

**PROJECT PLAN FOR
STOCHASTIC UNSATURATED
FLOW AND TRANSPORT**

Prepared for

**Nuclear Regulatory Commission
Contract NRC-02-93-005**

Prepared by

Amyrossios C. Bagtzoglou

**Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas**

**Revision 2
Change 3**

March 1994

UNCONTROLLED

**CENTER FOR NUCLEAR WASTE
REGULATORY ANALYSES**

Revision: 2

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Date: March 1994

Title: PROJECT PLAN FOR STOCHASTIC UNSATURATED FLOW AND TRANSPORT

EFFECTIVITY

Revision 2 of this document became effective on July 30, 1993.
This document consists of the pages and changes listed below.

<u>Page No.</u>	<u>Change No.</u>	<u>Date Effective</u>
Title Page	3	03/15/94
ii	3	03/15/94
iii - 3-9	0	07/30/93
3-10	3	03/15/94
3-11 - 5-2	0	07/30/93
A-1	1	09/25/93
A-2 -A-7	3	03/15/94

Supersedes: Revision 2, Change 2 - December 1993

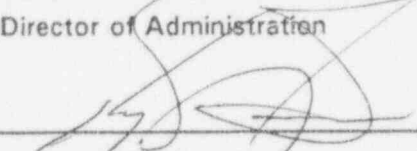
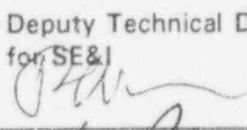

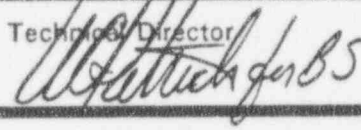
Director of Administration 	Date: 3/14/94	Deputy Technical Director for SE&I 	Date: 3/12/94
Director of QA 	Date: 3/12/94	Technical Director 	Date: 3/12/94

Table 3-1. List of milestones and completion dates

Milestone Number	Milestone Type	Deliverable Description	Completion Date
053094-001	Major	Large-Scale Simulation of Flow and Transport in Heterogeneous Fractured Rock: Results and Analyses	06/03/94
053094-002	Intermediate	Peer Review of Report on Large-Scale Flow and Transport	07/29/94
056094-003	Intermediate	Application of the RSRG Method to the Efficient Calculation of Effective Properties for Highly Fractured, Heterogeneous, Unsaturated Media	03/18/94
054094-004	Intermediate	Peer Review of Report on Effective Properties	04/30/94

3.4 INTERFACE WITH OTHER ORGANIZATIONS

The interrelations between this and other relevant projects outside the CNWRA were explained in some detail in Section 3.1. Some allowance for technical interchange with outside research groups and organizations is included in Section 4.5, Travel. In particular, technical interactions and dialogue will be pursued with:

- The University of Arizona group (for its continuing field experiment in unsaturated fractured tuff at the Apache Leap site and related laboratory tests on fractured rock samples)
- The Massachusetts Institute of Technology group (for its development of a stochastic approach to flow and transport in unsaturated porous media using some of the previous work by Dr. Rachid Ababou)
- The New Mexico State University at Las Cruces and Pacific Northwest Laboratories (for their monitoring and analysis of the 3D trench experiment of transient strip source flow and transport in unsaturated desert soil near Las Cruces)
- INTRAVAL, an international project for the validation of mathematical models of radionuclide transport that promotes the exchange of information and data

Table A-1. Stochastic flow and transport estimated spending plan, FY94

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Center P1-4	583	357	664	664	510	510	357	255	0	0	0	0	0	3,981
Center P1-3	116	77	116	116	77	77	39	39	39	39	0	0	0	775
Center P1-2	156	155	155	217	155	155	62	62	62	62	0	0	0	1,239
Center P1-1	2,697	2,706	2,664	3,367	2,706	2,665	874	874	874	874	810	0	0	21,130
Center Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clerical	361	370	359	462	359	370	483	483	483	483	483	482	0	4,674
Center Labor	3,963	3,896	3,956	4,825	3,847	3,797	1,814	1,712	1,457	1,457	1,272	0	0	31,798
Center Burden	1,745	1,602	1,729	2,109	1,681	1,659	793	748	637	637	556	0	0	13,896
Center Overhead	3,844	3,529	3,810	4,646	3,704	3,656	1,747	1,648	1,403	1,403	1,225	0	0	30,615
SwRI P1-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI P1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI P1-2	1,264	1,302	1,302	1,579	1,302	1,302	0	0	0	0	0	0	0	8,053
SwRI P1-1	1,230	1,210	1,229	1,513	1,229	1,210	946	946	946	946	963	0	0	12,387
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Labor	2,494	2,513	2,532	3,092	2,532	2,513	946	946	946	946	903	0	0	20,440
SwRI Burden	1,090	1,096	1,106	1,351	1,106	1,096	413	413	413	413	430	0	0	8,932
SwRI Overhead	4,157	4,188	4,220	5,155	4,220	4,188	1,576	1,576	1,576	1,576	1,639	0	0	34,071
ADP Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machine Shop	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material/Supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality Assur.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Report Services	258	258	258	322	258	258	177	113	49	49	49	0	0	2,000
Telephone & Togram	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel	0	0	0	9,840	0	0	0	0	0	0	0	0	0	9,840
Consultants	1,458	1,421	1,458	1,804	1,526	1,353	5,696	5,424	5,220	5,220	0	0	0	30,580
Clear Prem Pay	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temporary Svcs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Est excl. CFC, Fee	19,039	18,274	19,071	33,144	18,674	18,523	13,162	12,581	11,700	11,700	6,106	0	0	182,172
Center CFC	252	231	249	304	242	209	114	108	92	80	80	0	0	2,004
SwRI CFC	294	287	289	353	289	267	108	108	108	108	112	0	0	2,330
Tot Estimate Cost	19,575	18,792	19,609	33,801	19,406	19,049	13,384	12,796	11,900	11,900	6,297	0	0	186,507
Fee	1,523	1,402	1,505	2,652	1,510	1,482	1,119	1,069	995	995	519	0	0	14,850
Tot Cost with Fee	21,098	20,254	21,135	36,452	20,915	20,530	14,503	13,866	12,894	12,894	6,816	0	0	201,357
% Completion	10.48%	10.06%	10.50%	18.10%	10.39%	10.20%	7.20%	6.89%	6.40%	6.40%	3.38%	0.00%	0.00%	100.00%
Cumulative Cost	21,098	41,352	62,487	98,039	119,854	140,384	154,867	168,752	181,647	194,541	201,357	201,357	201,357	201,357
Cumulative Completion	10.48%	20.54%	31.03%	49.14%	59.52%	69.72%	76.92%	83.81%	90.21%	96.62%	100.00%	100.00%	100.00%	100.00%

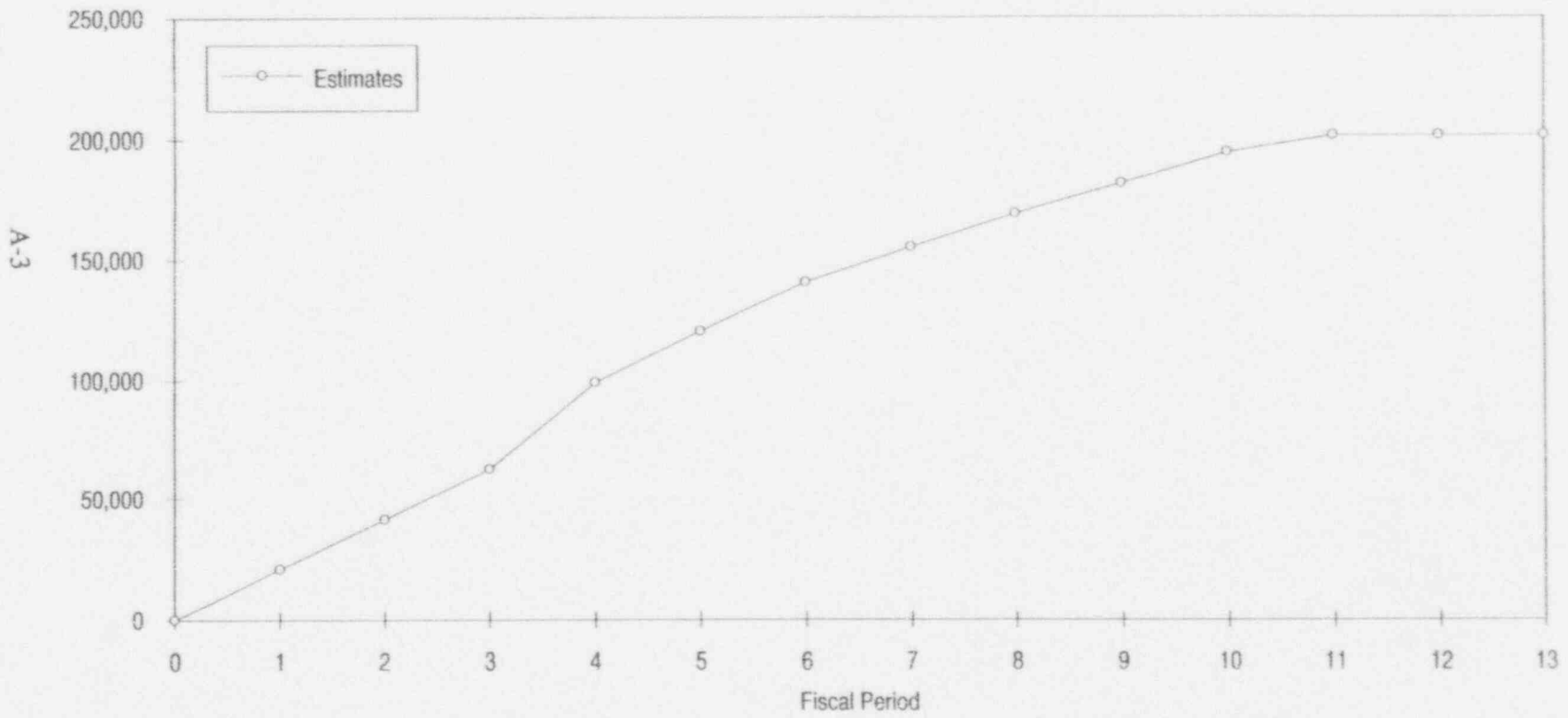


Figure A-1. Stochastic flow and transport estimated spending plan, FY94

Table A-2. Stochastic flow and transport estimated labor plan, FY94

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Center Labor	13	7	13	13	10	10	7	5	0	0	0	0	0	78
Center PH-4	3	2	3	3	3	2	1	1	1	1	1	0	0	20
Center PH-3	5	5	5	7	5	5	2	2	2	2	0	0	0	40
Center PH-2	127	127	125	158	127	126	41	41	41	41	38	0	0	962
Center PH-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Tech	35	36	35	45	35	36	47	47	47	47	45	0	0	455
Center Chemical	183	177	181	226	180	179	98	96	91	91	83	0	0	1,585
Total Center Labor														
SwRI Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PH-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PH-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PH-2	46	47	47	57	47	47	0	0	0	0	0	0	0	291
SwRI PH-1	65	64	65	80	65	64	50	50	50	50	52	0	0	655
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total SwRI Labor	111	111	112	137	112	111	50	50	50	50	52	0	0	946

Table A-3. Stochastic flow and transport task 3 estimated spending plan, FY94

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Center P1-4	255	153	255	255	204	204	204	153	0	0	0	0	0	1,684
Center P1-3	116	77	116	116	116	77	39	39	39	39	0	0	0	775
Center P1-2	155	155	155	217	155	155	62	62	62	62	0	0	0	1,237
Center P1-1	1,784	1,790	1,790	2,216	1,811	1,769	874	874	874	874	810	0	0	15,465
Center Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clinical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Labor	2,311	2,175	2,316	2,804	2,288	2,205	1,178	1,127	974	974	810	0	0	9,162
Center Burden	1,910	961	1,012	1,225	969	964	515	493	476	426	354	0	0	8,374
Center Overhead	2,225	2,094	2,230	2,700	2,201	2,123	1,135	1,065	938	938	780	0	0	18,449
SwRI P1-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI P1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI P1-2	880	914	887	1,108	887	914	0	0	0	0	0	0	0	5,591
SwRI P1-1	0	0	0	0	0	0	946	946	946	946	983	0	0	4,765
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Labor	880	914	887	1,108	887	914	946	946	946	946	983	0	0	10,356
SwRI Burden	384	400	388	494	388	400	413	413	413	413	430	0	0	4,525
SwRI Overhead	1,466	1,524	1,478	1,848	1,478	1,524	1,576	1,576	1,576	1,576	1,638	0	0	17,262
ADP Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machine Shop	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material/Supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality Assur.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Report Services	129	129	129	161	129	129	129	65	65	65	0	0	0	1,000
Telephone & Tigram	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel	0	0	0	6,554	0	0	0	0	0	0	0	0	0	6,554
Consultants	408	476	408	541	476	408	476	204	0	0	0	0	0	3,400
Clerk Prem Pay	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temporary Sics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Est. incl. CFC, Fee	9,814	8,664	8,848	17,429	8,844	8,667	6,358	5,929	5,273	5,273	4,995	0	0	89,083
Center CFC	146	137	146	177	144	139	74	71	61	61	51	0	0	1,208
SwRI CFC	100	104	101	126	101	104	108	108	108	108	112	0	0	1,181
Tot Estimate Cost	9,059	8,905	9,095	17,732	9,089	8,910	6,550	6,068	5,442	5,442	5,159	0	0	91,471
Fee	705	683	708	1,294	708	693	541	502	448	448	425	0	0	7,256
Tot Cost with Fee	9,765	9,598	9,802	19,126	9,797	9,604	7,091	6,591	5,890	5,890	5,583	0	0	98,737
% Completion	11.85%	9.72%	9.80%	19.37%	9.92%	9.73%	7.18%	6.67%	5.97%	5.97%	5.65%	0.00%	0.00%	100.00%
Cumulative Cost	9,765	19,363	29,165	48,292	58,088	67,692	74,783	81,374	87,264	93,154	98,737	98,737	98,737	98,737
Cumulative Completion	11.85%	19.61%	29.54%	48.91%	58.80%	68.56%	75.74%	82.41%	88.38%	94.35%	100.00%	100.00%	100.00%	100.00%

Table A-4. Stochastic flow and transport task 4 estimated spending plan, FY94

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Center PI-4	204	102	204	204	153	153	153	102	0	0	0	0	0	1,276
Center PI-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center PI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center PI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clinical	361	370	359	462	359	370	463	463	463	463	462	0	0	4,674
Center Labor	565	472	564	666	513	523	636	585	483	483	462	0	0	5,950
Center Burden	247	206	246	291	227	228	278	256	211	211	202	0	0	2,600
Center Overhead	544	454	543	642	494	503	612	563	465	465	445	0	0	5,779
SwRI PI-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PI-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Burden	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Overhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ADP Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mechine Shop	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material/Supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality Assur.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Report Services	0	0	0	0	0	0	48	48	49	49	49	0	0	194
Phone & Tgram	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Consultants	0	0	0	0	0	0	5,220	5,220	5,220	5,220	0	0	0	20,880
Cler Perm Pay	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temporary Svcs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Est excl. CFC Fee	1,355	1,132	1,353	1,599	1,230	1,255	6,794	6,671	6,427	6,427	1,109	0	0	35,352
Center CFC	36	30	36	42	32	33	40	37	30	30	29	0	0	375
SwRI CFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tot Estimate Cost	1,391	1,162	1,389	1,641	1,262	1,288	6,834	6,708	6,458	6,458	1,138	0	0	35,728
Fee	108	91	108	128	98	100	577	567	546	546	94	0	0	2,965
Tot Cost with Fee	1,499	1,253	1,498	1,769	1,361	1,388	7,411	7,275	7,004	7,004	1,232	0	0	38,693
% Completion	13.77%	3.24%	3.87%	4.57%	3.52%	3.59%	19.15%	18.80%	18.10%	18.10%	3.19%	0.00%	0.00%	100.00%
Cumulative Cost	1,499	2,752	4,248	6,017	7,378	8,766	15,177	20,452	30,456	37,460	38,693	38,693	38,693	38,693
Current Completion	13.77%	7.11%	10.98%	15.55%	19.07%	22.65%	41.81%	60.61%	78.71%	96.81%	100.00%	100.00%	100.00%	100.00%

Table A-5. Stochastic flow and and transport task 6 spending plan, FY94

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Center PI-4	204	102	204	204	153	153	0	0	0	0	0	0	0	1,021
Center PI-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center PI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center PI-1	913	916	874	1,151	885	916	0	0	0	0	0	0	0	5,665
Center Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clerical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Labor	1,117	1,018	1,078	1,355	1,048	1,069	0	0	0	0	0	0	0	6,686
Center Burden	488	445	471	592	458	467	0	0	0	0	0	0	0	2,922
Center Overhead	1,075	981	1,038	1,304	1,009	1,030	0	0	0	0	0	0	0	6,437
SwRI PI-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PI-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI PI-2	384	388	416	471	416	388	0	0	0	0	0	0	0	2,462
SwRI PI-1	1,230	1,210	1,229	1,513	1,229	1,210	0	0	0	0	0	0	0	7,822
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Labor	1,614	1,598	1,645	1,994	1,645	1,598	0	0	0	0	0	0	0	10,384
SwRI Burden	706	698	719	867	719	698	0	0	0	0	0	0	0	4,467
SwRI Overhead	2,691	2,664	2,742	3,307	2,742	2,664	0	0	0	0	0	0	0	16,810
ADP Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machine Shop	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material/Supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality Assur.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Report Services	129	129	129	161	129	129	0	0	0	0	0	0	0	906
Telephone & Tigram	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel	0	0	0	3,286	0	0	0	0	0	0	0	0	0	3,286
Consultants	1,050	945	1,050	1,250	1,050	945	0	0	0	0	0	0	0	6,300
Clear Prem Pay	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temporary Svcs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Est excl. CFC, Fee	8,870	8,479	8,671	14,116	8,800	8,501	0	0	0	0	0	0	0	57,737
Center CFC	70	64	68	85	66	67	0	0	0	0	0	0	0	421
SwRI CFC	184	182	188	226	188	182	0	0	0	0	0	0	0	1,150
Tot Estimate Cost	9,125	8,725	9,125	14,428	9,053	8,851	0	0	0	0	0	0	0	59,308
Fee	710	678	710	1,129	704	688	0	0	0	0	0	0	0	4,619
Tot Cost with Fee	9,835	9,403	9,835	15,557	9,757	9,539	0	0	0	0	0	0	0	63,928
% Completion	12.53%	14.71%	15.38%	24.34%	15.25%	14.92%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
Cumulative Cost	9,835	19,238	29,074	44,632	54,389	63,928	63,928	63,928	63,928	63,928	63,928	63,928	63,928	63,928
Cumul Completion	12.53%	30.09%	45.46%	69.82%	85.06%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%