

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

**NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING**

**SUBJECT: SUMMARY OF THREE STUDIES
RELATED TO FUTURE
DEVELOPMENT OF THE ESF**

- Calico Hills System Study
- Calico Hills Early Access Option
- North Ramp Extension Alternative Activity

PRESENTER: K. MICHAEL CLINE

**PRESENTER'S TITLE
AND ORGANIZATION: OFFICE MANAGER, REGULATORY INTEGRATION/PMO
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**SALT LAKE CITY, UTAH
JULY 11-12, 1995**

Introduction

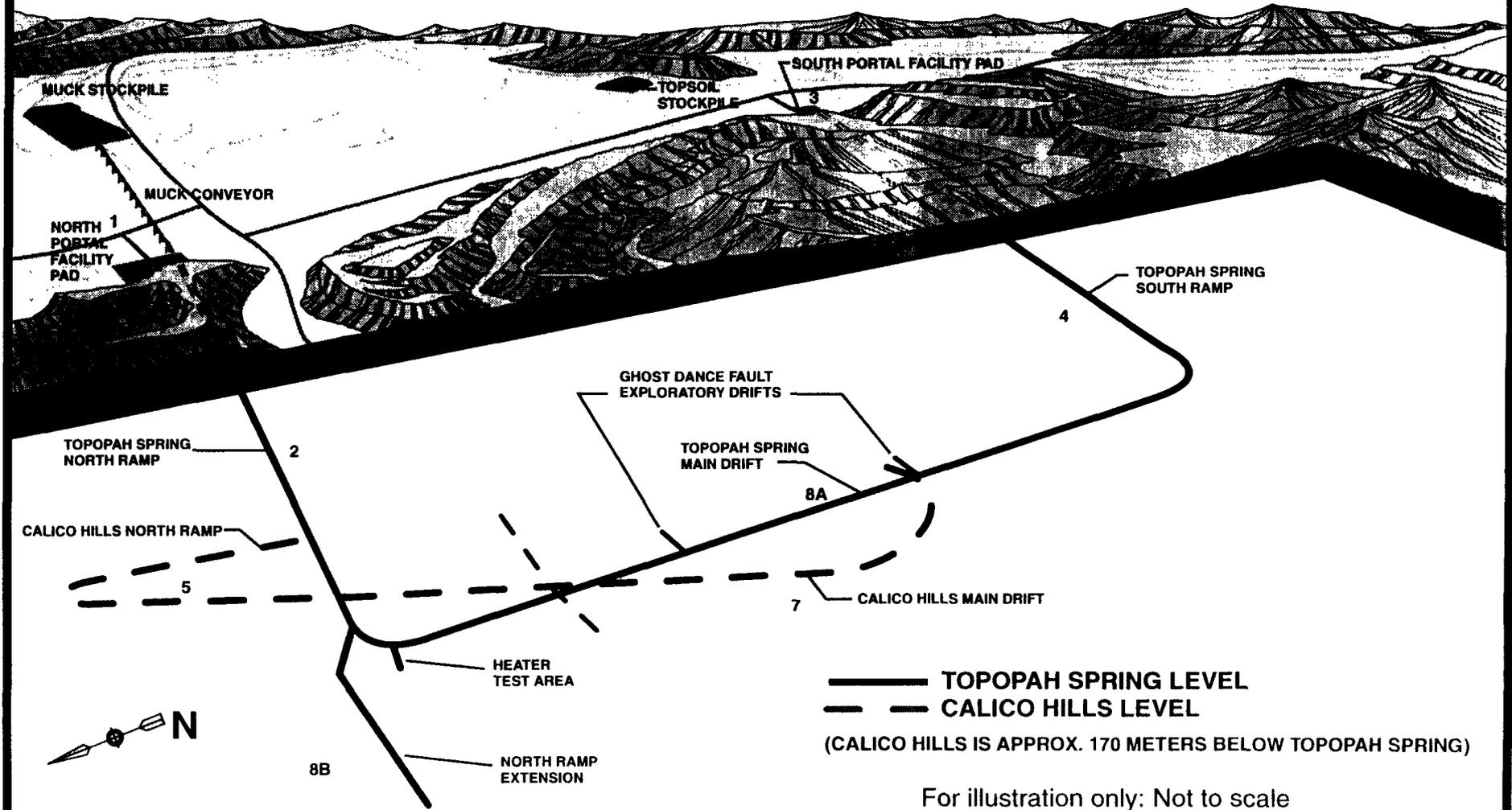
- **The three activities were an effort by DOE to address**
 - **The need to reduce uncertainties associated with CHn performance and the ability to do so based on drilling and drifting**
 - **ESF operational and configuration options that would enhance access to areas of the proposed repository horizon and the CHn unit earlier than is currently planned**
 - **Major uncertainties, as defined by the waste isolation and containment strategy**

Introduction

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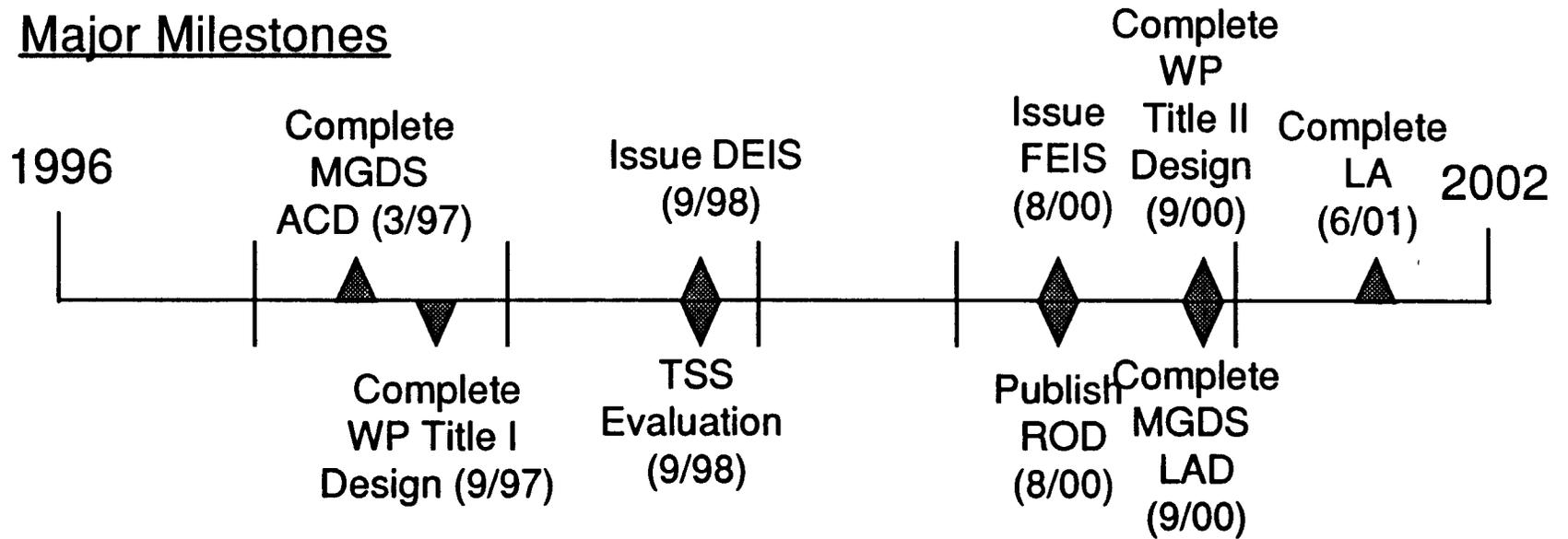
- **As a result, the activities**
 - **Provide a basis for the DOE to use in evaluating benefits of operational and configurational options for access to the western portion of the repository horizon and the CHn unit**
 - **Provide options for early access to the western repository block and CHn unit**

EXPLORATORY STUDIES FACILITY DESIGN

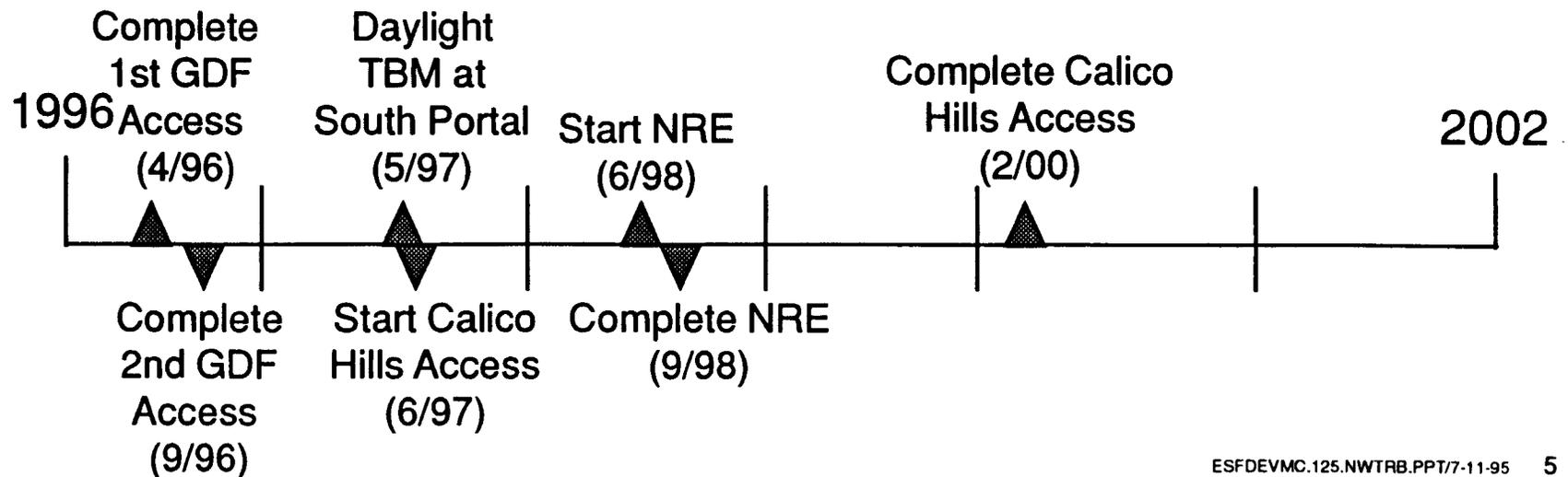


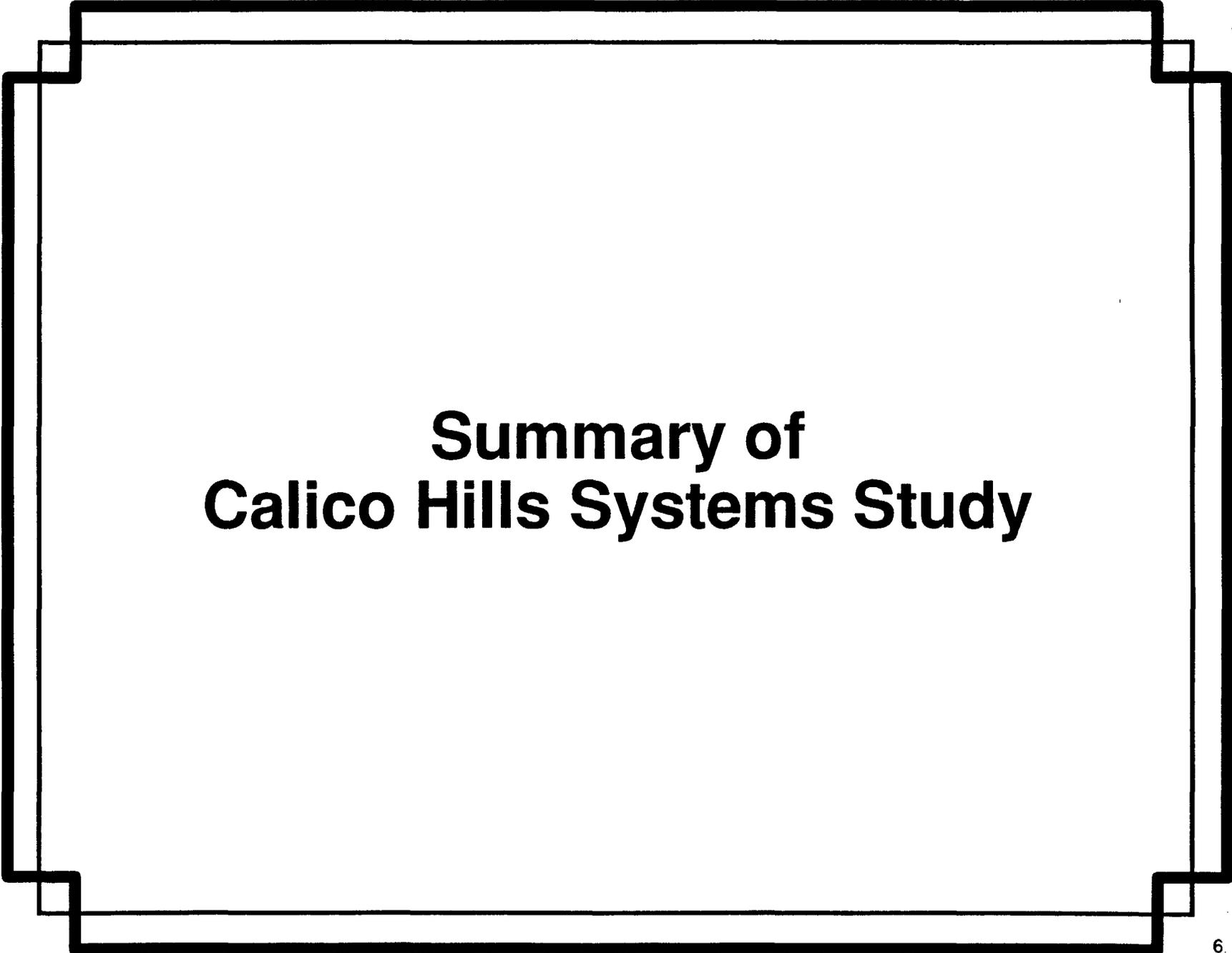
Program Plan Schedules

Major Milestones



ESF Milestones



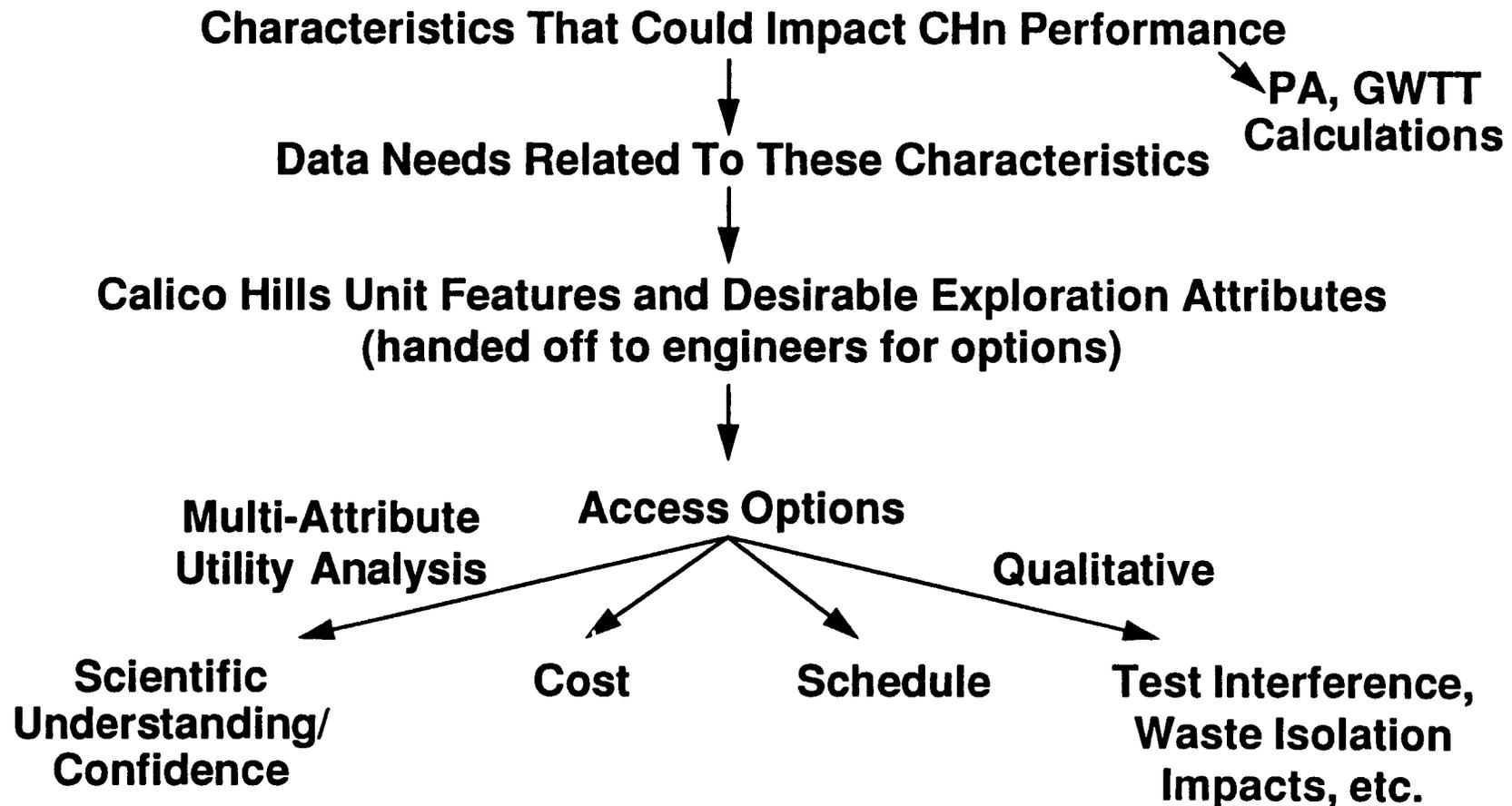


Summary of Calico Hills Systems Study

Calico Hills System Study Approach

- **Establish data needs from the CHn unit**
 - Role of fracture and matrix flow
 - Water chemistry and rock properties (retardation properties)
 - Matrix diffusion
- **Evaluate exploration options for accessing the CHn unit considering**
 - Scientific understanding with additional data
 - Confidence in scientific understanding
 - Cost and schedule
 - Test interference and impact to waste isolation
- **Assess benefits of acquiring data in the context of the remanded EPA standard and potential alternative standards**

Calico Hills System Study Process



Relative Scientific Understanding

- **CHn exploration options were evaluated**
 - **Multi-attribute utility analysis based on expert judgments**
 - » **value of 22 tests for improving scientific understanding of seven processes, features, and events that could significantly impact performance of the CHn**
 - » **ability of seven different exploratory alternatives to field the 22 tests**
 - » **importance of the seven processes, features, and events that could significantly impact performance**

Exploration Options

- **Program Plan**
- **Modified base case without boreholes**
 - **Moderate drifting option**
 - **Access from north ramp**
 - **Multiple fault accesses**
- **Modified case with boreholes**
- **Minimum excavation with boreholes**
 - **Minimal drifting option**
 - **Access from south portal**
 - **One fault accessed**

Exploration Options

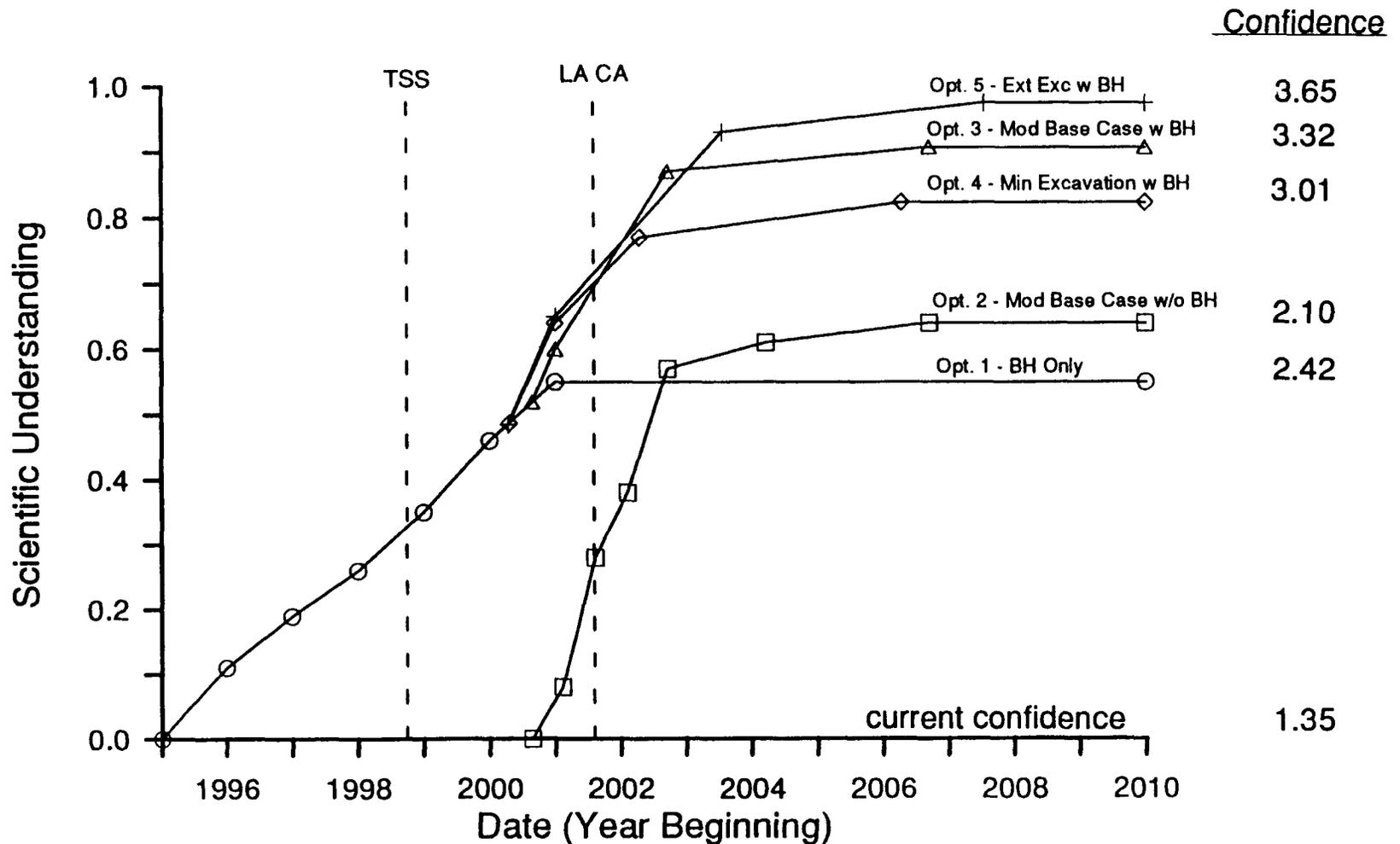
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- **Extensive excavation with boreholes**
 - **Targets all major faults within or adjacent to the repository footprint**
 - **Extensive north-south drifting**
 - **Significant east-west drifting**
 - **Access from south portal**
- **Extensive excavation accessing Ghost Dance fault at CHn prior to accessing at TSw**
- **Extensive excavation; includes raised base for second egress**

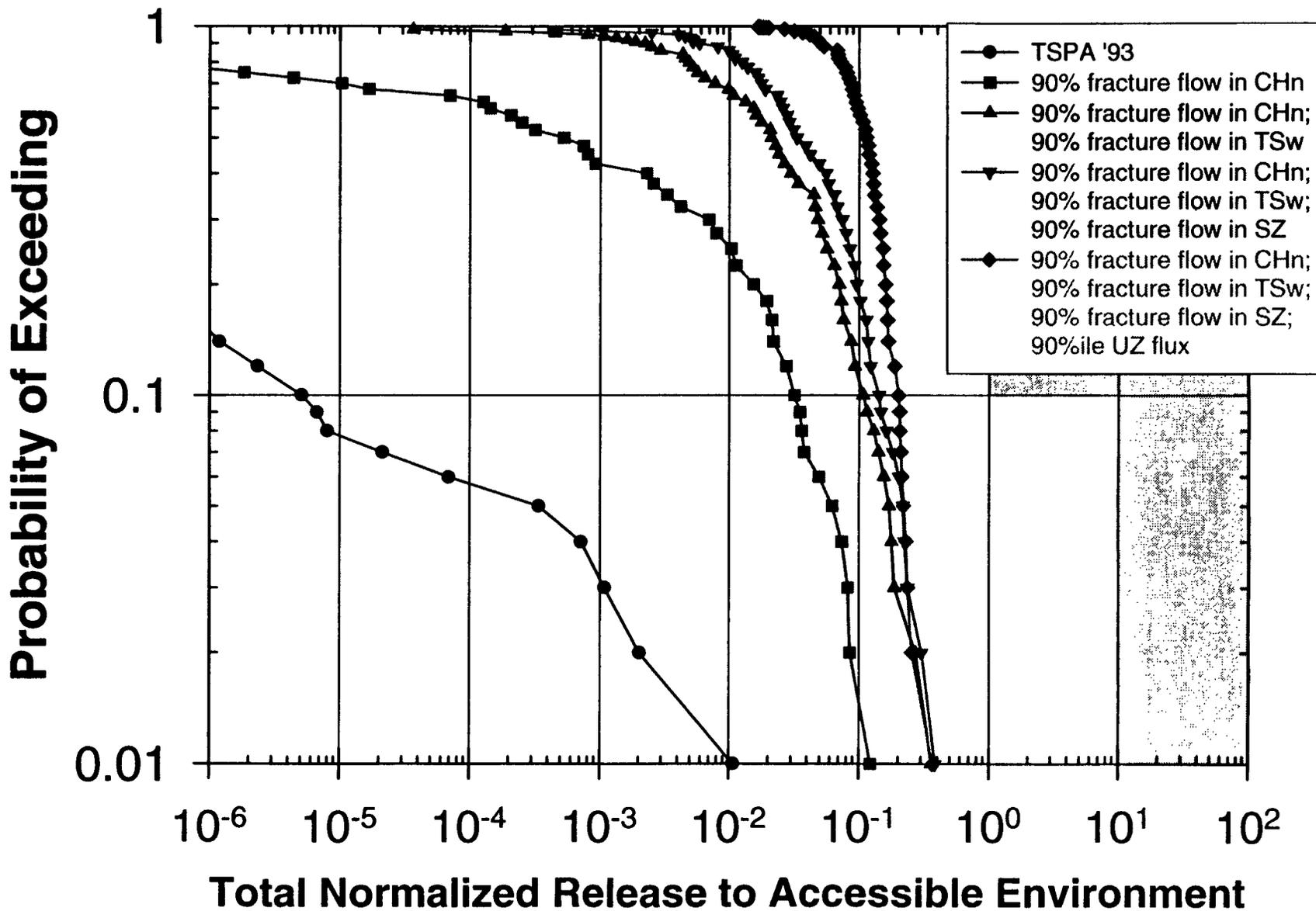
Confidence in Scientific Understandings

- **Developed five-step confidence scale “If additional data were to significantly change expectations of CHn performance, it would be:”**
 - » **Not surprising - Level 1**
 - » **Mildly surprising - Level 2**
 - » **Surprising - Level 3**
 - » **Very surprising - Level 4**
 - » **Extremely surprising - Level 5**

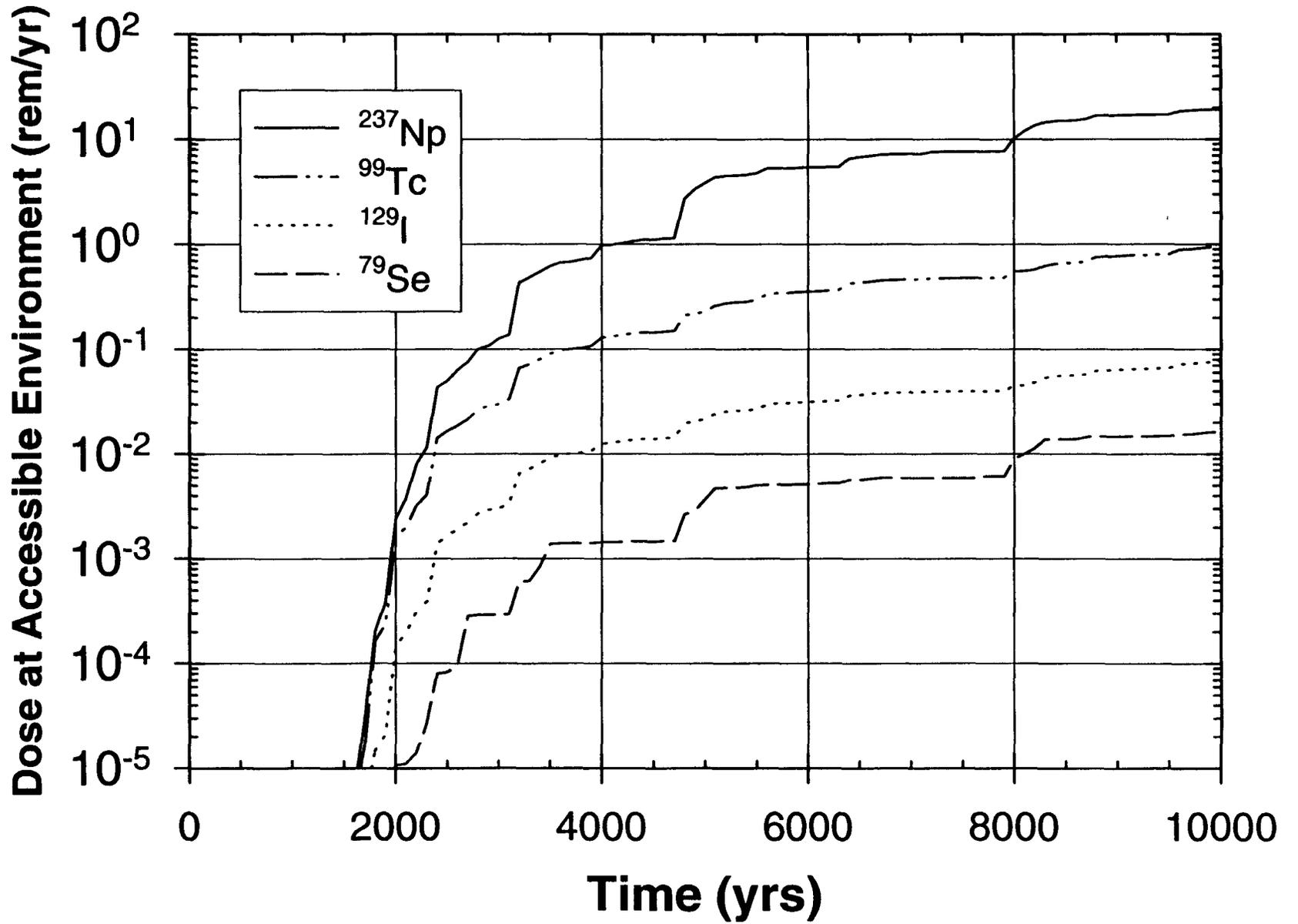
Relative Scientific Understanding with Assessment of Confidence



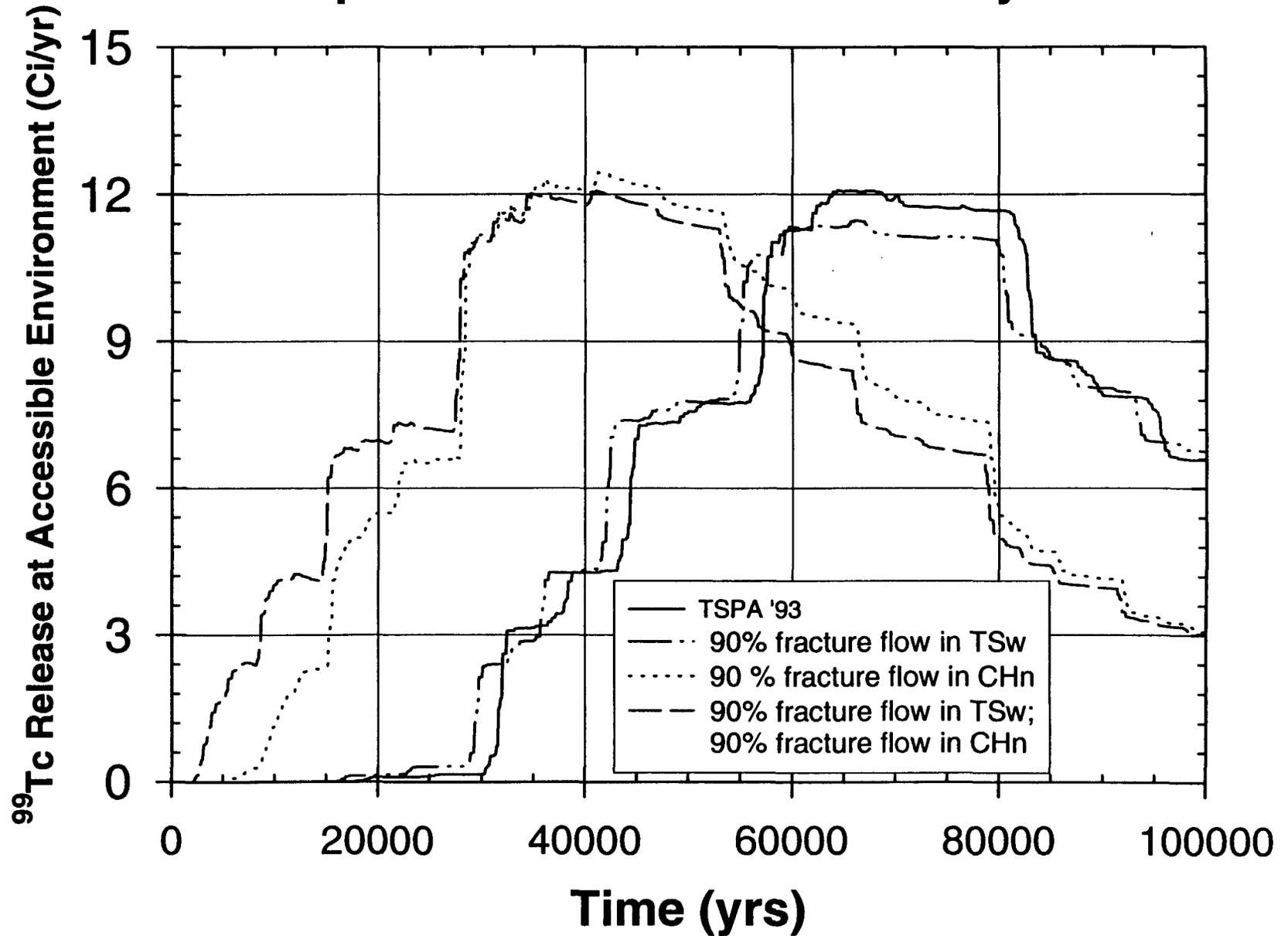
10,000-yr Total Release



Expected-Value Dose History, 90% fracture flow in TSw & CHn



Expected-Value Release History



Summary of Conclusions of the Calico Hills Systems Study

- **There is no technical imperative to further explore the CHn unit to demonstrate compliance with the remanded EPA standard**
- **Demonstrating compliance with a hypothetical standard for peak doses during the next 10,000 years likely would require reducing uncertainties about the performance of repository-system elements**

Summary of Conclusions

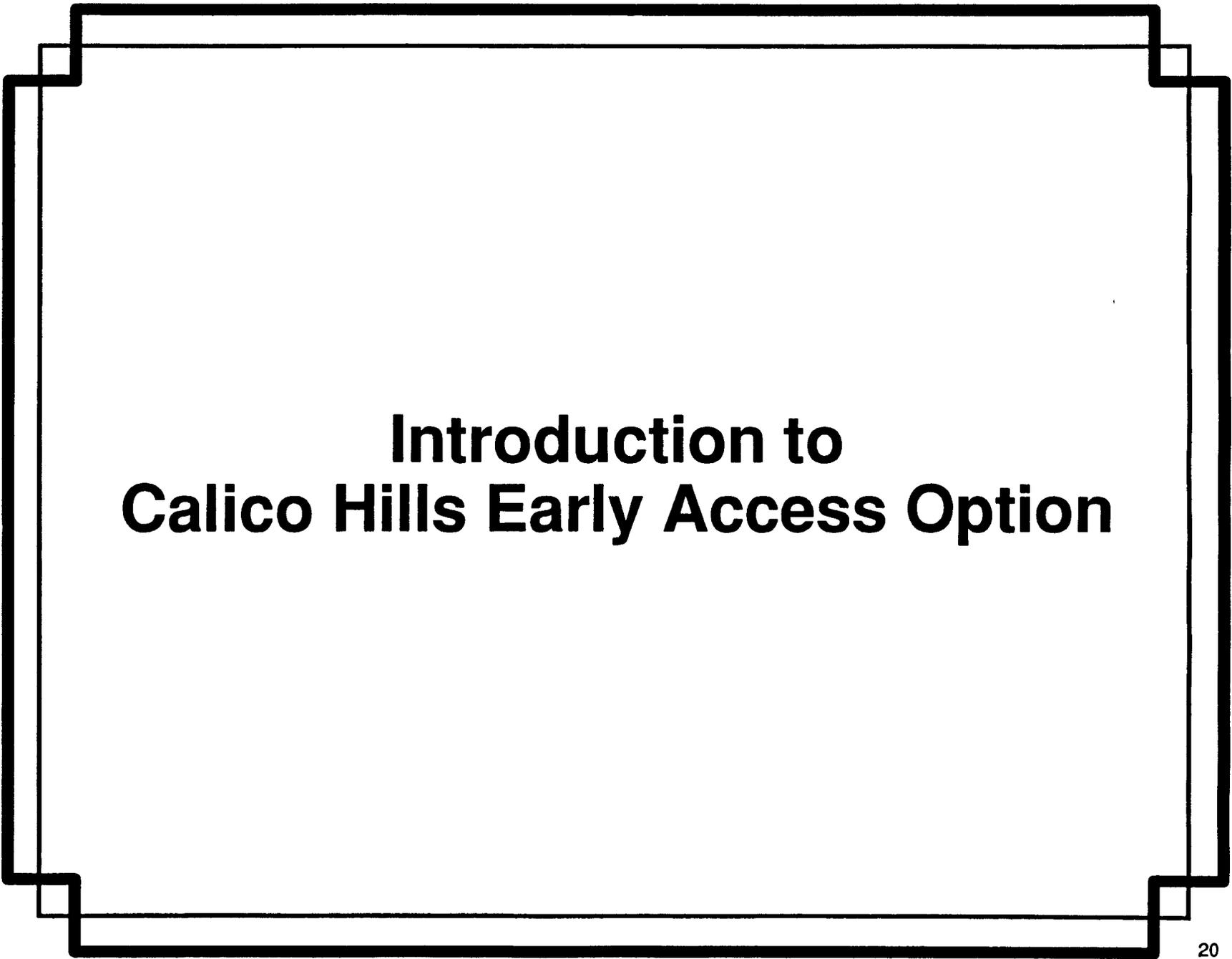
(continued)

- **Further exploration of the CHn unit would contribute little to a demonstration of compliance with a hypothetical standard for peak doses during the next 100,000 years or longer because calculated doses over such time are insensitive to CHn properties**
- **Additional exploration would support improved estimates of probability distributions for Ground Water Travel Time (GWTT) to the accessible environment, but may not permit the establishment of a lower bound on GWTT**

Summary of Conclusions

(continued)

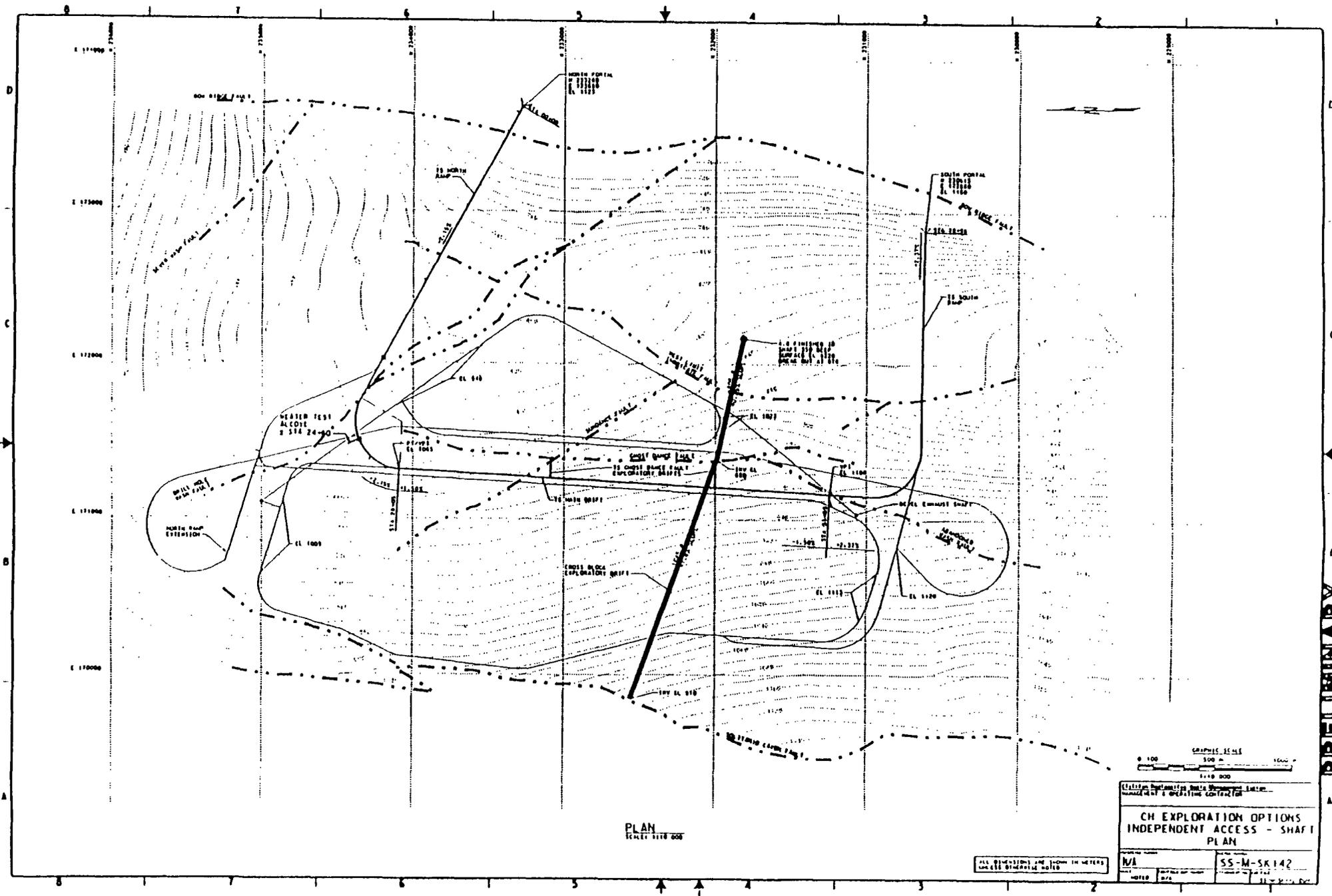
- **It would not be surprising, or would be only mildly surprising, if individual expectations for the performance of the CHn unit were to change significantly as additional data are collected**
- **Minimal drifting plus drilling (Option #4) would be required to reach a confidence level where it would be surprising if additional data were to significantly alter expectations of CHn performance**



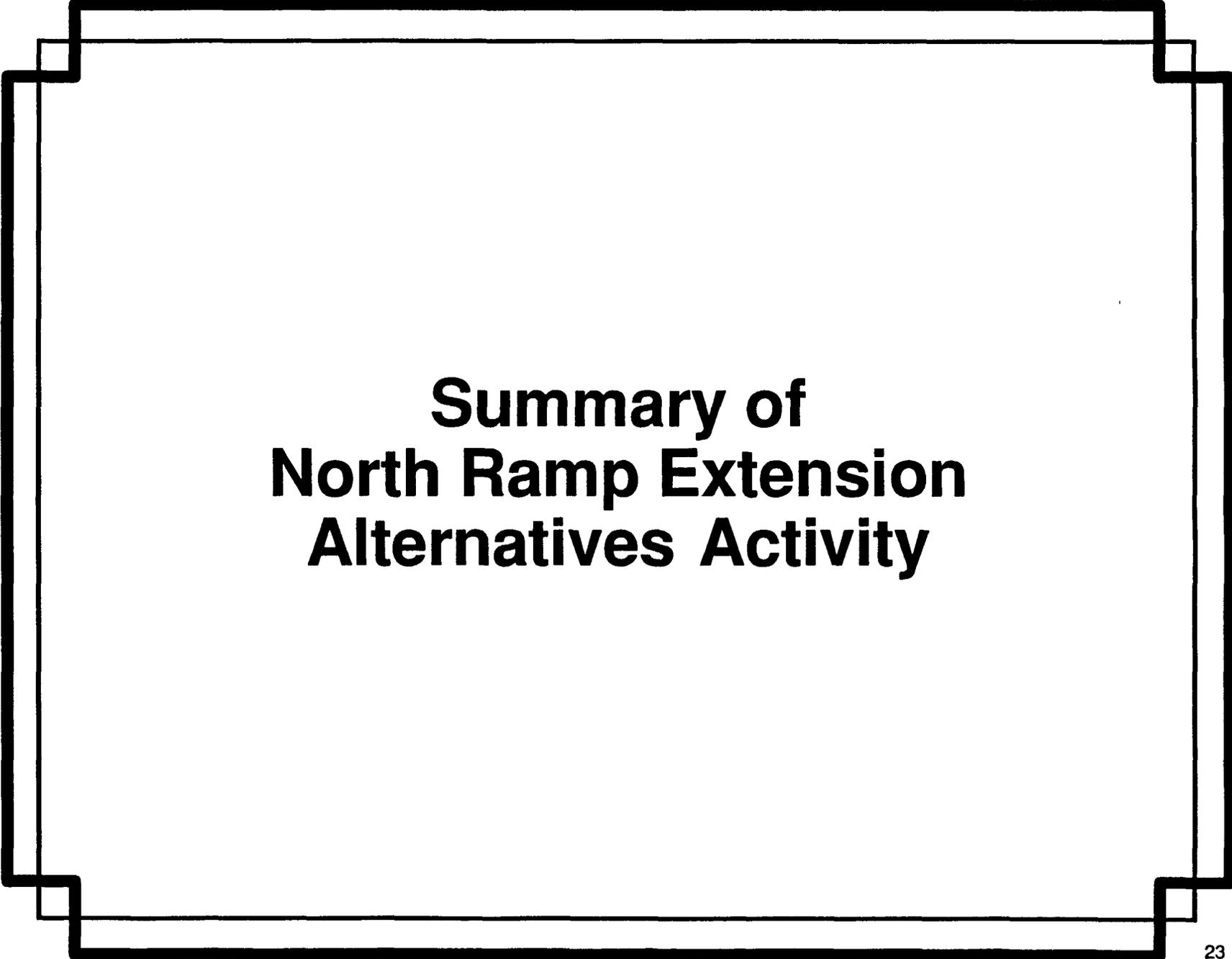
Introduction to Calico Hills Early Access Option

Calico Hills Early Access Option Background

- **A viable option has been developed for early access to the CHn unit that would provide comparable information to that from Options 3 & 4 of the Calico Hills Systems Study**
- **The option utilizes a shaft east of the repository block and a western drift in the CHn unit**



PRELIMINARY



Summary of North Ramp Extension Alternatives Activity

North Ramp Extension Alternatives Activity Background

- **The activity focused on acquiring information in the western repository block prior to TSS to address**
 - **Representativeness**
 - **Geologic and hydrologic features**
 - **Major uncertainty**
- **Early access to the CHn unit was not addressed**

North Ramp Extension Alternatives Activity Approach

- **Describe a set of ESF/NRE options, based on a common set of assumptions, that addresses an earlier completion of an east-west drift**
- **Establish a set of evaluation criteria that will discriminate among the ESF/NRE options and rank their relative importance**
- **Evaluate the options against the criteria, then rank the options by their weighted scores, establishing the preferred options**

ESF - North Ramp Extension Alternatives

- **Proceed with current ESF configuration and Program Plan schedule. Develop NRE in 1998**
 - **1A: Procure an 18 ft TBM for the NRE and CHn drifting**
 - **1B: Consolidated design schedule**
- **Develop early NRE based on current ESF configuration**
 - **2A: Start NRE using D&B techniques after 25 ft TBM turns south from north ramp**
 - **2B: Start NRE after 25 ft TBM passes second Ghost Dance fault access and stops. Use roadheader.**
 - **2C: Same NRE start as 2B but purchase 18 foot TBM**
 - **2D: Same NRE start as 2A but lease 18 ft TBM and run two headings concurrently**

ESF - North Ramp Extension Alternatives

(continued)

- **Excavate western drift to the Solitario Canyon fault in central portion of block after 25 ft TBM passes the second access to GDF and stops. Excavate Calico Hills (18 ft TBM) prior to restarting main TBM**
 - **3A: Excavate at the repository horizon**
 - **3B: Excavate cross drift below the repository horizon**

ESF - North Ramp Extension Alternatives

(continued)

- **Maintain Base Case Configuration for TSW, less NRE**
 - **4A: Initiate CHn unit drifting in Solitario Canyon using D&B and roadheader techniques**
 - **4B: Add western drift to Base Case in the CHn. Initiate excavation after second access to GDF**
 - **4C: Initiate excavation to the CHn after passing the curve at the bottom of the north ramp. Use dual headings**
 - **5: South Ramp turns west instead of east. CHn configuration same as Base Case.**

Criteria and Options Ranking

- **Criteria by order of importance:**
 - **Primary testing requirement**
 - **Representativeness**
 - **Repository interface**
 - **Schedule**
 - **Cost**
 - **Cost/schedule impacts**
 - **Physical interference**
 - **Technical feasibility**
 - **Multiple use**
 - **Compliance with oversight concerns**
 - **Environmental impact**

Evaluation of Options Summary (3/31/95)

	1A	1B	2A	2B	2C	2D	3A	3B	4A	4B	4C	5
Cost	15.5	16.5	30.0	29.0	15.5	21.5	23.5	19.0	48.0	38.5	38.0	37.0
Schedule	15.6	33.6	37.2	58.2	45.6	60.4	49.8	44.4	18.0	22.2	15.0	36.6
Multiple Use	18.9	18.6	17.1	18.9	19.2	18.9	13.5	15.0	8.1	9.9	9.9	11.4
Physical Interference	37.0	36.5	31.0	35.5	37.0	36.0	21.0	28.5	33.5	38.5	38.0	28.0
Technical Feasibility	32.0	30.8	30.4	15.6	32.4	32.4	28.0	27.2	22.8	28.0	26.4	24.0
Environmental Impact	7.5	7.3	7.1	7.5	7.5	7.8	8.0	7.4	3.1	6.5	6.5	3.6
Repository Interface	43.8	43.8	39.0	40.8	44.4	44.4	14.4	28.2	42.6	47.4	47.4	27.6
Representativeness	58.5	59.4	60.3	61.2	62.1	61.2	82.8	74.7	41.4	45.0	47.7	56.7
Cost/Schedule Impacts	29.0	33.5	32.5	26.0	33.0	25.5	37.0	35.0	26.0	33.5	26.5	30.0
Primary Testing Requirements	62.0	68.0	67.0	72.0	72.0	78.0	89.0	82.0	42.0	49.0	50.0	54.0
Compliance with Oversight Concerns	16.2	22.8	16.8	24.0	24.0	22.8	24.0	25.5	15.3	16.5	16.5	16.6
TOTALS (weighted)	336.0	370.8	368.4	388.7	392.7	408.9	394.6	387.7	300.8	335.0	321.9	325.5
TOTALS (raw)	657.0	720.0	705.0	741.0	758.0	783.0	735.0	726.0	576.0	659.0	631.0	603.0

Conclusions of the North Ramp Extension Alternatives Activity

- **Early NRE using leased 18 ft TBM (Option 2D)**
- **Same configuration as base case**
- **Total cost - same as base case**
- **18 ft and 25 ft TBM would operate concurrently (25 ft TBM may be held at 52+00, depending on funding)**
- **Begin/complete NRE - 1/96-6/96**
- **Daylight 25 ft TBM - 5/97 (unless deferred)**
- **Complete Calico Hills - 9/97 (depending on funding)**

Results of the Three Studies

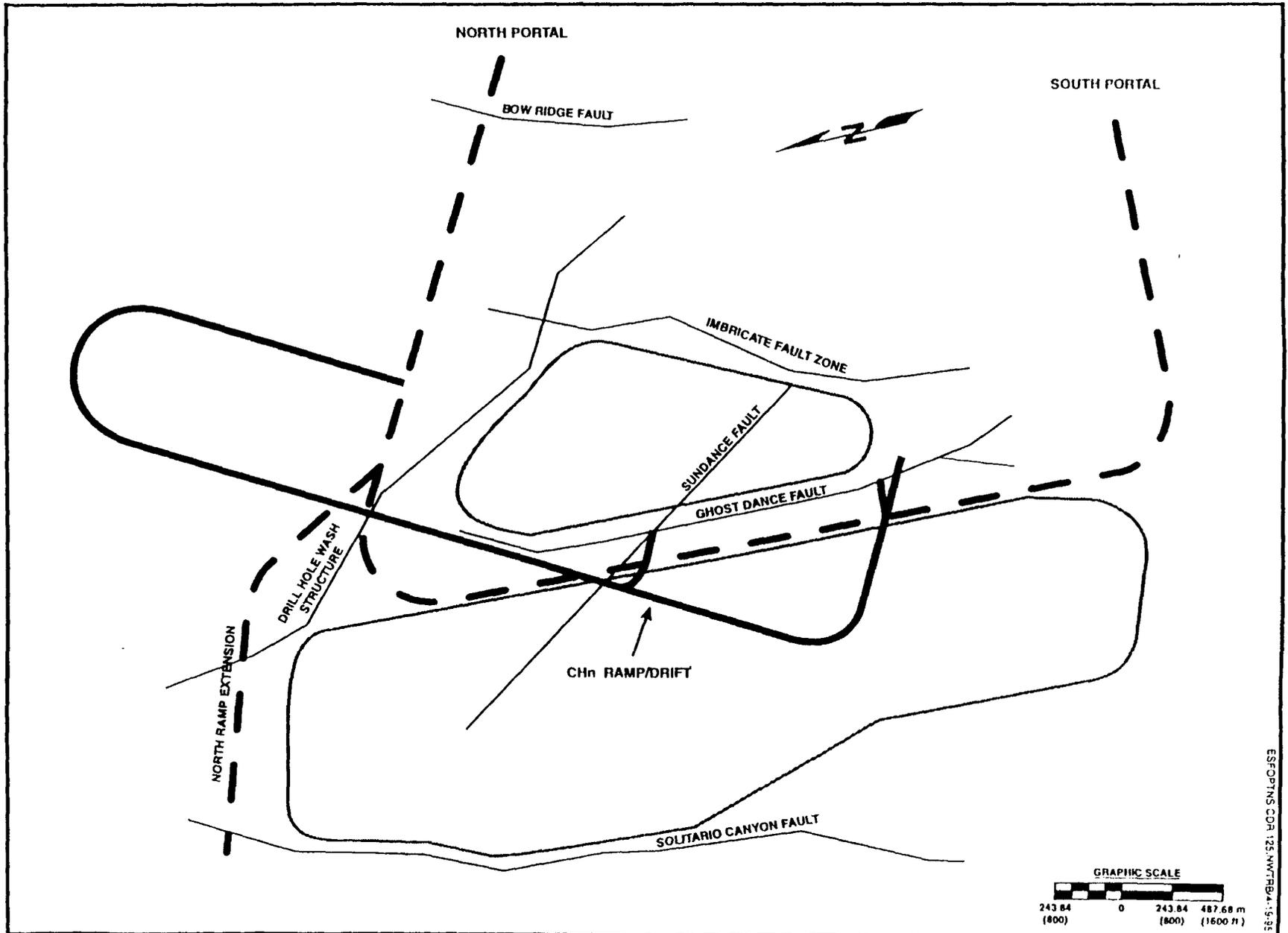
- **Extensive drifting may not significantly enhance confidence or reduce uncertainty over limited drifting**
- **Demonstrating CHn unit performance may be important, depending on the performance standard adopted by EPA and the amount of performance allocated to the CHn unit**
- **The DOE has a set of options for drifting in the western block of the repository horizon and a viable option for drifting in the CHn that can provide information earlier than is currently scheduled in the Program Plan**

Calico Hills Systems Study Background

Access Option Features/Attributes

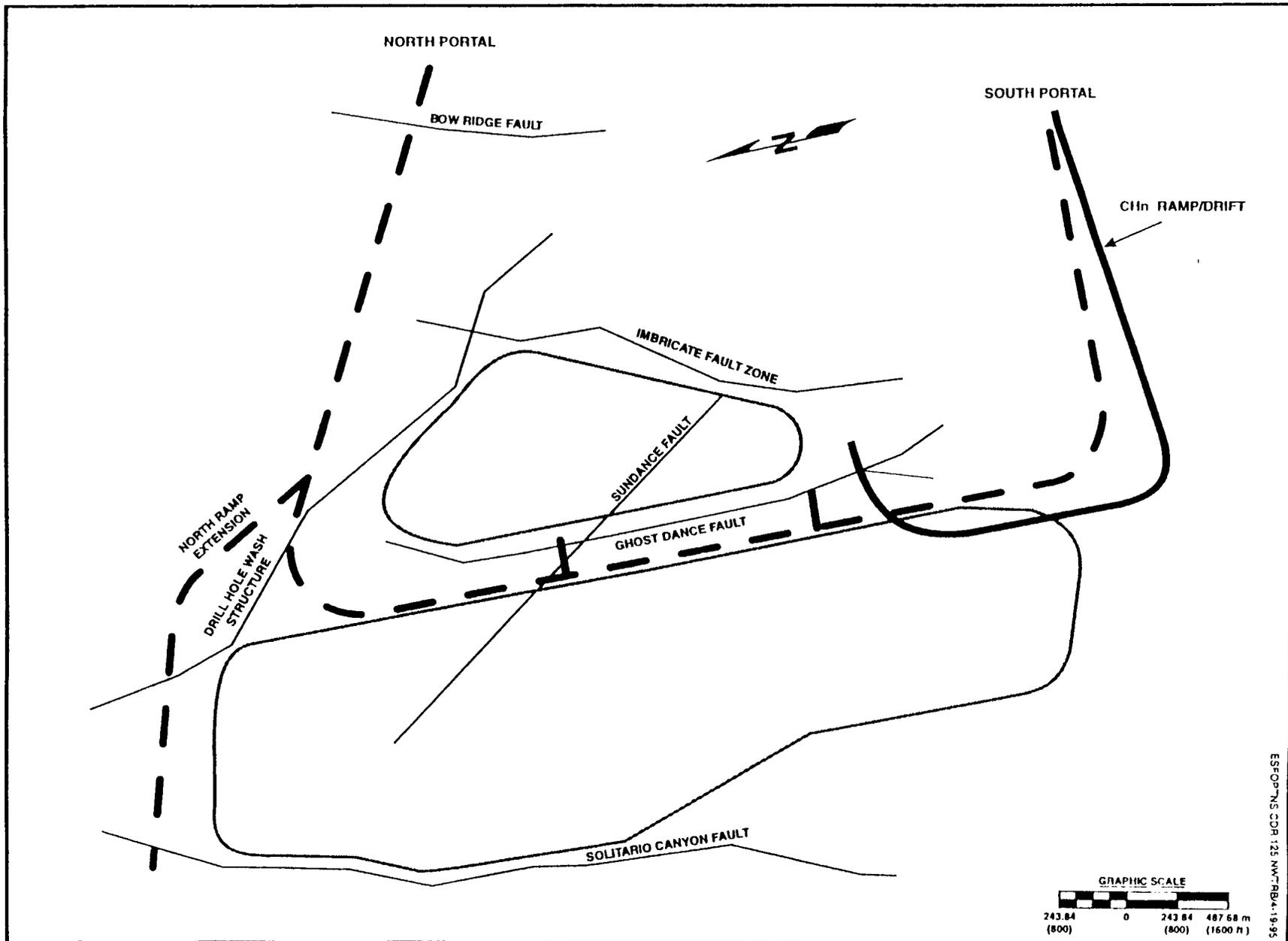
Access Option	Feature/Attribute								
	North-south distribution of features, properties & conditions	East-west distribution of features, properties, & conditions	Ghost Dance Fault access	Tsw basal vitrophyre	Imbricate Fault zone	Sundance-Ghost Dance Fault intersection	Long-term monitoring stations beneath repository	Drill Hole Wash structure	Solitario Canyon Fault
Boreholes	✓✓ vert	✓✓ vert	✓	✓✓✓	✓			✓	✓
Extensive excavation	✓✓✓ horiz	✓✓✓ horiz	✓✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Modified base case	✓✓	✓	✓✓✓	✓		✓✓✓	✓✓		
Minimum excavation	✓	✓	✓✓✓	✓			✓		

Modified Base Case Example

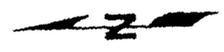
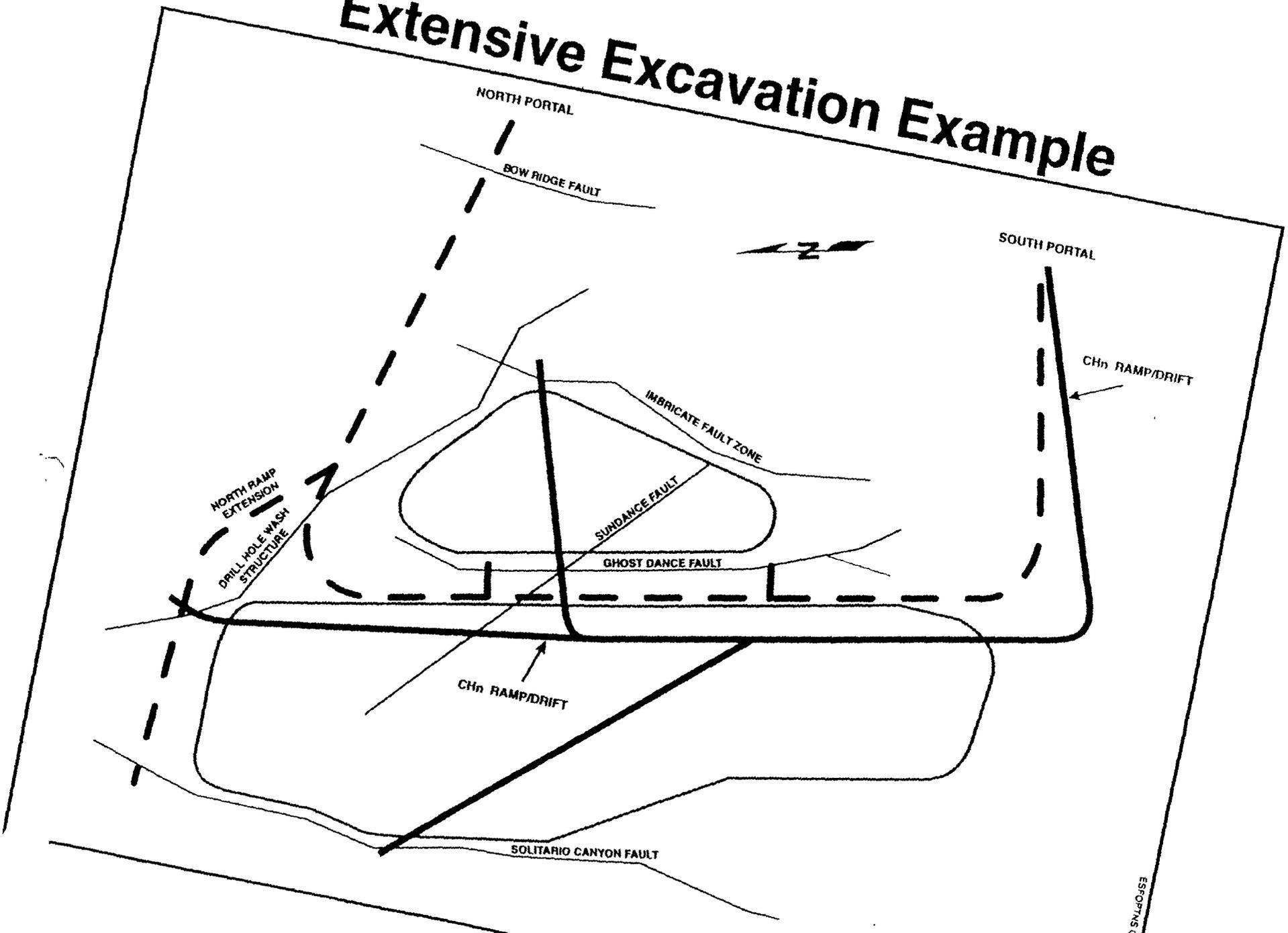


ES/PTNS CON 125 NMT/BA 1-5-95

Minimum Excavation Example



Extensive Excavation Example



ES/PTNS CDR 125 AMTRBA-15936

North Ramp Extension Alternatives Background

ASSUMPTIONS

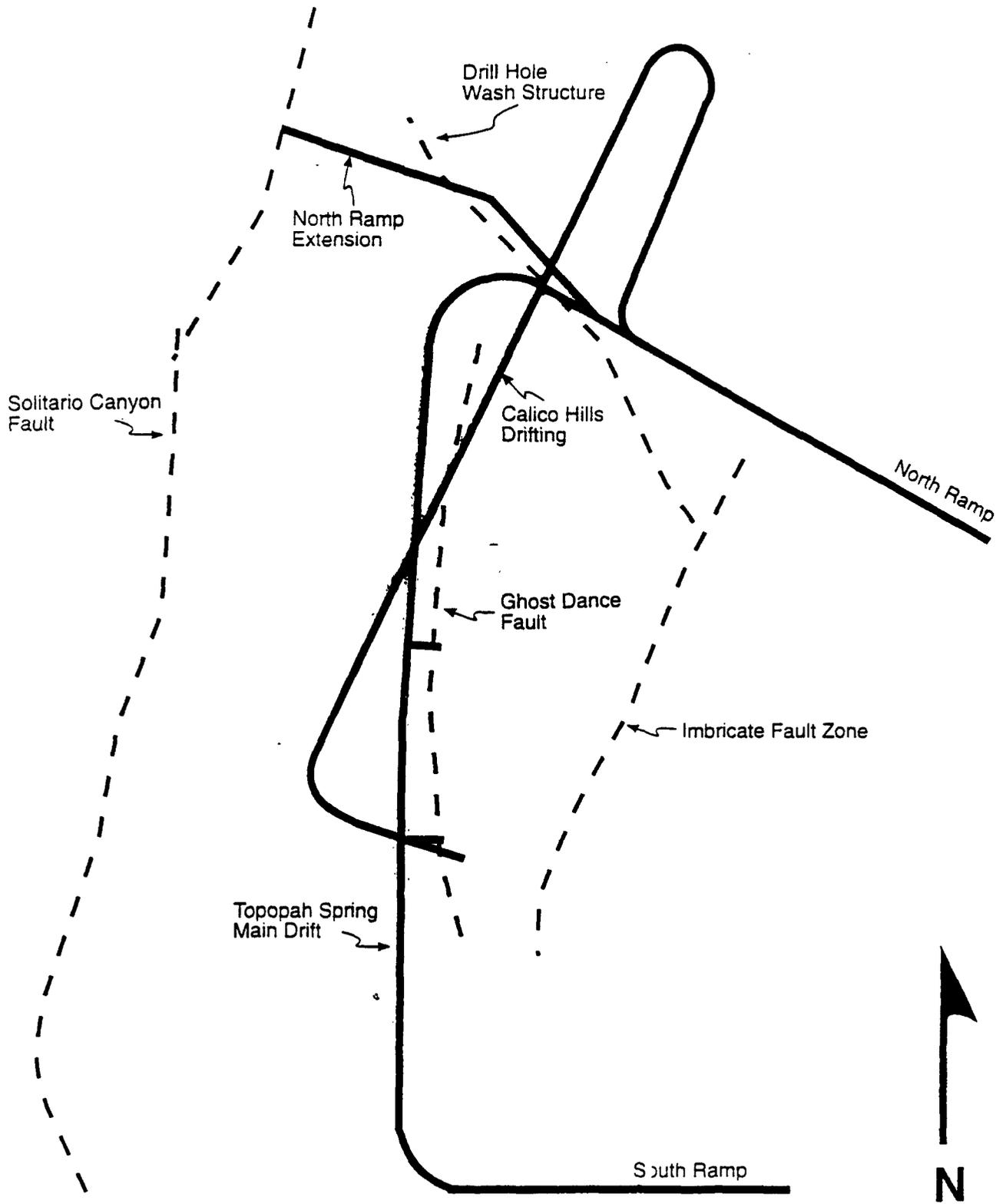
- Heater block testing will be initiated in TSW2 in early FY 97 (excavation of test area is complete in FY 96). The drift to TSW2 for heater block testing is separate from a NRE
- Preclude Drill and Blast in central portion of the block
- The NRE or east/west drift must be completed by May '98
- To support TSS, there will be a total of 11 or 12 boreholes near or within the block
 - Concentrated along main drift
 - Less concentrated in the western portion of the block
- Seismic studies will determine if any hidden major structures exist within the block
- Ghost Dance Fault access is the top priority, followed by a NRE or east/west drift
- Nonwelded tuff and vitrophyre must be segregated to meet environmental concerns.
- Daylighting the TBM at the South Portal is not a technical or programmatic requirement.
- A leased 18 ft TBM may result in significant savings (4-8 months) in construction of the NRE and CHn

COMPILED RANKINGS BY GROUP MEMBER

3-3-95

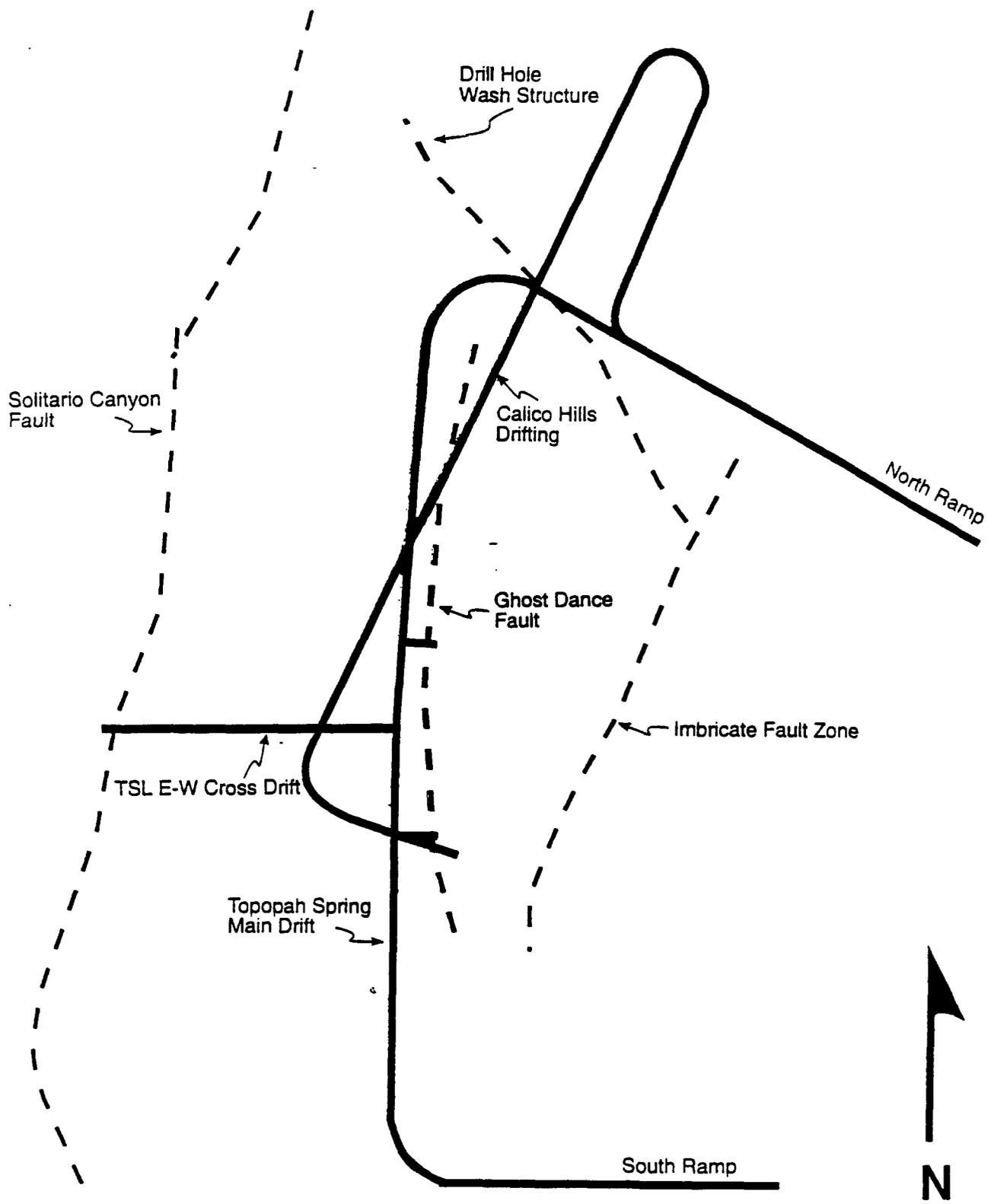
	A	B	C	D	E	F	G	H	I	Total	Normalized Value*
Cost	4	9	6	5	7	2	8	3	7	51	5
Schedule	5	7	8	3	10	3	9	10	9	64	6
Multiple Use	2	3	5	7	3	5	4	4	1	34	3
Physical Interference	7	5	2	9	6	9	3	7	4	52	5
Technical Feasibility	9	6	3	6	5	6	2	5	3	45	4
Environmental Impact	3	2	1	2	1	1	1	1	5	17	1
Repository Interface	10	4	4	10	4	8	5	8	8	61	6
Representativeness	8	10	10	8	11	10	10	11	10	88	9
Cost/Schedule Impacts	6	8	7	4	2	7	6	6	6	52	5
Primary Testing Requirement	11	11	11	11	9	11	11	9	11	95	10
Compliance with NWTRB Concerns	1	1	9	1	8	4	7	2	2	35	3

*Normalized Value to 10 (with 10 being the best)

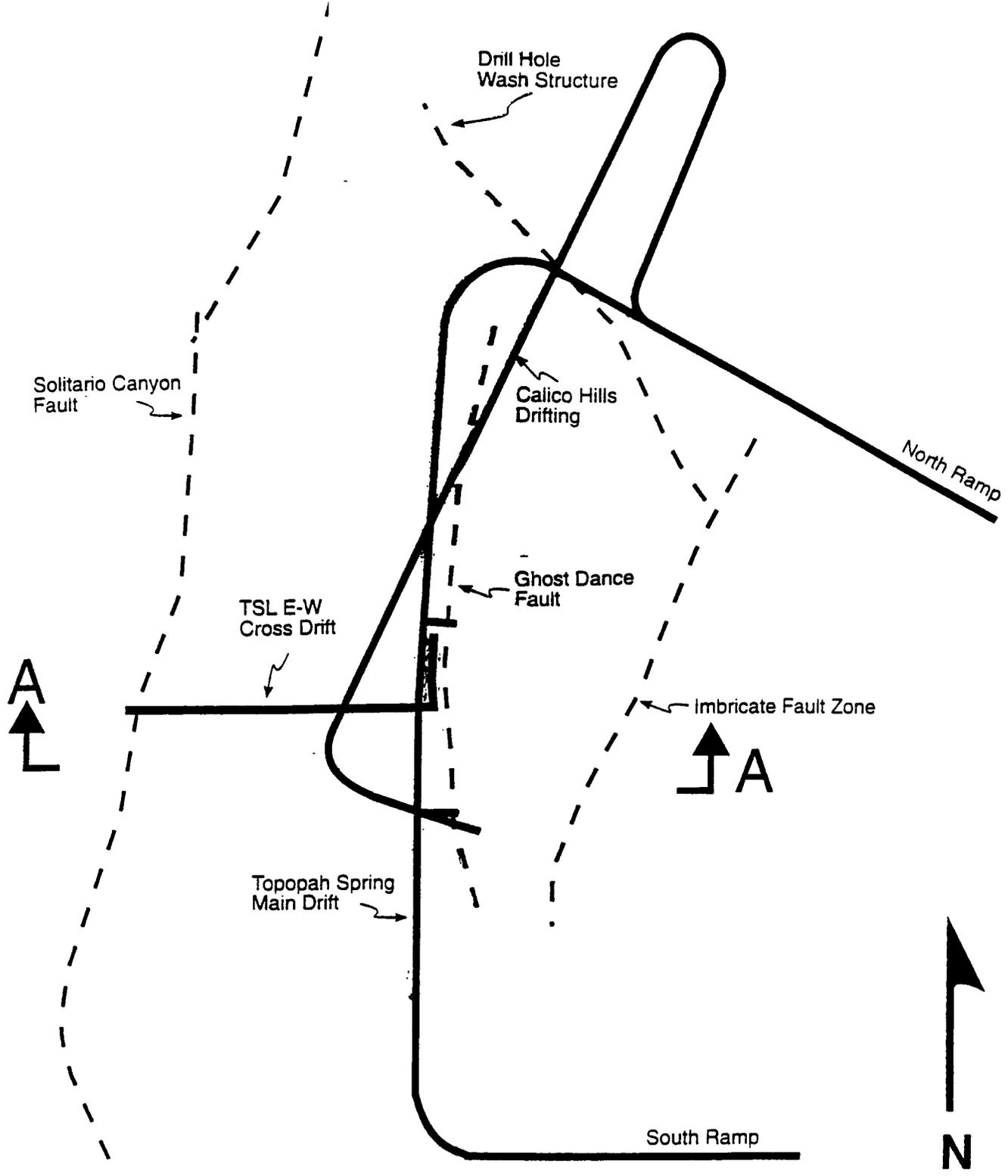


ESF Layout

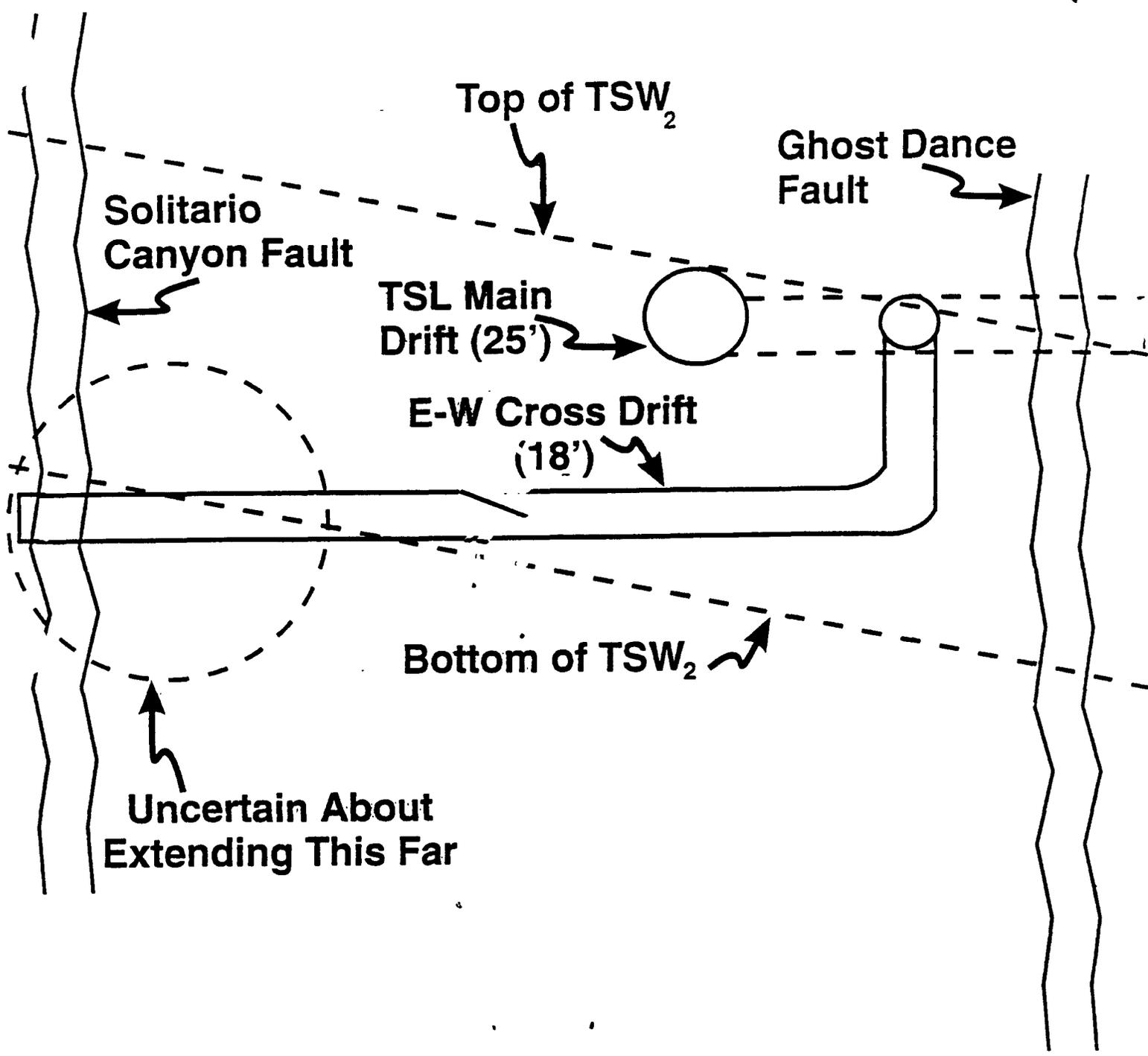
Options 1A, 1B, 2A, 2B, 2C, 2D



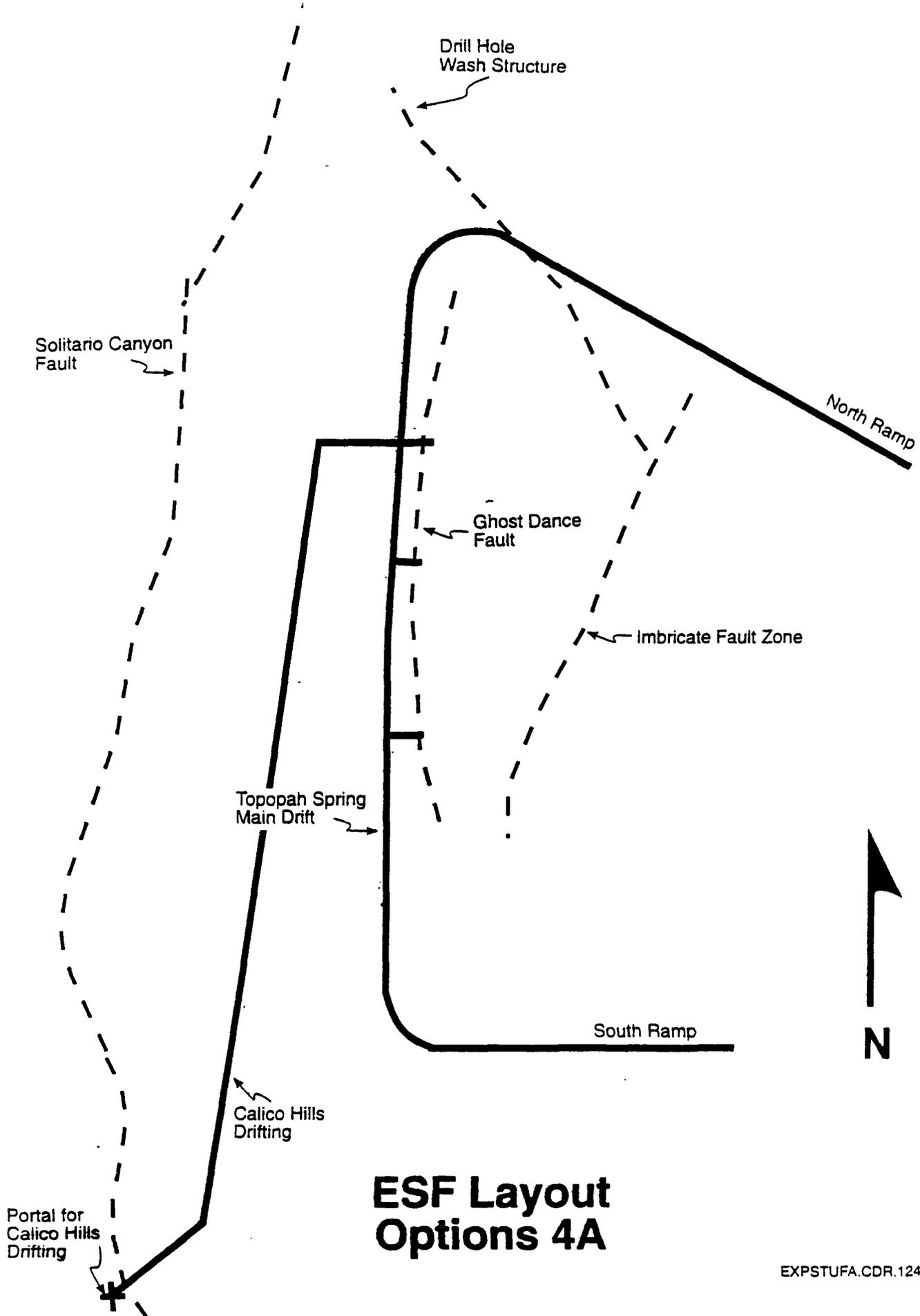
ESF Layout Options 3A



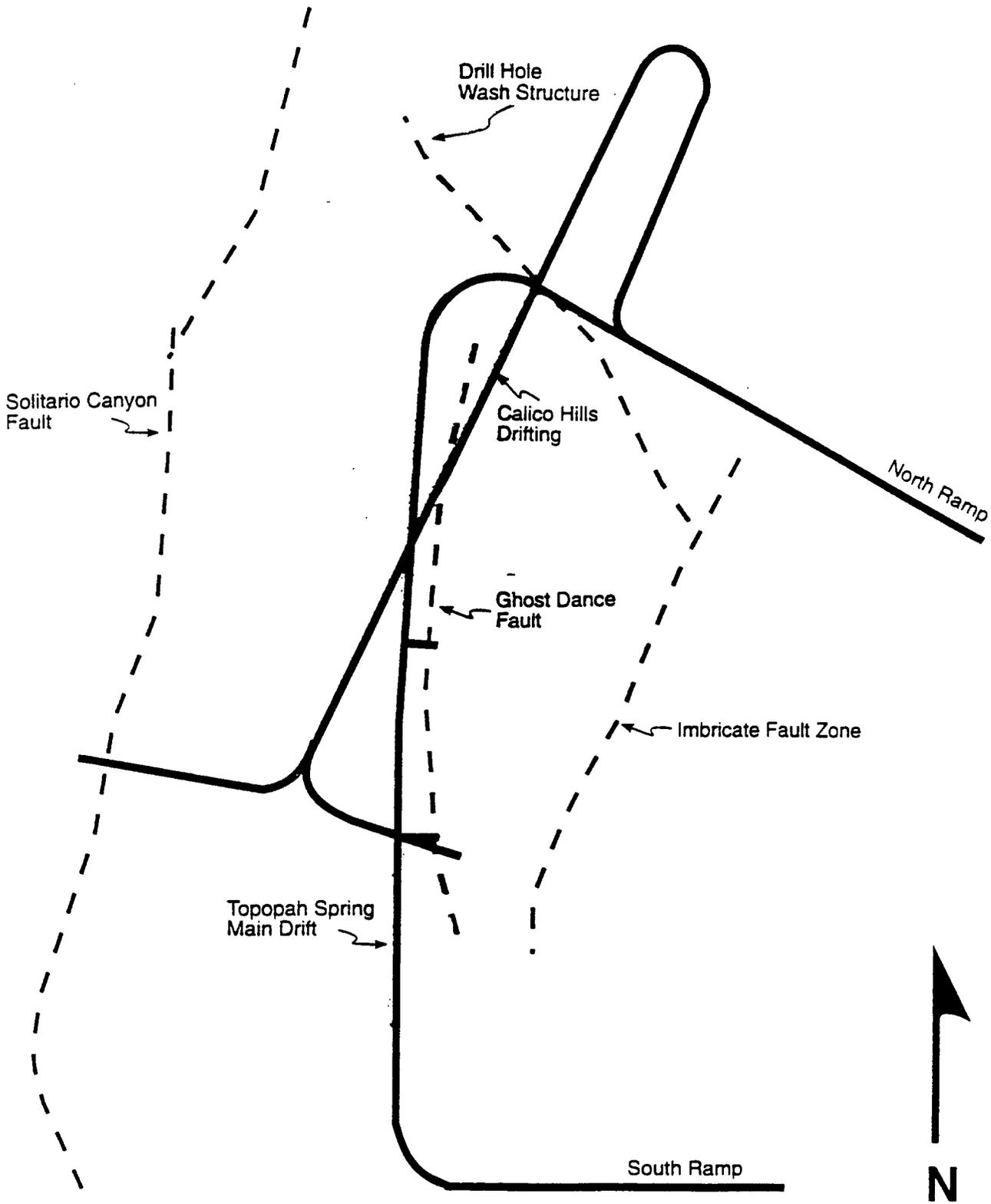
ESF Layout Options 3B



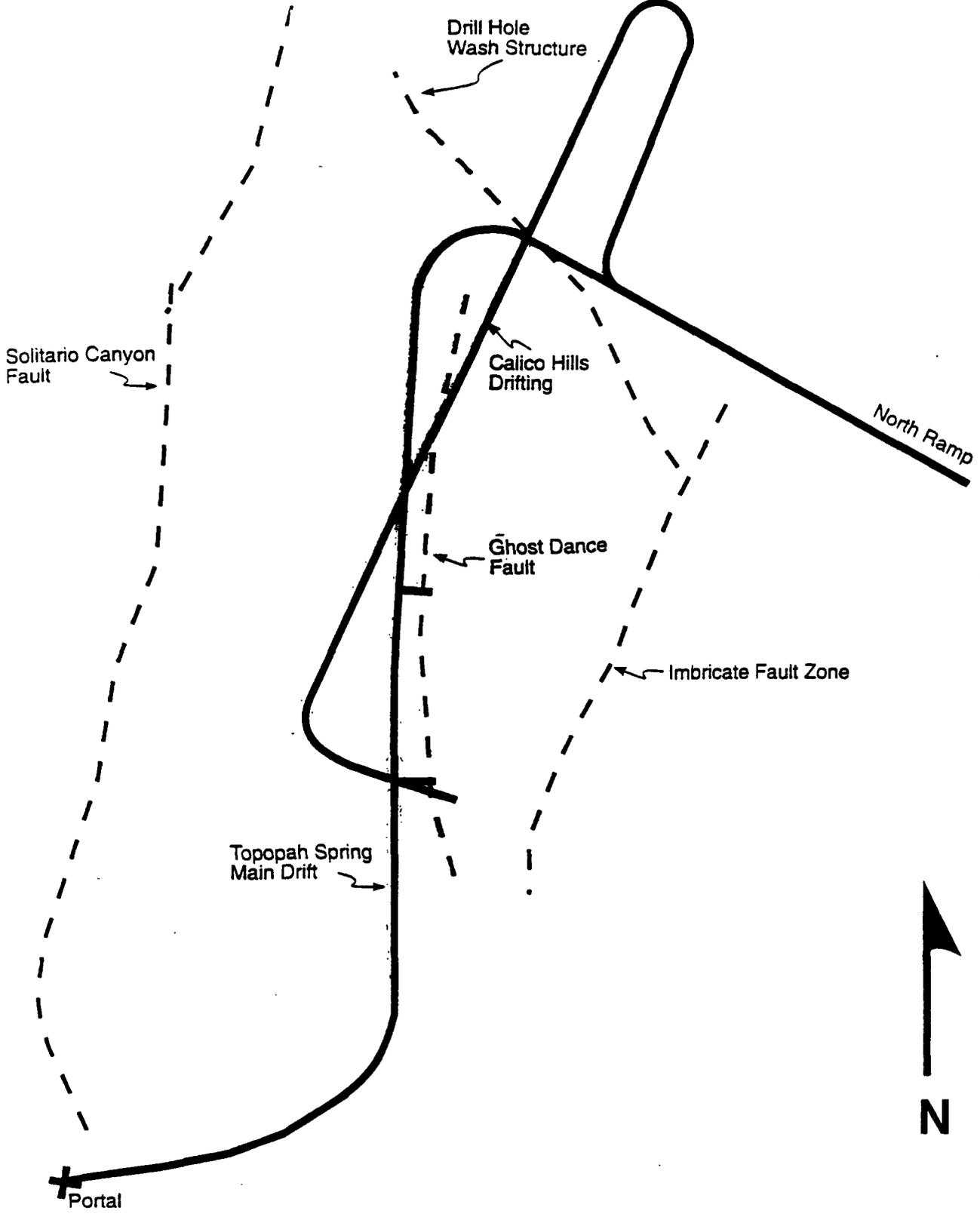
**Section A-A
Option 3B**



ESF Layout Options 4A



ESF Layout Options 4B & 4C



ESF Layout Option 5

NORTH RAMP EXTENSION ALTERNATIVES

COST ANALYSIS

OPTIONS	COST	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
1A	\$88.1M	0	0	\$13.3M	\$22.7M	\$39.7M	12.4M
1B	0	0	0	0	+17.5	-5.1M	-12.4M
2A	-14.5M	+1.0M	+4.1M	+0.3	-0.6	-7.0M	-12.4M
2B	-13.7M	+0.95M	+11.35M	+17.45M	+8.65M	-39.6M	-12.4M
2C	0	+0.05M	-0.05M	-31.2	+16.6M	+21.8M	-7.2M
2D	0	+5M	+9M	+13M	0	-18M	-9M
3A	-5.3M	+0.05M	-0.55M	-30.9M	+15.7M	+20.3M	-9.9M
3B	-1.2M	+0.05M	-0.55M	-30.9M	+16.5M	+22.9M	-9.2M
4A	-52.1M	+1.0M	+11.1M	-6.2M	-10.5M	-35.0M	-12.4M
4B	-26.4M	+0.05M	+2.15M	-37.1M	+27.9M	-6.9M	-12.4M
4C	-26.4M	+0.05M	+9.75M	+2.2M	+13.3M	-39.1M	-12.4M
5	-26.4M	+0.05M	+9.75M	+2.2M	+13.3M	-39.1M	-12.4M

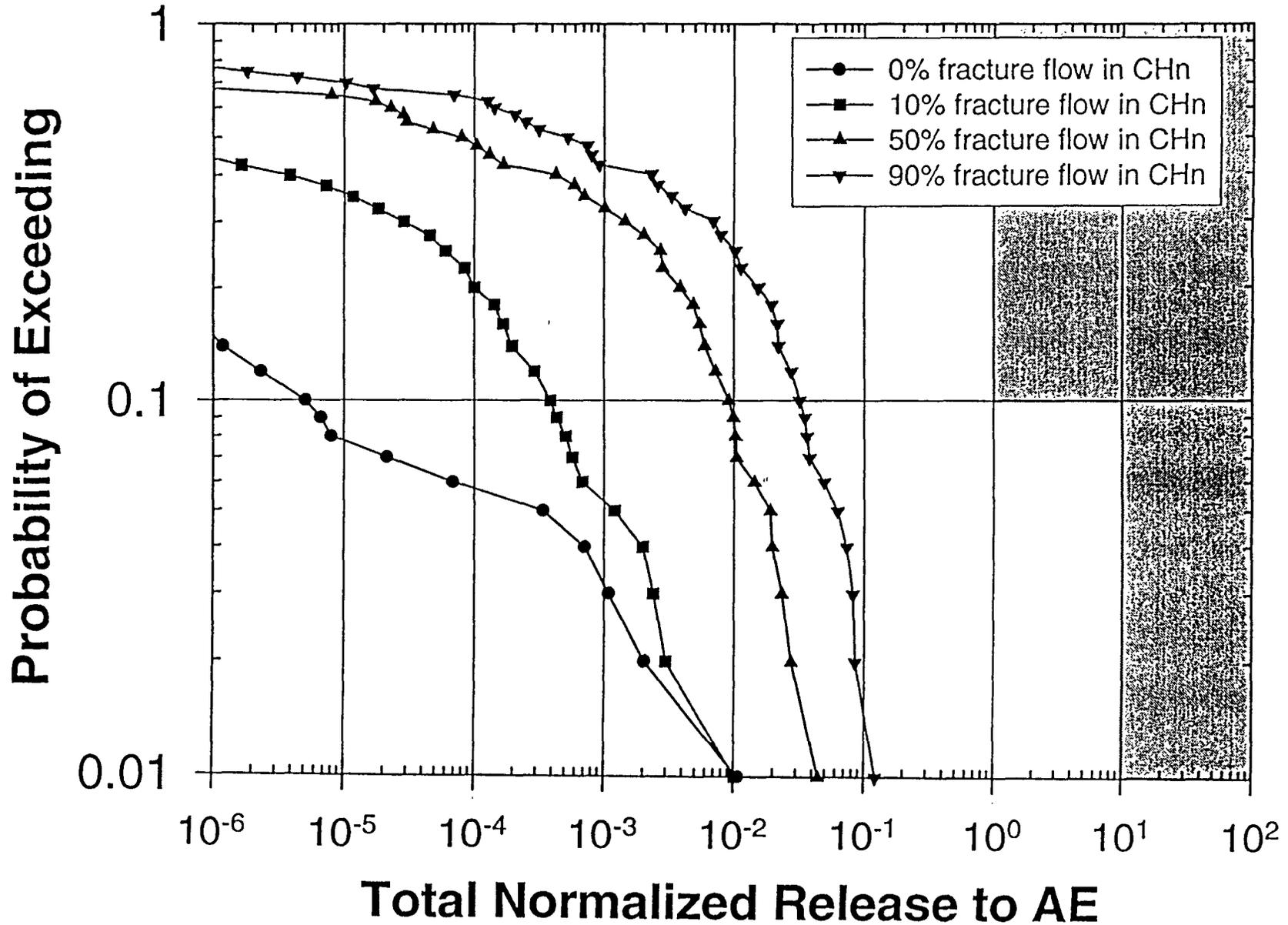
SCHEDULE ANALYSIS

OPTION	1A	1B	2A	2B	2C	2D	3A	3B	4A	4B	4C	5
COMP./NRE	9/98	3/98	2/98	2/97	11/97	6/96	9/97	11/97	---	---	---	---
COMP CHn	12/99	6/99	6/99	7/98	2/99	7/97	1/99	2/99	8/98	6/98	9/98	9/98
Daylight	5/97	5/97	5/97	5/97	10/99		9/99	10/99	---	3/99	5/97	7/97

- NOTES:
1. All \$ are given in FY1995 \$.
 2. Option 1A shows the actual \$ required to design and construct the North Ramp Extension and Calico Hills.

C Line

10,000-yr Total Releases: Fracture Flow in CHn



10,000-yr Total Releases: Fracture Flow in CHn

