Attachment 6
Hydrologic and Hydraulic Analysis

HYDROLOGIC AND HYDRAULIC ANALYSIS

COMBINATION POND DAM

VT Dam #173.03
City of Rutland, Vermont

Prepared for:
City of Rutland

Prepared by:

DuBois & King inc.

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D&K #121240

HYDROLOGIC AND HYDRAULIC ANALYSIS

COMINATION POND DAM
VT Dam #173.03
City of Rutland, Vermont

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1.0 INTRODUCTION

1.1 Overview

This report summarizes a hydrologic and hydraulic (H&H) evaluation of the existing Combination Pond Dam (VTDEC Dam #173.03) located in the City of Rutland, Rutland County, Vermont. This evaluation was conducted in support of an Alternatives Evaluation for the dam to improve downstream water quality and reduce the risk of dam failure and the associated downstream damages.

While removal of the dam is among the alternatives being evaluated, all other alternatives entail keeping the dam and making other changes to improve downstream water quality. If the dam is to remain, upgrades to bring it into compliance with current safety standards – including an increase in hydraulic capacity given the dam's history of overtopping – will likely be required. This H&H report focusses on the hydraulic capacity issue. Other deficiencies with the dam are addressed in the Alternatives Evaluation.

Combination Pond Dam was originally constructed sometime prior to 1958. It was previously known as Healy Pond. The dam is presently owned by Charter Hills, Inc, and is used for recreational purposes. By deed, many of the parcels on either side of the dam have rights to use the parcel with the dam for recreation.

The existing dam is an earthen embankment approximately 120 feet long and 14 feet high. The side slopes on the upstream and downstream slopes are approximately 2H:1V. Sharon Drive runs across the top of the dam. The spillway consists of a 4' x 4' concrete riser that discharges to a 36" corrugated metal outlet pipe. There is a second riser measuring 7' x 4' approximately 1' higher than the primary spillway that also connects to the same 36" outlet pipe. Photographs of the dam and an existing condition site plan are included in Attachment A.

1.2 Design Storm

Vermont's dam statutes and regulations do not define specific spillway design floods (SDF) for jurisdictional dams. The policy of the DEC's Dam Safety program, as documented in the State's Dam Order application (the permit needed to alter or construct a dam), is that the SDF should be consistent with guidelines established by Federal agencies including the Corps of Engineers, Natural Resources Conservation Service, and the Bureau of Reclamation.

Typically in Vermont, the Corps of Engineer's guidelines are employed. These guidelines provide a range of applicable design storms for a dam based on the size of the impoundment and the downstream Hazard Classification.

In addition to Corps guidelines, the State's Dam Order application specifies the following minimum hydraulic design standards for all jurisdictional dams:

- The SDF shall not be less than the routed 100-year inflow.
- Freeboard shall not be less than 1.5 feet from the routed 100-year water surface elevation to the top of dam.
- Freeboard shall not be less than 3.0 feet from the principal spillway crest (usually the normal water level) to the top of dam.

The Dam Safety program currently classifies Combination Pond Dam as a Low Hazard structure. By Corps guidelines, the potential water storage at the top of the dam (20 ac-ft) puts it in the Small Size (50 - 1,000 ac-ft of storage) category by default, though it is actually smaller than the lower threshold. For a Low Hazard, Small Size structure, the Corps guidelines recommend that the SDF be the 50 to 100-year frequency storm.

In the latest State inspection report (2007), the State suggested that the presence of houses downstream might warrant a change in hazard classification. If it were to be reclassified to Significant Hazard, Corps guidelines recommend that the SDF be the 100-year to ½ Probable Maximum Flood (PMF) event.

The PMF is defined as the flood resulting from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible at a specific location. The ½ and ¼ PMF storms are simply smaller fractions of the full PMF storm. For comparison, a ½ PMF is typically on the order of 3 – 5 times larger than the 100-year flood event, and the full PMF is typically 5 – 10 times larger. Designing a dam to safely pass the ½ PMF or full PMF requires either a relatively large spillway or a relatively large amount of available storage below the top of the dam.

2.0 HYROLOGIC ANALYSIS

2.1 Hydrologic Methods

D&K prepared a rainfall-runoff model for contributing watershed using the HydroCad computer program. The model was used to calculate the volume and timing of flows into the reservoir during the 2, 10, 25, 50, and 100-year storm events as well as the ¼, ½, and full Probable Maximum Flood (PMF) events. It was then used to evaluate the hydraulic capacity of the existing dam and its performance during the various flood events.

The HydroCad program uses the SCS (now NRCS) unit hydrograph method to compute stormwater runoff from a watershed. The method determines runoff discharge rates for a given drainage area over a specified duration of time. The parameters required for this method include the drainage areas, rainfall depth, times of concentration, curve numbers, and dimensions of structures such as dams. The major inputs are summarized below. Additional details are included with the attached HydroCad input and output files (Attachment C).

Drainage Areas. The watershed area was delineated using the USGS online StreamStats program. The drainage area at the dam is 1.64 square miles (1051 acres). The watershed was modeled as one subbasin. A map showing the watershed is included in Attachment A.

Times of Concentration. The time of concentration for the watershed was determined by summing the travel time for sheet flow, shallow concentrated flow, and channel flow along the flow path from the most hydrological distant point within the watershed. Data about the flow path such as slope, flow length, and surface roughness was developed using the USGS online StreamStats program. A map showing the times of concentration flow path is included in Attachment A.

Rainfall. Rainfall values used for the 2-year through the 100-year storms were obtained from the Northeast Regional Climate Center Atlas of Precipitation Extremes for Northeastern United States and Southeastern Canada. The 100-year total 24-hour precipitation for the watershed is 6.05 inches. The NRCS Type II rainfall distribution was used for the 2-year to 100-year, 24-hour storms.

For the ¼, ½, and full Probable Maximum Precipitation (PMP) storms, a center-weighted 24-hour storm distribution based on precipitation values obtained from the National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Reports No. 51 and No. 52 was used. The full PMP 24-hour precipitation for the contributing watershed is 24 inches, the ½ PMP 24-hour precipitation is 14 inches, and the ¼ PMP 24-hour precipitation is 7 inches. Precipitation documentation is included in Attachment B.

Land Cover, Soils, and Curve Numbers. The curve numbers were determined using standard NRCS reference values based on land cover, hydrologic soil group, and professional judgment. Land cover was based on observations during a Summer 2011 site visit and interpretation of the 2009 aerial photography (National Agricultural Imagery Program). Approximately 60% of the watershed is forested, and the remaining 40% is predominantly residential and commercial or institutional development with the associated buildings and roads. Less than 1% is open water. An orthophoto map of the project area is included in Attachment A.

The hydrologic soil groups (HSG) for each subwatershed were based on NRCS digital maps. Approximately 17% of the watershed is comprised of relatively well-drained HSG A soils, 11% is B soils, 58% is C soils, and the remaining 14% is D soils and water. A map of the hydrologic soil groups in the watershed is included in Attachment A.

Dam and Pond Dimensions. D&K conducted a limited survey of the dam in June. An Existing Conditions Plan was developed from this survey and is included in Attachment A. The stage-surface area data at the dam was based on the field survey.

2.2 Hydrologic Results

The results of the hydrologic analysis are summarized in Table 1. The results are presented for the 100-year rainfall event, the ¼ PMF event, the ½ PMF event, and the full PMF. Note that the model was run assuming antecedent moisture condition level 2, which is standard for determining spillway capacity. Detailed HydroCad input and output are included in Attachment C.

Table 1. Summary of Computed Inflow

Event	24-hour Rainfall Depth (in)	Peak Inflow to Reservoir (cfs)	Unit Discharge (cfs/sq mi)
2-year	2.49	39	24
10-year	3.58	133	81
25-year	4.41	231	141
50-year	5.17	337	205
100-year	6.05	472	288
¼ PMF	7.00	692	422
½ PMF	14.00	2116	1290
Full PMF	28.00	5199	3170

The calculated 100-year peak runoff was compared to 100-year flow at 138 stream gages in Vermont and surrounding states as reported by the USGS. The ½ and full PMF were compared to PMFs previously computed by the U.S. Army Corps of Engineers for flood control dams in the region that they operate. A graph of the results is included in Attachment C.

The predicted 100-year runoff is above the best-fit line through the data. This is to be expected given the steep slopes in the contributing watershed and the prevalence of soils with relatively slow infiltration rates (72% C and D type soils). The fact that the computed value is significantly above the best-fit line indicates that the results are likely conservative. The computed PMF is in line with PMFs for Corps dams in the region.

3.0 EXISTING CONDITIONS HYDRAULIC ANALYSIS

3.1 Hydraulic Methods

The computed inflows were routed through the existing spillway using HydroCad. The existing primary spillway was modeled as a horizontal orifice with flow treated as weir flow at low heads. The outlet pipe was modeled as a 36” CMP. The concrete and masonry portion near the upstream end of the pipe was neglected, and treated simply as an extension of the CMP. The secondary drop-inlet was also modeled as a horizontal orifice, though the computed outflow was reduced by 50% to account for blockage caused by the grating over the opening. The crest of the principle spillway was set at elevation 647.2 feet, which corresponds to the normal summer pool elevation. Based on D&K’s field survey, the top of the dam was set 2.5’ higher at elevation 649.7.

3.2 Hydraulic Results

The results of the hydraulic analysis are summarized in Tables.

Table 2. Hydraulic Results

Storm Event	Top of Dam Elev. (ft)	Normal Pool Elev. (ft)	Inflow (cfs)	Outflow (cfs)	Peak WSEL (ft)	Freeboard (ft)
Primary drop inlet (4'x4') at elevation 647.2, second drop inlet (7'x4') at elevation 648.75, both connecting to one 36" CMP. Top of dam treated as broad crested weir.						
Q2	649.7	647.2	39	37	648.0	1.7
Q10	649.7	647.2	133	102	649.7	0.0
Q25	649.7	647.2	231	228	650.3	-0.6
Q50	649.7	647.2	337	335	650.6	-0.9
Q100	649.7	647.2	472	470	650.8	-1.1
¼ PMF	649.7	647.2	692	690	651.1	-1.4
½ PMF	649.7	647.2	2116	2114	652.3	-2.6
Full PMF	649.7	647.2	5199	5196	653.7	-4.0

Under current existing conditions, only the 2-year and 10-year design storms pass through the spillways without overtopping the dam. The 2-year event passes with water rising to within 1.7 feet of the top of dam (i.e., the road). The 10-year event rises to the road but does not overtop.

Above the 10-year event, the dam is overtopped. The 100-year design storm event overtops with a depth of 1.1 feet. During the ¼ PMF and ½ PMF (possible design storms were the Vermont DEC to reclassify the dam to Significant Hazard), the dam dam overtops by 1.4 feet and 2.6 feet, respectively.

During the 2-year storm event there is relatively little reduction of the peak inflow, meaning the reservoir does little to reduce peak flows downstream. The inflow is reduced 5% from 39 cfs to 37 cfs, which is an insignificant and likely imperceptible difference. During the 10-year storm event, flows are reduced 23% from 133 cfs to 102 cfs. Once the dam overtops, there is almost no attenuation of peak flows; what comes in goes immediately out.

While the 23% reduction in peak flow (inflow vs. outflow) during the 10-year storm may seem significant on the surface, the flood attenuating value of the pond should not be overstated. During Tropical Storm Irene, the dam overtopped by roughly a foot (suggesting approximately the 100-year flood event) and there was no meaningful reduction in flows. Yet the City reports that downstream flooding was limited to low-lying areas rather than road crossings. This suggests that at the 100-year flood level the channel capacity is exceeded only in limited locations, and it further suggests that during lesser events (e.g, the 10-year), the channel would likely have adequate capacity. Thus, the 23% reduction in peak flow provided during the 10-year event is of little value because indications are that the downstream system can already accommodate the 10-year event and probably and somewhat larger flows; such a reduction in flow rates would only be of value from a flood reduction standpoint if it occurred during the larger events when downstream flooding is an issue, and Combination Pond is simply too small to provide the storage necessary to provide flow reduction during those larger events. .

4.0 ALTERNATIVES FOR ADDITIONAL HYDRAULIC CAPACITY

There are a number of measures – both physical and administrative – to address a dam that can not pass as much water as regulatory standards require. A brief description of nine measures is attached. If Combination Pond is to remain in place and be brought up to current State standards, the three measures below, alone or in combination with each other, have the most potential.

1. Larger Spillway (bigger pipes equals more water). The existing pipes are limiting outflow. Given that they are approaching or are beyond their reliable service life, and thus replacement is a matter of time, it makes sense to replace them with larger components.

2. Raise Dam (higher crest means more storage volume before it overtops). While raising a dam crest means more potential storage and thus greater potential impacts downstream in the event of a breach, relatively minor raising can be a cost-effective way to increase storage capacity.

3. Armor Embankment for Overtopping (essentially, make the top of dam a new spillway). For reservoirs like combination pond where the volume of storm inflow during major events dwarfs the available storage volume, designing a dam to safely overtop is often much more practical and cost-effective than trying to capture and pass all the water through a spillway. With armoring, in effect, the dam crest itself becomes a new auxiliary spillway.

4.1 Description of Alternatives

Two alternatives (A and B), which are combinations of the measures above, were identified and evaluated.

4.1.1 Alt A: Relatively Large New Spillway plus Leveling of Dam Crest

The intent of Alternative A is to provide enough hydraulic capacity for the 100-year storm plus one foot of vertical freeboard as a safety factor. This would meet the hydraulic capacity requirements for the dam with its current classification as a Low Hazard structure.

Under this alternative, the existing riser structure, secondary drop inlet, and the entire outlet barrel would be removed and replaced. A single 8’ x 8’ concrete riser would replace the two existing inlets, and a new 6’-wide x 5-tall concrete box culvert would replace the existing 36” CMP culvert. The dam crest would be raised 1.3’ from 499.7’ to 451.0’.

4.1.2 Alt B: Relatively Small New Spillway plus Overtopping Protection

The intent of Alternative B is to improve the existing hydraulic capacity from the 10-year to the 25-year event, and then protect the dam so that it remains stable when overtopped by storms up

to at least the ¼ PMP. This would meet the hydraulic capacity requirements for the dam should the State reclassify it to a Significant Hazard structure.

Under this alternative, the existing riser structure, secondary drop inlet, and the entire outlet barrel would be removed and replaced, but the replacement components would not be as large (and thus would not pass as much water) as under Alternative A. Specifically, a single 72" diameter concrete riser would replace the two existing inlets, and a new 42" diameter concrete culvert would replace the existing 36" CMP culvert. The crest of the dam would not be raised, but the downstream embankment would be armored to prevent erosion when the dam overtops.

4.2 Hydraulic Results of Alternatives

Table 3. Alternative A Hydraulic Results

Storm Event	Top of Dam Elev. (ft)	Normal Pool Elev. (ft)	Inflow (cfs)	Outflow (cfs)	Peak WSEL (ft)	Freeboard (ft)
Single drop inlet (8'x8') at elevation 647.2, connecting to one 6'x5' concrete box culvert. Top of dam raised 1.3' to 651.0'.						
Q2	651.0	647.2	39	38	647.7	3.3
Q10	651.0	647.2	133	131	648.4	2.6
Q25	651.0	647.2	231	228	648.9	2.1
Q50	651.0	647.2	337	332	649.4	1.6
Q100	651.0	647.2	472	454	650.0	1.0
¼ PMF	651.0	647.2	692	678	651.8	-0.8
½ PMF	651.0	647.2	2116	2113	653.3	-2.3
Full PMF	651.0	647.2	5199	5181	654.9	-3.9

The relatively large new spillway components of Alternative A, coupled with a 1.8' raising of the dam, provide enough capacity to pass the 100-year storm event with 1.5 feet of vertical freeboard. This would meet the hydraulic capacity standards with the dam's current Low Hazard classification. A flow somewhere between the Q100 and the ¼ PMF would reach the top of the dam and begin overtopping.

The major benefit of this alternative is that the frequency of dam overtopping – the single greatest cause of earthen dam failure – is greatly reduced. Since the 100-year storm passes with room to spare, the annual probability of the dam overtopping in any given year is less than 1%. That is a dramatic improvement over existing conditions where the probability is approximately 10%.

The major drawback is that if the State reclassifies the dam as a Significant Hazard structure, the design storm will likely increase from the 100-year event to the ¼ PMF event, and this alternative can't meet pass the ¼ PMF. Another drawback is that the larger spillway components of this approach are relatively expensive. And a final drawback is that raising the dam by 1.3 feet means that more water can be stored and there is theoretically greater potential for downstream damages in the event of a dam breach.

Table 4. Alternative B Hydraulic Results

Storm Event	Top of Dam Elev. (ft)	Normal Pool Elev. (ft)	Inflow (cfs)	Outflow (cfs)	Peak WSEL (ft)	Freeboard (ft)
Single drop inlet (6' diam) at elevation 647.2, connecting to one 42" diameter culvert. Top of dam leveled at elevation 650'. Crest treated as broad crested weir. Downstream face armored for overtopping protection.						
Q2	650.0	647.2	39	37	647.9	2.1
Q10	650.0	647.2	133	129	648.8	1.2
Q25	650.0	647.2	231	205	649.9	0.1
Q50	650.0	647.2	337	330	650.6	-0.6
Q100	650.0	647.2	472	469	650.9	-0.9
¼ PMF	650.0	647.2	692	690	651.3	-1.3
½ PMF	650.0	647.2	2116	2114	652.5	-2.5
Full PMF	650.0	647.2	5199	5196	654.0	-4.0

The new spillway components of Alternative B are smaller than Alternative A (though still larger than existing), and that is reflected in the results. This alternative passes the 25-year event without overtopping (compared to the 10-year under existing conditions and the 100-year under the previous Alternative). However, the overtopping protection on the downstream embankment means that the dam could safely pass the 100-year and even the ¼ PMF.

The major benefits of this alternative is that the annual risk of dam overtopping is reduced from about 10% to about 4%, and the armoring on the downstream side means that the dam is stable when overtopped for even for very significant storm events including the ¼ PMF. If the State reclassifies the dam to a Significant Hazard structure, this alternative would meet the hydraulic capacity requirement. Another benefit is that the spillway components are relatively inexpensive and easy to construct.

A significant drawback is that the potential for overtopping, while much reduced, is still relatively high. With flows above the 25-year (4% annual probability) event causing overtopping, there's a 33% chance the dam will overtop at least once every ten years.

5.0 DISCUSSION AND RECOMMENDATIONS

- The dam is currently classified as a Low Hazard dam, and as such the applicable hydraulic design standard is safe passage of the 100-year storm with at least one foot of additional vertical freeboard between the computed water surface elevation and the top of the dam. Were the dam to be reclassified to Significant Hazard, the design storm would increase to the ¼ PMF.

- No detailed analysis has been conducted of potential downstream impacts following a catastrophic breach of the dam, but a screening level review of downstream development and experience with breach analyses for similar dams, it is likely that such an evaluation would show enough houses and road crossings at risk of damage that a reclassification to Significant Hazard would be warranted.

- The existing dam overtops during storms greater than the 10-year event. During the 100-year storm, the dam would overtop by 1.1 feet, falling well short of the current standard of a foot of vertical freeboard between the computed water surface and the top of dam.

- Erosion during overtopping of a dam is the single greatest cause of failure for earthen dams.

- The pond lacks the storage volume to provide any meaningful reduction in peak flows (inflow vs. outflow), and thus even removing the dam completely would have almost no perceptible impact on flows at downstream locations.

- A combination of a new larger spillway (8'x8' riser leading to a 6'x5' box culvert outlet pipe) plus raising the dam by 1.3' – the components of Alternative A – would allow the 100-year storm to pass with 1.5 feet of freeboard, thereby meeting current State requirements.

- Passing the ¼ PMF or larger storm events through a closed outlet system is not practical; excessively large components and significant raising of the dam would be necessary. Thus for safe passage of flows greater than the 100-year event, modestly upsizing the existing spillway and protecting the downstream slope so that it is stable when overtopped – Alternative B -- is a more practical approach.

- If the dam is to remain and is to be brought into compliance with current hydraulic capacity standards, we would recommend implementing the components of Alternative B.

Combination Pond Dam Photos. June 13, 2011

1. Looking upstream at the dam's downstream embankment including outlet of primary spillway and outlet of storm drain pipe.

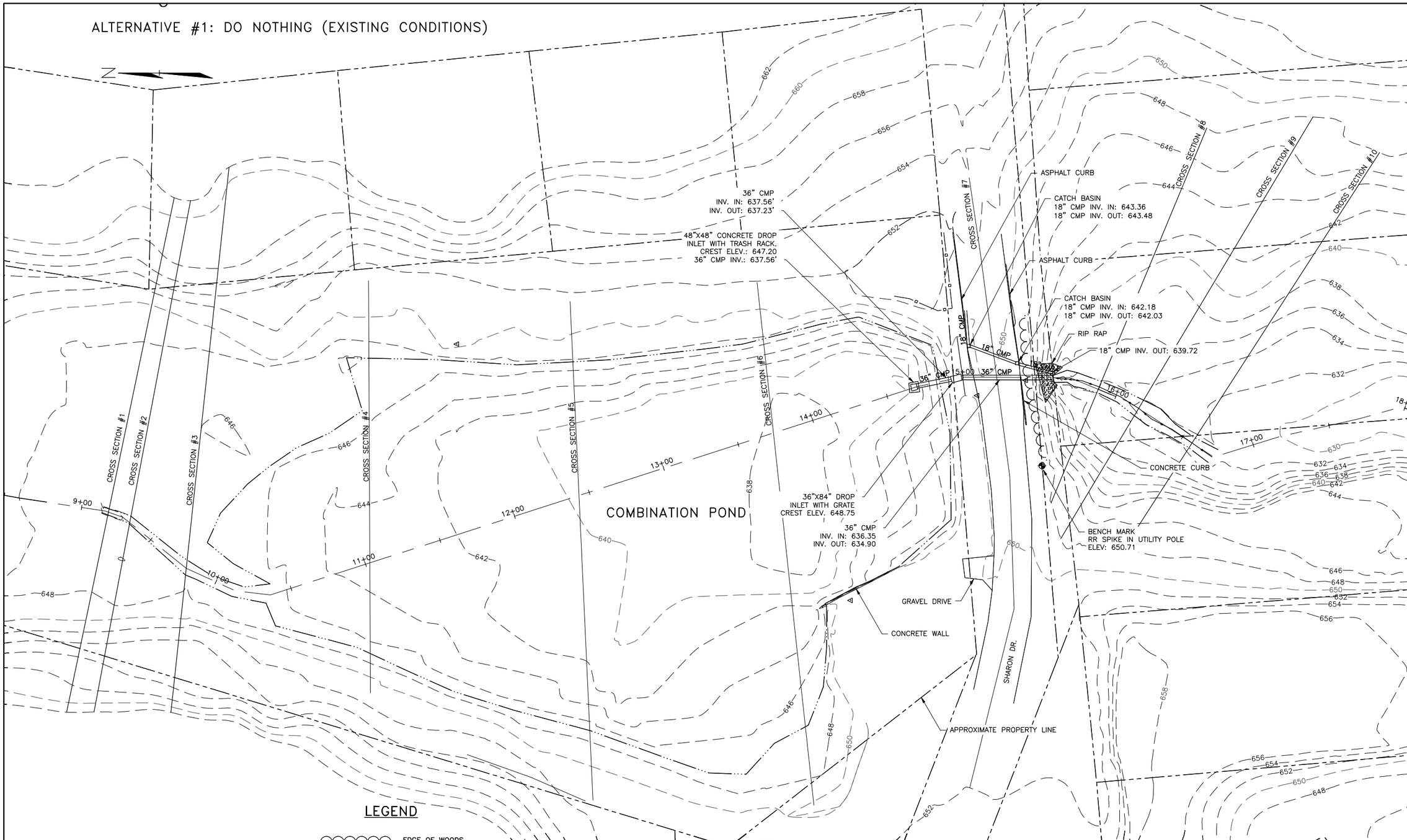
2. Looking in downstream direction across the pond with inlet stream/head of impouindment on photo right.

3. Looking at primary riser with woody debris in trash rack, from edge of water on right side of dam. Dam crest is out of photo on photo right.

4. On left abutment looking across the top of dam. Pond is just visible in photo right.

5. Looking up the barrel of the primary spillway.

ALTERNATIVE #1: DO NOTHING (EXISTING CONDITIONS)



LEGEND

- EDGE OF WOODS
- EDGE OF WATER
- WOODEN FENCE
- BENCH MARK
- UTILITY POLE
- SURVEY CONTROL
- CATCH BASIN

30 0 15 30 60 120

SCALE: 1"=30' (22x34) 1"=60' (11x17)

NOTES:

1. TOPO BASED ON FIELD SURVEY BY DUBOIS & KING ON JUNE 2011.
2. TOPO INFORMATION GENERALLY ABOVE ELEVATION 650± AND UPSTREAM OF STATION 9+00 AND DOWNSTREAM OF STATION 16+70 IS BASED ON LIDAR.
3. PARCEL BOUNDARIES ARE APPROXIMATE ONLY, AND ARE BASED APON TAX MAP INFORMATION FROM THE VGIS DATA WEBSITE.

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PROFESSIONAL SEAL

NOT FOR CONSTRUCTION PRELIMINARY PLANS

NO.	DATE	DESCRIPTION	BY	CK'D
–	00-00-2011	INSERT TEXT	XXX	XXX

CITY OF RUTLAND
RUTLAND, VERMONT

COMBINATION POND

SHEET TITLE

ALTERNATIVE #1
DO NOTHING
(EXISTING CONDITIONS)

DRAWN BY	DATE
ZDC	FEB. 2012
CHECKED BY	D&K PROJECT #
MTM	121024 L1
PROJ. ENG.	D&K ARCHIVE #
MTM	XXXXXX

SHEET NUMBER

EX1

I:\121024_CombePond\dwg\V121024 NU01.dwg 2/24/2012 3:03 PM

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Vermont
Location	near 49 Town Line Rd, Mendon, VT 05701, USA
Longitude	72.933 degrees West
Latitude	43.618 degrees North
Elevation	912 feet
Date/Time	Tue, 25 Oct 2011 13:34:29 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.50	0.65	0.81	1.01	**1yr**	0.70	0.94	1.16	1.42	1.73	2.11	2.48	**1yr**	1.87	2.39	2.80	3.38	3.90	**1yr**
2yr	0.31	0.48	0.59	0.78	0.99	1.22	**2yr**	0.85	1.11	1.40	1.71	2.07	2.49	2.85	**2yr**	2.20	2.74	3.20	3.83	4.37	**2yr**
5yr	0.37	0.57	0.72	0.97	1.23	1.54	**5yr**	1.07	1.39	1.77	2.14	2.57	3.06	3.48	**5yr**	2.71	3.34	3.86	4.56	5.20	**5yr**
10yr	0.42	0.66	0.83	1.13	1.47	1.84	**10yr**	1.26	1.65	2.11	2.55	3.04	3.58	4.04	**10yr**	3.17	3.88	4.44	5.21	5.93	**10yr**
25yr	0.50	0.79	1.01	1.39	1.84	2.32	**25yr**	1.59	2.07	2.66	3.20	3.79	4.41	4.93	**25yr**	3.91	4.74	5.36	6.23	7.06	**25yr**
50yr	0.57	0.91	1.17	1.63	2.19	2.78	**50yr**	1.89	2.46	3.18	3.81	4.47	5.17	5.73	**50yr**	4.57	5.51	6.18	7.12	8.06	**50yr**
100yr	0.64	1.05	1.35	1.91	2.61	3.32	**100yr**	2.25	2.92	3.80	4.53	5.28	6.05	6.67	**100yr**	5.36	6.41	7.13	8.15	9.20	**100yr**
200yr	0.75	1.22	1.58	2.25	3.10	3.96	**200yr**	2.68	3.46	4.53	5.38	6.24	7.10	7.76	**200yr**	6.28	7.46	8.23	9.34	10.51	**200yr**
500yr	0.90	1.48	1.93	2.80	3.92	5.00	**500yr**	3.38	4.35	5.72	6.76	7.77	8.75	9.48	**500yr**	7.75	9.12	9.96	11.18	12.54	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.21	0.32	0.40	0.53	0.65	0.76	**1yr**	0.56	0.74	0.83	1.23	1.55	1.66	2.31	**1yr**	1.47	2.22	2.61	2.79	3.70	**1yr**
2yr	0.30	0.46	0.57	0.77	0.95	1.09	**2yr**	0.82	1.07	1.25	1.61	2.08	2.43	2.77	**2yr**	2.15	2.67	3.13	3.75	4.29	**2yr**
5yr	0.33	0.51	0.63	0.87	1.10	1.28	**5yr**	0.95	1.25	1.47	1.85	2.34	2.88	3.24	**5yr**	2.55	3.12	3.65	4.32	4.95	**5yr**
10yr	0.35	0.54	0.67	0.94	1.22	1.43	**10yr**	1.05	1.40	1.66	2.04	2.53	3.27	3.65	**10yr**	2.89	3.51	4.09	4.80	5.51	**10yr**
25yr	0.39	0.59	0.73	1.05	1.38	1.67	**25yr**	1.19	1.63	1.96	2.33	2.78	3.85	4.27	**25yr**	3.40	4.10	4.76	5.52	6.34	**25yr**
50yr	0.41	0.62	0.77	1.11	1.49	1.87	**50yr**	1.29	1.83	2.20	2.58	2.99	4.37	4.81	**50yr**	3.87	4.62	5.35	6.13	7.07	**50yr**
100yr	0.43	0.65	0.82	1.18	1.62	2.08	**100yr**	1.40	2.04	2.48	2.85	3.19	4.95	5.42	**100yr**	4.38	5.21	6.00	6.80	7.87	**100yr**
200yr	0.45	0.67	0.85	1.24	1.72	2.34	**200yr**	1.49	2.29	2.80	3.15	3.40	5.62	6.12	**200yr**	4.97	5.89	6.73	7.56	8.76	**200yr**
500yr	0.46	0.69	0.89	1.29	1.84	2.70	**500yr**	1.59	2.64	3.31	3.58	3.65	6.65	7.21	**500yr**	5.89	6.93	7.85	8.65	10.10	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.30	0.46	0.56	0.76	0.94	1.09	**1yr**	0.81	1.06	1.24	1.56	1.92	2.25	2.64	**1yr**	1.99	2.54	2.98	3.59	4.10	**1yr**
2yr	0.33	0.52	0.63	0.86	1.06	1.19	**2yr**	0.91	1.17	1.36	1.76	2.27	2.56	2.94	**2yr**	2.26	2.83	3.28	3.93	4.48	**2yr**
5yr	0.41	0.63	0.79	1.08	1.37	1.57	**5yr**	1.19	1.53	1.75	2.24	2.80	3.24	3.73	**5yr**	2.86	3.59	4.07	4.78	5.47	**5yr**
10yr	0.50	0.76	0.94	1.32	1.70	1.93	**10yr**	1.47	1.89	2.13	2.70	3.33	3.88	4.46	**10yr**	3.44	4.29	4.80	5.56	6.36	**10yr**
25yr	0.64	0.98	1.22	1.74	2.28	2.56	**25yr**	1.97	2.50	2.78	3.48	4.20	4.93	5.66	**25yr**	4.37	5.45	5.99	6.81	7.79	**25yr**
50yr	0.78	1.19	1.48	2.12	2.86	3.18	**50yr**	2.47	3.10	3.41	4.23	5.02	5.92	6.79	**50yr**	5.24	6.53	7.08	7.95	9.08	**50yr**
100yr	0.96	1.45	1.82	2.62	3.60	3.94	**100yr**	3.10	3.85	4.17	5.13	5.99	7.10	8.12	**100yr**	6.28	7.81	8.38	9.28	10.61	**100yr**
200yr	1.18	1.77	2.24	3.25	4.53	4.90	**200yr**	3.91	4.79	5.10	6.23	7.20	8.52	9.72	**200yr**	7.54	9.35	9.95	10.86	12.40	**200yr**
500yr	1.56	2.32	2.99	4.34	6.17	6.53	**500yr**	5.33	6.39	6.66	8.07	9.16	10.86	12.34	**500yr**	9.61	11.86	12.48	13.39	15.24	**500yr**

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United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Rutland County, Vermont

Combo Pond

October 25, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Combo Pond)

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

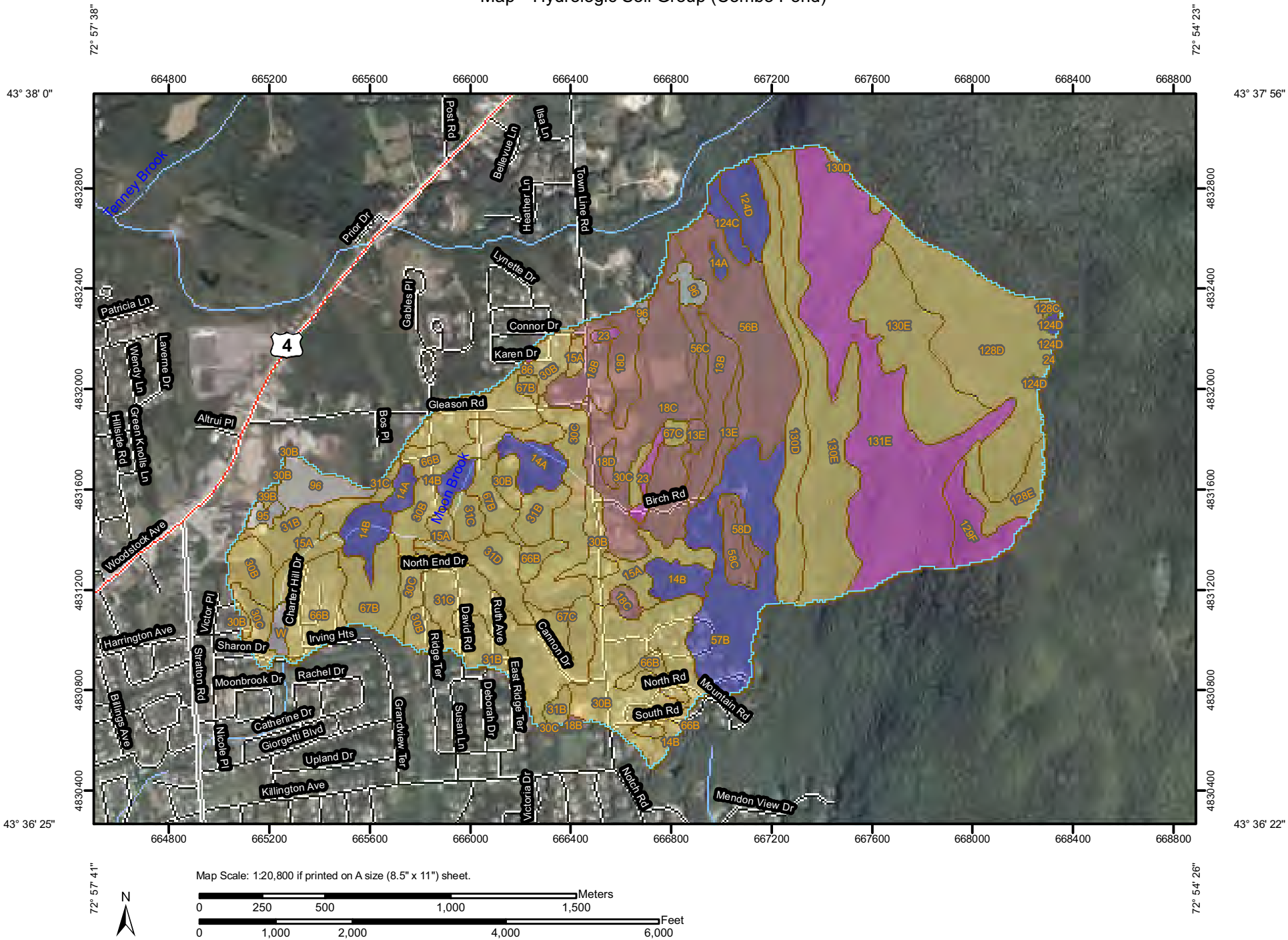
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group (Combo Pond)



Map Scale: 1:20,800 if printed on A size (8.5" x 11") sheet.

N

Meters: 0, 250, 500, 1,000, 1,500

Feet: 0, 1,000, 2,000, 4,000, 6,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:20,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rutland County, Vermont
Survey Area Data: Version 15, Jan 19, 2010

Date(s) aerial images were photographed: 8/20/2003; 8/21/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group (Combo Pond)

Hydrologic Soil Group— Summary by Map Unit — Rutland County, Vermont (VT021)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
13B	Hinckley gravelly loamy fine sand, 0 to 8 percent slopes	A	15.9	1.5%
13E	Hinckley gravelly loamy fine sand, 25 to 40 percent slopes	A	7.9	0.7%
14A	Sudbury fine sandy loam, 0 to 3 percent slopes	B	15.5	1.5%
14B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	21.6	2.1%
15A	Walpole fine sandy loam, 0 to 5 percent slopes	C	26.0	2.5%
18B	Windsor loamy sand, 3 to 8 percent slopes	A	14.0	1.3%
18C	Windsor loamy sand, 8 to 15 percent slopes	A	69.6	6.6%
18D	Windsor loamy sand, 15 to 25 percent slopes	A	13.5	1.3%
23	Adrian muck	D	4.8	0.5%
24	Pinnebog muck	D	0.1	0.0%
30B	Paxton fine sandy loam, 2 to 8 percent slopes	C	112.1	10.7%
30C	Paxton fine sandy loam, 8 to 15 percent slopes	C	42.4	4.0%
31B	Paxton fine sandy loam, 2 to 8 percent slopes, very stony	C	35.4	3.4%
31C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	C	46.9	4.5%
31D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	C	14.2	1.4%
39B	Galway-Nellis-Farmington complex, 3 to 8 percent slopes	C	1.0	0.1%
56B	Colton-Duxbury complex, 2 to 8 percent slopes, very stony	A	48.9	4.7%
56C	Colton-Duxbury complex, 8 to 15 percent slopes, very stony	A	5.1	0.5%
57B	Duxbury-Colton complex, 2 to 8 percent slopes	B	55.9	5.3%
58C	Colton-Duxbury complex, 8 to 15 percent slopes	A	6.5	0.6%
58D	Colton-Duxbury complex, 15 to 25 percent slopes	A	3.5	0.3%
66B	Georgia and Amenia soils, 3 to 8 percent slopes	C	45.2	4.3%
67B	Georgia and Amenia soils, 3 to 8 percent slopes, very stony	C	27.5	2.6%
67C	Georgia and Amenia soils, 8 to 15 percent slopes, very stony	C	6.7	0.6%
86	Linwood muck	D	0.4	0.0%

Hydrologic Soil Group— Summary by Map Unit — Rutland County, Vermont (VT021)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
95	Udorthents loamy		2.8	0.3%
96	Udipsamments, nearly level		16.8	1.6%
124C	Sunapee fine sandy loam, 8 to 15 percent slopes, very stony	B	5.7	0.5%
124D	Sunapee fine sandy loam, 15 to 35 percent slopes, very stony	B	13.4	1.3%
128C	Rawsonville-Houghtonville complex, 8 to 15 percent slopes, rocky	C	1.1	0.1%
128D	Rawsonville-Houghtonville complex, 15 to 35 percent slopes, rocky	C	77.0	7.3%
128E	Rawsonville-Houghtonville complex, 35 to 60 percent slopes, rocky	C	13.6	1.3%
129F	Killington-Rawsonville complex, 35 to 70 percent slopes, very rocky	D	14.8	1.4%
130D	Tunbridge-Berkshire complex, 15 to 35 percent slopes, rocky	C	31.9	3.0%
130E	Tunbridge-Berkshire complex, 35 to 60 percent slopes, rocky	C	105.0	10.0%
131E	Lyman-Tunbridge-Rock outcrop complex, 35 to 60 percent slopes, very stony	D	124.9	11.9%
W	Water		2.9	0.3%
Totals for Area of Interest			**1,050.7**	**100.0%**

Rating Options—Hydrologic Soil Group (Combo Pond)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

AOI Inventory

This folder contains a collection of tabular reports that present a variety of soil information. Included are various map unit description reports, special soil interpretation reports, and data summary reports.

Component Legend (Combo Pond)

This report presents general information about the map units and map unit components in the selected area. It shows map unit symbols and names and the components in each map unit. It also shows the percent of the components in the map units, the kind of component, and the slope range of each component.

Report—Component Legend (Combo Pond)

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
13B—Hinckley gravelly loamy fine sand, 0 to 8 percent slopes						
	80	Hinckley	Series	0	5	8
	7	Paxton	Series	0	5	8
	7	Sudbury	Series	0	5	8
	6	Windsor	Series	0	5	8
13E—Hinckley gravelly loamy fine sand, 25 to 40 percent slopes						
	80	Hinckley	Series	25	33	40
	7	Paxton	Series	25	33	40
	7	Sudbury	Series	8	11	15
	6	Windsor	Series	25	33	40

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
14A—Sudbury fine sandy loam, 0 to 3 percent slopes						
	85	Sudbury	Series	0	1	3
	8	Hinckley	Series	0	1	3
	7	Walpole	Series	0	1	3
14B—Sudbury fine sandy loam, 3 to 8 percent slopes						
	85	Sudbury	Series	3	5	8
	8	Hinckley	Series	3	5	8
	7	Walpole	Series	3	5	8
15A—Walpole fine sandy loam, 0 to 5 percent slopes						
	85	Walpole	Series	0	5	5
	4	Adrian, undrained	Series	0	1	1
	4	Raynham	Series	0	5	5
	4	Scarboro, undrained	Series	0	1	3
	3	Sudbury	Series	0	5	5
18B—Windsor loamy sand, 3 to 8 percent slopes						
	80	Windsor	Series	3	5	8
	7	Deerfield	Series	3	5	8
	7	Ninigret	Series	3	5	8
	6	Hinckley	Series	3	5	8
18C—Windsor loamy sand, 8 to 15 percent slopes						
	80	Windsor	Series	8	11	15
	7	Deerfield	Series	8	11	15
	7	Ninigret	Series	8	11	15
	6	Hinckley	Series	8	11	15
18D—Windsor loamy sand, 15 to 25 percent slopes						
	85	Windsor	Series	15	20	25
	5	Deerfield	Series	8	11	15
	5	Hinckley	Series	15	20	25
	5	Ninigret	Series	8	11	15
23—Adrian muck						
	85	Adrian, undrained	Series	0	1	2
	5	Fredon	Series	0	1	2
	5	Pinnebog, undrained	Series	0	1	2
	5	Walpole	Series	0	1	2

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
24—Pinnebog muck						
	85	Pinnebog, undrained	Series	0	1	2
	8	Adrian, undrained	Series	0	1	2
	7	Linwood, undrained	Series	0	1	2
30B—Paxton fine sandy loam, 2 to 8 percent slopes						
	80	Paxton	Series	2	5	8
	5	Amenia	Series	2	5	8
	5	Dutchess	Series	2	5	8
	5	Georgia	Series	2	5	8
	5	Hinckley	Series	2	5	8
30C—Paxton fine sandy loam, 8 to 15 percent slopes						
	80	Paxton	Series	8	11	15
	5	Amenia	Series	8	11	15
	5	Dutchess	Series	8	11	15
	5	Georgia	Series	8	11	15
	5	Hinckley	Series	8	11	15
31B—Paxton fine sandy loam, 2 to 8 percent slopes, very stony						
	80	Paxton	Series	2	5	8
	5	Amenia	Series	2	5	8
	5	Dutchess	Series	2	5	8
	5	Georgia	Series	2	5	8
	5	Hinckley	Series	2	5	8
31C—Paxton fine sandy loam, 8 to 15 percent slopes, very stony						
	80	Paxton	Series	8	11	15
	5	Amenia	Series	8	11	15
	5	Dutchess	Series	8	11	15
	5	Georgia	Series	8	11	15
	5	Hinckley	Series	8	11	15
31D—Paxton fine sandy loam, 15 to 25 percent slopes, very stony						
	80	Paxton	Series	15	20	25
	5	Amenia	Series	15	20	25
	5	Dutchess	Series	15	20	25
	5	Georgia	Series	15	20	25
	5	Hinckley	Series	15	20	25

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
39B—Galway-Nellis-Farmington complex, 3 to 8 percent slopes						
	40	Galway	Series	3	5	8
	40	Nellis	Series	3	5	8
	10	Farmington	Series	3	5	8
	4	Amenia	Series	3	5	8
	3	Belgrade	Series	3	5	8
	3	Palatine	Series	3	5	8
56B—Colton-Duxbury complex, 2 to 8 percent slopes, very stony						
	50	Colton	Series	2	5	8
	35	Duxbury	Series	2	5	8
	5	Adams	Series	2	5	8
	5	Berkshire	Series	2	5	8
	5	Sheepscot	Series	2	5	8
56C—Colton-Duxbury complex, 8 to 15 percent slopes, very stony						
	50	Colton	Series	8	11	15
	35	Duxbury	Series	8	11	15
	5	Adams	Series	8	11	15
	5	Berkshire	Series	8	11	15
	5	Sheepscot	Series	8	11	15
57B—Duxbury-Colton complex, 2 to 8 percent slopes						
	50	Duxbury	Series	2	5	8
	35	Colton	Series	2	5	8
	5	Adams	Series	2	5	8
	5	Berkshire	Series	2	5	8
	5	Sheepscot	Series	2	5	8
58C—Colton-Duxbury complex, 8 to 15 percent slopes						
	50	Colton	Series	8	11	15
	35	Duxbury	Series	8	11	15
	5	Adams	Series	8	11	15
	5	Berkshire	Series	8	11	15
	5	Sheepscot	Series	8	11	15

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
58D—Colton-Duxbury complex, 15 to 25 percent slopes						
	50	Colton	Series	15	20	25
	35	Duxbury	Series	15	20	25
	5	Adams	Series	15	20	25
	5	Berkshire	Series	15	20	25
	5	Sheepscot	Series	8	11	15
66B—Georgia and Amenia soils, 3 to 8 percent slopes						
	40	Georgia	Series	3	5	8
	40	Amenia	Series	3	5	8
	7	Lyons	Series	0	5	5
	7	Massena	Series	3	5	8
	6	Paxton	Series	3	5	8
67B—Georgia and Amenia soils, 3 to 8 percent slopes, very stony						
	40	Georgia	Series	3	5	8
	40	Amenia	Series	3	5	8
	7	Lyons	Series	0	5	5
	7	Massena	Series	3	5	8
	6	Paxton	Series	3	5	8
67C—Georgia and Amenia soils, 8 to 15 percent slopes, very stony						
	40	Georgia	Series	8	11	15
	40	Amenia	Series	8	11	15
	7	Lyons	Series	0	5	5
	7	Massena	Series	8	11	15
	6	Paxton	Series	8	11	15
86—Linwood muck						
	90	Linwood, undrained	Series	0	1	2
	10	Pinnebog, undrained	Series	0	1	2
95—Udorthents loamy						
	100	Udorthents	Taxon above family			
96—Udipsamments, nearly level						
	100	Udipsamments	Taxon above family			

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
124C—Sunapee fine sandy loam, 8 to 15 percent slopes, very stony						
	80	Sunapee	Series	8	11	15
	7	Berkshire	Series	8	11	15
	7	Lyme	Series	8	11	15
	6	Peru	Series	8	11	15
124D—Sunapee fine sandy loam, 15 to 35 percent slopes, very stony						
	80	Sunapee	Series	15	25	35
	7	Berkshire	Series	15	25	35
	7	Lyme	Series	8	11	15
	6	Peru	Series	15	25	35
128C—Rawsonville-Houghtonville complex, 8 to 15 percent slopes, rocky						
	55	Rawsonville	Series	8	11	15
	30	Houghtonville	Series	8	11	15
	5	Berkshire	Series	8	11	15
	5	Killington	Series	8	11	15
	5	Tunbridge	Series	8	11	15
128D—Rawsonville-Houghtonville complex, 15 to 35 percent slopes, rocky						
	55	Rawsonville	Series	15	25	35
	30	Houghtonville	Series	15	25	35
	5	Berkshire	Series	15	25	35
	5	Killington	Series	15	25	35
	5	Tunbridge	Series	15	25	35
128E—Rawsonville-Houghtonville complex, 35 to 60 percent slopes, rocky						
	50	Rawsonville	Series	35	48	60
	35	Houghtonville	Series	35	48	60
	5	Berkshire	Series	35	48	60
	5	Killington	Series	35	48	60
	5	Tunbridge	Series	35	48	60

Component Legend– Rutland County, Vermont						
Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. slope		
				Low	RV	High
129F—Killington-Rawsonville complex, 35 to 70 percent slopes, very rocky						
	50	Killington	Series	35	53	70
	30	Rawsonville	Series	35	53	70
	5	Houghtonville	Series	35	53	70
	5	Lyman	Series	35	53	70
	5	Rock outcrop	Miscellaneous area			
	5	Tunbridge	Series	35	53	70
130D—Tunbridge-Berkshire complex, 15 to 35 percent slopes, rocky						
	55	Tunbridge	Series	15	25	35
	30	Berkshire	Series	15	25	35
	4	Lyman	Series	15	25	35
	4	Marlow	Series	15	25	35
	4	Monadnock	Series	15	25	35
	3	Sunapee	Series	15	25	35
130E—Tunbridge-Berkshire complex, 35 to 60 percent slopes, rocky						
	55	Tunbridge	Series	35	48	60
	30	Berkshire	Series	35	48	60
	4	Lyman	Series	35	48	60
	4	Marlow	Series	35	48	60
	4	Monadnock	Series	35	48	60
	3	Sunapee	Series	35	48	60
131E—Lyman-Tunbridge-Rock outcrop complex, 35 to 60 percent slopes, very stony						
	40	Lyman	Series	35	48	60
	35	Tunbridge	Series	35	48	60
	10	Rock outcrop	Miscellaneous area			
	8	Berkshire	Series	35	48	60
	7	Macomber	Series	35	48	60
W—Water						
	100	Water	Miscellaneous area			

Combo Pond Soils

13B	Hinckley	A	15.9	1.50%
13E	Hinckley	A	7.9	0.70%
14A	Sudbury	B	15.5	1.50%
14B	Sudbury	B	21.6	2.10%
15A	Walpole	C	26	2.50%
18B	Windsor	A	14	1.30%
18C	Windsor	A	69.6	6.60%
18D	Windsor	A	13.5	1.30%
23	Adrian	D	4.8	0.50%
24	Pinnebog	D	0.1	0.00%
30B	Paxton	C	112.1	10.70%
30C	Paxton	C	42.4	4.00%
31B	Paxton	C	35.4	3.40%
31C	Paxton	C	46.9	4.50%
31D	Paxton	C	14.2	1.40%
39B	Galway-	C	1	0.10%
56B	Colton-	A	48.9	4.70%
56C	Colton-	A	5.1	0.50%
57B	Duxbury-	B	55.9	5.30%
58C	Colton-	A	6.5	0.60%
58D	Colton-	A	3.5	0.30%
66B	Georgia	C	45.2	4.30%
67B	Georgia	C	27.5	2.60%
67C	Georgia	C	6.7	0.60%
86	Linwood	D	0.4	0.00%
95	Udorthent		2.8	0.30%
96	Udipsamm		16.8	1.60%
124C	Sunapee	B	5.7	0.50%
124D	Sunapee	B	13.4	1.30%
128C	Rawsonvill	C	1.1	0.10%
128D	Rawsonvill	C	77	7.30%
128E	Rawsonvill	C	13.6	1.30%
129F	Killington-	D	14.8	1.40%
130D	Tunbridge-	C	31.9	3.00%
130E	Tunbridge-	C	105	10.00%
131E	Lyman-	D	124.9	11.90%
W	Water	W	2.9	0.30%
Totals for Area of Interest			**1,050.70**	**100.00%**

Soil Class	Acres	% of Total	"Other" distrbuted by weight (ac)	Resulting Total with "Other" added in (ac)	%
A	184.9	17.9%	3.6	188	18%
B	112.1	10.9%	2.2	114	11%
C	586	56.8%	11.3	597	57%
D	145	14.1%	2.8	148	14%
W	2.9	0.3%	0.1	3	0.3%
Total	1030.9	100%	19.8	1051	100%
Other	19.80				
Grand Total	1050.7				

Summary for Subcatchment 3S: Drainage Area MTM EDITS

Runoff = 38.64 cfs @ 15.25 hrs, Volume= 23.339 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.49"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 0.27" for 2-yr event
Inflow = 38.64 cfs @ 15.25 hrs, Volume= 23.339 af
Outflow = 36.79 cfs @ 15.83 hrs, Volume= 23.339 af, Atten= 5%, Lag= 34.9 min
Primary = 36.79 cfs @ 15.83 hrs, Volume= 23.339 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 647.99' @ 15.83 hrs Surf.Area= 121,796 sf Storage= 550,101 cf (89,791 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 402.0 min calculated for 12.759 af (55% of inflow)

Center-of-Mass det. time= 50.1 min (1,171.6 - 1,121.5)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0333 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**48.0" x 94.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=36.77 cfs @ 15.83 hrs HW=647.99' (Free Discharge)
└─**1=Culvert** (Passes 36.77 cfs of 94.35 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 36.77 cfs @ 2.91 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=647.20' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Controls 0.00 cfs)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

Runoff = 132.60 cfs @ 14.95 hrs, Volume= 65.311 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=3.58"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 0.75" for 10-yr event
Inflow = 132.60 cfs @ 14.95 hrs, Volume= 65.311 af
Outflow = 101.89 cfs @ 16.21 hrs, Volume= 65.311 af, Atten= 23%, Lag= 75.8 min
Primary = 101.89 cfs @ 16.21 hrs, Volume= 65.311 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 649.67' @ 16.21 hrs Surf.Area= 177,213 sf Storage= 800,752 cf (340,442 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 175.0 min calculated for 54.744 af (84% of inflow)

Center-of-Mass det. time= 44.5 min (1,120.6 - 1,076.1)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0333 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**48.0" x 94.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=101.88 cfs @ 16.21 hrs HW=649.67' (Free Discharge)
└─**1=Culvert** (Barrel Controls 101.88 cfs @ 14.41 fps)
  ├─**2=Orifice/Grate** (Passes < 121.02 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 34.01 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=647.20' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Controls 0.00 cfs)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

Runoff = 231.39 cfs @ 14.76 hrs, Volume= 106.045 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.41"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 1.21" for 25-yr event
Inflow = 231.39 cfs @ 14.76 hrs, Volume= 106.045 af
Outflow = 227.84 cfs @ 15.11 hrs, Volume= 106.045 af, Atten= 2%, Lag= 21.0 min
Primary = 104.73 cfs @ 15.11 hrs, Volume= 85.539 af
Secondary = 123.11 cfs @ 15.11 hrs, Volume= 20.506 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 650.33' @ 15.11 hrs Surf.Area= 202,699 sf Storage= 926,833 cf (466,523 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 126.1 min calculated for 95.478 af (90% of inflow)

Center-of-Mass det. time= 42.9 min (1,101.9 - 1,059.0)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0333 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**48.0" x 94.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=104.73 cfs @ 15.11 hrs HW=650.33' (Free Discharge)
└─**1=Culvert** (Barrel Controls 104.73 cfs @ 14.82 fps)
  ├─**2=Orifice/Grate** (Passes < 136.39 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 77.17 cfs potential flow)

Secondary OutFlow Max=122.48 cfs @ 15.11 hrs HW=650.33' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 122.48 cfs @ 1.88 fps)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

Runoff = 336.88 cfs @ 14.74 hrs, Volume= 148.152 af, Depth= 1.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=5.17"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 1.69" for 50-yr event
Inflow = 336.88 cfs @ 14.74 hrs, Volume= 148.152 af
Outflow = 334.67 cfs @ 14.90 hrs, Volume= 148.152 af, Atten= 1%, Lag= 9.4 min
Primary = 105.73 cfs @ 14.90 hrs, Volume= 98.579 af
Secondary = 228.94 cfs @ 14.90 hrs, Volume= 49.573 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 650.57' @ 14.90 hrs Surf.Area= 213,028 sf Storage= 976,410 cf (516,100 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 98.1 min calculated for 137.442 af (93% of inflow)

Center-of-Mass det. time= 37.9 min (1,086.2 - 1,048.3)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0333 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**48.0" x 94.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=105.73 cfs @ 14.90 hrs HW=650.57' (Free Discharge)
└─**1=Culvert** (Barrel Controls 105.73 cfs @ 14.96 fps)
  ├─**2=Orifice/Grate** (Passes < 141.49 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 95.24 cfs potential flow)

Secondary OutFlow Max=227.06 cfs @ 14.90 hrs HW=650.57' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 227.06 cfs @ 2.19 fps)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

Runoff = 471.73 cfs @ 14.73 hrs, Volume= 201.306 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100.yr Rainfall=6.05"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 2.30" for 100.yr event
Inflow = 471.73 cfs @ 14.73 hrs, Volume= 201.306 af
Outflow = 469.52 cfs @ 14.82 hrs, Volume= 201.306 af, Atten= 0%, Lag= 5.5 min
Primary = 106.70 cfs @ 14.82 hrs, Volume= 110.436 af
Secondary = 362.82 cfs @ 14.82 hrs, Volume= 90.870 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 650.81' @ 14.82 hrs Surf.Area= 223,132 sf Storage= 1,027,294 cf (566,984 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 78.6 min calculated for 190.540 af (95% of inflow)

Center-of-Mass det. time= 33.4 min (1,072.3 - 1,039.0)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0333 '/' Cc= 0.900 n= 0.025 Corrugated metal
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**48.0" x 94.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=106.70 cfs @ 14.82 hrs HW=650.81' (Free Discharge)
└─**1=Culvert** (Barrel Controls 106.70 cfs @ 15.09 fps)
  ├─**2=Orifice/Grate** (Passes < 146.30 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 108.17 cfs potential flow)

Secondary OutFlow Max=362.37 cfs @ 14.82 hrs HW=650.81' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 362.37 cfs @ 2.45 fps)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

1. Shallow conc and channel lengths increased 25%, and slopes adjusted correspondingly.
2. CNs for C soils shifted 1/2 way to B values.

Runoff = 692.29 cfs @ 15.18 hrs, Volume= 262.794 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
D&K M-VT PMP 24-hr 1/4 PMP Rainfall=7.00"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond Existing

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 3.00" for 1/4 PMP event
Inflow = 692.29 cfs @ 15.18 hrs, Volume= 262.794 af
Outflow = 690.36 cfs @ 15.23 hrs, Volume= 262.794 af, Atten= 0%, Lag= 2.8 min
Primary = 107.90 cfs @ 15.23 hrs, Volume= 108.504 af
Secondary = 582.46 cfs @ 15.23 hrs, Volume= 154.290 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 651.10' @ 15.23 hrs Surf.Area= 235,795 sf Storage= 1,094,387 cf (634,077 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 60.9 min calculated for 252.227 af (96% of inflow)
Center-of-Mass det. time= 27.2 min (1,050.3 - 1,023.1)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0332 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**36.0" x 84.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=107.90 cfs @ 15.23 hrs HW=651.10' (Free Discharge)
└─**1=Culvert** (Barrel Controls 107.90 cfs @ 15.26 fps)
  ├─**2=Orifice/Grate** (Passes < 152.11 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 77.48 cfs potential flow)

Secondary OutFlow Max=581.56 cfs @ 15.23 hrs HW=651.10' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 581.56 cfs @ 2.73 fps)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

1. Shallow conc and channel lengths increased 25%, and slopes adjusted correspondingly.
2. CNs for C soils shifted 1/2 way to B values.

Runoff = 2,116.10 cfs @ 14.97 hrs, Volume= 784.549 af, Depth= 8.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
D&K M-VT PMP 24-hr 1/2 PMP Rainfall=14.00"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond Existing

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 8.96" for 1/2 PMP event
Inflow = 2,116.10 cfs @ 14.97 hrs, Volume= 784.549 af
Outflow = 2,114.05 cfs @ 15.04 hrs, Volume= 784.549 af, Atten= 0%, Lag= 4.0 min
Primary = 112.55 cfs @ 15.04 hrs, Volume= 145.036 af
Secondary = 2,001.50 cfs @ 15.04 hrs, Volume= 639.513 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 652.26' @ 15.04 hrs Surf.Area= 285,649 sf Storage= 1,397,122 cf (936,812 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 28.8 min calculated for 773.982 af (99% of inflow)
Center-of-Mass det. time= 15.3 min (1,014.2 - 998.8)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0332 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**36.0" x 84.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=112.55 cfs @ 15.04 hrs HW=652.26' (Free Discharge)
└─**1=Culvert** (Barrel Controls 112.55 cfs @ 15.92 fps)
  ├─**2=Orifice/Grate** (Passes < 173.28 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 94.71 cfs potential flow)

Secondary OutFlow Max=2,000.47 cfs @ 15.04 hrs HW=652.26' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 2,000.47 cfs @ 3.67 fps)

Summary for Subcatchment 3S: Drainage Area MTM EDITS

1. Shallow conc and channel lengths increased 25%, and slopes adjusted correspondingly.
2. CNs for C soils shifted 1/2 way to B values.

Runoff = 5,198.99 cfs @ 14.93 hrs, Volume= 1,945.858 af, Depth=22.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
D&K M-VT PMP 24-hr Full PMP Rainfall=28.00"

	Area (ac)	CN	Description
	3.000	98	Water Surface, HSG C
*	377.100	75	1/2 acre lots, 25% imp, HSG C
	21.600	70	1/2 acre lots, 25% imp, HSG B
	15.500	70	1/2 acre lots, 25% imp, HSG B
	0.400	85	1/2 acre lots, 25% imp, HSG D
	0.100	85	1/2 acre lots, 25% imp, HSG D
	4.800	85	1/2 acre lots, 25% imp, HSG D
	55.900	58	Woods/grass comb., Good, HSG B
	5.700	55	Woods, Good, HSG B
	13.400	55	Woods, Good, HSG B
	184.900	32	Woods/grass comb., Good, HSG A
*	228.600	63	Woods, Good, HSG C
	139.700	77	Woods, Good, HSG D
	1,050.700	64	Weighted Average
	942.825		89.73% Pervious Area
	107.875		10.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.7	200	0.0313	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.49"
24.4	924	0.0639	0.63		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
46.4	5,610	0.1866	2.01	12.69	**Channel Flow,** Area= 6.3 sf Perim= 9.4' r= 0.67' n= 0.244
77.8	10,428	0.0305	2.23	30.60	**Channel Flow,** Area= 13.7 sf Perim= 15.5' r= 0.88' n= 0.107
210.3	17,162	Total			

Summary for Pond 2P: ComboPond Existing

Inflow Area = 1,050.700 ac, 10.27% Impervious, Inflow Depth = 22.22" for Full PMP event
Inflow = 5,198.99 cfs @ 14.93 hrs, Volume= 1,945.858 af
Outflow = 5,196.15 cfs @ 14.95 hrs, Volume= 1,945.857 af, Atten= 0%, Lag= 1.2 min
Primary = 118.16 cfs @ 14.95 hrs, Volume= 182.360 af
Secondary = 5,077.99 cfs @ 14.95 hrs, Volume= 1,763.497 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 647.20' Surf.Area= 105,368 sf Storage= 460,310 cf
Peak Elev= 653.73' @ 14.95 hrs Surf.Area= 346,938 sf Storage= 1,861,335 cf (1,401,025 cf above start)
Flood Elev= 649.70' Surf.Area= 178,281 sf Storage= 806,486 cf (346,176 cf above start)

Plug-Flow detention time= 16.4 min calculated for 1,935.290 af (99% of inflow)
Center-of-Mass det. time= 9.4 min (988.5 - 979.2)

Volume	Invert	Avail.Storage	Storage Description
#1	638.00'	1,957,676 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

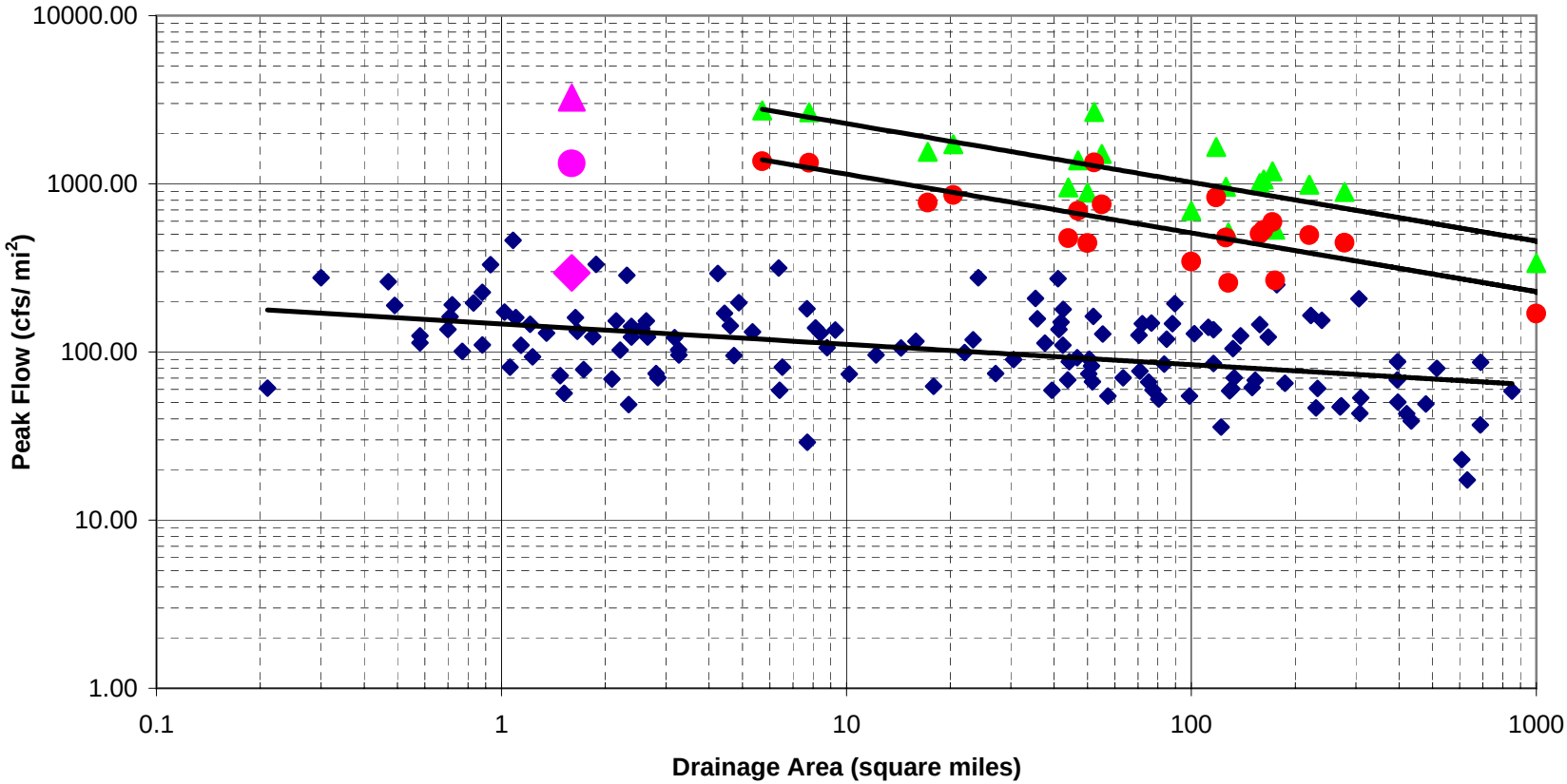
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
638.00	4,890	0	0
640.00	24,689	29,579	29,579
642.00	44,120	68,809	98,388
644.00	62,946	107,066	205,454
646.00	80,431	143,377	348,831
648.00	121,992	202,423	551,254
650.00	188,214	310,206	861,460
652.00	274,828	463,042	1,324,502
654.00	358,346	633,174	1,957,676

Device	Routing	Invert	Outlet Devices
#1	Primary	637.56'	**36.0" Round Culvert** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 637.56' / 634.90' S= 0.0332 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf
#2	Device 1	647.20'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	648.75'	**36.0" x 84.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#4	Secondary	649.70'	**BCWeir - Top of Dam, Cv= 2.10 (C= 2.63)** Head (feet) 0.00 0.10 0.30 1.30 2.30 3.30 4.30 Width (feet) 0.00 83.00 105.00 229.00 314.00 382.00 445.00

Primary OutFlow Max=118.16 cfs @ 14.95 hrs HW=653.73' (Free Discharge)
└─**1=Culvert** (Barrel Controls 118.16 cfs @ 16.72 fps)
  ├─**2=Orifice/Grate** (Passes < 196.82 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 112.79 cfs potential flow)

Secondary OutFlow Max=5,075.91 cfs @ 14.95 hrs HW=653.73' (Free Discharge)
└─**4=BCWeir - Top of Dam** (Weir Controls 5,075.91 cfs @ 4.60 fps)

Combination Pond Dam
Computed Peak Flows in the Northeast Vermont-Western New Hampshire-Northwestern Mass.- Eastern New York



- USGS Calculated 100-year Discharge at 138 USGS Stations (Flow-Frequency Characteristics of Vermont Streams:Water-Resources Investigations Report 02-4238)
- Probable Maximum Flood (PMF) for Corps of Engineers Facilities in the Northeast
- 1/2 PMF COE Facilities
- Combo Pond, Drainage Area = 1.6 square miles, Q100 = 472 cfs
- Combo Pond, 1/2 PMF = 2116 cfs
- Combo Pond, Full PMF = 5199 cfs

DuBois & King inc.