# NEW SMALL TOWN SCHOOL

# NEW SMALL TOWN SCHOOL
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# SECTION I

# NEW SMALL TOWN SCHOOL

# PROJECT NARRATIVE & STORMWATER MANAGEMENT CALCULATIONS

# NEW SMALL TOWN SCHOOL

## Project Narrative
## &
## Stormwater Management Calculations

Department of Conservation and Recreation
Plan Review Course

## DCR E&S Plan Review Course

Sample Plan Narrative
New Small Town School

### Project Description

The proposed project is the construction of a new school, parking and recreational area which will accommodate approximately 400 elementary school children. The new school is in addition to the existing three elementary schools which are currently in use in this locality. The intended start date of the project will be January 1999 and the expected completion of the project will be June 2000.

### Existing Site Conditions

The existing site is an agricultural field which is planted in small grain wheat. The site is bordered by a mature stand of hardwood and softwood trees to the south and east. The western edge of the property is Virginia Route 750, a secondary road that is currently maintained by VDOT. The site is relatively flat with small natural drainage divides.

### Adjacent Areas

Adjacent areas along the east and south are wooded areas that are owned by the locality. An unnamed tributary which feeds a fairly large river is located approximately one half mile south of the site.

### Off-Site Areas

The cut and fill operations to be conducted on this project are in balance, therefore, no off-site land disturbance shall be conducted,

### Soils

Most of the soil of the site is made up of Sassafras Fine Sandy Loam with gentle slopes. This material is medium to well drained soil and has a K factor of 0.28. The southern end of the project has a soil classified as Rumford Loamy Sand with a K factor of 0.17.

### Critical Areas

The only critical area of the project is the outlet structure number 19. There will be only limited disturbance in this area for the installation of the outfall pipe, riprap outlet protection, and the Sediment Basin. This area is considered critical due to the steepness of the existing slopes.

**Erosion and Sediment Control Measures**

The erosion and sediment control measures shown on the plan for this project consistent with the requirements o the *Virginia Erosion and Sediment Control Handbook, 1992 Edition.*

The Following E&S measures will be used for this project:

**3.02 Construction Entrance:** A construction entrance is shown located a the new entrance to the project to prevent the tracking of mud onto the existing surface of Route 750. It is to be constructed of VDOT number 1 stone at a thickness of six inches for the stated distance shown on the plan. It shall be cleaned and maintained as need per specification 3.12 of the handbook.

**3.05 Silt Fence:** A silt fence perimeter barrier will be placed along the outside of the project to contain sediment laden runoff from the project. Since the site is relatively flat, this should provide adequate protection for off-site areas.

**3.07 Inlet Protection:** All Storm Drain Inlets will be protected from sediment laden water entering the storm sewer by inlet protection per specification 3.07 of the handbook. See detail sheet for proper inlet protection methods.

**3.09 Diversion Dike:** A diversion Dike will be used to divert sheet flow runoff into the sediment trap and sediment basin.

**3.13 Sediment Trap:** A Sediment Trap is proposed to trap sediment laden runoff from the front portion of the project. At the completion of the project, the sediment trap will be removed and all grades are to be finished according to the plan to accommodate the installation of the dry storage pond noted on the plan.

**3.14 Sediment Basin:** A sediment basin will control sediment laden runoff from 9.5 acres of the site. The location shown on the plan was chosen because the natural contours. No excavation will be needed to acquire the needed wet and dry storage areas. Only tree removal will be allowed in this area. No other grading except for construction of the embankment will be permitted. At the completion of the project, the basin will be removed, and all areas will be permanently stabilized.

**3.19 Riprap:** VDOT Class 1 riprap will be used at the end of all outlet pipes to dissipate energy of the runoff and prevent scour at the end of the pipes.

**3.30 Top soiling:** Topsoil will be stripped from the portion of the site that will be built on then will be spread over all other areas to promote good growth of a permanent stand of grass. Topsoil shall be placed in various depths depending on finished grade requirements.

**3.31 Temporary Seeding:** Temporary Seeding will be applied to the topsoil stock pile to prevent erosion from rain and wind actions during the course of the project.

**3.32 Permanent Seeding:** Once the site is at final grade, a permanent stand of grass consisting of Kentucky 31 Tall Fescue shall be established in accordance with specification 3.32 of the handbook.

**3.35 Mulch:** Straw mulch shall be applied to all seeded areas at a rate of 2 tons per acre to provide protection of the topsoil and seed application.

**Permanent Stabilization**

A permanent stand of Kentucky 31 Tall Fescue turf type grass will be established on all disturbed areas as well as all areas now under agricultural production. Established turf must survive at least one growing season and is to be guaranteed by the installer.

**Storm Water Runoff Considerations**

There will be an increase in the amount of post development runoff leaving the project. A Dry Detention Storm Water basin will be installed to detain runoff from most of the project and will release it at the pre-development two year runoff rate. The west end of the project will release runoff through the 15 inch storm drain pipe into the wooded area where no adverse conditions will occur.

**Calculations:**

Calculations showing pre-development and post-development runoff conditions and drainage areas have been provided.

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Storm Sewer Design

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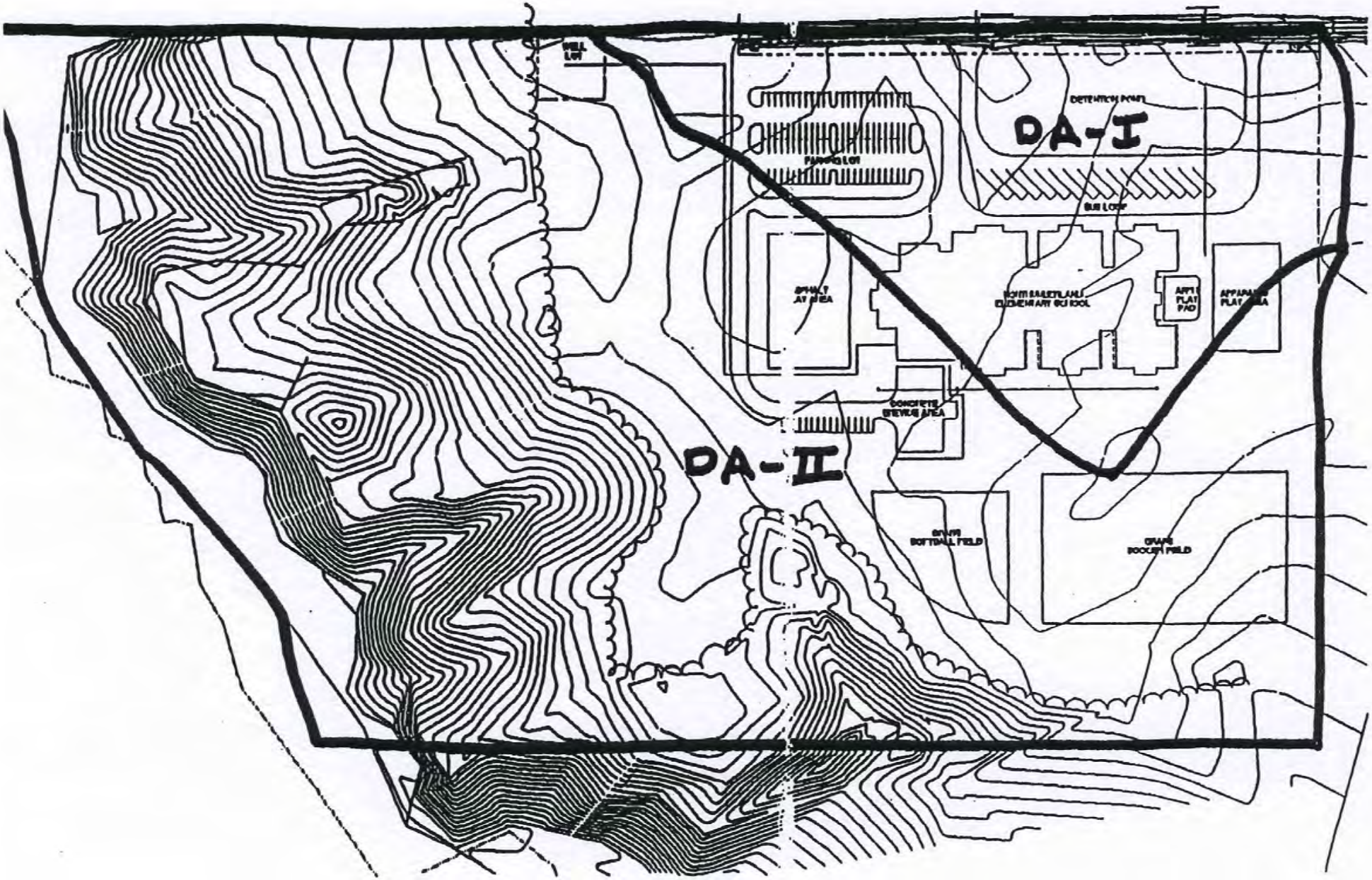
# On-Site Storm Sewer Design

PRE-DEVELOPMEN



## Worksheet 2: Runoff curve number and runoff

2

Project NEW SMALL TOWN SCHOOL By ____ Date ____

Location DCR PLAN REVIEW COURSE Checked ____ Date ____

Circle one: (Present) Developed DA-I

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN 1/ Table 2-2 | CN 1/ Fig. 2-3 | CN 1/ Fig. 2-4 | Area ☒ acres ☐ mi² ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| SASSAFRAS (B) | ROW CROPS (SR+CR) POOR COVER | 80 | | | 9.46 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 9.46 | |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = ____ Use CN = 80

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|
| Frequency ..... yr | 2 | 10 | |
| Rainfall, P (24-hour) ..... in | 3.5 | 6.0 | |
| Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 1.6 | 3.8 | |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

3

Project NEW Small Town School By ____ Date ____

Location DCR-PLAN REVIEW COURSE Checked ____ Date ____

Circle one: (Present) Developed DA - I

Circle one: ($T_c$) $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) ..... | | CULT. SOIL | | | | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | 0.06 | | | | |
| 3. Flow length, L (total L ≤ 300 ft) ..... | ft | 300 | | | | |
| 4. Two-yr 24-hr rainfall, $P_2$ ..... | in | 3.5 | | | | |
| 5. Land slope, s ..... | ft/ft | .0133 | | | | |
| 6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute $T_t$ ..... | hr | .21 | + | | = | |

| Shallow concentrated flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) ..... | | UNPAVED | | | | |
| 8. Flow length, L ..... | ft | 370 | | | | |
| 9. Watercourse slope, s ..... | ft/ft | .0216 | | | | |
| 10. Average velocity, V (figure 3-1) ..... | ft/s | 2.30 | | | | |
| 11. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | .04 | + | | = | |

| Channel flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a ..... | $ft^2$ | | | | | |
| 13. Wetted perimeter, $p_w$ ..... | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... | ft | | | | | |
| 15. Channel slope, s ..... | ft/ft | | | | | |
| 16. Manning's roughness coeff., n ..... | | | | | | |
| 17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... | ft/s | | | | | |
| 18. Flow length, L ..... | ft | | | | | |
| 19. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | | + | | = | |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ..... hr .25

# Worksheet 5a: Basic watershed data

Project New Small Town School Location DCR. Plan Review Course By _____ Date _____

Circle one: (Present) Developed DA - I Frequency (yr) _____ Checked _____ Date _____

| | Subarea name | Drainage area $A_m$ ($mi^2$) | Time of concentration $T_c$ (hr) | Travel time through subarea $T_t$ (hr) | Downstream subarea names | Travel time summation to outlet $\Sigma T_t$ (hr) | 24-hr Rainfall P (in) | Runoff curve number CN | Runoff Q (in) | $A_m Q$ ($mi^2$-in) | Initial abstraction $I_a$ (in) | $I_a/P$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | .0148 | .25 | | | | 3.5 | 80 | 1.6 | .0237 | 0.50 | .14 |
| | | | | | | | | | | | | |
| 10 | | .0148 | .25 | | | | 6.0 | 80 | 3.8 | .0562 | 0.50 | .08 |
| | | | | | | | | | | | | |
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From worksheet 3 From worksheet 2 From table 5-1

# Worksheet 4: Graphical Peak Discharge method

Project New Small Town School By ____ Date ____

Location DCR-Plan Review Course Checked ____ Date ____

Circle one: (Present) Developed D4 - I

1. Data:

Drainage area ..... $A_m$ = .0147 $mi^2$ (acres/640)

Runoff curve number .... CN = 80 (From worksheet 2)

Time of concentration .. $T_c$ = .75 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = _____ percent of $A_m$ (____ acres or $mi^2$ covered)

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| 2. Frequency ..... | yr | 2 | 10 | |
| 3. Rainfall, P (24-hour) ..... | in | 3.5 | 6.0 | |
| 4. Initial abstraction, $I_a$ ..... (Use CN with table 4-1.) | in | .50 | .50 | |
| 5. Compute $I_a/P$ ..... | | .14 | .08 | |
| 6. Unit peak discharge, $q_u$ ..... (Use $T_c$ and $I_a/P$ with exhibit 4-____) | csm/in | 681 | 679 | |
| 7. Runoff, Q ..... (From worksheet 2). | in | 1.6 | 3.8 | |
| 8. Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | | | | |
| 9. Peak discharge, $q_p$ ..... (Where $q_p = q_u A_m Q F_p$) | cfs | 16.02 | 37.92 | |

# Worksheet 2: Runoff curve number and runoff

Project New Small Town School By ____ Date ____

Location DCR Plan Review Course Checked ____ Date ____

Circle one: (Present) Developed DA-II

## 1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN 1/ Table 2-2 | CN 1/ Fig. 2-3 | CN 1/ Fig. 2-4 | Area ☒ acres ☐ mi² ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| SASSAFRAS (B) | ROW CROPS (SR+CR) POOR COVER | 80 | | | 12.24 | 979.20 |
| Steep Sandy Land (B) | WOODS GOOD COVER | 55 | | | 20.80 | 1,144.00 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 33.04 | 2,123.20 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2123.2}{33.04} = 64.2$; Use CN = 64

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|
| Frequency ..... yr | 2 | 10 | |
| Rainfall, P (24-hour) ..... in | 3.5 | 6.0 | |
| Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 0.7 | 2.2 | |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

7

Project NEW SMALL TOWN SCHOOL By ____ Date ____

Location DCR-PLAN REVIEW COURSE Checked ____ Date ____

Circle one: Present Developed DA - II

Circle one: $T_c$ $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) ..... | | CULT. SOIL | | | | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | 0.06 | | | | |
| 3. Flow length, L (total L $\leq$ 300 ft) ..... | ft | 300 | | | | |
| 4. Two-yr 24-hr rainfall, $P_2$ ..... | in | 3.5 | | | | |
| 5. Land slope, s ..... | ft/ft | .0183 | | | | |
| 6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute $T_t$ ..... | hr | .19 | + | | - | |

| Shallow concentrated flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) ..... | | UNPAVED | | | | |
| 8. Flow length, L ..... | ft | 330 | | | | |
| 9. Watercourse slope, s ..... | ft/ft | .0470 | | | | |
| 10. Average velocity, V (figure 3-1) ..... | ft/s | 3.50 | | | | |
| 11. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | .03 | + | | - | |

| Channel flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a ..... | $ft^2$ | 4.00 | | | | |
| 13. Wetted perimeter, $P_w$ ..... | ft | 7.32 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ..... | ft | .55 | | | | |
| 15. Channel slope, s ..... | ft/ft | .0944 | | | | |
| 16. Manning's roughness coeff., n ..... | | .040 | | | | |
| 17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... | ft/s | 7.63 | | | | |
| 18. Flow length, L ..... | ft | 360 | | | | |
| 19. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | .01 | + | | - | |
| 20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ..... | hr | | | | | .23 |

## Worksheet 5a: Basic watershed data

Project New Small Town School Location DCR. Plan Review Course By _____ Date _____

Circle one: (Present) Developed DA - II Frequency (yr) _____ Checked _____ Date _____

| | Subarea name | Drainage area $A_m$ ($mi^2$) | Time of concentration $T_c$ (hr) | Travel time through subarea $T_t$ (hr) | Downstream subarea names | Travel time summation to outlet $\Sigma T_t$ (hr) | 24-hr Rainfall P (in) | Runoff curve number CN | Runoff Q (in) | $A_m Q$ ($mi^2$-in) | Initial abstraction $I_a$ (in) | $I_a/P$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | .0516 | .23 | | | | 3.5 | 64 | 0.7 | .0361 | 1.125 | .32 |
| | | | | | | | | | | | | |
| 10 | | .0516 | .23 | | | | 6.0 | 64 | 2.2 | .1135 | 1.125 | .19 |
| | | | | | | | | | | | | |
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From worksheet 3 From worksheet 2 From table 5-1

# Worksheet 4: Graphical Peak Discharge method

Project New Small Town School By ____ Date ____

Location DCR-Plan Review Course Checked ____ Date ____

Circle one: (Present) Developed 04-II

1. Data:

Drainage area ..... $A_m$ = .0516 $mi^2$ (acres/640)

Runoff curve number .... CN = 64 (From worksheet 2)

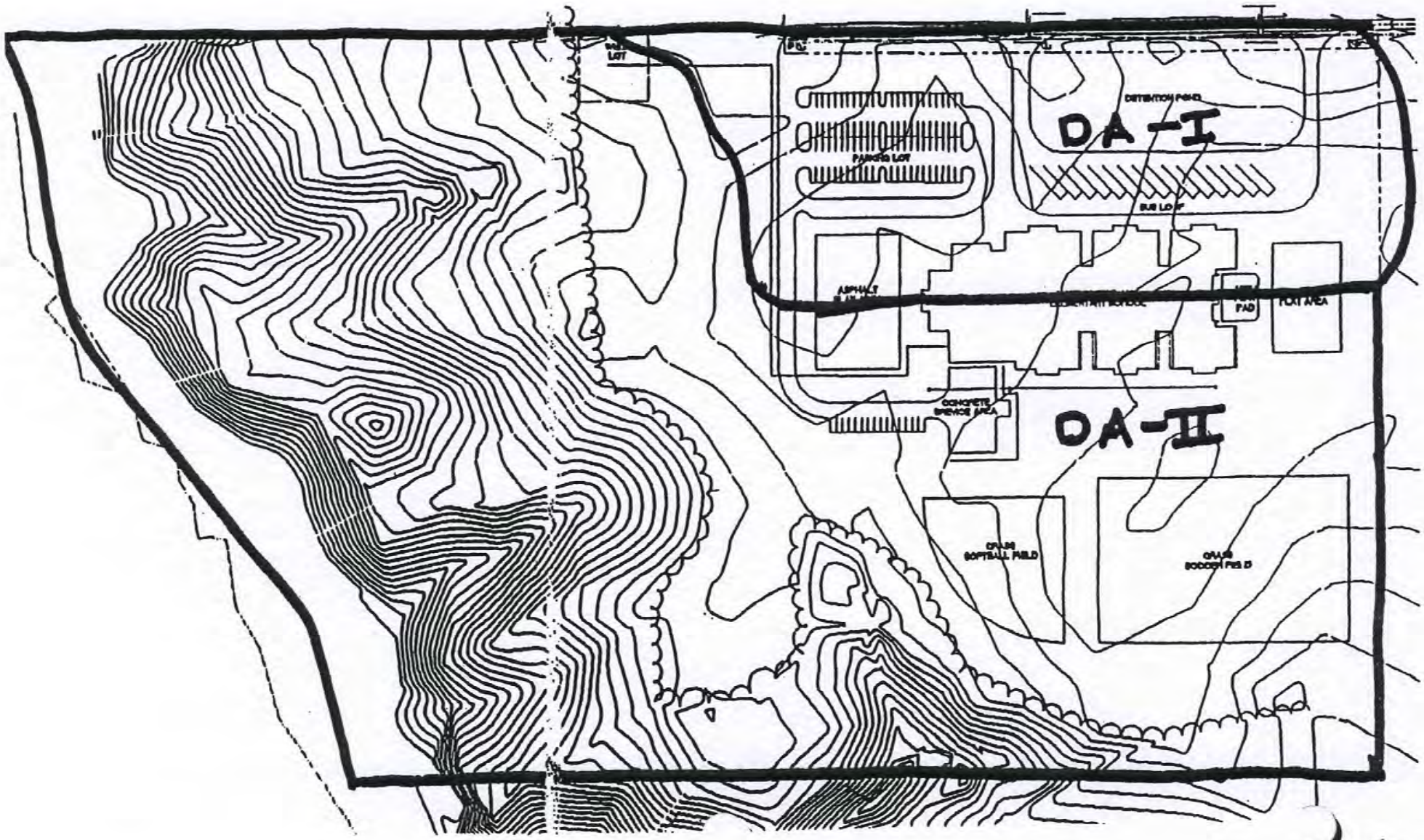
Time of concentration .. $T_c$ = .23 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = _____ percent of $A_m$ (____ acres or $mi^2$ covered)

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| 2. Frequency ..... | yr | 2 | 10 | |
| 3. Rainfall, P (24-hour) ..... | in | 3.5 | 6.0 | |
| 4. Initial abstraction, $I_a$ ..... (Use CN with table 4-1.) | in | 1.125 | 1.125 | |
| 5. Compute $I_a/P$ ..... | | .32 | .19 | |
| 6. Unit peak discharge, $q_u$ ..... (Use $T_c$ and $I_a/P$ with exhibit 4-____) | csm/in | 696 | 800 | |
| 7. Runoff, Q ..... (From worksheet 2). | in | 0.7 | 2.2 | |
| 8. Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | | | | |
| 9. Peak discharge, $q_p$ ..... (Where $q_p = q_u A_m Q F_p$) | cfs | 25.16 | 90.8 | |

POS - DEVELOPMENT



# Worksheet 2: Runoff curve number and runoff

Project New Small Town School By ____ Date ____

Location DCR Plan Review Course Checked ____ Date ____

Circle one: Present (Developed) DA-I

## 1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN 1/ Table 2-2 | CN 1/ Fig. 2-3 | CN 1/ Fig. 2-4 | Area ☒ acres ☐ mi² ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| SASSAFRAS (B) | Building/Pavement | 98 | | | 3.66 | 358.68 |
| SASSAFRAS (B) | Grass Good Condition | 61 | | | 4.36 | 265.96 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 8.02 | 624.64 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{624.64}{8.02} = 77.9$ Use CN = 78

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|
| Frequency ..... yr | 2 | 10 | |
| Rainfall, P (24-hour) ..... in | 3.5 | 6.0 | |
| Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 1.5 | 3.6 | |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

Project NEW SMALL TOWN SCHOOL By ____ Date ____

Location DCR-PLAN REVIEW COURSE Checked ____ Date ____

Circle one: Present (Developed) DA-I

Circle one: ($T_c$) $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) ..... | | PAVED | | | | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | .011 | | | | |
| 3. Flow length, L (total L ≤ 300 ft) ..... | ft | 300 | | | | |
| 4. Two-yr 24-hr rainfall, $P_2$ ..... | in | 3.5 | | | | |
| 5. Land slope, s ..... | ft/ft | .0078 | | | | |
| 6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute $T_t$ ..... | hr | .07 | + | | - | |

| Shallow concentrated flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) ..... | | | | | | |
| 8. Flow length, L ..... | ft | | | | | |
| 9. Watercourse slope, s ..... | ft/ft | | | | | |
| 10. Average velocity, V (figure 3-1) ..... | ft/s | | | | | |
| 11. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | | + | | - | |

| Channel flow | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a ..... | $ft^2$ | 1.77 | | | | |
| 13. Wetted perimeter, $P_w$ ..... | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ..... | ft | 0.38 | | | | |
| 15. Channel slope, s ..... | ft/ft | .005 | | | | |
| 16. Manning's roughness coeff., n ..... | | .013 | | | | |
| 17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... | ft/s | 4.24 | | | | |
| 18. Flow length, L ..... | ft | 420 | | | | |
| 19. $T_t = \frac{L}{3600\ V}$ Compute $T_t$ ..... | hr | .03 | + | | - | |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ..... hr .10

## Worksheet 5a: Basic watershed data

Project New Small Town School Location DCR. Plan Review Course By _____ Date _____

Circle one: Present (Developed) DA-I Frequency (yr) _____ Checked _____ Date _____

| | Subarea name | Drainage area $A_m$ ($mi^2$) | Time of concentration $T_c$ (hr) | Travel time through subarea $T_t$ (hr) | Downstream subarea names | Travel time summation to outlet $\Sigma T_t$ (hr) | 24-hr Rainfall P (in) | Runoff curve number CN | Runoff Q (in) | $A_mQ$ ($mi^2$-in) | Initial abstraction $I_a$ (in) | $I_a/P$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | .0125 | .10 | | | | 3.5 | 78 | 1.5 | .0188 | 0.564 | .16 |
| | | | | | | | | | | | | |
| 10 | | .0125 | .10 | | | | 6.0 | 78 | 3.6 | .0450 | 0.564 | .09 |
| | | | | | | | | | | | | |
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From worksheet 3 From worksheet 2 From table 5-1

# Worksheet 4: Graphical Peak Discharge method

Project New Small Town School By ____ Date ____

Location DCR-Plan Review Course Checked ____ Date ____

Circle one: Present (Developed) DA-I

1. Data:

Drainage area ..... $A_m$ = .0125 $mi^2$ (acres/640)

Runoff curve number .... CN = 78 (From worksheet 2)

Time of concentration .. $T_c$ = .10 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = _____ percent of $A_m$ (____ acres or $mi^2$ covered)

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| 2. Frequency ..... | yr | 2 | 10 | |
| 3. Rainfall, P (24-hour) ..... | in | 3.5 | 6.0 | |
| 4. Initial abstraction, $I_a$ ..... (Use CN with table 4-1.) | in | .564 | .564 | |
| 5. Compute $I_a/P$ ..... | | .16 | .09 | |
| 6. Unit peak discharge, $q_u$ ..... (Use $T_c$ and $I_a/P$ with exhibit 4-____) | csm/in | 1000 | 1000 | |
| 7. Runoff, Q ..... (From worksheet 2). | in | 1.5 | 3.6 | |
| 8. Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | | | | |
| 9. Peak discharge, $q_p$ ..... (Where $q_p = q_u A_m Q F_p$) | cfs | 18.75 | 45.0 | |

# Worksheet 2: Runoff curve number and runoff

Project New Small Town School By ____ Date ____

Location DCR Plan Review Course Checked ____ Date ____

Circle one: Present (Developed) DA - II

## 1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio) | CN 1/ Table 2-2 | CN 1/ Fig. 2-3 | CN 1/ Fig. 2-4 | Area ☒ acres ☐ mi² ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| SASSAFRAS (B) | Roof / Pavement | 98 | | | 1.99 | 195.02 |
| SASSAFRAS (B) | Grass Good Condition | 61 | | | 11.69 | 713.09 |
| Steep Sandy Land | Woods Good Cover | 55 | | | 20.80 | 1,144.00 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | Totals = | 34.48 | 2052.11 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2052.11}{34.48} = 59.5$; Use CN = 60

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|
| Frequency ..... yr | 2 | 10 | |
| Rainfall, P (24-hour) ..... in | 3.5 | 6.0 | |
| Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 0.5 | 1.9 | |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

Project New Small Town School By ____ Date ____

Location DCR-Plan Review Course Checked ____ Date ____

Circle one: Present (Developed) D4-II

Circle one: ($T_c$) $T_t$ through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

| Sheet flow (Applicable to $T_c$ only) | | Segment ID | | | |
|---|---|---|---|---|---|
| 1. Surface description (table 3-1) ..... | | Dense Grass | | | |
| 2. Manning's roughness coeff., n (table 3-1) .. | | 0.24 | | | |
| 3. Flow length, L (total L ≤ 300 ft) ..... | ft | 200 | | | |
| 4. Two-yr 24-hr rainfall, $P_2$ ..... | in | 3.5 | | | |
| 5. Land slope, s ..... | ft/ft | .015 | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute $T_t$ ..... | hr | .44 | + | | = |

| Shallow concentrated flow | | Segment ID | | | |
|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) ..... | | | | | |
| 8. Flow length, L ..... | ft | | | | |
| 9. Watercourse slope, s ..... | ft/ft | | | | |
| 10. Average velocity, V (figure 3-1) ..... | ft/s | | | | |
| 11. $T_t = \frac{L}{3600\,V}$ Compute $T_t$ ..... | hr | | + | | = |

| Channel flow | | Segment ID | | | |
|---|---|---|---|---|---|
| 12. Cross sectional flow area, a ..... | $ft^2$ | 1.77 | | | |
| 13. Wetted perimeter, $p_w$ ..... | ft | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... | ft | 0.38 | | | |
| 15. Channel slope, s ..... | ft/ft | .005 | | | |
| 16. Manning's roughness coeff., n ..... | | .013 | | | |
| 17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ..... | ft/s | 4.24 | | | |
| 18. Flow length, L ..... | ft | 740 | | | |
| 19. $T_t = \frac{L}{3600\,V}$ Compute $T_t$ ..... | hr | .05 | + | | = |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) ..... hr .49

## Worksheet 5a: Basic watershed data

Project New Small Town School Location DCR. Plan Review Course By _____ Date _____

Circle one: Present (Developed) 04 - II Frequency (yr) _____ Checked _____ Date _____

| | Subarea name | Drainage area $A_m$ ($mi^2$) | Time of concentration $T_c$ (hr) | Travel time through subarea $T_t$ (hr) | Downstream subarea names | Travel time summation to outlet $\Sigma T_t$ (hr) | 24-hr Rainfall P (in) | Runoff curve number CN | Runoff Q (in) | $A_m Q$ ($mi^2$-in) | Initial abstraction $I_a$ (in) | $I_a/P$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | .0539 | .49 | | | | 3.5 | 60 | 0.5 | .0270 | 1.333 | .38 |
| | | | | | | | | | | | | |
| 10 | | .0539 | .49 | | | | 6.0 | 60 | 1.9 | .1024 | 1.333 | .22 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |

From worksheet 3 From worksheet 2 From table 5-1

# Worksheet 4: Graphical Peak Discharge method

Project New Small Town School By ____ Date ____

Location DCR-Plan Review Course Checked ____ Date ____

Circle one: Present (Developed) 04-II

1. Data:

Drainage area ..... $A_m$ = .0539 $mi^2$ (acres/640)

Runoff curve number .... CN = 60 (From worksheet 2)

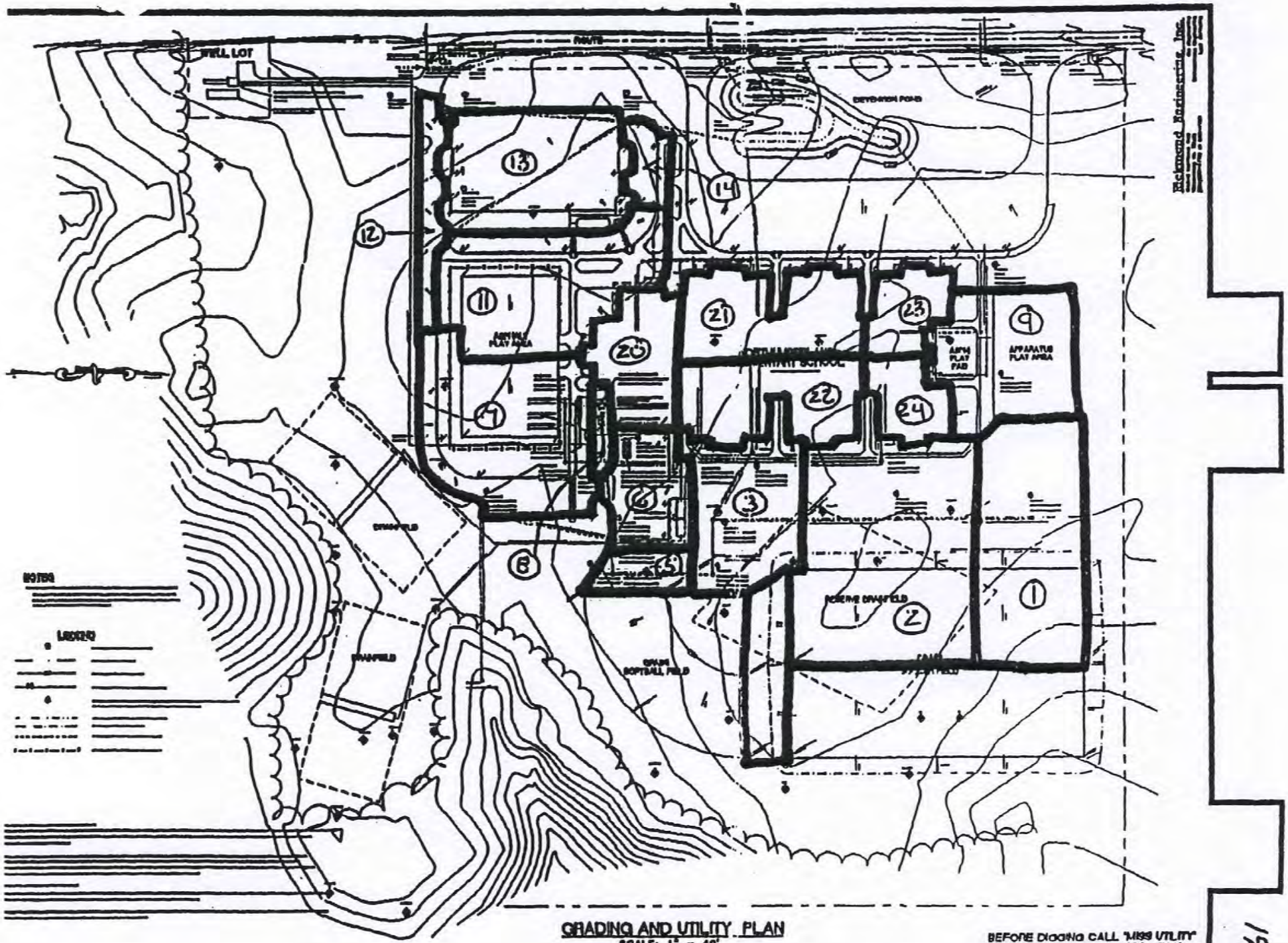
Time of concentration .. $T_c$ = .49 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = _____ percent of $A_m$ (____ acres or $mi^2$ covered)

| | | Storm #1 | Storm #2 | Storm #3 |
|---|---|---|---|---|
| 2. Frequency ..... | yr | 2 | 10 | |
| 3. Rainfall, P (24-hour) ..... | in | 3.5 | 6.0 | |
| 4. Initial abstraction, $I_a$ ..... (Use CN with table 4-1.) | in | 1.333 | 1.333 | |
| 5. Compute $I_a/P$ ..... | | .38 | .22 | |
| 6. Unit peak discharge, $q_u$ ..... (Use $T_c$ and $I_a/P$ with exhibit 4-____) | csm/in | 370 | 520 | |
| 7. Runoff, Q ..... (From worksheet 2). | in | .5 | 1.9 | |
| 8. Pond and swamp adjustment factor, $F_p$ .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.) | | | | |
| 9. Peak discharge, $q_p$ ..... (Where $q_p = q_u A_m Q F_p$) | cfs | 9.97 | 53.25 | |

# On-Site Stormwater Management



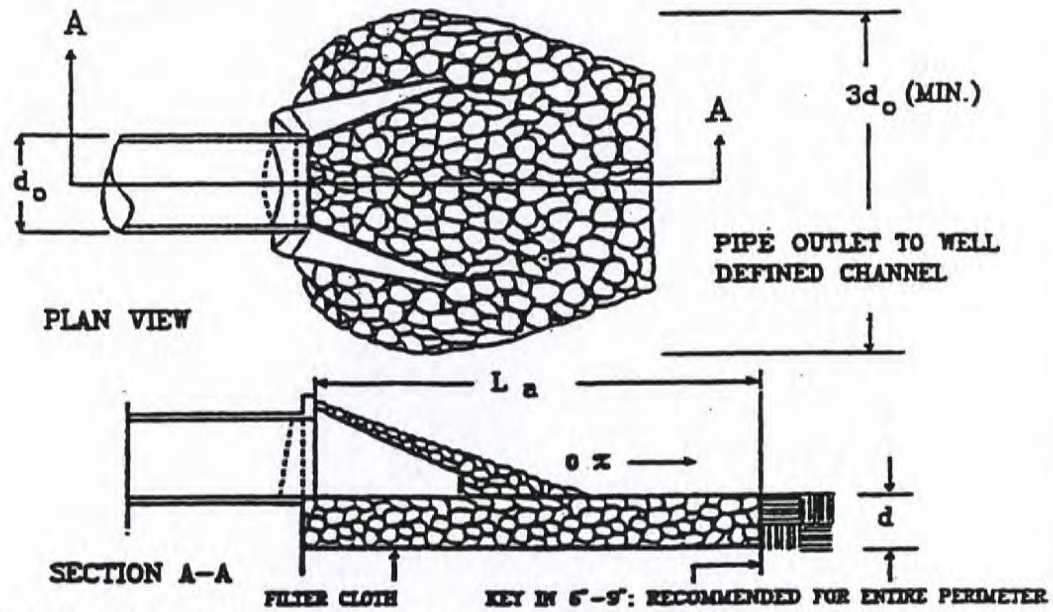

GRADING AND UTILITY PLAN
SCALE: 1" = 40'

BEFORE DIGGING CALL "MISS UTILITY" OF VIRGINIA AT 1 - 800 - 552 - 7001

# Inlet Protection Calculations

| Drainage Area Number | Area (Acres) | Q10(cfs) |
|---|---|---|
| 1 | 0.97 | 3.7 |
| 2 | 1.27 | 0.58 |
| 3 | 0.3 | 0.29 |
| 5 | 0.12 | 0.07 |
| 6 | 0.36 | 1.63 |
| 7 | 0.95 | 3.36 |
| 8 | 0.03 | 0.06 |
| 9 | 0.61 | 2.97 |
| 11 | 0.94 | 4.06 |
| 12 | 0.17 | 1.09 |
| 13 | 0.82 | 3.76 |
| 14 | 0.13 | 0.67 |
| 16 | 0.24 | 0.17 |
| 20 | 0.39 | 2.49 |
| 21/22 | 0.49 | 3.13 |
| 23/24 | 0.21 | 1.34 |

DESIGN OUTLET PROTECTION




NOTES: 1. APRON LINING MAY BE RIPRAP, GROUTED RIPRAP, GABION BASKET, OR CONCRETE.
2. La IS THE LENGTH OF THE RIPRAP APRON AS CALCULATED USING PLATES 3.18-3 AND 3.18-4.
3. d = 1.5 TIMES THE MAXIMUM STONE DIAMETER, BUT NOT LESS THAN 6 INCHES.

$Q = 5.96$ cfs

Max Tailwater Condition

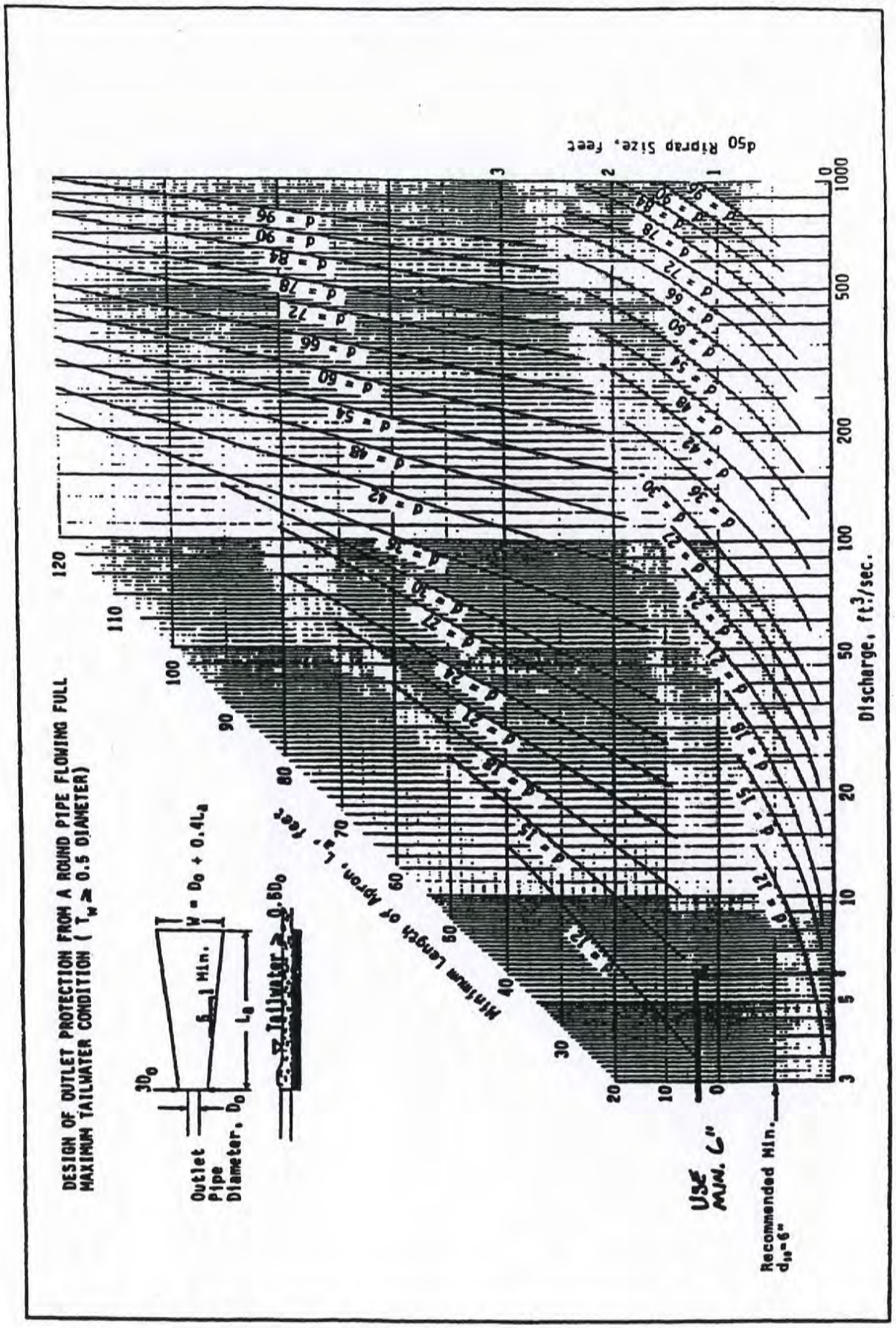
$L_a = 6'$

$d_o = 1.25'$

$3d_o = 4'$

$W = 4'$

USE VDOT CLASS I RIP RAP APRON




Source: USDA-SCS

Plate 3.18-4