PondBuilder (SM)
Report for Landowner

Prepared By:	Stan
Preparer Phone:	712-792-6248
Date Created:	March 31, 2010
Location:	Washington County, Iowa
Twnshp-Rng-Sec:	74N-9W-23
Landowner:	Joe Farmer
Landowner Phone:	777-777-7777

Disclaimer Statements

Estimate: This estimate is for planning purposes only. In no way shall it be construed as an engineering design. This estimate is valid only for low hazard dams. Planning for moderate and high hazard dams requires an on site investigation as well as additional evaluation of the hydrology and hydraulics by a licensed engineer.

Cost: This is a preliminary cost estimate for planning purposes only. The final construction cost may vary depending on actual site conditions, timing of construction, availability of fill materials, inflation, competitive bid process, construction method, etc.

Water Level: There is no guarantee that a pond in this location will fill and/or remain filled with water to the principal spillway crest elevation.

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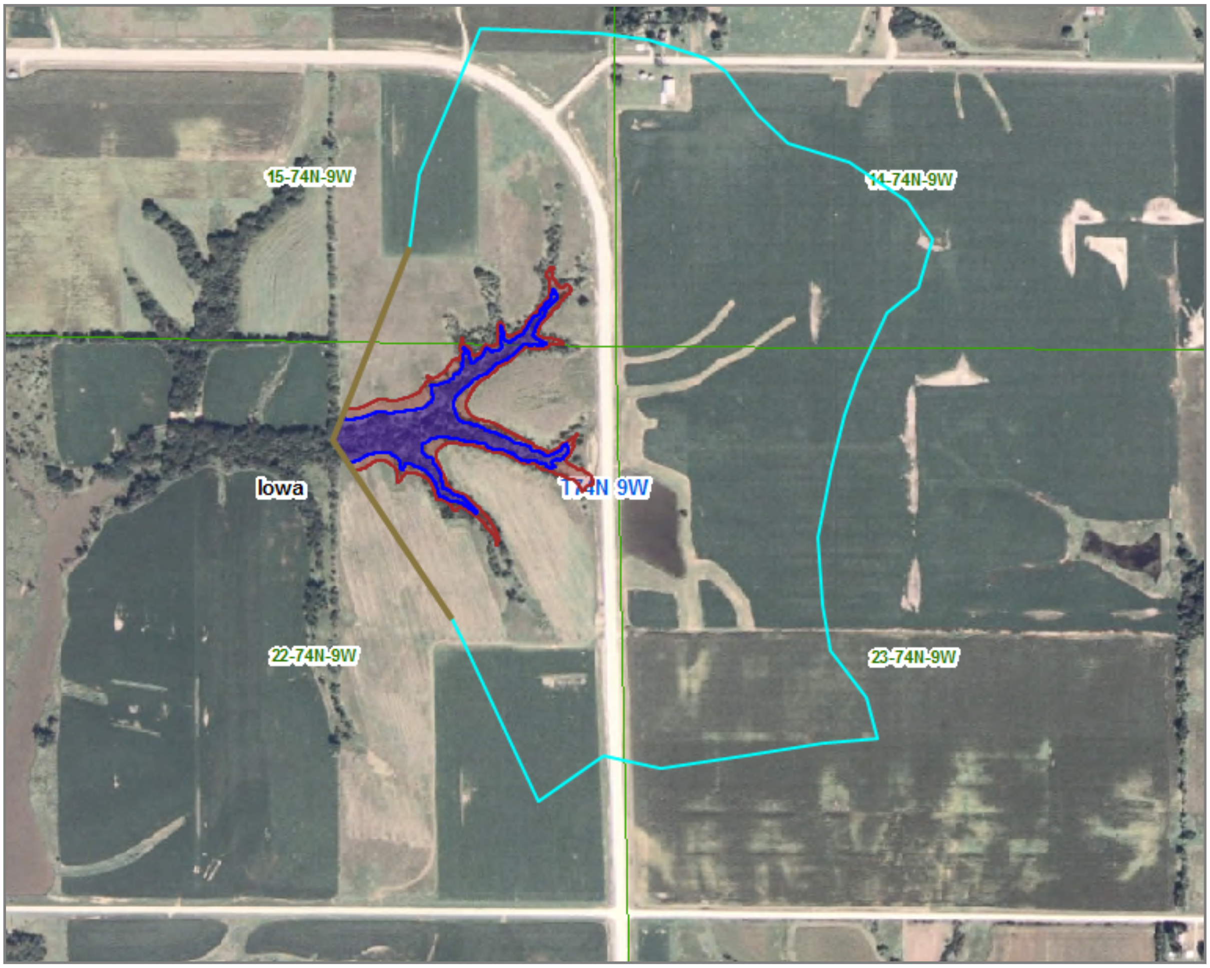
Aerial View of Pond



Information and Estimated Cost

Pond Depth: 19 feet
Pond Surface Area: 4.74 acres
Dam Top Width: 14 feet

Item	Subtotal
Dam, Berm, and Core Trench Fill	$16,180
Core Trench Excavation	$1,050
Principal Spillway Pipe	$2,590
Grubbing	$1,020
Seeding	$580
Fencing	$10,750
Total:	$32,170

Warnings:

Utilities: Iowa law requires that any person, homeowner, professional, public or private entity, planning to engage in any form of excavation within the state of Iowa, notify the Iowa One Call notification system, at 1-800-292-8989 or 811, at least 48 hours prior to excavating.

Cultural Resources: Numerous laws such as the National Historic Preservation Act of 1966 have been enacted to preserve cultural resources. Under these laws, Federal agencies, including the USDA's Natural Resources Conservation Service, are required to protect cultural resources. Therefore, their technical and financial assistances may be limited if cultural resources are located in the area.

NEPA/T&E Species: All federal agencies must follow the National Environmental Policy Act (NEPA) and the Threatened and Endangered Species Act. They are required to protect habitat for threatened and endangered species when providing technical assistance or financial assistance through any USDA program

Additional Information:

Fencing: If necessary, fences shall be installed and maintained to prevent unauthorized human or livestock access.

Managing Iowa Acreages: Protect Your Pond

http://www.ia.nrcs.usda.gov/news/brochures/Acreages/ponds.html

Iowa's Ponds

http://www.iowadnr.com/fish/programs/farmpond/fpp.html

Iowa Farm Pond Program

http://www.iowadnr.com/fish/programs/farmpond.html

OPERATIONS & MAINTENANCE

I. Embankment

A.) Vegetation – Proper vegetation is required on earth dams. Maintain vigorous growth of desirable vegetative coverings. This includes reseeding, fertilization, and appropriate controlled application of herbicides when necessary. Periodic mowing may also be needed to control vegetation height.

B.) Tree and Brush – Trees and shrubs are not allowed on the embankment. Trees that have been allowed to grow on the dam shall be removed completely, including all roots. Craters resulting from the tree root removal shall be re-filled with the appropriate soil, and compacted until design grades are achieved.

C.) Mowing and Brush Removal – Mowing is necessary to control the establishment of woody growth and to maintain the vegetative cover. The embankment, a fifteen (15) foot wide buffer strip adjacent to the toe, upstream and downstream of the embankment, and the area within 25 feet of the control structures need to be mowed.

D.) Erosion and Slope Protection – The rate of erosion is directly related to the lack of vegetation. Prompt repair of eroding areas is required. Vegetation should be inspected in the early spring and late summer, and any bare or eroded areas repaired and reseeded. Problem erosion areas of pedestrian or animal traffic should be controlled with filter cloth and rock rip rap. The upstream face of a dam can be protected from wave erosion by the same method.

E.) Seepage – Must be controlled in quantity and velocity to minimize damage to the dam. Regular monitoring to detect wet areas, "spring" flow, "piping, and "boils" on the downstream embankment should be done. Excessive seepage pressure can threaten the downstream slope stability.

F.) Stability – Large cracks, slides, sloughing, and excessive settlement are signs of embankment distress and indicate that remedial work is required.

G.) Rodent Guard – Control of rodents such as beavers, groundhogs, and muskrats is required as they can damage structural integrity and performance of the embankment and spillway. Groundhog and muskrat burrows serve as pathways for seepage. Beavers may plug the spillway and raise the pool level. Rodent removal and elimination of burrows is required when encountered.

H.) Determine and eliminate causes of settlement or cracks in the earthen sections, then repair damage.

I.) Replace weathered or displaced rock riprap to constructed grade.

J.) Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, or outlets or other apparatuses.

II. **Spillway and Outlet Works**

A.) Pipes – All conduits should be inspected thoroughly once a year. Inspect for improper alignment (sagging), elongation, and displacement at joint. Inspect for cracks, leaks, surface wear, loss of protective coatings, corrosion and blockage.

B.) Vegetated Earth Spillways – An emergency spillway is designed to pass infrequent large flood flows around the dam to prevent overtopping. The vegetative cover should be maintained the same as the embankment to provide a vigorous grass cover. Prompt repair of erosion damage and removal of flow obstructions are required.

C.) Outlet – Erosion at the spillway outlet is a common maintenance problem. Severe undermining, displacement of pipes, and dam failure can occur. Often the outlet is adequate for normal flow, but not for extreme storm flows. Provide prompt repair of damages.

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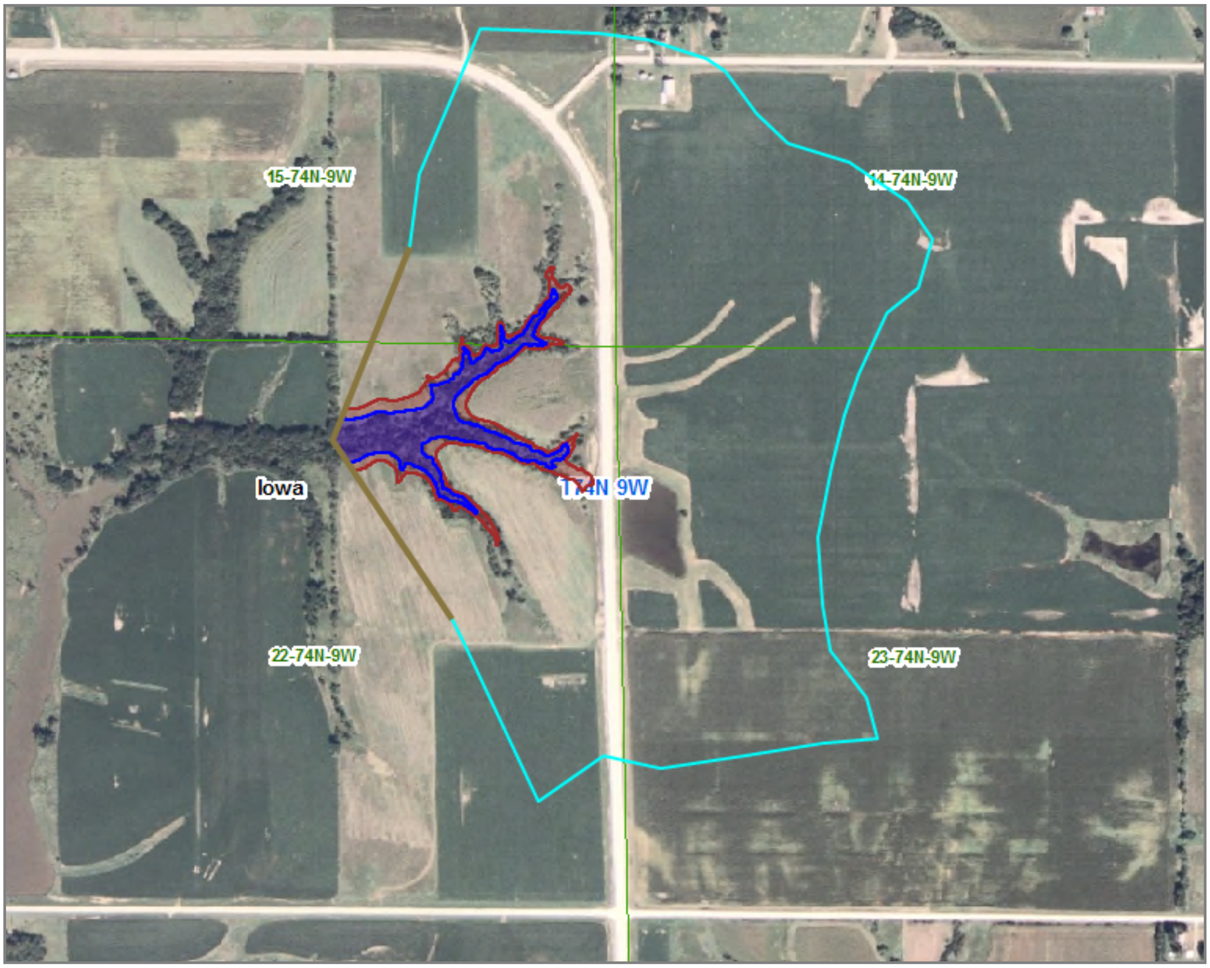


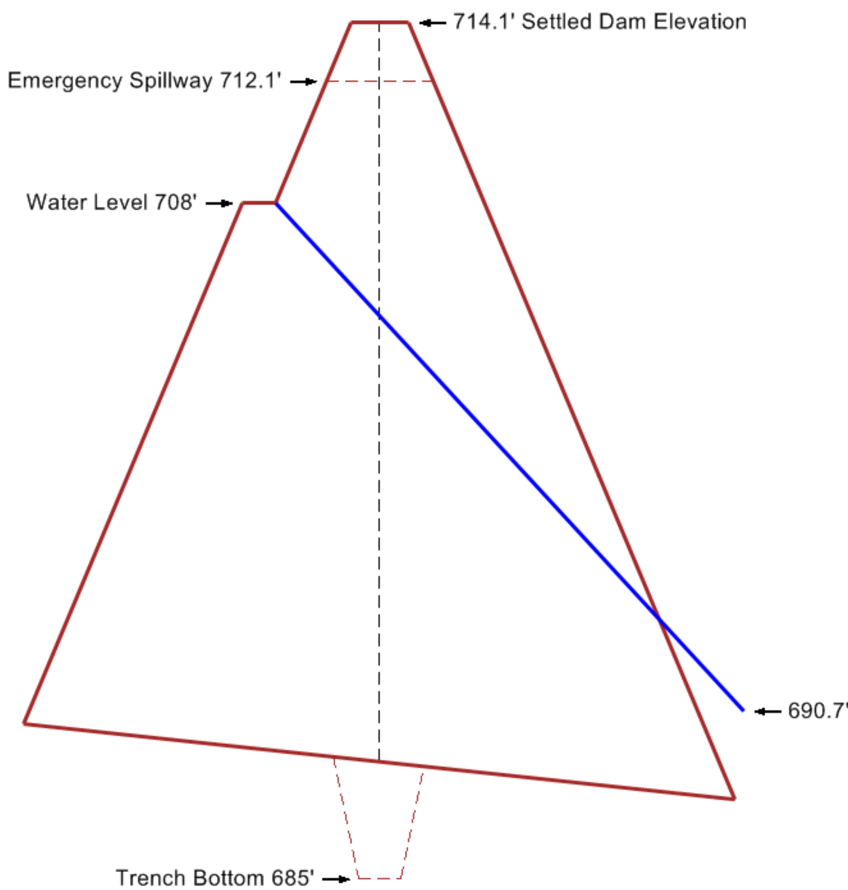
Information and Estimated Cost

Pond Depth:	19 feet
Pond Surface Area:	4.74 acres
Dam Top Width:	14 feet

Item	Quantity	Units	Cost Per Unit	Subtotal
Dam, Berm, and Core Trench Fill	12,072	cubic yards	$1.34	$16,180
Core Trench Excavation	557	cubic yards	$1.89	$1,050
Principal Spillway Pipe	115.1	feet	$22.50	$2,590
Grubbing	1.00	acres	$1,025.00	$1,020
Seeding	1.00	acres	$579.00	$580
Fencing	5,000.0	feet	$2.15	$10,750
			Total:	$32,170

Pond Planning Details

Drainage Area:	153.47 acres
Drainage/Pond Area Ratio:	32 : 1
Effective Fill Height:	23.1 feet
Constructed Fill Height:	26.4 feet
Dam Height (settled):	25.1 feet
Lowest pond elevation:	689 feet
Top of settled fill elevation:	714.1 feet
Auxiliary spillway elevation:	712.1 feet
Elevation of crest:	708 feet
Volume of permanent pool:	30.13 acre-ft
Volume of temporary pool:	24.05 acre-ft
Volume of total storage to top of fill:	69.47 acre-ft
Soil loss rate:	5 tons per acre per year
Runoff curve number:	81
Main fill including berm (if any) and core trench backfill:	12,071.9 cu. yds.
Core Trench Excavation:	557.3 cu. yds.
Pipe Type:	Smooth Steel Pipe
Pipe Size:	10 inch
Pipe Length:	115.1 feet



Earthwork Dimensions

Square Yardage reflects earth quantity before settling.

Station	Elevation	Grade	Sq. Yds.
805.5	714.3	0.85	0.6
810.5	713.5	0.97	2.2
815.5	713.0	1.11	3.7
820.5	712.2	1.32	6.1
825.5	711.6	1.35	8.2
830.5	710.8	1.50	11.8
835.5	710.4	1.44	13.5
840.5	709.9	1.43	16.0
845.5	709.2	1.50	19.4
850.5	708.9	1.39	21.7
855.5	708.3	1.35	24.8
860.5	708.1	1.21	26.6
865.5	707.7	1.07	29.6
870.5	707.6	1.00	30.4
875.5	707.6	1.13	30.2
880.5	707.0	1.70	35.0
885.5	706.5	1.76	38.5
890.5	705.2	2.11	50.4
895.5	703.6	2.25	66.1
900.5	702.1	2.48	83.3
905.5	701.5	3.05	90.3
910.5	701.1	3.20	95.9
915.5	700.7	3.57	101.0
920.5	700.8	3.55	98.9
925.5	700.4	3.22	104.0
930.5	699.8	3.46	111.7
935.5	699.0	4.11	123.1
940.5	698.5	5.46	131.2
945.5	698.2	5.43	136.3
950.5	696.1	5.79	168.6
955.5	694.0	5.78	205.5
960.5	693.2	5.95	220.5
965.5	691.8	4.30	243.9
970.5	691.4	4.02	252.0
975.5	691.0	6.96	267.0
980.5	690.7	5.02	267.4
985.5	690.5	3.50	269.2
990.5	689.7	2.08	286.2
995.5	688.6	1.20	308.6
1,000.5	688.3	1.61	314.6
1,005.5	688.5	2.76	312.1
1,010.5	689.7	3.52	285.4
1,015.5	691.2	4.70	258.0
1,020.5	692.2	6.35	239.9
1,025.5	693.8	8.09	214.0
1,030.5	694.9	9.16	196.7
1,035.5	697.1	10.02	160.8
1,040.5	698.5	9.78	138.9
1,045.5	699.9	8.92	116.2
1,050.5	701.5	9.14	94.9
1,055.5	702.5	9.48	82.8
1,060.5	702.9	9.20	77.9
1,065.5	703.4	8.37	70.4
1,070.5	704.6	7.87	58.1
1,075.5	705.2	7.36	51.0
1,080.5	705.9	6.07	44.1
1,085.5	706.6	5.42	37.7
1,090.5	707.6	5.00	30.2
1,095.5	707.9	4.79	27.3
1,100.5	708.4	4.40	24.8
1,105.5	709.0	4.30	21.3
1,110.5	710.1	4.29	15.3
1,115.5	710.7	4.04	12.2
1,120.5	711.3	3.64	9.6
1,125.5	711.8	3.57	7.6
1,130.5	712.8	3.65	4.3
1,135.5	713.3	3.48	2.8
1,140.5	713.9	3.63	1.4
1,141.5	714.1	3.62	1.0

Estimated Runoff Curve Number Worksheet

Soil / Hyd.	Cover Description	CN	Acres	CN x Area
Givin C	Row Crop - SR + CR - G	82	37.3	3055.4
Inton B	Row Crop - SR + CR - G	75	25.5	1909.4
Ashgrove D	Pasture - P	89	15.6	1392.8
Clinton B	Pasture - P	79	15.2	1198.6
Inton B	Pasture - P	79	14.7	1158.3
Clinton B	Row Crop - SR + CR - G	75	6.9	521.1
Inton B	Roads with dirt	82	6.9	563.7
Rubio (C)	Row Crop - SR + CR - G	82	6	493.8
Clinton B	Row Crop - SR + CR - P	80	5.3	423.1
Keomah C	Row Crop - SR + CR - P	87	4.5	390.9
Water (D)	Row Crop - SR + CR - G	85	2.5	212.6
Keomah C	Row Crop - SR + CR - G	82	2.5	202.8
Clinton B	Roads with dirt	82	2.3	187.1
Keomah C	Roads with dirt	87	2	174.3
Givin C	Roads with dirt	87	1.7	145.7
Lindley-Keswick C	Pasture - P	86	1.4	124
Ashgrove D	Roads with dirt	89	1	88
Rubio (C)	Row Crop - SR + CR - P	87	0.9	74.1
Givin C	Row Crop - SR + CR - P	87	0.6	49.2
Inton B	Row Crop - SR + CR - P	80	0.4	32.4
Keomah C	Pasture - P	86	0.3	27.6
Givin C	Pasture - P	86	0.1	6.4
		Totals:	153.5	12436.8

CN (Weighted) = 12436.8 / 153.5 = 81

Technical Calculations

Below you'll find all the math calculations used to construct this pond. Please note that some of the figures are rounded for display purposes, but that the original non-rounded numbers were used in the equations.

1a. Find the minimum volume of the pond V_{min} (acre-feet):

A_w = area of watershed (acres) = 153.5

ye = years of erosion = 35

E = rate of erosion (tons per acre per year) = 5

$sedPct$ = percent of sediment (from lookup table) = 40

$$V_{min} = \frac{A_w \cdot ye \cdot E \cdot (\frac{sedPct}{100}) \cdot 0.80}{1300}$$

$$V_{min} = \frac{153.5 \cdot 35 \cdot 5 \cdot (\frac{40}{100}) \cdot 0.80}{1300}$$

$V_{min} = 6.61$

1b. Use basin model to find minimum pond depth and minimum acreage:

D_{min}= minimum pond depth (feet) = 11.2

A_{min}= minimum pond area (acres) = 1.6

2. Find the "20% sediment volume" V_{20} (acre-feet):

$$V_{20} = \frac{A_w \cdot ye \cdot (\frac{sedPct}{100}) \cdot 0.20}{1750}$$

$$V_{20} = \frac{153.5 \cdot 35 \cdot (\frac{40}{100}) \cdot 0.20}{1750}$$

$V_{20} = 1.23$

3a. Find Curve Number CN:

$CN = 81$

3b. Find rainfall P (inches):

(from lookup table)

$P = 4.7$

3c. Find runoff Q (inches) and runoff volume V_r (acre-feet):

$$Q = \frac{[P - 0.2(\frac{1000}{CN} - 10)]^2}{P + 0.8(\frac{1000}{CN} - 10)}$$

$$Q = \frac{[4.7 - 0.2(\frac{1000}{81} - 10)]^2}{4.7 + 0.8(\frac{1000}{81} - 10)}$$

$Q = 2.72$

A_{wmi^2}= watershed area (sq mi.) $= \frac{A_w}{640}$

$A_{wmi^2} = \frac{153.5}{640} = 0.2$

$V_r = 53.33 \cdot Q \cdot A_{wmi^2}$

$V_r = 53.33 \cdot 2.72 \cdot 0.2$

$V_r = 34.81$

3d. Find time of concentration T_c:

l = longest flow length (feet) = 3048

Y = average watershed slope (percent) = 20.7662940303453

$$T_c = \frac{l^{0.8}[(\frac{1000}{CN}) - 9]^{0.7}}{1140 Y^{0.5}}$$

$$T_c = \frac{3048^{0.8}[(\frac{1000}{81}) - 9]^{0.7}}{1140 \cdot 20.7662940303453^{0.5}}$$

$T_c = 0.27$

3e. Find initial abstraction I_a(lookup table) and find I_a/P ratio:

I_a= 0.47

$I_a/P = \frac{I_a}{P} = \frac{0.47}{4.7} = 0.1$

3f. Find unit peak discharge q_u. Interpolate between lower and upper q_u:

Lower:

$I_a/P_{lower} = 0.1$

c_0= 2.55323

c_1= -0.61512

c_2= -0.16403

$q_{ulower} = 10^{c_0 + c_1 \cdot log(T_C) + c_2 \cdot [log(T_C)]^2}$

$q_{ulower} = 10^{2.55323 + (-0.61512) \cdot log(0.27) + (-0.16403) \cdot [log(0.27)]^2}$

$q_{ulower} = 702.761$

Upper:

I_a/P_{upper} = 0.3

c_0= 2.46532

c_1= -0.62257

c_2= -0.11657

$q_{uupper} = 10^{c_0 + c_1 \cdot log(T_C) + c_2 \cdot [log(T_C)]^2}$

$q_{uupper} = 10^{2.46532+(-0.62257)\cdot log(0.27)+(-0.11657)\cdot [log(0.27)]^2}$

q_{uupper} = 599.834

Interpolated:

m = interpolation slope = $\frac{q_{uupper} - q_{ulower}}{I_a/P_{uupper} - I_a/P_{lower}}$

$m = \frac{599.834 - 702.761}{0.3 - 0.1}$

m = -514.639

b = interpolation y-intercept = $q_{uupper} - (m \cdot I_a/P_{upper})$

$b = 599.834 - (-514.639 \cdot 0.3)$

b = 754.225

$q_u = m(I_a/P) + b$

$q_u = -514.639 \cdot 0.1 + 754.225$

q_u = 702.761

3g. Find the peak discharge q_p (cfs):

F_p = pond and swamp adjustment factor = 1

$q_p = q_u \cdot A_{wmi^2} \cdot Q \cdot F_p$

$q_p = 702.761 \cdot 0.24 \cdot 2.72 \cdot 1$

q_p = 458.696

4. For the user selected pond depth/acreage and pipe size/type, we run an iterative process to find the dam height and pipe length.

H = dam height (feet)

D = pond depth (feet) (user-chosen) = 19

PS = pipe size (diameter in inches) (user-chosen) = 10

Pond storage below crest = 30.1 acre-feet

Initial estimate:

$H = D + 1.8 \cdot PS + 2$

$H = 19 + 1.8 \cdot 10 + 2$

$H = 22.5$

4a. Find the pipe flow Q_{pipe}(cfs):

n = Manning's N for the pipe = 0.012

K_p = pipe head loss coefficient = $\frac{5087 \cdot n^2}{PS^{4/3}}$

$K_p = \frac{5087 \cdot 0.012^2}{10^{4/3}} = 0.034$

h_p = head (feet) = $D - 2$ = 19 - 2 = 20.5

K_e = entrance|loss coefficient = 1

K_m = bend loss = 0

s = slope of dam = 0.333

t = dam top width (feet) = 14

L_p = length of pipe (feet) = $\sqrt{D^2 + [\frac{2 \cdot H - D + 2}{s} + t + 3]^2}$

$L_p = \sqrt{19^2 + [\frac{2 \cdot 22.5 - 19 + 2}{0.333} + 14 + 3]^2}$

$L_p = 97$

A_p = cross-sectional area of pipe (sq. ft.) = $\pi \cdot (\frac{PS/12}{2})^2$

$A_p = \pi \cdot (\frac{10/12}{2})^2 = 0.5$

g = acceleration of gravity (ft per sec per sec) = 32.2

$$Q_{pipe} = A_p \sqrt{\frac{2 \cdot g \cdot h_p}{1 + K_e + K_m + K_p L_p}}$$

$$Q_{pipe} = 0.5 \sqrt{\frac{2 \cdot 32.2 \cdot 20.5}{1 + 1 + 0 + 0.034 \cdot 97}}$$

$Q_{pipe} = 8.61$

4b. Find the storage volume V_s (acre-feet):

Coefficients (lookup):

C_0 = 0.682

C_1 = -1.43

C_2 = 1.64

C_3 = -0.804

Equation:

$$V_s = V_r(C_0 + C_1(\frac{Q_{pipe}}{q_p}) + C_2(\frac{Q_{pipe}}{q_p})^2 + C_3(\frac{Q_{pipe}}{q_p})^3$$

$$V_s = 34.81(0.682 + (-1.43)(0.019) + (1.64)(0.019)^2 + (-0.804)(0.019)^3$$

$$V_s = 22.83$$

4c. Find the auxillary storage volume V_{aux} (acre-feet):

$$V_{aux} = V_s + V_{20}$$

$$V_{aux} = 22.83 + 1.23$$

$$V_{aux} = 24.05$$

4d. Fill the basin model to the pond depth D, and fill with additional volume V_{aux}:

The new dam height H (feet) is two feet above the top of the V_{aux}

$H = 25.1483$

4e. See if H has converged to a value.

If the new value of H is **not** within 0.005 feet of the value of H we used in step 4a above, repeat steps 4a through 4e with this new value of H.

If the new value of H **is** within 0.005 feet of the value of H we used in step 4a, then we consider the value to have converged, and move on to step 4f.

4f. Accept the converged value of the dam height H (feet):

$H = 25.14755$
Use this value to construct the pond in the GIS.