Appendix D

Sample Engineering Notes and Computations

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Appendix D Sample Engineering Notes and Computations

Appendix D contains the format for engineering field notes and related field staking in the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). The instructions and sample notes represent the best practicable blending of the many existing note formats to fit the needs of the NRCS.

Engineering surveys, staking, notekeeping, calculations, and note interpretations are part of the daily activities of many NRCS personnel, as well as contractors, consultants, district employees, and others.

It is important, therefore, that these operations are performed with the greatest possible efficiency and in a manner that will result in maximum usefulness of the information obtained. This calls for uniformity in methods and procedures between States and between workstations within States.

General

Field notebooks and special forms
Bound and loose-leaf field notebooks are both satisfactory for most NRCS engineering surveys. However, the loose-leaf notebooks should not be used for project or other contract work where the notes might be used as evidence or supporting data in court actions. Loose-leaf notes are not generally acceptable to the courts.

The use of special forms is recommended for recording engineering notes and design data for such practices as terraces, diversions, waterways, small pond dams, and similar work. It is extremely important, however, that the method be uniform and forms provide for at least the minimum construction check information shown in the sample notes.

Numbering, identifying, indexing, and filing

Numbering bound notebooks
Bound field notebooks should be numbered consecutively for each broad activity. Use one series of numbers for ordinary on-farm work (including cost-share programs} in each field office. The numbering may run consecutively from year to year or may start with number 1 at the beginning of each year. In the latter case, the year should precede the number such as 2010–1, 2010–2, etc.

Design and construction notebooks for project installation will be numbered in a separate series for each structure. Place the name of the project and the name (if there is one) and number of the structure site on each notebook. All notebooks used to record notes during the project planning stage may be numbered in one continuous series for the project area. A separate series of numbers will be used for each group project. Books containing notes of surveys made for other agencies should be numbered and identified as outlined for group or project type work. In all cases, the identifying name should be lettered with indelible ink or its equivalent.

Identifying notebooks
Identify all field notebooks, both bound and loose-leaf, so that they can be returned to proper headquarters if lost. Place this identification on the inside on the front cover or on the flyleaf of bound notebooks. For most loose-leaf notebook binders, it will be necessary to paste a white tab to the inside front cover.

The following identification should be used:

U.S. GOVERNMENT PROPERTY

Finder please return to

NATURAL RESOURCES
CONSERVATION SERVICE

_____

(Street or P.O. Box No.)

_____

(City) (State) (Zip)

Indexing bound notebooks

The first 5 to 10 pages of each bound notebook should be reserved for indexing.

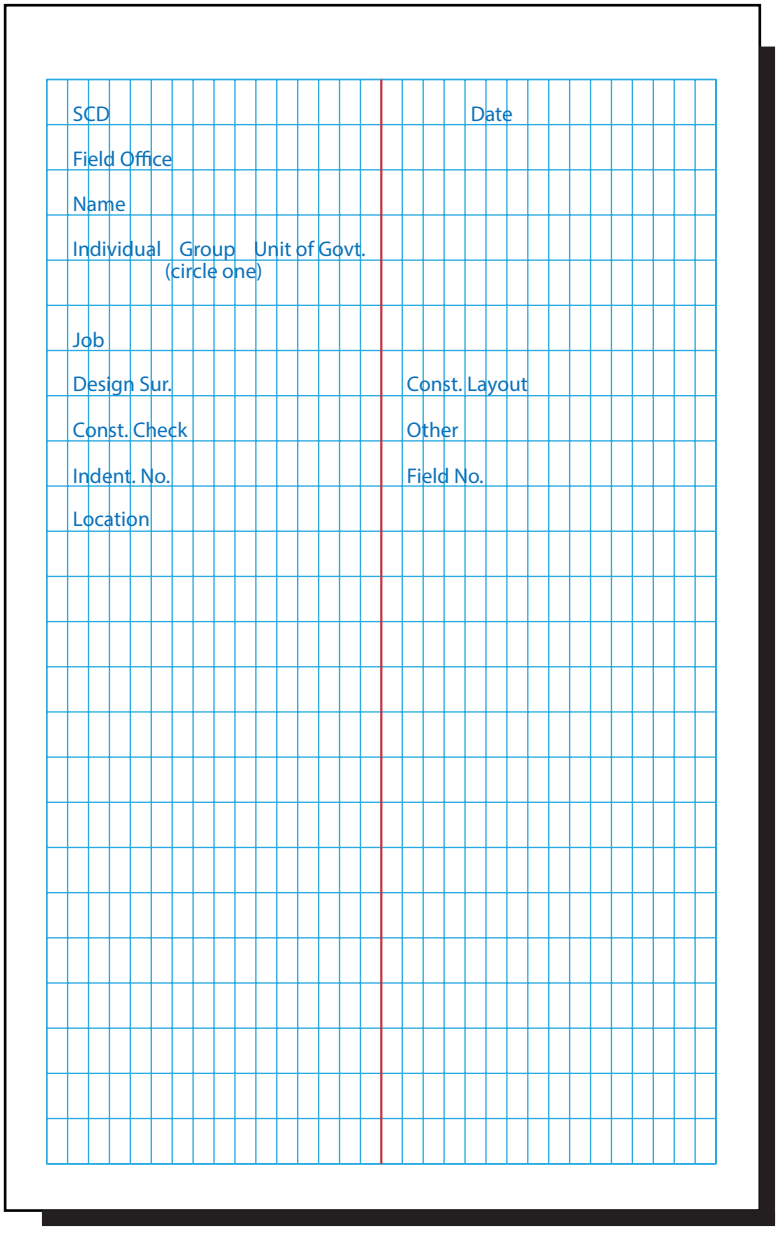
Note identification

Each set of notes should have a title page. Printed title pages are available for use in loose-leaf notebook binders (sample D–1). Rubber stamps may be obtained for stamping the title page in bound notebooks.

Bound notebooks

A single title page will suffice for all the surveys related to the same job if the notes are recorded on consecutive pages or clearly cross referenced by notations such as "continued on page ___" and "continued from page _____." If this is not feasible, use a separate title page for each set of notes.

Sample D–1 Title page



Show the following information on the first page of notes following the title page:

- page number
- names of party members and assignments
- purpose of survey (design, construction layout, construction check, etc.)
- date

Show only the page number on subsequent pages unless there is a change in purpose of survey, party members, or date. Stamps may be used for recurring titles and other information.

Loose-leaf notebooks
Use a separate title page for each set of loose-leaf notes (sample D–1).

Show the following information on the right-hand face of the first page of notes following the title page:

- page number
- individual, group, or project name (may be abbreviated)
- practice or construction item (abbreviated if feasible)
- purpose of survey (design, construction layout, etc.)
- party members and their assignments
- date

Show the same information on the succeeding pages, except for party members and date, which need not be listed unless they change.

Filing notes
File all field notes in the office responsible for follow-up on the job. Fasten each set of loose-leaf notes together and file in the plan folder or appropriate job file or folder. A large envelope stapled inside the folder makes a good repository.

Recording survey data
Record all numbers, figures, and explanatory notes clearly and legibly. Use pencils of a hardness equal to or exceeding No. 2–H. Do not erase numbers. If an error is made in recording a number, a line should be drawn through it and the correct number written above.

The recorded data should give a true picture of the precision of the survey. The decimal point should never be omitted when recording decimals. If measurements are made to the nearest 0.01 foot, 2 digits should always be recorded to the right of the decimal point even though the last one, or last two, may be zeros, for example 2.10 or 4.00.

The sample notes illustrate the precision required for ordinary NRCS engineering surveys. A higher degree of precision may be required for project type work or special or unique jobs. The work outline for surveys should specify the degree of precision required. The National Engineering Handbook (NEH), Part 650, Engineering Field Handbook (EFH), Chapter 1, Engineering Surveys, describes survey precision and accuracy.

Sketches

Sketches are an important part of survey notes and should be made for all types of surveys. Sketches are of two general types: those used on the title page for general location of the job and those used in the body of the notes to show data that cannot be readily shown in other ways. Normally, sketches are not drawn to scale, but are proportioned by eye.

Stationing

Normally the starting station for survey of streams, waterways, canals, ditches, and gullies is located at the upstream end and proceeds in the direction of flow. Stationing should be compatible with computer use. In some cases, however, the survey can be accomplished with less time and effort and be related better with subsequent sections of the job by locating the starting point at the downstream end. This is especially true of drainage surveys.

Positive stationing is always preferable. Negative stationing tends to be confusing and can cause errors. When the extent of the survey is not known at the beginning, a station value sufficiently greater than 0+00 should be assigned to the starting station to ensure all stationing will be positive.

Left and right designations

Banks of streams are normally designated left and right facing downstream. Cross sections, slope stakes, and notes are directed left and right as viewed in the direction of increasing stations.

Grade rod

The notes for construction layout and check surveys illustrate the use of the grade rod. The grade rod is a time saver and has wide application in NRCS work. It eliminates the need for converting rod readings to elevations and facilitates computations since they may be made directly from the field notes. This eliminates copying time, reduces the time for checking, and the chance for errors.

The grade rod is obtained by subtracting the planned elevation at each station from the height of instrument (grade rod = H.I. – planned elev.). When the height of instrument is above the planned elevation, the grade rod has a plus value and is so marked in the notes, such as +5.2. If the height of instrument is below planned elevation, the grade rod has a minus value and is so marked, such as –8.3.

To find the cut or fill in construction layout surveys, subtract the actual rod reading from the grade rod. If the result has a minus value, a fill is indicated. If the result has a plus value, it indicates a cut.

Example A:
H.I. = 249.3

Planned elev. = 243.0

Grade rod = 249.3 – 243.0 = +6.3

Foresight = 9.8

+6.3 – 9.8 = –3.5 a fill

Example B:
H.I. = 127.4

Planned elev. = l32.6

Grade rod = 127.4 – l32.6 = –5.2

Foresight = 4.2

–5.2 – 4.2 = –9.4 a fill

Example C:
H.I. = l34.6

Planned elev. = 128.4

Grade rod = 134.6 – 128.4 = +6.2

Foresight = 2.9

+6.2 – 2.9 = +3.3 a cut

In construction check surveys, the grade rod for each station is computed as explained. The foresight at each station is mentally compared with the grade rod for that station. Thus, the work can be checked rapidly without the necessity of converting rod readings to elevations.

Standard note samples for ordinary on-farm work

The following sample notes illustrate the format for several types of surveys used for ordinary on-farm activities. The intent of these samples is to illustrate notekeeping methods, format, identification, content, and completeness.

In a limited number of instances, the sample notes include design information for the simpler projects. These design data were used only for illustration and do not establish design criteria.

Each set of notes is preceded by explanatory statements that should be studied carefully.

Sample D–2 Engineering notes for pond dam design and construction layout survey—Sheet 1 of 6

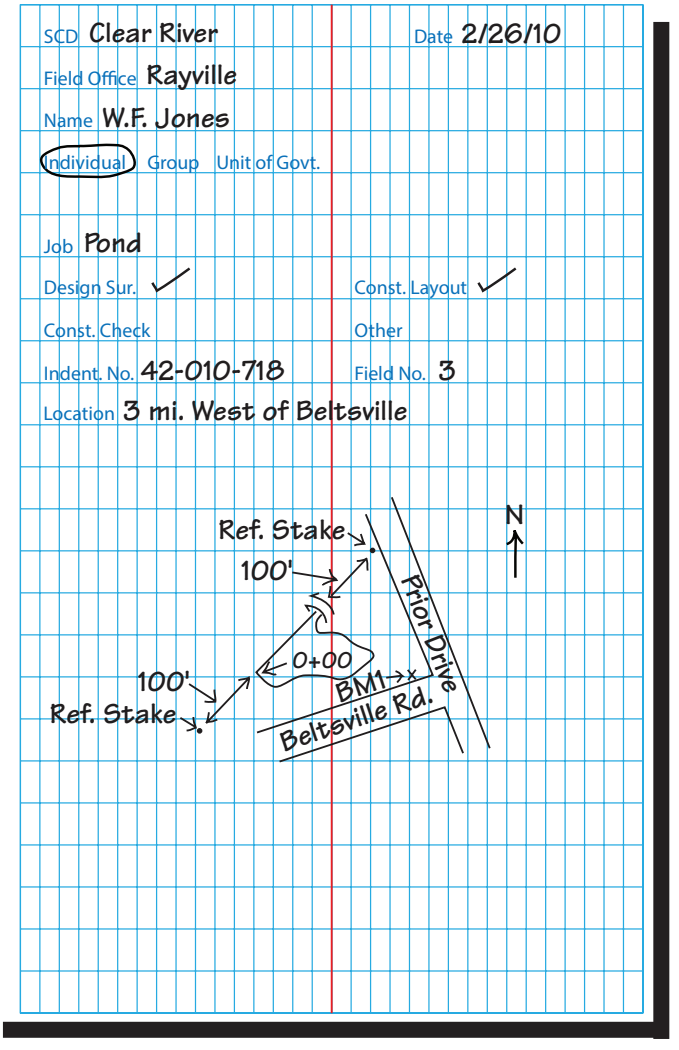
Engineering notes for pond dam design and construction layout survey

These notes are for a small pond dam that was designed and staked for construction during one trip to the field. The design survey and the construction layout survey were combined in one operation.

A reference hub was set at spillway elevation, and the following information was given to the landowner for use by him and the contractor:

1. Total fill height (design height plus allowance for settlement) at each station as measured from the reference hub.
2. Spillway dimensions and its elevation in relation to the reference hub.
3. Top width of fill.
4. Side slopes of fill.
5. Standard specifications for site preparation and placement of fill.

Soil investigations and fill volume computations were made and recorded in accordance with State NRCS procedures.



Sample D–2 Engineering notes for pond dam design and construction layout survey—Sheet 2 of 6

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Settlement =10% ℄ H.
BM1	2.80	102.80		100.00	
0+0			+0.8	102.0	
0+85			+0.8	102.0	0.5
1+0			+0.8	102.0	0.9
1+35			+0.8	102.0	0.8
2+00			+0.8	102.0	0.5
2+45			+0.8	102.0	0.2

W.F. Jones Pond — ⊼ J. Gibbs
Design & Const. Layout — ⌀ K. Hill — 2-26-10

Design Data
D.A. 8.0 ac. Q=18 (ES-1027)
Elev. top dam=102.0 top width=8.0'
Earth spillway 10.0' x 2.0 2:1 s.s.
Add 10% to ℄H for settlement

Left (downstream) 2:1	℄	Right (upstream) 3:1
	20d nail in root of 12" maple in fence corner 200' E. of S. end of dam	
F=0.0 0.8 4.0	F=0.0 0.8 0.0	F=0.0 0.8 4.0
F=5.6 6.4 15.2	F=5.0 5.8 0.0	F=4.2 5.0 16.6
F=9.2 10.0 22.4	F=9.1 9.9 0.0	F=8.2 9.0 28.6
F=8.8 9.6 21.6	F=7.9 8.7 0.0	F=7.2 8.0 25.6
F=4.8 5.6 13.6	F=4.7 5.5 0.0	F=2.4 3.2 11.2
F=3.3 4.1 10.6	F=2.0 2.8 0.0	F=1.0 1.8 7.0

Sample D–2 Engineering notes for pond dam design and construction layout survey—Sheet 3 of 6

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Settlement =10% ℄ H.
		102.80			
2+50	End fill		0.8	102.0	0.0
2+61	Spillway	℄	2.8	100.0	
	Slope Stakes–Spillway				
0+00			2.8	100.0	
0+12			2.8	100.0	℄ Dam Sta. 2+61 @ 90°
0+25			2.8	100.0	
TBM1			2.81	99.99	OK

W.F. Jones Pond
Design & Const. Layout 2

Left	℄	Right
F=0.0 0.8 4.0	F=0.0 0.8 0.0	F=0.0 0.8 4.0
	F=2.3 0.5 0.0	
Left 2:1	℄	Right 2:1
C=0.0 2.8 5.0	C=0.0 2.8 0.0	C=0.0 2.8 5.0
C=2.2 0.6 9.4	C=2.3 0.5 0.0	C=2.5 0.3 10.0
C=0.0 2.8 5.0	C=0.0 2.8 0.0	C=0.1 2.7 5.2

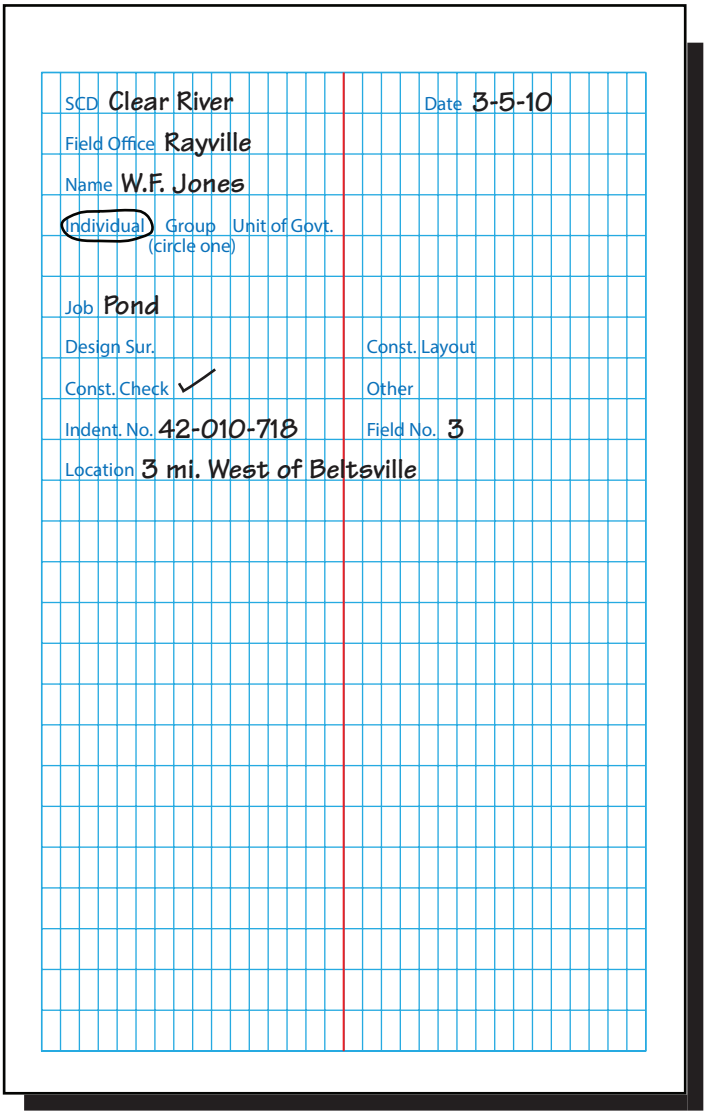
(Spillway stationing increases downstream)

Sample D–2 Engineering notes for pond dam construction check survey—Sheet 4 of 6

To expedite the construction check survey, the following information was taken from the plans and listed in the field notebook where it would be convenient for reference. This was done before any survey work was started.

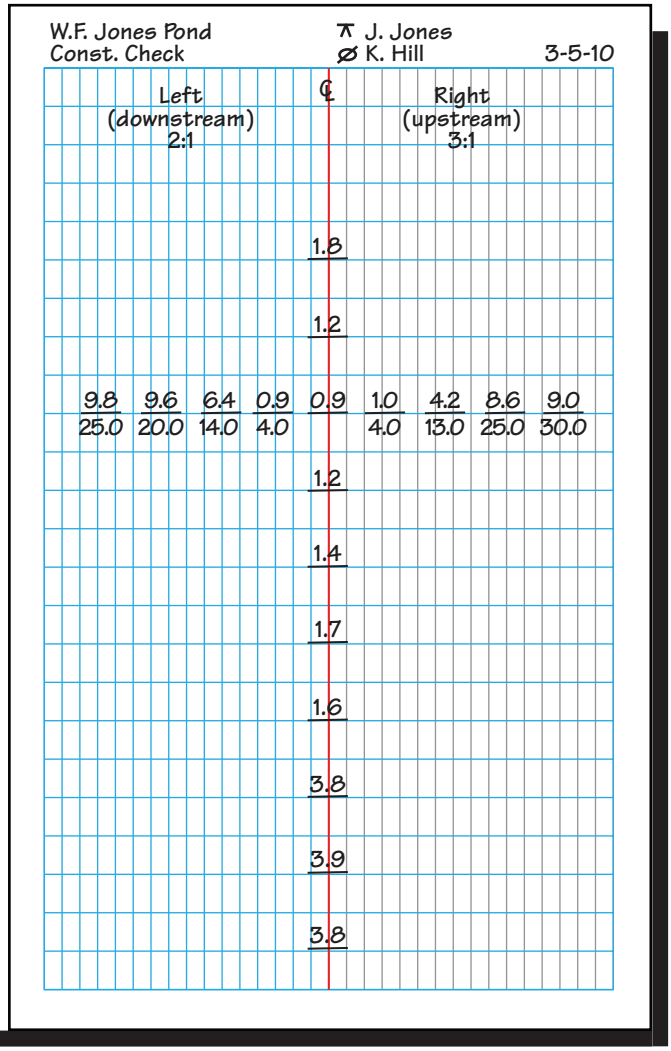
Sta	Planned elev.	Planned elev. + 10% of ℄ height
0 + 00	102.0	
0 + 85	102.0	102.5
1 + 35	102.0	102.8
2 + 00	102.0	102.5
2 + 45	102.0	102.2
2 + 50	102.0	
2 + 51.6	102.2	
2 + 56	100.0	
2 + 61	100.0	
2 + 66	100.0	
2 + 71	102.5	

The constructed fill was uniform in appearance; therefore, only one cross section was taken.



Sample D–2 Engineering notes for pond dam construction check survey—Sheet 5 of 6

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Planned Elev. + 10% ℄ H.
BM1	3.81	103.81		100.00	
0+00			+1.8		102.0
0+85			+1.3		102.5
1+35			+1.0		102.8
2+00			+1.3		102.5
2+45			+1.6		102.2
2+50	End Fill		+1.8		102.0
2+52	Edge Spillway Cut		+1.6	102.2	
2+57	Bottom Spillway		+3.8	100.0	
2+62	℄ Spillway		+3.8	100.0	
2+67	Bottom Spillway		+3.8	100.0	



Sample D–2 Engineering notes for pond dam construction check survey—Sheet 6 of 6

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		103.81		
2+72	Edge Spillway Cut		+1.3	102.5
TP	3.87	104.42	3.26	100.55
BM1			4.42	100.00
	7.68		7.68	OK

Note: Normally rod readings are sufficient for checkout, but complex or large dams may require a plotted section.

W.F. Jones Pond
Const. Check 2

℄

1.3

Pond has 0.1 acre area at elev. 90.1 as determined with hand level and tape.

Fill and spillway not seeded. N.W. end of fill is rip-rapped with stone.

Construction meets plans and specifications except for seeding.

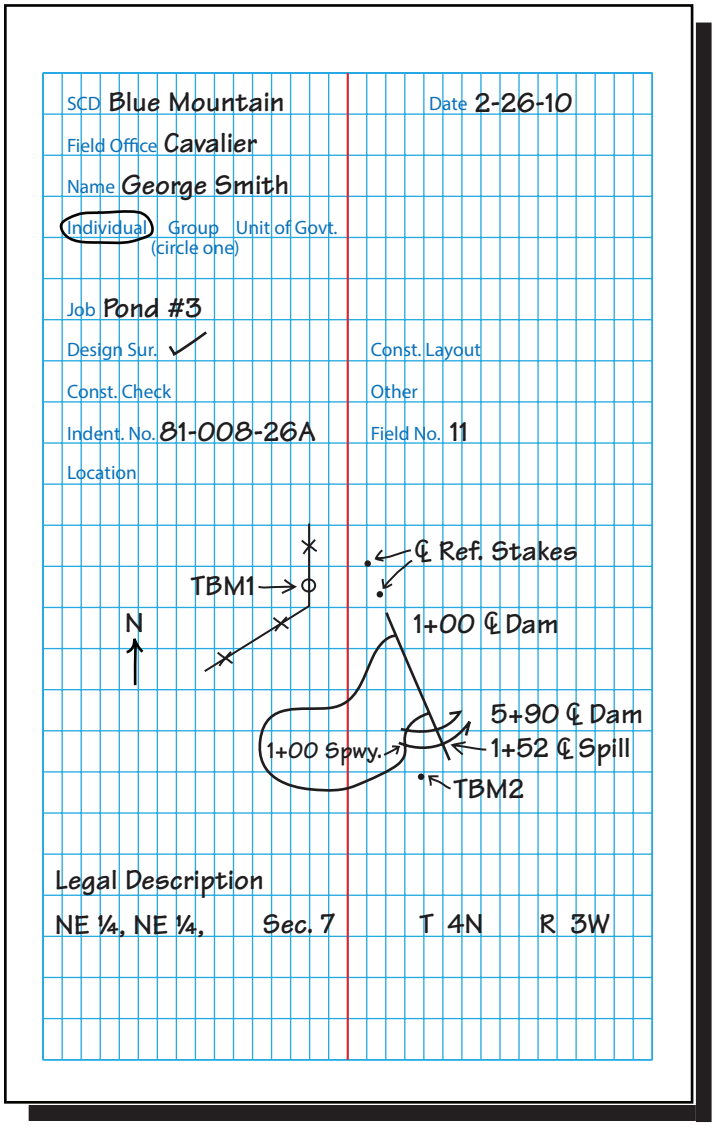
J. Jones
J. Jones
Cons. Tech.
3/5/10

Sample D–3 Engineering notes for pond dam and spillway—Design survey—Sheet 1 of 14

Engineering notes for pond dam and spillway design survey

These notes illustrate a job where the design survey was made by a survey party, and the plans and specifications prepared from the notes by an engineer.

Soil investigations and hydrologic studies were made and recorded in accordance with NRCS standards and procedures for the State.



Sample D–3 Engineering notes for pond dam and spillway—Design survey—Sheet 2 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM1	6.71	106.71		100.00
1+00				
2+00				
2+39				
TP1	1.32	96.17 (96.2)	11.86	94.85
2+83				
3+00				
3+35				
4+00				
TP2	11.82	106.46 (106.5)	1.53	94.64
4+69				

Geo. Smith Pond #3 — ℸ J. Doe — 2
Design Survey Dam — ⌀ R. Rowe — 2-26-10

Left ℄ Right

1" Steel axle in fence 200' N.W. of N.W. end of dam ℄

	105.8 0.9 15	105.9 0.8 0	105.9 0.8 15		
	105.5 1.2 15	105.5 1.2 0	105.6 1.1 15		
	94.8 11.9 29	95.1 11.6 0	95.8 10.9 13	98.2 8.5 23	98.9 7.8 46
92.2 4.0 36	91.4 4.8 19	93.5 2.7 0	95.3 0.9 15	94.6 1.6 27	94.4 1.8 49
87.7 8.5 68	85.3 10.9 31	88.0 8.2 0	87.7 8.5 17	88.6 7.6 40	88.9 7.3 80
84.3 11.9 60	86.2 10.0 20	85.0 11.2 0	87.4 8.8 20	85.9 10.3 42	86.7 9.5 80
93.5 2.7 45	95.9 0.3 15	94.3 1.9 0	94.6 1.6 15	96.0 0.2 46	95.4 0.8 70
95.3 11.2 40	95.8 10.7 30	96.0 10.5 0	96.3 10.2 35	96.7 9.8 50	

Sample D–3 Engineering notes for pond dam and spillway—Design survey—Sheet 3 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		106.46		
5+00		(106.5)		
5+27				
5+50				
TP3	5.73	110.87	1.32	105.14
		(110.9)		
5+65				
5+72				
5+90				
6+00				
6+50				
BM2	0.33	110.34	0.86	110.01

Geo. Smith Pond #3
Design Survey Dam 2

Left			℄			Right
96.3 / 10.2 / 35	96.8 / 9.7 / 25	100.1 / 6.4 / 10.0	97.4 / 9.1 / 0	95.4 / 11.1 / 15	98.1 / 8.4 / 35	99.3 / 7.2 / 50
	100.4 / 6.1 / 25	101.0 / 5.5 / 15	101.3 / 5.2 / 0	101.5 / 5.0 / 20	101.9 / 4.6 / 35	
	104.7 / 1.8 / 25	104.8 / 1.7 / 15	105.0 / 1.5 / 0	105.1 / 1.4 / 15	105.4 / 1.1 / 30	
			106.4 / 4.5 / 0			
			104.6 / 6.3 / 0			
			105.2 / 5.7 / 0			
			105.9 / 5.0 / 0			
			109.2 / 1.7 / 0			

Spike in base of lone elm.

Sample D–3 Engineering notes for pond dam and spillway—Design survey—Sheet 4 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		110.34		
TP1	4.87	105.00	10.21	100.13
1+00	Starting sta.			
TP2	9.60	110.95 (110.9)	3.65	101.35
1+40				
1+52 = Sta. 5+90		℄ Dam		
2+00				
TP3	0.84	100.56 (100.6)	11.23	99.72
2+40				
2+56				
TP4	1.76	92.18	10.14	90.42

Geo. Smith Pond #3
Design Survey Auxillary Spillway 3

Left			℄		Right
		98.6 / 6.4 / 30	98.5 / 6.5 / 0	98.7 / 6.3 / 25	
108.9 / 2.0 / 35	108.6 / 2.3 / 15	105.0 / 5.9 / 9.0	104.0 / 6.9 / 0	104.7 / 6.2 / 9	105.2 / 5.7 / 31
	106.4 / 4.5 / 25	104.5 / 6.4 / 18	105.2 / 5.7 / 0	105.9 / 5.0 / 10	107.8 / 3.1 / 25
	103.6 / 7.3 / 30	101.6 / 9.3 / 12	100.3 / 10.6 / 0	101.0 / 9.9 / 15	103.9 / 7.0 / 30
	96.5 / 4.1 / 30	95.4 / 5.2 / 20	94.4 / 6.2 / 0	95.2 / 5.4 / 20	96.3 / 4.3 / 30
	94.4 / 6.2 / 32	93.2 / 7.4 / 15	92.9 / 7.7 / 0	93.1 / 7.5 / 15	94.2 / 6.4 / 30

Sample D–3 Engineering notes for pond dam and spillway—Design survey—Sheet 5 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		92.18			
3+00		(92.2)			
3+42					
TP5	11.48	102.49	1.17	91.01	
BM1			2.51	99.98	
	54.46		54.48		
	Correct elev. BM1=100.00				
		Diff.=		.02	OK
	Adjust elve. BM2=.01			110.00	Adjusted

J Doe

Geo. Smith Pond #3
Design Survey Auxillary Spillway 4

Left		℄		Right
90.2 / 2.0 / 30	89.5 / 2.7 / 18	88.8 / 3.4 / 0	89.6 / 2.6 / 20	90.0 / 2.2 / 35
	85.5 / 6.7 / 32	85.0 / 7.2 / 0	85.3 / 6.9 / 30	

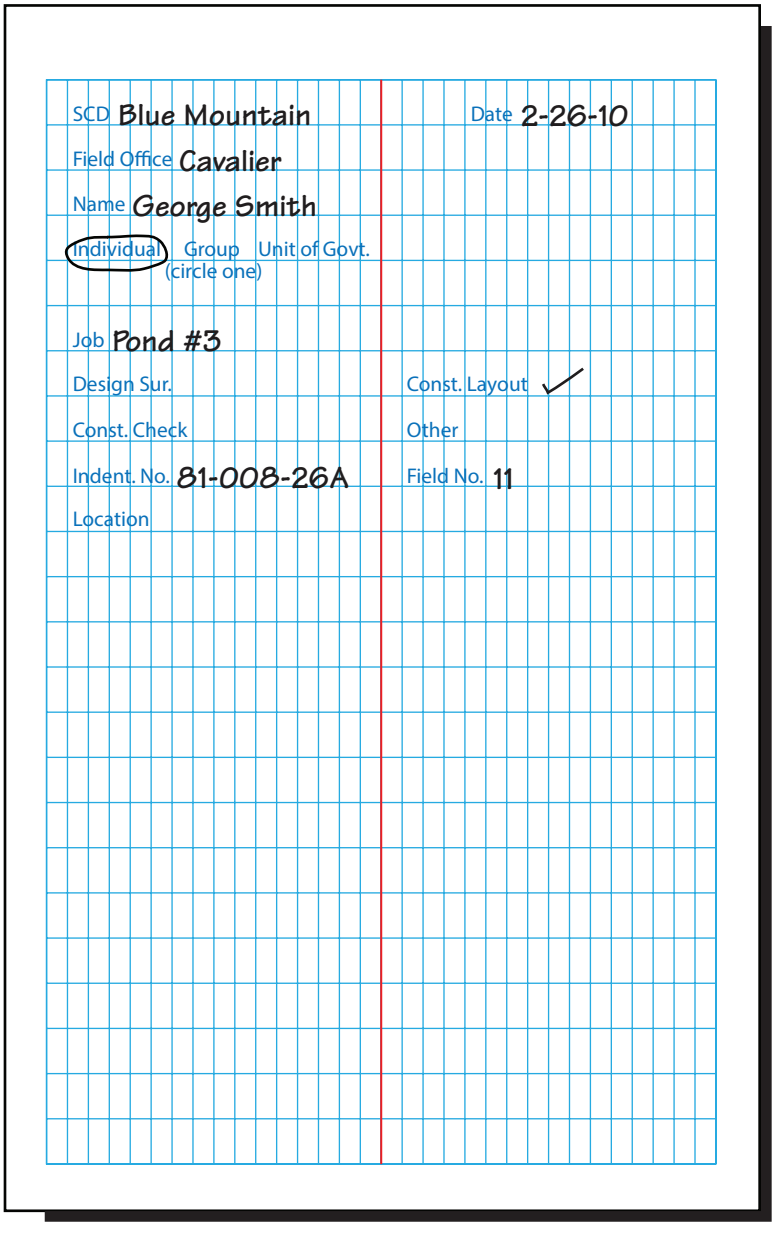
Sample D–3 Engineering notes for pond dam and spillway—Construction layout survey—Sheet 6 of 14

Engineering notes for pond dam and spillway construction layout

To expedite the construction layout survey, the following information was taken from the plans and listed in the field notebook. This information is also useful in construction check survey.

1. Planned elevation of top of embankment at each station and the allowance for settlement. In this example, settled heights are shown.
2. Planned top width of embankment.
3. Planned elevation of bottom of excavation for the conduit at upper end, lower end, and intermediate points.
4. Planned elevation of auxiliary spillway at several points.
5. Dimensions of auxiliary spillway.

After the job was staked, a reference hub was set at auxiliary spillway crest elevation so the contractor could make preliminary checks for completion before calling on the NRCS for final check-out.



Sample D–3 Engineering notes for pond dam and spillway—Construction layout survey—Sheet 7 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Settlement =0.5x ℄ H.
BM1	7.42	107.42		100.00	
2+05	N.W. end dam		+2.4	105.0	0.0
2+39			+2.4	105.0	0.5
TP1	0.15	95.31	12.26	95.16	
2+83			-9.7	105.0	0.6
3+00			-9.7	105.0	0.9
3+35			-9.7	105.0	1.0
TP2	11.88	106.32	0.87	94.44	
4+00			+1.3	105.0	0.5
4+69			+1.3	105.0	0.5

Geo. Smith Pond #3 — ℸ J. Doe — 1
Const. Layout Dam — ⌀ R. Rowe — 3-5-10

Left 2:1 ℄ Right 3:1

Top elev. 105.0 Top width 12'

1" Steel axle in fence line 200' N.W. of N.W. end of dam

F=0.0 / 2.4 / 6.0	F=0.0 / 2.4 / 0.0	F=0.0 / 2.4 / 6.0
F=10.1 / 12.5 / 26.2	F=9.9 / 12.3 / 0.0	F=6.8 / 9.2 / 26.4
F=13.3 / 3.6 / 32.6	F=11.5 / 1.8 / 0.0	F=10.5 / 0.8 / 37.5
F=18.8 / 9.1 / 43.6	F=17.0 / 7.3 / 0.0	F=16.2 / 6.5 / 54.6
F=20.7 / 11.0 / 47.4	F=20.0 / 10.3 / 0.0	F=19.6 / 9.9 / 64.8
F=11.2 / 12.5 / 28.4	F=10.7 / 12.0 / 0.0	F=8.3 / 9.6 / 30.9
F=9.2 / 10.5 / 24.4	F=9.0 / 10.3 / 0.0	F=8.7 / 10.0 / 32.1

Sample D–3 Engineering notes for pond dam and spillway—Construction layout survey—Sheet 8 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Settlement =5% ℄ H.
		106.32			
5+27			+1.3	105.0	0.2
5+50	S.E. end dam		+1.3	105.0	0.0
BM1			6.31	100.01	
	19.45		19.44		
	Correct elev. TBM1=			100.00	
			Diff=	0.01	OK

Geo. Smith Pond #3
Const. Layout Dam 2

Left ℄ Right

F=4.0	F=3.7	F=3.5
5.3	5.0	4.8
14.0	0.0	16.5
F=0.1	**F=0.0**	**F=0.0**
1.4	1.3	1.3
6.2	0.0	6.0

Note: See sample D-23 for stripping and core trench notes if they are to be measured.

Sample D–3 Engineering notes for pond dam and spillway—Construction layout survey—Sheet 9 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM1	0.18	100.18		100.00	
TP1	1.24	89.70	11.72	88.46	
0+00	At riser		+4.2	85.5	
0+23	℄ Dam		+4.0	85.7	
0+48			+4.3	85.4	
0+75			+4.7	85.0	
TP2	11.87	101.10	0.47	89.23	
BM1			1.09	100.01	
	13.29		13.28		
	Correct elev. BM1=			100.00	
			Diff=	0.01	OK

Geo. Smith Pond #3
Const. Layout
Prinical Spwy. Excav.

3

Left ℄ Right

See page 1

(Pipe at right angle to ℄ Dam sta. 3+00)

C=1.2
3.0
0

C=2.3
1.7
0

C=2.8
1.5
0

C=2.7
2.0
0

Sample D–3 Engineering notes for pond dam and spillway—Construction layout survey—Sheet 10 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM2	1.02	111.02		110.00	
TP1	4.02	107.54 (107.5)	7.50	103.52	
1+05	Starting sta.		+8.4	99.1	
1+40			+7.1	100.4	
1+52			+7.1	100.4	
2+00			+10.5	97.0	
TP2	3.92	100.60	10.86	96.68	
2+56			+7.7	92.9	
TP3	11.03	111.01	0.62	99.98	
BM2			1.03	109.98	
	19.99		20.01		
	Correct elev. BM2=			110.00	
			Diff=	0.02	OK

Geo. Smith Pond #3
Const. Layout
Auxiliary Spwy.

4

Left ℄ Right

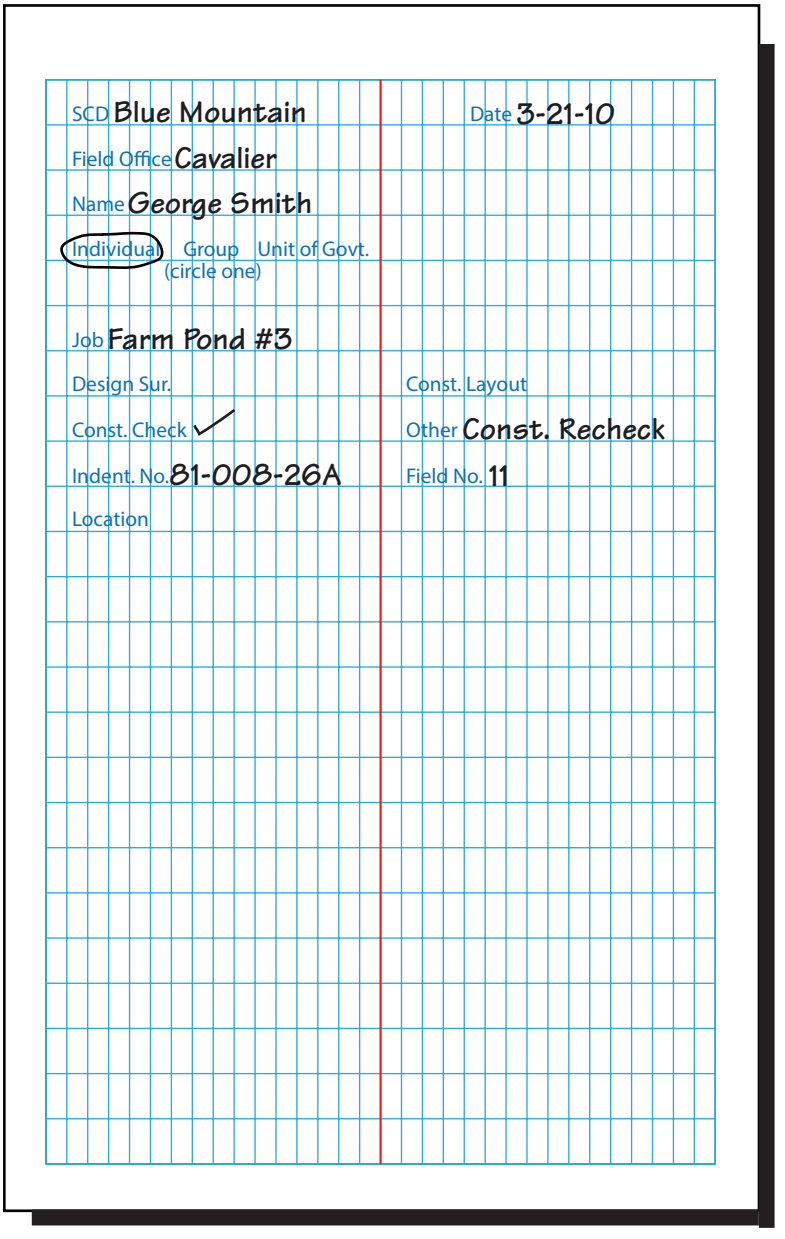
Spike in base of lone elm.
Bottom width = 20.0'
Side slopes = 2:1

Left	℄	Right
C=0.1 / 8.3 / 10.2	C=0.0 / 8.4 / 0	C=0.0 / 8.4 / 10.0
C=4.7 / 2.4 / 19.4	C=3.6 / 3.5 / 0	C=4.3 / 2.8 / 18.6
C=5.5 / 1.6 / 21.0	C=4.8 / 2.3 / 0	C=5.1 / 2.0 / 20.2
C=4.6 / 5.9 / 19.2	C=3.3 / 7.2 / 0	C=4.0 / 6.5 / 18.0
C=0.0 / 7.7 / 10.0	C=0.0 / 7.7 / 0	C=0.1 / 7.6 / 10.2

Sample D–3 Engineering notes for pond dam and spillway—Construction check survey—Sheet 11 of 14

Engineering notes for pond dam and spillway construction check survey

These notes illustrate the standard NRCS format for a fill that is too high to be checked from one instrument setup. To expedite the construction, check survey necessary dimensions, stations, and elevations are taken from the plans and entered in the field notebook for ready reference.



Sample D–3 Engineering notes for pond dam and spillway—Construction check survey—Sheet 12 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Planned +5% ℄ H.
	Upper portion of dam				
BM1	7.51	107.51		100.00	
2+05			+2.5		105.0
2+39			+2.0		105.5
2+83			+1.8		105.7
3+00			+1.5		106.0
3+35			+1.5		106.0
Side shot			10.1	97.4	
4+00			+2.0		105.5
4+69			+2.0		105.5
5+27			+2.3		105.2
5+50			+2.5		105.0

Geo. Smith Pond #3 — J. Doe — 1
Const. Check Dam — R. Rowe — 3-21-10

Left (DS) ℄ Right (US)

1" Steel axle in fence line 200' N.W. of N.W. end of dam

2.4

12.6/26 1.9/6 1.8 2.0/6 8.6/25

1.7

11.7/26 1.3/6 1.4 1.4/6 11.6/35

11.8/26 1.3/6 1.3 1.4/6 11.7/35

Crest of Principal Spillay

11.9/25 2.0/5 1.9 2.0/7 10.7/31

2.1

6.3/14 2.2/6 2.1 2.0/6 5.4/17

2.4

Sample D–3 Engineering notes for pond dam and spillway—Construction check survey—Sheet 13 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Lower portion of dam–downstream				
		107.51			
TP1	1.21	97.01	11.71	95.80	
3+00					
Side shot			12.0	85.0	
3+35					
	Lower portion of dam upstream				
TP2	11.66	107.59	1.08	95.93	
TP3	1.29	97.10	11.78	95.81	
3+00					
3+35					
TP4	11.31	107.31	1.10	96.00	
BM1	37.10		7.29 37.08	100.02	
	Correct elev. BM1=100.00				
		Diff.=		0.02	OK

Geo. Smith Pond #3 — ℸ J. Doe — 2
Const. Check Dam — ⌀ R. Rowe — 3-21-10

Left (DS) ℄ Right (US)

10.8 / 4.4

Downstream invert of principal S.W.

12.7 / 4.8

8.3 / 5.5

12.7 / 6.6

Sample D–3 Engineering notes for pond dam and spillway—Construction check survey—Sheet 14 of 14

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM2	0.80	110.80		110.00	
TP1	2.02	101.11	11.71	99.09	
1+80			+2.7	98.4	
2+00			+4.1	97.0	
2+20			+5.6	95.5	
TP2	11.80	111.80	1.11	100.00	
BM2			1.79	110.01	
	14.62		14.61		
	Correct elev. TBM2=			110.00	
			Diff=	0.01	OK

Geo. Smith Pond #3 — ℸ J. Doe — 4
Const. Recheck Spillway — ⌀ Geo. Smith — 3-22-10

Left ℄ Right

Spike in base of lone elm.

2.6 / 10	2.7	2.6 / 10
4.1 / 10	4.1	4.1 / 10
5.5 / 10	5.6	5.5 / 10

Construction meets plans and specs.

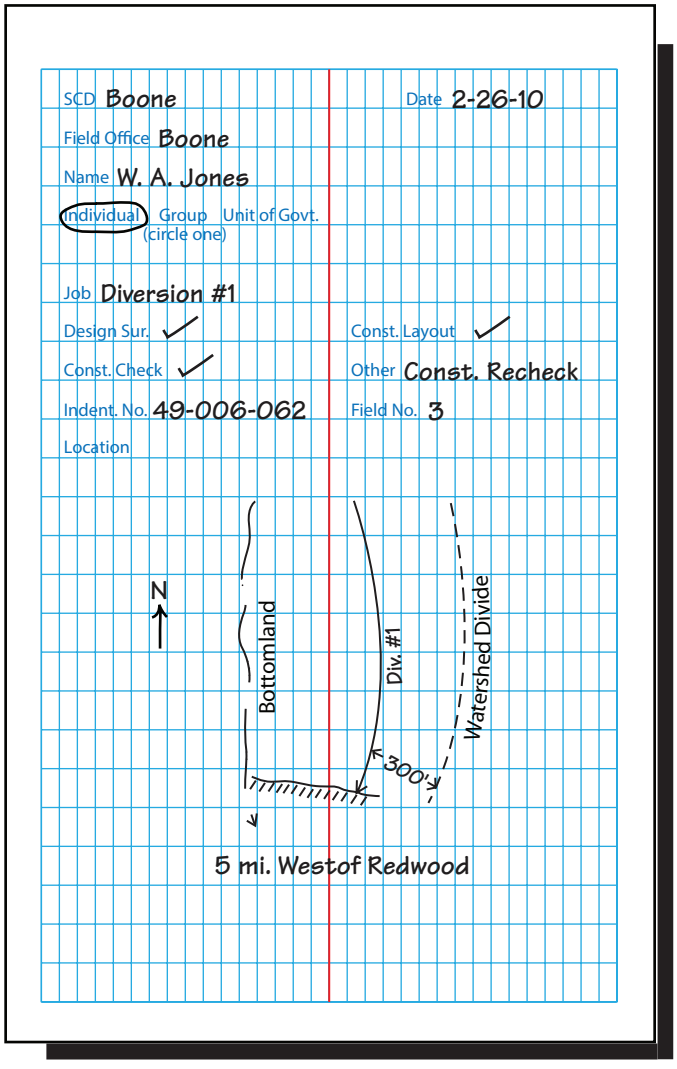
J. Doe
Engr. Tech.
3-22-10

Sample D–4 Engineering notes for a diversion—Sheet 1 of 3

Engineering notes for a diversion

The format and information illustrated by these notes are satisfactory for small diversions when drainage areas are small, topography is reasonably uniform, elevations with respect to other structures are not important, and where approved design tables are available.

Notes similar to the format shown in sample D–8 should be recorded for the larger diversions where considerable cut and fill are required and where vertical control is important.



Sample D–4 Engineering notes for a diversion—Sheet 2 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
0+00			9.3		
1+00			7.9		
2+00			7.5		
3+00			7.1		
4+00			6.7		
5+00			6.3		
6+00			5.9		
7+00			5.5		
7+62			5.2		

W. A. Jones
Diversion #1
Design & Const. Layout

π V. Ray
⌀ W. A. Jones

1
2-26-10

Outlet–Veg. W. W.

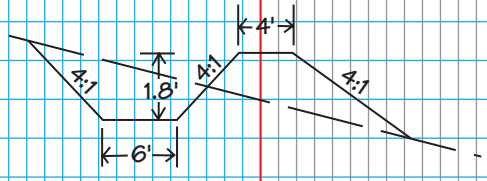
Total length–762 ft.

Av. fill/100 ft=48.2 yd^3

Total Fill=$48.2\left(\frac{762}{100}\right)$=367 yd^3

Design

D. A.–20 ac, Q=30 ft^3/s
Channel Grade–0.4%
Velocity–2 ft/s



Sample D–4 Engineering notes for a diversion—Sheet 3 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Chan. Rod	Ridge Rod			
0+00	8.6	Bottom of vegetated waterway			
1+00	8.2	6.4			
2+00	7.8	6.0			
			Recheck Chan.	3-1-10 Ridge	
3+00	7.5	5.6	6.6	4.7	
3+50	High 6.9	Low 6.1	6.4	4.6	OK V. Ray
4+00	7.1	5.2	6.2	4.3	
5+00	6.6	4.7			
6+00	6.3	4.4			
7+00	5.9	3.9			
7+65	5.6	3.8			

W. A. Jones, Diversion #1 — π & Notes V. Ray — 1
Const. Check & Recheck — ∅ W. A. Jones — 2-28-10

Nat. gr. Nat. gr.

4.3	4.7	6.2	6.2	4.4	4.4	6.1	6.5
0	10	17	23	31	35	43	53

Construction meets plans and specs.

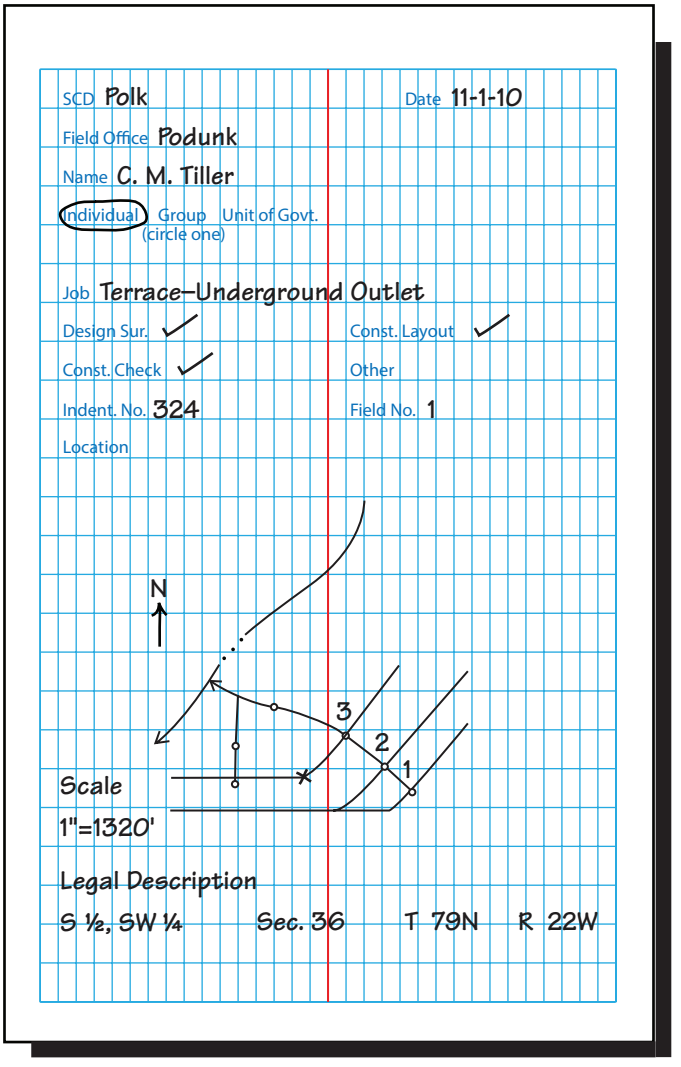
V. Ray
Const. Tech.
3-1-10

Sample D–5 Engineering notes for terraces—Sheet 1 of 3

Engineering notes for terraces

The layout notes illustrated here are considered appropriate for parallel terraces with underground outlet.

Terrace notes should be adequate to portray layout and checking in sufficient detail to ensure proper functioning of the terrace.



Sample D–5 Engineering notes for terraces—Sheet 2 of 3

Terrace No. 1

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Rod	Channel Rod	Ridge Rod	Cut	Fill
0+00	6.0	5.3			0.7
1+00	6.4	5.7			0.7
2+00	7.0	6.3			0.7
+50	8.3	7.4			0.9
3+00	8.9				1.5
+50	9.1				1.7
4+00	9.3		9.3	0.0	1.9
+50	8.9		9.4	0.5	1.5
5+00	8.5	Sum=115.1	9.5	1.0	1.1
+50	9.4		9.6	0.2	2.0
6+00	9.2		9.7	0.5	1.8
+50	7.7		9.8	2.1	0.3
7+00	8.0		9.9	1.9	0.6
+50	10.0		10.0	0.0	2.6
8+00	10.0	7.4		0.0	2.8
+50	7.6	6.9		0.0	0.7
9+00	6.3	5.8		0.2	0.5
9+50	6.5	5.6		0.0	0.9

C.M. Tiller
Terraces
Design & Const. Layout

P. Roe
I. Cant

1
2-26-10

Water Storage ft^3

Field Slope 4%
Horizontal Spacing 188 ft.
Storage Interval 2+50 to 8+50
Intake @8+00

16
38 Sum Rod Readings=115.1
47
57 Avg. Rod= $\frac{115.1}{13}$ =8.9
45
36 Try 8.9–1.5=7.4
66
59 Segments= $\frac{950}{50}$ =19
31
35 Avail. Storage= $\frac{647}{19}$ =34.4 $\frac{ft^3}{ft}$
101
116 Required Storage=188 $\left(\frac{2}{12}\right)$ =31.3 $\frac{ft^3}{ft}$
0
647

Trial OK

Use Ridge Rod 7.4

Sample D–5 Engineering notes for terraces—Sheet 3 of 3

Terrace No. 1

Sta.	B.S. Channel Rod	H.I. Ridge Rod	F.S. or Grade Rod	Elev. or Planned Elev.
0	4.7	3.8		
1	5.7	4.2		
2	6.0	4.7		
3	7.4	5.8		
4	7.9	5.9	Low Point–OK	
5	8.1	5.8		
6	8.2	5.7		
7	8.5	5.6		
8	8.7	5.7		
9	3.6	4.4		

C. M. Tiller — J. Jones — 1
Terraces, Const. Check — C. Tiller — 12-3-10

5.5/50 6.7/20 7.1/10 8.1/0 5.8/15 7.5/24

Outlet-Top 6.1 Ground 8.8

Total Length Completed 4030 Lin. ft
Steep Backslope Seeded 45,600 ft^2
Practice Meets Specifications

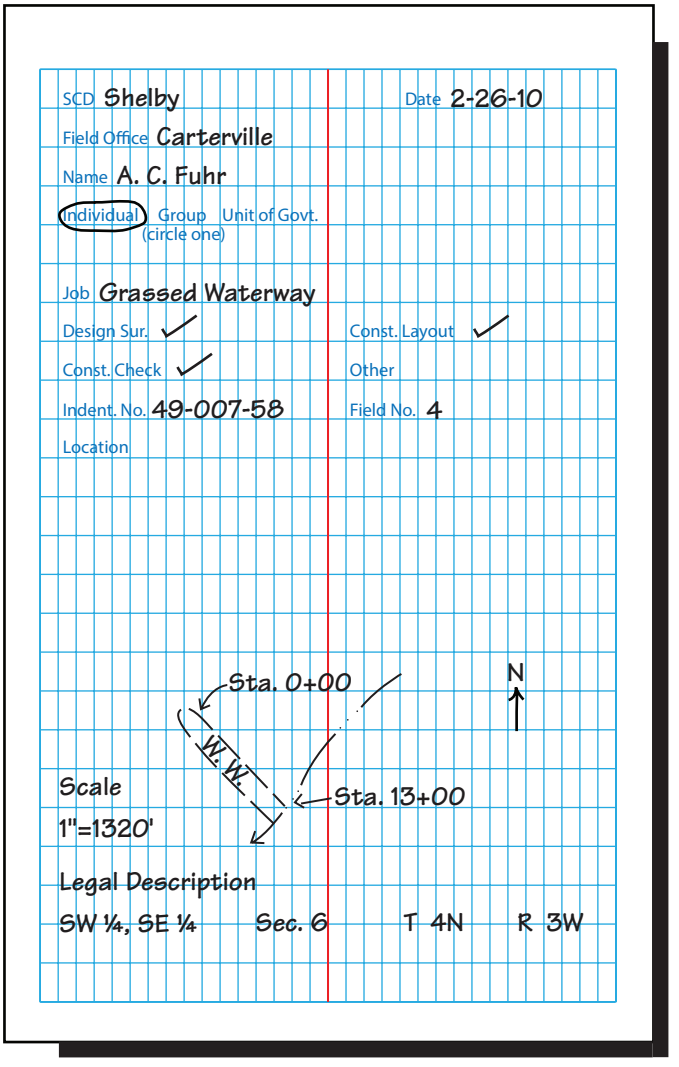
J. Jones
Eng. Tech.
12-3-10

Sample D–6 Engineering notes for grassed waterway—Sheet 1 of 3

Engineering notes for grassed waterway

The format and content of this set of notes are suitable only for simple waterways where vertical controls and slope stakes are not necessary.

For the more complex types of waterways involving considerable cut and fill and requiring vertical control and sloped stakes, the general format illustrated in sample D–8 should be followed.



Sample D–6 Engineering notes for grassed waterway—Sheet 2 of 3

~~Sta.~~	~~B.S.~~	~~H.I.~~	~~F.S. or Grade Rod~~	~~Elev. or Planned Elev.~~

Design Data
Drainage Area
Sta. 8+00=20 ac.
Sta. 13+00=40 ac
Runoff
Q=33 ft^3/s at Sta. 8+00
=56 ft^3/s at Sta. 13+00
V=4 ft/s Grade=3.0%
Dimensions
Sta. 0+00 to 8+00
Top width 22.0' Depth 13'
Stat. 8+00 to 13+00
Top width 32.0' Depth 1.3'

(Runoff & dimensions taken from tables)

Sta. 13+00 is intersection of
℄ of water way & ℄ main draw.

A. C. Fuhr
Grassed Waterway
Design & Const. Layout

ℸ J. Rowe
⌀ A. C. Fuhr

1
2-26-10

Typical existing x-sections
(All rod readings with hand level)

5.0	5.3	5.5	7.5	7.2	5.6	4.9	47
0	10	15	16	18	20	35	50

Sta. 3+00
This section used in computing
cut & fill in upper 800'

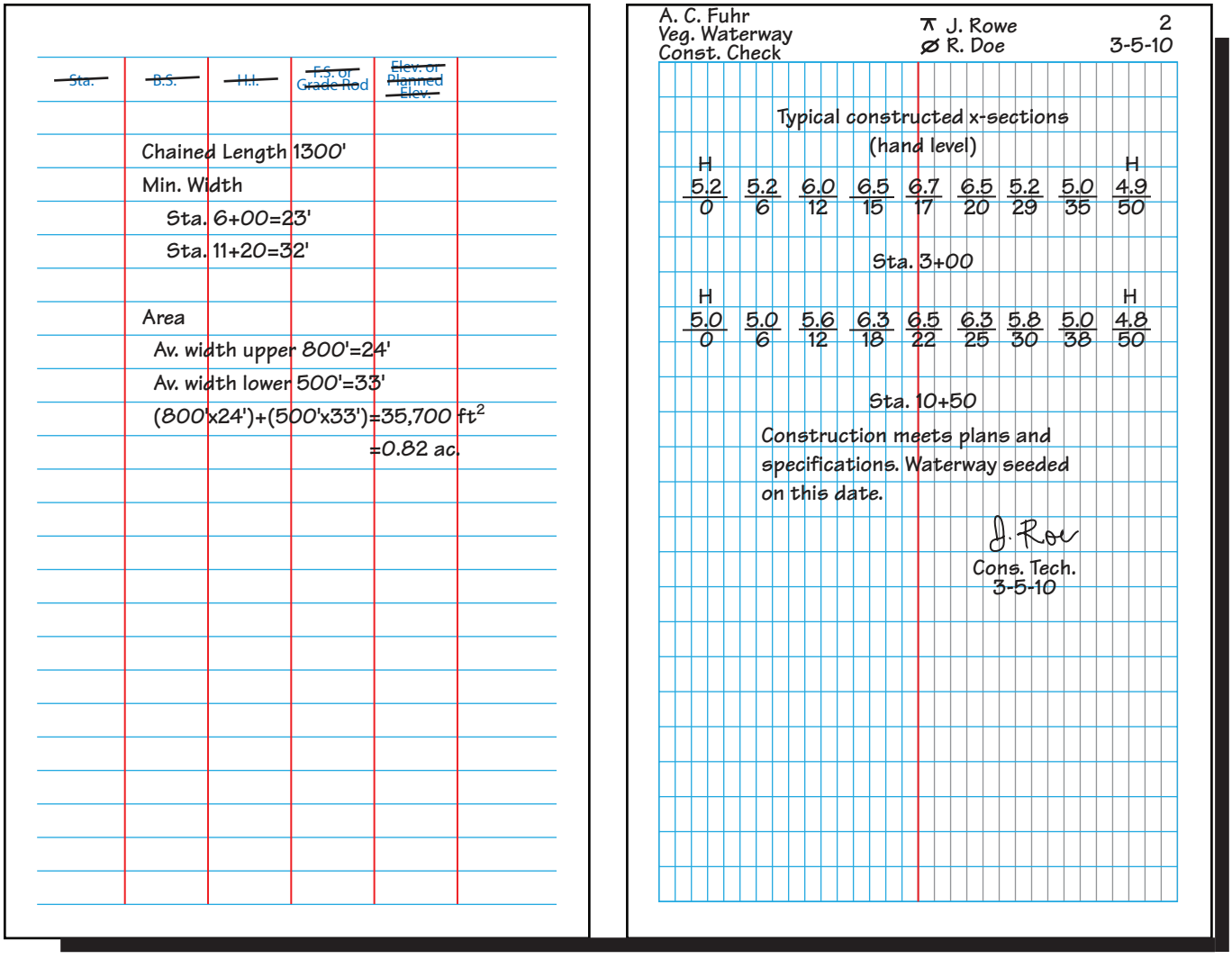
Hub.

5.6	5.8	5.9	8.6	8.5	6.0	5.6	5.4
0	10	18	20	24	25	35	50

Sta. 10+50
This section used in computing
cut & fill in lower 500'

Outside edges of waterway staked
at 100' intervals. Increases from
22' W. to 32' W. between stations
7+50 & 10+50

Sample D–6 Engineering notes for grassed waterway—Sheet 3 of 3



Sta. | B.S. | H.I. | F.S. or Grade Rod | Elev. or Planned Elev.

Chained Length 1300'
Min. Width
Sta. 6+00=23'
Sta. 11+20=32'

Area
Av. width upper 800'=24'
Av. width lower 500'=33'
(800'x24')+(500'x33')=35,700 ft^2
=0.82 ac.

A. C. Fuhr
Veg. Waterway
Const. Check

π J. Rowe
⌀ R. Doe

2
3-5-10

Typical constructed x-sections
(hand level)

H								H
5.2	5.2	6.0	6.5	6.7	6.5	5.2	5.0	4.9
0	6	12	15	17	20	29	35	50

Sta. 3+00

H								H
5.0	5.0	5.6	6.3	6.5	6.3	5.8	5.0	4.8
0	6	12	18	22	25	30	38	50

Sta. 10+50

Construction meets plans and specifications. Waterway seeded on this date.

J. Rowe
Cons. Tech.
3-5-10

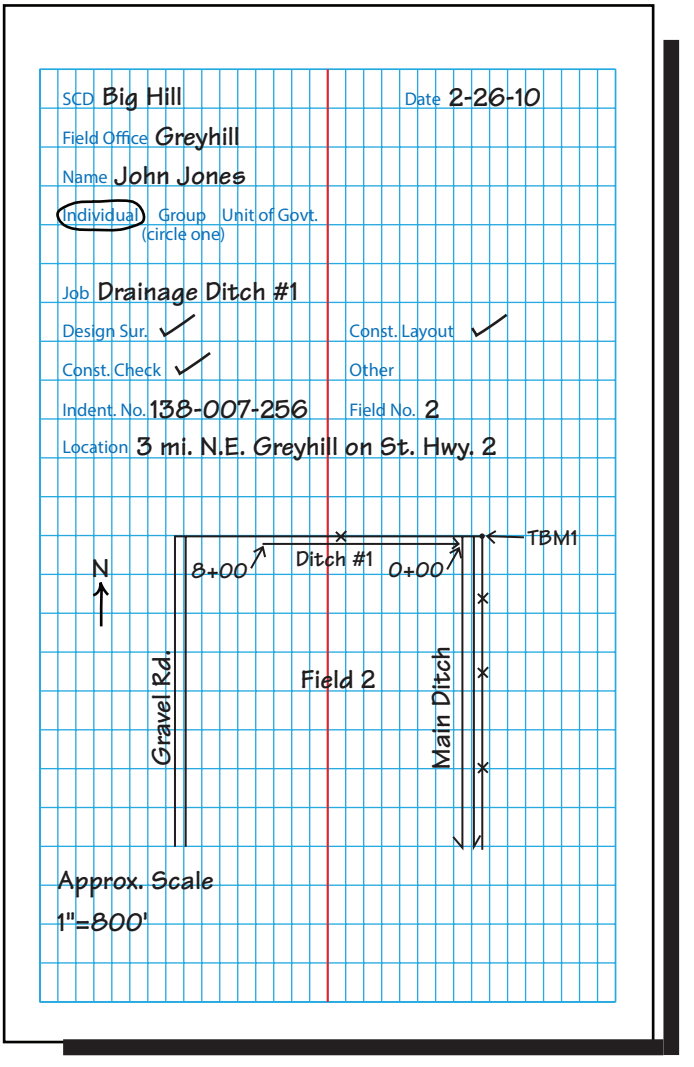
Sample D–7 Engineering notes for small drainage ditch—Sheet 1 of 3

Engineering notes for small drainage ditch

These notes are for a small ditch. It was determined by taking a few random shots that a ditch with bottom elevation at outlet end 1 foot above bottom of the main ditch and having a 0.05 percent bottom grade would give the desired drainage. With this information, the planned bottom elevation and grade rod at each station were calculated.

Spoil is to be spread uniformly along each side of ditch during construction. For that reason, reference hubs showing cut from top of hub were offset 50 feet, so they would not be disturbed during construction.

The topography was reasonably uniform; therefore, slope stakes were set at 200-foot intervals. Line stakes were set on the centerline at 100-foot intervals.



Sample D–7 Engineering notes for small drainage ditch—Sheet 2 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM1	4.22	45.22		41.00
Side shot			9.0	36.2
0+00			+8.0	37.2
2+00			+7.9	37.3
4+00			+7.8	37.4
6+00			+7.7	37.5
8+00			+7.6	37.6
TP1	3.94	44.34	4.82	40.40
BM1			3.34	41.00
	8.16	OK	8.16	

J. Jones Ditch #1 — T. Edwards — 1
Design & Const. Layout — R. Ray — 2-26-10

"V" Ditch—4:1 S. S.

60d nail near ground in W. side 16" cottonwood in N.E. corner fence.

Bottom of main ditch.

℄	Right Hubs
C=2.4	C=3.0
5.6	5.0
0.0	50.0
C=2.5	C=3.0
5.4	4.9
0.0	50.0
C=2.9	C=3.2
4.9	4.6
0.0	50.0
C=3.0	C=3.4
4.7	4.3
0.0	50.0
C=1.9	C=2.9
5.7	4.7
0.0	50.0

Note: Cut to be measured from top of hub.

Sample D–7 Engineering notes for small drainage ditch—Sheet 3 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM1	4.00	45.00		41.00	
0+00			+7.8	37.2	
2+00			+7.7	37.3	
4+00			+7.6	37.4	
6+00			+7.5	37.5	
8+00			+7.4	37.6	
BM1			4.00	41.00	OK

J. Jones Ditch #1 — J. Ryals — 2
Dr. Ditch #1 Const. Check — J. Jones — 3-5-10

Left ℄ Right

See page 1

7.9

Spoil: 5.2/56, 4.7/44, 4.7/16, 5.3/12

7.9

5.4/10

Spoil: 4.8/16, 4.7/43, 5.2/45

7.8

4.9/45, 4.4/43, 4.3/16, 4.6/12

7.7

4.7/12, 4.1/16, 4.2/44, 4.5/46

7.6

Construction meets plans and specs.

J. Ryals
Eng. Tech.
3-5-10

Sample D–8 Engineering notes for surface drainage—Sheet 1 of 17

Engineering notes for surface drainage (main ditch) design survey

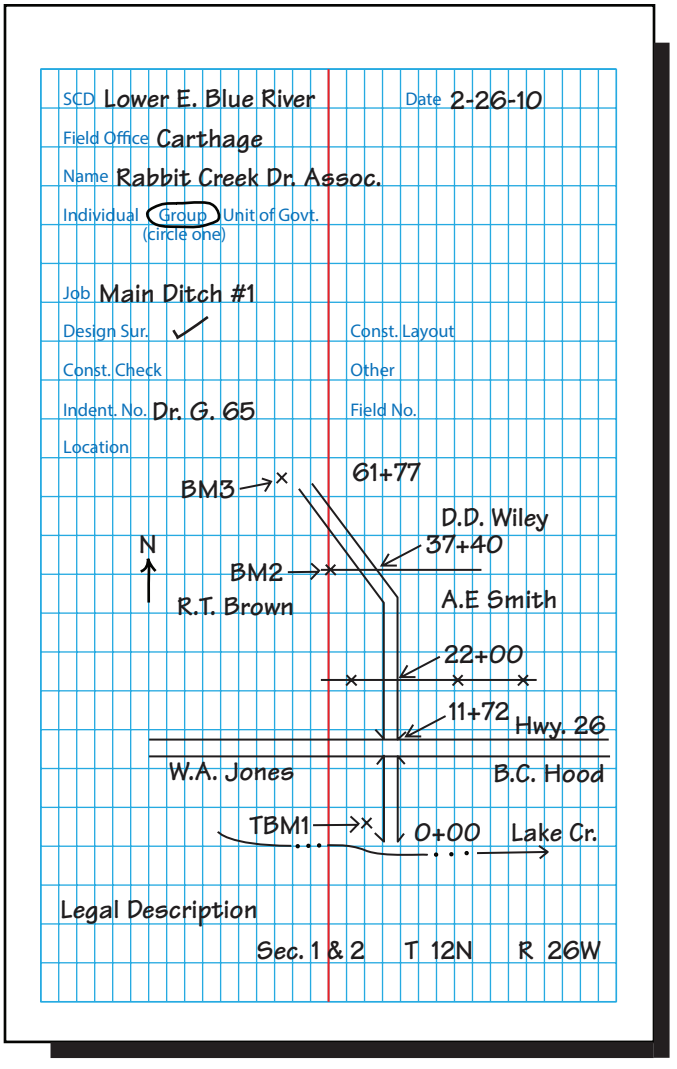
These notes are for a proposed main ditch involving enlargement and extension of an existing ditch. However, the general format is applicable to all open ditches.

A series of temporary bench marks was set prior to the design survey.

In the design survey, sufficient cross sections were taken of the old ditch to determine how much of it was adequate and the volume of excavation required to enlarge other parts.

The center of the old ditch was used as centerline for taking cross sections. This may not be practicable where there is water in the old ditch. In such cases, it may be better to establish a baseline along one side of the ditch and extend the cross sections from it.

The uniformity of the topography made it feasible to use an interval of 200 feet between profile shots and an average interval of 400 feet between cross sections. Each job will have its own conditions for spacing of profile shots and frequency of cross sections.



Sample D–8 Engineering notes for surface drainage—Sheet 2 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM1	1.67	50.77		49.10
		(50.8)		
0+00				
1+00				
2+00				
3+00				
TP1	5.01	53.90	1.88	48.89
4+00				
6+00				
8+00				

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Design Surv.

R. Ryals
O. Brown
CH.C. Smith

1
2-26-10

Left ℄ Right

20^{d} nail in 8" pecan tree blazed △ 40' W. &
75' N. Sta. 0+00 Main Ditch #1

39.0
11.8
Outlet

39.2
11.6

39.3
11.5

Natural drain from sta. 0+00 to sta. 3+00 is adequate in size and well stabilized with vegetation

39.3
11.5

48.8 49.4 48.9 46.6 42.3 42.0 42.3 48.8 49.1 47.9
5.1 4.5 5.0 7.3 11.6 11.9 11.6 5.1 4.8 5.0
50 25 12 7 2 2 16 30 50

42.4
11.5

Low area in field

48.8 43.7 43.0 43.9 45.4 48.9 48.1
5.1 10.2 10.9 10.0 8.5 5.0 5.8
14 3 4 7 14 550

Sample D–8 Engineering notes for surface drainage—Sheet 3 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		53.90			
TP2	4.61	54.23	4.28	49.62	
		(54.2)			
10+00					
11+36	Outlet end 6'x6' R.C. box culvert				
11+42					
11+54					
11+66					
11+72	Upper end culvert				
12+00					
14+00					
16+00					

Rabbit Cr. Dr. Assoc. 2
Main Ditch #1 Design Surv.

Left ℄ Right

44.7
9.5

44.2
10.0 Invert

51.8
2.4 Road shoulder

52.4
1.8 ℄ Hwy. #26

52.0
2.2 Road shoulder

44.3
9.9 Invert

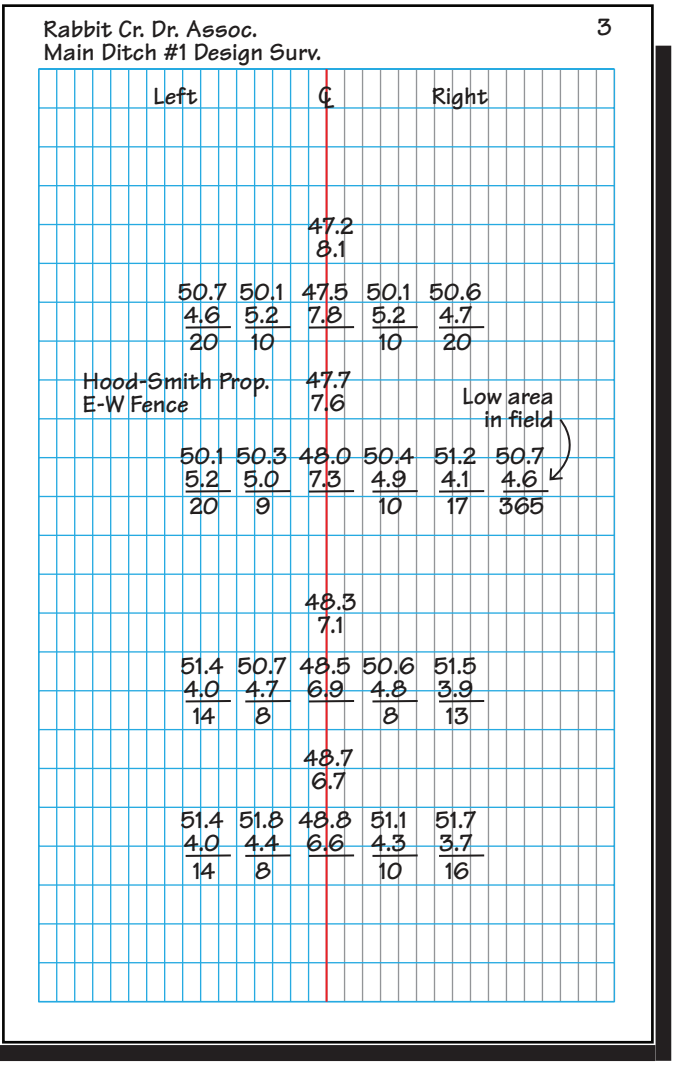
49.6	48.9	46.6	47.5	48.8	49.6
4.6	5.3	7.6	6.7	5.4	4.6
17	8		4	10	16

46.7
7.5

49.6	49.2	47.2	49.2	49.6
4.6	5.0	7.0	5.0	4.6
20	11		11	20

Sample D–8 Engineering notes for surface drainage—Sheet 4 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		54.23		
TP3	4.83	55.33	3.73	50.50
18+00				
20+00				
22+00				
24+00				
TP4	3.97	55.36	3.94	51.39
		(55.4)		
26+00				
28+00				
30+00				
32+00				
TP5	3.42	56.05	2.73	52.63



Sample D–8 Engineering notes for surface drainage—Sheet 5 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		56.05		
34+00		(56.0)		
36+00				
36+72				
37+40				
BM2	2.99	55.61	3.43	52.62
	23.51		19.99	
	19.99			
	3.52	Correct elev. BM2=52.60		
	Diff. in elev. BMI & BM2=3.50 OK			
38+00				
40+00				
TP6	5.62	57.24	3.99	51.62

Rabbit Cr. Dr. Assoc. 4
Main Ditch #1 Design Surv.

Left ℄ Right

49.2
6.8

5.9 51.6 49.3 51.4 52.0
4.1 4.4 6.7 4.6 4.0
13 8 10 15

Ditch curves left

Smith-Wiley E–W. Boundary fence

20^{d} nail in S. side corner post in S.W. corner D.D. Wiley tract El. 52.60

49.3
6.3

52.1 51.7 49.5 51.2 51.9
3.5 3.9 6.1 4.4 3.7
14 7 7 13

Sample D–8 Engineering notes for surface drainage—Sheet 6 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		57.24		
40+25	End old ditch		5.3	51.9
42+00				
44+00				
46+00				
48+00				
TP7	4.46	57.28 (57.3)	4.42	52.82
50+00				
52+00				
54+00				
56+00				
TP8	3.26	57.22	3.32	53.96

Rabbit Cr. Dr. Assoc. 5
Main Ditch #1 Design Surv.

Left	℄	Right
51.9 / 5.3 / 10	51.9 / 5.3	51.8 / 5.4 / 10
51.7 / 5.5 / 12	5.7 / 5.5	51.7 / 5.5 / 12
51.2 / 6.0 / 275 ← Low area in field	5.8 / 5.4	
52.1 / 5.1 / 15	52.1 / 5.1	52.2 / 5.0 / 15
	52.1 / 5.1	
52.6 / 4.7 / 15	52.5 / 4.8	52.4 / 4.9 / 15
	52.6 / 4.7	
52.9 / 4.4 / 15	52.8 / 4.5	52.9 / 4.4 / 15
	53.0 / 4.3	

Sample D–8 Engineering notes for surface drainage—Sheet 7 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		57.22		
58+00				
60+00				
61+77				
BM3			4.19	53.03
	39.84		35.91	
	35.91			
	3.93			

Correct elev. BM3=53.00

Diff. in elev. BM1 & BM3=3.90

Allowable error=$0.1\sqrt{M}$

$=0.1\sqrt{1.2}$

$=0.11$

Rabbit Cr. Dr. Assoc. 6
Main Ditch #1 Design Surv.

Left	℄	Right
53.2 / 4.0 / 15	53.2 / 4.0	53.1 / 4.1 / 15
	53.3 / 3.9	
	54.0 / 3.2	

End of proposed ditch

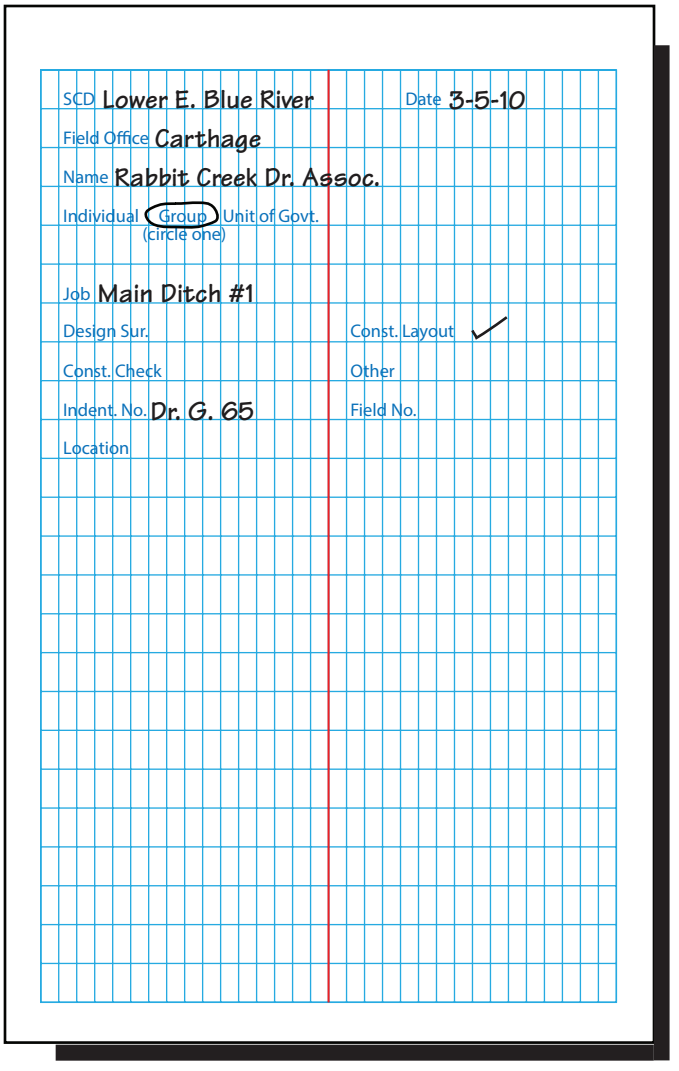
20^d nail in 12" pecan tree 50' W. Sta. 61+77

Sample D–8 Engineering notes for surface drainage—Sheet 8 of 17

Engineering notes for surface drainage (main ditch) construction layout

To expedite the construction layout survey, the planned elevation of the ditch bottom at each station was determined from the plans and entered on a sheet of paper so it could be referred to conveniently. This made it possible to calculate and record the grade rods rapidly after each instrument setup.

To save space, the layout notes have been recorded at 200-foot horizontal intervals. However, in actual practice, the slope stakes would be set at not more than 100-foot intervals.



Sample D–8 Engineering notes for surface drainage—Sheet 9 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM1	4.53	53.63		49.10
TP1	5.00	54.84 (54.8)	3.79	49.84
Old ditch adequate Sta. 0+00 to 9+00				
9+00			+10.8	44.0
10+00			+10.7	44.1
12+00			+10.5	44.3
14+00			+10.3	44.5
16+00			+10.0	44.8
TP2	3.84	55.02 (55.0)	3.66	51.18
18+00			+10.0	45.0
20+00			+9.8	45.2

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Layout

ℸ R. Ryals
⌀ O. Brown
Ch. C. Smith

1
3-5-74

Bottom width 4.0' S.S. 2:1

Left ℄ Right

20^{d} nail in 8" pecan tree 40'
W. & 75' N. Sta. 0+00 Main Ditch #1

Left	℄	Right
C=5.1	C=0	C=5.0
5.7	10.9	5.8
12.2	0.0	12.0
C=4.9	C=0.6	C=4.8
5.8	10.1	5.9
11.8	0.0	11.6
C=5.2	C=2.3	C=5.3
5.3	8.2	5.2
12.4	0.0	12.6
C=4.8	C=2.2	C=5.0
5.5	8.1	5.3
11.6	0.0	12.0
C=4.5	C=2.4	C=4.6
5.5	7.6	5.4
11.0	0.0	11.2
C=6.0	C=2.2	C=5.2
5.0	7.8	4.8
12.0	0.0	12.4
C=5.3	C=2.3	C=5.1
4.5	7.5	4.7
12.6	0.0	12.2

Sample D–8 Engineering notes for surface drainage—Sheet 10 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		55.02		
22+00			+9.5	45.5
24+00			+9.2	45.8
TP3	4.57	55.47 (55.5)	4.12	50.90
26+00			+9.5	46.0
28+00			+9.2	46.3
30+00			+8.9	46.6
32+00			+8.6	46.9
TP4	6.38	56.42 (56.4)	5.43	50.04
34+00			+9.2	47.2
36+00			+9.0	47.4

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Layout

2

Left	℄	Right
C=5.0 4.5 12.0	C=2.2 7.3 0.0	C=5.1 4.4 12.2
C=4.4 4.8 10.8	C=2.2 7.0 0.0	C=6.0 4.2 12.0
C=5.1 4.4 12.2	C=2.3 7.2 0.0	C=4.8 4.7 11.6
C=5.0 4.2 12.0	C=2.2 7.0 0.0	C=5.1 4.1 12.2
C=4.6 4.3 11.2	C=2.1 6.8 0.0	C=4.8 4.1 11.6
C=4.4 4.2 10.8	C=1.9 6.7 0.0	C=4.6 4.0 11.2
C=4.2 5.0 10.4	C=2.0 7.2 0.0	C=4.0 5.2 10.0
C=4.4 4.6 10.8	C=1.9 7.1 0.0	C=4.2 4.8 10.4

Sample D–8 Engineering notes for surface drainage—Sheet 11 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		56.42		
BM2			3.84	52.58
	24.32		20.84	
	20.84			
	3.48			
	Correct elev. BM2=52.60			
	Diff. in elev. BM1 & BM2=3.50			Check OK
38+00			+8.7	47.7
40+00			+8.4	48.0
TP5	5.19	56.50	5.11	51.31
40+30	old ditch ends		+8.5	48.0
42+00			+8.2	48.3
44+00			+8.0	48.5
46+00			+7.7	48.8
48+00			+7.4	49.1

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Layout

3

Left	℄	Right
C=4.3	C=1.6	C=4.1
4.4	7.1	4.6
10.6	0.0	10.2
C=3.6	C=1.5	C=3.5
4.8	6.9	4.9
9.2	0.0	9.0
C=3.8	C=3.9	C=3.8
4.7	4.6	4.7
9.6	0.0	9.6
C=3.4	C=3.4	C=3.6
4.8	4.8	4.6
8.8	0.0	9.2
C=3.3	C=3.3	C=3.3
4.7	4.7	4.7
8.6	0.0	8.6
C=3.4	C=3.2	C=3.3
4.3	4.5	4.4
8.8	0.0	8.6
C=3.0	C=3.0	C=2.9
4.4	4.4	4.5
8.0	0.0	7.8

Sample D–8 Engineering notes for surface drainage—Sheet 12 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		56.50		
TP6	5.03	57.32	4.21	52.29
		(57.3)		
50+00			+7.9	49.4
52+00			+7.6	49.7
54+00			+7.3	50.0
56+00			+7.0	50.3
TP7	5.08	57.30	5.10	52.22
	old ditch ends			
58+00			+6.8	50.5
60+00			+6.5	50.8
61+82			+6.3	51.0
BM3			4.33	52.97
	39.62		35.75	
	35.75			
	3.87			

Correct elev. BM3=53.00
Diff. in elev. BM1 & BM3=3.90 Check OK

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Layout

4

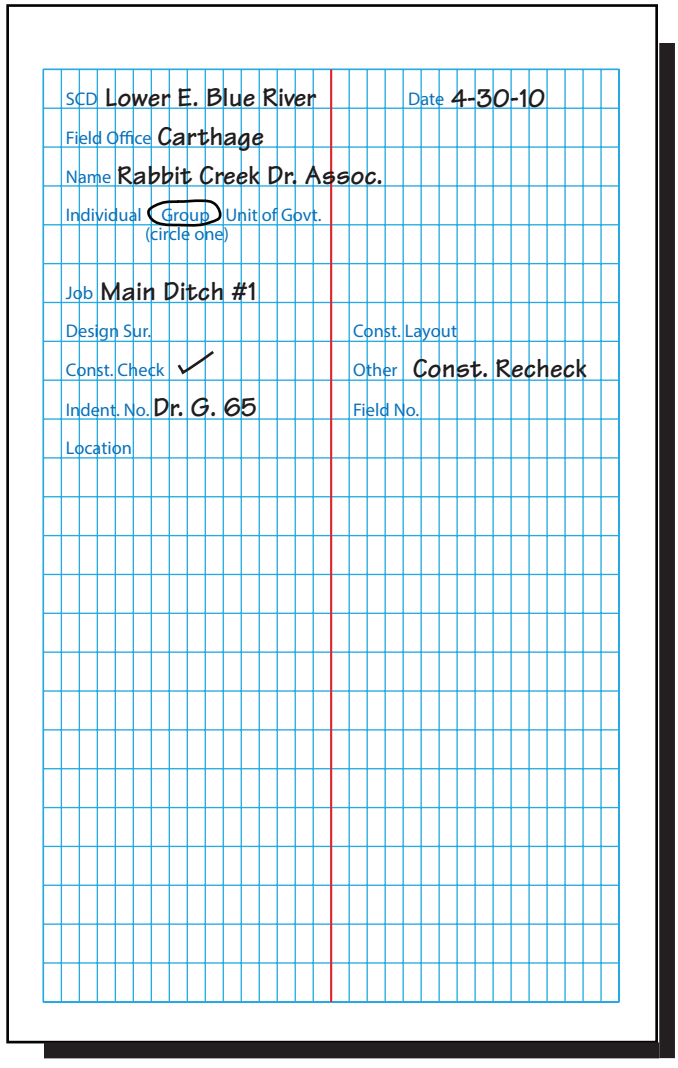
Left	℄	Right
C=3.1 4.8 8.2	C=3.1 4.8 0.0	C=3.1 4.8 8.2
C=2.9 4.7 7.8	C=2.8 4.8 0.0	C=2.9 4.7 7.8
C=2.8 4.5 7.6	C=2.8 4.5 0.0	C=2.7 4.6 7.4
C=2.7 4.3 7.4	C=2.8 4.2 0.0	C=2.8 4.2 7.6
C=2.7 4.1 7.4	C=2.7 4.1 0.0	C=2.7 4.1 7.4
C=2.4 4.1 6.8	C=2.5 4.0 0.0	C=2.6 3.9 7.2
C=2.6 3.7 7.2	C=2.6 3.7 0.0	C=2.5 3.8 7.0

Sample D–8 Engineering notes for surface drainage—Sheet 13 of 17

Engineering notes for surface drainage (main ditch) construction check

The following check notes are for a ditch that was uniform in appearance. A small trickle of water along the ditch bottom indicated uniform grade except at one or two points. These facts were taken into consideration in deciding how intensively the work should be checked.

Design data from the plan such as bottom width, side slopes, and the planned bottom elevation at each station were listed on a sheet of paper so it would be convenient for reference. This was done before starting the survey.



Sample D–8 Engineering notes for surface drainage—Sheet 14 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM1	3.80	52.90		49.10
TP1	4.83	54.72	3.01	49.89
TP2	4.04	54.50	4.26	50.46
9+00			+10.5	44.0
12+00			+10.2	44.3
16+00			+9.7	44.8
TP3	4.28	54.77 (54.8)	4.01	50.49
22+00			+9.3	45.5
TP4	4.46	55.45 (55.4)	3.78	50.99
28+00			+9.1	46.3
TP5	4.26	55.69	4.02	51.43

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Check
Dr. Ditch #1 Const. Check

π J. Ryals
⌀ J. Jones

7
3-5-10

Left ℄ Right

20^{d} nail in 8" pecan tree blazed △
40' W. & 75' N. Sta. 0+00

Design: 4' BW, 2:1 SS, 10' Berm

Berm

5.3 / 24	5.4 / 13	10.6 / 2	10.6	10.5 / 2	5.5 / 12

10.4

5.1 / 22	5.2 / 11	9.7 / 2	9.7	9.7 / 2	5.1 / 12

4.0 / 22	4.2 / 12	9.5 / 2	9.3	9.4 / 2	4.2 / 13

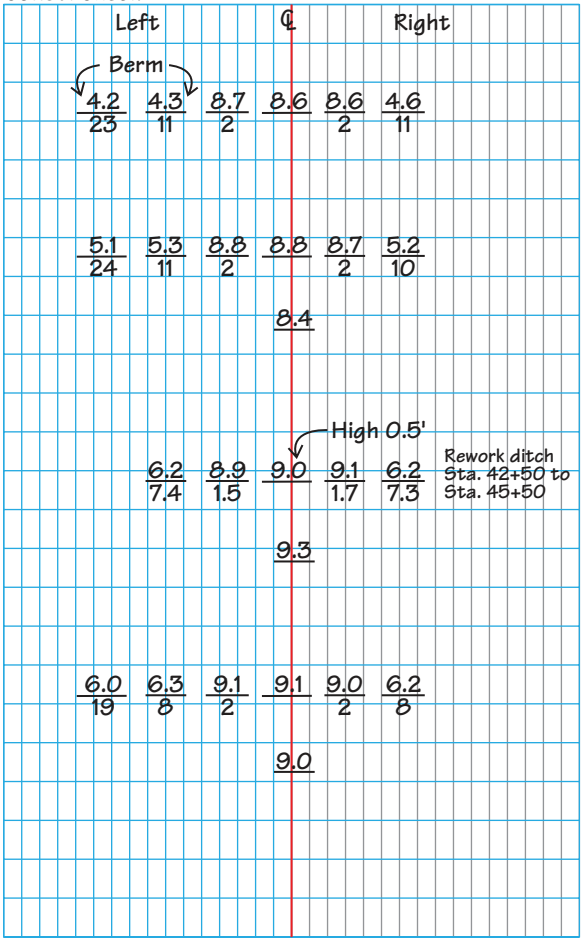
9.3

Sample D–8 Engineering notes for surface drainage—Sheet 15 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		55.69			
34+00		(55.7)	+8.5	47.2	
BM2	4.12	56.73	3.08	52.61	OK
	Correct	elev. BM2=52.60 (56.7)			
40+00			+8.7	48.0	
42+00			+8.4	48.3	
TP7	4.32	58.04 (58.0)	3.01	53.72	
44+00			+9.5	48.5	
46+00			+9.2	48.8	
TP8	4.02	58.95 (58.9)	3.11	54.93	
52+00			+9.2	49.7	
54+00			+8.9	50.0	

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Check

2



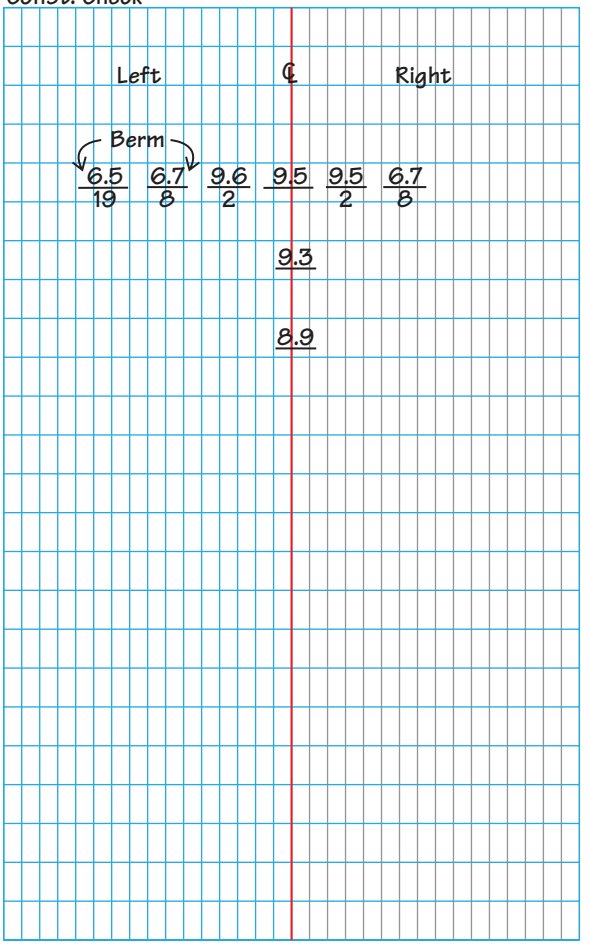
Sample D–8 Engineering notes for surface drainage—Sheet 16 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		58.95		
TP9	4.14	60.01	3.08	55.87
58+00				50.5
			+9.5	
60+00				50.8
			+9.2	
61+82				51.0
			+9.0	
BM3				53.04
	42.27			
	38.33		6.97	
	3.94			

Correct elev. BM3=53.00
Diff. in elev. BM1 & BM3=3.90
Check OK

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Check

3



Sample D–8 Engineering notes for surface drainage—Sheet 17 of 17

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM2	5.04	57.64 (57.6)		52.60	
42+00			+9.3	48.3	
43+00			+9.2	48.4	
44+00			+9.1	48.5	
45+50			9.0	48.6	
BM2			5.04	52.60	OK

Rabbit Cr. Dr. Assoc.
Main Ditch #1
Const. Check

J. Ryals
O. Brown
Ch. R. Jones

4
5-2-10

Left ℄ Right

9.4

9.3

5.8/20 5.9/9 9.3/2 9.2 9.2/2 6.0/9

9.1

Construction meets plans and specs.

J. Ryals

Eng. Tech.
5-2-10

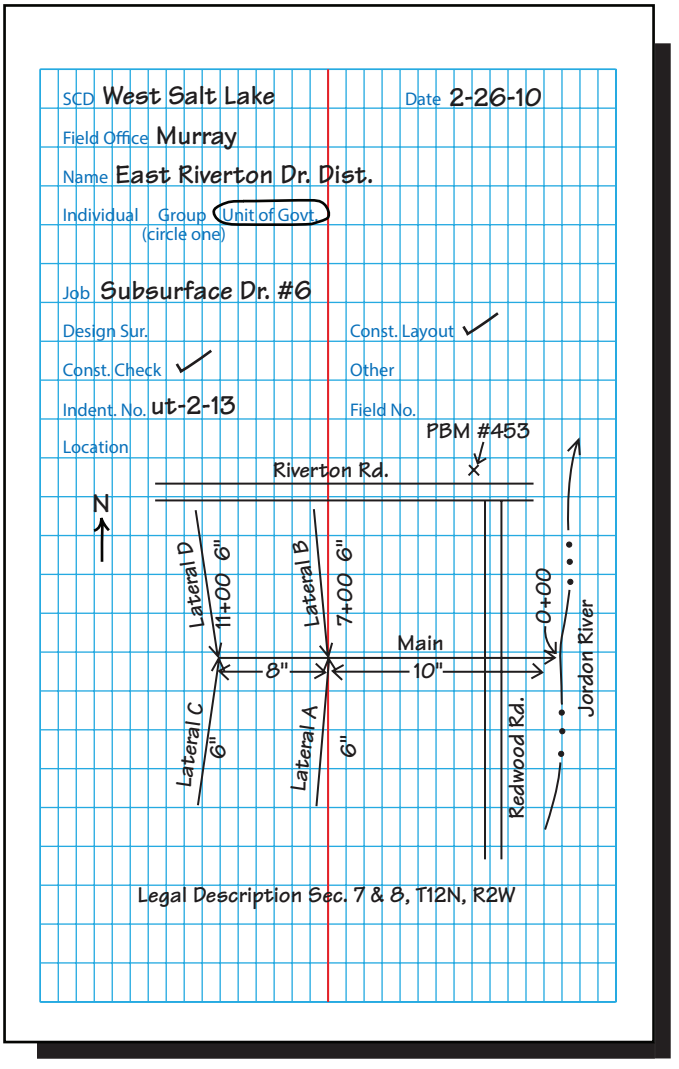
Sample D–36 Engineering notes for subsurface drain (main line) construction layout and construction check—Sheet 1 of 4

Engineering notes for subsurface drain (main line) construction layout and construction check

These notes illustrate the general format for subsurface drains. The design was prepared from a survey and soils investigations made during development of an overall plan for the district.

The construction check notes illustrate a simple method of checking from the reference hubs. It is simpler and faster than carrying elevations from bench marks, and it is satisfactory for most jobs if reference hubs are offset a safe distance where they will not be disturbed during construction. In using this method, the person who is to do the checking must be given the following information:

1. Planned cut from top of reference hub to bottom of trench at each station.
2. Outside diameter of each size pipe used in the line.



Sample D–36 Engineering notes for subsurface drain (main line) construction layout and construction check—Sheet 2 of 4

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Reference Hubs 8 ft Left ℄
BM	6.43	62.60		4356.17	
TP1	3.32	58.81 (58.8)	7.11	55.49	
0+00					
0+10			+10.8	48.0	
					C-6.7
0+20			+10.8	48.0	4.1
					C-6.6
1+00			+10.7	48.1	4.0
					C-7.1
2+00			+10.6	48.2	3.5
2.54					
					C-7.4
3+04			+10.5	48.3	3.1
					C-7.2
4+00			+10.4	48.4	3.2

Rabbit Cr. Dr. Assoc.
Main Drain #6
Const. Check

T. Scope
I. Rodd
Ch. H. Roy

1
2-26-10

Left ℄ Right

U.S.G.S. BM #453 S.E. Corner Sec. 6

℄ Jordan River — 46.0 elev. 12.8

Begin 10" CMP — 11.3 Drive piling at 0+12

C=6.3
4.5

Begin 10" conc. file — C=6.4 4.3

C=6.6
4.0

R.O.W. fence

℄ Redwood Rd. — 55.5 elev. 3.3

C=6.8
3.7

C=6.7
3.7

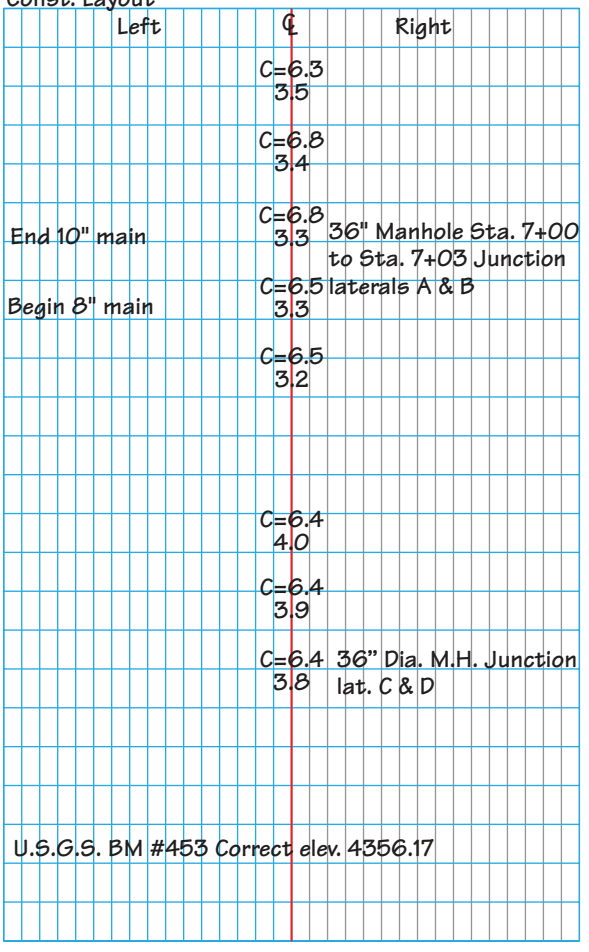
Note: Cut to be mesured from top of reference hubs.

Sample D–36 Engineering notes for subsurface drain (main line) construction layout and construction check—Sheet 3 of 4

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	Reference Hubs & Left ℄
					C=7.4
5+00		58.81	+10.3	48.50	2.9
		(58.8)			C=7.3
6+00			+10.2	48.60	2.9
					C=7.3
7+00			+10.1	48.70	2.8
					C=7.0
7+03			+9.8	49.0	2.8
					C=7.0
8+00			+9.7	49.1	2.7
TP2	3.19	59.70	2.30	56.51	
					C=6.9
9+00			+10.4	49.3	3.5
					C=6.8
10+00			10.3	49.4	3.5
					C=6.6
11+02			+10.2	49.5	3.6
TP3	4.12	60.04	3.78	55.92	
		(60.0)			
BM			3.85	4356.19	
	17.06	OK	17.04		

E. Riverton Dr. Dist.
Main Drain #1
Const. Layout

2



Sample D–36 Engineering notes for subsurface drain (main line) construction layout and construction check—Sheet 4 of 4

Sta.	B.S. On Ref. Hub	H.I.	~~F.S. or~~ Grade Rod to bottom of trench	Elev. or Planned Elev.	Planned cut from Ref. Hub to bottom of trench
0+20	4.7		11.4		6.7
3+04	4.6		12.0		7.4
7+00	4.9		12.2		7.3
7+03	4.9		11.9		7.0
9+00	4.8		11.7		6.9
11+02	4.8		11.4		6.6

E. Riverton Dr. Dist.
Main Drain #6
Const. Check

π J. Brown
⌀ R. Rush

3
3-12-10

Tile O.D ft.	Rod Reading Top of Tile	
1.0	10.4	
1.0	11.0	
1.0	11.2	
0.8	11.1	
0.8	11.0	OK with in 0.1 ft
0.8	10.6	

Construction dimensions, elevations, and locations of manholes, outlet prop and filter noted on "As -built" plans. all construction meets plan and specs.

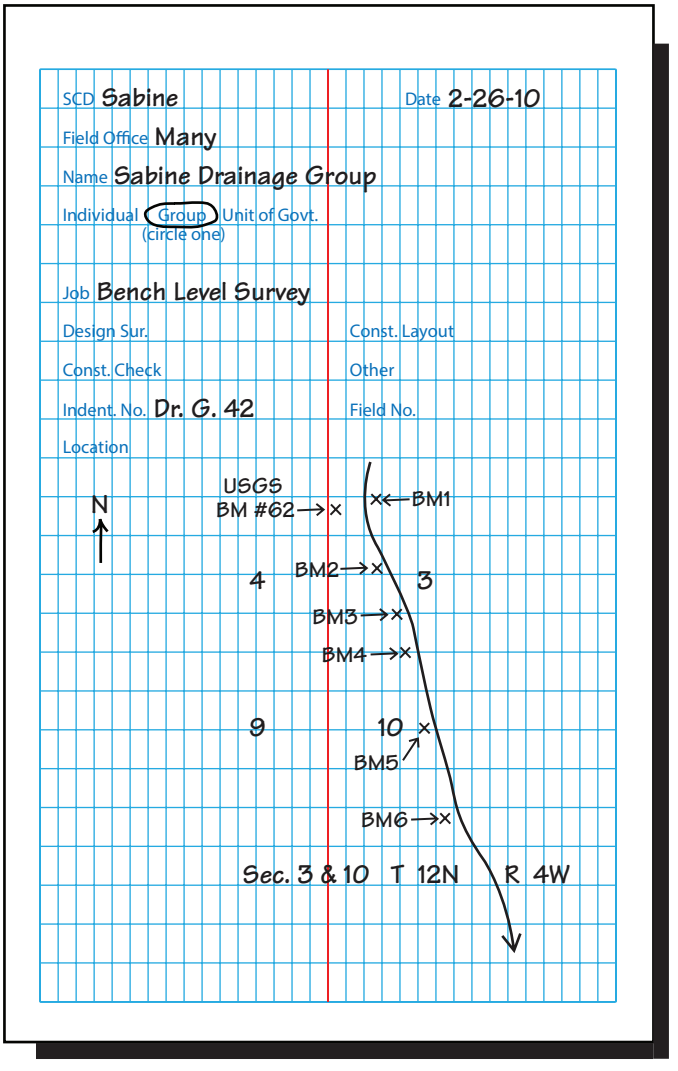
J. Brown
Dr. Dist. Insp.
3-12-10

Sample D–10 Engineering notes for bench level survey—Sheet 1 of 5

Engineering notes for bench level survey

These notes illustrate the general format for setting bench marks as vertical control points for subsequent surveys and construction work.

It will be noted that turning points have been numbered in these sample notes. This practice is optional.



Sample D–10 Engineering notes for bench level survey—Sheet 2 of 5

Sta.	B.S.	H.I.	F.S. ~~or Grade Rod~~	Elev. ~~or Planned Elev.~~
BM	6.82	151.44		144.62
TP1	4.92	151.19	5.17	146.27
TP2	5.69	148.63	8.25	142.94
BM1	1.90	148.58	1.95	146.68
TP3	3.02	148.36	3.24	145.34
TP4	5.57	148.48	5.45	142.91
BM2	5.16	148.13	5.51	142.97
TP5	4.93	149.28	3.78	144.35
TP6	4.42	149.58	4.12	145.16
BM3	4.65	149.22	5.01	144.57
TP7	3.72	148.56	4.38	144.84

Sabine Dr. Group
Bench Levels

ℸ S. Jones
⌀ R. Brown

1
2-26-10

Hot and Clear

USGS BM #62-Conc. Mon. 10' S. & 15' E. N.W. Corn. Sec. 3; T12N; R4W

60^{d} nail in S. side 18" cottonwood in N. E. Corn; N.W. ¼; N.W. ¼; Sec. 3

1" Steel axle in S.E. Corn.; N".W. ¼; N.W. ¼; Sec. 3

60^{d} nail in N. side 15" hickory tree in S. E. Corn; S.E. ¼; N.W. ¼; Sec. 3

Sample D–10 Engineering notes for bench level survey—Sheet 3 of 5

Sta.	B.S.	H.I.	F.S. ~~or Grade Rod~~	Elev. ~~or Planned Elev.~~
		148.56		
TP8	4.02	147.17	5.41	143.15
TP9	4.31	146.62	4.86	142.31
TP10	4.56	146.20	4.98	141.64
TP11	4.65	145.84	5.01	141.19
BM4	4.72	145.60	4.96	140.88
TP12	4.82	145.21	5.21	140.39
TP13	4.61	144.35	5.47	139.74
TP14	4.41	143.50	5.26	139.09
BM5	4.26	142.97	4.79	138.71
TP15	4.75	142.71	5.01	137.96
TP16	3.95	141.01	5.65	137.06

Sabine Dr. Group
Bench Levels
2

¾" iron pipe 160' E. S.W. corn. S.E. ¼ Sec. 3

¾" iron pipe 262' E. S.W. corn. N.E. ¼ Sec. 10

Sample D–10 Engineering notes for bench level survey—Sheet 4 of 5

Sta.	B.S.	H.I.	F.S. ~~or Grade Rod~~	Elev. ~~or Planned Elev.~~
		141.01		
TP17	4.12	140.33	4.80	136.21
TP18	4.23	139.65	4.91	135.42
TP19	3.93	138.94	4.64	135.01
BM6	4.12	138.38	4.68	134.26
TP20	4.73	139.25	3.86	134.52
TP21	4.68	140.12	3.81	135.44
TP22	4.87	140.98	4.01	136.11
TP23	4.79	141.79	3.98	137.00
TP24	4.83	142.55	4.07	137.72
TP25	4.43	142.86	4.12	138.43
TP26	4.63	143.36	4.13	138.73

Sabine Dr. Group
Bench Levels
3

60^d nail in W. side 20" elm 350' W. of S.E. corn. Sec. 10

Sample D–10 Engineering notes for bench level survey—Sheet 5 of 5

Sta.	B.S.	H.I.	F.S. ~~or Grade Rod~~	Elev. ~~or Planned Elev.~~	
		143.36			
TP27	4.54	144.01	3.89	139.47	
TP28	4.64	144.87	3.78	140.23	
TP29	4.51	145.63	3.75	141.12	
TP30	4.44	146.54	3.53	142.10	
TP31	4.40	147.66	3.28	143.26	
BM62			3.09	144.57	
ΣBS	171.75	ΣFS	171.80		
	171.80		Correct elev. BM 62 =	144.62	
	−000.05		Diff. =	−0.05	OK
			Allowable error =	$.1\sqrt{M}$	
			=	$.1\sqrt{4.11}$	
			=	.203	

Sabine Dr. Group
Bench Levels

4

Total circuit distance as scaled from aerial photo=4.11 miles

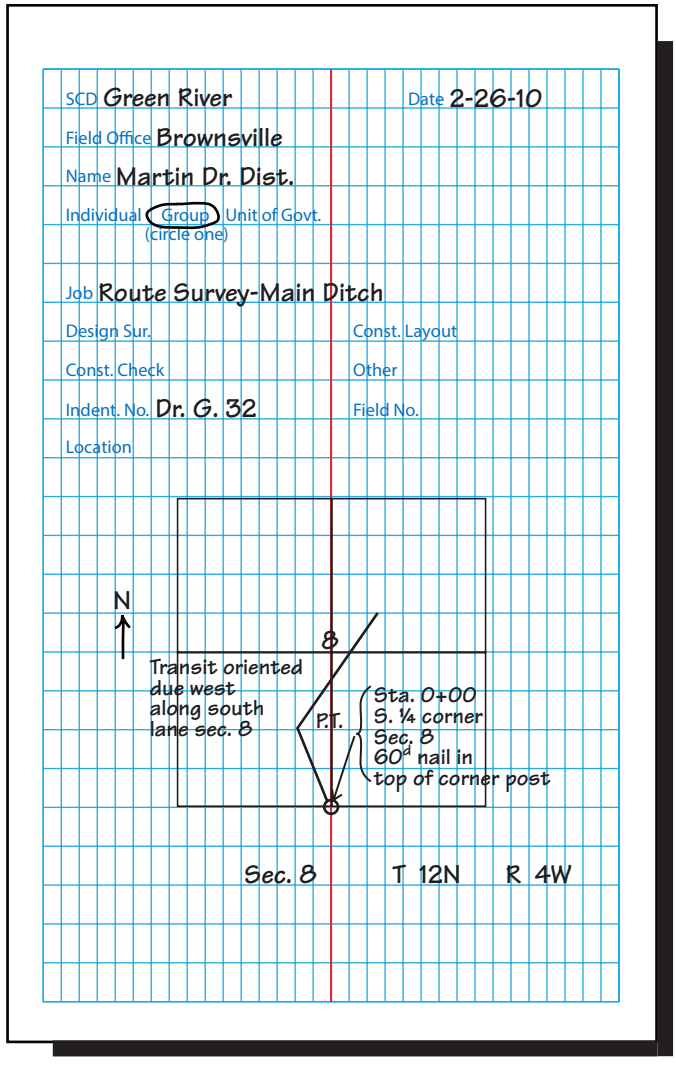
Sample D–11 Engineering notes for route survey—Sheet 1 of 3

Engineering notes for route survey

These notes illustrate the format of a location or route survey by deflection angles.

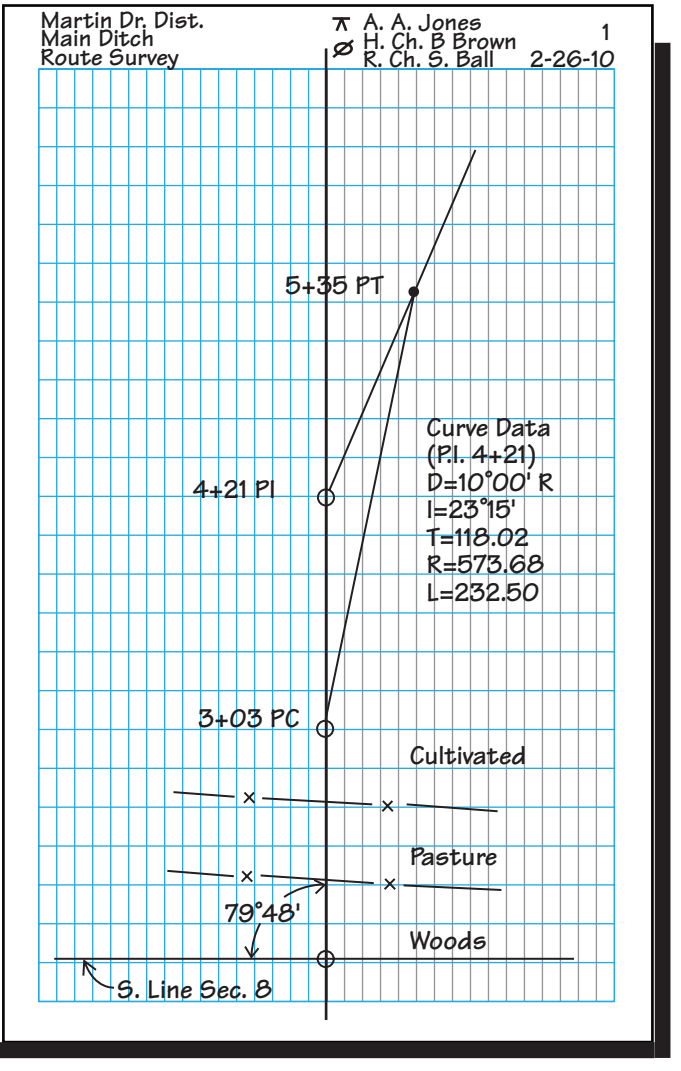
The columns Deflection Angle and Double Deflection Angle are for the recording of observed values. One-half of the Double Deflection Angle is recorded in the column headed Calculated Deflection Angle.

It will be noted that curves were calculated and staked as the survey progressed. This requires experienced personnel, but if it is not done, it is necessary to re-station the line after the curves are staked.



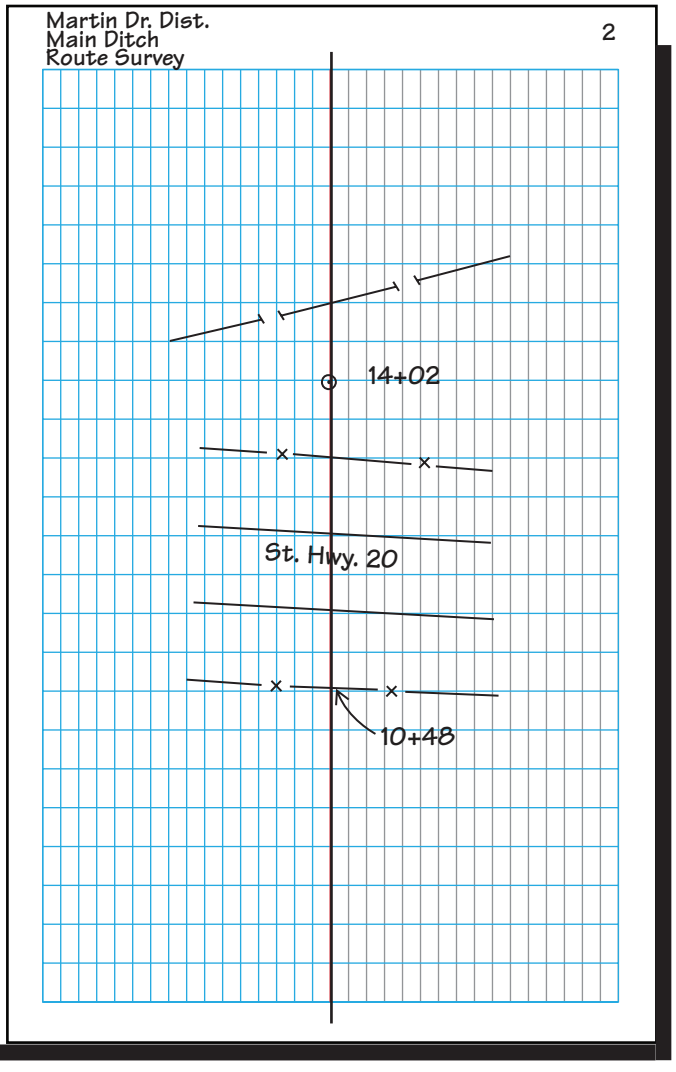
Sample D–11 Engineering notes for route survey—Sheet 2 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Def<	Dbl Def. <	Cal. Def. <	Mag. Bearing	Point
6+00				N13°03'E	Line Stake P.O.T.
5+35.5	11°37.5'				P.T.
5+00	9°51'				P.O.C.
4+50	7°21'				P.O.C.
4+47					W. Line SE 1/4 Sec. 8
⊙ 4+21	23°14'R	46°30'R	23°15'R		P.I.
4+00	4°51'				P.O.C.
3+50	2°21'				P.O.C.
⊙ 3+03					P.C.
2+00					Fence
1+00					Fence
				N10°12'W	
⊙ 0+00					



Sample D–11 Engineering notes for route survey—Sheet 3 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Def<	Dbl Def. <	Cal. Def. <	Ma. Bearing	Point Line Stake
	Continue Survey to End				
14+51					Pipeline
				N13°03E	
⊙ 14.02					P.O.T.
11+48					R.O.W. Fence S.H. 20
11+08					Edge Conc. Slab S.H. 20
10+88					Edge Conc. Slab S.H. 20
10+48					R.O.W. Fence S.H. 20
9+00					Line Stake
8+00					Line Stake
7+00					Line Stake
				N13°03E	



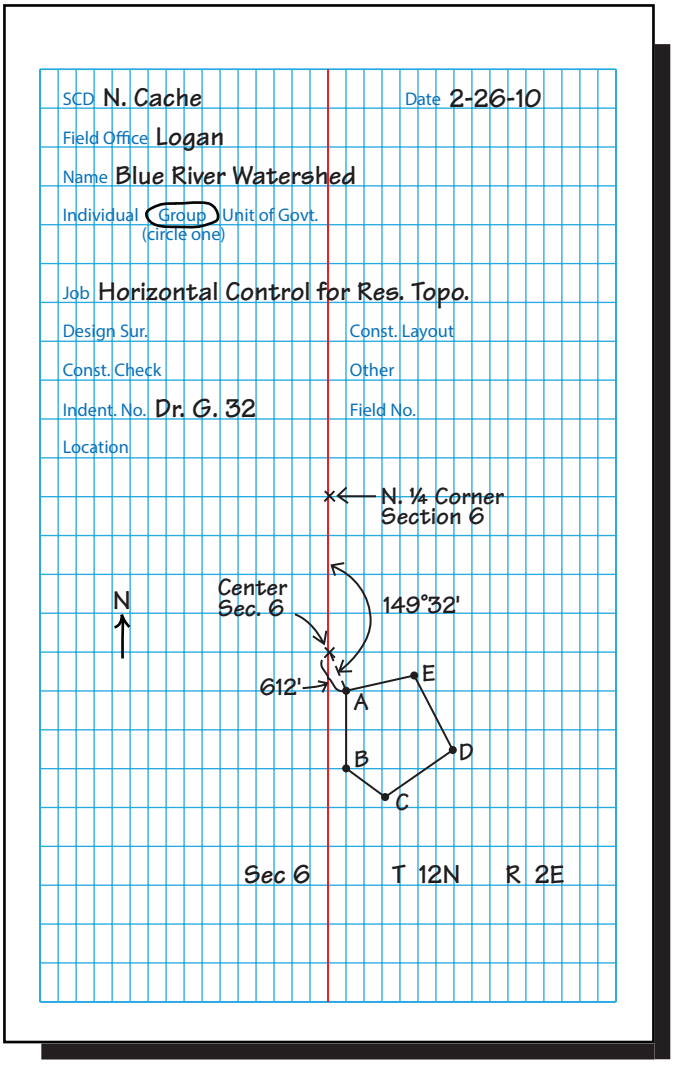
Sample D–12 Engineering notes for closed traverse—Sheet 1 of 3

Engineering notes for closed traverse

These notes illustrate the format for a closed traverse by the deflection angle method. The traverse is to serve as horizontal control for a topographic survey of a reservoir site.

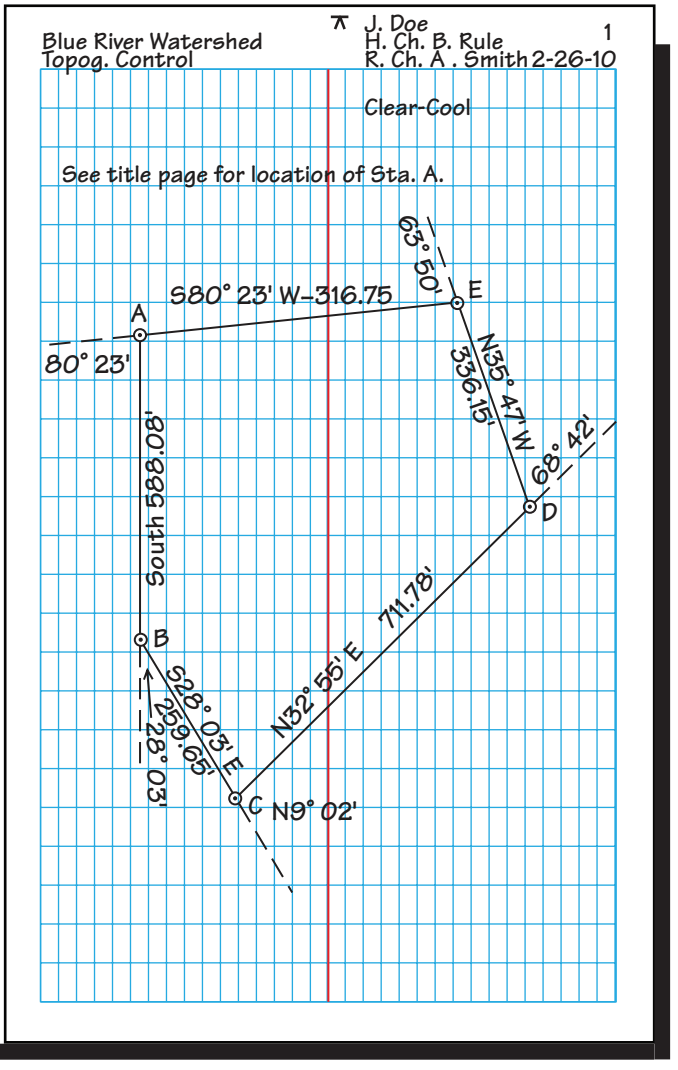
Transit station elevations will be established by a bench level survey from a permanent bench mark. Locations and elevations of pertinent topographic features will then be obtained with the transit by means of horizontal and vertical angles and stadia or chained distances.

See sample D–13 for a method of obtaining all needed information during one operation.



Sample D–12 Engineering notes for closed traverse—Sheet 2 of 3

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
	Def<	Dbl Def. <	Cal. Def. <	Hor. Dist.	Mag. Br.
A					
				588.08'	South
B	28°02'L	56°06'L	28°03'L		
				259.65'	S28°03'E
C	119°02'L	238°04'L	119°02'L		
				711.78'	N32°5'E
D	68°41'L	137°24'L	68°42'L		
				336.15'	N35°47'W
E	63°51'L	127°40'L	63°50'L		
				316.75'	S80°23'W
A	80°24'L	160°46'L	80°23'L		
					South
B					



Sample D–12 Engineering notes for closed traverse—Sheet 3 of 3

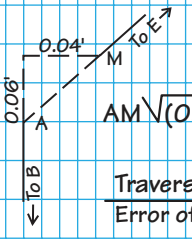
Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		Check for angular error			
EAB=	99°37'				
ABC=	151°57'	≤ int. angles	=	n-2(180°)	
BCD=	60°58'		=	n-2(180°)	
CDE=	111°18'		=	3(180°)	
DEA=	116°10'		=	540°	
≤ =	537°180'	=540° OK			
		Check for horizontal closure.			
		Latitude and departures			

Course	A–B	B–C	C–D	D–E	E–A
Bearing	South	S28°03'E	N32°55'E	N35°47'W	S80°23'W
Lat.	588.08'	229.152	597.510	272.695	52.196
Cosine		.88254	.83946	.81123	.16706
Dist.	588.08'	259.65'	711.78'	336.15'	316.75'
Sine		.47024	.54342	.58472	.98595
Dep.	0.0	122.098	386.795	196.554	312.300

Blue River Watershed
Topog. Control

2

≤N	≤N	≤E	≤N
870.21	870.15	508.89	508.85



$AM\sqrt{(0.06)^2+(0.04)^2} = 0.072$

$$\frac{\text{Traverse perimeter}}{\text{Error of closure}} = \frac{2,212.41}{0.072}$$

$$= 30,728$$

Measure of accuracy = 1 : 30,728

OK

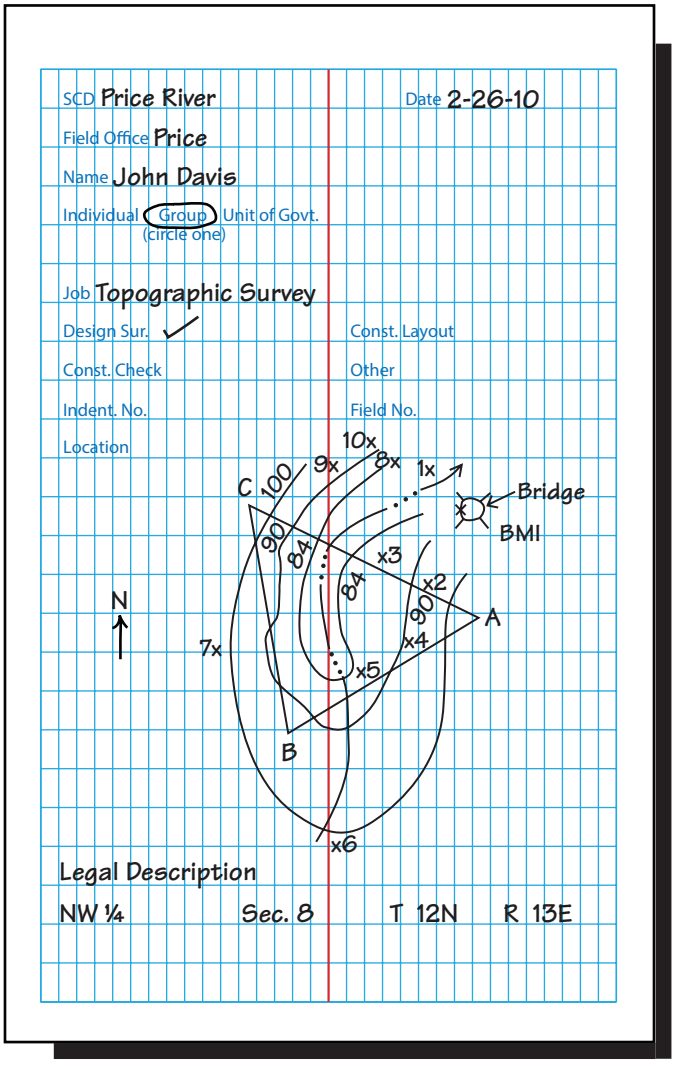
Check by
A. L. Jones
Eng. tech
2/26/10

Sample D–13 Engineering notes for topographic survey with transit—Sheet 1 of 2

Engineering notes for topographic survey with transit

These notes illustrate a method of running a closed traverse and obtaining topographic information in one operation. The traverse can be checked for closure as shown in sample D–12.

Direct leveling was done wherever possible. Vertical angles were used only where the observed point was above the instrument, too far below it, or where the line of sight, with vertical arm at zero, was obscured by brush.



Sample D–13 Engineering notes for topographic survey with transit—Sheet 2 of 2

Sta.	Azimuth ~~B.S.~~	Horizontal Distance ~~H.I.~~	Vertical Angle/ Foresight ~~F.S. or Grade Rod~~	Difference in Elevation ~~Elev. of Planned Elev.~~	Elevation
π at A; Elev. of A=101.6 F.S.; H.I.=106.4					
BM1	301°00	281	0° / 6.4	–1.6	100.00
1	323°30	388	0° / 10.4	–5.6	96.0
2	269°45	307	0° / 9.6	–4.8	96.8
3	269°50	453	-1°26 / 4.8	–11.3	90.3
4	240°00	386	0° / 9.5	–4.7	96.9
B	223°40	752	0° / 10.9	–6.1	95.5
π at B; Elev. of B=95.5 F.S.; H.I.=99.9					
A	43°40	752	+0°28 / 6.4	+6.1	101.6
5	24°50	83-'	-4°26 / 10.4	-10.4	85.1
6	161°10	445	+0°31 / 9.6	+4.0	99.5
7	275°40	290	0°52 / 4.8	+4.4	99.9
C	333°15	722	0°52 / 9.5	+10.9	106.4
π at C; Elev. of C=106.4 F.S.; H.I.=110.9					
B	153°15	72.	–0°52 / 4.5	–10.9	95.5
8	92°25	228–2	-4°50 / 4.5	–19.0	87.4
9	45°40	190	–2°13 / 4.5	–7.4	99.0
10	22°20	157	–2°44 / 4.5	–7.5	98.9
A	96°48	850	0° / 9.3	–4.8	101.6

John Davis
Topo.

π J. Gunn
⌀ T. Smith

1
2-26-10

Azimuths From Magnetic North

Top of painted bolt head S.E. crn. bridge elev. assumed

Bottom of streambed

Top of streambank

Sample D–14 Plane surface design—Sheet 1 of 3

Plane Surface Design
Table 1

Sheet 1 of 2

Title= Ralph Krey, Garden City, Kansas

Title= Field No. 2, NE 40 acres in SE 18-21-32

*BM= 50.0 *Description Steel stake at sta N 14

BS= 5.3 *

*HI= 55.3 *

*

GRID= 100 x 100

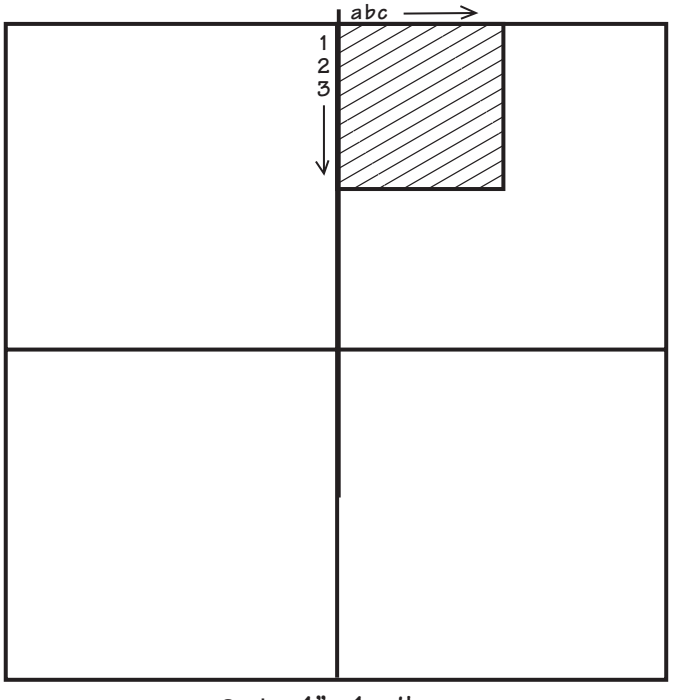
*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
X+(A,1)	5.6	3.7	2.9	2.7	2.6	3.2	4.2	4.9	5.0	4.9	4.5	3.9	3.2	1.6	
X+(A,2)	5.5	4.1	3.3	2.7	3.0	4.0	4.7	5.4	5.5	5.5	5.2	5.0	4.6	3.9	
X+(A,3)	5.5	3.9	3.4	3.0	3.8	5.0	5.7	6.1	6.3	6.9	5.5	5.4	4.9	4.1	
X+(A,4)	5.3	3.6	3.1	3.4	4.6	5.7	6.4	6.3	6.5	6.2	5.4	5.7	5.2	4.1	
X+(A,5)	5.1	3.7	3.1	3.7	5.2	6.3	6.9	7.1	7.1	6.2	5.4	5.3	5.0	3.3	
X+(A,6)	5.0	3.6	3.4	4.1	5.8	6.9	7.7	7.8	7.5	6.6	5.4	5.2	4.0	1.0	
X+(A,7)	5.1	3.9	3.9	4.3	6.1	7.4	8.8	9.1	8.1	7.0	5.3	4.1	2.4	0.3	
X+(A,8)	5.8	4.3	4.1	4.6	5.9	7.4	9.1	9.3	9.2	7.4	5.3	3.5	1.5	0.3	
X+(A,9)	6.1	4.4	4.3	4.5	5.7	7.0	8.6	8.6	9.0	8.3	6.3	4.1	1.5	0.5	
X+(A,10)	5.8	4.6	4.3	4.9	5.3	6.6	7.8	8.6	9.3	8.7	7.3	4.8	3.5	2.4	
X+(A,11)	5.3	4.3	4.0	4.8	5.1	5.9	7.1	7.9	8.9	8.8	7.5	5.9	4.4	3.1	
X+(A,12)	4.7	4.0	3.8	4.7	5.2	5.8	6.3	7.8	8.4	8.5	7.7	6.5	5.1	3.8	
X+(A,13)	4.0	3.6	3.4	4.6	5.2	5.7	6.3	7.1	7.9	7.9	7.5	6.9	5.4	4.5	
X+(A,14)	3.3	3.1	3.1	3.8	5.2	5.6	6.0	6.5	7.7	8.0	7.8	7.1	5.9	5.1	

Sample D–14 Plane surface design—Sheet 2 of 3

Special Design Instructions

Location Map



Scale 4"= 1 mile

Legal Description NW ¼ of NE ¼ Sec. 18 T 21 R 32

District Agreement No. _____ GPCP No. _____

Design Survey ☑ Construction Check ☐

Date 8-30-10 John W. Branden, Civil Eng. Tech.

Technician and Title

The symbol * is a note to the computer for blank space or for information not used by the computer.

Sample D–14 Plane surface design—Sheet 3 of 3

Plane Surface Design
Table 2

Sheet 2 of 2

* Design Requirements
* Title Ralph Krey, Run No. 1
* Hundredth=1
Origin= Upper Left
C/F Ratio= 1.50
Slope (X)= -0.1, -0.1
Slope (Y)= +0.1, +0.7 * Slope to South
Bench = (A,1) (N,1) (N,14) (A,14)
Borrow = n.a.
Waste = n.a.
Maxelev (,) = n.a.
Minelev (,) = n.a.
Go, Detail
* Title Ralph Krey, Run No. 2
Slope (X)= +0.1, -0.1
Slope (Y)= +0.1, +0.7 * Slope to North
Bench (A,1) (N,1) (N,14) (A,14)
Go, Detail
* Title Ralph Krey, Run No. 2
Slope (X)= +0.1, -0.1
Slope (Y)= +0.1, +0.7 * Slope to West
Bench (A,1) (N,1) (N,14) (A,14)
Go, Detail
* Title
Slope (X)=
Slope (Y)=
Go, Detail
End Job
*
Cross out all fringe points in data grid after entering in fringe areas.
Cross out all computer command lines not used.

Standards for project and larger group jobs

Standard staking and notekeeping procedures are shown for representative type structures and portions of structures. Every situation is not covered. The samples show format and procedure in sufficient detail for the field engineer or survey party chief to apply them to the particular job. Construction staking must be consistent with contract provisions, and some of the samples may represent portions that are the responsibility of the contractor.

Unless otherwise specified, basic staking for embankments and excavations includes centerline, slope (toe of slope or edge of cut), and offset reference stakes with hubs at each station and more frequently on curves along the axis of the embankment or excavation. Stakes at significant breaks in topography or changes in section of the planned work are also included. Basic staking for structures includes alignment and grade along the principal axis and may include offset stakes for linear structures, such as a principal spillway through a dam.

Computations are closely related to notekeeping. These samples can be used to compute quantities directly from the field notes. Placing the cut or fill above the distance from centerline or reference point facilitates direct computations. A sample plotted dam cross section and computation are shown.

Samples D–15 through D–18 show components of a typical floodwater retarding structure. These exhibits are referred to in the presentation of the sample field notes for layout and also for calculations. Although these figures and the field notes presented are for an earth dam, the content, procedures, and completeness of notekeeping are directly applicable to other major construction work.

Elevations for earthwork are usually computed to the nearest one-tenth (0.1) foot. Where grades or control elevations are not shown on the drawings, sufficient information for rough grading may be established by scaled measurements taken from the drawings.

A standard practice is to set grades for the various elements of structures to the nearest hundredth (0.01) of a foot.

All construction stakes should be set and marked to show finish elevation. Additional information may be added to stakes and notes for subgrades or other specific construction datums as needed.

Engineering notes—Construction stakeout

Sample D–24 illustrates a format for stakeout notes for dams or other embankments. The elevations and structure dimensions illustrated are from plan data in samples D–l5 through D–18 and field notebook sample D–20.

The example shows the original cross section and embankment staking. The foundation was stripped and a second cross section was taken concurrently with setting the cutoff trench cut stakes. This is an optional procedure and, in some cases, one cross section will be sufficient. The (T) denotes the edge (toe) of fill or cut.

Sample D–24 illustrates a format that may be used for recording the layout notes for the construction of principal spillways for flood control dams and can also be readily adapted for use in laying out other types of closed conduits or culverts.

Sample D–25 illustrates a format that may be used for recording notes for the cross sections and the layout of the auxiliary spillway or other earthwork. The work may consist of excavation or sections that combine excavation and embankment.

The layout, including curve data, and the elevations for this example were taken from sample D–22. Simple curves are frequently required in the layout of embankments, excavations, or elements of structures. Sample D–35 shows how a correction for curvature is made for an excavation between two asymmetrical sections located in the curve of an auxiliary spillway.

Stationing for the project should be continued along the centerline of the curve at the time of stakeout, and these stations should be used as control points for cross sections and the staking of the structure limits. Transverse measurements are made normal to the tangent to the curve at the point under consideration. This measurement line parallels an imaginary line that passes through the centerline station and the reference or radius point for the curve.

Plotting and considerations

Sample D–26 shows the plotted cross section of dam centerline station 15+10. Fill height and distance from the centerline are the parameters used for plotting.

Calculations should normally be made directly from field notes. It may be necessary in cases of complex geometry to plot cross sections to visualize the element. However, copying numbers and plotting cross sections should be kept to the minimum. They may be used were appropriate. Sample D–27 shows a convenient way of tabulating field notes for calculations where it is not convenient to compute directly from the field notebook.

Setting and marking stakes

Sample D–28 shows an example for staking embankments. This is the same cross section as recorded on sample D–23 shows an example for staking an open channel spillway. This is the same cross section as recorded for auxiliary spillway station 9+12 on sample D–25. The berm was added to the sketch to show the procedure (not in notes.) Stake location and markings must convey the necessary information. The examples show proven methods but may be varied to accomplish this objective.

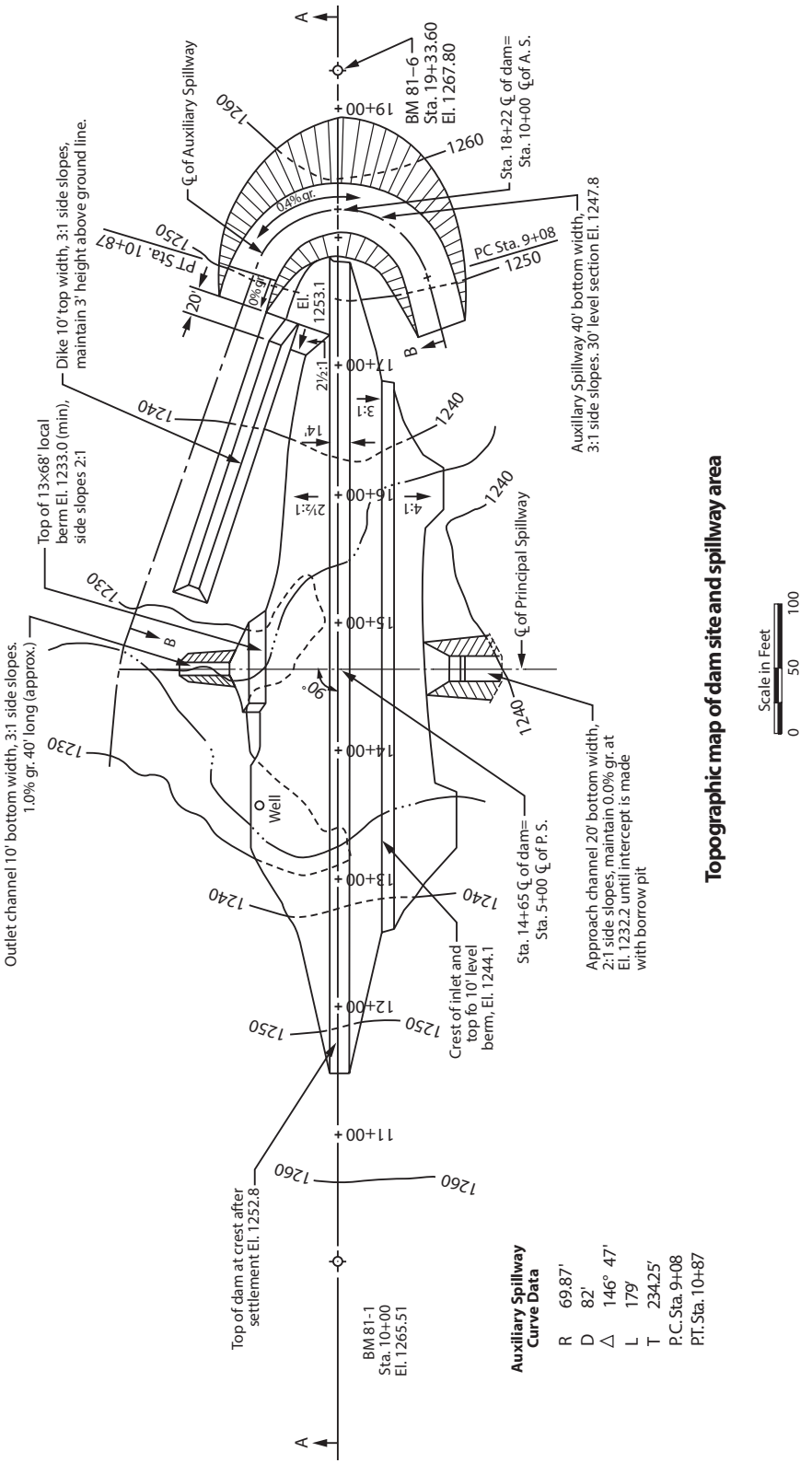
Sample D–30 shows stake marking for various purposes applicable to construction. Samples D–31, D–32, and D–33 show methods of staking various other structures.

Engineering notes—checking completed work

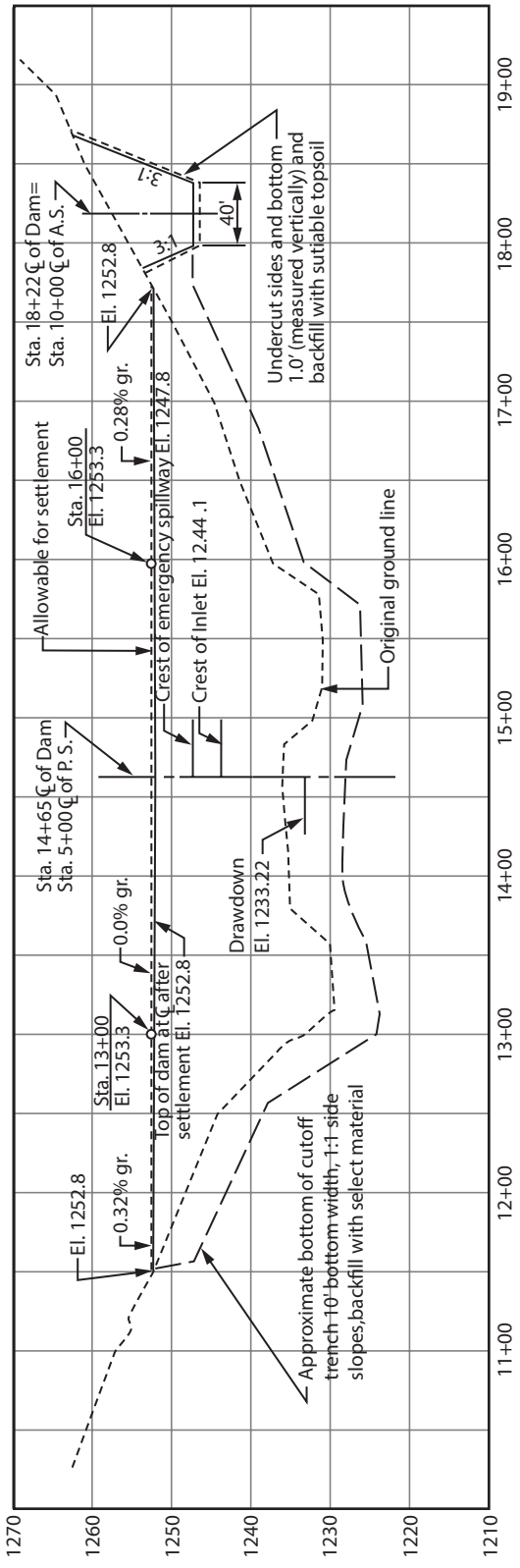
Sample D–34 shows an example of recording a check of completed construction and, although an embankment is shown, the principles are applicable for all construction work.

Some technicians develop a checkout schedule similar to the stakeout schedule based on constructed fill height to the dam centerline. Use of such schedules may be appropriate for large complex dams. The notes shown, along with good visual judgment, should be sufficient for the ordinary dam. A plot of the planned embankment section overlain with the constructed cross section can also be made to visually compare the two.

Sample D–15 Topographic map of dam site and spillway area

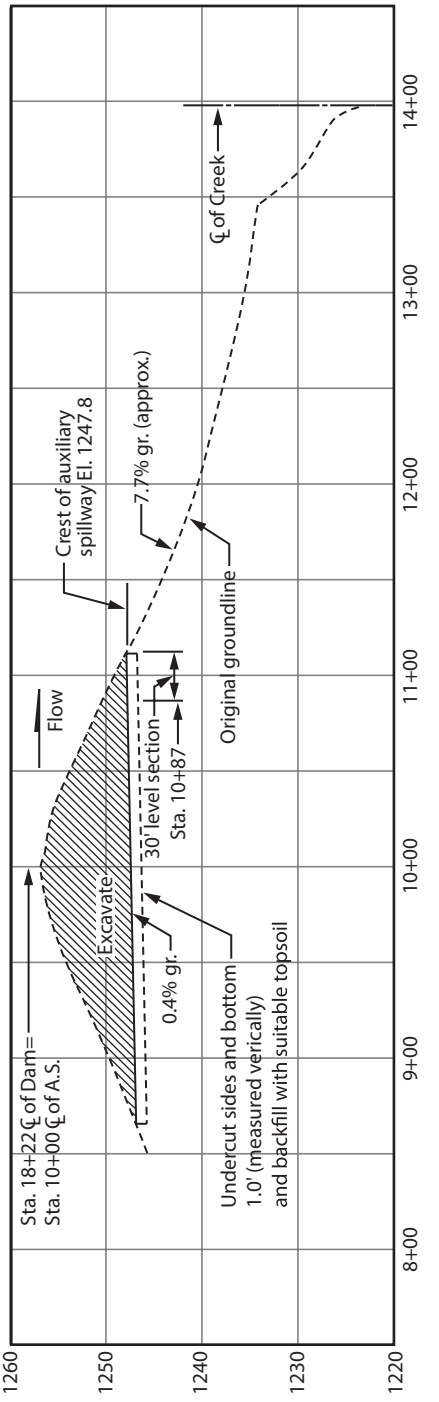


Sample D–16 Profile along centerline of dam



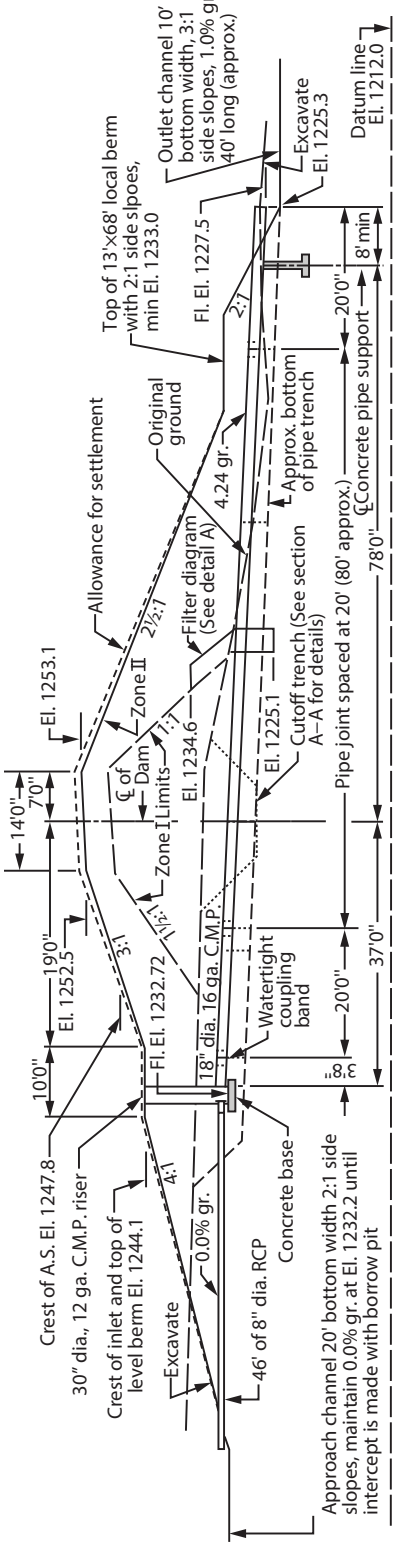
Section A-A
Profile along ℄ of dam

Sample D–17 Profile along centerline of auxiliary spillway



Section B-B
Profile Along ℄ Of Auxiliary Spillway

Sample D–18 Profile along centerline of principal spillway



Cross section of dam along ℄ of principal spillway

(Sta. 14+65)

Sample D–19 BM level circuit—Sheet 1 of 2

BM Level Circuit

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM81-1	1.75	1267.26		1265.11	
TP	0.22	1255.33	12.15	1255.11	
TP	1.15	12.43.70	12.78	1242.55	
TP	9.17	1240.51	12.36	1231.34	
TP	11.61	1250.75	1.37	1239.14	
TP	12.60	1262.29	0.66	1250.09	
TP	8.51	1296.54	1.66	1261.03	
BM81-6	1.29	1269.09	1.74	1267.80	
TP	0.35	1257.34	12.10	1256.99	
TP	1.54	12.46.88	12.00	1245.34	
TP	9.77	1247.73	8.92	1237.96	
TP	11.11	1258.26	0.58	1247.15	

McVicker Beason 7-1-10

Top of ½" rebar set in concrete @ Sta. 10+00
℄ of dam guarded by R&W steel post

Top of south steel handle on well cap

Top of ½" rebar @ R&W steel post on ℄ of dam Sta. 19+33.60

Top of steel post

Sample D–19 BM level circuit—Sheet 2 of 2

BM Level Circuit

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		1258.26			
BM81-2	10.14	1266.77	1.63	1256.63	
BM81-1			1.25	1265.52	0.01 error

Note: If the error exceeds 0.01 but is within allowable error for the precision of the survey, the elevations should be adjusted.

7-1-10

Top gate post downstream from north end of dam.

Checked: H.H.A.
7-24-10

Sample D–20 Embankment stakeout schedule—Sheet 1 of 2

EMBANKMENT
Stakeout Schedule

Sta.	~~B.S.~~	~~H.I.~~	~~F.S. or~~ ~~Grade Rod~~	Elev. or Planned Elev.	Settlement
		BERM			
	Elev.	Settlement	Const. elev.		
11+51				1252.8	0.0
11+56					0.0
12+56					0.3
13+00	1244.1	0.3	1244.4		0.5
13+15		0.3	1244.4		0.5
13+60		0.3	1244.4		0.5
13+80		0.2	1244.3		0.5
14+00		0.2	1244.3		0.5
14+75		0.2	1244.3		0.5
15+10		0.2	1244.3		0.5
15+75	1244.1	.02	1244.3	1252.8	0.5

Constructed Elev.	Constructed Core Trench Elev.	
1252.8		End of dam
1252.8	1247.3	
1253.1	1240.0	Begin berm
1253.3	1224.0	
1253.3	1224.0	
1253.3	1226.0	Ground core break
1253.3	1227.5	Ground break
1253.3	1229.0	
1253.3	1228.6	
1253.3	1226.5	
1253.3	1226.5	

Sample D–20 Embankment stakeout schedule—Sheet 2 of 2

EMBANKMENT
Stakeout Schedule

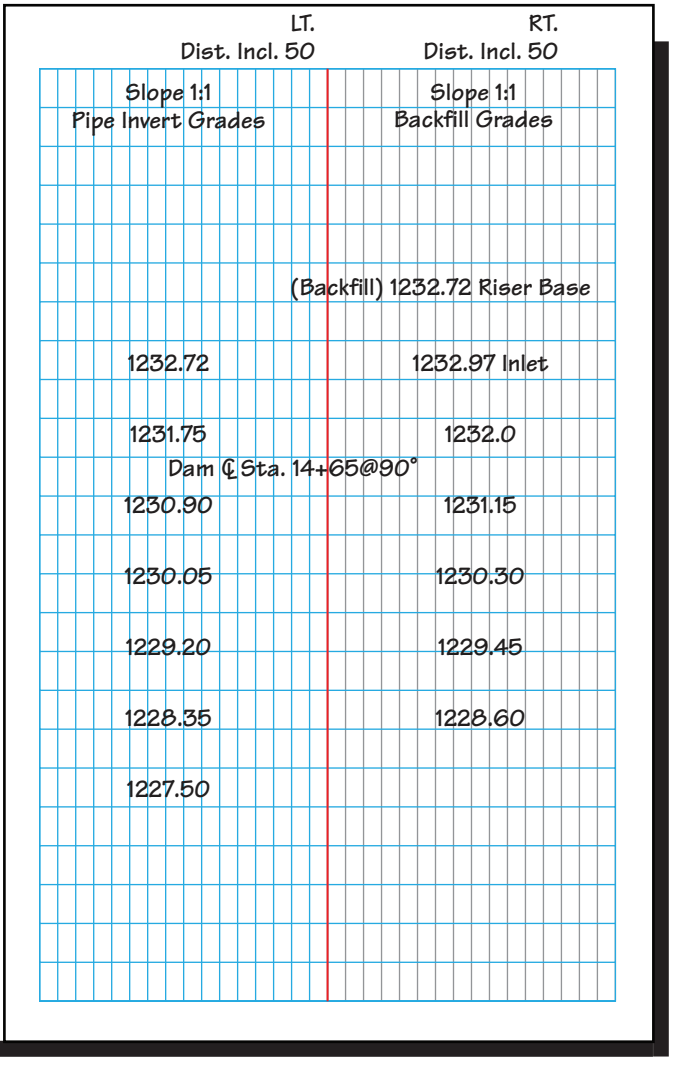
Sta.	~~B.S.~~	~~H.I.~~	~~F.S. or Grade Rod~~	Elev. or Planned Elev.	Settlement
		BERM			
	Elev.	Settlement	Const. elev.		
16+00	1244.1	0.2	1244.3	1252.8	0.5
16+90				1252.8	0.2
17+78				1252.8	0.0

Constructed Elev.	Constructed Core Trench Elev.
1253.3	1233.5
1253.0	1240.0 End berm
1252.8	1247.8

Sample D–21 Principle spillway stakeout schedule

PRINCIPLE SPILLWAY
Stakeout Schedule

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev. Trench Bottom
4+50				1237.0
4+56				1231.0
4+64				1230.2
4+86				1229.2
5+00				
5+06				1228.5
5+26				1227.8
5+46				1227.0
5+66				1226.2
5+86				1225.3



Sample D–22 Auxiliary spillway stakeout schedule—Sheet 1 of 2

AUXILIARY SPILLWAY
Stakeout Schedule

Sta.	~~B.S.~~ Defl.	~~H.I.~~ Central	~~F.S. or Grade Rod~~	Elev. or Planned Elev. Design	Subgrade
8+61				1246.8	1245.8
9+08PC	0°00'	0°00'		1247.0	1246.0
9+12	1°38'	3°17'		1247.1	1246.1
9+37	11°53'	23°47'		1247.2	1246.2
9+62	22°08'	44°17'		1247.3	1246.3
9+87	32°23'	64°47'		1247.4	1246.4
10+00		75°26'			
10+12	42°38'	85°17'		1247.5	1246.5

LT. Dist. Incl. 20 | RT. Dist. Incl. 20

Slope 3:1 | Slope 3:1

Curve Data
RP 17+52.1
R = 69.87'
D = 82°
Δ = 146°47'
L = 179'
T = 234.25
PC Sta. 9+08
PT Sta. 10+87

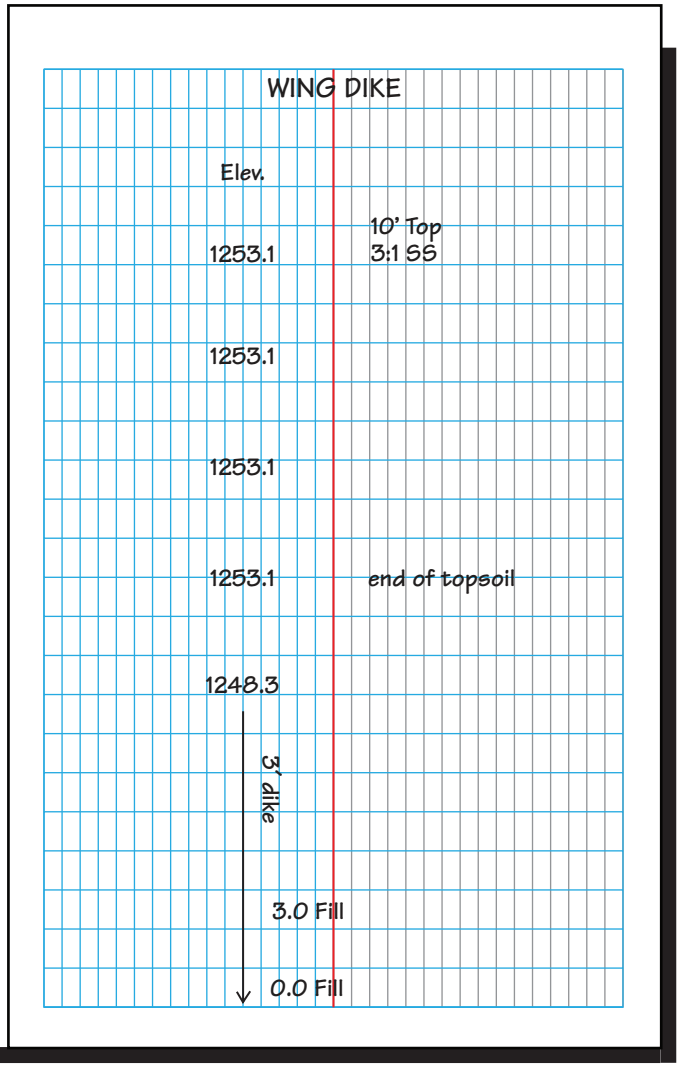
Sta. 10+00 ES=18+22 ℄ of Dam

Dam ℄

Sample D–22 Auxiliary spillway stakeout schedule—Sheet 2 of 2

AUXILIARY SPILLWAY
Stakeout Schedule

Sta.	~~B.S.~~ Defl.	~~H.I.~~ Central	~~F.S. or Grade Rod~~	Elev. or Planned Elev. Design	Subgrade
10+37	52°53'	105°47'		1247.6	1246.6
10+62	63°08'	126°17'		1247.7	12.46.7
10+87PT	73°23'	146°47'		1247.8	1246.8
11+17				1247.8	1246.8
11+37				1245.3	Natural Ground
12+37					
13+37					
13+47				Natural Ground	



Sample D–23 Embankment stakeout notes—Sheet 1 of 2

EMBANKMENT
Stakeout Notes

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		1241.06 (1241.1)			pg. 15
15+10			–11.7	1252.8	Fill
			–12.2	1253.3	Const.
			–3.0	1244.1	Berm
			–3.2	1244.3	Const.

Down LT.

Gr. Rd. Fill Adj.–0.3
Dist. Adj. for Berm
Slope 2½:1
Settlement

Up RT.

Gr. Rd. Fill Adj.+0.3
Slope 3:1 & 4:1
Berm
Settlement 0.2

SETTLEMENT 0.5

F–23.6	F–25.2	F–23.9	F–22.2	F–17.4	F–15.6
11.4	13.0	11.7	10.0	5.2	3.4
48.0	38.0	32.0	0.0	19.0	33.0

10' O.S. 10' O.S.

F–17.7	F–20.2 (T)	F–14.6	F–14.2	F–5.2
5.5	8.0	2.4	2.0	2.0
–67.0	F 19.7–57.0 2.43:1	F 14.1–63.8	–73.8	31.6

F–18.2
6.0
87.0

F–13.7
1.5
93.8

Note: Fills below the line used for computing slope distances.

Checked:
R.D.M.
7-14-10

Sample D–23 Embankment stakeout notes—Sheet 2 of 2

EMBANKMENT AFTER STRIPPING
Core Trench Stakeout Notes

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM 81–7	0.15	1239.58 (1239.6)		1239.43	pg. 3 C–Book
15+10			–13.7	1253.3	
		Core Trench			
			+13.1	1226.5	OK
TP	5.28	1242.13	2.73	1236.85	

LT. Dist. Incl. 5.0 Slope 1:1 | RT. Dist. Incl. 5.0 Slope 1:1 | 9-15-10

5′ O.S.

(T)			(T)		
F–26.6 / 12.9 / 38.0	F–24.9 / 11.2 / 32.0	F–24.2 / 10.5 / C2.6–76	F–20.5 / 6.8 / C63–11.3	F–19.0 / 5.3 / C7.8–16.3	F–18.9 / 5.2 / 19.0

Core Trench Cut for Stakes

(T)					(T)
F–20.2 / 6.5 / 57.0	F–21.1 / 7.4 / 56.0	F–24.6 / 10.9 / 48.0	F–17.2 / 3.5 / 33.0	F–15.6 / 1.9 / 62.8	F–14.6 / 0.9 / 63.8

10′ O.S. F–17.7 / 4.0 / 67.0

10′ O.S. F–14.2 / 0.5 / 73.8

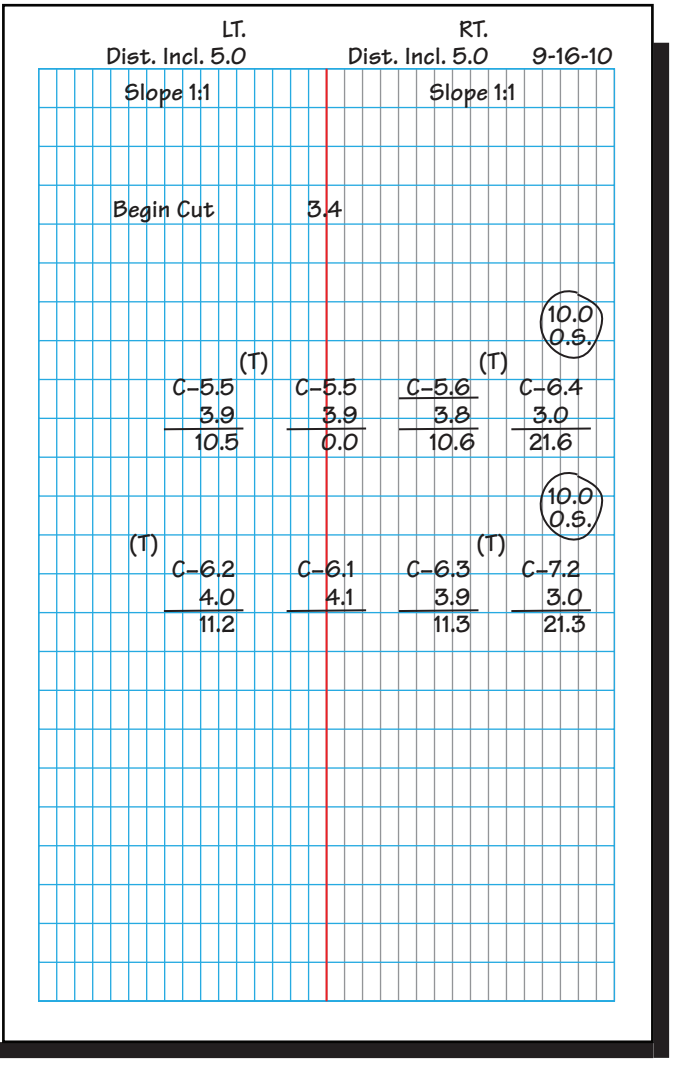
Note: Core checkout not shown–would be similar to other checkout notes.

Checked: DB 9-16-10

Sample D–24 Principle spillway pipe trench stakeout notes—Sheet 1 of 2

PRINCIPLE SPILLWAY
Pipe Trench Stakeout Notes

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM81–7	0.95	1240.38 (1240.4)		1239.43	Pg. 3 C–Book
4+50			+3.4	1237.0	
4+56			+9.4	1231.0	Cut
				1231.72	Backfill
4+64			+10.2	1230.2	
				1233.0	



Sample D–24 Principle spillway pipe trench stakeout notes—Sheet 2 of 2

PRINCIPLE SPILLWAY
Pipe Trench Stakeout Notes

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		1240.38 (1240.4)			Pg. 27
5+06			+11.9	1228.5	
				1231.2	
5+46			+13.4	1227.0	
			+10.9	1229.5	
BM81–7			0.95	1239.43	0.00 Closure
	BS & 0.95		FS & 0.95		
		0.95			
		−0.95			
		0.00	Error in closure		

LT. Dist. Incl. 5.0 Slope 1:1

RT. Dist. Incl. 5.0 Slope 1:1

9-16-10

10.0' O.S.

(T) C–6.4 5.5 11.4

C–6.0 5.9

(T) C–5.5 6.4 10.5

C–5.2 6.7 20.5

10.0' O.S.

(T) C–3.0 10.4 8.0

C–2.4 11.0

C–2.2 11.2 7.2

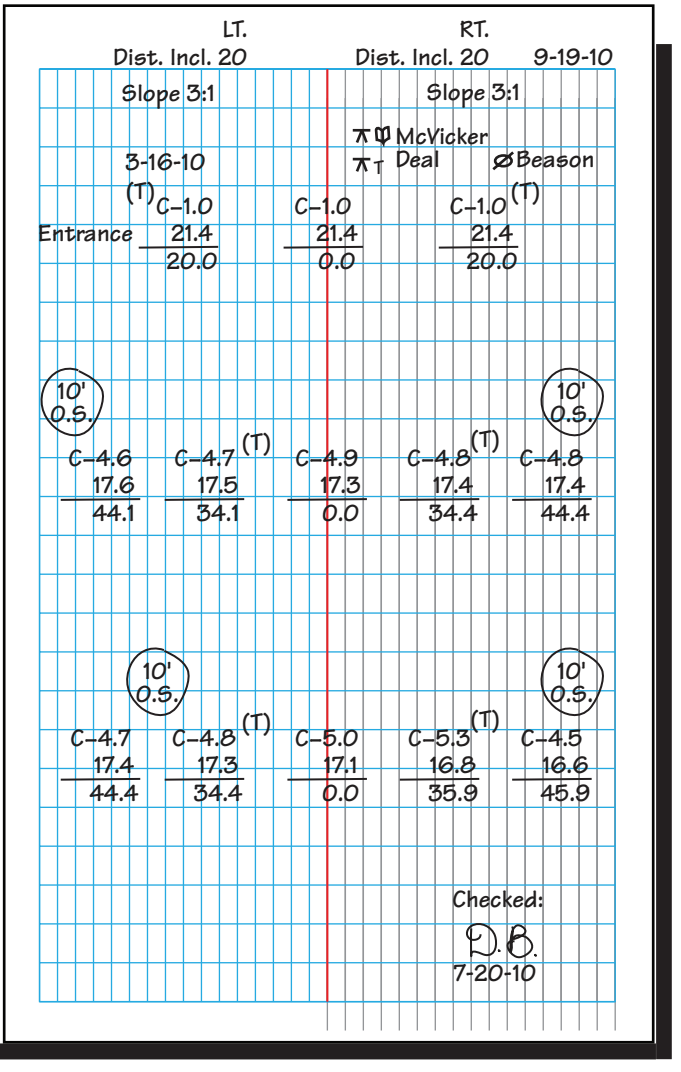
C–3.1 10.3 17.2

Checked: H.C.P. 9-18-10

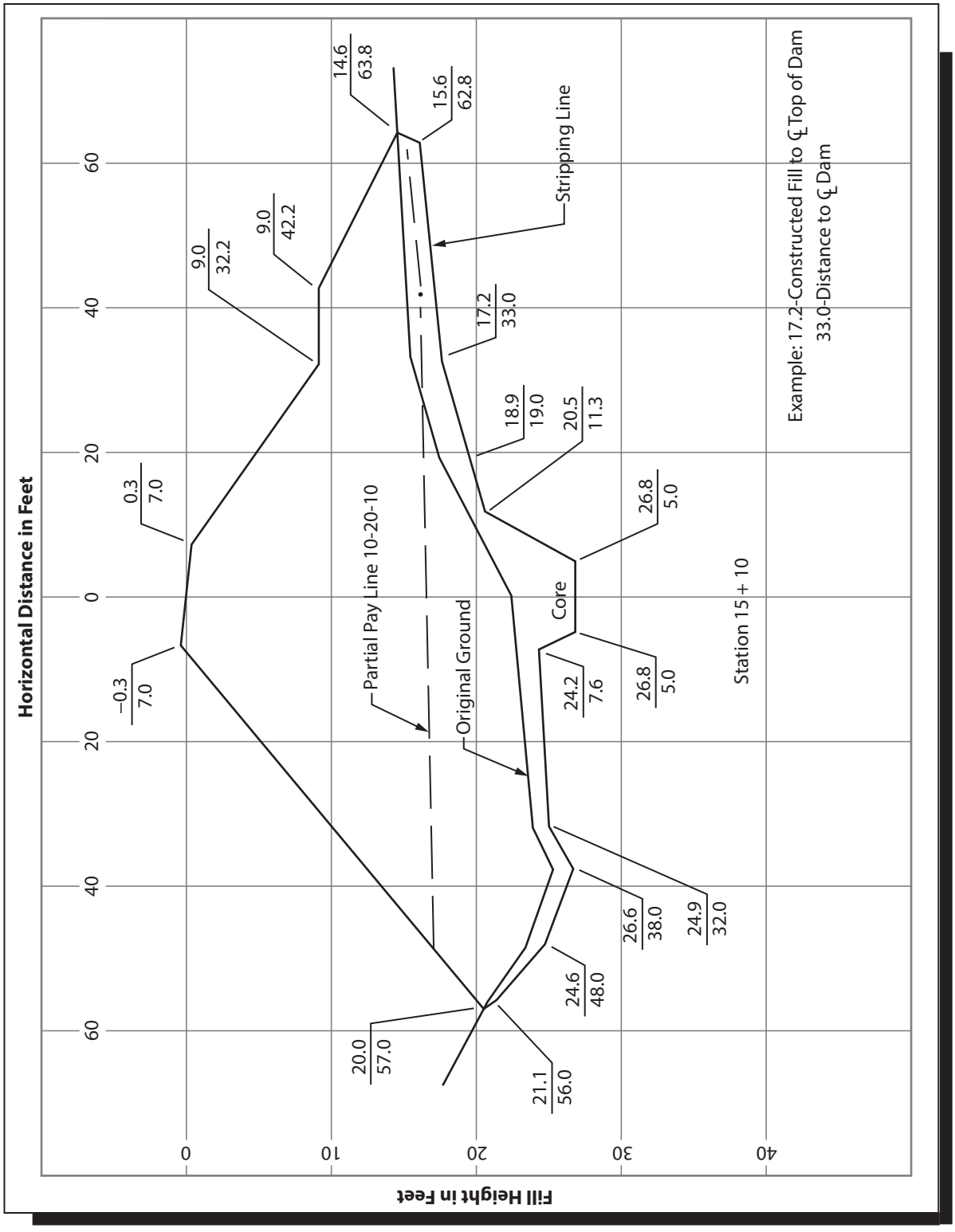
Sample D–25 Auxiliary spillway stakeout notes

AUXILLARY SPILLWAY
Stakeout Notes

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
BM81–6	0.38	1268.18		1267.80	Pg. 27
		(1268.2)			C-Book
8+61			21.4	1246.8	Backfill
			22.4	1245.8	Cut
9+08 PC			21.2	1247.0	Cut
			22.2	1246.0	
				1247.1	Cut
				1246.1	
9+12					



Sample D–26 Plotted dam cross section



Sample D–27 Earthwork survey data and computation sheet

Earthwork Survey Data and Computation Sheet

Location Frankfort, Kansas Owner _____ Contractor Williams Const. Co, Brown Bros. Const. Co. Contract No. NBV–IC–4764

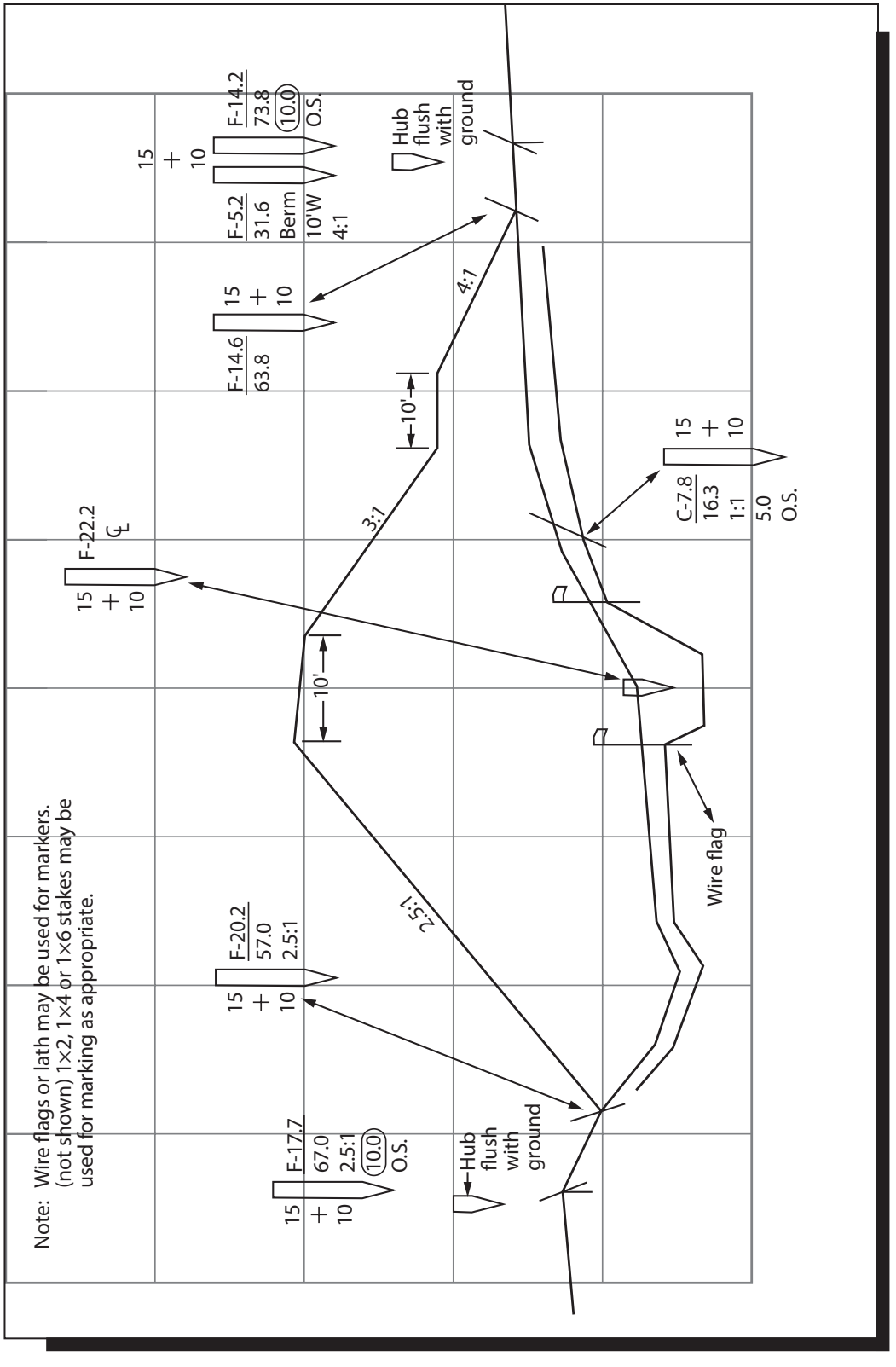
Watershed North Black Vermillion Item 3-Earth Fill-Embankment Computed by G. Noll Date 10-13 2010

Sub-Watershed _____ Site No. 81 Final Quantity _____ Cu. yds. _____ Checked by Hwa Date 10-13 2010

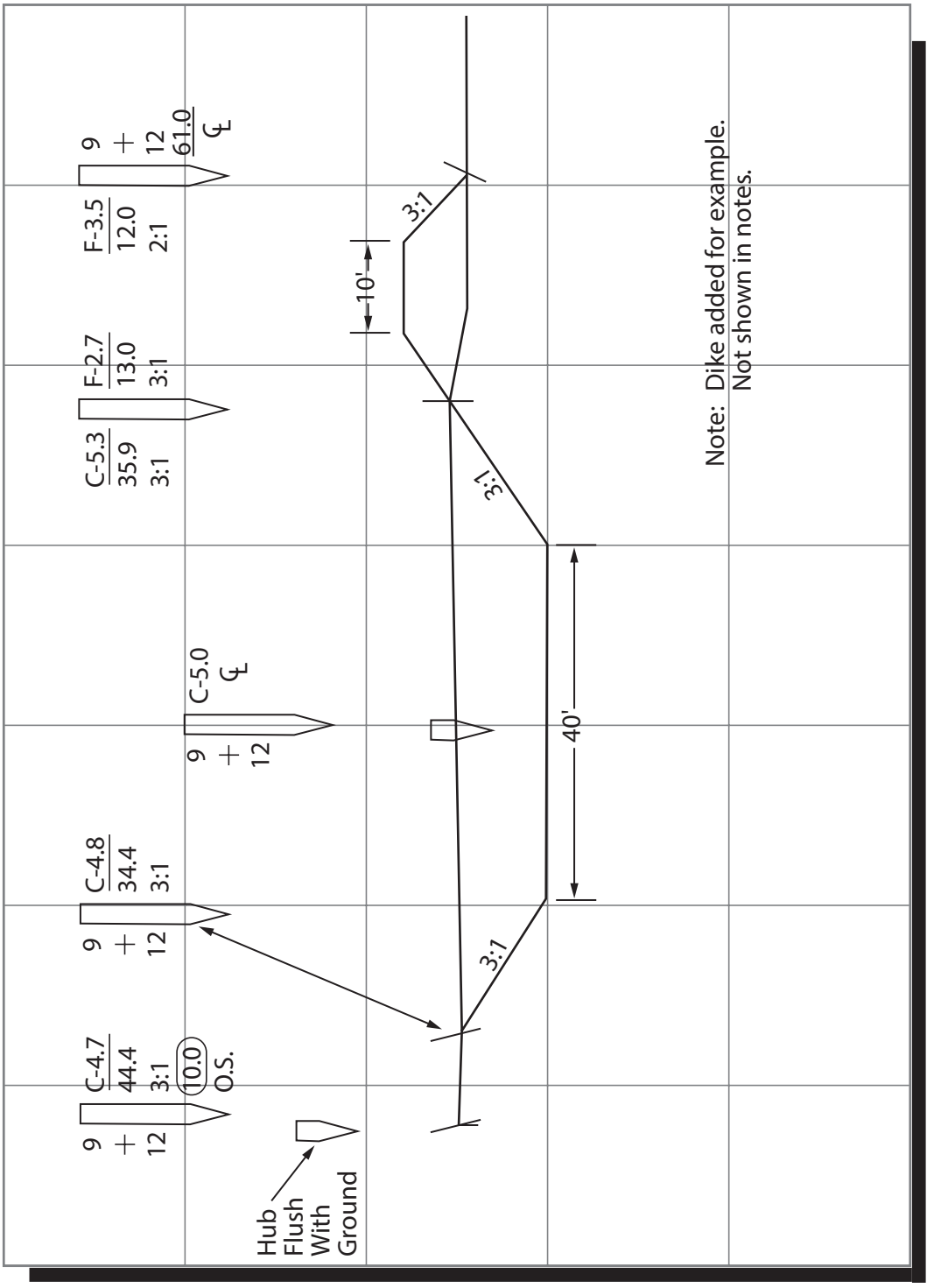
Station	*						*		*			Double End Areas			
15+10	0.0	–0.3	20.2	21.1	24.6	26.6	24.9	24.2	26.8	26.8	20.5	18.9			
	0.0	–7.0+	–57.0+	–56.0+	–48.0+	–38.0+	–32.0+	–7.6+	–5.0+	+5.0–	+11.3–	+19.0–			
	17.2	15.6	14.6	9.0	9.0	0.3	0.0						3289.83		
	+33.0–	+62.8–	+63.8–	+42.2–	+32.2–	+7.0–	0.0								

*Provide appropriate headings for use of offset or ℄ baseline

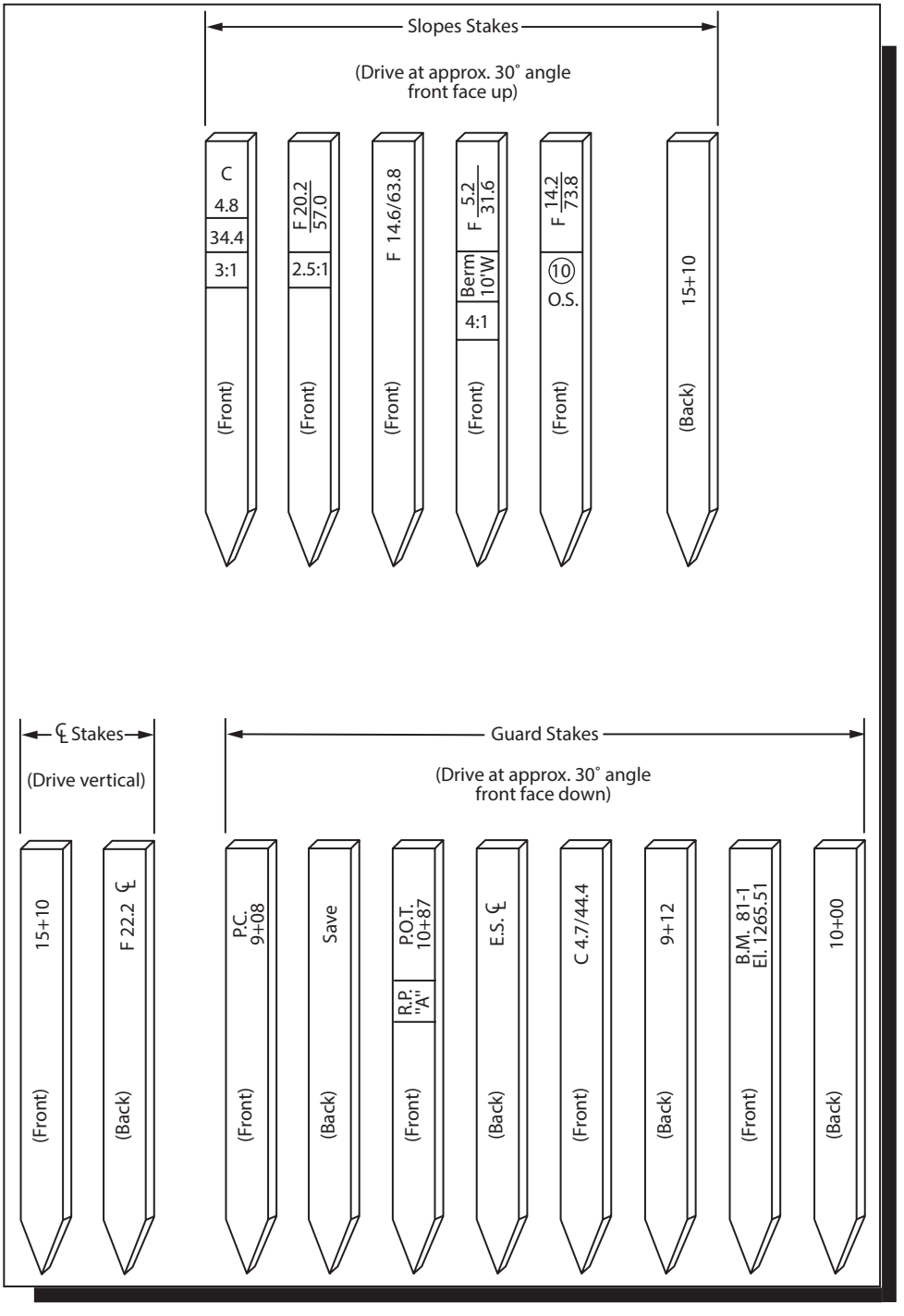
Sample D–28 Example for staking embankments



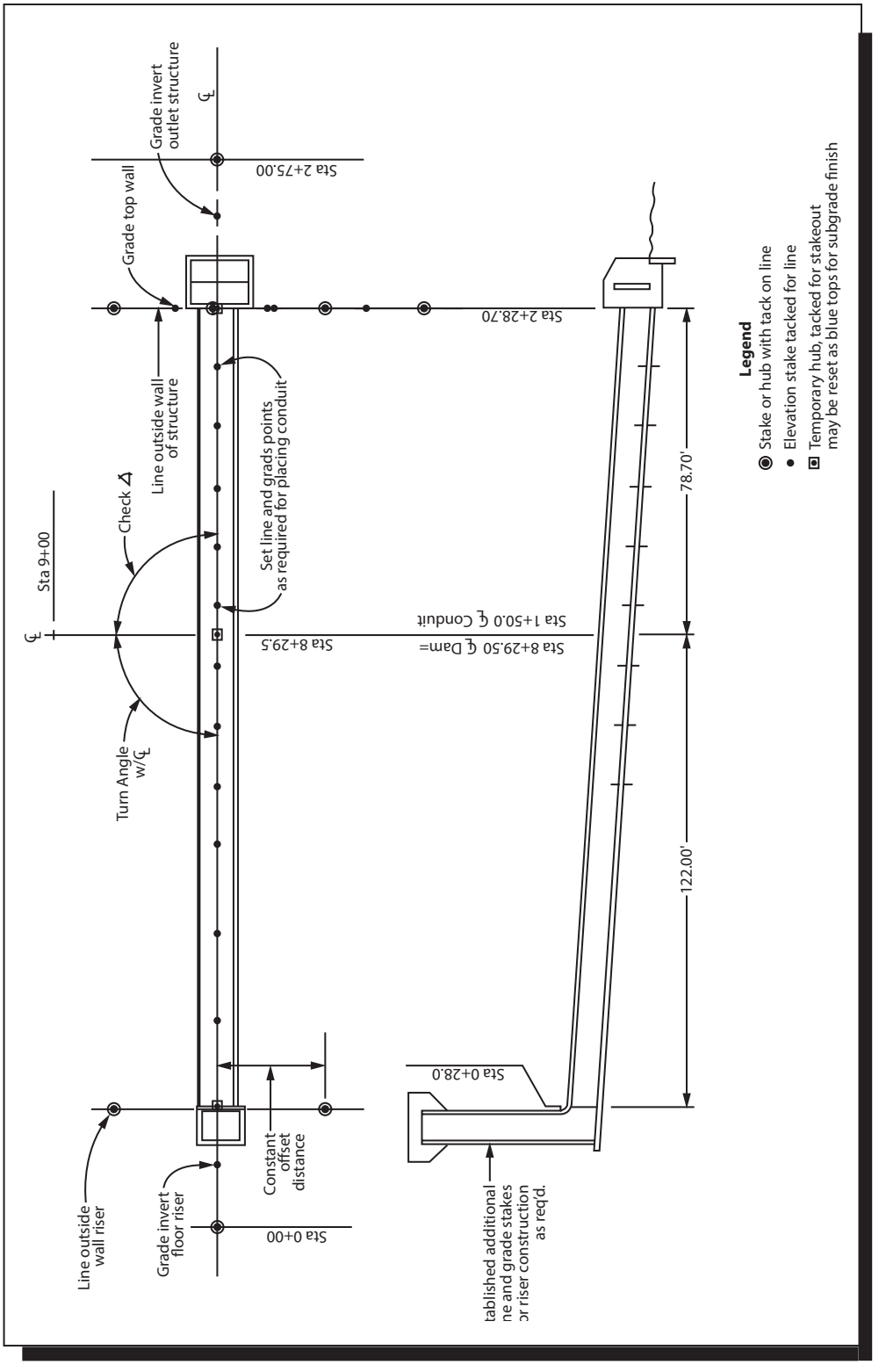
Sample D–29 Example for staking excavations



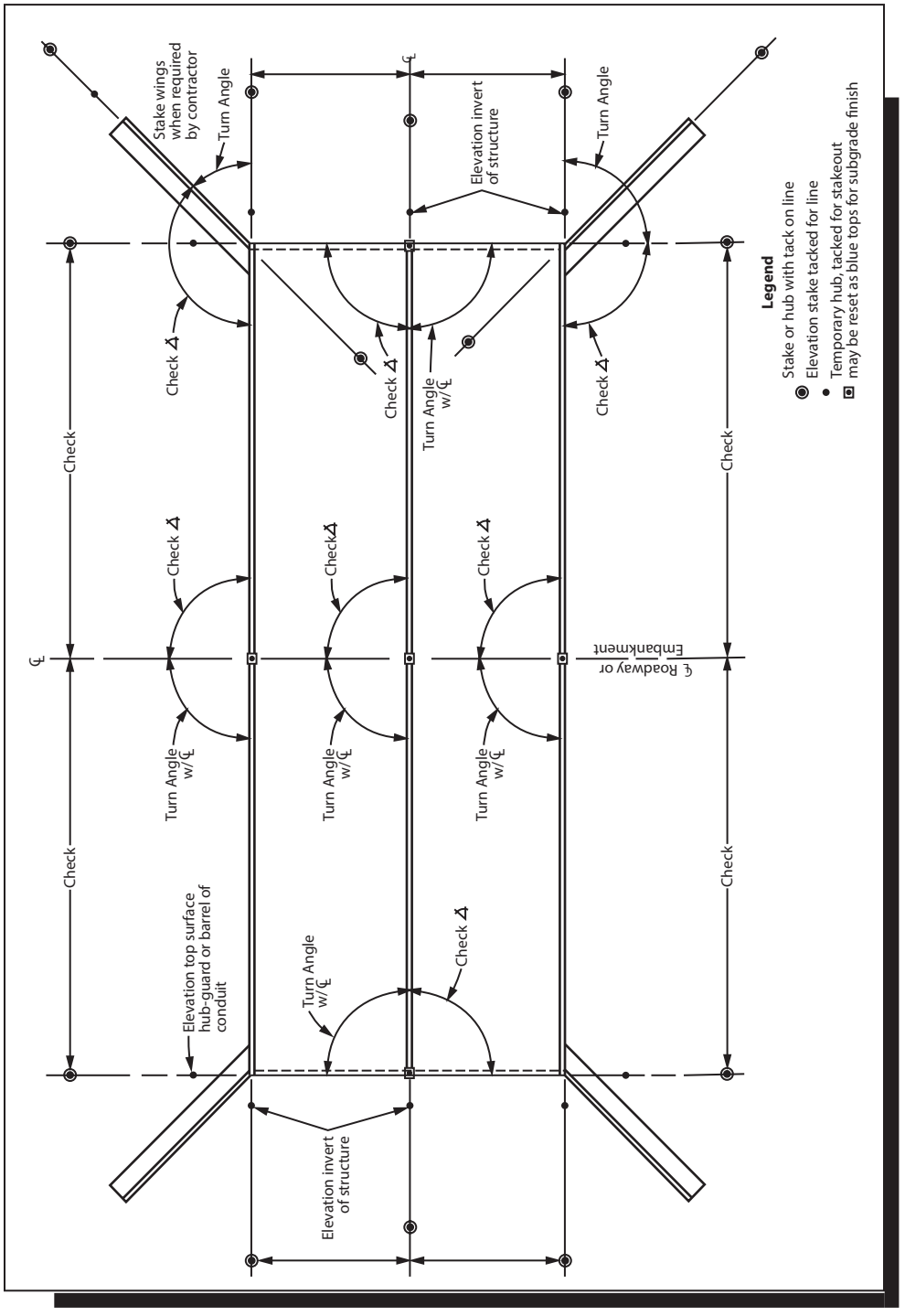
Sample D–30 Example for marking construction stakes



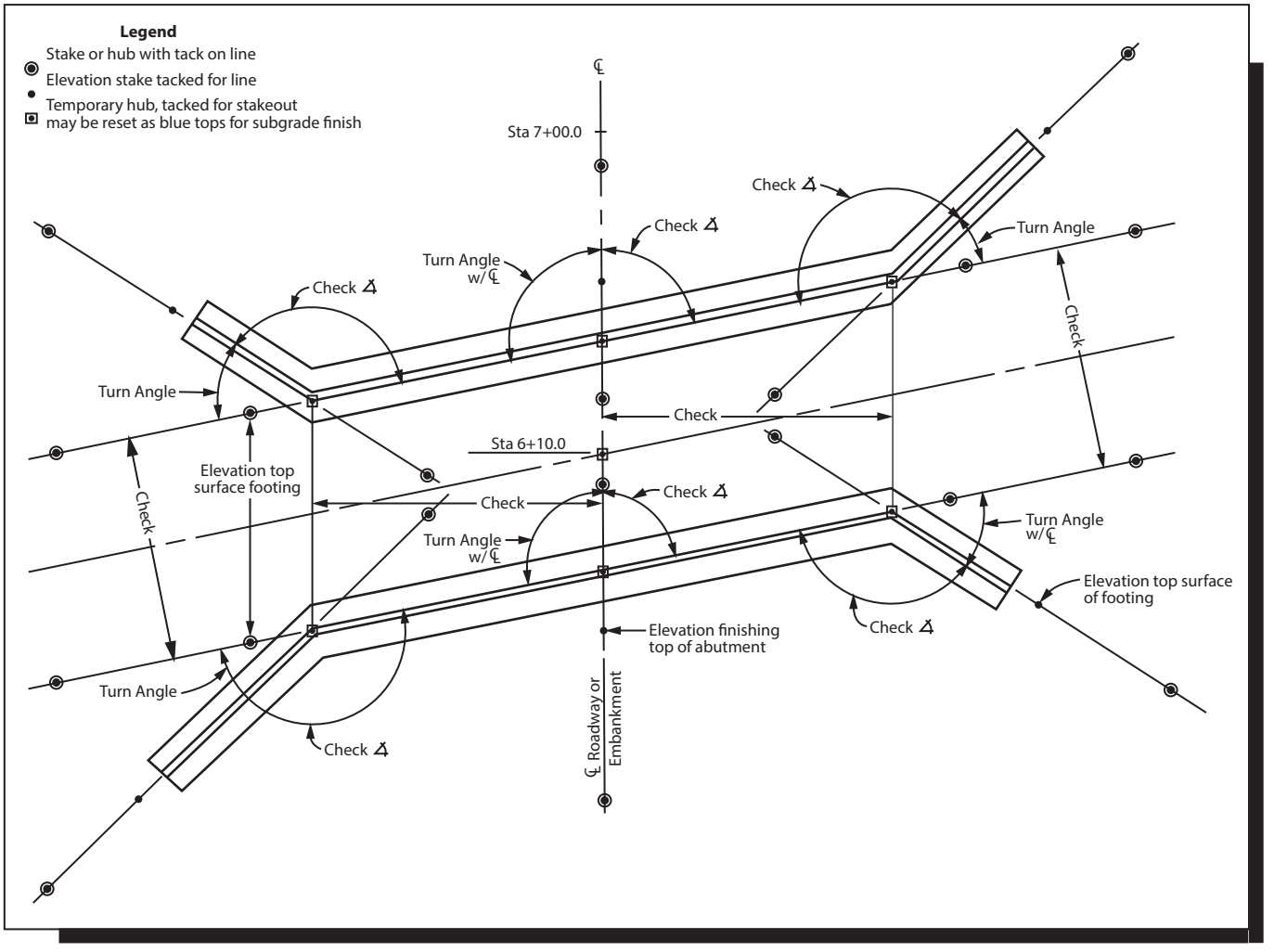
Sample D–31 Example for staking single barrel culverts or conduits



Sample D–32 Example for staking multiple box conduits



Sample D–33 Example for staking cantilever abutments on skew angle



Sample D–34 Final dam checkout—sheet 1 of 2

Final Dam Checkout (cont'd)

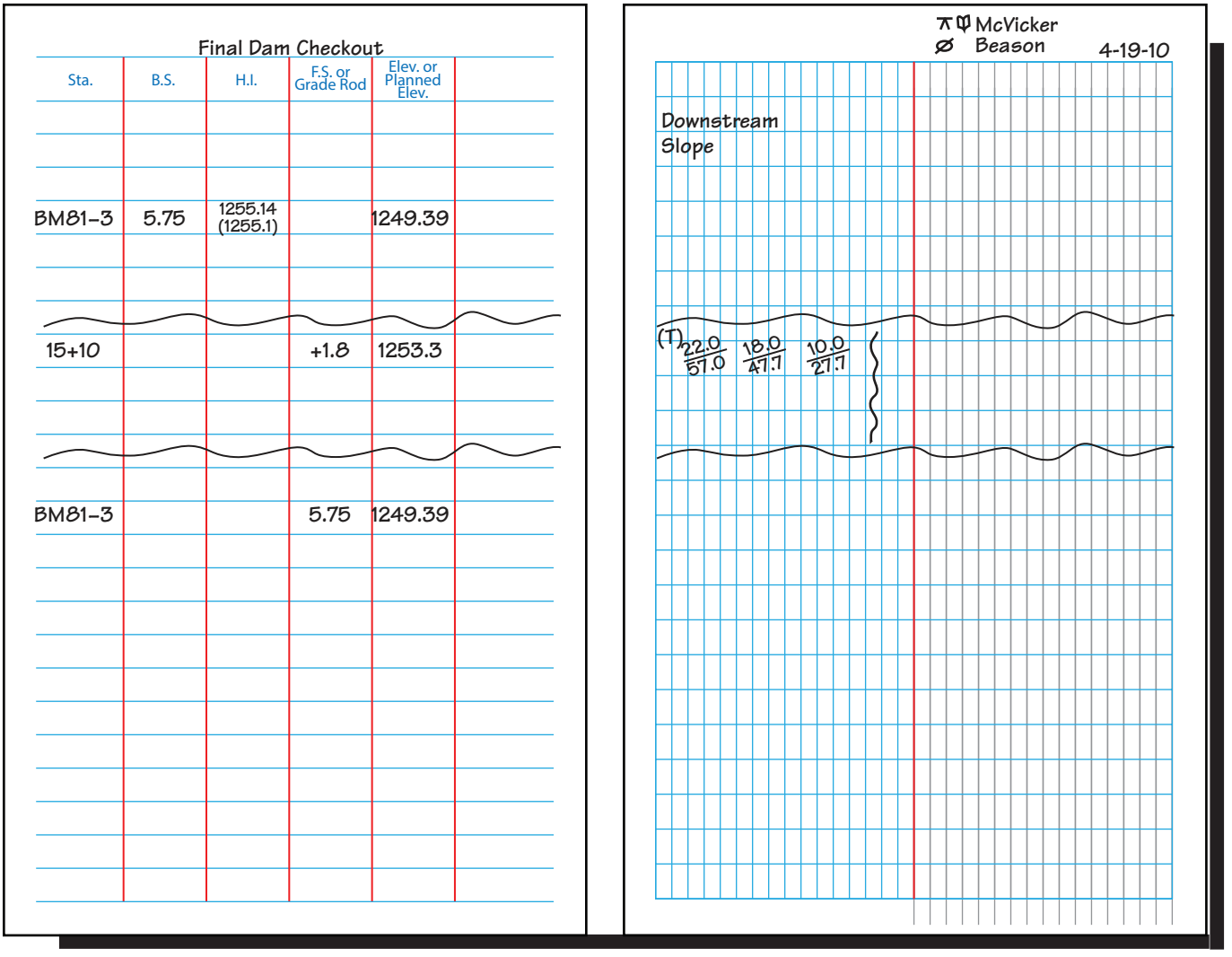
Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
		1256.66 (1256.7)			
14+75			+3.4	1253.3	
15+10			+3.4	1253.3	
15+75			+3.4	1253.3	
16+00			+3.4	1253.3	
16+90			+3.7	1253.0	
17+78			+3.9	1252.8	
BM81–3			7.27	1249.39	
				1249.39	Corr. Elev. No Error

TM McVicker
Ø Beason
4-19-10

	Crown 7' D.S. Need	Crown 7' D.S. FS	Check 7' D.S. Need	Check 7' D.S. FS	
	–0.3		+3.0		(Crown tilt)
	3.1	3.0	3.7	3.7	
11.6 / 27.7	3.1	3.1	3.7	3.7	8.3 / 21.1 — 12.2 / 32.2
See Page 63			12.4 / 42.2	15.5 / 54.2	18.0 / 63.8
	3.1	3.1	3.7	3.6	
	3.1	3.1	3.7	3.6	
	3.4	3.4	4.0	4.0	
	3.6	3.6	4.2	4.0	

Note: Crown was checked at most stations. Slopes were checked at representative locations.

Sample D–34 Final dam checkout—sheet 2 of 2



Sample D–35 Correction for curvature—sheet 1 of 7

COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE TX		PROJECT Sample Problem			
BY Jnc	DATE 2/2/12	CHECKED BY JJP	DATE 2/2/12	JOB NO. —	
SUBJECT Correction for curvature				SHEET 1 OF 7	

Vertical values are grade rod readings

All values shown in feet

D° = degree of curvature

D° is the central angle subtended by a chord of 100 ft

Given:

A 40-foot bottom spillway is being excavated with payment to be made on a cubic-yard basis. For computing the volume of excavation, the upper limits shall be the original ground surface as it exists prior to excavation, and the lower limits shall be the neat line and grades shown on the drawings. The portion of the spillway between stations 2+25 and 2+88 is curved with 22 degrees of curvature. The limits of excavation are sketched below in Fig D-4.

Required:

Compute the true volume of excavation between stations 2+25 and 2+88.

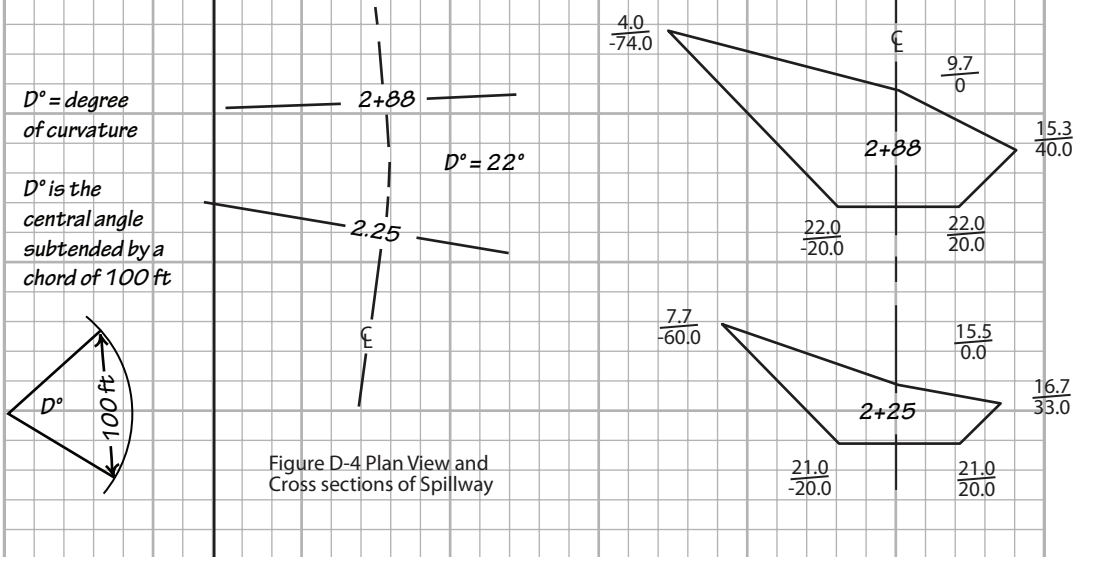


Figure D-4 Plan View and Cross sections of Spillway

Sample D–35 Correction for curvature—sheet 2 of 7

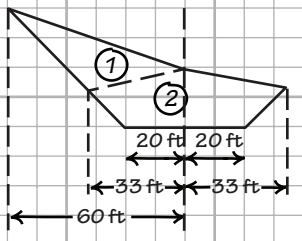
COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

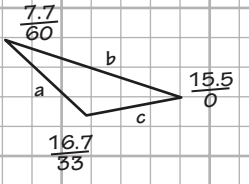
STATE	TX	PROJECT	Sample Problem		
BY mc	DATE 2/2/12	CHECKED BY JSP	DATE 2/2/12	JOB NO. —	
SUBJECT Correction for curvature (cont.)				SHEET 2	OF 7

STA. 2+25

Divide section into subareas (1) and (2)



Compute area of subarea (1)



$A=\sqrt{s\,(s-a)(s-b)(s-c)}$

$a=\sqrt{(16.7-7.7)^2+(60-33)^2}=28.5$ ft

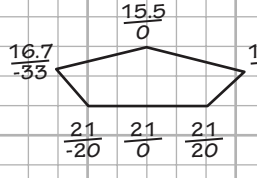
$b=\sqrt{(15.5-7.7)^2+(60-0)^2}=60.5$ ft

$c=\sqrt{(16.7-15.5)^2+(33-0)^2}=33.0$ ft

$s=\frac{1}{2}(28.5+60.5+33.0)=61.0$ ft

$A_{(1)}=\sqrt{61.0\,(61.0-28.5)(61.0-60.5)(61.0-33.0)}=166.6$ ft^2

Compute area of subarea (2)



21 16.7 15.5 16.7 21 21 21
-20 + -33 + -0 - +33 - +20 - +0 + 20

20	X	16.7	=	334
33	X	15.5	=	511.5
-33	X	21	=	-693
-20	X	21	=	-420
-20	X	21	=	-420
20	X	16.7	=	334
33	X	15.5	=	511.5
-33	X	21	=	-693
				-535
			÷	2

$A_{(2)}=267.5$ ft^2

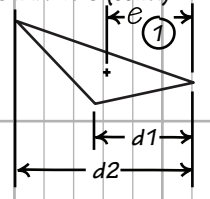
Sample D–35 Correction for curvature—sheet 3 of 7

COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE	PROJECT			
TX	Sample Problem			
BY: Jnc	DATE: 2/2/12	CHECKED BY: JSP	DATE: 2/2/12	JOB NO. —
SUBJECT: Correction for curvature			SHEET 3 OF 7	

STA. 2+25 (cont.) ℄



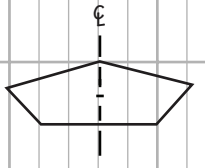
Note: "d" is negative when it falls on the inside of the curve.

$e = \frac{2}{3}$ AVG d

Determine the eccentricity of subarea (1)

$e_{(1)} = \frac{-33 + (-60)}{3} = -31$ ft.

Determine the eccentricity of subarea (2)



Subarea (2) is symetrical with equal parts on each side of the centerline.

$\therefore e_{(2)} = 0$ ft

Compute the eccentricity of the composite area

$A_{(1)} \times e_{(1)} = 166.6\ ft^2 \times (-31)ft = -5164.6\ ft^3$

$A_{(2)} \times e_{(2)} = 267.5\ ft^2 \times 0\ ft = 0.0\ ft^3$

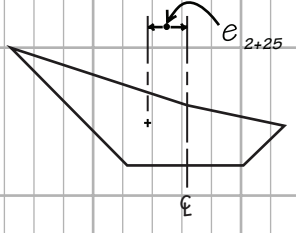
$\Sigma = -5164.6\ ft^3$

Sum the areas

$A_{(1)} + A_{(2)} = 166.6\ ft^2 + 267.5\ ft^2 = 434.1\ ft^2$

Compute e_{2+25}

$e_{2+25} = \frac{-5164.6\ ft^3}{434.1\ ft^2} = -11.9$ ft



Compute the curve correction

$Cc = \frac{Ae\,D°}{1550}\ Yd^3$

$Cc_{2+25} = (434.1\ ft^2)(-11.9\ ft)(22) = -73.3\ yd^3$

Sample D–35 Correction for curvature—sheet 4 of 7

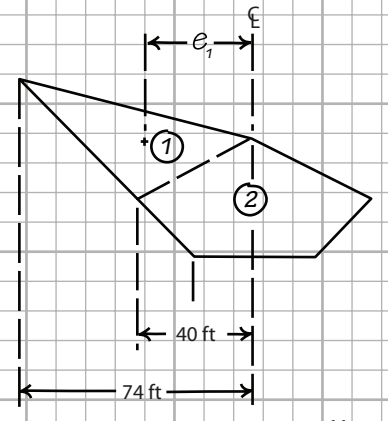
COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

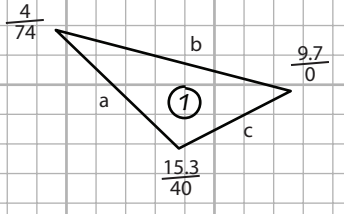
STATE	TX	PROJECT	Sample Problem		
BY	Jnc	DATE 2/2/12	CHECKED BY JSP	DATE 2/2/12	JOB NO. —
SUBJECT	Correction for curvature			SHEET 4	OF 7

STA. 2+88(cont.)

Divide section into subareas (1) and (2)



Compute area of subarea (1)



$a=\sqrt{(74-40)^2+(15.3-4)^2} = 35.8$ ft

$b=\sqrt{(74-0)^2+(9.7-4)^2} = 74.2$ ft

$c=\sqrt{(40-0)^2+(15.3-9.7)^2} = 40.4$ ft

$s=\frac{1}{2}(35.8+74.2+40.4) = 75.2$ ft

$A_{(1)} = \sqrt{75.2\,(75.2-35.8)(75.2-74.2)(75.2-40.4)} = 321.1$ ft^2

Sample D–35 Correction for curvature—sheet 5 of 7

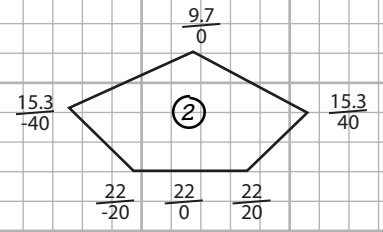
COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE TX		PROJECT Sample Problem			
BY Jmc	DATE 2/2/12	CHECKED BY JJP	DATE 2/2/12	JOB NO. —	
SUBJECT Correction for curvature (cont.)				SHEET 5	OF 7

STA. 2+88 (cont.)

Compute area of subarea (2)



22 15.3 9.7 15.3 22 22 22
-20+ -40+ -0- +40- +20- +0+ -20

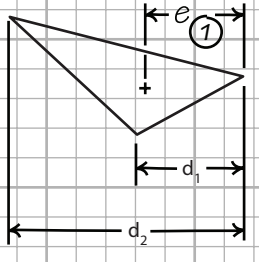
-22	X 40	=	-880
9.7	X 40	=	388
15.3	X 20	=	306
-22	X 20	=	-440
-22	X 20	=	-440
-22	X 40	=	-880
9.7	X 40	=	388
15.3	X 20	=	306

-1252.0
÷ 2

$A_{(2)}$ = 626.0 ft²

SS

Determine the eccentricity of subarea (1)



$e_1 = \frac{-40 + (-74)}{3} = -38$ ft

SS

Sample D–35 Correction for curvature—sheet 6 of 7

COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

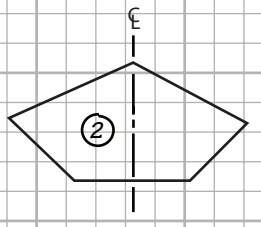
U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE TX		PROJECT Sample Problem			
BY Jnc	DATE 2/2/12	CHECKED BY JSP	DATE 2/2/12	JOB NO. —	
SUBJECT Correction for curvature				SHEET 6	OF 7

STA. 2+88 (cont.)

Since subarea (2) is symetrical with equal parts on each side of the centerline, $e_{(2)} = 0$.

Determine the eccentricity of subarea (2)



Compute the eccentricity of the composite area

$A_{(1)} \times e_{(1)} = 321.1\ ft^2 \times (-38)ft = -12{,}201.8\ ft^3$

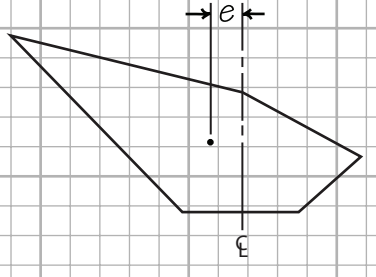
$A_{(2)} \times e_{(2)} = 626.0\ ft^2 \times 0 = 0$

$\Sigma = -12{,}201.8\ ft^3$

Sum the areas

$A_{2+88} = A_{(1)} + A_{(2)} = 321.1\ ft^2 + 626.0\ ft^2 = 947.1\ ft^2$

Compute e_{2+88}



$e_{2+88} = \frac{-12{,}201.8\ ft^3}{947.1\ ft^2} = -12.9\ ft$

Compute the curve correction

$Cc = \frac{Ae\,D°}{1550}\ Yd^3$

$Cc = \frac{(STA\ 2+88) = (947.1\ ft^2)(-12.9\ ft)(22)}{1550} = -173.4\ Yd^3$

Sample D–35 Correction for curvature—sheet 7 of 7

COMPUTATION SHEET
NRCS-ENG-523-a Rev. 10-97

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE: TX		PROJECT: Sample Problem			
BY: JNC	DATE: 2/2/12	CHECKED BY: JSP	DATE: 2/2/12	JOB NO.	—
SUBJECT: Correction for curvature				SHEET 7 OF 7	

STA. 2+25 to STA 2+88

Compute curve correction between stations L=288 - 225

$$Cc = (2+25 \text{ to } 2+88) = \frac{L}{100\ ft}\left(\frac{Cc\ 2+25 + Cc\ 2+88}{2}\right) Yd^3$$

$$Cc = (2+25 \text{ to } 2+88) = \frac{63\ ft}{100\ ft}\left(\frac{-73.3\ Yd^3 + (-174.4\ Yd^3)}{2}\right) = -77.7\ Yd^3$$

Compute the volume between stations without the correction for curvature

$$V_{computed\ 2+25 \text{ to } 2+88} = \frac{L}{27}\left(\frac{A2+25 + A2+88}{2}\right)$$

$$V_{computed\ (2+25 \text{ to } 2+88)} = \frac{63\ ft}{27\ \frac{ft^3}{Yd^3}}\left(\frac{434.1\ ft^2 + 947.1\ ft^2}{2}\right) = 1611.4\ Yd^3$$

Compute the true volume between stations

$$V_{true\ (2+25 \text{ to } 2+88)} = V_{computed} + Cc\ (2+25 \text{ to } 2+88)$$

$$V_{true\ (2+25 \text{ to } 2+88)} = 1611.4\ Yd^3 + (-77.7\ Yd^3) = 1533.7\ Yd^3$$

Sample D–36 Field Notes of Pile Driving Using Field Book—sheet 1 of 2

U.S. Department of Agriculture
Natural Resources Conservation Service

Station	B.S.	H.I.	F.S. or grade rod	Elev. or planned elev.		
	E rating	Average	Weight of			Piston
	(Ft-lb	(Blows	Striking	Stroke		Area
Hammer	/blow)	/min)	Parts(lbs.)	(ft)		(in2)
Vulcan #1	15000	60	5000	3		133.51
air/steam			Bearing	Formula		
Single-act			R = 2WH	/ (S+1.0)		
Blows @	Penetration		Computed	Top of		pile
Fall ht.	Total	Average	Bearing	After		driving
(# @ ft.)	(in.)	(in./blow)	Numbers	rod		elevation
Pile #1				(11:00 am -		11:15 am)
5 @ 3	3.0	0.60	18,750			
5 @ 3	2.25	0.45	20,690			
5 @ 3	1.75	0.35	22,222	11.62		145.9
Pile #2	Apparently	broke	---	(11:20 am -		11:30 am)
Pile # 3				(11:55 am -		12:15 am)
5 @ 3	3.25	0.65	18,182			
5 @ 3	2.75	0.55	19,355			
5 @ 3	2.25	0.45	20,690			
5 @ 3	2.0	0.40	21,429	11.13		146.4

Sample D–36 Field Notes of Pile Driving Using Field Book—sheet 2 of 2

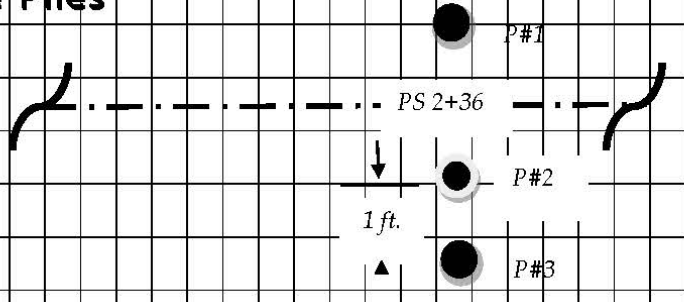
U.S. Department of Agriculture
Natural Resources Conservation Service

Pile Driving Record — J.D. Douglas Inspector

Doe Creek 19 pipe support — 11/29/17, 11:00am-1:00

Station PS 2+36 — Cloudy, 60°F

Concrete Piles



Cutoff Elev.	Length of cutoff (ft.)	Length in leads (ft.)	Length in place (ft.)	Dim. of pile Butt (in.)	Tip (in.)
145.1	0.8	18.2	17.4	12X12	4X4
145.1	6.3	18.5	12.2	12X12	4X4
145.1	1.3	18.5	17.2	12X12	4X4

Sample D–37 Field Notes of Test Pile Driving and Loading Using Field Book—sheet 1 of 4

U.S. Department of Agriculture
Natural Resources Conservation Service

Station	B.S.	H.I.	F.S. or grade rod	Elev. or planned elev.	
Test Pile	**Concrete**				
Average drop (ft)	**Pene-tration (ft)**	**Total blows @ ea. foot**	**Blows per foot**	**Elev. of pile tip**	
	0			**150.38**	
	1	**0**			
	2	**5**	**5**		
	3	**12**	**7**		
	4	**20**	**8**		
	5	**30**	**10**		
	…	**…**	**…**		
	20	**600**	**83**		
	21	**695**	**95**		
	22	**811**	**116**		
	23	**990**	**179**	**127.38**	
	23.1	**1,025**		**127.28**	

Sample D–37 Field Notes of Test Pile Driving and Loading Using Field Book—sheet 2 of 4

U.S. Department of Agriculture
Natural Resources Conservation Service

Test Pile Driving Record	**J.D. Douglas** **Inspector**
Doe Creek 18	**11/19/17**
10' Right of Station PS 2+36	**Cloudy, 60°F**
Hammer make/model:	**Vulcan-Model-1**
Type of hammer:	**Single action, steam-air**
Weight of hammer:	**5,000 lbs.**
Average blow per minute:	**60**
Stroke or fall:	**36 in.**
Manufacturer's rating "E":	**15,000 ft-lbs**
Pile length – total:	**28 ft.**
Pile diameter:	**Butt: 13", Tip: 9"**
After cutoff:	**24.5 ft.**
In ground:	**23.1 ft.**
Pile dimension:	**12" x 12" @ cutoff; same @ ground**
Kind of pile:	**Square, concrete, tapered tip**
Observations:	
6 blows/in. @ 18 ft.	**14 blows/in. @22.75 ft.**
7 blows/in. @ 19.5 ft.	**20 blows/in. @ 23 ft.**
9 blows/in. @ 21 ft.	**Driving stopped at 21blows/in.**
12 blows/in. @ 22.5 ft.	

Sample D–37 Field Notes of Test Pile Driving and Loading Using Field Book—sheet 3 of 4

U.S. Department of Agriculture
Natural Resources Conservation Service

Station	B.S.	H.I.	F.S. or grade rod	Elev. or planned elev.	
Date & time	**Elapsed time**	**Load (ton)**	**Settle-ment**	**Remarks**	
11/20/17	0:00	0.0	0.000		
8:00am	0:02	12.5	0.000		
	0:10	12.5	0.000		
	0:20	12.5	0.000		
	0:40	12.5	0.000		
	1:00	25.0	0.003		
	…	…	…		
	3:00	37.5	0.006		
	4:00	50.0	0.008		
	5:00	62.5	0.011		
	6:00	75.0	0.013		
	…	…	…		
	30:00	100.0	0.018		
	32:00	25.0	0.010		
11/21/17	33:00	10.0	0.007		
6:00pm	34:00	0.0	0.005		

Sample D–37 Field Notes of Test Pile Driving and Loading Using Field Book—sheet 4 of 4

U.S. Department of Agriculture
Natural Resources Conservation Service

Test Pile Loading Record — **J.D. Douglas**
R.W. Brown

Doe Creek 18 — **11/20-21/17**
10' Right of Station PS 2+36 — **Cloudy, 57°F**

Test Pile:
Date pile driven: 11/19/31
Kind/shape of pile: Concrete/ 12"x12" Square tapered tip
Condition of pile: Smooth and sound at cutoff
Elev.: 151.78 ft. @ butt; 127.28 ft. @ tip
Ground elev. at pile: 150.2 ft.

Method of loading/equipment:
Reaction load consisting of box filled with sand, supported by timbers and steel I-beam cribbing.
Load applied to pile by calibrated hydraulic jack.
Four photos taken of test equipment.
Method of measuring settlement: Engineers level and rod with Vernier.