Monitoring & Control of Cryptosporidium

JITMM Cryptosporidium Workshop
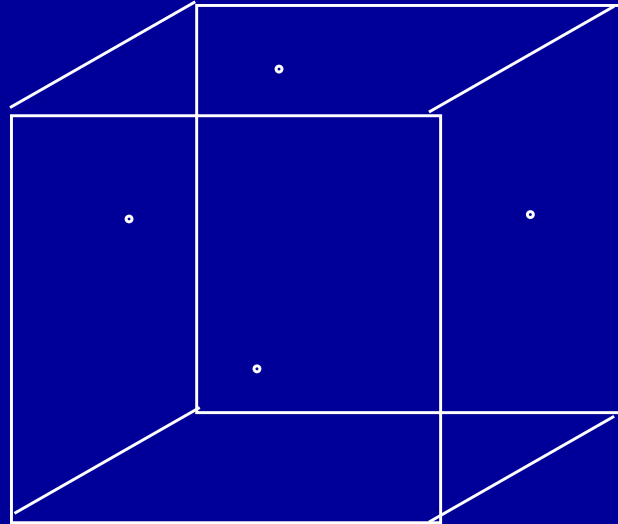## Bangkok, Thailand

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<u>INTRODUCTION</u>

- <u>**Crypto**</u> **&** <u>**Giardia**</u> **INFECT HUMANS AND ANIMALS WORLD-WIDE...ARE SHED WORLD-WIDE**

- <u>**Crypto**</u> **&** <u>**Giardia**</u>**...IN ALL SURFACE WATERS**

- **PROBLEM: TO MEASURE CONCENTRATIONS UNDER ALL SURFACE WATER CONDITIONS**

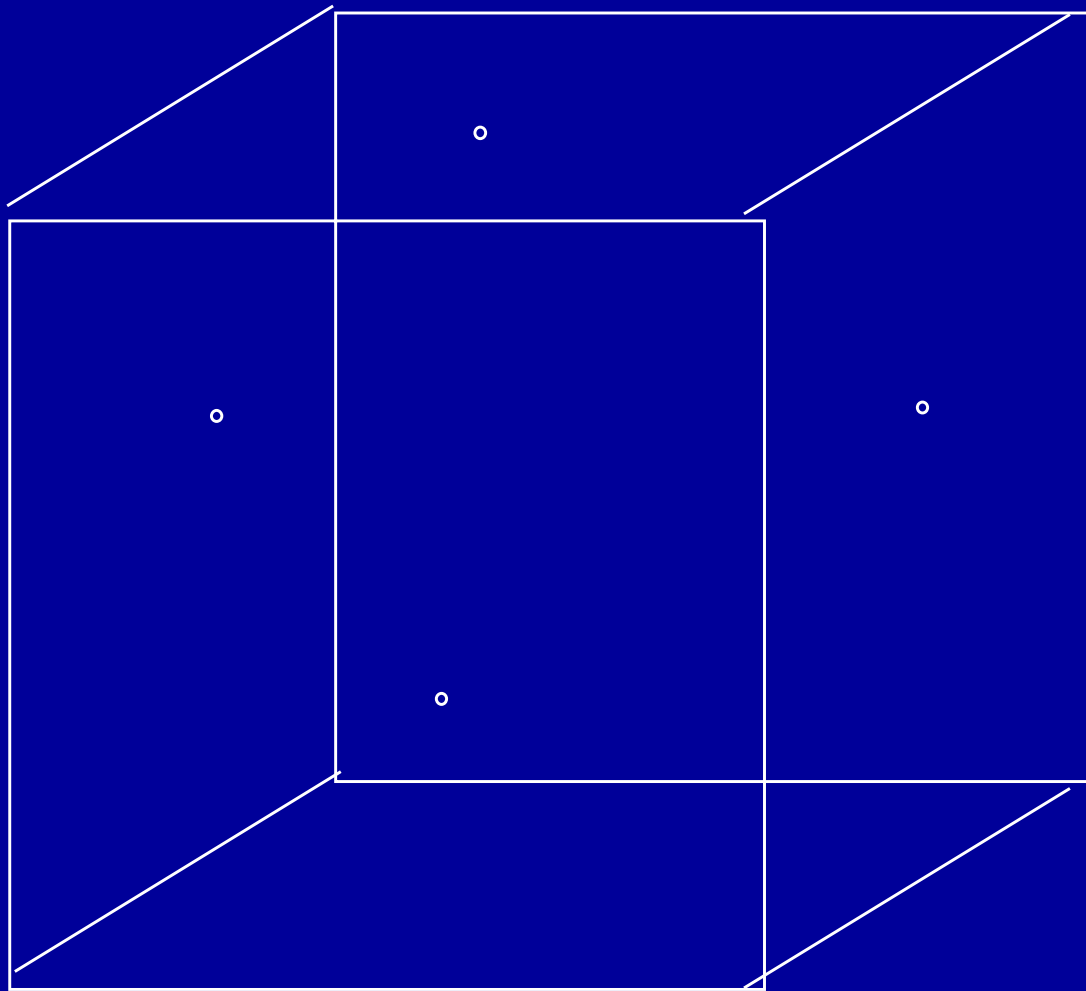# SAMPLING PROBLEMS

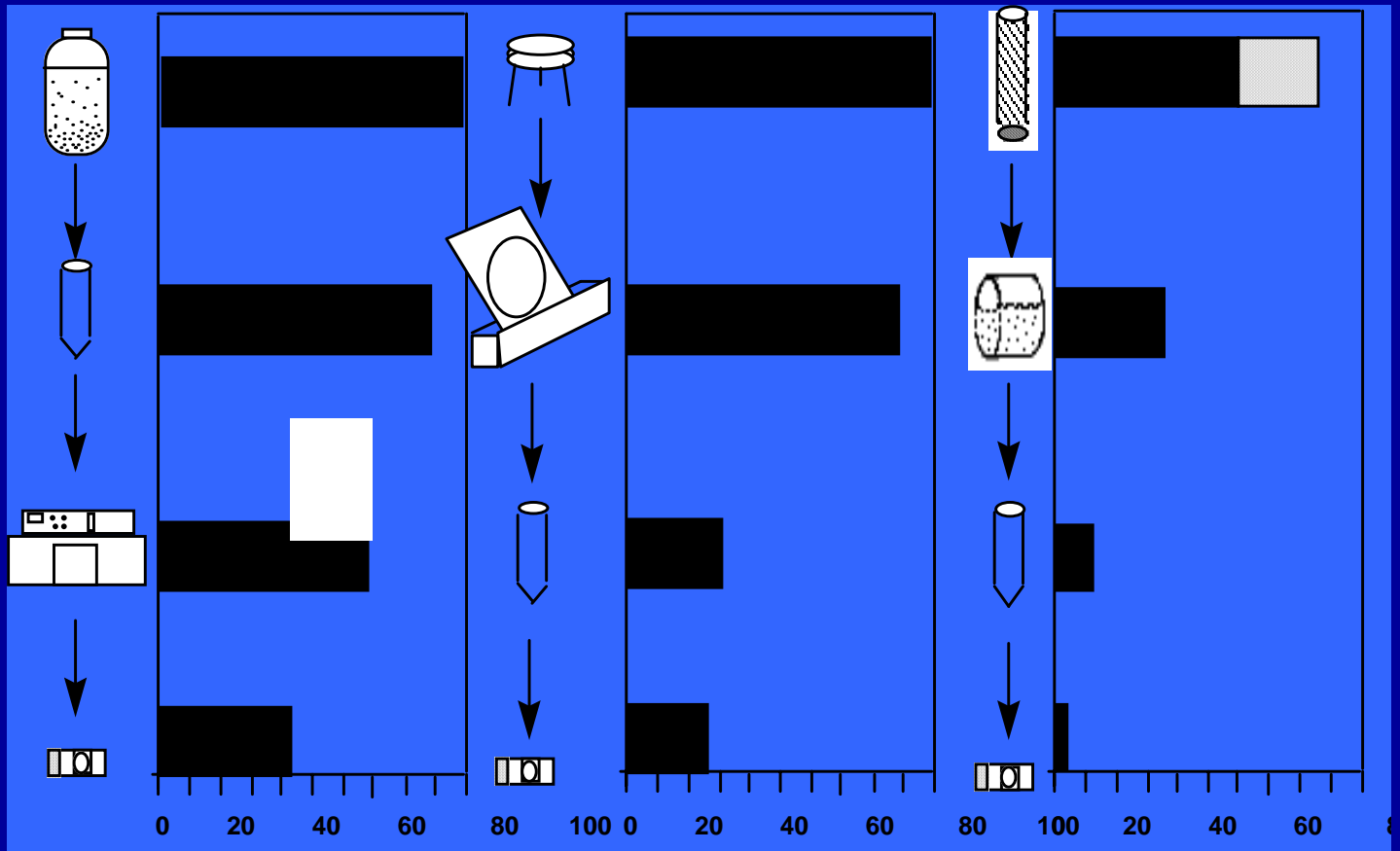

- COLLECT VOLUME INCLUDING A DETECTABLE NUMBER

- REPRESENTATIVE IN TIME AND SPACE

- MATCH SAMPLES TO ANALYSIS METHOD

- BEGIN BY TRIAL & ERROR TO ESTABLISH CONCENTRATION RANGE

FINDING CRYPTOSPORIDIUM...

"*A NEEDLE IN A HAYSTACK*"

FEATURES of ANALYSIS METHODS

PROBLEM DESCRIPTION

- **DEVELOPING A SAMPLING PLAN**
  - CONCENTRATION LEVEL
  - VARIATIONS
    - » SHORT-TERM
   - » LONG-TERM
  - STATISTICAL TESTS

- **TREATMENT PLANT PERFORMANCE**
  - OVERALL REMOVAL
  - REMOVAL BY STAGE
  - NEED FOR SEEDING???
  - CONTINUOUS VS. INTERMITTENT...TRACING
  - BACKWASH RECYCLE EFFECTS

WHY CONCENTRATION???

ALL INTERRETATION DEPENDS ON CONCENTRATION

- **SIGNIFICANCE TO CONSUMERS**

- **PROBLEM SCALE AT ANY SAMPLING LOCATION**

- **SELECTION OF APPROACH TO CONTROL**

- **TREATMENT PROCESS EFFECTIVENESS**

- **CATCHMENT MANAGEMENT EFFECTIVENESS**

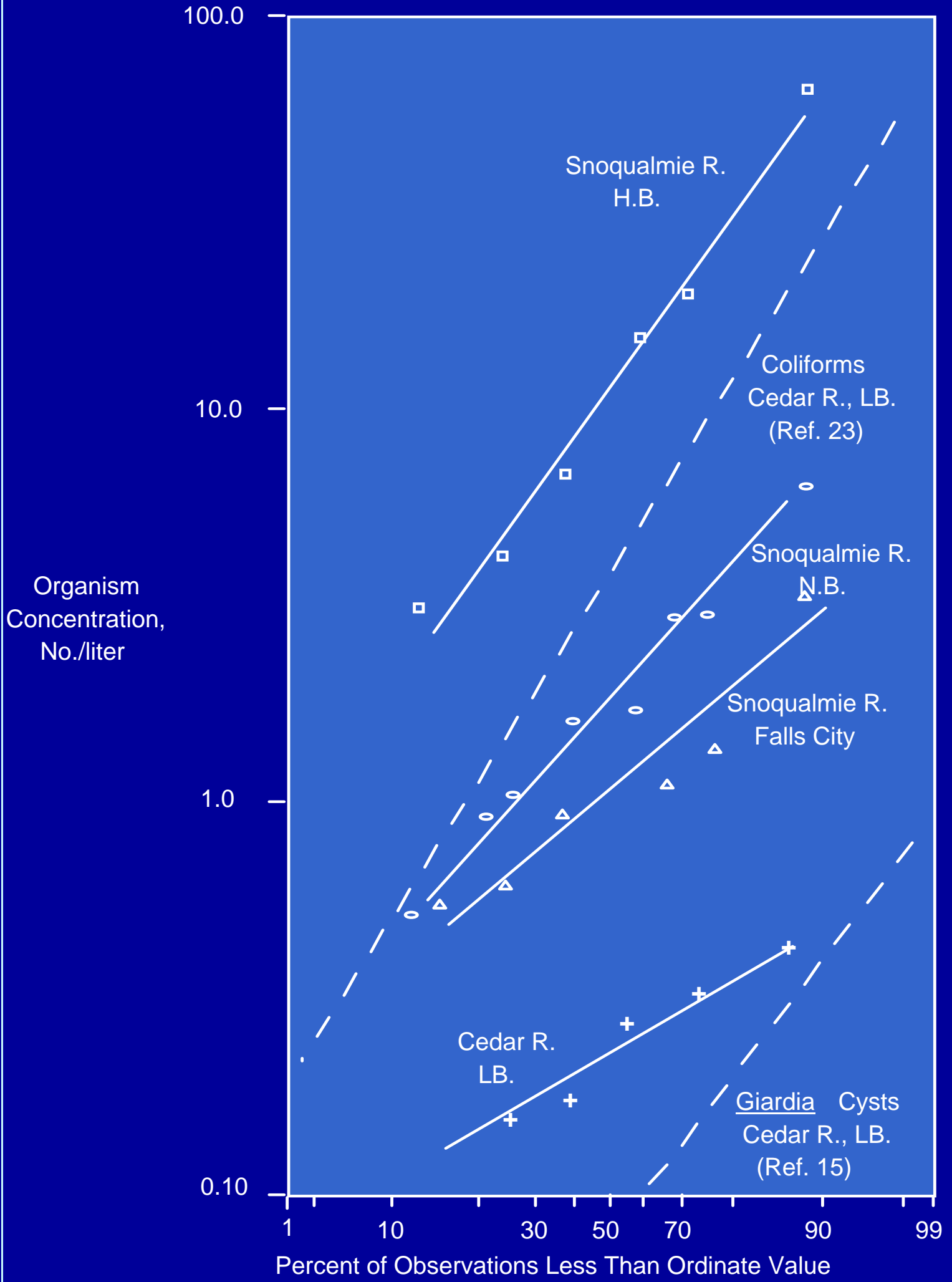# WATER SYSTEM SCHEMATIC
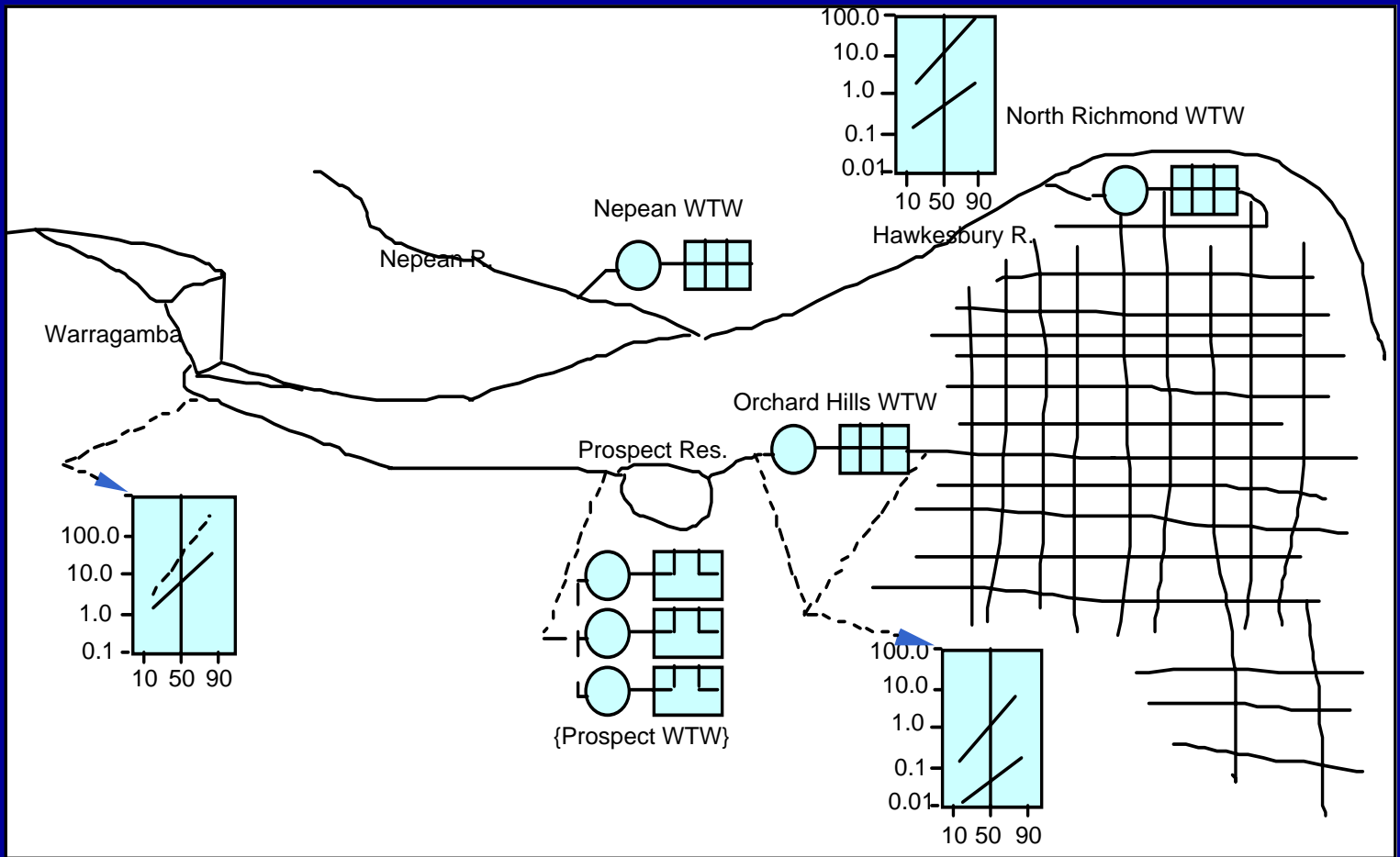
NATURE OF THE PROBLEM

- **FINDING A NEEDLE IN A HAYSTACK**

- **TYPICALLY, Crypto & Giardia CONCENTRATIONS INVERSELY RELATED TO WATER QUALITY**

- **SELECT ANALYSIS METHOD COMPONENTS TO SUIT CONDITIONS AND REQUIREMENTS**

SAMPLING PLAN STEPS

- **ASSESS CATCHMENT CHARACTERISTICS**
  - IDENTIFY SOURCES

- **ASSESS WATER QUALITY @ SAMPLE LOCATION**

- **SELECT ANALYSIS METHOD COMPONENTS**
  - MINIMISE SAMPLE VOLUME TO GET POSITIVE RESULTS
  - TRY TO PRODUCE 75% OR MORE POSITIVE RESULTS
  - CONDUCT ALL SAMPLE PROCESSING IN LAB IF POSSIBLE
  - AVOID DIVIDING SAMPLES (PELLETS) AND EXTRAPOLATION

- **ANALYSE TRIAL SAMPLES AS INITIAL STEP**
  - EX. ANALYSE 3 TO 5 REPLICATE 20 L VOLUMES
  - VERY FEW SURFACE WATERS HAVE CONC >0.01/L

CONCENTRATION VARIABILITY

- **METHOD PRECISION--5 SIMULTANEOUS SAMPLES**

- **SHORT-TERM--5 SAMPLES @ 1 to 2 hr INTERVALS**

- **LONG-TERM--ca. MONTHLY FOR AT LEAST 1 YEAR**

Figure. Organism concentration versus percent of observations less than ordinate value, showing data for Snoqualmie R. H.B., Coliforms Cedar R., LB. (Ref. 23), Snoqualmie R. N.B., Snoqualmie R. Falls City, Cedar R. LB., and Giardia Cysts Cedar R., LB. (Ref. 15).

LIMIT OF DETECTION

L.D. = 1/(SAMPLE VOL. x RECOVERY %
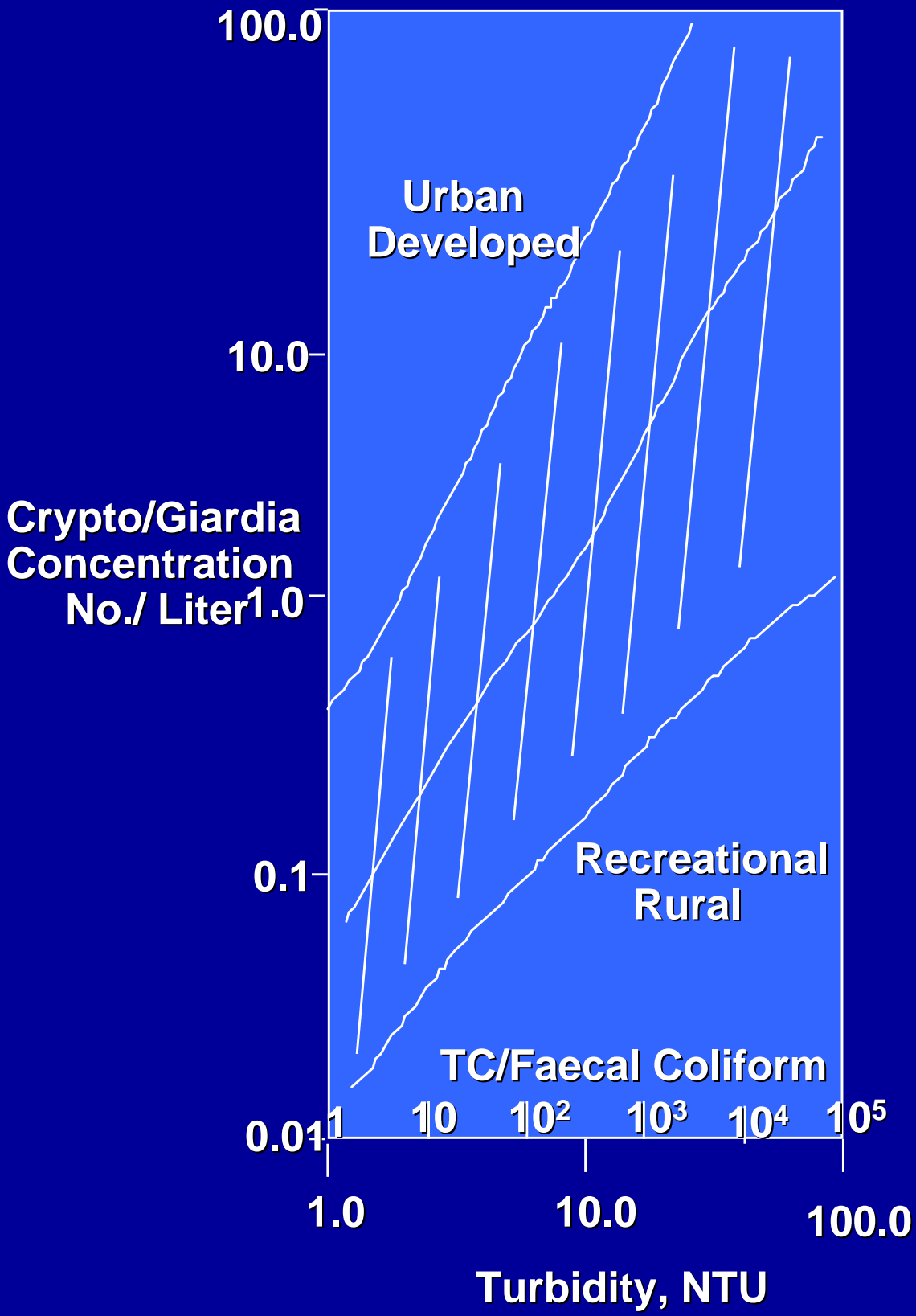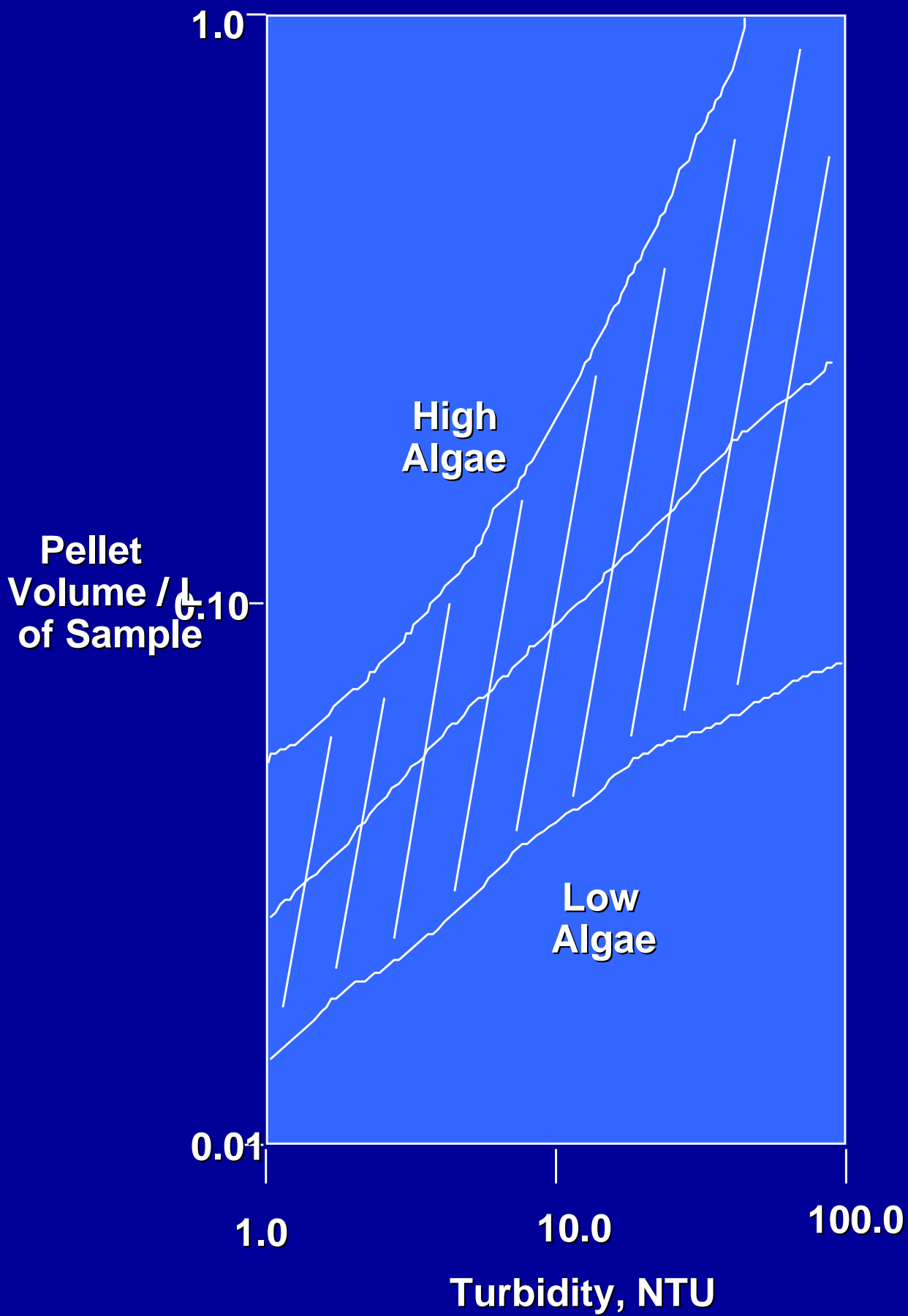
EXAMPLE:
1. High quality upstream water
   – sample volume = 20 L
   – recovery fraction = 0.20
   – L.D. = 1/(20 L x 0.20) = 1/4 L or 0.25/ L

2. Medium quality downstream water
   – sample volume = 20 L
   – recovery fraction = 0.10
   – L.D. = 1/ (20 L x 0.10) = 1 / 2 L or 0.5 per L

LIMITATIONS of ANALYSIS METHODS

ANALYSIS LIMITATIONS

- **FLOC-PRECIPITATION--VOLUME < 25-100 L**

- **293mm MEMBRANE--TURBIDITY < ca. 5 NTU**

- **13mm MICROSCOPY--PELLET VOL. < 0.5-1.0mL**
  - **PRODUCTION @ 5 TO 10 SAMPLES PER WEEK**

- **25mm MICROSCOPY--PELLET VOL. < 2-4mL**
  - **PRODUCTION @ 2 TO 5 SAMPLES PER WEEK**

- **CARTRIDGE FILTER-TURBIDITY < 10 NTU; C &G CONC. > 10 per L; SAMPLE VOLUME ca. 20 L**

- **FLOW CYTOMETER--w/o floatation, ca. 10/ day; -- w/ floatation, ca. 40/ day**

TREATMENT PERFORMANCE EVALUATION

$C_2 = 0.1C_1$

$C_3 = 0.001C_1$

$Q_b = 0.05Q_1$

$C_5 = 0.1C_4$

Q, C_1

C_2

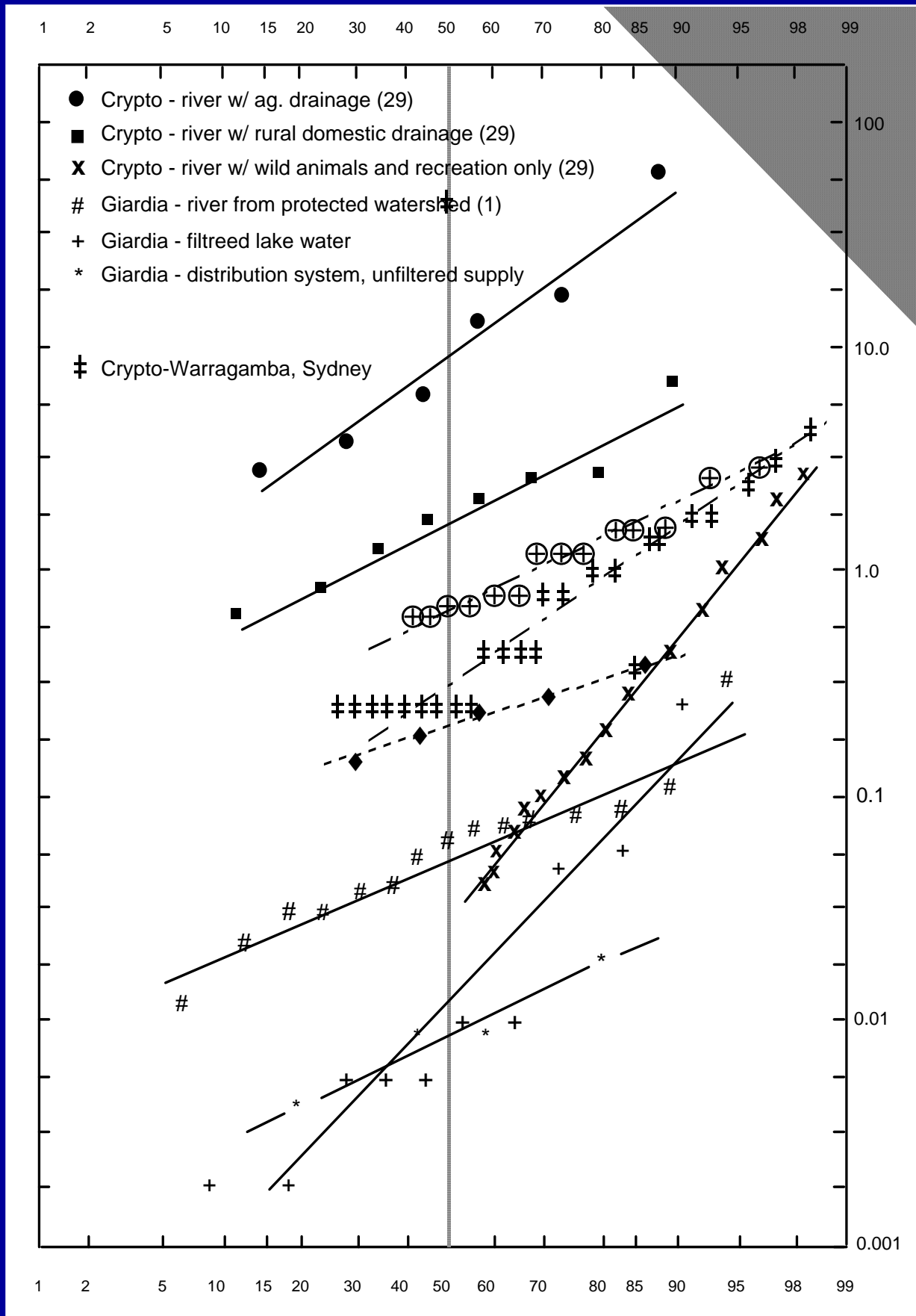Q_3, C_3

C_5

Q_b, C_4
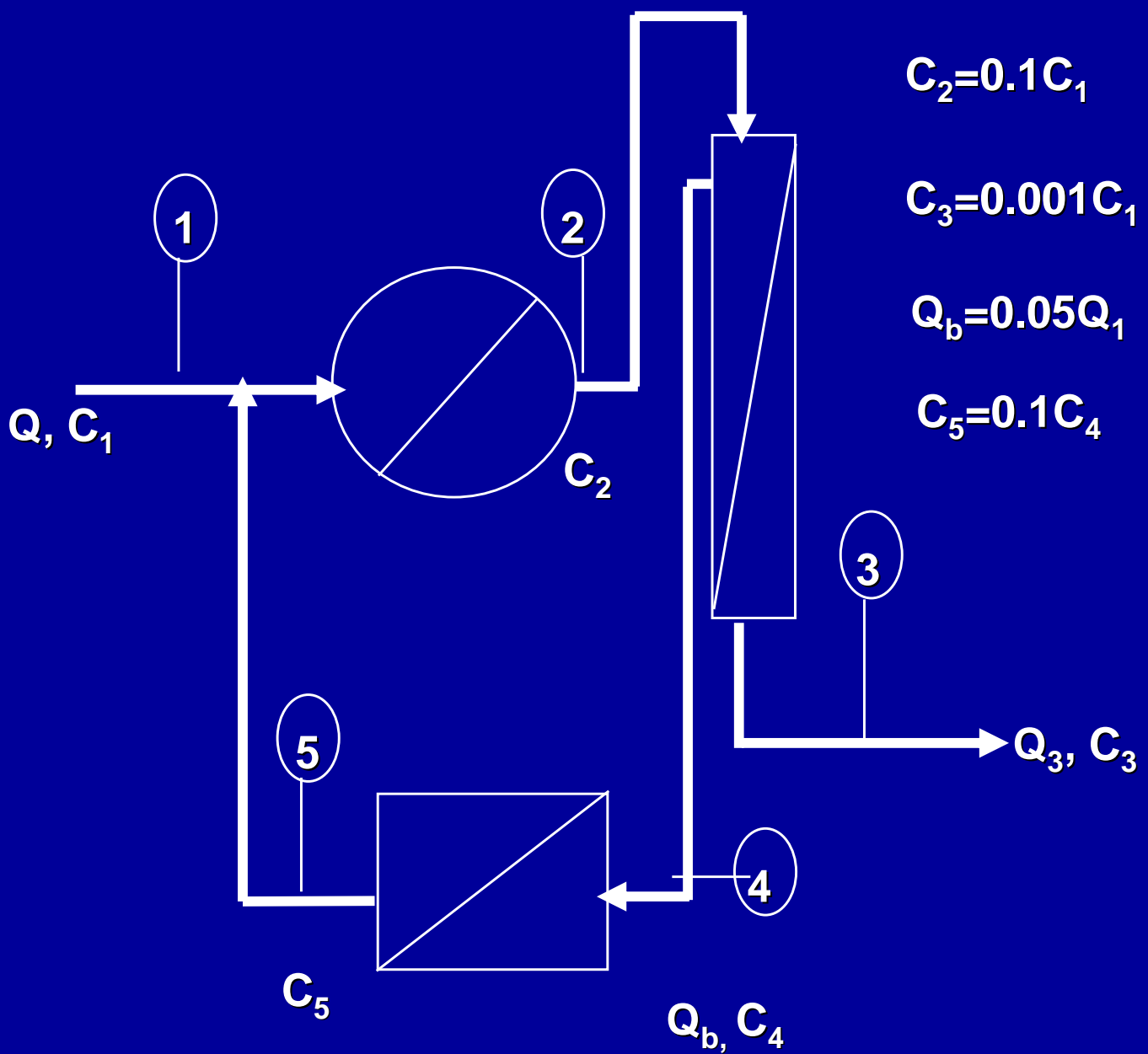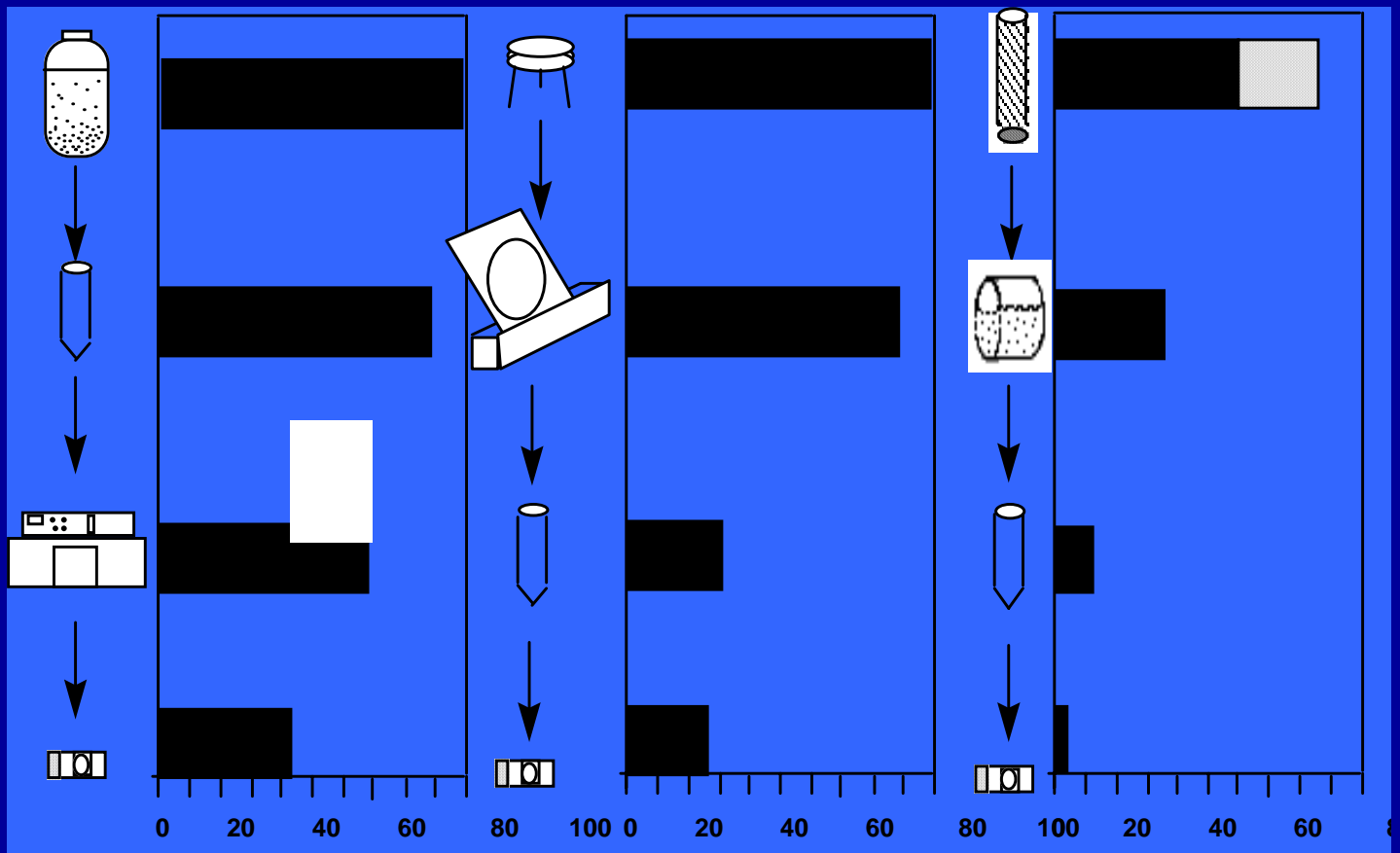
TREATMENT PERFORMANCE MEASUREMENTS
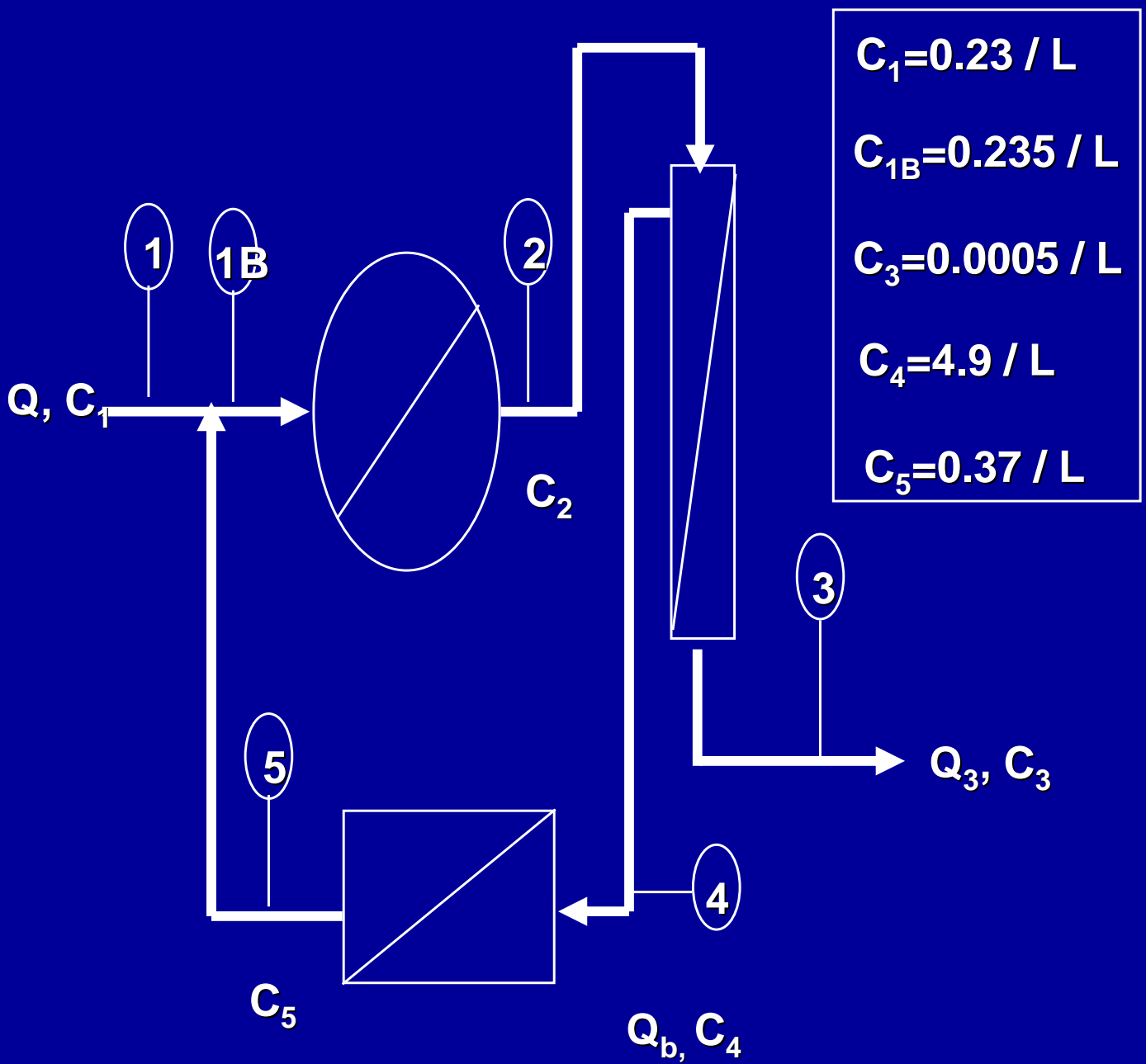
PERFORMANCE EVALUATION PLANNING STEPS

- **MEASURE PLANT INFLUENT CONCENTRATION**

- **SELECT ANALYSIS COMPONENTS BY LOCATION**
  - **BEST AVAILABLE METHOD FOR PLANT INFLUENT**
  - **SET SAMPLING VOLUMES TO GIVE ALL POSITIVE RESULTS**
  - **USE MEMBRANE FILTER FOR SETTLED AND FILTERED SAMPLES**

- **SET SAMPLING POINTS TO COMLETE MASS BAL.**

- **ANALSYSE TRIAL SAMPLES TO CHECK VOLUMES**

- **INCLUDE RECYCLE IF ANY QUESTIONS re. EFFECTS**

- **FILTERED CONC. WILL BE 3 to 4-Logs < INF.CONC. MUST ANALYSE 10^3 to 10^4 x INF. SAMPLE VOLUME**

- **CAN AGGREGATE EFFLUENT SAMPLE VOLUMES**

TYPICAL CRYPTO & GIARDIA CONCENTRATIONS

- ● Crypto - river w/ ag. drainage (29)
- ■ Crypto - river w/ rural domestic drainage (29)
- X Crypto - river w/ wild animals and recreation only (29)
- # Giardia - river from protected watershed (1)
- + Giardia - filtreed lake water
- * Giardia - distribution system, unfiltered supply
- ‡ Crypto-Warragamba, Sydney

ALTERNATE ANALYSIS METHODS

CONCLUSIONS

- **MEASURING CONCENTRATION IS ESSENTIAL**

- **CONTROL FOR SPECIFIC CONDITIONS IS ESSENTIAL**

- **ZEROS ARE OF VERY LITTLE VALUE…DESIGN SAMPLING TO GIVE POSITIVE RESULTS**

- **WATER TREATMENT EFFECTS ARE PREDICTABLE**