority issues.



Very quick and easy - Does not have to be fancy - just show the interconnectedness of various phenomena

Your PRPs should be encouraged to be detailed with the graphical representation of the CSM

Developing a CSM

- Outlines the Exposure Assessment (cont'd)
  - Exposure Routes: Ingestion, Inhalation, Dermal, Dietary
    - Others, dependent on how specific the RA is going to be
      - Radiation, fish and game, fruits and veggies, beef, milk, eggs, pork, chicken all pretty standard for agricultural farm family (adult and child)

TechLaw

EPA Region 4

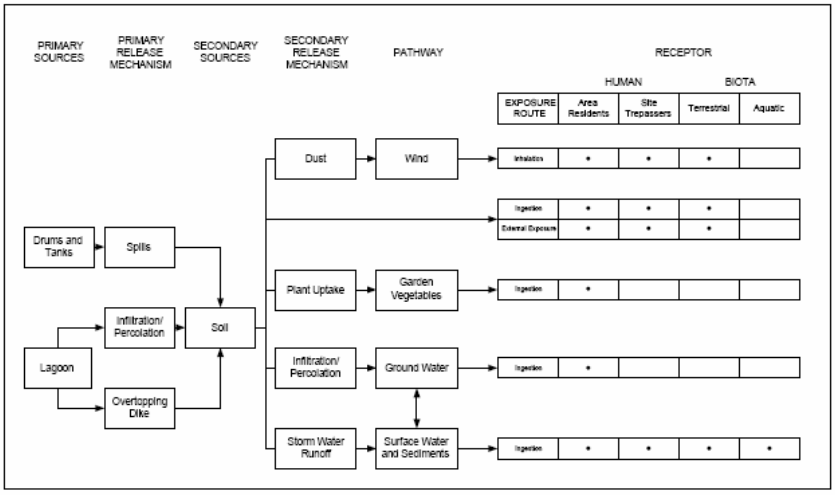
Developing a CSM

- Outlines the Exposure Assessment (cont'd)
  - Receptor Populations: Adult, Youth, Child
    - Adult: Residential, Industrial/Commercial (Outdoor, Indoor, Construction), Agricultural, Recreational
      - Will Drive on Basis of Carcinogenic Exposure
  - Receptor Populations: Adult, Youth, Child (cont'd)
    - Youth - Trespassing Youth - not well standardized - use your commonsense and remember that we're not interested in protecting the worst case, just the "reasonable maximum exposure"
    - Child: Residential, Agricultural, Recreational
      - Will Drive on Basis of Hazard

TechLaw

EPA Region 4

CSM - Example 1

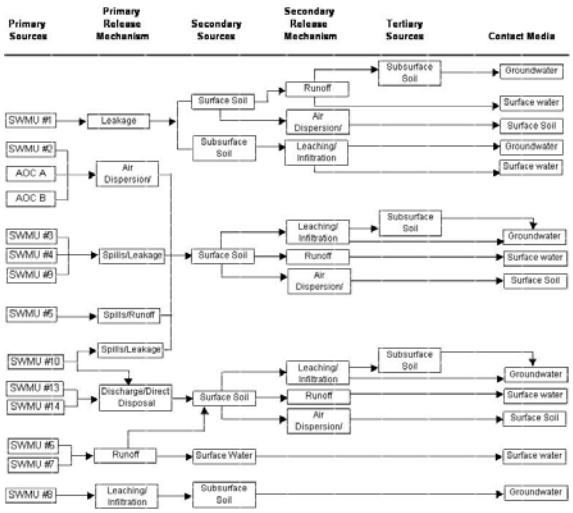


TechLaw

EPA Region 4

CSM - Example 2

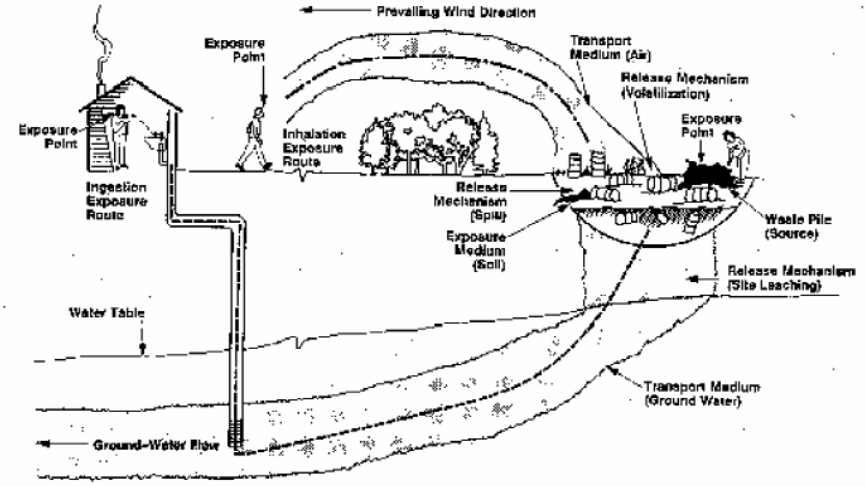
Figure 16. Wall Colmonoy Corporation Conceptual Site Model



TechLaw

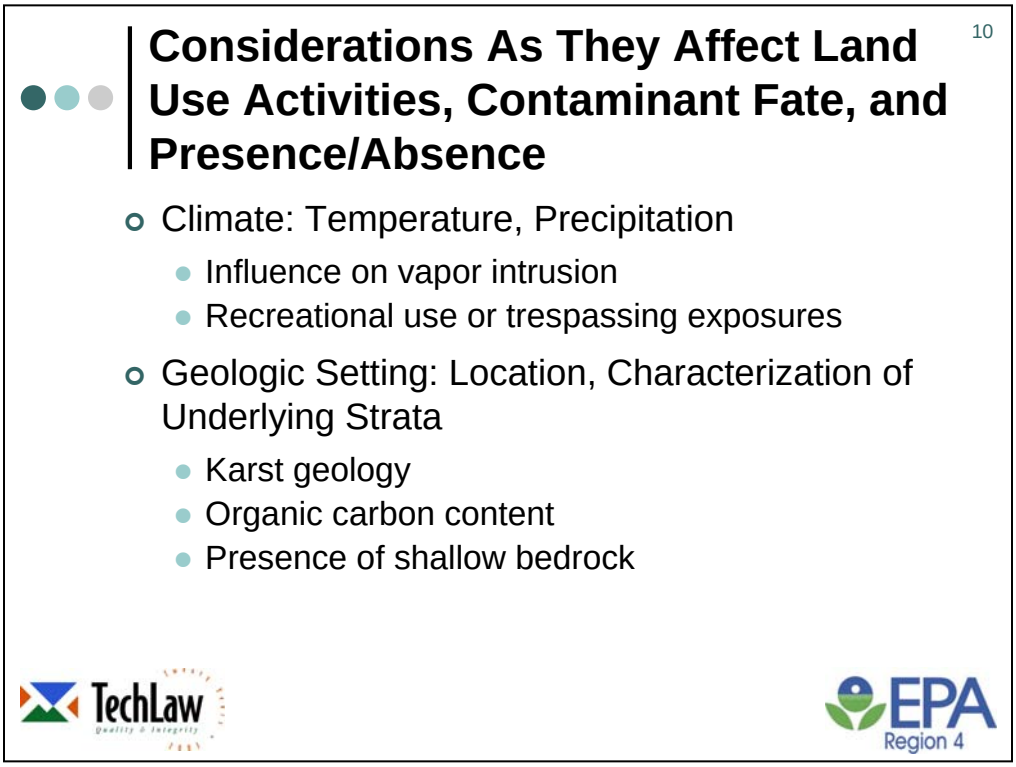
EPA Region 4

CSM - Example 3



TechLaw

EPA Region 4



Climate: Temperature, Precipitation

Precipitation will influence vapor intrusion significantly - keep this in mind

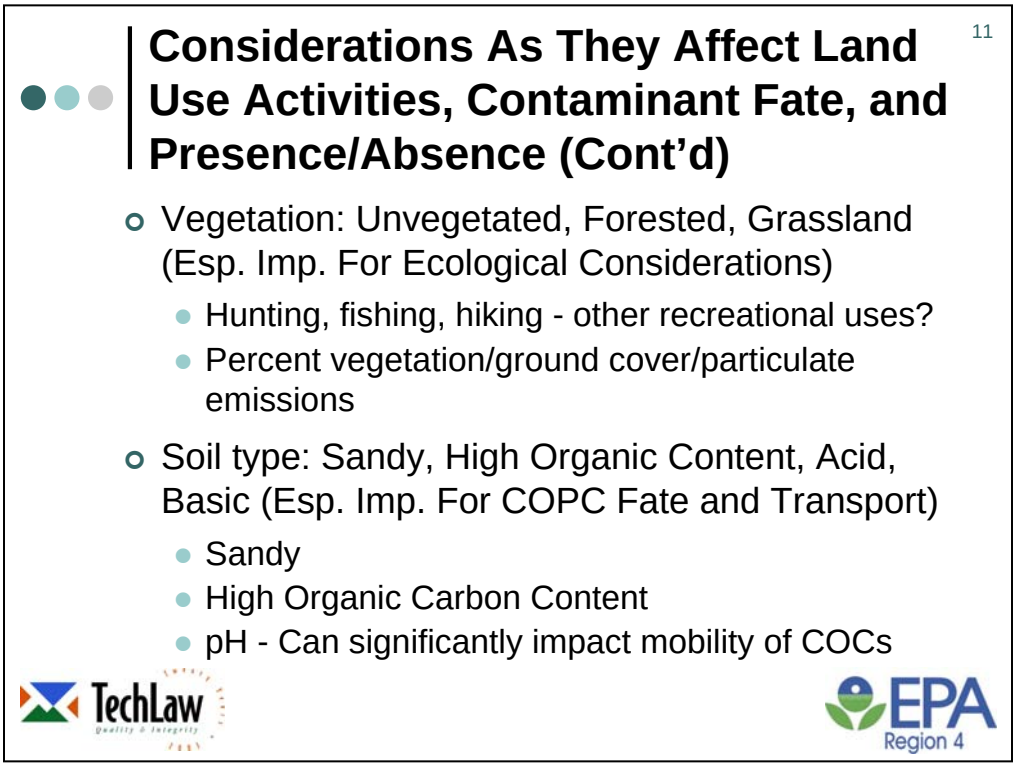
Climate may dictate recreational use or trespassing exposures and limit direct contact with media - frozen soil - no dermal contact, no dust suspension

Extra! Extra! Hotlanta Freezes Over!

Karst geology - preferential transport pathways in subsurface - for impacts to groundwater and may invalidate vapor intrusion models like J&E

Organic carbon content can influence mobility of COCs

Does bedrock impede subsurface development? No construction activity below … utility grade? Typical construction footing assumed to go to 10 ft - direct contact with groundwater for a construction worker?

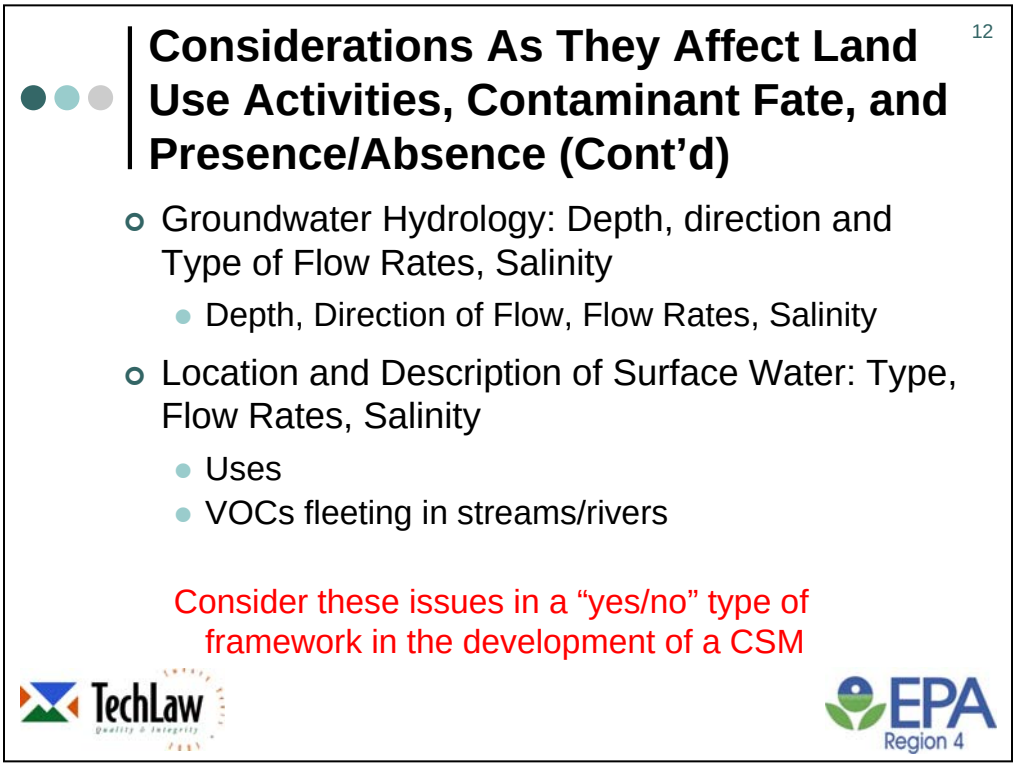


Exposed dirt can significantly influence particulate emissions. The USEPA standard PEF assumes 50% vegetative cover - so if you see more or less, realize there could be an effect. Note here that ingestion is by far and away the driver for risk exposure when it occurs, that inhalation of VOCs and Particulates, though they can be significant exposures, generally are not associated with higher risk. There are exceptions - Chromium VI - carcinogenic via inhalation. If you review a Risk Assessment and see that risk is being driven by inhalation or dermal exposure and direct contact via ingestion is complete, you should be asking yourself "Why?" It could be that COCs are segregated by media, with more potent COCs in air, or could be artifact of route-to-route extrapolation in toxicity criteria or some other supposed phenomena - but just something to keep in mind.

Sandy - high potential for vapor movement up and liquid movement down

High OC - Strong potential to limit leaching, bioavailability

pH - Can significantly impact mobility of COCs, esp. inorganics that would otherwise be captured in the higher organic carbon content of topsoil or show limited leaching potential from subsurface material.



Depth to groundwater - Direct contact during intrusive operations? Vapor intrusion 100 ft bgs fair game

Direction - In consideration of future exposures - monitoring points - off-site receptors where exposure is uncontrolled?

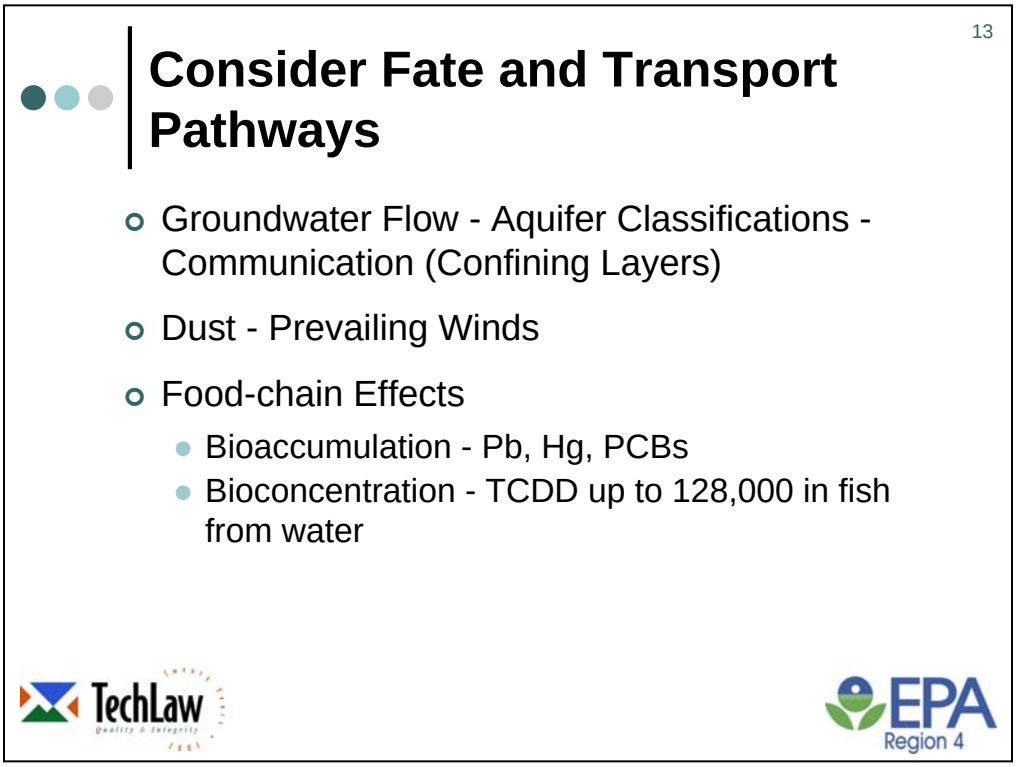
Flow Rates - Fate and Transport w/r/t time - communication between aquifers to expose other populations - aquitards

Salinity (TSS/TDS) often used as rationale to limit future potential domestic water use

Uses: Drinking water sources? Recreational uses? Incidental ingestion during swimming - 50 mL. Dermal exposure

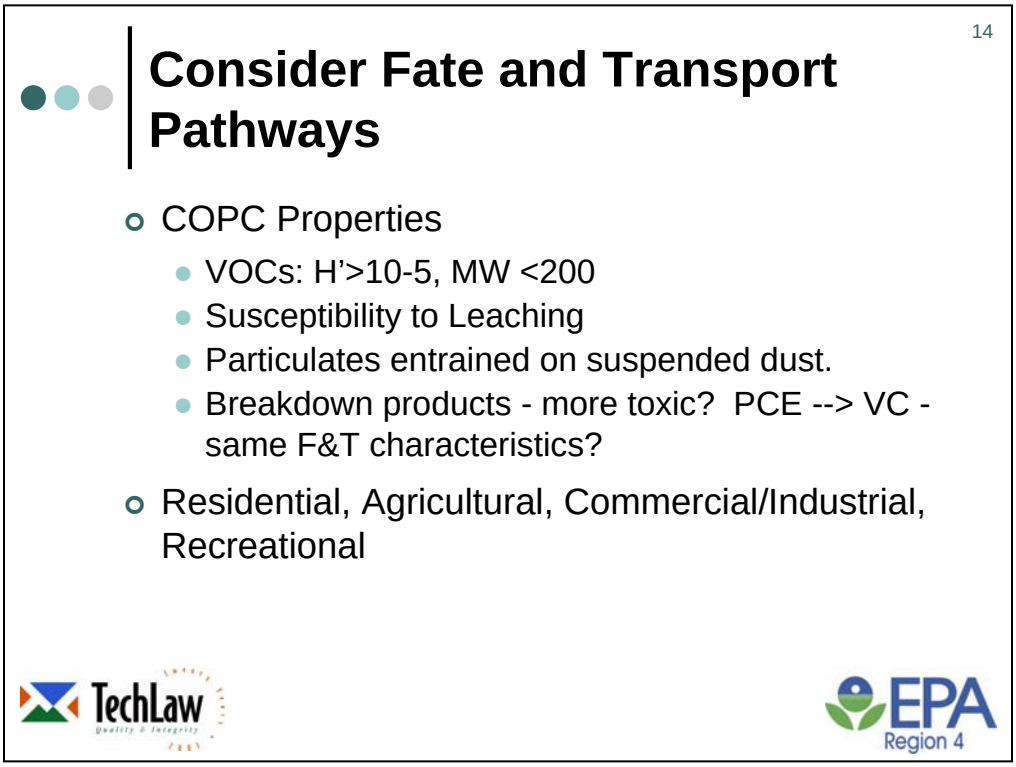
VOCs fleeting in streams/rivers - even where contaminated groundwater discharging. Can be detected though.

These are just considerations - view them in a "yes/no" type of framework in development of a CSM - not degrees of exposure - that will be handled in the RA. These considerations are only important as they contribute to complete or potentially complete pathways (or invalidate pathways of exposure).



We talked about about this already - but recognize that communication with a deeper aquifer may invalidate assumptions about a groundwater divide precluding exposure to another receptor group (deeper aquifer flowing underneath a stream).

You can look at wind rose to see prevailing wind direction, but consider that the RA looks at closest receptor population if deposition is at all possible.



Can quickly determine what is a VOC by looking at the Region 9 PRG table.

Contaminant impacts to ambient air only assessed via VF or PEF - not both.

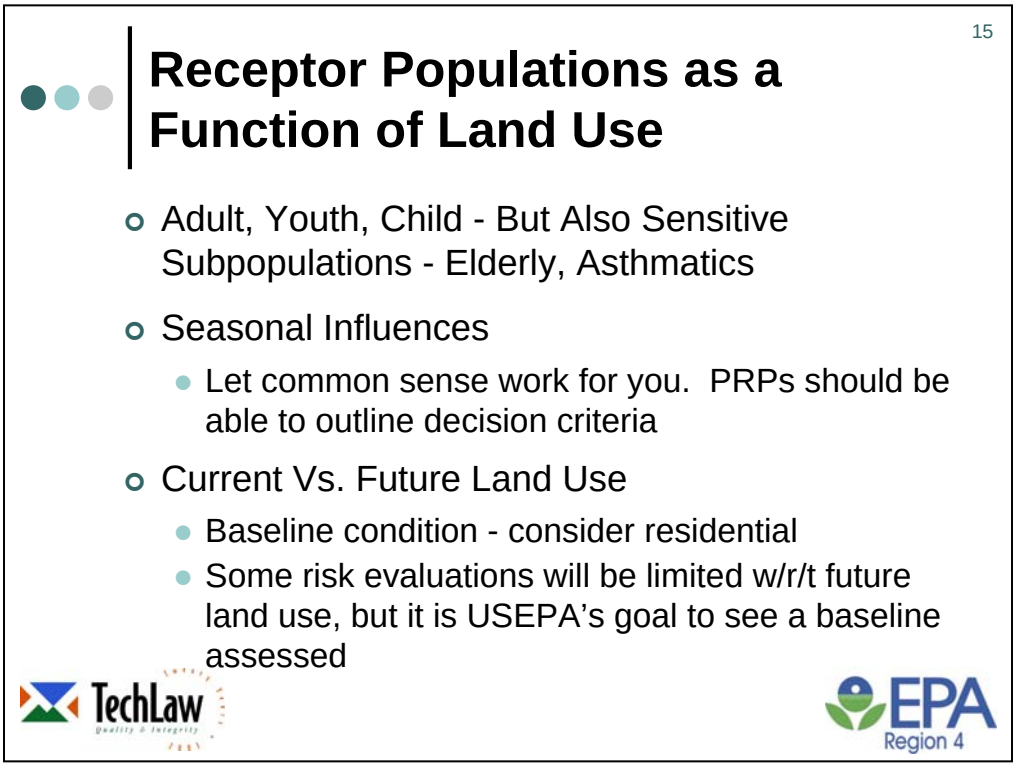
Susceptibility to Leaching - see SSL - soil-water partitioning equation - linear - inorganics and organics, equations 22 and 24 - organics largely limited by soil organic carbon content. Inorganics more complex, a number of significant influences - pH, oxidation-reduction conditions, iron oxide content, soil organic carbon content, cation-exchange capacity and major ion chemistry.

Residential…We already touched on this, but:

Residential is the conservative standard for the baseline condition. If land use is not constrained/limited - should consider this as part of baseline assessment - perhaps limited to future on-site condition.

Agricultural family is probably the most conservative exposure - given the same exposures as residential family plus very conservative intakes associated with fruits and veggies, plus beef, milk, chicken, pork, etc.

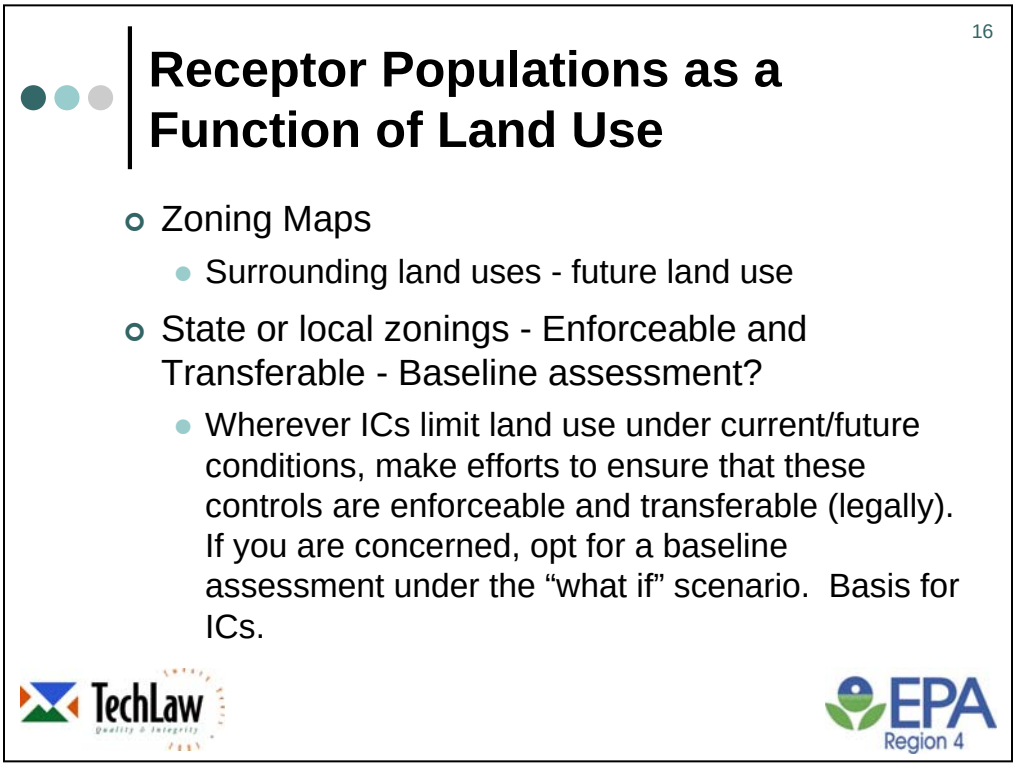
For some sites, the preeminent exposure could be associated with a "recreational" exposure - under a subsistence fisher exposure - though this is a higher degree of exposure than a true "recreational fisher scenario. Often this exposure is limiting in combustion risk scenarios.



We already talked about the adult and child considerations - but baseline assessments should take into account the presence of sensitive subpopulations. Toxicity criteria already incorporate an uncertainty factor of 10 designed to account for sensitive subpopulations, but their presence should be addressed by the baseline risk assessment.

I think we touched on this and it may be more of an issue in the northern climes, but remember when you look at exposure parameter values that involve professional judgement (trespasser, recreation users), let common sense dictate the value. A facility shouldn't just give "professional judgement" as rationale - they should be able to outline their decision criteria supporting an exposure frequency, for example, of 17 days per year.

Some risk evaluations will be limited w/r/t future populations and land use, but it is USEPA's goals to see a baseline assessed - provide the support for the implementation and continuity of institutional controls - like limitations on groundwater usage.



You can consider these maps to give you an idea of the surrounding land uses and development trends over time. May help you with decisions about how to assess future land use.

Consider the need for a baseline assessment in their absence.

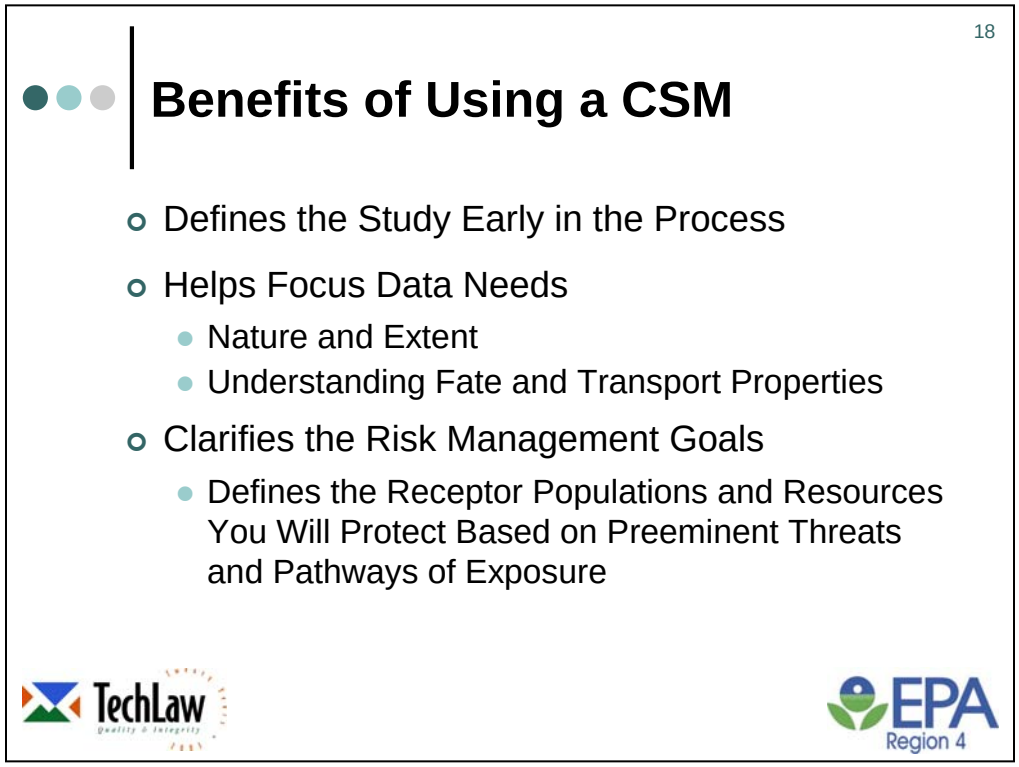
Wherever institutional controls limit land use under current or future conditions, make efforts to ensure that these controls are enforceable and transferable (legally). If you are concerned, opt for a baseline assessment so you have knowledge of the "what if" scenario. It will give you basis for institutional control needs.

Receptor Populations as a Function of Land Use

- Topographic, land use, housing or other maps
- Aerial photographs
  - Can be very helpful in giving you an idea about surrounding land use, preferential pathways of exposure - recreational use areas, etc.

TechLaw

EPA Region 4



Please, please, please, let this process start off with Common Sense as your guide. Don't get wrapped up in the details at the start of the CA process - these refinements will work themselves in as the process moves forward.

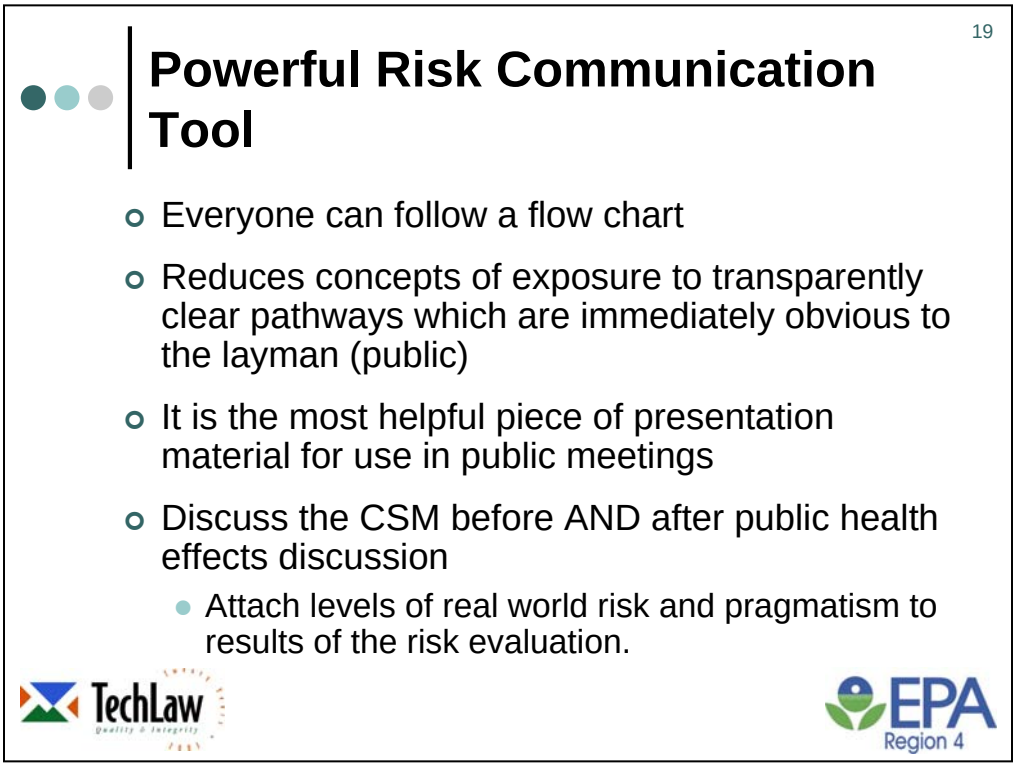
Understanding Fate and Transport Properties

Aquifer Characterization - Multiple Water-Bearing Units and Communication

Groundwater Flow

Meteorological Parameters

Prevailing Winds - Entrainment of Contaminants on Suspended Soil/Dust Particles



(Scott - Insert graphic: “child” + “cookie” = “happy child”)

It is the most helpful piece of presentation material for use in public meetings - shows release mechanisms and sources, fate and transport characteristics of COPCs, exposure routes, etc.