0013

CONSULTANTS / ENGINEERS
VAUGHN HANSEN ASSOCIATES
WATERBURY PLAZA - SUITE A
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SALT LAKE CITY, UTAH 84121
(801) 272-5263

February 21, 1980

Mr. Robert Eccli
Mine Engineer
United States Fuel Company
Hiawatha, Utah 84527

Dear Mr. Eccli:

This letter is in response to OSM comments on the hydrology report we submitted to U.S. Fuels in August, 1978.

OSM stated that the method used for computing flood peak flows was inadequate in this case. They recommended incorporating the use of a synthetic hydrograph. We acknowledge that the method recommended by them is more theoretically correct. As they pointed out in their letter, the peak flow values computed in the initial report vary according to the duration of storm used. Consequently, the accuracy of the method is dependent on the storm duration selected. We have used the procedure recommended by OSM at Hiawatha as a check on the method previously used. In about 80 percent of the cases tested, the flows we computed initially are as large or larger than those computed using the synthetic hydrograph method for a 50-year, 6-hour storm suggested by OSM. Of the 20 percent where flows with the synthetic hydrograph were higher than those submitted in the initial report, each culvert is adequate to pass the flows computed by either method. We feel that this indicates a general conservatism in the initial report and consequently believe that its use, although generally conservative in this case because of the storm duration selected, is adequate for reasonable culvert design. For your information, the results of using the synthetic hydrograph method recommended by OSM have been included (Enclosures No. 1 and No. 2).

Trash racks should be installed at the entrance to culverts No 24 and No. 25 in the Middle Fork Yard, and at the proposed 36-inch culvert underneath the sedimentation pond in the South Fork Yard. These trash racks should have inclined trash bars spaced at approximately one-half to one-third the culvert diameter. The rack should not be placed tightly over the culvert entrance, but should be inclined at about 60 degrees from vertical. This arrangement will help prevent plugging of the rack

as debris will tend to slide up the rack and accumulate at the top of the rack. The bars should be sturdy enough so that horizontal bracing is unnecessary except at the top and bottom edge of the rack. The rack should be anchored securely in place.

The Middle Fork Yard sedimentation pond will be built over a 36-inch culvert (culvert No. 25). This culvert has a capacity of 32 cubic feet per second with no water back-up and will safely pass the 50-year, 6-hour flood flow of 28.8 cubic feet per second as computed using the synthetic hydrograph method (see Enclosure No. 2).

The flood in Miller Creek adjacent to the Upper Coal Storage Yard caused by the 25-year, 6-hour precipitation event has been calculated using a synthetic hydrograph approach (Enclosure No. 3). Hydraulic calculations, based on the Mannings Equation and an actual field survey of Miller Creek adjacent to the sedimentation pond, indicate that Miller Creek will be approximately 4.3 feet deep during such a flood. The adjacent sedimentation pond is nearly 20 feet above this flood stage and is protected by well-vegetated streambanks (Enclosure No. 3). Consequently, the sedimentation pond and its side slopes will be stable when Miller Creek is flowing at a discharge equal to or less than the runoff resulting from the 25-year, 6-hour precipitation event.

The plans for the sedimentation pond near the South Fork Yard show a 36-inch corrugated metal pipe conveying the natural stream flow under the pond. Enclosure No. 4 shows that the runoff peak caused by the 50-year, 6-hour precipitation event calculated using the synthetic hydrograph method is approximately 55 cubic feet per second. This flow will pass through the 36-inch culvert with water backing up 2.1 feet above the top of the culvert (inlet control governs). Enclosure No. 5 shows how the surface drainage will be diverted into the proposed sedimentation pond. The drainage will require an additional culvert underneath the road. I have called this culvert No. 36. Flow calculations are included in Enclosures No. 1 and No. 2. A 15-inch corrugated metal pipe laid at a 2 percent slope will pass the flood caused by a 50-year, 6-hour storm.

The above information should answer the questions raised by OSM. For your information, I have enclosed a table indicating the adequacy of the original 35 culverts in passing flows calculated using the synthetic hydrograph method (Enclosure No. 6). As mentioned previously, these flows are generally smaller than those submitted earlier. If we can be of any further assistance, please feel free to call me.

Sincerely,

D. George Chadwick Jr.

D. George Chadwick, Jr.

DGC:lg

Enclosures: 6

10-yr, 24-hr storm runoff

Culvert No.	A	CN	ℓ	Y	Computed T_p	Hydro. Form. No.	P	Q	T_0	T_0/T_p Computed	T_0/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
1	0.239	85	5570	27.8	0.24	3	2.25	0.98	14.7	61.2	50	0.29	390.9	38.0
2	0.228	85	4870	29.1	0.21	3	2.25	0.98	14.7	70.0	75	0.20	540.7	36.1
3	—	—	TO BE DIRECTLY CONNECTED TO CULVERT NO. 4											—
4	0.384	75	7680	39.9	0.35	4	2.25	0.51	12.5	35.7	36	0.35	270.8	18.2
5	0.383	75	7530	40.1	0.34	4	2.25	0.51	12.5	36.8	36	0.35	270.1	18.2
6	0.381	75	7370	40.3	0.34	4	2.25	0.51	12.5	36.8	36	0.35	268.7	18.1
7	0.380	75	7230	40.4	0.33	4	2.25	0.51	12.5	37.9	36	0.35	268.0	18.0
8	0.083	76	3710	32.4	0.21	4	2.25	0.55	12.6	60.0	50	0.25	88.4	4.1
9	0.106	90	4260	13.5	0.23	2	2.25	1.31	17.1	74.3	75	0.23	292.2	23.1
10	0.108	90	4290	13.3	0.23	2	2.25	1.31	17.1	74.3	75	0.23	297.7	23.5
11	0.109	90	4860	13.8	0.25	2	2.25	1.31	17.1	68.4	75	0.23	300.5	23.7
12	0.175	90	4540	35.9	0.21	2	2.25	1.31	17.1	81.4	75	0.23	482.4	38.1

Notes

A = area (mi^2)
CN = runoff curve number
ℓ = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
$= 1.17L$

L = watershed lag (hr)
$= \frac{(\ell^{0.8})(S+1)^{0.7}}{1900\, Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip. depth (in)

Q = runoff volume (in)
T_0 = duration of excess rainfall (hr)
q = peak flow (cfs)

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS
BY RBW (a DSC for Culvert #36) DATE 23 Jan 80 CHECKED BY ____ DATE ____
JOB NO. ____ FILE NO. ____
SHEET 1 OF 3

ENCLOSURE #1

10-yr, 24-hr storm runoff

Culvert No.	A	CN	l	Y	Computed T_p	Hydro. Fam. No.	P	Q	T_o	T_o/T_p Computed	T_o/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
13	3.29	75	18,330	54.6	0.60	4	2.25	0.51	12.5	20.8	25	0.50	1624.2	149.4
14	3.32	75	18,930	54.2	0.62	4	2.25	0.51	12.5	20.2	16	0.78	1050.7	134.5
15	13.76	75	30,240	50.9	0.93	4	2.25	0.51	12.5	13.4	16	0.78	4354.5	557.4
16	1.80	75	12,670	65.2	0.41	4	2.25	0.51	12.5	30.5	25	0.50	888.6	81.8
17	5.60	75	23,510	42.0	0.83	4	2.25	0.51	12.5	15.1	16	0.78	1772.2	226.8
18	3.94	70	16,340	33.4	0.80	4	2.25	0.34	12.3	15.4	16	0.77	842.0	107.8
19	0.008	85	1,200	80.5	0.04	3	2.25	0.98	14.7	367.5	75	0.20	19.0	1.3
20	0.010	85	1,400	49.0	0.06	3	2.25	0.98	14.7	245.0	75	0.20	23.7	1.6
21	0.001	90	610	0.5	0.25	2	2.25	1.31	17.1	68.4	75	0.23	2.8	0.2
22	9.13	75	25,800	51.8	0.81	4	2.25	0.51	12.5	15.4	16	0.78	2889.3	369.8
23	0.022	90	1,650	19.5	0.09	2	2.25	1.31	17.1	190.0	75	0.23	60.6	4.8
24	0.241	70	4,480	58.6	0.22	4	2.25	0.34	12.3	55.9	50	0.25	158.6	7.4

Notes

A = area (mi^2)
CN = runoff curve number
l = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
= 1.17 L

L = watershed lag (hr)
$= \frac{(l^{0.8})(S+1)^{0.7}}{1900\,Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip. depth (in)

Q = runoff volume (in)
T_o = duration of excess rainfall (hr)
q = peak flow (cfs)

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS
SHEET 2 OF 3
JOB NO.
FILE NO.
BY RBW
DATE 23 Jan 80
CHECKED BY
DATE

10-yr, 24-hr storm runoff

Culvert No.	A	CN	l	Y	Computed T_p	Hydro. Form. No.	P	Q	T_0	T_0/T_p Computed	T_0/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
25	0.534	70	4980	58.6	0.23	4	2.25	0.34	12.3	53.5	50	0.25	351.5	16.3
26	0.806	70	7570	44.0	0.38	4	2.25	0.34	12.3	32.4	36	0.34	390.1	26.2
27	0.077	75	3300	35.6	0.19	4	2.25	0.51	12.5	65.8	50	0.25	76.0	3.5
28	0.036	75	2100	46.4	0.11	4	2.25	0.51	12.5	113.6	50	0.25	35.5	1.6
29	1.94	75	13,950	54.5	0.48	4	2.25	0.51	12.5	26.0	25	0.50	957.7	88.1
30	0.364	75	2100	75.9	0.09	4	2.25	0.51	12.5	138.9	50	0.25	359.4	16.7
31	0.050	75	2100	54.6	0.11	4	2.25	0.51	12.5	113.6	50	0.25	49.4	2.3
32	0.031	75	1600	65.4	0.08	4	2.25	0.51	12.5	156.2	50	0.25	30.6	1.4
33	0.156	75	3700	65.0	0.15	4	2.25	0.51	12.5	83.3	50	0.25	154.0	7.1
34	0.684	75	8770	35.7	0.41	4	2.25	0.51	12.5	30.2	25	0.50	337.7	31.1
35	0.238	85	5370	28.0	0.23	3	2.25	0.98	14.7	63.9	75	0.20	564.4	37.6
36	0.060	70	2700	61.2	0.12	4	2.25	0.34	12.3	102.5	50	0.25	39.5	1.8

Notes

A = area (mi^2)
CN = runoff curve number
l = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
$T_p = 1.17L$

L = watershed lag (hr)
$= \frac{(l^{0.8})(S+1)^{0.7}}{1900\,Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip. depth (in)

Q = runoff volume (in)
T_0 = duration of excess rainfall (hr)
q = peak flow (cfs)

BY RBW DATE 23 Jan 80 CHECKED BY ____ DATE ____

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS FILE NO. ____ JOB NO. ____

SHEET 3 OF 3

50-yr, 6-hr storm runoff

Culvert NO.	A	CN	l	Y	Computed T_p	Hydro. Fam. No.	P	Q	T_o	T_o/T_p Computed	T_o/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
1	0.239	85	5570	27.8	0.24	3	1.89	0.72	4.2	17.5	16	0.26	320.3	73.7
2	0.228	85	4870	29.1	0.21	3	1.89	0.72	4.2	20.0	16	0.26	305.6	70.3
3	TO BE DIRECTLY CONNECTED TO CULVERT NO. 4													
4	0.384	75	7680	39.9	0.35	4	1.89	0.33	3.8	10.9	10	0.38	161.4	28.6
5	0.383	75	7530	40.1	0.34	4	1.89	0.33	3.8	11.2	10	0.38	161.0	28.5
6	0.381	75	7370	40.3	0.34	4	1.89	0.33	3.8	11.2	10	0.38	160.1	28.3
7	0.380	75	7230	40.4	0.33	4	1.89	0.33	3.8	11.5	10	0.38	159.7	28.3
8	0.083	76	3710	32.4	0.21	4	1.89	0.36	3.9	18.6	16	0.24	60.3	7.7
9	0.106	90	4260	13.5	0.23	3	1.89	1.00	4.7	20.4	16	0.29	176.9	40.7
10	0.108	90	4290	13.3	0.23	3	1.89	1.00	4.7	20.4	16	0.29	180.2	41.4
11	0.109	90	4860	13.8	0.25	3	1.89	1.00	4.7	18.8	16	0.29	181.9	41.8
12	0.175	90	4540	35.9	0.21	3	1.89	1.00	4.7	22.4	25	0.19	445.8	77.1

Notes

A = area (mi^2)
CN = runoff curve number
l = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
$= 1.17L$

L = watershed lag (hr)
$= \frac{(l^{0.8})(S+1)^{0.7}}{1900\,Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip depth (in)

Q = runoff volume (in)
T_o = duration of excess rainfall (hr)
q = peak flow (cfs)

BY Pitzl/Le DGCR: Culvert #36 DATE 23 Jan 80 CHECKED BY ____ DATE ____

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS FILE NO. ____ JOB NO. ____

SHEET 1 OF 3

CLOSURE #2

50-yr, 6-hr storm runoff

Culvert No.	A	CN	ℓ	Y	Computed T_p	Hydro. Fam. No.	P	Q	T_o	T_o/T_p Computed	T_o/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
13	3.29	75	18,330	54.6	0.60	4	1.89	0.33	3.8	6.3	6	0.63	834.1	208.5
14	3.32	75	18,930	54.2	0.62	4	1.89	0.33	3.8	6.1	6	0.63	841.7	210.4
15	13.76	75	30,240	50.9	0.93	4	1.89	0.33	3.8	4.1	4	0.95	2313.4	786.6
16	1.80	75	12,670	65.2	0.41	4	1.89	0.33	3.8	9.3	10	0.38	756.6	133.9
17	5.60	75	23,510	42.0	0.83	4	1.89	0.33	3.8	4.6	4	0.95	941.5	320.1
18	3.94	70	16,340	33.4	0.80	4	1.89	0.20	3.7	4.6	4	0.92	414.6	140.9
19	0.008	85	1,200	80.5	0.04	3	1.89	0.72	4.2	105.0	75	0.06	46.5	3.1
20	0.010	85	1,400	49.0	0.06	3	1.89	0.72	4.2	70	75	0.06	58.1	3.9
21	0.001	90	610	0.5	0.25	3	1.89	1.00	4.7	18.8	16	0.29	1.7	0.4
22	9.13	75	25,800	51.8	0.81	4	1.89	0.33	3.8	4.7	4	0.95	1535.0	521.9
23	0.022	90	1,650	19.5	0.09	3	1.89	1.00	4.7	52.2	50	0.09	118.3	11.5
24	0.241	70	4,480	58.6	0.22	4	1.89	0.20	3.7	16.8	16	0.23	101.4	13.0

Notes

A = area (mi^2)
CN = runoff curve number
ℓ = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
$T_p = 1.17L$

L = watershed lag (hr)
$= \frac{(\ell^{0.8})(S+1)^{0.7}}{1900\, Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip. depth (in)

Q = runoff volume (in)
T_o = duration of excess rainfall (hr)
q = peak flow (cfs)

BY RGW DATE 23 Jan 80 CHECKED BY ____ DATE ____

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS FILE NO. ____ JOB NO. ____

SHEET 2 OF 3

50-yr, 6-hr storm runoff

Culvert No.	A	CN	ℓ	Y	Computed T_p	Hydro. Fam. No.	P	Q	T_o	T_o/T_p Computed	T_o/T_p Used	$(T_p)_{revised}$	$\frac{484AQ}{(T_p)_{rev}}$	q
25	0.534	70	4980	58.6	0.23	4	1.89	0.20	3.7	16.1	16	0.23	224.7	28.8
26	0.806	70	7570	44.0	0.38	4	1.89	0.20	3.7	9.7	10	0.37	210.9	37.3
27	0.077	75	3300	35.6	0.19	4	1.89	0.33	3.8	20.0	16	0.24	51.2	6.6
28	0.036	75	2100	46.4	0.11	4	1.89	0.33	3.8	34.5	36	0.11	52.3	3.5
29	1.94	75	13,950	54.5	0.48	4	1.89	0.33	3.8	7.9	6	0.63	491.8	123.0
30	0.364	75	2100	75.9	0.09	4	1.89	0.33	3.8	42.2	36	0.11	528.5	35.5
31	0.050	75	2100	54.6	0.11	4	1.89	0.33	3.8	34.5	36	0.11	72.6	4.9
32	0.031	75	1600	65.4	0.08	4	1.89	0.33	3.8	47.5	50	0.08	61.9	2.9
33	0.156	75	3700	65.0	0.15	4	1.89	0.33	3.8	25.3	25	0.15	166.1	15.3
34	0.684	75	8770	35.7	0.41	4	1.89	0.33	3.8	9.3	10	0.38	287.5	50.9
35	0.238	85	5370	28.0	0.23	3	1.89	0.72	4.2	18.3	16	0.26	319.0	73.4
36	0.060	70	2700	61.2	0.14	4	1.89	0.20	3.7	26.4	25	0.15	38.7	3.6

Notes

A = area (mi^2)
CN = runoff curve number
ℓ = hydraulic length of basin (ft)
Y = avg. slope (%)
T_p = time to hydrograph peak
$T_p = 1.17L$

L = watershed lag (hr)
$= \frac{(\ell^{0.8})(S+1)^{0.7}}{1900\, Y^{0.5}}$

$S = \frac{1000}{CN} - 10$

P = precip. depth (in)

Q = runoff volume (in)
T_o = duration of excess rainfall (hr)
q = peak flow (cfs)

SUBJECT DIMENSIONLESS HYDROGRAPH COMPUTATIONS
BY RBW DATE 23 Jan 80 CHECKED BY DATE
FILE NO. JOB NO.
SHEET 3 OF 3

25-yr, 6 hr storm runoff

Location	Area (mi^2)	CN	l (ft)	y (%)	Computed T_p	Hydro. Family #	P (in)	Q (in)	T_o (hrs)	T_o/T_p computed	T_o/T_p used	T_p (revised)	$\frac{484AQ}{T_p(rev.)}$	q (cfs)
Miller Creek	9.45	75	27,100	52	.84	4	1.69	.24	3.8	4.5	4	.95	1155	393

VAUGHN HANSEN ASSOCIATES
CONSULTANTS/ENGINEERS
ENCLOSURE # 3

COMPUTED DGC CLIENT U.S. Fuels
CHECKED _____ PROJECT Cl[illegible]ts
DATE 2/11/80 FEATURE UPPER COAL STORAGE YARD

1/4

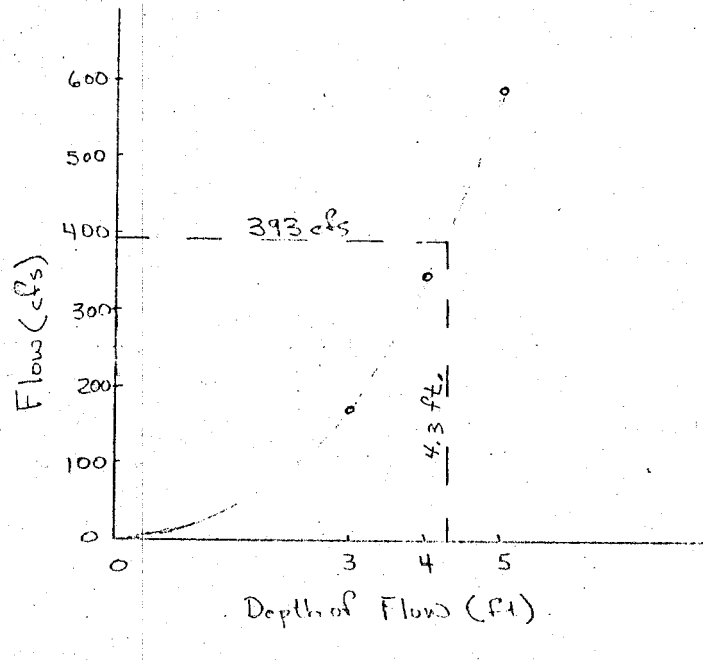
VAUGHN HANSEN ASSOCIATES
CONSULTANTS/ENGINEERS

COMPUTED DGC CLIENT [illegible]
CHECKED PROJECT [illegible]
DATE 2/11/80 FEATURE [illegible]

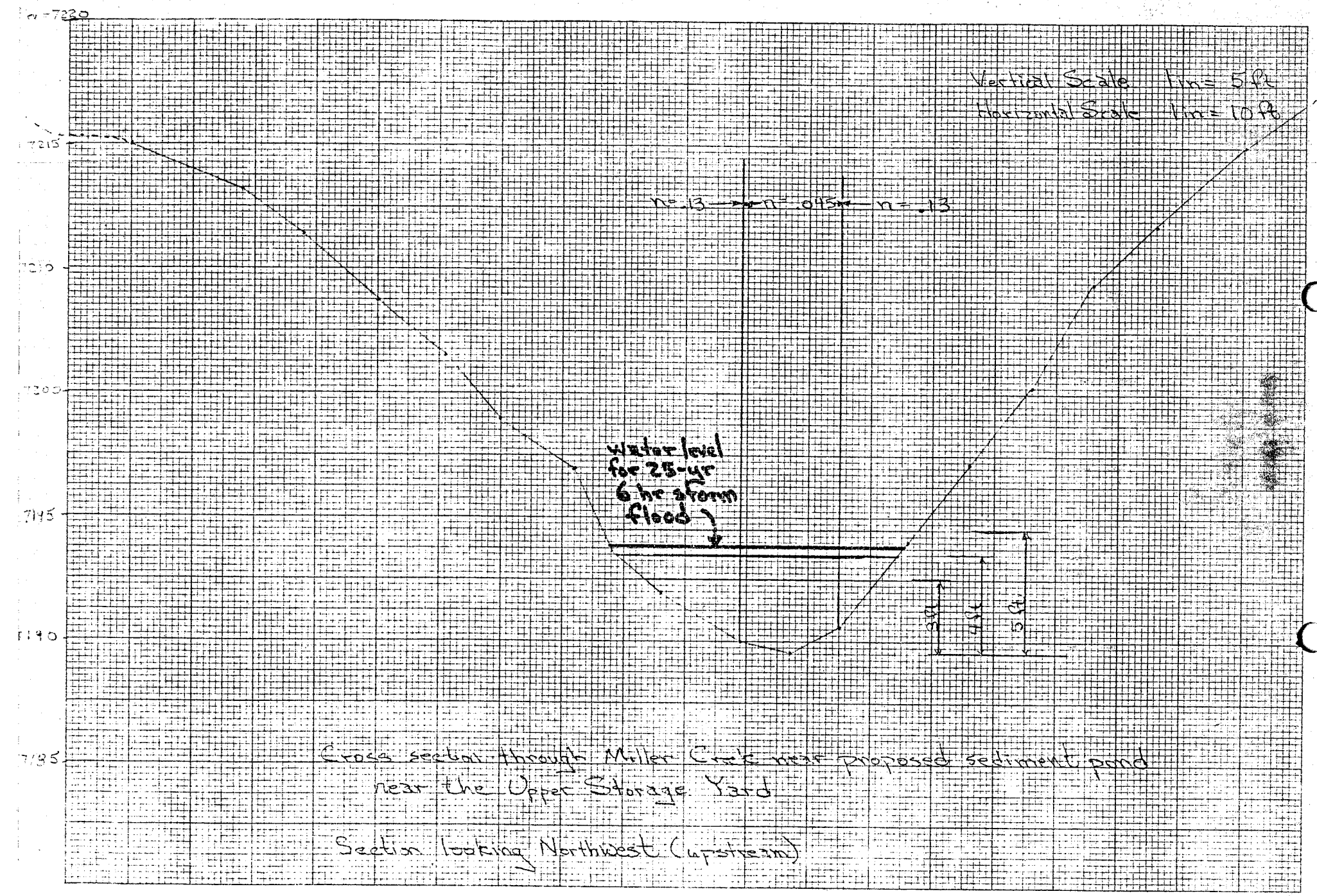
Trial depth (ft)	Stream Section A_1	P_1	R_1	n_1	Q_1	Flood Plain A_2	P_2	R_2	n_2	Q_2	Q_{total}
3	15.9	7.9	2.01	.045	142	12.7	8.25	1.54	.13	33	175
5	31.7	7.9	4.01	.045	450	41.4	18.8	2.20	.13	136	586
4	23.8	7.9	3.01	.045	279	25.1	15.2	1.65	.13	68	347

Slope = .0285

$$Q = A \frac{1.5}{n} R^{2/3} S^{1/2}$$

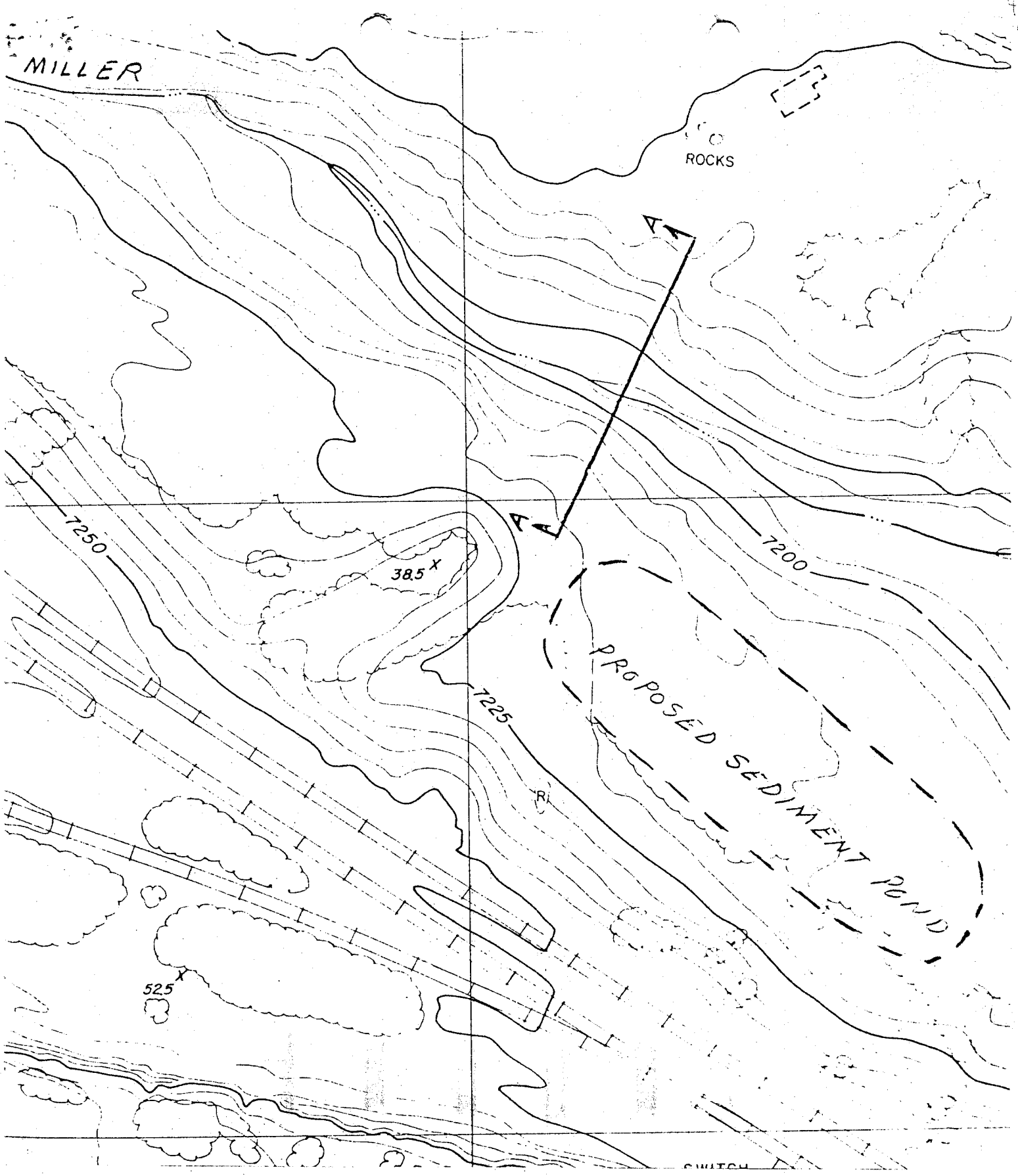


K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1322



Cross section through Miller Creek near proposed sediment pond near the Upper Storage Yard

Section looking Northwest (upstream)



Location of X-section surveyed on Miller Creek near the Upper Coal Storage Yard