Calculation Cover Sheet

Calc. No. 10-591-01-00

Contract No. 5057-05 Discipline ESCI No. of Sheets 9

Project UMTRA-GRN

Feature Tailings, Off-pile, Buffer Materials

Item In-place Parameter Characterization

Sources of Data

1. MKE document # 5057-GRN-R-02-01587-00, "Contaminated Materials and Type "A" Fill Test Results", supplied by MK-F.

~~Sources of Formulae & References~~

Preliminary Calc. ☐ Final Calc. ☒ Supersedes Calc. No. ——

Rev No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	——	Monica Goodman	7/27/89	H.O. CHAN	7/28/89	G.B. Gunn	8-16-89

SUMMARY

Based on available construction data, in-place buffer and contaminated material mean water content and density values are as follows (see Table 4):

MAT'L TYPE	W(%)	γ_d (pcf)	θ (%)
Tailings	4.6	99.0	7.0
Offpile	5.5	115.2	10.8
Buffer	8.3	119.2	15.8

Mean values of optimum water content and maximum dry density of D-698 compaction tests used to control placement of tailings, "windblown" and buffer materials are presented in Table 10, sheet A-29.

PURPOSE

Estimate inplace (as-compacted) mean values of the following parameters for the tailings, offpile contaminated material ("windblown" and vicinity property) and buffer materials:

- gravimetric water content (w)
- dry density (γ_d)
- volumetric water content (θ).

PROCEDURE

1. W and γ_d (test data for tailings, offpile and buffer materials presented in ref. 1, are reproduced in Tables 1-3, respectively.
2. Data from tests designated as "failed" or from tests performed on tailings/native soil mixtures are excluded from the data base.
3. Mean and standard deviation values of (water content and dry density tests in the data base are then estimated for the tailings, offpile and buffer materials. It is assumed these mean test values are approximately equivalent to mean inplace values because tests were performed at an approximate frequency dictated by specifications in the project's Subcontract Documents. [The same remark also applies to the volumetric water content, θ].

...

(PROCEDURE CONTINUED ON P. A-20)...

MJG
7/26/89
UMTRA-GRA
5057-05
CKD. WOC 7/28/89

TAILINGS*

* All data compacted in-place.

SAMPLE #	w(%) / θ(%)	γd (pcf)	
MKE - 038	~~5.9~~	~~104.2~~	tailings mixture
- 039	~~3.3~~	~~104.9~~	" "
- 040	~~5.5~~	~~106.9~~	" "
- 041	2.9 / (4.8)	102.3	
- 042	4.4 / 7.0	99.4	
- 043	4.7 / 7.5	100.0	
- 044	3.7 / 5.8	97.1	
- 045	3.9 / 6.0	96.2	
- 046	2.8 / 4.4	97.8	
- 047	3.3 / 5.2	98.8	
- 048	3.0 / 4.9	102.0	
- 049	5.3 / 8.5	99.6	
- 050	3.9 / 6.3	101.2	
- 051	4.1 / 6.4	97.6	
- 052	3.4 / 5.4	98.8	
- 053	5.1 / 7.8	95.7	
- 054	6.3 / 9.7	96.3	
- 055	3.3 / 5.2	99.2	
- 056	3.3 / 5.2	99.1	
- 057	6.1 / 9.6	97.9	
- 058	3.2 / 5.0	97.0	
- 059	4.0 / 6.2	96.8	
- 060	3.7 / 5.8	98.1	
- 061	5.8 / 9.5	101.9	
- 062	5.4 / 8.9	103.1	
- 063	1.9 / 3.0	98.7	
- 064	6.7 / 10.5	98.1	
- 065	5.3 / 8.3	97.5	
- 066	4.1 / 6.5	98.4	
- 067	5.3 / 8.6	101.0	
- 068	6.7 / 11.2	104.4	
- 069	4.8 / 7.9	102.9	
- 070	3.9 / 6.2	99.5	
- 071	5.0 / 7.8	96.8	

TABLE 1
(adapted from ref 1)

TAILINGS

MJG
26 July 89
UMTRA-GRN
5057-05 CRS. WOC. 7/28/89

Sample #	In Place		
	Wt% / θ%	γ_d (pcf)	
MK-E-072	~~3.9~~	~~109.9~~	mixture
-073	3.9 / 6.1	97.9	
-074	4.2 / 6.4	95.2	
-075	5.9 / 9.3	98.7	
-076	5.2 / 8.2	98.7	
CM-M-142	4.6	—	
-143	3.1	—	
-144	3.4	—	
-145	5.7		
-146	3.8		
-147	6.7		
-148	5.0		
-149	3.8		
-150	6.9		
-151	4.8		
-152	2.5		
-153	2.0		
-154	3.5		
-155	3.7		
-156	3.6		
-157	3.2		
-158	3.8		
-159	3.3		
-160	4.0		
-161	6.0		
-162	4.3		
-163	3.9		
-164	4.2		
-165	4.3		
-166	2.7		
-167	5.2		
-168	8.0		
-169	6.3		
-170	5.0		
-171	4.5		

TABLE 1 (cont)
(adapted from ref 1)

TAILINGS

MJG
26 July 89
UMTRA GRN
5057-05
CKD: WDC 7/28/89

Sample #	w(%)
CM-M-172	3.1
-173	2.5
-174	4.0
-175	4.8
-176	4.6
-177	3.3
-178	7.4
-179	5.4
-180	4.1
-181	5.2
-182	3.4
-183	4.7
-184	4.1
-185	3.0
-186	2.6
-187	2.2
-188	2.6
-189	3.0
-190	2.4
-191	2.5
-192	2.5
-193	3.9
-194	4.0
-195	3.8
-196	4.1
-197	5.7
-198	6.6
-199	4.3
-200	3.9
-201	1.1
-202	3.9
-203	3.4
-204	3.0
-205	5.3
-206	3.2

Sample #	w(%)
CM-M-207	3.1
-208	3.3
-209	4.5
-210	4.9
-211	5.7
-212	5.1
-213	5.0
-214	6.9
-215	4.8
-216	3.5
-217	5.1
-218	5.6
-219	4.0
-220	3.9
-221	5.1
-222	4.4
-223	6.7
-224	4.4
-225	5.2
-226	5.5
-227	6.0
-228	5.3
-229	5.6
-230	8.0
-231	9.2
-232	7.4
-233	5.9
-234	6.9
-235	8.0
-236	5.5
-237	5.5
-238	4.0
-239	5.4
-240	5.6
-241	7.0

Sample #	w(%)	
CM-M-242	5.0	
-243	6.1	
-244	6.0	
-245	~~7.8~~	Fail
-245-R1	~~5.7~~	middle
-246	~~6.0~~	mix
-247	~~4.6~~	mix

~~θ~~ (summary)

$n = 35$

$\bar{x} = \underline{7.0}$

$\sigma_x = 1.91$

$V = \frac{\sigma}{\bar{x}} = 0.27$

TABLE 1 (cont)
(adapted from ref 1)

11 July 89
MJC
5057-05
UNITRA-GRN

OFFPILE

MJC
7/27/89
UNITRA-GRN
5057-05
CKD. WOC 7/28/89

Sample #	In-place w(%)/θ(%)	In-place γd (pcf)	
MKE -001	5.5 / 9.6	108.7	
-002	5.6 / 10.2	113.4	
-003	6.3 / 10.6	105.2	
-004	5.6 / 10.1	112.2	
-005	6.8 / 12.4	114.1	
-006	5.6 / 10.6	118.2	
-007	4.1 / 7.9	120 7	
-008	7.0 / 13.3	118.7	
-009	5.4 / 10.1	117.2	
-010	~~4.7~~	~~110.6~~	Failed
-010 R1	5.1 / 9.7	118.1	
-011	7.5 / 14.1	117.2	
-012	5.7 / 10.5	115.0	
-013	6.3 / 11.8	116.8	
-014	4.4 / 8.1	115.3	
-015	6.0 / 11.5	119.5	
-016	5.0 / 9.5	119.0	
-017	6.6 / 12.2	115.6	
-018	7.0 / 12.5	111.2	
-019	6.8 / 12.8	117.0	
-020	6.0 / 11.4	118.1	
-021	6.6 / 11.8	111.7	
-022	7.6 / 14.5	119.3	
-023	5.8 / 10.6	114.2	
-024	4.8 / 9.1	117.8	
-025	6.4 / 12.4	121.3	
-026	5.8 / 10.6	114.5	
-027	5.7 / 10.5	114.6	
-028	4.8 / 9.2	119.7	
-029	5.3 / 9.6	113.1	
-030	5.3 / 9.6	113.0	
-031	6.3 / 10.6	105.2	
-032	4.7 / 8.7	114.9	
-033	7.0 / 12.8	114.0	
-034	7.7 / 14.2	111.1	

TABLE 2
(adapted from Nº 1)

MJG
7/27/89
UMTRA-GRN
5057-05
CKD. [illegible] 7/28/89

Off pile

Sample #	In-Place W% / θ %	In-Place γ_d (pcf)	
MK-E-035	5.7 / 10.9	119.4	
-036	4.1 / 7.8	119.2	
-037	5.4 / 9.1	105.5	
-077	4.9 / 8.5	108.7	
-078	6.1 / 11.3	115.1	
-079	5.7 / 11.0	120.0	
CM-M-001	7.4		
-002	7.2		
-003	~~10.~~		FAIL
-004	5.4		
-005	~~4.4~~		FAIL
-006	6.3		
-007	~~10.2~~		FAIL
-008	7.7		
-005-R1	4.0		
-003-R1	6.7		
-009	~~8.0~~		FAIL
-009-R1	5.7		
-010	5.5		
-011	5.8		
-012	5.7		
-007-R1	6.2		
-013	5.5		
-014	7.3		
-015	7.0		
-016	7.7		
-017	5.9		
-018	5.4		
-019	5.6		
-020	6.5		
-021	6.2		
-022	5.9		
-023	5.8		
-024	5.1		
-025	5.3		

TABLE 2 (cont)
(adapted from ref 1)

OFFPILE

NJG
7/27/89
UMTRA-GRN
5057-05
CKD. WOC 7/28/89

SAMPLE #	INPLACE W (%)		SAMPLE #	INPLACE W (%)
CM-M 026	6.3		CM-M-059	6.7
-027	5.6		-060	6.7
-028	4.9		-061	5.9
-029	4.8		-062	6.1
-030	5.6		-063	5.5
-031	4.6		-064	6.3
-032	3.7		-065	5.5
-033	5.0		-066	4.8
-034	5.9		-067	4.0
-035	6.8		-068	5.2
-036	4.6		-069	6.0
-037	5.6		-070	7.6
-038	4.1		-071	6.0
-039	4.2		-072	4.8
-040	~~5.3~~	Fill	-073	4.3
-041	3.9		-074	7.0
-042	~~5.5~~	Fill	-075	5.8
-043	5.7		-076	5.9
-040-R1	4.2		-077	4.6
-042-R1	4.3		-078	5.8
-044	5.5		-079	6.0
-045	5.0		-080	7.1
-046	5.4		-081	6.5
-047	4.0		-082	5.7
-048	4.7		-083	6.7
-049	5.4		-084	4.7
-050	4.4		-085	6.5
-051	4.0		-086	6.0
-052	5.4		-087	6.7
-053	4.6		-088	6.3
-054	5.2		-089	6.4
-055	4.9		-090	6.1
-056	6.8		-091	5.7
-057	5.7		-092	5.9
-058	6.5		-093	6.2

TABLE 2 (cont) (adapted from ref 4)

OFFPILE

MJG
7/27/89
ULTRA-GRN
5057-05
CKD. WOC 7/28/89

SAMPLE #	Inplace W(%)	
CM-M-094	7.0	
-095	4.9	
-096	6.9	
-097	4.9	
-098	4.9	
-099	6.0	
-100	5.4	
-101	5.9	
-102	5.4	
-103	5.2	
-104	7.2	
-105	7.3	
-106	6.1	
-107	5.5	
-108	5.8	
-109	4.7	
-110	5.5	
-111	5.1	
-112	4.7	
-113	5.7	
-114	5.4	
-115	~~8.5~~	F
-116	~~10.4~~	F
-115-R1	5.5	
-116-R1	5.8	
-117	7.5	
-118	5.4	
-119	4.9	
-120	4.3	
-121	4.8	
-122	5.6	
-123	4.1	
-124	6.0	
-125	5.6	
-126	5.9	

Sample #	Inplace W%
CM-M-127	6.6
-128	6.5
-129	5.4
-130	4.2
-131	1.9
-132	3.6
-133	2.8
-134	2.8
-135	3.3
-136	4.4
-137	3.9
-138	3.5
-139	2.0
-140	5.1
-141	3.6
-248	5.3
-249	3.6
-250	7.8
-251	6.3
-252	4.2
-253	1.9
-254	3.6

Θ (summary)

$n = 40$

$\bar{X} = 10.8$

$\sigma_x = 1.70$

$V = \frac{\sigma_x}{\bar{x}} = 0.16$

TABLE 2 (cont) (adapted from ref 1)

Buffer Mat'l (i.e., Type A Special Fill)

MJG
7/27/89
UMTRA-GRN
5057-05
CKD. KWC 7/28/89

Test #	(data) γ_d (pcf)	(data) w (%)	(calculated) θ (%)	
SFA-S-004	118.9	5.1	9.72	
-005	120.0	6.7	12.86	
-006	122.2	4.7	9.20	
-007	123.0	4.6	9.07	
SFA-N-008 ↓ 061	see attached sheets			
SFA-S-062	~~116.4~~	~~6.0~~		Fail
-062-R1	117.5	6.0	11.30	
-062-R2	118.3	9.2	17.44	
-063	~~116.0~~	~~5.8~~		Fail
-063-R1	119.0	6.6	12.59	
-064	119.0	6.3	12.01	
-065	123.4	6.6	13.05	
-066	125.3	7.5	15.06	
-067	118.0	7.7	14.56	
-068	121.1	7.3	14.17	
-069	119.8	10.1	19.39	
-070	124.8	8.1	16.2	
-071	122.6	8.9	17.49	
-072	~~116.4~~	~~5.0~~		Fail
-072-R1	120.2	9.3	17.91	
-073	120.1	7.8	15.01	
-074	123.6	8.0	15.85	
-075	125.0	7.0	14.02	
-076	119.1	10.0	19.09	
-077	123.4	9.5	18.79	
-078	121.0	8.9	17.26	
-079	123.3	7.6	15.02	

TABLE 3

(adapted from ref 1)

MK-FERGUSON COMPANY

JOB: ~~[illegible]~~ GREEN RIVER

DATE: ~~3/[illegible]~~ ~~CONTRACT # 3050~~

GREEN RIVER, UTAH

[QUAL]ITY REQUIREMENTS BY SDM 3/30/89

QA ENTRY NO. 612

TEST SPECIFICATIONS: 02200 BELC. - 95% OF A D698
02200 BELC OPT. MOISTURE TO -4% OF OPT. MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE		% OF MAX. DRY DENSITY	PASS/FAIL
SFA-N-008	N59,450 E58,850 ELEV 4099 1ST 12" LEFT	SFA-4-001	SILTY SAND	124.9	8.7	130.2	121.3	7.3	14.19	SD 3-89 97.1 2	PASS
SFA-N-009	N59,330 E58,970 ELEV 4099 1ST 12" LEFT	SFA-4-001	SILTY SAND	124.9	8.7	124.7	119.1	4.8	9.16	95.4	PASS
* ** SFA-N-010	N 59,390 E 59,052 ELEV 4099 1ST 12" LEFT	SFA-4-004	SILTY SAND	(ONE-POINT) 127.8	SDM 3/[illegible]/89 10.1 ~~8.7~~	130.2	122.1	6.7	13.11	95.5	PASS
SFA-N-011	N59,482 E58,955 ELEV 4099 1ST 12" LEFT	SFA-4-004	SILTY SAND	127.8	10.1	129.7	122.3	6.1	11.96	95.7	PASS
SFA-N-012	N59,528 E58,891 ELEV 4100 2ND 12" LEFT	SFA-4-004	SILTY SAND	~~127.8~~	~~10.1~~	~~128.3~~	~~119.1~~	~~7.7~~		~~93.3~~	~~FAIL~~
(RETEST) SFA-N-012-R1	N59,528 E58,891 ELEV 4100 2ND 12" LEFT	SFA-4-004	SILTY SAND	127.8	10.1	132.7	121.7	9.0	12.55	SD 3-89 95.2	PASS
** SFA-N-013	N59,408 E58,890 ELEV 4100 2ND 12" LEFT	SFA-4-005	CLAYEY SILT	(FOUR POINT) 125.4	10.8	127.7	119.5	6.9	13.21	SD 3-89 95.3	PASS
SFA-N-014	N59,414 E59,058 ELEV 4100 2ND 12" LEFT	SFA-4-005	CLAYEY SILT	125.4	10.8	130.3	119.3	9.2	12.59	95.1 ~~97.0~~ SDM 3/[illegible]	PASS
SFA-N-015	N59,302 E59,012 ELEV 4100 2ND 12" LEFT	SFA-4-005	CLAYEY SILT	125.4	10.8	131.2	122.2	7.4	14.39	97.4	PASS

(TROXLER 3440 CG-50 5337 AM-471737)

TABLE 3 (cont) {adapted from ref 1}

MJG 7/8/89 Rev. No. 505-05-0 [illegible] 7/[illegible]

OPERATOR: [illegible signature]

REVIEWED BY: Steve Dike

COMMENTS: * SAND CONE CORRELATION CONDUCTED ** ONE-POINT OF FOUR POINT CONDUCTED

A-10

MK-FER[illegible] COMPANY

QC [illegible] REQUIREMENTS

BY: SDM 3/31/89

QA ENTRY NO. 651

/ ORIGINAL

CONTRACT # 3050

GREEN RIVER, UTAH

JOB: ~~3050~~ Green River

DATE: ~~3-30-89~~

TEST SPECIFICATIONS: 02200 Rev 2 -95% of A D698
02200 Rev C opt. moisture to -4% of opt. moisture

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	θ	% OF MAX. DRY DENSITY	PASS/FAIL
SFA-N-016	N59635 E58964 Elev. 4099	SFA-4-005	Clayey Silt	125.4	10.8	132.5	122.2	8.4	16.45	97.4	PASS
SFA-N-017	N59633 E59097 Elev. 4099	SFA-4-005	Clayey Silt	)	)	130.3	119.9	8.7	16.72	95.6	PASS
* ** SFA-N-018	N59500 E59111 Elev. 4099	SFA-4-005	|	)	)	131.9	121.5	8.6	16.75	96.9	PASS
SFA-N-019	N59475 E59212 Elev. 4099	SFA-4-005	|	)	)	131.7	120.5	9.3	17.96	96.1	PASS
SFA-N-020	N59585 E59135 Elev. 4099	SFA-4-005	Clayey Silt	125.4	10.8	131.1	119.4	9.8	18.75	95.2	PASS
SFA-N-021	N59355 E59050 Elev. 4101	SFA-4-005	Clayey Silt	125.4	10.8	131.2	120.7	8.7	16.83	96.3	PASS
SFA-N-022	N59360 E59125 Elev. 4101	SFA-4-005	Clayey Silt	125.4	10.8	130.5	119.7	9.0	17.26	95.5	PASS
** SFA-N-023	N59380 E58975 Elev. 4101	SFA-4-003	Silty Sand	123.9	10.0	132.3	120.8	9.5	18.39	97.5	PASS
SFA-N-024	N59450 E58960 Elev. 4101	SFA-4-003	Silty Sand	)	)	132.9	120.9	9.9	17.18	97.6	PASS
* ~~SFA-N-025~~	N59490 E58810 ~~Elev. 4101~~	SFA ~~4-003~~	Silty ~~Sand~~	~~123.9~~	~~10.0~~	~~134.4~~	~~121.4~~	(10.7)	20.82	98.0	FAIL
Troxler 3440		CS-50 50		5537	Am-47	11737					

TABLE 3 (cont) {adapted from ref 1}

UMTRA-GRN 505-05 Cal. dec. 7/20/89

MJG 7/27/89

OPERATOR: Steve Dike

REVIEWED BY: Steve Mat[illegible]

REMARKS: * Surface correction conducted ** One-point or four-point conducted

A-11

MK-FERGUSON COMPANY

ORIGINAL

CONTRACT # 3050
GREEN RIVER, UTAH

JOB: 3050 Green River   DATE: 3-31-89

QA ENTRY NO. 612

TEST SPECIFICATIONS: 02200 Bal Z - 95% of A D698
02200 Bal C opt. moisture to -4% of opt. moisture

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	Ø	% OF MAX. DRY DENSITY	PASS/ FAIL
SFA N-025-R1	N59490 E58810 Elev. 4101	SFA-4-003	Silty Sand	123.9	10.0	133.1	122.0	9.1	18.3A	98.5	PASS
SFA-N-026	N59637 E58963 Elev. 4100	SFA-4-003	Silty Sand	123.9	10.0	125.0	117.9	6.1	11.5	95.2	PASS
SFA-N-027	N59568 E59062 Elev. 4100	SFA-4-003	Silty Sand	123.9	10.0	133.4	122.6	8.8	17.29	99.0	PASS
SFA-N-028	N59160 E59160 Elev. 4100	SFA-4-003	Silty Sand	123.9	10.0	131.6	122.1	7.7	15.0	98.5	PASS
* SFA-N-029	N59470 E59258 Elev. 4100	SFA-4-003	Silty Sand	123.9	10.0	131.2	120.3	9.0	17.35	97.1	PASS

(TROXLER 5440 CS-505737 AM-4711737)

TABLE 3 (cont)

(adapted from ref 1)

7 Jan 89 UMTRA-GRN 5057-05 MJG

CES. WOC 7/25/89

OPERATOR: Steve Dike   REVIEWED BY: [signature]

COMMENTS: * A sandcone correlation and a one-point conducted. (See SFA-C-0016)

MK-FERGUSON COMPANY

ORIGINAL

QUALITY REQUIREMENTS

BY SDM 4/3/89

QA ENTRY NO. 6-11

JOB: ~~3050~~ Green River

DATE: ~~3/31/89~~ ~~CONTRACT # 3050~~

GREEN RIVER, UTAH

TEST SPECIFICATIONS: 02200 3.12 - 95% of D 698

02200 3.12 OPT. MOISTURE TO -4% OF OPT. MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	Ø	% OF MAX. DRY DENSITY	PASS/FAIL
SFA-N-030	N 59,560 E 59,180 @ ELEV 4100	SFA-4 -003	SILTY SAND	123.9	10.0	129.7	119.5	8.5	16.28	96.4	PASS
SFA-N-031	N 59,696 E 59,065 @ ELEV 4100	SFA-4 -003	SILTY SAND	123.9	10.0	128.1	118.2	8.4	15.91	95.4	PASS
SFA-N-032	N 59,444 E 58,830 @ ELEV 4102	SFA-4 -003	SILTY SAND	123.9	10.0	132.4	121.7	8.8	12.16	98.2	PASS
SFA-N-033	N 59,365 E 58,918 @ ELEV 4102	SFA-4 -003	SILTY SAND	123.9	10.0	130.8	120.7	8.4	16.25	97.4	PASS
SFA-N-034	N 59,270 E 59,080 @ ELEV 4102	SFA-4 -005	CLAYEY SILT	125.4	10.8	129.4	120.4	7.5	14.47	96.0	PASS
SFA-N-035	N 59,505 E 58,782 @ ELEV 4102	SFA-4 -005	CLAYEY SILT	125.4	10.8	132.1	122.3	8.0	15.68	97.5	PASS
SFA-N-036	N 59,374 E 59,038 @ ELEV 4102	SFA-4 -005	CLAYEY SILT	125.4	10.8	133.2	122.3	8.9	17.14	97.5	PASS

(TROXLER 3440 CS-50 5337 AM 471173)

CEQ. MOC. 7/27/89

7/27/89 UMTRA-GRN 5057-05

MJG

TABLE 3 (cont)

(adapted from ref 1)

OPERATOR: [illegible] SIEVE. OPT.

REVIEWED BY: [illegible]

COMMENTS: #1 SAND CONE CORRELATION AND A ONE POINT PROCTOR (SFT SFA-C-001)

1-W

H.H. & D.M.

[illegible] COMPANY

ORIGINAL

CONTRACT # 3050

GREEN RIVER, UTAH

JOB: TEST - GREEN RIVER

DATE: ~~4/1/87~~

REVIEWED FOR QUALITY REQUIREMENTS BY: SDM 4/4/87

QA ENTRY NO. 662

TEST SPECIFICATIONS: 95% of A. [illegible] 02200 REV 2, 02200 REV C. OPT. MOISTURE TO ±1% OF OPTIMUM MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	% OF MAX. DRY DENSITY	PASS/FAIL
~~SFA-N-037~~	N59635 E58990 Elev. 4101	SFA-4-006	Silty Sand	** ~~118.2~~	~~12.3~~	~~116.0~~	~~109.5~~	~~5.9~~	~~92.6~~	FAIL
SFA-N-038	N59640 E59100 Elev. 4101			~~118.2~~	~~12.3~~	~~115.1~~	~~109.6~~	~~5.0~~	~~92.7~~	~~FAIL~~
* SFA-N-039	N59515 E59100 Elev. 4101			118.2	12.3	132.2	118.0	12.0	99.8	PASS
SFA-N-037-R1	N59635 E58990 Elev. 4101			~~118.2~~	~~12.3~~	~~122.9~~	109.4 ~~113.2~~	~~8.6~~	92.6 ~~95.8~~	FAIL ~~PASS~~
SFA-N-038R1	N59640 E59100 Elev. 4101			~~118.2~~	~~12.3~~	~~126.7~~	112.2 ~~116.1~~	~~9.1~~	94.9 ~~98.2~~	FAIL ~~PASS~~
SFA-N-040	N59545 E59215 Elev. 4101			~~118.2~~	~~12.3~~	~~122.2~~	109.2 ~~113.0~~	~~8.7~~	92.4 ~~95.6~~	FAIL ~~PASS~~
SFA-N-041	N59255 E59030 Elev. 4103	SFA-4-006	Silty Sand	~~118.2~~	~~12.3~~	~~124.5~~	110.2 ~~114.0~~	~~9.2~~	93.2 ~~96.4~~	FAIL ~~PASS~~
* SFA-N-042	N59320 E58965 Elev. 4103	SFA-4-007	Silty Sand	** ~~117.2~~	~~11.7~~	~~126.7~~	110.1 ~~113.4~~	~~11.2~~	93.9 ~~97.2~~	FAIL ~~PASS~~

SEE SAND CONE CORRELATION SFA-C-001. TEST NUMBERS SFA-N-037-R1, SFA-N-038-R1, SFA-N-040, SFA-N-041 AND SFA-N-042 WERE RETESTED ON 4/4/89. SEE DENSE [illegible] FOR SAND CONE CORRELATION SFA-C-002. (SEE SFA-DE-009)

TABLE 3 (cont) {adapted from ref 1}

5057-05 [illegible] 7/89

JH 4/7/89 UMTRA GR.

OPERATOR: Steve Dike

REVIEWED BY: [illegible]

COMMENTS: * [illegible] sand cone correlation conducted [illegible]

MK-FERGUSON COMPANY

ORIGINAL
~~CONTRACT # 3050~~
GREEN RIVER, UTAH

QA [illegible] FOR QUALITY REQUIREMENTS BY SDM 4/4/87
QA ENTRY NO. 662

JOB: ~~3050~~ GREEN RIVER

DATE: 4/2/87

TEST SPECIFICATIONS: 02200 REV 2 – 75% OF T 0698
02200 REV 2 OPT. MOISTURE TO –4% OF OPT. MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	Ø	% OF MAX. DRY DENSITY	PASS/ FAIL
SFA-N-043	N59460 E59040 Elev. 4103	SFA-4 -007	SILTY SAND	117.2	11.7	122.3	112.4	8.8	15.85	95.9	PASS
SFA-N-044	N59,815 E58,850 @ ELEV 4103	SFA-4 -007	SILTY SAND	117.2	11.7	124.0	114.1	8.7	15.91	97.4	PASS
SFA-N-045	N59,430 E58,930 @ ELEV 4103	SFA-4 -007	SILTY SAND	117.2	11.7	123.5	112.8	9.5	17.17	96.2	PASS
SFA-N-046	N59,620 E58,965 @ ELEV 4102	SFA-4 -007	SILTY SAND	117.2	11.7	125.1	115.0 (SD 4/9/87)	8.7	16.05	98.2 (SD 4/9)	PASS
* SFA-N-047	N59,440 E59,195 @ ELEV 4102	SFA-4 -007	SILTY SAND	117.2	11.7	126.1	113.7 (SD 4/9)	10.9	19.86	97.0 (SD 4/9) ~~96.9~~	PASS
(TROXLER 3440 AM-4711727 CS-50 5337)											

TABLE 3 (cont.)

(adapted from ref 1)

UMTRA-GRN 5057-05 GEO.NOC 7/28/89

MJG 7/27/89

OPERATOR: Steve Dike

REVIEWED BY: [illegible signature]

COMMENTS: * A SAND CONE [illegible]

7-15

F.H.

[illegible]-FERGUSON COMPANY

JOB: ~~3050~~ ~~Green~~ River

DATE: ~~4-4-89~~ ~~CONTRACT # 3050~~

ORIGINAL

GREEN RIVER, UTAH

QA [illegible] REQUIREMENTS BY Som 4/5/07

QA ENTRY NO. 624

TEST SPECIFICATIONS: 02200 [illegible] - 95% of A D698
02200 [illegible] OPT. MOISTURE TO -4% OF OPT. MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE		% OF MAX. DRY DENSITY	PASS/ FAIL
SFA N-037-R2	N59635 E58990 Elev. 4101	SFA-4-006	Silty Sand	118.2	12.3	128.9	118.1	9.2	12.41	99.9	PASS
SFA N-038-R2	N59640 E59100 Elev. 4101					124.8	113.0	10.4	18.81	95.6	PASS
SFA N-040 R1	N59515 E59215 Elev. 4101					128.9	116.9	10.3	19.3	98.9	PASS
SFA N-041-R1	N59265 E59050 Elev. 4103					123.9	113.6	9.1	16.57	96.1	PASS
* SFA N 042-R1	N59320 E58765 Elev. 4103	SFA-4-006	Silty Sand	~~118.2~~ 117.2	~~12.3~~ 11.7	125.9	~~114.34~~ 114.49	10.1	18.58	~~96.6~~ 97.6	PASS
SFA-N-048	N59503 E59255 Elev. 4102	SFA-4-007	Silty Sand	117.2	11.7	124.9	115.2	8.4	15.51	98.3	PASS
SFA-N-049	N59565 E59060 Elev. 4102					126.8	116.3	9.0	16.77	99.2	PASS
SFA N-050	N59590 E58980 Elev. 4103					127.8	116.9	9.3	17.42	99.7	PASS
SFA-N-051	N59430 E58860 Elev. 4104	SFA-4-007	Silty Sand	117.2	11.7	126.7	116.2	9.0	16.76	99.1	PASS
* SFA-N-052	N59535 E58930 Elev. 4104	SFA-4-002	Silty Sand	** 119.2	10.8	130.1	119.9	8.5	16.33	100.6	PASS

** - MAX [illegible] SAME ORIGINAL CURVE [illegible] ALL [illegible]

TABLE 3 (cont)

UMTRA-GRW 5.0.5.1-0 [illegible]

OPERATOR: Steve Dike

REVIEWED BY: Steve [illegible]

REMARKS: * A sandcone correlation was conducted ** A one point or four point was conducted

16

PK-FENIX COMPANY

JOB: ~~3050~~ Green River DATE: ~~4-4-89~~ CONTRACT # 3050

ORIGINAL

GREEN RIVER, UTAH

REVIEWED FOR QUALITY REQUIREMENTS BY Sam 4/5/89 QA ENTRY NO. 625

TEST SPECIFICATIONS: ASTM D698 - 95% OF ASTM D698 OPTIMUM MOISTURE TO -4% OF OPT. MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE	% OF MAX. DRY DENSITY	PASS/ FAIL
STA 11-053	N59675 E59080 Elev. 4103	STA-1-002	Silty Sand	119.2	10.8	122.8	114.2	7.5	95.8	PASS
STA 11-054	N59380 E59020 Elev. 4104	〃	〃	〃	〃	126.6	115.4	9.7	96.8	PASS
STA-N-055	N69350 E59140 Elev. 4104	〃	〃	〃	〃	126.8	115.9	9.4	97.2	PASS
STA-N-056	N59990 E59155 Elev. 4103	STA-1-002	Silty Sand	119.2	10.8	127.2	117.5	8.3	98.6	PASS
(TEDX LEE 3440		CS-50		5.33		AN-47 (1737)				
				TABLE 3 (Cont)						
				(adapted from ref 1)						

UNTRATGRN 5057-05 Cert. Mod 7/19/89

MJG 7/21/89

OPERATION: Steel Dike REVIEWED BY: Stan Mark

MK-FER[redacted] COMPANY

ORIGINAL

REVIEWED FOR ... QUALITY REQUIREMENTS BY Sbm 4/6/89 QA ENTRY NO. 692

JOB: ~~3050~~ Green River   DATE: ~~4-5-89~~ ~~CONTRACT # 3050~~
GREEN RIVER, UTAH

TEST SPECIFICATIONS: 02200-[illegible] 95% OF A D698
02200 - [illegible] OPT MOISTURE TO -4% OF OPT MOISTURE

TEST NO.	LOCATION	CURVE ENTRY NO.	TYPE OF MATERIAL	MAX. DRY DENSITY	OPTIMUM MOISTURE	WET DENSITY	DRY DENSITY	PERCENT MOISTURE		% OF MAX. DRY DENSITY	PASS/FAIL
* SFA H-057	N59570 E59175 Elev. 4103	SFA-4-C02	Silty Sand	119.2	10.8	127.9	117.1	9.2	12.26	98.~~6~~ 2 Sbm 4/5/89	PASS
SFA H-058	N59500 E59280 Elev. 4104	)	)	)	)	124.5	116.~~8~~ 4	7.0	13.06	97.7	PASS
SFA H-059	N59460 E59115 Elev. 4104	)	)	)	)	126.0	115.9	8.7	16.16	97.2	PASS
SFA H-060	N59610 E59115 Elev. 4104	)	)	)	)	123.5	114.5	7.9	14.5	96.~~0~~ 6 Sbm 4/5/89	PASS
* SFA-H-061	N59620 E58980 Elev. 4104	SFA-4-C02	Silty Sand	119.2	10.8	122.5	114.4	7.1	13.02	96.0	PASS

(TROXLER 3440 CS-50 5337 AM-471737)

TABLE 3 (cont)

(adapted from ref 1)

UMTRA-GRN 5057-05 Geo. Hoc 7/31/89

MJC 7/31/89

OPERATOR: Steve Dike   REVIEWED BY: [signature]

COMMENTS: * A sandcone correlation was conducted.

INPLACE BUFFER (summary)

77 data pts (see sheets A-9 through A-18)

	γ_d (pcf)	W (%)	ϕ (decimal)
$\bar{x}$	119.2	8.3	15.8
σ	3.18	1.43	2.64
$J = \sigma/\bar{x}$	0.027	0.173	0.167

TABLE 3 (cont)

Procedure (cont)

4. Calculate θ for each (w, γ_d) data pair for each material type using the following formula:

$$\theta = w \frac{\gamma_d}{\gamma_w}$$

where $\gamma_w = 62.4$ pcf.

5. The mean value (and the standard deviation) of θ for each of the materials is calculated from the individual θ's in the data base (see step 4, above).

RESULTS

Mean values of w, γ_d and θ for the tailings, offpile and buffer materials are presented in Table 4.

Standard deviation, σ, and coefficient of variation, $V = \sigma/\text{mean}$ of θ for the above materials are presented in Table 5.

Mean values and standard deviations of the water content data sets used to estimate w and θ are presented in Table 6.

MAT'L TYPE	$\bar{w}$ (%)	$\bar{\gamma}_d$ (pcf)	$\bar{\theta}$ (%)	
			Method ① 1	Method ② 2
Tailings	4.56	98.96	7.0	7.2
Offpile	5.52	115.19	10.8	10.2
Buffer	8.30	119.2	15.8	15.9

NOTES

① $\bar{\theta}$ estimated as mean value of individual θ values, i.e.,

$$\bar{\theta} = \frac{1}{n\gamma_w} \sum_{i=1}^{n} w_i \gamma_{d_i}$$

where: (w_i, γ_{d_i}) are (water content, dry density) measurements on one test specimen;
n = number of (w_i, γ_{d_i}) pairs

② $\bar{\theta}$ estimated from mean w and γ_d values, i.e.,

$$\bar{\theta} = \frac{1}{\gamma_w}(\bar{w})(\bar{\gamma}_d)$$

where $\bar{w}$ and $\bar{\gamma}_d$ are the mean values of w and γ_d on test specimens for which both w and γ_d data are available

TABLE 4

MATL TYPE	θ (%)[1]		
	Mean	σ	V[2]
Tailings	7.0	1.91	0.27
Offpile	10.8	1.70	0.16
Buffer	15.8	2.64	0.17

NOTES

(1) See data summaries, Tables 1-3.

(2) $V = \sigma / \text{mean}$

TABLE 5

Complete Data Set

Mat'l	# Data Points	Grav. Water Content	
		Mean	σ
Tailings	138	4.56	1.43
Offpile	188	5.52	1.13

Table 6a

Subset Used To Estimate θ

Mat'l	# Data Points	Grav. Water Content	
		Mean	σ
Tailings	35	4.41	1.19
Offpile	40	5.05	0.91

Table 6b

DISCUSSION

1. The mean values of ~~δ~~ estimated herein are not significantly different than would be estimated using mean values of W and γ_d (see Table 4)

2. Although fewer γ_d tests were performed than W tests, based on a comparison of the mean value and standard deviation of all water contents measured and of the mean and standard deviation of water contents for which γ_d data are also available (see Table 6), it can be seen that compacted water content (and presumably γ_d) of the data set used to estimate ~~δ~~ is not significantly different than compacted water content (and γ_d) of the complete data set.

SUPPLEMENT

PURPOSE

Determine the mean values of optimum water content (OMC) and maximum dry density (γ_{dmax}) based on ASTM D-698 of compaction tests used to control compaction of tailings, offpile and buffer materials.

Procedure

1. OMC and γ_{dmax} test data from ref. 1 are reproduced in Tables 7-9.
2. Mean values of OMC and γ_{dmax} are calculated using coventional formulae. Results are presented in Table 10.

Discussion

1. Mean OMC and γ_{dmax} values of offpile materials are similar to those of the buffer materials. This corroborates that the buffer material is composed of the same materials as the offpile materials.

MJG
5057-05
12 July 89
UMTRA-GRN
CKJ. WOC 7/20/89

TAILINGS

CONTROL CURVE	D-698 * OMC (%)	D-698 * γ_{dmax} (pcf)	
CM4-001	18.2	97.6	
no-number	14.9	103.6	
CM4-002	16.5	99.5	
CM4-024	14.8	103.0	
CM-4-025	14.1	105.1	
CM-4-026	14.0	104.	
CM-4-027	13.9	103..	
CM-4-028	15.8	99.6	
CM-4-029	15.2	102.3	
CM-4-032	~~13.5~~	~~107.3~~	← 95% tailings (not included in avg
CM-4-033	13.5	104.4	
CM-4-034	13.8	103.5	
CM-4-035	14.5	102.0	
CM-4-036	13.1	107.6	
CM-4-037	15.0	101.0	
CM-4-038	15.0	102.3	
CM-4-039	13.7	104.2	
CM-4-040	14.8	103.1	
CM-4-041	13.8	101.2	
CM-4-042	~~13.3~~	~~110.~~	← (unknown amount of instrument do not include in avg.
CM-4-043	~~12.7~~	~~115.6~~	
CM-4-044	~~9.1~~	~~123.0~~	
n =	18	18	does not include tailings mixed w/ other mat'l.
$\bar{x}$ =	14.70	102.7	
σ_x =	1.22	2.34	
$V = \sigma/\bar{x}$ =	0.083	0.023	

* 4-pt compaction tests

TABLE 7

Tabulated from ref 1)

MJG
5057-05
12 July 89
UMTRA-GRN
cco. WOC 7/28/89

Offpile

Control Curve	D-698 *	
	OMC (%)	$\gamma_{d\,max}$ (pcf)
CM-4-004	10.8	124.4
CM-4-003	10.3	127.7
CM-4-005	9.7	126.8
CM-4-006	13.1	118.8
CM-4-007	10.9	125.7
CM-4-008	10.9	120.6
CM-4-009	10.9	124.7
CM-4-010	10.7	124.2
CM-4-011	10.2	125.2
CM-4-012	10.0	124.7
CM-4-013	10.0	125.6
CM-4-014	12.5	112.8
CM-4-015	15.4	105.8
CM-4-016	12.0	119.3
CM-4-017	11.7	117.7
CM-4-018	10.8	121.7
CM-4-019	13.2	111.2
CM-4-020	11.9	116.5
CM-4-021	7.9	130.9
CM-4-022	10.6	123.4
CM-4-023	12.3	114.8
CM-4-030	10.9	123.0
CM-4-031	12.2	116.1
n =	23	23
$\bar{X}$ =	11.26	120.94
σ_x =	1.50	6.00
$V = \sigma/\bar{X}$ =	0.133	0.050

* 4-pt compaction tests

TABLE 8

(adapted from ref 1)

TYPE A SELECT FILL (BUFFER)

CONTROL CURVE	D-698 *	
	γ_d max (pcf)	OMC (%)
SFA-N-001	124.9	8.7
SFA-N-010	127.8	10.1
SFA-N-013	125.4	10.8
SFA-N-023	123.9	10.0
SFA-N-037	118.2	12.3
SFA-N-043	117.2	11.7
SFA-N-052	119.2	10.8
Mean	122.4	10.6
Std. dev.	4.1	1.2

* Data taken from field density tests; compaction test data are not available in ref. 1.

TABLE 9

(adapted from ref 1)

MATERIAL	MEAN * D-698 Compaction Variables	
	γ_d max (pcf)	OMC (%)
Tailings	102.7	14.7
Offpile	120.9	11.3
Buffer	122.4	10.6

* based on data in Tables 7-9.

TABLE 10