6377 U-004-409 .2

PADDYS RUN, 100-YEAR FLOOD ELEVATION, INTEROFFICE MEMORANDUM - (USED AS A REFERENCE IN OU2 FS)

08/05/93

M:CRU2:93-0262
FERMCO FILE
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MEMO

DOCUMENT FILE NO. 32163

6377

Fernald Environmental
FERMCO
Restoration Management Corporation

INTEROFFICE MEMORANDUM

17 6.16.29

To:	File	Date:	August 5, 1993
Location:	CRU2	Reference:	
From:	Greg Jones GNJ	FERMCO #:	M:CRU2:93-0262
Location:	T-78	Client:	DOE DE-AC05-920R21972
Extension:	6133	Subject:	Paddys Run, 100-Year Flood Elevation

c: S. Garland
N. Weatherup
File Record Storage Copy 106.4.12.2

The attached calculations provide a simplified analysis of the increase in flood elevations along Paddys Run in the vicinity of the erosion control berm. The calculations are in two sections. The first 9 pages provide a calculation based on flow of 8969 cfs which comes from an analysis done by Parsons for P047. The second, 6 page revision is based on a flow of approximately 11,152 cfs and a revised Manning coefficient which come from a recent draft report by Parsons dated July 16, 1993 ("Supporting Study of In Situ Remediation," 90% Draft Report, Revision 1). Both calculations yield similar results for the increase in depth: 0.3 feet.

GNJ:epm
Attachments (2)

OU2FS Ref #1

1

Revision of Flood Elevation Calculation

Purpose: Recent studies by Parsons have predicted higher flood flows and a different Manning coefficient from that used in the earlier calculation. This calculation checks the effect of the erosion control berm under the revised conditions.

Procedure: ① Determine revised conditions

② Substitute revised conditions into original spreadsheet in order to recalculate flood level.

8/4/93

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PROJECT CRU 2		ORIGINATED BY SN Jones	DATE 8/2/93
ENG. COMM. NO.	PROJECT NO. 04424321	CHECKED BY	DATE
AREA		REVISION NUMBER	DATE
SUBJECT PADDYS RUN FLOOD ELEVATION		REVISED BY	

Form ES3-2 (2-90)

① Determination of revised conditions

Source: "Supporting Study of In-Situ Remediation"
90% Draft Report, Revision 1
by Parsons for FERNCO, CRU 1
July 16, 1993

As can be seen in the attached figure, the area of concern is located between sections 2 and 3, about $\frac{1}{3}$ of the way from section 2 and $\frac{2}{3}$ of the way from section 3.

From the appendices to the source document:

Section 2, Peak discharge during 100 year event	11,154 cfs
" 3, " " " " " "	11,147 cfs
Section 2, HEC 2 Computed Elevation of Water Surface	545.26 ft.
" 3, " " " " " " "	548.98 ft.
Section 2, Stated Result for Water Surface Elevation *	545.50 ft.
" 3, " " " " " " *	549.00 ft.
n, channel	0.06555
n, flood plain	0.122
n, grass/pasture	0.067
Accuracy, as % of depth of flow	± 10%
Accuracy, as feet for 100 year flood	± 1.5 ft.

* Stated result was the HEC 2 computed elevation rounded up to the nearest 0.5 ft.

8/4/93

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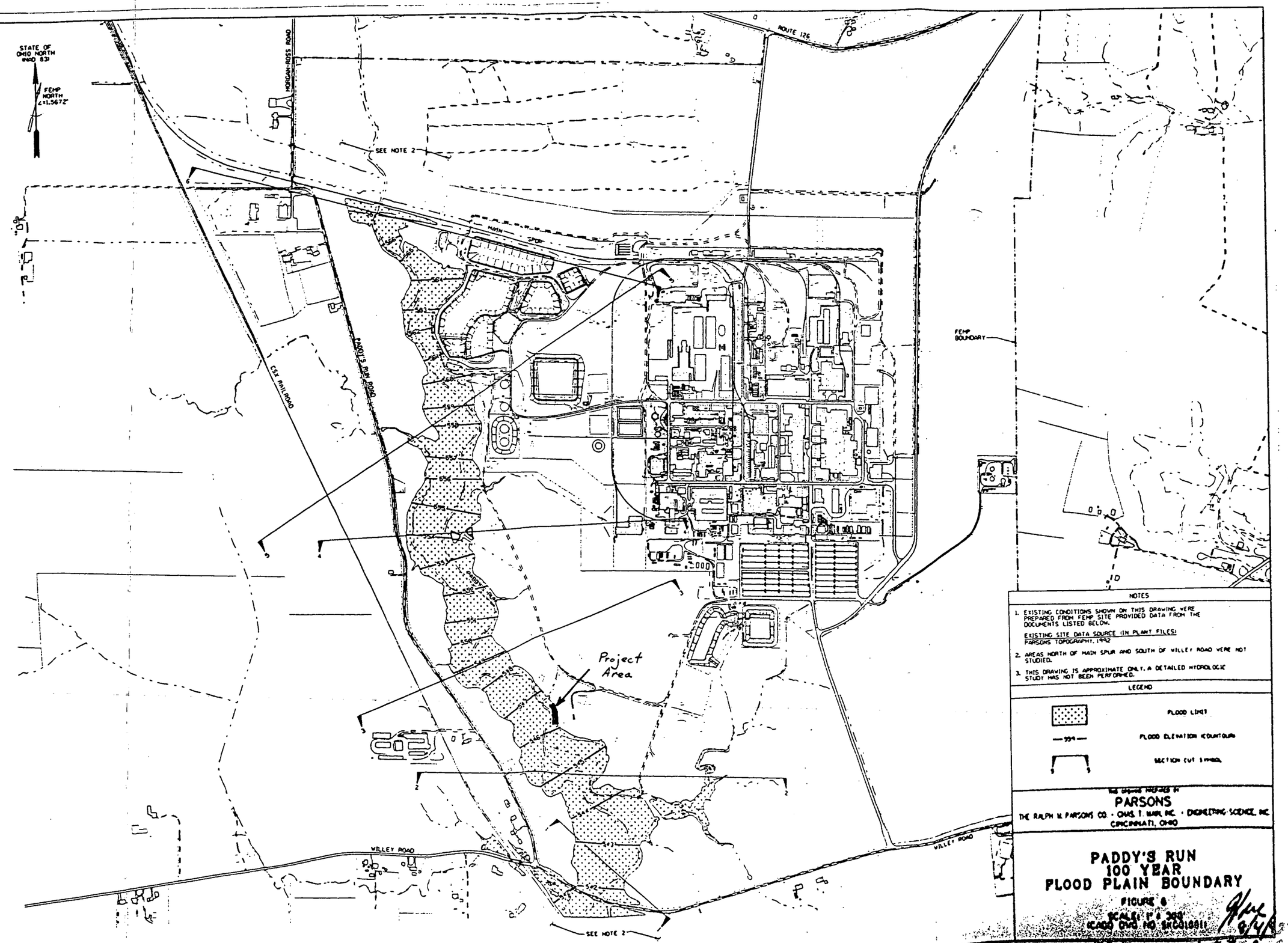
SUBJECT		REVISED BY	

skg01881.ml(4107,ws314) po84@ws314. Thu Jul 29 13:04:35 CDT 1993



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Since the area of concern is ⅓ of the way from Section 2 to Section 3 . . .

Interpolated Peak discharge during 100yr. event $= 11,154 \text{ cfs} - \frac{(11,154 - 11,147)}{3}$

$= 11,151.7 \text{ cfs}$

Interpolated Elevation (based on HEC 2 Calcs) $= 545.26 \text{ ft.} + \frac{(548.98 - 545.26)}{3}$

$= 546.50 \text{ ft.}$

The Manning coefficient, n, value should be a composite of the values in the channel, flood plain, and pasture area. The composite should be weighted by the volume of flow in each section. For the current simplified analysis the following arbitrary assumption about n value will be made – flow will either be in channel (assume 75%) or overflowing to flood plain (25%), ignoring pasture:

$n = 0.75 (n_{channel}) + 0.25 (n_{flood\,plain})$

$= 0.75 (0.06555) + 0.25 (0.122)$

$n = 0.07966$

8/4/93

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(2)

6377

Q, 100 Yr Flood	11151.7
Manning Coef.	0.0797
Slope	0.0031

	Elev. (ft)	P (ft)	A (sq.ft.)	1.49/n*AR^2/3*S^1/2 (cfs)
Old, Revised Flow	542.00	382.53	1106.50	2339
	547.00	429.43	3112.25	12138
	546.00	420.05	2692.98	9678
	546.50	424.74	2901.48	10878
	546.75	427.09	3006.58	11501
	546.68	426.38	2974.99	11312
	546.59	425.58	2939.25	11101
	546.64	426.01	2958.17	11213
→	546.61	425.78	2947.87	11152
New, Revised Flow	542.00	382.53	978.50	1906
	547.00	429.43	2984.25	11317
	546.00	420.05	2564.98	8924
	546.50	424.74	2773.48	10090
	546.75	427.09	2878.58	10696
	546.88	428.26	2931.35	11005
	546.94	428.84	2957.78	11161
	546.91	428.59	2946.14	11092
	546.94	428.82	2956.72	11154
→	546.93	428.81	2956.30	11152

C:\CRU2\IFAP\MANNING.WK1

Old = Prior to construction

New = Following proposed construction

Difference = 546.93 − 546.61 = 0.32 feet

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GN Jones 8/2/93

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Conclusions:

The change in flood elevation is similar to that in the earlier calculation. The overall conclusions are unaffected by the revised flow and Manning coefficient.

Additional Remarks:

The case using the preconstruction conditions (Old, Revised Flow) yields a result close to that interpolated from the HEC 2 results (546.6 and 546.5, respectively). That closeness lends some additional credibility to the method used for this simplified analysis.

8/4/93

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INCREASE IN FLOOD LEVEL DUE TO BERM AT PADDYS RUN NEAR INACTIVE FLY ASH PILE

Steps:

1. Determine original section
2. Determine relationship between area and water surface elevation
3. Determine relationship between wetted perimeter and water surface elevation
4. Calculate changes in area and wetted perimeter caused by berm
5. Determine water surface elevation for original section (old) and modified section (new) during 100 yr. flood.

Note: This method will only yield an approximation of the effect of the berm. A full flood analysis is needed for a more reliable estimate of the effect.

7/30/93

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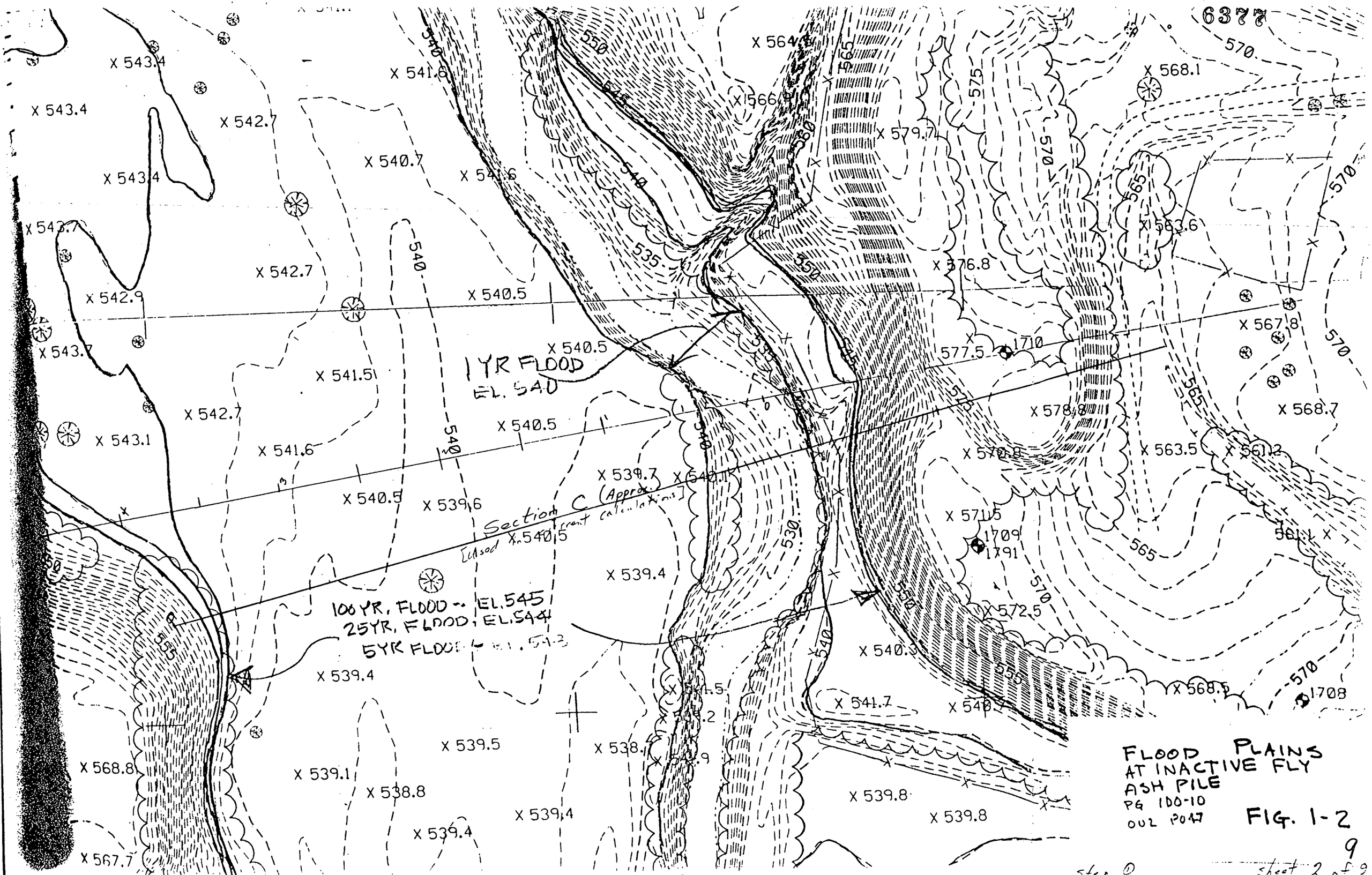
AREA		REVISION NUMBER	DATE
SUBJECT Paddys Run		REVISED BY	



FLOOD PLAINS AT INACTIVE FLY ASH PILE
PG 100-10
OU2 P047

FIG. 1-2

Section C (Approx.)
from FIG. 1-2 from Parsons Design Calcs on P047

Elevations, looking North (upstream) at section:

Distance from West to East (ft)	Elev. (ft)	
0	550	Approximate west bank of flood plain
17.5	545	
24	544	
30	543	
39	542	
55	541	
87	540	
103.5	540	
136	540	
192	540	
242.5	540	
299	540	
340	540	
359.5	535	
386	530	
404	530	
410	535	
422.5	540	Approximate east bank of flood plain
432	545	
443	550	

Based on earlier analysis by Parsons (P0-47), 100 Year flood level would be near the 545' elevation. Therefore, the lateral movement of the edges of the flood can be calculated around that elevation. Note that on the west, a one foot rise in water elevation would be accompanied by about 4.9 feet of westward shift:

$$\frac{\text{station @El. 542} - \text{station @El. 550}}{\text{El. 550} - \text{El. 542}} = \frac{39' - 0'}{550' - 542'} = \frac{39'}{8'} = 4.9$$

Meanwhile, on the east, a one foot rise would mean about 2.1 feet of eastward shift.

$$\frac{\text{station @550} - \text{station @El. 540}}{\text{El. 550} - \text{El. 540}} = \frac{443' - 422.5}{550' - 540'} = \frac{20.5'}{10'} = 2.1$$

7/30/93

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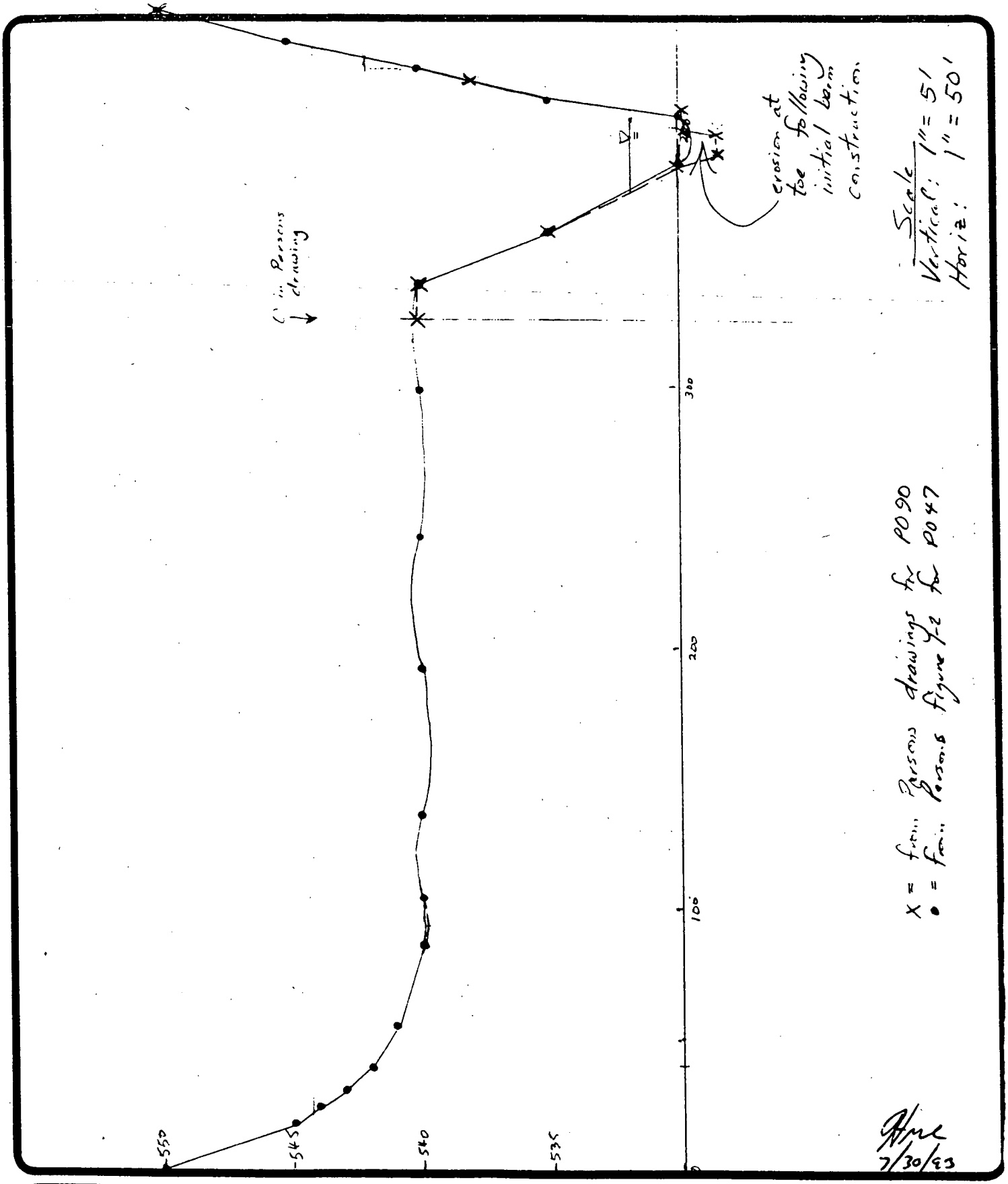
SUBJECT ① continued		REVISED BY	

Form E53-2 (2-90)



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PROJECT		ORIGINATED BY GNJones	DATE 7/21/93
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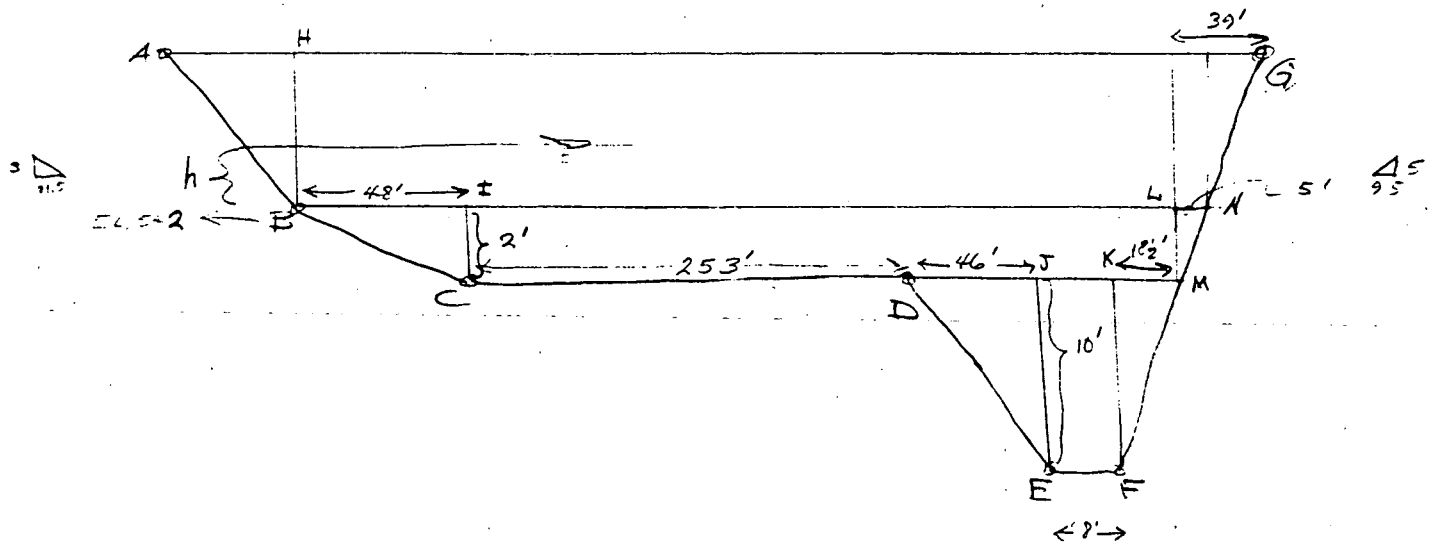
SUBJECT Stop 1 continued		REVISED BY	

Area



Name	Area (ft²)
BCI	48
DEJ	230
EFKJ	80
FMK	92.5
CMLI	651
LMN	5
Subtotal	1106.5 ft²

Area above BN } $h\{378.5'\} + \left(\frac{1}{2}h\ \frac{21.5}{3}h\right) + \left(\frac{1}{2}h\ \frac{9.5}{5}h\right)$

or $378.5h + 4.53h^2$

So, for areas at elevations above El. 542, use

$$A = 1106.5 + 378.5h + 4.53h^2$$

where h = Actual Elev. − 542

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Form ES3-2 (2-90)

Wetted Perimeter

Name	Length (ft)
BC	$(48^2+2^2)^{1/2} = \sqrt{2308} = 48.04'$
CD	$253'$
DE	$(46^2+10^2)^{1/2} = \sqrt{2216} = 47.07'$
EF	$8'$
FM	$(10^2+18.5^2)^{1/2} = \sqrt{442} = 21.03'$
MN	$(2^2+5^2)^{1/2} = \sqrt{29} = 5.39'$
S.b total	$382.53'$
Above BN	$\left[h^2+\left(\frac{21.5}{3}h\right)^2\right]^{1/2} + \left[h^2+\left(\frac{9.5}{5}h\right)^2\right]^{\frac{1}{2}}$
	or $\left\{(52.4h^2)^{\frac{1}{2}} + (4.6h^2)^{\frac{1}{2}}\right\}$
	or $9.38h$

So, for areas at elevations above El. 542

$$P_w \approx 382.53 + 9.38h$$

where h = Actual Elev. − 542

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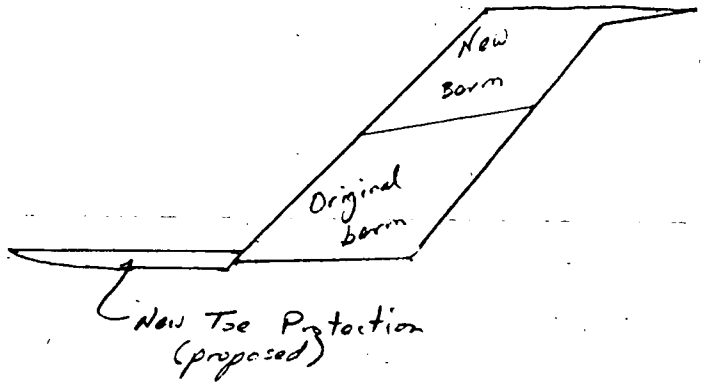
SUBJECT Step (3)		REVISED BY	

Form E53-2 (2-90)

Revisions to Area and Wetted Perimeter caused by Placement of Berm in Paddys Run.



- New berm indicates proposed increase in elevation.
- Original berm currently exists.

Old Portion of P_w = 41' (before any berm)

New Portion of P_w = 41' (after proposed construction)

Old Portion of Area = 0 ft^2 (before any berm)

New Portion of Area = 13' high × 9' wide + 11' long × 1' deep = 128 ft^2 (after proposed construction)

For P_w, new section, use same as old section.

For A, new section, use old minus 128 $ft.^2$

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Form ES3-2 (2-90)

Manning Formula for uniform flow in open channels*:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

n = Manning's coefficient = 0.06 (based on earlier assumption in Parson's study for P047)

S = Channel slope = 0.0031 (based on earlier assumption in Parson's study for P047)

R = hydraulic radius = $\frac{\text{area}}{\text{Wetted Perimeter}} = \frac{A}{P_w}$

A = area

Q = flowrate = 8969 cfs for 100 yr flood (based on earlier value used in Parsons' study for P047)

Solution for elevation will be done by iteration. I will assume an elevation, determine A and P_w, calculate the right-hand-side of the equation, compare to Q, and repeat the process until the elevation change is less than 0.05 ft.

* Uniform flow is being assumed to be acceptable for this before/after analysis. Actual flow will not be uniform.

7/30/93

CLIENT		DEPARTMENT	
PROJECT		ORIGINATED BY GN Jones	DATE 7/21/93
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SUBJECT Step (5)		REVISED BY	

Form E53-2 (2-90)

Q, 100 Yr Flood	8969
Manning Coef.	0.06
Slope	0.0031

	Elev. (ft)	P (ft)	A (sq.ft.)	1.49/n*AR^2/3*S^1/2 (cfs)
Old	542.00	382.53	1106.50	3106
	546.00	420.05	2692.98	12850
	544.00	401.29	1881.62	7288
	545.00	410.67	2282.77	9904
	544.50	405.98	2081.06	8554
	544.75	408.33	2181.63	9219
	544.68	407.62	2151.40	9017
	544.58	406.73	2113.18	8765
	544.63	407.20	2133.29	8897
	→ 544.66	407.45	2144.07	8969
New	542.00	382.53	978.50	2531
	546.00	420.05	2564.98	11848
	544.00	401.29	1753.62	6481
	545.00	410.67	2154.77	8996
	544.50	405.98	1953.06	7696
	544.75	408.33	2053.63	8335
	544.88	409.50	2104.13	8663
	544.94	410.11	2130.45	8836
	544.97	410.39	2142.60	8916
	→ 544.99	410.58	2150.71	8969

Lotus 1-2-3 File: C:\CEU2\IFAP\MANNING.UK1

The modification to the stream (the erosion control berm) might be expected to cause a 0.3 foot rise in flood elevation.

This would widen the flooded area by about 4.9 x 0.3' or ~1.5' on the west and 2.1 x 0.3' or ~0.6' on the east. (See Page 3 of 9). Based on review of available aerials, land to the west appears to be pasture, and to the east is still the ash pile.

GN Jones
7/21/93

7/30/93

Step (5) continued