U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: ESF ALTERNATIVES STUDY - METHODOLOGY IMPLEMENTATION AND CURRENT STATUS

PRESENTER: DR. PAUL GNIRK

PRESENTER'S TITLE AND ORGANIZATION: PRINCIPAL CONSULTANT
RE/SPEC INC.

PRESENTER'S TELEPHONE NUMBER: (505) 268-2661

JULY 24-25, 1990

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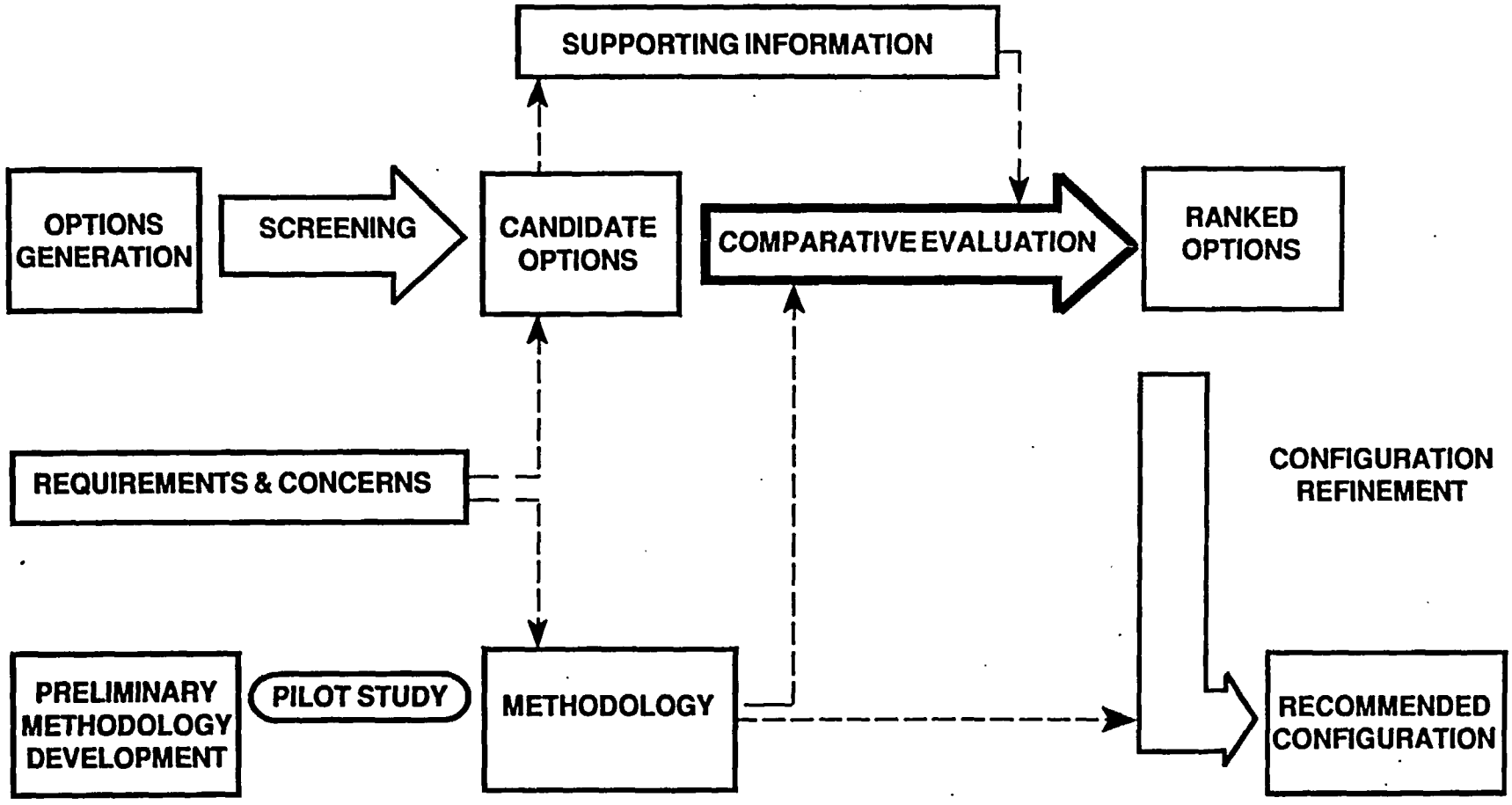
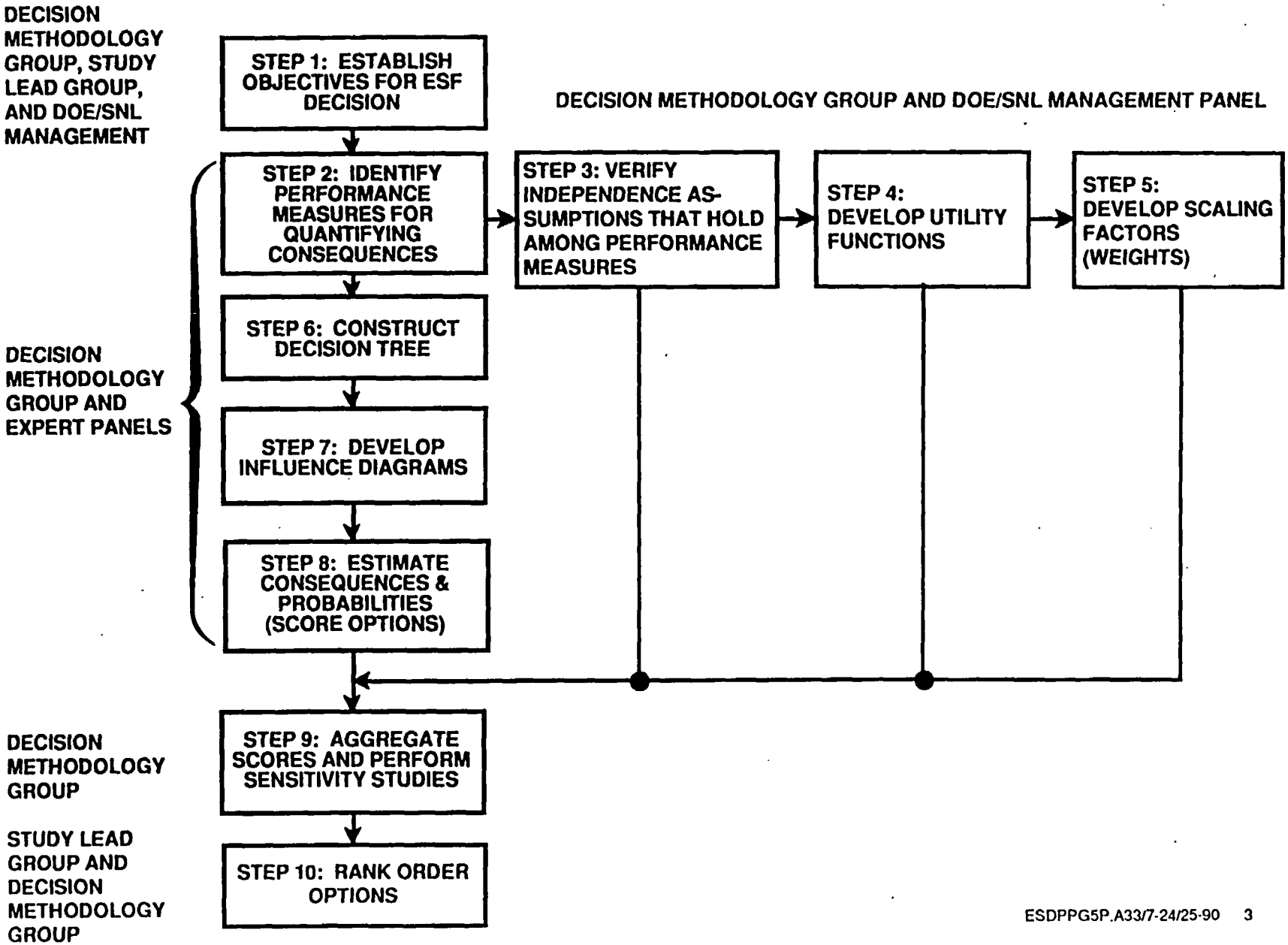
ESF ALTERNATIVES STUDY
COMPARATIVE EVALUATION



TOPICS

- CURRENT STATUS
- EXPERT PANELS
- OBJECTIVES HIERARCHY
- EXAMPLE OF EXPERT PANEL INVOLVEMENT
  - INFLUENCE DIAGRAM
  - PERFORMANCE MEASURE SCALE
  - SCORING OF ESF OPTIONS
- EXAMPLE OF MANAGEMENT PANEL INVOLVEMENT
  - UTILITY FUNCTIONS
  - SCALING FACTORS (WEIGHTS)
- FUTURE PLANS

IMPLEMENTATION OF ESF ALTERNATIVES STUDY



CURRENT STATUS

• OBJECTIVES:	DETAILED COMPLETENESS ASSESSMENT BY MANAGEMENT IN EARLY MAY
• INFLUENCE DIAGRAMS:	EXCEPT FOR REPOSITORY CLOSURE/RETRIEVAL, COMPLETED IN MAY
• PERFORMANCE-MEASURE SCALES:	EXCEPT FOR POSTCLOSURE HEALTH AND SAFETY, COMPLETED IN JUNE
• UTILITY FUNCTIONS:	AESTHETIC PROPERTIES (ENVIRONMENT) AND HISTORICAL PROPERTIES (ENVIRONMENT) COMPLETED BY MANAGEMENT SUB-PANEL IN EARLY JUNE
• SCALING FACTORS:	AESTHETIC PROPERTIES vs HISTORICAL PROPERTIES, AESTHETIC PROPERTIES vs COST, AND PRECLOSURE RADIATION DOSE vs COST COMPLETED BY MANAGEMENT SUB-PANEL IN EARLY JUNE
• SCORING:	AESTHETIC PROPERTIES, HISTORICAL PROPERTIES, PRECLOSURE RADIOLOGICAL HEALTH EFFECTS TO REPOSITORY WORKERS AND MEMBERS OF THE PUBLIC COMPLETED BY EXPERT PANELS IN JUNE

PERSONNEL COMPONENTS

SANDIA ESF ALTERNATIVES STUDY LEAD GROUP

AL STEVENS
AL DENNIS
LARRY COSTIN
STEVEN BAUER

DECISION METHODOLOGY GROUP

LEE MERKHOFER (ADA)
PHIL BECCUE (ADA)
PAUL GNIRK (RE/SPEC)
DAVID PARRISH (RE/SPEC)

MANAGEMENT PANEL

LAKE BARRETT (DOE)
TOM ISAACS (DOE)
RALPH STEIN (DOE)
CARL GERTZ (DOE)
MAXWELL BLANCHARD (DOE)
TED PETRIE (DOE)
TOM HUNTER (SNL)
RICHARD LYNCH (SNL)
WENDELL WEART (SNL)

PERSONNEL COMPONENTS

(CONTINUED)

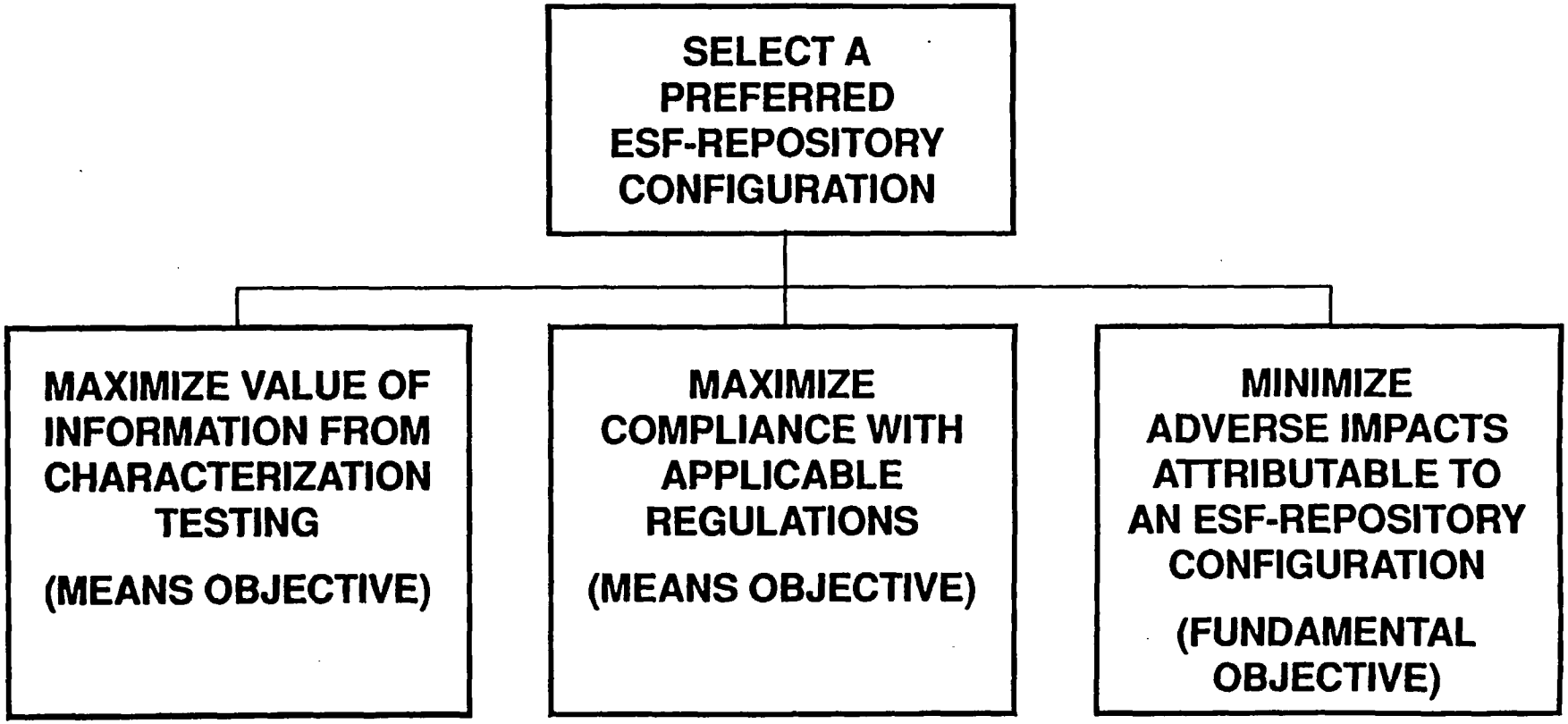
EXPERT PANELS

- POSTCLOSURE HEALTH AND SAFETY
- PRECLOSURE RADIOLOGICAL HEALTH AND SAFETY
- PRECLOSURE NON-RADIOLOGICAL HEALTH AND SAFETY
- ENVIRONMENT
  - AESTHETIC PROPERTIES
  - HISTORICAL PROPERTIES
  - BIOLOGICAL PROPERTIES (NON-DISCRIMINATORY)
- SOCIOECONOMICS (NON-DISCRIMINATORY)
- COST AND SCHEDULE
- CHARACTERIZATION TESTING
- REGULATORY APPROVAL

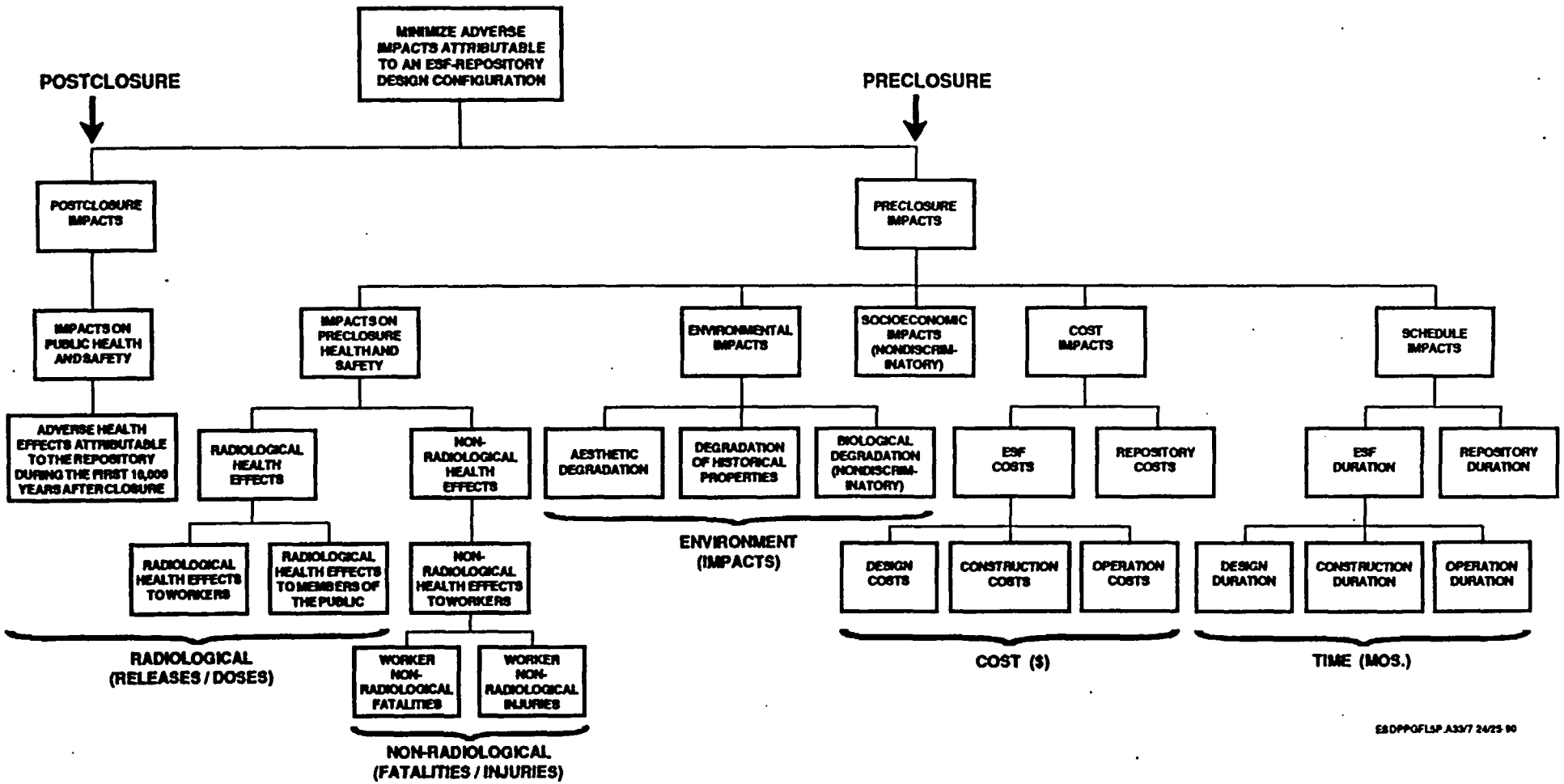
DESIGN SUPPORT GROUPS

- SURFACE
- UNDERGROUND

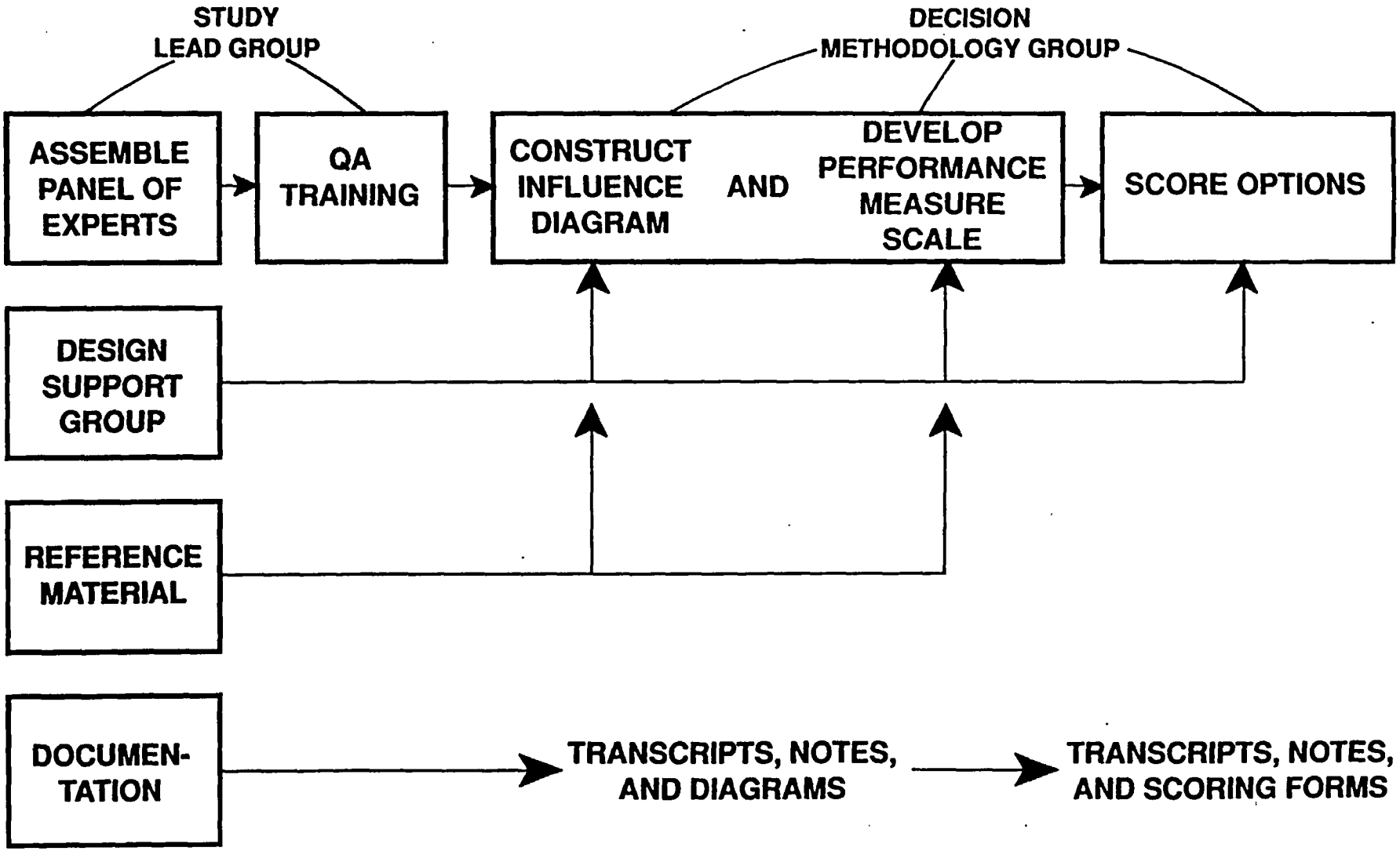
HIGHEST-LEVEL OBJECTIVES OF THE ESF ALTERNATIVES STUDY



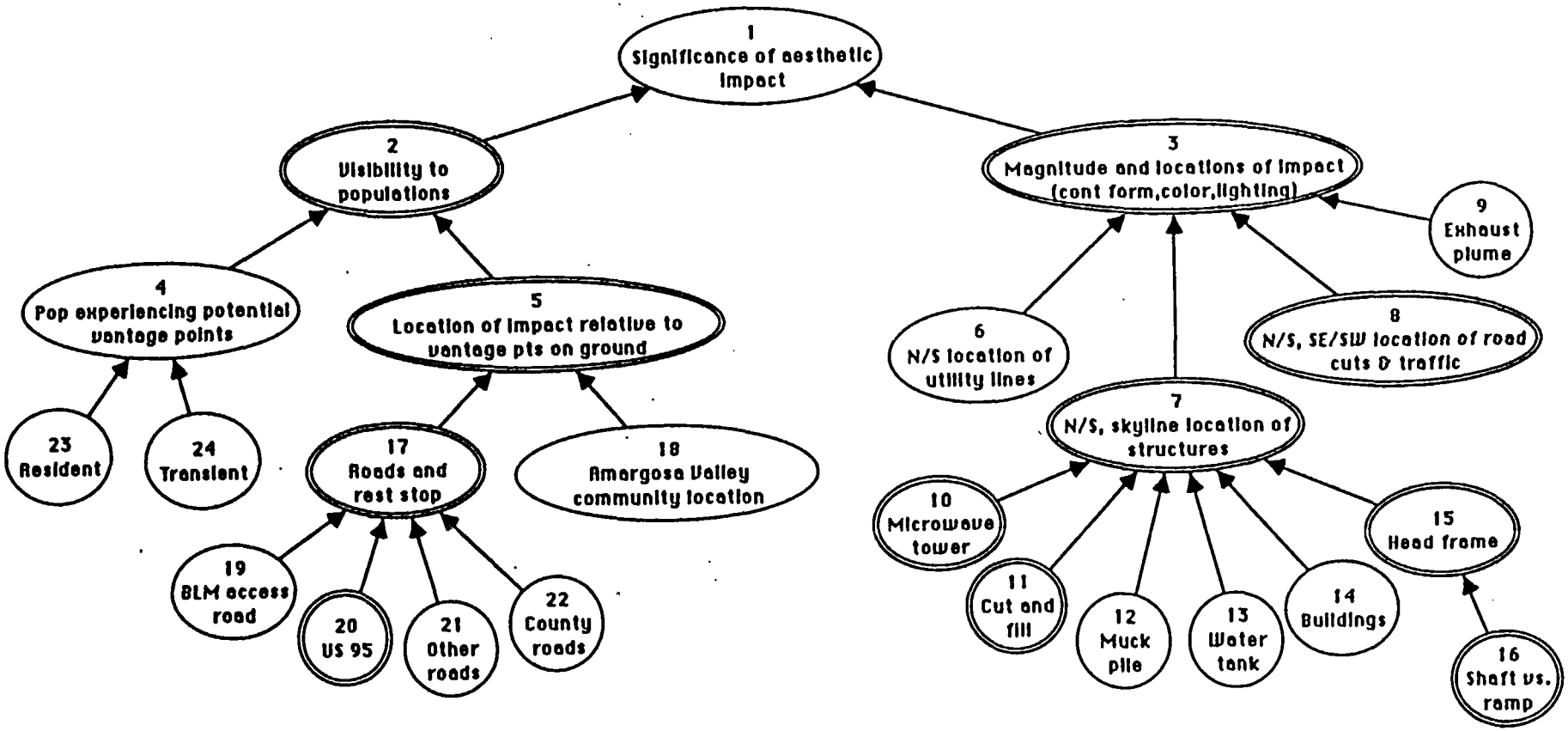
FUNDAMENTAL (VALUE) OBJECTIVES HIERARCHY FOR THE ESF ALTERNATIVES STUDY



EXPERT PANEL INVOLVEMENT (FOR EACH OBJECTIVE)



INFLUENCE DIAGRAM FOR THE ENVIRONMENT-AESTHETIC PROPERTIES



PERFORMANCE MEASURE SCALE FOR THE ENVIRONMENT

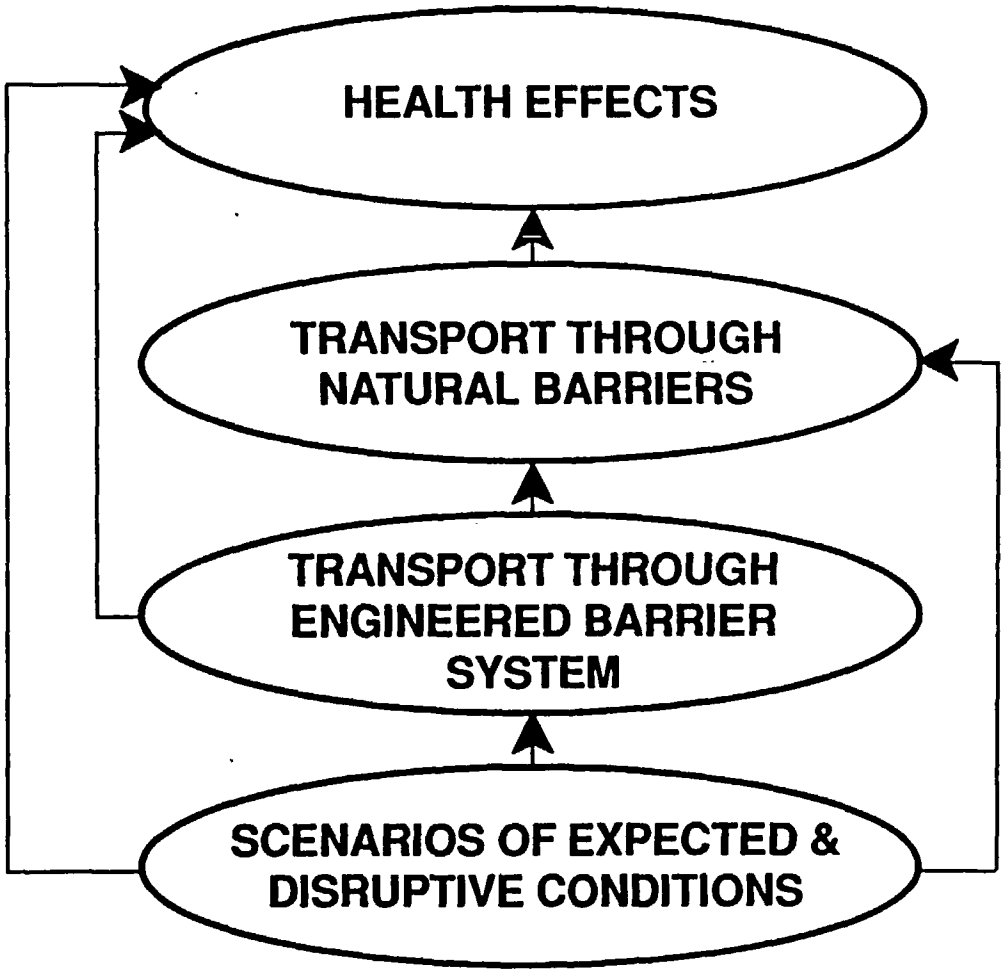
AESTHETIC PROPERTIES: VISUAL IMPACTS

SCORE	DESCRIPTION
12 (BEST)	NO IMPACTS VISIBLE FROM ANY VANTAGE POINT
11	ROAD-CUTS/TRAFFIC VISIBLE FROM ONE VANTAGE POINT
10	ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS
9	STRUCTURES/FACILITIES VISIBLE FROM ONE VANTAGE POINT
8	STRUCTURES/FACILITIES VISIBLE FROM ONE VANTAGE POINT ROAD-CUTS/TRAFFIC VISIBLE FROM ONE VANTAGE POINT
7	STRUCTURES/FACILITIES VISIBLE FROM ONE VANTAGE POINT PLUS ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS
6	STRUCTURES/FACILITIES VISIBLE FROM MULTIPLE VANTAGE POINTS
5	STRUCTURES/FACILITIES AND ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS
4	SKYLINE STRUCTURES VISIBLE FROM ONE VANTAGE POINT
3	SKYLINE STRUCTURES VISIBLE FROM ONE VANTAGE POINT PLUS ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS
2	SKYLINE STRUCTURES VISIBLE FROM ONE VANTAGE POINT PLUS STRUCTURES/FACILITIES VISIBLE FROM MULTIPLE VANTAGE POINTS
1	SKYLINE STRUCTURES VISIBLE FROM MULTIPLE VANTAGE POINTS
0 (WORST)	SKYLINE STRUCTURES, STRUCTURES/FACILITIES, AND ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS

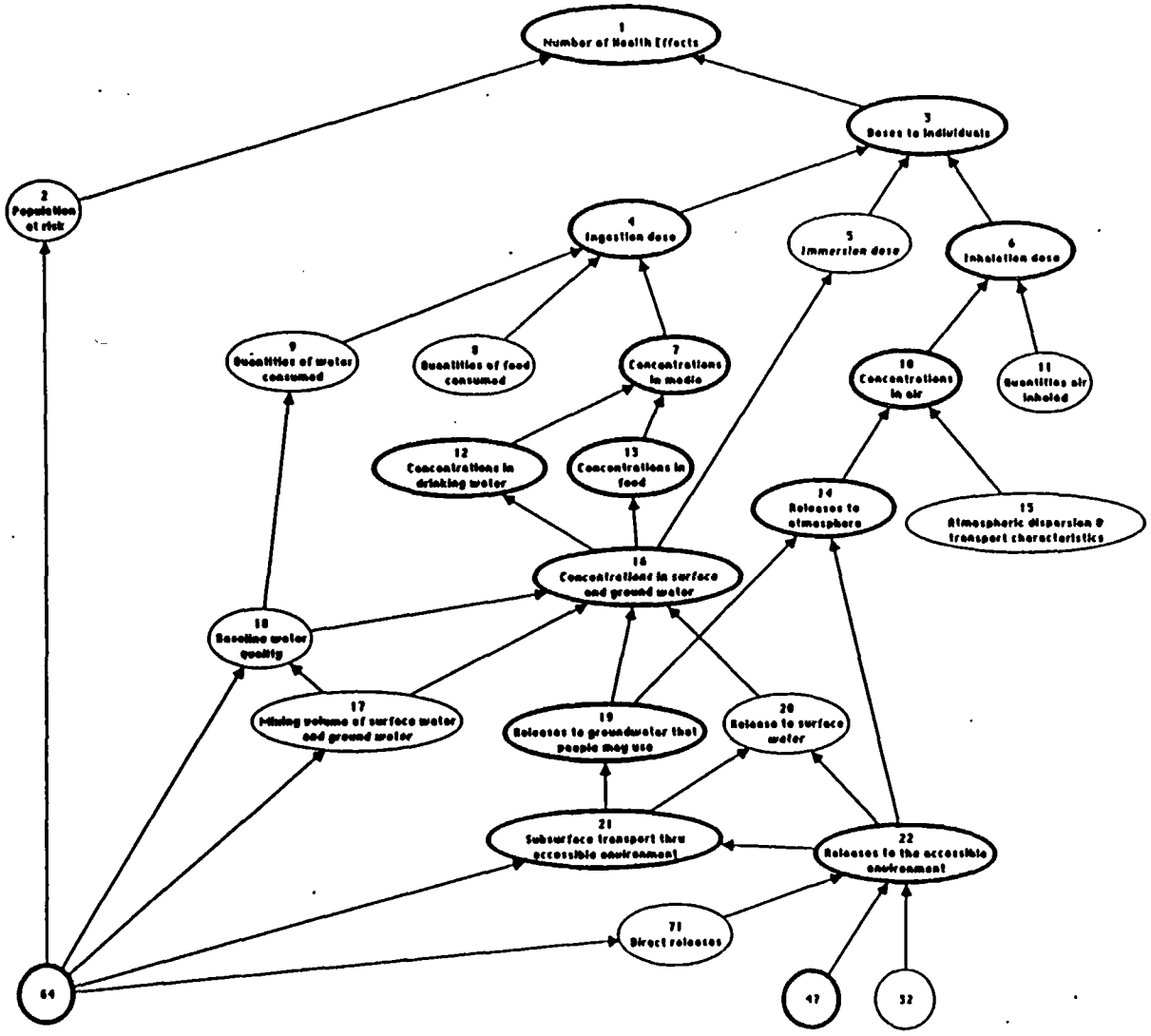
SCORING RESULTS FOR AESTHETIC PROPERTIES

EVALUATION	DESIRABILITY	ESF OPTION	SCORE	EXPLANATION
BEST JUDGMENT	HIGHEST	BASE CASE, A1, A2, A4-REV.1, A7, C1, B3-REV. 2, 3, 4, 5, 6	8	STRUCTURES/FACILITIES & ROAD-CUTS/ TRAFFIC VISIBLE FROM ONE VANTAGE POINT
OPTIMISTIC			9	STRUCTURE/FACILITIES VISIBLE FROM ONE VANTAGE POINT
PESSIMISTIC			8	STRUCTURES/FACILITIES & ROAD-CUTS/ TRAFFIC VISIBLE FROM ONE VANTAGE POINT
BEST JUDGMENT	LOWEST	B4, C4	0.5	SKYLINE STRUCTURES TO SKYLINE STRUCTURES - STRUCTURES/FACILITIES - ROAD-CUTS/TRAFFIC VISIBLE FROM MULTIPLE VANTAGE POINTS
OPTIMISTIC			1	SKYLINE STRUCTURES VISIBLE FROM MULTIPLE VANTAGE POINTS
PESSIMISTIC			0	SKYLINE STRUCTURES, STRUCTURES/ FACILITIES, & ROAD-CUTS/TRAFFIC VIS-IBLE FROM MULTIPLE VANTAGE POINTS

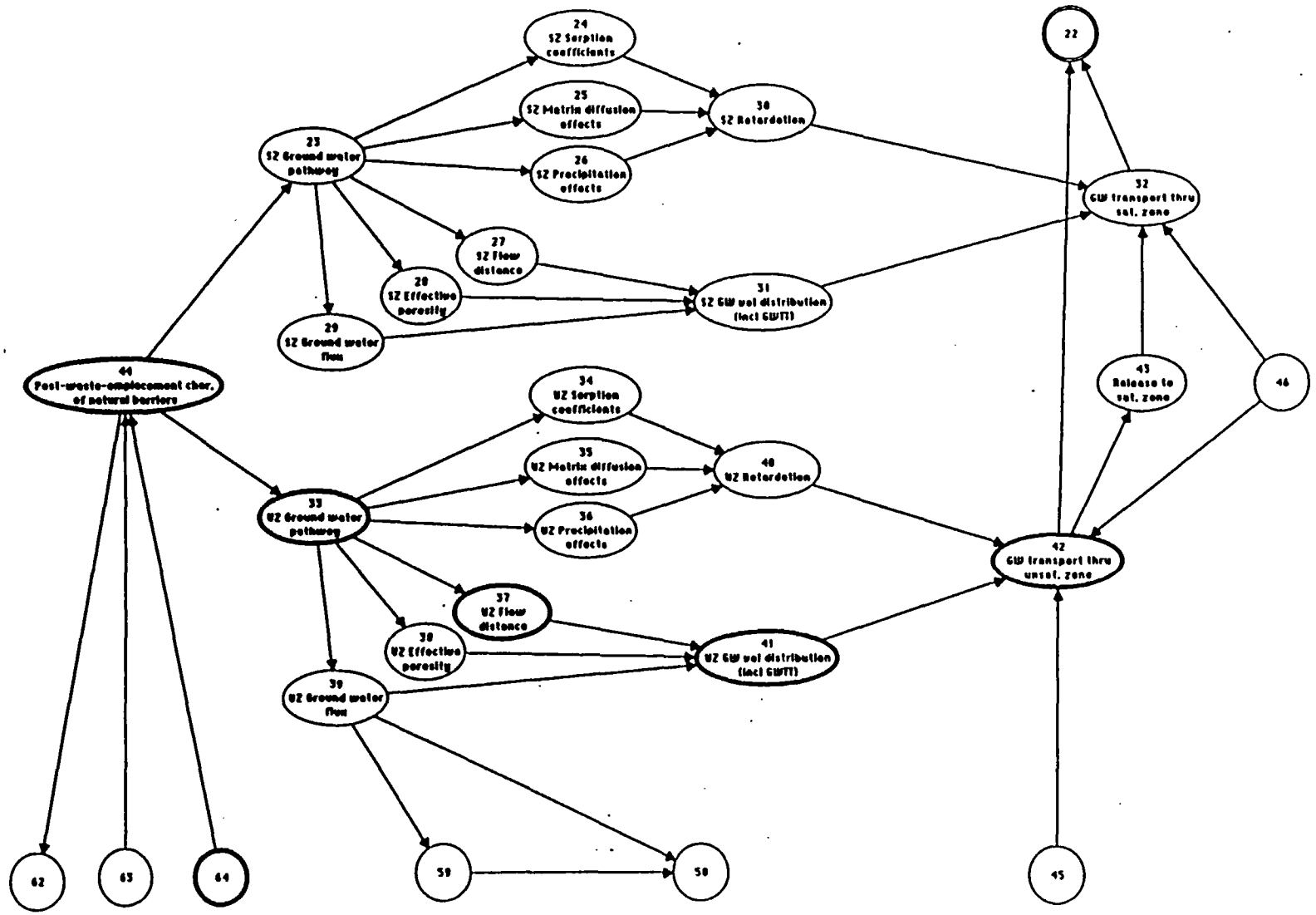
INFLUENCE DIAGRAM FOR POSTCLOSURE HEALTH EFFECTS ATTRIBUTABLE TO THE REPOSITORY DURING THE FIRST 10,000 YEARS AFTER CLOSURE



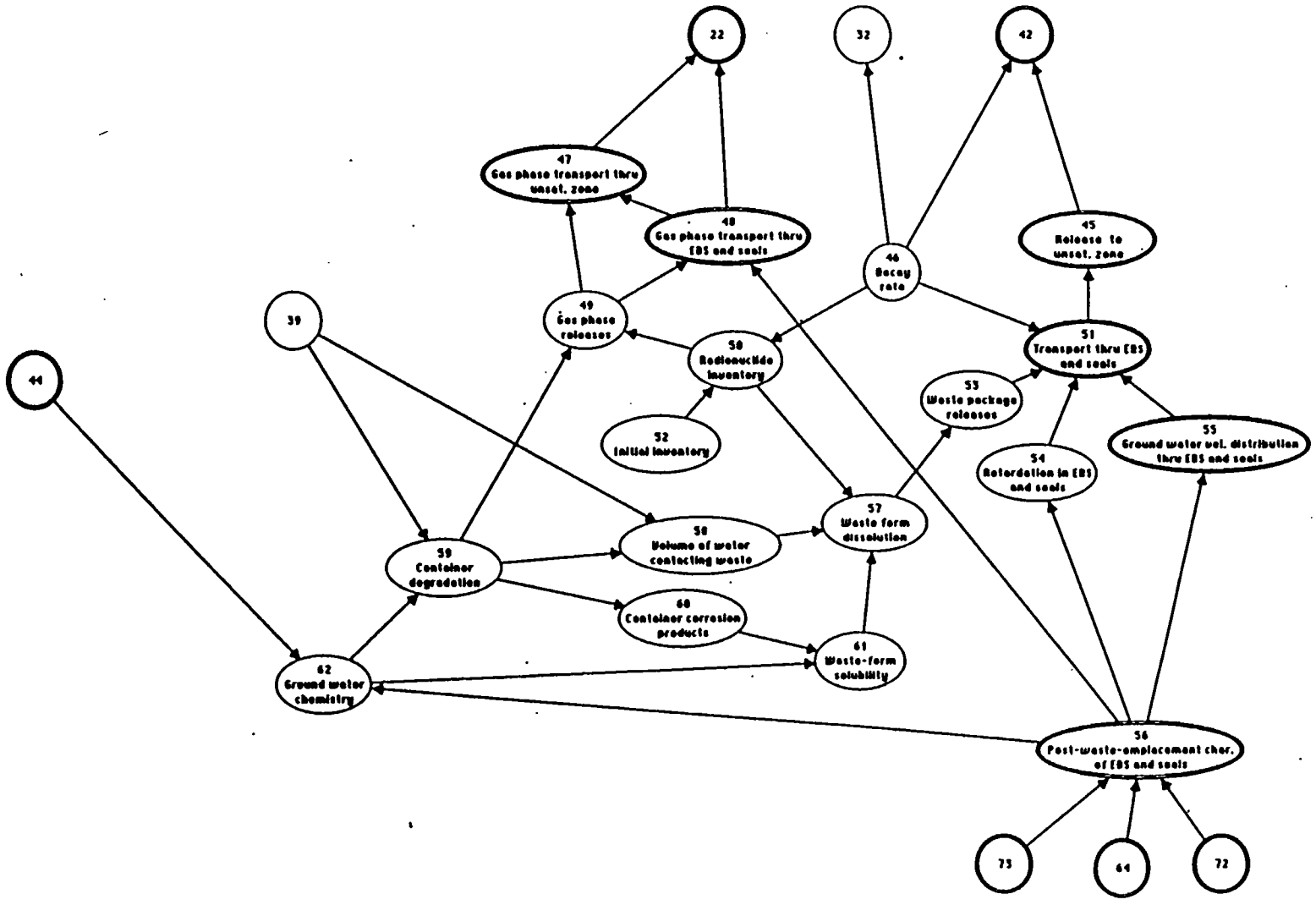
INFLUENCE DIAGRAM FOR POSTCLOSURE HEALTH EFFECTS



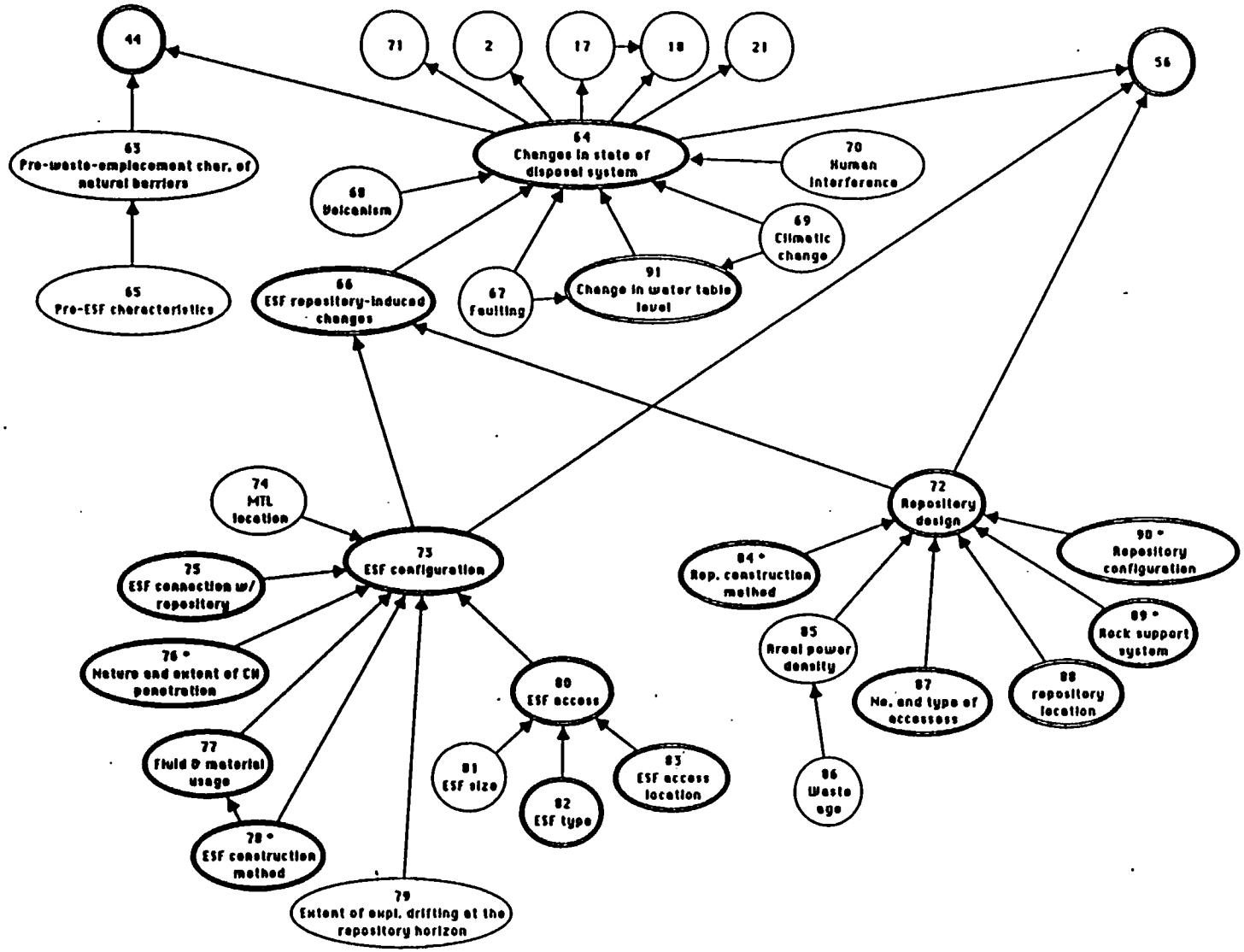
INFLUENCE DIAGRAM FOR POSTCLOSURE TRANSPORT THROUGH NATURAL BARRIERS



INFLUENCE DIAGRAM FOR POSTCLOSURE ENGINEERED BARRIER SYSTEM



INFLUENCE DIAGRAM FOR POSTCLOSURE EXPECTED AND DISRUPTIVE SCENARIOS



POSTCLOSURE HEALTH EFFECTS

PERFORMANCE MEASURE: RADIONUCLIDE RELEASES TO ACCESSIBLE ENVIRONMENT DURING THE FIRST 10,000 YEARS AFTER REPOSITORY CLOSURE

RANGE OF IMPACT (AS JUDGED BY EXPERT PANEL):

- LOWEST IMPACT: 10^{-8} OF EPA RELEASE LIMIT ASSUMING GROUND WATER FLOW IN ROCK MATRIX AND 50% INCREASE IN DEPTH TO WATER TABLE

- HIGHEST IMPACT: 10^{-2} OF EPA RELEASE LIMIT ASSUMING GROUND WATER FLOW IN ROCK FRACTURES AND 50% DECREASE IN DEPTH TO WATER TABLE

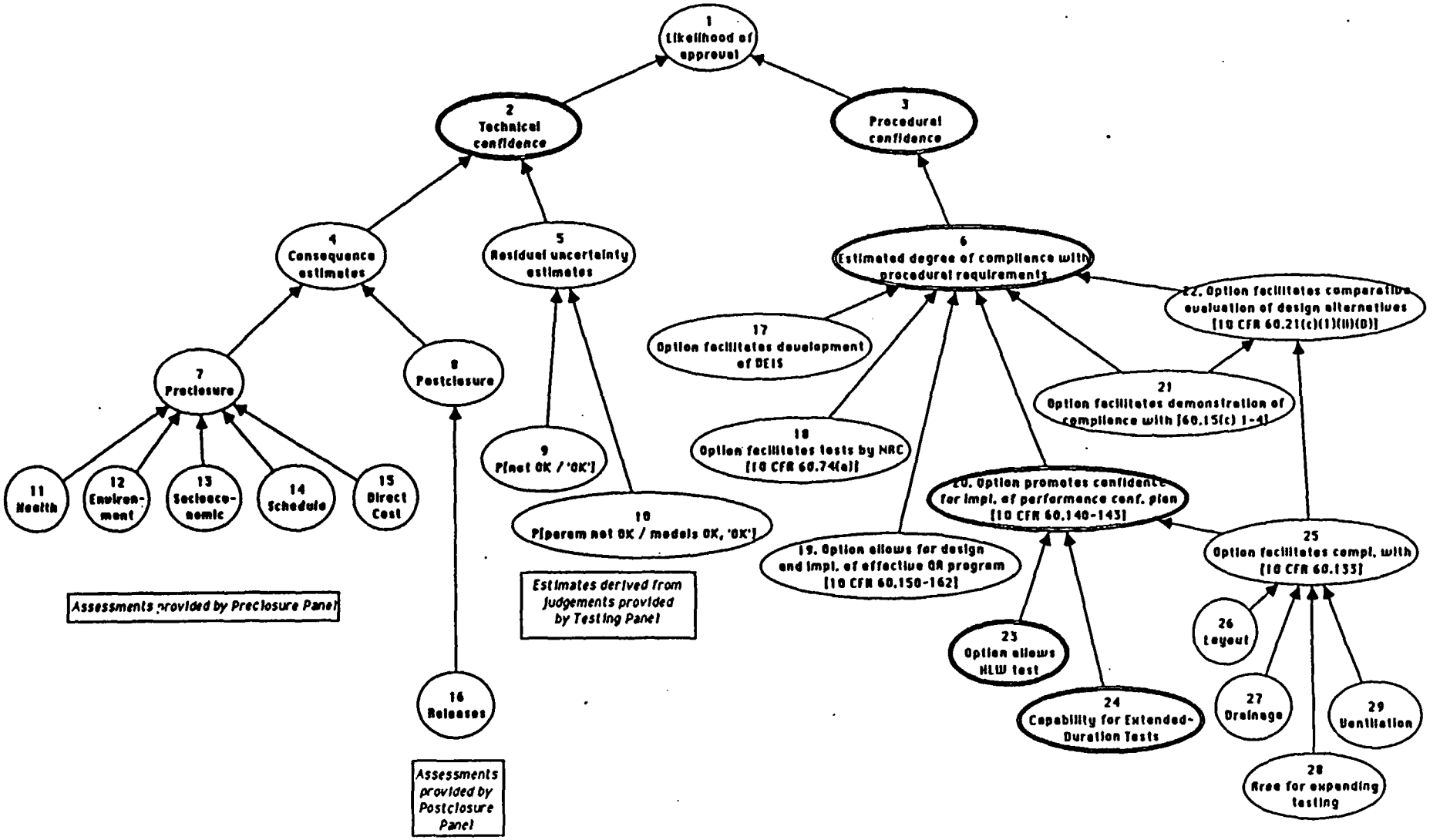
POSTCLOSURE HEALTH EFFECTS

(CONTINUED)

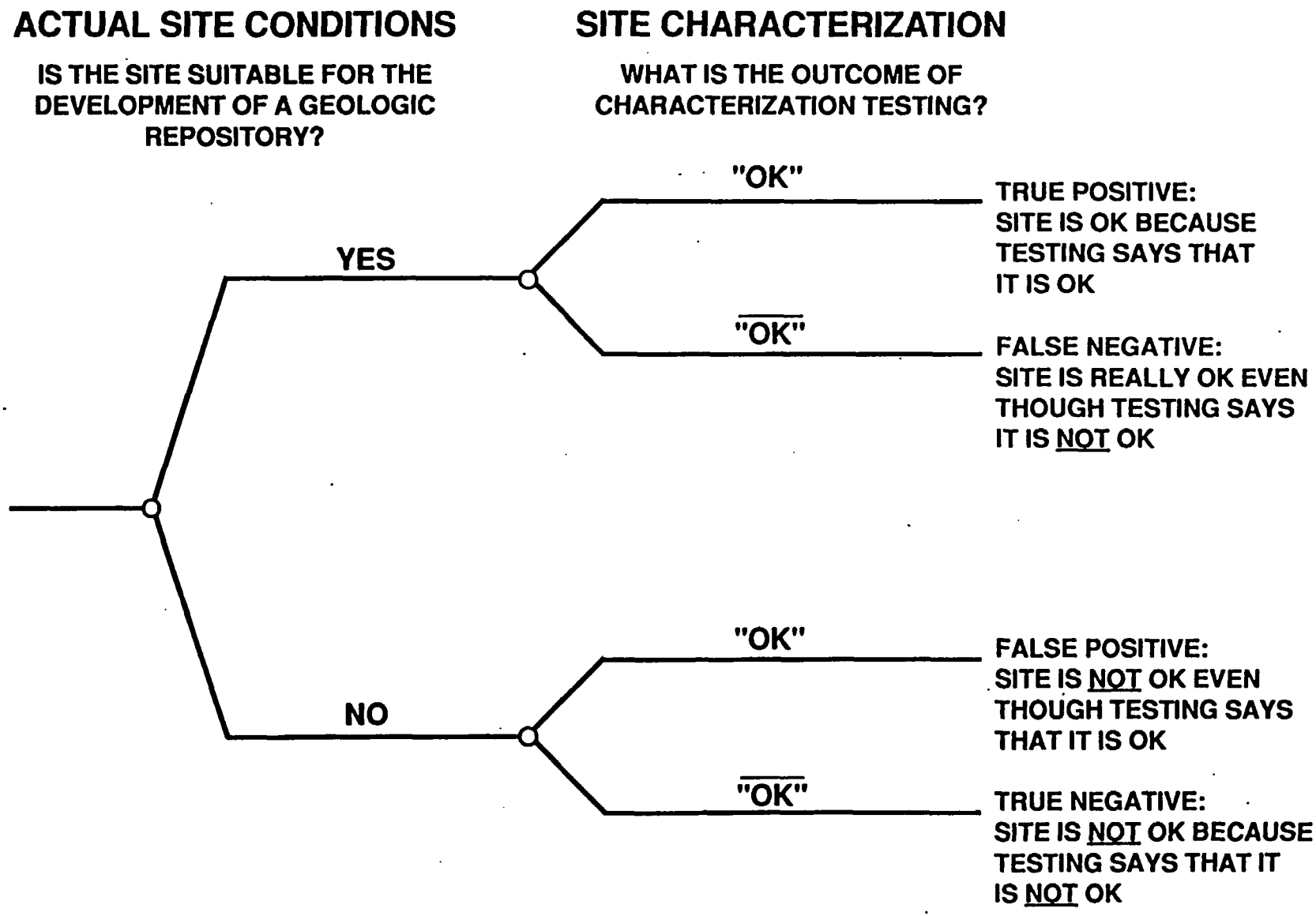
IMPACT IS A FUNCTION OF (AS JUDGED BY EXPERT PANEL):

- GROUND WATER FLOW IN ROCK MATRIX OR ROCK FRACTURES
- DISTANCE FROM WASTE EMPLACEMENTS TO WATER TABLE
- ESF CONNECTION TO REPOSITORY
- REPOSITORY CONFIGURATION
- ESF/REPOSITORY CONSTRUCTION METHOD
- RAMPS vs SHAFTS (LOCATION AND NUMBER)
- SEAL EFFECTIVENESS
- ROCK SUPPORT SYSTEM
- FLUID/ MATERIAL USAGE IN ESF/REPOSITORY
- NATURE AND EXTENT OF CALICO HILLS PENETRATION

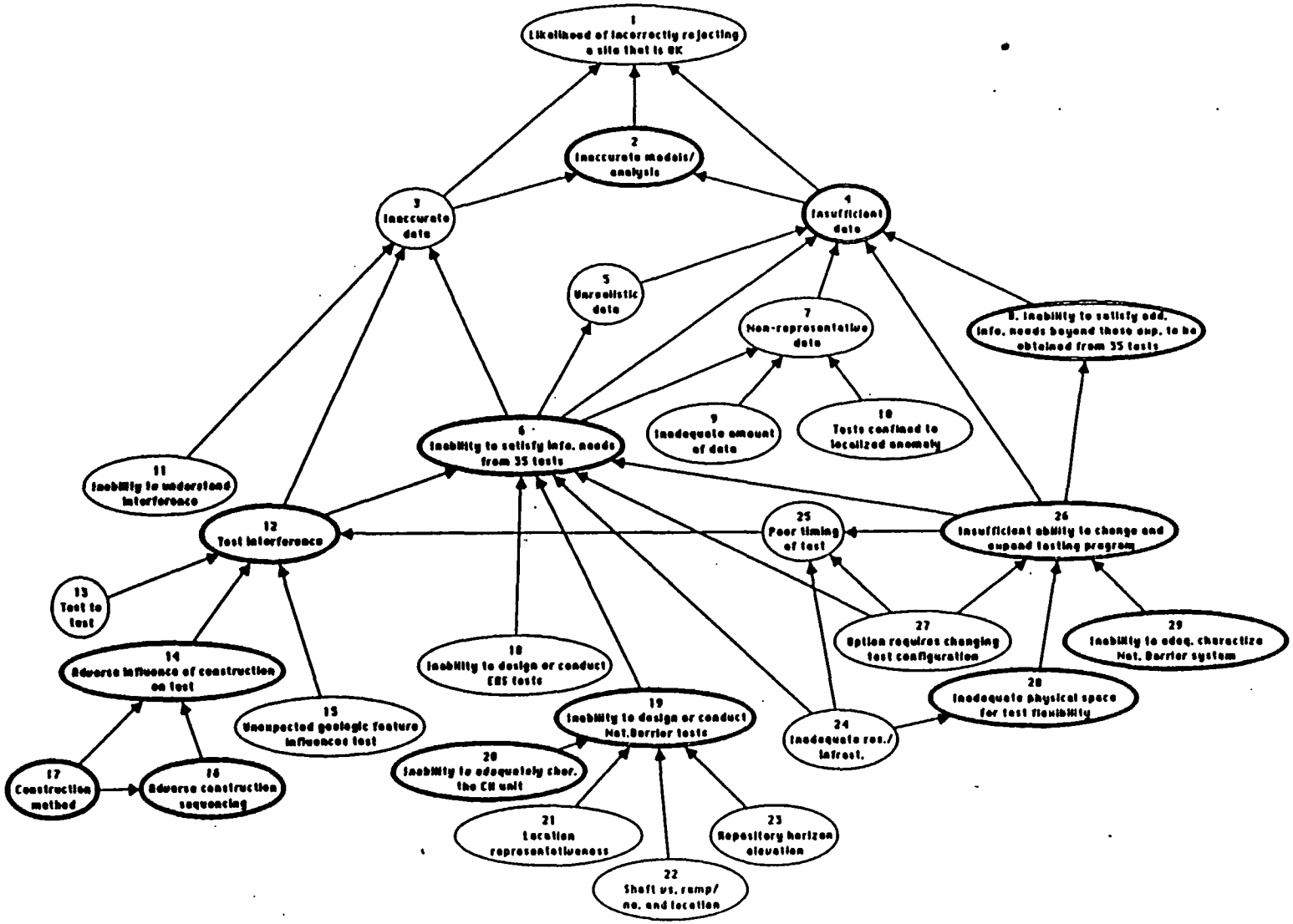
INFLUENCE DIAGRAM FOR LIKELIHOOD OF LICENSE APPROVAL



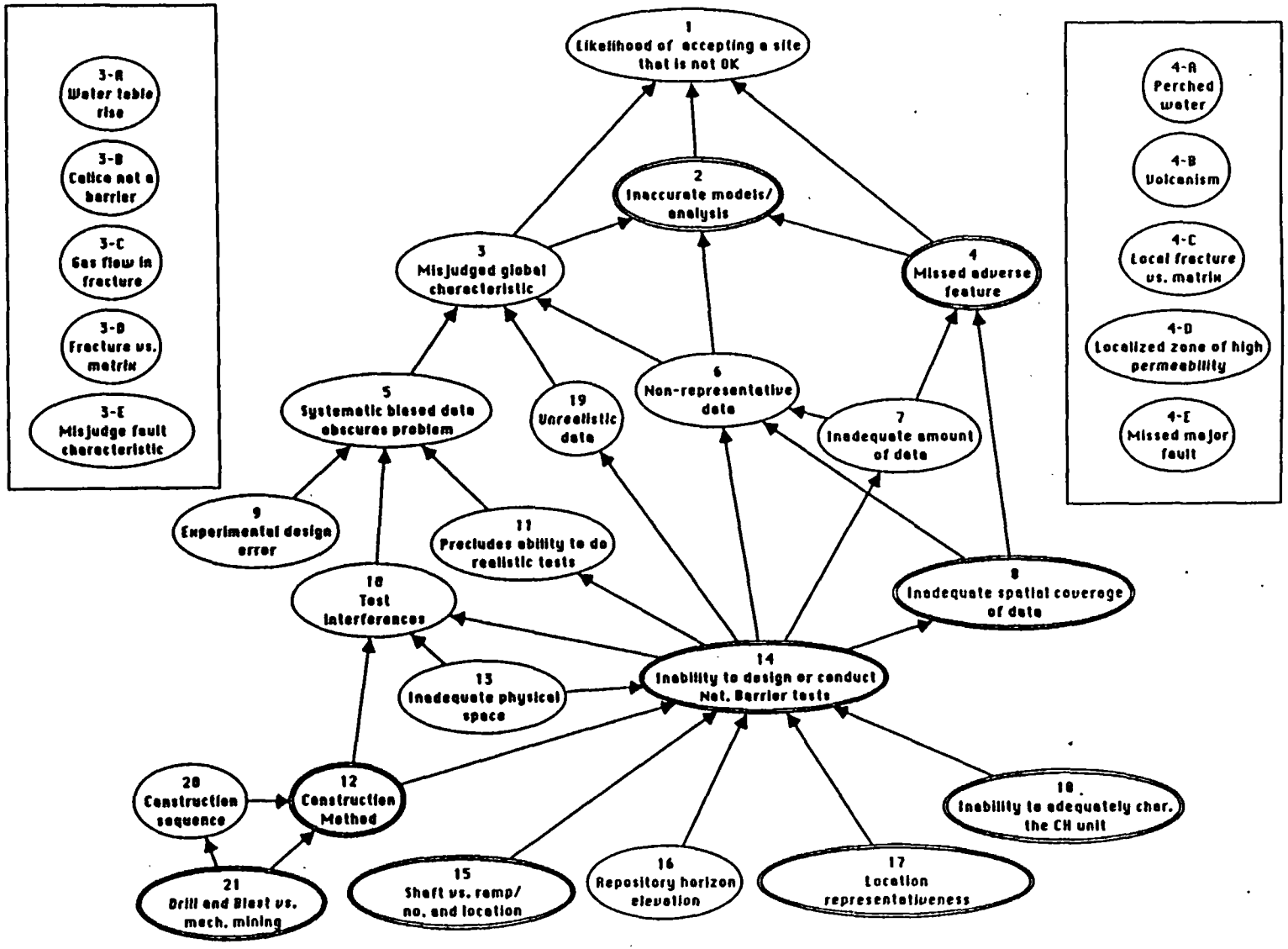
"NATURE'S TREE"



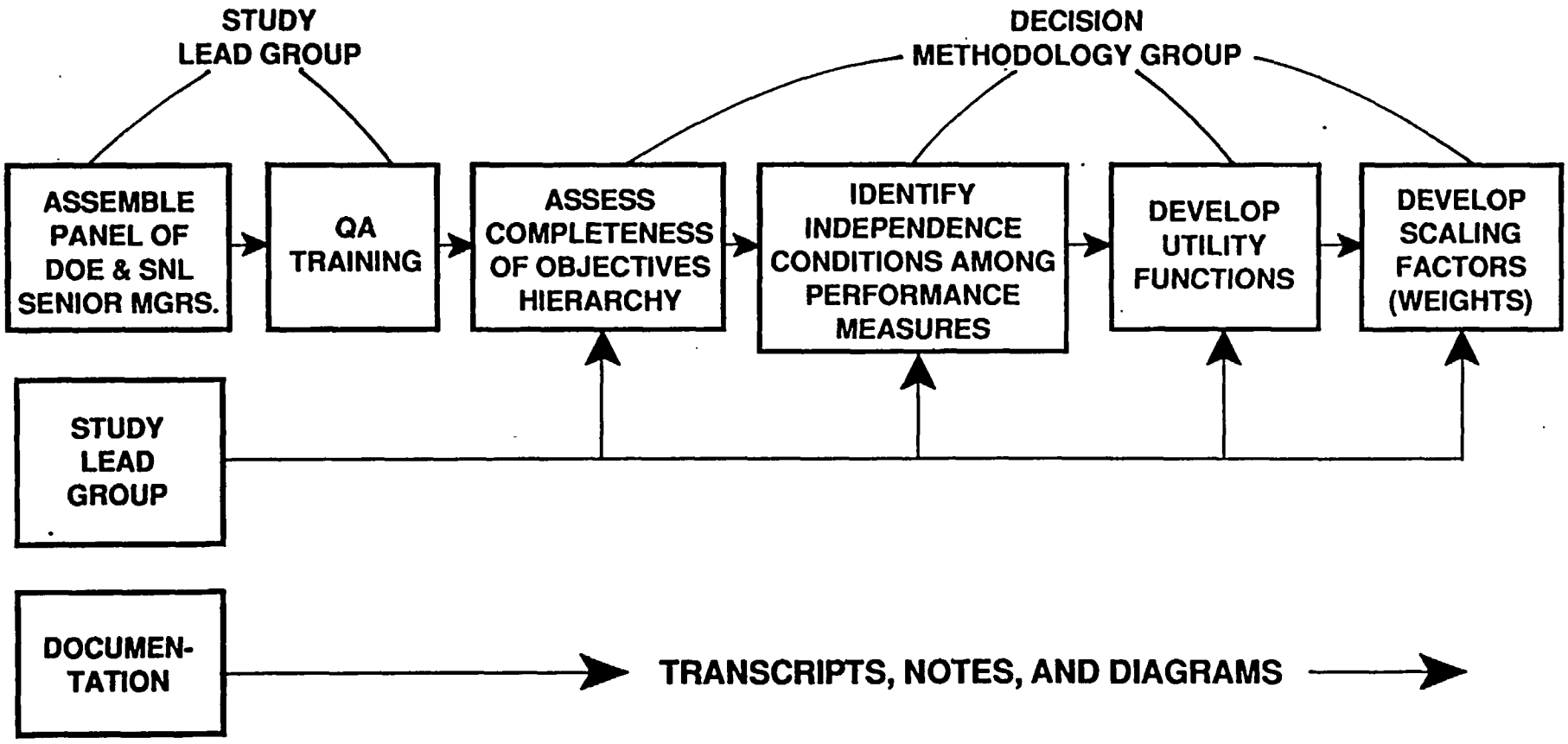
INFLUENCE DIAGRAM FOR LIKELIHOOD OF INCORRECTLY REJECTING A SITE THAT IS OK (FALSE NEGATIVE)



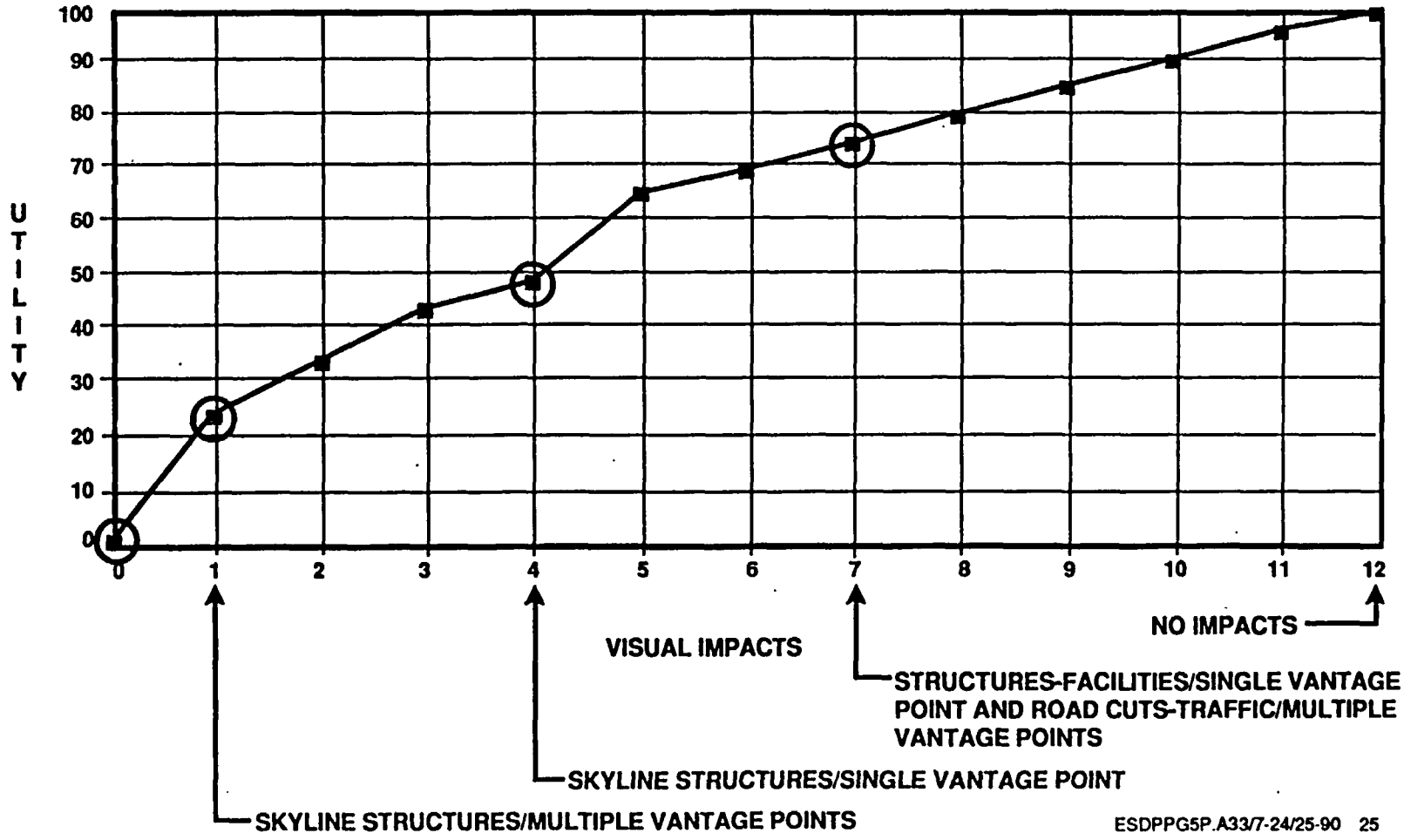
INFLUENCE DIAGRAM FOR LIKELIHOOD OF INCORRECTLY ACCEPTING A SITE THAT IS NOT OK (FALSE POSITIVE)



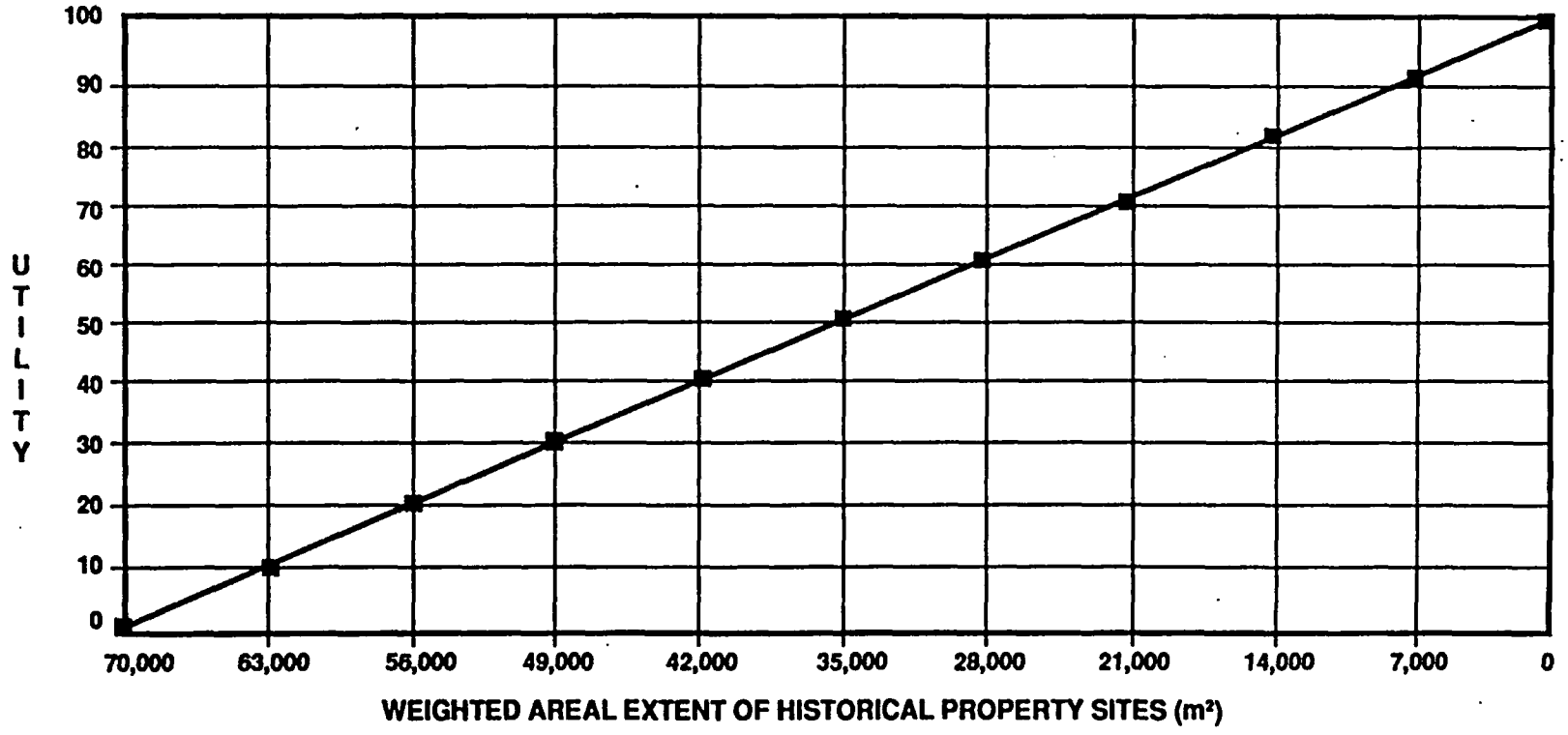
MANAGEMENT PANEL INVOLVEMENT



EXAMPLE
DEVELOPMENT OF A SINGLE-ATTRIBUTE UTILITY FUNCTION
ENVIRONMENT: ASTHETIC PROPERTIES



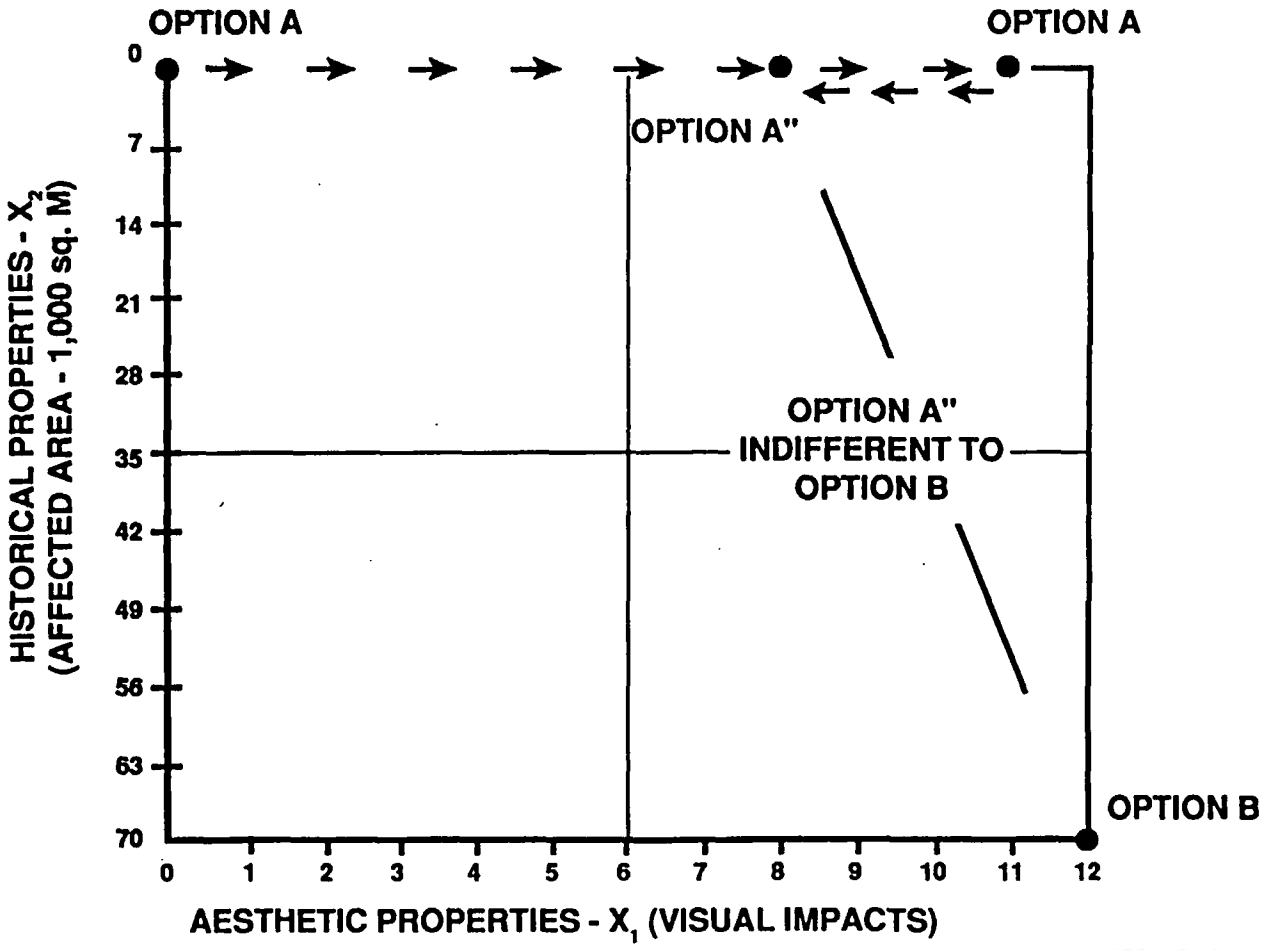
EXAMPLE
DEVELOPMENT OF A SINGLE-ATTRIBUTE UTILITY FUNCTION
ENVIRONMENT: HISTORICAL PROPERTIES



EXAMPLE SCALING (WEIGHTING) FACTOR

AESTHETIC PROPERTIES vs HISTORICAL PROPERTIES

$$W_{AESTHETIC} = \left\{ \begin{matrix} 0.86 \\ 5 \end{matrix} \right\} \times W_{HISTORICAL}$$



FUTURE PLANS

- COMPLETE SCORING AND MANAGEMENT ELICITATION ACTIVITIES
- AGGREGATE SCORES AND PERFORM SENSITIVITY STUDIES
- RANK ORDER ESF OPTIONS
- SELECT ESF CONFIGURATION TO BE RECOMMENDED TO DOE