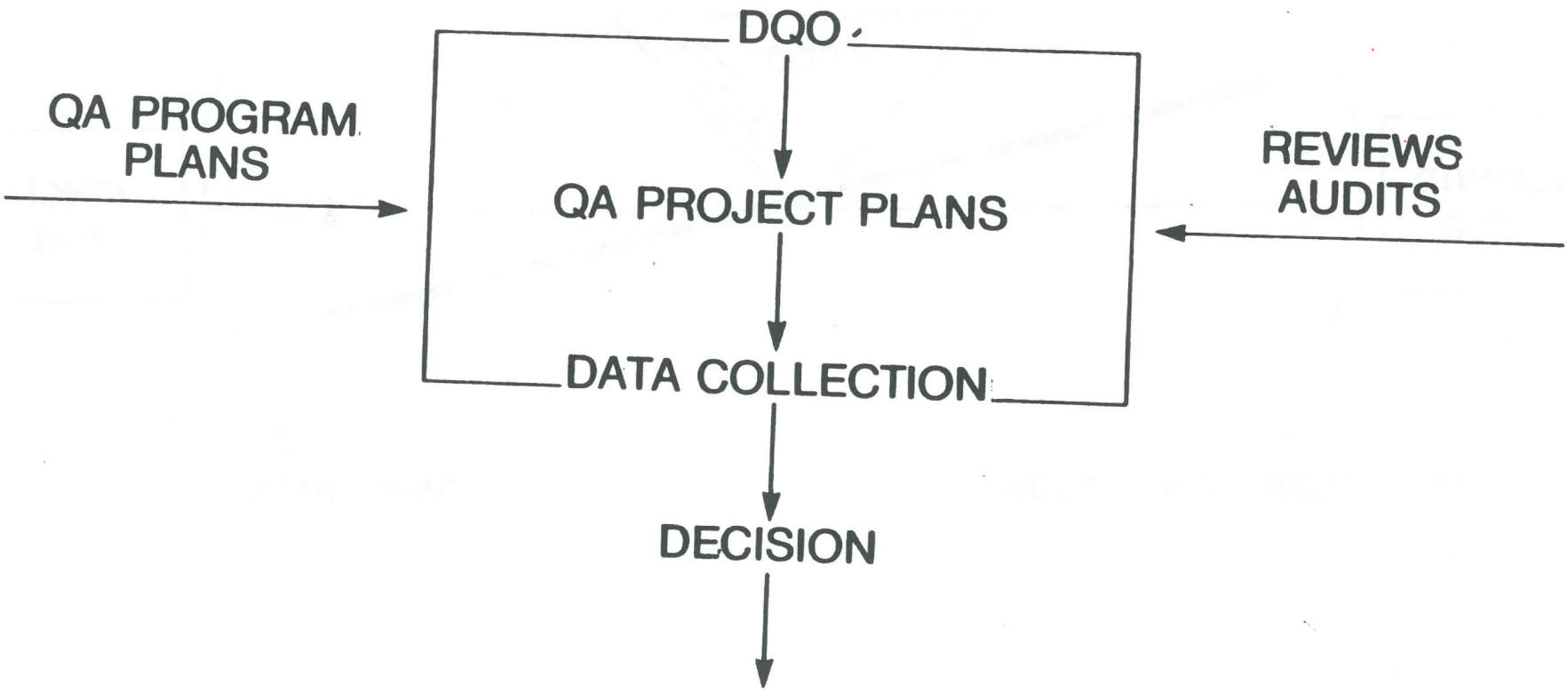
DATA QUALITY OBJECTIVES

DQOs

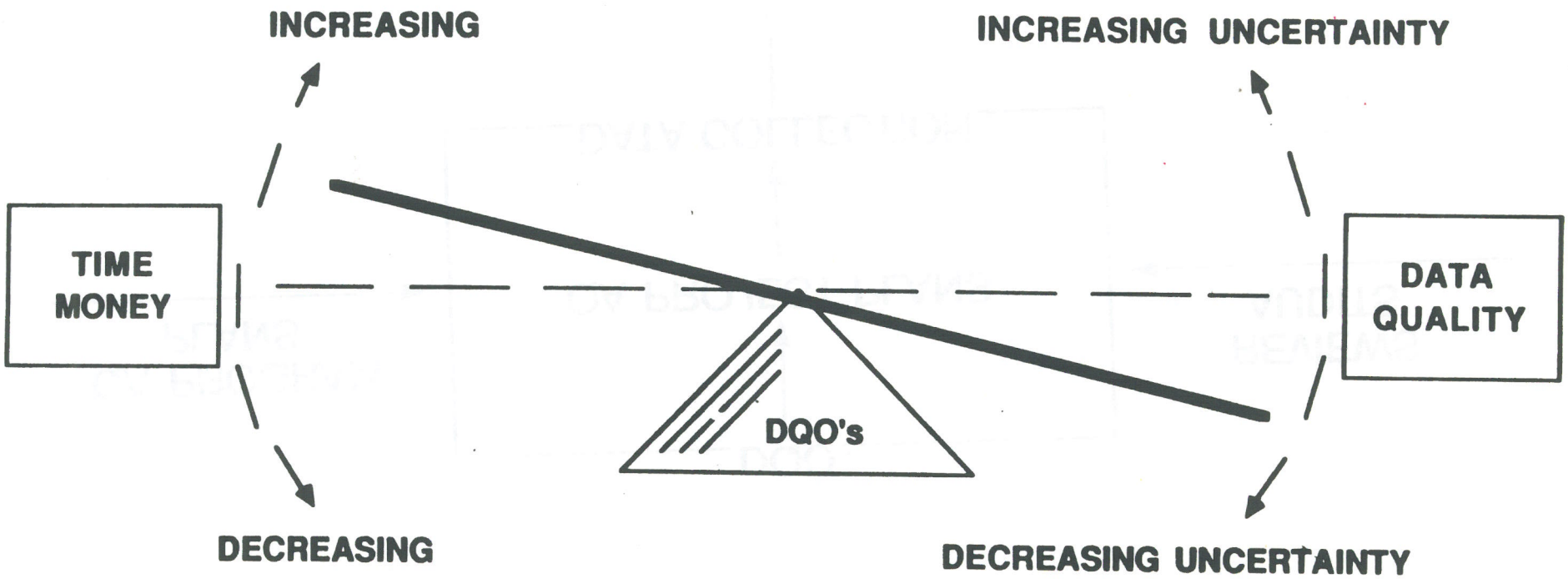
US ENVIRONMENTAL PROTECTION AGENCY

NOVEMBER 1990

EPA QUALITY ASSURANCE PROGRAM



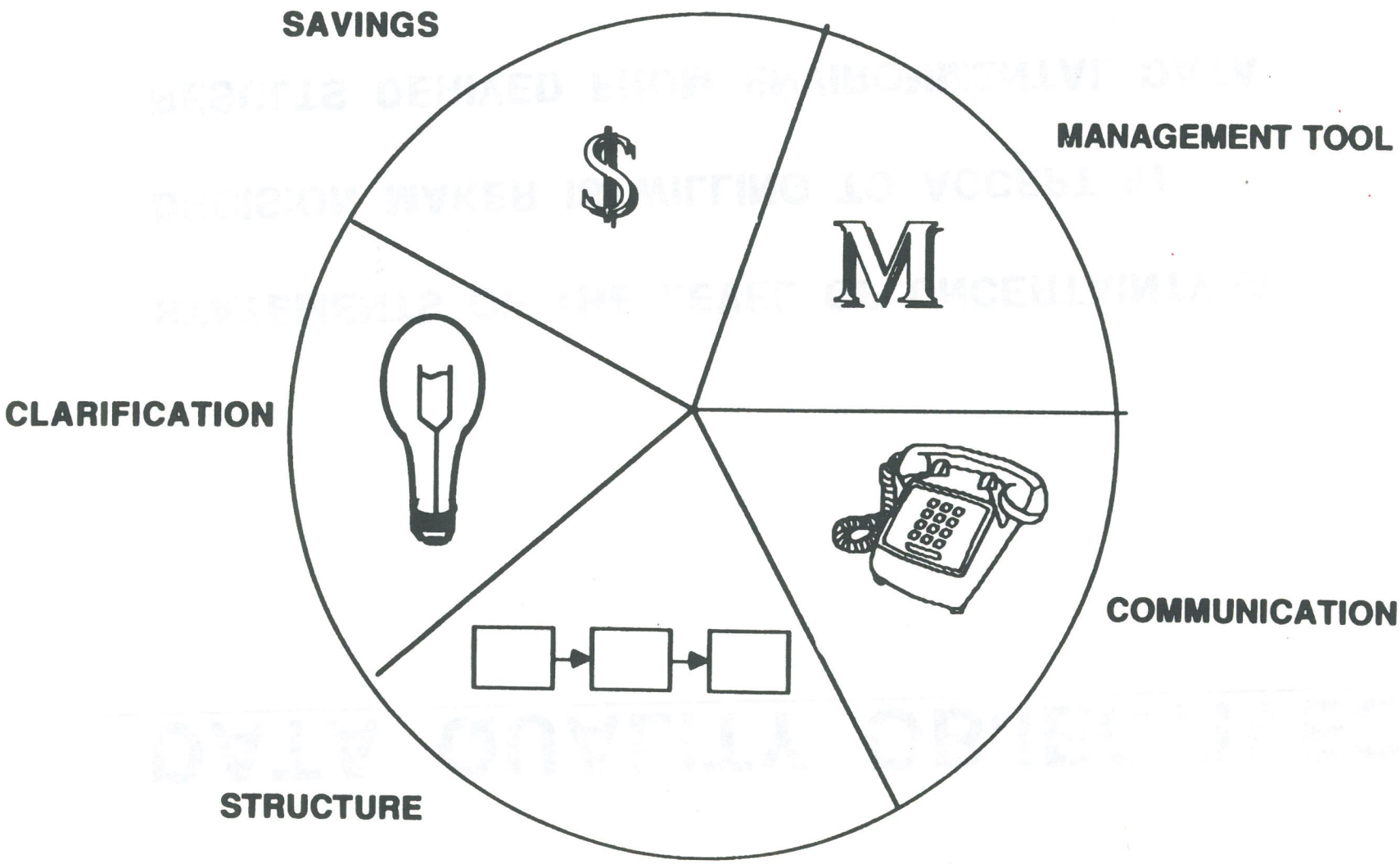
DQO'S STRIKE A BALANCE



DATA QUALITY OBJECTIVES

STATEMENTS OF THE LEVEL OF UNCERTAINTY A DECISION MAKER IS WILLING TO ACCEPT IN RESULTS DERIVED FROM ENVIRONMENTAL DATA

IMPORTANCE TO MANAGERS



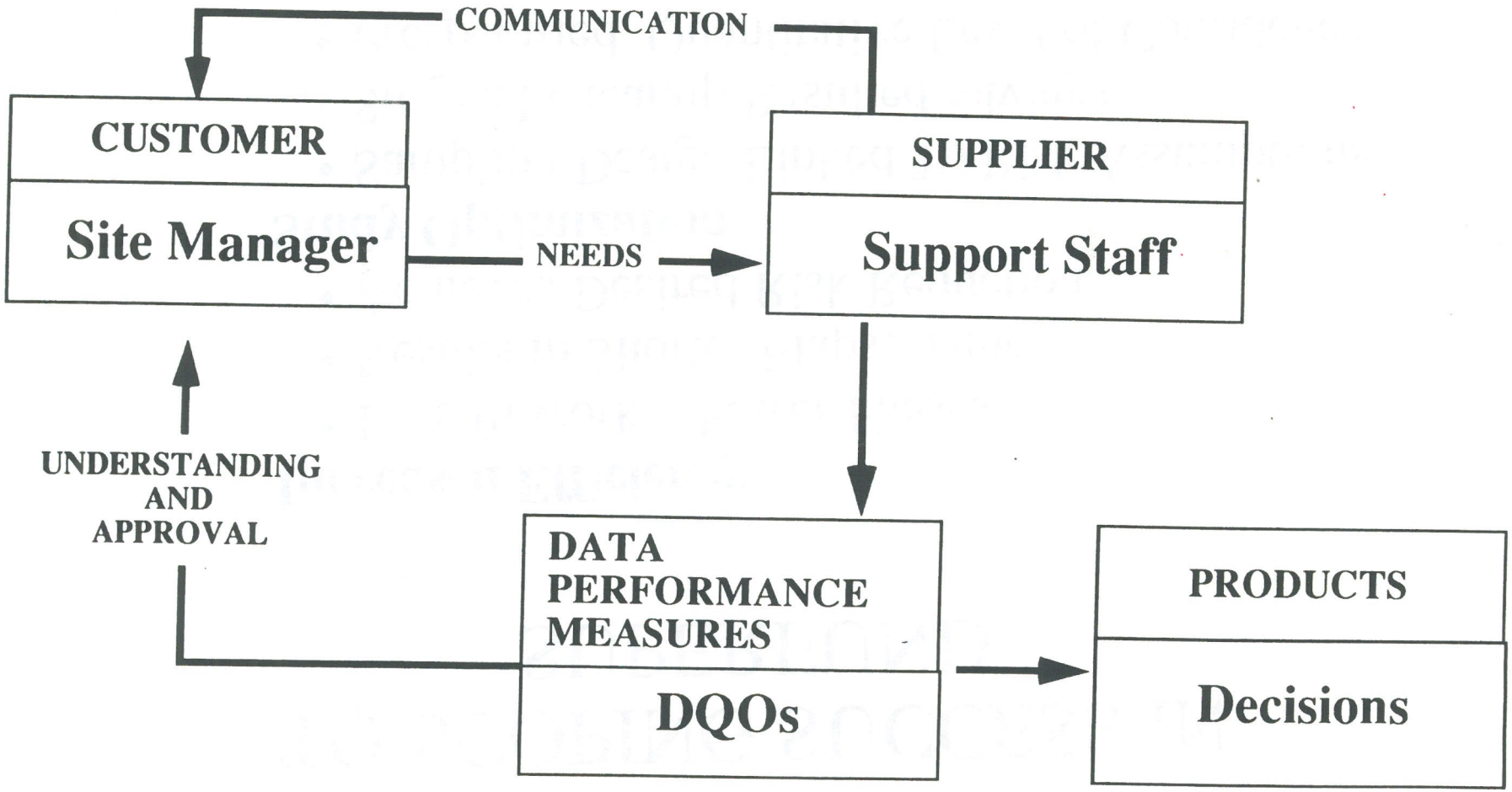
UPFRONT PLANNING IN SUPERFUND

TOTAL QUALITY IN EPA

Process	-	**Understanding Current Program Recipe**
Planning	-	**Developing Quantitative Performance Measures**
People	-	**ImprovingCustomer-Supplier Relationships**

RESULTS IN CONTINUOUSLY IMPROVED PRODUCTS

TQ CYCLE


COMMUNICATION
CUSTOMER
Site Manager
NEEDS
SUPPLIER
Support Staff
UNDERSTANDING AND APPROVAL
DATA PERFORMANCE MEASURES
DQOs
PRODUCTS
Decisions

TQ SCOPING SUCCESS IN SUPERFUND

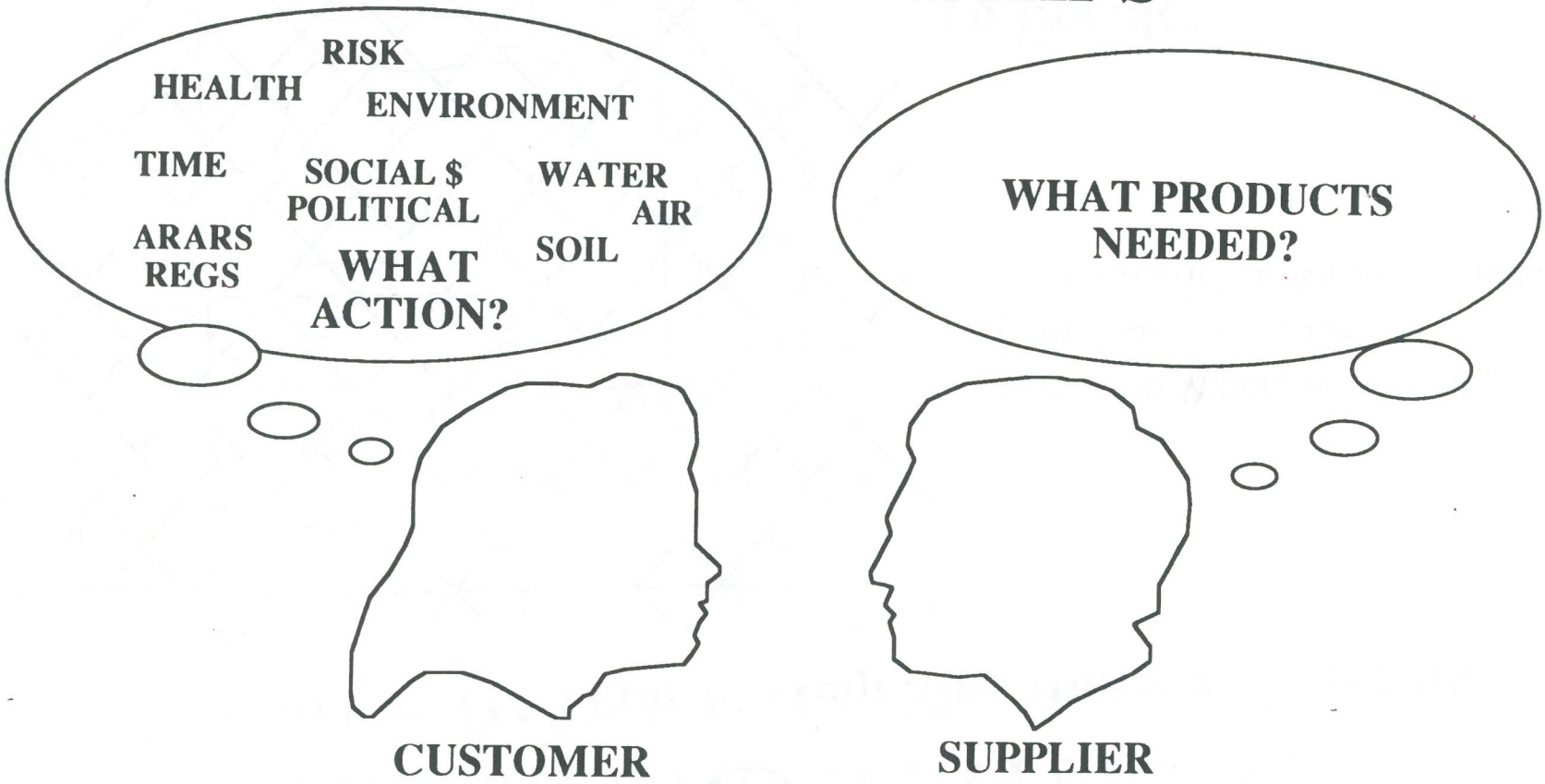
Increased Efficiency

- Less Rework—Fewer Phases
- Results in Shorter Elapse Time
- Achieves Desired Risk Reduction

Study Optimization

- Sampling Design Linked To Risk Assumptions
- Surgical Cleanup Resulted Savings
- Prespecified, Quantitative Level of Confidence
- Upfront Consensus

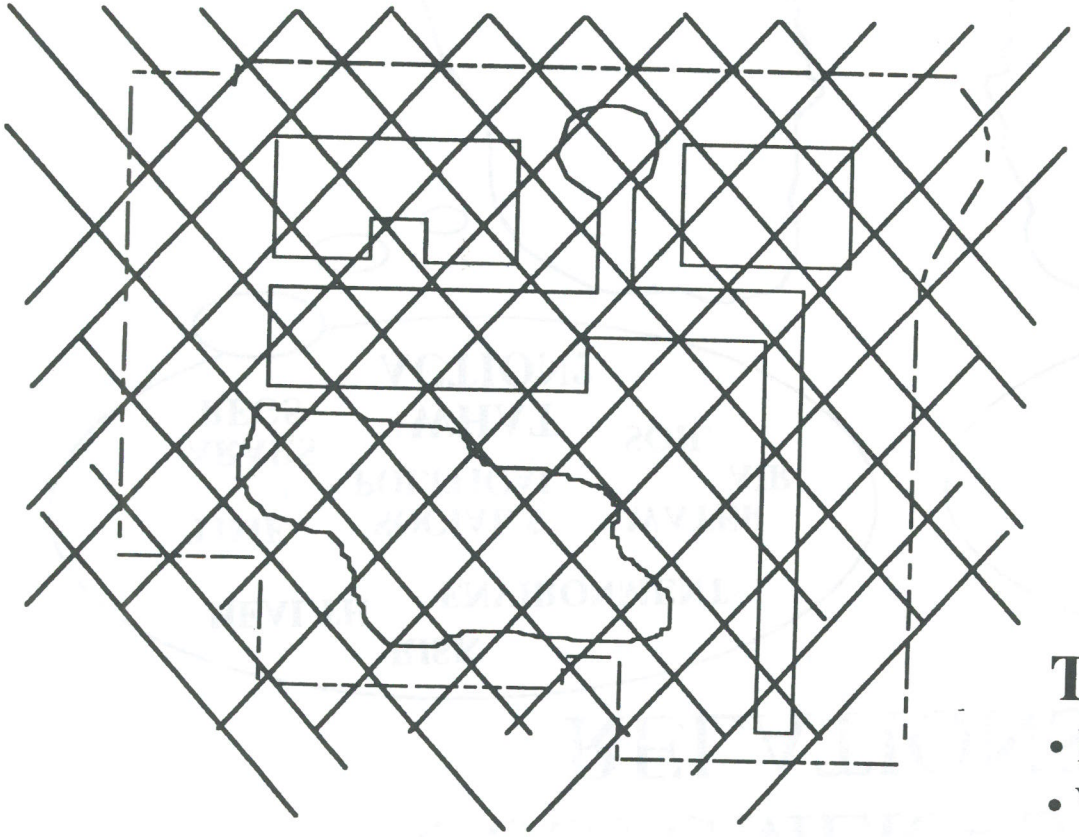
CUSTOMER - SUPPLIER RELATIONSHIPS



COMMUNICATION
UNDERSTANDING

SUPERFUND'S INTEREST

How to Use TQ Tools to Help Site Manager Determine:

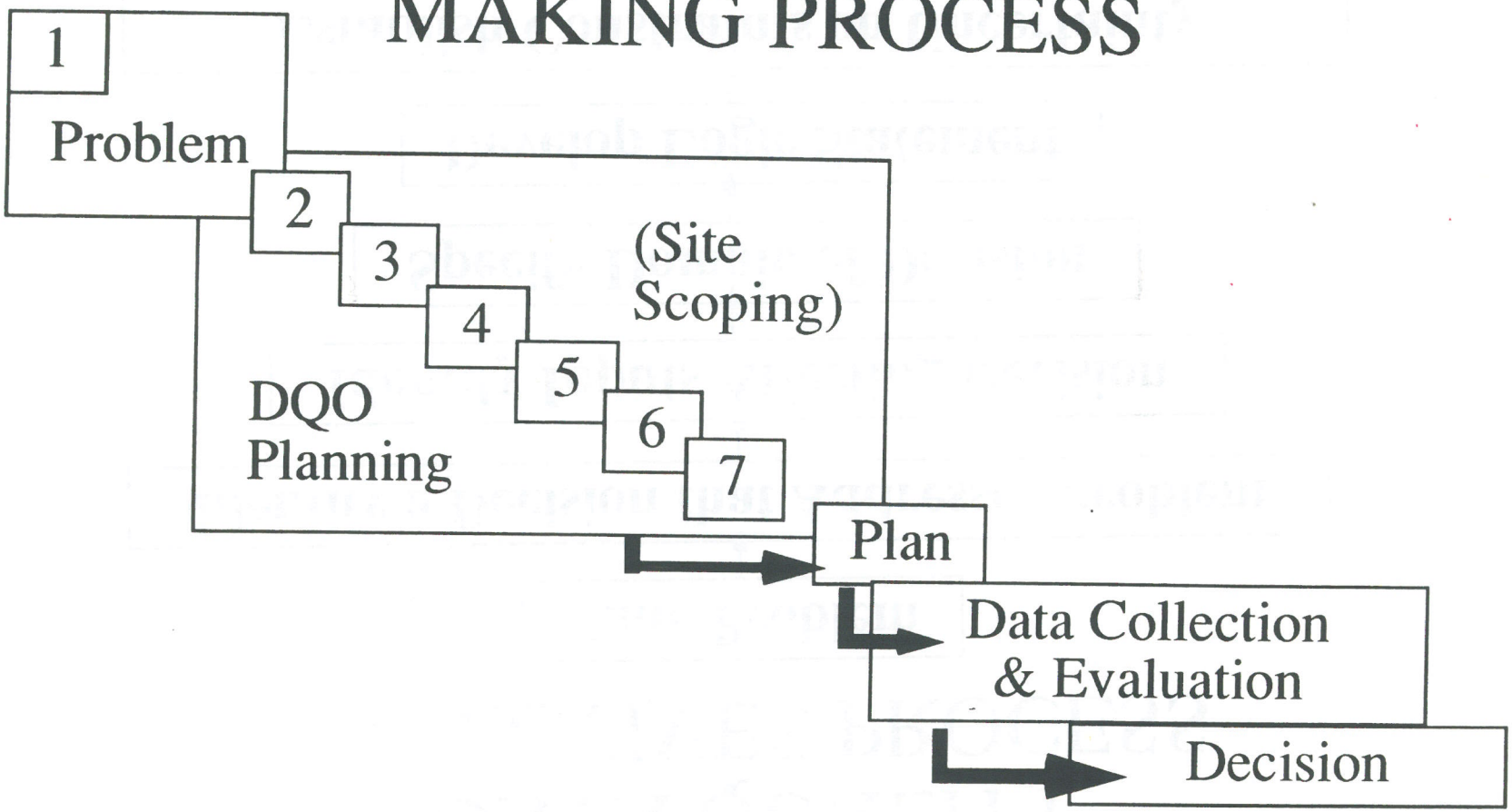


- What and Where to Sample?
- How Many Samples?
- What Quality of Measurements?

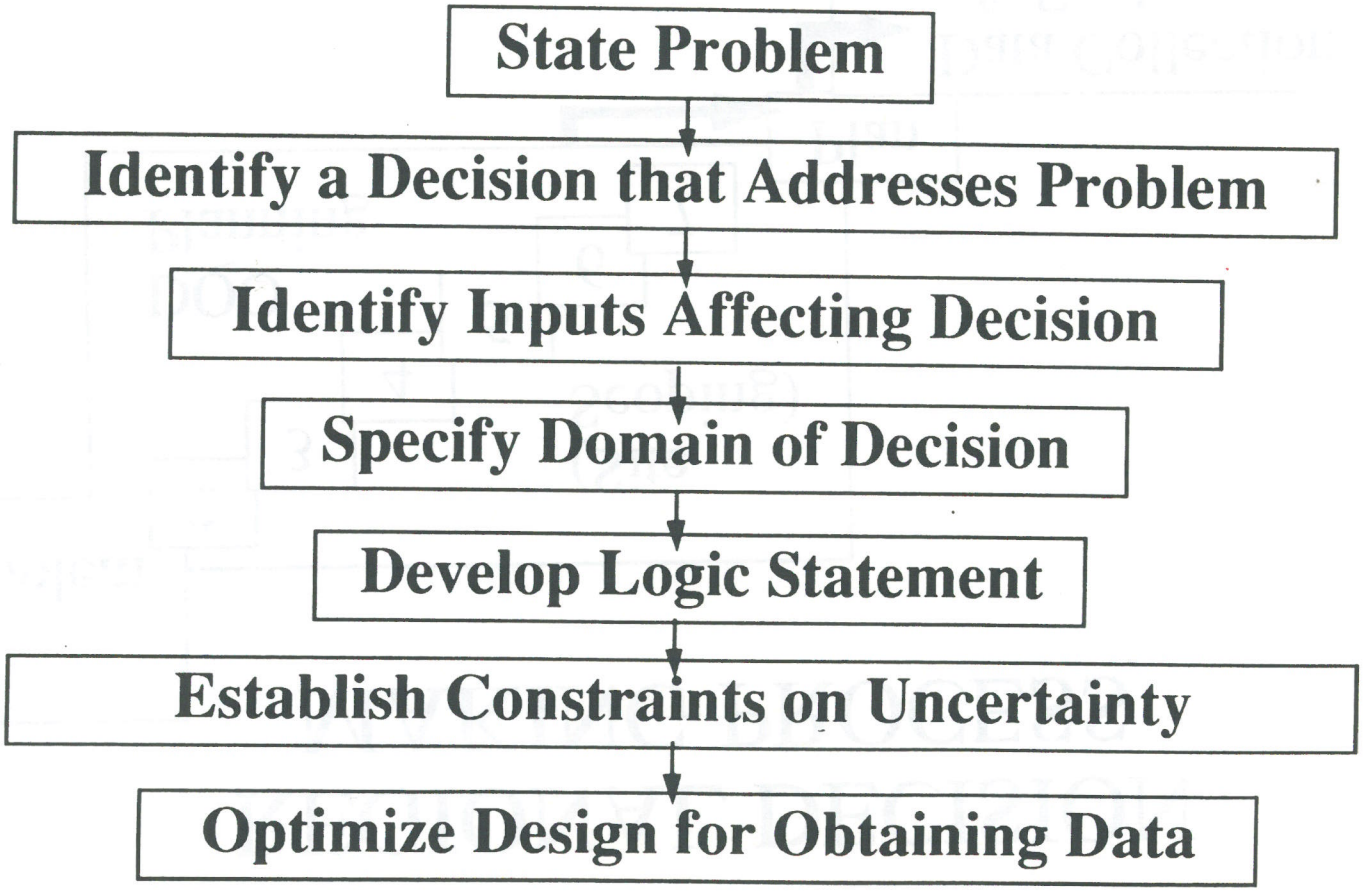
To Decide:

- Is the Site a Problem?
- What is the Best Way to Clean it Up?

REGIONAL DECISION MAKING PROCESS



DATA QUALITY OBJECTIVES PROCESS



STATE PROBLEM

PRODUCT

- What is Known or Expected?
  - Exposure Scenarios
  - Contaminants
- How We Know it?
  - Information Sources
  - Historical Data
  - Site-Visit

PARTICIPANTS

- Site Manager
- Risk Assessment Team
- Support Staff
- ARCs

IDENTIFY A DECISION THAT ADDRESSES PROBLEM

PRODUCT

- What Actions Will Address the Problem?
  - Delist
  - Study the Site Further to Develop Remedial Alternatives
  - ERA
  - Remedial Design
- State Decision as a Choice Between the Most Appropriate Action

PARTICIPANTS

- Site Manager

IDENTIFY INPUTS AFFECTING DECISION

PRODUCT

- What Questions Must Be Answered to Make Decision?
  - Is Environmental Data Important?
  - What Questions About the Environment Must Be Answered?
  - What are the Action Levels?

PARTICIPANTS

- Site Manager
- Support Staff
- ARCs

SPECIFY DOMAIN OF DECISION

PRODUCT

- What Spatial and Temporal Boundaries Must be Placed on the Questions?

  Exposure Scenario

  Smallest Decision Unit

PARTICIPANTS

- Site Manager
- Risk Assessment Team
- Support Staff
- ARCs

DEVELOP LOGIC STATEMENT

PRODUCT

- Algorithm that Specifies How Data will be Summarized and Compared to an Action Criterion to Make a Decision
- Action Criteria: Risk Based or ARAR's

PARTICIPANTS

- Site Manager
- Risk Assessment
- Statistician

ESTABLISH CONSTRAINTS ON UNCERTAINTY

PRODUCTS

- Qualitative and Quantitative Performance Measures
  - Analysis of Consequences of Error
  - Level of Uncertainty Site Manager will Accept in Decision

PARTICIPANTS

- Site Manager
- Statistician
- Risk Assessment Team
- Cost Analyst

OPTIMIZE DESIGN FOR OBTAINING DATA

PRODUCT

- Most Cost Efficient Design that Meets the Constraints Set Above and Provides for Protection of Human Health and Environment

  Optimal Error Allocation: Sampling and Analysis

PARTICIPANTS

- Statistician
- Site Manager
- Support Staff
- Cost Analyst
- ARC's

TQ BENEFITS

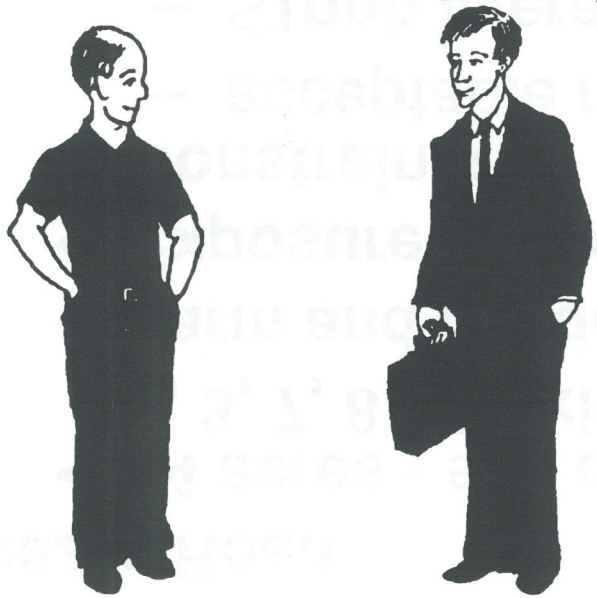
- Structure in Planning Enhances Thinking
- Improves Dialogue Amongst Participants
- Quantitative, Defensible Design Endpoints
  - Control Probability of Incorrect Decisions
  - Know When to Stop Sampling
  - Collect Only Data Needed for Stated Decision
- Facilitates Input by Public and Their Technical Consultants During Planning
- Cost and Time Effective Way to Comply with Risk Based Decision Making

Applying TQM to Superfund Cleanup

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Key to Success – Planning

communication
understanding



Customer
(decision-maker)

Supplier
(data supplier)

Planning Issues

- Optimize sampling
- Optimize remediation
- Minimize cost and time
- Produce defensible data

Application

Piazza Road

- 14 acres - soil contaminated with 2, 3, 7, 8 - Dioxin
- Farm and residential use
- Exposure route - soil ingestion
- Constraints
  - acceptable risk -- 10^{-6} or 1 ppb dioxin
  - $\leq$1ppb average remaining concentration in each 5000 ft^2 unit
- Current approach
  - remediate $\approx$10 acres
  - data and "professional judgement" based

How!!

- Precisely define problem
- Establish tolerance for making wrong decision
- choose least cost that meets risk requirements

Constraints on Decision Making

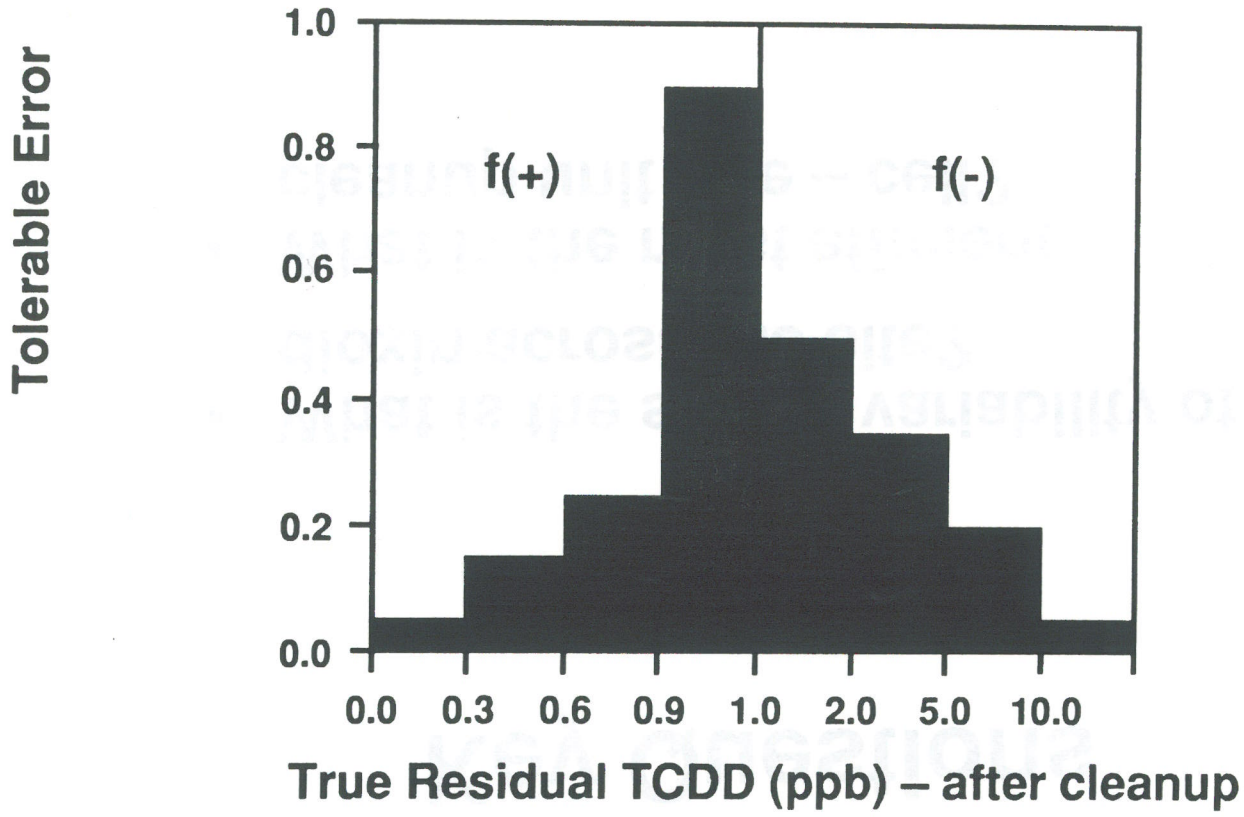
Facts

- 5000 ft^2 exposure unit
- 10 x 10 ft smallest reasonable cleanup unit size -- cell
- Cleanup level
  - average dioxin level $\leq$1 ppb in exposure unit
- No reliable data on dioxin distribution and variability

Decision Rule

- If the UCL of the average dioxin concentration at a fixed depth in an EU is less than or equal to 1 ppb then do not cleanup
- If the UCL of the average dioxin concentration in an EU is greater than 1 ppb, then remediate the most contaminated cells so that the expected average in the EU is less than 1 ppb.

Discomfort Curve



Total False Negatives < 5%

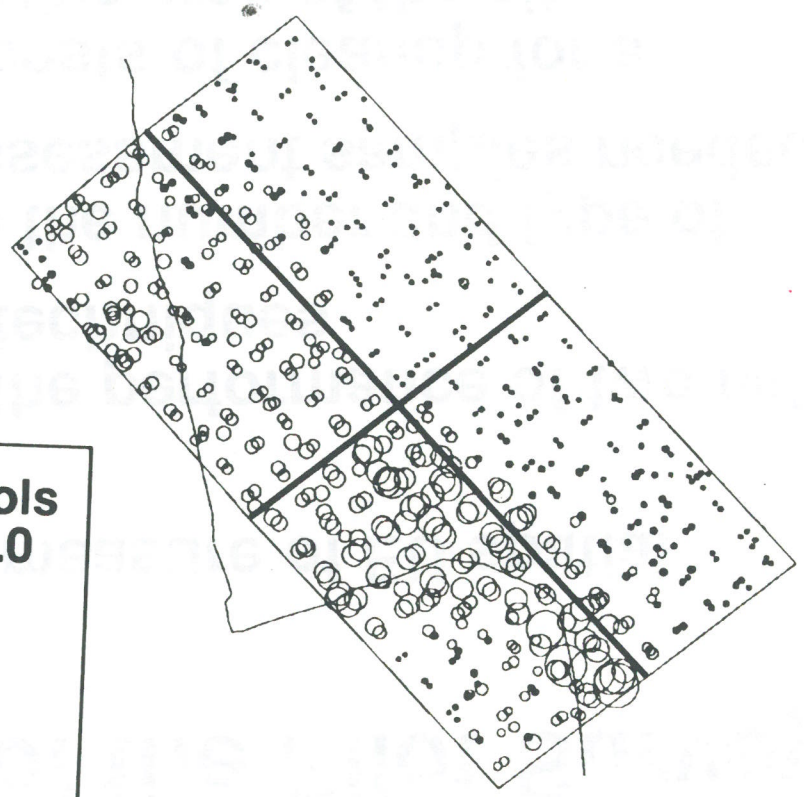
Key Questions

- What is the spatial variability of dioxin across the site?
- What is the most efficient cleanup unit size – cell?

Goals of the Pilot Survey

- Provide a measure of EU spatial variability
- Compare the performance of two field sampling techniques
- Determine the number and type of Quality Assessment samples needed
- Compute costs of cleanup for a representative area of the site

Dioxin Study



Solid symbols are below 1.0

10 feet

.30

103.92

Measurement Error Summary

- Laboratory analytical error is small (4%)
- The composite samples are less variable than the point (spoon) samples (17% vs. 21%)

Conclusions

- more complete mixing of composite samples may be the most effective way to reduce measurement error
- local measurement error is less important than the differences between samples > 10 feet apart

Questions

Does more detailed knowledge lead to less volume?

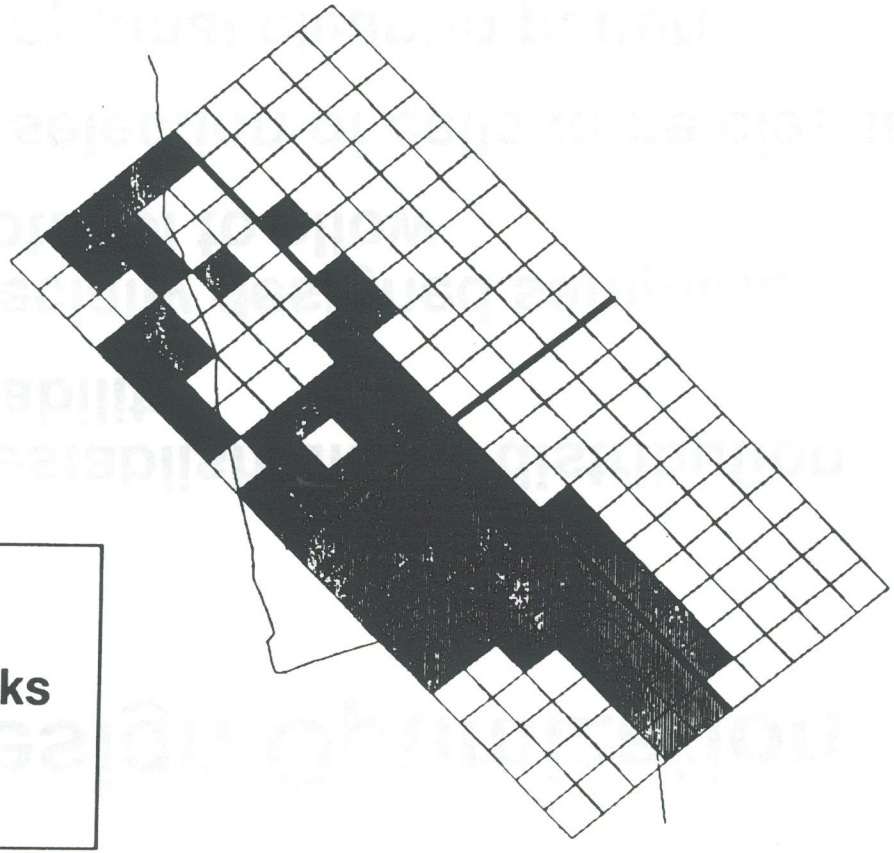
What cell size leads to the lowest total cost?

Design Optimization

Pilot to establish dioxin distribution and variability

- specially designed sampling protocol to allow
  - selection of cells to be cleaned
  - optimal cleanup pattern

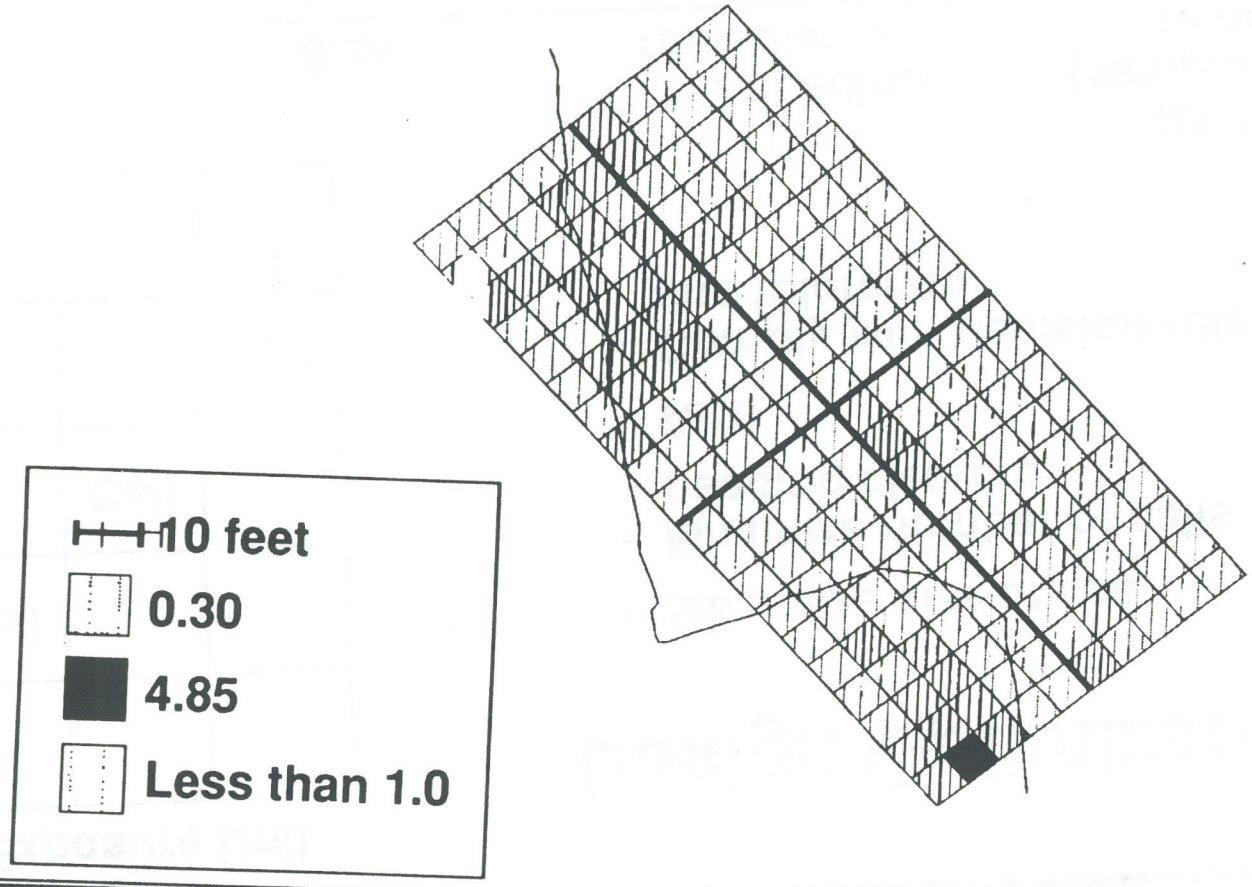
Blocks to be Cleaned



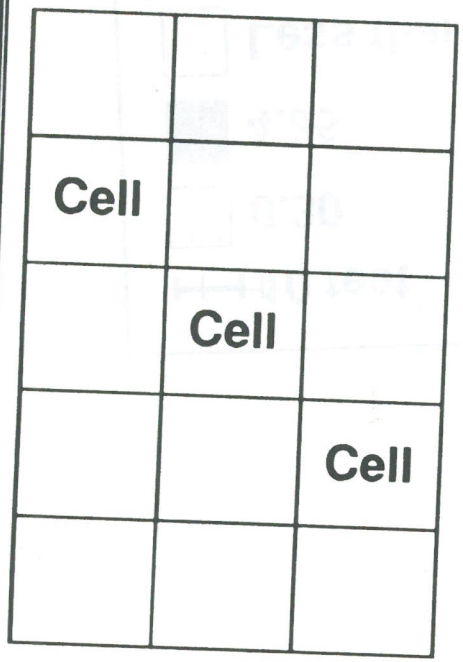
10 feet

Filled blocks are to be cleaned

Dioxin Levels After Cleanup



Exposure Unit



Design Optimization

- Maximize size of cell
- Minimize number of cells needing cleanup

  AND
- Comply with decision rule and tolerance

Size	% EU needing remediation	total cost/EU (sampling, analysis, remediation)
10x10 ft	36.5%	$42K
14x14	38.8	40K
20x20	46.0	46K
50x100	100	91K

Results

- Sample 14x14 ft sized cells over rest of site
- Save ≈ $51K per EU

EU	100% Cleanup Cost	Improved Cleanup Cost	Saving
65 (7.5 ac)	$6.0 M̄	$2.6 M̄	$3.4 M̄

Results (cont.)

- Quantitative "paper trail" to base cleanup decision
- Save time
  - know what to do
  - know how to do it
  - eliminate rework
    - resampling
    - redefining problem
  - quantitative methodology reduces reliance on "best judgement"