(130)

DRAINAGE REVIEW

for

PUBLIC SERVICE OF NEW HAMPSHIRE
COAL YARD AT SCHILLER STATION
Portsmouth, NH

August 16, 2005

Prepared for:

PSNH
Gosling Road
Portsmouth, NH 03801

Prepared by:

Waterfront Engineers, LLC
3 Linda Lane
Stratham, NH
&
Haight Engineering, LLC
P.O. Box 1166
Dover, NH

HAIGHT ENGINEERING, LLC
CIVIL ENGINEERS
P.O. Box 1166, 181 WATSON ROAD, DOVER, NH
TEL: (603) 750-4266, FAX: (603)749-7348

September 7, 2005

To: Duncan Mellor, Waterfront Engineers, LLC
3 Linda Lane,Stratham, NH 03885

From: Stephen Haight

Re: Coal Yard Drainage

Our review was based on the existing conditions "today" and the proposed developed condition after the coal yard expansion. We did not compare our results to the previous drainage calculations since those were based on a condition of the watershed from 1983. Please note: our review was performed using a current industry standard runoff estimating software based on the techniques developed by the USDA, Soil Conservation Services (SCS) whereas the 1983 analysis was performed using the Rational Method. Although both are industry recognized methodologies the SCS method tends to allow for more refinement in estimating surface conditions in urban area.

The drainage review we prepared for the Coal Yard was done for the current existing condition and for the proposed condition with the 20,000 s.f. +/- coal yard expansion. The storm that was used for the review was the type III - 10-yr storm event as suggested by the SCS for this area of the country.

To generate runoff coefficients for use in estimating the runoff volumes in a certain watershed, the SCS has a fairly extensive list of typical cover types but not all cover types are identified. The reviewer has the discretion as to how to generate an antecedent runoff condition (cover type) that would best approximate the conditions in the field. In this case to best approximate a cover type that is predominately an active coal yard with piles of covered and uncovered coal we used a cover type that we estimated best reflects the condition. I.e... that the coal would retain some but not all of the rain falling on it and shed a large portion of the runoff such as would be consistent with a gravel road.

Our review showed that the watershed as it exists today would generate about 251,000 gallons of runoff and that after the proposed coal yard was expanded the watershed would generate about 287,000 gallons of runoff.

If you have any further questions please do not hesitate to call.

CONTENTS

A-1

PRE-DEVELOPMENT
CALCULATIONS

1.0 INTRODUCTION

Waterfront Engineers and Haight Engineering, LLC have conducted a hydrologic analysis of the 4 acre +/- subcatchment watershed area which contains the existing Portsmouth, NH, Schiller Station coal storage area. The purpose of the analysis was to determine the amount of runoff generated within this watershed contributing flow to the existing settling/detention basin and to estimate the additional runoff generated with the proposed 20,000 sf +/- expansion of the coal storage area.

The watershed and site slopes west to east and all runoff generated within the watershed is collected via a concrete drainage swale which directs all the runoff to an existing settling/detention basin. Based on previous design data provided by the Owner the existing settling/detention basin has a storage volume capacity of ***324,000*** gallons. Please note that this analysis did not include an assessment of the existing pond. We are relying on the information provided by the owner as being accurate.

The analysis showed that for a 10-yr storm event the watershed generates approximately .77 AC-FT of runoff or about 251,000 gallons. The analysis was also performed with the proposed 20,000 sf +/- coal yard expansion. The analysis showed that with this proposed expansion the watershed is expected to generate approximately 0.88 AC-FT of runoff or about 287,000 gallons.

It appears that based on the stated capacity of the settling/detention basin that the additional runoff generated by the coal yard expansion could be accommodated by the existing settling/detention basin.

2.0 DRAINAGE ANALYSIS

The hydrologic study of this site has been performed utilizing nationally recognized runoff estimating techniques developed by the USDA, Soil Conservation Services (SCS). The technique and runoff models are described in various SCS publications and references as follows:

"Stormwater Management and Erosion Sediment Control Handbook for Urban and Developing Areas in New Hampshire"

"Civil Engineering Reference Manual, Fifth Edition"

"Open-Channel Hydraulics" Chow.

"Stormwater Modeling System" HydroCad Ver. 7

2.1 DRAINAGE DESIGN PARAMETERS

A brief review of the procedures and parameters used in the drainage study follows:

2.1.1 Watersheds

The sub-catchment watershed area was delineated using on-site topographic survey data provided by James Verra Survey Associates.

2.1.2 Soils

Soil information used to estimate the runoff curve numbers was obtained from the Rockingham County Soil Maps.

Soil/Soil Group
799-Urban land-Canton complex, 3-15% slopes

2.1.3 Rainfall Data

The SCS, Type III, 24-hour storm distribution has been used in all runoff models. The analysis has been performed for the 10-year storm event with a 4.32" rainfall depth.

2.1.4 Runoff Curve Numbers

The SCS runoff curve numbers were used and summarized within each subcatchment. Refer to the drainage summary within Appendix A.

2.2 EXISTING CONDTIONS

2.2.1 Table A – Existing Conditions (10 yr storm event)

Sub-catchment	Pre-Development Peak Volume (af/gal)
1	.769 af/251,000 gal

2.3 DEVELOPED CONDITIONS

The developed conditions of the site include the 20,000 +/- SF coal storage expansion.

2.3.1 Table B – Developed Conditions (10 yr storm event)

Catchment	Post- Development Peak Volume (af/gal) 10yr /100 yr
A	.882af/287,000 gal

Comparison Chart

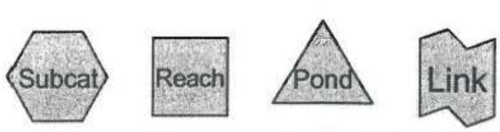
Storage Capacity*	10 yr PRE	10 yr POST
324,000 gal	251,000 gal	287,000 gal

* Existing storage capacity as provided by owner. See information contained in Appendix B.

APPENDIX A

HYDROLOGIC CALCULATIONS

SUBCATCH-1



Drainage Diagram for PSNH-PRE
Prepared by Haight Engineering - Dover NH
HydroCAD® 7.10 s/n 003240 © 2005 HydroCAD Software Solutions LLC

Subcatchment 1: SUBCATCH-1

[49] Hint: Tc<2dt may require smaller dt

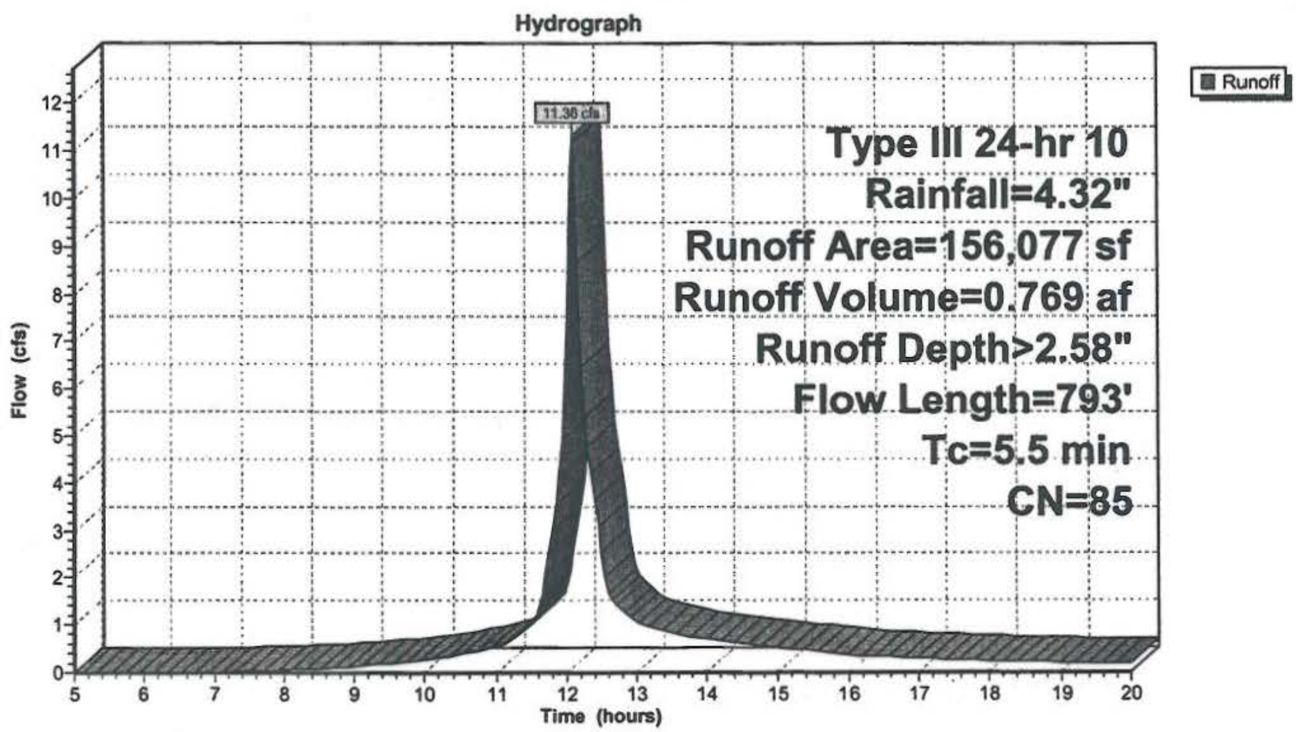
Runoff = 11.36 cfs @ 12.08 hrs, Volume= 0.769 af, Depth> 2.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Rainfall=4.32"

Area (sf)	CN	Description
156,077	85	Gravel roads, HSG B

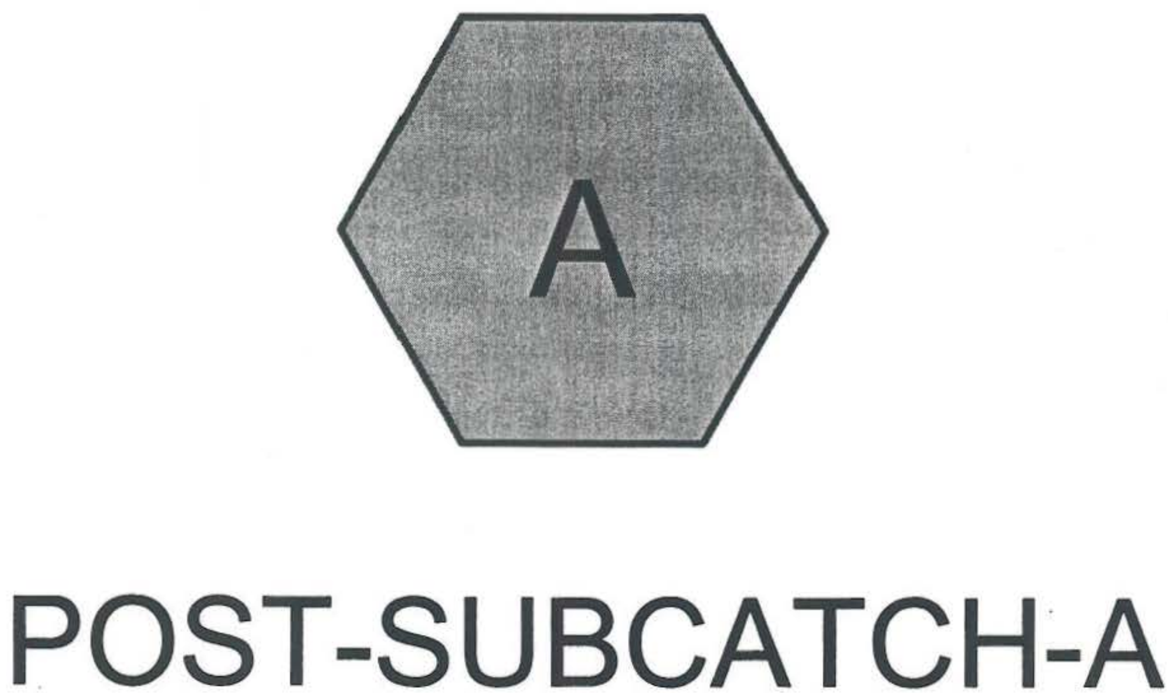
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	242	0.0331	1.9		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.00"
3.4	551	0.0180	2.7		**Shallow Concentrated Flow, SHALLOW CONCENTRATED** Paved Kv= 20.3 fps
5.5	793	Total			

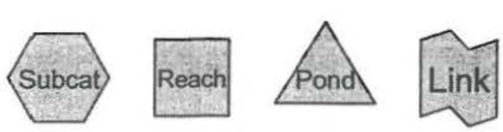
Subcatchment 1: SUBCATCH-1



A-2

POST-DEVELOPMENT CALCULATIONS





Drainage Diagram for PSNH-POST
Prepared by Haight Engineering - Dover NH
HydroCAD® 7.10 s/n 003240 © 2005 HydroCAD Software Solutions LLC

Subcatchment 2S: POST-SUBCATCH-A

[49] Hint: Tc<2dt may require smaller dt

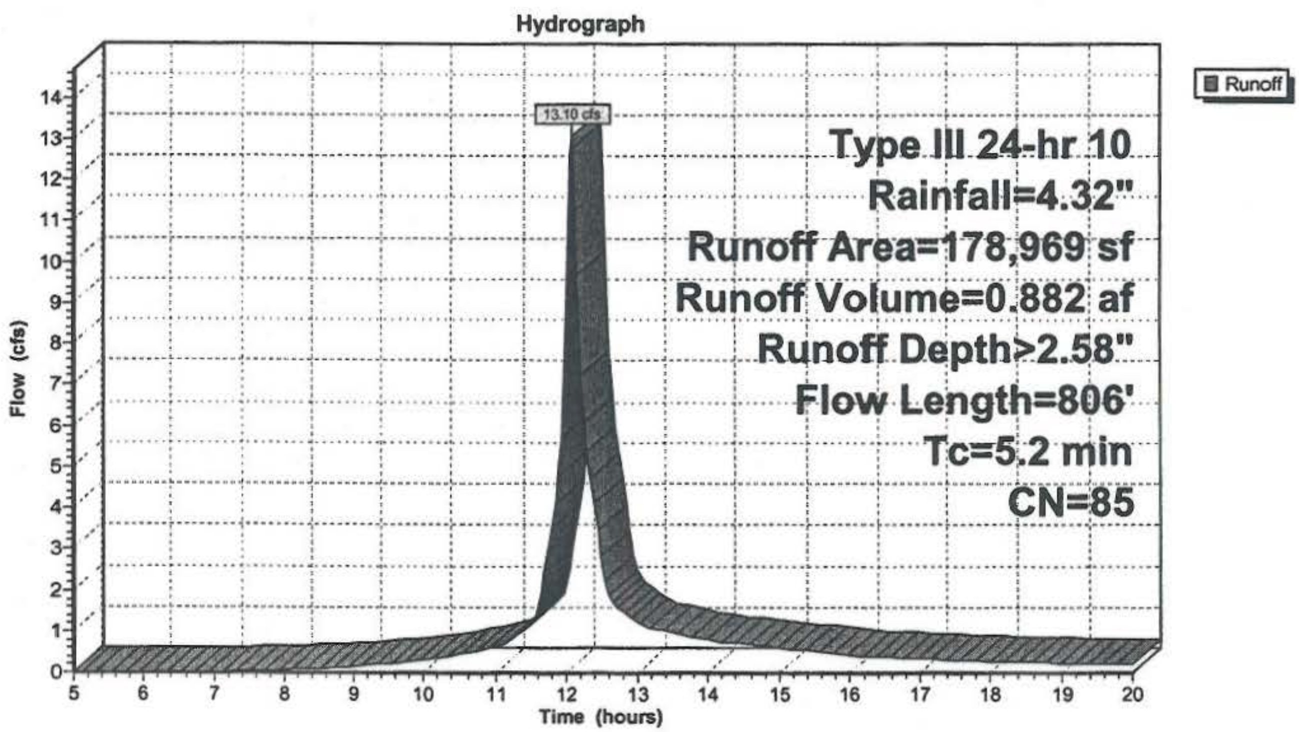
Runoff = 13.10 cfs @ 12.08 hrs, Volume= 0.882 af, Depth> 2.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Rainfall=4.32"

Area (sf)	CN	Description
178,969	85	Gravel roads, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	153	0.0522	2.1		**Sheet Flow, SHEET FLOW** Smooth surfaces n= 0.011 P2= 3.00"
4.0	653	0.0184	2.8		**Shallow Concentrated Flow, SHALLOW CONCENTRATED FLO** Paved Kv= 20.3 fps
5.2	806	Total			

Subcatchment 2S: POST-SUBCATCH-A



APPENDIX B

RECORD PSNH DESIGN CALCULATIONS

SC 164
1507/2203

Public Service of New Hampshire

September 8, 1983

New Hampshire Water Supply and
Pollution Control Commission
Health and Welfare Building
Hazen Drive
Concord, NH 03301

Attention: Mr. David J. Allain and Mr. Fred Elkin

Subject: Design of Surface Run-Off Ditch

Gentlemen:

We researched into a solution for the flow velocity in the lower section of the surface run-off ditch per your request.

Please refer to the sheet labeled "Appendix A".

This table contains "Manning Roughness Coefficients" which we used in our calculations. Notice in Group III, Section E, No. 1, there is a range for "dense weeds, high as flow depth". This was chosen because this would give us a higher roughness coefficient than a rock bottom. The lower number, 0.08, was used to be conservative.

The following three pages, are calculations using the new roughness coefficient and the original design data. Two points to note are: (1) The maximum bottom slope is 0.005 or 0.5%. The reason for this is due to the elevation of the drain at the end of the ditch; (2) The maximum depth of the ditch is 1.5 feet. Again due to the elevation of the drain.

As you can see, we can meet the velocity requirement of 1 f.p.s. if we have a 17 ft. ditch with a slope of 0.002. However, we do not have ample room for a ditch which has a 23 ft. wide opening at the top. Also, a slope of 0.002 is extremely hard to construct.

We would like to recommend design #3. By adding weeds and brush, with a 10 ft. ditch, we can lower the velocity to 1.46 f.p.s. which is relatively close to your requirements.

Please refer to the last sheet. What was done here was that we eliminated the flow from the Coal Run-Off Basin Overflow. This was included because of "worst case" conditions. But by eliminating this flow, for the sake of comparison, we show that a 4 ft. ditch with weeds and brush, could maintain the flow at a reasonable velocity. Therefore, in reality, the proposed 10 ft. ditch would decrease the velocity even further.

1000 Elm St., P.O. Box 330, Manchester, NH 03105 • Telephone (603) 669-4000 • TWX 7102207595

We hope you will consider this proposed design seriously. We do not have much space available due to the railroad property on one side and an embankment on the other. We do not want to cut into the embankment for fear of severe erosion. Therefore, all additional space will be on the side of the railroad tracks. With the original ditch design, we have about 20 ft. to the railroad. With the proposed ditch, we would only have 13 ft. which we would like to maintain for access.

If you have any questions, please contact Richard Despins at 431-4994, extension 35.

Very truly yours,

George C. Herrick

George C. Herrick
Chief Mechanical Engineer

Enc.

cc: W. Harvey
G. Herrick
J. Lander
A. Palmer
R. Rand
R. Despins
J. Miranda, C.T. Main

GCH:cmd

DESIGN CHARTS FOR OPEN-CHANNEL FLOW
U.S. DEPT. OF TRANSPORTATION - HYD. DESIGN SERIES #3

[illegible]
[illegible]

Table 1. Manning roughness coefficients, n[1]

	Manning's n range[1]
I. Closed conduits:	
A. Concrete pipe	0.011-0.013
B. Corrugated-metal pipe or pipe-arch:	
1. 2⅔ by ½-in. corrugation (riveted pipe):[2]	
a. Plain or fully coated	0.024
b. Paved invert (range values are for 25 and 50 percent of circumference paved):	
(1) Flow full depth	0.021-0.018
(2) Flow 0.8 depth	0.021-0.016
(3) Flow 0.6 depth	0.019-0.013
2. 6 by 2 in. corrugation (field bolted)	0.03
C. Vitrified clay pipe	0.012-0.014
D. Cast-iron pipe, uncoated	0.013
E. Steel pipe	0.009-0.011
F. Brick	0.014-0.017
G. Monolithic concrete:	
1. Wood forms, rough	0.015-0.017
2. Wood forms, smooth	0.012-0.014
3. Steel forms	0.012-0.013
H. Cemented rubble masonry walls:	
1. Concrete floor and top	0.017-0.022
2. Natural floor	0.019-0.025
I. Laminated treated wood	0.015-0.017
J. Vitrified clay liner plates	0.015
II. Open channels, lined[4] (straight alignment):[5]	
A. Concrete, with surfaces as indicated:	
1. Formed, no finish	0.013-0.017
2. Trowel finish	0.012-0.014
3. Float finish	0.013-0.015
4. Float finish, some gravel on bottom	0.015-0.017
5. Gunite, good section	0.016-0.019
6. Gunite, wavy section	0.018-0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015-0.017
2. Random stone in mortar	0.017-0.020
3. Cement rubble masonry	0.020-0.025
4. Cement rubble masonry, plastered	0.016-0.020
5. Dry rubble (riprap)	0.020-0.030
C. Gravel bottom, sides as indicated:	
1. Formed concrete	0.017-0.020
2. Random stone in mortar	0.020-0.023
3. Dry rubble (riprap)	0.023-0.033
D. Brick	0.014-0.017
E. Asphalt:	
1. Smooth	0.013
2. Rough	0.016
F. Wood, planed, clean	0.011-0.013
G. Concrete-lined excavated rock:	
1. Good section	0.017-0.020
2. Irregular section	0.022-0.027
III. Open channels, excavated[4] (straight alignment,[5] natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016-0.018
2. Clean, after weathering	0.018-0.020
3. With short grass, few weeds	0.022-0.027
4. In gravelly soil, uniform section, clean	0.022-0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022-0.025
2. Grass, some weeds	0.025-0.030
3. Dense weeds or aquatic plants in deep channels	0.030-0.035
4. Sides clean, gravel bottom	0.025-0.030
5. Sides clean, cobble bottom	0.030-0.040
C. Dragline excavated or dredged:	
1. No vegetation	0.028-0.033
2. Light brush on banks	0.035-0.050
D. Rock:	
1. Based on design section	0.035
2. Based on actual mean section:	
a. Smooth and uniform	0.035-0.040
b. Jagged and irregular	0.040-0.045
E. Channels not maintained, weeds and brush uncut:	
1. Dense weeds, high as flow depth	0.08-0.12
2. Clean bottom, brush on sides	0.05-0.08
3. Clean bottom, brush on sides, highest stage of flow	0.07-0.11
4. Dense brush, high stage	0.10-0.14
IV. Highway channels and swales with maintained vegetation[7] (values shown are for velocities of 2 and 6 f.p.s.):	
A. Depth of flow up to 0.7 foot:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.07-0.045
b. Length 4-6 inches	0.09-0.05
2. Good stand, any grass:	
a. Length about 12 inches	0.18-0.09
b. Length about 24 inches	0.30-0.15
3. Fair stand, any grass:	
a. Length about 12 inches	0.14-0.08
b. Length about 24 inches	0.25-0.13
B. Depth of flow 0.7-1.5 feet:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.05-0.035
b. Length 4 to 6 inches	0.06-0.04
2. Good stand, any grass:	
a. Length about 12 inches	0.12-0.07
b. Length about 24 inches	0.20-0.10
3. Fair stand, any grass:	
a. Length about 12 inches	0.10-0.06
b. Length about 24 inches	0.17-0.09
V. Street and expressway gutters:	
A. Concrete gutter, troweled finish	0.012
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement:	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.016
E. For gutters with small slope, where sediment may accumulate, increase above values of n by	0.002
VI. Natural stream channels:[8]	
A. Minor streams[9] (surface width at flood stage less than 100 ft.):	
1. Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030-0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035-0.05
c. Some weeds, light brush on banks	0.035-0.05
d. Some weeds, heavy brush on banks	0.05-0.07
e. Some weeds, dense willows on banks	0.06-0.08
f. For trees within channel, with branches submerged at high stage, increase all above values by	0.01-0.02
2. Irregular sections, with pools, slight channel meander; increase values given in 1a-e about	0.01-0.02
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:	
a. Bottom of gravel, cobbles, and few boulders	0.04-0.05
b. Bottom of cobbles, with large boulders	0.05-0.07
B. Flood plains (adjacent to natural streams):	
1. Pasture, no brush:	
a. Short grass	0.030-0.035
b. High grass	0.035-0.05
2. Cultivated areas:	
a. No crop	0.03-0.04
b. Mature row crops	0.035-0.045
c. Mature field crops	0.04-0.05
3. Heavy weeds, scattered brush	0.05-0.07
4. Light brush and trees:[10]	
a. Winter	0.05-0.06
b. Summer	0.06-0.08
5. Medium to dense brush:[10]	
a. Winter	0.07-0.11
b. Summer	0.10-0.16
6. Dense willows, summer, not bent over by current	0.15-0.20
7. Cleared land with tree stumps, 100-150 per acre:	
a. No sprouts	0.04-0.05
b. With heavy growth of sprouts	0.06-0.08
8. Heavy stand of timber, a few down trees, little undergrowth:	
a. Flood depth below branches	0.10-0.12
b. Flood depth reaches branches	0.12-0.16
C. Major streams (surface width at flood stage more than 100 ft.): Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follow recommendation in publication cited[1] if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of	0.028-0.033

Use n = .08

Footnotes to table 1 appear at the top of page 101.

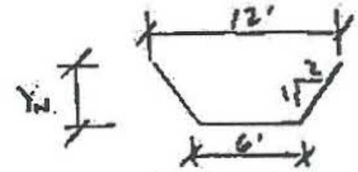
Client PSNH Job No. 2316-24 Sheet 1 of 3

Subject ______ By ALC Date 5/7/83

Chd. ______ Rev. ______

USE $n = .08$ (WEEDS / GRASS) ⇒ ROUGHNESS COEFFICIENT

① USE ORIGONAL DESIGN FLOW OF Q = 28.35 CFS



Q = 28.35 CFS
b = 6'
S = .005
SIDE S = 2:1
$n = .08$

Y_N = 1.88 FT

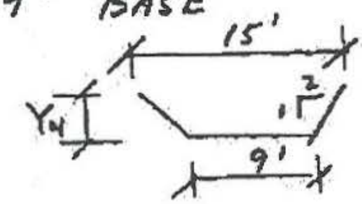
V_N = 1.54 FPS

NO GOOD Y_N (1.88) > 1.50
WATER WILL OVERFLOW SIDES OF DITCH

MAX. BOTTOM SLOPE = .005 OR .5%

MAX DEPTH OF DITCH = 1.5 FT

② INCREASE SIZE OF DITCH TO 9' BASE

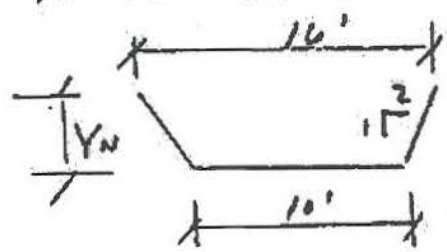


Q = 28.35 CFS
b = 9'
S = .005
SIDE S = 2:1
$n = .08$

Y_N = 1.58 FT
V_N = 1.31 FPS

NO GOOD Y_N (1.58)' > 1.50'

③ INCREASE SIZE OF DITCH TO 10' BASE



Q = 28.35 CFS
b = 9'
S = .005
SIDE S = 2:1
$n = .08$

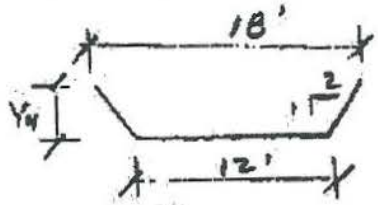
Y_N = 1.50 FT

V_N = 1.46 FPS

MAIN 1893

Client: PSNH Job No. 2316-24 Sheet 2 of 3
Subject: By ALC Date 9/7/83
Ckd. Rev.

(4) A) INCREASE SIZE OF DITCH TO 12' BASE TO REDUCE VELOCITY OF WATER

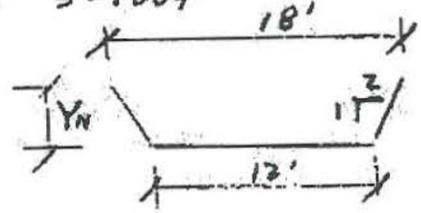


$Q = 28.35$ CFS
$b = 12$ FT
$S = .005$
SIDE S = 2:1
$n = .08$

$Y_N = 1.37$ FT

$V_N = 1.41$ FPS

B) ALLOW WATER TO RISE UP TO MAX. OF 1.5 FT. BY REDUCING SLOPE OF DITCH TO $S = .004$

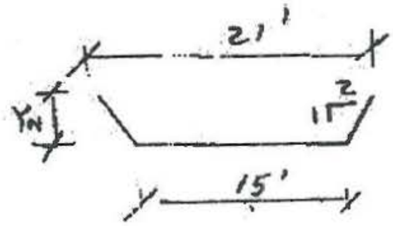


$Q = 28.35$ CFS
$b = 12$ FT
$S = .004$
SIDE S = 2:1
$n = .08$

$Y_N = 1.46$ FT

$V_N = 1.31$ FPS

(5) A) INCREASE SIZE OF DITCH TO 15' BASE TO TRY AND REDUCE VELOCITY.

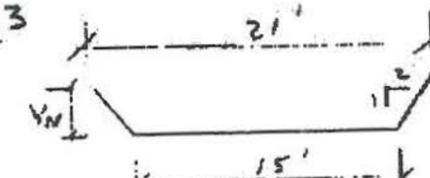


$Q = 28.35$ CFS
$b = 15$ FT
$S = .005$
SIDE S = 2:1
$n = .08$

$Y_N = 1.21$ FT

$V_N = 1.34$ FPS

B) ALLOW WATER TO RISE UP TO MAX 1.5 FT BY REDUCING SLOPE OF DITCH TO $S = .003$



$Q = 28.35$ CFS
$b = 15'$
$S = .003$
SIDE S = 2:1
$n = .08$

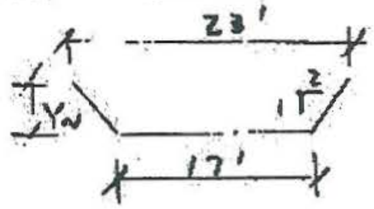
$Y_N = 1.40$ FT

$V_N = 1.13$ FPS

MAIN
1893

Client PSNH Job No. 2316-24 Sheet 3 of 3
Subject By ALC Date 9/7/83
Chkd. Rev.

⑥ a) INCREASE SIZE OF DITCH TO 17' BASE

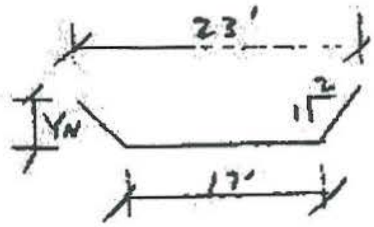


Q = 28.35
b = 17'
s = .005
SIDE S = 2:1
n = .08

Y_N = 1.13 FT

V_N = 1.30 FPS

b) ALLOW WATER TO RISE TO MAX. 1.5 FT BY REDUCING SLOPE OF DITCH TO S = .002



Q = 28.35
b = 17'
S = .002
SIDE S = 2:1
n = .08

Y_N = 1.48 FT

V_N = 0.96 FPS

MAIN 1893

Client: PSNH Job No. 2316-24 Sheet 1 of 1

Subject: By: ALC Date: 9/7/83

Ckd. Rev.

① ORIGANAL DITCH AS SHOWN IN PLAN W/ Q = 14 CFS

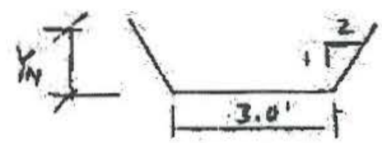
Q = 14.0 CFS (EXCLUDE RUNOFF FROM COAL PILE)

n = .035 (CRUSHED STONE)
SLOPE = .005
SIDE SLOPE = 2:1

Y_N = 1.11 ft - HEIGHT OF WATER IN DITCH
V_N = 2.43 Ft/Sec - VELOCITY OF WATER IN DITCH

② A) CHANGE LINING OF DITCH TO WEEDS & BRUSH OR GRASS ∴ USE n = 0.08

Q = 14.0
n = .08
SLOPE = .005
SIDE SLOPE = 2:1

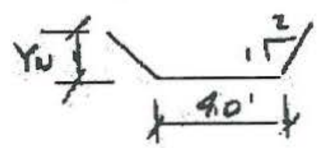


Y_N = 1.67 ft.
V_N = 1.32 F.P.S.

B) INCREASE BOTTOM OF DITCH TO 4.0'

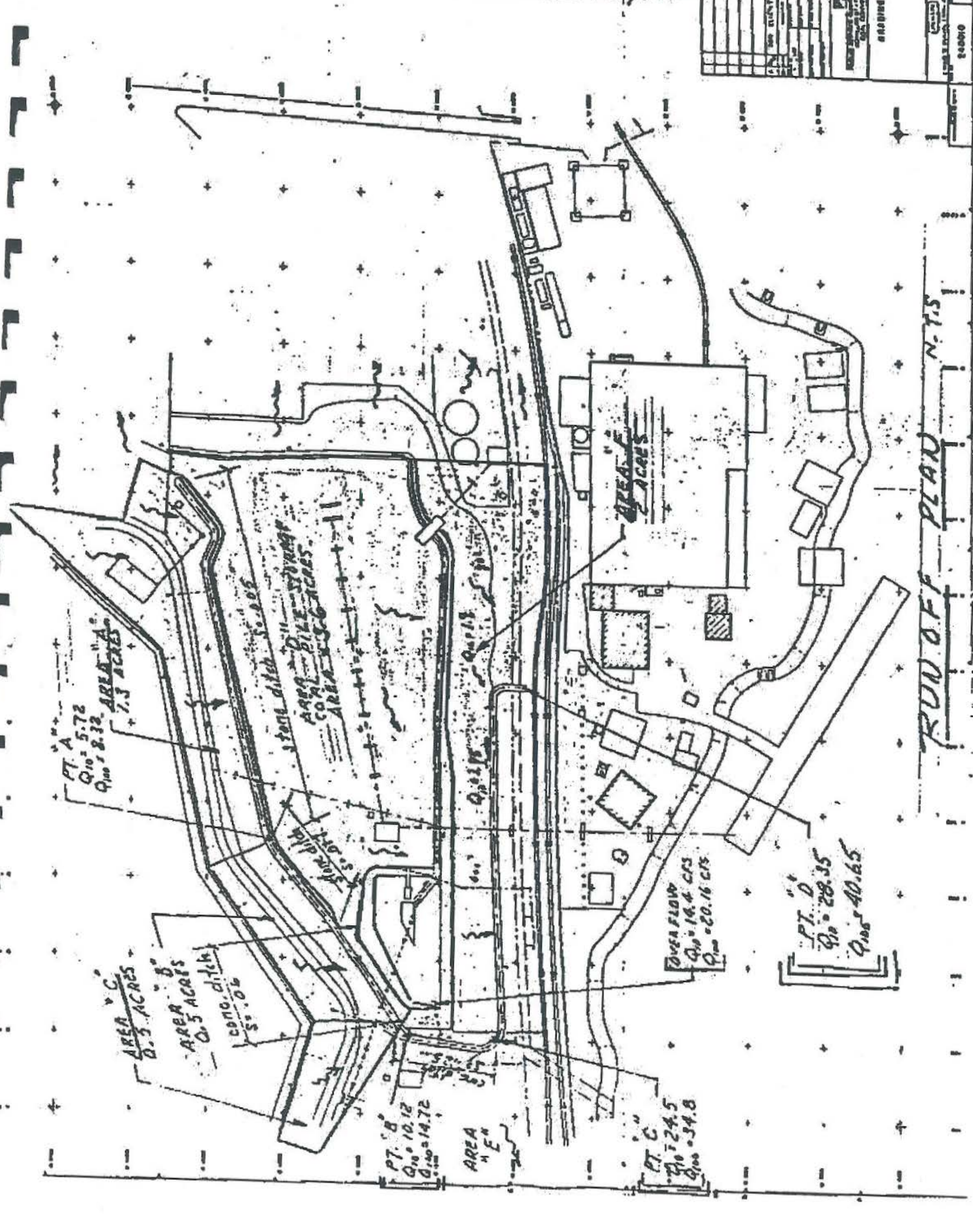
Q = 14.0
n = .08
SLOPE = .005
SIDE SLOPE = 2:1

Y_N = 1.52 FT
V_N = 1.31 FPS



P.S.N.H.
COAL CONVERSION PROJECT
SCHILLER STA.

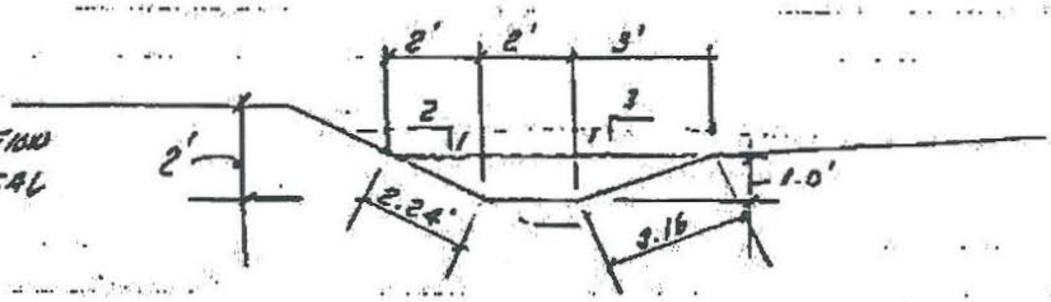
2316-24
SH. 1 OF 7
JAN. 9, 1983



Client P. S. N. H Job No. 2316-24 Sheet 2 of 7
Subject COAL CONVERSION PROJECT By B.B Date JAN. 4, 1983
SCHILLER STA Chd. ALC Rev.

COMPUTE RUNOFF FROM COAL PILE & DITCH SIZE REQ'D.

DITCH
CROSS SECTION
FOR TYPICAL



WATERWAY AREA $A = 4.5$ S/F
$A = 2.5 + 2 = 4.5$ S/F $S = .005$ $S^{1/2} = .07071$
$R = \frac{A}{P} = \frac{4.5}{7.4} = .608$ $R = 0.608$ $R^{2/3} = 0.717$
$P = 2.24 + 3.16 + 2 = 7.4$
$n = .016$ PAVED LINING

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$

$= \frac{1.486}{.016} \times 0.717 \times 0.07071 = 4.7$ F.P.S.

$Q = A \times V$
$= 4.5 \times 4.7$
$= 21.2$ C.F.S. — THIS DITCH CAPABLE TO HANDLE 100 YR STORM IF NOT BLOCKED

RUNOFF FROM COAL PILE
DISTANCE OF RUNOFF TRAVEL. 600'
SLOPE = 5% TO 8%
APPROX TIME = 10 min

AREA "D"

100 YR / 1 hr = 2.9 $i = 7.0$
$c = .8$ (ASSUME SOME PERCOLATION INTO COAL PILE)

$Q = A.c.i$
$Q_{100} = (3.5)(.8)(7.6)$
$= 20.16$ C.F.S.

10 YR / 1 hr = 1.75 $i = 5.0$
$c = .6$ (ASSUME SOME PERCOLATION INTO COAL PILE)
$Q = A.c.i$
$Q_{10} = (3.5)(.6)(5.0)$
= [illegible]

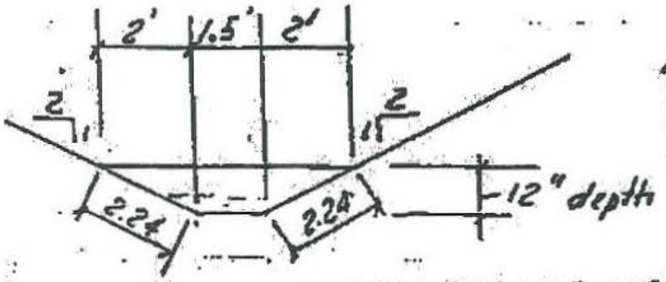
Client P.S. N.H — Job No. 2316-24 — Sheet 3 of 7

Subject COAL CONVERSION PROJECT — By B.B. — Date JAN. 4, 1983

SCHILLER STA — Ckd. Alc — Rev.

COMPUTE RUNOFF FROM SPRAGUE OIL FARM & DITCH SIZE REQ'D.

DITCH "A"
CROSS SECTION
FOR TYPICAL



NOTE THIS DITCH IS SIZED FOR PRACTICAL CONSTRUCTION - STONE IS FOR GRASS CONTROL ONL.

$P = 2.24 + 2.24 + 1.5 = 5.98$

WATERWAY AREA
$A = 2 + 1.5 = 3.5$ S/F
$R = \frac{A}{P} = \frac{3.5}{5.98} = .585$

$S = .005$; $S^{1/2} = .07071$
$R = .585$; $R^{2/3} = .70$
$n = .035$ ROCK LINING

ACTUAL VELOCITY
2.0 FPS FOR
$Q_{10} = 5.72$ CFS

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2} = \frac{1.486}{.035} \times .70 \times .07071 = 2.10$ F.P.S.

$Q = A \times V = 3.5 \times 2.10 = 7.35$ C.F.S.

DITCH "B"

$S = .017$; $S^{1/2} = .1304$
$R = .585$; $R^{2/3} = .70$
$n = .035$ ROCK LINING

ACTUAL VELOCITY
3.1 FPS. FOR
$Q_{10} = 5.72$ CF.

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2} = \frac{1.486}{.035} \times .70 \times .1304 = 3.9$ F.P.S.

$Q = A \times V = 3.5 \times 3.9 = 13.6$ C.F.S.

RUNOFF - FROM NORTH END OF OIL FARM to stone ditch
@ POINT "A" - 1.3 ACRES ± — 10 YR./1 HR = 1.75"
OVERLAND TIME = 5 MIN
$i = 5.5$" $C = .8$ (grass & paving.

AREA "A"

$Q_{10} = A \cdot c \cdot i$
$= (1.3)(.8)(5.5)$
$= 5.72$ C.F.S.

100 YR/1 Hr = 2.9"
OVERLAND TIME = 5 MIN
$i = 8.0$ $C = .8$ (grass & paving.

$Q_{100} = A\,c\,i$
$= (1.3)(.8)(8.0)$
$= 8.32$ C.F.S.

Client P.S N.H. Job No 2316-24 Sheet 4 of 7

Subject COAL CONVERSION PROJECT By BB Date JAN. 5, 1983

SCHILLER STA Chd. Alc Rev.

DITCH "C" WATERWAY AREA = 3.5 S/F

STONE

$R = .585 \quad = R^{2/3} = .70$

$S = .06 \quad = S^{1/2} = .245$

$n = .035$ ROCK LINING

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2} = \frac{1.486}{.035} \times .70 \times .245 = 7.3$ F.P.S.

$Q = A \times V = 3.5 \times 7.3 = 25.5$ C.F.S.

THIS DITCH LINING NOT RECOMMENDED AS VELOCITYS COULD BE HIGH

DITCH "C"

CONC

$A = 3.5$ S/F

$R = .585 \quad R^{2/3} = .70$

$S = .06 \quad S^{1/2} = .245$

$n = .016$ CONC. LINING

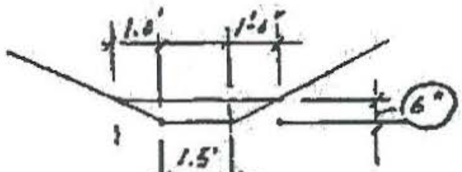
$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2} = \frac{1.486}{.016} \times .70 \times .245 = 15.9$ F.P.S.

$Q = A \times V = 3.5 \times 15.9 = 55.6$ CFS.

THIS DITCH LINING IS MORE THAN REQ'D BUT FOR SIMPLICITY OF CONSTRUCTION CROSS SECTION REMAINS SAME

---

* CHECK MIN. SIZE OF DITCH REQ'D. FOR RUNOFF FROM OIL FARM @ .06 SLOPE USING CONCRETE LINING



WATERWAY AREA

$A = .75 + .50 = 1.25$ S/F

$P = 1.0 + 1.5 + 1.0 = 3.5$

$R = \frac{A}{P} = \frac{1.25}{3.5} = .357 = R \quad = R^{2/3} = .506$

$S = .06 \quad = S^{1/2} = .245$

$n = .016$ CONC. LINING

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$

$= \frac{1.486}{.016} \times .506 \times .245 =$

$= 11.5$ F.P.S

$Q = A \times V = 1.25 \times 11.5 = 14.4$ C.F.S.

POSSIBILITY THAT DITCH CONC. COULD BE LOWERED TO 6" HIGH CONCRETE

Client P.S. N.H Job No. 2316-24 Sheet 5 of 7
Subject COAL CONVERSION By B.B. Date JAN. 6, 83
SCHILLER STA. Chd. ALC Rev.

RUNOFF FROM AREA "B" (.5 ACRES) + AREA "C" (.5 ACRES)
= 1.0 ACRE
USE SAME $i = 5.5$ (10 YR/1 hr)
$C = .8$

$Q_{10} = A \cdot c \cdot i$
$= (1.0)(.8)(5.5)$
$= 4.4$ CFS

$Q_{100} = A \cdot c \cdot i$ USE SAME $i = 8.0$ (100 YR/1 hr)
$= (1.0)(.8)(8.0)$ $C = .8$
$= 6.4$ C.F.S

ADD RUNOFF FROM AREA "A" TO RUNOFF FROM "B+C"

AREA A = $Q_{10} = 5.72$ CFS $Q_{100} = 8.32$ C.F.S.

AREA B+C $Q_{10} = 4.40$ $Q_{100} = 6.4$

RUNOFF TO PT "B" = $Q_{10} = 10.12$ CFS* $Q_{100} = 14.72$ C.F.S*

ASSUME RUNOFF FROM AREA "E"
IS FLOWING SOUTHERLY.
ADD COAL PILE RUNOFF OVERFLOW TO ABOVE
QUANTITIES. : $Q_{10} = 10.12$ * $Q_{100} = 14.72$ *
(COAL PILE) AREA "D" = $Q_{10} = 14.4$ $Q_{100} = 20.16$

RUNOFF TO PT. "C" = $Q_{10} = 24.52$ CFS TOTAL $Q_{100} = 34.88$ CFS

ADD RUNOFF FROM AREA "F" TO RUNOFF @
PT. "C" = $Q_{10} = 24.5$ CFS $Q_{100} = 34.8$
AREA F + $Q_{10} = 3.85$ $Q_{100} = 5.85$

RUNOFF TO PT. "D" Q_{10} 28.35 CFS Q_{100} 40.65

Client P.S. N.H. Job No. 2316-24 Sheet 7 of 7

Subject COAL CONVERSION By BB Date JAN. 6, 1982

SCHILLER STA Chd. ALC Rev.

PROBLEM: DETERMINE RUNOFF FROM AREA "F". THIS AREA WILL CONTRIBUTE TO TOTAL Q ENTERING THE NEW INLET CONSTRUCTION CONNECTED TO THE EXIST. 18" φ RCP

$Q_{10} = A.c.i$ — 10 YR / 1HR = 1.75

$= (1.0)(.6)(3.25)$ — OVERLAND (400' @ .005) poor grass-surface

$= 1.95$ CFS — $t = 22$ min, $i = 3.25$

c = .6 (figure is high

$Q_{10} = A.c.i$ — 10 yr / 1hr = 1.75

$= (.9)(.6)(3.5)$ — OVERLAND (300' @ .005) poor grass surface

$= 1.9$ CFS — t: 20 min, $i = 3.5$

c = .6

total Q_{10} = 3.85 CFS FOR AREA "F"

$Q_{100} = A.c.i$ — 100 YR / 1hr = 2.9"

$= (1.0)(.6)(5.0)$ — OVERLAND (400' @ .005) poor grass

$= 3.0$ CFS — t: 22 min, i: 5.0"

100 yr / 1hr = 2.9

OVERLAND (300' @ .005) poor grass

$Q_{100} = A.c.i$ — t: 20 min, i: 5.25

$= (.9)(.6)(5.25)$

$= 2.8$ CFS.

total $Q_{100} = 5.84$ CFS FOR AREA "F"

Client P.S. N.H. Job No 2316-29 Sheet 11 of 11
Subject COAL CONVERSION PROJECT By BCS. Date JAN. 15, 1985
SCHILLER STA. Chkd. [illegible] Rev.

CONCLUSION:

1. STORM DRAINAGE DITCHES HAVE BEEN DESIGNED FOR THE WORST CONDITION (100 YR/1HR STORM) TO INTERCEPT THE RUNOFF FROM SPRAGUE OIL TANK FARM.
   DITCH CROSS SECTIONS HAVE BEEN KEPT TYPICAL FOR EASE OF CONSTRUCTION EVEN THOUGH CAPACITY IS GREATER THAN REQ'D.
2. COAL PILE RUNOFF INTO BASIN HAS BEEN CALCULATED FOR WORST CONDITION (100 YR/1HR). ASSUMING THAT THE BASIN IS FULL, THE Q_{100} FLOW ENTERING OVERFLOW INLET CAN SAFELY BE DISCHARGE INTO THE DRAINAGE DITCH AND THUS TO THE LOWER AREA. THIS ASSUMPTION WAS MADE IN ORDER TO PREVENT WASHOUT OF THE UPPER PLATEAU EMBANKMENTS.
3. THE TOTAL RUNOFF ENTERING THE PROPOSED INLET ON THE WEST SIDE OF THE TRACKS HAS BEEN COMPUTED FOR BOTH 10 YR/1HR & 100 YR/1HR STORMS.
   WITH THESE QUANTITIES IT HAS BEEN DETERMINED THAT DUE TO THE EXISTING PIPE (18" Ø R.C.P. PIPE CROSSING UNDER TRACKS) CAPACITY, ONLY A 10 YR/1HR STORM RUNOFF CAN BE DISCHARGED TO THE RIVER.
   THE REMAINDER OF RUNOFF FROM A 100 YR/1HR STORM WILL OVERFLOW THE DITCH LOCATED @ THE TOE OF SLOPE (WEST SIDE OF TRACKS) & FLOW IN A SOUTHERLY DIRECTION ADJACENT TO THE TRACKS WHERE THE OVERFLOW WILL BE INTERCEPTED BY EXIST. CULVERTS LOCATED ALONG THE R.R. RIGHT OF WAY.
4. RUNOFF FROM THE COAL PILE WILL BE COLLECTED & TREATED & THEN DISCHARGED TO THE RIVER.
   RUNOFF FROM SPRAGUE OIL FARM WILL BE COLLECTED & DISCHARGED INTO RIVER.

Client ... Job No. ... Sheet 1 of 3
Subject COAL CONVERSION By ... Date 11/28/82
SCHILLER STA. Ckd. ... Rev. ...

DETERMINE SIZE OF COAL PILE RUNOFF RETENTION BASIN

1. APPROX. AREA OF CONTAMINATED COAL PILE STORAGE = 3.6 ACRES

2. STORM DURATION 10/YR./24 hr = 4.6

ASSUME COAL PILE HAS C = .70* (ASSUME COAL PILE WILL RETAIN .3 OF RUNOFF)
FOR RATIONAL FORMULA
(3630 cf (H_2O) = 1" deep, 1 acre)

Q = A C i
= (3.6)(.70)(4.6)
= 11.6 ACRE INCH
= (11.6)(3630)(7.48)
= 314,750 gals CALL 315,000 gals.

* NOTE: AMOUNT OF RUNOFF WILL DEPEND ON MANY VARIABLES WHICH AFFECT THE ACTUAL Q. THEY INCLUDE: 1. SHAPE OF COAL PILE IN STORAGE 2. HEIGHT/AREA @ TIME OF STORM, 3. COMPACTION/DENSITY

CONCLUSION:
THE C = .70 USED FOR COMPUTATIONS IS A CONSERVATIVE & REASONABLE VALUE

Client. P-S[illegible] Job No. [illegible] Sheet 2 of 3
Subject COAL [illegible] By. B.B. Date [illegible]
SCHILLER STA. Ckd. [illegible] Rev.

DE[illegible] SIZE & VOLUME (CAPACITY) OF COAL PILE RUNOFF RETENSION BASIN - SEE SH. 3 of 3 FOR PLAN

AT [illegible] (L.W) = 1417 s/f = A_0 (B)
AT [illegible] (H.W) = 9090 s/f = A_1 (T)

(END [illegible]) PAGE [illegible]
[illegible] = .1482
(distance)

[illegible]
= 1417 + 9090 X [illegible] X 27 = 42,042.7 c/f
X 7.48 = 314,479 gals.

WORKING VOLUME

ALTERNATE METHOD OF COMPUTATION
CHECK 9090 - 1417 = 7673

1417 × 8 = 11336
7673 × 8/2 = 30692
43,028
× 7.48
= 314,369 gals

CHECK

$V = \frac{A_0 + A_1}{2} \cdot L =$

$= \frac{1417 + 9090}{2} \cdot 8 = 42,028$ c/f $\times 7.48 = 314,369$ gals.

DETERMINE VOLUME OF SLUDGE CAPACITY @ BOTTOM OF BASIN — END METHOD COMPUTATION FORMULA
P. 322 constant - 2' depth = .0370

AT EL. 46.00 = 1417 S/F (L.W) = "T"
AT EL 44.00 = 525 S/F (BOTT) = "B"

V = B + T × constant
= 525 + 1417 × .0370 × 27 = 1940 c/f SLUDGE
1940 × 7.48 = 14,511 gals.

CHECK

$V = \frac{A_0 + A_1}{2} \cdot L$

$= \frac{525 + 1417}{2} \cdot 2 = 1942$ c/f

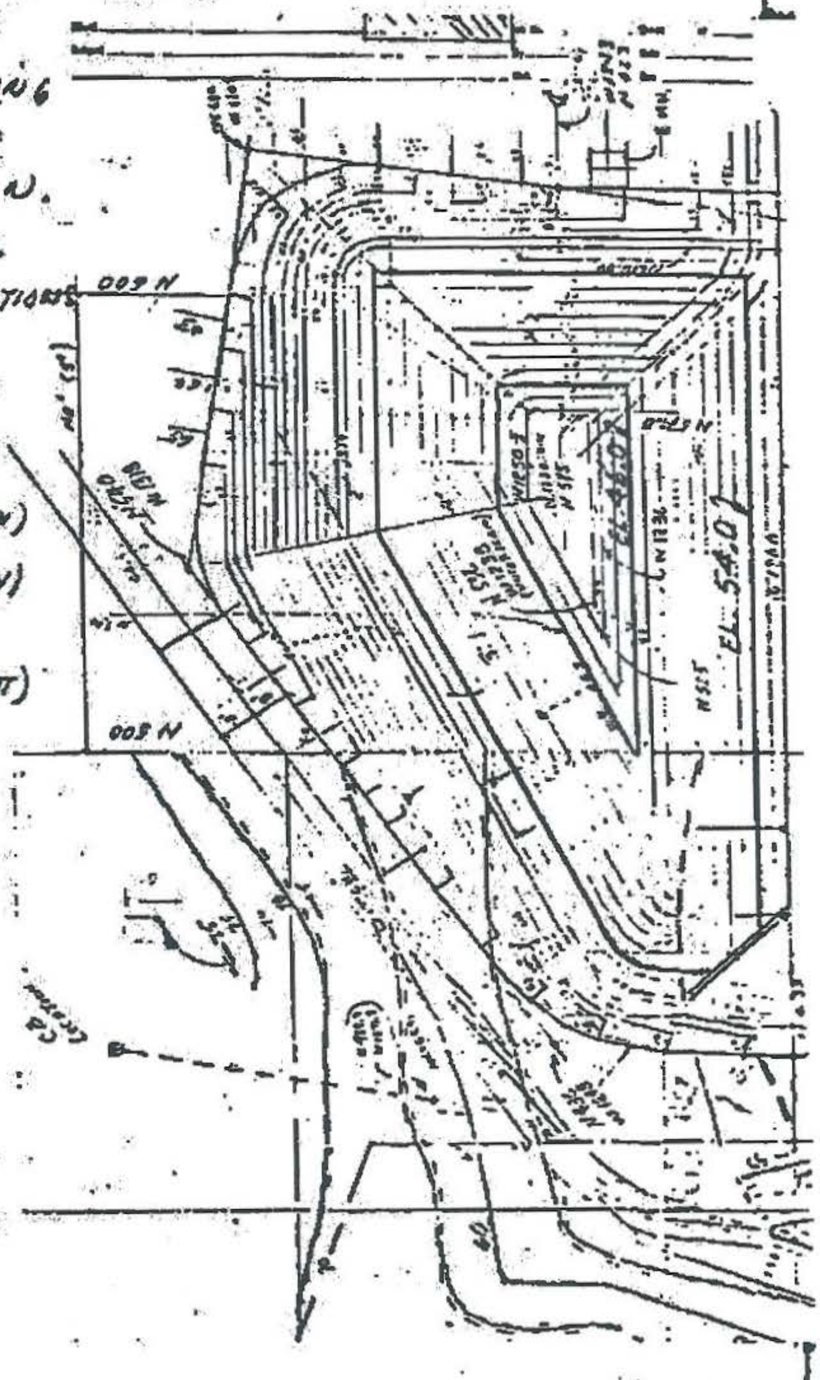
COAL CONVERSION
SCHILLER STA.

B.B.
WLC

11/20/82

PLAN OF COAL PILE RETENTION BASIN.

DETERMINE CAPACITY OF BASIN BY OBTAINING AREA OF BASIN AT WORKING VOLUME ELEVATIONS AS SHOWN ON PLAN. SEE SH. 2 OF 3 FOR END METHOD COMPUTATIONS

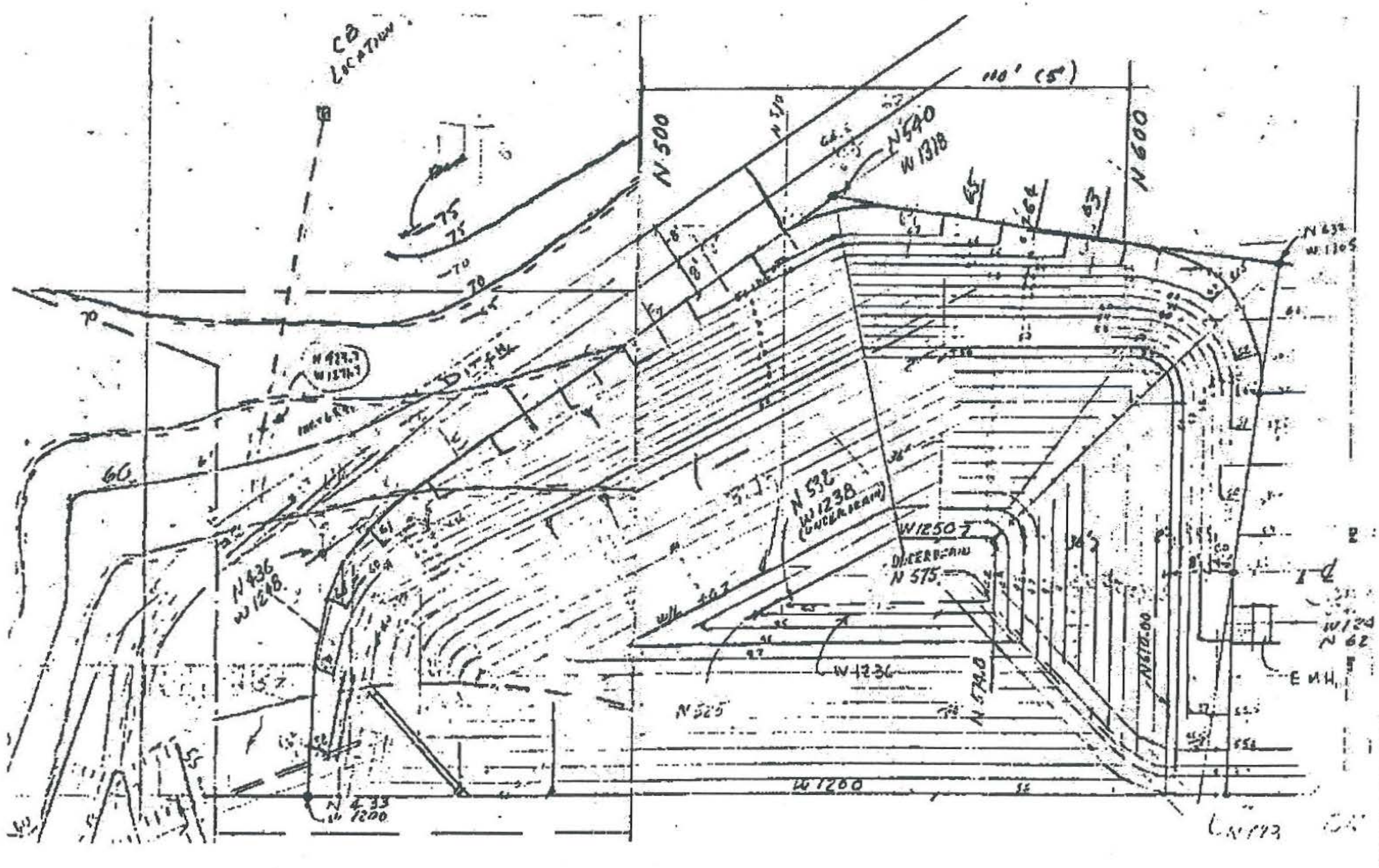


BY PLANIMETER

WORKING VOLUME AREAS
- EL. 46.00 = 1417 S/F (L.W)
- EL 54.00 = 9090 S/F (HW)

EL 44.00 = 525 S/F (BOTT)

SCALE: 1" = 40'



CB
LOCATION
75
70
DITCH
60
N 500
N 600
110' (5')
N 540
W 1318
N 632
W 1305
N 538
W 1238
(UNDERDRAIN)
W1250.7
UNDERDRAIN
N 575
N 436
W 1218
N 525
W 1236
N 574.0
N 610.00
W 1200
N 433
W 1200
W 124
N 62
E MH

MAIN

Client PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

Project COAL CONVERSION PROJECT

Subject SCHILLER STATION UNITS 4,5,& 6

Client No. 2316 Job No. 24 Task No.

Description

1. DETERMINE SIZE OF OVERFLOW WEIR & PIPE SIZE FROM COAL PILE RETENSION BASIN IN THE EVENT BASIN IS FULL & 100 YR/1HR STORM OCCURS
2. DETERMINE SIZE OF BAFFLE CHUTE ENTERING RETENSION BASIN.

Codes and Standards

1. DESIGN CRITERIA DOCUMENT
2. HANDBOOK FOR CONC. CULVERT PIPE HYDRAULICS (PORTLAND CEMENT ASSOC)
3. MANNINGS FORMULA

Information Sources

4.
5.
6.
7.
8.
9.
10.
11.
12.

Assumptions

Output Documents

C.T. MAIN DWGS.
- SITE PLAN DWG. 240000, SITE GRADING PLAN 240010
SITE DETAILS DWG 240020 & 240030

Revision	Description	By	Date	Chk.	Date	Appd.	Date
	STORM RUN-OFF - DRAINAGE CALCS	BK	1/4/83	AC	8/3/83		

Client P.S. & H.

Subject [illegible] — Schiller Sta.

Job No. [illegible] Sheet 1 of 2

By B.B. Date 1/6/83

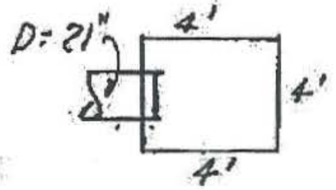
Chd. [illegible] Rev.

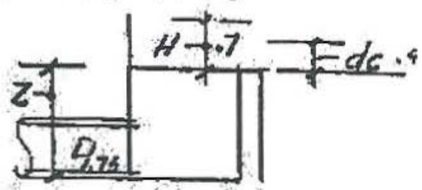
PROBLEM: ASSUME COAL PILE RETENSION BASIN IS FULL & A 100 YR / 1 HR STORM OCCURS. OBTAIN SIZE OF OVERFLOW WEIR FOR DISCHARGE & PIPE CAPACITY

REF. Handbook for Conc. Culvert pipe Hydraulics (P.C.A) chapter 7

1. OBTAIN CRITICAL DEPTH OF DROP INLET USING Q_{100} = <u>20 CFS.</u> ($Z = 2D$ min.)

TRY WEIR SIZE
$L = 12'$ LG
$g = 32.2$ ft/sec





$$d_c = \sqrt[3]{\frac{Q^2}{L^2 g}} = \sqrt[3]{\frac{20^2}{(12)^2(32.2)}} = \sqrt[3]{\frac{400}{4636.8}} = \sqrt[3]{.0862} = d_c = \underline{.44}$$

2. OBTAIN FLOW OVER WEIR.

$$C = \frac{H}{D} = \frac{.7}{1.75} = .40$$

C = DISCHARGE COEFFICIENT
D = CULVERT PIPE SIZE
H = HEAD WATER DEPTH
L = LENGTH OF WEIR

REFER TO PAGE 174 HANDBOOK OF CONC. PIPE HYDRAULICS.

VALUE OF C = 3.33

$$Q = C L H^{3/2}$$
$$= (3.33)(12.0)(0.7)^{3/2}$$
$$= \underline{23.47} \text{ CFS.}$$

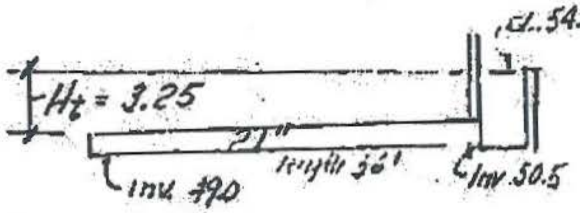
Client ______ Job No. ______ Sheet 2 of 2

Subject COAL ______ By BD Date ______

______ Chk. REC Rev. ______

(REF: Handbook of conc. culv. pipe hyd: PCA page 1_)

3. OBTAIN CAPACITY OF DISCHARGE PIPE



$D = 21''\ (1.75')$

$g = 32.2$

H_t: total head, ft measured from headwater surface in riser to crown of culvert outlet

$n = .015$

outlet loss K_o = usually 1.0

Entrance loss $K_e = 1.2$ (SQ EDGE PIPE OPENING INTO RISER

$$\begin{array}{r} EL.\ 49.0 \\ +\ 1.75 \\ \hline 50.75 \end{array} \qquad \begin{array}{r} EL.\ 54.00 \\ -\ 50.75 \\ \hline 3.25 \end{array}$$

$$Q = \frac{\pi D^2}{4}\sqrt{\frac{2gH_t}{K_e + K_o + fL/D}}$$

Darcy Friction factor $= f = (185)\frac{n^2}{D^{1/3}}$

$$= (185)\frac{.015^2}{1.75^{1/3}}$$

$$= (185)\frac{0.000225}{1.2}$$

$$f = .035$$

$$= \frac{(3.1416)(1.75)^2}{4}\sqrt{\frac{(2)(32.2)(3.25)}{1.2 + 1.0 + 1.12}}$$

$$= 2.41\sqrt{\frac{209.3}{3.32}}$$

$$= (2.41)(7.9)$$

$fL/D = (.035)\frac{56}{1.75}$

$fL/D = 1.12$

Q = 19.04 C.F.S. CAPACITY OF PIPE

NOTE: SINCE H_t IS ACTUALLY higher $H_t\ 3.25 + D_c\ .44 = 3.69$ FT.

CAPACITY OF PIPE IS GREATER.

$$R = 1.0 \times \frac{D}{4} = 1.0\,\frac{1.75}{4} = .44 = R$$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2} = \frac{1.486}{.015}(.44)^{2/3}(.024)^{1/2}$$

$$= \frac{1.486}{.015}(.578)(.1549) = \underline{8.9}\ F.P.S$$

APPENDIX C

MAPS

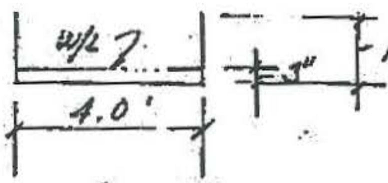
Client P.S.N.H. Job No. [illegible] Sheet 1 of 1

Subject Coal Conversion Project By B.B. Date Jan. 26, 1983

Schiller Sta. Chd. [illegible] Rev.

PROBLEM: DETERMINE SIZE OF BAFFLE CHUTE FOR COAL PILE RUNOFF DISCHARGING INTO RETENTION BASIN.

TRY WATER DEPTH 3"



WATERWAY AREA $A = 1.0$ S/F

$P = .25 + 4.0 + .25 = 4.5$

$S = .33 \;\; S^{1/2} = .58$

$R = .22 \;\; R^{2/3} = .364$

$n = .016$ CONC LINING

$R = \frac{A}{P} = \frac{1.0}{4.5} = .22$

$$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$$

$$= \frac{1.486}{.016} \times .364 \times .58$$

$$= 19.6 \text{ F.P.S.}$$

$$Q = A \times V$$

$$= 1.0 \times 19.6 =$$

$= 19.6$ C.F.S. OK AS $Q_{100} = 20$ C.F.S.

1. CHUTE TO BE PROVIDED WITH BAFFLES TO REDUCE VELOCITY BEFORE ENTERING RETENTION BASIN
2. BAFFLE SIZE & SPACING TO BE AS RECOMMENDED BY REFERENCE MATERIAL:

DESIGN OF SMALL DAMS
BY U.S. DEPT. OF INTERIOR - BUREAU OF RECLAMATION

USE CONCEPT OF BAFFLED CHUTE SPILLWAY