REPORT

FOR

Combined Sewer System Study

FOR

CITY OF BERKLEY

JULY 2018
(FINAL)

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Table of Contents

Section 1 - Executive Summary ***1-1***

Section 2 - Introduction ***2-1***

Section 3 - Design Storm Event ***3-1***

A. GENERAL 3-1

B. PRECIPITATION AND RECURRENCE INTERVALS 3-1

C. CLIMATE RESILIENCY 3-4

Section 4 - Existing Combined Sewer System ***4-1***

Section 5 - Capacity Analysis ***5-1***

A. GENERAL 5-1

B. DESIGN CRITERIA 5-2

C. SUMMARY OF CAPACITY ANALYSIS (UNRESTRICTED CONDITION) 5-5

D. EFFECT OF RESTRICTED COVERS ON SEWER CAPACITY 5-6

Section 6 - Sewer System Improvements ***6-1***

A. PRIORITIZING SEWER SYSTEM IMPROVEMENTS 6-1

B. FUTURE CAPITAL IMPROVEMENTS AND SEWER IMPROVEMENT STRATEGIES 6-2

Appendix A – Existing Sewer System Maps (with sewer sizes, MH numbers, restricted CB's)

Appendix B – Sewer Flow Calculations (unrestricted condition)

Appendix C – Sewer Flow Calculations (restricted cover condition)

List of Figures

Figure A – Southeast Oakland County Drain Map

Figure B – City of Berkley Combined Sewer Subdistricts

Figure C – Subdistrict Capacity Evaluation Summary (Restricted Condition)

Figure D – Sewer Surcharging Evaluation Summary (Restricted Condition)

Figure E – Subdistrict Restricted Cover Benefit Summary

Figure F – Subdistrict Prioritization for Sewer Improvements

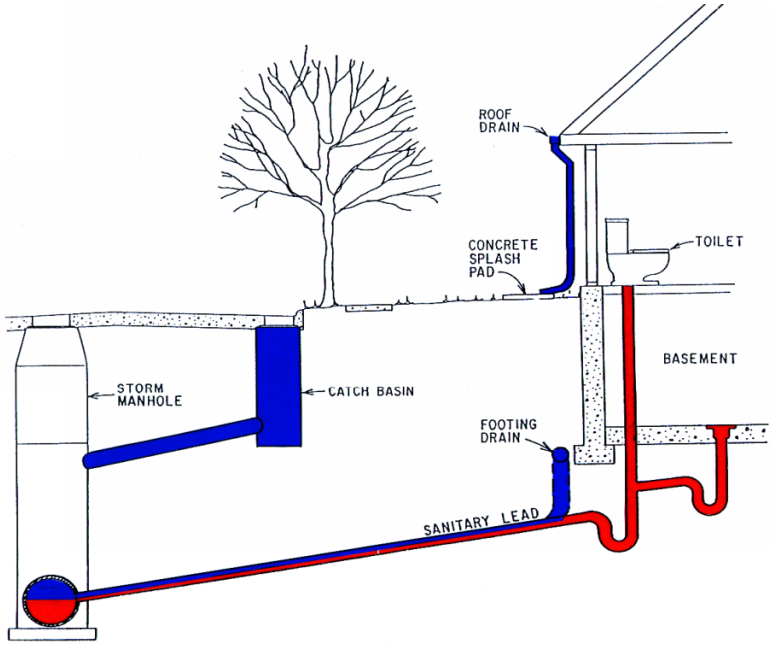
Section 1 - Executive Summary

In the Fall of 2017, Hubbell Roth & Clark, Inc. (HRC) was tasked by the City of Berkley to prepare a City-wide Combined Sewer Capacity Study in response to basement flooding occurrences that residents experienced during a high intensity rain event in August, 2017. HRC's study was also intended to explore the benefits of a catch basin restriction program expansion in reducing peak flows in the sewer system. Historically, Berkley residents have experienced basement flooding during extreme rain events however, the occurrences were scarce following large-scale improvements made to the City and County drain systems in the 1960's and 1970's.

The City's sewer system is combined which, by definition, is a sewer that transports domestic/commercial sanitary sewage, storm water runoff from pavements ground surfaces through catch basins along streets, parking lots, rear yards and drainage from footing drains and sump pumps. See the depiction of a combined sewer system on Page 1-2. With one pipe accepting flow from all these sources, there is the potential for the entire sewer system to back-up and cause basement flooding. There are several factors contributing factors which can cause sewage back-ups and basement flooding including:

1. The capacity of the sewer is simply overwhelmed by the volume and intensity of storm water entering into it.
2. A blockage (e.g., debris, roots, pipe collapse, etc.) in the City's sewer or County drain.
3. A blockage in the private sewer lead (from the home/business to the City's main).

Frequently, private sewer back-ups are a result of the lead being overwhelmed by the amount of storm water entering it from downspouts, footing drains and sump pumps that are directly connected. Downspouts have the most direct impact on the combined sewer, thus, it is highly recommended that all downspouts be disconnected from the sewer and instead discharged on the ground.



COMBINED SEWER SYSTEM

The intent of this Report is to provide an overview of the City's combined sewer system capacity; to discuss the flood exposures within the City and the challenges within the local and regional sewer systems; and to identify opportunities in flood prevention and mitigation for both the City and their residential and commercial property owners. Additional goals of this Study are to provide the City with the information to support the prioritization of future capital improvement projects (CIP) based on the analysis of the calculated pipe capacity data.

It must be understood that the efficiency of the City's sewer system is firmly limited to its ultimate outlet – the Oakland County Water Resources Commissioner's (WRC) system of drains that runs through the City and into the Twelve Towns Relief Drain. Further, the City is located in an area that does not have any potential storm water outlets, such as open channel streams, rivers, or lakes that many of the neighboring communities have at their disposal, including Birmingham, Beverly Hills and Southfield that all have a branch of the Rouge River within their limits. Because of this, it is an important fact that there is nothing the City of Berkley, nor any other City or County for that matter, can do to completely protect and eliminate basement flooding from occurring.[1]

[1] "No amount of sewer investment could have stopped flooding, city official says." Windsor Star, August 31, 2017. http://windsorstar.com/news/local-news/no-amount-of-sewer-investment-could-have-stopped-flooding-city-official-says

Rainfall events causing basement and/or street flooding has not only been a City of Berkley issue, but an ongoing regional issue as well. Over time, various large-scale improvements have been made in response to the flooding, such as the construction of the Twelve Towns relief sewers and several combined relief sewers around the City in the 1970's, which did alleviate the flooding concerns at the time. However, these multi-million dollar system improvements were not meant to be a guarantee that the City or the surrounding communities would never again experience flooding. There is always the potential for an extreme rain event to occur that will be larger than the capacity of any sewer system. It is simply not economically feasible and physically impossible (due to space limitations in densely developed communities) to design and construct a system capable of handling the volume of an extreme storm event.

Since the 1970's, the City of Berkley has been working to implement enhancements to mitigate the impact of extreme rain events within the City. Examples of these efforts include the following:

- Downspout Disconnection Programs
- Catch Basin Restriction Programs (ongoing; recently expanded Program in 2018 for the installation of 200 new restricted covers throughout the City). See below for a comparison of restricted and unrestricted catch basin covers.
- City-Wide Sewer Televising, Cleaning and Structural Lining Programs (over 25 years to present day)
- Storm water and Wastewater Asset Management Grant recipient
- New commercial development standards (i.e., restricted covers, storm water detention, etc.)
- City-conducted Backwater Valve Workshop for property owners and offered a Permit Fee Reimbursement for Backflow Valve Installation.

Moving forward, the City could consider the following options to enhance the City's sewer system:

- The data presented in this Study will allow the City to consider to individual subdistricts with the highest priority rating and determine what is feasible for future capital improvements.
- Continue to operate the recently expanded Catch Basin Restriction Program and monitor where additional restricted covers could be utilized.
- Investigate City owned facilities, e.g., parking lots, alleys, etc., to implement additional restrictive covers, as necessary.
- Explore potential cost sharing options/arrangements for funding backflow prevention measures at individual homes and businesses.
- Review and explore revisions to the current Storm Water Ordinance for both commercial and residential properties, including requiring catch basin restriction and onsite detention.
- Review and explore revisions to the current Standards for Development for both commercial and residential properties, alongside the Storm Water Ordinance, in particular, for requiring catch basin restriction and onsite detention, lot coverage restrictions, etc.
- Re-evaluate the current E.R.U. (Equivalent Residential Units) calculations for determination of utility fees.
- Initiate discussions with WRC regarding future improvements to the County's sewer system.
- Prepare a feasibility study for the implementation of bioswales/bioretention within City road rights-of-way.

In addition to the above items, the City can consider future larger-scale mitigation efforts that potentially could alleviate some flooding concerns where economically feasible. Projects like segment-by-segment replacement of combined sewers, installation of combined relief sewers, installation of storm relief sewers, parallel sanitary sewer installation, detention/retention of storm flows (combined sewage or storm water), implementing comprehensive catch basin restrictions, and taking advantage of low impact development (LID) opportunities may be considered. Selection of the appropriate strategy for any given area will require further investigation and analysis so that the "best" strategy is implemented based on the desired level of service improvement, cost and timing. Engagement of the public is advisable for certain strategies, especially those that will change or limit the public's use of land (including road right-of-way) after the improvements. It would be the City's expectation to undertake said future sewer

improvement projects in conjunction with other capital improvements projects in a given area, such as water main replacement, road rehabilitation, etc., or where unique opportunities or requirements may exist.

Because of the historic, sporadic nature of the rain events leading to flooding occurrences, it is very difficult to prepare the perfect 'road map' as to where projects could be undertaken and/or where the priorities would be. Improvements were made to the local and regional sewer systems over time; however, the realities of changing weather patterns, increased number of high intensity rain events, and land use modifications have contributed to periodic basement flooding in recent years. It is also important to understand that flooding related to extreme rain events is a regional issue, not just a City issue, and regional cooperation (in particular, with the Oakland County Water Resources Commissioner and neighboring 12-Towns Communities) will ultimately be required in order to properly address these concerns.

From the individual resident and commercial property owner's perspective, there are a number of potential opportunities to mitigate flooding that could include:

- Maintaining private sanitary leads (hiring a plumber to televise, clean, inspect lines, and replace, if necessary)
- Incorporating storm water management applications such as ensuring all downspouts are disconnected from the main line sewer and either discharged on grade or directed to rain barrels
- Planting trees, shrubbery and ground cover vegetation
- Installing backflow prevention measures on private leads

Understanding that both the City and property owners have limited resources with respect to funding infrastructure improvements is of particular importance. This Study is only the first step in the process of determining what changes can be made locally and as a region to mitigate basement flooding during extreme rain events. On behalf of the City of Berkley, HRC hereby presents the Study of the City's Combined Sewer System along with an overview and discussions on potential efforts that both the City and property owners can undertake to further mitigate basement flooding.

Section 2 - Introduction

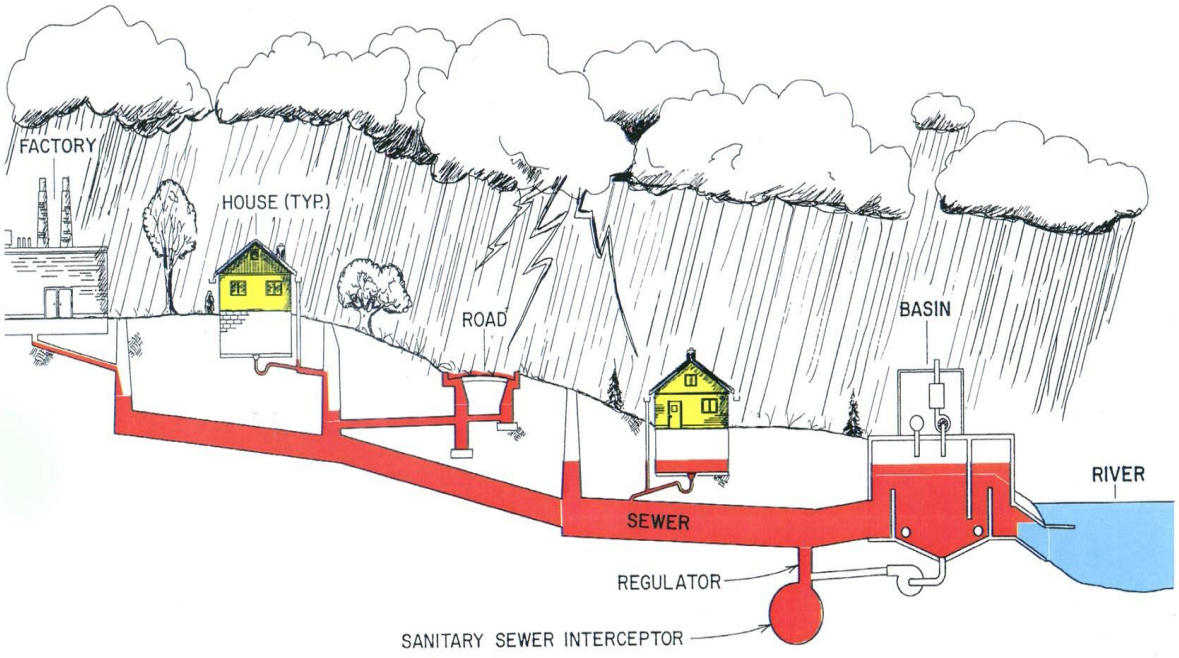
One of the goals of this Combined Sewer System Study is to provide the City with the information needed to support the planning process for future capital improvement projects (CIP). The results of the Study will provide the City with the additional information needed to evaluate sewer system improvement needs by considering the potential system capacity in addition to the structural conditions. The Study will also provide context for future decision making related to overall infrastructure projects that might include improvements to the roads, sewers, and water mains.

The Combined Sewer System Study evaluated the flows in the local, City-owned, combined sewer collection system only. Analysis of the potential flows in the Drains that are under the Oakland County Water Resources Commissioner's (WRC) jurisdiction were beyond the scope of the Study. Similarly, private sewer systems and individual City-owned catch basin leads were not analyzed as part of the Study. The design flows included in the Study were based on a design 10-year storm event (10% annual recurrence interval), with the basic assumptions that the precipitation is uniform across the City and of a sufficiently long duration to fully develop the design flows.

The City of Berkley owns and operates 69 miles of gravity combined sewers that serve as the sewage collection system for the residential, commercial and government owned properties in the City. By definition, a combined sewer is one that transports both domestic sanitary sewage and storm water. During wet weather events, runoff from pavements and ground surfaces is collected in the combined sewers through the catch basins and inlets located along streets, and in parking lots and yards. Some sewers in the City may not have catch basins or inlets connected to them; however, they may still transport some storm water through footing drain or sump pump connections. The City is not unique in terms of having this type of sewer system as many of the City's neighboring communities share in this same system configuration.

The City sewers are tributary to the Southeast Oakland County Sewage Disposal District (SOCSDD), which includes several Drains that are under the jurisdiction of the Oakland County Water Resources Commissioner (WRC). These Drains deliver flows to the Dequindre Interceptor, which is under the jurisdiction of the Great Lakes Water Authority (GLWA) – formerly the Detroit Water and Sewerage Department (DWSD) - and eventually drains to the Detroit Wastewater Treatment Plant. Wet-weather combined flows that exceed the regulated rate to the Interceptor are diverted to the George W. Kuhn

(GWK) combined sewer overflow Retention Treatment Facility (GWK RTF), which is owned and operated by WRC. The schematic below shows an example of a combined sewer system with a retention treatment basin (RTB) facility being overwhelmed when it experiences a 'really big storm' and subsequently overflows to a body of water before it can be dewatered and dumped back into the sewer system and ultimately downstream to a full-service treatment facility. As seen by the illustration, the lower-elevation basements and roadways would experience sewage back-up during these large rain events.



COMBINED SEWER SYSTEM
WITH
RETENTION TREATMENT BASIN
WET WEATHER – REALLY BIG STORM

Even with construction of the 12-Towns Relief Drains in the mid-1960's, the City continued to experience wide-spread basement flooding during certain high intensity rain events. This was attributed to the capacity limitations of the local system. In 1976, a Facilities Plan for Combined Relief Sewers was prepared for the City to present alternatives that would alleviate the recurrence of basement flooding. The intent of that project was to intercept flows from the overloaded local system and transport them more efficiently to fully utilize the available outlet capacity provided by the 12-Towns Relief Drain (now known as the GWK Drain).

By the 1970's, the City had already begun utilizing restricted catch basin covers in certain areas of the local sewer system to further reduce the risk of basement flooding after intense rain events. Catch basin restrictions limit the rate that surface runoff from intense storm events can enter the sewer system by temporarily storing the excess water at the surface (in the roadway) around the catch basin. While a comprehensive catch basin restriction program can produce some benefits in reducing peak flows in the local combined sewers, the benefit is not unlimited because the restricted flow rate continues to increase as the depth of the water ponding around the catch basin increases.

With construction of the relief sewers in the late 1970's and the continued use of restricted catch basin covers throughout the sewer system, the recurring wide-spread basement flooding after certain intense rain events that had historically plagued the City had generally been avoided. However, certain high intensity rain events in 2011 (local), 2014 (regional) and 2017 (local) resulted in basement flooding occurrences, and the City subsequently engaged HRC to prepare this Combined Sewer System Study.

The purpose of the Combined Sewer System Study is to provide the City with an evaluation of the current flow conditions in the system. This evaluation considers the relief sewers constructed in 1977 and the continued use of restricted catch basin covers to reduce peak runoff flows that can enter the sewer system during a rain event. The flow conditions in the sewer system were analyzed in greater detail than in previous studies, and include calculations of the peak flow in each sewer segment for the design storm event, as well as the resulting hydraulic grade line (HGL) elevation from routing that flow through the system. Modern computing techniques and sewer system data available in the City's geographic information system (GIS) enabled this detailed analysis to be completed in an efficient manner.

Section 3 - Design Storm Event

A. GENERAL

The function of a combined sewer system is to transport both the day-to-day municipal wastewater generated from the homes and businesses with sanitary service connections to them, along with storm water that enters the system from precipitation events. Because the amount of storm water that a combined sewer must transport is usually much greater than the "dry-weather" sanitary flows, the designs of the capacity of combined sewers are based on a design storm event. Historically, the basis-of-design for combined sewers was not always thoroughly documented, and many parts of the system could have been built based on "rule-of-thumb" practices: where an 8" diameter segment drain to a 10" segment, which then drains to a 12" segment, and continuing to gradually increase in size until the sewer connected to a County Drain. Modern practice throughout southeast Michigan is to design combined sewers using the 10-year design storm as the basis-of-design.

B. PRECIPITATION AND RECURRENCE INTERVALS

A design storm represents an intensity of rainfall, for a specified duration, based on a statistical analysis of actual, historic rain events for a region. The statistical analysis is performed by the United States National Oceanic and Atmospheric Administration (NOAA) on a national data set consisting of thousands of weather stations. The statistical probability of a specified storm event occurring in a given year is determined from this analysis, and called the recurrence interval, which is represented by a percent chance of occurring. The common convention for using the "year" when referencing design storms was likely established because some people thought that was easier to understand compared to probabilities. In this context, the "year" is the inverse of the recurrence interval. Therefore, a design storm that has a 10% recurrence interval can be referred to as a 10-year storm (1 / 0.10 = 10).

The statistical analysis on the precipitation data set is completed for various durations of storm events, from 5 minutes to 24 hours, and out to 60-days, with other times in between. Design storms are generally referred to by both their recurrence interval and duration; such as 10-year, 1-hour storm event.

These definitions and concepts are unfortunately easily misunderstood. It is a misconception that the recurrence interval represents a period of years that would occur between these types of storms. A 10-year storm has a 10% chance of occurring in ANY year, not once every 10 years. In addition, by their definition, these probabilities do not prohibit similar intensity storms from occurring multiple times in a single year. More information related to precipitation frequency estimates can be obtained by visiting www.noaa.gov. A more detailed explanation of recurrence intervals can be found at https://water.usgs.gov/edu/100yearflood.html.

NOAA periodically updates their precipitation analysis based on recently recorded data. The following table shows how the precipitation amounts for a selection of design storm events and durations have changed over time for southeast Oakland County and the City of Berkley. Note that certain reports did not include values for some of the recurrence intervals.

Table 3-1: 1-Hour Duration Storm Events

		Precipitation Amount (inches) for Various Recurrence Intervals						
Report	Year	1-year 100%	2-year 50%	5-year 20%	10-year 10%	25-year 4%	50-year 2%	100-year 1%
TP-25[2]	1955	-	1.10	1.60	2.00	2.50	2.80	3.10
TP-40[3]	1961	1.00	1.20	1.50	1.70	2.00	2.30	2.50
Bulletin 71[4]	1992	-	-	-	1.66	-	2.23	2.48
Atlas 14[5]	2013	0.95	1.13	1.44	1.70	2.07	2.37	2.67
HRC Design*	1960's+	0.85	1.06	1.71	2.06	2.53	2.88	3.24

* HRC Design based on HRC's analysis of precipitation data from the City of Detroit for the years 1896 to 1957 and used for design of combined sewers for the City of Berkley, Oakland County (including 12-Towns Relief Drains), and other communities in the area

[2] Technical Paper No. 25 – Rainfall Intensity-Duration-Frequency Curves; U.S. Department of Commerce, Weather Bureau, December 1955
[3] Technical Paper No. 40 – Rainfall Frequency Atlas of the United States; U.S. Department of Commerce, Weather Bureau, May 1961
[4] Bulletin 71 - Rainfall Frequency Atlas of the Midwest; Midwestern Climate Center, U.S. Department of Commerce, National Weather Service, National Oceanic and Atmospheric Administration, 1992
[5] NOAA Atlas 14, Volume 8, Version 2.0 – Precipitation-Frequency Atlas of the United States; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, 2013

Table 3-2: 24-Hour Duration Storm Events

		Precipitation Amount (inches) for Various Recurrence Intervals						
Report	Year	1-year 100%	2-year 50%	5-year 20%	10-year 10%	25-year 4%	50-year 2%	100-year 1%
TP-25[1]	1955	-	2.16	2.88	3.60	4.08	4.56	5.28
TP-40[2]	1961	2.10	2.40	3.00	3.50	4.00	4.40	4.80
Bulletin 71[3]	1992	-	2.26	2.75	3.13	3.60	3.98	4.36
Atlas 14[4]	2017	2.08	2.36	2.86	3.32	4.00	4.58	5.20

Evidence of changing precipitation patterns over the years is illustrated in the previous tables by noting the differences in precipitation amount for the same statistical probabilities for recurrence and duration. These values are shown to increase or decrease as more recent data was added to the analysis. While the trend from the 1950's through the 1990's appeared to be decreasing amounts of precipitation for a given recurrence interval, there is now an upward trend appearing over the last 25 years. An example would be for the 10-year, 1-hour storm (10% recurrence interval) has increased from 1.66 to 1.70 inches, which is an approximate 2% increase.

A more significant increase is observed for the 100-year, 24-hour storm (1% recurrence interval), where the precipitation amount has increased from 4.36 to 5.20 inches, which is an approximate 19% increase. Another way to look at this example is to note that in the 1990's, 4.36 inches of precipitation in 24 hours would have been considered the 1% recurrence interval storm, and based on the latest statistical analysis, the same amount of precipitation would now be considered between a 4% and 2% recurrence interval storm.

At the bottom of Table 3-1, there is a row labeled "HRC Design". HRC has been involved with many of the relief sewer projects that have been constructed in the City and in southern Oakland County over the years. In the late 1950's, when the 12-Towns Relief Drains were being planned, HRC performed a statistical analysis of rainfall data collected by the City of Detroit as an independent check on the national publications. These results are included in Table 3-1 (this analysis was only performed for the 1-hour storm event) for comparison, and the precipitation amount for the 10-year event (10% recurrence interval) of 2.06 inches was used for design of the combined relief sewers then. This design storm was adopted by the Oakland County Drain Commissioner for combined sewer projects going forward.

C. *CLIMATE RESILIENCY*

Climate resiliency can be defined as a community's ability to respond to, withstand, and recover from changing precipitation patterns and extreme rainfall events. Recent extreme rain events have exposed the limits of existing sewer systems in communities across southeastern Michigan, including the City of Berkley. The City is committed to understanding the resilience of its infrastructure with respect to changing precipitation patterns. The completion of the Combined Sewer System Study is an important step in support of that commitment.

Within the context of this Study, the discussion on climate resiliency relates to design and performance of the City's combined sewer system. For municipal combined sewer systems, the modern practice has been to use the 10-year, 1-hour storm event as the basis-of-design, and many ordinances have been adopted with this requirement. Sewers designed using 2.06 inches of precipitation in 1-hour for the design storm followed the principals of climate resiliency in effect at that time. The City's relief sewers constructed in the 1970's and the 12-Towns Relief Drains constructed in the 1960's, were designed using those principals as it related to changing precipitation patterns experienced at that time. The amount of precipitation these sewers are designed for exceeds the current 10-year, 1-hour storm value of 1.70 inches from NOAA Atlas 14.

The debate over what recurrence interval storm event should be used for sewer designs has been going on for a long time, and has always been related to balancing the size or capacity of the sewers versus the level of protection these facilities offer (i.e., cost vs. risk). An example of this is illustrated in the 1976 Facilities Plan for the Berkley Sewage Disposal system, where it was concluded that designing the City relief sewers for 25-year or 50-year intensity rainfalls was not feasible because the capacity of the 12-Towns Drain was based on a 10-year rainfall. This conclusion was based on the fact that the cost to construct larger sewers with increased capacity would offer little improvement to their performance, as measured by reducing risk of basement flooding due to sewage backups, because the flow limitations in the outlet sewers would control the hydraulics of the system. The report also mentions that design for storm events less than the 10-year intensity would not be advisable because the capacity available in the outlet sewers would not be fully utilized, and therefore not considered cost effective.

Other design storms are utilized for designing different types of infrastructure where the risk of underperformance or failure outweighs the higher cost to construct facilities to handle more intense storm events. Separate sanitary sewer systems, pump stations, storm water storage facilities, dams/levees, and culverts/stream channels are regularly designed considering the 25-year or 100-year rainfall events.

For the City's combined sewer system, approaching climate resiliency in the future by simply increasing sewer pipe sizes to transport flows from storm events more intense than a 10-year storm is not a feasible alternative. The regional collection and interceptor systems were designed based on a 10-year storm. If the City were to design and build sewers to exceed that, the allowable flows out of the City system would have to be restricted to minimize the risk to other users of the regional systems. Going forward, the City could consider pursuing other opportunities that could handle storm water at its source, within the City boundaries, and by participating in regional initiatives for storm water management. Methods for source storm water control include a comprehensive catch basin restriction program, storm water detention, and low impact development (LID) techniques for individual and larger-scale properties. These methods are addressed in more detail in Section 6 of this Study.

Section 4 - Existing Combined Sewer System

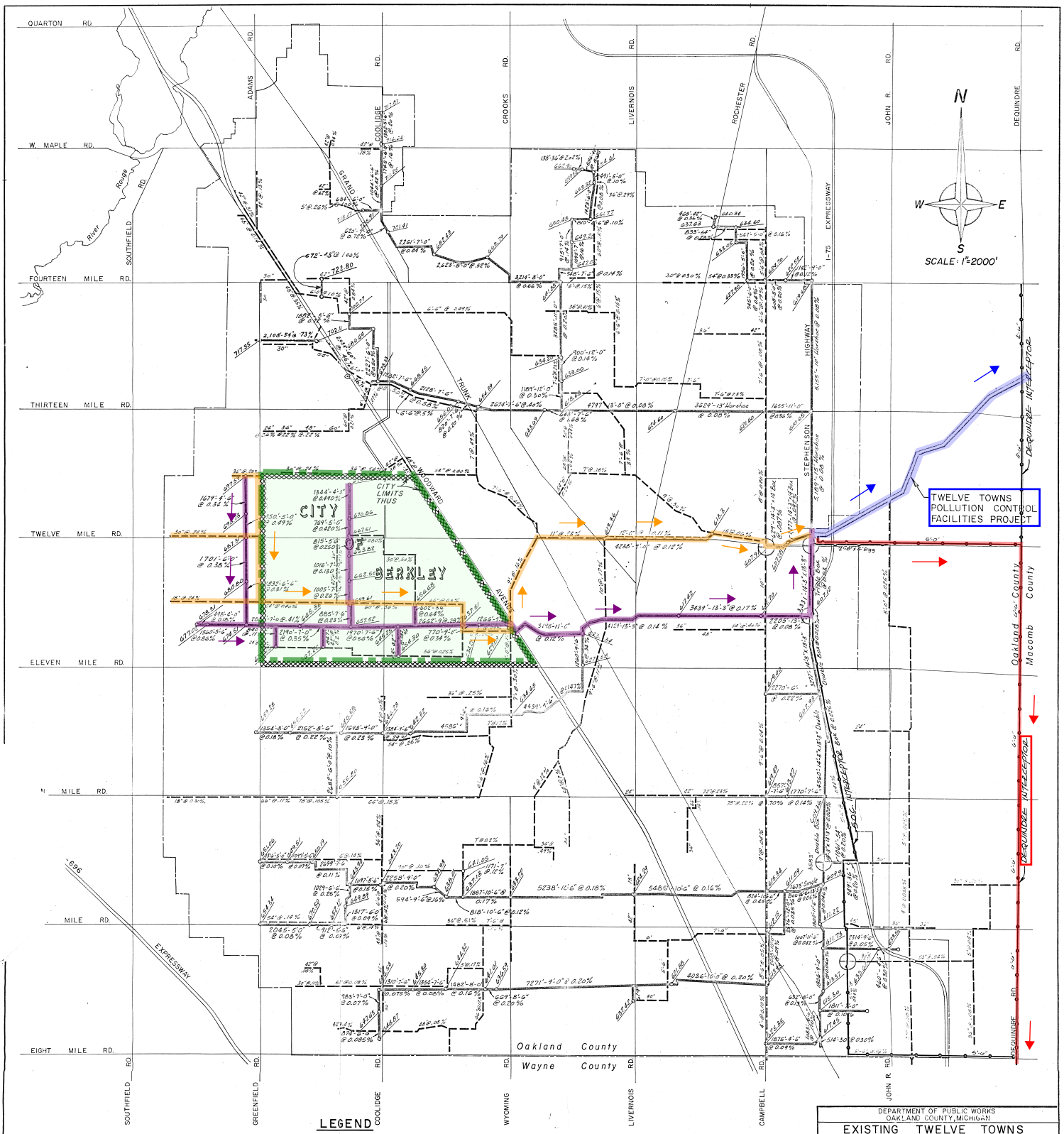
The entire City of Berkley is located within the GWK Relief Drain District (formerly known as 12-Towns Relief Drain District), which lies within the Southeast Oakland County Sewage Disposal District (SOCSDS), and is part of the Clinton River Drainage Basin. The GWK Relief Drain District is a combined sewer system covering over 38 square miles. It discharges to the GWK Pollution Control Facility at Dequindre and 13 Mile Road. Dry-weather and limited wet weather flows are discharged to the Dequindre Interceptor, under the jurisdiction of the Great Lakes Water Authority (GLWA – formerly DWSD), and ultimately discharges to the GLWA Detroit Wastewater Treatment Plant. The amount of combined sewage flow that can be discharged to the Dequindre Interceptor is strictly regulated. Flows in excess of that amount are diverted to the retention facility for either short-term storage and pumped back to the Dequindre Interceptor after the storm event, or will overflow to the Red Run Drain in Warren after receiving primary treatment (settling & skimming) and disinfection within the facility. Figure A shows the entire GWK system.

Within the City of Berkley, several Drains under the jurisdiction of the WRC directly serve the City, and include the Royal Oak Drain, Hubbard Drain, and the George W Kuhn (GWK) Relief Drain (formerly known as the 12-Towns Drain). The Royal Oak Drain and Hubbard Drain were the original outlets for the City's sewers. The Royal Oak Drain runs down Greenfield (at the City of Southfield border), from north of 12 Mile Road, along Catalpa to Cass Avenue where it continues south to Larkmoor and ultimately to Woodward. The Hubbard Drain runs in a south-north direction where Larkmoor intersects Woodward. In the mid-1960's, the Middle Arm of the 12-Towns Drain was installed in the City to provide relief to the Royal Oak Drain. The main route of the 12-Towns Drain is along Oxford from Greenfield (at the City of Southfield border) to Woodward, where it intersects with the Hubbard Drain, and continues on to the Dequindre Interceptor. Another main branch was installed on Robina, from Morrison to Oxford. The 12-Towns Drain, mostly installed by tunneling, is located beneath the City's sewer network.

In the mid-1970's, the City of Berkley installed a series of combined relief sewers to provide additional capacity in the local system to alleviate basement flooding that had been frequently occurring. These sewers generally cross the existing sewers, intercepting flow at those points, and transporting the flow to the WRC Drains. The major relief sewers were constructed on Morrison, Edwards, Beverly, Wiltshire, Berkley, and Mortenson.

For the purposed of conducting this Combined Sewer System Study, the City's existing combined sewer system was divided into drainage subdistricts for analysis. Each subdistrict can be described as a branch, or "sub-network" of sewers that has an outlet to the WRC drain system. A total of 77 subdistricts were defined and analyzed for the purpose of this Study. Each subdistrict varies greatly in size and complexity. The simplest subdistricts are one block long, located at geographic points where a relief sewer intercepts upstream flow, and only flows draining directly to that block continue to the connection to the WRC drain. The larger, more complex subdistricts include the sewer network that drains to branches of the relief sewers. The sewer system has many locations where diversions in flow can occur, depending on the depth of the flow, or if the sewer is in a surcharged state. The subdistricts are shown on Figure B, along with the WRC Drains and larger-diameter City sewer pipes. Also highlighted are connection points to the Drains and points of the system where flow can diverge.

The City of Berkley is essentially completely built-up, and consists of mostly single family residential parcels. Commercial corridors are mainly along Woodward, Coolidge Highway (between 12 Mile and Catalpa), and 12 Mile Road (between Coolidge and Greenfield). Most of the residential development occurred in the 1940's and 1950's. Many of the homes are of modest size, and neighborhoods are somewhat densely developed. In general, land use has likely become more intense since the original development in the 1940's. Impervious surfaces, such as roof areas, pavements, sidewalks, and patios have proliferated over time areas across the City. Examples of this include additions to homes, garages, and driveways. Parking lots have also been expanded. It is important to note, however, that there has not been substantial changes/increases in impervious surfaces throughout the City since the 1970's when the relief sewers were constructed. Because the majority of the City's residential lots are relatively small, when a house is redeveloped, the upgrade is typically vertical and the footprint is not significantly altered.



DEPARTMENT OF PUBLIC WORKS
OAKLAND COUNTY, MICHIGAN

EXISTING TWELVE TOWNS RELIEF SEWERS

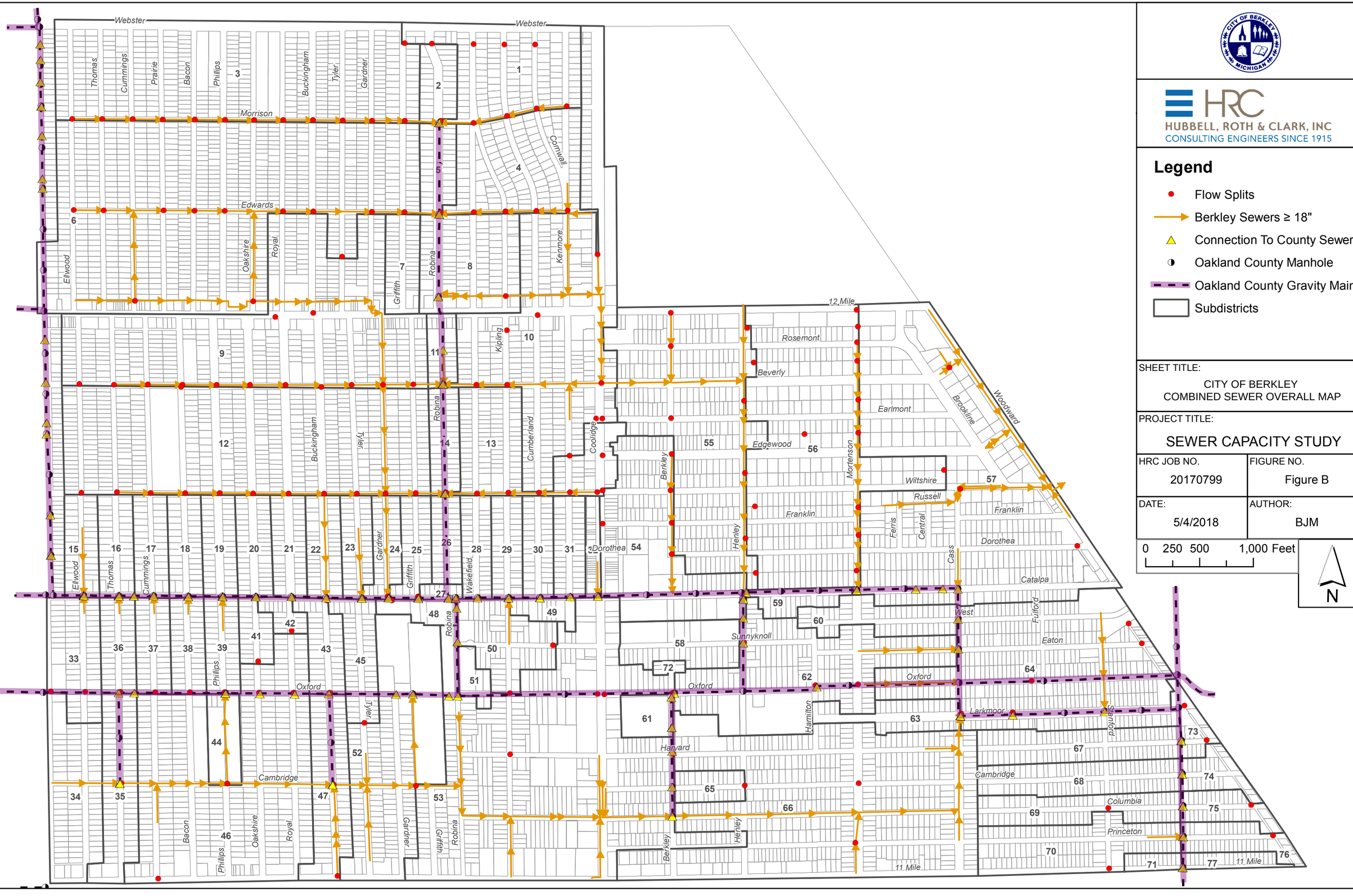
FACILITIES PLANNING
BERKLEY SEWAGE DISPOSAL SYSTEM
COMBINED RELIEF SEWERS
CITY OF BERKLEY, OAKLAND COUNTY, MICHIGAN

JOB NO. 75024
DATE APR. 75

HUBBELL, ROTH & CLARK, INC.
CONSULTING ENGINEERS
2323 FRANKLIN ROAD P.O. BOX 824
BLOOMFIELD HILLS, MICH., 48013

FIGURE No 2

FIGURE A



CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- Flow Splits
- Berkley Sewers ≥ 18"
- Connection To County Sewer
- Oakland County Manhole
- Oakland County Gravity Main
- Subdistricts

SHEET TITLE:
CITY OF BERKLEY
COMBINED SEWER OVERALL MAP

PROJECT TITLE:
SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Figure B
DATE: 5/4/2018	AUTHOR: BJM

0 250 500 1,000 Feet

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Section 5 - Capacity Analysis

A. GENERAL

The Study Area is a combined sewer system, located within one primary combined sewer drainage district of the George W. Kuhn (GWK) Drain District, which is part of the South Oakland County Sewage Disposal District (SOCSDS). The entire City of Berkley is tributary to the GWK Drain. For the purpose of this Study, the primary drainage district was divided into drainage subdistricts for comparative analysis.

In a combined sewer system, the sanitary and storm flows are collected and transported in a single, homogeneous sewer. Sewers have an inherent capacity to effectively transport flow, which is dependent on the size, slope, material and condition of the pipe. When actual flows in the pipe exceed its capacity, the flow in the sewer will surcharge, and in a combined sewer with individual house leads connected to it, may result in the flow backing up into the basements. Surcharge in a flowing pipe is a condition where a pressure must build up to force the flow through, and at places where the pipe network is open, such as in a manhole, this pressure is observed by the depth of water over the top of the pipe.

The City completed a major relief sewer project in 1977 that included construction of new sewers on Morrison, Edwards, Cummings, Oakshire, Beverly, Wiltshire, Berkley, Mortenson, and Phillips. This resulted in a significant improvement to the hydraulic conditions in the combined sewer system. In this Study, sewer design calculations were performed for the combined sewer system, and included consideration of the 1977 sewer improvements. The sewer calculations were used to determine peak design flows, as well as the resultant hydraulic grade line elevations for all of the City's sewer segments. The 10-year design storm was used in these calculations. Further analysis was performed to account for the presence of restricted catch basin covers, and their effect on peak flows and resulting hydraulic grade line elevations.

B. DESIGN CRITERIA

In a combined sewer system, it is typical to design the sewers to accommodate storm flows, because design storm water flows are much greater than sanitary flows alone. In the City of Berkley, and those sewers under the jurisdiction of the Oakland County Water Resources Commissioner (WRC), new combined sewers must be designed to transport storm flows based on the 10-year design storm. A design storm represents the intensity of rainfall, over a specified duration, based on a statistical analysis of historic storm events. The statistical probability of a specified storm event occurring in a given year is determined and called the recurrence interval (represented as a % chance of occurring). The "year" referenced in the design storm is the inverse of the recurrence interval. So a 10-year storm is one that has a 10% chance of occurring in a given year.

Combined sewer calculations were completed using the Rational Method, which calculates peak flow for a sewer segment, on a segment-by-segment basis, starting at the most upstream part of the system, and continuing downstream. The Rational Method uses the following equation:

$$Q = C\ I\ A$$

where Q = flow (cfs), C = runoff coefficient, I = rainfall intensity (in/hr), A = tributary area (acres)

The runoff coefficient, C, is calculated for each individual tributary area based on the amount of impervious surfaces within the particular tributary area using an equation developed by HRC in the 1960's for use in the City and other communities of southern Oakland County:

$$C = 0.6 * \%IA + 0.1$$

with %IA = percent of impervious surface area to the total area

For the 10-year design storm in the southeastern part of Oakland County, Michigan, the rainfall intensity, I, is represented by the following equation:

$$I = 175 / (T_c + 25)$$

wititi.comh T_c being the calculated time of concentration

The tributary area, A, was determined for each sewer system design point (each sewer manhole in this Study) that has catch basins or drainage inlets connected to it that will allow surface runoff to enter the sewer system. Tributary areas were based on an examination of 1-foot contour mapping that uses relatively current satellite-derived surface elevation data in the City's GIS database.

For the purpose of this capacity analysis, it is assumed that all surface runoff that arrives at a design point will be able to enter the sewer system. This can be considered a conservative assumption for the capacity analysis, because in the "real world", certain conditions can reduce the amount of the runoff, or impede the surface flow path the runoff takes to get to the catch basins. As a result, the calculated flow conditions will likely be greater than the flows actually experienced during an actual storm event similar to the design storm. These "real world" conditions that contribute to how much and how quickly surface runoff can enter the sewer system include:

- shallow surface ponding in yards and on pavements
- improper grading of yards
- property development (garages, sheds, landscaping berms, etc.) blocked flow paths
- buried, covered or blocked catch basin covers
- surface slopes steep enough so sheet flow bypasses catch basins
- variability in soil type that may allow more rain water to percolate (or seep) into the ground instead of developing into runoff

Two flow conditions were analyzed, one referred to as to as the "restricted" condition, and the other the "unrestricted" condition. The "restricted" condition represents the existing sewer system because it accounts for the restricted catch basin covers that are currently in place. The "restricted" condition is used in this Study for evaluation of the system capacity and as part of the subdistrict prioritization for future system improvements. The "unrestricted" condition assumes that there are no restricted catch basin covers in place, and does not represent the existing system. The "unrestricted" condition is theoretical and could be used for design purposes for future sewer improvements.

With the Rational Method, the tributary area and associated runoff coefficient is determined for each design point that allows surface runoff to enter the sewer system. One of the basic assumptions with the Rational Method is that the rainfall will be uniform over the tributary area and will have a duration at least as long as the calculated time of concentration at each design point. The Rational Method calculations start at the most upstream end of the sewer system, and proceed in a downstream direction, with the tributary areas accumulating at each step. The Rational Method calculations are generally described as follows:

- The peak design flow for a particular sewer segment is calculated by taking the sum of the tributary area times the runoff coefficient (**C x A**) for all areas upstream of the design point, plus the **C x A** for the area directly tributary to that design point, and then multiplying that result by the calculated rainfall intensity (**I**) for that particular segment.

- The runoff coefficient, **C**, is a number that represents the fraction of precipitation that falls on a particular tributary area that would result in surface runoff. A value of 1.0 indicates every drop of rain will become runoff. For residential areas, typical values for **C** are 0.3 to 0.5. In commercial areas, **C** can typically range between 0.5 to 0.7. Variables that most influence C include the amount of impervious surfaces, slope of the ground, and permeability of soils. For this Study, impervious surface areas within each tributary area were measured using GIS tools and the impervious surface data provided by SEMCOG to member communities in 2013.

- The time of concentration ($\mathbf{T_c}$) is used to calculate **I**, and it will be different for each sewer segment in the system. $\mathbf{T_c}$ generally represents the time it takes for surface runoff to travel from the furthest reach of the tributary area, then through the sewer system, to a design point.

- The velocity of the design flow in each sewer segment is calculated using Manning's Equation to determine the "travel time" through the sewer segment to the next downstream design point.

In this Study, the sewer invert elevations and manhole rim elevations were taken from the City's GIS database for the existing combined sewer system. After design flows are determined for all of the sewer segments, the hydraulic grade line resulting from the design flows being "pushed" or "forced" through the system can be calculated. A sewer is considered to be surcharged when the hydraulic grade line elevation is above the top of the sewer pipe. When a sewer segment is surcharged, there is increased pressure in the sewer line. If there is conduit or space open along the sewer segment, such as at a manhole or building sewer service pipe (or the basement space at the end of the pipe), then the sewage will flow into those open spaces up to the elevation of the hydraulic grade line for that segment. More specifically, when the hydraulic grade line is above basement floor elevations, basements are at risk of flooding.

The capacity of a sewer segment is the flow rate that can be transported through the sewer pipe when it is "flowing-full". The "flowing-full" capacity is calculated using a variation of Manning's Equation, which is dependent on the sewer diameter (**d**), longitudinal slope ($\mathbf{S_o}$), and pipe material for roughness coefficient (**n**):

$$\mathbf{Q_{full} = (0.464 / n) \times d^{8/3} \times S_o^{1/2}}$$

after reducing the equation with information added for area and hydraulic radius for a circular pipe that is flowing full

C. SUMMARY OF CAPACITY ANALYSIS (RESTRICTED CONDITION)

For each combined sewer segment, the calculated design flow is compared to the pipe's "flowing-full" capacity. If the design flow is greater than the pipe capacity, then the sewer segment does not have the capacity for the design storm used in the calculation. For this Study, the 10-year design storm was used to calculate design flows. Please refer to Section 3, Part B, for the definition of a 10-year design storm. An additional calculation was performed to determine the "effective" capacity of the sewer segments that did not have capacity for the 10-year flows. The results of this analysis can be sorted into four categories depending on the calculated storm capability as follows: 10-year storm, 6 to 9-year storm, 2 to 5-year storm, and 1-year storm or less.

For the sewer segments with an "effective" capacity less than a 10-year storm, the pipe size required (if constructed at the same longitudinal slope as the existing pipe) was determined to have capacity for the 10-year storm. These calculated sewer sizes are <u>not</u> intended to be used as a scope-of-work for any future sewer improvements. The calculated size should serve as a guide for preliminary estimating of potential improvement scenarios. Detailed sewer design calculations should be performed for any specific improvement that might be considered.

Based on the sewer design calculations for the "restricted" condition, approximately:

- 71% of the combined sewer system (by length) has capacity for the 10-year storm
- 5% of the combined sewer system has capacity for a 6 to 9-year storm
- 15% of the combined sewer system has capacity for a 2 to 5-year storm
- 9% of the combined sewer system has capacity for a 1-year storm.

In general, if a sewer has a calculated storm capability of a 5-year storm or less, it will tend to surcharge under 10-year storm design conditions, with potential to result in basement flooding. A summary of the design storm capability of the combined sewer system for each drainage subdistrict is summarized on Table 5-1. Figure C graphically shows the design storm capability subdistrict rankings (for "restricted" condition).

As part of the design calculations performed in this Study, the hydraulic grade line was calculated throughout the City's combined sewer system based on design flows for the 10-year storm. Even if a particular sewer segment has the capacity for the design flow, if downstream sewers are in a surcharged condition, the resulting surcharging can extend back, or upstream, potentially resulting in basement flooding. For the purpose of this Study, individual basement elevations were not evaluated with respect to potential sewer surcharging. In evaluating the risk for potential basement flooding due to sewer surcharging, it was assumed that if the calculated hydraulic grade line elevation was 6 feet or less below grade (manhole rim elevation), any homes connected to that sewer segment could potentially experience basement flooding under 10-year storm conditions. Based on this observation, approximately 30% of the homes in the entire combined sewer area are at risk of basement flooding under 10-year storm design conditions. A summary of the sewer surcharging analysis for the combined sewer system within each drainage subdistrict is summarized on Table 5-2. Figure D graphically shows the subdistrict rankings (for "restricted" condition).

D. EFFECT OF RESTRICTED COVERS ON SEWER CAPACITY

For several decades, the City has utilized restricted catch basin covers as a measure to mitigate basement flooding from intense rain events. Restricted covers can limit the peak flow allowed through the cover and into the sewer system during intense rain events. Restricted covers limit flow because there are fewer openings in the restricted cover compared to a standard catch basin cover. Typically, each opening in a manufactured restricted cover has an area of approximately 5 square inches. A 4-hole restricted cover would therefore have a total opening of 20 square inches, compared to a standard cover that has approximately 160 square inches of open area. When a rain event occurs and surface runoff starts building up, the openings in the cover act as a weir and the flow spills into the openings and enters the sewer system. As the surface flow increases, the ability of the restricted cover to easily allow flow in is reached and the openings begin acting as orifices as the water begins ponding over them. While the water is ponded, the restricted discharge rate into the sewer system is a function of the depth, and generally approaches a maximum value

because the physical nature of the available storage areas limits the maximum depth that can practically be achieved. For example, ponding in streets will only fill to the centerline crown elevation or high point along the road, then begin spilling over the crest towards another drainage structure. Ponding depths will vary at each location in the City, but are typically 6 to 8 inches. This condition can become a nuisance if the ponding depth is excessive.

The City owns and maintains a total of 1,725 catch basins or inlets throughout the City. Approximately 59% (or 1,011) currently have restricted covers. 200 restricted covers were recently installed. Figure E shows the subdistricts with the highest percentage of restricted covers currently in use.

For the purpose of this Study, the effect of the existing catch basin restrictions on the design flows, and capacity of the sewer system, was considered. In the sewer calculations, the number of restricted and unrestricted catch basins at each design point (manhole or junction) was determined. The maximum inflow rate for a restricted cover and a standard, unrestricted cover were calculated for typical ponding depths. The total allowable inflow rate for the design point was calculated by multiplying the number of restricted covers and unrestricted covers by their respective maximum inflow rates.

When the calculated surface runoff to a particular design point exceeded the total allowable inflow rate, the restricted covers were considered to be beneficial to the sewer system because the flow into the sewers would be limited to the maximum allowable inflow rate. On a City-wide basis, the effect of the restricted catch basin covers appears to reduce the peak runoff flows for the 10-year storm that can enter the combined sewer system by 33%.

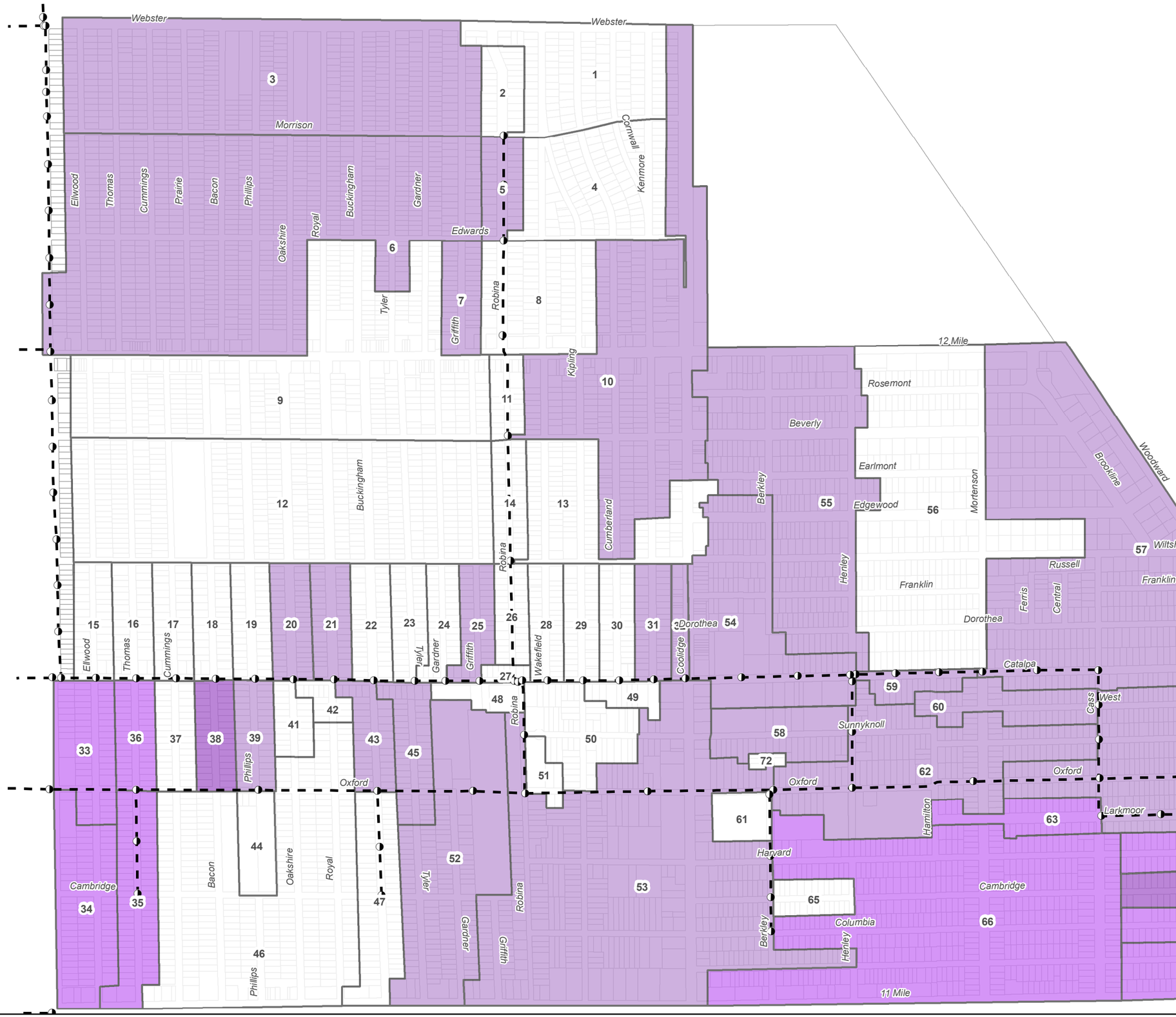
A summary of the restricted cover analysis for the combined sewer system within each drainage subdistrict is summarized on Table 5-3. Figure E graphically shows the restricted cover benefit subdistrict rankings.

Table 5-1
Pipe Capacity Evaluation Ranking (Restricted Condition)

Drainage Subdistricts	Total Sewer Pipe Length	Length of Sewer with 10-Yr. Capacity	Length of Sewer with 6 to 9-Yr. Capacity	Length of Sewer with 5-Yr. or Less Capacity	% of Pipes w/ < 5 Year Storm Capacity	
	Ft	Ft	Ft	Ft	%	Score
38	892	172	0	720	81%	30
68	1903	402	0	1500	79%	30
71	686	0	0	686	100%	30
63	1494	168	346	979	66%	25
67	1897	797	0	1100	58%	25
69	2019	524	405	1090	54%	25
33	1933	1091	0	842	44%	20
34	4320	2069	481	1770	41%	20
35	2373	1344	0	1029	43%	20
36	892	530	0	362	41%	20
66	15624	8614	620	6390	41%	20
70	3811	2045	0	1766	46%	20
74	1159	649	0	509	44%	20
5	871	587	0	283	33%	15
6	22995	14149	1865	6981	30%	15
7	1505	1050	0	455	30%	15
20	956	638	0	317	33%	15
21	954	634	0	319	33%	15
31	970	648	0	322	33%	15
32	1079	749	0	331	31%	15
45	1777	1172	0	605	34%	15
53	19301	11976	714	6338	33%	15
54	6023	3693	45	2286	38%	15
57	20989	14301	432	6257	30%	15
58	1112	780	0	332	30%	15
59	1026	685	0	341	33%	15
62	4821	3085	105	1631	34%	15
73	616	380	0	236	38%	15
3	13378	9936	817	2624	20%	10
10	16325	11758	853	4064	25%	10
25	1258	947	0	312	25%	10
39	1187	871	0	316	27%	10
43	1180	878	0	302	26%	10
52	6019	4452	0	1567	26%	10
55	14304	9477	999	3739	26%	10
60	1538	921	306	311	20%	10
64	9842	6358	1004	2479	25%	10
4	6149	4710	357	1081	18%	5
9	19172	15444	1494	2234	12%	5
13	5176	4255	338	584	11%	5
37	895	724	0	171	19%	5

Table 5-1
Pipe Capacity Evaluation Ranking (Restricted Condition)

Drainage Subdistricts	Total Sewer Pipe Length	Length of Sewer with 10-Yr. Capacity	Length of Sewer with 6 to 9-Yr. Capacity	Length of Sewer with 5-Yr. or Less Capacity	% of Pipes w/ < 5 Year Storm Capacity	
	Ft	Ft	Ft	Ft	%	Score
46	12734	10219	469	2046	16%	5
47	2055	1485	284	285	14%	5
50	2273	1616	414	243	11%	5
56	14073	12260	180	1633	12%	5
1	6022	5345	676	0	0%	0
2	758	758	0	0	0%	0
8	3687	2631	827	229	6%	0
11	795	795	0	0	0%	0
12	14470	12806	993	670	5%	0
14	1008	1008	0	0	0%	0
15	956	956	0	0	0%	0
16	963	963	0	0	0%	0
17	955	955	0	0	0%	0
18	958	958	0	0	0%	0
19	957	957	0	0	0%	0
22	967	967	0	0	0%	0
23	970	970	0	0	0%	0
24	1192	1192	0	0	0%	0
26	979	979	0	0	0%	0
27	421	421	0	0	0%	0
28	969	969	0	0	0%	0
29	974	687	287	0	0%	0
30	974	974	0	0	0%	0
40	12	0	0	0	0%	0
41	897	600	297	0	0%	0
42	614	614	0	0	0%	0
44	839	839	0	0	0%	0
48	615	615	0	0	0%	0
49	740	427	290	23	3%	0
51	316	316	0	0	0%	0
61	239	239	0	0	0%	0
65	676	676	0	0	0%	0
72	286	286	0	0	0%	0
75	984	984	0	0	0%	0
76	1132	1132	0	0	0%	0
77	1005	600	325	80	8%	0



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CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- Oakland County Manhole
- Oakland County Gravity Main

Subdistricts

Pipe Capacity Evaluation Score

- 30
- 20 - 25
- 10 - 15
- 0 - 5

SHEET TITLE:
SUBDISTRICT CAPACITY EVALUATION SUMMARY (RESTRICTED CONDITION)

PROJECT TITLE:
SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Figure C
DATE: 6/22/2018	AUTHOR: BJM

0 250 500 1,000 Feet

N

Table 5-2
Sewer Surcharging Evaluation Ranking (Restricted Condition)

Drainage Subdistricts	# Homes w/ H.G.L. < 6 feet Below Grade	
	REUs	Score
53	609	50
57	215	50
3	169	40
6	107	40
9	107	40
54	102	40
58	162	40
62	124	40
66	191	40
70	115	40
7	80	30
35	54	30
64	97	30
67	69	30
68	81	30
34	25	20
46	47	20
52	22	20
63	38	20
69	44	20
73	25	20
74	33	20
12	6	10
21	11	10
45	13	10
50	10	10
55	2	10
56	10	10
71	5	10
1	0	0
2	0	0
4	0	0
5	0	0
8	0	0
10	0	0
11	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0

Drainage Subdistricts	# Homes w/ H.G.L. < 6 feet Below Grade	
	REUs	Score
20	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
31	0	0
32	0	0
33	0	0
36	0	0
37	0	0
38	0	0
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
47	0	0
48	0	0
49	0	0
51	0	0
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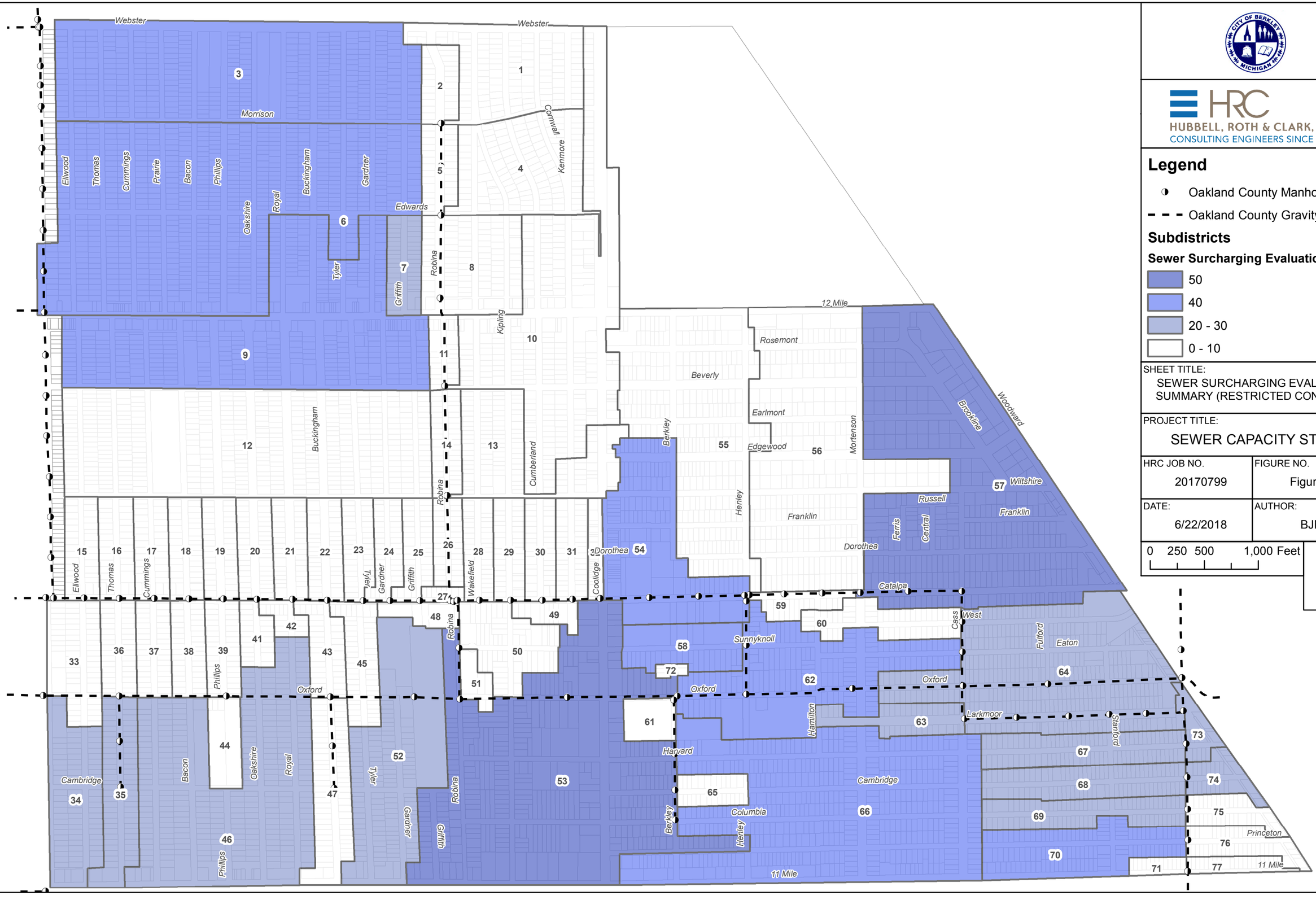
61	0	0
65	0	0
72	0	0
75	0	0
76	0	0
77	0	0



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CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- Oakland County Manhole
- Oakland County Gravity Main

Subdistricts

Sewer Surcharging Evaluation Score

- 50
- 40
- 20 - 30
- 0 - 10

SHEET TITLE:
SEWER SURCHARGING EVALUATION SUMMARY (RESTRICTED CONDITION)

PROJECT TITLE:
SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Figure D
DATE: 6/22/2018	AUTHOR: BJM

0 250 500 1,000 Feet

N

Table 5-3
Restricted Cover Benefit Ranking

Drainage Subdistricts	Total Tributary Area	Total Unrestricted CB	Total Restricted CB	Total CB	% of CB Restricted	Averge C Value (Unrestricted)	Average C_r Value (Restricted)	% Reduction in C Due to Restricted Catch Basin Covers	
	Acre	Num.	Num.	Num.	%			%	Score
30	2.3	3	6	9	67%	0.43	0.43	0%	20
38	3.2	3	3	6	50%	0.38	0.38	0%	20
40	1.4	1	1	2	50%	0.34	0.00	0%	20
48	0.2	1	0	1	0%	0.36	0.36	0%	20
59	2.1	2	2	4	50%	0.44	0.44	0%	20
61	1.1	3	0	3	0%	0.49	0.49	0%	20
72	0.0	0	0	0	0%	0.00	0.00	0%	20
73	2.8	5	0	5	0%	0.63	0.63	0%	20
74	5.4	14	1	15	7%	0.52	0.52	0%	20
76	1.8	5	1	6	17%	0.57	0.57	0%	20
11	3.7	4	3	7	43%	0.51	0.49	5%	15
15	3.4	3	2	5	40%	0.39	0.32	18%	15
23	3.2	3	5	8	63%	0.37	0.30	19%	15
26	3.1	4	2	6	33%	0.40	0.37	6%	15
31	4.5	3	4	7	57%	0.42	0.34	19%	15
32	4.4	7	0	7	0%	0.58	0.52	11%	15
35	12.7	10	9	19	47%	0.41	0.37	11%	15
37	6.4	3	5	8	63%	0.37	0.32	13%	15
43	7.1	6	7	13	54%	0.35	0.34	3%	15
50	6.7	8	9	17	53%	0.41	0.37	10%	15
51	4.1	2	2	4	50%	0.40	0.35	11%	15
60	8.1	6	2	8	25%	0.39	0.34	12%	15
71	5.2	3	1	4	25%	0.48	0.46	3%	15
77	4.6	6	0	6	0%	0.52	0.50	3%	15
6	87.6	95	109	204	53%	0.42	0.30	28%	10
10	46.7	60	65	125	52%	0.43	0.30	30%	10
18	1.8	2	2	4	50%	0.31	0.22	29%	10
20	3.9	3	4	7	57%	0.39	0.29	25%	10
29	8.3	4	2	6	33%	0.42	0.31	26%	10
33	6.7	7	6	13	46%	0.39	0.30	25%	10
39	12.0	6	8	14	57%	0.36	0.27	25%	10
52	29.0	17	21	38	55%	0.43	0.31	29%	10
53	110.3	115	69	184	38%	0.44	0.34	22%	10
54	26.1	26	19	45	42%	0.47	0.37	22%	10
70	14.8	12	11	23	48%	0.43	0.35	20%	10
3	72.3	31	71	102	70%	0.39	0.26	33%	5
7	7.0	4	8	12	67%	0.45	0.31	31%	5
9	70.5	67	56	123	46%	0.47	0.31	34%	5
13	17.9	16	13	29	45%	0.45	0.28	38%	5
14	7.8	4	4	8	50%	0.40	0.27	33%	5
21	5.9	4	5	9	56%	0.38	0.26	32%	5
44	0.0	0	3	3	100%	0.20	0.13	37%	5
46	71.4	31	61	92	66%	0.37	0.24	34%	5
47	6.3	5	12	17	71%	0.38	0.25	35%	5
57	104.6	80	46	126	37%	0.39	0.26	34%	5
64	54.0	36	45	81	56%	0.43	0.26	39%	5
68	8.5	5	7	12	58%	0.42	0.27	36%	5
69	5.8	4	5	9	56%	0.42	0.29	31%	5
1	21.9	9	26	35	74%	0.39	0.17	57%	0
2	4.5	0	5	5	100%	0.36	0.09	74%	0
4	27.6	2	33	35	94%	0.36	0.14	62%	0
5	7.3	1	5	6	83%	0.35	0.12	65%	0
8	19.7	4	23	27	85%	0.41	0.15	62%	0
12	3.6	28	60	88	68%	0.40	0.21	47%	0

Table 5-3
Restricted Cover Benefit Ranking

Drainage Subdistricts	Total Tributary Area	Total Unrestricted CB	Total Restricted CB	Total CB	% of CB Restricted	Averge C Value (Unrestricted)	Average C_r Value (Restricted)	% Reduction in C Due to Restricted Catch Basin Covers	
	Acre	Num.	Num.	Num.	%			%	Score
16	3.0	1	4	5	80%	0.38	0.14	64%	0
17	2.0	1	6	7	86%	0.38	0.22	42%	0
19	2.3	0	6	6	100%	0.38	0.14	63%	0
22	7.0	1	5	6	83%	0.35	0.14	61%	0
24	6.0	1	7	8	88%	0.38	0.11	70%	0
25	5.9	3	8	11	73%	0.41	0.19	53%	0
27	0.0	0	3	3	100%	0.42	0.16	62%	0
28	3.9	1	3	4	75%	0.45	0.14	68%	0
34	19.0	10	9	19	47%	0.41	0.24	42%	0
36	5.9	3	3	6	50%	0.38	0.19	50%	0
41	8.5	2	5	7	71%	0.39	0.21	45%	0
42	2.1	0	2	2	100%	0.37	0.08	80%	0
45	8.4	4	8	12	67%	0.39	0.22	43%	0
49	7.0	2	7	9	78%	0.37	0.17	54%	0
55	94.5	39	70	109	64%	0.39	0.20	47%	0
56	36.7	15	23	38	61%	0.38	0.19	49%	0
58	7.8	2	3	5	60%	0.45	0.20	56%	0
62	24.8	13	26	39	67%	0.40	0.23	41%	0
63	17.7	3	5	8	63%	0.33	0.12	64%	0
65	8.4	1	5	6	83%	0.41	0.12	71%	0
66	80.9	42	58	100	58%	0.41	0.22	47%	0
67	13.7	3	5	8	63%	0.41	0.18	57%	0
75	3.9	2	2	4	50%	0.49	0.15	69%	0

CITY OF BERKLEY MICHIGAN

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Legend

- Oakland County Manhole
- Oakland County Gravity Main

Subdistricts

% Reduction in C Score	% of Restricted CBs
20	≥ 60%
15	> 0% and < 60%
10	0%
0 - 5	

SHEET TITLE:
SUBDISTRICT RESTRICTED COVER BENEFIT SUMMARY

PROJECT TITLE:
SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Figure E
DATE: 6/22/2018	AUTHOR: BJM

0 250 500 1,000 Feet

N

Document Path: Y:\2017\20170799\03_Studies\Working\GIS\Maps_For_Final_Report\Restricted_Condition\Bin_Ponding\Figure_E_Restricted_Cover_Benefit.mxd

Section 6 - Sewer System Improvements

A. PRIORITIZING SEWER SYSTEM IMPROVEMENTS

In this Section, the resulting subdistrict scores and rankings were combined to present a prioritization concept that can be applied to the combined sewer system. When this sewer capacity-related information is considered along with the sewer condition assessments, a better understanding of the overall condition of the sewer system is presented, and will assist the City with future planning of sewer capital improvement projects.

For convenience, the scoring for each category will range from potentially 100 points for subdistricts with high ranking in each of the categories being evaluated, to 0 points for those with the lowest ranking. The weighted scores used are as follows:

- 30 points for "restricted" condition design storm capacity (higher score means fewer sewers with 10-year storm capacity)
- 50 points for surcharging concern (higher score means more buildings are connected to sewers with HGL 6 feet or less below grade)
- 20 points for restricted cover benefit (lower score means more catch basin cover restrictions are in place and are effective at reducing peak runoff inflow rates)

With these weighted scores, an emphasis is placed on possible sewer surcharging conditions that could result in basement flooding, compared to sewers with "restricted" condition capacities of a 5-year storm or less. This rationale will tend to put subdistricts with shallower, under-sized sewers higher in the ranking compared to other subdistricts that may have similar capacity concerns, but have deeper sewers that can tolerate more surcharging before basement flooding might occur.

Another observation can be made from the prioritization ranking and the benefit of using restricted catch basin covers. The ranking is done using "reverse" scoring, where 0 points are assigned to subdistricts with the greatest degree of benefit from existing restricted catch basin covers, and 30 points are assigned to subdistricts with the least benefit. Subdistricts with "restricted" condition capacity concerns with catch basin restrictions already in place will tend to be lower in the prioritization ranking compared to those subdistricts with similar capacity concerns but do not have catch basin restrictions in place. This rationale was made so that the prioritization ranking

more accurately reflects "existing" conditions, and that the City's resources can be applied in an effective manner.

The Combined Sewer System Capacity Study Prioritization Rankings for the subdistricts is shown on Table 6-1. The higher ranked subdistricts are shown graphically on Figure F.

B. FUTURE CAPITAL IMPROVEMENTS AND SEWER IMPROVEMENT STRATEGIES

HRC recommends that the City consider the following broad recommendations:

- Develop and implement a long-range sewer system improvement plan. This plan would provide the framework for including sewer capacity improvements for future infrastructure projects and coordinating with the County on specific projects or opportunities related to increasing sewer capacities.
- Develop preliminary design concepts and cost estimates for subdistrict improvements, starting with the subdistricts with the highest prioritization ranking (refer to Table 6-1). Preliminary design concepts for improvements would help determine the possible strategies (refer to Table 6-2) for increasing capacity and provide the preliminary scope-of-work for potential alternatives, estimated costs for improvements, and discussion of sequence or schedule for implementation.
- The remaining subdistricts of the City could be addressed on a street-by-street basis as opportunities arise and be combined with other future infrastructure projects.

The following discussion and recommendations provide the City with a general understanding of areas where the sewer system could benefit from improvements. They are not meant to serve as a defined sewer improvement program. Subdistricts can be grouped into "tiers" based on the rankings, and all those within the highest scoring "tier" can be considered equal with respect to sewer improvement consideration. The prioritization of subdistricts (as outlined in Table 6-1) can be used as a tool, along with sewer condition assessments, to help the City develop future sewer improvement projects. These can also be considered in conjunction with road paving assessments and water system conditions to create a comprehensive approach to infrastructure improvements within the City.

Strategies for improving how the sewer system functions can include segment-by-segment replacement of combined sewers, combined relief sewers, storm sewer relief, parallel sanitary sewer installation, detention/retention of storm flows (combined sewage or storm water), implementing comprehensive catch basin restrictions, and taking advantage of low impact development (LID) opportunities where available. Selection of the appropriate strategy for any given area will require further investigation and analysis so that the "best" strategy is implemented, considering level of service improvement, cost and timing. Engagement of the public may be advisable for certain strategies, especially those that will change or limit the public's use of land (including road right-of-way) following the improvements. The following are sewer improvements strategies that could be considered by the City and are summarized in Table 6-2.

- Comprehensive Catch Basin Restriction Program:

  For certain subdistricts, a viable approach to reducing peak wet-weather flows could be to increase the number of restricted covers in that subdistrict. Catch basin restriction programs are generally more effective in areas with simple sewer networks and should be carefully designed so that surface runoff is not diverted to other areas that cannot tolerate additional flow. In addition, the surface conditions and grading must be evaluated to prevent temporary flooding during rain events and excessive ponding that can become a nuisance or result in property damage. Also note that restricted covers can be easily removed, thereby allowing storm water to enter the sewers more quickly and possibly overload the system. The City currently has a large number of restricted covers in use.

- Segment-by-Segment Replacement:

  This is most applicable for simple networks (one or more branches) where the sewer network outlets have sufficient capacity and hydraulic performance. With this method, sewers segments could be replaced, starting at the downstream end, with new sewers that are sized to transport the design flows without surcharging. This method can be coordinated with other planned infrastructure improvements such as road replacement projects. Another benefit of this method is that the aged sewers are removed, and the new sewers could be designed with a minimum 75-100-year service life with proper installation and maintenance. This approach is applicable in many of the subdistricts.

- Combined Relief Sewers:

  With this strategy, new combined sewers are designed to intercept flows from the existing system and deliver them to a point of the network that has sufficient capacity and hydraulic performance. As the relief sewers intercept flows, the flows in the portion of the existing sewer lines downstream of the relief are reduced, potentially not requiring further improvement. Incorporating this strategy into other infrastructure improvements being completed on a street-by-street basis can be done. This requires significant planning and coordination because the relief sewers must be constructed starting with the downstream end, and proceeding in an upstream direction. This strategy can be advantageous in the larger subdistricts with a more intricate sewer network.

- Storm Sewer Relief:

  This strategy requires that the combined sewer downstream of the connection from the storm sewer has sufficient capacity and hydraulic performance. This method has an additional potential to protect the City's investments where recent combined sewer lining has been performed to restore service life of those facilities. In most cases, construction of storm sewers are less expensive on a foot-by-foot basis compared to combined sewers because they can be installed at shallower depths, and don't have building services connected to them. As a general practice, sump pump leads or other private lateral storm lines are connected to the drainage structures, not the pipe. This strategy can best be used in situations where the sewer segments requiring relief are isolated, and removal of the catch basins connected to them reduces the design flow sufficiently.

- Sanitary Sewer Separation (new sanitary sewer):

  This strategy consists of constructing a parallel sanitary sewer system adjacent to the existing combined sewer. Sanitary leads from all homes would connected to the new sanitary sewer and the existing sewer would be converted to carry only storm water. The major drawback of this technique is that it requires construction on most city streets. It would take decades and be very expensive to install a parallel sanitary pipe network and make new sanitary lead connections. This would obviously be very expensive and inconvenient for residents and business owners. Another drawback is that the City discharges all sewer flows into the county combined sewer system. This strategy is best used in developing communities that do not have an existing road and combined sewer network.

- Storage Facilities (Combined or Storm Water):

  For certain subdistricts, there may be an opportunity to consider implementing a large-scale storage facility for storing sewage. It could be located either underground or at the surface if storing only storm water. City-controlled property could be used to construct one of these facilities, such as a park, vacant property, or even road right-of-way. For example, on the streets with wide boulevard areas that are generally higher than the road, they could be re-graded to form above ground storm water detention volume. New storm sewers could be installed along the street to direct the flow from catch basins into the detention system, which would in turn be restricted prior to discharging back into the combined sewer system.

- Low Impact Development (LID) Measures:

  LID measures, also known as best management practices (BMP's) in certain contexts, are intended to intercept storm water in some manner before it has a chance to get into the sewer system (sometimes referred to as "source control"). After intercepting the storm water, LID measures use one or more of the following mechanisms to handle storm water:

  - storage
  - transpiration/evaporation
  - infiltration

  Because clay (with low permeability rates) is the predominant subsoil in the Berkley area, infiltration is generally not significant, although systems can be engineered to take advantage of what is available.

  Common BMP's include rain gardens, bio-swales, rain barrels, cisterns, pervious pavement, and vegetated roofs. These measures could be implemented on a small scale by individual property owners, or as part of a larger scale initiative lead by the City or other agency. While it may be a good practice to implement these types of measures when opportunities arise, they generally don't have a significant impact on peak flow reduction for the 10-year or more intense-type storm events. They are generally designed to intercept the low intensity, longer duration events that occur most of the time, and have overflows for when the measures are overwhelmed by the higher intensity events. Their bigger impact is on reducing the amount of storm water that enters the sewer system on an annual basis, and the costs associated with transporting and treating that storm water

as sewage. A good resource for LID is the LID Manual for Michigan, published by SEMCOG, which can be referenced online at http://semcog.org/Reports/LID/index.html.

Funding for future sewer improvement could be achieved through a number of sources, including:

- Sewer rate adjustments ("pay-as-you-go" approach)
- Millage proposals (with associated bond sales)
- State Revolving Fund loan (requires a Project Plan and high score on the State of Michigan project list) with sewer rate adjustment to payback loan
- Petitioning the Water Resources Commissioner for a drain extension (special assessment through WRC or bond sale for "at-large" special assessment)
- Certain storm sewer improvements could be funded through Storm Water Utility proceeds

The City's sewer system is an intricate, interconnected system, and there is not a single, best solution for all areas. Understanding there is no ultimate "fix" for addressing sewer capacity issues for every amount of rainfall that could occur in a combined sewer system and considering that the City does not have unlimited financial resources for infrastructure improvements, initial efforts should be focused in areas that could potentially benefit the most residents and help reduce the risk of basement flooding under design storm conditions. This Study is a first step in the process, prioritizing the drainage subdistricts based on sewer capacity conditions. Preliminary design of potential improvements in higher priority areas, or as opportunities arise in the lower priority areas, will help determine specific projects that could be implemented.

Table 6-2: Sewer System Improvement Strategy Summary		General Cost Range
Applications/Advantages	**Challenges**	
Comprehensive Catch Basin Restriction Program		
• Easy to implement, can use City forces • More effective in areas with simple sewer networks • Targeted implementation - can be quicker • Flexibility in deployment - can be removed if found to cause nuisance ponding	• Must be carefully planned and designed so that surface runoff is not diverted to other areas that cannot tolerate additional flow • Surface conditions and grading must be evaluated to prevent excessive or nuisance ponding • Restricted covers can be easily removed allowing storm water to enter the sewers more quickly and overload the system	$200 to $300 each ($100k to $200k total)
Segment-by-Segment Replacement		
• Focus on sewers w/ 5-year storm capacity • Designed for 10-year storm capacity • New sewers w/ 75-100-yr design life • Long-term solution • Single sewer system to maintain • Can be completed on a street-by-street basis • Applicable to all subdistricts	• Costly and disruptive to public • Long time to implement • May not eliminate all surcharging for 10-year storm and will not prevent surcharging during extreme rain events	$39 million to $45 million (City Wide)
Combined Relief Sewers		
• Focus on sewers w/ 5-year storm capacity • Designed for 10-year storm capacity • New comb sewers w/ 75-100-yr design life • Flows downstream of relief interconnections are reduced and may not need further improvements • Targeted implementation - can be quicker • Applicable to larger subdistricts with an intricate sewer network • Usually less overall cost (subdistrict basis) compared to line-by-line replacement	• Costly and disruptive to public • Requires significant planning as the relief sewers must be constructed from downstream to upstream • Will not eliminate all surcharging for 10-year storm and will not prevent surcharging during extreme rain events	$400k to $600k per 1,000 ft
Storm Sewer Relief		
• Applicable near sewer system outlets • Designed to remove flow from comb sewer to improve capacity of comb system • New storm sewers w/ 75-100-yr design life • Targeted implementation - can be quicker • Less construction cost vs. comb sewer (shallower, no service connections)	• Costly and disruptive to public • Will not eliminate all surcharging for 10-year storm and will not prevent surcharging during extreme rain events • Dual sewer system - more maintenance costs	$300k to $400k per 1,000 ft
Sanitary Sewer Separation (new sanitary sewer)		
• New san sewer has less wet weather flow • New san sewer w/ 50-year design life • Long-term solution • Applicable to all subdistricts	• Most costly and disruptive to public • Sanitary outlets to combined GWK Drains • Footing drains still a wet weather flow component • Have 2 sewer systems to maintain • Very long time to implement	$85 million to $105 million (City Wide)

Table 6-2: Sewer System Improvement Strategy Summary		General Cost Range
Applications/Advantages	**Challenges**	
Storage Facilities (Combined or Storm Water)		
• Constructed "offline" of sewer system - less disruptive to public • Storage can be in a basin facility, or by linear storage in oversized sewers/tunnel or in surface detention basins • Can be implemented w/series of smaller basins • Applicable to subdistricts where land or ROW is available and accessible • Land above facility may be used for recreational purposes	• Requires significant parcel(s) of land • High capital costs • High long-term O&M costs, energy costs • Will not eliminate all surcharging for 10-year storm and will not prevent surcharging during extreme rain events • Long time to implement & permit	$40k to $180k per 10,000 gallons
Low Impact Development (LID) Measures		
• Intended to intercept and handle storm water before it enters the sewer system • Can be implemented on a small scale or larger scale initiative • Designed to intercept the low intensity, longer duration events with overflows for higher intensity events • Reduces the amount of storm water that enters the system on an annual basis and the costs associated with transporting and treating the storm water as sewage	• Do not have a significant impact on peak flow reduction for the 10-year+ storm events • Will not eliminate surcharging for 10-year storm and will not prevent surcharging during extreme rain events	Varies

Table 6-1
Capacity Study Subdistrict Prioritization Ranking (Restricted Condition)

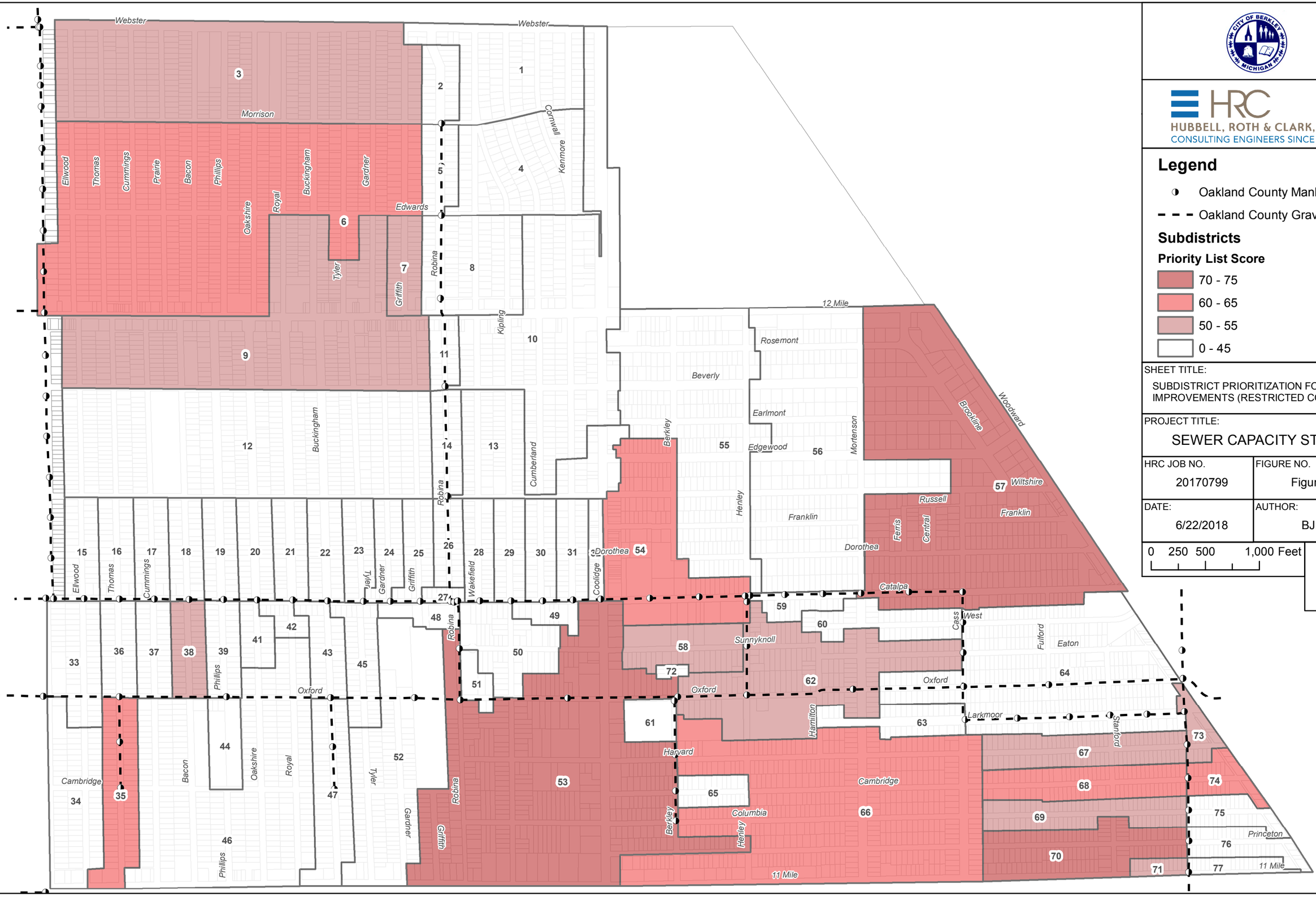
Drainage Subdistricts	% of Pipes w/ < 5 Year Storm Capacity		# Homes w/ H.G.L. < 6 feet Below Grade		% Reduction in C Due to Restricted Catch Basin Covers		Total Score
	%	Score	REUs	Score	%	Score	
53	33%	15	609	50	22%	10	75
57	30%	15	215	50	34%	5	70
70	46%	20	115	40	20%	10	70
6	30%	15	107	40	28%	10	65
35	43%	20	54	30	11%	15	65
54	38%	15	102	40	22%	10	65
68	79%	30	81	30	36%	5	65
66	41%	20	191	40	47%	0	60
74	44%	20	33	20	0%	20	60
3	20%	10	169	40	33%	5	55
58	30%	15	162	40	56%	0	55
62	34%	15	124	40	41%	0	55
67	58%	25	69	30	57%	0	55
71	100%	30	5	10	3%	15	55
73	38%	15	25	20	0%	20	55
7	30%	15	80	30	31%	5	50
9	12%	5	107	40	34%	5	50
38	81%	30	0	0	0%	20	50
69	54%	25	44	20	31%	5	50
63	66%	25	38	20	64%	0	45
64	25%	10	97	30	39%	5	45
34	41%	20	25	20	42%	0	40
52	26%	10	22	20	29%	10	40
59	33%	15	0	0	0%	20	35
21	33%	15	11	10	32%	5	30
31	33%	15	0	0	19%	15	30
32	31%	15	0	0	11%	15	30
33	44%	20	0	0	25%	10	30
46	16%	5	47	20	34%	5	30
50	11%	5	10	10	10%	15	30
20	33%	15	0	0	25%	10	25
43	26%	10	0	0	3%	15	25
45	34%	15	13	10	43%	0	25
60	20%	10	0	0	12%	15	25
10	25%	10	0	0	30%	10	20
30	0%	0	0	0	0%	20	20
36	41%	20	0	0	50%	0	20
37	19%	5	0	0	13%	15	20
39	27%	10	0	0	25%	10	20
40	0%	0	0	0	0%	20	20
48	0%	0	0	0	0%	20	20

Note: Listed in Priority Order

Table 6-1
Capacity Study Subdistrict Prioritization Ranking (Restricted Condition)

Drainage Subdistricts	% of Pipes w/ < 5 Year Storm Capacity		# Homes w/ H.G.L. < 6 feet Below Grade		% Reduction in C Due to Restricted Catch Basin Covers		Total Score
	%	Score	REUs	Score	%	Score	
55	26%	10	2	10	47%	0	20
61	0%	0	0	0	0%	20	20
72	0%	0	0	0	0%	20	20
76	0%	0	0	0	0%	20	20
5	33%	15	0	0	65%	0	15
11	0%	0	0	0	5%	15	15
15	0%	0	0	0	18%	15	15
23	0%	0	0	0	19%	15	15
26	0%	0	0	0	6%	15	15
51	0%	0	0	0	11%	15	15
56	12%	5	10	10	49%	0	15
77	8%	0	0	0	3%	15	15
12	5%	0	6	10	47%	0	10
13	11%	5	0	0	38%	5	10
18	0%	0	0	0	29%	10	10
25	25%	10	0	0	53%	0	10
29	0%	0	0	0	26%	10	10
47	14%	5	0	0	35%	5	10
4	18%	5	0	0	62%	0	5
14	0%	0	0	0	33%	5	5
44	0%	0	0	0	37%	5	5
1	0%	0	0	0	57%	0	0
2	0%	0	0	0	74%	0	0
8	6%	0	0	0	62%	0	0
16	0%	0	0	0	64%	0	0
17	0%	0	0	0	42%	0	0
19	0%	0	0	0	63%	0	0
22	0%	0	0	0	61%	0	0
24	0%	0	0	0	70%	0	0
27	0%	0	0	0	62%	0	0
28	0%	0	0	0	68%	0	0
41	0%	0	0	0	45%	0	0
42	0%	0	0	0	80%	0	0
49	3%	0	0	0	54%	0	0
65	0%	0	0	0	71%	0	0
75	0%	0	0	0	69%	0	0

Note: Listed in Priority Order



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CITY OF BERKLEY MICHIGAN

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Legend

- Oakland County Manhole
- Oakland County Gravity Main

Subdistricts

Priority List Score

- 70 - 75
- 60 - 65
- 50 - 55
- 0 - 45

SHEET TITLE:
SUBDISTRICT PRIORITIZATION FOR SEWER IMPROVEMENTS (RESTRICTED CONDITION)

PROJECT TITLE:
SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Figure F
DATE: 6/22/2018	AUTHOR: BJM

0 250 500 1,000 Feet

N

Appendix A

Existing Sewer System Maps

Webster

Cummings

Prairie

Phillips

Oakshire

Tyler

Morrison

Ellwood

Thomas

Bacon

Edwards

Royal

Gardner

Griffith

Robina

1 inch = 250 feet

N

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

CITY OF BERKLEY MICHIGAN

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SHEET TITLE: AREA 1	
PROJECT TITLE: SEWER CAPACITY STUDY	
HRC JOB NO. 20170799	FIGURE NO. Appendix A
DATE: 5/4/2018	AUTHOR: BJM

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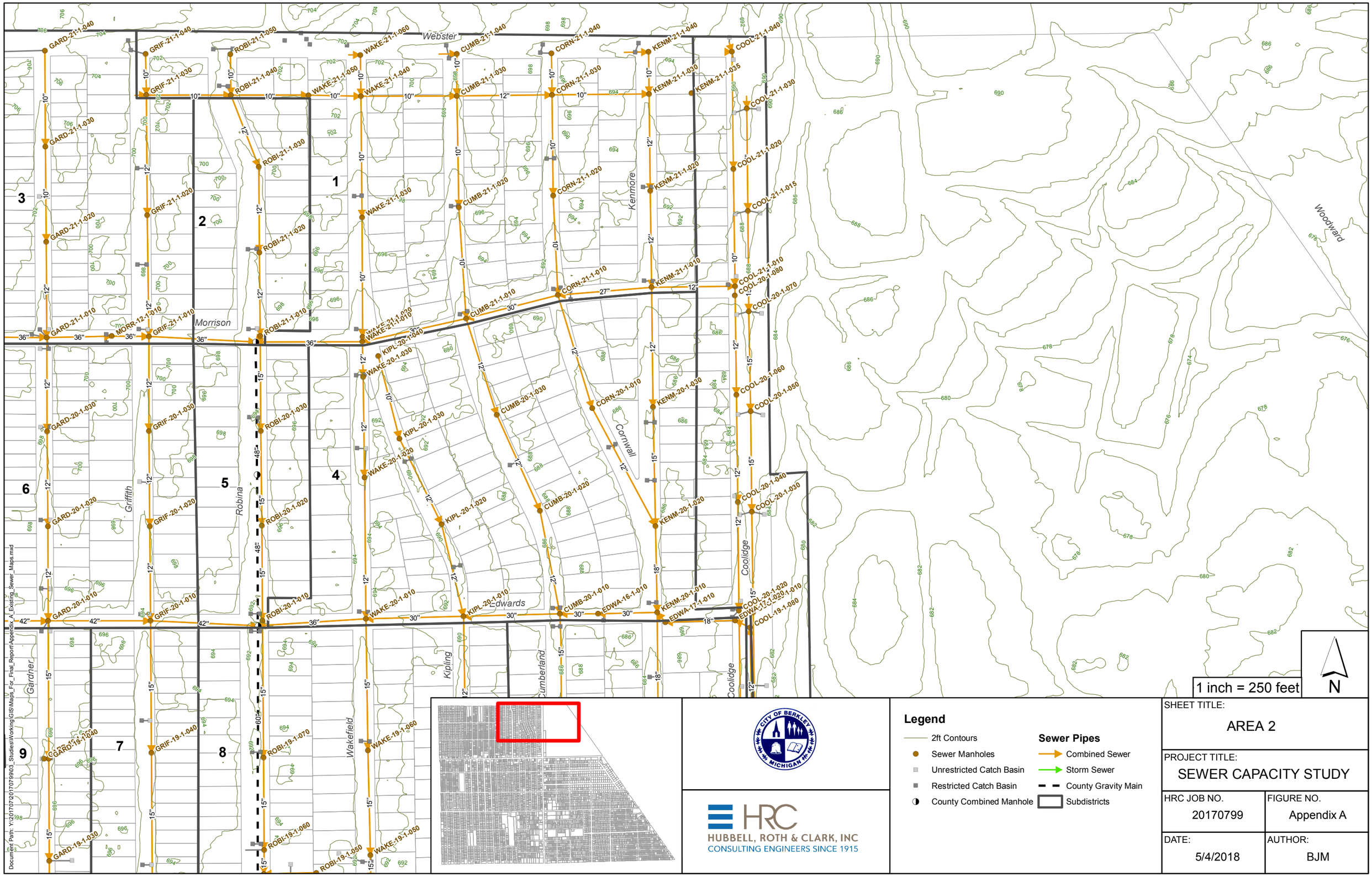

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CITY OF BERKLEY MICHIGAN

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Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

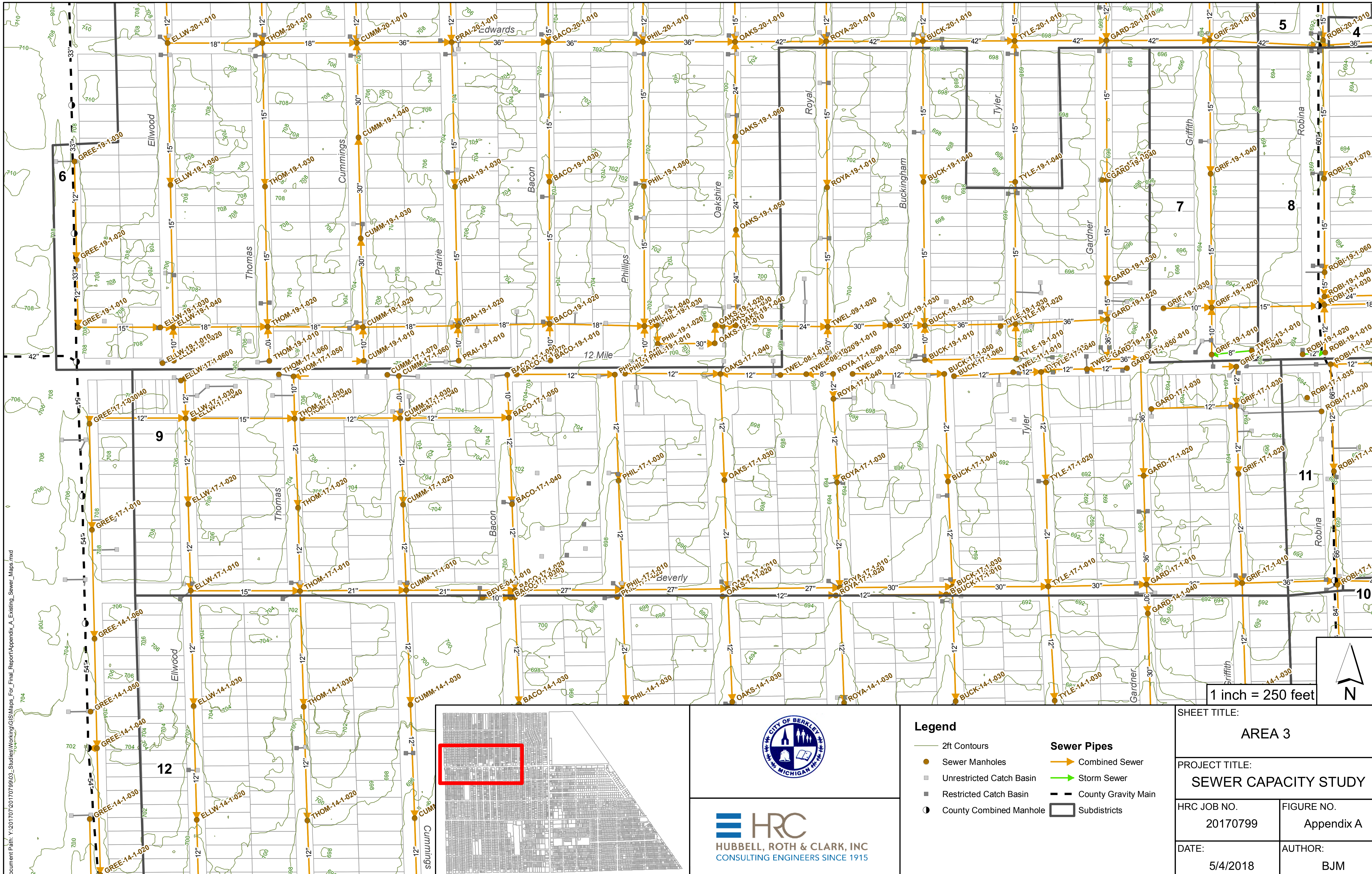
Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 2

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM



Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

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CITY OF BERKLEY MICHIGAN

SHEET TITLE: AREA 3	
PROJECT TITLE: SEWER CAPACITY STUDY	
HRC JOB NO. 20170799	FIGURE NO. Appendix A
DATE: 5/4/2018	AUTHOR: BJM

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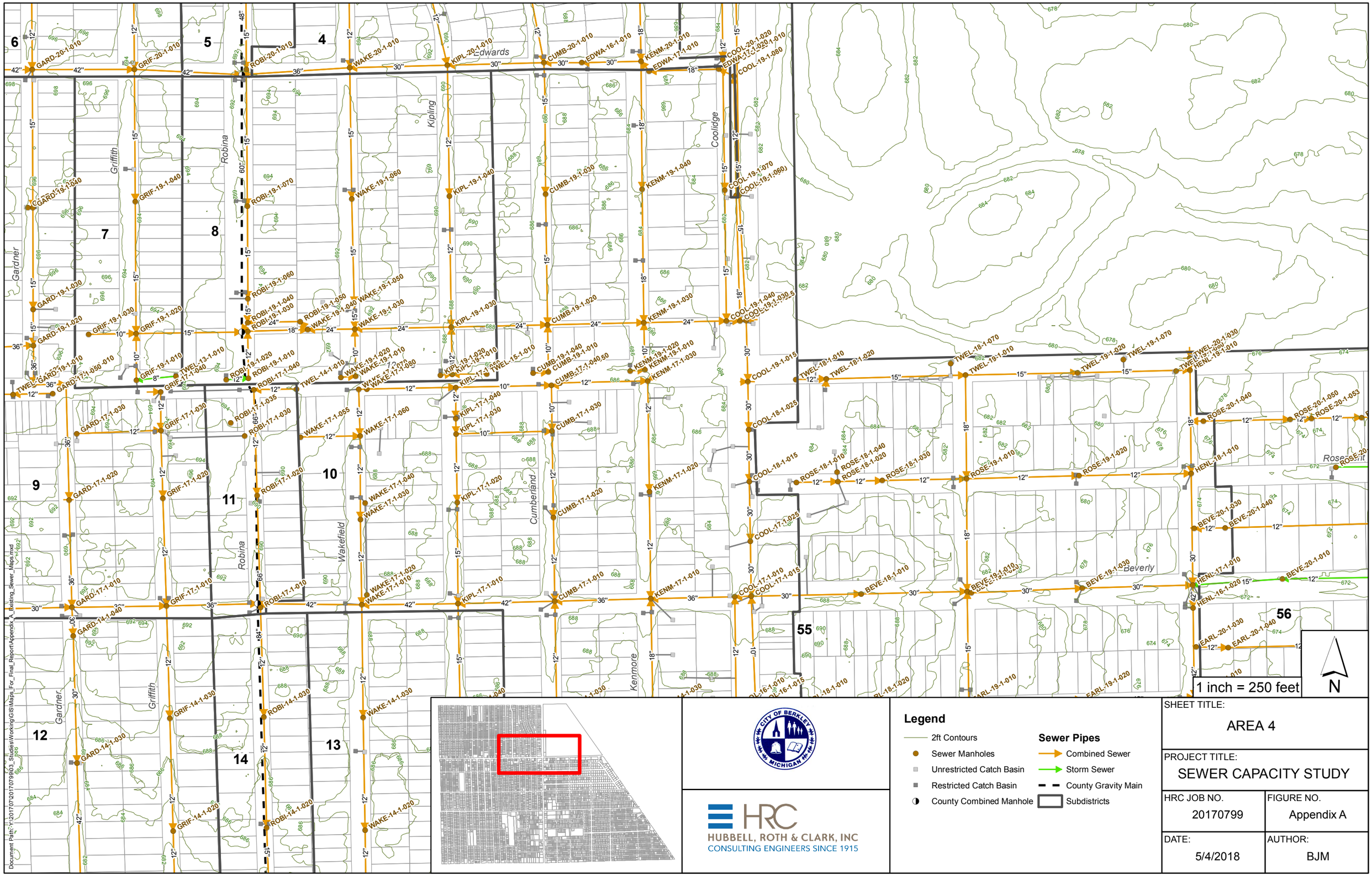

HRC
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CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 4

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM

Document Path: X:\2017\07\20170799\03_Studies\Working\GIS\Maps_For_Final_Report\Appendix_A_Existing_Sewer_Maps.mxd

Beverly

Wiltshire

Gardner

Buckingham

Ellwood

Bacon

Cummings

Thomas

Royal

Tyler

Robina

1 inch = 250 feet

N

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CITY OF BERKLEY MICHIGAN

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Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

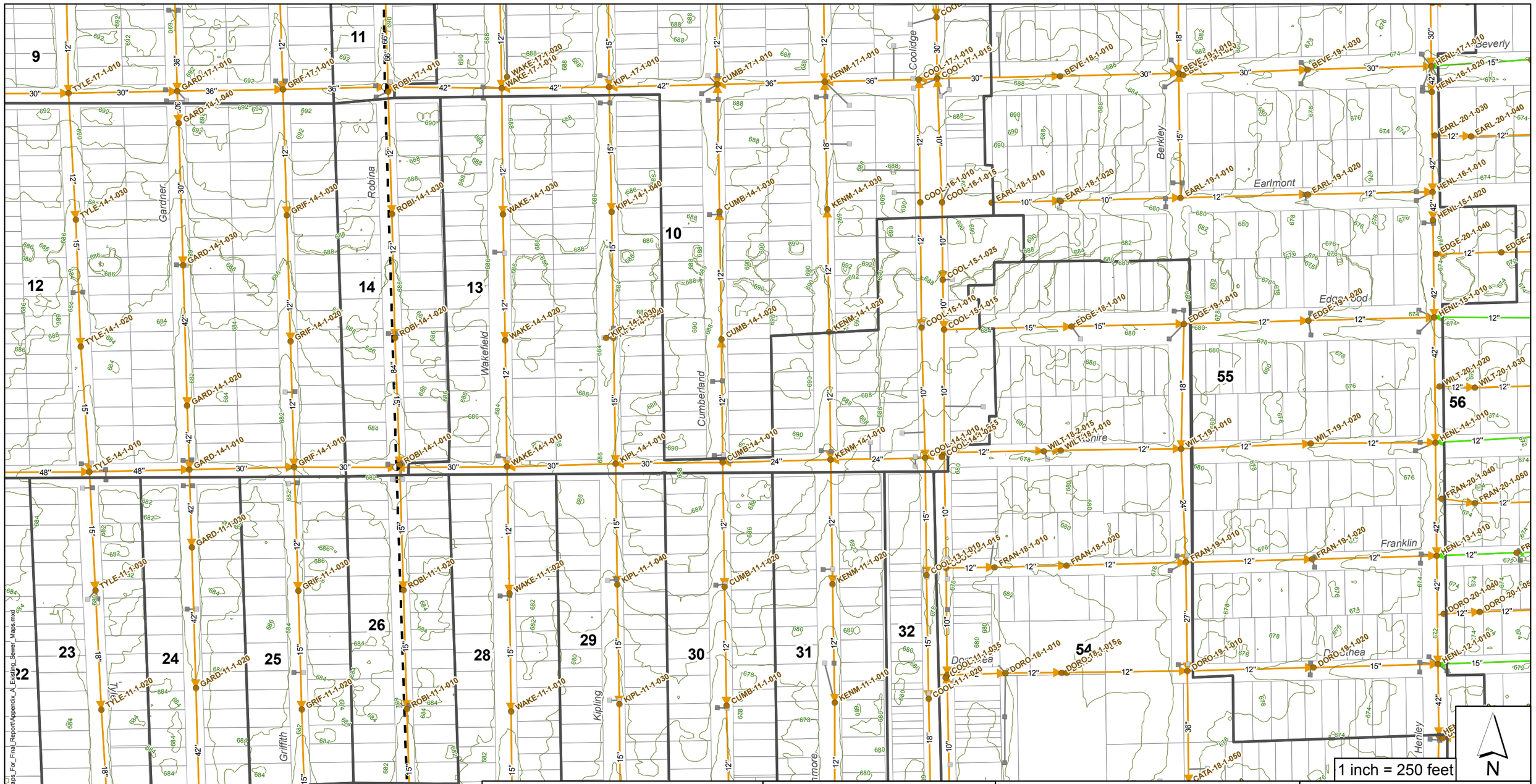
Sewer Pipes

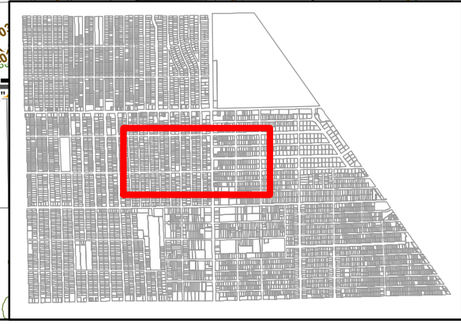
- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 5

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM





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CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

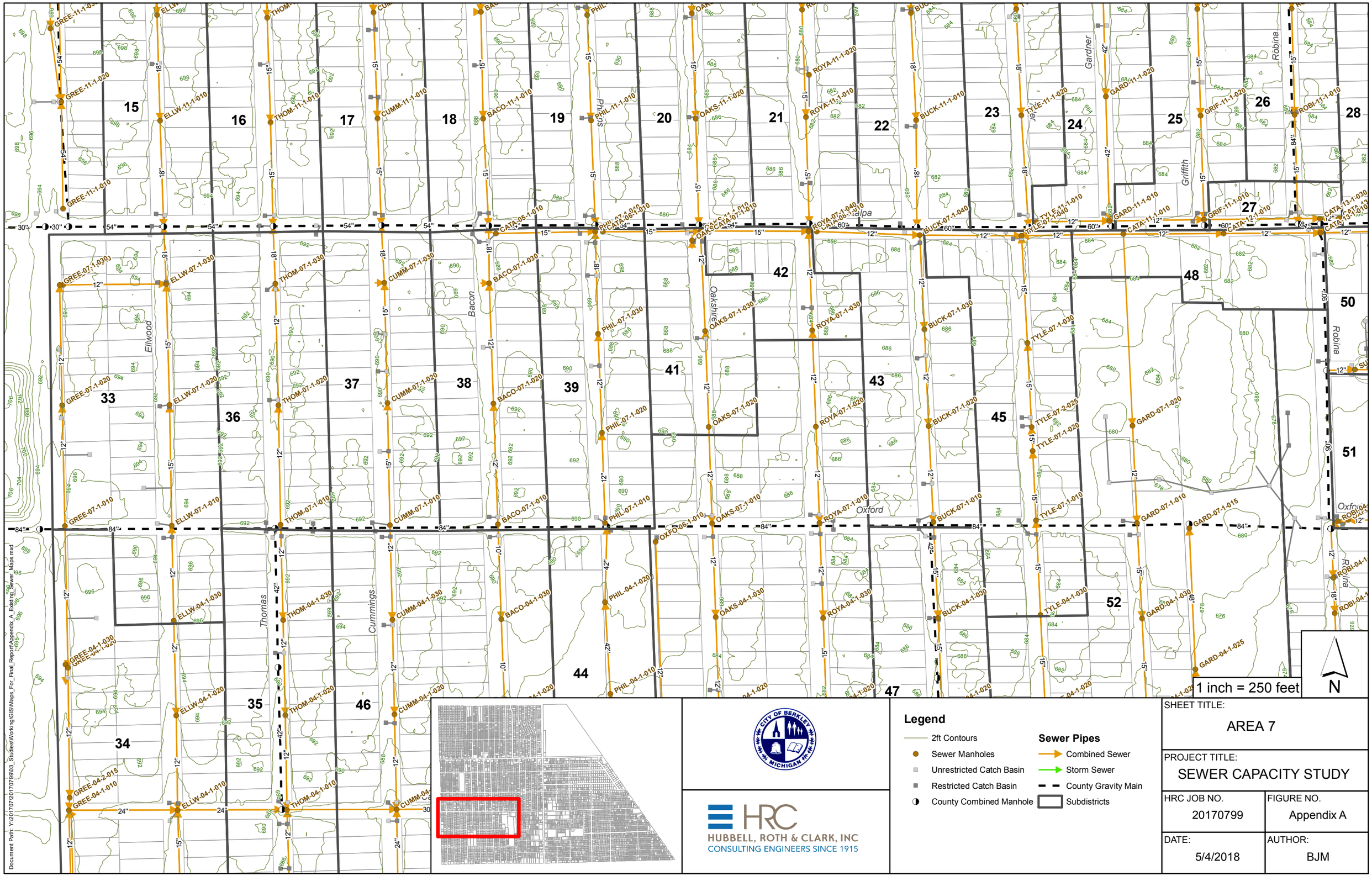
Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 6

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM



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CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

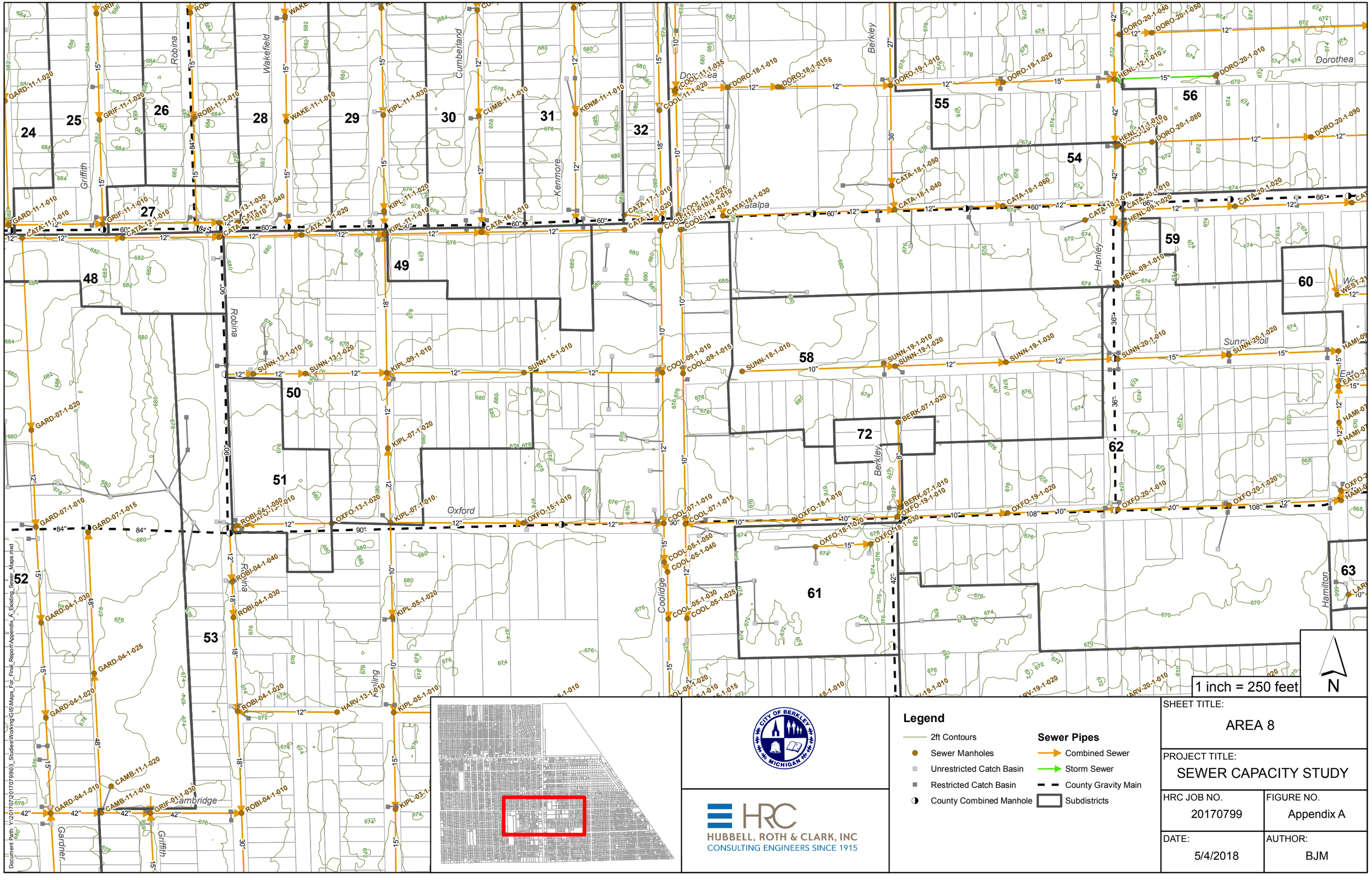
Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 7

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM



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HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

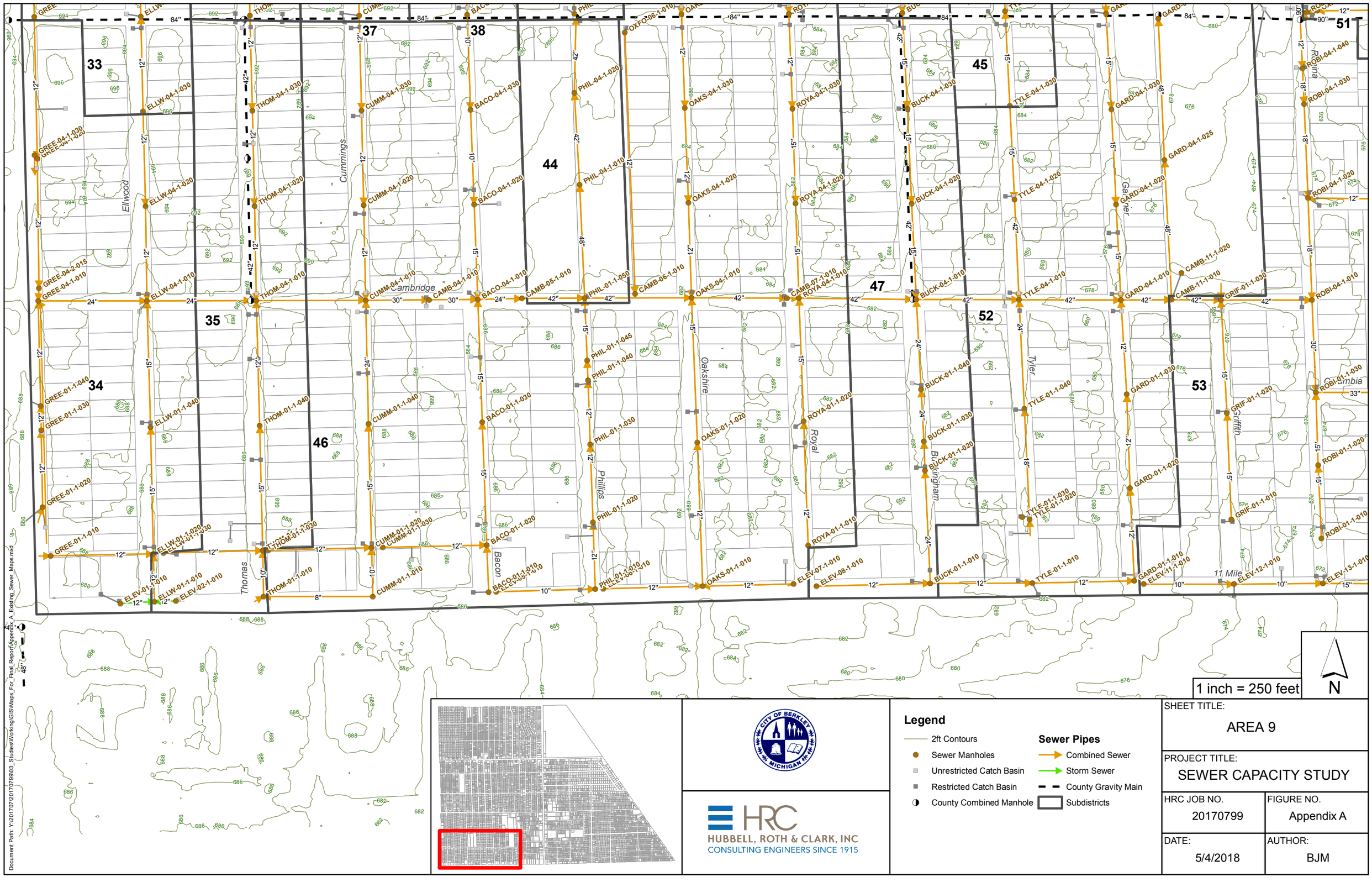
Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 8

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM



CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 9

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM

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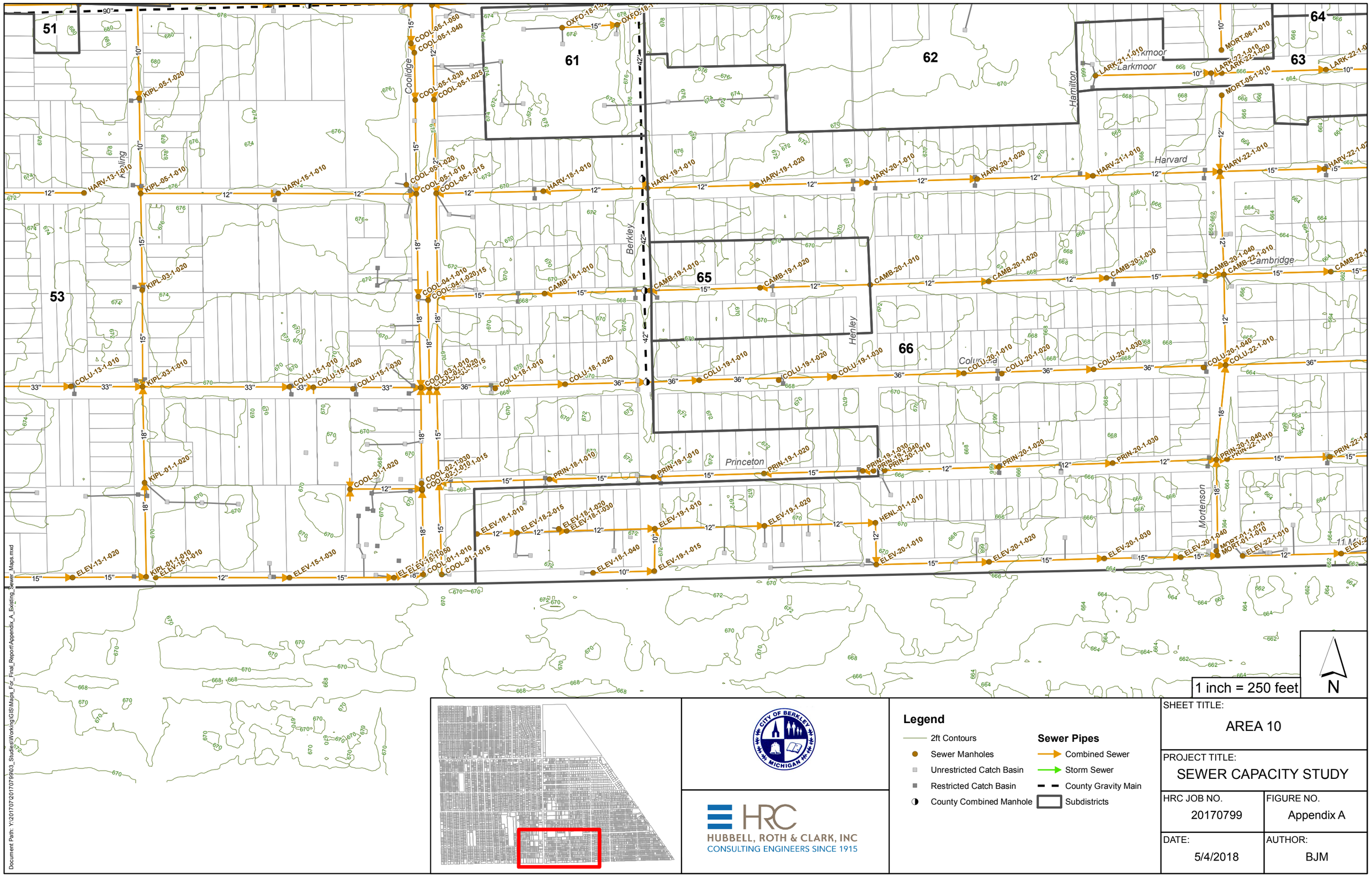


Legend

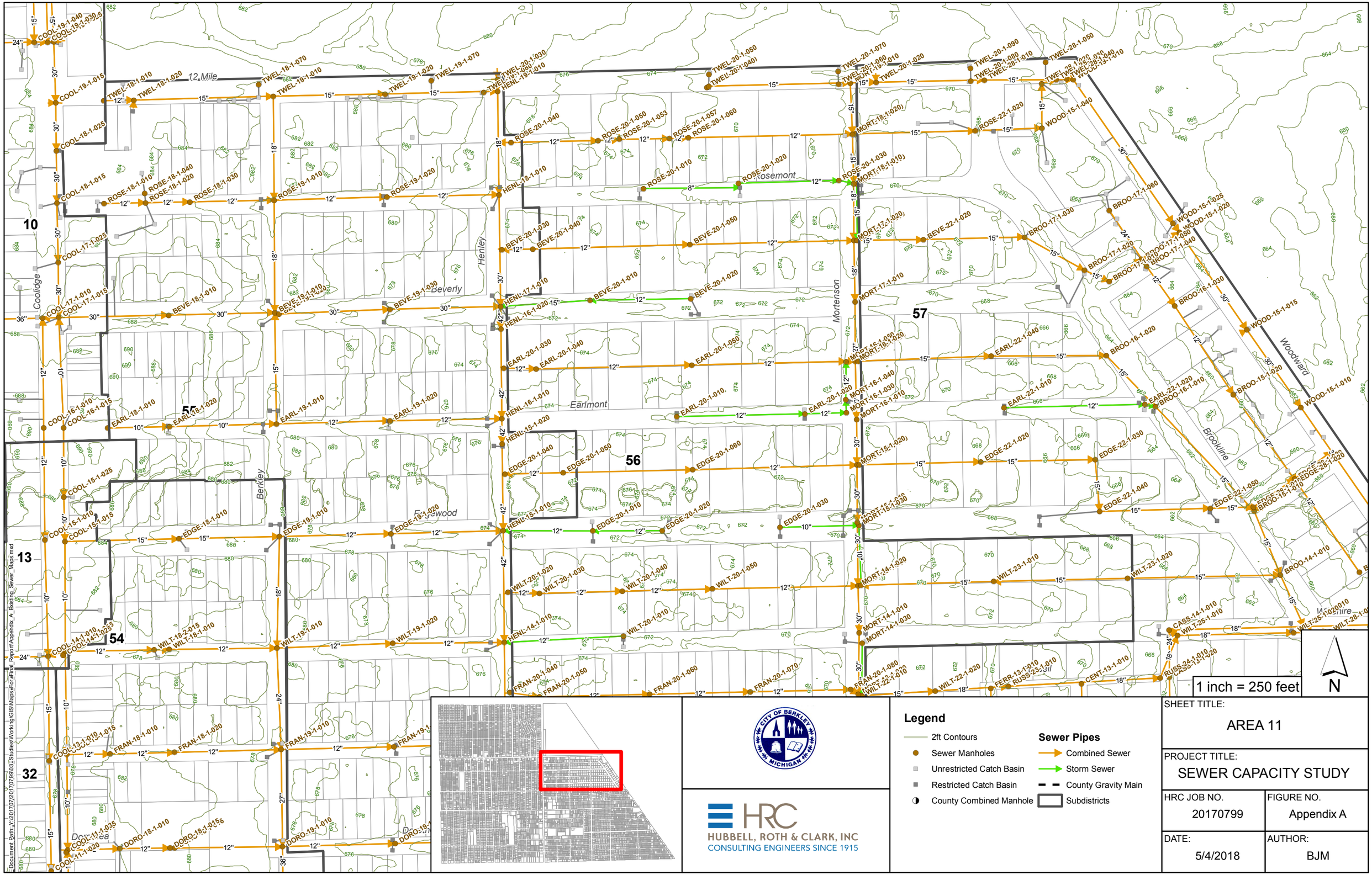
- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

SHEET TITLE: AREA 10	
PROJECT TITLE: SEWER CAPACITY STUDY	
HRC JOB NO. 20170799	FIGURE NO. Appendix A
DATE: 5/4/2018	AUTHOR: BJM



Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

SHEET TITLE: AREA 11

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM

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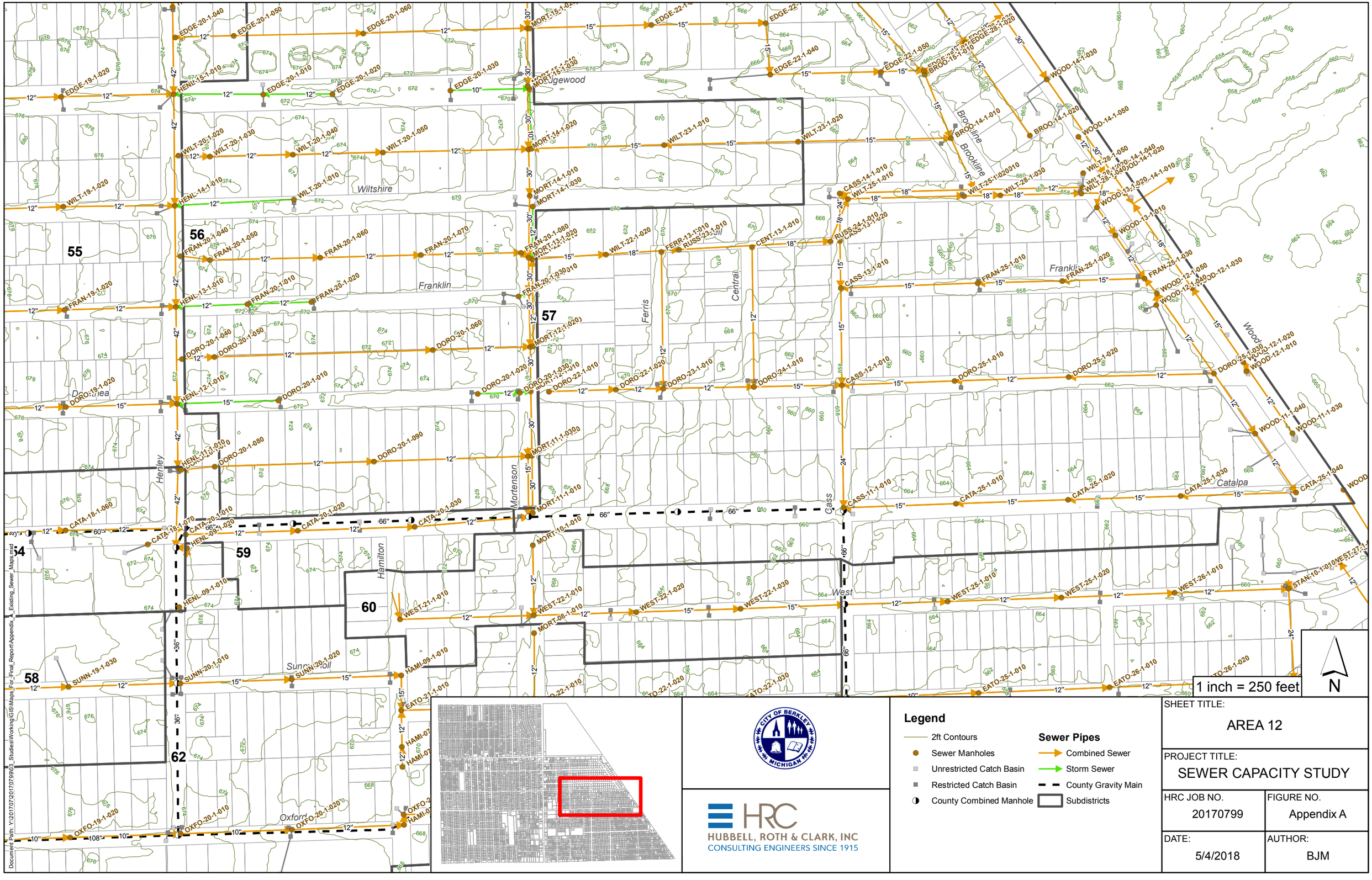


CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

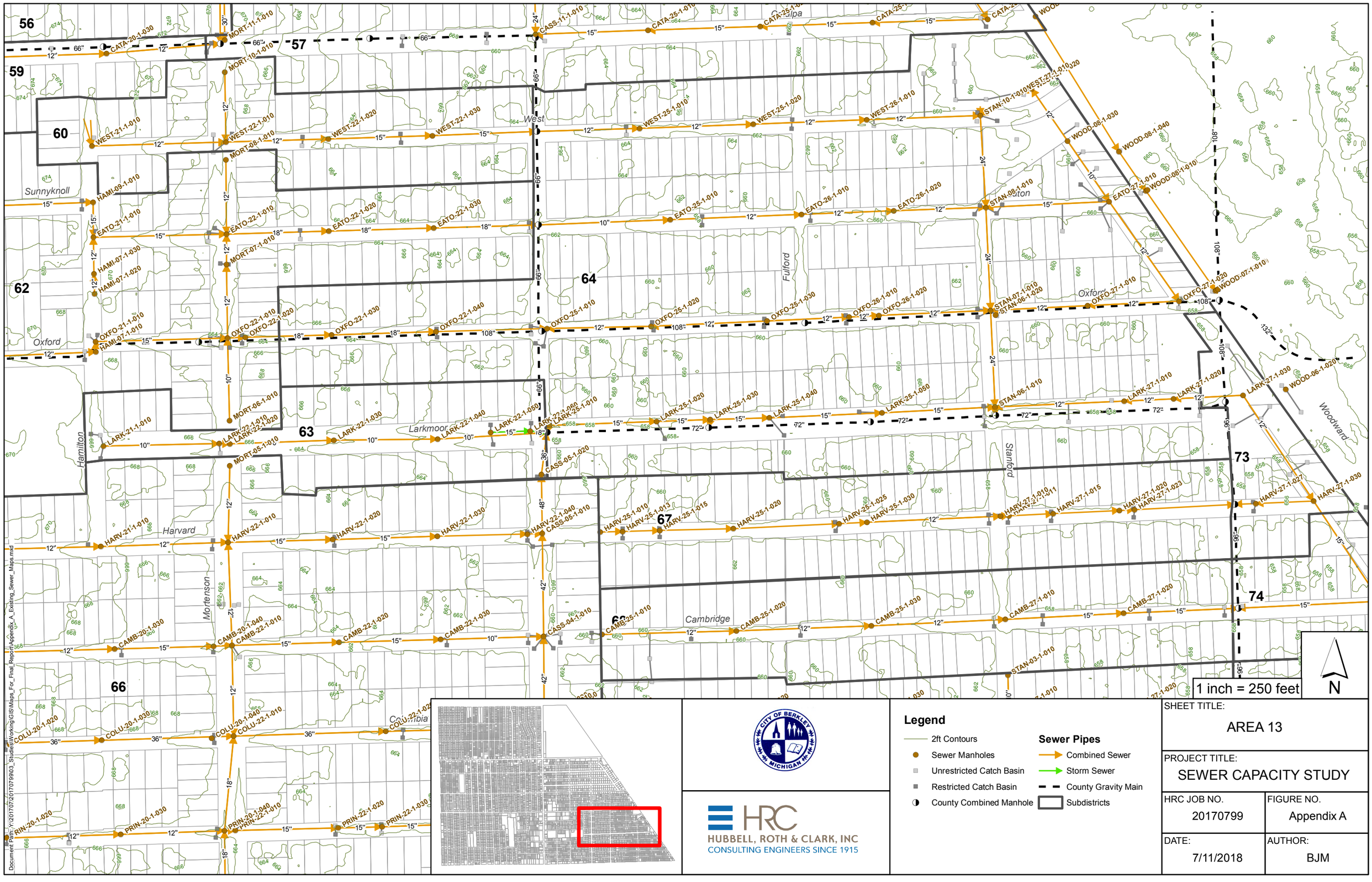
- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 12

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 5/4/2018	AUTHOR: BJM

Document Path: Y:\20170\20170799\03_Studies\Working\GIS\Maps\For_Final_Report\Appendix_A_Existing_Sewer_Maps.mxd



CITY OF BERKLEY MICHIGAN

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

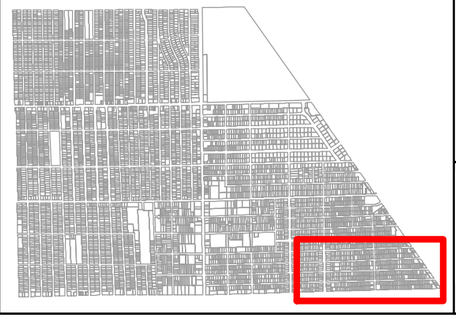
SHEET TITLE: AREA 13

PROJECT TITLE: SEWER CAPACITY STUDY

HRC JOB NO.	FIGURE NO.
20170799	Appendix A
DATE: 7/11/2018	AUTHOR: BJM

Document Path: Y:\2017\07\20170799\03_Studies\Working\GIS\Maps_For_Final_Report\Appendix_A_Existing_Sewer_Maps.mxd

Larkmoor
Harvard
Cambridge
Columbia
Stanford
Woodward
Cass
Princeton
11 Mile
63
64
65
66
67
69
70
71
73
74
75
76
77
72"
96"
84"
1 inch = 250 feet
N



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HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Legend

- 2ft Contours
- Sewer Manholes
- Unrestricted Catch Basin
- Restricted Catch Basin
- County Combined Manhole

Sewer Pipes

- Combined Sewer
- Storm Sewer
- County Gravity Main
- Subdistricts

SHEET TITLE: AREA 14	
PROJECT TITLE: SEWER CAPACITY STUDY	
HRC JOB NO. 20170799	FIGURE NO. Appendix A
DATE: 7/11/2018	AUTHOR: BJM

Appendix B

Sewer Flow Calculations

(unrestricted condition)

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
MORRISON LATERAL (EAST) - 37																
Robina Avenue	1	ROBI-21-1-050	ROBI-21-1-040	0.9	3	1.4	122	10	3.831%	4.3	5.7	5.0	-2.9	-67.0%	10	
Wakefield Road	1	WAKE-21-1-060	WAKE-21-1-040	1.0	4	1.7	123	10	2.905%	3.7	6.2	5.5	-2.1	-55.5%	10	
Cumberland Road	1	CUMB-21-1-040	CUMB-21-1-030	0.6	4	1.0	126	10	0.834%	2.0	6.7	6.0	-1.0	-49.3%	10	
Cornwall Street	1	CORN-21-1-040	CORN-21-1-030	0.6	4	1.0	125	10	1.982%	3.1	6.1	5.4	-2.1	-66.7%	10	
Kenmore Road	1	KENM-21-1-040	KENM-21-1-030	0.5	3	0.9	125	10	0.971%	2.2	9.4	8.7	-1.2	-57.9%	10	
ABANDONED		~~KENM-21-1-035~~	~~KENM-21-1-030~~													
Griffith Avenue	1	GRIF-21-1-040	GRIF-21-1-030	0.8	4	1.4	122	10	3.598%	4.2	5.0	4.3	-2.8	-67.2%	10	
(South of) Webster Road	1	GRIF-21-1-030	ROBI-21-1-040	0.0	0	0.0	253	10	0.354%	1.3	10.2	8.8	-1.3	-100.0%	10	
(South of) Webster Road	1	ROBI-21-1-040	WAKE-21-1-050	0.6	3	1.0	232	10	0.049%	0.5	10.4	8.1	0.6	113.3%	1	15
(South of) Webster Road	1	WAKE-21-1-050	WAKE-21-1-040	0.6	3	1.0	156	10	0.042%	0.4	11.0	9.1	0.5	121.9%	1	15
(South of) Webster Road	1	WAKE-21-1-040	CUMB-21-1-030	1.1	5	1.7	287	10	0.956%	2.1	10.2	9.5	-0.4	-20.8%	10	
(South of) Webster Road	1	CUMB-21-1-030	CORN-21-1-030	1.1	6	1.6	284	12	0.707%	3.0	10.2	9.4	-1.4	-45.6%	10	
(South of) Webster Road	1	CORN-21-1-030	KENM-21-1-030	0.8	5	1.1	290	10	1.307%	2.5	9.7	9.0	-1.4	-54.3%	10	
Wakefield Road	1	WAKE-21-1-040	WAKE-21-1-030	0.5	14	0.8	361	10	0.822%	2.0	11.1	10.1	-1.2	-59.8%	10	
Wakefield Road	1	WAKE-21-1-030	WAKE-21-1-020	1.8	25	2.7	358	10	0.879%	2.1	9.7	6.2	0.6	29.1%	4	12
Wakefield Road	1	WAKE-21-1-020	WAKE-21-1-010	7.1	25	8.7	14	12	1.028%	3.6	10.4	8.9	5.1	139.9%	1	18
Cumberland Road	1	CUMB-21-1-030	CUMB-21-1-020	0.6	15	0.9	332	10	1.084%	2.3	10.4	9.7	-1.4	-59.8%	10	
Cumberland Road	1	CUMB-21-1-020	CUMB-21-1-010	2.6	26	3.6	334	10	1.894%	3.0	10.7	7.1	0.5	17.8%	6	
Cornwall Street	1	CORN-21-1-030	CORN-21-1-020	0.9	13	1.3	300	10	1.165%	2.4	9.3	8.6	-1.1	-45.5%	10	
Cornwall Street	1	CORN-21-1-020	CORN-21-1-010	1.9	23	2.5	298	10	1.427%	2.6	10.7	10.0	-0.1	-3.8%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Kenmore Road	1	KENM-21-1-030	KENM-21-1-020	1.3	17	1.8	289	12	0.463%	2.4	11.3	8.6	-0.6	-24.2%	10	
Kenmore Road	1	KENM-21-1-020	KENM-21-1-010	3.5	27	4.2	288	12	0.492%	2.5	10.7	7.4	1.7	66.2%	3	15
		~~WAKE-21-1-020~~	~~CUMB-21-1-010~~													
Morrison Avenue	1	KENM-21-1-010	CORN-21-1-010	5.4	23	6.1	281	27	0.108%	10.2	12.3	10.2	-4.1	-39.7%	10	
Morrison Avenue	1	CORN-21-1-010	CUMB-21-1-010	8.7	39	9.6	283	30	0.090%	12.3	13.5	11.2	-2.7	-21.9%	10	
Morrison Avenue	1	CUMB-21-1-010	WAKE-21-1-010	14.9	66	15.9	318	30	0.125%	14.5	13.6	11.1	1.4	9.7%	8	
Morrison Avenue (outlet to Robina 48")	1	WAKE-21-1-010	24750	21.9	91	22.6	319	36	0.071%	17.7	17.5	15.1	4.9	27.4%	4	42
ROBINA INLET (MORRISON) - 22																
Robina Avenue	2	ROBI-21-1-040	ROBI-21-1-030	0.7	9	1.2	230	12	0.425%	2.3	10.1	8.1	-1.1	-47.6%	10	
Robina Avenue	2	ROBI-21-1-030	ROBI-21-1-020	0.7	18	1.2	255	12	0.597%	2.8	9.7	6.9	-1.6	-57.6%	10	
Robina Avenue	2	ROBI-21-1-020	ROBI-21-1-010	3.3	26	4.4	250	12	0.440%	2.4	9.0	4.9	2.1	88.2%	2	18
Robina Avenue (outlet to Robina 48")	2	ROBI-21-1-010	24750	4.5	17	5.6	22	15	0.274%	3.4	9.0	7.9	2.2	65.3%	2	21
MORRISON LATERAL (WEST) - 38																
Ellwood Avenue	3	ELLW-21-1-050	ELLW-21-1-040	0.8	10	1.5	277	10	0.439%	1.5	8.3	0.0	0.0	2.3%	10	
Ellwood Avenue	3	ELLW-21-1-040	ELLW-21-1-030	2.1	22	3.5	282	10	0.329%	1.3	8.9	0.0	2.3	180.6%	0	15
Ellwood Avenue	3	ELLW-21-1-030	ELLW-21-1-020	3.7	28	5.7	177	12	0.128%	1.3	9.8	0.0	4.4	345.0%	0	21
Ellwood Avenue	3	ELLW-21-1-020	ELLW-21-1-010	5.0	32	7.3	109	12	0.275%	1.9	9.9	0.0	5.4	289.3%	0	21
Thomas Avenue	3	THOM-21-1-040	THOM-21-1-050	0.0	0	0.0	11	10	1.963%	3.1	3.8	0.0	-3.1	-100.0%	10	
Thomas Avenue	3	THOM-21-1-050	THOM-21-1-030	3.7	10	6.4	280	10	0.394%	1.4	7.3	0.0	5.0	361.8%	0	18
Thomas Avenue	3	THOM-21-1-030	THOM-21-1-020	5.2	22	8.5	282	10	0.369%	1.3	7.8	0.0	7.1	535.8%	0	21
Thomas Avenue	3	THOM-21-1-020	THOM-21-1-010	6.1	31	9.6	287	12	0.227%	1.7	8.7	0.0	7.9	467.2%	0	24
Cummings Avenue	3	CUMM-21-1-040	CUMM-21-1-030	0.0	9	0.2	271	10	1.987%	3.1	8.0	6.4	-2.9	-94.2%	10	
Cummings Avenue	3	CUMM-21-1-030	CUMM-21-1-020	1.0	21	1.4	283	10	0.472%	1.5	8.2	1.3	-0.1	-9.5%	10	
Cummings Avenue	3	CUMM-21-1-020	CUMM-21-1-010	1.0	31	1.3	286	12	0.544%	2.6	9.8	2.8	-1.3	-50.2%	10	
Prairie Avenue	3	PRAI-21-1-040	PRAI-21-1-030	0.7	10	1.1	273	10	0.572%	1.7	8.0	0.1	-0.6	-35.1%	10	
Prairie Avenue	3	PRAI-21-1-030	PRAI-21-1-020	0.7	22	1.0	282	10	0.387%	1.4	8.9	0.0	-0.3	-24.8%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Prairie Avenue	3	PRAI-21-1-020	PRAI-21-1-010	2.8	32	4.3	288	12	0.393%	2.2	9.8	0.0	2.1	94.4%	2	18
Bacon Avenue	3	BACO-21-1-030	BACO-21-1-020	0.0	11	0.2	415	12	0.717%	3.0	8.0	7.1	-2.8	-92.7%	10	
Bacon Avenue	3	BACO-21-1-020	BACO-21-1-010	1.8	27	2.4	418	12	0.689%	3.0	8.4	4.5	-0.5	-17.3%	10	
Phillips Avenue	3	PHIL-21-1-040	PHIL-21-1-030	0.3	6	0.6	265	10	1.326%	2.5	7.6	6.9	-2.0	-77.4%	10	
Phillips Avenue	3	PHIL-21-1-030	PHIL-21-1-020	1.4	11	1.8	285	10	0.249%	1.1	9.7	5.2	0.7	64.0%	3	15
Phillips Avenue	3	PHIL-21-1-020	PHIL-21-1-010	2.1	24	2.5	287	12	0.447%	2.4	10.2	6.8	0.1	5.5%	9	
Oakshire Avenue	3	OAKS-21-1-050	OAKS-21-1-040	0.3	5	0.6	269	12	0.292%	1.9	10.2	4.4	-1.3	-69.3%	10	
Oakshire Avenue	3	OAKS-21-1-040	OAKS-21-1-030	2.2	12	2.5	273	12	0.475%	2.5	10.2	3.6	0.0	1.6%	10	
Oakshire Avenue	3	OAKS-21-1-030	OAKS-21-1-020	3.6	13	4.5	59	12	0.065%	0.9	10.0	3.3	3.6	392.2%	0	24
Oakshire Avenue	3	OAKS-21-1-020	OAKS-21-1-010	3.6	18	4.4	218	12	0.593%	2.7	9.9	4.0	1.7	61.1%	3	15
Royal Avenue	3	ROYA-21-1-040	ROYA-21-1-030	4.7	5	5.8	268	12	0.503%	2.5	8.6	0.0	3.3	129.5%	1	18
Royal Avenue	3	ROYA-21-1-030	ROYA-21-1-020	5.8	53	6.9	284	12	0.318%	2.0	10.1	0.0	4.9	245.5%	0	21
Royal Avenue	3	ROYA-21-1-020	ROYA-21-1-010	7.1	58	9.2	285	12	0.496%	2.5	9.7	0.0	6.7	267.6%	0	21
Buckingham Avenue	3	BUCK-21-1-030	BUCK-21-1-020	1.7	19	2.5	415	12	0.453%	2.4	8.5	7.4	0.1	4.5%	10	
Buckingham Avenue	3	BUCK-21-1-020	BUCK-21-1-010	1.7	38	2.4	419	12	0.476%	2.5	11.2	10.2	-0.1	-3.0%	10	
Tyler Avenue	3	TYLE-21-1-040	TYLE-21-1-030	0.0	11	0.2	276	12	0.893%	3.4	8.7	7.9	-3.1	-93.5%	10	
Tyler Avenue	3	TYLE-21-1-030	TYLE-21-1-020	0.0	23	0.5	282	12	0.797%	3.2	11.3	10.5	-2.7	-85.5%	10	
Tyler Avenue	3	TYLE-21-1-020	TYLE-21-1-010	2.2	34	3.5	285	12	0.608%	2.8	11.2	9.5	0.7	26.7%	4	15
Gardner Avenue	3	GARD-21-1-040	GARD-21-1-030	1.0	11	1.5	287	10	0.553%	1.6	10.0	7.0	-0.1	-7.0%	10	
Gardner Avenue	3	GARD-21-1-030	GARD-21-1-020	1.0	25	1.5	284	10	0.561%	1.6	10.2	7.0	-0.2	-11.2%	10	
Gardner Avenue	3	GARD-21-1-020	GARD-21-1-010	3.3	39	4.8	287	12	0.874%	3.3	9.3	5.7	1.5	45.1%	3	15
Griffith Avenue	3	GRIF-21-1-030	GRIF-21-1-020	0.8	16	1.3	360	12	0.386%	2.2	10.2	8.8	-0.9	-39.5%	10	
Griffith Avenue	3	GRIF-21-1-020	GRIF-21-1-010	2.6	28	3.7	361	12	0.660%	2.9	10.0	7.7	0.8	27.7%	4	15
Morrison Avenue	3	ELLW-21-1-010	THOM-21-1-010	5.7	30	8.0	280	18	0.321%	5.9	12.3	0.3	2.1	35.1%	4	21
Morrison Avenue	3	THOM-21-1-010	CUMM-21-1-010	12.2	59	17.3	280	27	0.349%	18.3	12.3	1.3	-1.0	-5.4%	10	
Morrison Avenue	3	CUMM-21-1-010	PRAI-21-1-010	18.4	85	24.4	280	27	0.694%	25.8	13.8	2.7	-1.4	-5.3%	10	
Morrison Avenue	3	PRAI-21-1-010	BACO-21-1-010	24.6	114	32.3	299	27	0.686%	25.7	14.9	3.8	6.7	26.0%	4	30

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Morrison Avenue	3	BACO-21-1-010	PHIL-21-1-010	31.5	140	39.3	279	36	0.285%	35.6	15.3	5.3	3.8	10.6%	7	
Morrison Avenue	3	PHIL-21-1-010	OAKS-21-1-010	34.8	160	42.8	271	36	0.449%	44.7	16.8	7.1	-1.9	-4.3%	10	
Morrison Avenue	3	OAKS-21-1-010	ROYA-21-1-010	40.0	171	48.0	269	36	0.374%	40.8	16.1	6.5	7.2	17.6%	5	42
Morrison Avenue	3	ROYA-21-1-010	BUCK-21-1-010	48.6	227	57.3	277	36	0.519%	48.0	17.0	7.8	9.3	19.3%	5	42
Morrison Avenue	3	BUCK-21-1-010	TYLE-21-1-010	55.7	265	65.4	279	36	0.596%	51.5	18.2	9.5	13.9	27.0%	4	42
Morrison Avenue	3	TYLE-21-1-010	GARD-21-1-010	59.2	293	69.1	270	36	0.647%	53.7	18.2	11.1	15.5	28.8%	4	42
Morrison Avenue	3	GARD-21-1-010	MORR-12-1-010	65.6	332	76.1	195	36	0.891%	62.9	18.7	12.8	13.1	20.8%	5	42
Morrison Avenue	3	MORR-12-1-010	GRIF-21-1-010	67.0	332	77.1	111	36	2.094%	96.5	19.7	14.6	-19.4	-20.1%	10	
Morrison Avenue (outlet to Robina 48")	3	GRIF-21-1-010	24750	72.3	360	83.1	319	36	0.404%	42.4	20.8	15.0	40.7	96.0%	2	48
EDWARDS LATERAL (EAST) - 35																
Kenmore Road	4	KENM-21-1-010	KENM-20-1-030	0.8	14	0.9	357	12	0.477%	2.5	12.0	10.9	-1.5	-62.7%	10	
Kenmore Road	4	KENM-20-1-030	KENM-20-1-020	2.3	21	3.5	356	15	0.294%	3.5	9.1	6.2	0.0	-0.8%	10	
Cornwall Street	4	CORN-21-1-010	CORN-20-1-010	1.4	14	1.6	352	12	0.677%	2.9	12.2	11.4	-1.3	-45.9%	10	
Cornwall Street	4	CORN-20-1-010	KENM-20-1-020	1.4	20	1.5	400	12	0.241%	1.7	9.7	7.4	-0.2	-13.4%	10	
Kenmore Road	4	KENM-20-1-020	KENM-20-1-010	8.8	51	8.3	258	18	0.283%	5.6	11.0	8.1	2.7	48.7%	3	21
Cumberland Road	4	CUMB-21-1-010	CUMB-20-1-030	0.0	8	0.2	302	12	0.243%	1.8	10.5	8.7	-1.6	-90.9%	10	
Cumberland Road	4	CUMB-20-1-030	CUMB-20-1-020	0.0	20	0.4	314	12	0.526%	2.6	9.1	6.5	-2.2	-84.5%	10	
Cumberland Road	4	CUMB-20-1-020	CUMB-20-1-010	3.5	31	4.9	313	12	0.571%	2.7	9.3	5.1	2.2	80.6%	2	15
Kipling Avenue	4	KIPL-20-1-040	KIPL-20-1-030	0.0	5	0.1	254	10	1.636%	2.8	9.5	8.8	-2.7	-96.4%	10	
Kipling Avenue	4	KIPL-20-1-030	KIPL-20-1-020	0.0	12	0.2	285	12	0.192%	1.6	9.8	9.0	-1.3	-84.6%	10	
Kipling Avenue	4	KIPL-20-1-020	KIPL-20-1-010	1.4	21	2.2	283	12	0.307%	2.0	9.8	8.8	0.2	11.0%	8	
Wakefield Road	4	WAKE-21-1-010	WAKE-20-1-030	0.0	1	0.0	105	12	0.608%	2.8	10.2	6.9	-2.8	-99.3%	10	
Wakefield Road	4	WAKE-20-1-030	WAKE-20-1-020	0.4	6	0.5	299	12	0.232%	1.7	9.3	5.4	-1.3	-73.5%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Wakefield Road	4	WAKE-20-1-020	WAKE-20-1-010	3.2	18	3.9	423	12	0.297%	1.9	9.9	5.4	1.9	99.6%	2	18
Coolidge Avenue	4	COOL-19-1-060	COOL-19-1-080	0.0	0	0.0	356	12	0.139%	1.3	5.8	5.0	-1.3	-100.0%	10	
Coolidge Avenue	4	COOL-19-1-080	EDWA-17-1-020	0.0	0	0.0	50	12	0.290%	1.9	7.7	6.8	-1.9	-100.0%	10	
Edwards Avenue	4	EDWA-17-1-020	EDWA-17-1-010	0.0	0	0.0	208	18	0.179%	4.4	8.4	7.2	-4.4	-100.0%	10	
Edwards Avenue	4	EDWA-17-1-010	KENM-20-1-010	0.0	0	0.0	38	24	0.251%	11.3	10.6	9.0	-11.3	-100.0%	10	
Edwards Avenue	4	KENM-20-1-010	EDWA-16-1-010	10.6	51	9.8	176	30	0.138%	15.2	12.2	9.7	-5.5	-35.8%	10	
Edwards Avenue	4	EDWA-16-1-010	CUMB-20-1-010	11.0	51	10.0	114	30	0.180%	17.4	12.6	10.0	-7.4	-42.4%	10	
Edwards Avenue	4	CUMB-20-1-010	KIPL-20-1-010	18.9	82	17.2	288	30	0.082%	11.7	11.8	9.0	5.5	46.7%	3	36
Edwards Avenue	4	KIPL-20-1-010	WAKE-20-1-010	21.9	103	19.3	292	30	0.198%	18.3	18.2	15.8	1.1	5.9%	8	
Edwards Avenue (outlet to Robina 60")	4	WAKE-20-1-010	24752	27.6	121	23.6	324	36	0.070%	17.7	21.2	18.8	6.0	33.7%	4	42
ROBINA INLET (EDWARDS) - 21																
Robina Avenue	5	ROBI-21-1-010	ROBI-20-1-030	2.2	17	2.8	283	15	0.384%	4.0	9.3	8.3	-1.2	-31.2%	10	
Robina Avenue	5	ROBI-20-1-030	ROBI-20-1-020	3.2	27	3.9	283	15	0.368%	3.9	10.1	8.5	-0.1	-1.4%	10	
Robina Avenue	5	ROBI-20-1-020	ROBI-20-1-010	3.2	36	3.8	283	15	0.153%	2.5	10.1	8.4	1.2	49.0%	3	18
Robina Avenue (outlet to Robina 60")	5	ROBI-20-1-010	24752	7.3	30	8.0	21	15	0.948%	6.3	8.4	7.3	1.7	27.1%	4	18
EDWARDS LATERAL (WEST) - 36																
Ellwood Avenue	6	ELLW-21-1-010	ELLW-20-1-030	0.4	10	0.6	238	12	0.344%	2.1	10.7	0.3	-1.5	-71.1%	10	
Ellwood Avenue	6	ELLW-20-1-030	ELLW-20-1-020	1.8	18	2.2	185	12	0.267%	1.8	11.2	0.0	0.4	21.0%	5	15
Ellwood Avenue	6	ELLW-20-1-020	ELLW-20-1-010	1.8	34	2.2	424	12	0.323%	2.0	11.8	0.0	0.2	7.5%	9	
Thomas Avenue	6	THOM-21-1-010	THOM-20-1-030	0.4	12	0.5	296	12	0.286%	1.9	9.3	0.7	-1.4	-71.9%	10	
Thomas Avenue	6	THOM-20-1-030	THOM-20-1-020	1.4	24	1.8	282	12	0.189%	1.5	9.3	0.0	0.3	17.7%	6	
Thomas Avenue	6	THOM-20-1-020	THOM-20-1-010	3.2	34	3.9	270	12	0.359%	2.1	9.4	0.0	1.8	82.6%	2	18
Cummings Avenue	6	CUMM-21-1-010	CUMM-20-1-020	1.0	20	1.3	436	12	0.355%	2.1	10.2	2.5	-0.8	-39.4%	10	
Cummings Avenue	6	CUMM-20-1-020	CUMM-20-1-010	2.3	36	3.0	411	12	0.389%	2.2	9.7	1.0	0.7	33.2%	4	15
Prairie Avenue	6	PRAI-21-1-010	PRAI-20-1-030	0.8	14	1.0	281	12	0.213%	1.6	10.3	4.4	-0.6	-39.2%	10	
Prairie Avenue	6	PRAI-20-1-030	PRAI-20-1-020	1.6	26	2.2	282	12	0.112%	1.2	10.2	3.8	1.0	83.3%	2	18

Appendix B
Combined Sewer Area Study
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COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Prairie Avenue	6	PRAI-20-1-020	PRAI-20-1-010	1.6	36	2.1	282	12	0.563%	2.7	11.4	5.7	-0.6	-21.6%	10	
Bacon Avenue	6	BACO-21-1-010	BACO-20-1-030	0.3	13	0.4	281	12	0.225%	1.7	10.3	5.8	-1.3	-76.5%	10	
Bacon Avenue	6	BACO-20-1-030	BACO-20-1-020	1.9	27	2.4	285	15	0.234%	3.1	9.5	4.4	-0.8	-24.1%	10	
Bacon Avenue	6	BACO-20-1-020	BACO-20-1-010	1.9	39	2.3	282	15	0.493%	4.5	10.8	5.6	-2.3	-49.7%	10	
Phillips Avenue	6	PHIL-21-1-010	PHIL-20-1-030	0.7	14	0.9	280	12	1.153%	3.8	8.0	7.2	-3.0	-77.2%	10	
Phillips Avenue	6	PHIL-20-1-030	PHIL-20-1-020	1.6	26	2.1	283	12	0.371%	2.2	9.1	5.5	-0.1	-4.9%	10	
Phillips Avenue	6	PHIL-20-1-020	PHIL-20-1-010	1.6	40	2.0	284	12	0.437%	2.4	9.4	5.6	-0.4	-15.0%	10	
Oakshire Avenue	6	OAKS-21-1-010	OAKS-20-1-030	1.7	18	2.0	277	12	0.475%	2.5	9.7	6.4	-0.5	-18.6%	10	
Oakshire Avenue	6	OAKS-20-1-030	OAKS-20-1-020	2.4	31	2.7	284	12	0.400%	2.3	10.6	6.8	0.5	21.2%	5	15
Oakshire Avenue	6	OAKS-20-1-020	OAKS-20-1-010	4.1	45	4.9	286	15	0.571%	4.9	11.0	7.4	0.0	0.5%	10	
Royal Avenue	6	ROYA-21-1-010	ROYA-20-1-030	0.5	14	0.6	281	12	0.353%	2.1	10.1	8.0	-1.5	-72.6%	10	
Royal Avenue	6	ROYA-20-1-030	ROYA-20-1-020	1.8	27	2.1	283	12	0.105%	1.2	9.7	6.5	0.9	81.9%	2	18
Royal Avenue	6	ROYA-20-1-020	ROYA-20-1-010	3.0	41	3.5	283	12	0.646%	2.9	8.7	6.2	0.7	23.1%	5	15
Buckingham Avenue	6	BUCK-21-1-010	BUCK-20-1-030	0.0	11	0.2	281	12	0.322%	2.0	10.4	7.7	-1.8	-89.1%	10	
Buckingham Avenue	6	BUCK-20-1-030	BUCK-20-1-020	1.4	23	1.9	284	12	0.469%	2.4	8.6	4.9	-0.6	-23.7%	10	
Buckingham Avenue	6	BUCK-20-1-020	BUCK-20-1-010	3.3	37	4.6	284	12	0.685%	2.9	7.6	3.4	1.7	57.2%	3	15
Tyler Avenue	6	TYLE-21-1-010	TYLE-20-1-030	1.2	14	1.4	282	12	0.566%	2.7	11.4	10.6	-1.3	-47.4%	10	
Tyler Avenue	6	TYLE-20-1-030	TYLE-20-1-025	2.3	24	2.5	208	15	0.181%	2.7	10.2	8.9	-0.3	-9.2%	10	
Tyler Avenue	6	TYLE-20-1-025	TYLE-20-1-020	2.3	28	2.4	74	15	0.181%	2.7	9.6	8.2	-0.3	-11.7%	10	
Tyler Avenue	6	TYLE-20-1-020	TYLE-20-1-010	4.4	40	4.6	283	15	0.362%	3.9	9.3	7.9	0.7	19.1%	5	18
Gardner Avenue	6	GARD-21-1-010	GARD-20-1-030	0.0	12	0.2	280	12	0.318%	2.0	10.1	8.9	-1.8	-88.1%	10	
Gardner Avenue	6	GARD-20-1-030	GARD-20-1-020	1.2	26	2.0	283	12	0.313%	2.0	9.5	7.4	0.0	0.8%	10	
Gardner Avenue	6	GARD-20-1-020	GARD-20-1-010	2.1	39	3.6	283	12	0.574%	2.7	9.1	7.0	0.9	34.2%	4	15
Griffith Avenue	6	GRIF-21-1-010	GRIF-20-1-030	0.0	8	0.2	283	12	0.536%	2.6	9.2	8.4	-2.4	-93.9%	10	
Griffith Avenue	6	GRIF-20-1-030	GRIF-20-1-020	0.0	18	0.4	284	12	0.536%	2.6	10.5	9.7	-2.2	-86.2%	10	
Griffith Avenue	6	GRIF-20-1-020	GRIF-20-1-010	1.3	29	2.3	282	12	0.455%	2.4	10.4	9.6	-0.1	-4.5%	10	
Edwards Avenue	6	ELLW-20-1-010	THOM-20-1-010	6.0	34	7.1	280	18	0.485%	7.3	15.3	0.7	-0.3	-3.5%	10	
Edwards Avenue	6	THOM-20-1-010	CUMM-20-1-010	11.5	68	13.4	278	18	0.891%	9.9	15.1	0.4	3.5	35.1%	4	21
Ellwood Avenue	6	ELLW-20-1-010	ELLW-19-1-050	0.0	16	0.3	419	15	0.197%	2.9	12.9	0.6	-2.5	-88.8%	10	
Ellwood Avenue	6	ELLW-19-1-050	ELLW-19-1-040	0.0	31	0.6	419	15	0.324%	3.7	13.8	0.6	-3.1	-83.1%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Greenfield Road	6	GREE-19-1-030	GREE-19-1-020	2.4	8	5.2	290	12	0.659%	2.9	7.4	0.0	2.3	79.7%	2	15
Greenfield Road	6	GREE-19-1-020	GREE-19-1-010	2.4	11	5.1	199	12	0.713%	3.0	7.1	0.0	2.0	67.9%	2	15
Greenfield Road	6	GREE-19-1-010	ELLW-19-1-030	3.3	19	6.5	243	15	0.303%	3.6	9.4	0.0	2.9	82.0%	2	21
(North of) 12 Mile Road	6	ELLW-19-1-030	ELLW-19-1-040	3.6	19	7.0	38	15	0.440%	4.3	10.8	0.1	2.8	64.4%	2	21
Ellwood Avenue	6	ELLW-19-1-020	ELLW-19-1-040	0.8	0	1.9	99	10	2.510%	3.5	4.9	0.0	-1.5	-44.4%	10	
Thomas Avenue	6	THOM-20-1-010	THOM-19-1-030	0.0	16	0.3	423	15	0.246%	3.2	10.9	0.3	-2.9	-90.0%	10	
Thomas Avenue	6	THOM-19-1-030	THOM-19-1-020	0.0	32	0.6	414	15	0.743%	5.6	12.7	1.1	-4.9	-88.5%	10	
Thomas Avenue	6	THOM-19-1-010	THOM-19-1-020	1.0	0	2.0	101	10	0.317%	1.2	4.9	0.0	0.8	63.4%	3	15
(North of) 12 Mile Road	6	ELLW-19-1-040	THOM-19-1-020	7.9	53	13.9	278	18	0.430%	6.9	15.0	0.0	7.0	102.3%	1	24
(North of) 12 Mile Road	6	THOM-19-1-020	CUMM-19-1-020	13.4	99	21.2	282	18	0.395%	6.6	14.9	0.0	14.6	220.7%	0	30
Cummings Avenue	6	CUMM-19-1-010	CUMM-19-1-020	1.2	0	3.2	100	10	1.586%	2.8	6.7	0.0	0.4	14.4%	6	
Cummings Avenue	6	CUMM-19-1-020	CUMM-19-1-030	15.1	95	24.1	262	30	0.236%	19.9	14.9	0.0	4.2	21.0%	5	33
Cummings Avenue	6	CUMM-19-1-030	CUMM-19-1-040	17.4	107	26.8	298	30	0.113%	13.8	16.1	1.2	13.0	94.5%	2	42
Cummings Avenue	6	CUMM-19-1-040	CUMM-20-1-010	17.4	117	26.0	279	30	0.175%	17.1	17.2	3.2	8.8	51.5%	3	36
Edwards Avenue	6	CUMM-20-1-010	PRAI-20-1-010	38.0	221	47.0	280	36	0.502%	47.3	17.6	3.8	-0.3	-0.6%	10	
Edwards Avenue	6	PRAI-20-1-010	BACO-20-1-010	42.0	257	51.4	286	36	0.363%	40.2	19.5	5.4	11.2	27.9%	4	42
Edwards Avenue	6	BACO-20-1-010	PHIL-20-1-010	48.0	296	57.5	280	36	0.402%	42.3	18.5	5.1	15.2	36.0%	4	42
Edwards Avenue	6	PHIL-20-1-010	OAKS-20-1-010	52.5	326	62.2	272	36	0.546%	49.3	18.7	6.7	12.9	26.2%	4	42
Prairie Avenue	6	PRAI-20-1-010	PRAI-19-1-030	0.0	17	0.3	426	15	0.294%	3.5	11.5	0.8	-3.2	-90.3%	10	
Prairie Avenue	6	PRAI-19-1-030	PRAI-19-1-020	2.6	33	4.1	411	15	0.732%	5.5	11.9	0.0	-1.4	-25.4%	10	
Prairie Avenue	6	PRAI-19-1-010	PRAI-19-1-020	0.6	0	1.3	102	10	0.626%	1.7	6.7	0.0	-0.4	-25.7%	10	
Bacon Avenue	6	BACO-20-1-010	BACO-19-1-030	0.0	20	0.4	412	15	0.193%	2.8	11.6	1.3	-2.4	-85.9%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Bacon Avenue	6	BACO-19-1-030	BACO-19-1-020	1.4	34	2.3	420	15	0.512%	4.6	11.2	0.0	-2.3	-49.4%	10	
Bacon Avenue	6	BACO-19-1-010	BACO-19-1-020	0.3	0	0.8	108	10	0.661%	1.8	13.4	0.5	-1.0	-55.1%	10	
Phillips Avenue	6	PHIL-20-1-010	PHIL-19-1-050	1.6	27	1.9	427	15	0.404%	4.1	10.0	6.1	-2.2	-53.1%	10	
Phillips Avenue	6	PHIL-19-1-050	PHIL-19-1-040	4.1	44	4.4	412	15	0.750%	5.6	9.7	4.5	-1.2	-21.7%	10	
Phillips Avenue	6	PHIL-19-1-010	PHIL-19-1-040	0.3	0	0.7	103	10	1.080%	2.3	5.0	4.3	-1.6	-71.3%	10	
(North of) 12 Mile Road	6	CUMM-19-1-020	PRAI-19-1-020	2.3	24	3.6	280	18	0.362%	6.3	14.1	0.0	-2.7	-42.9%	10	
(North of) 12 Mile Road	6	PRAI-19-1-020	BACO-19-1-020	7.2	72	10.5	271	18	0.451%	7.1	15.1	0.0	3.4	48.5%	3	21
(North of) 12 Mile Road	6	BACO-19-1-020	PHIL-19-1-040	12.7	120	18.3	280	18	0.247%	5.2	15.4	0.7	13.1	251.6%	0	30
(North of) 12 Mile Road	6	PHIL-19-1-040	PHIL-19-1-030	19.2	164	21.8	37	30	0.054%	9.5	15.4	7.8	12.2	128.3%	1	42
(North of) 12 Mile Road	6	PHIL-19-1-030	PHIL-19-1-020	19.2	164	21.8	55	30	0.054%	9.5	12.7	5.2	12.2	128.0%	1	42
(North of) 12 Mile Road	6	PHIL-19-1-020	OAKS-19-1-010	19.2	173	21.6	168	30	0.054%	9.5	13.0	5.6	12.1	126.4%	1	42
(North of) 12 Mile Road	6	OAKS-19-1-010	OAKS-19-1-020	19.7	173	22.0	54	30	0.054%	9.5	12.2	5.1	12.5	130.8%	1	42
(North of) 12 Mile Road	6	OAKS-19-1-020	OAKS-19-1-030	19.7	173	21.9	23	24	2.357%	34.7	12.4	5.5	-12.8	-37.0%	10	
(North of) 12 Mile Road	6	OAKS-19-1-030	OAKS-19-1-040	20.4	173	23.0	39	24	1.149%	24.3	12.3	5.4	-1.3	-5.4%	10	
Oakshire Avenue	6	OAKS-19-1-040	OAKS-19-1-050	0.0	12	0.2	282	24	0.011%	2.3	12.1	4.0	-2.1	-89.8%	10	
Oakshire Avenue	6	OAKS-19-1-050	OAKS-19-1-060	0.0	25	0.5	276	24	0.267%	11.7	14.9	6.2	-11.2	-95.7%	10	
Oakshire Avenue	6	OAKS-19-1-060	OAKS-20-1-010	2.0	37	2.9	280	24	0.267%	11.7	16.4	7.0	-8.7	-74.8%	10	
Edwards Avenue	6	OAKS-20-1-010	ROYA-20-1-010	61.5	408	71.8	269	42	0.610%	78.6	19.1	8.0	-6.7	-8.6%	10	
Edwards Avenue	6	ROYA-20-1-010	BUCK-20-1-010	64.6	432	74.9	285	42	0.562%	75.4	19.6	8.5	-0.6	-0.7%	10	
Edwards Avenue	6	BUCK-20-1-010	TYLE-20-1-010	70.2	469	80.1	271	42	0.597%	77.7	19.5	14.6	2.4	3.1%	9	
Tyler Avenue	6	TYLE-19-1-040	TYLE-20-1-010	0.0	20	0.4	417	15	0.336%	3.7	7.9	6.9	-3.3	-89.3%	10	
Edwards Avenue	6	TYLE-20-1-010	GARD-20-1-010	76.8	529	86.7	271	42	0.522%	72.7	21.3	16.5	14.0	19.3%	5	48
Edwards Avenue	6	GARD-20-1-010	GRIF-20-1-010	82.4	568	91.9	305	42	0.685%	83.3	21.4	17.1	8.6	10.4%	7	

Appendix B
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Combined Sewer Sewer Capacity Analysis

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Edwards Avenue (outlet to Robina 60")	6	GRIF-20-1-010	24752	87.6	597	96.4	321	42	0.554%	74.9	21.3	17.4	21.5	28.8%	4	48
12 MILE LATERAL (WEST) - 44																
Griffith Avenue	7	GRIF-20-1-010	GRIF-19-1-040	0.0	16	0.3	394	15	0.207%	2.9	10.1	0.8	-2.6	-89.1%	10	
Griffith Avenue	7	GRIF-19-1-040	GRIF-19-1-020	1.9	29	2.9	395	15	0.217%	3.0	10.1	0.0	-0.1	-4.2%	10	
Griffith Avenue	7	GRIF-19-1-030	GRIF-19-1-020	0.0	20	0.4	142	10	0.963%	2.1	10.4	0.8	-1.7	-81.4%	10	
12 Mile Road	7	TWEL-13-1-010	GRIF-19-1-010	0.2	0	0.6	119	8	1.275%	1.4	3.4	0.0	-0.8	-56.5%	10	
12 Mile Road	7	GRIF-19-1-010	GRIF-19-1-020	1.8	0	4.7	139	10	0.420%	1.4	6.3	0.0	3.3	230.8%	0	18
Griffith Avenue (outlet to Robina 66")	7	GRIF-19-1-020	24753	7.0	80	12.8	315	15	0.342%	3.8	11.8	0.0	9.0	237.9%	0	24
ROBINA INLET (12 MILE) - 40																
Robina Avenue	8	ROBI-20-1-010	ROBI-19-1-070	1.5	20	1.6	409	15	0.305%	3.6	9.3	7.8	-1.9	-54.1%	10	
Robina Avenue	8	ROBI-19-1-070	ROBI-19-1-060	4.9	31	5.2	276	15	0.534%	4.7	11.3	8.8	0.5	10.4%	7	
Robina Avenue	8	ROBI-19-1-060	ROBI-19-1-040	7.5	31	8.6	72	15	0.060%	1.6	12.9	10.7	7.1	445.2%	0	30
Kipling Avenue	8	KIPL-20-1-010	KIPL-19-1-040	0.0	11	0.2	391	12	0.322%	2.0	11.1	10.3	-1.8	-89.1%	10	
Kipling Avenue	8	KIPL-19-1-040	KIPL-19-1-030	0.0	24	0.5	392	12	0.400%	2.3	10.9	10.1	-1.8	-78.7%	10	
12 Mile Road	8	KIPL-19-1-010	KIPL-19-1-030	3.2	0	5.3	140	12	1.480%	4.3	5.2	3.3	1.0	23.4%	4	15
Wakefield Avenue	8	WAKE-20-1-010	WAKE-19-1-060	0.0	13	0.3	392	15	0.273%	3.4	12.6	11.6	-3.1	-92.3%	10	
Wakefield Avenue	8	WAKE-19-1-060	WAKE-19-1-050	3.1	22	4.4	314	15	0.156%	2.5	11.2	9.2	1.9	74.3%	2	21
Wakefield Avenue	8	WAKE-19-1-050	WAKE-19-1-030	4.5	23	6.4	75	15	0.930%	6.2	11.6	10.6	0.1	2.3%	9	
12 Mile Road	8	WAKE-19-1-020	WAKE-19-1-010	0.9	0	2.4	44	10	3.879%	4.3	3.9	3.2	-1.9	-43.5%	10	
Wakefield Avenue	8	WAKE-19-1-010	WAKE-19-1-030	0.9	0	2.4	141	10	1.154%	2.4	5.6	4.8	0.1	3.3%	9	
12 Mile Road	8	ROBI-19-1-020	ROBI-19-1-010	0.0	0	0.0	67	12	0.345%	2.1	6.1	5.3	-2.1	-100.0%	10	
Robina Avenue	8	ROBI-19-1-010	ROBI-19-1-030	0.2	0	0.6	141	12	2.030%	5.1	6.1	5.3	-4.5	-88.9%	10	
12 Mile Road	8	KIPL-19-1-030	WAKE-19-1-030	5.6	39	8.6	288	24	0.360%	13.6	13.4	10.5	-5.0	-36.9%	10	

Appendix B
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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
12 Mile Road	8	WAKE-19-1-030	WAKE-19-1-040	11.0	62	16.8	140	24	0.157%	9.0	16.8	13.3	7.8	87.3%	2	33
12 Mile Road	8	ROBI-19-1-030	WAKE-19-1-040	0.2	13.00	0.5	180	18	2.319%	16.0	13.1	11.9	-15.4	-96.6%	10	
12 Mile Road	8	WAKE-19-1-040	ROBI-19-1-050	11.2	75	17.0	34	24	0.149%	8.7	18.9	15.9	8.3	94.9%	2	33
12 Mile Road	8	ROBI-19-1-050	ROBI-19-1-040	11.2	75	16.9	157	24	0.051%	5.1	19.2	16.4	11.8	231.8%	0	42
12 Mile Road (outlet to Robina 66")	8	ROBI-19-1-040	24753	19.7	106	23.6	33	30	3.094%	72.1	19.5	17.5	-48.5	-67.3%	10	
BEVERLY LATERAL (WEST) - 34																
Royal Avenue	9	ROYA-20-1-010	ROYA-19-1-010	2.7	37	3.1	431	15	0.358%	3.9	9.3	8.3	-0.7	-19.3%	10	
Royal Avenue	9	ROYA-19-1-010	TWEL-09-1-020	3.8	57	4.4	412	15	0.975%	6.4	11.3	10.3	-2.0	-30.9%	10	
Royal Avenue	9	TWEL-09-1-010	TWEL-09-1-020	0.3	0	0.8	99	10	1.467%	2.7	4.4	3.8	-1.9	-71.6%	10	
Buckingham Avenue	9	BUCK-20-1-010	BUCK-19-1-040	0.0	17	0.3	416	15	0.323%	3.7	9.4	8.4	-3.3	-90.7%	10	
Buckingham Avenue	9	BUCK-19-1-040	BUCK-19-1-020	1.6	29	2.8	424	15	0.770%	5.7	9.3	8.3	-2.9	-50.9%	10	
12 Mile Road	9	BUCK-19-1-010	BUCK-19-1-020	2.1	0	4.0	102	10	1.507%	2.7	5.2	2.7	1.3	47.6%	3	12
Tyler Avenue	9	TYLE-19-1-040	TYLE-19-1-020	3.2	15	5.3	420	15	0.297%	3.5	10.4	8.4	1.8	50.6%	3	18
12 Mile Road	9	BUCK-19-1-010	TYLE-19-1-010	1.5	0	2.8	270	10	0.988%	2.2	4.7	2.9	0.6	26.6%	4	12
	9	TYLE-19-1-010	TYLE-19-1-020	1.8	0	3.4	102	12	0.915%	3.4	6.5	5.7	0.0	0.8%	10	
Gardner Avenue	9	GARD-20-1-010	GARD-19-1-040	0.0	16	0.3	411	15	0.296%	3.5	9.7	8.7	-3.2	-90.9%	10	
Gardner Avenue	9	GARD-19-1-040	GARD-19-1-030	1.8	28	2.6	305	15	0.184%	2.8	10.5	9.5	-0.2	-6.6%	10	
Gardner Avenue	9	GARD-19-1-030	GARD-19-1-020	3.1	35	4.8	108	15	2.023%	9.2	9.8	8.8	-4.4	-47.8%	10	
Twelve Mile Road	9	OAKS-19-1-040	TWEL-09-1-020	25.0	177	27.5	272	24	0.263%	11.6	11.9	4.9	15.9	137.5%	1	36
Twelve Mile Road	9	TWEL-09-1-020	BUCK-19-1-030	30.8	250	34.1	184	30	0.349%	24.2	14.8	10.9	9.9	40.8%	3	36
Buckingham Avenue	9	BUCK-19-1-030	BUCK-19-1-020	30.8	250	33.8	102	30	0.197%	18.2	15.0	11.7	15.6	86.0%	2	42
Twelve Mile Road	9	BUCK-19-1-020	TYLE-19-1-020	34.5	296	37.7	268	36	0.433%	43.9	12.9	10.1	-6.1	-14.0%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Twelve Mile Road	9	TYLE-19-1-020	GARD-19-1-020	42.4	318	46.2	272	36	0.267%	34.4	11.9	8.7	11.7	34.0%	4	42
Gardner Avenue	9	GARD-19-1-020	GARD-19-1-010	46.8	353	50.2	118	36	0.303%	36.7	13.2	10.5	13.5	36.7%	4	42
Twelve Mile Road	9	GARD-19-1-010	TWEL-12-1-010	47.2	357	50.4	96	36	0.503%	47.3	14.3	11.7	3.1	6.6%	8	
Gardner Avenue	9	TWEL-12-1-010	GARD-17-1-020	47.2	363	50.3	345	36	0.655%	54.0	14.6	12.2	-3.7	-6.9%	10	
Gardner Avenue	9	GARD-17-1-020	GARD-17-1-010	47.4	374	50.1	322	36	0.639%	53.3	13.3	10.9	-3.2	-6.0%	10	
Twelve Mile Road	9	GREE-17-1-040	ELLW-17-1-030	0.0	15	0.3	260	12	0.363%	2.1	10.3	5.1	-1.8	-86.0%	10	
Ellwood Avenue	9	ELLW-17-1-050	ELLW-17-1-030	0.5	0	1.1	117	12	0.738%	3.1	6.3	3.5	-2.0	-65.0%	10	
Ellwood Avenue	9	ELLW-17-1-030	ELLW-17-1-020	1.3	25	3.1	253	12	0.461%	2.4	10.1	4.1	0.7	27.9%	4	15
Ellwood Avenue	9	ELLW-17-1-020	ELLW-17-1-010	1.3	37	3.0	257	12	0.271%	1.9	9.9	4.6	1.2	62.1%	3	15
Twelve Mile Road	9	ELLW-17-1-040	THOM-17-1-030	0.0	10	0.2	297	15	0.627%	5.1	10.9	9.9	-4.9	-96.3%	10	
Thomas Avenue	9	THOM-17-1-050	THOM-17-1-030	0.2	0	0.5	125	10	1.111%	2.3	5.2	4.5	-1.8	-76.9%	10	
Thomas Avenue	9	THOM-17-1-030	THOM-17-1-020	0.3	20	0.9	263	12	0.424%	2.3	10.1	9.3	-1.4	-62.4%	10	
Thomas Avenue	9	THOM-17-1-020	THOM-17-1-010	0.3	28	0.8	246	12	0.362%	2.1	10.1	9.3	-1.3	-61.1%	10	
Twelve Mile Road	9	THOM-17-1-040	CUMM-17-1-030	0.0	18	0.4	289	12	0.769%	3.1	10.6	9.8	-2.8	-88.5%	10	
Cummings Avenue	9	CUMM-17-1-060	CUMM-17-1-030	0.1	0	0.4	125	10	1.161%	2.4	6.3	5.6	-2.0	-83.5%	10	
Cummings Avenue	9	CUMM-17-1-030	CUMM-17-1-020	1.3	29	2.6	255	12	0.487%	2.5	9.8	8.8	0.1	5.7%	9	
Cummings Avenue	9	CUMM-17-1-020	CUMM-17-1-010	1.3	39	2.6	254	12	0.331%	2.1	10.5	9.6	0.5	24.6%	5	15
Twelve Mile Road	9	CUMM-17-1-040	BACO-17-1-050	0.1	13	0.4	299	12	0.386%	2.2	9.7	1.4	-1.9	-83.7%	10	
Bacon Avenue	9	BACO-17-1-060	BACO-17-1-050	1.0	0	2.7	127	10	1.272%	2.5	6.5	0.0	0.2	9.5%	7	
Bacon Avenue	9	BACO-17-1-050	BACO-17-1-040	1.1	20	2.9	255	12	0.468%	2.4	10.1	0.7	0.5	19.3%	5	15
Bacon Avenue	9	BACO-17-1-040	BACO-17-1-020	3.1	49	6.7	255	12	0.362%	2.1	9.7	0.9	4.5	211.6%	0	21
Beverly Boulevard	9	BEVE-04-1-010	BACO-17-1-030	1.3	46	1.9	83	10	1.087%	2.3	6.8	5.2	-0.4	-18.0%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Beverly Boulevard	9	BACO-17-1-030	BACO-17-1-020	1.3	46	1.9	25	12	10.916%	11.8	6.8	6.0	-9.9	-84.3%	10	
Twelve Mile Road	9	BACO-17-1-070	PHIL-17-1-040	0.0	13	0.3	290	12	0.521%	2.6	10.0	9.2	-2.3	-89.9%	10	
Phillips Avenue	9	PHIL-17-1-040	PHIL-17-1-030	0.9	20	2.3	313	12	0.801%	3.2	9.0	8.2	-0.8	-26.3%	10	
Phillips Avenue	9	PHIL-17-1-030	PHIL-17-1-010	2.1	26	4.3	323	12	1.259%	4.0	8.9	7.4	0.3	8.7%	8	
Twelve Mile Road	9	PHIL-17-1-050	OAKS-17-1-040	0.0	7	0.1	281	12	0.043%	0.7	11.5	0.3	-0.6	-82.4%	10	
Twelve Mile Road	9	TWEL-08-1-020	OAKS-17-1-040	0.0	9	0.2	253	12	0.769%	3.1	9.0	0.0	-3.0	-94.6%	10	
Oakshire Avenue	9	OAKS-17-1-040	OAKS-17-1-030	2.0	22	5.4	313	12	0.559%	2.7	11.6	0.2	2.7	101.1%	2	18
Oakshire Avenue	9	OAKS-17-1-030	OAKS-17-1-010	2.0	35	5.2	322	12	0.478%	2.5	12.4	6.3	2.7	110.1%	1	18
Twelve Mile Road	9	TWEL-08-1-020	ROYA-17-1-050	0.0	0	0.0	79	8	2.455%	1.9	4.1	3.6	-1.9	-100.0%	10	
Royal Avenue	9	ROYA-17-1-050	ROYA-17-1-040	0.0	0	0.0	73	12	0.905%	3.4	10.8	10.0	-3.4	-100.0%	10	
Royal Avenue	9	ROYA-17-1-040	ROYA-17-1-030	0.1	7	0.2	247	12	0.870%	3.3	11.3	10.5	-3.2	-95.5%	10	
Royal Avenue	9	ROYA-17-1-030	ROYA-17-1-010	2.4	23	4.3	312	12	0.898%	3.4	10.2	7.7	0.9	27.0%	4	15
Twelve Mile Road	9	TWEL-09-1-030	BUCK-17-1-050	0.0	7	0.1	271	12	0.739%	3.1	9.7	8.9	-2.9	-95.6%	10	
Buckingham Avenue	9	BUCK-17-1-050	BUCK-17-1-040	1.1	14	2.9	318	12	0.875%	3.3	9.9	9.1	-0.4	-13.0%	10	
Buckingham Avenue	9	BUCK-17-1-040	BUCK-17-1-030	1.1	23	2.8	312	12	0.985%	3.5	11.2	10.4	-0.7	-20.5%	10	
Beverly Boulevard	9	OAKS-17-1-020	ROYA-17-1-020	0.0	0	0.0	335	12	0.368%	2.2	7.6	6.8	-2.2	-100.0%	10	
Beverly Boulevard	9	ROYA-17-1-020	BUCK-17-1-020	0.0	0	0.0	326	12	0.230%	1.7	7.1	6.3	-1.7	-100.0%	10	
Beverly Boulevard	9	BUCK-17-1-020	BUCK-17-1-010	0.0	0	0.0	19	12	0.527%	2.6	5.6	4.8	-2.6	-100.0%	10	
Beverly Boulevard	9	BUCK-17-1-010	BUCK-17-1-030	0.0	0	0.0	23	12	0.930%	3.4	10.9	10.1	-3.4	-100.0%	10	
Twelve Mile Road	9	BUCK-17-1-060	TYLE-17-1-030	0.0	12	0.2	257	12	0.321%	2.0	12.3	2.1	-1.8	-87.8%	10	
Twelve Mile Road	9	TWEL-11-1-010	TYLE-17-1-030	0.0	0	0.0	82	12	0.346%	2.1	6.5	0.8	-2.1	-100.0%	10	
Twelve Mile Road	9	GARD-17-1-050	TWEL-11-1-020	0.1	22	0.4	119	12	0.392%	2.2	10.0	0.9	-1.9	-83.2%	10	
Twelve Mile Road	9	TWEL-11-1-020	TYLE-17-1-040	0.2	22	0.6	113	12	0.475%	2.5	10.5	0.9	-1.9	-75.5%	10	
Twelve Mile Road	9	TYLE-17-1-040	TYLE-17-1-030	0.2	22	0.6	23	12	1.266%	4.0	11.0	0.8	-3.4	-85.3%	10	
Tyler Avenue	9	TYLE-17-1-030	TYLE-17-1-020	1.2	38	3.2	327	12	0.716%	3.0	11.8	0.8	0.2	5.6%	9	
Tyler Avenue	9	TYLE-17-1-020	TYLE-17-1-010	5.1	51	9.7	308	12	0.713%	3.0	11.0	0.0	6.7	222.3%	0	21

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Twelve Mile Road	9	GARD-17-1-030	GRIF-17-1-030	0.2	18	0.5	252	12	0.541%	2.6	10.0	9.2	-2.1	-81.1%	10	
Griffith Avenue	9	GRIF-17-1-040	GRIF-17-1-030	0.1	22	0.2	115	12	1.285%	4.0	11.0	10.2	-3.8	-93.9%	10	
Griffith Avenue	9	GRIF-17-1-030	GRIF-17-1-020	0.8	44	1.9	202	12	0.381%	2.2	12.0	11.2	-0.3	-15.7%	10	
Griffith Avenue	9	GRIF-17-1-020	GRIF-17-1-010	0.9	56	2.0	323	12	0.454%	2.4	12.7	11.9	-0.4	-18.1%	10	
Beverly Boulevard	9	ELLW-17-1-010	THOM-17-1-010	4.5	30	8.2	323	15	0.717%	5.5	10.1	5.1	2.7	49.4%	3	18
Beverly Boulevard	9	THOM-17-1-010	CUMM-17-1-010	4.1	26	6.2	313	21	0.455%	10.7	11.6	10.2	-4.4	-41.6%	10	
Beverly Boulevard	9	CUMM-17-1-010	BACO-17-1-020	4.9	39	7.5	321	21	1.157%	17.0	11.7	10.3	-9.6	-56.2%	10	
Beverly Boulevard	9	BACO-17-1-020	PHIL-17-1-010	6.0	95	10.2	317	27	0.812%	27.9	14.2	12.4	-17.7	-63.3%	10	
Beverly Boulevard	9	PHIL-17-1-010	OAKS-17-1-010	5.3	26	10.4	311	27	0.134%	11.3	15.6	13.8	-1.0	-8.4%	10	
Beverly Boulevard	9	OAKS-17-1-010	ROYA-17-1-010	6.8	35	12.5	331	27	0.883%	29.1	14.0	13.0	-16.6	-57.1%	10	
Beverly Boulevard	9	ROYA-17-1-010	BUCK-17-1-030	4.9	23	7.9	333	30	0.892%	38.7	15.8	13.8	-30.8	-79.5%	10	
Beverly Boulevard	9	BUCK-17-1-030	TYLE-17-1-010	10.2	45	16.6	282	30	0.162%	16.5	16.2	14.2	0.1	0.7%	10	
Beverly Boulevard	9	TYLE-17-1-010	GARD-17-1-010	15.3	96	25.2	290	30	1.697%	53.4	20.0	18.0	-28.3	-52.9%	10	
Beverly Boulevard	9	GARD-17-1-010	GRIF-17-1-010	67.3	470	70.9	283	36	0.529%	48.5	22.5	17.9	22.4	46.2%	3	42
Beverly Boulevard (outlet to Robina 84")	9	GRIF-17-1-010	25779	70.5	526	73.7	272	42	0.202%	45.2	24.0	21.2	28.5	63.0%	3	54
BEVERLY LATERAL (EAST) - 33																
Coolidge Highway	10	COOL-21-1-030	COOL-21-1-015	0.9	0	1.1	305	15	0.519%	4.7	7.1	3.6	-3.6	-76.8%	10	
Coolidge Highway	10	COOL-21-1-015	COOL-20-1-070	2.3	0	2.9	300	15	1.350%	7.5	6.9	1.8	-4.6	-61.7%	10	
Coolidge Highway	10	COOL-20-1-070	COOL-20-1-050	2.9	0	3.6	298	15	0.354%	3.8	8.8	0.2	-0.2	-5.2%	10	
Coolidge Highway	10	COOL-20-1-050	COOL-20-1-030	4.9	0	5.7	301	15	0.253%	3.2	8.9	0.0	2.4	74.0%	2	21
Coolidge Highway	10	COOL-20-1-030	COOL-20-1-010	7.0	0	7.7	300	15	0.389%	4.0	8.5	0.0	3.7	90.7%	2	21
Coolidge Highway	10	COOL-20-1-010	COOL-19-1-050	7.4	0	8.0	400	15	0.373%	3.9	7.8	0.0	4.0	102.2%	1	21

Appendix B
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COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	10	COOL-19-1-050	COOL-19-1-025	8.1	0	8.5	375	15	1.183%	7.0	8.5	0.0	1.4	20.5%	5	18
		~~COOL-21-1-040~~	~~COOL-21-1-020~~													
Coolidge Highway	10	COOL-21-1-020	COOL-21-1-010	0.0	0	0.0	350	10	1.772%	2.9	7.7	4.5	-2.9	-100.0%	10	
Twelve Mile Road	10	KENM-21-1-010	COOL-21-1-010	0.0	0	0.0	249	12	0.610%	2.8	11.9	4.3	-2.8	-100.0%	10	
Coolidge Highway	10	COOL-21-1-010	COOL-20-1-060	1.9	0	2.1	324	12	0.426%	2.3	10.9	1.5	-0.2	-9.4%	10	
Coolidge Highway	10	COOL-20-1-060	COOL-20-1-040	1.9	0	2.0	320	12	0.315%	2.0	10.6	0.8	0.0	1.0%	10	
Coolidge Highway	10	COOL-20-1-040	COOL-20-1-020	1.9	0	1.9	324	12	0.315%	2.0	10.7	0.9	-0.1	-3.3%	10	
Coolidge Highway	10	COOL-20-1-020	COOL-19-1-070	3.5	0	3.6	391	15	0.235%	3.1	11.1	0.9	0.4	13.8%	7	
Coolidge Highway	10	COOL-19-1-070	COOL-19-1-040	4.4	0	4.2	390	15	0.143%	2.4	10.6	0.6	1.8	72.3%	2	21
Coolidge Highway	10	COOL-19-1-060	COOL-19-1-030	0.0	0	0.0	375	18	1.121%	11.1	5.8	3.1	-11.1	-100.0%	10	
Cumberland Road	10	CUMB-20-1-010	CUMB-19-1-030	0.0	13	0.3	394	15	0.081%	1.8	9.8	3.4	-1.6	-85.8%	10	
Cumberland Road	10	CUMB-19-1-030	CUMB-19-1-020	0.0	26	0.5	390	15	0.341%	3.8	11.0	4.3	-3.3	-86.2%	10	
Cumberland Road	10	CUMB-19-1-040	CUMB-19-1-010	0.7	0	1.7	47	10	0.350%	1.3	4.6	3.8	0.4	32.9%	4	12
Cumberland Road	10	CUMB-19-1-010	CUMB-19-1-020	0.7	0	1.7	141	10	2.068%	3.2	5.6	4.9	-1.4	-45.7%	10	
Kenmore Road	10	KENM-20-1-010	KENM-19-1-040	0.0	11	0.2	382	18	0.210%	4.8	11.5	3.9	-4.6	-95.4%	10	
Kenmore Road	10	KENM-19-1-040	KENM-19-1-030	3.3	22	4.7	399	18	0.329%	6.0	10.9	2.4	-1.3	-21.6%	10	
Kenmore Road	10	KENM-19-1-020	KENM-19-1-010	0.5	0	1.3	45	10	0.331%	1.3	4.4	3.7	0.0	3.7%	9	
Kenmore Road	10	KENM-19-1-010	KENM-19-1-030	0.5	0	1.3	141	10	2.102%	3.2	5.1	4.4	-1.9	-59.1%	10	
Twelve Mile Road	10	KIPL-19-1-030	CUMB-19-1-020	0.0	12	0.2	288	24	0.793%	20.1	12.7	7.0	-19.9	-98.8%	10	
Twelve Mile Road	10	CUMB-19-1-020	KENM-19-1-030	5.7	44	8.8	288	24	0.633%	18.0	13.3	5.2	-9.1	-50.8%	10	
Twelve Mile Road	10	KENM-19-1-030	COOL-19-1-040	11.6	74	17.8	247	24	0.612%	17.7	13.4	4.0	0.1	0.5%	10	
Coolidge Highway	10	COOL-19-1-040	COOL-19-1-030	16.8	74	19.8	41	24	0.929%	21.8	13.2	3.7	-2.0	-9.0%	10	
Coolidge Highway	10	COOL-19-1-030	COOL-19-1-025	19.1	74	23.0	18	24	0.784%	20.0	13.4	3.8	3.0	14.8%	6	
Coolidge Highway	10	COOL-19-1-025	COOL-19-1-015	27.7	83	31.6	183	30	0.074%	11.1	13.5	3.9	20.5	184.5%	0	48

Appendix B
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Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	10	COOL-19-1-015	COOL-18-1-025	27.7	86	30.9	144	30	0.291%	22.1	14.9	6.1	8.8	39.8%	4	36
Coolidge Highway	10	COOL-18-1-025	COOL-18-1-015	27.7	116	30.6	156	30	0.183%	17.5	14.1	5.7	13.1	74.8%	2	42
Coolidge Highway	10	COOL-18-1-015	COOL-17-1-025	31.6	124	37.3	178	30	0.024%	6.4	14.6	6.8	30.9	484.6%	0	60
Coolidge Highway	10	COOL-17-1-025	COOL-17-1-015	32.2	147	37.4	165	30	0.224%	19.4	16.6	10.2	18.0	93.0%	2	42
Coolidge Highway	10	COOL-16-1-015	COOL-17-1-015	0.2	13	0.5	330	10	2.019%	3.1	8.9	8.2	-2.6	-84.4%	10	
Coolidge Highway	10	COOL-16-1-010	COOL-17-1-010	0.0	22	0.4	328	12	1.555%	4.4	9.1	8.3	-4.0	-90.3%	10	
Twelve Mile Road	10	CUMB-17-1-050	KENM-17-1-030	0.0	10	0.2	263	12	0.353%	2.1	10.3	3.4	-1.9	-90.8%	10	
Kenmore Road	10	KENM-17-1-030	KENM-17-1-020	0.4	22	1.1	331	12	0.230%	1.7	10.3	2.5	-0.7	-38.2%	10	
Kenmore Road	10	KENM-17-1-020	KENM-17-1-010	3.6	34	6.0	321	12	0.453%	2.4	9.5	1.1	3.6	149.1%	1	18
Kenmore Road	10	KENM-14-1-020	KENM-14-1-030	0.0	14	0.3	327	12	0.514%	2.6	8.8	8.0	-2.3	-89.0%	10	
Kenmore Road	10	KENM-14-1-030	KENM-17-1-010	0.0	20	0.4	340	18	0.779%	9.3	11.1	9.9	-8.9	-95.7%	10	
Twelve Mile Road	10	WAKE-17-1-080	KIPL-17-1-050	0.0	9	0.2	265	12	0.498%	2.5	11.3	10.1	-2.3	-92.8%	10	
Twelve Mile Road	10	CUMB-17-1-040	KIPL-17-1-050	0.1	11	0.2	286	10	0.794%	2.0	7.0	6.3	-1.8	-92.3%	10	
Cumberland Road	10	CUMB-17-1-040	CUMB-17-1-030	0.3	0	0.7	137	10	0.647%	1.8	7.4	6.7	-1.0	-57.5%	10	
Kipling Avenue	10	KIPL-17-1-050	KIPL-17-1-040	0.5	20	1.2	93	12	0.468%	2.4	10.6	7.9	-1.2	-51.3%	10	
Kipling Avenue	10	KIPL-17-1-040	KIPL-17-1-030	1.3	22	3.1	47	12	0.177%	1.5	10.3	7.2	1.6	106.8%	1	18
Twelve Mile Road	10	KIPL-17-1-030	CUMB-17-1-030	0.0	0	0.0	287	10	0.659%	1.8	8.9	7.3	-1.8	-100.0%	10	
Cumberland Road	10	CUMB-17-1-030	CUMB-17-1-020	1.1	10	2.2	258	12	0.221%	1.7	9.3	6.0	0.5	32.3%	4	15
Cumberland Road	10	CUMB-17-1-020	CUMB-17-1-010	2.7	20	4.0	251	12	0.390%	2.2	9.6	6.6	1.8	79.5%	2	15
Cumberland Road	10	CUMB-14-1-010	CUMB-14-1-020	0.0	12	0.2	329	12	0.252%	1.8	8.9	8.1	-1.5	-86.6%	10	
Cumberland Road	10	CUMB-14-1-020	CUMB-14-1-030	0.5	26	0.9	340	12	0.490%	2.5	9.0	8.2	-1.6	-65.6%	10	
Cumberland Road	10	CUMB-14-1-030	CUMB-17-1-010	2.5	37	3.4	340	12	0.960%	3.5	9.0	8.2	-0.1	-2.5%	10	
Kipling Avenue	10	KIPL-17-1-030	KIPL-17-1-020	1.3	30	3.1	205	12	0.267%	1.8	10.4	7.6	1.2	66.9%	3	15
Kipling Avenue	10	KIPL-17-1-020	KIPL-17-1-010	2.3	41	4.6	303	15	0.225%	3.1	10.0	8.2	1.5	49.5%	3	18
Wakefield Road	10	WAKE-17-1-070	WAKE-17-1-060	0.5	0	1.4	140	12	0.783%	3.2	6.7	5.9	-1.7	-54.2%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Wakefield Road	10	WAKE-17-1-055	WAKE-17-1-060	0.0	18	0.4	178	12	0.350%	2.1	10.4	9.2	-1.8	-83.4%	10	
Wakefield Road	10	WAKE-17-1-060	WAKE-17-1-030	0.5	24	1.4	249	12	0.513%	2.6	8.2	6.4	-1.1	-44.8%	10	
Wakefield Road	10	WAKE-17-1-030	WAKE-17-1-010	1.6	33	4.0	256	12	0.513%	2.6	8.4	5.7	1.4	56.4%	3	15
Coolidge Highway	10	COOL-17-1-015	COOL-17-1-010	18.4	85	21.9	49	36	0.161%	26.7	18.9	13.4	-4.8	-18.1%	6	
Beverly Boulevard	10	COOL-17-1-010	KENM-17-1-010	19.4	106	32.7	251	36	0.253%	33.6	18.7	13.3	-0.9	-2.7%	10	
Beverly Boulevard	10	KENM-17-1-010	CUMB-17-1-010	24.9	160	37.8	287	36	0.257%	33.8	19.9	14.7	4.0	11.8%	7	
Beverly Boulevard	10	CUMB-17-1-010	KIPL-17-1-010	35.4	217	51.2	289	42	0.099%	31.6	19.0	14.0	19.5	61.7%	3	54
Beverly Boulevard	10	KIPL-17-1-010	WAKE-17-1-010	40.2	258	57.0	287	42	0.047%	21.9	19.9	15.3	35.2	160.8%	0	66
Beverly Boulevard (outlet to Robina 84")	10	WAKE-17-1-010	25779	46.7	290	65.1	312	42	-0.079%	28.2	21.6	17.7	36.9	130.8%	1	#NUM!
ROBINA INLET (BEVERLY) - 45																
Robina Avenue	11	TWEL-14-1-010	ROBI-17-1-040	0.0	0	0.0	127	12	0.237%	1.7	8.9	6.4	-1.7	-100.0%	10	
Robina Avenue	11	ROBI-17-1-040	ROBI-17-1-020	0.5	2	1.4	316	12	0.600%	2.8	10.3	7.5	-1.3	-48.0%	10	
Robina Avenue	11	ROBI-17-1-020	ROBI-17-1-010	2.2	14	4.8	336	66	0.688%	278.6	9.7	5.3	-273.8	-98.3%	10	
Robina Avenue (outlet to Robina 84")	11	ROBI-17-1-010	25779	3.7	11	6.6	15	12	6.333%	9.0	11.4	10.6	-2.4	-26.6%	10	
WILTSHIRE LATERAL (WEST) - 32																
Ellwood Avenue	12	ELLW-17-1-010	ELLW-14-1-030	1.1	22	1.9	340	12	0.534%	2.6	9.4	5.2	-0.7	-26.4%	10	
Ellwood Avenue	12	ELLW-14-1-030	ELLW-14-1-020	1.1	37	1.8	336	12	0.456%	2.4	10.3	5.1	-0.6	-23.9%	10	
Ellwood Avenue	12	ELLW-14-1-020	ELLW-14-1-010	3.6	52	5.1	333	12	0.557%	2.7	9.8	3.9	2.5	92.3%	2	18
Thomas Avenue	12	THOM-17-1-010	THOM-14-1-030	0.3	16	0.5	342	12	0.822%	3.2	9.8	9.0	-2.8	-85.4%	10	
Thomas Avenue	12	THOM-14-1-030	THOM-14-1-020	0.3	32	0.4	336	12	0.219%	1.7	10.5	9.0	-1.2	-73.3%	10	
Thomas Avenue	12	THOM-14-1-020	THOM-14-1-010	3.0	47	3.8	323	12	0.718%	3.0	9.0	6.8	0.8	27.3%	4	15
Cummings Avenue	12	CUMM-17-1-010	CUMM-14-1-030	0.0	6	0.1	337	12	0.643%	2.9	10.8	10.0	-2.7	-95.8%	10	
Cummings Avenue	12	CUMM-14-1-030	CUMM-14-1-020	0.0	13	0.3	336	12	0.670%	2.9	10.8	10.0	-2.7	-91.1%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cummings Avenue	12	CUMM-14-1-020	CUMM-14-1-010	2.7	20	4.0	336	12	0.770%	3.1	9.6	7.2	0.8	26.5%	4	15
Bacon Avenue	12	BACO-17-1-020	BACO-17-1-010	0.0	0	0.0	21	12	1.572%	4.5	9.5	8.3	-4.5	-100.0%	10	
Bacon Avenue	12	BACO-17-1-030	BACO-17-1-010	0.0	0	0.0	12	12	1.923%	4.9	7.9	7.1	-4.9	-99.9%	10	
Bacon Avenue	12	BACO-17-1-010	BACO-14-1-030	0.0	6	0.1	314	12	1.039%	3.6	9.6	8.3	-3.5	-96.6%	10	
Bacon Avenue	12	BACO-14-1-030	BACO-14-1-020	2.4	12	4.8	337	12	0.791%	3.2	9.3	4.7	1.7	53.0%	3	15
Bacon Avenue	12	BACO-14-1-020	BACO-14-1-010	2.8	18	5.5	334	15	1.000%	6.5	10.1	9.1	-0.9	-14.4%	10	
Phillips Avenue	12	PHIL-17-1-010	PHIL-14-1-030	0.0	14	0.3	334	12	0.640%	2.9	10.2	9.0	-2.6	-90.2%	10	
Phillips Avenue	12	PHIL-14-1-030	PHIL-14-1-020	0.0	26	0.5	337	12	0.732%	3.0	9.8	6.3	-2.5	-82.9%	10	
Phillips Avenue	12	PHIL-14-1-020	PHIL-14-1-010	4.1	37	5.7	336	12	1.025%	3.6	9.5	3.6	2.1	57.1%	3	15
Oakshire Avenue	12	OAKS-17-1-010	OAKS-14-1-030	0.0	13	0.3	333	12	0.875%	3.3	11.6	11.4	-3.1	-92.2%	10	
Oakshire Avenue	12	OAKS-14-1-030	OAKS-14-1-020	1.8	27	2.5	336	12	0.756%	3.1	11.1	10.6	-0.6	-20.6%	10	
Oakshire Avenue	12	OAKS-14-1-020	OAKS-14-1-010	4.5	41	5.8	341	15	0.595%	5.0	10.0	9.6	0.8	15.4%	6	
Royal Avenue	12	ROYA-17-1-010	ROYA-14-1-030	0.0	12	0.2	339	12	0.979%	3.5	11.4	6.9	-3.3	-93.2%	10	
Royal Avenue	12	ROYA-14-1-030	ROYA-14-1-020	1.8	27	2.5	333	12	0.774%	3.1	9.6	1.8	-0.6	-19.1%	10	
Royal Avenue	12	ROYA-14-1-020	ROYA-14-1-010	5.5	40	7.1	341	12	0.671%	2.9	8.7	0.0	4.1	142.1%	1	18
Buckingham Avenue	12	BUCK-17-1-010	BUCK-14-1-030	0.0	14	0.3	315	12	0.925%	3.4	10.8	10.0	-3.1	-91.8%	10	
Buckingham Avenue	12	BUCK-14-1-030	BUCK-14-1-020	1.5	28	2.3	337	15	0.517%	4.6	10.3	9.3	-2.3	-50.2%	10	
Buckingham Avenue	12	BUCK-14-1-020	BUCK-14-1-010	3.7	43	5.4	337	15	0.559%	4.8	10.4	8.9	0.6	12.4%	7	
Tyler Avenue	12	TYLE-17-1-010	TYLE-14-1-030	0.0	13	0.3	337	12	0.784%	3.2	13.8	13.0	-2.9	-91.8%	10	
Tyler Avenue	12	TYLE-14-1-030	TYLE-14-1-020	0.0	27	0.5	339	15	0.784%	5.7	8.5	7.5	-5.2	-90.6%	10	
Tyler Avenue	12	TYLE-14-1-020	TYLE-14-1-010	3.9	39	6.0	336	15	0.784%	5.7	8.6	7.6	0.3	5.5%	9	
Gardner Avenue	12	GARD-17-1-010	GARD-14-1-040	0.0	2	0.0	86	30	0.717%	34.7	15.7	13.7	-34.7	-99.9%	10	
Gardner Avenue	12	GARD-14-1-040	GARD-14-1-030	0.0	17	0.3	379	30	0.812%	37.0	15.5	13.5	-36.6	-99.1%	10	
Gardner Avenue	12	GARD-14-1-030	GARD-14-1-020	2.0	31	2.9	376	42	0.410%	64.4	11.8	9.0	-61.5	-95.5%	10	
Gardner Avenue	12	GARD-14-1-020	GARD-14-1-010	2.0	37	2.7	171	42	0.549%	74.5	11.6	8.8	-71.8	-96.3%	10	
Griffith Avenue	12	GRIF-17-1-010	GRIF-14-1-030	0.0	11	0.2	335	12	0.479%	2.5	12.3	11.5	-2.2	-91.1%	10	
Griffith Avenue	12	GRIF-14-1-030	GRIF-14-1-020	0.0	25	0.5	337	12	0.809%	3.2	10.9	10.1	-2.7	-84.4%	10	
Griffith Avenue	12	GRIF-14-1-020	GRIF-14-1-010	0.0	37	0.7	336	12	0.699%	3.0	8.7	7.9	-2.2	-75.2%	10	
Whiltshire Road	12	ELLW-14-1-010	THOM-14-1-010	6.6	47	8.7	329	15	1.270%	7.3	13.5	10.2	1.5	19.9%	5	18

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Whiltshire Road	12	THOM-14-1-010	CUMM-14-1-010	8.1	47	9.9	315	24	0.782%	20.0	14.7	13.1	-10.1	-50.3%	10	
Whiltshire Road	12	CUMM-14-1-010	BACO-14-1-010	7.0	20	9.8	322	24	0.842%	20.8	14.9	13.3	-11.0	-53.0%	10	
Whiltshire Road	12	BACO-14-1-010	PHIL-14-1-010	7.4	18	10.2	317	36	0.572%	50.4	15.3	12.9	-40.3	-79.9%	10	
Whiltshire Road	12	PHIL-14-1-010	OAKS-14-1-010	7.2	37	9.8	313	36	0.560%	49.9	15.7	13.3	-40.1	-80.4%	10	
Whiltshire Road	12	OAKS-14-1-010	ROYA-14-1-010	8.0	41	10.8	329	36	0.617%	52.4	13.9	11.5	-41.6	-79.4%	10	
Whiltshire Road	12	ROYA-14-1-010	BUCK-14-1-010	10.4	40	13.8	330	48	0.153%	56.1	12.3	9.1	-42.3	-75.5%	10	
Whiltshire Road	12	BUCK-14-1-010	TYLE-14-1-010	5.5	43	8.0	304	48	0.154%	56.4	13.6	10.4	-48.4	-85.9%	10	
Whiltshire Road	12	TYLE-14-1-010	GARD-14-1-010	7.7	39	11.5	267	48	0.431%	94.3	12.1	8.9	-82.8	-87.8%	10	
Whiltshire Road	12	GARD-14-1-010	GRIF-14-1-010	8.6	37	11.1	280	30	0.470%	28.1	13.3	11.3	-17.0	-60.6%	10	
Wiltshire Road (outlet to Robina 84")	12	GRIF-14-1-010	25780	3.6	37	5.8	273	30	0.323%	23.3	16.0	14.0	-17.5	-74.9%	10	
WILTSHIRE LATERAL (EAST) - 31																
Kenmore Road	13	KENM-14-1-020	KENM-14-1-010	0.0	11	0.2	342	12	1.340%	4.1	9.3	8.5	-3.9	-94.7%	10	
Kipling Avenue	13	KIPL-17-1-010	KIPL-14-1-040	0.0	12	0.2	332	15	0.194%	2.8	10.8	5.2	-2.6	-91.6%	10	
Kipling Avenue	13	KIPL-14-1-040	KIPL-14-1-020	0.0	28	0.6	337	15	0.286%	3.5	10.4	4.1	-2.9	-83.8%	10	
Kipling Avenue	13	KIPL-14-1-020	KIPL-14-1-010	6.3	38	9.3	337	15	0.222%	3.0	9.9	2.7	6.3	206.1%	0	24
Wakefield Avenue	13	WAKE-17-1-010	WAKE-14-1-030	0.0	12	0.2	337	12	0.382%	2.2	9.6	8.8	-2.0	-89.1%	10	
Wakefield Avenue	13	WAKE-14-1-030	WAKE-14-1-020	0.0	28	0.6	336	12	0.493%	2.5	8.6	6.6	-1.9	-77.6%	10	
Wakefield Avenue	13	WAKE-14-1-020	WAKE-14-1-010	2.7	40	4.2	338	12	0.573%	2.7	9.8	6.3	1.5	55.2%	3	15
Coolidge Highway	13	COOL-16-1-015	COOL-15-1-025	0.0	11	0.2	206	10	1.247%	2.4	8.7	8.0	-2.2	-91.4%	10	
Coolidge Highway	13	COOL-15-1-025	COOL-15-1-015	0.4	11	1.1	134	10	1.144%	2.3	9.7	9.0	-1.2	-53.0%	10	
Coolidge Highway	13	COOL-15-1-015	COOL-14-1-015	0.0	7	0.1	328	10	1.886%	3.0	9.0	7.1	-2.9	-95.3%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	13	COOL-14-1-015	COOL-14-1-010	0.0	0	0.0	53	30	0.081%	11.7	10.6	8.1	-11.7	-100.0%	10	
Coolidge Highway	13	COOL-16-1-010	COOL-15-1-010	0.0	12	0.2	335	12	1.328%	4.1	10.0	9.2	-3.9	-94.2%	10	
Coolidge Highway	13	COOL-15-1-010	COOL-14-1-010	1.0	23	2.6	349	10	1.446%	2.6	11.1	8.7	0.0	-1.8%	10	
Coolidge Highway	13	COOL-14-1-010	KENM-14-1-010	2.6	19	6.1	253	24	0.237%	11.0	10.3	7.8	-4.9	-44.3%	10	
Wilshire Road	13	KENM-14-1-010	CUMB-14-1-010	4.7	30	9.4	288	24	0.041%	4.6	16.3	13.5	4.8	104.2%	1	33
Wilshire Road	13	CUMB-14-1-010	KIPL-14-1-010	5.9	30	10.7	286	30	0.664%	33.4	19.4	16.8	-22.7	-67.9%	10	
Wilshire Road	13	KIPL-14-1-010	WAKE-14-1-010	12.2	91	18.2	290	30	0.332%	23.7	19.4	15.1	-5.5	-23.1%	10	
Wilshire Road (outlet to Robina 84")	13	WAKE-14-1-010	25780	17.9	131	47.0	296	30	0.235%	19.9	17.7	13.0	27.1	136.6%	1	42
ROBINA INLET (WILTSHIRE) - 46																
Robina Avenue	14	ROBI-17-1-010	ROBI-14-1-030	0.9	15	1.6	326	12	0.502%	2.5	11.2	10.4	-0.9	-34.8%	10	
Robina Avenue	14	ROBI-14-1-030	ROBI-14-1-020	0.9	28	1.6	331	12	0.502%	2.5	7.1	6.0	-1.0	-37.9%	10	
Robina Avenue	14	ROBI-14-1-020	ROBI-14-1-010	4.6	40	6.0	340	15	0.401%	4.1	10.0	7.9	1.9	47.1%	3	18
Robina Avenue (outlet to Robina 84")	14	ROBI-14-1-010	25780	7.8	35	9.4	11	15	9.360%	19.8	8.5	7.9	-10.3	-52.3%	10	
CATALPA INLET (NORTH - ELLWOOD)																
Ellwood Avenue	15	ELLW-14-1-010	ELLW-11-1-020	0.7	15	1.3	323	15	0.549%	4.8	9.6	8.6	-3.5	-72.3%	10	
Ellwood Avenue	15	ELLW-11-1-020	ELLW-11-1-010	0.7	26	1.3	316	18	0.527%	7.6	9.7	8.5	-6.4	-83.4%	10	
Ellwood Avenue	15	ELLW-11-1-010	25762	3.4	32	3.9	317	18	0.527%	7.6	9.1	7.9	-3.7	-48.3%	10	
CATALPA INLET (NORTH - THOMAS)																
Thomas Avenue	16	THOM-14-1-010	THOM-11-1-020	0.0	10	0.2	340	15	0.041%	1.3	10.1	9.1	-1.1	-84.7%	10	
Thomas Avenue	16	THOM-11-1-020	THOM-11-1-010	0.0	21	0.4	313	15	0.950%	6.3	8.8	7.8	-5.9	-93.3%	10	
Thomas Avenue	16	THOM-11-1-010	25763	3.0	32	4.0	311	15	0.950%	6.3	10.4	9.4	-2.3	-37.3%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
CATALPA INLET (NORTH - CUMMINGS)																
Cummings Avenue	17	CUMM-14-1-010	CUMM-11-1-020	0.0	9	0.2	318	15	0.620%	5.1	10.5	9.5	-4.9	-96.5%	10	
Cummings Avenue	17	CUMM-11-1-020	CUMM-11-1-010	1.2	20	1.8	317	15	0.351%	3.8	9.6	8.6	-2.0	-52.9%	10	
Cummings Avenue	17	CUMM-11-1-010	25764	2.0	31	2.9	320	15	0.351%	3.8	10.6	9.6	-0.9	-23.4%	10	
CATALPA INLET (NORTH - BACON)																
Bacon Avenue	18	BACO-14-1-010	BACO-11-1-020	0.0	9	0.2	318	15	0.240%	3.2	10.4	9.4	-3.0	-94.3%	10	
Bacon Avenue	18	BACO-11-1-020	BACO-11-1-010	0.0	20	0.4	319	15	0.271%	3.4	9.4	8.4	-3.0	-88.1%	10	
Bacon Avenue	18	BACO-11-1-010	25765	1.8	31	2.8	321	15	0.271%	3.4	9.7	8.7	-0.5	-16.2%	10	
CATALPA INLET (NORTH - PHILLIPS)																
Phillips Avenue	19	PHIL-14-1-010	PHIL-11-1-020	0.0	11	0.2	328	15	0.364%	3.9	11.1	10.1	-3.7	-94.4%	10	
Phillips Avenue	19	PHIL-11-1-020	PHIL-11-1-010	1.0	22	1.6	315	15	0.192%	2.8	10.8	9.8	-1.2	-42.8%	10	
Phillips Avenue	19	PHIL-11-1-010	25766	2.3	33	3.4	314	15	0.192%	2.8	10.0	8.7	0.6	20.9%	6	
CATALPA INLET (NORTH - OAKSHIRE)																
Oakshire Avenue	20	OAKS-14-1-010	OAKS-11-1-030	0.0	12	0.2	324	15	0.174%	2.7	11.0	10.0	-2.5	-91.1%	10	
Oakshire Avenue	20	OAKS-11-1-030	OAKS-11-1-020	1.6	23	2.2	314	15	0.330%	3.7	9.2	7.6	-1.5	-41.3%	10	
Oakshire Avenue	20	OAKS-11-1-020	25767	3.9	34	5.2	317	15	0.212%	3.0	10.1	7.7	2.2	74.9%	2	21
CATALPA INLET (NORTH - ROYAL)																
Royal Avenue	21	ROYA-14-1-010	ROYA-11-1-030	0.0	10	0.2	313	15	0.287%	3.5	9.4	5.4	-3.3	-94.2%	10	
Royal Avenue	21	ROYA-11-1-030	ROYA-11-1-010	1.4	21	2.0	321	15	0.226%	3.1	8.8	3.9	-1.1	-35.3%	10	
Royal Avenue	21	ROYA-11-1-010	25769	5.9	32	8.2	319	15	0.226%	3.1	10.3	4.9	5.1	165.3%	0	24
CATALPA INLET (NORTH - BUCKINGHAM)																
Buckingham Avenue	22	BUCK-14-1-010	BUCK-11-1-020	0.0	9	0.2	326	18	0.215%	4.9	10.3	8.8	-4.7	-96.3%	10	
Buckingham Avenue	22	BUCK-11-1-020	BUCK-11-1-010	1.2	20	1.6	321	18	0.215%	4.9	7.2	5.0	-3.2	-66.6%	10	
Buckingham Avenue	22	BUCK-11-1-010	25770	7.0	31	8.7	320	18	0.215%	4.9	9.0	6.3	3.9	79.6%	2	24

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
CATALPA INLET (NORTH - TYLER)																
Tyler Avenue	23	TYLE-14-1-010	TYLE-11-1-030	0.0	10	0.2	317	15	0.127%	2.3	8.6	7.6	-2.1	-91.3%	10	
Tyler Avenue	23	TYLE-11-1-030	TYLE-11-1-020	3.2	21	4.6	318	18	0.372%	6.4	8.6	7.4	-1.8	-28.5%	10	
Tyler Avenue	23	TYLE-11-1-020	25768	3.2	32	4.4	335	18	0.372%	6.4	11.0	9.8	-2.0	-31.6%	10	
CATALPA INLET (NORTH - GARDNER)																
Gardner Avenue	24	GARD-14-1-010	GARD-11-1-030	0.0	6	0.1	207	42	0.331%	57.9	12.1	9.3	-57.7	-99.8%	10	
Gardner Avenue	24	GARD-11-1-030	GARD-11-1-020	0.8	17	1.3	377	42	0.292%	54.4	13.6	10.8	-53.0	-97.5%	10	
Gardner Avenue	24	GARD-11-1-020	GARD-11-1-010	2.5	28	3.7	372	42	0.429%	65.9	15.4	12.6	-62.2	-94.5%	10	
Catalpa Avenue	24	TYLE-11-1-010	GARD-11-1-010	0.0	4	0.1	219	12	0.104%	1.1	11.0	10.2	-1.1	-93.0%	10	
Gardner Avenue	24	GARD-11-1-010	25771	6.0	32	8.2	17	42	7.417%	274.0	17.0	14.2	-265.8	-97.0%	10	
CATALPA INLET (NORTH - GRIFFITH)																
Griffith Avenue	25	GRIF-14-1-010	GRIF-11-1-030	0.0	12	0.2	329	12	0.289%	1.9	10.7	9.4	-1.7	-87.5%	10	
Griffith Avenue	25	GRIF-11-1-030	GRIF-11-1-020	2.4	23	3.9	318	15	0.361%	3.9	13.4	11.2	0.0	-0.3%	10	
Griffith Avenue	25	GRIF-11-1-020	GRIF-11-1-010	3.5	34	5.4	312	15	0.281%	3.4	13.2	11.0	2.0	58.4%	3	18
Catalpa Avenue	25	GARD-11-1-010	GRIF-11-1-010	0.0	4	0.1	282	12	0.464%	2.4	12.4	11.6	-2.3	-96.7%	10	
Griffith Avenue	25	GRIF-11-1-010	25772	5.9	38	8.9	18	15	7.527%	17.7	12.1	11.1	-8.8	-49.7%	10	
CATALPA INLET (NORTH - ROBINA)																
Robina Avenue	26	ROBI-14-1-010	ROBI-11-1-020	1.1	17	1.3	333	15	0.155%	2.5	8.5	7.9	-1.3	-49.5%	10	
Robina Avenue	26	ROBI-11-1-020	ROBI-11-1-010	1.1	28	1.2	318	15	0.162%	2.6	11.0	12.1	-1.4	-52.8%	10	
Robina Avenue	26	ROBI-11-1-010	25773	3.1	39	3.6	328	15	1.818%	8.7	10.9	13.6	-5.1	-58.5%	10	
CATALPA INLET (NORTH 2 - ROBINA)																
Catalpa Drive	27	GRIF-11-1-010	CATA-13-1-030	0.0	6	0.1	347	12	0.474%	2.5	11.1	10.3	-2.3	-95.1%	10	
Catalpa Drive	27	CATA-13-1-040	CATA-13-1-030	0.0	1	0.0	56	12	0.733%	3.1	11.0	10.2	-3.0	-99.3%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Catalpa Drive	27	CATA-13-1-030	30769	0.0	7	0.1	17	12	0.430%	2.3	12.1	11.3	-2.2	-94.0%	10	
CATALPA INLET (NORTH - WAKEFIELD)																
Wakefield Road	28	WAKE-14-1-010	WAKE-11-1-020	0.0	8	0.2	338	12	0.255%	1.8	11.3	9.0	-1.6	-91.1%	10	
Wakefield Road	28	WAKE-11-1-020	WAKE-11-1-010	3.9	19	7.0	315	15	0.385%	4.0	8.7	5.4	3.0	75.9%	2	21
Wakefield Road	28	WAKE-11-1-010	25774	3.9	30	6.8	316	15	1.551%	8.0	10.1	9.1	-1.2	-15.4%	10	
CATALPA INLET (NORTH - KIPLING)																
Kipling Avenue	29	KIPL-14-1-010	KIPL-11-1-040	0.0	8	0.2	321	15	0.644%	5.2	13.4	9.9	-5.0	-96.9%	10	
Kipling Avenue	29	KIPL-11-1-040	KIPL-11-1-030	3.3	19	6.0	320	15	0.883%	6.1	10.0	4.7	-0.1	-1.9%	10	
Kipling Avenue	29	KIPL-11-1-030	KIPL-11-1-020	6.2	30	10.0	287	15	0.943%	6.3	8.5	3.1	3.8	59.9%	3	18
Kipling Avenue	29	KIPL-11-1-020	25775	8.3	41	12.8	46	15	3.182%	11.5	9.7	8.4	1.3	10.9%	7	
CATALPA INLET (NORTH - CUMBERLAND)																
Cumberland Road	30	CUMB-14-1-010	CUMB-11-1-020	0.0	12	0.2	332	12	1.919%	4.9	8.6	7.8	-4.7	-95.1%	10	
Cumberland Road	30	CUMB-11-1-020	CUMB-11-1-010	1.0	23	1.7	316	12	1.794%	4.8	9.0	8.2	-3.1	-65.0%	10	
Cumberland Road	30	CUMB-11-1-010	25776	2.3	34	3.6	326	12	1.428%	4.3	8.5	7.7	-0.6	-14.7%	10	
CATALPA INLET (NORTH - KENMORE)																
Kenmore Road	31	KENM-14-1-010	KENM-11-1-020	0.0	11	0.2	332	12	1.301%	4.1	11.2	7.4	-3.8	-94.6%	10	
Kenmore Road	31	KENM-11-1-020	KENM-11-1-010	2.0	22	3.4	316	12	1.197%	3.9	9.8	1.5	-0.5	-13.9%	10	
Kenmore Road	31	KENM-11-1-010	25777	4.5	33	7.0	322	12	1.197%	3.9	10.9	1.5	3.1	79.9%	2	15
CATALPA INLET (NORTH - COOLIDGE)																
Coolidge Highway	32	COOL-14-1-010	COOL-13-1-010	0.5	8	1.2	312	15	0.333%	3.7	10.3	7.8	-2.6	-68.7%	10	
Coolidge Highway	32	COOL-13-1-010	COOL-11-1-020	3.2	19	6.8	331	15	0.323%	3.7	8.9	5.4	3.1	84.3%	2	21
Coolidge Highway	32	COOL-11-1-020	25778	3.9	30	7.9	324	18	2.159%	15.4	11.3	10.1	-7.5	-48.6%	10	
Coolidge Highway	32	CATA-17-1-010	25778	0.5	0	0.9	112	12	0.473%	2.5	8.9	8.1	-1.5	-62.3%	10	
CATALPA INLET (SOUTH - ELLWOOD)																
Greenfield Road	33	GREE-07-1-010	GREE-07-1-020	0.0	7	0.1	361	12	0.337%	2.1	7.5	6.7	-1.9	-93.2%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Greenfield Road	33	GREE-07-1-020	GREE-07-1-030	1.1	13	1.6	359	12	0.275%	1.9	7.7	6.9	-0.3	-14.1%	10	
Greenfield Road	33	GREE-07-1-030	GREE-07-1-040	1.8	13	2.9	10	12	13.500%	13.1	10.2	9.4	-10.2	-78.0%	10	
Greenfield Road	33	GREE-07-1-040	ELLW-07-1-030	1.8	16	2.9	309	12	0.339%	2.1	12.0	10.2	0.8	38.8%	4	15
Ellwood Avenue	33	ELLW-07-1-010	ELLW-07-1-020	2.1	10	3.1	361	15	0.960%	6.3	9.1	7.5	-3.3	-51.5%	10	
Ellwood Avenue	33	ELLW-07-1-020	ELLW-07-1-030	4.5	24	6.4	361	15	0.340%	3.8	10.7	6.4	2.6	69.8%	2	21
Ellwood Avenue	33	ELLW-07-1-030	25762	6.7	46	9.5	172	18	0.340%	6.1	12.7	10.7	3.3	54.6%	3	24
THOMAS INLET (WEST - CAMBRIDGE)																
Greenfield Road	34	GREE-07-1-010	GREE-04-1-020	0.0	7	0.1	424	12	0.651%	2.9	7.5	6.7	-2.7	-95.1%	10	
Greenfield Road	34	GREE-04-1-020	GREE-04-2-015	0.8	15	1.4	387	12	0.150%	1.4	9.8	9.0	0.0	-1.0%	10	
Greenfield Road	34	GREE-04-2-015	GREE-04-1-010	1.0	15	1.7	38	15	1.302%	7.4	8.5	7.5	-5.7	-77.4%	10	
Greenfield Road	34	GREE-01-1-020	GREE-01-1-030	2.0	6	4.2	229	12	0.324%	2.0	7.4	0.0	2.2	108.1%	1	18
Greenfield Road	34	GREE-01-1-030	GREE-01-1-040	3.6	8	6.8	73	12	0.333%	2.1	7.6	0.0	4.7	229.0%	0	21
Greenfield Road	34	GREE-01-1-040	GREE-04-1-010	3.6	13	6.7	313	12	0.696%	3.0	8.4	0.0	3.7	125.4%	1	18
Ellwood Avenue	34	ELLW-07-1-010	ELLW-04-1-030	2.3	10	3.3	283	12	0.265%	1.8	9.1	5.6	1.4	77.7%	2	15
Ellwood Avenue	34	ELLW-04-1-030	ELLW-04-1-020	2.3	20	3.3	284	12	0.824%	3.2	10.6	8.7	0.0	0.8%	9	
Ellwood Avenue	34	ELLW-04-1-020	ELLW-04-1-010	2.3	30	3.3	282	12	0.797%	3.2	10.9	9.1	0.1	2.5%	9	
Ellwood Avenue	34	ELEV-01-1-010	ELLW-01-1-010	0.8	0	2.1	102	12	0.327%	2.0	4.6	0.3	0.1	3.4%	9	
Ellwood Avenue	34	ELEV-02-1-010	ELLW-01-1-010	0.3	0	0.7	64	12	0.334%	2.1	5.3	0.1	-1.3	-64.5%	10	
Ellwood Avenue	34	ELLW-01-1-010	ELLW-01-1-020	1.1	0	2.8	142	12	0.152%	1.4	7.1	0.0	1.4	101.2%	1	18
Greenfield Road	34	GREE-01-1-010	ELLW-01-1-020	0.0	11	0.2	307	12	0.217%	1.7	9.7	2.1	-1.4	-86.7%	10	
Ellwood Avenue	34	ELLW-01-1-020	ELLW-01-1-040	4.0	23	7.4	379	15	0.292%	3.5	8.5	0.0	3.9	112.2%	1	21
Ellwood Avenue	34	ELLW-01-1-040	ELLW-04-1-010	6.5	37	10.0	377	15	0.167%	2.6	10.7	0.0	7.4	278.4%	0	27
Cambridge Avenue	34	GREE-04-1-010	ELLW-04-1-010	4.6	28	8.1	325	24	0.295%	12.3	14.1	9.0	-4.2	-33.9%	10	
Cambridge Avenue	34	ELLW-04-1-010	24798	19.0	95	26.7	311	24	0.295%	12.3	14.0	8.4	14.4	117.2%	1	33

Appendix B
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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
THOMAS INLET (EAST - CAMBRIDGE)																
Thomas Avenue	35	THOM-07-1-010	THOM-04-1-030	0.2	10	0.4	284	12	0.350%	2.1	10.3	9.5	-1.7	-80.3%	10	
Thomas Avenue	35	THOM-04-1-030	THOM-04-1-020	0.2	22	0.4	284	12	0.265%	1.8	10.2	9.4	-1.4	-78.5%	10	
Thomas Avenue	35	THOM-04-1-020	THOM-04-1-010	1.6	32	2.3	283	12	0.259%	1.8	9.7	8.5	0.5	25.2%	5	15
Eleven Mile Road	35	CUMM-01-1-010	THOM-01-1-010	0.0	7	0.1	326	8	0.096%	0.4	6.8	1.4	-0.2	-62.7%	10	
Eleven Mile Road	35	THOM-01-1-010	THOM-01-1-020	0.0	7	0.1	137	10	0.614%	1.7	7.0	1.2	-1.6	-91.8%	10	
Eleven Mile Road	35	ELLW-01-1-030	THOM-01-1-020	0.1	21	0.3	296	12	0.201%	1.6	9.5	0.9	-1.3	-83.3%	10	
Thomas Avenue	35	THOM-01-1-020	THOM-01-1-040	2.2	40	5.0	373	15	0.217%	3.0	9.5	0.0	2.0	67.7%	3	21
Thomas Avenue	35	THOM-01-1-040	THOM-04-1-010	6.2	54	10.0	373	12	0.185%	1.5	9.8	0.0	8.4	549.4%	0	27
Cambridge Avenue	35	THOM-04-1-010	24798	12.7	86	17.3	16	36	1.931%	92.7	14.8	12.4	-75.4	-81.4%	10	
CATALPA INLET (SOUTH - THOMAS)																
Thomas Avenue	36	THOM-07-1-010	THOM-07-1-020	0.0	14	0.3	358	12	0.214%	1.6	10.1	1.9	-1.4	-83.0%	10	
Thomas Avenue	36	THOM-07-1-020	THOM-07-1-030	4.9	28	7.4	362	12	0.408%	2.3	8.9	0.0	5.1	223.9%	0	21
Thomas Avenue	36	THOM-07-1-030	25763	5.9	34	8.3	172	18	0.408%	6.7	11.4	9.8	1.6	24.1%	4	21
CATALPA INLET (SOUTH - CUMMINGS)																
Cummings Avenue	37	CUMM-07-1-010	CUMM-07-1-020	0.7	14	1.1	364	15	0.255%	3.3	10.1	9.1	-2.1	-65.7%	10	
Cummings Avenue	37	CUMM-07-1-020	CUMM-07-1-030	1.5	28	2.4	359	15	0.262%	3.3	9.9	8.7	-0.9	-28.5%	10	
Cummings Avenue	37	CUMM-07-1-030	25764	6.4	33	8.2	171	18	0.262%	5.4	11.5	9.7	2.8	51.5%	3	24
CATALPA INLET (SOUTH - BACON)																
Bacon Avenue	38	BACO-07-1-010	BACO-07-1-020	1.9	14	2.7	360	12	0.254%	1.8	8.6	6.2	0.9	50.7%	3	15
Bacon Avenue	38	BACO-07-1-020	BACO-07-1-030	1.9	28	2.6	360	12	0.323%	2.0	9.2	8.0	0.5	26.2%	5	15
Bacon Avenue	38	BACO-07-1-030	25765	3.2	33	4.4	172	18	0.323%	6.0	9.3	8.1	-1.6	-26.4%	10	
CATALPA INLET (SOUTH - PHILLIPS)																
Phillips Avenue	39	PHIL-07-1-010	PHIL-07-1-020	0.0	9	0.2	270	12	0.327%	2.0	9.0	8.2	-1.9	-91.2%	10	
Phillips Avenue	39	PHIL-07-1-020	PHIL-07-1-030	0.0	19	0.4	296	12	0.303%	2.0	9.6	8.8	-1.6	-80.6%	10	
Phillips Avenue	39	PHIL-07-1-030	PHIL-07-1-040	2.1	31	2.9	305	18	0.517%	7.6	9.1	7.9	-4.6	-61.2%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Catalpa Drive	39	CATA-05-1-010	PHIL-07-1-040	8.2	0	11.2	297	15	0.412%	4.1	9.9	1.1	7.1	170.3%	0	24
Phillips Avenue	39	PHIL-07-1-040	25766	12.0	31	16.0	19	18	0.518%	7.6	10.8	9.3	8.4	111.3%	1	24
OXFORD INLET (NORTH - PHILLIPS)																
Phillips Avenue	40	PHIL-07-1-010	24790	1.4	0	1.8	12	12	81.500%	32.2	9.0	8.2	-30.3	-94.3%	10	
CATALPA INLET (SOUTH - OAKSHIRE)																
Oakshire Avenue	41	OAKS-07-1-020	OAKS-07-1-030	0.0	11	0.2	287	12	0.255%	1.8	9.7	7.6	-1.6	-87.8%	10	
Oakshire Avenue	41	OAKS-07-1-030	OAKS-11-1-010	2.4	21	3.5	297	12	0.531%	2.6	9.2	6.4	0.9	34.8%	4	15
Catalpa Drive	41	CATA-06-1-010	OAKS-11-1-010	0.0	0	0.0	292	15	0.582%	4.9	9.8	8.8	-4.9	-100.0%	10	
Oakshire Avenue	41	OAKS-11-1-010	25767	8.5	21	12.6	21	24	0.531%	16.5	9.9	8.3	-3.9	-23.6%	10	
CATALPA INLET (SOUTH - ROYAL)																
Royal Avenue	42	ROYA-07-1-030	ROYA-07-1-040	2.1	8	3.0	296	12	0.091%	1.1	10.3	7.5	2.0	182.9%	0	18
Catalpa Drive	42	CATA-07-1-010	ROYA-07-1-040	0.0	6	0.1	296	15	0.283%	3.4	9.5	8.5	-3.3	-96.5%	10	
Royal Avenue	42	ROYA-07-1-040	25769	2.1	14	2.9	22	18	0.091%	3.2	12.2	10.9	-0.3	-9.1%	10	
OXFORD INLET (NORTH - BUCKINGHAM)																
Catalpa Drive	43	CATA-08-1-010	BUCK-07-1-040	0.0	5	0.1	307	12	0.287%	1.9	9.6	8.3	-1.8	-94.8%	10	
Buckingham Avenue	43	BUCK-07-1-040	BUCK-07-1-030	0.0	5	0.1	283	12	0.354%	2.1	8.7	6.3	-2.0	-95.3%	10	
Buckingham Avenue	43	BUCK-07-1-030	BUCK-07-1-020	0.9	16	1.3	288	12	0.205%	1.6	10.0	6.5	-0.3	-21.4%	10	
Buckingham Avenue	43	BUCK-07-1-020	BUCK-07-1-010	2.8	26	3.6	288	12	0.246%	1.8	10.5	6.7	1.8	104.0%	1	18
Buckingham Avenue	43	BUCK-07-1-010	24791	7.1	19	8.7	14	12	0.073%	1.0	10.7	9.0	7.8	805.0%	0	30

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
OXFORD INLET (SOUTH - PHILLIPS)																
Phillips Avenue	44	PHIL-01-1-050	PHIL-04-1-010	0.0	0	0.0	340	42	0.203%	45.3	12.9	10.1	-45.3	-100.0%	10	
Phillips Avenue	44	PHIL-04-1-010	PHIL-04-1-020	0.0	0	0.0	275	42	0.203%	45.3	16.3	13.5	-45.3	-100.0%	10	
Phillips Avenue	44	PHIL-04-1-020	24790	0.0	0	0.0	225	42	0.203%	45.3	18.6	15.8	-45.3	-100.0%	10	
CATALPA INLET (SOUTH - TYLER)																
Tyler Avenue	45	TYLE-04-1-030	TYLE-07-1-010	0.0	11	0.2	284	15	0.614%	5.1	8.1	2.3	-4.8	-95.7%	10	
Tyler Avenue	45	TYLE-07-1-010	TYLE-07-1-020	1.3	19	2.2	208	15	0.167%	2.6	8.7	1.2	-0.5	-17.6%	10	
Tyler Avenue	45	TYLE-07-1-020	TYLE-07-2-025	1.3	22	2.1	72	15	0.086%	1.9	7.9	0.3	0.2	10.3%	7	
Tyler Avenue	45	TYLE-07-2-025	TYLE-07-1-030	6.8	32	9.8	250	15	0.159%	2.6	7.7	0.0	7.2	280.2%	0	27
Tyler Avenue	45	TYLE-07-1-030	TYLE-07-1-040	6.8	40	9.4	322	15	0.159%	2.6	10.6	3.0	6.8	264.9%	0	27
Catalpa Drive	45	BUCK-07-1-040	TYLE-07-1-040	0.5	11	0.9	304	12	1.459%	4.3	8.0	7.2	-3.4	-79.4%	10	
Catalpa Drive	45	CATA-11-1-010	TYLE-07-1-040	0.0	2	0.0	305	12	0.458%	2.4	10.7	9.9	-2.4	-98.3%	10	
Tyler Avenue	45	TYLE-07-1-040	25768	8.4	53	11.0	33	15	0.217%	3.0	10.5	8.7	8.0	265.8%	0	27
BUCKINGHAM INLET (WEST - CAMBRIDGE)																
Cummings Avenue	46	CUMM-01-1-010	CUMM-01-1-020	0.0	0	0.0	146	10	0.729%	1.9	8.4	5.6	-1.9	-100.0%	10	
Eleven Mile Road	46	THOM-01-1-030	CUMM-01-1-020	0.0	9	0.2	308	12	0.289%	1.9	10.4	4.9	-1.7	-90.6%	10	
Cummings Avenue	46	CUMM-01-1-020	CUMM-01-1-040	3.0	23	6.1	369	15	0.431%	4.2	10.1	3.8	1.9	44.2%	4	18
Cummings Avenue	46	CUMM-01-1-040	CUMM-04-1-010	3.0	37	5.9	369	24	0.087%	6.7	11.1	6.5	-0.8	-11.8%	10	
Cummings Avenue	46	CUMM-07-1-010	CUMM-04-1-030	0.0	10	0.2	283	12	0.717%	3.0	10.1	8.2	-2.8	-93.4%	10	
Cummings Avenue	46	CUMM-04-1-030	CUMM-04-1-020	1.8	22	2.4	282	12	0.633%	2.8	11.4	7.3	-0.4	-13.8%	10	
Cummings Avenue	46	CUMM-04-1-020	CUMM-04-1-010	2.9	32	4.2	285	12	0.686%	2.9	11.2	6.7	1.3	43.5%	3	15
Bacon Avenue	46	BACO-07-1-010	BACO-04-1-030	1.4	6	2.0	284	10	0.612%	1.7	8.8	6.0	0.3	19.1%	6	
Bacon Avenue	46	BACO-04-1-030	BACO-04-1-020	1.4	12	2.0	283	10	0.735%	1.9	10.4	8.4	0.1	5.1%	9	
Bacon Avenue	46	BACO-04-1-020	BACO-04-1-010	4.0	17	5.2	283	15	1.853%	8.8	10.6	8.7	-3.5	-40.3%	10	
Bacon Avenue	46	BACO-01-1-010	BACO-01-1-020	0.8	0	2.0	140	10	0.941%	2.1	6.1	2.3	-0.1	-6.5%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eleven Mile Road	46	CUMM-01-1-030	BACO-01-1-020	0.0	18	0.4	310	12	0.116%	1.2	11.3	4.5	-0.9	-70.3%	10	
Bacon Avenue	46	BACO-01-1-020	BACO-01-1-030	0.8	29	2.0	367	15	0.320%	3.7	9.7	2.2	-1.7	-46.3%	10	
Bacon Avenue	46	BACO-01-1-030	BACO-04-1-010	3.7	43	7.2	366	15	0.320%	3.7	11.1	2.7	3.5	95.8%	2	21
Eleven Mile Road	46	ELEV-05-1-010	PHIL-01-1-010	0.0	26	0.5	296	10	0.166%	0.9	10.7	1.3	-0.4	-41.7%	10	
Phillips Avenue	46	PHIL-01-1-010	PHIL-01-1-020	1.0	26	2.4	199	12	0.690%	3.0	9.7	0.0	-0.5	-18.0%	10	
Phillips Avenue	46	PHIL-01-1-020	PHIL-01-1-030	2.5	36	4.9	233	12	0.093%	1.1	10.4	0.0	3.8	345.9%	0	24
Phillips Avenue	46	PHIL-01-1-030	PHIL-01-1-040	2.5	44	4.7	191	12	0.380%	2.2	10.9	0.9	2.5	112.1%	1	18
Phillips Avenue	46	PHIL-01-1-040	PHIL-01-1-045	5.7	46	8.2	60	12	0.159%	1.4	10.8	3.5	6.8	475.6%	0	24
Phillips Avenue	46	PHIL-01-1-045	PHIL-01-1-050	5.7	52	8.1	186	15	0.232%	3.1	11.2	6.8	5.0	160.6%	0	24
Oakshire Avenue	46	OXFO-06-1-010	CAMB-06-1-010	0.5	0	0.2	782	12	0.320%	2.0	13.9	13.1	-1.8	-89.4%	10	
Oakshire Avenue	46	OAKS-07-1-020	OAKS-07-1-010	0.0	10	0.2	288	12	0.679%	2.9	9.7	8.9	-2.7	-93.2%	10	
Oakshire Avenue	46	OAKS-07-1-010		2.8	20	3.8	10	18	76.029%	91.6	9.2	9.0	-87.8	-95.9%	10	
Oakshire Avenue	46	OAKS-07-1-010	OAKS-04-1-030	0.0	10	0.2	280	12	0.363%	2.1	9.2	9.0	-1.9	-90.7%	10	
Oakshire Avenue	46	OAKS-04-1-030	OAKS-04-1-020	0.0	20	0.4	283	12	0.647%	2.9	10.0	9.8	-2.5	-86.0%	10	
Oakshire Avenue	46	OAKS-04-1-020	OAKS-04-1-010	2.3	32	2.1	284	12	0.541%	2.6	10.1	9.2	-0.6	-21.1%	10	
Royal Avenue	46	ROYA-07-1-030	ROYA-07-1-020	1.3	10	1.9	288	12	0.285%	1.9	9.2	7.5	0.0	-2.1%	10	
Royal Avenue	46	ROYA-07-1-020	ROYA-07-1-010	1.3	20	1.8	288	12	0.578%	2.7	9.0	8.2	-0.9	-34.2%	4	12
Royal Avenue	46	ROYA-07-1-010		4.6	29	6.5	10	15	69.197%	53.7	9.1	8.8	-47.2	-87.9%	10	
Royal Avenue	46	ROYA-07-1-010	ROYA-04-1-030	0.2	11	0.3	284	12	0.291%	1.9	9.1	8.8	-1.6	-82.2%	10	
Royal Avenue	46	ROYA-04-1-030	ROYA-04-1-020	2.3	23	2.9	283	15	0.422%	4.2	9.5	9.3	-1.3	-31.0%	10	
Royal Avenue	46	ROYA-04-1-020	ROYA-04-1-010	2.3	33	2.8	283	15	0.226%	3.1	9.9	9.5	-0.3	-9.3%	10	
Eleven Mile Road	46	ELEV-06-1-010	OAKS-01-1-010	0.0	22	0.4	297	12	0.435%	2.3	11.2	1.4	-1.9	-81.3%	10	
Eleven Mile Road	46	ELEV-07-1-010	OAKS-01-1-010	0.0	0	0.0	272	12	0.253%	1.8	10.8	0.6	-1.8	-100.0%	10	
Oakshire Avenue	46	OAKS-01-1-010	OAKS-01-1-020	2.5	47	4.1	429	12	0.290%	1.9	11.0	0.0	2.1	111.4%	1	18
Oakshire Avenue	46	OAKS-01-1-020	OAKS-04-1-010	7.2	63	11.0	432	15	0.257%	3.3	9.7	0.0	7.7	234.5%	0	24

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Royal Avenue	46	ROYA-01-1-010	ROYA-01-1-020	0.0	12	0.2	371	12	0.255%	1.8	10.4	8.0	-1.6	-86.7%	10	
Royal Avenue	46	ROYA-01-1-020	ROYA-04-1-010	3.4	25	5.2	368	15	0.306%	3.6	9.7	6.2	1.7	46.4%	3	18
Cambridge Avenue	46	THOM-04-1-010	CUMM-04-1-010	0.0	0	0.0	327	24	0.156%	8.9	14.9	10.5	-8.9	-100.0%	10	
Cambridge Avenue	46	CUMM-04-1-010	CAMB-04-1-010	12.5	69	17.8	189	30	0.524%	29.7	12.5	7.5	-11.8	-39.9%	10	
Cambridge Avenue	46	CAMB-04-1-010	BACO-04-1-010	14.9	69	20.4	146	30	0.317%	23.1	12.5	7.1	-2.7	-11.7%	10	
Cambridge Avenue	46	BACO-04-1-010	CAMB-05-1-010	26.5	129	37.2	132	24	0.375%	13.9	14.5	8.1	23.4	168.6%	0	36
Cambridge Avenue	46	CAMB-05-1-010	PHIL-01-1-050	26.5	129	36.8	187	42	0.341%	58.8	14.7	11.4	-21.9	-37.3%	10	
Cambridge Avenue	46	PHIL-01-1-050	OAKS-04-1-010	35.3	181	46.0	320	42	0.152%	39.2	13.8	10.4	6.8	17.3%	6	
Cambridge Avenue	46	OAKS-04-1-010	CAMB-07-1-010	52.0	276	61.8	285	42	0.281%	53.4	13.8	10.0	8.5	15.9%	6	
Cambridge Avenue	46	CAMB-07-1-010	ROYA-04-1-010	53.9	276	63.1	36	42	0.158%	40.0	13.3	9.6	23.0	57.5%	3	54
Cambridge Avenue	46	ROYA-04-1-010	24796	64.0	334	75.1	340	42	0.281%	53.4	13.4	9.9	21.7	40.7%	4	48
BUCKINGHAM INLET (EAST - CAMBRIDGE)																
Buckingham Avenue	47	BUCK-07-1-010	BUCK-04-1-030	2.6	17	3.2	285	15	0.175%	2.7	10.7	9.3	0.5	19.5%	6	
Buckingham Avenue	47	BUCK-04-1-030	BUCK-04-1-020	3.0	29	3.8	284	15	0.279%	3.4	11.7	10.5	0.4	11.2%	7	
Buckingham Avenue	47	BUCK-04-1-020	BUCK-04-1-010	3.0	41	3.7	287	15	0.370%	3.9	12.1	11.1	-0.3	-6.5%	10	
Eleven Mile Road	47	ELEV-08-1-010	BUCK-01-1-010	0.0	4	0.1	340	12	0.399%	2.3	11.6	10.8	-2.2	-96.4%	10	
Buckingham Avenue	47	BUCK-01-1-010	BUCK-01-1-020	0.6	22	1.6	337	24	0.352%	13.4	12.2	10.6	-11.8	-87.8%	10	
Buckingham Avenue	47	BUCK-01-1-020	BUCK-01-1-030	5.4	26	8.0	88	24	0.033%	4.1	10.9	9.0	3.9	93.7%	2	33
Buckingham Avenue	47	BUCK-01-1-030	BUCK-01-1-040	5.4	32	7.9	154	24	0.564%	17.0	10.4	8.8	-9.1	-53.8%	10	
Buckingham Avenue	47	BUCK-01-1-040	BUCK-04-1-010	6.7	41	9.4	269	24	0.296%	12.3	10.7	9.1	-2.9	-23.5%	10	
Cambridge Avenue	47	BUCK-04-1-010	24796	6.3	41	7.9	11	42	0.282%	53.4	14.4	11.6	-45.5	-85.2%	10	
CATALPA INLET (SOUTH - ROBINA)																
Catalpa Drive	48	CATA-11-1-010	CATA-12-1-010	0.0	0	0.0	299	12	0.789%	3.2	10.5	9.7	-3.2	-100.0%	10	
Catalpa Drive	48	CATA-12-1-010	CATA-13-1-010	0.0	0	0.0	290	12	0.705%	3.0	10.6	9.8	-3.0	-100.0%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Catalpa Drive	48	CATA-13-1-010	30769	0.2	0	0.3	26	12	0.764%	3.1	12.7	11.9	-2.8	-89.2%	10	
CATALPA INLET (SOUTH - CUMBERLAND)																
Catalpa Drive	49	KIPL-11-1-010	CATA-16-1-010	0.7	10	1.0	290	12	0.391%	2.2	10.8	10.0	-1.2	-53.2%	10	
Catalpa Drive	49	CATA-17-1-020	CATA-16-1-010	0.0	15	0.3	427	12	0.988%	3.5	11.0	10.2	-3.2	-91.5%	10	
Catalpa Drive	49	CATA-16-1-010	25776	7.0	25	8.6	23	12	0.880%	3.3	12.0	10.1	5.3	158.2%	0	18
CATALPA INLET (SOUTH - KIPLING)																
Catalpa Drive	50	CATA-13-1-010	CATA-13-1-020	0.0	5	0.1	245	12	0.628%	2.8	11.3	10.5	-2.7	-96.5%	10	
Catalpa Drive	50	CATA-13-1-020	KIPL-11-1-010	0.0	9	0.2	249	12	0.758%	3.1	12.1	11.3	-2.9	-94.2%	10	
Sunnyknoll Avenue	50	25782	SUNN-13-1-010	0.0	0	0.0	85	12	0.412%	2.3	11.5	6.6	-2.3	-100.0%	10	
Sunnyknoll Avenue	50	SUNN-13-1-010	SUNN-13-1-020	0.2	3	0.4	156	12	0.232%	1.7	11.4	6.1	-1.3	-76.4%	10	
Sunnyknoll Avenue	50	SUNN-13-1-020	KIPL-09-1-010	3.1	13	4.8	243	12	0.484%	2.5	9.7	4.1	2.3	94.1%	2	18
Sunnyknoll Avenue	50	SUNN-15-1-010	KIPL-09-1-010	0.0	13	0.3	410	12	0.619%	2.8	10.0	9.2	-2.5	-90.7%	10	
Kipling Avenue	50	KIPL-07-1-010	KIPL-07-1-020	0.0	6	0.1	223	12	0.505%	2.5	8.8	8.0	-2.4	-95.3%	10	
Kipling Avenue	50	KIPL-07-1-020	KIPL-09-1-010	0.0	10	0.2	225	12	0.781%	3.1	10.8	10.0	-2.9	-93.6%	10	
Kipling Avenue	50	KIPL-09-1-010	KIPL-11-1-010	5.0	42	7.3	414	18	0.249%	5.2	11.8	9.1	2.1	40.1%	4	21
Kipling Avenue	50	KIPL-11-1-010	25775	6.7	46	9.4	24	18	2.500%	16.6	10.8	9.6	-7.2	-43.5%	10	
OXFORD INLET (NORTH - ROBINA)																
Oxford Road	51	OXFO-13-1-020	OXFO-13-1-010	0.0	50	1.0	255	12	0.914%	3.4	10.9	10.1	-2.4	-70.6%	10	
Oxford Road	51	OXFO-13-1-010	ROBI-04-1-050	0.0	50	1.0	31	12	1.380%	4.2	11.0	10.2	-3.2	-76.1%	10	
Oxford Road	51	ROBI-04-1-050	24793	4.1	50	6.3	30	12	9.527%	11.0	11.1	10.3	-4.7	-42.8%	10	
OXFORD INLET (SOUTH - GARDNER)																

Appendix B
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COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Gardner Avenue	52	CATA-11-1-010	GARD-07-1-020	0.0	79	1.6	574	12	0.519%	2.6	11.1	10.3	-1.0	-38.5%	10	
Gardner Avenue	52	GARD-07-1-020	GARD-07-1-010	0.0	79	1.6	290	12	0.272%	1.9	11.3	10.5	-0.3	-14.9%	10	
Gardner Avenue	52	GARD-07-1-010	GARD-04-1-030	0.3	86	0.6	286	15	0.396%	4.1	10.8	9.8	-3.5	-85.4%	10	
Gardner Avenue	52	GARD-04-1-030	GARD-04-1-020	1.9	97	2.7	285	15	0.374%	4.0	12.6	11.6	-1.3	-31.9%	10	
Gardner Avenue	52	GARD-04-1-020	GARD-04-1-010	1.9	109	2.6	285	15	0.270%	3.4	10.3	9.0	-0.8	-23.4%	10	
Tyler Avenue	52	TYLE-04-1-030	TYLE-04-1-020	0.0	12	0.2	280	15	1.784%	8.6	8.1	7.1	-8.4	-97.2%	10	
Tyler Avenue	52	TYLE-04-1-020	TYLE-04-1-010	1.3	24	2.2	299	42	1.145%	107.7	10.7	7.9	-105.5	-98.0%	10	
Tyler Avenue	52	TYLE-01-1-020	TYLE-01-1-040	1.1	15	1.6	331	18	0.447%	7.0	10.7	9.5	-5.5	-77.8%	10	
Tyler Avenue	52	TYLE-01-1-040	TYLE-04-1-010	2.9	27	3.9	325	24	0.413%	14.5	11.6	10.0	-10.6	-72.8%	10	
Eleven Mile Road	52	BUCK-01-1-010	TYLE-01-1-010	0.0	1	0.0	305	12	0.527%	2.6	11.6	2.8	-2.6	-99.2%	10	
Eleven Mile Road	52	TYLE-01-1-010	GARD-01-1-010	1.3	4	2.9	305	12	0.420%	2.3	12.1	1.5	0.6	25.4%	4	15
Gardner Avenue	52	GARD-01-1-010	GARD-01-1-020	2.4	9	5.8	277	12	0.300%	2.0	10.3	0.0	3.8	194.9%	0	18
Gardner Avenue	52	GARD-01-1-020	GARD-01-1-030	3.7	22	7.4	281	12	0.300%	2.0	12.7	0.0	5.4	277.1%	0	21
Gardner Avenue	52	GARD-01-1-030	GARD-04-1-010	3.7	33	7.1	282	12	0.300%	2.0	17.8	5.9	5.1	263.1%	0	21
Cambridge Avenue	52	BUCK-04-1-010	TYLE-04-1-010	6.3	41	7.9	307	42	0.395%	63.2	14.4	11.6	-55.3	-87.5%	10	
Cambridge Avenue	52	TYLE-04-1-010	GARD-04-1-010	14.4	92	17.6	304	42	0.822%	91.2	13.5	10.7	-73.6	-80.7%	10	
Cambridge Avenue	52	GARD-04-1-010	CAMB-11-1-010	29.0	234	35.6	151	42	0.135%	36.9	12.7	9.9	-1.3	-3.7%	10	
Cambridge Avenue	52	CAMB-11-1-010	GARD-04-1-025	29.0	234	35.2	418	48	0.100%	45.5	14.8	11.6	-10.3	-22.7%	10	
Gardner Avenue	52	GARD-04-1-025	GARD-07-1-015	29.0	234	33.8	423	48	0.019%	19.8	17.9	14.6	14.0	71.0%	3	60
Gardner Avenue	52	GARD-07-1-015	24792	29.0	234	32.0	11	48	4.428%	302.3	18.1	14.9	-270.3	-89.4%	10	
BERKLEY INLET (WEST - COLUMBIA)																
Griffith Avenue	53	GRIF-01-1-010	GRIF-01-1-020	1.5	14	2.4	317	15	0.469%	4.4	7.4	0.0	-2.0	-45.6%	10	
Griffith Avenue	53	GRIF-01-1-020	GRIF-01-1-030	3.8	28	5.6	338	15	0.376%	4.0	10.2	0.6	1.7	42.5%	4	18
Robina Avenue	53	ROBI-01-1-010	ROBI-01-1-020	2.5	6	4.6	219	15	0.233%	3.1	9.9	0.0	1.4	46.1%	3	18
Robina Avenue	53	ROBI-01-1-020	ROBI-01-1-030	3.3	13	6.0	217	15	0.240%	3.2	11.3	0.3	2.8	89.6%	2	21
Eleven Mile Road	53	ELEV-11-1-010	ELEV-12-1-010	0.0	18	0.4	269	10	1.608%	2.8	11.4	3.5	-2.4	-87.4%	10	
Eleven Mile Road	53	ELEV-12-1-010	ELEV-13-1-010	1.2	31	3.3	265	10	0.966%	2.2	10.2	0.0	1.1	51.9%	3	12
Eleven Mile Road	53	ELEV-13-1-010	ELEV-13-1-020	1.8	53	4.5	220	15	0.142%	2.4	11.5	0.1	2.1	84.8%	2	21

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eleven Mile Road	53	ELEV-13-1-020	KIPL-01-1-010	1.8	67	4.3	220	15	1.135%	6.9	10.7	0.0	-2.6	-37.2%	10	
Kipling Avenue	53	KIPL-01-1-010	KIPL-01-1-020	3.1	67	7.5	282	18	0.225%	5.0	10.3	0.0	2.5	50.3%	3	21
Kipling Avenue	53	KIPL-01-1-020	KIPL-03-1-010	8.7	76	15.7	287	18	0.090%	3.1	10.0	0.0	12.6	399.6%	0	33
Robina Avenue	53	24793	ROBI-04-1-040	0.0	2	0.0	146	12	0.421%	2.3	11.2	3.4	-2.3	-98.3%	10	
Robina Avenue	53	ROBI-04-1-040	ROBI-04-1-030	0.9	7	1.1	106	18	0.336%	6.1	10.1	1.5	-5.0	-81.4%	10	
Robina Avenue	53	ROBI-04-1-030	ROBI-04-1-020	0.9	14	1.1	282	18	0.223%	5.0	9.8	0.9	-3.9	-77.6%	10	
Harvard Road	53	HARV-13-1-010	ROBI-04-1-020	0.0	10	0.2	298	12	0.455%	2.4	9.0	0.8	-2.2	-91.7%	10	
Robina Avenue	53	ROBI-04-1-020	ROBI-04-1-010	14.3	35	13.2	305	18	0.150%	4.1	9.6	0.0	9.1	224.4%	0	30
Cambridge Avenue	53	CAMB-11-1-010	GRIF-01-1-030	0.0	0	0.0	147	42	0.647%	80.9	12.8	4.7	-80.9	-100.0%	10	
Cambridge Avenue	53	GRIF-01-1-030	ROBI-04-1-010	4.9	28	7.2	272	42	0.017%	13.2	13.4	4.4	-6.0	-45.5%	10	
Robina Avenue	53	ROBI-04-1-010	ROBI-01-1-030	20.0	72	20.5	276	30	0.836%	37.5	13.4	4.3	-17.0	-45.4%	10	
Columbia Road	53	ROBI-01-1-030	COLU-13-1-010	24.5	89	26.6	236	33	0.433%	34.8	14.1	3.2	-8.2	-23.6%	10	
Columbia Road	53	COLU-13-1-010	KIPL-03-1-010	28.3	91	29.9	215	33	0.266%	27.3	11.4	0.0	2.6	9.6%	7	
Kipling Avenue	53	KIPL-07-1-010	KIPL-05-1-020	0.0	10	0.2	283	10	0.503%	1.6	10.6	6.2	-1.4	-87.1%	10	
Kipling Avenue	53	KIPL-05-1-020	KIPL-05-1-010	0.8	20	1.3	284	10	0.742%	1.9	10.4	4.5	-0.6	-32.2%	10	
Kipling Avenue	53	KIPL-05-1-010	KIPL-03-1-020	1.7	29	2.6	289	15	0.942%	6.3	10.4	3.4	-3.7	-58.4%	10	
Kipling Avenue	53	KIPL-03-1-020	KIPL-03-1-010	2.5	41	3.8	289	15	0.760%	5.6	10.5	1.1	-1.9	-33.1%	10	
Sunnyknoll Avenue	53	SUNN-15-1-010	COOL-09-1-010	0.0	11	0.2	414	12	0.637%	2.8	10.0	1.7	-2.6	-92.3%	10	
Oxford Road	53	KIPL-07-1-010	OXFO-15-1-010	0.9	10	1.6	397	12	0.916%	3.4	9.4	8.6	-1.8	-53.3%	10	
Oxford Road	53	OXFO-15-1-010	COOL-07-1-010	2.2	34	3.7	420	12	0.860%	3.3	10.7	8.4	0.4	13.0%	7	
Harvard Road	53	KIPL-05-1-010	HARV-15-1-010	0.0	23	0.5	412	12	0.723%	3.0	9.2	1.8	-2.6	-84.8%	10	
Harvard Road	53	HARV-15-1-010	COOL-05-1-010	6.4	42	9.8	413	12	0.712%	3.0	10.3	0.0	6.8	226.3%	0	21
Columbia Road	53	KIPL-03-1-010	COLU-15-1-010	40.6	224	49.0	439	33	0.351%	31.3	12.2	0.0	17.7	56.6%	3	42
Columbia Road	53	COLU-15-1-010	COLU-15-1-020	41.1	235	48.6	72	33	0.273%	27.6	12.2	0.0	21.0	75.9%	2	42
Columbia Road	53	COLU-15-1-020	COOL-03-1-010	46.6	245	52.5	321	33	0.386%	32.9	12.7	0.0	19.7	59.9%	3	42

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eleven Mile Road	53	ELEV-15-1-010	ELEV-15-1-030	0.0	41	0.8	400	12	0.284%	1.9	9.5	1.1	-1.1	-56.8%	10	
Eleven Mile Road	53	ELEV-15-1-030	ELEV-15-1-040	2.5	60	6.1	312	15	0.193%	2.8	9.5	0.0	3.3	115.8%	1	21
Eleven Mile Road	53	ELEV-15-1-040	ELEV-15-1-050	3.1	60	7.4	31	18	0.174%	4.4	11.5	0.0	3.0	69.5%	2	24
Coolidge Highway	53	ELEV-15-1-050	COOL-01-1-010	3.1	60	7.4	57	18	0.205%	4.8	11.4	0.0	2.6	55.3%	3	24
Coolidge Highway	53	COOL-01-1-010	COOL-02-1-010	3.9	60	9.4	252	18	0.441%	7.0	12.0	0.0	2.4	34.2%	4	21
Coolidge Highway	53	COOL-02-1-010	COOL-02-1-020	5.6	60	12.7	5	18	0.025%	1.7	11.9	0.0	11.1	663.7%	0	42
Coolidge Highway	53	COOL-01-1-020	COOL-02-1-020	0.0	15	0.3	216	12	2.329%	5.4	7.7	1.2	-5.1	-94.5%	10	
Coolidge Highway	53	COOL-02-1-020	COOL-02-1-030	5.6	75	12.7	16	18	0.024%	1.6	11.9	0.0	11.1	686.2%	0	42
Coolidge Highway	53	COOL-02-1-030	COOL-03-1-010	5.6	82	12.7	287	18	0.416%	6.8	11.9	0.0	5.9	87.2%	2	24
Coolidge Highway	53	COOL-11-1-010	COOL-09-1-010	0.0	18	0.4	425	10	0.976%	2.2	9.9	3.2	-1.8	-83.4%	10	
Coolidge Highway	53	COOL-09-1-010	COOL-07-1-010	3.5	33	8.3	450	12	0.770%	3.1	11.0	0.0	5.1	164.6%	0	18
Coolidge Highway	53	COOL-07-1-010		11.7	66	20.3	12	15	69.167%	53.7	11.3	10.3	-33.4	-62.2%	10	
Coolidge Highway	53	COOL-07-1-010	COOL-05-1-050	0.0	0	0.0	117	15	0.457%	4.4	12.0	1.8	-4.4	-100.0%	10	
Coolidge Highway	53	COOL-05-1-050	COOL-05-1-040	0.0	0	0.0	30	15	0.364%	3.9	12.2	1.5	-3.9	-99.9%	10	
Coolidge Highway	53	COOL-05-1-040	COOL-05-1-030	0.0	43	0.9	141	15	0.534%	4.7	11.8	1.0	-3.9	-81.9%	10	
Coolidge Highway	53	COOL-05-1-030	COOL-05-1-010	0.0	43	0.9	281	15	0.393%	4.1	12.0	0.5	-3.2	-79.0%	10	
Coolidge Highway	53	COOL-05-1-010	COOL-04-1-010	11.0	90	19.6	306	18	0.651%	8.5	12.8	0.0	11.1	131.0%	1	27
Coolidge Highway	53	COOL-04-1-010	COOL-03-1-010	11.7	103	20.7	272	18	0.435%	6.9	13.4	0.0	13.8	198.5%	0	30
Coolidge Highway	53	COOL-04-1-020	COOL-03-1-020	0.4	0	1.0	262	18	0.539%	7.7	6.4	1.0	-6.7	-87.5%	10	
Coolidge Highway	53	COOL-03-1-010	COOL-03-1-020	69.4	430	88.4	26	36	0.366%	40.3	14.1	0.0	48.1	119.1%	1	54
Oxford Road	53	OXFO-19-1-010	OXFO-18-1-010	1.2	7	1.8	309	10	0.151%	0.9	10.6	3.6	0.9	106.8%	1	15
Oxford Road	53	OXFO-18-1-010	COOL-07-1-015	2.3	9	3.1	325	10	0.867%	2.0	9.4	4.1	1.1	54.0%	3	12
Harvard Road	53	HARV-19-1-010	HARV-18-1-010	0.0	11	0.2	311	12	0.691%	3.0	10.7	3.7	-2.7	-92.6%	10	
Harvard Road	53	HARV-18-1-010	COOL-05-1-015	0.0	20	0.4	320	12	0.187%	1.5	9.1	0.0	-1.1	-74.0%	10	
Harvard Road	53	HARV-19-1-010	25934	0.0	0	0.0	31	15	29.150%	34.9	10.0	9.0	-34.9	-100.0%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cambridge Avenue	53	25935	CAMB-18-1-010	0.0	14	0.3	298	15	0.284%	3.4	9.8	0.8	-3.2	-91.9%	10	
Cambridge Avenue	53	CAMB-18-1-010	COOL-04-1-015	0.0	22	0.4	319	15	0.221%	3.0	9.9	0.0	-2.6	-85.5%	10	
Princeton Road	53	PRIN-19-1-040	PRIN-19-1-030	0.0	0	0.0	33	15	1.438%	7.7	7.6	0.3	-7.7	-100.0%	10	
Princeton Road	53	PRIN-19-1-030	PRIN-19-1-020	2.5	11	4.2	295	15	0.118%	2.2	7.9	0.0	2.0	88.3%	2	21
Princeton Road	53	PRIN-19-1-020	PRIN-19-1-010	2.5	24	4.0	330	15	0.174%	2.7	11.5	0.0	1.3	46.7%	3	18
Princeton Road	53	PRIN-19-1-010	PRIN-18-1-010	3.4	37	5.4	310	15	0.161%	2.6	12.7	0.0	2.8	107.9%	1	21
Princeton Road	53	PRIN-18-1-010	COOL-02-1-015	4.7	37	7.2	331	15	0.154%	2.5	11.7	0.0	4.6	182.3%	0	24
Coolidge Highway	53	COOL-11-1-015	COOL-09-1-015	0.0	5	0.1	430	10	0.875%	2.0	10.1	3.0	-1.9	-95.1%	10	
Coolidge Highway	53	COOL-09-1-015	COOL-07-1-015	1.8	36	4.2	450	10	0.835%	2.0	10.8	0.0	2.2	108.0%	1	15
Coolidge Highway	53	COOL-07-1-015		7.8	48	13.6	12	15	72.500%	55.0	11.0	10.0	-41.4	-75.3%	10	
Coolidge Highway	53	COOL-07-1-015	COOL-05-1-025	0.0	3	0.1	283	12	0.495%	2.5	11.7	1.6	-2.4	-97.6%	10	
Coolidge Highway	53	COOL-05-1-025	COOL-05-1-015	1.8	18	4.1	282	12	0.516%	2.6	11.4	0.0	1.6	61.6%	3	15
Coolidge Highway	53	COOL-05-1-015	COOL-04-1-015	6.8	48	13.2	307	15	0.592%	5.0	12.7	0.0	8.3	166.2%	0	24
Coolidge Highway	53	COOL-04-1-015	COOL-03-1-015	9.6	70	17.0	273	18	0.567%	7.9	13.1	0.0	9.1	115.4%	1	24
Coolidge Highway	53	COOL-01-1-015	COOL-02-1-015	0.3	21	0.8	274	15	0.443%	4.3	10.9	1.7	-3.5	-80.8%	10	
Coolidge Highway	53	COOL-02-1-015	COOL-03-1-015	6.6	37	10.8	284	15	0.378%	4.0	11.5	0.0	6.8	170.7%	0	24
Coolidge Highway	53	COOL-03-1-020	COOL-03-1-015	69.7	430	89.0	22	36	0.822%	60.5	14.8	0.0	28.6	47.2%	3	42
Columbia Road	53	COOL-03-1-015	COLU-18-1-020	87.8	548	116.0	384	36	0.211%	30.6	14.9	0.0	85.4	279.0%	0	60
Columbia Road	53	COLU-18-1-020	25936	90.8	557	116.5	243	36	0.078%	18.7	15.5	5.5	97.8	524.5%	0	72
CATALPA INLET (WEST - HENLEY)																
Edgewood Boulevard	54	COOL-15-1-015	EDGE-18-1-010	0.4	21	1.1	341	15	1.926%	9.0	9.2	8.2	-7.9	-88.0%	10	
Edgewood Boulevard	54	EDGE-18-1-010	EDGE-19-1-010	3.8	35	6.4	300	15	0.591%	5.0	10.0	5.3	1.4	28.7%	4	18
Wiltshire Road	54	COOL-14-1-015	WILT-18-2-015	0.6	11	1.7	266	12	0.376%	2.2	8.8	2.0	-0.5	-22.6%	10	
Wiltshire Road	54	WILT-18-2-015	WILT-18-1-010	6.0	13	9.5	45	12	0.377%	2.2	7.2	0.0	7.4	336.3%	0	21
Wiltshire Road	54	WILT-18-1-010	WILT-19-1-010	6.0	23	9.5	322	12	0.315%	2.0	8.0	0.0	7.5	374.6%	0	24

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	54	COOL-14-1-015	COOL-13-1-015	0.3	18	0.9	309	10	0.314%	1.2	9.2	2.0	-0.4	-29.0%	10	
Franklin Road	54	COOL-13-1-015	FRAN-18-1-010	1.5	14	3.7	129	12	0.432%	2.3	7.9	0.0	1.4	59.8%	3	15
Franklin Road	54	FRAN-18-1-010	FRAN-18-1-020	2.1	21	4.9	193	12	0.496%	2.5	10.8	2.5	2.3	93.7%	2	18
Franklin Road	54	FRAN-18-1-020	FRAN-19-1-010	2.1	28	4.8	319	12	0.622%	2.8	11.5	5.8	2.0	69.5%	2	15
Coolidge Highway	54	COOL-13-1-015	COOL-11-1-035	0.4	15	1.1	285	10	0.537%	1.6	7.7	0.0	-0.6	-34.3%	10	
Coolidge Highway	54	COOL-11-1-025	COOL-11-1-035	0.2	16	0.4	376	10	0.484%	1.5	9.6	1.4	-1.1	-72.0%	10	
Dorothea Road	54	COOL-11-1-035	DORO-18-1-010	2.1	31	4.8	156	12	0.560%	2.7	10.1	0.0	2.2	81.4%	2	15
Dorothea Road	54	DORO-18-1-010	DORO-18-1-015	4.2	31	6.7	150	12	0.333%	2.1	12.7	0.0	4.6	225.7%	0	21
Dorothea Road	54	DORO-18-1-015	DORO-18-1-016	4.2	31	6.6	13	12	0.372%	2.2	13.7	2.1	4.4	202.3%	0	21
Dorothea Road	54	DORO-18-1-016	DORO-19-1-010	4.2	31	6.6	322	12	0.639%	2.8	13.8	2.6	3.7	130.3%	1	18
Berkley Avenue	54	EDGE-19-1-010	WILT-19-1-010	4.4	27	6.7	334	18	0.281%	5.6	12.2	9.0	1.1	19.9%	5	21
Berkley Avenue	54	WILT-19-1-010	FRAN-19-1-010	10.4	49	14.8	304	24	0.283%	12.0	13.6	10.6	2.8	23.3%	5	27
Berkley Avenue	54	FRAN-19-1-010	DORO-19-1-010	13.8	71	19.6	290	27	0.300%	17.0	13.0	10.3	2.7	15.8%	6	
Berkley Avenue	54	DORO-19-1-010	CATA-18-1-050	18.9	92	24.9	299	36	0.371%	40.6	13.5	11.1	-15.7	-38.8%	10	
Berkley Avenue	54	CATA-18-1-050		20.0	92	26.3	74	27	9.459%	95.3	13.4	11.6	-69.0	-72.4%	10	
Catalpa Drive	54	CATA-18-1-030	CATA-18-1-040	0.0	11	0.2	514	12	0.814%	3.2	9.1	4.1	-3.0	-93.5%	10	
Catalpa Drive	54	CATA-18-1-040	CATA-18-1-060	3.1	32	6.0	324	12	0.527%	2.6	9.2	0.0	3.4	132.8%	1	18
Catalpa Drive	54	CATA-18-1-060	25923	6.1	50	12.2	358	12	0.527%	2.6	8.5	0.0	9.6	373.1%	0	24
CATALPA INLET (NORTH - HENLEY)																
Twelve Mile Road	55	TWEL-18-1-010	TWEL-18-1-020	0.0	0	0.0	90	12	0.768%	3.1	10.4	6.5	-3.1	-100.0%	10	
Twelve Mile Road	55	TWEL-18-1-020	TWEL-19-1-010	1.1	8	2.8	416	15	0.406%	4.1	11.1	6.5	-1.3	-32.4%	10	
Rosemont Road	55	ROSE-18-1-010	ROSE-18-1-020	0.7	0	1.6	125	12	0.418%	2.3	8.5	0.1	-0.7	-29.2%	10	
Rosemont Road	55	ROSE-18-1-020	ROSE-18-1-030	2.2	2	4.8	132	12	0.485%	2.5	9.8	1.3	2.3	94.4%	2	18
Rosemont Road	55	ROSE-18-1-030	ROSE-19-1-010	2.2	11	4.8	252	12	1.005%	3.6	9.6	2.8	1.2	33.0%	4	15

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Beverly Boulevard	55	COOL-17-1-015	BEVE-18-1-010	16.3	83	19.4	328	30	0.565%	30.8	18.4	13.6	-11.4	-37.0%	10	
Beverly Boulevard	55	BEVE-18-1-010	BEVE-19-1-010	17.0	94	20.0	317	30	0.269%	21.3	22.4	16.4	-1.3	-6.0%	10	
Earlmont Road	55	EARL-18-1-010	EARL-18-1-020	0.0	6	0.1	185	10	1.600%	2.8	10.6	9.9	-2.7	-95.7%	10	
Earlmont Road	55	EARL-18-1-020	EARL-19-1-010	0.5	18	0.8	320	10	1.577%	2.8	10.3	9.6	-1.9	-70.7%	10	
Berkley Avenue	55	TWEL-19-1-010	ROSE-19-1-010	0.3	1	0.7	310	18	0.241%	5.2	12.1	6.5	-4.5	-86.9%	10	
Berkley Avenue	55	ROSE-19-1-010	BEVE-19-1-010	5.2	9	8.6	336	18	0.365%	6.3	11.6	6.6	2.3	35.8%	4	21
Berkley Avenue	55	EARL-19-1-010	BEVE-19-1-010	1.8	8	2.3	332	15	1.339%	7.5	9.2	8.2	-5.2	-69.2%	10	
Beverly Boulevard	55	BEVE-19-1-010	BEVE-19-1-020	24.0	112	27.9	13	30	1.370%	48.0	18.0	11.5	-20.1	-41.8%	10	
Beverly Boulevard	55	BEVE-19-1-020	BEVE-19-1-030	25.7	122	29.8	332	30	0.594%	31.6	16.4	9.8	-1.9	-5.9%	10	
Beverly Boulevard	55	BEVE-19-1-030	HENL-17-1-010	27.0	133	30.8	331	30	0.486%	28.6	14.1	7.3	2.2	7.6%	8	
Beverly Boulevard	55	BEVE-20-1-020	BEVE-20-1-010	4.7	0	6.4	300	12	0.629%	2.8	5.9	0.0	3.6	128.0%	1	18
Beverly Boulevard	55	BEVE-20-1-010	HENL-17-1-010	4.7	0	6.2	268	15	0.437%	4.3	9.6	2.4	2.0	46.4%	3	18
Twelve Mile Road	55	TWEL-19-1-010	TWEL-19-1-020	2.1	12	4.5	334	15	0.387%	4.0	12.0	6.6	0.5	12.5%	7	
Twelve Mile Road	55	TWEL-19-1-020	HENL-19-1-010	3.2	22	6.5	336	15	0.563%	4.8	11.4	6.3	1.7	34.1%	4	18
Rosemont Road	55	ROSE-19-1-010	ROSE-19-1-020	1.4	13	2.3	337	12	1.044%	3.6	9.7	5.2	-1.3	-37.1%	10	
Rosemont Road	55	ROSE-19-1-020	HENL-18-1-010	3.3	26	4.5	335	12	1.102%	3.7	11.4	4.9	0.8	20.8%	5	15
Earlmont Road	55	EARL-19-1-010	EARL-19-1-020	2.0	20	2.6	340	12	1.491%	4.4	9.8	6.9	-1.8	-40.4%	10	
Earlmont Road	55	EARL-19-1-020	HENL-16-1-010	3.4	33	4.3	334	12	0.694%	3.0	10.3	4.2	1.4	45.8%	3	15
Edgewood Boulevard	55	EDGE-19-1-010	EDGE-19-1-020	1.3	24	2.0	333	12	0.527%	2.6	11.6	9.4	-0.6	-22.8%	10	
Edgewood Boulevard	55	EDGE-19-1-020	HENL-15-1-010	2.6	34	3.8	336	12	0.699%	3.0	10.8	8.0	0.8	28.2%	4	15
Edgewood Boulevard	55	EDGE-20-1-020	EDGE-20-1-010	1.3	0	2.0	207	12	0.611%	2.8	5.7	4.0	-0.8	-27.9%	10	
Edgewood Boulevard	55	EDGE-20-1-010	HENL-15-1-010	2.6	0	3.7	267	12	0.334%	2.1	7.8	5.1	1.6	78.3%	2	15
Wiltshire Road	55	WILT-19-1-010	WILT-19-1-020	0.0	11	0.2	346	12	0.051%	0.8	11.1	10.3	-0.6	-72.8%	10	
Wiltshire Road	55	WILT-19-1-020	HENL-14-1-010	0.0	21	0.4	333	12	1.402%	4.2	9.3	8.5	-3.8	-90.0%	10	
Wiltshire Road	55	WILT-20-1-010	HENL-14-1-010	3.8	0	4.8	356	12	0.335%	2.1	6.1	0.0	2.8	134.6%	1	18

Appendix B
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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Franklin Road	55	FRAN-19-1-010	FRAN-19-1-020	1.4	19	1.9	337	12	0.564%	2.7	10.9	9.7	-0.7	-27.4%	10	
Franklin Road	55	FRAN-19-1-020	HENL-13-1-010	2.4	31	3.2	333	12	0.392%	2.2	10.3	8.2	0.9	41.4%	4	15
Franklin Road	55	FRAN-20-1-020	FRAN-20-1-010	1.5	0	1.8	192	12	0.125%	1.3	3.2	0.0	0.6	46.4%	3	15
Franklin Road	55	FRAN-20-1-010	HENL-13-1-010	4.0	0	5.0	213	12	0.635%	2.8	4.3	0.6	2.2	77.3%	2	15
Dorothea Road	55	DORO-19-1-010	DORO-19-1-020	1.9	22	2.5	337	12	0.323%	2.0	12.3	10.8	0.4	21.5%	5	15
Dorothea Road	55	DORO-19-1-020	HENL-12-1-010	2.8	35	3.5	332	15	0.533%	4.7	11.1	10.1	-1.2	-25.1%	10	
Dorothea Road	55	DORO-20-1-010	HENL-12-1-010	1.2	0	1.9	303	15	0.041%	1.3	3.5	2.4	0.5	41.9%	4	18
Rosemont Road	55	ROSE-20-1-040		0.0	0	0.0	38	15	12.913%	23.2	8.2	7.2	-23.2	-100.0%	10	
Beverly Boulevard	55	BEVE-20-1-040	BEVE-20-1-030	0.0	3	0.1	93	12	0.327%	2.0	7.1	5.4	-2.0	-97.1%	10	
Beverly Boulevard	55	BEVE-20-1-030		0.0	3	0.1	11	12	28.692%	19.1	7.6	5.6	-19.0	-99.7%	10	
Earlmont Road	55	EARL-20-1-030		0.0	0	0.0	11	12	41.253%	22.9	8.1	6.3	-22.9	-100.0%	10	
Edgewood Boulevard	55	EDGE-20-1-060	EDGE-20-1-050	0.0	11	0.2	387	12	0.300%	2.0	8.9	8.1	-1.7	-88.7%	10	
Edgewood Boulevard	55	EDGE-20-1-050	EDGE-20-1-040	0.0	16	0.3	174	12	0.884%	3.4	7.3	6.5	-3.0	-90.4%	10	
Edgewood Boulevard	55	EDGE-20-1-040		0.0	16	0.3	7	8	65.012%	9.7	9.9	8.7	-9.4	-96.7%	10	
Wiltshire Road	55	WILT-20-1-020		0.0	0	0.0	13	8	60.664%	9.4	9.3	8.8	-9.4	-100.0%	10	
Franklin Road	55	FRAN-20-1-050	FRAN-20-1-040	0.0	3	0.1	89	12	1.377%	4.2	8.0	7.2	-4.1	-98.6%	10	
Franklin Road	55	FRAN-20-1-040		0.0	3	0.1	15	8	51.641%	8.7	9.1	8.6	-8.6	-99.3%	10	
Dorothea Road	55	DORO-20-1-040		0.0	0	0.0	17	8	69.851%	10.1	7.8	7.3	-10.1	-100.0%	10	
Dorothea Road	55	DORO-20-1-080	DORO-20-1-070	0.0	2	0.0	101	12	1.355%	4.1	6.9	6.1	-4.1	-99.0%	10	
Dorothea Road	55	DORO-20-1-070	HENL-12-1-010	0.0	2	0.0	11	12	3.240%	6.4	8.7	7.9	-6.4	-99.4%	10	
Henley Avenue	55	TWEL-20-1-030	HENL-19-1-010	0.0	0	0.0	36	18	1.035%	10.7	13.3	7.7	-10.7	-100.0%	10	
Henley Avenue	55	HENL-19-1-010	HENL-18-1-010	3.9	33	7.9	309	18	0.152%	4.1	13.6	7.5	3.8	92.3%	2	24
Henley Avenue	55	HENL-18-1-010	HENL-17-1-010	10.2	58	16.0	334	30	0.324%	23.4	11.4	6.2	-7.3	-31.3%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Henley Avenue	55	HENL-17-1-010	HENL-16-1-020	48.5	194	53.2	68	42	0.049%	22.3	11.4	4.5	30.9	138.8%	1	60
Henley Avenue	55	HENL-16-1-020	HENL-16-1-010	48.7	194	53.0	267	42	0.385%	62.5	11.4	4.7	-9.4	-15.1%	10	
Henley Avenue	55	HENL-16-1-010	HENL-15-1-020	55.6	227	58.7	75	42	0.040%	20.1	13.9	6.9	38.6	192.0%	0	66
Henley Avenue	55	HENL-15-1-020	HENL-15-1-010	55.7	227	58.4	261	42	0.001%	3.4	13.7	6.9	55.0	1611.3%	0	108
Henley Avenue	55	HENL-15-1-010	HENL-14-1-010	64.6	276	65.1	334	42	0.325%	57.3	16.0	8.8	7.8	13.6%	6	
Henley Avenue	55	HENL-14-1-010	HENL-13-1-010	73.6	297	71.9	302	42	0.177%	42.3	16.6	9.8	29.5	69.7%	2	54
Henley Avenue	55	HENL-13-1-010	HENL-12-1-010	82.6	331	78.6	290	42	0.334%	58.1	17.2	11.2	20.5	35.2%	4	48
Henley Avenue	55	HENL-12-1-010	HENL-11-1-010	90.3	367	85.1	191	42	0.223%	47.5	17.3	11.9	37.6	79.2%	2	54
Henley Avenue	55	HENL-11-1-010	25928	94.5	369	86.9	239	42	0.048%	22.0	17.7	13.2	64.9	295.5%	0	72
CATALPA INLET (NORTH - MORTENSON)																
Twelve Mile Road	56	TWEL-20-1-010	MORT-19-1-010	2.2	0	5.4	423	15	0.576%	4.9	7.3	0.0	0.5	9.6%	8	
Rosemont Road	56	ROSE-20-1-040	ROSE-20-1-050	0.0	6	0.1	260	12	0.133%	1.3	10.6	6.8	-1.2	-90.7%	10	
Rosemont Road	56	ROSE-20-1-050	ROSE-20-1-053	0.0	15	0.3	64	12	3.137%	6.3	10.2	5.9	-6.0	-95.2%	10	
Rosemont Road	56	ROSE-20-1-053	ROSE-20-1-057	0.0	18	0.4	150	12	0.336%	2.1	10.5	4.2	-1.7	-82.6%	10	
Rosemont Road	56	ROSE-20-1-057	ROSE-20-1-060	0.0	19	0.4	57	12	0.330%	2.0	9.3	1.9	-1.7	-81.4%	10	
Rosemont Road	56	ROSE-20-1-060	MORT-18-1-020	0.0	26	0.5	491	12	0.331%	2.1	9.7	1.9	-1.5	-74.6%	10	
Beverly Boulevard	56	BEVE-20-1-040	BEVE-20-1-050	0.0	14	0.3	470	12	0.328%	2.0	6.3	5.5	-1.8	-86.3%	10	
Beverly Boulevard	56	BEVE-20-1-050	MORT-17-1-020	0.0	26	0.5	490	12	0.408%	2.3	6.5	5.7	-1.8	-77.1%	10	
Earlmont Road	56	EARL-20-1-030	EARL-20-1-040	0.0	2	0.0	96	12	5.194%	8.1	7.9	7.1	-8.1	-99.5%	10	
Earlmont Road	56	EARL-20-1-040	EARL-20-1-050	0.0	13	0.3	466	12	0.402%	2.3	7.2	6.4	-2.0	-88.5%	10	
Earlmont Road	56	EARL-20-1-050	MORT-16-1-050	0.0	23	0.5	461	12	0.427%	2.3	9.2	8.4	-1.9	-80.2%	10	
Earlmont Road	56	EARL-20-1-010	EARL-20-1-020	4.3	0	5.3	382	12	0.288%	1.9	4.2	0.0	3.4	179.4%	0	18
Earlmont Road	56	EARL-20-1-020	MORT-16-1-030	6.8	0	8.1	124	12	0.300%	2.0	4.3	0.0	6.1	313.2%	0	21
Mortenson Boulevard	56	MORT-16-1-030	MORT-16-1-040	6.8	0	7.9	39	12	1.534%	4.4	5.1	0.0	3.5	79.7%	2	15
Mortenson Boulevard	56	MORT-16-1-040	MORT-16-1-050	7.7	0	9.2	114	12	0.519%	2.6	6.5	0.0	6.7	259.4%	0	21

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Mortenson Boulevard	56	MORT-16-1-050	MORT-16-1-020	7.7	23	9.1	28	12	0.520%	2.6	10.6	8.7	6.5	254.8%	0	21
Edgewood Boulevard	56	EDGE-20-1-060	MORT-15-1-020	0.0	12	0.2	491	12	1.175%	3.9	8.9	8.1	-3.6	-93.8%	10	
Wiltshire Road	56	WILT-20-1-020	WILT-20-1-030	0.0	2	0.0	94	12	0.364%	2.1	9.3	8.5	-2.1	-98.1%	10	
Wiltshire Road	56	WILT-20-1-030	WILT-20-1-040	0.0	7	0.1	247	12	0.478%	2.5	7.4	6.6	-2.3	-94.3%	10	
Wiltshire Road	56	WILT-20-1-040	WILT-20-1-050	0.0	14	0.3	269	12	0.131%	1.3	8.7	7.9	-1.0	-78.3%	10	
Wiltshire Road	56	WILT-20-1-050	MORT-14-1-020	0.0	24	0.5	435	12	0.364%	2.1	9.6	8.8	-1.7	-77.7%	10	
Franklin Road	56	FRAN-20-1-050	FRAN-20-1-060	0.0	12	0.2	330	12	0.403%	2.3	8.1	7.3	-2.0	-89.4%	10	
Franklin Road	56	FRAN-20-1-060	FRAN-20-1-070	0.0	23	0.5	300	12	0.406%	2.3	8.9	8.1	-1.8	-79.7%	10	
Franklin Road	56	FRAN-20-1-070	FRAN-20-1-080	0.0	33	0.7	300	12	0.438%	2.4	8.9	8.1	-1.7	-72.0%	10	
Franklin Road	56	FRAN-20-1-080	MORT-13-1-020	0.0	33	0.7	27	12	16.845%	14.6	8.3	7.5	-14.0	-95.5%	10	
Dorothea Road	56	DORO-20-1-040	DORO-20-1-050	0.0	4	0.1	97	12	1.591%	4.5	7.8	7.0	-4.4	-98.2%	10	
Dorothea Road	56	DORO-20-1-050	DORO-20-1-060	0.0	27	0.5	652	12	0.413%	2.3	7.2	6.4	-1.7	-76.4%	10	
Dorothea Road	56	DORO-20-1-060	MORT-12-1-020	0.0	35	0.7	292	12	0.340%	2.1	9.3	8.5	-1.4	-66.3%	10	
Dorothea Road	56	DORO-20-1-080	DORO-20-1-090	0.0	8	0.2	476	12	0.408%	2.3	7.3	6.5	-2.1	-93.0%	10	
Dorothea Road	56	DORO-20-1-090	MORT-11-1-030	0.0	17	0.3	460	12	0.283%	1.9	9.3	8.5	-1.6	-82.1%	10	
Rosemont Road	56	ROSE-22-1-010	MORT-18-1-020	0.0	0	0.0	8	15	2.751%	10.7	9.3	0.2	-10.7	-100.0%	10	
Earlmont Road	56	EARL-22-1-030	MORT-16-1-020	0.0	0	0.0	9	18	1.402%	12.4	10.6	9.4	-12.4	-100.0%	10	
Edgewood Boulevard	56	EDGE-22-1-010	MORT-15-1-020	0.0	0	0.0	8	12	3.019%	6.2	9.2	8.4	-6.2	-100.0%	10	
Wiltshire Road	56	WILT-23-1-020	WILT-23-1-010	0.0	15	0.3	400	15	0.628%	5.1	8.7	7.7	-4.8	-94.3%	10	
	56	WILT-23-1-010	WILT-22-1-030	0.0	28	0.6	396	15	0.567%	4.9	9.4	8.4	-4.3	-88.5%	10	
Edgewood Boulevard	56	EDGE-20-1-030	MORT-15-1-030	1.2	0	1.9	236	10	0.877%	2.1	5.5	4.8	-0.2	-8.8%	10	
Mortenson Boulevard	56	MORT-15-1-030	WILT-22-1-030	1.2	0	1.8	180	10	0.572%	1.7	6.3	5.6	0.2	10.1%	7	
Wiltshire Road	56	WILT-22-1-030	MORT-14-1-020	1.2	28	1.8	9	12	0.949%	3.5	7.4	6.6	-1.7	-48.5%	10	
Wiltshire Road	56	WILT-22-1-010	MORT-13-1-020	4.9	2	6.8	12	12	3.930%	7.1	8.4	7.6	-0.3	-4.1%	10	
Mortenson Boulevard	56	MORT-12-1-030	MORT-12-1-020	0.0	0	0.0	9	12	1.766%	4.7	8.1	7.3	-4.7	-100.0%	10	

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Mortenson Boulevard	56	MORT-12-1-030	WILT-22-1-010	0.0	2	0.0	261	12	0.485%	2.5	8.2	7.4	-2.4	-98.4%	10	
Mortenson Boulevard	56	MORT-14-1-030	WILT-22-1-010	5.6	0	7.8	157	12	0.598%	2.8	6.0	0.0	5.1	184.0%	0	18
Mortenson Boulevard	56	MORT-19-1-010	MORT-18-1-020	0.8	0	1.9	154	15	0.563%	4.8	8.3	0.0	-3.0	-61.8%	10	
Mortenson Boulevard	56	MORT-18-1-020	MORT-18-1-010	3.4	28	6.4	148	15	0.223%	3.1	9.5	0.0	3.3	108.8%	1	21
Mortenson Boulevard	56	MORT-18-1-010	MORT-18-1-030	2.2	5	3.3	9	12	4.674%	7.7	6.4	2.3	-4.4	-57.0%	10	
Mortenson Boulevard	56	MORT-18-1-030	BEVE-22-1-010	2.2	5	3.3	169	15	0.366%	3.9	6.3	2.1	-0.6	-15.3%	10	
Rosemont Road	56	ROSE-20-1-010	ROSE-20-1-020	2.1	0	3.4	287	8	1.138%	1.3	4.8	0.0	2.1	163.7%	0	12
Rosemont Road	56	ROSE-20-1-020	ROSE-20-1-030	2.1	0	3.3	300	12	0.548%	2.6	6.9	0.0	0.7	25.2%	4	15
Rosemont Road	56	ROSE-20-1-030	MORT-18-1-010	2.1	0	3.2	45	12	0.587%	2.7	8.8	1.8	0.5	17.2%	5	15
Mortenson Boulevard	56	MORT-18-1-010	MORT-17-1-020	9.6	23	14.1	170	18	0.280%	5.6	10.3	1.9	8.6	154.4%	0	27
Mortenson Boulevard	56	MORT-17-1-020	MORT-17-1-010	9.6	49	13.9	183	18	0.088%	3.1	12.1	6.1	10.8	345.2%	0	33
Mortenson Boulevard	56	MORT-17-1-010	MORT-16-1-020	9.6	49	13.5	178	27	0.462%	21.0	14.4	11.3	-7.6	-36.0%	10	
Mortenson Boulevard	56	MORT-16-1-020	MORT-16-1-010	17.2	72	21.8	174	30	0.447%	27.4	13.8	10.2	-5.6	-20.5%	10	
Mortenson Boulevard	56	MORT-16-1-010	MORT-15-1-020	17.2	72	21.5	136	30	0.320%	23.2	14.3	10.4	-1.7	-7.2%	10	
Mortenson Boulevard	56	MORT-15-1-020	MORT-15-1-010	17.2	84	21.3	171	30	0.650%	33.1	14.0	9.9	-11.7	-35.5%	10	
Mortenson Boulevard	56	MORT-15-1-010	MORT-14-1-020	20.4	84	24.5	190	30	0.202%	18.4	15.6	10.5	6.1	33.0%	4	36
Mortenson Boulevard	56	MORT-14-1-020	MORT-14-1-010	21.6	136	25.7	140	30	0.343%	24.0	15.1	10.3	1.7	6.9%	8	
Mortenson Boulevard	56	MORT-14-1-010	MORT-13-1-020	21.6	136	25.5	184	30	0.914%	39.2	15.1	10.4	-13.8	-35.1%	10	
Mortenson Boulevard	56	MORT-13-1-020	MORT-13-1-010	26.6	170	30.7	105	30	2.211%	61.0	16.2	13.4	-30.3	-49.6%	10	
Franklin Road	56	FRAN-20-1-030	MORT-13-1-010	5.1	0	7.5	32	12	5.918%	8.7	4.8	4.0	-1.2	-13.8%	10	
Mortenson Boulevard	56	MORT-13-1-010	MORT-12-1-020	31.7	170	36.5	162	30	0.564%	30.8	17.1	12.5	5.7	18.5%	5	33
Mortenson Boulevard	56	MORT-12-1-020	MORT-12-1-010	31.7	205	36.2	132	30	0.356%	24.5	18.0	13.8	11.8	48.0%	3	36

Appendix B
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COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Dorothea Road	56	DORO-20-1-020	DORO-20-1-030	1.6	0	2.4	126	12	0.319%	2.0	4.1	2.9	0.4	21.1%	5	15
Dorothea Road	56	DORO-20-1-030	MORT-12-1-010	5.0	0	6.3	33	12	1.454%	4.3	4.6	3.2	2.0	47.5%	3	15
Mortenson Boulevard	56	MORT-12-1-010	MORT-11-1-020	36.7	205	41.0	192	30	0.387%	25.5	19.4	15.5	15.5	60.9%	3	36
Mortenson Boulevard	56	MORT-11-1-030	MORT-11-1-020	0.0	0	0.0	12	12	5.642%	8.5	9.5	8.7	-8.5	-100.0%	10	
Mortenson Boulevard	56	MORT-11-1-030	25926	0.0	0	0.0	182	15	0.830%	5.9	10.8	9.8	-5.9	-100.0%	10	
Mortenson Boulevard	56	MORT-11-1-020	MORT-11-1-010	36.7	205	40.6	172	30	0.893%	38.8	19.3	16.3	1.8	4.8%	8	
Mortenson Boulevard	56	MORT-11-1-010	25926	36.7	205	40.3	17	30	1.179%	44.5	19.9	17.1	-4.2	-9.4%	10	
CATALPA INLET (NORTH - CASS)																
Twelve Mile Road	57	MORT-19-1-010	TWEL-20-1-020	2.5	0	5.9	77	15	0.291%	3.5	8.2	0.0	2.4	68.1%	2	21
Twelve Mile Road	57	TWEL-20-1-020	TWEL-28-1-010	2.5	20	5.8	324	15	0.376%	4.0	8.1	0.0	1.8	46.6%	3	18
Twelve Mile Road	57	TWEL-28-1-010	TWEL-28-1-030	3.7	24	7.5	214	15	0.493%	4.5	8.9	0.0	2.9	64.5%	3	21
Rosemont Road	57	ROSE-22-1-010	ROSE-22-1-020	0.0	3	0.1	358	15	0.314%	3.6	9.3	1.9	-3.6	-98.3%	10	
Rosemont Road	57	ROSE-22-1-020	WOOD-15-1-040	1.9	5	3.5	200	15	0.201%	2.9	9.2	0.7	0.6	22.0%	5	18
Brookline Street	57	WOOD-15-1-040	TWEL-28-1-020	2.8	5	5.4	133	15	0.300%	3.5	8.5	0.2	1.9	52.6%	3	18
Twelve Mile Road	57	TWEL-28-1-020	TWEL-28-1-030	3.1	5	6.0	45	15	0.300%	3.5	8.9	1.1	2.5	69.9%	2	21
Twelve Mile Road	57	TWEL-28-1-030	WOOD-19-1-010	7.3	29	13.9	51	15	0.359%	3.9	8.6	1.1	10.0	259.6%	0	27
Woodward Avenue	57	WOOD-19-1-010	WOOD-15-1-025	7.6	47	14.4	524	30	0.300%	22.5	8.8	3.4	-8.1	-35.9%	10	
Woodward Avenue	57	WOOD-15-1-025	WOOD-15-1-020	9.2	47	17.0	32	30	0.300%	22.5	8.1	1.8	-5.5	-24.5%	10	
Beverly Boulevard	57	MORT-17-1-020	BEVE-22-1-010	0.0	0	0.0	10	15	1.643%	8.3	8.7	3.9	-8.3	-100.0%	10	
Beverly Boulevard	57	BEVE-22-1-010	BEVE-22-1-020	2.2	14	3.2	197	15	0.240%	3.2	9.5	4.5	0.1	2.4%	10	
Beverly Boulevard	57	BEVE-22-1-020	BROO-17-1-030	2.2	24	3.2	302	15	0.240%	3.2	12.2	4.0	0.0	-0.1%	10	
Brookline Street	57	BROO-17-1-030	BROO-17-1-020	4.9	28	5.4	204	15	0.026%	1.1	8.6	0.4	4.4	417.8%	0	30
Brookline Street	57	BROO-17-1-020	BROO-17-1-010	8.9	28	9.9	82	15	0.236%	3.1	6.9	0.0	6.8	216.0%	0	24
Brookline Street	57	BROO-17-1-010	BROO-17-1-050	8.9	28	9.8	118	18	0.514%	7.5	20.7	13.3	2.3	30.4%	4	21
Brookline Street	57	BROO-17-1-060	BROO-17-1-050	0.3	10	0.8	180	12	0.767%	3.1	10.8	2.8	-2.3	-74.8%	10	
Brookline Street	57	BROO-17-1-050	WOOD-15-1-020	7.3	26	8.3	138	18	0.433%	6.9	8.8	1.9	1.4	20.6%	5	21

Appendix B
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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Brookline Street	57	BROO-17-1-050	BROO-17-1-040	3.1	11	3.6	20	12	0.750%	3.1	11.0	1.7	0.5	15.9%	6	
Brookline Street	57	BROO-17-1-040	BROO-16-1-030	3.1	20	3.6	146	12	0.211%	1.6	9.4	0.0	1.9	117.9%	1	18
Brookline Street	57	BROO-16-1-030	BROO-15-1-020	3.4	26	3.7	317	12	0.321%	2.0	9.4	0.0	1.7	83.2%	2	18
Brookline Street	57	BROO-15-1-020	EDGE-28-1-020	5.2	41	5.8	322	12	0.324%	2.0	8.8	0.0	3.8	185.5%	0	18
Woodward Avenue	57	WOOD-15-1-020	WOOD-15-1-015	16.5	73	24.2	355	30	0.217%	19.1	9.0	2.2	5.0	26.4%	4	33
Woodward Avenue	57	WOOD-15-1-015	WOOD-15-1-010	17.4	73	25.2	281	30	0.062%	10.2	8.1	1.5	15.0	146.3%	1	48
Woodward Avenue	57	WOOD-15-1-010	WOOD-14-1-030	18.2	73	25.5	396	30	0.097%	12.8	7.6	1.9	12.7	99.7%	2	42
Woodward Avenue	57	WOOD-14-1-030	WOOD-14-1-020	26.1	118	33.2	351	30	0.080%	11.6	6.3	1.7	21.6	186.6%	0	48
Woodward Avenue	57	WOOD-14-1-020		27.0	118	33.3	102	30	0.080%	11.6	5.0	2.4	21.7	187.0%	0	48
Woodward Avenue	57	WOOD-11-1-030	WOOD-12-1-020	0.5	0	1.4	258	12	0.322%	2.0	4.4	2.4	-0.6	-29.9%	10	
Woodward Avenue	57	WOOD-12-1-020	WOOD-12-1-030	1.3	0	3.2	270	15	0.253%	3.3	5.5	3.7	0.0	-1.0%	10	
Woodward Avenue	57	WOOD-12-1-030		2.0	0	4.6	306	15	0.249%	3.2	6.4	4.6	1.4	44.2%	4	18
Earlmont Road	57	EARL-22-1-030	EARL-22-1-040	0.0	22	0.4	398	15	0.664%	5.3	10.7	9.6	-4.8	-91.8%	10	
Earlmont Road	57	EARL-22-1-040	BROO-16-1-020	0.0	37	0.7	344	15	0.664%	5.3	17.1	13.4	-4.5	-85.9%	10	
Brookline Street	57	BROO-16-1-020	BROO-16-1-010	0.0	37	0.7	211	15	0.668%	5.3	7.0	1.1	-4.5	-86.0%	10	
Earlmont Road	57	EARL-22-1-010	EARL-22-1-020	1.7	0	2.2	421	12	0.259%	1.8	6.1	2.4	0.4	23.5%	6	
Earlmont Road	57	EARL-22-1-020	BROO-16-1-010	7.4	0	7.8	32	12	4.831%	7.8	2.8	0.0	0.0	-0.1%	10	
Brookline Street	57	BROO-16-1-010	BROO-15-1-010	8.5	37	9.2	430	15	0.973%	6.4	7.3	0.0	2.8	44.5%	3	18
Edgewood Boulevard	57	EDGE-22-1-010	EDGE-22-1-020	0.0	20	0.4	362	15	0.404%	4.1	9.5	8.3	-3.7	-90.3%	10	
Edgewood Boulevard	57	EDGE-22-1-020	EDGE-22-1-030	0.0	35	0.7	342	15	0.509%	4.6	8.9	6.2	-3.9	-85.0%	10	
Edgewood Boulevard	57	EDGE-22-1-030	EDGE-22-1-040	0.0	37	0.7	155	15	0.873%	6.0	7.6	3.3	-5.3	-87.7%	10	
Edgewood Boulevard	57	EDGE-22-1-040	EDGE-22-1-050	2.5	45	3.6	331	15	0.261%	3.3	8.7	2.8	0.3	9.8%	8	
Edgewood Boulevard	57	EDGE-22-1-050	EDGE-28-1-010	5.0	45	6.5	128	15	0.132%	2.3	5.8	0.1	4.2	177.3%	0	24
Edgewood Boulevard	57	EDGE-28-1-010	EDGE-28-1-030	5.0	45	6.4	149	18	0.234%	5.1	6.2	1.3	1.3	25.5%	4	21
Edgewood Boulevard	57	EDGE-28-1-030		6.1	45	7.7	138	18	0.209%	4.8	6.3	1.5	2.9	59.3%	3	24
Brookline Street	57	BROO-14-1-020	EDGE-28-1-020	0.0	15	0.3	329	12	0.529%	2.6	6.3	0.0	-2.3	-88.4%	10	
Edgewood Boulevard	57	EDGE-28-1-020	BROO-15-1-010	6.1	56	6.8	154	18	0.243%	5.2	9.8	0.0	1.6	31.0%	4	21
Brookline Street	57	BROO-15-1-010	BROO-14-1-010	17.5	93	16.2	206	15	0.256%	3.3	10.8	0.0	13.0	396.6%	0	30
Wiltshire Road	57	WILT-23-1-020	BROO-14-1-010	0.0	16	0.3	457	15	3.141%	11.4	8.7	7.7	-11.1	-97.3%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Brookline Street	57	BROO-14-1-010	WILT-28-1-010	21.7	108	18.9	169	15	0.174%	2.7	11.7	0.0	16.2	601.4%	0	33
Wiltshire Road	57	WILT-22-1-010	WILT-22-1-020	0.7	5	0.9	220	15	0.084%	1.9	8.7	7.6	-1.0	-50.7%	10	
Wiltshire Road	57	WILT-22-1-020	RUSS-23-1-010	0.7	7	0.9	219	18	0.768%	9.2	10.4	9.2	-8.3	-90.4%	10	
Wiltshire Road	57	RUSS-23-1-010	RUSS-24-1-010	0.7	15	0.9	453	18	0.585%	8.0	11.1	9.9	-7.2	-89.4%	10	
Wiltshire Road	57	RUSS-24-1-010	WILT-25-1-010	0.7	15	0.8	137	18	0.079%	2.9	6.6	5.4	-2.2	-73.0%	10	
Wiltshire Road	57	WILT-25-1-010	WILT-25-1-020	2.6	23	3.0	347	18	0.195%	4.6	6.8	5.6	-1.6	-35.6%	10	
Wiltshire Road	57	WILT-25-1-020	WILT-28-1-030	3.2	25	3.4	108	18	0.460%	7.1	4.2	2.9	-3.7	-51.9%	10	
Wiltshire Road	57	WILT-28-1-030	WILT-28-1-040	3.2	29	3.4	242	18	0.107%	3.4	4.2	2.6	-0.1	-2.0%	10	
Wiltshire Road	57	WILT-28-1-040	WOOD-14-1-010	5.0	29	5.4	130	18	0.394%	6.6	4.0	2.3	-1.2	-18.0%	10	
Wiltshire Road	57	WOOD-14-1-010		5.6	29	6.6	2	24	0.411%	14.5	5.1	3.3	-7.9	-54.8%	10	
Wiltshire Road	57	WILT-28-1-020	WILT-28-1-010	0.2	3	0.4	324	12	0.359%	2.1	7.7	0.0	-1.7	-79.3%	10	
Wiltshire Road	57	WILT-28-1-010	CASS-14-1-010	21.9	111	18.8	403	18	0.226%	5.0	10.6	0.0	13.8	276.5%	0	30
Wiltshire Road	57	WILT-25-1-010	CASS-14-1-010	0.0	0	0.0	31	15	6.388%	16.3	5.3	0.0	-16.3	-100.0%	10	
Cass Boulevard	57	CASS-14-1-010	CASS-13-1-020	22.7	111	19.1	142	24	0.417%	14.6	15.6	0.0	4.5	30.7%	4	27
Cass Boulevard	57	CASS-13-1-020	CASS-13-1-010	23.7	113	20.0	141	15	0.601%	5.0	15.2	0.0	15.0	299.0%	0	27
Dorothea Road	57	DORO-22-1-010	DORO-22-1-020	0.0	8	0.2	200	12	0.774%	3.1	8.1	7.3	-3.0	-94.9%	10	
Dorothea Road	57	DORO-22-1-020	DORO-23-1-010	0.0	13	0.3	142	12	1.393%	4.2	11.9	7.8	-3.9	-93.8%	10	
Ferris Street	57	FERR-13-1-010	DORO-23-1-010	0.0	11	0.2	408	12	0.373%	2.2	11.9	9.2	-2.0	-89.9%	10	
Dorothea Road	57	DORO-23-1-010	DORO-24-1-010	4.3	34	5.3	271	12	0.742%	3.1	16.0	5.8	2.2	72.6%	2	15
Central Street	57	CENT-13-1-010	DORO-24-1-010	0.0	8	0.2	418	12	1.195%	3.9	11.0	10.2	-3.7	-95.9%	10	
Dorothea Road	57	DORO-24-1-010	CASS-12-1-010	7.5	51	9.6	263	15	0.867%	6.0	11.2	5.0	3.6	59.8%	3	18
Woodward Avenue	57	WOOD-14-1-050	WOOD-14-1-040	0.0	4	0.1	138	12	0.323%	2.0	8.9	1.1	-1.9	-96.0%	10	
Woodward Avenue	57	WOOD-14-1-040	WOOD-13-1-020	0.0	4	0.1	101	12	0.282%	1.9	9.0	0.8	-1.8	-95.8%	10	
Woodward Avenue	57	WOOD-13-1-020	WOOD-13-1-010	0.3	9	0.6	100	12	0.331%	2.0	9.1	0.5	-1.5	-73.1%	10	
Woodward Avenue	57	WOOD-13-1-010	FRAN-25-1-030	0.3	14	0.5	156	12	0.325%	2.0	9.4	0.5	-1.5	-73.3%	10	

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Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Woodward Avenue	57	DORO-25-1-030	WOOD-12-1-050	0.0	17	0.3	295	12	0.556%	2.7	10.2	2.2	-2.3	-87.6%	10	
Woodward Avenue	57	WOOD-12-1-050	FRAN-25-1-030	0.8	17	2.0	57	12	0.239%	1.7	11.3	1.8	0.3	14.4%	6	
Franklin Road	57	FRAN-25-1-030	FRAN-25-1-020	2.0	39	4.3	246	15	0.248%	3.2	10.1	0.0	1.1	34.5%	4	18
Franklin Road	57	FRAN-25-1-020	FRAN-25-1-010	2.0	49	4.2	252	15	0.026%	1.0	9.8	0.0	3.2	303.8%	0	27
Franklin Road	57	FRAN-25-1-010	CASS-13-1-010	8.4	64	12.0	410	15	0.138%	2.4	9.3	0.0	9.6	398.9%	0	30
Dorothea Road	57	DORO-25-1-030	DORO-25-1-020	1.2	18	2.1	435	12	0.306%	2.0	10.1	7.1	0.2	7.8%	9	
Dorothea Road	57	DORO-25-1-020	DORO-25-1-010	1.2	32	2.0	341	12	0.382%	2.2	13.0	9.5	-0.2	-9.3%	10	
Dorothea Road	57	DORO-25-1-010	CASS-12-1-010	3.9	43	5.3	337	15	0.268%	3.3	11.5	7.8	2.0	58.5%	3	18
Woodward Avenue	57	DORO-25-1-030	WOOD-11-1-040	0.0	0	0.0	217	12	2.026%	5.1	6.6	0.0	-5.1	-100.0%	10	
Woodward Avenue	57	WOOD-11-1-040	CATA-25-1-040	2.6	9	3.7	214	12	0.290%	1.9	11.3	0.0	1.8	94.0%	2	18
Catalpa Drive	57	CATA-25-1-040	CATA-25-1-030	5.2	14	8.7	345	15	0.181%	2.7	10.3	0.0	6.0	217.8%	0	24
Catalpa Drive	57	CATA-25-1-030	CATA-25-1-020	5.2	28	8.3	336	15	0.112%	2.2	12.5	0.0	6.1	282.9%	0	27
Catalpa Drive	57	CATA-25-1-020	CATA-25-1-010	6.7	40	10.0	335	15	0.144%	2.5	14.6	0.0	7.6	308.9%	0	27
Catalpa Drive	57	CATA-25-1-010	CASS-11-1-010	6.7	51	9.5	336	15	0.296%	3.5	16.2	8.0	6.0	171.1%	0	24
Cass Boulevard	57	CASS-13-1-010	CASS-12-1-010	33.1	178	29.9	290	15	0.177%	2.7	14.1	0.0	27.2	997.9%	0	42
Cass Boulevard	57	CASS-12-1-010	CASS-11-1-010	54.5	272	47.0	367	48	0.210%	65.8	12.3	9.1	-18.9	-28.7%	10	
Cass Boulevard	57	CASS-11-1-010	26355	64.0	323	56.0	10	48	24.277%	707.8	15.4	12.2	-651.8	-92.1%	10	
HENLEY INLET (WEST - SUNNYKNOLL)																
Sunnyknoll Avenue	58	SUNN-18-1-010	SUNN-19-1-020	0.0	152	3.0	456	10	0.798%	2.0	8.9	0.0	1.1	54.8%	10	
Sunnyknoll Avenue	58	SUNN-19-1-020	SUNN-19-1-030	5.0	162	8.9	332	12	0.232%	1.7	9.2	0.0	7.2	416.9%	0	24
Sunnyknoll Avenue	58	SUNN-19-1-030	25929	7.8	169	13.0	323	12	3.592%	6.8	9.8	0.0	6.2	92.3%	2	18
CATALPA INLET (WEST - MORTENSON)																
Catalpa Drive	59	CATA-20-1-010	CATA-20-1-020	0.0	11	0.2	335	12	0.628%	2.8	9.2	8.4	-2.6	-92.2%	10	
Catalpa Drive	59	CATA-20-1-020	CATA-20-1-030	0.9	23	1.5	350	12	0.697%	3.0	11.1	10.3	-1.4	-48.7%	10	
Catalpa Drive	59	CATA-20-1-030	25926	2.1	34	3.5	341	12	0.652%	2.9	13.3	11.5	0.6	20.3%	5	15
CASS INLET (WEST - WEST)																

Appendix B
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Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
West Boulevard	60	WEST-21-1-010	WEST-22-1-010	0.6	11	1.0	400	12	1.665%	4.6	8.8	8.0	-3.6	-78.6%	10	
Mortenson Boulevard	60	MORT-10-1-010	WEST-22-1-010	0.0	8	0.2	209	12	0.290%	1.9	11.1	7.9	-1.8	-91.7%	10	
West Boulevard	60	WEST-22-1-010	WEST-22-1-020	3.4	25	4.9	306	12	1.486%	4.3	9.9	5.6	0.5	12.0%	7	
West Boulevard	60	WEST-22-1-020	WEST-22-1-030	3.9	37	5.7	312	15	1.500%	7.9	9.2	6.1	-2.2	-27.8%	10	
West Boulevard	60	WEST-22-1-030	26354	8.1	49	11.0	311	15	1.500%	7.9	14.6	9.3	3.1	39.0%	4	18
OXFORD INLET (SOUTH - BERKLEY)																
Oxford Road	61	OXFO-18-1-020	OXFO-18-1-030	0.9	23	2.0	165	15	0.693%	5.4	9.1	8.1	-3.4	-63.6%	10	
Oxford Road	61	OXFO-18-1-030	25933	1.1	23	2.1	74	15	0.652%	5.2	11.0	10.0	-3.2	-60.7%	10	
CASS INLET (WEST - EATON)																
Oxford Road	62	OXFO-19-1-010	OXFO-19-1-020	0.0	12	0.2	330	10	2.077%	3.2	4.8	2.8	-2.9	-92.4%	10	
Oxford Road	62	OXFO-19-1-020	OXFO-20-1-010	0.0	21	0.4	330	10	0.441%	1.5	10.9	2.0	-1.0	-71.1%	10	
Oxford Road	62	OXFO-20-1-010	OXFO-20-1-020	2.2	27	3.7	333	10	1.273%	2.5	10.2	0.0	1.2	48.8%	3	12
Oxford Road	62	OXFO-20-1-020	HAMI-07-1-010	3.8	82	6.7	335	12	0.582%	2.7	10.3	0.0	4.0	145.8%	1	18
Hamilton Avenue	62	HAMI-07-1-010	OXFO-21-1-010	3.8	82	6.5	31	15	0.088%	1.9	10.1	8.4	4.5	236.9%	0	24
Oxford Road	62	OXFO-21-1-010		4.7	82	7.9	15	18	69.398%	87.5	9.9	8.7	-79.6	-90.9%	10	
Oxford Road	62	OXFO-21-1-010	OXFO-22-1-010	0.0	8	0.2	394	15	0.591%	5.0	10.1	9.1	-4.8	-96.8%	10	
Mortenson Boulevard	62	MORT-06-1-010	OXFO-22-1-010	0.0	10	0.2	247	10	0.422%	1.4	9.5	8.8	-1.2	-85.9%	10	
Sunnyknoll Avenue	62	SUNN-20-1-010	25929	4.4	0	6.1	11	12	1.837%	4.8	9.0	8.1	1.3	27.0%	4	15
Sunnyknoll Avenue	62	SUNN-20-1-010	SUNN-20-1-020	0.0	11	0.2	333	15	0.602%	5.0	9.2	1.9	-4.8	-95.6%	10	
Sunnyknoll Avenue	62	SUNN-20-1-020	HAMI-09-1-010	3.5	22	4.0	327	15	0.267%	3.3	9.4	0.0	0.7	21.2%	5	18
Hamilton Avenue	62	HAMI-09-1-010	EATO-21-1-010	5.8	22	7.0	105	15	0.404%	4.1	10.0	0.4	2.9	71.2%	2	21
Hamilton Avenue	62	HAMI-07-1-020	HAMI-07-1-030	0.0	2	0.0	60	12	0.269%	1.8	6.9	0.0	-1.8	-97.8%	10	
Hamilton Avenue	62	HAMI-07-1-030	EATO-21-1-010	0.0	2	0.0	109	12	0.468%	2.4	8.6	0.0	-2.4	-98.4%	10	
Eaton Road	62	EATO-21-1-010	EATO-22-1-010	6.0	32	7.3	397	15	1.234%	7.2	11.1	0.6	0.1	1.3%	10	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Mortenson Boulevard	62	MORT-08-1-010	EATO-22-1-010	0.0	10	0.2	222	12	0.192%	1.6	10.5	1.5	-1.4	-87.2%	10	
Mortenson Boulevard	62	OXFO-22-1-010	MORT-07-1-010	0.0	10	0.2	220	12	0.211%	1.6	9.4	1.4	-1.4	-87.8%	10	
Mortenson Boulevard	62	MORT-07-1-010	EATO-22-1-010	1.8	12	2.7	90	12	0.093%	1.1	8.5	0.0	1.6	149.8%	0	18
Eaton Road	62	EATO-22-1-010	EATO-22-1-020	10.3	60	13.6	306	18	0.258%	5.3	10.3	0.0	8.3	155.6%	0	27
Eaton Road	62	EATO-22-1-020	EATO-22-1-030	12.3	72	15.8	313	18	0.124%	3.7	10.3	0.0	12.2	329.1%	0	33
Eaton Road	62	EATO-22-1-030	26353	15.7	84	20.1	313	18	0.262%	5.4	10.7	0.0	14.7	274.2%	0	30
CASS INLET (WEST - LARKMOOR)																
Larkmoor Boulevard	63	LARK-21-1-010	LARK-22-1-010	9.8	8	10.3	346	10	1.656%	2.8	4.1	0.0	7.5	267.0%	0	18
Larkmoor Boulevard	63	LARK-22-1-010	LARK-22-1-020	10.5	8	11.3	32	10	0.783%	1.9	9.2	0.0	9.4	484.8%	0	21
Larkmoor Boulevard	63	LARK-22-1-020	LARK-22-1-030	10.5	14	11.3	311	10	0.726%	1.9	9.7	0.0	9.4	505.3%	0	21
Larkmoor Boulevard	63	LARK-22-1-030	LARK-22-1-040	10.5	26	10.9	310	10	0.883%	2.1	11.2	0.0	8.9	431.6%	0	21
Larkmoor Boulevard	63	LARK-22-1-040	26347	10.5	38	10.6	327	10	0.801%	2.0	10.8	0.0	8.7	442.5%	0	21
Larkmoor Boulevard	63	LARK-22-1-050	LARK-22-1-060	5.6	0	8.7	118	15	1.369%	7.6	7.7	6.2	1.1	15.0%	6	
Larkmoor Boulevard	63	LARK-22-1-060	26347	7.2	0	11.2	50	18	1.379%	12.3	8.5	7.3	-1.1	-9.2%	10	
LARKMOOR INLET (NORTH - STANFORD)																
Oxford Road	64	OXFO-22-1-010	OXFO-22-1-020	3.3	18	4.8	53	15	0.480%	4.5	10.2	8.9	0.3	7.3%	8	
Oxford Road	64	OXFO-22-1-020	OXFO-22-1-030	4.0	24	6.0	257	18	0.659%	8.5	9.9	8.5	-2.5	-29.8%	10	
Oxford Road	64	OXFO-22-1-030	OXFO-22-1-040	4.0	36	5.8	312	18	0.433%	6.9	12.0	10.8	-1.1	-15.7%	10	
Oxford Road	64	OXFO-22-1-040		5.3	48	7.5	332	18	3.617%	20.0	8.7	7.5	-12.5	-62.4%	10	
Oxford Road	64	OXFO-25-1-030	OXFO-25-1-020	3.2	15	4.5	347	12	0.317%	2.0	9.3	3.1	2.5	125.0%	1	18
Oxford Road	64	OXFO-25-1-020		4.6	29	6.6	311	12	3.071%	6.2	10.0	8.0	0.4	6.0%	8	
Oxford Road	64	OXFO-25-1-030	OXFO-26-1-010	0.0	8	0.2	246	12	0.179%	1.5	9.4	0.0	-1.3	-89.4%	10	
Oxford Road	64	OXFO-26-1-010	OXFO-26-1-020	2.7	14	4.2	89	12	0.497%	2.5	10.0	0.0	1.7	69.0%	2	15
Oxford Road	64	OXFO-26-1-020	STAN-07-1-010	2.7	27	4.2	334	12	1.705%	4.7	9.6	0.0	-0.5	-9.7%	10	
Larkmoor Boulevard	64	LARK-25-1-010	26347	0.0	0	0.0	23	18	0.338%	6.1	8.9	7.7	-6.1	-100.0%	10	
Larkmoor Boulevard	64	LARK-25-1-010	LARK-25-1-020	0.0	13	0.3	320	15	0.251%	3.2	7.1	5.5	-3.0	-92.0%	10	
Larkmoor Boulevard	64	LARK-25-1-020	LARK-25-1-030	4.0	20	6.5	161	15	0.552%	4.8	7.8	5.5	1.7	36.3%	4	18
Larkmoor Boulevard	64	LARK-25-1-030	26348	4.0	20	6.4	25	18	0.312%	5.9	9.1	7.9	0.6	9.8%	7	

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Larkmoor Boulevard	64	LARK-25-1-030	LARK-25-1-040	0.0	7	0.1	177	15	0.228%	3.1	9.4	3.6	-2.9	-95.5%	10	
Larkmoor Boulevard	64	LARK-25-1-040	LARK-25-1-050	4.2	23	5.9	337	15	0.211%	3.0	10.2	3.5	3.0	100.2%	2	21
Larkmoor Boulevard	64	LARK-25-1-050	STAN-06-1-010	5.3	38	7.5	338	15	0.246%	3.2	11.2	6.5	4.3	133.3%	1	21
Eaton Road	64	26353	EATO-25-1-010	0.0	19	0.4	395	10	0.242%	1.1	10.5	2.6	-0.7	-64.8%	10	
Eaton Road	64	EATO-25-1-010	EATO-26-1-010	0.0	36	0.7	392	12	0.232%	1.7	8.9	0.0	-1.0	-58.0%	10	
Eaton Road	64	EATO-26-1-010	EATO-26-1-020	6.7	45	11.4	276	12	0.202%	1.6	10.9	0.0	9.8	609.6%	0	27
Eaton Road	64	EATO-26-1-020	STAN-08-1-010	6.7	53	10.8	275	12	0.344%	2.1	11.5	0.0	8.7	417.2%	0	24
West Boulevard	64	26354	WEST-25-1-010	0.0	14	0.3	308	12	0.249%	1.8	8.5	0.0	-1.5	-84.2%	10	
West Boulevard	64	WEST-25-1-010	WEST-25-1-020	1.2	30	2.1	340	12	0.279%	1.9	9.1	0.0	0.3	13.6%	7	
West Boulevard	64	WEST-25-1-020	WEST-26-1-010	1.2	46	2.0	339	12	0.210%	1.6	9.6	0.0	0.4	24.4%	5	15
West Boulevard	64	WEST-26-1-010	STAN-10-1-010	3.5	55	5.5	340	12	0.348%	2.1	9.4	0.0	3.4	161.9%	0	18
West Boulevard	64	WOOD-08-1-030	WEST-27-1-020	0.0	0	0.0	189	12	0.228%	1.7	11.7	2.5	-1.7	-100.0%	10	
West Boulevard	64	WEST-27-1-020	WEST-27-1-010	0.2	19	0.5	33	12	1.044%	3.6	11.0	1.3	-3.1	-86.3%	10	
West Boulevard	64	WEST-27-1-010	STAN-10-1-010	1.6	19	4.3	140	15	0.451%	4.3	11.2	1.1	-0.1	-1.8%	10	
Woodward Avenue	64	WOOD-08-1-030	EATO-27-1-010	0.0	7	0.1	219	10	0.461%	1.5	12.0	3.0	-1.3	-90.6%	10	
Woodward Avenue	64	EATO-27-1-010	OXFO-27-1-020	1.3	18	2.6	364	12	0.332%	2.1	9.9	0.0	0.5	25.4%	5	15
Oxford Road	64	OXFO-27-1-020	OXFO-27-1-010	4.6	58	9.2	273	12	0.385%	2.2	10.2	0.0	7.0	316.6%	0	21
Oxford Road	64	OXFO-27-1-010	STAN-07-1-010	4.6	72	8.9	291	12	0.448%	2.4	12.4	0.0	6.5	273.7%	0	21
Eaton Road	64	EATO-27-1-010	STAN-08-1-010	0.7	13	1.4	368	15	0.405%	4.1	10.2	0.0	-2.7	-66.3%	10	
Stanford Road	64	STAN-10-1-010	STAN-08-1-010	10.1	74	16.5	274	24	0.217%	10.5	14.4	0.0	5.9	56.4%	3	30
Stanford Road	64	STAN-08-1-010	STAN-07-1-010	20.0	141	29.7	308	24	0.186%	9.7	15.6	0.0	19.9	204.6%	0	42
Stanford Road	64	STAN-07-1-010	STAN-06-1-010	29.9	240	43.9	289	24	0.166%	9.2	15.2	2.0	34.7	376.9%	0	48
Larkmoor Boulevard	64	LARK-27-1-030	LARK-27-1-020	0.0	2	0.0	207	12	0.324%	2.0	8.9	8.1	-2.0	-98.0%	10	
Larkmoor Boulevard	64	LARK-27-1-020	LARK-27-1-010	0.0	7	0.1	147	12	0.565%	2.7	10.0	9.2	-2.5	-94.8%	10	
Larkmoor Boulevard	64	LARK-27-1-010	STAN-06-1-010	0.0	25	0.5	387	12	0.340%	2.1	10.6	9.8	-1.6	-75.9%	10	
Stanford Road	64	STAN-06-1-010	26350	40.0	303	55.4	26	24	0.311%	12.6	15.3	12.2	42.8	339.1%	0	42

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
BERKLEY INLET (EAST - CAMBRIDGE)																
	65	CAMB-20-1-010	CAMB-19-1-020	0.0	13	0.3	329	12	0.357%	2.1	9.6	8.8	-1.9	-87.8%	10	
	65	CAMB-19-1-020	CAMB-19-1-010	1.1	26	1.9	330	15	0.273%	3.4	8.6	7.6	-1.5	-44.0%	10	
	65	CAMB-19-1-010	25935	8.4	26	12.7	17	15	28.107%	34.2	8.6	7.6	-21.5	-62.8%	10	
LARKMOOR INLET (SOUTH - CASS)																
Harvard Road	66	HARV-19-1-010	HARV-19-1-020	0.0	47	0.9	328	12	0.010%	0.4	11.0	3.3	0.6	164.5%	10	
Harvard Road	66	HARV-19-1-020	HARV-20-1-010	0.0	56	1.1	329	12	0.328%	2.0	8.3	0.8	-0.9	-45.1%	10	
Harvard Road	66	HARV-20-1-010	HARV-20-1-020	4.6	70	7.3	330	12	0.365%	2.2	8.7	0.0	5.2	240.4%	0	21
Harvard Road	66	HARV-20-1-020	HARV-21-1-010	6.0	84	9.0	346	12	0.651%	2.9	9.6	0.0	6.2	214.6%	0	21
Harvard Road	66	HARV-21-1-010	HARV-22-1-010	7.2	93	10.7	380	12	0.925%	3.4	10.1	0.0	7.2	211.0%	0	21
Cambridge Road	66	CAMB-20-1-010	CAMB-20-1-020	0.0	11	0.2	354	12	0.563%	2.7	12.2	6.1	-2.5	-91.8%	10	
Cambridge Road	66	CAMB-20-1-020	CAMB-20-1-030	0.0	26	0.5	353	12	0.557%	2.7	11.2	3.1	-2.1	-80.4%	10	
Cambridge Road	66	CAMB-20-1-030	CAMB-20-1-040	3.3	34	5.0	296	15	0.291%	3.5	10.0	0.0	1.5	43.1%	4	18
Cambridge Road	66	CAMB-20-1-040	CAMB-22-1-010	5.8	34	7.9	55	15	0.162%	2.6	10.0	1.0	5.3	204.2%	0	24
Columbia Road	66	25936	COLU-19-1-010	0.0	5	0.1	159	36	0.205%	30.2	16.2	13.8	-30.1	-99.7%	10	
Columbia Road	66	COLU-19-1-010	COLU-19-1-030	0.0	24	0.5	404	36	0.262%	34.1	16.8	14.4	-33.7	-98.6%	10	
Columbia Road	66	COLU-19-1-030	COLU-20-1-010	3.9	37	5.9	387	36	0.251%	33.4	17.1	14.1	-27.5	-82.2%	10	
Columbia Road	66	COLU-20-1-010	COLU-20-1-030	3.9	53	5.5	388	36	0.233%	32.2	16.7	12.8	-26.7	-82.8%	10	
Columbia Road	66	COLU-20-1-030	COLU-22-1-010	5.8	6	19.8	395	36	0.301%	36.6	17.3	12.5	-16.8	-45.8%	10	
Princeton Road	66	PRIN-20-1-010	PRIN-20-1-020	4.4	15	7.0	341	12	0.398%	2.2	9.5	0.0	4.8	211.4%	0	21
Princeton Road	66	PRIN-20-1-020	PRIN-20-1-030	6.7	28	10.0	342	12	0.341%	2.1	11.2	0.0	7.9	380.2%	0	24
Princeton Road	66	PRIN-20-1-030	PRIN-20-1-040	7.3	36	10.3	309	12	0.394%	2.2	11.4	0.0	8.1	360.9%	0	24
Eleven Mile Road	66	ELEV-18-1-010	ELEV-18-2-015	0.0	15	0.3	120	12	0.688%	3.0	11.2	0.0	-2.7	-89.9%	10	
Eleven Mile Road	66	ELEV-18-2-015	ELEV-18-1-030	0.6	15	1.5	147	12	0.101%	1.1	12.6	0.0	0.4	35.7%	4	15
Eleven Mile Road	66	ELEV-18-1-030	ELEV-19-1-010	1.2	15	2.8	264	12	0.320%	2.0	12.6	0.0	0.8	38.6%	4	15
Eleven Mile Road	66	ELEV-18-1-040	ELEV-19-1-015	0.3	19	0.8	183	10	0.447%	1.5	3.7	0.0	-0.6	-44.0%	10	
Eleven Mile Road	66	ELEV-19-1-015	ELEV-19-1-010	0.3	19	0.8	127	10	1.664%	2.8	5.2	0.4	-2.0	-71.9%	10	
Eleven Mile Road	66	ELEV-19-1-010	ELEV-19-1-020	2.1	43	4.9	327	12	0.329%	2.0	13.0	0.0	2.8	139.2%	1	18
Eleven Mile Road	66	ELEV-19-1-020	HENL-01-1-010	2.4	50	5.4	332	12	0.320%	2.0	14.4	0.0	3.4	167.8%	0	18
Henley Avenue	66	HENL-01-1-010	ELEV-20-1-010	2.5	50	5.4	126	12	0.725%	3.0	13.5	0.0	2.4	78.3%	2	15
Eleven Mile Road	66	ELEV-20-1-010	ELEV-20-1-020	4.4	71	9.1	337	15	0.206%	2.9	14.1	0.0	6.1	209.1%	0	24
Eleven Mile Road	66	ELEV-20-1-020	ELEV-20-1-030	4.6	84	9.1	345	15	0.365%	3.9	12.8	0.0	5.2	134.3%	1	21
Eleven Mile Road	66	ELEV-20-1-030	ELEV-20-1-040	7.0	89	12.6	228	15	0.481%	4.5	11.8	0.0	8.1	180.5%	0	24
Eleven Mile Road	66	ELEV-20-1-040	MORT-01-1-010	7.6	89	13.5	111	15	0.375%	4.0	12.5	0.0	9.6	241.9%	0	24

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Mortenson Boulevard	66	MORT-01-1-010	PRIN-20-1-040	9.5	99	16.2	287	18	0.150%	4.1	12.4	0.0	12.1	297.7%	0	33
Mortenson Boulevard	66	MORT-05-1-010	HARV-22-1-010	0.0	10	0.2	229	12	0.335%	2.1	10.6	1.6	-1.9	-90.3%	10	
Mortenson Boulevard	66	CAMB-22-1-010	HARV-22-1-010	0.0	10	0.2	308	12	0.351%	2.1	9.6	0.9	-1.9	-90.5%	10	
Harvard Road	66	HARV-22-1-010	HARV-22-1-020	13.2	119	18.2	313	15	0.347%	3.8	10.1	0.0	14.4	379.0%	0	27
Harvard Road	66	HARV-22-1-020	HARV-22-1-030	16.4	131	21.3	313	15	0.190%	2.8	9.6	0.0	18.5	658.6%	0	33
Harvard Road	66	HARV-22-1-030	CASS-05-1-010	16.4	140	20.4	313	18	0.526%	7.6	10.1	0.0	12.8	168.3%	0	27
Cambridge Road	66	CAMB-22-1-010	CAMB-22-1-020	2.3	18	3.1	320	15	0.341%	3.8	10.2	1.9	-0.6	-16.9%	10	
Cambridge Road	66	CAMB-22-1-020	CAMB-22-1-030	2.3	30	3.0	303	15	0.506%	4.6	10.0	1.4	-1.6	-34.6%	10	
Cambridge Road	66	CAMB-22-1-030	CASS-04-1-010	6.2	36	7.8	308	10	0.673%	1.8	9.4	0.0	6.0	335.2%	0	18
Mortenson Boulevard	66	CAMB-22-1-010	COLU-22-1-010	4.4	30	6.1	271	12	0.317%	2.0	9.6	2.1	4.1	203.6%	0	21
Mortenson Boulevard	66	PRIN-20-1-040	COLU-22-1-010	15.3	111	20.9	284	18	0.241%	5.2	13.6	0.0	15.8	305.8%	0	33
Columbia Road	66	COLU-22-1-010	COLU-22-1-020	27.3	160	43.6	454	36	0.276%	35.1	16.6	11.0	8.5	24.2%	4	42
Columbia Road	66	COLU-22-1-020	CASS-03-1-010	29.4	172	45.1	479	42	0.280%	53.2	14.7	9.7	-8.2	-15.4%	10	
Princeton Road	66	PRIN-20-1-040	PRIN-22-1-010	5.1	34	7.0	33	12	0.195%	1.6	11.2	0.0	5.4	343.6%	0	21
Princeton Road	66	PRIN-22-1-010	PRIN-22-1-020	5.1	40	6.9	307	15	0.463%	4.4	10.9	0.0	2.6	58.1%	3	18
Princeton Road	66	PRIN-22-1-020	PRIN-22-1-030	6.9	46	8.8	132	15	0.164%	2.6	10.8	0.0	6.2	236.9%	0	24
Princeton Road	66	PRIN-22-1-030	PRIN-22-1-040	8.0	52	9.9	178	15	0.198%	2.9	10.9	0.0	7.1	246.1%	0	24
Princeton Road	66	PRIN-22-1-040	CASS-02-1-010	8.0	58	9.7	311	15	0.427%	4.2	11.5	0.0	5.5	130.8%	1	21
Eleven Mile Road	66	ELEV-22-1-010	ELEV-22-1-020	1.3	3	2.4	295	12	0.286%	1.9	12.0	0.0	0.5	27.4%	4	15
Eleven Mile Road	66	ELEV-22-1-020	ELEV-22-1-030	2.5	9	4.4	296	12	0.293%	1.9	12.0	0.0	2.4	126.2%	1	18
Eleven Mile Road	66	ELEV-22-1-030	CASS-01-1-010	4.5	12	6.5	295	12	0.280%	1.9	12.0	0.0	4.6	246.0%	0	21
Cass Boulevard	66	CASS-01-1-010	CASS-02-1-010	6.8	22	10.2	291	15	0.124%	2.3	11.6	0.0	8.0	349.6%	0	27
Cass Boulevard	66	CASS-02-1-010	CASS-02-1-020	18.2	89	21.1	231	18	0.352%	6.2	12.7	0.0	14.9	238.2%	0	30
Cass Boulevard	66	CASS-02-1-020	CASS-03-1-010	19.2	89	21.5	66	18	0.127%	3.7	14.2	7.8	17.8	475.1%	0	36
Cass Boulevard	66	CASS-03-1-010	CASS-04-1-010	50.6	271	66.0	255	42	0.331%	57.9	15.2	9.7	8.1	14.0%	6	
Cass Boulevard	66	CASS-04-1-010	CASS-05-1-010	58.8	316	73.3	308	42	0.229%	48.2	15.7	10.4	25.1	52.1%	3	54

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cass Boulevard	66	CASS-05-1-010	CASS-05-1-020	79.3	460	92.2	177	48	0.379%	88.4	16.2	11.7	3.8	4.3%	8	
Cass Boulevard	66	CASS-05-1-020	26347	80.9	460	93.0	125	36	0.346%	39.2	15.3	10.9	53.8	137.0%	1	54
E OF STANFORD INLET (WEST - HARVARD)																
Harvard Road	67	HARV-25-1-010	HARV-25-1-020	0.0	16	0.3	398	12	0.364%	2.1	9.3	0.0	-1.8	-85.1%	10	
Harvard Road	67	HARV-25-1-020	HARV-25-1-030	3.6	34	5.3	399	12	0.272%	1.9	11.0	0.0	3.5	187.1%	0	18
Harvard Road	67	HARV-25-1-030	HARV-27-1-010	6.0	51	8.3	400	12	0.350%	2.1	11.3	0.0	6.2	292.7%	0	21
Harvard Road	67	HARV-27-1-010	HARV-27-1-020	13.7	69	19.4	356	15	0.226%	3.1	11.0	0.0	16.3	532.3%	0	30
Harvard Road	67	HARV-27-1-020	26469	13.7	84	18.5	345	15	0.373%	3.9	12.3	0.0	14.6	369.7%	0	27
E OF STANFORD INLET (WEST - CAMBRIDGE)																
Cambridge Road	68	CAMB-25-1-010	CAMB-25-1-020	0.9	14	1.3	402	12	0.407%	2.3	8.2	0.0	-1.0	-44.3%	10	
Cambridge Road	68	CAMB-25-1-020	CAMB-25-1-030	2.7	32	3.8	404	12	0.277%	1.9	9.5	0.0	1.9	100.7%	2	18
Cambridge Road	68	CAMB-25-1-030	CAMB-27-1-010	5.2	49	7.1	400	12	0.277%	1.9	12.9	0.0	5.2	276.8%	0	21
Cambridge Road	68	CAMB-27-1-010	CAMB-27-1-020	7.5	65	9.9	354	15	0.254%	3.3	10.1	0.0	6.6	203.1%	0	24
Cambridge Road	68	CAMB-27-1-020	26470	8.5	81	11.0	342	15	0.244%	3.2	10.2	0.1	7.8	244.4%	0	24
E OF STANFORD INLET (WEST - COLUMBIA)																
Columbia Road	69	COLU-25-1-010	COLU-25-1-020	0.5	14	1.0	404	12	0.356%	2.1	8.5	0.2	-1.1	-52.5%	10	
Columbia Road	69	COLU-25-1-020	COLU-25-1-030	1.6	32	2.2	405	12	0.305%	2.0	9.4	0.0	0.2	11.9%	8	
Columbia Road	69	COLU-25-1-030	COLU-27-1-010	5.0	44	7.1	398	12	0.321%	2.0	10.7	0.0	5.1	253.1%	0	21
Stanford Road	69	STAN-03-1-010	COLU-27-1-010	0.0	3	0.1	120	10	0.629%	1.7	9.0	2.0	-1.7	-97.1%	10	
Columbia Road	69	COLU-27-1-010	COLU-27-1-020	5.8	59	8.0	356	15	0.323%	3.7	10.0	1.2	4.3	117.5%	1	21
Columbia Road	69	COLU-27-1-020	26471	5.8	74	7.7	336	15	0.379%	4.0	10.1	5.6	3.7	93.6%	2	21
E OF STANFORD INLET (WEST - PRINCETON)																
Princeton Road	70	PRIN-25-1-010	PRIN-25-1-020	0.0	15	0.3	405	12	0.258%	1.8	8.5	1.3	-1.5	-83.4%	10	
Princeton Road	70	PRIN-25-1-020	PRIN-25-1-030	2.2	35	3.1	406	12	0.023%	0.5	8.2	0.0	2.5	469.3%	0	24
Princeton Road	70	PRIN-25-1-030	PRIN-27-1-010	5.8	47	7.6	407	15	0.785%	5.7	8.1	0.0	1.9	32.6%	4	18
Eleven Mile Road	70	ELEV-25-1-010	ELEV-25-1-020	0.0	4	0.1	336	12	0.214%	1.6	9.7	0.4	-1.6	-95.1%	10	
Eleven Mile Road	70	ELEV-25-1-020	ELEV-25-1-030	0.9	11	1.7	335	12	0.316%	2.0	10.3	0.3	-0.3	-13.1%	10	
Eleven Mile Road	70	ELEV-25-1-030	ELEV-25-1-040	1.6	19	3.1	336	12	0.339%	2.1	10.3	0.0	1.0	49.1%	3	15
Eleven Mile Road	70	ELEV-25-1-040	ELEV-27-1-010	3.5	24	6.5	333	12	0.332%	2.1	11.2	0.0	4.5	217.3%	0	21

Appendix B
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR EXISTING UNRESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Stanford Road	70	ELEV-27-1-010	STAN-01-1-010	0.0	1	0.0	50	12	0.453%	2.4	8.9	0.0	-2.4	-99.2%	10	
Stanford Road	70	STAN-01-1-010	PRIN-27-1-010	1.0	9	1.8	231	15	0.215%	3.0	9.3	0.0	-1.2	-40.3%	10	
Stanford Road	70	COLU-27-1-010	PRIN-27-1-010	0.0	10	0.2	281	15	0.246%	3.2	9.3	0.0	-3.0	-93.8%	10	
Princeton Road	70	PRIN-27-1-010	PRIN-27-1-020	13.2	76	18.8	354	15	0.290%	3.5	10.3	0.0	15.3	439.7%	0	30
Princeton Road	70	PRIN-27-1-020	26472	14.8	91	20.2	336	18	0.313%	5.9	10.3	0.0	14.3	243.6%	0	30
E OF STANFORD INLET (WEST - 11 MILE)																
Eleven Mile Road	71	ELEV-27-1-010	ELEV-27-1-020	5.0	29	8.8	330	15	0.422%	4.2	11.6	1.0	4.6	108.7%	1	21
Eleven Mile Road	71	ELEV-27-1-020	ELEV-27-1-030	5.2	37	8.7	321	15	0.397%	4.1	13.6	7.6	4.7	114.7%	1	21
Eleven Mile Road	71	ELEV-27-1-030	26466	5.2	37	8.5	36	15	0.383%	4.0	14.2	12.7	4.5	112.3%	1	21
BERKLEY INLET (NORTH - OXFORD)																
Berkley Avenue	72	BERK-07-1-020	BERK-07-1-010	0.0	4	0.1	254	8	0.572%	0.9	7.4	6.9	-0.8	-91.2%	10	
Berkley Avenue	72	BERK-07-1-010	25932	0.0	5	0.1	32	8	4.420%	2.5	9.2	8.7	-2.4	-96.1%	10	
E OF STANFORD INLET (EAST - HARVARD)																
Woodward Avenue	73	LARK-27-1-030	HARV-27-1-030	0.0	15	0.3	380	12	0.325%	2.0	8.7	1.8	-1.7	-85.2%	10	
Harvard Road	73	HARV-27-1-030	26469	2.8	25	6.9	236	12	0.324%	2.0	10.4	1.5	4.9	241.6%	0	21
E OF STANFORD INLET (EAST - CAMBRIDGE)																
Woodward Avenue	74	HARV-27-1-030	CAMB-27-1-030	0.0	7	0.1	359	15	0.141%	2.4	9.4	1.3	-2.3	-94.2%	10	
Woodward Avenue	74	COLU-27-1-040	CAMB-27-1-040	0.0	8	0.2	290	15	0.664%	5.3	9.9	1.6	-5.1	-97.2%	10	
Woodward Avenue	74	CAMB-27-1-040	CAMB-27-1-030	2.9	8	5.2	85	12	0.152%	1.4	11.1	0.8	3.9	277.9%	0	21
Cambridge Road	74	CAMB-27-1-030	26470	5.4	33	9.4	425	15	0.237%	3.1	10.1	1.1	6.3	199.0%	0	24
E OF STANFORD INLET (EAST - COLUMBIA)																

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STREET/LOCATION	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Woodward Avenue	75	PRIN-27-1-040	COLU-27-1-040	0.0	0	0.0	347	15	0.488%	4.5	12.1	10.8	-4.5	-100.0%	10	
Columbia Road	75	COLU-27-1-040	COLU-27-1-030	0.7	0	1.4	278	15	0.363%	3.9	10.6	7.4	-2.5	-65.3%	10	
Columbia Road	75	COLU-27-1-030	26471	3.9	0	7.1	359	15	0.362%	3.9	9.8	5.7	3.2	83.4%	2	21
E OF STANFORD INLET (EAST - PRINCETON)																
Woodward Avenue	76	ELEV-27-1-090	PRIN-27-1-050	0.0	5	0.1	209	12	0.277%	1.9	11.8	11.0	-1.8	-95.2%	10	
Woodward Avenue	76	PRIN-27-1-050	PRIN-27-1-040	0.4	5	1.1	88	12	0.265%	1.8	13.6	12.8	-0.8	-41.1%	10	
Princeton Road	76	PRIN-27-1-040	PRIN-27-1-030	0.4	24	1.1	410	15	0.293%	3.5	14.2	13.2	-2.4	-69.6%	10	
Princeton Road	76	PRIN-27-1-030	26472	1.8	45	3.5	426	15	0.282%	3.4	10.2	9.1	0.1	3.4%	10	
E OF STANFORD INLET (EAST - 11 MILE)																
Eleven Mile Road	77	ELEV-27-1-080	ELEV-27-1-070	0.5	7	1.0	331	15	0.394%	4.1	10.8	9.8	-3.0	-75.0%	10	
Eleven Mile Road	77	ELEV-27-1-070	ELEV-27-1-060	0.9	14	1.9	268	15	0.375%	4.0	10.7	9.7	-2.1	-53.1%	10	
Eleven Mile Road	77	ELEV-27-1-060	ELEV-27-1-050	2.1	15	3.8	66	15	0.135%	2.4	10.0	8.4	1.5	61.5%	3	18
Eleven Mile Road	77	ELEV-27-1-050	ELEV-27-1-040	2.1	23	3.8	325	15	0.266%	3.3	10.3	8.9	0.5	13.7%	7	
Eleven Mile Road	77	ELEV-27-1-040	26466	4.6	23	7.8	14	15	0.377%	4.0	11.2	10.0	3.9	97.3%	1	21

Appendix C

Sewer Flow Calculations

(restricted cover condition)

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
MORRISON LATERAL (EAST) - 37																
Robina Avenue	1	ROBI-21-1-050	ROBI-21-1-040	0.9	3	1.0	122	10	3.831%	4.3	5.7	5.0	-3.3	-76.7%	10	
Wakefield Road	1	WAKE-21-1-060	WAKE-21-1-040	1.0	4	1.7	123	10	2.905%	3.7	6.2	5.5	-2.1	-55.5%	10	
Cumberland Road	1	CUMB-21-1-040	CUMB-21-1-030	0.6	4	1.0	126	10	0.834%	2.0	6.7	6.0	-1.0	-49.3%	10	
Cornwall Street	1	CORN-21-1-040	CORN-21-1-030	0.6	4	1.0	125	10	1.982%	3.1	6.1	5.4	-2.1	-66.7%	10	
Kenmore Road	1	KENM-21-1-040	KENM-21-1-030	0.5	3	0.9	125	10	0.971%	2.2	9.4	8.7	-1.2	-57.9%	10	
ABANDONED	1	~~KENM-21-1-035~~	~~KENM-21-1-030~~			0.0									10	
Griffith Avenue	1	GRIF-21-1-040	GRIF-21-1-030	0.8	4	1.4	122	10	3.598%	4.2	5.0	4.3	-2.8	-67.2%	10	
(South of) Webster Road	1	GRIF-21-1-030	ROBI-21-1-040	0.0	0	0.0	253	10	0.354%	1.3	10.2	9.5	-1.3	-100.0%	10	
(South of) Webster Road	1	ROBI-21-1-040	WAKE-21-1-050	0.4	3	0.5	232	10	0.049%	0.5	10.4	9.7	0.0	5.8%	9	
(South of) Webster Road	1	WAKE-21-1-050	WAKE-21-1-040	0.4	3	0.5	156	10	0.042%	0.4	11.0	9.7	0.0	10.1%	8	
(South of) Webster Road	1	WAKE-21-1-040	CUMB-21-1-030	0.5	2	0.7	287	10	0.956%	2.1	10.2	9.5	-1.4	-67.3%	10	
(South of) Webster Road	1	CUMB-21-1-030	CORN-21-1-030	0.0	0	0.0	284	12	0.707%	3.0	10.2	9.4	-3.0	-99.9%	10	
(South of) Webster Road	1	CORN-21-1-030	KENM-21-1-030	0.6	4	1.0	290	10	1.307%	2.5	9.7	9.0	-1.5	-59.9%	10	
Wakefield Road	1	WAKE-21-1-040	WAKE-21-1-030	0.9	16	1.3	361	10	0.822%	2.0	11.1	10.4	-0.7	-34.6%	10	
Wakefield Road	1	WAKE-21-1-030	WAKE-21-1-020	2.2	27	2.1	358	10	0.879%	2.1	9.7	8.8	0.1	2.5%	10	
Wakefield Road	1	WAKE-21-1-020	WAKE-21-1-010	7.5	27	2.9	14	12	1.028%	3.6	10.4	9.6	-0.7	-20.1%	10	
Cumberland Road	1	CUMB-21-1-030	CUMB-21-1-020	1.1	18	1.5	332	10	1.084%	2.3	10.4	9.7	-0.7	-32.1%	10	
Cumberland Road	1	CUMB-21-1-020	CUMB-21-1-010	3.1	29	2.3	334	10	1.894%	3.0	10.7	10.0	-0.7	-22.6%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cornwall Street	1	CORN-21-1-030	CORN-21-1-020	0.0	8	0.2	300	10	1.165%	2.4	9.3	8.6	-2.2	-93.2%	10	
Cornwall Street	1	CORN-21-1-020	CORN-21-1-010	1.0	18	1.0	298	10	1.427%	2.6	10.7	10.0	-1.6	-61.8%	10	
Kenmore Road	1	KENM-21-1-030	KENM-21-1-020	1.1	16	1.8	289	12	0.463%	2.4	11.3	10.5	-0.6	-25.8%	10	
Kenmore Road	1	KENM-21-1-020	KENM-21-1-010	3.3	26	2.6	288	12	0.492%	2.5	10.7	9.9	0.1	4.6%	9	
	1	~~WAKE-21-1-020~~	~~CUMB-21-1-010~~			0.0										
Morrison Avenue	1	KENM-21-1-010	CORN-21-1-010	1.1	5	0.6	281	27	0.108%	10.2	12.3	10.5	-9.6	-94.0%	10	
Morrison Avenue	1	CORN-21-1-010	CUMB-21-1-010	1.3	6	0.8	283	30	0.090%	12.3	13.5	11.5	-11.5	-93.5%	10	
Morrison Avenue	1	CUMB-21-1-010	WAKE-21-1-010	8.0	35	3.8	318	30	0.125%	14.5	13.6	11.6	-10.7	-74.1%	10	
Morrison Avenue (outlet to Robina 48")	1	WAKE-21-1-010	24750	15.4	63	6.2	319	36	0.071%	17.7	17.5	15.1	-11.6	-65.2%	10	
ROBINA INLET (MORRISON) - 22																
Robina Avenue	2	ROBI-21-1-040	ROBI-21-1-030	1.0	9	1.3	230	12	0.425%	2.3	10.1	9.6	-1.0	-43.1%	10	
Robina Avenue	2	ROBI-21-1-030	ROBI-21-1-020	1.0	18	1.3	255	12	0.597%	2.8	9.7	9.1	-1.5	-53.9%	10	
Robina Avenue	2	ROBI-21-1-020	ROBI-21-1-010	3.5	26	2.1	250	12	0.440%	2.4	9.0	7.9	-0.2	-10.5%	10	
Robina Avenue (outlet to Robina 48")	2	ROBI-21-1-010	24750	2.9	11	1.0	22	15	0.274%	3.4	9.0	8.0	-2.3	-69.1%	10	
MORRISON LATERAL (WEST) - 38																
Ellwood Avenue	3	ELLW-21-1-050	ELLW-21-1-040	0.8	10	0.5	277	10	0.439%	1.5	8.3	0.5	-1.0	-65.5%	10	
Ellwood Avenue	3	ELLW-21-1-040	ELLW-21-1-030	2.1	22	2.5	282	10	0.329%	1.3	8.9	0.0	1.3	102.7%	2	15
Ellwood Avenue	3	ELLW-21-1-030	ELLW-21-1-020	3.7	28	4.7	177	12	0.128%	1.3	9.8	0.2	3.4	269.4%	0	21
Ellwood Avenue	3	ELLW-21-1-020	ELLW-21-1-010	5.0	32	6.3	109	12	0.275%	1.9	9.9	3.2	4.5	238.2%	0	21
Thomas Avenue	3	THOM-21-1-040	THOM-21-1-050	0.0	0	0.0	11	10	1.963%	3.1	3.8	3.1	-3.1	-100.0%	10	
Thomas Avenue	3	THOM-21-1-050	THOM-21-1-030	3.7	10	1.0	280	10	0.394%	1.4	7.3	3.8	-0.4	-27.3%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Thomas Avenue	3	THOM-21-1-030	THOM-21-1-020	5.2	22	1.9	282	10	0.369%	1.3	7.8	3.7	0.6	42.9%	4	12
Thomas Avenue	3	THOM-21-1-020	THOM-21-1-010	6.1	31	2.7	287	12	0.227%	1.7	8.7	5.5	1.0	61.4%	3	15
Cummings Avenue	3	CUMM-21-1-040	CUMM-21-1-030	0.0	9	0.2	271	10	1.987%	3.1	8.0	7.3	-2.9	-94.2%	10	
Cummings Avenue	3	CUMM-21-1-030	CUMM-21-1-020	1.0	21	1.0	283	10	0.472%	1.5	8.2	7.2	-0.5	-33.6%	10	
Cummings Avenue	3	CUMM-21-1-020	CUMM-21-1-010	1.0	31	1.0	286	12	0.544%	2.6	9.8	8.3	-1.7	-63.8%	10	
Prairie Avenue	3	PRAI-21-1-040	PRAI-21-1-030	0.7	10	1.0	273	10	0.572%	1.7	8.0	5.0	-0.7	-39.6%	10	
Prairie Avenue	3	PRAI-21-1-030	PRAI-21-1-020	0.7	22	1.0	282	10	0.387%	1.4	8.9	4.8	-0.4	-30.1%	10	
Prairie Avenue	3	PRAI-21-1-020	PRAI-21-1-010	2.8	32	3.4	288	12	0.393%	2.2	9.8	5.2	1.2	54.4%	3	15
Bacon Avenue	3	BACO-21-1-030	BACO-21-1-020	0.0	11	0.2	415	12	0.717%	3.0	8.0	7.2	-2.8	-92.7%	10	
Bacon Avenue	3	BACO-21-1-020	BACO-21-1-010	1.8	27	2.4	418	12	0.689%	3.0	8.4	5.4	-0.5	-17.3%	10	
Phillips Avenue	3	PHIL-21-1-040	PHIL-21-1-030	0.3	6	0.5	265	10	1.326%	2.5	7.6	6.9	-2.0	-80.2%	10	
Phillips Avenue	3	PHIL-21-1-030	PHIL-21-1-020	1.4	11	1.7	285	10	0.249%	1.1	9.7	5.6	0.6	58.0%	3	12
Phillips Avenue	3	PHIL-21-1-020	PHIL-21-1-010	2.1	24	2.5	287	12	0.447%	2.4	10.2	7.0	0.1	2.9%	10	
Oakshire Avenue	3	OAKS-21-1-050	OAKS-21-1-040	0.3	5	0.5	269	12	0.292%	1.9	10.2	9.0	-1.4	-74.0%	10	
Oakshire Avenue	3	OAKS-21-1-040	OAKS-21-1-030	2.2	12	2.4	273	12	0.475%	2.5	10.2	8.2	0.0	-1.9%	10	
Oakshire Avenue	3	OAKS-21-1-030	OAKS-21-1-020	3.6	13	3.3	59	12	0.065%	0.9	10.0	7.8	2.4	259.4%	0	21
Oakshire Avenue	3	OAKS-21-1-020	OAKS-21-1-010	3.6	18	3.2	218	12	0.593%	2.7	9.9	8.1	0.5	17.6%	6	
Royal Avenue	3	ROYA-21-1-040	ROYA-21-1-030	4.7	5	2.5	268	12	0.503%	2.5	8.6	3.6	0.0	-1.0%	10	
Royal Avenue	3	ROYA-21-1-030	ROYA-21-1-020	5.8	53	3.4	284	12	0.318%	2.0	10.1	5.1	1.4	69.1%	2	15
Royal Avenue	3	ROYA-21-1-020	ROYA-21-1-010	7.1	58	4.2	285	12	0.496%	2.5	9.7	6.4	1.7	67.2%	2	15
Buckingham Avenue	3	BUCK-21-1-030	BUCK-21-1-020	1.7	19	2.5	415	12	0.453%	2.4	8.5	7.6	0.1	4.5%	10	
Buckingham Avenue	3	BUCK-21-1-020	BUCK-21-1-010	1.7	38	2.4	419	12	0.476%	2.5	11.2	10.4	-0.1	-3.0%	10	
Tyler Avenue	3	TYLE-21-1-040	TYLE-21-1-030	0.0	11	0.2	276	12	0.893%	3.4	8.7	7.9	-3.1	-93.5%	10	
Tyler Avenue	3	TYLE-21-1-030	TYLE-21-1-020	0.0	23	0.5	282	12	0.797%	3.2	11.3	10.5	-2.7	-85.5%	10	
Tyler Avenue	3	TYLE-21-1-020	TYLE-21-1-010	2.2	34	2.8	285	12	0.608%	2.8	11.2	10.4	0.0	0.8%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Gardner Avenue	3	GARD-21-1-040	GARD-21-1-030	1.0	11	1.5	287	10	0.553%	1.6	10.0	8.7	-0.1	-7.0%	10	
Gardner Avenue	3	GARD-21-1-030	GARD-21-1-020	1.0	25	1.5	284	10	0.561%	1.6	10.2	8.7	-0.2	-11.2%	10	
Gardner Avenue	3	GARD-21-1-020	GARD-21-1-010	3.3	39	4.0	287	12	0.874%	3.3	9.3	7.4	0.7	20.2%	5	15
Griffith Avenue	3	GRIF-21-1-030	GRIF-21-1-020	0.8	16	1.3	360	12	0.386%	2.2	10.2	9.4	-0.9	-39.5%	10	
Griffith Avenue	3	GRIF-21-1-020	GRIF-21-1-010	2.6	28	2.2	361	12	0.660%	2.9	10.0	9.2	-0.7	-24.7%	10	
Morrison Avenue	3	ELLW-21-1-010	THOM-21-1-010	5.3	28	6.7	280	18	0.321%	5.9	12.3	7.3	0.7	12.4%	7	
Morrison Avenue	3	THOM-21-1-010	CUMM-21-1-010	10.9	52	8.8	280	27	0.349%	18.3	12.3	7.2	-9.5	-51.8%	10	
Morrison Avenue	3	CUMM-21-1-010	PRAI-21-1-010	15.3	71	9.3	280	27	0.694%	25.8	13.8	7.7	-16.5	-64.0%	10	
Morrison Avenue	3	PRAI-21-1-010	BACO-21-1-010	19.4	89	13.0	299	27	0.686%	25.7	14.9	7.5	-12.6	-49.3%	10	
Morrison Avenue	3	BACO-21-1-010	PHIL-21-1-010	22.4	98	16.2	279	36	0.285%	35.6	15.3	6.2	-19.4	-54.6%	10	
Morrison Avenue	3	PHIL-21-1-010	OAKS-21-1-010	26.4	122	20.1	271	36	0.449%	44.7	16.8	10.5	-24.6	-55.0%	10	
Morrison Avenue	3	OAKS-21-1-010	ROYA-21-1-010	33.3	140	25.7	269	36	0.374%	40.8	16.1	13.7	-15.0	-36.9%	10	
Morrison Avenue	3	ROYA-21-1-010	BUCK-21-1-010	42.3	198	31.0	277	36	0.519%	48.0	17.0	14.6	-17.0	-35.5%	10	
Morrison Avenue	3	BUCK-21-1-010	TYLE-21-1-010	49.5	236	34.2	279	36	0.596%	51.5	18.2	15.8	-17.3	-33.6%	10	
Morrison Avenue	3	TYLE-21-1-010	GARD-21-1-010	54.2	270	38.4	270	36	0.647%	53.7	18.2	15.8	-15.3	-28.4%	10	
Morrison Avenue	3	GARD-21-1-010	MORR-12-1-010	60.5	309	44.2	195	36	0.891%	62.9	18.7	16.3	-18.8	-29.9%	10	
Morrison Avenue	3	MORR-12-1-010	GRIF-21-1-010	62.0	309	44.5	111	36	2.094%	96.5	19.7	17.3	-52.0	-53.9%	10	
Morrison Avenue (outlet to Robina 48")	3	GRIF-21-1-010	24750	67.3	337	47.8	319	36	0.404%	42.4	20.8	18.3	5.4	12.6%	7	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
EDWARDS LATERAL (EAST) - 35																
Kenmore Road	4	KENM-21-1-010	KENM-20-1-030	4.9	32	2.8	357	12	0.477%	2.5	12.0	10.6	0.3	13.4%	7	
Kenmore Road	4	KENM-20-1-030	KENM-20-1-020	6.3	39	3.5	356	15	0.294%	3.5	9.1	7.9	0.0	0.7%	10	
Cornwall Street	4	CORN-21-1-010	CORN-20-1-010	3.7	25	2.3	352	12	0.677%	2.9	12.2	11.4	-0.7	-22.5%	10	
Cornwall Street	4	CORN-20-1-010	KENM-20-1-020	3.7	31	2.2	400	12	0.241%	1.7	9.7	8.3	0.4	25.1%	5	15
Kenmore Road	4	KENM-20-1-020	KENM-20-1-010	15.2	79	6.8	258	18	0.283%	5.6	11.0	9.8	1.2	21.6%	5	21
Cumberland Road	4	CUMB-21-1-010	CUMB-20-1-030	0.0	8	0.2	302	12	0.243%	1.8	10.5	9.7	-1.6	-90.9%	10	
Cumberland Road	4	CUMB-20-1-030	CUMB-20-1-020	0.0	20	0.4	314	12	0.526%	2.6	9.1	8.3	-2.2	-84.5%	10	
Cumberland Road	4	CUMB-20-1-020	CUMB-20-1-010	3.5	31	1.0	313	12	0.571%	2.7	9.3	8.5	-1.7	-62.8%	10	
Kipling Avenue	4	KIPL-20-1-040	KIPL-20-1-030	0.0	5	0.1	254	10	1.636%	2.8	9.5	8.8	-2.7	-96.4%	10	
Kipling Avenue	4	KIPL-20-1-030	KIPL-20-1-020	0.0	12	0.2	285	12	0.192%	1.6	9.8	9.0	-1.3	-84.6%	10	
Kipling Avenue	4	KIPL-20-1-020	KIPL-20-1-010	1.4	21	1.0	283	12	0.307%	2.0	9.8	9.0	-1.0	-49.4%	10	
Wakefield Road	4	WAKE-21-1-010	WAKE-20-1-030	0.0	1	0.0	105	12	0.608%	2.8	10.2	8.8	-2.8	-99.3%	10	
Wakefield Road	4	WAKE-20-1-030	WAKE-20-1-020	0.4	6	0.5	299	12	0.232%	1.7	9.3	7.2	-1.3	-73.5%	10	
Wakefield Road	4	WAKE-20-1-020	WAKE-20-1-010	3.2	18	3.1	423	12	0.297%	1.9	9.9	7.2	1.1	58.9%	3	15
Coolidge Avenue	4	COOL-19-1-060	COOL-19-1-080	0.0	0	0.0	356	12	0.139%	1.3	5.8	5.0	-1.3	-100.0%	10	
Coolidge Avenue	4	COOL-19-1-080	EDWA-17-1-020	0.0	0	0.0	50	12	0.290%	1.9	7.7	6.8	-1.9	-100.0%	10	
Edwards Avenue	4	EDWA-17-1-020	EDWA-17-1-010	0.0	0	0.0	208	18	0.179%	4.4	8.4	7.2	-4.4	-100.0%	10	
Edwards Avenue	4	EDWA-17-1-010	KENM-20-1-010	0.0	0	0.0	38	24	0.251%	11.3	10.6	9.0	-11.3	-100.0%	10	
Edwards Avenue	4	KENM-20-1-010	EDWA-16-1-010	15.2	71	6.6	176	30	0.138%	15.2	12.2	11.1	-8.6	-56.3%	10	
Edwards Avenue	4	EDWA-16-1-010	CUMB-20-1-010	15.6	71	7.0	114	30	0.180%	17.4	12.6	11.0	-10.4	-59.7%	10	
Edwards Avenue	4	CUMB-20-1-010	KIPL-20-1-010	23.5	102	9.1	288	30	0.082%	11.7	11.8	9.8	-2.7	-22.7%	10	
Edwards Avenue	4	KIPL-20-1-010	WAKE-20-1-010	26.6	123	10.1	292	30	0.198%	18.3	18.2	16.2	-8.2	-44.7%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Edwards Avenue (outlet to Robina 60")	4	WAKE-20-1-010	24752	32.2	141	12.6	324	36	0.070%	17.7	21.2	18.8	-5.1	-28.9%	10	
ROBINA INLET (EDWARDS) - 21																
Robina Avenue	5	ROBI-21-1-010	ROBI-20-1-030	4.0	24	2.6	283	15	0.384%	4.0	9.3	8.3	-1.4	-34.9%	10	
Robina Avenue	5	ROBI-20-1-030	ROBI-20-1-020	5.0	34	3.3	283	15	0.368%	3.9	10.1	9.0	-0.6	-14.9%	10	
Robina Avenue	5	ROBI-20-1-020	ROBI-20-1-010	5.0	43	3.2	283	15	0.153%	2.5	10.1	8.7	0.7	28.0%	4	18
Robina Avenue (outlet to Robina 60")	5	ROBI-20-1-010	24752	0.0	0	0.0	21	15	0.948%	6.3	8.4	7.4	-6.3	-100.0%	10	
EDWARDS LATERAL (WEST) - 36																
Ellwood Avenue	6	ELLW-21-1-010	ELLW-20-1-030	0.8	12	1.0	238	12	0.344%	2.1	10.7	7.1	-1.1	-52.2%	10	
Ellwood Avenue	6	ELLW-20-1-030	ELLW-20-1-020	2.2	20	3.1	185	12	0.267%	1.8	11.2	7.0	1.2	67.5%	2	15
Ellwood Avenue	6	ELLW-20-1-020	ELLW-20-1-010	2.2	36	3.0	424	12	0.323%	2.0	11.8	8.5	1.0	48.1%	3	15
Thomas Avenue	6	THOM-21-1-010	THOM-20-1-030	1.3	16	1.1	296	12	0.286%	1.9	9.3	7.2	-0.8	-42.8%	10	
Thomas Avenue	6	THOM-20-1-030	THOM-20-1-020	2.3	28	2.3	282	12	0.189%	1.5	9.3	6.8	0.7	47.5%	3	15
Thomas Avenue	6	THOM-20-1-020	THOM-20-1-010	4.1	38	3.1	270	12	0.359%	2.1	9.4	7.5	1.0	46.2%	3	15
Cummings Avenue	6	CUMM-21-1-010	CUMM-20-1-020	2.7	29	1.6	436	12	0.355%	2.1	10.2	8.2	-0.5	-22.7%	10	
Cummings Avenue	6	CUMM-20-1-020	CUMM-20-1-010	4.0	45	3.3	411	12	0.389%	2.2	9.7	7.1	1.0	46.4%	3	15
Prairie Avenue	6	PRAI-21-1-010	PRAI-20-1-030	2.9	23	1.9	281	12	0.213%	1.6	10.3	7.3	0.3	18.2%	6	
Prairie Avenue	6	PRAI-20-1-030	PRAI-20-1-020	3.8	35	3.0	282	12	0.112%	1.2	10.2	7.4	1.8	155.1%	0	18
Prairie Avenue	6	PRAI-20-1-020	PRAI-20-1-010	3.8	45	2.9	282	12	0.563%	2.7	11.4	10.3	0.3	9.4%	8	
Bacon Avenue	6	BACO-21-1-010	BACO-20-1-030	4.3	31	3.1	281	12	0.225%	1.7	10.3	6.6	1.4	82.2%	2	18
Bacon Avenue	6	BACO-20-1-030	BACO-20-1-020	5.9	45	4.8	285	15	0.234%	3.1	9.5	7.3	1.7	55.0%	3	18
Bacon Avenue	6	BACO-20-1-020	BACO-20-1-010	5.9	57	4.7	282	15	0.493%	4.5	10.8	9.7	0.2	3.7%	9	
Phillips Avenue	6	PHIL-21-1-010	PHIL-20-1-030	0.0	11	0.2	280	12	1.153%	3.8	8.0	7.2	-3.6	-94.2%	10	
Phillips Avenue	6	PHIL-20-1-030	PHIL-20-1-020	0.9	23	1.1	283	12	0.371%	2.2	9.1	8.3	-1.0	-47.7%	10	
Phillips Avenue	6	PHIL-20-1-020	PHIL-20-1-010	0.9	37	1.1	284	12	0.437%	2.4	9.4	8.6	-1.3	-53.6%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Oakshire Avenue	6	OAKS-21-1-010	OAKS-20-1-030	0.0	11	0.2	277	12	0.475%	2.5	9.7	8.9	-2.2	-91.0%	10	
Oakshire Avenue	6	OAKS-20-1-030	OAKS-20-1-020	0.7	24	0.7	284	12	0.400%	2.3	10.6	9.8	-1.5	-68.0%	10	
Oakshire Avenue	6	OAKS-20-1-020	OAKS-20-1-010	2.4	38	2.6	286	15	0.571%	4.9	11.0	10.0	-2.3	-47.2%	10	
Royal Avenue	6	ROYA-21-1-010	ROYA-20-1-030	0.0	12	0.2	281	12	0.353%	2.1	10.1	8.2	-1.9	-88.7%	10	
Royal Avenue	6	ROYA-20-1-030	ROYA-20-1-020	1.3	25	2.1	283	12	0.105%	1.2	9.7	6.7	0.9	77.7%	2	15
Royal Avenue	6	ROYA-20-1-020	ROYA-20-1-010	2.5	39	3.9	283	12	0.646%	2.9	8.7	6.3	1.1	37.0%	4	15
Buckingham Avenue	6	BUCK-21-1-010	BUCK-20-1-030	0.0	11	0.2	281	12	0.322%	2.0	10.4	9.6	-1.8	-89.1%	10	
Buckingham Avenue	6	BUCK-20-1-030	BUCK-20-1-020	1.4	23	1.0	284	12	0.469%	2.4	8.6	7.8	-1.4	-59.0%	10	
Buckingham Avenue	6	BUCK-20-1-020	BUCK-20-1-010	3.3	37	1.9	284	12	0.685%	2.9	7.6	6.8	-1.0	-35.6%	10	
Tyler Avenue	6	TYLE-21-1-010	TYLE-20-1-030	0.0	8	0.2	282	12	0.566%	2.7	11.4	10.6	-2.5	-94.0%	10	
Tyler Avenue	6	TYLE-20-1-030	TYLE-20-1-025	1.1	18	1.0	208	15	0.181%	2.7	10.2	9.2	-1.7	-63.6%	10	
Tyler Avenue	6	TYLE-20-1-025	TYLE-20-1-020	1.1	22	1.0	74	15	0.181%	2.7	9.6	8.6	-1.8	-65.0%	10	
Tyler Avenue	6	TYLE-20-1-020	TYLE-20-1-010	3.2	34	1.9	283	15	0.362%	3.9	9.3	8.3	-2.0	-51.1%	10	
Gardner Avenue	6	GARD-21-1-010	GARD-20-1-030	0.0	12	0.2	280	12	0.318%	2.0	10.1	8.9	-1.8	-88.1%	10	
Gardner Avenue	6	GARD-20-1-030	GARD-20-1-020	1.2	26	2.0	283	12	0.313%	2.0	9.5	7.4	0.0	0.8%	10	
Gardner Avenue	6	GARD-20-1-020	GARD-20-1-010	2.1	39	3.6	283	12	0.574%	2.7	9.1	7.0	0.9	34.2%	4	15
Griffith Avenue	6	GRIF-21-1-010	GRIF-20-1-030	0.0	8	0.2	283	12	0.536%	2.6	9.2	8.4	-2.4	-93.9%	10	
Griffith Avenue	6	GRIF-20-1-030	GRIF-20-1-020	0.0	18	0.4	284	12	0.536%	2.6	10.5	9.7	-2.2	-86.2%	10	
Griffith Avenue	6	GRIF-20-1-020	GRIF-20-1-010	1.3	29	2.3	282	12	0.455%	2.4	10.4	9.6	-0.1	-4.5%	10	
Edwards Avenue	6	ELLW-20-1-010	THOM-20-1-010	6.3	36	8.0	280	18	0.485%	7.3	15.3	11.3	0.6	8.9%	8	
Edwards Avenue	6	THOM-20-1-010	CUMM-20-1-010	12.9	75	14.0	278	18	0.891%	9.9	15.1	11.4	4.1	41.0%	4	21
Ellwood Avenue	6	ELLW-20-1-010	ELLW-19-1-050	0.0	16	0.3	419	15	0.197%	2.9	12.9	9.4	-2.5	-88.8%	10	
Ellwood Avenue	6	ELLW-19-1-050	ELLW-19-1-040	0.0	31	0.6	419	15	0.324%	3.7	13.8	9.4	-3.1	-83.1%	10	
Greenfield Road	6	GREE-19-1-030	GREE-19-1-020	2.4	8	4.6	290	12	0.659%	2.9	7.4	0.2	1.7	59.1%	3	15
Greenfield Road	6	GREE-19-1-020	GREE-19-1-010	2.4	11	4.5	199	12	0.713%	3.0	7.1	2.7	1.5	48.6%	3	15

Appendix C
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COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Greenfield Road	6	GREE-19-1-010	ELLW-19-1-030	3.3	19	5.9	243	15	0.303%	3.6	9.4	6.2	2.3	66.0%	3	21
(North of) 12 Mile Road	6	ELLW-19-1-030	ELLW-19-1-040	3.6	19	6.5	38	15	0.440%	4.3	10.8	8.9	2.2	51.5%	3	18
Ellwood Avenue	6	ELLW-19-1-020	ELLW-19-1-040	0.8	0	1.9	99	10	2.510%	3.5	4.9	4.2	-1.5	-44.4%	10	
Thomas Avenue	6	THOM-20-1-010	THOM-19-1-030	0.0	16	0.3	423	15	0.246%	3.2	10.9	9.9	-2.9	-90.0%	10	
Thomas Avenue	6	THOM-19-1-030	THOM-19-1-020	0.0	32	0.6	414	15	0.743%	5.6	12.7	11.6	-4.9	-88.5%	10	
Thomas Avenue	6	THOM-19-1-010	THOM-19-1-020	1.0	0	2.0	101	10	0.317%	1.2	4.9	3.7	0.8	63.4%	3	15
(North of) 12 Mile Road	6	ELLW-19-1-040	THOM-19-1-020	7.9	53	10.8	278	18	0.430%	6.9	15.0	8.7	3.9	57.4%	3	24
(North of) 12 Mile Road	6	THOM-19-1-020	CUMM-19-1-020	13.4	99	13.3	282	18	0.395%	6.6	14.9	10.5	6.7	101.3%	1	24
Cummings Avenue	6	CUMM-19-1-010	CUMM-19-1-020	1.2	0	3.2	100	10	1.586%	2.8	6.7	5.5	0.4	14.4%	6	
Cummings Avenue	6	CUMM-19-1-020	CUMM-19-1-030	13.9	88	14.9	262	30	0.236%	19.9	14.9	13.3	-5.0	-25.2%	10	
Cummings Avenue	6	CUMM-19-1-030	CUMM-19-1-040	16.2	100	16.9	298	30	0.113%	13.8	16.1	14.3	3.1	22.4%	5	33
Cummings Avenue	6	CUMM-19-1-040	CUMM-20-1-010	16.2	110	16.3	279	30	0.175%	17.1	17.2	15.4	-0.8	-4.6%	10	
Edwards Avenue	6	CUMM-20-1-010	PRAI-20-1-010	39.9	229	33.3	280	36	0.502%	47.3	17.6	15.2	-13.9	-29.5%	10	
Edwards Avenue	6	PRAI-20-1-010	BACO-20-1-010	46.0	274	38.2	286	36	0.363%	40.2	19.5	17.1	-2.0	-5.1%	10	
Edwards Avenue	6	BACO-20-1-010	PHIL-20-1-010	55.9	331	44.2	280	36	0.402%	42.3	18.5	16.0	1.9	4.6%	9	
Edwards Avenue	6	PHIL-20-1-010	OAKS-20-1-010	61.3	368	44.7	272	36	0.546%	49.3	18.7	16.2	-4.6	-9.4%	10	
Prairie Avenue	6	PRAI-20-1-010	PRAI-19-1-030	0.0	17	0.3	426	15	0.294%	3.5	11.5	4.6	-3.2	-90.3%	10	
Prairie Avenue	6	PRAI-19-1-030	PRAI-19-1-020	2.6	33	2.8	411	15	0.732%	5.5	11.9	3.8	-2.7	-49.3%	10	
Prairie Avenue	6	PRAI-19-1-010	PRAI-19-1-020	0.6	0	1.3	102	10	0.626%	1.7	6.7	4.1	-0.4	-25.7%	10	

Appendix C
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Bacon Avenue	6	BACO-20-1-010	BACO-19-1-030	0.0	20	0.4	412	15	0.193%	2.8	11.6	5.1	-2.4	-85.9%	10	
Bacon Avenue	6	BACO-19-1-030	BACO-19-1-020	1.4	34	2.3	420	15	0.512%	4.6	11.2	3.8	-2.3	-49.4%	10	
Bacon Avenue	6	BACO-19-1-010	BACO-19-1-020	0.3	0	0.8	108	10	0.661%	1.8	13.4	5.3	-1.0	-55.1%	10	
Phillips Avenue	6	PHIL-20-1-010	PHIL-19-1-050	0.0	17	0.3	427	15	0.404%	4.1	10.0	9.0	-3.8	-91.7%	10	
Phillips Avenue	6	PHIL-19-1-050	PHIL-19-1-040	2.5	34	3.8	412	15	0.750%	5.6	9.7	8.7	-1.8	-32.5%	10	
Phillips Avenue	6	PHIL-19-1-010	PHIL-19-1-040	0.3	0	0.7	103	10	1.080%	2.3	5.0	4.3	-1.6	-71.3%	10	
(North of) 12 Mile Road	6	CUMM-19-1-020	PRAI-19-1-020	3.5	31	4.0	280	18	0.362%	6.3	14.1	13.2	-2.3	-36.5%	10	
(North of) 12 Mile Road	6	PRAI-19-1-020	BACO-19-1-020	8.4	79	9.7	271	18	0.451%	7.1	15.1	4.3	2.6	37.2%	4	21
(North of) 12 Mile Road	6	BACO-19-1-020	PHIL-19-1-040	13.9	127	17.6	280	18	0.247%	5.2	15.4	5.5	12.4	237.2%	0	30
(North of) 12 Mile Road	6	PHIL-19-1-040	PHIL-19-1-030	18.8	161	23.6	37	30	0.054%	9.5	15.4	11.9	14.1	147.7%	0	48
(North of) 12 Mile Road	6	PHIL-19-1-030	PHIL-19-1-020	18.8	161	23.6	55	30	0.054%	9.5	12.7	9.3	14.0	147.1%	0	48
(North of) 12 Mile Road	6	PHIL-19-1-020	OAKS-19-1-010	18.8	170	23.4	168	30	0.054%	9.5	13.0	9.7	13.8	145.1%	1	42
(North of) 12 Mile Road	6	OAKS-19-1-010	OAKS-19-1-020	19.3	170	23.8	54	30	0.054%	9.5	12.2	9.3	14.3	149.9%	0	48
(North of) 12 Mile Road	6	OAKS-19-1-020	OAKS-19-1-030	19.3	170	23.7	23	24	2.357%	34.7	12.4	9.7	-11.1	-31.9%	10	
(North of) 12 Mile Road	6	OAKS-19-1-030	OAKS-19-1-040	20.0	170	25.0	39	24	1.149%	24.3	12.3	9.6	0.7	2.9%	9	
Oakshire Avenue	6	OAKS-19-1-040	OAKS-19-1-050	10.1	82	11.1	282	24	0.011%	2.3	12.1	9.0	8.8	372.9%	0	48
Oakshire Avenue	6	OAKS-19-1-050	OAKS-19-1-060	10.1	95	14.5	276	24	0.267%	11.7	14.9	11.8	2.8	24.0%	4	27
Oakshire Avenue	6	OAKS-19-1-060	OAKS-20-1-010	12.0	107	17.3	280	24	0.267%	11.7	16.4	13.7	5.6	47.9%	3	30
Edwards Avenue	6	OAKS-20-1-010	ROYA-20-1-010	78.7	513	60.7	269	42	0.610%	78.6	19.1	16.3	-17.9	-22.8%	10	
Edwards Avenue	6	ROYA-20-1-010	BUCK-20-1-010	84.0	552	64.5	285	42	0.562%	75.4	19.6	16.8	-10.9	-14.4%	10	
Edwards Avenue	6	BUCK-20-1-010	TYLE-20-1-010	89.6	589	67.5	271	42	0.597%	77.7	19.5	16.7	-10.2	-13.1%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Tyler Avenue	6	TYLE-19-1-040	TYLE-20-1-010	0.0	20	0.4	417	15	0.336%	3.7	7.9	6.9	-3.3	-89.3%	10	
Edwards Avenue	6	TYLE-20-1-010	GARD-20-1-010	95.0	643	70.3	271	42	0.522%	72.7	21.3	18.5	-2.4	-3.3%	10	
Edwards Avenue	6	GARD-20-1-010	GRIF-20-1-010	100.6	682	75.2	305	42	0.685%	83.3	21.4	18.6	-8.1	-9.7%	10	
Edwards Avenue (outlet to Robina 60")	6	GRIF-20-1-010	24752	105.8	711	77.7	321	42	0.554%	74.9	21.3	18.5	2.8	3.7%	9	
12 MILE LATERAL (WEST) - 44																
Griffith Avenue	7	GRIF-20-1-010	GRIF-19-1-040	0.0	16	0.3	394	15	0.207%	2.9	10.1	5.0	-2.6	-89.1%	10	
Griffith Avenue	7	GRIF-19-1-040	GRIF-19-1-020	1.9	29	2.8	395	15	0.217%	3.0	10.1	4.2	-0.2	-7.0%	10	
Griffith Avenue	7	GRIF-19-1-030	GRIF-19-1-020	0.0	20	0.4	142	10	0.963%	2.1	10.4	5.6	-1.7	-81.4%	10	
12 Mile Road	7	TWEL-13-1-010	GRIF-19-1-010	0.2	0	0.5	119	8	1.275%	1.4	3.4	0.0	-0.9	-63.4%	10	
12 Mile Road	7	GRIF-19-1-010	GRIF-19-1-020	1.8	0	4.6	139	10	0.420%	1.4	6.3	0.0	3.2	224.3%	0	18
Griffith Avenue (outlet to Robina 66")	7	GRIF-19-1-020	24753	7.0	80	9.7	315	15	0.342%	3.8	11.8	4.8	5.9	156.5%	0	24
ROBINA INLET (12 MILE) - 40																
Robina Avenue	8	ROBI-20-1-010	ROBI-19-1-070	10.6	57	3.9	409	15	0.305%	3.6	9.3	7.3	0.3	8.7%	8	
Robina Avenue	8	ROBI-19-1-070	ROBI-19-1-060	14.0	68	5.2	276	15	0.534%	4.7	11.3	9.5	0.5	10.7%	7	
Robina Avenue	8	ROBI-19-1-060	ROBI-19-1-040	16.6	68	5.9	72	15	0.060%	1.6	12.9	11.4	4.3	269.7%	0	27
Kipling Avenue	8	KIPL-20-1-010	KIPL-19-1-040	0.0	11	0.2	391	12	0.322%	2.0	11.1	10.3	-1.8	-89.1%	10	
Kipling Avenue	8	KIPL-19-1-040	KIPL-19-1-030	0.0	24	0.5	392	12	0.400%	2.3	10.9	10.1	-1.8	-78.7%	10	
12 Mile Road	8	KIPL-19-1-010	KIPL-19-1-030	3.2	0	1.0	140	12	1.480%	4.3	5.2	4.4	-3.3	-76.9%	10	

Appendix C
Combined Sewer Area Study
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Wakefield Avenue	8	WAKE-20-1-010	WAKE-19-1-060	0.0	13	0.3	392	15	0.273%	3.4	12.6	11.6	-3.1	-92.3%	10	
Wakefield Avenue	8	WAKE-19-1-060	WAKE-19-1-050	3.1	22	1.0	314	15	0.156%	2.5	11.2	10.2	-1.5	-60.8%	10	
Wakefield Avenue	8	WAKE-19-1-050	WAKE-19-1-030	4.5	23	3.1	75	15	0.930%	6.2	11.6	10.6	-3.1	-50.1%	10	
12 Mile Road	8	WAKE-19-1-020	WAKE-19-1-010	0.9	0	2.4	44	10	3.879%	4.3	3.9	3.2	-1.9	-43.5%	10	
Wakefield Avenue	8	WAKE-19-1-010	WAKE-19-1-030	0.9	0	2.4	141	10	1.154%	2.4	5.6	4.8	0.1	3.3%	9	
12 Mile Road	8	ROBI-19-1-020	ROBI-19-1-010	0.0	0	0.0	67	12	0.345%	2.1	6.1	5.3	-2.1	-100.0%	10	
Robina Avenue	8	ROBI-19-1-010	ROBI-19-1-030	0.2	0	0.5	141	12	2.030%	5.1	6.1	5.3	-4.6	-90.2%	10	
12 Mile Road	8	KIPL-19-1-030	WAKE-19-1-030	3.9	32	1.4	288	24	0.360%	13.6	13.4	11.8	-12.2	-89.9%	10	
12 Mile Road	8	WAKE-19-1-030	WAKE-19-1-040	9.3	55	6.6	140	24	0.157%	9.0	16.8	14.9	-2.4	-26.3%	10	
12 Mile Road	8	ROBI-19-1-030	WAKE-19-1-040	0.2	13.00	0.5	180	18	2.319%	16.0	13.1	11.9	-15.5	-97.0%	10	
12 Mile Road	8	WAKE-19-1-040	ROBI-19-1-050	9.5	68	6.9	34	24	0.149%	8.7	18.9	16.8	-1.8	-20.9%	10	
12 Mile Road	8	ROBI-19-1-050	ROBI-19-1-040	9.5	68	6.9	157	24	0.051%	5.1	19.2	17.1	1.8	34.6%	4	27
12 Mile Road (outlet to Robina 66")	8	ROBI-19-1-040	24753	27.1	136	13.0	33	30	3.094%	72.1	19.5	17.5	-59.1	-82.0%	10	
BEVERLY LATERAL (WEST) - 34																
Royal Avenue	9	ROYA-20-1-010	ROYA-19-1-010	0.0	19	0.4	431	15	0.358%	3.9	9.3	8.3	-3.5	-90.2%	10	
Royal Avenue	9	ROYA-19-1-010	TWEL-09-1-020	1.1	40	2.1	412	15	0.975%	6.4	11.3	10.3	-4.3	-67.0%	10	
Royal Avenue	9	TWEL-09-1-010	TWEL-09-1-020	0.3	0	0.8	99	10	1.467%	2.7	4.4	3.8	-1.9	-71.6%	10	
Buckingham Avenue	9	BUCK-20-1-010	BUCK-19-1-040	0.0	17	0.3	416	15	0.323%	3.7	9.4	8.4	-3.3	-90.7%	10	
Buckingham Avenue	9	BUCK-19-1-040	BUCK-19-1-020	1.6	29	2.8	424	15	0.770%	5.7	9.3	8.3	-2.9	-50.9%	10	
12 Mile Road	9	BUCK-19-1-010	BUCK-19-1-020	1.7	0	1.6	102	10	1.507%	2.7	5.2	4.5	-1.1	-41.1%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Tyler Avenue	9	TYLE-19-1-040	TYLE-19-1-020	3.2	15	1.0	420	15	0.297%	3.5	10.4	9.4	-2.5	-71.6%	10	
12 Mile Road	9	BUCK-19-1-010	TYLE-19-1-010	1.9	0	1.7	270	10	0.988%	2.2	4.7	4.0	-0.5	-21.2%	10	
	9	TYLE-19-1-010	TYLE-19-1-020	2.2	0	2.4	102	12	0.915%	3.4	6.5	5.7	-1.0	-29.5%	10	
Gardner Avenue	9	GARD-20-1-010	GARD-19-1-040	0.0	16	0.3	411	15	0.296%	3.5	9.7	8.7	-3.2	-90.9%	10	
Gardner Avenue	9	GARD-19-1-040	GARD-19-1-030	1.8	28	2.6	305	15	0.184%	2.8	10.5	9.5	-0.2	-6.6%	10	
Gardner Avenue	9	GARD-19-1-030	GARD-19-1-020	3.1	35	4.6	108	15	2.023%	9.2	9.8	8.8	-4.5	-49.5%	10	
Twelve Mile Road	9	OAKS-19-1-040	TWEL-09-1-020	14.5	104	16.0	272	24	0.263%	11.6	11.9	9.3	4.4	37.7%	4	30
Twelve Mile Road	9	TWEL-09-1-020	BUCK-19-1-030	17.6	159	20.8	184	30	0.349%	24.2	14.8	12.6	-3.4	-14.2%	10	
Buckingham Avenue	9	BUCK-19-1-030	BUCK-19-1-020	17.6	159	20.5	102	30	0.197%	18.2	15.0	12.5	2.3	12.9%	6	
Twelve Mile Road	9	BUCK-19-1-020	TYLE-19-1-020	20.9	205	23.6	268	36	0.433%	43.9	12.9	10.5	-20.3	-46.2%	10	
Twelve Mile Road	9	TYLE-19-1-020	GARD-19-1-020	29.2	227	29.7	272	36	0.267%	34.4	11.9	9.5	-4.7	-13.7%	10	
Gardner Avenue	9	GARD-19-1-020	GARD-19-1-010	33.7	262	34.6	118	36	0.303%	36.7	13.2	10.8	-2.2	-5.9%	10	
Twelve Mile Road	9	GARD-19-1-010	TWEL-12-1-010	34.0	266	34.9	96	36	0.503%	47.3	14.3	11.9	-12.4	-26.2%	10	
Gardner Avenue	9	TWEL-12-1-010	GARD-17-1-020	34.0	272	34.8	345	36	0.655%	54.0	14.6	12.2	-19.2	-35.6%	10	
Gardner Avenue	9	GARD-17-1-020	GARD-17-1-010	34.3	283	34.6	322	36	0.639%	53.3	13.3	10.9	-18.8	-35.2%	10	
Twelve Mile Road	9	GREE-17-1-040	ELLW-17-1-030	0.0	15	0.3	260	12	0.363%	2.1	10.3	8.6	-1.8	-86.0%	10	
Ellwood Avenue	9	ELLW-17-1-050	ELLW-17-1-030	0.5	0	1.1	117	12	0.738%	3.1	6.3	5.5	-2.0	-65.0%	10	
Ellwood Avenue	9	ELLW-17-1-030	ELLW-17-1-020	1.3	25	3.1	253	12	0.461%	2.4	10.1	7.5	0.7	27.9%	4	15
Ellwood Avenue	9	ELLW-17-1-020	ELLW-17-1-010	1.3	37	3.0	257	12	0.271%	1.9	9.9	8.1	1.2	62.1%	3	15
Twelve Mile Road	9	ELLW-17-1-040	THOM-17-1-030	0.0	10	0.2	297	15	0.627%	5.1	10.9	9.9	-4.9	-96.3%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Thomas Avenue	9	THOM-17-1-050	THOM-17-1-030	0.2	0	0.5	125	10	1.111%	2.3	5.2	4.5	-1.8	-76.9%	10	
Thomas Avenue	9	THOM-17-1-030	THOM-17-1-020	0.3	20	0.9	263	12	0.424%	2.3	10.1	9.3	-1.4	-62.4%	10	
Thomas Avenue	9	THOM-17-1-020	THOM-17-1-010	0.3	28	0.8	246	12	0.362%	2.1	10.1	9.3	-1.3	-61.1%	10	
Twelve Mile Road	9	THOM-17-1-040	CUMM-17-1-030	0.0	18	0.4	289	12	0.769%	3.1	10.6	9.8	-2.8	-88.5%	10	
Cummings Avenue	9	CUMM-17-1-060	CUMM-17-1-030	0.1	0	0.4	125	10	1.161%	2.4	6.3	5.6	-2.0	-83.5%	10	
Cummings Avenue	9	CUMM-17-1-030	CUMM-17-1-020	1.3	29	2.6	255	12	0.487%	2.5	9.8	8.8	0.1	5.7%	9	
Cummings Avenue	9	CUMM-17-1-020	CUMM-17-1-010	1.3	39	2.6	254	12	0.331%	2.1	10.5	9.6	0.5	24.6%	5	15
Twelve Mile Road	9	CUMM-17-1-040	BACO-17-1-050	0.1	13	0.4	299	12	0.386%	2.2	9.7	8.5	-1.9	-83.7%	10	
Bacon Avenue	9	BACO-17-1-060	BACO-17-1-050	1.0	0	2.3	127	10	1.272%	2.5	6.5	5.8	-0.2	-6.9%	10	
Bacon Avenue	9	BACO-17-1-050	BACO-17-1-040	1.1	20	2.5	255	12	0.468%	2.4	10.1	7.9	0.1	3.4%	9	
Bacon Avenue	9	BACO-17-1-040	BACO-17-1-020	3.1	49	3.4	255	12	0.362%	2.1	9.7	7.5	1.2	57.4%	3	15
Beverly Boulevard	9	BEVE-04-1-010	BACO-17-1-030	1.3	46	1.0	83	10	1.087%	2.3	6.8	5.6	-1.3	-56.2%	10	
Beverly Boulevard	9	BACO-17-1-030	BACO-17-1-020	1.3	46	1.0	25	12	10.916%	11.8	6.8	6.0	-10.8	-91.6%	10	
Twelve Mile Road	9	BACO-17-1-070	PHIL-17-1-040	0.0	13	0.3	290	12	0.521%	2.6	10.0	9.2	-2.3	-89.9%	10	
Phillips Avenue	9	PHIL-17-1-040	PHIL-17-1-030	0.9	20	2.3	313	12	0.801%	3.2	9.0	8.2	-0.9	-27.9%	10	
Phillips Avenue	9	PHIL-17-1-030	PHIL-17-1-010	2.1	26	3.2	323	12	1.259%	4.0	8.9	8.1	-0.8	-20.6%	10	
Twelve Mile Road	9	PHIL-17-1-050	OAKS-17-1-040	0.0	7	0.1	281	12	0.043%	0.7	11.5	0.3	-0.6	-82.4%	10	
Twelve Mile Road	9	TWEL-08-1-020	OAKS-17-1-040	0.0	9	0.2	253	12	0.769%	3.1	9.0	0.0	-3.0	-94.6%	10	
Oakshire Avenue	9	OAKS-17-1-040	OAKS-17-1-030	2.0	22	5.4	313	12	0.559%	2.7	11.6	0.2	2.7	101.1%	2	18

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Oakshire Avenue	9	OAKS-17-1-030	OAKS-17-1-010	2.0	35	5.2	322	12	0.478%	2.5	12.4	6.3	2.7	110.1%	1	18
Twelve Mile Road	9	TWEL-08-1-020	ROYA-17-1-050	0.0	0	0.0	79	8	2.455%	1.9	4.1	3.6	-1.9	-100.0%	10	
Royal Avenue	9	ROYA-17-1-050	ROYA-17-1-040	0.0	0	0.0	73	12	0.905%	3.4	10.8	10.0	-3.4	-100.0%	10	
Royal Avenue	9	ROYA-17-1-040	ROYA-17-1-030	0.1	7	0.2	247	12	0.870%	3.3	11.3	10.5	-3.2	-95.5%	10	
Royal Avenue	9	ROYA-17-1-030	ROYA-17-1-010	2.4	23	1.1	312	12	0.898%	3.4	10.2	9.4	-2.3	-67.4%	10	
Twelve Mile Road	9	TWEL-09-1-030	BUCK-17-1-050	0.0	7	0.1	271	12	0.739%	3.1	9.7	8.9	-2.9	-95.6%	10	
Buckingham Avenue	9	BUCK-17-1-050	BUCK-17-1-040	1.1	14	2.9	318	12	0.875%	3.3	9.9	9.1	-0.4	-13.0%	10	
Buckingham Avenue	9	BUCK-17-1-040	BUCK-17-1-030	1.1	23	2.8	312	12	0.985%	3.5	11.2	10.4	-0.7	-20.5%	10	
Beverly Boulevard	9	OAKS-17-1-020	ROYA-17-1-020	0.0	0	0.0	335	12	0.368%	2.2	7.6	6.8	-2.2	-100.0%	10	
Beverly Boulevard	9	ROYA-17-1-020	BUCK-17-1-020	0.0	0	0.0	326	12	0.230%	1.7	7.1	6.3	-1.7	-100.0%	10	
Beverly Boulevard	9	BUCK-17-1-020	BUCK-17-1-010	0.0	0	0.0	19	12	0.527%	2.6	5.6	4.8	-2.6	-100.0%	10	
Beverly Boulevard	9	BUCK-17-1-010	BUCK-17-1-030	0.0	0	0.0	23	12	0.930%	3.4	10.9	10.1	-3.4	-100.0%	10	
Twelve Mile Road	9	BUCK-17-1-060	TYLE-17-1-030	0.0	12	0.2	257	12	0.321%	2.0	12.3	6.7	-1.8	-87.8%	10	
Twelve Mile Road	9	TWEL-11-1-010	TYLE-17-1-030	0.0	0	0.0	82	12	0.346%	2.1	6.5	5.3	-2.1	-100.0%	10	
Twelve Mile Road	9	GARD-17-1-050	TWEL-11-1-020	0.1	22	0.4	119	12	0.392%	2.2	10.0	5.4	-1.9	-83.2%	10	
Twelve Mile Road	9	TWEL-11-1-020	TYLE-17-1-040	0.2	22	0.6	113	12	0.475%	2.5	10.5	5.5	-1.9	-75.5%	10	
Twelve Mile Road	9	TYLE-17-1-040	TYLE-17-1-030	0.2	22	0.6	23	12	1.266%	4.0	11.0	5.4	-3.4	-85.3%	10	
Tyler Avenue	9	TYLE-17-1-030	TYLE-17-1-020	1.2	38	3.2	327	12	0.716%	3.0	11.8	5.4	0.2	5.6%	9	
Tyler Avenue	9	TYLE-17-1-020	TYLE-17-1-010	5.1	51	5.7	308	12	0.713%	3.0	11.0	4.6	2.7	89.0%	2	18
Twelve Mile Road	9	GARD-17-1-030	GRIF-17-1-030	0.2	18	0.5	252	12	0.541%	2.6	10.0	9.2	-2.1	-81.1%	10	
Griffith Avenue	9	GRIF-17-1-040	GRIF-17-1-030	0.1	22	0.2	115	12	1.285%	4.0	11.0	10.2	-3.8	-93.9%	10	
Griffith Avenue	9	GRIF-17-1-030	GRIF-17-1-020	0.8	44	1.9	202	12	0.381%	2.2	12.0	11.2	-0.3	-15.7%	10	

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Griffith Avenue	9	GRIF-17-1-020	GRIF-17-1-010	0.9	56	2.0	323	12	0.454%	2.4	12.7	11.9	-0.4	-18.1%	10	
Beverly Boulevard	9	ELLW-17-1-010	THOM-17-1-010	4.1	27	4.3	323	15	0.717%	5.5	10.1	8.9	-1.2	-21.1%	10	
Beverly Boulevard	9	THOM-17-1-010	CUMM-17-1-010	3.2	20	2.7	313	21	0.455%	10.7	11.6	10.2	-8.0	-74.4%	10	
Beverly Boulevard	9	CUMM-17-1-010	BACO-17-1-020	4.9	39	6.7	321	21	1.157%	17.0	11.7	10.3	-10.3	-60.7%	10	
Beverly Boulevard	9	BACO-17-1-020	PHIL-17-1-010	6.0	95	6.2	317	27	0.812%	27.9	14.2	12.4	-21.7	-77.6%	10	
Beverly Boulevard	9	PHIL-17-1-010	OAKS-17-1-010	5.3	26	6.2	311	27	0.134%	11.3	15.6	13.8	-5.2	-45.5%	10	
Beverly Boulevard	9	OAKS-17-1-010	ROYA-17-1-010	6.8	35	7.6	331	27	0.883%	29.1	14.0	12.2	-21.5	-73.9%	10	
Beverly Boulevard	9	ROYA-17-1-010	BUCK-17-1-030	4.9	23	1.9	333	30	0.892%	38.7	15.8	13.8	-36.8	-95.0%	10	
Beverly Boulevard	9	BUCK-17-1-030	TYLE-17-1-010	10.2	45	10.7	282	30	0.162%	16.5	16.2	14.2	-5.8	-35.4%	10	
Beverly Boulevard	9	TYLE-17-1-010	GARD-17-1-010	15.3	96	15.3	290	30	1.697%	53.4	20.0	18.0	-38.1	-71.3%	10	
Beverly Boulevard	9	GARD-17-1-010	GRIF-17-1-010	54.1	379	49.5	283	36	0.529%	48.5	22.5	19.6	1.0	2.0%	9	
Beverly Boulevard (outlet to Robina 84")	9	GRIF-17-1-010	25779	57.3	435	51.1	272	42	0.202%	45.2	24.0	21.2	5.8	12.9%	7	
BEVERLY LATERAL (EAST) - 33																
Coolidge Highway	10	COOL-21-1-030	COOL-21-1-015	0.9	0	1.1	305	15	0.519%	4.7	7.1	3.6	-3.6	-76.8%	10	
Coolidge Highway	10	COOL-21-1-015	COOL-20-1-070	2.3	0	2.9	300	15	1.350%	7.5	6.9	1.8	-4.6	-61.7%	10	
Coolidge Highway	10	COOL-20-1-070	COOL-20-1-050	2.9	0	3.6	298	15	0.354%	3.8	8.8	0.2	-0.2	-5.2%	10	
Coolidge Highway	10	COOL-20-1-050	COOL-20-1-030	4.9	0	5.7	301	15	0.253%	3.2	8.9	0.0	2.4	74.0%	2	21
Coolidge Highway	10	COOL-20-1-030	COOL-20-1-010	7.0	0	7.7	300	15	0.389%	4.0	8.5	0.0	3.7	90.7%	2	21
Coolidge Highway	10	COOL-20-1-010	COOL-19-1-050	7.4	0	8.0	400	15	0.373%	3.9	7.8	0.0	4.0	102.2%	1	21

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	10	COOL-19-1-050	COOL-19-1-025	8.1	0	8.5	375	15	1.183%	7.0	8.5	1.0	1.4	20.5%	5	18
	10	~~COOL-21-1-040~~	~~COOL-21-1-020~~	~~0.7~~	~~2~~	0.0	~~351~~	~~10~~	~~#VALUE!~~	~~#VALUE!~~	~~11.0~~	~~#VALUE!~~	~~#VALUE!~~	~~#VALUE!~~	10	
Coolidge Highway	10	COOL-21-1-020	COOL-21-1-010	0.0	0	0.0	350	10	1.772%	2.9	7.7	7.0	-2.9	-100.0%	10	
Twelve Mile Road	10	KENM-21-1-010	COOL-21-1-010	0.0	0	0.0	249	12	0.610%	2.8	11.9	8.5	-2.8	-100.0%	10	
Coolidge Highway	10	COOL-21-1-010	COOL-20-1-060	1.9	0	2.1	324	12	0.426%	2.3	10.9	5.7	-0.2	-9.4%	10	
Coolidge Highway	10	COOL-20-1-060	COOL-20-1-040	1.9	0	2.0	320	12	0.315%	2.0	10.6	5.0	0.0	1.0%	10	
Coolidge Highway	10	COOL-20-1-040	COOL-20-1-020	1.9	0	1.9	324	12	0.315%	2.0	10.7	5.1	-0.1	-3.3%	10	
Coolidge Highway	10	COOL-20-1-020	COOL-19-1-070	3.5	0	3.6	391	15	0.235%	3.1	11.1	5.1	0.4	13.8%	7	
Coolidge Highway	10	COOL-19-1-070	COOL-19-1-040	4.4	0	4.2	390	15	0.143%	2.4	10.6	4.8	1.8	72.3%	2	21
Coolidge Highway	10	COOL-19-1-060	COOL-19-1-030	0.0	0	0.0	375	18	1.121%	11.1	5.8	4.6	-11.1	-100.0%	10	
Cumberland Road	10	CUMB-20-1-010	CUMB-19-1-030	0.0	13	0.3	394	15	0.081%	1.8	9.8	8.6	-1.6	-85.8%	10	
Cumberland Road	10	CUMB-19-1-030	CUMB-19-1-020	0.0	26	0.5	390	15	0.341%	3.8	11.0	9.5	-3.3	-86.2%	10	
Cumberland Road	10	CUMB-19-1-040	CUMB-19-1-010	0.7	0	0.5	47	10	0.350%	1.3	4.6	3.9	-0.8	-61.4%	10	
Cumberland Road	10	CUMB-19-1-010	CUMB-19-1-020	0.7	0	0.5	141	10	2.068%	3.2	5.6	4.9	-2.7	-84.3%	10	
Kenmore Road	10	KENM-20-1-010	KENM-19-1-040	1.7	19	0.7	382	18	0.210%	4.8	11.5	11.1	-4.1	-84.7%	10	
Kenmore Road	10	KENM-19-1-040	KENM-19-1-030	5.0	30	2.0	399	18	0.329%	6.0	10.9	8.9	-4.0	-66.9%	10	
Kenmore Road	10	KENM-19-1-020	KENM-19-1-010	0.5	0	0.5	45	10	0.331%	1.3	4.4	3.7	-0.8	-60.3%	10	
Kenmore Road	10	KENM-19-1-010	KENM-19-1-030	0.5	0	0.5	141	10	2.102%	3.2	5.1	4.4	-2.7	-84.4%	10	
Twelve Mile Road	10	KIPL-19-1-030	CUMB-19-1-020	1.7	19	0.9	288	24	0.793%	20.1	12.7	11.1	-19.3	-95.6%	10	
Twelve Mile Road	10	CUMB-19-1-020	KENM-19-1-030	7.4	51	6.8	288	24	0.633%	18.0	13.3	10.4	-11.2	-62.4%	10	
Twelve Mile Road	10	KENM-19-1-030	COOL-19-1-040	15.0	89	11.8	247	24	0.612%	17.7	13.4	9.0	-5.9	-33.3%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	10	COOL-19-1-040	COOL-19-1-030	20.2	89	15.0	41	24	0.929%	21.8	13.2	7.9	-6.8	-31.0%	10	
Coolidge Highway	10	COOL-19-1-030	COOL-19-1-025	22.5	89	18.2	18	24	0.784%	20.0	13.4	7.9	-1.8	-9.2%	10	
Coolidge Highway	10	COOL-19-1-025	COOL-19-1-015	31.1	98	26.9	183	30	0.074%	11.1	13.5	7.9	15.8	142.0%	1	42
Coolidge Highway	10	COOL-19-1-015	COOL-18-1-025	31.1	101	26.3	144	30	0.291%	22.1	14.9	9.8	4.2	18.9%	5	33
Coolidge Highway	10	COOL-18-1-025	COOL-18-1-015	31.1	131	26.1	156	30	0.183%	17.5	14.1	9.2	8.5	48.6%	3	36
Coolidge Highway	10	COOL-18-1-015	COOL-17-1-025	35.0	139	32.7	178	30	0.024%	6.4	14.6	10.0	26.4	413.5%	0	60
Coolidge Highway	10	COOL-17-1-025	COOL-17-1-015	35.5	162	33.0	165	30	0.224%	19.4	16.6	13.1	13.6	70.2%	2	42
Coolidge Highway	10	COOL-16-1-015	COOL-17-1-015	0.2	13	0.5	330	10	2.019%	3.1	8.9	8.2	-2.6	-84.4%	10	
Coolidge Highway	10	COOL-16-1-010	COOL-17-1-010	0.0	22	0.4	328	12	1.555%	4.4	9.1	8.3	-4.0	-90.3%	10	
Twelve Mile Road	10	CUMB-17-1-050	KENM-17-1-030	0.0	10	0.2	263	12	0.353%	2.1	10.3	9.5	-1.9	-90.8%	10	
Kenmore Road	10	KENM-17-1-030	KENM-17-1-020	0.4	22	0.5	331	12	0.230%	1.7	10.3	8.8	-1.2	-72.1%	10	
Kenmore Road	10	KENM-17-1-020	KENM-17-1-010	3.6	34	3.4	321	12	0.453%	2.4	9.5	7.2	1.0	42.7%	4	15
Kenmore Road	10	KENM-14-1-020	KENM-14-1-030	0.0	14	0.3	327	12	0.514%	2.6	8.8	8.0	-2.3	-89.0%	10	
Kenmore Road	10	KENM-14-1-030	KENM-17-1-010	0.0	20	0.4	340	18	0.779%	9.3	11.1	9.9	-8.9	-95.7%	10	
Twelve Mile Road	10	WAKE-17-1-080	KIPL-17-1-050	0.0	9	0.2	265	12	0.498%	2.5	11.3	10.5	-2.3	-92.8%	10	
Twelve Mile Road	10	CUMB-17-1-040	KIPL-17-1-050	0.4	11	0.5	286	10	0.794%	2.0	7.0	6.3	-1.5	-74.4%	10	
Cumberland Road	10	CUMB-17-1-040	CUMB-17-1-030	0.0	0	0.0	137	10	0.647%	1.8	7.4	6.7	-1.8	-100.0%	10	
Kipling Avenue	10	KIPL-17-1-050	KIPL-17-1-040	0.8	20	1.5	93	12	0.468%	2.4	10.6	8.6	-0.9	-36.9%	10	
Kipling Avenue	10	KIPL-17-1-040	KIPL-17-1-030	1.6	22	2.5	47	12	0.177%	1.5	10.3	8.0	1.0	66.4%	2	15
Twelve Mile Road	10	KIPL-17-1-030	CUMB-17-1-030	0.3	3	0.4	287	10	0.659%	1.8	8.9	8.2	-1.4	-77.8%	10	
Cumberland Road	10	CUMB-17-1-030	CUMB-17-1-020	1.0	13	1.9	258	12	0.221%	1.7	9.3	8.0	0.2	11.0%	8	
Cumberland Road	10	CUMB-17-1-020	CUMB-17-1-010	2.6	23	2.7	251	12	0.390%	2.2	9.6	8.4	0.5	20.3%	5	15

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cumberland Road	10	CUMB-14-1-010	CUMB-14-1-020	0.0	12	0.2	329	12	0.252%	1.8	8.9	8.1	-1.5	-86.6%	10	
Cumberland Road	10	CUMB-14-1-020	CUMB-14-1-030	0.5	26	0.9	340	12	0.490%	2.5	9.0	8.2	-1.6	-65.6%	10	
Cumberland Road	10	CUMB-14-1-030	CUMB-17-1-010	2.5	37	1.7	340	12	0.960%	3.5	9.0	8.2	-1.7	-49.9%	10	
Kipling Avenue	10	KIPL-17-1-030	KIPL-17-1-020	1.3	26	2.1	205	12	0.267%	1.8	10.4	9.3	0.2	12.8%	7	
Kipling Avenue	10	KIPL-17-1-020	KIPL-17-1-010	2.3	37	3.0	303	15	0.225%	3.1	10.0	9.0	-0.1	-3.4%	10	
Wakefield Road	10	WAKE-17-1-070	WAKE-17-1-060	0.5	0	0.5	140	12	0.783%	3.2	6.7	5.9	-2.7	-84.1%	10	
Wakefield Road	10	WAKE-17-1-055	WAKE-17-1-060	0.0	18	0.4	178	12	0.350%	2.1	10.4	9.6	-1.8	-83.4%	10	
Wakefield Road	10	WAKE-17-1-060	WAKE-17-1-030	0.5	24	0.5	249	12	0.513%	2.6	8.2	7.4	-2.1	-80.9%	10	
Wakefield Road	10	WAKE-17-1-030	WAKE-17-1-010	1.6	33	3.1	256	12	0.513%	2.6	8.4	7.1	0.5	20.6%	5	15
Coolidge Highway	10	COOL-17-1-015	COOL-17-1-010	10.7	49	10.3	49	36	0.161%	26.7	18.9	16.5	-16.4	-61.3%	10	
Beverly Boulevard	10	COOL-17-1-010	KENM-17-1-010	11.6	70	16.6	251	36	0.253%	33.6	18.7	16.3	-17.0	-50.6%	10	
Beverly Boulevard	10	KENM-17-1-010	CUMB-17-1-010	17.2	125	21.3	287	36	0.257%	33.8	19.9	17.3	-12.5	-36.9%	10	
Beverly Boulevard	10	CUMB-17-1-010	KIPL-17-1-010	27.6	185	28.4	289	42	0.099%	31.6	19.0	16.0	-3.2	-10.2%	10	
Beverly Boulevard	10	KIPL-17-1-010	WAKE-17-1-010	32.4	222	33.2	287	42	0.047%	21.9	19.9	16.8	11.4	52.0%	3	54
Beverly Boulevard (outlet to Robina 84")	10	WAKE-17-1-010	25779	38.9	255	36.2	312	42	-0.079%	28.2	21.6	18.6	8.0	28.2%	4	#NUM!
ROBINA INLET (BEVERLY) - 45																
Robina Avenue	11	TWEL-14-1-010	ROBI-17-1-040	0.0	0	0.0	127	12	0.237%	1.7	8.9	6.6	-1.7	-100.0%	10	
Robina Avenue	11	ROBI-17-1-040	ROBI-17-1-020	0.5	2	1.0	316	12	0.600%	2.8	10.3	7.7	-1.8	-63.8%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Robina Avenue	11	ROBI-17-1-020	ROBI-17-1-010	2.2	14	4.4	336	66	0.688%	278.6	9.7	5.3	-274.2	-98.4%	10	
Robina Avenue (outlet to Robina 84")	11	ROBI-17-1-010	25779	3.5	11	6.0	15	12	6.333%	9.0	11.4	10.6	-3.0	-33.5%	10	
WILTSHIRE LATERAL (WEST) - 32																
Ellwood Avenue	12	ELLW-17-1-010	ELLW-14-1-030	1.5	25	1.6	340	12	0.534%	2.6	9.4	8.6	-1.0	-38.7%	10	
Ellwood Avenue	12	ELLW-14-1-030	ELLW-14-1-020	1.5	40	1.5	336	12	0.456%	2.4	10.3	8.6	-0.9	-37.2%	10	
Ellwood Avenue	12	ELLW-14-1-020	ELLW-14-1-010	4.0	55	3.7	333	12	0.557%	2.7	9.8	7.1	1.1	40.5%	4	15
Thomas Avenue	12	THOM-17-1-010	THOM-14-1-030	1.2	21	1.0	342	12	0.822%	3.2	9.8	9.0	-2.2	-68.6%	10	
Thomas Avenue	12	THOM-14-1-030	THOM-14-1-020	1.2	37	1.0	336	12	0.219%	1.7	10.5	9.7	-0.7	-42.4%	10	
Thomas Avenue	12	THOM-14-1-020	THOM-14-1-010	3.9	52	3.2	323	12	0.718%	3.0	9.0	8.0	0.1	4.8%	9	
Cummings Avenue	12	CUMM-17-1-010	CUMM-14-1-030	0.0	6	0.1	337	12	0.643%	2.9	10.8	10.0	-2.7	-95.8%	10	
Cummings Avenue	12	CUMM-14-1-030	CUMM-14-1-020	0.0	13	0.3	336	12	0.670%	2.9	10.8	10.0	-2.7	-91.1%	10	
Cummings Avenue	12	CUMM-14-1-020	CUMM-14-1-010	2.7	20	1.0	336	12	0.770%	3.1	9.6	8.8	-2.1	-68.0%	10	
Bacon Avenue	12	BACO-17-1-020	BACO-17-1-010	0.0	0	0.0	21	12	1.572%	4.5	9.5	8.7	-4.5	-100.0%	10	
Bacon Avenue	12	BACO-17-1-030	BACO-17-1-010	0.0	0	0.0	12	12	1.923%	4.9	7.9	7.1	-4.9	-100.0%	10	
Bacon Avenue	12	BACO-17-1-010	BACO-14-1-030	0.0	6	0.1	314	12	1.039%	3.6	9.6	8.8	-3.5	-96.7%	10	
Bacon Avenue	12	BACO-14-1-030	BACO-14-1-020	2.4	12	4.6	337	12	0.791%	3.2	9.3	5.3	1.4	45.2%	3	15
Bacon Avenue	12	BACO-14-1-020	BACO-14-1-010	2.8	18	5.3	334	15	1.000%	6.5	10.1	9.1	-1.2	-18.1%	10	
Phillips Avenue	12	PHIL-17-1-010	PHIL-14-1-030	0.0	14	0.3	334	12	0.640%	2.9	10.2	9.4	-2.6	-90.2%	10	
Phillips Avenue	12	PHIL-14-1-030	PHIL-14-1-020	0.0	26	0.5	337	12	0.732%	3.0	9.8	9.0	-2.5	-82.9%	10	
Phillips Avenue	12	PHIL-14-1-020	PHIL-14-1-010	4.1	37	1.0	336	12	1.025%	3.6	9.5	8.7	-2.6	-72.3%	10	
Oakshire Avenue	12	OAKS-17-1-010	OAKS-14-1-030	0.0	13	0.3	333	12	0.875%	3.3	11.6	10.8	-3.1	-92.2%	10	
Oakshire Avenue	12	OAKS-14-1-030	OAKS-14-1-020	1.8	27	2.5	336	12	0.756%	3.1	11.1	10.3	-0.6	-20.6%	10	
Oakshire Avenue	12	OAKS-14-1-020	OAKS-14-1-010	4.5	41	5.1	341	15	0.595%	5.0	10.0	8.9	0.1	1.5%	10	
Royal Avenue	12	ROYA-17-1-010	ROYA-14-1-030	0.0	12	0.2	339	12	0.979%	3.5	11.4	10.6	-3.3	-93.2%	10	

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Royal Avenue	12	ROYA-14-1-030	ROYA-14-1-020	1.8	27	2.5	333	12	0.774%	3.1	9.6	8.8	-0.6	-19.1%	10	
Royal Avenue	12	ROYA-14-1-020	ROYA-14-1-010	5.5	40	3.4	341	12	0.671%	2.9	8.7	7.1	0.5	16.7%	6	
Buckingham Avenue	12	BUCK-17-1-010	BUCK-14-1-030	0.0	14	0.3	315	12	0.925%	3.4	10.8	10.0	-3.1	-91.8%	10	
Buckingham Avenue	12	BUCK-14-1-030	BUCK-14-1-020	1.5	28	2.3	337	15	0.517%	4.6	10.3	9.3	-2.3	-50.2%	10	
Buckingham Avenue	12	BUCK-14-1-020	BUCK-14-1-010	3.7	43	4.8	337	15	0.559%	4.8	10.4	9.4	0.0	-0.3%	10	
Tyler Avenue	12	TYLE-17-1-010	TYLE-14-1-030	0.0	13	0.3	337	12	0.784%	3.2	13.8	13.0	-2.9	-91.8%	10	
Tyler Avenue	12	TYLE-14-1-030	TYLE-14-1-020	0.0	27	0.5	339	15	0.784%	5.7	8.5	7.5	-5.2	-90.6%	10	
Tyler Avenue	12	TYLE-14-1-020	TYLE-14-1-010	3.9	39	1.0	336	15	0.784%	5.7	8.6	7.6	-4.7	-82.5%	10	
Gardner Avenue	12	GARD-17-1-010	GARD-14-1-040	0.0	2	0.0	86	30	0.717%	34.7	15.7	13.7	-34.7	-99.9%	10	
Gardner Avenue	12	GARD-14-1-040	GARD-14-1-030	0.0	17	0.3	379	30	0.812%	37.0	15.5	13.5	-36.6	-99.1%	10	
Gardner Avenue	12	GARD-14-1-030	GARD-14-1-020	2.0	31	2.8	376	42	0.410%	64.4	11.8	9.0	-61.6	-95.7%	10	
Gardner Avenue	12	GARD-14-1-020	GARD-14-1-010	2.0	37	2.6	171	42	0.549%	74.5	11.6	8.8	-71.9	-96.5%	10	
Griffith Avenue	12	GRIF-17-1-010	GRIF-14-1-030	0.0	11	0.2	335	12	0.479%	2.5	12.3	11.5	-2.2	-91.1%	10	
Griffith Avenue	12	GRIF-14-1-030	GRIF-14-1-020	0.0	25	0.5	337	12	0.809%	3.2	10.9	10.1	-2.7	-84.4%	10	
Griffith Avenue	12	GRIF-14-1-020	GRIF-14-1-010	0.0	37	0.7	336	12	0.699%	3.0	8.7	7.9	-2.2	-75.2%	10	
Whiltshire Road	12	ELLW-14-1-010	THOM-14-1-010	7.8	55	7.7	329	15	1.270%	7.3	13.5	11.5	0.4	5.7%	8	
Whiltshire Road	12	THOM-14-1-010	CUMM-14-1-010	8.9	52	4.3	315	24	0.782%	20.0	14.7	13.1	-15.7	-78.7%	10	
Whiltshire Road	12	CUMM-14-1-010	BACO-14-1-010	7.0	20	4.0	322	24	0.842%	20.8	14.9	13.3	-16.7	-80.5%	10	
Whiltshire Road	12	BACO-14-1-010	PHIL-14-1-010	7.4	18	7.8	317	36	0.572%	50.4	15.3	12.9	-42.7	-84.6%	10	
Whiltshire Road	12	PHIL-14-1-010	OAKS-14-1-010	7.2	37	1.9	313	36	0.560%	49.9	15.7	13.3	-48.0	-96.2%	10	
Whiltshire Road	12	OAKS-14-1-010	ROYA-14-1-010	8.0	41	8.0	329	36	0.617%	52.4	13.9	11.5	-44.4	-84.7%	10	
Whiltshire Road	12	ROYA-14-1-010	BUCK-14-1-010	10.4	40	7.3	330	48	0.153%	56.1	12.3	9.1	-48.8	-87.0%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Whiltshire Road	12	BUCK-14-1-010	TYLE-14-1-010	5.5	43	7.2	304	48	0.154%	56.4	13.6	10.4	-49.1	-87.2%	10	
Whiltshire Road	12	TYLE-14-1-010	GARD-14-1-010	7.7	39	4.5	267	48	0.431%	94.3	12.1	8.9	-89.8	-95.2%	10	
Whiltshire Road	12	GARD-14-1-010	GRIF-14-1-010	8.6	37	4.4	280	30	0.470%	28.1	13.3	11.3	-23.8	-84.5%	10	
Wiltshire Road (outlet to Robina 84")	12	GRIF-14-1-010	25780	3.6	37	2.8	273	30	0.323%	23.3	16.0	14.0	-20.5	-88.0%	10	
WILTSHIRE LATERAL (EAST) - 31																
Kenmore Road	13	KENM-14-1-020	KENM-14-1-010	0.0	11	0.2	342	12	1.340%	4.1	9.3	8.5	-3.9	-94.7%	10	
Kipling Avenue	13	KIPL-17-1-010	KIPL-14-1-040	0.0	12	0.2	332	15	0.194%	2.8	10.8	9.8	-2.6	-91.6%	10	
Kipling Avenue	13	KIPL-14-1-040	KIPL-14-1-020	0.0	28	0.6	337	15	0.286%	3.5	10.4	9.4	-2.9	-83.8%	10	
Kipling Avenue	13	KIPL-14-1-020	KIPL-14-1-010	6.3	38	2.8	337	15	0.222%	3.0	9.9	8.9	-0.2	-8.0%	10	
Wakefield Avenue	13	WAKE-17-1-010	WAKE-14-1-030	0.0	12	0.2	337	12	0.382%	2.2	9.6	8.8	-2.0	-89.1%	10	
Wakefield Avenue	13	WAKE-14-1-030	WAKE-14-1-020	0.0	28	0.6	336	12	0.493%	2.5	8.6	7.8	-1.9	-77.6%	10	
Wakefield Avenue	13	WAKE-14-1-020	WAKE-14-1-010	2.7	40	2.8	338	12	0.573%	2.7	9.8	8.9	0.1	3.8%	9	
Coolidge Highway	13	COOL-16-1-015	COOL-15-1-025	0.0	11	0.2	206	10	1.247%	2.4	8.7	8.0	-2.2	-91.4%	10	
Coolidge Highway	13	COOL-15-1-025	COOL-15-1-015	0.4	11	1.1	134	10	1.144%	2.3	9.7	9.0	-1.2	-51.2%	10	
Coolidge Highway	13	COOL-15-1-015	COOL-14-1-015	0.0	7	0.1	328	10	1.886%	3.0	9.0	8.3	-2.9	-95.3%	10	
Coolidge Highway	13	COOL-14-1-015	COOL-14-1-010	0.9	6	2.4	53	30	0.081%	11.7	10.6	8.5	-9.4	-79.9%	10	
Coolidge Highway	13	COOL-16-1-010	COOL-15-1-010	0.0	12	0.2	335	12	1.328%	4.1	10.0	9.2	-3.9	-94.2%	10	
Coolidge Highway	13	COOL-15-1-010	COOL-14-1-010	1.0	23	2.3	349	10	1.446%	2.6	11.1	10.0	-0.3	-12.7%	10	
Coolidge Highway	13	COOL-14-1-010	KENM-14-1-010	3.1	23	7.2	253	24	0.237%	11.0	10.3	8.1	-3.8	-34.3%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Wilshire Road	13	KENM-14-1-010	CUMB-14-1-010	5.2	34	10.0	288	24	0.041%	4.6	16.3	13.9	5.5	119.2%	1	33
Wilshire Road	13	CUMB-14-1-010	KIPL-14-1-010	6.5	34	11.4	286	30	0.664%	33.4	19.4	17.2	-22.0	-65.9%	10	
Wilshire Road	13	KIPL-14-1-010	WAKE-14-1-010	12.7	95	13.3	290	30	0.332%	23.7	19.4	15.6	-10.3	-43.6%	10	
Wilshire Road (outlet to Robina 84")	13	WAKE-14-1-010	25780	18.4	135	45.6	296	30	0.235%	19.9	17.7	13.2	25.7	129.5%	1	42
ROBINA INLET (WILTSHIRE) - 46																
Robina Avenue	14	ROBI-17-1-010	ROBI-14-1-030	1.1	15	1.9	326	12	0.502%	2.5	11.2	10.4	-0.6	-25.4%	10	
Robina Avenue	14	ROBI-14-1-030	ROBI-14-1-020	1.1	28	1.8	331	12	0.502%	2.5	7.1	6.3	-0.7	-28.6%	10	
Robina Avenue	14	ROBI-14-1-020	ROBI-14-1-010	4.8	40	2.5	340	15	0.401%	4.1	10.0	9.0	-1.6	-37.9%	10	
Robina Avenue (outlet to Robina 84")	14	ROBI-14-1-010	25780	8.1	36	6.1	11	15	9.360%	19.8	8.5	8.0	-13.7	-69.1%	10	
CATALPA INLET (NORTH - ELLWOOD)																
Ellwood Avenue	15	ELLW-14-1-010	ELLW-11-1-020	0.0	10	0.2	323	15	0.549%	4.8	9.6	8.6	-4.6	-95.8%	10	
Ellwood Avenue	15	ELLW-11-1-020	ELLW-11-1-010	0.0	21	0.4	316	18	0.527%	7.6	9.7	8.5	-7.2	-94.5%	10	
Ellwood Avenue	15	ELLW-11-1-010	25762	2.6	27	2.0	317	18	0.527%	7.6	9.1	7.9	-5.6	-73.6%	10	
CATALPA INLET (NORTH - THOMAS)																
Thomas Avenue	16	THOM-14-1-010	THOM-11-1-020	0.0	10	0.2	340	15	0.041%	1.3	10.1	9.1	-1.1	-84.7%	10	
Thomas Avenue	16	THOM-11-1-020	THOM-11-1-010	0.0	21	0.4	313	15	0.950%	6.3	8.8	7.8	-5.9	-93.3%	10	
Thomas Avenue	16	THOM-11-1-010	25763	3.0	32	2.8	311	15	0.950%	6.3	10.4	9.4	-3.5	-55.5%	10	
CATALPA INLET (NORTH - CUMMINGS)																

Appendix C
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Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cummings Avenue	17	CUMM-14-1-010	CUMM-11-1-020	0.0	9	0.2	318	15	0.620%	5.1	10.5	9.5	-4.9	-96.5%	10	
Cummings Avenue	17	CUMM-11-1-020	CUMM-11-1-010	1.2	20	1.0	317	15	0.351%	3.8	9.6	8.6	-2.8	-73.9%	10	
Cummings Avenue	17	CUMM-11-1-010	25764	2.0	31	1.9	320	15	0.351%	3.8	10.6	9.6	-1.9	-50.7%	10	
CATALPA INLET (NORTH - BACON)																
Bacon Avenue	18	BACO-14-1-010	BACO-11-1-020	0.0	9	0.2	318	15	0.240%	3.2	10.4	9.4	-3.0	-94.3%	10	
Bacon Avenue	18	BACO-11-1-020	BACO-11-1-010	0.0	20	0.4	319	15	0.271%	3.4	9.4	8.4	-3.0	-88.1%	10	
Bacon Avenue	18	BACO-11-1-010	25765	1.8	31	2.8	321	15	0.271%	3.4	9.7	8.7	-0.6	-16.8%	10	
CATALPA INLET (NORTH - PHILLIPS)																
Phillips Avenue	19	PHIL-14-1-010	PHIL-11-1-020	0.0	11	0.2	328	15	0.364%	3.9	11.1	10.1	-3.7	-94.4%	10	
Phillips Avenue	19	PHIL-11-1-020	PHIL-11-1-010	1.0	22	1.0	315	15	0.192%	2.8	10.8	9.8	-1.8	-64.6%	10	
Phillips Avenue	19	PHIL-11-1-010	25766	2.3	33	1.9	314	15	0.192%	2.8	10.0	9.0	-0.9	-33.2%	10	
CATALPA INLET (NORTH - OAKSHIRE)																
Oakshire Avenue	20	OAKS-14-1-010	OAKS-11-1-030	0.0	12	0.2	324	15	0.174%	2.7	11.0	10.0	-2.5	-91.1%	10	
Oakshire Avenue	20	OAKS-11-1-030	OAKS-11-1-020	1.6	23	2.2	314	15	0.330%	3.7	9.2	8.0	-1.5	-41.3%	10	
Oakshire Avenue	20	OAKS-11-1-020	25767	3.9	34	4.7	317	15	0.212%	3.0	10.1	8.1	1.7	58.3%	3	18
CATALPA INLET (NORTH - ROYAL)																
Royal Avenue	21	ROYA-14-1-010	ROYA-11-1-030	0.0	10	0.2	313	15	0.287%	3.5	9.4	7.5	-3.3	-94.2%	10	
Royal Avenue	21	ROYA-11-1-030	ROYA-11-1-010	1.4	21	2.0	321	15	0.226%	3.1	8.8	6.0	-1.1	-35.3%	10	
Royal Avenue	21	ROYA-11-1-010	25769	5.9	32	6.2	319	15	0.226%	3.1	10.3	7.1	3.1	102.4%	2	21
CATALPA INLET (NORTH - BUCKINGHAM)																
Buckingham Avenue	22	BUCK-14-1-010	BUCK-11-1-020	0.0	9	0.2	326	18	0.215%	4.9	10.3	9.1	-4.7	-96.3%	10	
Buckingham Avenue	22	BUCK-11-1-020	BUCK-11-1-010	1.2	20	1.0	321	18	0.215%	4.9	7.2	6.0	-3.9	-79.5%	10	
Buckingham Avenue	22	BUCK-11-1-010	25770	7.0	31	1.9	320	18	0.215%	4.9	9.0	7.8	-3.0	-61.2%	10	

Appendix C
Combined Sewer Area Study
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
CATALPA INLET (NORTH - TYLER)																
Tyler Avenue	23	TYLE-14-1-010	TYLE-11-1-030	0.0	10	0.2	317	15	0.127%	2.3	8.6	7.6	-2.1	-91.3%	10	
Tyler Avenue	23	TYLE-11-1-030	TYLE-11-1-020	3.2	21	4.6	318	18	0.372%	6.4	8.6	7.4	-1.8	-28.5%	10	
Tyler Avenue	23	TYLE-11-1-020	25768	3.2	32	4.4	335	18	0.372%	6.4	11.0	9.8	-2.0	-31.6%	10	
CATALPA INLET (NORTH - GARDNER)																
Gardner Avenue	24	GARD-14-1-010	GARD-11-1-030	0.0	6	0.1	207	42	0.331%	57.9	12.1	9.3	-57.7	-99.8%	10	
Gardner Avenue	24	GARD-11-1-030	GARD-11-1-020	0.8	17	1.0	377	42	0.292%	54.4	13.6	10.8	-53.4	-98.2%	10	
Gardner Avenue	24	GARD-11-1-020	GARD-11-1-010	2.5	28	3.3	372	42	0.429%	65.9	15.4	12.6	-62.5	-94.9%	10	
Catalpa Avenue	24	TYLE-11-1-010	GARD-11-1-010	0.0	4	0.1	219	12	0.104%	1.1	11.0	10.2	-1.1	-93.0%	10	
Gardner Avenue	24	GARD-11-1-010	25771	6.0	32	4.0	17	42	7.417%	274.0	17.0	14.2	-270.0	-98.5%	10	
CATALPA INLET (NORTH - GRIFFITH)																
Griffith Avenue	25	GRIF-14-1-010	GRIF-11-1-030	0.0	12	0.2	329	12	0.289%	1.9	10.7	9.9	-1.7	-87.5%	10	
Griffith Avenue	25	GRIF-11-1-030	GRIF-11-1-020	2.4	23	2.8	318	15	0.361%	3.9	13.4	12.4	-1.1	-27.8%	10	
Griffith Avenue	25	GRIF-11-1-020	GRIF-11-1-010	3.5	34	4.3	312	15	0.281%	3.4	13.2	11.8	0.9	26.5%	4	18
Catalpa Avenue	25	GARD-11-1-010	GRIF-11-1-010	0.0	4	0.1	282	12	0.464%	2.4	12.4	11.6	-2.3	-96.7%	10	
Griffith Avenue	25	GRIF-11-1-010	25772	5.9	38	5.5	18	15	7.527%	17.7	12.1	11.1	-12.2	-68.7%	10	
CATALPA INLET (NORTH - ROBINA)																
Robina Avenue	26	ROBI-14-1-010	ROBI-11-1-020	0.9	16	0.7	333	15	0.155%	2.5	8.5	8.0	-1.9	-73.4%	10	
Robina Avenue	26	ROBI-11-1-020	ROBI-11-1-010	0.9	27	0.6	318	15	0.162%	2.6	11.0	12.2	-2.0	-75.1%	10	
Robina Avenue	26	ROBI-11-1-010	25773	2.9	38	3.0	328	15	1.818%	8.7	10.9	13.7	-5.7	-65.0%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
CATALPA INLET (NORTH 2 - ROBINA)																
Catalpa Drive	27	GRIF-11-1-010	CATA-13-1-030	0.0	6	0.1	347	12	0.474%	2.5	11.1	10.3	-2.3	-95.1%	10	
Catalpa Drive	27	CATA-13-1-040	CATA-13-1-030	0.0	1	0.0	56	12	0.733%	3.1	11.0	10.2	-3.0	-99.3%	10	
Catalpa Drive	27	CATA-13-1-030	30769	0.0	7	0.1	17	12	0.430%	2.3	12.1	11.3	-2.2	-94.0%	10	
CATALPA INLET (NORTH - WAKEFIELD)																
Wakefield Road	28	WAKE-14-1-010	WAKE-11-1-020	0.0	8	0.2	338	12	0.255%	1.8	11.3	10.5	-1.6	-91.1%	10	
Wakefield Road	28	WAKE-11-1-020	WAKE-11-1-010	3.9	19	1.0	315	15	0.385%	4.0	8.7	7.7	-3.0	-75.0%	10	
Wakefield Road	28	WAKE-11-1-010	25774	3.9	30	0.9	316	15	1.551%	8.0	10.1	9.1	-7.1	-88.3%	10	
CATALPA INLET (NORTH - KIPLING)																
Kipling Avenue	29	KIPL-14-1-010	KIPL-11-1-040	0.0	8	0.2	321	15	0.644%	5.2	13.4	12.4	-5.0	-96.9%	10	
Kipling Avenue	29	KIPL-11-1-040	KIPL-11-1-030	3.3	19	2.8	320	15	0.883%	6.1	10.0	9.0	-3.3	-53.9%	10	
Kipling Avenue	29	KIPL-11-1-030	KIPL-11-1-020	6.2	30	6.8	287	15	0.943%	6.3	8.5	7.2	0.5	7.9%	8	
Kipling Avenue	29	KIPL-11-1-020	25775	8.3	41	9.2	46	15	3.182%	11.5	9.7	8.7	-2.3	-19.8%	10	
CATALPA INLET (NORTH - CUMBERLAND)																
Cumberland Road	30	CUMB-14-1-010	CUMB-11-1-020	0.0	12	0.2	332	12	1.919%	4.9	8.6	7.8	-4.7	-95.1%	10	
Cumberland Road	30	CUMB-11-1-020	CUMB-11-1-010	1.0	23	1.7	316	12	1.794%	4.8	9.0	8.2	-3.1	-65.0%	10	
Cumberland Road	30	CUMB-11-1-010	25776	2.3	34	3.6	326	12	1.428%	4.3	8.5	7.7	-0.6	-14.7%	10	
CATALPA INLET (NORTH - KENMORE)																
Kenmore Road	31	KENM-14-1-010	KENM-11-1-020	0.0	11	0.2	332	12	1.301%	4.1	11.2	10.4	-3.8	-94.6%	10	
Kenmore Road	31	KENM-11-1-020	KENM-11-1-010	2.0	22	2.8	316	12	1.197%	3.9	9.8	7.3	-1.1	-28.2%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Kenmore Road	31	KENM-11-1-010	25777	4.5	33	5.4	322	12	1.197%	3.9	10.9	6.5	1.5	39.1%	4	15
CATALPA INLET (NORTH - COOLIDGE)																
Coolidge Highway	32	COOL-14-1-010	COOL-13-1-010	0.9	10	2.0	312	15	0.333%	3.7	10.3	8.2	-1.7	-45.2%	10	
Coolidge Highway	32	COOL-13-1-010	COOL-11-1-020	3.6	21	6.2	331	15	0.323%	3.7	8.9	6.1	2.5	67.8%	3	21
Coolidge Highway	32	COOL-11-1-020	25778	4.2	32	7.4	324	18	2.159%	15.4	11.3	10.1	-8.1	-52.4%	10	
Coolidge Highway	32	CATA-17-1-010	25778	0.5	0	0.9	112	12	0.473%	2.5	8.9	8.1	-1.5	-62.3%	10	
CATALPA INLET (SOUTH - ELLWOOD)																
Greenfield Road	33	GREE-07-1-010	GREE-07-1-020	0.0	7	0.1	361	12	0.337%	2.1	7.5	6.7	-1.9	-93.2%	10	
Greenfield Road	33	GREE-07-1-020	GREE-07-1-030	1.1	13	1.6	359	12	0.275%	1.9	7.7	6.9	-0.3	-14.1%	10	
Greenfield Road	33	GREE-07-1-030	GREE-07-1-040	1.8	13	2.9	10	12	13.500%	13.1	10.2	9.4	-10.2	-78.0%	10	
Greenfield Road	33	GREE-07-1-040	ELLW-07-1-030	1.8	16	2.9	309	12	0.339%	2.1	12.0	10.2	0.8	38.8%	4	15
Ellwood Avenue	33	ELLW-07-1-010	ELLW-07-1-020	3.4	10	2.5	361	15	0.960%	6.3	9.1	8.1	-3.8	-59.9%	10	
Ellwood Avenue	33	ELLW-07-1-020	ELLW-07-1-030	5.7	24	5.5	361	15	0.340%	3.8	10.7	7.5	1.7	45.6%	3	18
Ellwood Avenue	33	ELLW-07-1-030	25762	8.0	46	8.7	172	18	0.340%	6.1	12.7	10.9	2.5	41.3%	3	21
THOMAS INLET (WEST - CAMBRIDGE)																
Greenfield Road	34	GREE-07-1-010	GREE-04-1-020	0.0	7	0.1	424	12	0.651%	2.9	7.5	6.7	-2.7	-95.1%	10	
Greenfield Road	34	GREE-04-1-020	GREE-04-2-015	0.8	15	1.4	387	12	0.150%	1.4	9.8	9.0	0.0	-1.0%	10	
Greenfield Road	34	GREE-04-2-015	GREE-04-1-010	1.0	15	1.7	38	15	1.302%	7.4	8.5	7.5	-5.7	-77.4%	10	
Greenfield Road	34	GREE-01-1-020	GREE-01-1-030	2.0	6	4.2	229	12	0.324%	2.0	7.4	0.0	2.2	108.1%	1	18
Greenfield Road	34	GREE-01-1-030	GREE-01-1-040	3.6	8	6.3	73	12	0.333%	2.1	7.6	0.0	4.3	206.9%	0	21
Greenfield Road	34	GREE-01-1-040	GREE-04-1-010	3.6	13	6.2	313	12	0.696%	3.0	8.4	0.0	3.3	110.2%	1	18
Ellwood Avenue	34	ELLW-07-1-010	ELLW-04-1-030	1.0	10	0.8	283	12	0.265%	1.8	9.1	8.3	-1.1	-58.6%	10	
Ellwood Avenue	34	ELLW-04-1-030	ELLW-04-1-020	1.0	20	0.7	284	12	0.824%	3.2	10.6	9.8	-2.5	-77.7%	10	

Appendix C
Combined Sewer Area Study
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Ellwood Avenue	34	ELLW-04-1-020	ELLW-04-1-010	1.0	30	0.7	282	12	0.797%	3.2	10.9	10.1	-2.5	-78.4%	10	
Ellwood Avenue	34	ELEV-01-1-010	ELLW-01-1-010	0.8	0	2.1	102	12	0.327%	2.0	4.6	3.8	0.1	3.4%	9	
Ellwood Avenue	34	ELEV-02-1-010	ELLW-01-1-010	0.3	0	0.7	64	12	0.334%	2.1	5.3	4.5	-1.3	-64.5%	10	
Ellwood Avenue	34	ELLW-01-1-010	ELLW-01-1-020	1.1	0	2.8	142	12	0.152%	1.4	7.1	5.1	1.4	101.2%	1	18
Greenfield Road	34	GREE-01-1-010	ELLW-01-1-020	0.0	11	0.2	307	12	0.217%	1.7	9.7	7.3	-1.4	-86.7%	10	
Ellwood Avenue	34	ELLW-01-1-020	ELLW-01-1-040	4.0	23	3.7	379	15	0.292%	3.5	8.5	5.3	0.2	5.6%	9	
Ellwood Avenue	34	ELLW-01-1-040	ELLW-04-1-010	6.5	37	4.4	377	15	0.167%	2.6	10.7	7.6	1.8	67.8%	0	21
Cambridge Avenue	34	GREE-04-1-010	ELLW-04-1-010	4.6	28	7.7	325	24	0.295%	12.3	14.1	12.0	-4.6	-37.4%	4	21
Cambridge Avenue	34	ELLW-04-1-010	24798	17.7	95	14.9	311	24	0.295%	12.3	14.0	11.4	2.6	20.9%	5	27
THOMAS INLET (EAST - CAMBRIDGE)																
Thomas Avenue	35	THOM-07-1-010	THOM-04-1-030	0.2	10	0.4	284	12	0.350%	2.1	10.3	9.5	-1.7	-80.3%	10	
Thomas Avenue	35	THOM-04-1-030	THOM-04-1-020	0.2	22	0.4	284	12	0.265%	1.8	10.2	9.4	-1.4	-78.5%	10	
Thomas Avenue	35	THOM-04-1-020	THOM-04-1-010	1.6	32	2.3	283	12	0.259%	1.8	9.7	8.5	0.5	25.2%	5	15
Eleven Mile Road	35	CUMM-01-1-010	THOM-01-1-010	0.0	7	0.1	326	8	0.096%	0.4	6.8	1.4	-0.2	-62.7%	10	
Eleven Mile Road	35	THOM-01-1-010	THOM-01-1-020	0.0	7	0.1	137	10	0.614%	1.7	7.0	1.2	-1.6	-91.8%	10	
Eleven Mile Road	35	ELLW-01-1-030	THOM-01-1-020	0.1	21	0.3	296	12	0.201%	1.6	9.5	0.9	-1.3	-83.3%	10	
Thomas Avenue	35	THOM-01-1-020	THOM-01-1-040	2.2	40	5.0	373	15	0.217%	3.0	9.5	0.0	2.0	67.7%	3	21
Thomas Avenue	35	THOM-01-1-040	THOM-04-1-010	6.2	54	9.8	373	12	0.185%	1.5	9.8	0.0	8.3	541.6%	0	27
Cambridge Avenue	35	THOM-04-1-010	24798	11.0	75	13.4	16	36	1.931%	92.7	14.8	12.4	-79.3	-85.5%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
CATALPA INLET (SOUTH - THOMAS)																
Thomas Avenue	36	THOM-07-1-010	THOM-07-1-020	0.0	14	0.3	358	12	0.214%	1.6	10.1	9.0	-1.4	-83.0%	10	
Thomas Avenue	36	THOM-07-1-020	THOM-07-1-030	4.9	28	2.8	362	12	0.408%	2.3	8.9	7.0	0.5	23.1%	5	15
Thomas Avenue	36	THOM-07-1-030	25763	5.9	34	4.0	172	18	0.408%	6.7	11.4	10.2	-2.7	-41.0%	10	
CATALPA INLET (SOUTH - CUMMINGS)																
Cummings Avenue	37	CUMM-07-1-010	CUMM-07-1-020	0.3	14	0.5	364	15	0.255%	3.3	10.1	9.8	-2.8	-86.2%	10	
Cummings Avenue	37	CUMM-07-1-020	CUMM-07-1-030	1.1	28	1.7	359	15	0.262%	3.3	9.9	9.3	-1.6	-47.4%	10	
Cummings Avenue	37	CUMM-07-1-030	25764	6.0	33	6.6	171	18	0.262%	5.4	11.5	10.5	1.2	22.2%	5	21
CATALPA INLET (SOUTH - BACON)																
Bacon Avenue	38	BACO-07-1-010	BACO-07-1-020	1.8	14	2.6	360	12	0.254%	1.8	8.6	6.5	0.8	45.4%	4	15
Bacon Avenue	38	BACO-07-1-020	BACO-07-1-030	1.8	28	2.5	360	12	0.323%	2.0	9.2	8.1	0.4	21.8%	5	15
Bacon Avenue	38	BACO-07-1-030	25765	3.2	33	4.3	172	18	0.323%	6.0	9.3	8.1	-1.7	-27.8%	10	
CATALPA INLET (SOUTH - PHILLIPS)																
Phillips Avenue	39	PHIL-07-1-010	PHIL-07-1-020	1.4	9	1.8	270	12	0.327%	2.0	9.0	8.1	-0.2	-10.2%	10	
Phillips Avenue	39	PHIL-07-1-020	PHIL-07-1-030	1.4	19	1.8	296	12	0.303%	2.0	9.6	8.5	-0.1	-6.8%	10	
Phillips Avenue	39	PHIL-07-1-030	PHIL-07-1-040	3.5	31	4.6	305	18	0.517%	7.6	9.1	7.9	-2.9	-38.7%	10	
Catalpa Drive	39	CATA-05-1-010	PHIL-07-1-040	8.2	0	6.6	297	15	0.412%	4.1	9.9	7.1	2.5	59.1%	3	18
Phillips Avenue	39	PHIL-07-1-040	25766	13.4	31	13.4	19	18	0.518%	7.6	10.8	9.4	5.8	77.0%	2	24
CATALPA INLET (SOUTH - OAKSHIRE)																
Oakshire Avenue	41	OAKS-07-1-020	OAKS-07-1-030	0.0	11	0.2	287	12	0.255%	1.8	9.7	8.6	-1.6	-87.8%	10	
Oakshire Avenue	41	OAKS-07-1-030	OAKS-11-1-010	2.4	21	2.8	297	12	0.531%	2.6	9.2	7.4	0.2	7.9%	8	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Catalpa Drive	41	CATA-06-1-010	OAKS-11-1-010	0.0	0	0.0	292	15	0.582%	4.9	9.8	8.8	-4.9	-100.0%	10	
Oakshire Avenue	41	OAKS-11-1-010	25767	8.5	21	6.9	21	24	0.531%	16.5	9.9	8.3	-9.6	-58.3%	10	
CATALPA INLET (SOUTH - ROYAL)																
Royal Avenue	42	ROYA-07-1-030	ROYA-07-1-040	3.4	8	1.0	296	12	0.091%	1.1	10.3	9.4	-0.1	-6.9%	10	
Catalpa Drive	42	CATA-07-1-010	ROYA-07-1-040	0.0	6	0.1	296	15	0.283%	3.4	9.5	8.5	-3.3	-96.5%	10	
	42	ROYA-07-1-040	25769	3.4	14	0.9	22	18	0.091%	3.2	12.2	10.9	-2.2	-70.1%	10	
Royal Avenue																
OXFORD INLET (NORTH - BUCKINGHAM)																
Catalpa Drive	43	CATA-08-1-010	BUCK-07-1-040	0.0	5	0.1	307	12	0.287%	1.9	9.6	8.9	-1.8	-94.8%	10	
Buckingham Avenue	43	BUCK-07-1-040	BUCK-07-1-030	0.0	5	0.1	283	12	0.354%	2.1	8.7	6.4	-2.0	-95.3%	10	
Buckingham Avenue	43	BUCK-07-1-030	BUCK-07-1-020	0.9	16	1.3	288	12	0.205%	1.6	10.0	6.6	-0.3	-21.4%	10	
Buckingham Avenue	43	BUCK-07-1-020	BUCK-07-1-010	2.8	26	3.6	288	12	0.246%	1.8	10.5	6.8	1.8	104.0%	1	18
Buckingham Avenue	43	BUCK-07-1-010	24791	6.9	18	8.2	14	12	0.073%	1.0	10.7	9.1	7.2	748.8%	0	27
OXFORD INLET (SOUTH - PHILLIPS)																
Phillips Avenue	44	PHIL-01-1-050	PHIL-04-1-010	9.0	46	7.9	340	42	0.203%	45.3	12.9	12.0	-37.4	-82.5%	10	
Phillips Avenue	44	PHIL-04-1-010	PHIL-04-1-020	9.0	46	7.5	275	42	0.203%	45.3	16.3	15.2	-37.8	-83.4%	10	

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Phillips Avenue	44	PHIL-04-1-020	24790	9.0	46	7.2	225	42	0.203%	45.3	18.6	17.4	-38.1	-84.0%	10	
CATALPA INLET (SOUTH - TYLER)																
Tyler Avenue	45	TYLE-04-1-030	TYLE-07-1-010	0.0	11	0.2	284	15	0.614%	5.1	8.1	7.1	-4.8	-95.7%	10	
Tyler Avenue	45	TYLE-07-1-010	TYLE-07-1-020	1.3	19	1.5	208	15	0.167%	2.6	8.7	6.6	-1.1	-43.2%	10	
Tyler Avenue	45	TYLE-07-1-020	TYLE-07-2-025	1.3	22	1.4	72	15	0.086%	1.9	7.9	5.5	-0.5	-24.0%	10	
Tyler Avenue	45	TYLE-07-2-025	TYLE-07-1-030	6.8	32	4.6	250	15	0.159%	2.6	7.7	5.2	2.0	77.2%	2	21
Tyler Avenue	45	TYLE-07-1-030	TYLE-07-1-040	6.8	40	4.4	322	15	0.159%	2.6	10.6	9.0	1.8	70.1%	3	21
Catalpa Drive	45	BUCK-07-1-040	TYLE-07-1-040	0.5	11	0.9	304	12	1.459%	4.3	8.0	7.2	-3.4	-79.4%	10	
Catalpa Drive	45	CATA-11-1-010	TYLE-07-1-040	0.0	2	0.0	305	12	0.458%	2.4	10.7	9.9	-2.4	-98.3%	10	
Tyler Avenue	45	TYLE-07-1-040	25768	8.4	53	6.2	33	15	0.217%	3.0	10.5	9.3	3.2	107.1%	1	21
BUCKINGHAM INLET (WEST - CAMBRIDGE)																
Cummings Avenue	46	CUMM-01-1-010	CUMM-01-1-020	0.0	0	0.0	146	10	0.729%	1.9	8.4	7.7	-1.9	-100.0%	10	
Eleven Mile Road	46	THOM-01-1-030	CUMM-01-1-020	0.0	9	0.2	308	12	0.289%	1.9	10.4	9.5	-1.7	-90.6%	10	
Cummings Avenue	46	CUMM-01-1-020	CUMM-01-1-040	3.0	23	3.3	369	15	0.431%	4.2	10.1	8.4	-0.9	-22.2%	10	
Cummings Avenue	46	CUMM-01-1-040	CUMM-04-1-010	3.0	37	3.1	369	24	0.087%	6.7	11.1	8.8	-3.5	-52.9%	10	
Cummings Avenue	46	CUMM-07-1-010	CUMM-04-1-030	0.4	10	0.6	283	12	0.717%	3.0	10.1	9.8	-2.5	-81.8%	10	
Cummings Avenue	46	CUMM-04-1-030	CUMM-04-1-020	2.2	22	2.8	282	12	0.633%	2.8	11.4	10.9	0.0	0.4%	10	
Cummings Avenue	46	CUMM-04-1-020	CUMM-04-1-010	3.3	32	3.7	285	12	0.686%	2.9	11.2	10.9	0.7	25.2%	4	15
Bacon Avenue	46	BACO-07-1-010	BACO-04-1-030	1.5	6	2.1	284	10	0.612%	1.7	8.8	6.5	0.4	24.6%	5	12
Bacon Avenue	46	BACO-04-1-030	BACO-04-1-020	1.5	12	2.1	283	10	0.735%	1.9	10.4	9.1	0.2	10.0%	8	
Bacon Avenue	46	BACO-04-1-020	BACO-04-1-010	4.0	17	5.1	283	15	1.853%	8.8	10.6	9.6	-3.7	-41.9%	10	
Bacon Avenue	46	BACO-01-1-010	BACO-01-1-020	0.8	0	0.5	140	10	0.941%	2.1	6.1	5.4	-1.6	-76.5%	10	

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Eleven Mile Road	46	CUMM-01-1-030	BACO-01-1-020	0.0	18	0.4	310	12	0.116%	1.2	11.3	10.1	-0.9	-70.3%	10	
Bacon Avenue	46	BACO-01-1-020	BACO-01-1-030	0.8	29	0.5	367	15	0.320%	3.7	9.7	7.8	-3.2	-86.7%	10	
Bacon Avenue	46	BACO-01-1-030	BACO-04-1-010	3.7	43	3.5	366	15	0.320%	3.7	11.1	8.0	-0.2	-5.0%	10	
Eleven Mile Road	46	ELEV-05-1-010	PHIL-01-1-010	0.0	26	0.5	296	10	0.166%	0.9	10.7	8.9	-0.4	-41.7%	10	
Phillips Avenue	46	PHIL-01-1-010	PHIL-01-1-020	1.0	26	0.5	199	12	0.690%	3.0	9.7	7.6	-2.5	-83.1%	10	
Phillips Avenue	46	PHIL-01-1-020	PHIL-01-1-030	2.5	36	2.9	233	12	0.093%	1.1	10.4	6.9	1.8	169.6%	0	18
Phillips Avenue	46	PHIL-01-1-030	PHIL-01-1-040	2.5	44	2.8	191	12	0.380%	2.2	10.9	8.9	0.6	28.3%	4	15
Phillips Avenue	46	PHIL-01-1-040	PHIL-01-1-045	5.7	46	3.7	60	12	0.159%	1.4	10.8	9.4	2.2	157.0%	0	18
Phillips Avenue	46	PHIL-01-1-045	PHIL-01-1-050	5.7	52	3.6	186	15	0.232%	3.1	11.2	10.2	0.5	16.4%	6	
Oakshire Avenue	46	OXFO-06-1-010	CAMB-06-1-010	0.5	0	0.2	782	12	0.320%	2.0	13.9	13.1	-1.8	-89.4%	10	
Oakshire Avenue	46	OAKS-07-1-020	OAKS-07-1-010	0.0	10	0.2	288	12	0.679%	2.9	9.7	8.9	-2.7	-93.2%	10	
Oakshire Avenue	46	OAKS-07-1-010		2.8	20	3.8	10	18	76.029%	91.6	9.2	9.0	-87.8	-95.9%	10	
Oakshire Avenue	46	OAKS-07-1-010	OAKS-04-1-030	0.0	10	0.2	280	12	0.363%	2.1	9.2	9.0	-1.9	-90.7%	10	
Oakshire Avenue	46	OAKS-04-1-030	OAKS-04-1-020	0.0	20	0.4	283	12	0.647%	2.9	10.0	10.2	-2.5	-86.0%	10	
Oakshire Avenue	46	OAKS-04-1-020	OAKS-04-1-010	2.3	32	1.0	284	12	0.541%	2.6	10.1	9.9	-1.7	-63.7%	10	
Royal Avenue	46	ROYA-07-1-030	ROYA-07-1-020	0.0	10	0.2	288	12	0.285%	1.9	9.2	8.3	-1.7	-89.5%	10	
Royal Avenue	46	ROYA-07-1-020	ROYA-07-1-010	0.0	20	0.4	288	12	0.578%	2.7	9.0	8.2	-2.3	-85.2%	10	
Royal Avenue	46	ROYA-07-1-010		3.3	29	3.5	10	15	69.197%	53.7	9.1	8.9	-50.2	-93.4%	10	
Royal Avenue	46	ROYA-07-1-010	ROYA-04-1-030	0.2	11	0.3	284	12	0.291%	1.9	9.1	8.9	-1.7	-86.1%	10	
Royal Avenue	46	ROYA-04-1-030	ROYA-04-1-020	2.3	23	3.1	283	15	0.422%	4.2	9.5	9.6	-1.1	-26.4%	10	
Royal Avenue	46	ROYA-04-1-020	ROYA-04-1-010	2.3	33	3.0	283	15	0.226%	3.1	9.9	10.0	-0.1	-3.5%	10	
Eleven Mile Road	46	ELEV-06-1-010	OAKS-01-1-010	0.0	22	0.4	297	12	0.435%	2.3	11.2	4.5	-1.9	-81.3%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eleven Mile Road	46	ELEV-07-1-010	OAKS-01-1-010	0.0	0	0.0	272	12	0.253%	1.8	10.8	3.6	-1.8	-100.0%	10	
Oakshire Avenue	46	OAKS-01-1-010	OAKS-01-1-020	2.5	47	4.1	429	12	0.290%	1.9	11.0	3.1	2.1	111.4%	1	18
Oakshire Avenue	46	OAKS-01-1-020	OAKS-04-1-010	7.2	63	4.7	432	15	0.257%	3.3	9.7	6.3	1.5	44.9%	4	18
Royal Avenue	46	ROYA-01-1-010	ROYA-01-1-020	0.0	12	0.2	371	12	0.255%	1.8	10.4	9.6	-1.6	-86.7%	10	
Royal Avenue	46	ROYA-01-1-020	ROYA-04-1-010	3.4	25	1.5	368	15	0.306%	3.6	9.7	8.7	-2.1	-58.0%	10	
Cambridge Avenue	46	THOM-04-1-010	CUMM-04-1-010	1.6	11	2.0	327	24	0.156%	8.9	14.9	12.5	-6.9	-77.5%	10	
Cambridge Avenue	46	CUMM-04-1-010	CAMB-04-1-010	14.5	80	14.5	189	30	0.524%	29.7	12.5	9.7	-15.2	-51.1%	10	
Cambridge Avenue	46	CAMB-04-1-010	BACO-04-1-010	17.0	80	16.7	146	30	0.317%	23.1	12.5	9.1	-6.4	-27.7%	10	
Cambridge Avenue	46	BACO-04-1-010	CAMB-05-1-010	28.7	140	29.3	132	24	0.375%	13.9	14.5	10.0	15.4	111.2%	1	33
Cambridge Avenue	46	CAMB-05-1-010	PHIL-01-1-050	28.7	140	29.0	187	42	0.341%	58.8	14.7	11.9	-29.8	-50.7%	10	
Cambridge Avenue	46	PHIL-01-1-050	OAKS-04-1-010	28.4	146	25.1	320	42	0.152%	39.2	13.8	12.0	-14.1	-35.9%	10	
Cambridge Avenue	46	OAKS-04-1-010	CAMB-07-1-010	45.6	241	32.3	285	42	0.281%	53.4	13.8	11.0	-21.0	-39.4%	10	
Cambridge Avenue	46	CAMB-07-1-010	ROYA-04-1-010	47.6	241	32.3	36	42	0.158%	40.0	13.3	10.4	-7.7	-19.3%	10	
Cambridge Avenue	46	ROYA-04-1-010	24796	57.7	299	38.0	340	42	0.281%	53.4	13.4	10.6	-15.3	-28.7%	10	
BUCKINGHAM INLET (EAST - CAMBRIDGE)																
Buckingham Avenue	47	BUCK-07-1-010	BUCK-04-1-030	2.8	18	3.3	285	15	0.175%	2.7	10.7	9.2	0.6	23.8%	5	18
Buckingham Avenue	47	BUCK-04-1-030	BUCK-04-1-020	3.2	30	3.9	284	15	0.279%	3.4	11.7	10.5	0.5	14.4%	7	
Buckingham Avenue	47	BUCK-04-1-020	BUCK-04-1-010	3.2	42	3.8	287	15	0.370%	3.9	12.1	11.1	-0.1	-3.8%	10	
Eleven Mile Road	47	ELEV-08-1-010	BUCK-01-1-010	0.0	4	0.1	340	12	0.399%	2.3	11.6	10.8	-2.2	-96.4%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Buckingham Avenue	47	BUCK-01-1-010	BUCK-01-1-020	0.6	22	0.5	337	24	0.352%	13.4	12.2	10.6	-12.9	-96.3%	10	
Buckingham Avenue	47	BUCK-01-1-020	BUCK-01-1-030	5.4	26	1.9	88	24	0.033%	4.1	10.9	9.1	-2.2	-54.3%	10	
Buckingham Avenue	47	BUCK-01-1-030	BUCK-01-1-040	5.4	32	1.9	154	24	0.564%	17.0	10.4	8.8	-15.1	-89.1%	10	
Buckingham Avenue	47	BUCK-01-1-040	BUCK-04-1-010	6.7	41	3.5	269	24	0.296%	12.3	10.7	9.1	-8.8	-71.4%	10	
Cambridge Avenue	47	BUCK-04-1-010	24796	0.0	0	0.0	11	42	0.282%	53.4	14.4	11.6	-53.4	-100.0%	10	
CATALPA INLET (SOUTH - ROBINA)																
Catalpa Drive	48	CATA-11-1-010	CATA-12-1-010	0.0	0	0.0	299	12	0.789%	3.2	10.5	9.7	-3.2	-100.0%	10	
Catalpa Drive	48	CATA-12-1-010	CATA-13-1-010	0.0	0	0.0	290	12	0.705%	3.0	10.6	9.8	-3.0	-100.0%	10	
Catalpa Drive	48	CATA-13-1-010	30769	0.2	0	0.3	26	12	0.764%	3.1	12.7	11.9	-2.8	-89.2%	10	
CATALPA INLET (SOUTH - CUMBERLAND)																
Catalpa Drive	49	KIPL-11-1-010	CATA-16-1-010	1.9	18	2.3	290	12	0.391%	2.2	10.8	10.0	0.1	5.4%	9	
Catalpa Drive	49	CATA-17-1-020	CATA-16-1-010	0.0	15	0.3	427	12	0.988%	3.5	11.0	10.2	-3.2	-91.5%	10	
Catalpa Drive	49	CATA-16-1-010	25776	8.2	33	4.0	23	12	0.880%	3.3	12.0	11.1	0.6	19.0%	5	15
CATALPA INLET (SOUTH - KIPLING)																
Catalpa Drive	50	CATA-13-1-010	CATA-13-1-020	0.0	5	0.1	245	12	0.628%	2.8	11.3	10.5	-2.7	-96.5%	10	
Catalpa Drive	50	CATA-13-1-020	KIPL-11-1-010	0.0	9	0.2	249	12	0.758%	3.1	12.1	11.3	-2.9	-94.2%	10	
Sunnyknoll Avenue	50	25782	SUNN-13-1-010	0.0	0	0.0	85	12	0.412%	2.3	11.5	7.2	-2.3	-100.0%	10	
Sunnyknoll Avenue	50	SUNN-13-1-010	SUNN-13-1-020	0.2	3	0.4	156	12	0.232%	1.7	11.4	6.8	-1.3	-76.4%	10	
Sunnyknoll Avenue	50	SUNN-13-1-020	KIPL-09-1-010	3.1	13	4.8	243	12	0.484%	2.5	9.7	4.8	2.3	94.1%	2	18
Sunnyknoll Avenue	50	SUNN-15-1-010	KIPL-09-1-010	0.0	13	0.3	410	12	0.619%	2.8	10.0	9.2	-2.5	-90.7%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Kipling Avenue	50	KIPL-07-1-010	KIPL-07-1-020	0.0	6	0.1	223	12	0.505%	2.5	8.8	8.0	-2.4	-95.3%	10	
Kipling Avenue	50	KIPL-07-1-020	KIPL-09-1-010	0.0	10	0.2	225	12	0.781%	3.1	10.8	10.0	-2.9	-93.6%	10	
Kipling Avenue	50	KIPL-09-1-010	KIPL-11-1-010	5.0	42	6.0	414	18	0.249%	5.2	11.8	9.8	0.7	13.6%	7	
Kipling Avenue	50	KIPL-11-1-010	25775	5.5	38	6.7	24	18	2.500%	16.6	10.8	9.6	-9.9	-59.8%	10	
OXFORD INLET (NORTH - ROBINA)																
Oxford Road	51	OXFO-13-1-020	OXFO-13-1-010	0.0	50	1.0	255	12	0.914%	3.4	10.9	10.1	-2.4	-70.6%	10	
Oxford Road	51	OXFO-13-1-010	ROBI-04-1-050	0.0	50	1.0	31	12	1.380%	4.2	11.0	10.2	-3.2	-76.1%	10	
Oxford Road	51	ROBI-04-1-050	24793	4.1	50	5.6	30	12	9.527%	11.0	11.1	10.3	-5.4	-49.1%	10	
OXFORD INLET (SOUTH - GARDNER)																
Gardner Avenue	52	CATA-11-1-010	GARD-07-1-020	0.0	79	1.6	574	12	0.519%	2.6	11.1	10.3	-1.0	-38.5%	10	
Gardner Avenue	52	GARD-07-1-020	GARD-07-1-010	0.0	79	1.6	290	12	0.272%	1.9	11.3	10.5	-0.3	-14.9%	10	
Gardner Avenue	52	GARD-07-1-010	GARD-04-1-030	0.3	86	0.5	286	15	0.396%	4.1	10.8	9.8	-3.6	-87.7%	10	
Gardner Avenue	52	GARD-04-1-030	GARD-04-1-020	1.9	97	2.6	285	15	0.374%	4.0	12.6	11.6	-1.4	-34.2%	10	
Gardner Avenue	52	GARD-04-1-020	GARD-04-1-010	1.9	109	2.5	285	15	0.270%	3.4	10.3	9.0	-0.9	-26.0%	10	
Tyler Avenue	52	TYLE-04-1-030	TYLE-04-1-020	0.0	12	0.2	280	15	1.784%	8.6	8.1	7.1	-8.4	-97.2%	10	
Tyler Avenue	52	TYLE-04-1-020	TYLE-04-1-010	1.3	24	2.2	299	42	1.145%	107.7	10.7	7.9	-105.5	-98.0%	10	
Tyler Avenue	52	TYLE-01-1-020	TYLE-01-1-040	1.1	15	1.6	331	18	0.447%	7.0	10.7	9.5	-5.5	-77.8%	10	
Tyler Avenue	52	TYLE-01-1-040	TYLE-04-1-010	2.9	27	3.9	325	24	0.413%	14.5	11.6	10.0	-10.6	-72.8%	10	
Eleven Mile Road	52	BUCK-01-1-010	TYLE-01-1-010	0.0	1	0.0	305	12	0.527%	2.6	11.6	2.8	-2.6	-99.2%	10	
Eleven Mile Road	52	TYLE-01-1-010	GARD-01-1-010	1.3	4	2.9	305	12	0.420%	2.3	12.1	1.5	0.6	25.4%	4	15
Gardner Avenue	52	GARD-01-1-010	GARD-01-1-020	2.4	9	5.5	277	12	0.300%	2.0	10.3	0.0	3.5	181.1%	0	18
Gardner Avenue	52	GARD-01-1-020	GARD-01-1-030	3.7	22	7.1	281	12	0.300%	2.0	12.7	0.0	5.1	263.8%	0	21
Gardner Avenue	52	GARD-01-1-030	GARD-04-1-010	3.7	33	6.8	282	12	0.300%	2.0	17.8	6.7	4.9	250.3%	0	21
Cambridge Avenue	52	BUCK-04-1-010	TYLE-04-1-010	12.7	83	9.2	307	42	0.395%	63.2	14.4	11.6	-54.1	-85.5%	10	

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Cambridge Avenue	52	TYLE-04-1-010	GARD-04-1-010	20.9	134	17.1	304	42	0.822%	91.2	13.5	10.7	-74.1	-81.3%	10	
Cambridge Avenue	52	GARD-04-1-010	CAMB-11-1-010	35.5	275	29.5	151	42	0.135%	36.9	12.7	9.9	-7.4	-20.2%	10	
Cambridge Avenue	52	CAMB-11-1-010	GARD-04-1-025	35.5	275	29.1	418	48	0.100%	45.5	14.8	11.6	-16.4	-36.1%	10	
Gardner Avenue	52	GARD-04-1-025	GARD-07-1-015	35.5	275	27.7	423	48	0.019%	19.8	17.9	14.6	8.0	40.2%	4	60
Gardner Avenue	52	GARD-07-1-015	24792	35.5	275	26.3	11	48	4.428%	302.3	18.1	14.9	-276.0	-91.3%	10	
BERKLEY INLET (WEST - COLUMBIA)																
Griffith Avenue	53	GRIF-01-1-010	GRIF-01-1-020	1.5	14	1.0	317	15	0.469%	4.4	7.4	2.5	-3.4	-77.4%	10	
Griffith Avenue	53	GRIF-01-1-020	GRIF-01-1-030	3.8	28	4.3	338	15	0.376%	4.0	10.2	3.9	0.4	8.9%	8	
Robina Avenue	53	ROBI-01-1-010	ROBI-01-1-020	2.5	6	2.8	219	15	0.233%	3.1	9.9	1.7	-0.3	-10.3%	10	
Robina Avenue	53	ROBI-01-1-020	ROBI-01-1-030	3.3	13	4.3	217	15	0.240%	3.2	11.3	3.0	1.1	35.2%	4	18
Eleven Mile Road	53	ELEV-11-1-010	ELEV-12-1-010	0.0	18	0.4	269	10	1.608%	2.8	11.4	3.5	-2.4	-87.4%	10	
Eleven Mile Road	53	ELEV-12-1-010	ELEV-13-1-010	1.2	31	3.3	265	10	0.966%	2.2	10.2	0.0	1.1	51.9%	3	12
Eleven Mile Road	53	ELEV-13-1-010	ELEV-13-1-020	1.8	53	4.5	220	15	0.142%	2.4	11.5	0.6	2.1	84.8%	2	21
Eleven Mile Road	53	ELEV-13-1-020	KIPL-01-1-010	1.8	67	4.3	220	15	1.135%	6.9	10.7	0.6	-2.6	-37.2%	10	
Kipling Avenue	53	KIPL-01-1-010	KIPL-01-1-020	3.1	67	4.7	282	18	0.225%	5.0	10.3	0.6	-0.3	-6.0%	10	
Kipling Avenue	53	KIPL-01-1-020	KIPL-03-1-010	8.7	76	13.0	287	18	0.090%	3.1	10.0	0.0	9.8	312.5%	0	33
Robina Avenue	53	24793	ROBI-04-1-040	0.0	2	0.0	146	12	0.421%	2.3	11.2	6.1	-2.3	-98.3%	10	
Robina Avenue	53	ROBI-04-1-040	ROBI-04-1-030	0.9	7	1.1	106	18	0.336%	6.1	10.1	4.3	-5.0	-81.4%	10	
Robina Avenue	53	ROBI-04-1-030	ROBI-04-1-020	0.9	14	1.1	282	18	0.223%	5.0	9.8	3.7	-3.9	-77.6%	10	
Harvard Road	53	HARV-13-1-010	ROBI-04-1-020	0.0	10	0.2	298	12	0.455%	2.4	9.0	3.6	-2.2	-91.7%	10	
Robina Avenue	53	ROBI-04-1-020	ROBI-04-1-010	14.3	35	4.6	305	18	0.150%	4.1	9.6	2.8	0.5	13.2%	7	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Cambridge Avenue	53	CAMB-11-1-010	GRIF-01-1-030	0.0	0	0.0	147	42	0.647%	80.9	12.8	7.0	-80.9	-100.0%	10	
Cambridge Avenue	53	GRIF-01-1-030	ROBI-04-1-010	4.9	28	5.9	272	42	0.017%	13.2	13.4	6.6	-7.3	-55.2%	10	
Robina Avenue	53	ROBI-04-1-010	ROBI-01-1-030	20.0	72	10.8	276	30	0.836%	37.5	13.4	6.6	-26.7	-71.1%	10	
Columbia Road	53	ROBI-01-1-030	COLU-13-1-010	24.5	89	15.3	236	33	0.433%	34.8	14.1	5.0	-19.5	-55.9%	10	
Columbia Road	53	COLU-13-1-010	KIPL-03-1-010	28.3	91	15.7	215	33	0.266%	27.3	11.4	1.4	-11.5	-42.3%	10	
Kipling Avenue	53	KIPL-07-1-010	KIPL-05-1-020	0.0	10	0.2	283	10	0.503%	1.6	10.6	8.9	-1.4	-87.1%	10	
Kipling Avenue	53	KIPL-05-1-020	KIPL-05-1-010	0.8	20	1.0	284	10	0.742%	1.9	10.4	7.2	-0.9	-47.0%	10	
Kipling Avenue	53	KIPL-05-1-010	KIPL-03-1-020	1.7	29	1.9	289	15	0.942%	6.3	10.4	5.7	-4.4	-69.7%	10	
Kipling Avenue	53	KIPL-03-1-020	KIPL-03-1-010	2.5	41	2.7	289	15	0.760%	5.6	10.5	3.2	-2.9	-51.8%	10	
Sunnyknoll Avenue	53	SUNN-15-1-010	COOL-09-1-010	0.0	11	0.2	414	12	0.637%	2.8	10.0	1.7	-2.6	-92.3%	10	
Oxford Road	53	KIPL-07-1-010	OXFO-15-1-010	0.9	10	1.6	397	12	0.916%	3.4	9.4	8.6	-1.8	-53.3%	10	
Oxford Road	53	OXFO-15-1-010	COOL-07-1-010	2.2	34	4.0	420	12	0.860%	3.3	10.7	7.7	0.7	21.2%	5	15
Harvard Road	53	KIPL-05-1-010	HARV-15-1-010	0.0	23	0.5	412	12	0.723%	3.0	9.2	1.8	-2.6	-84.8%	10	
Harvard Road	53	HARV-15-1-010	COOL-05-1-010	6.4	42	2.8	413	12	0.712%	3.0	10.3	0.0	-0.2	-6.9%	10	
Columbia Road	53	KIPL-03-1-010	COLU-15-1-010	40.6	224	30.2	439	33	0.351%	31.3	12.2	1.6	-1.1	-3.7%	10	
Columbia Road	53	COLU-15-1-010	COLU-15-1-020	41.1	235	29.8	72	33	0.273%	27.6	12.2	1.4	2.2	7.9%	7	
Columbia Road	53	COLU-15-1-020	COOL-03-1-010	46.6	245	30.1	321	33	0.386%	32.9	12.7	1.8	-2.8	-8.5%	10	
Eleven Mile Road	53	ELEV-15-1-010	ELEV-15-1-030	0.0	41	0.8	400	12	0.284%	1.9	9.5	1.1	-1.1	-56.8%	10	
Eleven Mile Road	53	ELEV-15-1-030	ELEV-15-1-040	2.5	60	5.1	312	15	0.193%	2.8	9.5	0.0	2.3	79.8%	2	21
Eleven Mile Road	53	ELEV-15-1-040	ELEV-15-1-050	3.1	60	6.5	31	18	0.174%	4.4	11.5	0.0	2.1	47.3%	3	21
Coolidge Highway	53	ELEV-15-1-050	COOL-01-1-010	3.1	60	6.4	57	18	0.205%	4.8	11.4	0.0	1.7	34.9%	4	21
Coolidge Highway	53	COOL-01-1-010	COOL-02-1-010	3.9	60	8.4	252	18	0.441%	7.0	12.0	0.0	1.4	20.4%	5	21
Coolidge Highway	53	COOL-02-1-010	COOL-02-1-020	5.6	60	11.8	5	18	0.025%	1.7	11.9	0.0	10.1	607.3%	0	42
Coolidge Highway	53	COOL-01-1-020	COOL-02-1-020	0.0	15	0.3	216	12	2.329%	5.4	7.7	1.2	-5.1	-94.5%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Coolidge Highway	53	COOL-02-1-020	COOL-02-1-030	5.6	75	11.8	16	18	0.024%	1.6	11.9	0.0	10.2	628.1%	0	42
Coolidge Highway	53	COOL-02-1-030	COOL-03-1-010	5.6	82	11.7	287	18	0.416%	6.8	11.9	0.0	5.0	73.3%	2	24
Coolidge Highway	53	COOL-11-1-010	COOL-09-1-010	0.0	18	0.4	425	10	0.976%	2.2	9.9	3.2	-1.8	-83.4%	10	
Coolidge Highway	53	COOL-09-1-010	COOL-07-1-010	3.5	33	8.3	450	12	0.770%	3.1	11.0	0.0	5.1	164.6%	0	18
Coolidge Highway	53	COOL-07-1-010		11.7	66	21.6	12	15	69.167%	53.7	11.3	10.3	-32.1	-59.7%	10	
Coolidge Highway	53	COOL-07-1-010	COOL-05-1-050	0.0	0	0.0	117	15	0.457%	4.4	12.0	1.8	-4.4	-99.9%	10	
Coolidge Highway	53	COOL-05-1-050	COOL-05-1-040	0.0	0	0.0	30	15	0.364%	3.9	12.2	1.5	-3.9	-99.9%	10	
Coolidge Highway	53	COOL-05-1-040	COOL-05-1-030	0.0	43	0.9	141	15	0.534%	4.7	11.8	1.0	-3.9	-81.9%	10	
Coolidge Highway	53	COOL-05-1-030	COOL-05-1-010	0.0	43	0.9	281	15	0.393%	4.1	12.0	0.5	-3.2	-79.0%	10	
Coolidge Highway	53	COOL-05-1-010	COOL-04-1-010	11.0	90	12.0	306	18	0.651%	8.5	12.8	0.0	3.5	41.4%	4	21
Coolidge Highway	53	COOL-04-1-010	COOL-03-1-010	11.7	103	13.2	272	18	0.435%	6.9	13.4	0.0	6.3	91.2%	2	24
Coolidge Highway	53	COOL-04-1-020	COOL-03-1-020	0.4	0	1.0	262	18	0.539%	7.7	6.4	4.8	-6.7	-87.5%	10	
Coolidge Highway	53	COOL-03-1-010	COOL-03-1-020	69.4	430	58.1	26	36	0.366%	40.3	14.1	3.0	17.8	44.0%	3	42
Oxford Road	53	OXFO-19-1-010	OXFO-18-1-010	1.2	7	1.8	309	10	0.151%	0.9	10.6	3.6	0.9	106.8%	1	15
Oxford Road	53	OXFO-18-1-010	COOL-07-1-015	2.3	9	3.1	325	10	0.867%	2.0	9.4	4.1	1.1	54.0%	3	12
Harvard Road	53	HARV-19-1-010	HARV-18-1-010	0.0	11	0.2	311	12	0.691%	3.0	10.7	3.7	-2.7	-92.6%	10	
Harvard Road	53	HARV-18-1-010	COOL-05-1-015	0.0	20	0.4	320	12	0.187%	1.5	9.1	0.0	-1.1	-74.0%	10	
Harvard Road	53	HARV-19-1-010	25934	0.0	0	0.0	31	15	29.150%	34.9	10.0	9.0	-34.9	-100.0%	10	
Cambridge Avenue	53	25935	CAMB-18-1-010	0.0	14	0.3	298	15	0.284%	3.4	9.8	0.8	-3.2	-91.9%	10	
Cambridge Avenue	53	CAMB-18-1-010	COOL-04-1-015	0.0	22	0.4	319	15	0.221%	3.0	9.9	0.0	-2.6	-85.5%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Princeton Road	53	PRIN-19-1-040	PRIN-19-1-030	0.0	0	0.0	33	15	1.438%	7.7	7.6	0.3	-7.7	-100.0%	10	
Princeton Road	53	PRIN-19-1-030	PRIN-19-1-020	2.5	11	1.0	295	15	0.118%	2.2	7.9	0.0	-1.2	-54.9%	10	
Princeton Road	53	PRIN-19-1-020	PRIN-19-1-010	2.5	24	0.9	330	15	0.174%	2.7	11.5	0.3	-1.7	-64.8%	10	
Princeton Road	53	PRIN-19-1-010	PRIN-18-1-010	3.4	37	2.5	310	15	0.161%	2.6	12.7	1.0	-0.1	-2.8%	10	
Princeton Road	53	PRIN-18-1-010	COOL-02-1-015	4.7	37	4.4	331	15	0.154%	2.5	11.7	0.0	1.9	73.9%	2	21
Coolidge Highway	53	COOL-11-1-015	COOL-09-1-015	0.0	5	0.1	430	10	0.875%	2.0	10.1	8.7	-1.9	-95.1%	10	
Coolidge Highway	53	COOL-09-1-015	COOL-07-1-015	1.8	36	2.8	450	10	0.835%	2.0	10.8	5.6	0.8	39.9%	4	12
Coolidge Highway	53	COOL-07-1-015		7.8	48	12.3	12	15	72.500%	55.0	11.0	10.0	-42.7	-77.6%	10	
Coolidge Highway	53	COOL-07-1-015	COOL-05-1-025	0.0	3	0.1	283	12	0.495%	2.5	11.7	1.6	-2.4	-97.6%	10	
Coolidge Highway	53	COOL-05-1-025	COOL-05-1-015	1.8	18	4.1	282	12	0.516%	2.6	11.4	0.0	1.6	61.6%	3	15
Coolidge Highway	53	COOL-05-1-015	COOL-04-1-015	6.8	48	13.2	307	15	0.592%	5.0	12.7	0.0	8.3	166.2%	0	24
Coolidge Highway		COOL-04-1-015	COOL-03-1-015	9.6	70	17.0	273	18	0.567%	7.9	13.1	0.0	9.1	115.4%	1	24
Coolidge Highway	53	COOL-01-1-015	COOL-02-1-015	0.3	21	0.8	274	15	0.443%	4.3	10.9	1.7	-3.5	-80.8%	10	
Coolidge Highway	53	COOL-02-1-015	COOL-03-1-015	6.6	37	8.1	284	15	0.378%	4.0	11.5	0.0	4.1	104.3%	1	21
Coolidge Highway	53	COOL-03-1-020	COOL-03-1-015	69.7	430	58.7	22	36	0.822%	60.5	14.8	3.8	-1.7	-2.9%	10	
Columbia Road	53	COOL-03-1-015	COLU-18-1-020	87.8	548	82.1	384	36	0.211%	30.6	14.9	3.7	51.5	168.1%	0	54
Columbia Road	53	COLU-18-1-020	25936	90.8	557	82.1	243	36	0.078%	18.7	15.5	9.2	63.5	340.3%	0	66
CATALPA INLET (WEST - HENLEY)																
Edgewood Boulevard	54	COOL-15-1-015	EDGE-18-1-010	0.4	21	1.1	341	15	1.926%	9.0	9.2	8.2	-7.8	-87.5%	10	
Edgewood Boulevard	54	EDGE-18-1-010	EDGE-19-1-010	3.8	35	3.6	300	15	0.591%	5.0	10.0	9.0	-1.3	-26.9%	10	

Appendix C
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Wiltshire Road	54	COOL-14-1-015	WILT-18-2-015	0.1	7	0.2	266	12	0.376%	2.2	8.8	8.0	-2.0	-90.6%	10	
Wiltshire Road	54	WILT-18-2-015	WILT-18-1-010	5.4	9	2.5	45	12	0.377%	2.2	7.2	5.9	0.3	14.5%	6	
Wiltshire Road	54	WILT-18-1-010	WILT-19-1-010	5.4	19	2.5	322	12	0.315%	2.0	8.0	6.6	0.5	24.5%	5	15
Coolidge Highway	54	COOL-14-1-015	COOL-13-1-015	0.0	16	0.3	309	10	0.314%	1.2	9.2	2.4	-0.9	-73.9%	10	
Franklin Road	54	COOL-13-1-015	FRAN-18-1-010	1.4	14	3.7	129	12	0.432%	2.3	7.9	0.0	1.4	57.9%	3	15
Franklin Road	54	FRAN-18-1-010	FRAN-18-1-020	2.0	21	4.9	193	12	0.496%	2.5	10.8	3.0	2.4	94.4%	2	18
Franklin Road	54	FRAN-18-1-020	FRAN-19-1-010	2.0	28	4.8	319	12	0.622%	2.8	11.5	6.4	2.0	69.9%	2	15
Coolidge Highway	54	COOL-13-1-015	COOL-11-1-035	0.2	13	0.5	285	10	0.537%	1.6	7.7	0.0	-1.1	-68.6%	10	
Coolidge Highway	54	COOL-11-1-025	COOL-11-1-035	0.2	16	0.4	376	10	0.484%	1.5	9.6	1.4	-1.1	-72.0%	10	
Dorothea Road	54	COOL-11-1-035	DORO-18-1-010	1.8	29	4.4	156	12	0.560%	2.7	10.1	0.0	1.8	66.9%	2	15
Dorothea Road	54	DORO-18-1-010	DORO-18-1-015	4.0	29	5.3	150	12	0.333%	2.1	12.7	2.5	3.2	157.9%	0	18
Dorothea Road	54	DORO-18-1-015	DORO-18-1-016	4.0	29	5.2	13	12	0.372%	2.2	13.7	6.4	3.0	139.2%	1	18
Dorothea Road	54	DORO-18-1-016	DORO-19-1-010	4.0	29	5.2	322	12	0.639%	2.8	13.8	6.7	2.3	82.2%	2	18
Berkley Avenue	54	EDGE-19-1-010	WILT-19-1-010	3.0	18	2.6	334	18	0.281%	5.6	12.2	11.0	-3.0	-53.9%	10	
Berkley Avenue	54	WILT-19-1-010	FRAN-19-1-010	8.5	37	4.5	304	24	0.283%	12.0	13.6	12.0	-7.5	-62.2%	10	
Berkley Avenue	54	FRAN-19-1-010	DORO-19-1-010	10.8	53	9.0	290	27	0.300%	17.0	13.0	11.2	-8.0	-46.9%	10	
Berkley Avenue	54	DORO-19-1-010	CATA-18-1-050	15.2	71	13.2	299	36	0.371%	40.6	13.5	11.1	-27.5	-67.6%	10	
Berkley Avenue	54	CATA-18-1-050		16.3	71	14.5	74	27	9.459%	95.3	13.4	11.6	-80.7	-84.7%	10	
Catalpa Drive	54	CATA-18-1-030	CATA-18-1-040	0.0	11	0.2	514	12	0.814%	3.2	9.1	4.1	-3.0	-93.5%	10	
Catalpa Drive	54	CATA-18-1-040	CATA-18-1-060	3.1	32	5.5	324	12	0.527%	2.6	9.2	0.0	2.9	112.6%	1	18
Catalpa Drive	54	CATA-18-1-060	25923	6.1	50	10.3	358	12	0.527%	2.6	8.5	0.0	7.7	297.1%	0	21

Appendix C
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CATALPA INLET (NORTH - HENLEY)																
Twelve Mile Road	55	TWEL-18-1-010	TWEL-18-1-020	0.0	0	0.0	90	12	0.768%	3.1	10.4	9.6	-3.1	-100.0%	10	
Twelve Mile Road	55	TWEL-18-1-020	TWEL-19-1-010	1.1	8	2.8	416	15	0.406%	4.1	11.1	10.1	-1.3	-32.4%	10	
Rosemont Road	55	ROSE-18-1-010	ROSE-18-1-020	0.7	0	1.6	125	12	0.418%	2.3	8.5	3.8	-0.7	-29.2%	10	
Rosemont Road	55	ROSE-18-1-020	ROSE-18-1-030	2.2	2	4.8	132	12	0.485%	2.5	9.8	5.0	2.3	94.4%	2	18
Rosemont Road	55	ROSE-18-1-030	ROSE-19-1-010	2.2	11	4.8	252	12	1.005%	3.6	9.6	6.6	1.2	33.0%	4	15
Beverly Boulevard	55	COOL-17-1-015	BEVE-18-1-010	27.5	134	26.6	328	30	0.565%	30.8	18.4	16.0	-4.2	-13.7%	10	
Beverly Boulevard	55	BEVE-18-1-010	BEVE-19-1-010	28.1	145	27.2	317	30	0.269%	21.3	22.4	19.4	5.9	27.8%	4	33
Earlmont Road	55	EARL-18-1-010	EARL-18-1-020	0.0	6	0.1	185	10	1.600%	2.8	10.6	9.9	-2.7	-95.7%	10	
Earlmont Road	55	EARL-18-1-020	EARL-19-1-010	0.5	18	0.8	320	10	1.577%	2.8	10.3	9.6	-1.9	-70.7%	10	
Berkley Avenue	55	TWEL-19-1-010	ROSE-19-1-010	0.4	1	0.9	310	18	0.241%	5.2	12.1	10.2	-4.3	-82.9%	10	
Berkley Avenue	55	ROSE-19-1-010	BEVE-19-1-010	4.4	8	4.0	336	18	0.365%	6.3	11.6	10.4	-2.3	-36.5%	10	
Berkley Avenue	55	EARL-19-1-010	BEVE-19-1-010	1.8	9	1.3	332	15	1.339%	7.5	9.2	8.2	-6.2	-83.0%	10	
Beverly Boulevard	55	BEVE-19-1-010	BEVE-19-1-020	34.4	162	30.7	13	30	1.370%	48.0	18.0	15.2	-17.3	-36.0%	10	
Beverly Boulevard	55	BEVE-19-1-020	BEVE-19-1-030	36.0	172	31.4	332	30	0.594%	31.6	16.4	13.5	-0.2	-0.6%	10	
Beverly Boulevard	55	BEVE-19-1-030	HENL-17-1-010	37.4	183	31.7	331	30	0.486%	28.6	14.1	11.2	3.1	10.8%	7	
Beverly Boulevard	55	BEVE-20-1-020	BEVE-20-1-010	4.7	0	3.8	300	12	0.629%	2.8	5.9	2.8	1.0	34.5%	4	15
Beverly Boulevard	55	BEVE-20-1-010	HENL-17-1-010	4.7	0	3.7	268	15	0.437%	4.3	9.6	8.0	-0.6	-13.7%	10	
Twelve Mile Road	55	TWEL-19-1-010	TWEL-19-1-020	2.0	11	4.3	334	15	0.387%	4.0	12.0	10.2	0.3	7.4%	8	
Twelve Mile Road	55	TWEL-19-1-020	HENL-19-1-010	3.1	21	6.3	336	15	0.563%	4.8	11.4	9.8	1.4	29.9%	4	18
Rosemont Road	55	ROSE-19-1-010	ROSE-19-1-020	2.3	14	2.1	337	12	1.044%	3.6	9.7	8.9	-1.6	-42.9%	10	
Rosemont Road	55	ROSE-19-1-020	HENL-18-1-010	4.2	27	2.8	335	12	1.102%	3.7	11.4	10.6	-0.9	-23.9%	10	

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Earlmont Road	55	EARL-19-1-010	EARL-19-1-020	2.0	19	1.4	340	12	1.491%	4.4	9.8	9.0	-3.0	-68.3%	10	
Earlmont Road	55	EARL-19-1-020	HENL-16-1-010	3.4	32	3.1	334	12	0.694%	3.0	10.3	9.3	0.1	4.0%	9	
Edgewood Boulevard	55	EDGE-19-1-010	EDGE-19-1-020	2.7	32	2.3	333	12	0.527%	2.6	11.6	10.8	-0.3	-12.0%	10	
Edgewood Boulevard	55	EDGE-19-1-020	HENL-15-1-010	4.0	42	3.1	336	12	0.699%	3.0	10.8	9.9	0.1	2.4%	10	
Edgewood Boulevard	55	EDGE-20-1-020	EDGE-20-1-010	1.3	0	2.0	207	12	0.611%	2.8	5.7	4.0	-0.8	-27.9%	10	
Edgewood Boulevard	55	EDGE-20-1-010	HENL-15-1-010	2.6	0	3.7	267	12	0.334%	2.1	7.8	5.1	1.6	78.3%	2	15
Wiltshire Road	55	WILT-19-1-010	WILT-19-1-020	0.0	11	0.2	346	12	0.051%	0.8	11.1	10.3	-0.6	-72.8%	10	
Wiltshire Road	55	WILT-19-1-020	HENL-14-1-010	0.0	21	0.4	333	12	1.402%	4.2	9.3	8.5	-3.8	-90.0%	10	
Wiltshire Road	55	WILT-20-1-010	HENL-14-1-010	3.8	0	2.8	356	12	0.335%	2.1	6.1	4.3	0.7	35.7%	4	15
Franklin Road	55	FRAN-19-1-010	FRAN-19-1-020	2.4	24	2.0	337	12	0.564%	2.7	10.9	10.1	-0.7	-26.1%	10	
Franklin Road	55	FRAN-19-1-020	HENL-13-1-010	3.4	36	2.7	333	12	0.392%	2.2	10.3	8.9	0.4	19.9%	5	15
Franklin Road	55	FRAN-20-1-020	FRAN-20-1-010	1.5	0	1.0	192	12	0.125%	1.3	3.2	2.4	-0.3	-20.5%	10	
Franklin Road	55	FRAN-20-1-010	HENL-13-1-010	4.0	0	1.9	213	12	0.635%	2.8	4.3	3.5	-0.9	-32.0%	10	
Dorothea Road	55	DORO-19-1-010	DORO-19-1-020	2.3	24	2.0	337	12	0.323%	2.0	12.3	11.4	-0.1	-3.0%	10	
Dorothea Road	55	DORO-19-1-020	HENL-12-1-010	3.2	37	2.6	332	15	0.533%	4.7	11.1	10.1	-2.1	-44.1%	10	
Dorothea Road	55	DORO-20-1-010	HENL-12-1-010	1.2	0	1.0	303	15	0.041%	1.3	3.5	2.5	-0.3	-23.3%	10	
Rosemont Road	55	ROSE-20-1-040		0.0	0	0.0	38	15	12.913%	23.2	8.2	7.2	-23.2	-100.0%	10	
Beverly Boulevard	55	BEVE-20-1-040	BEVE-20-1-030	0.0	3	0.1	93	12	0.327%	2.0	7.1	6.3	-2.0	-97.1%	10	
Beverly Boulevard	55	BEVE-20-1-030		0.0	3	0.1	11	12	28.692%	19.1	7.6	6.8	-19.0	-99.7%	10	
Earlmont Road	55	EARL-20-1-030		0.0	0	0.0	11	12	41.253%	22.9	8.1	7.3	-22.9	-100.0%	10	
Edgewood Boulevard	55	EDGE-20-1-060	EDGE-20-1-050	0.0	11	0.2	387	12	0.300%	2.0	8.9	8.1	-1.7	-88.7%	10	
Edgewood Boulevard	55	EDGE-20-1-050	EDGE-20-1-040	0.0	16	0.3	174	12	0.884%	3.4	7.3	6.5	-3.0	-90.4%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Edgewood Boulevard	55	EDGE-20-1-040		0.0	16	0.3	7	8	65.012%	9.7	9.9	9.4	-9.4	-96.7%	10	
Wiltshire Road	55	WILT-20-1-020		0.0	0	0.0	13	8	60.664%	9.4	9.3	8.8	-9.4	-100.0%	10	
Franklin Road		FRAN-20-1-050	FRAN-20-1-040	0.0	3	0.1	89	12	1.377%	4.2	8.0	7.2	-4.1	-98.6%	10	
Franklin Road	55	FRAN-20-1-040		0.0	3	0.1	15	8	51.641%	8.7	9.1	8.6	-8.6	-99.3%	10	
Dorothea Road	55	DORO-20-1-040		0.0	0	0.0	17	8	69.851%	10.1	7.8	7.3	-10.1	-100.0%	10	
Dorothea Road	55	DORO-20-1-080	DORO-20-1-070	0.0	2	0.0	101	12	1.355%	4.1	6.9	6.1	-4.1	-99.0%	10	
Dorothea Road	55	DORO-20-1-070	HENL-12-1-010	0.0	2	0.0	11	12	3.240%	6.4	8.7	7.9	-6.4	-99.4%	10	
Henley Avenue	55	TWEL-20-1-030	HENL-19-1-010	0.0	0	0.0	36	18	1.035%	10.7	13.3	11.0	-10.7	-100.0%	10	
Henley Avenue	55	HENL-19-1-010	HENL-18-1-010	3.8	32	7.7	309	18	0.152%	4.1	13.6	10.8	3.6	87.5%	2	24
Henley Avenue	55	HENL-18-1-010	HENL-17-1-010	11.0	59	11.2	334	30	0.324%	23.4	11.4	9.4	-12.1	-51.9%	10	
Henley Avenue	55	HENL-17-1-010	HENL-16-1-020	59.7	245	45.5	68	42	0.049%	22.3	11.4	8.5	23.2	104.1%	1	60
Henley Avenue	55	HENL-16-1-020	HENL-16-1-010	59.8	245	45.3	267	42	0.385%	62.5	11.4	8.6	-17.1	-27.4%	10	
Henley Avenue	55	HENL-16-1-010	HENL-15-1-020	66.7	277	47.7	75	42	0.040%	20.1	13.9	11.0	27.5	137.0%	1	60
Henley Avenue	55	HENL-15-1-020	HENL-15-1-010	66.8	277	47.5	261	42	0.001%	3.4	13.7	10.9	44.0	1290.1%	0	108
Henley Avenue	55	HENL-15-1-010	HENL-14-1-010	77.1	336	51.3	334	42	0.325%	57.3	16.0	12.5	-6.0	-10.5%	10	
Henley Avenue	55	HENL-14-1-010	HENL-13-1-010	86.1	357	52.9	302	42	0.177%	42.3	16.6	13.0	10.6	25.0%	4	48
Henley Avenue	55	HENL-13-1-010	HENL-12-1-010	96.1	395	56.1	290	42	0.334%	58.1	17.2	13.7	-2.0	-3.5%	10	

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Henley Avenue	55	HENL-12-1-010	HENL-11-1-010	104.2	432	59.7	191	42	0.223%	47.5	17.3	13.5	12.2	25.8%	4	48
Henley Avenue	55	HENL-11-1-010	25928	108.4	434	59.8	239	42	0.048%	22.0	17.7	14.2	37.8	172.3%	0	66
CATALPA INLET (NORTH - MORTENSON)																
Twelve Mile Road	56	TWEL-20-1-010	MORT-19-1-010	2.2	0	4.6	423	15	0.576%	4.9	7.3	2.7	-0.3	-6.2%	10	
Rosemont Road	56	ROSE-20-1-040	ROSE-20-1-050	0.0	6	0.1	260	12	0.133%	1.3	10.6	9.8	-1.2	-90.7%	10	
Rosemont Road	56	ROSE-20-1-050	ROSE-20-1-053	0.0	15	0.3	64	12	3.137%	6.3	10.2	9.4	-6.0	-95.2%	10	
Rosemont Road	56	ROSE-20-1-053	ROSE-20-1-057	0.0	18	0.4	150	12	0.336%	2.1	10.5	8.3	-1.7	-82.6%	10	
Rosemont Road	56	ROSE-20-1-057	ROSE-20-1-060	0.0	19	0.4	57	12	0.330%	2.0	9.3	5.9	-1.7	-81.4%	10	
Rosemont Road	56	ROSE-20-1-060	MORT-18-1-020	0.0	26	0.5	491	12	0.331%	2.1	9.7	6.0	-1.5	-74.6%	10	
Beverly Boulevard	56	BEVE-20-1-040	BEVE-20-1-050	0.0	14	0.3	470	12	0.328%	2.0	6.3	5.5	-1.8	-86.3%	10	
Beverly Boulevard	56	BEVE-20-1-050	MORT-17-1-020	0.0	26	0.5	490	12	0.408%	2.3	6.5	5.7	-1.8	-77.1%	10	
Earlmont Road	56	EARL-20-1-030	EARL-20-1-040	0.0	2	0.0	96	12	5.194%	8.1	7.9	7.1	-8.1	-99.5%	10	
Earlmont Road	56	EARL-20-1-040	EARL-20-1-050	0.0	13	0.3	466	12	0.402%	2.3	7.2	6.4	-2.0	-88.5%	10	
Earlmont Road	56	EARL-20-1-050	MORT-16-1-050	0.0	23	0.5	461	12	0.427%	2.3	9.2	8.4	-1.9	-80.2%	10	
Earlmont Road	56	EARL-20-1-010	EARL-20-1-020	4.3	0	2.8	382	12	0.288%	1.9	4.2	0.0	0.9	46.4%	4	15
Earlmont Road	56	EARL-20-1-020	MORT-16-1-030	6.8	0	5.3	124	12	0.300%	2.0	4.3	0.0	3.3	171.0%	0	18
Mortenson Boulevard	56	MORT-16-1-030	MORT-16-1-040	6.8	0	5.2	39	12	1.534%	4.4	5.1	1.7	0.8	17.9%	5	15
Mortenson Boulevard	56	MORT-16-1-040	MORT-16-1-050	7.7	0	6.1	114	12	0.519%	2.6	6.5	2.9	3.5	138.3%	1	18
Mortenson Boulevard	56	MORT-16-1-050	MORT-16-1-020	7.7	23	6.0	28	12	0.520%	2.6	10.6	9.1	3.5	135.2%	1	18
Edgewood Boulevard	56	EDGE-20-1-060	MORT-15-1-020	0.0	12	0.2	491	12	1.175%	3.9	8.9	8.1	-3.6	-93.8%	10	
Wiltshire Road	56	WILT-20-1-020	WILT-20-1-030	0.0	2	0.0	94	12	0.364%	2.1	9.3	8.5	-2.1	-98.1%	10	
Wiltshire Road	56	WILT-20-1-030	WILT-20-1-040	0.0	7	0.1	247	12	0.478%	2.5	7.4	6.6	-2.3	-94.3%	10	
Wiltshire Road	56	WILT-20-1-040	WILT-20-1-050	0.0	14	0.3	269	12	0.131%	1.3	8.7	7.9	-1.0	-78.3%	10	
Wiltshire Road	56	WILT-20-1-050	MORT-14-1-020	0.0	24	0.5	435	12	0.364%	2.1	9.6	8.8	-1.7	-77.7%	10	

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Franklin Road	56	FRAN-20-1-050	FRAN-20-1-060	0.0	12	0.2	330	12	0.403%	2.3	8.1	7.3	-2.0	-89.4%	10	
Franklin Road	56	FRAN-20-1-060	FRAN-20-1-070	0.0	23	0.5	300	12	0.406%	2.3	8.9	8.1	-1.8	-79.7%	10	
Franklin Road	56	FRAN-20-1-070	FRAN-20-1-080	0.0	33	0.7	300	12	0.438%	2.4	8.9	8.1	-1.7	-72.0%	10	
Franklin Road	56	FRAN-20-1-080	MORT-13-1-020	0.0	33	0.7	27	12	16.845%	14.6	8.3	7.5	-14.0	-95.5%	10	
Dorothea Road	56	DORO-20-1-040	DORO-20-1-050	0.0	4	0.1	97	12	1.591%	4.5	7.8	7.0	-4.4	-98.2%	10	
Dorothea Road	56	DORO-20-1-050	DORO-20-1-060	0.0	27	0.5	652	12	0.413%	2.3	7.2	6.4	-1.7	-76.4%	10	
Dorothea Road	56	DORO-20-1-060	MORT-12-1-020	0.0	35	0.7	292	12	0.340%	2.1	9.3	8.5	-1.4	-66.3%	10	
Dorothea Road	56	DORO-20-1-080	DORO-20-1-090	0.0	8	0.2	476	12	0.408%	2.3	7.3	6.5	-2.1	-93.0%	10	
Dorothea Road	56	DORO-20-1-090	MORT-11-1-030	0.0	17	0.3	460	12	0.283%	1.9	9.3	8.5	-1.6	-82.1%	10	
Rosemont Road	56	ROSE-22-1-010	MORT-18-1-020	0.0	0	0.0	8	15	2.751%	10.7	9.3	4.2	-10.7	-100.0%	10	
Earlmont Road	56	EARL-22-1-030	MORT-16-1-020	0.0	0	0.0	9	18	1.402%	12.4	10.6	9.4	-12.4	-100.0%	10	
Edgewood Boulevard	56	EDGE-22-1-010	MORT-15-1-020	0.0	0	0.0	8	12	3.019%	6.2	9.2	8.4	-6.2	-100.0%	10	
Wiltshire Road	56	WILT-23-1-020	WILT-23-1-010	0.0	15	0.3	400	15	0.628%	5.1	8.7	7.7	-4.8	-94.3%	10	
	56	WILT-23-1-010	WILT-22-1-030	0.0	28	0.6	396	15	0.567%	4.9	9.4	8.4	-4.3	-88.5%	10	
Edgewood Boulevard	56	EDGE-20-1-030	MORT-15-1-030	1.2	0	1.9	236	10	0.877%	2.1	5.5	4.8	-0.2	-8.8%	10	
Mortenson Boulevard	56	MORT-15-1-030	WILT-22-1-030	1.2	0	1.8	180	10	0.572%	1.7	6.3	5.6	0.2	10.1%	7	
Wiltshire Road	56	WILT-22-1-030	MORT-14-1-020	1.2	28	1.8	9	12	0.949%	3.5	7.4	6.6	-1.7	-48.5%	10	
Wiltshire Road	56	WILT-22-1-010	MORT-13-1-020	5.6	2	5.5	12	12	3.930%	7.1	8.4	7.6	-1.6	-22.0%	10	
Mortenson Boulevard	56	MORT-12-1-030	MORT-12-1-020	0.0	0	0.0	9	12	1.766%	4.7	8.1	7.3	-4.7	-100.0%	10	
Mortenson Boulevard	56	MORT-12-1-030	WILT-22-1-010	0.0	2	0.0	261	12	0.485%	2.5	8.2	7.4	-2.4	-98.4%	10	

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Mortenson Boulevard	56	MORT-14-1-030	WILT-22-1-010	5.6	0	5.6	157	12	0.598%	2.8	6.0	2.3	2.8	103.3%	1	18
Mortenson Boulevard	56	MORT-19-1-010	MORT-18-1-020	1.5	0	3.2	154	15	0.563%	4.8	8.3	3.4	-1.7	-34.1%	10	
Mortenson Boulevard	56	MORT-18-1-020	MORT-18-1-010	4.1	28	7.5	148	15	0.223%	3.1	9.5	4.0	4.4	144.1%	1	21
Mortenson Boulevard	56	MORT-18-1-010	MORT-18-1-030	0.0	0	0.0	9	12	4.674%	7.7	6.4	5.5	-7.7	-99.9%	10	
Mortenson Boulevard	56	MORT-18-1-030	BEVE-22-1-010	0.0	0	0.0	169	15	0.366%	3.9	6.3	5.3	-3.9	-99.7%	10	
Rosemont Road	56	ROSE-20-1-010	ROSE-20-1-020	2.1	0	2.8	287	8	1.138%	1.3	4.8	0.0	1.5	117.2%	1	12
Rosemont Road	56	ROSE-20-1-020	ROSE-20-1-030	2.1	0	2.7	300	12	0.548%	2.6	6.9	4.6	0.1	3.2%	10	
Rosemont Road	56	ROSE-20-1-030	MORT-18-1-010	2.1	0	2.6	45	12	0.587%	2.7	8.8	6.5	-0.1	-3.4%	10	
Mortenson Boulevard	56	MORT-18-1-010	MORT-17-1-020	12.5	28	9.9	170	18	0.280%	5.6	10.3	6.5	4.3	77.7%	2	24
Mortenson Boulevard	56	MORT-17-1-020	MORT-17-1-010	12.5	54	9.7	183	18	0.088%	3.1	12.1	9.1	6.6	210.7%	0	30
Mortenson Boulevard	56	MORT-17-1-010	MORT-16-1-020	12.5	54	9.4	178	27	0.462%	21.0	14.4	12.6	-11.7	-55.4%	10	
Mortenson Boulevard	56	MORT-16-1-020	MORT-16-1-010	20.2	77	14.8	174	30	0.447%	27.4	13.8	11.8	-12.6	-46.0%	10	
Mortenson Boulevard	56	MORT-16-1-010	MORT-15-1-020	20.2	77	14.6	136	30	0.320%	23.2	14.3	12.3	-8.6	-37.3%	10	
Mortenson Boulevard	56	MORT-15-1-020	MORT-15-1-010	20.2	89	14.4	171	30	0.650%	33.1	14.0	12.0	-18.7	-56.6%	10	
Mortenson Boulevard	56	MORT-15-1-010	MORT-14-1-020	23.3	89	15.7	190	30	0.202%	18.4	15.6	12.4	-2.7	-14.7%	10	
Mortenson Boulevard	56	MORT-14-1-020	MORT-14-1-010	24.6	141	17.0	140	30	0.343%	24.0	15.1	11.8	-7.1	-29.4%	10	
Mortenson Boulevard	56	MORT-14-1-010	MORT-13-1-020	24.6	141	16.7	184	30	0.914%	39.2	15.1	11.6	-22.5	-57.3%	10	
Mortenson Boulevard	56	MORT-13-1-020	MORT-13-1-010	30.2	176	20.8	105	30	2.211%	61.0	16.2	14.2	-40.1	-65.8%	10	
Franklin Road	56	FRAN-20-1-030	MORT-13-1-010	5.1	0	3.8	32	12	5.918%	8.7	4.8	4.0	-4.9	-56.2%	10	
Mortenson Boulevard	56	MORT-13-1-010	MORT-12-1-020	35.3	176	23.6	162	30	0.564%	30.8	17.1	15.1	-7.2	-23.3%	10	

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Mortenson Boulevard	56	MORT-12-1-020	MORT-12-1-010	35.3	211	23.4	132	30	0.356%	24.5	18.0	16.0	-1.1	-4.4%	10	
Dorothea Road	56	DORO-20-1-020	DORO-20-1-030	1.6	0	1.0	126	12	0.319%	2.0	4.1	3.3	-1.0	-50.3%	10	
Dorothea Road	56	DORO-20-1-030	MORT-12-1-010	5.0	0	2.0	33	12	1.454%	4.3	4.6	3.8	-2.3	-54.5%	10	
Mortenson Boulevard	56	MORT-12-1-010	MORT-11-1-020	40.4	211	24.7	192	30	0.387%	25.5	19.4	17.4	-0.8	-3.0%	10	
Mortenson Boulevard	56	MORT-11-1-030	MORT-11-1-020	0.0	0	0.0	12	12	5.642%	8.5	9.5	8.7	-8.5	-100.0%	10	
Mortenson Boulevard	56	MORT-11-1-030	25926	0.0	0	0.0	182	15	0.830%	5.9	10.8	9.8	-5.9	-100.0%	10	
Mortenson Boulevard	56	MORT-11-1-020	MORT-11-1-010	40.4	211	24.5	172	30	0.893%	38.8	19.3	17.3	-14.3	-36.8%	10	
Mortenson Boulevard	56	MORT-11-1-010	25926	40.4	211	24.3	17	30	1.179%	44.5	19.9	17.2	-20.3	-45.5%	10	
CATALPA INLET (NORTH - CASS)																
Twelve Mile Road	57	MORT-19-1-010	TWEL-20-1-020	1.8	0	3.8	77	15	0.291%	3.5	8.2	3.4	0.3	7.6%	8	
Twelve Mile Road	57	TWEL-20-1-020	TWEL-28-1-010	1.8	20	3.7	324	15	0.376%	4.0	8.1	3.3	-0.2	-6.1%	10	
Twelve Mile Road	57	TWEL-28-1-010	TWEL-28-1-030	2.9	24	5.4	214	15	0.493%	4.5	8.9	3.8	0.9	19.7%	5	18
Rosemont Road	57	ROSE-22-1-010	ROSE-22-1-020	0.0	3	0.1	358	15	0.314%	3.6	9.3	4.6	-3.6	-98.3%	10	
Rosemont Road	57	ROSE-22-1-020	WOOD-15-1-040	1.9	5	3.5	200	15	0.201%	2.9	9.2	3.4	0.6	22.0%	5	18
Brookline Street	57	WOOD-15-1-040	TWEL-28-1-020	2.8	5	5.4	133	15	0.300%	3.5	8.5	2.9	1.9	52.6%	3	18
Twelve Mile Road	57	TWEL-28-1-020	TWEL-28-1-030	3.1	5	6.0	45	15	0.300%	3.5	8.9	3.8	2.5	69.9%	2	21
Twelve Mile Road	57	TWEL-28-1-030	WOOD-19-1-010	6.6	29	11.9	51	15	0.359%	3.9	8.6	3.8	8.0	207.4%	0	24
Woodward Avenue	57	WOOD-19-1-010	WOOD-15-1-025	6.9	47	12.4	524	30	0.300%	22.5	8.8	5.4	-10.1	-44.8%	10	
Woodward Avenue	57	WOOD-15-1-025	WOOD-15-1-020	8.4	47	14.9	32	30	0.300%	22.5	8.1	3.7	-7.5	-33.6%	10	
Beverly Boulevard	57	MORT-17-1-020	BEVE-22-1-010	0.0	0	0.0	10	15	1.643%	8.3	8.7	7.7	-8.3	-99.9%	10	
Beverly Boulevard	57	BEVE-22-1-010	BEVE-22-1-020	0.0	9	0.2	197	15	0.240%	3.2	9.5	8.5	-3.0	-93.9%	10	
Beverly Boulevard	57	BEVE-22-1-020	BROO-17-1-030	0.0	19	0.4	302	15	0.240%	3.2	12.2	8.6	-2.8	-87.3%	10	

Appendix C
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Brookline Street	57	BROO-17-1-030	BROO-17-1-020	2.6	23	0.5	204	15	0.026%	1.1	8.6	4.3	-0.6	-54.6%	10	
Brookline Street	57	BROO-17-1-020	BROO-17-1-010	6.7	23	5.0	82	15	0.236%	3.1	6.9	2.4	1.8	58.4%	3	18
Brookline Street	57	BROO-17-1-010	BROO-17-1-050	6.7	23	4.9	118	18	0.514%	7.5	20.7	16.5	-2.6	-34.7%	10	
Brookline Street	57	BROO-17-1-060	BROO-17-1-050	0.3	10	0.8	180	12	0.767%	3.1	10.8	5.3	-2.3	-74.8%	10	
Brookline Street	57	BROO-17-1-050	WOOD-15-1-020	6.9	27	6.0	138	18	0.433%	6.9	8.8	4.2	-0.9	-12.7%	10	
Brookline Street	57	BROO-17-1-050	BROO-17-1-040	1.3	5	1.2	20	12	0.750%	3.1	11.0	4.2	-1.9	-62.7%	10	
Brookline Street	57	BROO-17-1-040	BROO-16-1-030	1.3	14	1.1	146	12	0.211%	1.6	9.4	2.3	-0.5	-30.0%	10	
Brookline Street	57	BROO-16-1-030	BROO-15-1-020	1.6	20	1.3	317	12	0.321%	2.0	9.4	2.1	-0.7	-33.8%	10	
Brookline Street	57	BROO-15-1-020	EDGE-28-1-020	3.4	35	3.6	322	12	0.324%	2.0	8.8	0.0	1.6	78.5%	2	15
Woodward Avenue	57	WOOD-15-1-020	WOOD-15-1-015	15.4	74	20.7	355	30	0.217%	19.1	9.0	4.1	1.6	8.3%	8	
Woodward Avenue	57	WOOD-15-1-015	WOOD-15-1-010	16.3	74	21.9	281	30	0.062%	10.2	8.1	3.1	11.6	113.8%	1	42
Woodward Avenue	57	WOOD-15-1-010	WOOD-14-1-030	17.0	74	22.4	396	30	0.097%	12.8	7.6	3.3	9.6	74.9%	2	42
Woodward Avenue	57	WOOD-14-1-030	WOOD-14-1-020	25.0	118	27.3	351	30	0.080%	11.6	6.3	2.6	15.7	135.6%	1	42
Woodward Avenue	57	WOOD-14-1-020		25.8	118	27.6	102	30	0.080%	11.6	5.0	2.6	16.0	138.1%	1	42
Woodward Avenue	57	WOOD-11-1-030	WOOD-12-1-020	0.5	0	1.4	258	12	0.322%	2.0	4.4	2.4	-0.6	-29.9%	10	
Woodward Avenue	57	WOOD-12-1-020	WOOD-12-1-030	1.3	0	3.2	270	15	0.253%	3.3	5.5	3.7	0.0	-1.0%	10	
Woodward Avenue	57	WOOD-12-1-030		2.0	0	4.6	306	15	0.249%	3.2	6.4	4.6	1.4	44.2%	4	18
Earlmont Road	57	EARL-22-1-030	EARL-22-1-040	0.0	22	0.4	398	15	0.664%	5.3	10.7	9.6	-4.8	-91.8%	10	
Earlmont Road	57	EARL-22-1-040	BROO-16-1-020	0.0	37	0.7	344	15	0.664%	5.3	17.1	13.4	-4.5	-85.9%	10	
Brookline Street	57	BROO-16-1-020	BROO-16-1-010	0.0	37	0.7	211	15	0.668%	5.3	7.0	1.1	-4.5	-86.0%	10	
Earlmont Road	57	EARL-22-1-010	EARL-22-1-020	1.7	0	1.0	421	12	0.259%	1.8	6.1	3.8	-0.8	-44.8%	10	
Earlmont Road	57	EARL-22-1-020	BROO-16-1-010	7.4	0	4.0	32	12	4.831%	7.8	2.8	0.0	-3.8	-49.1%	10	
Brookline Street	57	BROO-16-1-010	BROO-15-1-010	8.5	37	4.9	430	15	0.973%	6.4	7.3	0.0	-1.5	-23.0%	10	
Edgewood Boulevard	57	EDGE-22-1-010	EDGE-22-1-020	0.0	20	0.4	362	15	0.404%	4.1	9.5	8.5	-3.7	-90.3%	10	
Edgewood Boulevard	57	EDGE-22-1-020	EDGE-22-1-030	0.0	35	0.7	342	15	0.509%	4.6	8.9	7.9	-3.9	-85.0%	10	
Edgewood Boulevard	57	EDGE-22-1-030	EDGE-22-1-040	0.0	37	0.7	155	15	0.873%	6.0	7.6	6.6	-5.3	-87.7%	10	
Edgewood Boulevard	57	EDGE-22-1-040	EDGE-22-1-050	2.5	45	1.0	331	15	0.261%	3.3	8.7	6.9	-2.3	-69.7%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Edgewood Boulevard	57	EDGE-22-1-050	EDGE-28-1-010	5.0	45	2.4	128	15	0.132%	2.3	5.8	3.3	0.0	0.3%	10	
Edgewood Boulevard	57	EDGE-28-1-010	EDGE-28-1-030	5.0	45	2.3	149	18	0.234%	5.1	6.2	3.4	-2.8	-54.6%	10	
Edgewood Boulevard	57	EDGE-28-1-030		6.1	45	3.6	138	18	0.209%	4.8	6.3	3.1	-1.2	-24.8%	10	
Brookline Street	57	BROO-14-1-020	EDGE-28-1-020	0.0	15	0.3	329	12	0.529%	2.6	6.3	0.0	-2.3	-88.4%	10	
Edgewood Boulevard	57	EDGE-28-1-020	BROO-15-1-010	4.3	50	4.8	154	18	0.243%	5.2	9.8	0.0	-0.4	-8.3%	10	
Brookline Street	57	BROO-15-1-010	BROO-14-1-010	15.7	87	10.5	206	15	0.256%	3.3	10.8	0.0	7.2	219.8%	0	24
Wiltshire Road	57	WILT-23-1-020	BROO-14-1-010	0.0	16	0.3	457	15	3.141%	11.4	8.7	7.7	-11.1	-97.3%	10	
Brookline Street	57	BROO-14-1-010	WILT-28-1-010	19.9	102	11.0	169	15	0.174%	2.7	11.7	0.0	8.3	307.7%	0	27
Wiltshire Road	57	WILT-22-1-010	WILT-22-1-020	0.0	5	0.1	220	15	0.084%	1.9	8.7	7.7	-1.8	-94.7%	10	
Wiltshire Road	57	WILT-22-1-020	RUSS-23-1-010	0.0	7	0.1	219	18	0.768%	9.2	10.4	9.2	-9.1	-98.6%	10	
Wiltshire Road	57	RUSS-23-1-010	RUSS-24-1-010	0.0	15	0.3	453	18	0.585%	8.0	11.1	9.9	-7.7	-96.4%	10	
Wiltshire Road	57	RUSS-24-1-010	WILT-25-1-010	0.0	15	0.3	137	18	0.079%	2.9	6.6	5.4	-2.7	-90.2%	10	
Wiltshire Road	57	WILT-25-1-010	WILT-25-1-020	1.9	22	2.2	347	18	0.195%	4.6	6.8	5.6	-2.4	-52.3%	10	
Wiltshire Road	57	WILT-25-1-020	WILT-28-1-030	2.5	24	2.5	108	18	0.460%	7.1	4.2	3.0	-4.6	-65.0%	10	
Wiltshire Road	57	WILT-28-1-030	WILT-28-1-040	2.5	29	2.5	242	18	0.107%	3.4	4.2	2.8	-1.0	-28.7%	10	
Wiltshire Road	57	WILT-28-1-040	WOOD-14-1-010	4.3	29	4.5	130	18	0.394%	6.6	4.0	2.5	-2.1	-32.3%	10	
Wiltshire Road	57	WOOD-14-1-010		5.0	29	4.4	2	24	0.411%	14.5	5.1	3.3	-10.1	-69.6%	10	
Wiltshire Road	57	WILT-28-1-020	WILT-28-1-010	0.2	3	0.4	324	12	0.359%	2.1	7.7	0.0	-1.7	-79.3%	10	
Wiltshire Road	57	WILT-28-1-010	CASS-14-1-010	20.0	105	11.1	403	18	0.226%	5.0	10.6	0.0	6.1	121.5%	1	27
Wiltshire Road	57	WILT-25-1-010	CASS-14-1-010	0.0	0	0.0	31	15	6.388%	16.3	5.3	0.2	-16.3	-100.0%	10	
Cass Boulevard	57	CASS-14-1-010	CASS-13-1-020	20.9	105	11.0	142	24	0.417%	14.6	15.6	0.7	-3.6	-24.6%	10	
Cass Boulevard	57	CASS-13-1-020	CASS-13-1-010	21.9	107	11.2	141	15	0.601%	5.0	15.2	0.0	6.2	124.6%	1	21

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Dorothea Road	57	DORO-22-1-010	DORO-22-1-020	0.0	8	0.2	200	12	0.774%	3.1	8.1	7.3	-3.0	-94.9%	10	
Dorothea Road	57	DORO-22-1-020	DORO-23-1-010	0.0	13	0.3	142	12	1.393%	4.2	11.9	11.1	-3.9	-93.8%	10	
Ferris Street	57	FERR-13-1-010	DORO-23-1-010	0.0	11	0.2	408	12	0.373%	2.2	11.9	11.1	-2.0	-89.9%	10	
Dorothea Road	57	DORO-23-1-010	DORO-24-1-010	4.3	34	1.5	271	12	0.742%	3.1	16.0	15.2	-1.6	-51.1%	10	
Central Street	57	CENT-13-1-010	DORO-24-1-010	0.0	8	0.2	418	12	1.195%	3.9	11.0	10.2	-3.7	-95.9%	10	
Dorothea Road	57	DORO-24-1-010	CASS-12-1-010	7.5	51	2.4	263	15	0.867%	6.0	11.2	10.2	-3.6	-60.4%	10	
Woodward Avenue	57	WOOD-14-1-050	WOOD-14-1-040	0.0	4	0.1	138	12	0.323%	2.0	8.9	1.9	-1.9	-96.0%	10	
Woodward Avenue	57	WOOD-14-1-040	WOOD-13-1-020	0.0	4	0.1	101	12	0.282%	1.9	9.0	1.5	-1.8	-95.8%	10	
Woodward Avenue	57	WOOD-13-1-020	WOOD-13-1-010	0.3	9	0.6	100	12	0.331%	2.0	9.1	1.2	-1.5	-73.1%	10	
Woodward Avenue	57	WOOD-13-1-010	FRAN-25-1-030	0.3	14	0.5	156	12	0.325%	2.0	9.4	1.2	-1.5	-73.3%	10	
Woodward Avenue	57	DORO-25-1-030	WOOD-12-1-050	0.0	17	0.3	295	12	0.556%	2.7	10.2	3.1	-2.3	-87.6%	10	
Woodward Avenue	57	WOOD-12-1-050	FRAN-25-1-030	0.8	17	0.3	57	12	0.239%	1.7	11.3	2.7	-1.4	-81.1%	10	
Franklin Road	57	FRAN-25-1-030	FRAN-25-1-020	2.0	39	2.4	246	15	0.248%	3.2	10.1	0.8	-0.8	-24.7%	10	
Franklin Road	57	FRAN-25-1-020	FRAN-25-1-010	2.0	49	2.3	252	15	0.026%	1.0	9.8	0.2	1.3	123.9%	1	21
Franklin Road	57	FRAN-25-1-010	CASS-13-1-010	8.4	64	3.1	410	15	0.138%	2.4	9.3	0.0	0.7	29.2%	4	18
Dorothea Road	57	DORO-25-1-030	DORO-25-1-020	1.2	18	1.0	435	12	0.306%	2.0	10.1	9.3	-1.0	-49.2%	10	
Dorothea Road	57	DORO-25-1-020	DORO-25-1-010	1.2	32	0.9	341	12	0.382%	2.2	13.0	11.2	-1.3	-57.9%	10	
Dorothea Road	57	DORO-25-1-010	CASS-12-1-010	3.9	43	4.2	337	15	0.268%	3.3	11.5	8.7	0.8	24.9%	5	18
Woodward Avenue	57	DORO-25-1-030	WOOD-11-1-040	0.0	0	0.0	217	12	2.026%	5.1	6.6	0.8	-5.1	-100.0%	10	
Woodward Avenue	57	WOOD-11-1-040	CATA-25-1-040	2.6	9	2.3	214	12	0.290%	1.9	11.3	1.1	0.4	19.8%	5	15
Catalpa Drive	57	CATA-25-1-040	CATA-25-1-030	5.2	14	7.2	345	15	0.181%	2.7	10.3	0.0	4.4	160.9%	0	24
Catalpa Drive	57	CATA-25-1-030	CATA-25-1-020	5.2	28	6.8	336	15	0.112%	2.2	12.5	0.0	4.6	214.3%	0	24
Catalpa Drive	57	CATA-25-1-020	CATA-25-1-010	6.7	40	8.6	335	15	0.144%	2.5	14.6	2.9	6.2	251.8%	0	27
Catalpa Drive	57	CATA-25-1-010	CASS-11-1-010	6.7	51	8.2	336	15	0.296%	3.5	16.2	9.9	4.7	133.2%	1	21

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Cass Boulevard	57	CASS-13-1-010	CASS-12-1-010	31.3	172	14.3	290	15	0.177%	2.7	14.1	0.0	11.5	424.4%	0	30
Cass Boulevard	57	CASS-12-1-010	CASS-11-1-010	52.6	266	22.4	367	48	0.210%	65.8	12.3	9.1	-43.4	-66.0%	10	
Cass Boulevard	57	CASS-11-1-010	26355	62.2	317	29.5	10	48	24.277%	707.8	15.4	12.2	-678.2	-95.8%	10	
HENLEY INLET (WEST - SUNNYKNOLL)																
Sunnyknoll Avenue	58	SUNN-18-1-010	SUNN-19-1-020	0.0	152	3.0	456	10	0.798%	2.0	8.9	0.2	1.1	54.8%	10	
Sunnyknoll Avenue	58	SUNN-19-1-020	SUNN-19-1-030	5.0	162	3.8	332	12	0.232%	1.7	9.2	5.4	2.1	121.5%	1	18
Sunnyknoll Avenue	58	SUNN-19-1-030	25929	7.8	169	5.8	323	12	3.592%	6.8	9.8	9.0	-1.0	-14.5%	10	
CATALPA INLET (WEST - MORTENSON)																
Catalpa Drive	59	CATA-20-1-010	CATA-20-1-020	0.0	11	0.2	335	12	0.628%	2.8	9.2	8.4	-2.6	-92.2%	10	
Catalpa Drive	59	CATA-20-1-020	CATA-20-1-030	0.9	23	1.5	350	12	0.697%	3.0	11.1	10.3	-1.4	-48.7%	10	
Catalpa Drive	59	CATA-20-1-030	25926	2.1	34	3.5	341	12	0.652%	2.9	13.3	11.5	0.6	20.3%	5	15
CASS INLET (WEST - WEST)																
West Boulevard	60	WEST-21-1-010	WEST-22-1-010	0.6	11	1.0	400	12	1.665%	4.6	8.8	8.0	-3.6	-78.6%	10	
Mortenson Boulevard	60	MORT-10-1-010	WEST-22-1-010	0.0	8	0.2	209	12	0.290%	1.9	11.1	9.9	-1.8	-91.7%	10	
West Boulevard	60	WEST-22-1-010	WEST-22-1-020	3.4	25	4.9	306	12	1.486%	4.3	9.9	7.6	0.5	12.0%	7	
West Boulevard	60	WEST-22-1-020	WEST-22-1-030	3.9	37	5.7	312	15	1.500%	7.9	9.2	8.1	-2.2	-27.8%	10	
West Boulevard	60	WEST-22-1-030	26354	8.1	49	9.7	311	15	1.500%	7.9	14.6	11.3	1.8	22.5%	5	18
OXFORD INLET (SOUTH - BERKLEY)																
Oxford Road	61	OXFO-18-1-020	OXFO-18-1-030	0.9	23	2.0	165	15	0.693%	5.4	9.1	8.1	-3.4	-63.6%	10	

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

COMBINED SEWER DESIGN CALCULATIONS FOR RESTRICTED CONDITIONS (ASSUMING 12-TOWNS DRAIN HAS SUFFICIENT CAPACITY)

STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Oxford Road	61	OXFO-18-1-030	25933	1.1	23	2.1	74	15	0.652%	5.2	11.0	10.0	-3.2	-60.7%	10	
CASS INLET (WEST - EATON)																
Oxford Road	62	OXFO-19-1-010	OXFO-19-1-020	0.0	12	0.2	330	10	2.077%	3.2	4.8	2.8	-2.9	-92.4%	10	
Oxford Road	62	OXFO-19-1-020	OXFO-20-1-010	0.0	21	0.4	330	10	0.441%	1.5	10.9	2.0	-1.0	-71.1%	10	
Oxford Road	62	OXFO-20-1-010	OXFO-20-1-020	2.2	27	3.9	333	10	1.273%	2.5	10.2	0.0	1.4	57.9%	3	12
Oxford Road	62	OXFO-20-1-020	HAMI-07-1-010	3.8	82	7.0	335	12	0.582%	2.7	10.3	0.0	4.3	158.0%	0	18
Hamilton Avenue	62	HAMI-07-1-010	OXFO-21-1-010	3.8	82	6.8	31	15	0.088%	1.9	10.1	8.4	4.9	252.9%	0	27
Oxford Road	62	OXFO-21-1-010		4.7	82	8.3	15	18	69.398%	87.5	9.9	8.7	-79.2	-90.5%	10	
Oxford Road	62	OXFO-21-1-010	OXFO-22-1-010	0.0	8	0.2	394	15	0.591%	5.0	10.1	9.1	-4.8	-96.8%	10	
Mortenson Boulevard	62	MORT-06-1-010	OXFO-22-1-010	0.0	10	0.2	247	10	0.422%	1.4	9.5	8.8	-1.2	-85.9%	10	
Sunnyknoll Avenue	62	SUNN-20-1-010	25929	1.7	0	0.0	11	12	1.837%	4.8	9.0	8.2	-4.8	-100.0%	10	
Sunnyknoll Avenue	62	SUNN-20-1-010	SUNN-20-1-020	2.7	11	2.6	333	15	0.602%	5.0	9.2	8.2	-2.4	-47.7%	10	
Sunnyknoll Avenue	62	SUNN-20-1-020	HAMI-09-1-010	6.1	22	3.4	327	15	0.267%	3.3	9.4	7.0	0.1	2.6%	10	
Hamilton Avenue	62	HAMI-09-1-010	EATO-21-1-010	8.4	22	4.2	105	15	0.404%	4.1	10.0	7.5	0.1	2.2%	9	
Hamilton Avenue	62	HAMI-07-1-020	HAMI-07-1-030	0.0	2	0.0	60	12	0.269%	1.8	6.9	5.2	-1.8	-97.8%	10	
Hamilton Avenue	62	HAMI-07-1-030	EATO-21-1-010	0.0	2	0.0	109	12	0.468%	2.4	8.6	6.1	-2.4	-98.4%	10	
Eaton Road	62	EATO-21-1-010	EATO-22-1-010	8.6	32	4.5	397	15	1.234%	7.2	11.1	6.9	-2.7	-37.9%	10	
Mortenson Boulevard	62	MORT-08-1-010	EATO-22-1-010	0.0	10	0.2	222	12	0.192%	1.6	10.5	4.7	-1.4	-87.2%	10	
Mortenson Boulevard	62	OXFO-22-1-010	MORT-07-1-010	0.0	10	0.2	220	12	0.211%	1.6	9.4	3.6	-1.4	-87.8%	10	
Mortenson Boulevard	62	MORT-07-1-010	EATO-22-1-010	1.8	12	1.0	90	12	0.093%	1.1	8.5	2.2	-0.1	-7.8%	10	
Eaton Road	62	EATO-22-1-010	EATO-22-1-020	13.0	60	8.5	306	18	0.258%	5.3	10.3	3.2	3.1	58.4%	3	24
Eaton Road	62	EATO-22-1-020	EATO-22-1-030	14.9	72	10.5	313	18	0.124%	3.7	10.3	4.3	6.8	185.4%	0	27

Appendix C
Combined Sewer Area Study
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eaton Road	62	EATO-22-1-030	26353	18.4	84	10.1	313	18	0.262%	5.4	10.7	7.4	4.7	87.4%	2	24
CASS INLET (WEST - LARKMOOR)																
Larkmoor Boulevard	63	LARK-21-1-010	LARK-22-1-010	9.8	8	3.3	346	10	1.656%	2.8	4.1	0.0	0.5	17.1%	6	
Larkmoor Boulevard	63	LARK-22-1-010	LARK-22-1-020	10.5	8	4.5	32	10	0.783%	1.9	9.2	0.0	2.5	130.1%	1	15
Larkmoor Boulevard	63	LARK-22-1-020	LARK-22-1-030	10.5	14	4.4	311	10	0.726%	1.9	9.7	0.0	2.6	138.2%	1	15
Larkmoor Boulevard	63	LARK-22-1-030	LARK-22-1-040	10.5	26	4.3	310	10	0.883%	2.1	11.2	0.0	2.2	109.2%	1	15
Larkmoor Boulevard	63	LARK-22-1-040	26347	10.5	38	4.2	327	10	0.801%	2.0	10.8	0.8	2.2	113.5%	1	15
Larkmoor Boulevard	63	LARK-22-1-050	LARK-22-1-060	5.6	0	1.0	118	15	1.369%	7.6	7.7	6.7	-6.6	-86.8%	10	
Larkmoor Boulevard	63	LARK-22-1-060	26347	7.2	0	3.5	50	18	1.379%	12.3	8.5	7.3	-8.8	-71.5%	10	
LARKMOOR INLET (NORTH - STANFORD)																
Oxford Road	64	OXFO-22-1-010	OXFO-22-1-020	3.3	18	4.8	53	15	0.480%	4.5	10.2	8.9	0.3	7.3%	8	
Oxford Road	64	OXFO-22-1-020	OXFO-22-1-030	4.0	24	5.8	257	18	0.659%	8.5	9.9	8.6	-2.8	-32.4%	10	
Oxford Road	64	OXFO-22-1-030	OXFO-22-1-040	4.0	36	5.6	312	18	0.433%	6.9	12.0	10.8	-1.3	-18.9%	10	
Oxford Road	64	OXFO-22-1-040		5.3	48	6.3	332	18	3.617%	20.0	8.7	7.5	-13.6	-68.2%	10	
Oxford Road	64	OXFO-25-1-030	OXFO-25-1-020	3.2	15	1.0	347	12	0.317%	2.0	9.3	8.5	-1.0	-50.2%	10	
Oxford Road	64	OXFO-25-1-020		4.6	29	3.2	311	12	3.071%	6.2	10.0	9.2	-3.0	-48.3%	10	
Oxford Road	64	OXFO-25-1-030	OXFO-26-1-010	0.0	8	0.2	246	12	0.179%	1.5	9.4	8.6	-1.3	-89.4%	10	
Oxford Road	64	OXFO-26-1-010	OXFO-26-1-020	2.7	14	1.0	89	12	0.497%	2.5	10.0	9.2	-1.5	-60.2%	10	
Oxford Road	64	OXFO-26-1-020	STAN-07-1-010	2.7	27	1.0	334	12	1.705%	4.7	9.6	8.8	-3.7	-78.9%	10	
Larkmoor Boulevard	64	LARK-25-1-010	26347	0.0	0	0.0	23	18	0.338%	6.1	8.9	7.7	-6.1	-100.0%	10	
Larkmoor Boulevard	64	LARK-25-1-010	LARK-25-1-020	0.0	13	0.3	320	15	0.251%	3.2	7.1	6.1	-3.0	-92.0%	10	
Larkmoor Boulevard	64	LARK-25-1-020	LARK-25-1-030	4.0	20	2.8	161	15	0.552%	4.8	7.8	6.8	-2.0	-41.7%	10	
Larkmoor Boulevard	64	LARK-25-1-030	26348	0.0	0	0.0	25	18	0.312%	5.9	9.1	7.9	-5.9	-100.0%	10	

Appendix C
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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Larkmoor Boulevard	64	LARK-25-1-030	LARK-25-1-040	4.0	27	2.7	177	15	0.228%	3.1	9.4	8.4	-0.4	-11.6%	10	
Larkmoor Boulevard	64	LARK-25-1-040	LARK-25-1-050	8.2	43	3.6	337	15	0.211%	3.0	10.2	8.6	0.6	21.3%	6	
Larkmoor Boulevard	64	LARK-25-1-050	STAN-06-1-010	9.3	58	3.9	338	15	0.246%	3.2	11.2	9.8	0.7	21.1%	5	18
Eaton Road	64	26353	EATO-25-1-010	0.0	19	0.4	395	10	0.242%	1.1	10.5	9.0	-0.7	-64.8%	10	
Eaton Road	64	EATO-25-1-010	EATO-26-1-010	0.0	36	0.7	392	12	0.232%	1.7	8.9	6.4	-1.0	-58.0%	10	
Eaton Road	64	EATO-26-1-010	EATO-26-1-020	6.7	45	2.0	276	12	0.202%	1.6	10.9	7.5	0.4	25.0%	5	15
Eaton Road	64	EATO-26-1-020	STAN-08-1-010	6.7	53	1.9	275	12	0.344%	2.1	11.5	8.3	-0.2	-8.9%	10	
West Boulevard	64	26354	WEST-25-1-010	0.0	14	0.3	308	12	0.249%	1.8	8.5	5.8	-1.5	-84.2%	10	
West Boulevard	64	WEST-25-1-010	WEST-25-1-020	1.2	30	2.1	340	12	0.279%	1.9	9.1	5.7	0.3	13.6%	7	
West Boulevard	64	WEST-25-1-020	WEST-26-1-010	1.2	46	2.0	339	12	0.210%	1.6	9.6	6.5	0.4	24.4%	5	15
West Boulevard	64	WEST-26-1-010	STAN-10-1-010	3.5	55	2.8	340	12	0.348%	2.1	9.4	6.5	0.7	34.1%	4	15
West Boulevard	64	WOOD-08-1-030	WEST-27-1-020	0.0	0	0.0	189	12	0.228%	1.7	11.7	9.8	-1.7	-100.0%	10	
West Boulevard	64	WEST-27-1-020	WEST-27-1-010	0.2	19	0.5	33	12	1.044%	3.6	11.0	8.6	-3.1	-86.3%	10	
West Boulevard	64	WEST-27-1-010	STAN-10-1-010	1.6	19	4.3	140	15	0.451%	4.3	11.2	8.5	-0.1	-1.8%	10	
Woodward Avenue	64	WOOD-08-1-030	EATO-27-1-010	0.0	7	0.1	219	10	0.461%	1.5	12.0	9.8	-1.3	-90.6%	10	
Woodward Avenue	64	EATO-27-1-010	OXFO-27-1-020	0.0	13	0.3	364	12	0.332%	2.1	9.9	1.3	-1.8	-87.3%	10	
Oxford Road	64	OXFO-27-1-020	OXFO-27-1-010	3.3	53	5.1	273	12	0.385%	2.2	10.2	0.0	2.9	130.6%	1	18
Oxford Road	64	OXFO-27-1-010	STAN-07-1-010	3.3	67	4.9	291	12	0.448%	2.4	12.4	4.6	2.5	106.5%	1	18
Eaton Road	64	EATO-27-1-010	STAN-08-1-010	2.1	18	4.0	368	15	0.405%	4.1	10.2	6.8	-0.1	-3.6%	10	
Stanford Road	64	STAN-10-1-010	STAN-08-1-010	10.1	74	11.7	274	24	0.217%	10.5	14.4	7.3	1.1	10.7%	7	
Stanford Road	64	STAN-08-1-010	STAN-07-1-010	21.3	146	19.3	308	24	0.186%	9.7	15.6	8.6	9.6	98.1%	2	33
Stanford Road	64	STAN-07-1-010	STAN-06-1-010	29.9	240	26.8	289	24	0.166%	9.2	15.2	9.7	17.6	191.2%	0	36
Larkmoor Boulevard	64	LARK-27-1-030	LARK-27-1-020	0.0	2	0.0	207	12	0.324%	2.0	8.9	8.1	-2.0	-98.0%	10	
Larkmoor Boulevard	64	LARK-27-1-020	LARK-27-1-010	0.0	7	0.1	147	12	0.565%	2.7	10.0	9.2	-2.5	-94.8%	10	
Larkmoor Boulevard	64	LARK-27-1-010	STAN-06-1-010	0.0	25	0.5	387	12	0.340%	2.1	10.6	9.8	-1.6	-75.9%	10	

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Stanford Road	64	STAN-06-1-010	26350	44.0	323	36.0	26	24	0.311%	12.6	15.3	13.1	23.4	185.2%	0	36
BERKLEY INLET (EAST - CAMBRIDGE)																
	65	CAMB-20-1-010	CAMB-19-1-020	0.0	13	0.3	329	12	0.357%	2.1	9.6	8.8	-1.9	-87.8%	10	
	65	CAMB-19-1-020	CAMB-19-1-010	1.1	26	1.9	330	15	0.273%	3.4	8.6	7.6	-1.5	-44.0%	10	
	65	CAMB-19-1-010	25935	8.4	26	3.7	17	15	28.107%	34.2	8.6	7.6	-30.6	-89.3%	10	
LARKMOOR INLET (SOUTH - CASS)																
Harvard Road	66	HARV-19-1-010	HARV-19-1-020	0.0	47	0.9	328	12	0.010%	0.4	11.0	10.0	0.6	164.5%	10	
Harvard Road	66	HARV-19-1-020	HARV-20-1-010	0.0	56	1.1	329	12	0.328%	2.0	8.3	7.5	-0.9	-45.1%	10	
Harvard Road	66	HARV-20-1-010	HARV-20-1-020	4.6	70	2.0	330	12	0.365%	2.2	8.7	7.1	-0.2	-7.0%	10	
Harvard Road	66	HARV-20-1-020	HARV-21-1-010	6.0	84	2.9	346	12	0.651%	2.9	9.6	7.8	0.0	-0.4%	10	
Harvard Road	66	HARV-21-1-010	HARV-22-1-010	7.2	93	3.2	380	12	0.925%	3.4	10.1	8.3	-0.2	-5.7%	10	
Cambridge Road	66	CAMB-20-1-010	CAMB-20-1-020	0.0	11	0.2	354	12	0.563%	2.7	12.2	11.4	-2.5	-91.8%	10	
Cambridge Road	66	CAMB-20-1-020	CAMB-20-1-030	0.0	26	0.5	353	12	0.557%	2.7	11.2	10.4	-2.1	-80.4%	10	
Cambridge Road	66	CAMB-20-1-030	CAMB-20-1-040	3.3	34	1.0	296	15	0.291%	3.5	10.0	9.0	-2.5	-71.3%	10	
Cambridge Road	66	CAMB-20-1-040	CAMB-22-1-010	5.8	34	1.4	55	15	0.162%	2.6	10.0	8.7	-1.2	-45.4%	10	
Columbia Road	66	25936	COLU-19-1-010	0.0	5	0.1	159	36	0.205%	30.2	16.2	13.8	-30.1	-99.7%	10	
Columbia Road	66	COLU-19-1-010	COLU-19-1-030	0.0	24	0.5	404	36	0.262%	34.1	16.8	14.4	-33.7	-98.6%	10	
Columbia Road	66	COLU-19-1-030	COLU-20-1-010	3.9	37	1.0	387	36	0.251%	33.4	17.1	14.7	-32.4	-97.0%	10	
Columbia Road	66	COLU-20-1-010	COLU-20-1-030	3.9	53	0.9	388	36	0.233%	32.2	16.7	14.3	-31.3	-97.1%	10	
Columbia Road	66	COLU-20-1-030	COLU-22-1-010	5.8	6	19.8	395	36	0.301%	36.6	17.3	14.9	-16.8	-45.8%	10	
Princeton Road	66	PRIN-20-1-010	PRIN-20-1-020	4.4	15	5.1	341	12	0.398%	2.2	9.5	0.0	2.9	126.9%	1	18
Princeton Road	66	PRIN-20-1-020	PRIN-20-1-030	6.7	28	5.8	342	12	0.341%	2.1	11.2	0.0	3.8	180.9%	0	18
Princeton Road	66	PRIN-20-1-030	PRIN-20-1-040	7.3	36	6.3	309	12	0.394%	2.2	11.4	0.0	4.1	183.7%	0	18
Eleven Mile Road	66	ELEV-18-1-010	ELEV-18-2-015	0.0	15	0.3	120	12	0.688%	3.0	11.2	0.0	-2.7	-89.9%	10	
Eleven Mile Road	66	ELEV-18-2-015	ELEV-18-1-030	0.6	15	1.5	147	12	0.101%	1.1	12.6	0.0	0.4	35.7%	4	15
Eleven Mile Road	66	ELEV-18-1-030	ELEV-19-1-010	1.2	15	1.5	264	12	0.320%	2.0	12.6	0.0	-0.5	-25.8%	10	

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Eleven Mile Road	66	ELEV-18-1-040	ELEV-19-1-015	0.3	19	0.8	183	10	0.447%	1.5	3.7	0.0	-0.6	-44.0%	10	
Eleven Mile Road	66	ELEV-19-1-015	ELEV-19-1-010	0.3	19	0.8	127	10	1.664%	2.8	5.2	0.4	-2.0	-71.9%	10	
Eleven Mile Road	66	ELEV-19-1-010	ELEV-19-1-020	2.1	43	3.6	327	12	0.329%	2.0	13.0	0.0	1.6	76.1%	2	15
Eleven Mile Road	66	ELEV-19-1-020	HENL-01-1-010	2.4	50	4.2	332	12	0.320%	2.0	14.4	0.0	2.1	106.2%	1	18
Henley Avenue	66	HENL-01-1-010	ELEV-20-1-010	2.5	50	4.2	126	12	0.725%	3.0	13.5	0.0	1.2	39.1%	4	15
Eleven Mile Road	66	ELEV-20-1-010	ELEV-20-1-020	4.4	71	7.8	337	15	0.206%	2.9	14.1	0.0	4.9	167.7%	0	24
Eleven Mile Road	66	ELEV-20-1-020	ELEV-20-1-030	4.6	84	8.0	345	15	0.365%	3.9	12.8	0.0	4.1	104.6%	1	21
Eleven Mile Road	66	ELEV-20-1-030	ELEV-20-1-040	7.0	89	11.3	228	15	0.481%	4.5	11.8	0.0	6.9	153.2%	0	24
Eleven Mile Road	66	ELEV-20-1-040	MORT-01-1-010	7.6	89	12.3	111	15	0.375%	4.0	12.5	0.0	8.4	211.4%	0	24
Mortenson Boulevard	66	MORT-01-1-010	PRIN-20-1-040	9.5	99	15.0	287	18	0.150%	4.1	12.4	0.0	10.9	267.8%	0	30
Mortenson Boulevard	66	MORT-05-1-010	HARV-22-1-010	0.0	10	0.2	229	12	0.335%	2.1	10.6	9.3	-1.9	-90.3%	10	
Mortenson Boulevard	66	CAMB-22-1-010	HARV-22-1-010	0.0	10	0.2	308	12	0.351%	2.1	9.6	8.6	-1.9	-90.5%	10	
Harvard Road	66	HARV-22-1-010	HARV-22-1-020	13.2	119	4.0	313	15	0.347%	3.8	10.1	7.8	0.2	5.8%	9	
Harvard Road	66	HARV-22-1-020	HARV-22-1-030	16.4	131	4.8	313	15	0.190%	2.8	9.6	7.3	2.0	69.4%	2	21
Harvard Road	66	HARV-22-1-030	CASS-05-1-010	16.4	140	4.6	313	18	0.526%	7.6	10.1	8.9	-3.1	-40.1%	10	
Cambridge Road	66	CAMB-22-1-010	CAMB-22-1-020	4.5	29	1.9	320	15	0.341%	3.8	10.2	9.2	-1.9	-50.1%	10	
Cambridge Road	66	CAMB-22-1-020	CAMB-22-1-030	4.5	41	1.8	303	15	0.506%	4.6	10.0	8.5	-2.8	-61.2%	10	
Cambridge Road	66	CAMB-22-1-030	CASS-04-1-010	8.4	47	2.5	308	10	0.673%	1.8	9.4	6.7	0.7	41.6%	4	12
Mortenson Boulevard	66	CAMB-22-1-010	COLU-22-1-010	2.1	19	0.9	271	12	0.317%	2.0	9.6	8.8	-1.1	-55.8%	10	
Mortenson Boulevard	66	PRIN-20-1-040	COLU-22-1-010	17.8	127	17.7	284	18	0.241%	5.2	13.6	5.0	12.5	242.4%	0	30
Columbia Road	66	COLU-22-1-010	COLU-22-1-020	27.5	164	34.9	454	36	0.276%	35.1	16.6	13.8	-0.2	-0.6%	10	
Columbia Road	66	COLU-22-1-020	CASS-03-1-010	29.6	176	34.7	479	42	0.280%	53.2	14.7	11.9	-18.5	-34.7%	10	
Princeton Road	66	PRIN-20-1-040	PRIN-22-1-010	2.7	18	2.6	33	12	0.195%	1.6	11.2	4.8	1.1	67.8%	2	15
Princeton Road	66	PRIN-22-1-010	PRIN-22-1-020	2.7	24	2.6	307	15	0.463%	4.4	10.9	4.6	-1.8	-40.2%	10	
Princeton Road	66	PRIN-22-1-020	PRIN-22-1-030	4.5	30	4.5	132	15	0.164%	2.6	10.8	3.6	1.9	72.2%	2	21

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Princeton Road	66	PRIN-22-1-030	PRIN-22-1-040	5.6	36	5.7	178	15	0.198%	2.9	10.9	3.8	2.8	97.8%	2	21
Princeton Road	66	PRIN-22-1-040	CASS-02-1-010	5.6	42	5.6	311	15	0.427%	4.2	11.5	5.2	1.3	32.0%	4	18
Eleven Mile Road	66	ELEV-22-1-010	ELEV-22-1-020	1.3	3	2.4	295	12	0.286%	1.9	12.0	0.0	0.5	27.4%	4	15
Eleven Mile Road	66	ELEV-22-1-020	ELEV-22-1-030	2.5	9	4.4	296	12	0.293%	1.9	12.0	0.0	2.4	126.2%	1	18
Eleven Mile Road	66	ELEV-22-1-030	CASS-01-1-010	4.5	12	6.5	295	12	0.280%	1.9	12.0	0.0	4.6	246.0%	0	21
Cass Boulevard	66	CASS-01-1-010	CASS-02-1-010	6.8	22	8.7	291	15	0.124%	2.3	11.6	0.7	6.5	283.5%	0	27
Cass Boulevard	66	CASS-02-1-010	CASS-02-1-020	15.8	73	14.6	231	18	0.352%	6.2	12.7	6.6	8.3	133.8%	1	27
Cass Boulevard	66	CASS-02-1-020	CASS-03-1-010	16.7	73	15.0	66	18	0.127%	3.7	14.2	11.7	11.3	300.5%	0	33
Cass Boulevard	66	CASS-03-1-010	CASS-04-1-010	48.3	259	49.0	255	42	0.331%	57.9	15.2	12.2	-8.9	-15.4%	10	
Cass Boulevard	66	CASS-04-1-010	CASS-05-1-010	58.8	316	52.4	308	42	0.229%	48.2	15.7	12.5	4.2	8.8%	8	
Cass Boulevard	66	CASS-05-1-010	CASS-05-1-020	79.3	460	56.4	177	48	0.379%	88.4	16.2	13.0	-32.0	-36.2%	10	
Cass Boulevard	66	CASS-05-1-020	26347	80.9	460	56.5	125	36	0.346%	39.2	15.3	12.4	17.3	44.1%	3	42
E OF STANFORD INLET (WEST - HARVARD)																
Harvard Road	67	HARV-25-1-010	HARV-25-1-020	0.0	16	0.3	398	12	0.364%	2.1	9.3	0.4	-1.8	-85.1%	10	
Harvard Road	67	HARV-25-1-020	HARV-25-1-030	3.6	34	1.0	399	12	0.272%	1.9	11.0	0.6	-0.9	-46.1%	10	
Harvard Road	67	HARV-25-1-030	HARV-27-1-010	6.0	51	3.5	400	12	0.350%	2.1	11.3	0.0	1.4	67.9%	3	15
Harvard Road	67	HARV-27-1-010	HARV-27-1-020	13.7	69	8.3	356	15	0.226%	3.1	11.0	1.0	5.3	171.3%	0	24
Harvard Road	67	HARV-27-1-020	26469	13.7	84	8.0	345	15	0.373%	3.9	12.3	7.4	4.0	101.6%	1	21
E OF STANFORD INLET (WEST - CAMBRIDGE)																
Cambridge Road	68	CAMB-25-1-010	CAMB-25-1-020	0.9	14	1.3	402	12	0.407%	2.3	8.2	0.0	-1.0	-44.3%	10	
Cambridge Road	68	CAMB-25-1-020	CAMB-25-1-030	2.7	32	3.8	404	12	0.277%	1.9	9.5	0.0	1.9	100.7%	2	18
Cambridge Road	68	CAMB-25-1-030	CAMB-27-1-010	5.2	49	4.4	400	12	0.277%	1.9	12.9	0.8	2.6	136.5%	1	18
Cambridge Road	68	CAMB-27-1-010	CAMB-27-1-020	7.5	65	6.5	354	15	0.254%	3.3	10.1	3.1	3.3	101.0%	2	21
Cambridge Road	68	CAMB-27-1-020	26470	8.5	81	7.1	342	15	0.244%	3.2	10.2	5.9	3.9	121.9%	1	21
E OF STANFORD INLET (WEST - COLUMBIA)																

Appendix C
Combined Sewer Area Study
Combined Sewer Sewer Capacity Analysis

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STREET	DRAINAGE SUBDISTRICT	FROM MANHOLE	TO MANHOLE	TRIBUTARY AREA (acre)	# HOMES SERVED (REUs)	DESIGN FLOW (cfs)	LENGTH (feet)	SIZE (in.)	SLOPE (%)	PIPE CAPACITY (cfs)	SEWER DEPTH (feet)	H.G.L. DEPTH (feet)	CAPACITY OVERLOAD (cfs)	PIPE OVERLOAD (%)	DESIGN STORM CAPABILITY	PIPE SIZE REQUIRED
Columbia Road	69	COLU-25-1-010	COLU-25-1-020	0.5	14	1.0	404	12	0.356%	2.1	8.5	0.7	-1.1	-52.5%	10	
Columbia Road	69	COLU-25-1-020	COLU-25-1-030	1.6	32	2.2	405	12	0.305%	2.0	9.4	0.5	0.2	11.9%	8	
Columbia Road	69	COLU-25-1-030	COLU-27-1-010	5.0	44	4.6	398	12	0.321%	2.0	10.7	2.1	2.5	125.5%	1	18
Stanford Road	69	STAN-03-1-010	COLU-27-1-010	0.0	3	0.1	120	10	0.629%	1.7	9.0	7.3	-1.7	-97.1%	10	
Columbia Road	69	COLU-27-1-010	COLU-27-1-020	5.8	59	5.5	356	15	0.323%	3.7	10.0	6.5	1.9	50.7%	3	18
Columbia Road	69	COLU-27-1-020	26471	5.8	74	5.3	336	15	0.379%	4.0	10.1	8.1	1.4	34.2%	4	18
E OF STANFORD INLET (WEST - PRINCETON)																
Princeton Road	70	PRIN-25-1-010	PRIN-25-1-020	0.0	15	0.3	405	12	0.258%	1.8	8.5	1.3	-1.5	-83.4%	10	
Princeton Road	70	PRIN-25-1-020	PRIN-25-1-030	2.2	35	2.8	406	12	0.023%	0.5	8.2	0.0	2.3	419.7%	0	24
Princeton Road	70	PRIN-25-1-030	PRIN-27-1-010	5.8	47	3.5	407	15	0.785%	5.7	8.1	0.0	-2.2	-38.2%	10	
Eleven Mile Road	70	ELEV-25-1-010	ELEV-25-1-020	0.0	4	0.1	336	12	0.214%	1.6	9.7	0.4	-1.6	-95.1%	10	
Eleven Mile Road	70	ELEV-25-1-020	ELEV-25-1-030	0.9	11	1.7	335	12	0.316%	2.0	10.3	0.3	-0.3	-13.1%	10	
Eleven Mile Road	70	ELEV-25-1-030	ELEV-25-1-040	1.6	19	3.1	336	12	0.339%	2.1	10.3	0.0	1.0	49.1%	3	15
Eleven Mile Road	70	ELEV-25-1-040	ELEV-27-1-010	3.5	24	5.0	333	12	0.332%	2.1	11.2	0.0	3.0	145.8%	1	18
Stanford Road	70	ELEV-27-1-010	STAN-01-1-010	0.0	1	0.0	50	12	0.453%	2.4	8.9	0.0	-2.4	-99.2%	10	
Stanford Road	70	STAN-01-1-010	PRIN-27-1-010	1.0	9	1.0	231	15	0.215%	3.0	9.3	0.0	-2.0	-66.6%	10	
Stanford Road	70	COLU-27-1-010	PRIN-27-1-010	0.0	10	0.2	281	15	0.246%	3.2	9.3	0.0	-3.0	-93.8%	10	
Princeton Road	70	PRIN-27-1-010	PRIN-27-1-020	13.2	76	13.7	354	15	0.290%	3.5	10.3	0.0	10.3	295.1%	0	27
Princeton Road	70	PRIN-27-1-020	26472	14.8	91	15.3	336	18	0.313%	5.9	10.3	3.0	9.5	161.0%	0	27
E OF STANFORD INLET (WEST - 11 MILE)																
Eleven Mile Road	71	ELEV-27-1-010	ELEV-27-1-020	5.0	29	7.3	330	15	0.422%	4.2	11.6	4.8	3.1	73.2%	2	21
Eleven Mile Road	71	ELEV-27-1-020	ELEV-27-1-030	5.2	37	7.3	321	15	0.397%	4.1	13.6	9.6	3.2	79.1%	2	21
Eleven Mile Road	71	ELEV-27-1-030	26466	5.2	37	7.1	36	15	0.383%	4.0	14.2	12.9	3.1	77.1%	2	21

Appendix C
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BERKLEY INLET (NORTH - OXFORD)																
Berkley Avenue	72	BERK-07-1-020	BERK-07-1-010	0.0	4	0.1	254	8	0.572%	0.9	7.4	6.9	-0.8	-91.2%	10	
Berkley Avenue	72	BERK-07-1-010	25932	0.0	5	0.1	32	8	4.420%	2.5	9.2	8.7	-2.4	-96.1%	10	
E OF STANFORD INLET (EAST - HARVARD)																
Woodward Avenue	73	LARK-27-1-030	HARV-27-1-030	0.0	15	0.3	380	12	0.325%	2.0	8.7	2.2	-1.7	-85.2%	10	
Harvard Road	73	HARV-27-1-030	26469	2.7	25	6.8	236	12	0.324%	2.0	10.4	1.9	4.7	233.1%	0	21
E OF STANFORD INLET (EAST - CAMBRIDGE)																
Woodward Avenue	74	HARV-27-1-030	CAMB-27-1-030	0.1	7	0.2	359	15	0.141%	2.4	9.4	1.9	-2.3	-92.9%	10	
Woodward Avenue	74	COLU-27-1-040	CAMB-27-1-040	0.0	8	0.2	290	15	0.664%	5.3	9.9	2.2	-5.1	-97.2%	10	
Woodward Avenue	74	CAMB-27-1-040	CAMB-27-1-030	2.9	8	5.2	85	12	0.152%	1.4	11.1	1.3	3.9	277.9%	0	21
Cambridge Road	74	CAMB-27-1-030	26470	5.4	33	9.1	425	15	0.237%	3.1	10.1	1.6	6.0	189.9%	0	24
E OF STANFORD INLET (EAST - COLUMBIA)																
Woodward Avenue	75	PRIN-27-1-040	COLU-27-1-040	0.0	0	0.0	347	15	0.488%	4.5	12.1	11.1	-4.5	-100.0%	10	
Columbia Road	75	COLU-27-1-040	COLU-27-1-030	0.7	0	1.4	278	15	0.363%	3.9	10.6	9.6	-2.5	-65.3%	10	
Columbia Road	75	COLU-27-1-030	26471	3.9	0	2.2	359	15	0.362%	3.9	9.8	8.8	-1.6	-42.5%	10	
E OF STANFORD INLET (EAST - PRINCETON)																
Woodward Avenue	76	ELEV-27-1-090	PRIN-27-1-050	0.0	5	0.1	209	12	0.277%	1.9	11.8	11.0	-1.8	-95.2%	10	
Woodward Avenue	76	PRIN-27-1-050	PRIN-27-1-040	0.4	5	1.1	88	12	0.265%	1.8	13.6	12.8	-0.8	-41.1%	10	

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Princeton Road	76	PRIN-27-1-040	PRIN-27-1-030	0.4	24	1.1	410	15	0.293%	3.5	14.2	13.2	-2.4	-69.6%	10	
Princeton Road	76	PRIN-27-1-030	26472	1.8	45	3.5	426	15	0.282%	3.4	10.2	9.1	0.1	3.4%	10	
E OF STANFORD INLET (EAST - 11 MILE)																
Eleven Mile Road	77	ELEV-27-1-080	ELEV-27-1-070	0.5	7	1.0	331	15	0.394%	4.1	10.8	9.8	-3.0	-75.0%	10	
Eleven Mile Road	77	ELEV-27-1-070	ELEV-27-1-060	0.9	14	1.9	268	15	0.375%	4.0	10.7	9.7	-2.1	-53.1%	10	
Eleven Mile Road	77	ELEV-27-1-060	ELEV-27-1-050	2.1	15	3.8	66	15	0.135%	2.4	10.0	8.5	1.5	61.5%	3	18
Eleven Mile Road	77	ELEV-27-1-050	ELEV-27-1-040	2.1	23	3.8	325	15	0.266%	3.3	10.3	8.9	0.5	13.7%	7	
Eleven Mile Road	77	ELEV-27-1-040	26466	4.6	23	7.6	14	15	0.377%	4.0	11.2	10.1	3.6	91.2%	2	21