DON RAB/TRC
Training Workshop

Process for Developing a Site Investigation Approach

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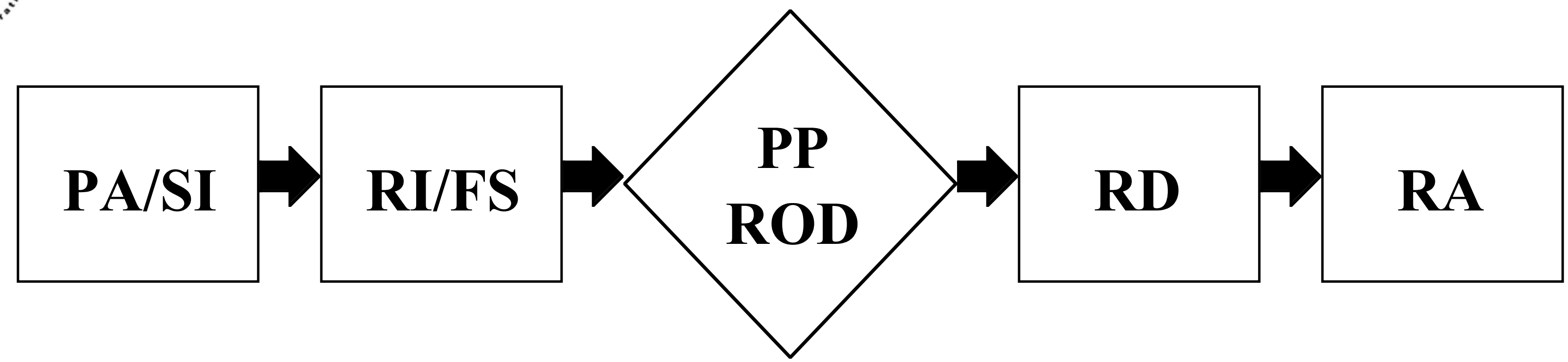
Goals of the Module

- Explain the Navy process of developing site investigations
- Outline the key components of the site investigation process
- Provide case studies

Module Outline

- The CERCLA Process
- Site Investigations
  - Purpose of investigations
  - Key Components
- Data Quality Objectives (DQOs)
- Community and regulatory involvement
- Case Studies
- Q and A

CERCLA Process



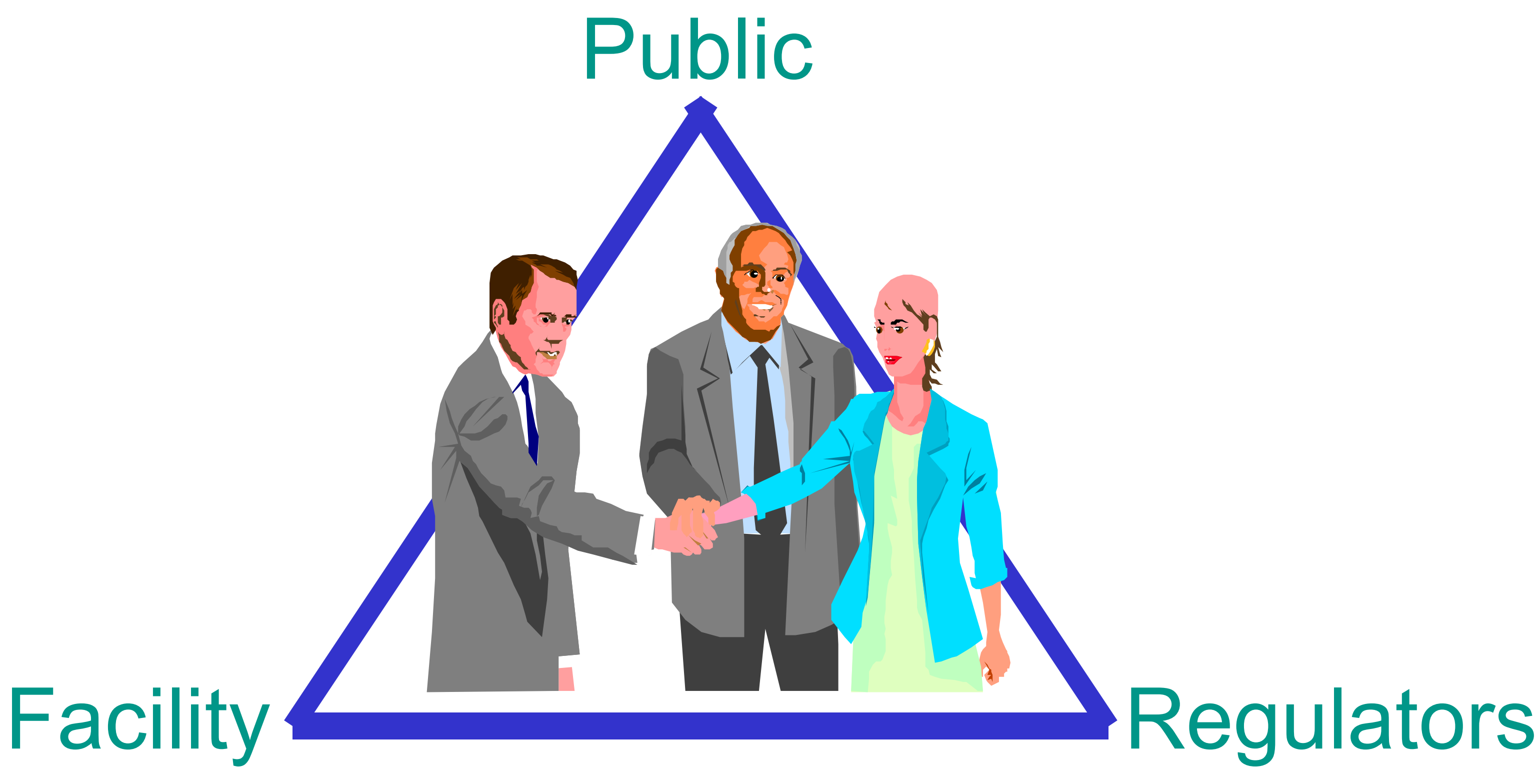
PA - Preliminary Assessment
SI - Site Inspection
RI - Remedial Investigation
FS - Feasibility Study

PP - Proposed Plan
ROD - Record of Decision
RD - Remedial Design
RA - Remedial Action

Site Investigation

- Purpose of Investigations
  - To answer questions
  - To support decisions
- Key Components
  - Community and Regulatory Involvement
  - Data Quality Objectives

Community and Regulatory Involvement



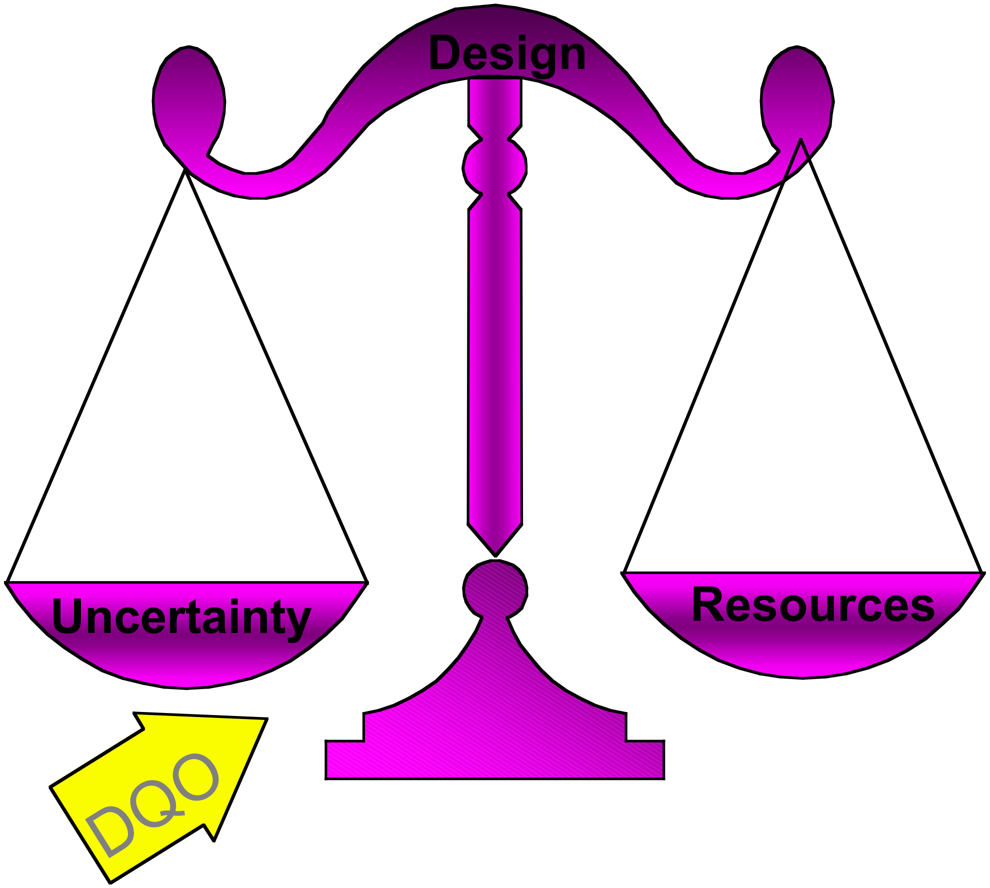
Community and Regulatory Involvement

- Site Investigations are the foundation to environmental decision making
- It is important to understand the objectives, rationale, limitations and uncertainties
- Stakeholder involvement is critical

Steps in the Site Investigation

- Define Data Quality Objectives (DQOs)
  - Evaluate existing data
  - Conduct Site Visit
  - Develop Conceptual Site Model
- Work Plan Development
- Implementation
- Reporting

The DQO Process is a Planning Tool



What are DQOs?

- Specifications needed to develop a sampling and analysis plan
- EPA Definition:
  - "Qualitative and quantitative statements derived from the output of each step of the DQO process that clarify study objectives, define the appropriate type of data, and specify the tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions"

(USEPA QA/G-4, 1994)

What is the Purpose of the DQO Process?

- Encourages thoughtful consideration about why data are needed and how data will be used in decision making
- Structures the discussion of project personnel, regulators and stakeholders
  - facilitates the best use of everyone's time
  - addresses the hard questions up-front
- Leads to development of the Workplan

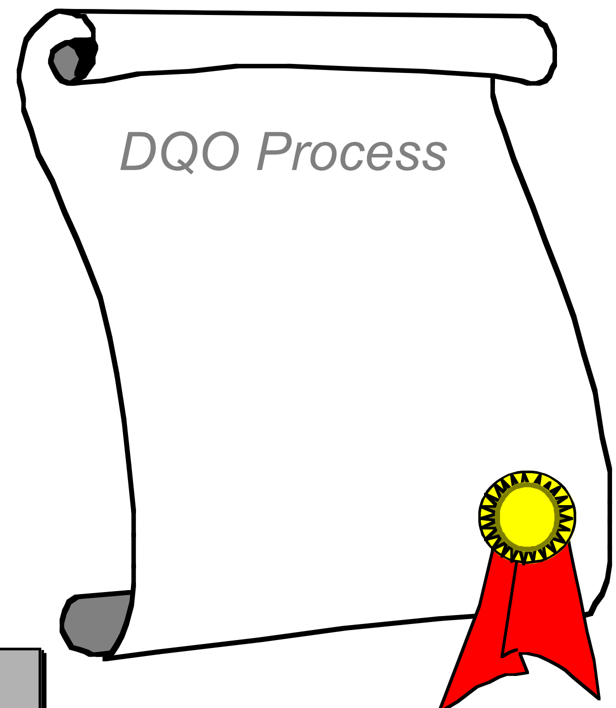
Getting Ready to Develop DQOs

- Get the right people involved in the right way
  - stakeholders
  - decision makers
  - technical subject matter experts
  - design statisticians
- Have them prepared to work on planning
  - summarize existing site knowledge
  - think about the overall project objectives
  - be realistic about resource/political/social constraints

Who do you need on your team?

The Seven DQO Process Steps

1. State the Problem to be Resolved
2. Identify the Decision
3. Identify the Inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Errors
7. Develop and Optimize the Design for Obtaining Data



Step 1: State the Problem

ACTIVITIES

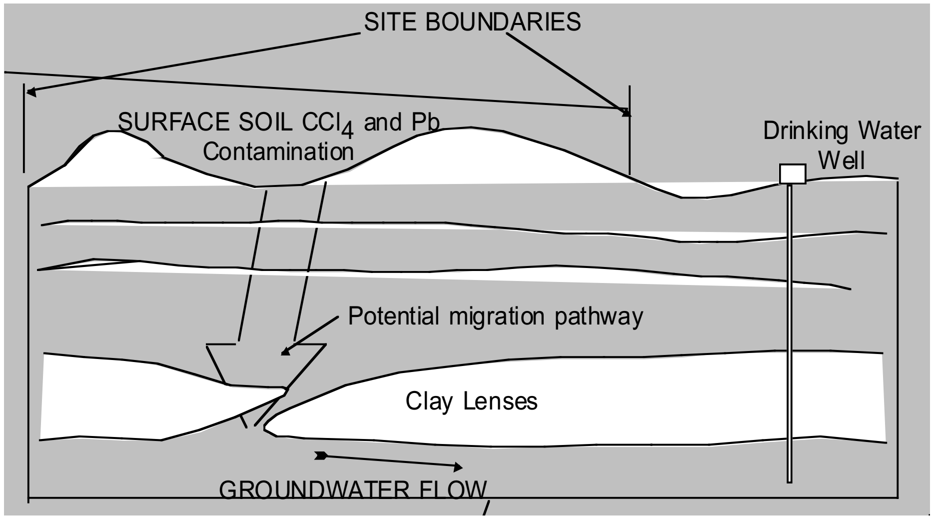
- Summarize knowledge about the site
- Develop a conceptual model based on existing information
- Develop a list of anticipated contaminants (COPCs)
- What course of action could be taken to address the problem?
- Consider practical resource and logistical issues

OUTPUTS

- Carbon tetrachloride and lead released into the soil from a building drain
- Surface soil contamination suspected
- Possible migration to ground water
- Desire to release site for possible residential use
- Possible candidate for accelerated action

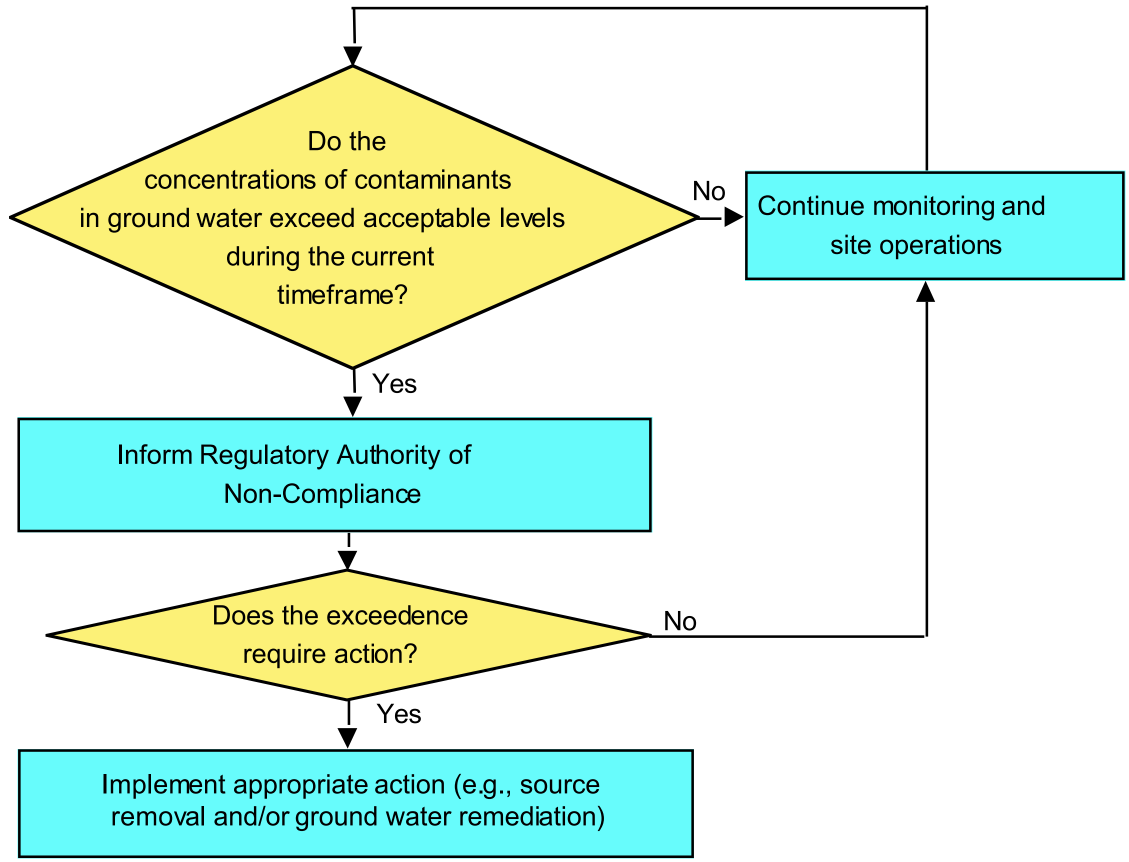
Document the Problem in the Work Plan Site Description

- Historical process knowledge
- Analysis of existing data
- Conceptual model
- Site map noting sample locations and measured concentrations



Step 2: Identify the Decision

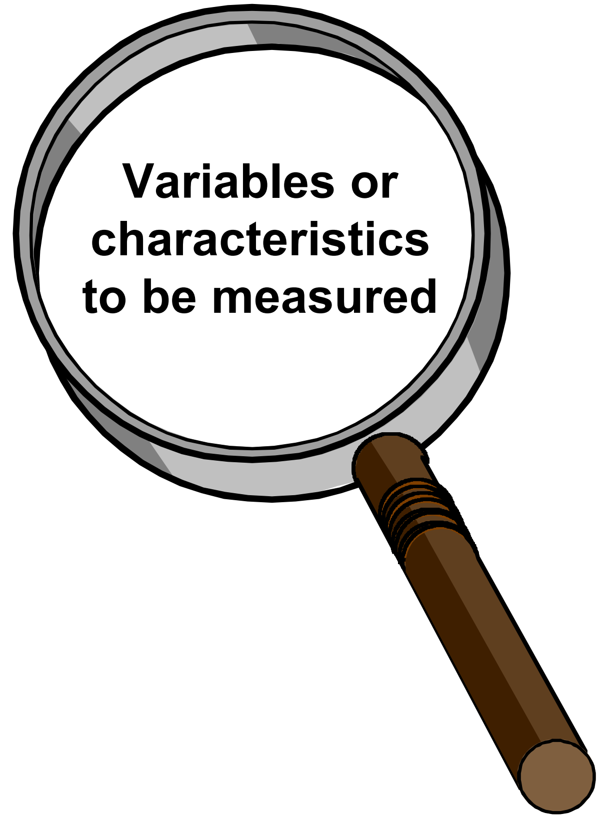
- What actions will resolve the problem?
- State each decision in terms of whether to take action.



Identify each data-driven decision and develop DQOs for each

Step 3: Identify Inputs to the Decision

- Focused list of variables to be measured
- Other informational inputs
- Confirm that adequate sampling and analytical methods exist



Focus of DQOs

"Cutting to the Chase" When Identifying Inputs

- Start by brainstorming all possible measurements and other inputs that would be "nice" to have
- Determine which of these are directly required by the decision
  - Establish that existing methodology is adequate to generate each variable
- Determine which inputs are required to address secondary data needs
  - Develop a written statement on how these variables will be used

Important Input – Background

- What is Background?
  - DON Background Policy
  - Procedural Guidance for Statistically Analyzing Environmental Background Data
    http://erb.nfesc.navy.mil/erb_a/restoration/analysis/procguid.pdf
  - Handbook for Statistical Analysis of Environmental Background Data
    http://erb.nfesc.navy.mil/erb_a/restoration/analysis/hndbk-sw.pdf

Important Input – Lack of Data

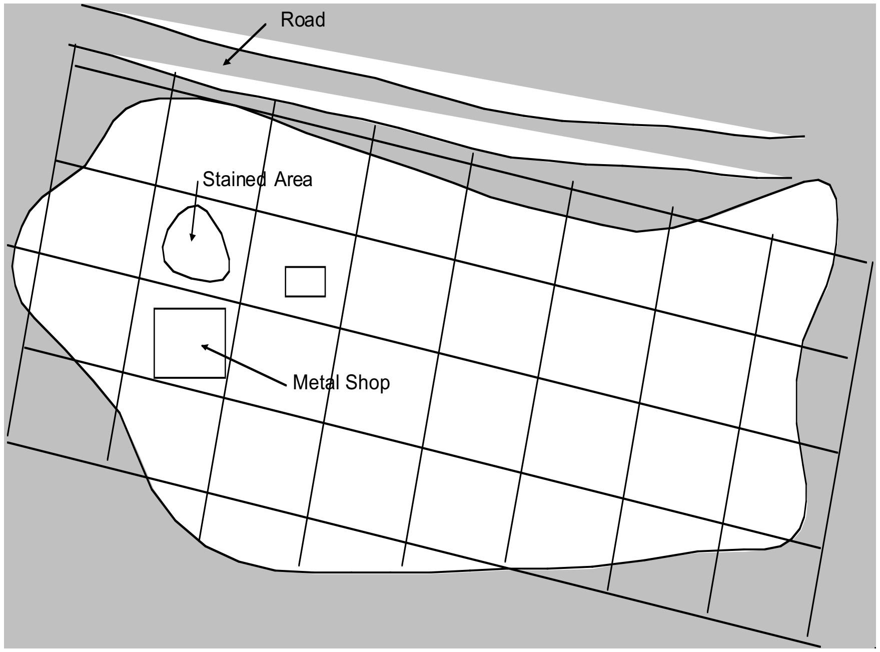
- Want to make sure locations where samples are to be collected from for expensive analytical methods will meet the needs for the decision rules
- Can use field screening methods (XRF, UVF, immunoassays, etc.) to collect and analyze a large number of samples to better understand the distribution of contamination to determine the appropriate placement of samples for fixed laboratory analysis

Field Screening Methods

- Analytical tools that provide measurements of chemical, biological or physical parameters on a real-time or near real-time basis
- Often commercial off-the-shelf (COTS) units
- Tools can be used individually or in concert depending on needs
- Examples of tools
  - Chemical Measurements
    - X-Ray Fluorescence (XRF) for Metals
    - Ultra-Violet Fluorescence (UVF) for PAHs
    - Immunoassay for Organics (PCBs, PAHs, and Pesticides)
  - Biological Measurements
    - QwikSed Bioassay for Biological Effects
  - Physical Measurements
    - Particle Size, Moisture, Density

Step 4: Define the Boundaries of the Decision

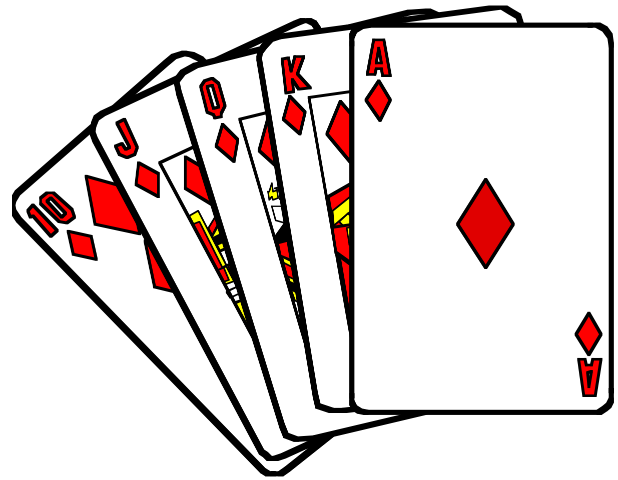
- Specify the population of interest
  - include specific boundaries on the media of interest (e.g. surface soil = 0 – 12”)
- Define the scale of decision making
  - define each subpopulation of interest



1/4 acre surface soil risk-based exposure units within site boundaries

Step 5: Develop a Decision Rule

- How will data be summarized and used to make a decision?
- What action levels will be used to make a decision?
- For each identified decision, develop an "if - then" decision rule integrating the:
  - result (e.g., mean, median)
  - action level
  - alternative courses of action



If the mean concentration of CCl_4 or Pb within an exposure unit exceeds risk-based concentrations (RBCs),determine the extent of soil to remediate.

Decision Rule Examples

- If the mean concentrations of all contaminants of potential concern (COPCs) in surface soil are less than their RBCs or representative background levels, then propose the site for no further action
- If the running average of the last two consecutive samples from any monitoring well exceeds the MCL for CCl4, then proceed to an evaluation of remedial alternatives for CCl4 contamination

Document the Rationale for the Approach in the Work Plan

- What decision(s) will be made?
- What data are needed to support the decisions and why?
- What portion of the environment (and/or what time frame) must be represented by data?
- How will data be used to support the decision?
- What level of certainty is desired?

These statements are the DQOs, translated for incorporation in the Work Plan

Step 6: Specify Limits on Uncertainty

- Determine the possible range of the results
- Define types of decision errors and assess their potential consequences
- Elicit acceptable probabilities for decision errors

You Don't Need to be a Statistician to Set Error Tolerances!

Identify decision errors and evaluate consequences

- Failure to find a problem that exists (underestimate result)
- Consequences
  - no remedial action will be taken prior to release of property
  - potential adverse health effects
  - integrity and cost to redo if error is subsequently discovered

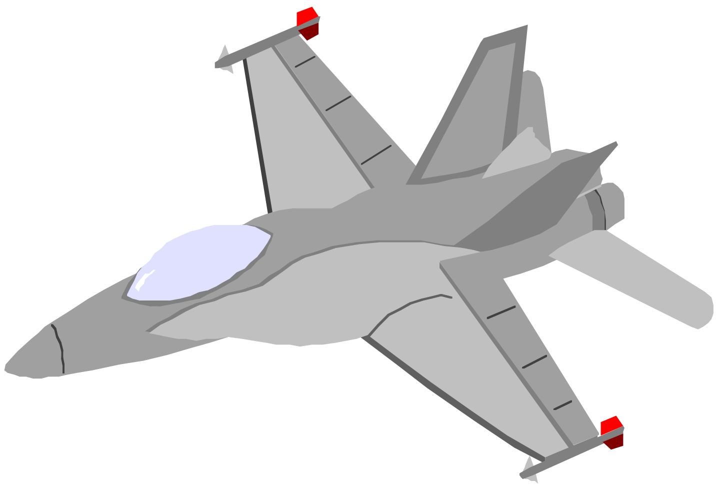
- Incorrect determination that a problem exists (overestimate result)
- Consequences
  - cost and integrity of further assessment or action taken unnecessarily
  - money and time spent could have gone to a "real" problem area

Decision Error Tolerances Are Policy Calls

- Determine which decision error would result in greater consequences
- Consider the consequences at several points above and below the action level
- Establish quantitative limits on decision errors by completing a decision error table or desired performance graph

Step 7: Optimize the Design

- Select an appropriate statistical test or model
- Obtain pertinent estimates of variability
- Develop and evaluate design alternatives
- Select the most cost-efficient design that will meet the DQOs

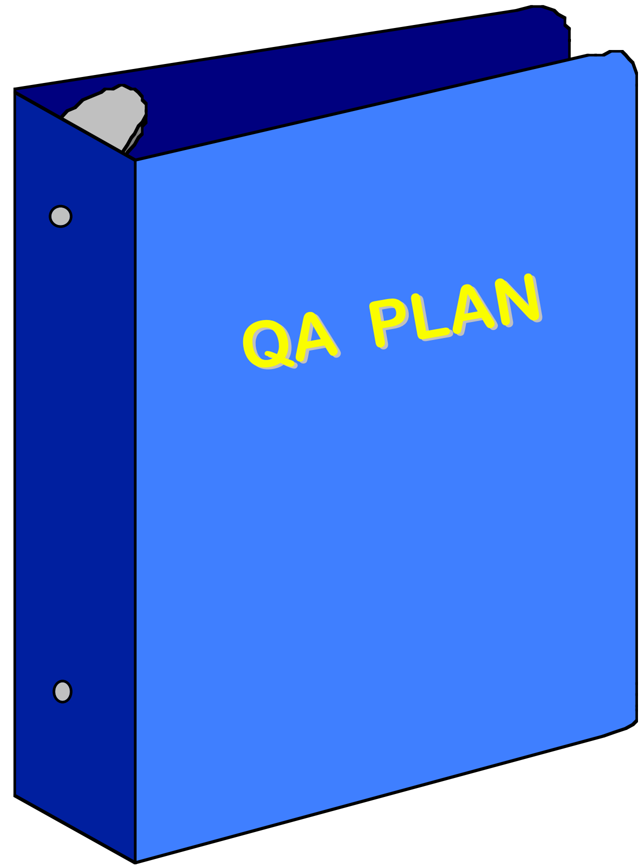


Document the Design in the Work Plan

- The type, number, and location of each sample to be collected
- Sampling locations denoted
- Sample acquisition methods specified
- Focused set of analytical requirements specified
- Field QA sample requirements specified

Specify Additional QA Requirements

- Specific SOPs for sample collection and handling
- QA acceptance criteria
- Laboratory QC requirements
  - Including QC for on-site methods
- Auditing and oversight activities



To Sum it Up, What do DQOs Impact?

- The form and substance of regulator, decision maker, and public involvement

- The roles played by the site manager, technical experts, design statistician, regulators and other Stakeholders
- The approach for problem resolution and defensibility of data collection
- The content of Work Plans

Case Study

- Naval Listening Station Transformer PCB
  Release

(See attachment)

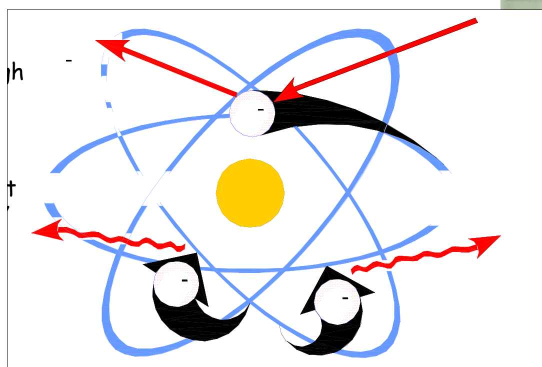
Additional Informational Slides

- X-Ray Fluorescence (XRF) for Metals
- UV Fluorescence (UVF) for PAHs
- Immunoassay for Organics
- QwikSed Biological Screen

Site Investigation

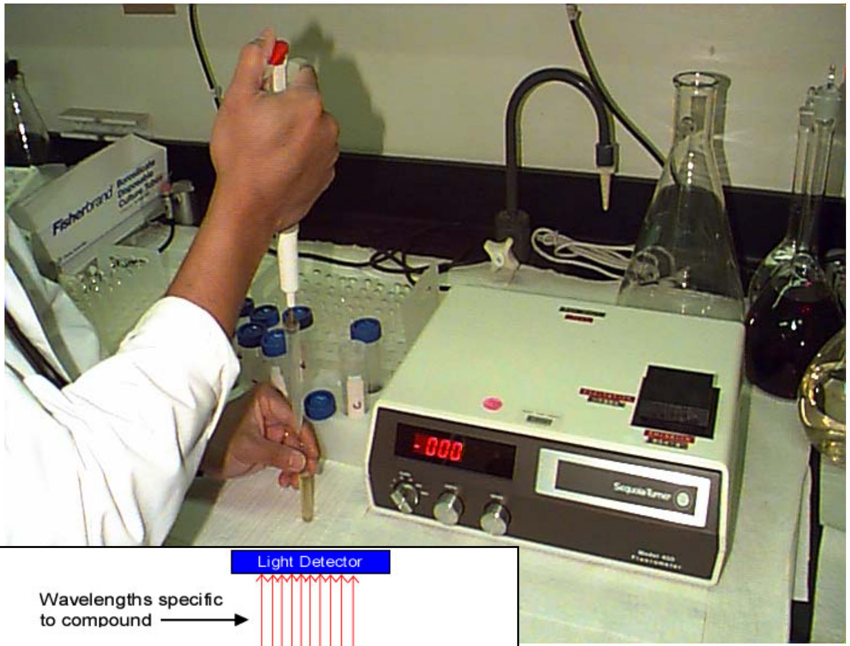
X-Ray Fluorescence (XRF) for Metals

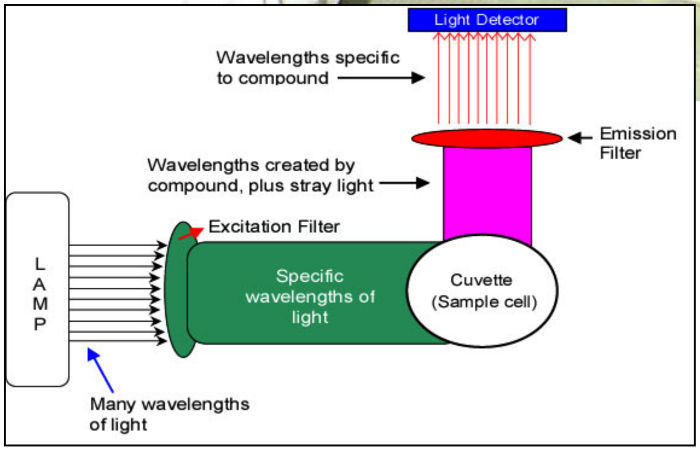
- Principal of operation
  - Samples are exposed to x-ray energy, which results in x-ray fluorescence (XRF).
  - The type (energy level) of fluorescence identifies which metals are present and its intensity is proportional to concentration.



UV Fluorescence (UVF) for PAHs

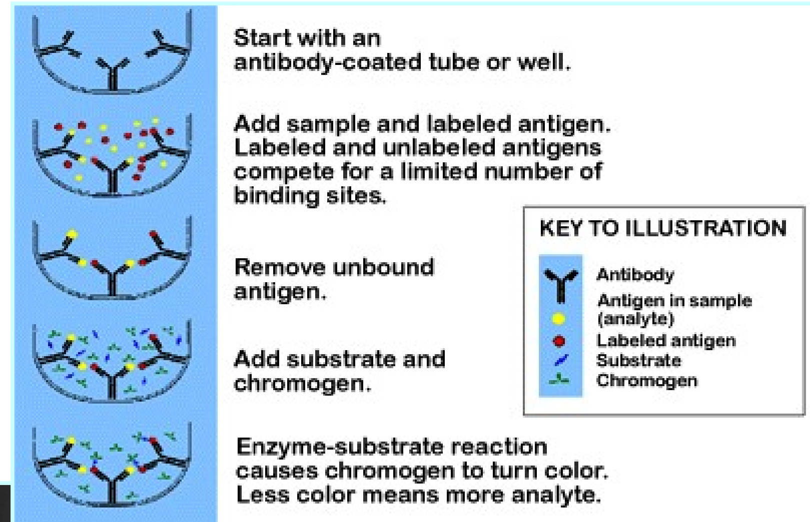
- Principal of operation
  - When ultraviolet (UV) light is passed through a sample extract, the sample emits light (fluorescence) proportional to the concentration of the fluorescent molecules (PAHs) in the sample.

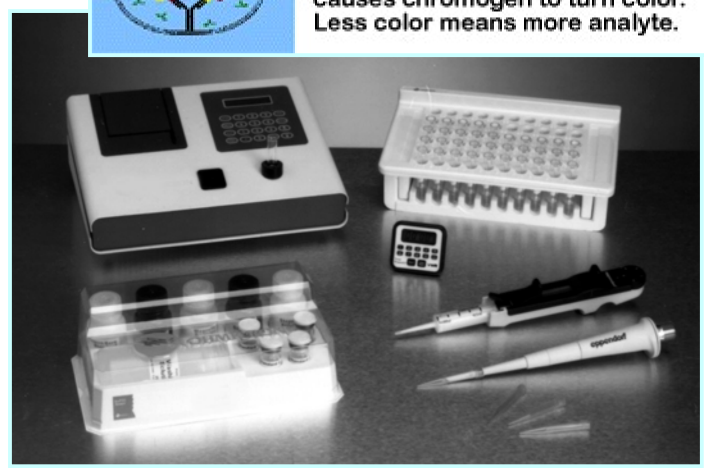




Immunoassay for Organics

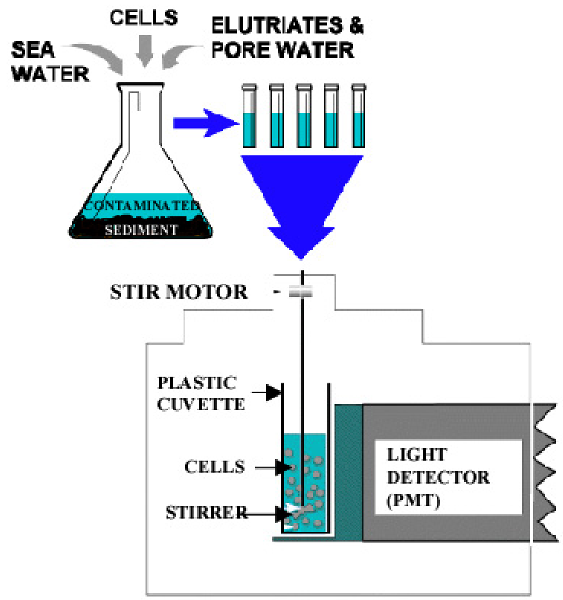
- <u>Principal of operation</u>
  - Antibodies are developed specifically to bind with organic compounds (e.g. PCBs, PAHs, pesticides) and that selective response is used to confirm the presence of the contaminant in samples. Color change in an extract solution is related to chemical concentration, with a spectrophotometer used to quantify the concentration.





QwikSed Biological Screen

- Principal of operation
  - The QwikSed Bioassay measures the inhibition of light emitted by marine bioluminescent dinoflagellates (e.g., Ceratocorys horrida) exposed to a test solution (effluents, elutriates, or sediment pore waters). Any decrease in light output relative to controls suggests bioavailable contaminants or other stressors.



Dinoflagellate
Ceratocorys horrida