VILLAGE OF SOUTH RUSSELL
GEAUGA COUNTY, OHIO

MASTER STORM STUDY

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EXECUTIVE SUMMARY

A study was commissioned to identify watersheds within the Village of South Russell, perform hydrologic analysis of each watershed, identify deficient areas within the system, offer proposed solutions to the identified deficiencies and provide preliminary cost data for each of the proposed improvements. Thirteen facilities within the study area were found to be deficient. The following information presented in **Table 1** is a summary of the deficient areas along with alternative solutions and preliminary project costs. Projects are ranked in order of their relative importance.

TABLE 1
EXECUTIVE SUMMARY

	Location	Sub-Water-shed	Facility	Improvement	Project Cost
1	Chelsea Court (Alternative 1)	MC-18	48” Culvert and 48” driveway culverts	4’ x 8’ Box culverts	$440,500
1	Chelsea Court (Alternative 2)	MC-18	48” Culvert	Upstream detention	$684,500
2	Chillicothe Road	MC-1	43” x 68” Culvert	43” x 68” Culvert/ regrade ditch	$277,000
3	Chillicothe Road	MC-13a	15” RCP culvert	29" x 45" Culvert	$30,680
4	Manorbrook/Reserve Trail	MC-10a	24” Culvert	30" Culvert	$35,250
5	Manorbrook Drive	MC-10b	36” Culvert	3-36” culvert	$129,560
6	Chillicothe Road (Alternative 1)	MC-5	15” Culvert	Upstream detention	$48,100
6	Chillicothe Road (Alternative 2)	MC-5	15” Culvert	30” culvert	$45,200
7	Chillicothe Road	MC-6	12” Culvert	30” culvert	$47,650
8	Woodside Road	CR-14	18” RCP culvert	30” culvert	$43,950
9	Forest Drive	CR-14	24” RCP culvert	30” culvert	$43,950
10	Sugar Bush Lane	MC-16	60” Culvert	4' x 8' Box Culvert	$82,310
11	Chillicothe Road	MC-4	15” Culvert	21" Culvert	$40,650
12	Bell Road	SC-13, SC-13a	15” Storm Sewer	18” Storm Sewer	$293,300
	Total*				**$1,512,900**

*Includes Alternate 1 where more than one alternate is shown

INTRODUCTION

The purpose of this study is to identify local and regional watersheds within the Village of South Russell, perform hydrologic analysis of each watershed, identify deficient areas based upon hydraulic capacity of the various structures and systems with respect to the Village standards, and to offer proposed solutions to the identified deficiencies. In addition, this study will offer recommendations on prioritization, funding and preliminary project costs.

LOCATION AND DESCRIPTION

The Village of South Russell is located along the western boundary of Geauga County, and is surrounded by Russell Township to the north, Newbury Township to the east, Bainbridge Township to the south and Chagrin Falls Village in Cuyahoga County to the west. The village is four square miles in area and has a current population of approximately 4000. The principal land use within the village is residential, however some commercial development exists along Chillicothe Road (SR 306) and on Washington Street adjacent to Chagrin Falls.

WATERSHED CHARACTERISTICS

The Village is divided into three regional watersheds: the Chagrin River (CR) above the Aurora Branch, Silver Creek (SC) which drains to the Chagrin River above the Aurora Branch, and McFarland Creek (MC) which drains to the Aurora Branch. Each regional watershed has been divided into numerous local watersheds or sub-watersheds that drain to identified storm structures, culverts or major storm sewers. The watershed areas, as shown in **Figure 1,** both inside and outside of the village, are comprised of a mixture of single-family residential, multi family residential, wooded, agricultural use, and pasture. The hydrologic characteristics of each sub-area were determined using the runoff Curve Number (CN) methodology developed by the Soil Conservation Service (SCS) (now the Natural Resources Conservation Service, NRCS). The CN is a measure of the quantity of runoff that will result from a given precipitation when soil type, land use and the antecedent soil moisture condition are considered.

The Soil Survey of Geauga County was used to determine the types of soil present in the South Russell watersheds and to classify the soil type by its hydrologic soil group (HSG). The HSG is a classification system that places all soils into one of four groups (A, B, C, and D) and describes the runoff potential of a particular soil. A soil with an HSG of "A" will have the least runoff potential and the highest infiltration rates, whereas a soil with an HSG of "D" will have the highest runoff potential and the lowest infiltration rate. **Table 2** summarizes the soil types and HSG's for the watersheds within the Village.

TABLE 2
SOIL TYPES AND CLASSIFICATIONS

Soil Symbol	Soil Name	HSG	Watershed Where Found
BrF	Brecksville Silt Loam, 25 to 70 percent slopes	C	CR
Ca	Canadice Silt Loam	D	MC
CcA	Caneadea Silt Loam, 0 to 2 percent slopes	B	MC
CnB	Chili Loam, 2 to 6 percent slopes	B	MC, SC
CnC	Chili Loam, 6 to 12 percent slopes	B	SC
EhB	Ellsworth Silt Loam, 2 to 6 percent slopes	C	SC
EhC	Ellsworth Silt Loam, 6 to 12 percent slopes	C	SC
EhD	Ellsworth Silt Loam, 12 to 18 percent slopes	C	SC
FcB	Fitchville Silt Loam, 2 to 6 percent slopes	C	SC
LxD	Lordstown Rock Outcrop Complex, 12 to 18 percent slopes	C	SC
LyB	Loudonville Silt Loam, 2 to 6 percent slopes	C	MC
LyC	Loudonville Silt Loam, 6 to 12 percent slopes	C	MC
MgA	Mahoning Silt Loam, 0 to 2 percent slopes	D	SC
MgB	Mahoning Silt Loam, 2 to 6 percent slopes	D	SC
MgC	Mahoning Silt Loam, 6 to 12 percent slopes	D	SC
Or	Orrville Silt Loam, Frequently Flooded	C	CR, MC, SC
RsB	Rittman Silt Loam, 2 to 6 percent slopes	C	MC, SC

Soil Symbol	Soil Name	HSG	Watershed Where Found
RsC	Rittman Silt Loam, 6 to 12 percent slopes	C	CR, MC, SC
RsC2	Rittman Silt Loam, 6 to 12 percent slopes, eroded	C	CR, SC
RsD	Rittman Silt Loam, 12 to 18 percent slopes	C	MC, SC
RsE	Rittman Silt Loam, 18 to 25 percent slopes	C	MC, SC
RsF	Rittman Silt Loam, 25 to 50 percent slopes	C	SC
Ud	Udorthents, Loamy	C	MC
WbA	Wadsworth Silt Loam, 0 to 2 percent slopes	C	CR, MC
WbB	Wadsworth Silt Loam, 2 to 6 percent slopes	C	CR, MC
Wt	Willette Muck, ponded	A/D	MC

The SCS has calculated CN's for various soil-cover complexes, which are simply land use-HSG combinations. CN's are assigned to the various soil-cover complexes within each sub-area and a weighted average CN is calculated for each sub-area. This weighted average is called a composite CN. The composite CN calculations for all sub-areas are included in the **Appendix.**

The time of concentration (TC) for each sub-area was calculated using the Curve Number Method or Lag Method as described in National Engineering Handbook, Part 630, formerly Section 4 or using the methodology as described in USDA SCS Technical Release 55, Urban Hydrology for Small Watersheds (TR-55). The TC is defined as the time required for runoff to flow from the hydraulically most remote part of a sub-area or watershed to the point under consideration such as a culvert or retention basin. The flow paths and slopes used in the calculation of the TC were obtained from the Geauga County GIS topographic maps. The TC calculations for all sub-areas are included in the **Appendix.**

Drainage areas were calculated from polygons delineated in the ESRI *ArcInfo* GIS environment.

HYDRAULIC AND HYDROLOGIC MODEL - METHODOLOGY

The regional and local watersheds were modeled using *Hydraflow Hydrographs 2002* by Intelisolve which is a computer program designed to simulate the precipitation-runoff process of watershed systems. The program uses the methodology as described in USDA SCS Technical

Release 20, Computer Program for Project Formulation, Hydrology (TR-20) for hydrograph generation, channel routing and basin routing. Flows for all standard storms including 1yr, 2 yr, 5 yr, 10 yr, 25 yr, 50 yr, and 100yr return frequency were calculated for each watershed.

The hydraulic capacity of culverts was analyzed using Federal Highway Administration (FHWA) Culvert Analysis Program, HY8, version 6.1.

The hydraulic capacity of storm sewers was analyzed using Manning's Equation for just-full flow condition.

DRAINAGE CRITERIA

The drainage criteria used for the analysis of existing facilities within the village is as shown in **Table 3**:

TABLE 3
DRAINAGE CRITERIA

Facility	Criteria	Return Frequency
Roadway culverts	Overtopping	25 year
Storm sewer	Just full capacity	5 year
Detention/retention basin	Overtopping	100 year

This criterion is consistent with the requirements of the village relative to its subdivision regulations. Culverts which are 12" and under and meet the capacity requirements of a 10 year storm are not considered deficient for the purposes of this study.

SUMMARY OF RESULTS

Tables 4, 5 and 6 are a summary of results of the hydrologic and hydraulic analysis for the each area identified for the appropriate return frequency storm.

TABLE 4
SUMMARY OF RESULTS - CHAGRIN RIVER WATERSHED

Sub-Watershed	Facility	Flow (cfs)	Capacity (cfs)	Deficiency
CR-1	Retention basin	21	25	
CR-2	Retention basin	29	47	
CR-3	Retention basin	29	51	
CR-3a	36" culvert	15	64	
CR-4	27" storm sewer	28	21	
CR-4	Retention basin	62	62	
CR-5	36" storm sewer	46	64	

CR-6	42” culvert	52	131	
CR-7	27” storm sewer	11	43	
CR-8	12” storm Sewer	5	5	
CR-9	24” RCP culvert	16	20	
CR-10	30” RCP culvert	21	45	
CR-11	RCP culvert	54		
CR-12	2-12” RCP culvert	29	22	Meets 10 year
CR-13	2-15” RCP culvert	15	28	
CR-14	18” RCP culvert, 24” RCP culvert	45	15/26	Undersized
CR-15	12” PVC culvert	13	9	Meets 10 year
CR-16	12” RCP culvert	12	9	Meets 10 year

TABLE 5
SUMMARY OF RESULTS – MCFARLAND CREEK WATERSHED

Sub-Watershed	Facility	Flow (cfs)	Capacity (cfs)	Deficiency
MC-1	43” x 68” CMP culvert	80	171	Localized flooding
MC-2	Retention basin	55	147	
MC-3	22” x 36” CMP culvert	20	31	
MC-4	15” RCP culvert	20	14	Undersized
MC-5	15” RCP culvert	41	14	Undersized
MC-6	12” VCP culvert	40	9	Undersized
MC-7	Dam/spillway (private)	85	unknown	
MC-8	Dam/spillway (private)	35	unknown	
MC-9	Retention basin	11	18	
MC-10	Retention basin	200	225	
MC-10a	24” culvert	36	25	Undersized
MC-10b	36” culvert	155	64	Undersized
MC-11	3-33” RCP culvert	141	233	
MC-12	2-48” RCP culvert	85	162	
MC-12a	Dam/spillway (private)	48	unknown	
MC-13a	15” RCP culvert	30	14	Undersized
MC-13a	Dam/spillway (private)	32	unknown	
MC-13b	Dam/spillway (private)	20	unknown	
MC-13c	Dam/spillway (private)	17	unknown	
MC-13d	Dam/spillway (private)	14	unknown	
MC-14	5.3’ x 3.8’ box culvert	205	210	
MC-15	4’ x 8’ RC box culvert	182	370	
MC-16	60” RCP culvert	245	209	Undersized
MC-16	Dam/spillway (private)	328	unknown	
MC-17	Retention basin	65	155	
MC-18	42” RCP drive culvert	273	77	Undersized

MC-18	48” RCP culvert	273	151	Undersized
MC-19	Dam/spillway (private)	275	unknown	
MC-19a	60” RCP culvert	181	211	
MC-20	34” x 53” culvert	25		
MC-21	Retention basin	7	87	
MC-22	Bridge	245		
MC-22a	36” culvert	54	64	

TABLE 6
SUMMARY OF RESULTS – SILVER CREEK WATERSHED

Sub-Watershed	Facility	Flow (cfs)	Capacity (cfs)	Deficiency
SC-2	Dam/spillway (private)	163	unknown	
SC-2a	2-18” culvert	29	35	
SC-3	72” culvert	138	345	
SC-4	30” storm sewer	14	41	
SC-5	48” culvert	59	147	
SC-5a	24” HDPE culvert	21	29	
SC-5b	24” CMP culvert	8	29	
SC-6	5’ x 8’ RC box culvert	195	394	
SC-7	48” RCP culvert	27	147	
SC-8	Dam/spillway (private)	222	unknown	
SC-9	24”,27” culvert	43	65	
SC-10	57” culvert	185	203	
SC-11	36” culvert	55	81	
SC-12	30” storm sewer	28	41	
SC-13	Detention Basin	6	6	
SC-13a	18” culvert	12	16	
SC-13/ SC-13a	15” Storm Sewer	11	7	Undersized, localized flooding
SC-14	15’ span bridge	590	986	
SC-14a	24” culvert	23	39	
SC-15	30” culvert	26	81	
SC-16	Dam/spillway (private)	827	unknown	
SC-17	36” culvert	28	81	
SC-18	Dam/spillway (private)	23	unknown	
SC-19	48” culvert	43	129	
SC-19a	15” culvert	16	14	
SC-20	24” culvert	41	45	

DISCUSSION, ALTERNATIVES AND COST ESTIMATES

The following areas as identified above as deficient merit further discussion. The information is presented in order of perceived importance to the community. **Figure 2** is an overall map of the Village illustrating the location of each of the areas as described below.

CHELSEA DRIVE - 48" ROADWAY CULVERT (MC-18)

The 48" culvert at Chelsea Drive has been found to have the capacity for the peak flow generated by a 5-year storm. This is well below the 25 year storm criteria used for a roadway culvert. The flooding, which occurs at this location as a result of larger storms, has been well documented in photographs of this area.

Aside from the culvert being undersized, improvements are needed in the geometry of the entrance to the culvert. A cursory review of the channel section has revealed that its capacity is about that of a 25 year storm, therefore channel itself is most likely not the primary cause of the flooding.

There are various improvements which can be employed to reduce the periodic flooding at this location:

1. Culvert Replacement - This solution would increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacement of the existing culvert with a 4' x 8' box culvert on a revised alignment. This option would require the procurement of easements along the alignment of the existing 48" culvert between house #11 and #12.

   The driveway culverts at house #21 and house #22 appear to be undersized as well. These 42" culverts are located immediately upstream of the 48" roadway culvert and will require the essentially same solution as the roadway culvert to reduce the flooding problem. Overtopping and street flooding may result if these culverts are not upsized as well. See **Figure 3** for a drawing of the proposed improvements.

   An estimate of preliminary project costs is as shown in **Table 7**.

TABLE 7
PROJECT COSTS - CHELSEA COURT, MC-18, ALTERNATIVE 1

Item	Qty/	Unit	Unit Price	Total
4' x 8' Box Culvert	360	FT	$500	$180,000
Headwall	6	EACH	$10,000	$60,000
Rock Channel Protection	200	CY YD	$50	$10,000
Pavement	200	SQ YD	$50	$10,000

Driveways	260	SQ YD	$50	$13,000
Restoration	1200	SQ YD	$4	$4,800
Contingency 20%				$55,600
Subtotal Construction				$333,400
Engineering/Survey/Inspection 25% Permitting/Environmental/Mitigation				$83,400 $5,000
Temporary Easements/Acquisition	0.17	ACRE	$10,000	$1,700
Permanent Easement/Acquisition	0.17	ACRE	$100,000	$17,000
Total Project Cost				**$440,500**

2. Upstream Detention - This solution would provide detention at a location upstream of the problem area while utilizing the existing storm system and culvert to reduce the peak flow. A possible location would be in the low area on the north side of Bell Road between Fox Trail and the driveway entrance to the Gurney School. This option would utilize the existing culvert under Bell Road as the control structure for the detention area. See **Figure 4** for a drawing of the proposed improvements.

   An estimate of preliminary project costs is as shown in **Table 8**.

TABLE 8
PROJECT COSTS - CHELSEA COURT, MC-18, ALTERNATIVE 2

Item	Qty/	Unit	Unit Price	Total
Clearing and Grubbing	1	LUMP	$10,000	$10,000
Excavation	17500	CU YD	$10	$175,000
Restoration	22000	SQ YD	$4	$88,000
Contingency 20%				$54,600
Subtotal Construction				$327,600
Engineering/Survey/Inspection 25%				$81,900
Permitting/Environmental/Mitigation				$5,000
Easements/Acquisition	4.5	ACRE	$60,000	$270,000
Total Project Cost				**$684,500**

3. Combination of 1 and 2 - Alternately, a combination of detention and culvert replacement can be employed to reduce the size of the culvert necessary to pass the calculated peak flow.

CHILLICOTHE ROAD – 43" X 68" CULVERT (MC-1)

Although the existing culvert has the capacity to pass the flow generated by a 25 year storm, there is reported flooding in many of the low-lying yard areas in the vicinity of this culvert. It would appear that the problem is not the culvert itself, but the ability for the water to get to the culvert.

A possible solution would be to lower the culvert and regrade the downstream channel. This would enable all of the swales and ditches draining to the culvert to be lowered as well, thereby improving overall drainage in the area. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 5** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 9**.

TABLE 9
PROJECT COSTS - CHILLICOTHE ROAD, MC-1

Item	Qty/	Unit	Unit Price	Total
43" X 68" Culvert	60	FT	$250	$15,000
Drive Culvert	240	FT	$30	$7,200
Headwall	2	EACH	$2,500	$5,000
Rock Channel Protection	50	CY YD	$50	$2,500
Pavement	70	SQ YD	$50	$3,500
Driveways	200	SQ YD	$50	$10,000
Restoration	8500	SQ YD	$4	$34,000
Regrade Ditch	2500	FT	$15	$37,500
Contingency 20%				$22,900
Subtotal Construction				$137,600
Engineering/Survey/Inspection 25%				$34,400
Permitting/Environmental/Mitigation				$50,000
Temporary Easements/Acquisition	0.5	ACRE	$10,000	$5,000
Permanent Easement/Acquisition	0.5	ACRE	$100,000	$50,000
Total Project Cost				**$277,000**

CHILLICOTHE ROAD – 15" CULVERT (MC-13A)

The 15" roadway culvert on Chillicothe Road at this location has been found to have the capacity for the peak flow generated by a 2 year storm. This is less than the 25 year criteria used for roadway culverts. When the Chagrin Lakes Club Subdivision was constructed, this culvert was extended on the downstream side with a 29" x 45" elliptical concrete pipe, which appears to have been properly sized for the flow to this point.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacing the existing culvert under the road with a 29" x 45" elliptical concrete pipe culvert. Preliminary analysis of the downstream drainage system indicates that there is capacity to handle the calculated peak flow to this point. Grading easements may be required up stream of the area to perform this work. See **Figure 6** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 10**.

TABLE 10
PROJECT COSTS - CHILLICOTHE ROAD, MC-13A

Item	Qty/.	Unit	Unit Price	Total
29" x 45" Culvert	60	FT	$150	$9,000
Headwall	2	EACH	$1,500	$3,000
Pavement	70	SQ YD	$50	$3,500
Restoration	70	SQ YD	$4	$280
Contingency 20%				$3,200
Subtotal Construction				$18,980
Engineering/Survey/Inspection 30%				$5,700
Permitting/Environmental/Mitigation				$5,000
Temporary Easements/Acquisition	0.1	ACRE	$10,000	$1,000
Total Project Cost				**$30,680**

MANORBROOK DRIVE/RESERVE TRAIL – 24" CULVERT (MC-10A)

The roadway culvert which consists of a 24" pipe under the pavement and a 30" pipe beyond the pavement between house #506 and house #508 located at the intersection of Manorbrook Drive and Reserve Trail has been found to have the capacity for the peak flow generated by a 5 year storm. This is less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacement of the existing 24" culvert with a 30"culvert on a same alignment. Presumably, the existing permanent easements for the 24" culvert can be utilized for this option. See **Figure 7** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 11**.

TABLE 11
PROJECT COSTS – MANORBROOK DRIVE/RESERVE TRAIL, MC-10A

Item	Qty/.	Unit	Unit Price	Total
30" Culvert	50	FT	$100	$5,000
Headwall	1	EACH	$1,500	$1,500
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$10	$1,500
Restoration	700	SQ YD	$4	$2,800
Contingency 20%				$2,400
Subtotal Construction				$14,450
Engineering/Survey/Inspection 30%				$4,300
Permitting/Environmental/Mitigation				$15,000
Temporary Easements/Acquisition	0.15	ACRE	$10,000	$1,500
Total Project Cost				**$35,250**

MANORBROOK DRIVE – 36" CULVERT (MC-10B)

The 36" roadway culvert on Manorbrook Drive, approximately 400 feet east of Alderwood Trail has been found to have the capacity for the peak flow generated by a 2 year storm. This is far less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the number of the culvert barrels to pass the calculated peak flow without overtopping the road. This would involve the addition of three 36" culverts in parallel, for a total of four, on a same alignment as the existing culvert. Due to pipe cover constraints, a single larger diameter pipe does not appear to be feasible at this site. Grading easements may be requires up and down stream of the work area to perform this work. See **Figure 8** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 12**.

TABLE 12
PROJECT COSTS – MANORBROOK DRIVE/RESERVE TRAIL, MC-10B

Item	Qty/.	Unit	Unit Price	Total
36" Culvert	600	FT	$120	$72,000
Headwall	2	EACH	$2,500	$5,000
Rock Channel Protection	30	CY YD	$50	$1,500
Pavement	70	SQ YD	$50	$3,500
Restoration	90	SQ YD	$4	$360
Contingency 20%				$16,500
Subtotal Construction				$98,860
Engineering/Survey/Inspection 25%				$24,700
Permitting/Environmental/Mitigation				$5,000
Temporary Easements/Acquisition	0.1	ACRE	$10,000	$1,000
Total Project Cost				**$129,560**

CHILLICOTHE ROAD – 15" CULVERT (MC-5)

The 15" roadway culvert on Chillicothe Road at this location has been found to have the capacity for the peak flow generated by a 2 year storm. This is far less than the 25 year criteria used for roadway culverts.

1. Modification of Retention Basin – This solution would involve the modification of the outlet of the retention basin in the Kensington Green subdivision to reduce peak flow rates and eliminate the need to replace the culvert. This solution would be the preferable because downstream flows would be reduced and may offset any negative effects of implementing the proposed solution to the problem at location MC-4. See **Figure 9** for a drawing of the proposed improvements.

   An estimate of preliminary project costs is as shown in **Table 13**.

TABLE 13
PROJECT COSTS - CHILLICOTHE ROAD, MC-5, ALTERNATIVE 1

Item	Qty/.	Unit	Unit Price	Total
Excavation	50	CU YD	$10	$500
Restoration	350	SQ YD	$4	$1,400
Concrete Masonry	25	CU YD	$800	$20,000
Rock Channel Protection	50	CU YD	$50	$2,500
Contingency 20%				$4,900
Subtotal Construction				$29,300
Engineering/Survey/Inspection 30%				$8,800
Permitting/Environmental/Mitigation				$5,000
Temporary Easements/Acquisition	0.5	ACRE	$10,000	$5,000
Total Project Cost				**$48,100**

2. Culvert Replacement – This solution would increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacing the existing culvert with a 30" culvert. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 10** for a drawing of the proposed improvements.

   An estimate of preliminary project costs is as shown in **Table 14**.

TABLE 14
PROJECT COSTS - CHILLICOTHE ROAD, MC-5, ALTERNATIVE 2

Item	Qty/.	Unit	Unit Price	Total
30" Culvert	60	FT	$100	$6,000
Headwall	2	EACH	$1,500	$3,000
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$15	$2,250
Pavement	70	SQ YD	$50	$3,500
Restoration	600	SQ YD	$4	$2,400
Contingency 20%				$3,700

Subtotal Construction				$22,100
Engineering/Survey/Inspection 30%				$6,600
Permitting/Environmental/Mitigation				$15,000
Temporary Easements/Acquisition	0.15	ACRE	$10,000	$1,500
Total Project Cost				**$45,200**

CHILLICOTHE ROAD – 12" CULVERT (MC-6)

The 12" roadway culvert on Chillicothe Road at this location has been found to have the capacity for the peak flow generated by a 1 year storm. This is far less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacing the existing culvert with a 30" culvert. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 11** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 15**.

TABLE 15
PROJECT COSTS - CHILLICOTHE ROAD, MC-6

Item	Qty/.	Unit	Unit Price	Total
30" Culvert	60	FT	$100	$6,000
Headwall	2	EACH	$1,500	$3,000
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$10	$1,500
Pavement	70	SQ YD	$50	$3,500
Restoration	1100	SQ YD	$4	$4,400
Contingency 20%				$3,900
Subtotal Construction				$23,550
Engineering/Survey/Inspection 30%				$7,100
Permitting/Environmental/Mitigation				$15,000

Temporary Easements/Acquisition	0.2	ACRE	$10,000	$2,000
Total Project Cost				**$47,650**

WOODSIDE ROAD – 18" CULVERT (CR-14)

The 18" roadway culvert on Woodside Road just south of the Forest Drive intersection, has been found to have the capacity for the peak flow generated by a 2 year storm. This is far less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve the replacement of the existing culvert with a 30" culvert. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 12** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 16**

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TABLE 16
PROJECT COSTS - WOODSIDE ROAD, CR-14

Item		Unit	Unit Price	Total
30" Culvert	60	FT	$100	$6,000
Headwall	2	EACH	$1,500	$3,000
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$10	$1,500
Pavement	70	SQ YD	$50	$3,500
Restoration	600	SQ YD	$4	$2,400
Contingency 20%				$3,500
Subtotal Construction				$21,150
Engineering/Survey/Inspection 30%				$6,300
Permitting/Environmental/Mitigation				$15,000
Temporary Easements/Acquisition	0.15	ACRE	$10,000	$1,500
Total Project Cost				**$43,950**

FOREST DRIVE – 24" CULVERT (CR-14)

The 24" roadway culvert on Forest Drive just west of the Woodside Road intersection, has been found to have the capacity for the peak flow generated by a 5 year storm. This is far less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve the replacement of the existing culvert with a 30" culvert. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 13** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 17**.

TABLE 17
PROJECT COSTS - FOREST DRIVE, CR-14

Item	Qty/.	Unit	Unit Price	Total
30" Culvert	60	FT	$100	$6,000
Headwall	2	EACH	$1,500	$3,000
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$10	$1,500
Pavement	70	SQ YD	$50	$3,500
Restoration	600	SQ YD	$4	$2,400
Contingency 20%				$3,500
Subtotal Construction				$21,150
Engineering/Survey/Inspection 30%				$6,300
Permitting/Environmental/Mitigation				$15,000
Temporary Easements/Acquisition	0.15	ACRE	$10,000	$1,500
Total Project Cost				**$43,950**

SUGAR BUSH LANE – 60" CULVERT (MC-16)

The 60" roadway culvert on Sugar Bush Lane, just south of Bell Road has been found to have the capacity of the peak flow generated by a 10 year storm. This is less than the 25 year criteria used for roadway culverts.

If a detention were constructed upstream of this culvert in the low area on the north side of Bell Road between Fox Trail and the driveway entrance to the school, peak flows could be reduced to

a level where this culvert will pass a 25 year return frequency storm without overtopping the road. This is one of the options as presented in the solution to the Chelsea Drive flooding problem.

Otherwise, the need exists for the culvert to be upsized to a 4' x 8' box culvert on the same alignment as the existing culvert. Grading easements may be required up and down stream of the work area to perform this work. See **Figure 14** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 18**.

TABLE 18
PROJECT COSTS - SUGAR BUSH LANE, MC-16

Item	Qty/.	Unit	Unit Price	Total
4' x 8' Box Culvert	50	FT	$500	$25,000
Headwall	2	EACH	$10,000	$20,000
Rock Channel Protection	50	CY YD	$50	$2,500
Pavement	55	SQ YD	$50	$2,750
Restoration	140	SQ YD	$4	$560
Contingency 20%				$10,200
Subtotal Construction				$61,010
Engineering/Survey/Inspection 25%				$15,300
Permitting/Environmental/Mitigation				$5,000
Temporary Easements/Acquisition	0.1	ACRE	$10,000	$1,000
Total Project Cost				**$82,310**

CHILLICOTHE ROAD – 15" CULVERT (MC-4)

The 15" roadway culvert on Chillicothe Road at this location has been found to have the capacity for the peak flow generated by a 10 year storm. This is less than the 25 year criteria used for roadway culverts.

A possible solution to the problem would be to increase the size of the culvert to pass the calculated peak flow without overtopping the road. This would involve replacing the existing culvert with a 21" culvert. Grading easements may be required up and down stream of the area to perform this work. See **Figure 15** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 19**.

TABLE 19
PROJECT COSTS - CHILLICOTHE ROAD, MC-4

Item	Qty/.	Unit	Unit Price	Total
21" Culvert	60	FT	$80	$4,800
Headwall	2	EACH	$1,000	$2,000
Rock Channel Protection	25	CY YD	$50	$1,250
Regrade Ditch	150	FT	$10	$1,500
Pavement	70	SQ YD	$50	$3,500
Restoration	600	SQ YD	$4	$2,400
Contingency 20%				$3,100
Subtotal Construction				$18,550
Engineering/Survey/Inspection 30%				$5,600
Permitting/Environmental/Mitigation				$15,000
Temporary Easements/Acquisition	0.15	ACRE	$10,000	$1,500
Total Project Cost				**$40,650**

BELL ROAD – 15" STORM SEWER (SC-13, SC-13A)

The 15" storm sewer along the north side of Bell road from the outlet of the Kensington Greens northeast detention pond to its outlet on Lakeview Lane has been found to have the capacity for the peak flow generated by a storm of less than a 5 year frequency. Although no record of this line has been obtained, its existence was verified by the Street Commissioner. Additionally, there are areas adjacent to the road where there is poor drainage, and the water is not getting into the existing storm sewer.

A possible solution to this problem would be to replace the existing storm sewer and add inlet basins along both sides of Bell Road. The proposed discharge point would be in the same location on Lakeview Lane. See **Figure 16** for a drawing of the proposed improvements.

An estimate of preliminary project costs is as shown in **Table 20**.

TABLE 20
PROJECT COSTS - BELL ROAD, SC-13, SC-13A

Item	Qty/.	Unit	Unit Price	Total
12" Storm Sewer	400	FT	$50	$20,000
18" Storm Sewer	1425	FT	$60	$85,500
21" Storm Sewer	300	FT	$70	$21,000
Headwall	2	EACH	$1,000	$2,000
Catch Basin	12	EACH	$1,500	$18,000
Rock Channel Protection	100	CY YD	$50	$5,000
Pavement	250	SQ YD	$50	$12,500
Driveways	150	SQ YD	$50	$7,500
Restoration	5000	SQ YD	$4	$20,000
Contingency 20%				$38,300
Subtotal Construction				$229,800
Engineering/Survey/Inspection 25%				$57,500
Permitting/Environmental/Mitigation				$5,000
Temporary Easements/Acquisition	0.1	ACRE	$10,000	$1,000
Total Project Cost				**$293,300**

FUNDING OPTIONS

Funding sources for storm water projects of the type described in this report are somewhat limited. Funding sources available include:

- Village general fund
- Ohio Public Works Commission (Issue 2) – Loans and Grants
- Creation of a storm water utility
- Outside developers
- U.S. Army Corps of Engineers

The Ohio Public Works Commission (OPWC) was created to assist in financing local public infrastructure improvements under the State Capital Improvements Program (SCIP) and the Local Transportation Improvements Program (LTIP). These programs provide financial assistance to local communities for the improvement of their basic infrastructure systems. Projects are selected for funding based upon the financial need of the community, the project's strategic importance to the OPWC district and the community, and places emphasis on the repair

and replacement of infrastructure rather than new and expansionary infrastructure. Zero interest loans and grants are available.

The creation of a storm water utility would assist the Village in complying with State and Federal storm water regulations, assure consistent attention to flooding problems and provide a funding mechanism for capital projects. The fees charged on individual parcels of land are based on the amount of impervious area (hard surface) on each property. Generally, residential parcels are charged a flat fee and nonresidential properties are charged based upon the square footage of impervious surface they contain divided by a number which represents an equivalent residential unit. This type of funding is in effect a "user tax" for the Village's storm water conveyance system.

Often times a developer is willing to share in the cost of a storm water improvement when a deficient area is located in close proximity to a proposed development area. In many cases detention, which is created as a requirement of development, can be optimized to aid in the overall reduction of peak flows downstream. Additionally, developers may be willing to participate in the replacement of downstream structures as a condition of approval of their development.

The U.S. Army Corps of Engineers administers storm water projects under the Authorized Study Program. Projects are nominated for study by the local congressional representative through the Public Works Committee. If a study is authorized, it is included in the President's annual budget. When the feasibility study is complete, it is reviewed at various levels of higher government, including the Corps, the Assistant Secretary of the Army, the Office of Management and Budget, and the U.S. Environmental Protection Agency, and is also made available for public comment. Based upon the report and review, congress decides whether or not to authorize construction. If authorized, the Corps will complete final design and oversee construction.

The Ohio Department of Transportation (ODOT) was contacted to check on the availability of funding for any work occurring along Chillicothe Road which is also has the designation of State Route (SR) 306. ODOT as the responsibility to maintain the surface of State Routes located within the corporation limits of a village. ODOT does not have the responsibility to correct drainage problems occurring outside of their right-of-way which may result from drainage facilities (culverts, sewers, etc.) within their right of way. In general, the only time ODOT would become involved in a drainage project on a start route within a village is if the road was somehow in jeopardy, such as from erosion problems or sinkholes.

5-YEAR CAPITAL PLAN

The following data presented in **Table 21** is a 5-year capital plan which illustrates how a portion of the projects may be completed over a 5-year period. An inflation rate of 3% per year is assumed and dollars in the TOTAL row are adjusted for inflation.

TABLE 21
5-YEAR CAPITAL PLAN

	Location	R/W Easement	Construction	Design	Construction Administration	Permitting/ Environmental	Contingency	Project Cost	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
				15%	10%		20%						
1	Chelsea Court (Alternative 1)	$18,700	$277,800	$50,040	$33,360	$5,000	$55,600	$440,500	$73,740		$366,760		
2	Chillicothe Road	$55,000	$114,700	$20,640	$13,760	$50,000	$22,900	$277,000		$125,640		$151,360	
3	Chillicothe Road	$1,000	$15,780	$3,420	$2,280	$5,000	$3,200	$30,680					$30,680
4	Manorbrook/Reserve Trail	$1,500	$12,050	$2,580	$1,720	$15,000	$2,400	$35,250					$35,250
5	Manorbrook Drive	$1,000	$82,360	$14,820	$9,880	$5,000	$16,500	$129,560					$129,560
6	Chillicothe Road (Alternative 1)	$5,000	$24,400	$5,280	$3,520	$5,000	$4,900	$48,100	$48,100				
7	Chillicothe Road	$2,000	$19,650	$4,260	$2,840	$15,000	$3,900	$47,650		$47,650			
8	Woodside Road	$1,500	$17,650	$3,780	$2,520	$15,000	$3,500	$43,950	$43,950				
9	Forest Drive	$1,500	$17,650	$3,780	$2,520	$15,000	$3,500	$43,950	$43,950				
10	Sugar Bush Lane	$1,000	$50,810	$9,180	$6,120	$5,000	$10,200	$82,310					
11	Chillicothe Road	$1,500	$15,450	$3,360	$2,240	$15,000	$3,100	$40,650				$40,650	
12	Bell Road	$1,000	$191,500	$34,500	$23,000	$5,000	$38,300	$293,300					
	Total (2004 Dollars)	**$90,700**	**$839,800**	**$155,640**	**$103,760**	**$155,000**	**$168,000**	**$1,512,900**	**$209,740**	**$173,290**	**$366,760**	**$192,010**	**$195,490**
	Inflation Factor (3%/year)								**$6,290**	**$10,550**	**$34,010**	**$24,100**	**$31,140**
	Total								**$216,030**	**$183,840**	**$400,770**	**$216,110**	**$226,630**

SUMMARY

The following data presented in **Table 22** is a summary of the various facilities which have been identified as deficient, along with a description of the proposed solution and the total project cost. The projects are prioritized in order of their perceived importance to the community.

TABLE 22
SUMMARY

	Location	Sub-Water-shed	Facility	Improvement	Project Cost
1	Chelsea Court (Alternative 1)	MC-18	48” Culvert	4’ x 8’ Box culvert	$440,500
1	Chelsea Court (Alternative 2)	MC-18	48” Culvert	Upstream detention	$684,500
2	Chillicothe Road	MC-1	43” x 68” Culvert	43” x 68” Culvert/ regrade ditch	$277,000
3	Chillicothe Road	MC-13a	15” RCP culvert	29" x 45" Culvert	$30,680
4	Manorbrook/Reserve Trail	MC-10a	24” Culvert	30" Culvert	$35,250
5	Manorbrook Drive	MC-10b	36” Culvert	3-36” Culvert	$129,560
6	Chillicothe Road (Alternative 1)	MC-5	15” Culvert	30” Culvert	$48,100
6	Chillicothe Road (Alternative 2)	MC-5	15” Culvert	Upstream detention	$45,200
7	Chillicothe Road	MC-6	12” Culvert	30” culvert	$47,650
8	Woodside Road	CR-14	18” RCP culvert	30” culvert	$43,950
9	Forest Drive	CR-14	24” RCP culvert	30” culvert	$43,950
10	Sugar Bush Lane	MC-16	60” Culvert	4' x 8' Box Culvert	$82,310
11	Chillicothe Road	MC-4	15” Culvert	21" Culvert	$40,650
12	Bell Road	SC-13, SC-13a	15” Storm Sewer	18” Storm Sewer	$293,300
	Total*				**$1,512,900**

*Includes Alternate 1 where more than one alternate is shown

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