City of Ann Arbor
Village Oaks-Chaucer Court Drainage Area Study Final Report

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1. Executive Summary

As vacant property is developed, the associated changes to natural storm drainage patterns can result in unintended impacts to adjoining properties. These negative impacts can occur despite the best efforts of the local community and property developers to provide adequate drainage. Typically, the storm water issues result from the compounded effect of runoff from multiple individual sites, none of which may be a problem on their own, but collectively impact the evolving drainage system and its outlet. Since the timing of individual property development can vary within a watershed and may occur over decades rather than years, it is not always practical to plan and implement construction of an ultimate master drainage system adequate to serve all properties until sufficient land development occurs, and the new runoff characteristics and specific drainage needs of the watershed are defined.

Historically during heavy rain events, backyard (and basement) flooding has occurred between the west edge of the Village Oaks Subdivision and the east edge of the Lansdowne Subdivision near Chaucer Court. The residents of the area reported that even during more frequent, less intense rain events there is still substantive overland flow in this same area. More specifically, flooding occurred during the June 5-6, 2010 storm event which led to backyard flooding in this area, as well as basement flooding. Known contributing sources of increased storm water include, but may not be limited to, the additive effects of nearby property development upstream of and at higher elevations from the affected area.

Site developments and storm improvements within the areas tributary to the point of flooding within the Village Oaks–Chaucer Court area were designed and constructed independently. In 1991, a new storm sewer was constructed by the City of Ann Arbor to address flooding issues on Chaucer Court, improving the outlet to Malletts Creek. However, drainage issues are present in the area today. Prior to the study conducted in conjunction with this report, there had not been a comprehensive

assessment of how runoff from the overall drainage system performs holistically which this study looked to achieve.

Working collaboratively with residents impacted by the flooding, the City of Ann Arbor solicited proposals for consulting services to evaluate the watershed and develop a recommended solution to this flooding problem. The drainage study was to define the tributary area, assess existing conditions, develop and evaluate alternatives and make recommendations for improvements. A key component of the work plan was the public engagement process that maintained active participation of local residents in the evaluation. During wet weather, excessive storm water causes extensive and frequent backyard flooding in the Village Oaks–Chaucer Court neighborhood, which has led to basement flooding.

The area impacted by flooding is the backyard area between Village Oaks and Chaucer Court that was designed to be a storm water detention basin. Although this basin currently receives flow from the upstream tributary area, it appears that it was only intended to receive flow from the Village Oaks.

Backyard flooding has been documented at least twice in 2010 during moderate rain events indicating that the existing drainage system is unable to handle a one-year frequency storm. In 2011, Ann Arbor experienced record breaking rainfall as local rain gages recorded the wettest year in recorded history which resulted in increased backyard flooding.

The problems associated with the chronic flooding of the storage area between Chaucer and Village Oaks Courts were identified from a number of contributing factors. Generally speaking, the Village Oaks (VO) storage is impacted by the storm water runoff from the upstream and downstream areas, including backwater conditions from the storm outlet to Malletts Creek. Specific factors identified in the drainage study, include:

- from larger storm events; tributary flows from Ann Arbor-Saline Road drainage, Lambeth Drive, and Chaucer Drive north of Ascot Road

- backwater conditions due to restricted flow where the 36-inch Chaucer Court sewer discharges to the 24-inch outlet sewer to Malletts Creek across Ann Arbor-Saline Road

- VO detention basin filling prematurely and to higher levels due to the configuration of the Chaucer Court Storm Sewer, and its inlets, that do not hydraulically separate all of the upstream flow from the VO detention basin and downstream tributary areas

- excess flows due to the existing conditions of the individual site detention basins and their outlets
- Lack of an emergency overflow from the VO detention

To determine the extent and nature of the upstream drainage area and contributing flows, a detailed analysis of the existing site conditions was performed. The existing site conditions information came from several sources including local residents, City staff, field investigations and topographic survey, record drawings, Geographic Information Systems (GIS) data, existing computer models, and Flood Insurance Studies (FIS). The information gathered from this analysis was used as inputs to develop the drainage system computer model.

Once the existing conditions model was developed and calibrated, the model was used to simulate various design rainfall conditions and to test various alternatives. The rainfall events simulated included the 100% annual occurrence (1-year), 20% annual occurrence (5-year), 10% annual occurrence (10-year), a storm equal to the June 2010 event and the August 1998 event.

Modeled alternatives were developed based on several Technical Advisory Committee (TAC) meetings. The TAC included City of Ann Arbor Staff, staff from the Washtenaw County Water Resources Commission (WCWRC), Wade Trim, and three residents from the VO neighborhood. A total of eight alternatives were developed, modeled and the results evaluated by the TAC.

The alternatives studied were wide-reaching, ranging from a complete capture and bypass of all upstream storm water flows directly to Malletts Creek, to a complete capture and detention of all upstream flows in a regional detention basin. Alternatives included a look at underground storage to replace above-grade detention requirements for VO; however, this proved to be cost prohibitive. Also, compliance with the WCWRC standard rules and regulations requires that there be no increased impact (i.e., flow rate or water quality) to Malletts Creek. Another important consideration is the impacts to natural features for proposed recommendations (including corrections to existing detention basins) that will need to be looked at during the final design phase. Examples of these potential impacts can be seen in the slides as shown in Appendix No. 11. Consequently, the TAC member's affiliated with the City selected alternative No. 5 as the leading option, based upon the City's interpretation of applicable requirements. This option includes restoration of basins at VO and the upstream developments, install restrictors where missing, and construction of a regional basin. Planning level estimates place the cost for this alternative in the range of $858,000 - $1,248,000. Cost range is due to potential land costs (associated with the area for the constructed regional basin) that range from an estimated $6/sf to $10/sf. However, due to VO and Chaucer property owner concerns regarding the adverse impacts of increased on-site detention at VO

(detailed below), No. 7, which involves approximately 7,000 cu. ft. for VO being stored off-site in the regional detention, would represent a more desirable outcome

2. Introduction

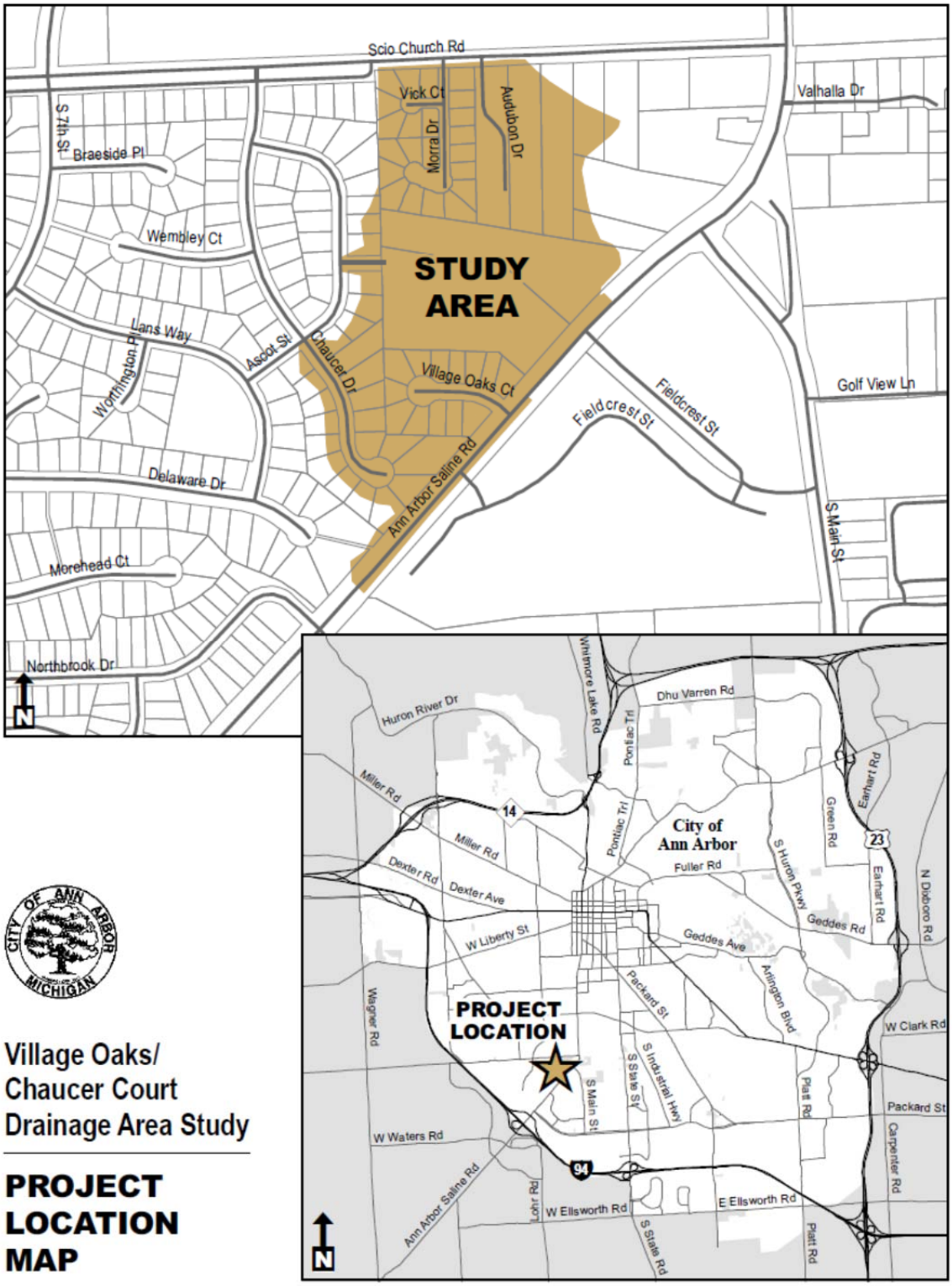
General – The Village Oaks–Chaucer Court study area is located near the southwest corner of the City of Ann Arbor. The study area is shown in Figure 1. The drainage area is comprised (in whole or in part) of eight entities including:

1. Lansdowne Subdivision (i.e. Chaucer Court & Lambeth)
2. The Meadows
3. Country Place
4. Karrington (a.k.a. Sunrise)
5. Village Oaks
6. Entire vacant parcel north of VO
7. Southern portion of vacant parcels east of Country place
8. City of Ann Arbor (Ann Arbor/Saline Rd)

Prior to the late 1970's, the only developed land in this area included the Lansdowne Subdivision. During the 1980's and 1990's the other sites were developed while the vacant parcels remain undeveloped.

Each of these developments was implemented under different land development rules and regulations that have changed through the years. For example, Meadows and Country Place were developed as site condominium projects (containing individually owned condominium units with general commonly owned elements), whereas Village Oaks and the Landsdowne Subdivision were developed as platted subdivisions. The land development review process varied based on the type of development. In addition, the storm water detention regulations changed through the years. City rules did not explicitly require emergency overflow structures or freeboard to be constructed as part of the storm water detention systems until June, 2000.

Figure 1 – Study Area



Purpose – The purpose of the project is to perform a drainage area study and recommend storm water improvements to the Village Oaks–Chaucer Court drainage area to mitigate flooding. Specific components necessary to the study include: public outreach and engagement; delineating the drainage area; developing an existing conditions model; characterizing previous storm events that have led to flooding in the Village Oaks–Chaucer Court area; reviewing historical requirements and identifying deficiencies within the watershed; developing and modeling improvement alternatives; and presenting a final recommendation.

Scope – The scope of the study is summarized as follows:

1. Existing conditions

   To determine the extent and nature of the upstream drainage area and contributing flows, a detailed analysis of the site conditions was performed. The information gathered during this analysis was used as inputs to the computer model.

   The existing site conditions information were developed from several sources including local residents, City staff, field investigations, record drawings, Geographic Information Systems (GIS) data, existing computer models, and Flood Insurance Studies (FIS).

2. Existing Storm Water Management System

   The flooding problem within the Village Oaks–Chaucer Court area has a complex tributary system that includes multiple sequential detention basins, restricted conveyance, and downstream backwater conditions. This type of system required the use of a dynamic computer model that accounts for these complexities and has the flexibility to verify the effectiveness of alternatives to correct the flooding. The City's previously developed model of the Ann Arbor storm water system was developed using the InfoSWMM framework. The portion of the InfoSWMM model related to this drainage area project was extracted and used as a starting point for the additional model development performed for this project.

   All modeling work was performed using the standard version of the U.S. EPA SWMM Version 5. Model development included both the hydrology and hydraulics to simulate the entire system.

3. Public Engagement

   Public involvement was an important component of the study project to reach out and engage neighbors as part of the information gathering, information sharing,

analysis, and development of recommendations. A Technical Advisory Committee (TAC) was formed that included residents from VO as well as City and County staff and public meetings were held for residents within the study area. Meeting minutes were kept and all engagement activities were documented in an outreach and engagement activities log. The outreach and activities log is included in Appendix No.1.

4. Recommendations

   Improvement alternatives for the existing drainage system were developed collaboratively with the TAC and evaluated with the calibrated SWMM model. The alternatives developed included re-establishing storage, increasing conveyance capacity, intercepting and bypassing upstream flows, regional detention, and emergency overflows.

   At the completion of the project, this final report was developed to include planning level cost estimates for the improvements studied, a description how the current system functions, the development of the hydrologic and hydraulic model, model calibration, findings, alternative screening and evaluations, and final recommendations.

Background – Historically during heavy rain events, backyard (and basement) flooding has occurred between the west edge of the Village Oaks Subdivision and the east edge of the Lansdowne Subdivision near Chaucer Court. The residents of the area reported that even during more frequent, less intense rain events there is still substantive overland flow in this same area.

In 1989, a drainage study (Chaucer Court Storm Sewer Study, Dated 12/1989) was performed in response to reported basement flooding which had occurred in the spring of that year on Chaucer Court, in Lansdowne Subdivision No. 3. That investigation led to the construction of a relief storm sewer (City file no. 89067) which was completed in 1991. A copy of the Chaucer Court Storm Sewer Study, Dated 12/1989 is included in the Appendix No.2.

The additional flooding that occurred in this area during the June 5-6, 2010 storm event led to backyard flooding as well as basement flooding. City staff met with residents of the Village Oaks–Chaucer Court area regarding recent and past excessive overland flow. Known contributing sources of increased storm water included the additive effects of nearby property development upstream of, and at higher elevations than, the affected area.

3. Technical Work

A. Existing conditions

1) Field work

i) survey

Detailed topographic surveys were performed at each of the existing detention basins for VO, Karrington, Country Place and the Meadows. These surveys were then compared to previously approved site plans for each development to determine the difference between approved detention basin volume capacities and the capacities as they exist today. With exception of Karrington, it was determined that all existing basins were currently under capacity. See Figure 2. Note: The 15,000 ft3 required volume for VO as shown in Figure 2 was later refined to be 14,061 ft3.

Figure 2 – Existing Storage Summary Table

Existing Storage - Review

Storage Location	Required Volume (ft^3)	Actual Volume (ft^3)	Intended Restricted Flow (cfs)	Actual Outlet Flow (cfs)	Comment
The Meadows	27,832	8,900	1.0	$1.0/14_{bypass}$	Undersized Storage
Country Place	10,379	4,900	0.4	7.0	No Orifice Plate
Karrington	19,130	19,400	0.8	9.7	No Orifice Plate
Village Oaks	15,000*	11,500	0.75	7.3	No Orifice Plate

*Based on design drawing contours

Field work also included a visual review of the existing outlet control structures to verify that storm water flow restrictors were installed in accordance with the approved site plans. Restrictors were missing from all the developments outlet control structures except for The Meadows.

Although the Meadows restrictor orifice plate was installed, a closer look revealed the restrictor has a larger opening (i.e. increased flow rate capacity) than was permitted in the approved plans. See Figure 3. The larger opening can be attributed to a poorly installed restrictor plate that allows a portion of the storm water flows to pass around the restrictor plate. The lower 25 percent of the restrictor plate is missing due to deterioration further reducing the effectiveness of the restrictor plate. Not including the storm water that flows around the plate, it was estimated the current restrictor is allowing for more than twice the allowable outflow rate.

Figure 3 – Meadows Place Existing Outlet Restrictor

ii) infiltration tests

Using the Natural Resources Conservation Service (NRCS) soils map for Washtenaw County, it was determined that there are four soils types within

the drainage area. Tests were conducted at three locations representing each of the three soil types to determine the difference between the dry and saturated soil infiltration rates. Both the dry and saturated soil infiltration rates were used as inputs in the hydrologic model. See Appendix No. 3 for testing locations, soil types and testing results.

2) GIS data
The City of Ann Arbor GIS database was used extensively throughout the study. Data used included:

- Storm sewer system
- soil surveys
- wetlands
- woodlands
- LiDAR based 2-foot contour
- impervious and pervious surfaces
- parcels
- aerial imagery

This information was used in conjunction with other data to prepare maps, determine drainage areas, and perform flow calculations.

3) Record drawings

Approved site plan drawings and storm water calculations were reviewed and compared to existing conditions as determined from the field work and from the City's GIS.

Originally approved storm water calculations for VO were unavailable for review. Calculations were performed, based on the criteria as required at the time VO was being approved, and it was determined that 22,000 ft3 of storage was required for the storm water detention basin. Absent the originally approved calculations, the contours, as depicted on the approved site plans, were used as the basis for the required storm water detention basin volume which was determined to be 14,061 ft3. A review of the design calculations and drawings for Meadows Place were compared to recalculations and anomalies were identified. These discrepancies along with concerns expressed by VO TAC members are further described in Appendix No. 4.

4) Existing computer models

The City of Ann Arbor had developed an InfoSWMM model of the storm water collection system that was used as a starting point for the development of the more detailed SWMM5 model representing the additional hydraulic complexities of the system from Malletts Creek to the head waters of the system.

5) City staff and resident input

Actual storm flow measurements were unavailable for this study; therefore, the drainage area study had limited data for use in calibrating the computer model. As a result, the historic information provided by the local residents describing how the watershed responds to rainfall events was a key source of information. The information included high level water marks the residents documented during the 2010 flooding events that played an integral role in understanding the impacts to the system during those events. See Figures 4 & 5. Residents that attended the public meetings were able to provide specific accounts of observed flows that helped to verify if the delineated drainage area was accurate and in some areas, the drainage area was modified.

Figure 4 – High Water Mark

Figure 5 – Flow Path

July 2010 – Staking

City of Ann Arbor staff regularly reviewed documents providing valuable feedback and were a constant source for overall historical perspective of how the various components of the system evolved over time. Staff provided rainfall data for specific storm events and land valuation figures that were used in the cost estimates.

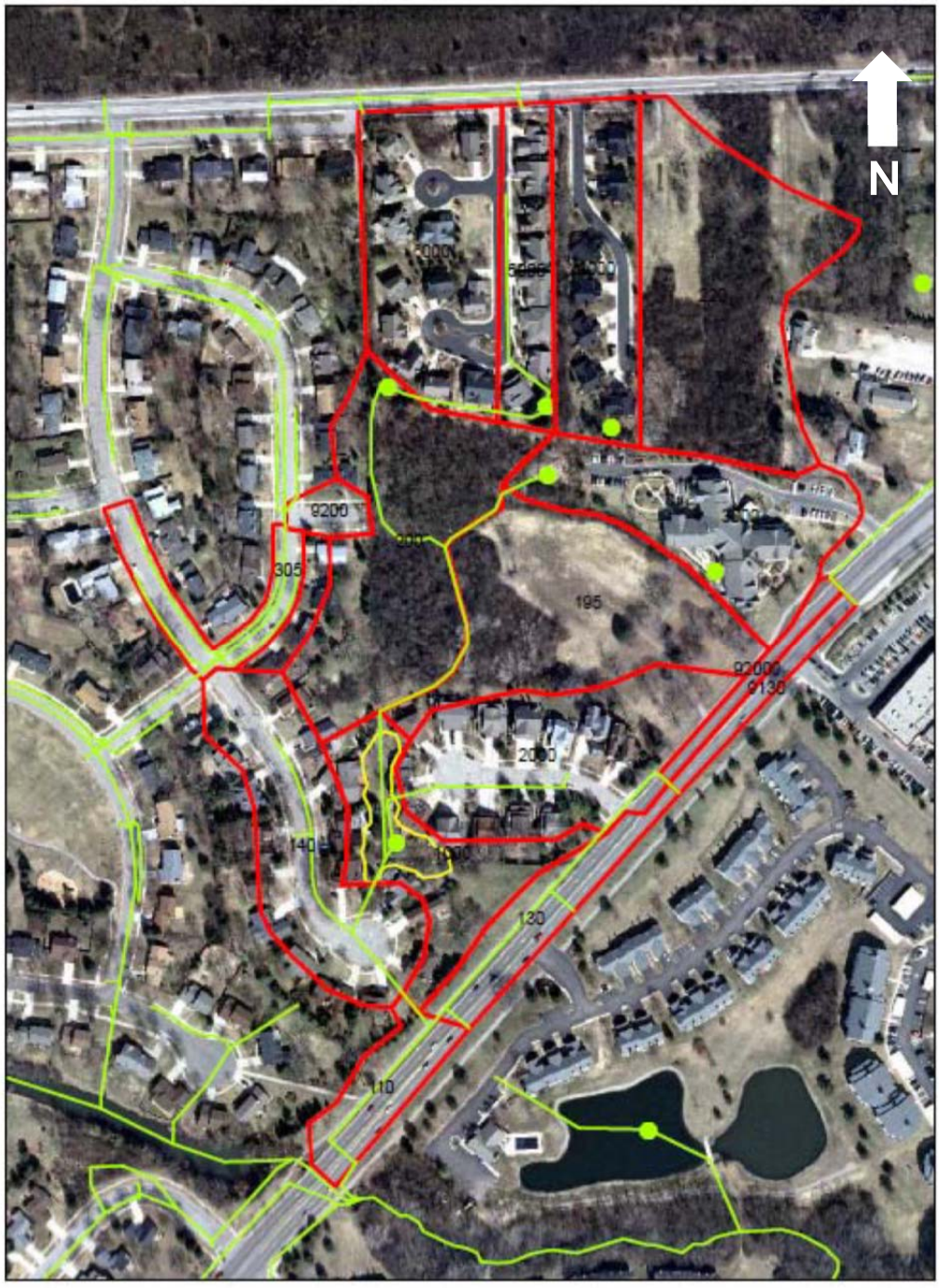
B. Computer modeling

1) Hydrologic

i) LiDAR

The initial step in developing the hydrologic model involved a comprehensive delineation of the watershed and the individual subareas within the watershed. See Figure 6. The initial delineation was performed using the available 2-foot contour data in the City's GIS, developed from Light Detection and Ranging (LIDAR) data. The initial delineation was mapped in GIS and field investigations were performed to verify that the delineation was accurate and to identify any additional areas that have inflow to the system that was not consistent with the GIS and record drawings.

Figure 6 – Watershed Subareas



ii) Field survey data

Detailed topographic surveys were performed at each of the existing detention basins for VO, Karrington, Country Place and the Meadows. Storm sewer pipes and control structures were observed to confirm the

storm water flow paths and to identify new flow paths that do not show up in the record drawings or the City's GIS. One example of a new flow path was discovered where storm water discharge from the Country Place basin was routed directly into the Karrington basin through a storm water collection pipe.

iii) Measurements from residents

Measurements, as shown in Figures 4 & 5 were used to help quantify the storm water volume and water depth that was later used to calibrate the computer model.

iv) Rain gauge data

Rain gauge data used to drive the model was based on over a month of continuous radar rainfall data that was provided by the City. The radar rainfall data had a start date several weeks before the June event making it possible to perform a continuous model simulation during the calibration process and to account for antecedent soil moisture conditions leading up to the June 2010 event.

C. Hydraulic

1) Collection and conveyance systems

i) The hydraulic model included multiple branches that extend upstream to the points of inflow from individual subareas. These branches included both open channel and piped systems. The closed conduits were modeled based on available record drawings and supplemental field survey data. The open channels in the model were largely based on cross-sections cut using the 2-foot contour data provided in the City's GIS.

In some instances it was necessary to model the drainage route using both parallel closed conduit and open channel elements such as the drainage between the Village Oaks and Chaucer Court Subdivisions. Under these instances, the closed conduit represented the intended flow path below grade, and the open channel represented a higher level overland flow relief.

2) Detention

i) At the point of inflow from a subarea containing a detention basin, a storage node was added to the model simulating the stage/storage relationship as shown on the record drawings supplemented with field information. Each storage node had an associated stage/discharge relationship that simulated the rate of discharge from each basin.

In the area of flooding between Chaucer and Village Oaks Court, a storage element was added to the model representing the same stage/storage characteristic for this area. The stage/storage relationship, as well as the stage/discharge characteristics, at this location was based on the available 2-foot contour data, supplemented with field survey data with special attention given to the high level overflow points from this storage area.

3) Downstream boundary conditions

   i) Downstream boundary conditions were established at Malletts Creek as a simple, fixed 10-year flood elevation based on the Federal Emergency Management Agency (FEMA) FIS backwater profiles. The Malletts Creek 10-year flood elevation did not have an appreciable backwater impact on the collection system.

4) Calibration

   i) The initial development of the hydrologic and hydraulic models was based on the best available information to represent the physical properties associated with rainfall, runoff, flow routing, and backwater conditions. After the initial model was developed, historic model simulations were performed and the results compared to measured data from the field and observations from the local residents. Based on a comparison of the model and measured results, specific parameters were adjusted to improve the correlation of the model results to measured data.

      The model was calibrated to the June 2010 event to match the extent of the flooding reported by the residents. The model was further calibrated to observed rear yard storm water flow width from the July 21, 2010 and July 23, 2010 events including recorded high water marks observed by the local residents during the events. The rainfall data used to drive the model was based on over a month of continuous radar rainfall data that was provided by the City.

      The continuous rainfall record for the period made it possible to perform a continuous model simulation during the calibration process to account for antecedent moisture conditions in the soil column leading up to the June event. Antecedent conditions account for the buildup of moisture that fills the available surface depression storage and saturate the soil column. This moisture buildup reduces the capacity of soil to adsorb additional moisture thereby increasing the percent of storm water runoff during subsequent events.

5) Simulations/determination of existing level of service

i) The hydrologic/hydraulic model, using design storm inputs based the Soil Conservation Service (SCS) Type II rainfall distribution, was used to simulate various design rainfall conditions and to test various alternatives. The model was run for several design storm rainfall events to identify the level of service provided by the existing system without the risk of flooding to the adjacent homes. The design events used in the modeling included the 100% annual occurrence (1-year), 20% annual occurrence (5-year), 10% annual occurrence (10-year), a storm equal to the June 2010 event, and the August 1998 event. The model results indicate that the watershed in the model is relatively small and very sensitive to peak rainfall intensity. Based on the simulation results, the June 2010 storm event was categorized as a 3-year storm based on peak flow and 7-year storm based on runoff volume.

4. Alternatives Development

Improvement alternatives for the existing drainage system were developed collaboratively with the TAC and evaluated with the calibrated SWMM model. The alternatives included improvements to storage, increased conveyance capacity, flow interception and bypass, regional detention, and emergency overflows. Alternatives were to incorporate the use of storm water best management practices (BMPs) to improve water quality and area aesthetics, including opportunities for Low Impact Development (LID) principles. However, such principles would likely be difficult to incorporate without the needed magnitude of storm water reduction to resolve the flooding issues and therefore were not incorporated in the study. Best management practice principles should be incorporated during the design phase.

The development of alternatives begins by understanding the components that make up the drainage area and how they contribute to the flooding issues experienced by the residents. The drainage area is comprised (in whole or in part) of eight entities including:

1. Lansdowne Subdivision (i.e. Chaucer Court & Lambeth)
2. The Meadows
3. Country Place
4. Karrington (a.k.a. Sunrise)
5. Village Oaks
6. Entire vacant parcel north of VO
7. Southern portion of vacant parcels east of Country place
8. City of Ann Arbor (Ann Arbor/Saline Rd)

The overall drainage area can be broken down into subareas as shown in Figure 7. Each subarea has its own contributing flow, both intended and unintended. These areas include:

- Approximately 475 feet of roadway drainage from Chaucer Drive is intended to be intercepted by two catch basins at Ascot Road. Due to the size of the drainage area and the slope of Chaucer Drive, a portion of the flow from Chaucer Drive overruns the catch basins during large storm events and becomes tributary to Chaucer Court.

- Similarly, approximately 450 feet of the north side of Ann Arbor-Saline Road is served by a single catch basin just north/east of Village Oaks Court. Due to the size of the area tributary to this catch basin and the extreme slope of the roadway, a portion of Ann Arbor/Saline Road drainage, during large storm events, overruns this catch basin and discharges to the Village Oaks Court. Although some of the flow overrunning the catch basin was observed to flow past Village Oaks Court; the flow diverted into the Village Oaks Court is further contributing to the downstream effects due to backwater conditions.

- Each of the existing developments (with exception to Karrington) has detention basins not meeting the required storage volume capacity requirements as shown on their original construction documents. Furthermore, each development is missing the required restrictor (or has a partial restrictor) that is allowing a significant amount of flow to essentially pass directly through their respective storm systems leading to the VO detention area.

- Due to the existing soil types and their infiltration rates and clearing and compaction of soils in the vacant parcels; overland flow from these parcels is typically exceeding the traditionally assumed (agricultural) flow rate of 0.20 cfs/ac.

Figure 7 – Drainage Subareas

Collectively, these factors have resulted in significantly high flow rates to the Village Oaks – Chaucer Court area that cannot be served by the existing downstream conveyance system.

A total of eight alternatives were developed by the TAC and modeled. Alternatives 1 through 8 are summarily described below:

1. Collect all upstream (US) flows and VO flows into single large pipe connected directly to Malletts Creek

2. Restore all US basins and collect and bypass flows, construct 14,000 ft3 below grade detention for VO (box culvert)

3. Restore all US basins, construct US regional basin, connect outlet from US regional basin to existing bypass, construct 14,000 ft3 below grade detention for VO (box culvert)

4. Restore all US basins and collect and bypass flows, construct 14,000 ft3 above grade detention for VO (excavated basin), replace 24” pipe under Ann Arbor/Saline Road with 36” pipe

5. Restore all US basins, construct US regional basin, connect outlet from US regional basin to existing bypass, construct 14,000 ft3 above grade detention for VO (excavated basin & retaining wall)

6. Restore all US basins and collect and bypass US flows, construct 6,500 ft3 above grade detention for VO (excavated basin), replace 24” pipe under Ann Arbor/Saline Road with 36” pipe

7. Restore all US basins, construct US regional basin, connect outlet from US regional basin to existing bypass. Pursue alternatives to store Village Oaks detention exceeding 6,500 ft3 in regional basin; the Meadows and/or Country Place might also participate in regional detention.

8. Restore all US basins, construct US regional basin, connect outlet from US regional basin to existing bypass, extend and upsize VO current outlet, no storage for VO

Underground storage to replace above grade detention requirements for VO were looked at in alternatives 2 and 3 but proved to be cost prohibitive. Other alternatives were also ruled out based on other factors including; WCWRC standard rules and regulations that require there be no increased impact (i.e., flow rate or water quality) to Malletts Creek; all developments are required to provide their own on-site storm water detention; and VO requirement to provide 14,061 ft3 of storage. These factors

led to the TAC to select alternative No. 5, based on the City's interpretation of the requirements, or alternative No. 7, also acceptable to the City and the County, and preferable to the property owners. Both include installation of upstream restrictors where missing and broken, and construction of a regional basin; the two alternatives differ in whether all US and VO detention is on-site, or if a portion is stored in the regional detention. Other, specific improvements may be necessary (i.e. increasing the size of the 24-inch pipe under Ann Arbor/Saline Road) depending on the final design and the level of service proposed. Planning level estimates place the cost for this alternative in the range of $858,000 - $1,248,000 noting that other specific requirements not yet identified may increase the estimated costs. See Appendix No. 5 for detailed descriptions of each alternative and cost estimates. Cost range is due to potential land purchase costs (associated with the area for the constructed regional basin) that range from an estimated $6/sf to $10/sf.

5. Public Meetings

1) Meeting #1 – Open Sharing

The first public meeting was held on January 19, 2011 at Lawton Elementary School. Approximately 20 residents, City staff and Wade Trim were in attendance. See Appendix No. 6 for meeting notice.

The goals of the meeting were to inform the residents of the reason for the study, the project goals, background, and the study process. The meeting was also intended to solicit additional input from the residents to gain a historical perspective and better understand the flooding issues they have directly observed. Wade Trim presented for approximately 30 minutes before opening the floor to a question and answer session that lasted for approximately 50 minutes. After the Q & A session; the group was divided into 3 sub-groups with one Wade Trim and one City representative at each table reviewing an aerial view drawing of the study area to allow for the residents to ask any questions they wanted and to share their history of the area. Wade Trim and City staff pointed out areas of initial concern prompting input from residents of their observations to help confirm issues and to refine the existing conditions that would be later used in the development of the existing conditions model. See Appendix No. 7 for the PowerPoint presentation that was given to the residents.

2) Meeting #2 - Alternatives

The second public meeting was held on March 2, 2011 at Lawton Elementary School. Approximately 20 residents, City staff, City Council and Wade Trim were in attendance. See Appendix No. 8 for meeting notice.

The goals of this meeting were to present the model results of the existing conditions, present the four initial alternatives (Alternatives 1, 2, 3 & 4) developed and looked at by the TAC at that time, and obtain additional input from residents. The TAC felt presenting the development and results of the existing conditions

model was important but did not want to spend much time on this subject to allow for a maximum amount of time collaborating with the residents over the 4 studied alternatives. The presentation included pictures taken during the June 2010 event to help remind folks of the extent of the flooding problems and why the study was being conducted. There was also a slide added to help the audience understand some of the frequently used terms so they can better understand the material being presented. The meeting was held for approximately 2 hours that included a 30 minute presentation by Wade Trim and then a collaborative session with the residents as each alternative was discussed. The pros and cons of each alternative were discussed and noted on a large easel for all to see. See Appendix No. 9 for the PowerPoint presentation that was given to the residents.

3) Meeting #3

   The City will be meeting with each of the neighborhoods to present the final recommendations and discuss future action plans.

4) An “Outreach and Activities” log was kept for the project that documented dates and individuals involved for each of the TAC meetings, public meetings, meetings with residents and home owners associations, phone calls and other specific items. See Appendix No. 1.

6. TAC Meetings/Review

A Technical Advisory Committee (TAC) was assembled at the beginning of the study that was comprised of a small group of representative stakeholders including; City Staff, residents, and the WCWRC. See Appendix No. 10 for TAC role description.

The main function of the TAC was to provide input on the existing conditions and to offer stakeholder guidance for determining the most efficient, cost effective, practical, and implementable solution to mitigate future flooding in the Village Oaks-Chaucer Court drainage area.

The TAC met a total of eight times between January of 2011 and January of 2012. See Appendix No. 11 for each of the PowerPoint presentations and respective meeting minutes for each TAC meeting.

Note: The first two TAC meetings were based on the PowerPoint presentation given at the first two public meetings to the residents and therefore the final version of the PowerPoint presentations became the meeting minutes of the first two TAC meetings. The Final TAC meeting focused on a summary review of the alternatives amd a final alternative selection. Npo official presentation was prepared or meeting minutes kept. A copy of the agenda has been included in Appendix No. 11.

7. Conclusions/Recommendations

The Village Oaks – Chaucer Court drainage area as we see it today has evolved over the past 40 years. This evolution has resulted, due to the compounding effects of combined surface storm water runoff, in unintended impacts to residents. This is largely due to the span of time over which these developments have occurred. As a result, each development was implemented under differing rules and regulations that have changed through the years; making it impractical to plan and implement a master drainage system that will adequately serve all properties until such time that a sufficient amount of development has occurred that more clearly defines the needed components of a master drainage system.

The Village Oaks – Chaucer Court area is comprised of a complex tributary system that includes multiple sequential detention basins, restricted conveyance, and downstream backwater conditions. Each tributary identified has been ostensibly operating, independently with no negative impacts, when reality reveals the collective negative effects of this "system" as seen downstream and adjacent to the Village Oaks – Chaucer Court area.

This study reveals that a number of smaller mitigation steps can be taken to alleviate the flooding issues including: adding additional catch basins along Ann Arbor/Saline Road, Chaucer and Ascot Drives; restoring detention basin volume capacities and installing and fixing restrictors; and, installing emergency overflow measures to increase levels of service. A larger and more comprehensive step involves construction of a regional basin to collect, detain, and slowly release storm water flow from US developments. This step can be a win-win situation for not only the existing developments; but for future development as well.

Although a number of alternatives were studied, and certainly more could be developed; the standards and regulations that exist today limit the approaches one can look at to resolve the flooding problems. Construction costs also play a significant role in limiting options, particularly when considering the impact to individual property owners to contribute to the cost.

It's these limiting factors that have led to the selection of alternative No. 5 by the TAC that includes VO and the upstream developments to restore their basins, installation of restrictors where missing and broken, and construction of a regional basin. As previously stated; other, more specific improvements may be necessary (i.e. increasing the size of the 24-inch pipe under Ann Arbor/Saline Road) depending on the final design and the level of service proposed. The location of the regional basin is best served in the wooded area located on the vacant parcel immediately north of the VO subdivision. This area currently serves as storm water collection point for all areas US, and contributing flows directly to the Village Oaks – Chaucer Court area. The process of establishing a regional basin would include the city

petitioning the Washtenaw County Water Resource Commissioner (WCWRC) to undertake the basin project. This process requires the application of the WCWRC rules and regulations as they pertain to storm water storage and water quality. This point of clarification seeks to help the reader differentiate the many cost estimates in the Appendix items that are based on differing criteria that were used in the calculation of estimated construction quantities and subsequent cost estimates.

Final planning level estimates, based on the WCWRC rules and regulations, place the cost for alternative No. 5 in the range of $858,000 - $1,248,000 noting that other specific requirements not yet identified may increase the estimated costs. See final cost estimate, Appendix No. 5. Cost range is due to potential land purchase costs (associated with the area for the constructed regional basin) that range from an estimated $6/sf to $10/sf.

8. Action Items

During the course of this study, the city has moved forward with working with the upstream developments (Meadows, Country Place and Karrington) on the re-installation of the missing restrictors. However, the detention volume deficiency identified during the field investigation phase remains to be addressed for the detention systems located at Village Oaks, Country Place and Meadows.

One of the items identified with the Village Oaks detention system is the lack of an emergency overflow structure which was not required by city code at the time of the development. As a result, the city has acknowledged the installation of an emergency overflow structure would be performed at city cost as part of the anticipated regional basin project.

The city plans to meet with the existing developments to share the findings and recommendations from the study as well as begin discussion on alternatives for correcting the volume deficiencies. The regional basin may provide an option for the existing developments to utilize it for providing their missing volume. A planning level cost estimate and allocation for this option has been developed by the city and is included in Appendix No. 5. The alternatives and steps for correcting the volume deficiencies are outlined below.

If Village Oaks, Country Place, and/or the Meadows choose to correct and maintain the detention volume on-site, there are several options:

1. Restore the required storm water detention volume in the location shown on the approved site plan.

- The only permit necessary to do this is a Grading/Soil Erosion and Sedimentation Control Permit which can be obtained from the City Planning and Development Services Unit.

2. Restore the required storm water detention volume with no more than 50% of the volume being relocated elsewhere on-site.

    - Chapter 57, Section 5:122 (5)(k) - An administrative amendment to site plan is required. Note – Village Oaks was a platted subdivision, therefore this step is not applicable for the Village Oaks site.

    - Provided there is not a net increase in impervious area to the site, this process does not require the existing storm water management system to be brought into compliance with current Chapter 63 storm water management requirements.

    - Implementation of this option will require a Grading/Soil Erosion and Sedimentation Control Permit which can be obtained from the City Planning and Development Services Unit.

    - Applicable condominium master deed document(s) will need to be reviewed for any necessary amendments.

3. Restore the required storm water detention volume with more than 50% of the volume being relocated elsewhere on-site.

    - Chapter 57, Section 4:122 (4) - A site plan for Planning Commission approval is required. Note – Village Oaks was a platted subdivision, therefore this step is not applicable for the Village Oaks site.

    - Existing storm water management system will need to be brought into compliance with current Chapter 63 requirements.

    - Implementation of this option will require a Grading/Soil Erosion and Sedimentation Control Permit which can be obtained from the City Planning and Development Services Unit.

    - Applicable condominium master deed document(s) will need to be reviewed for any necessary amendments.

Below are the necessary potential options identified by the City to date through which the existing developments request might participate in the anticipated regional basin project (i.e., off-site detention) as opposed to correcting and maintaining the full detention volume on their own sites.

Village Oaks

1. Establishment of a homeowners association (necessary for Zoning Board of Appeals petition)

2. In accordance with Chapter 63, Section 5:668 obtain a request for a variance from the Zoning Board of Appeals for shifting required detention volume upstream to the regional basin (since rate of runoff from VO will exceed Chapter 63 requirements).

3. In accordance with Chapter 57, Section 5:133, propose an amendment to the Site Development Agreement for City Council approval (necessary for documenting the required volume amount stored on-site and off-site).

Country Place/Meadows

1. Restore the required storm water detention volume with no more than 50% of the volume being relocated off-site.

    - Chapter 57, Section 5:122 (5)(k) - An administrative amendment to site plan is required.

    - Provided there is not a net increase in impervious area to the site, this process does not require the existing storm water management system to be brought into compliance with current Chapter 63 storm water management requirements.

    - If grading activities are proposed on-site, a Grading/Soil Erosion and Sedimentation Control Permit will need to be obtained from the City Planning and Development Services Unit.

    - Applicable condominium master deed document(s) will need to be reviewed for any necessary amendments.

2. Restore the required storm water detention volume with more than 50% of the volume being relocated off-site.

    - Chapter 57, Section 4:122 (4) - A site plan for Planning Commission approval is required.

    - Existing storm water management system will need to be brought into compliance with current Chapter 63 requirements.

- Implementation of this option will require a Grading/Soil Erosion and Sedimentation Control Permit which can be obtained from the City Planning and Development Services Unit.

3. Applicable condominium master deed document(s) will need to be reviewed for any necessary amendments.

4. In accordance with Chapter 57, Section 5:133, propose an amendment to the Site Development Agreement for City Council approval (necessary for documenting amount off volume to be stored off-site).

Note: The Site Plan amendment process opens the site to a comprehensive review by all city departments which may result in other compliance issues being identified.

Appendix:

1. Outreach and engagement activities log
2. 12/1989 Chaucer Ct Storm Sewer Study
3. Infiltration Tests
4. VO Record Drawings and calculation discrepancies
5. Cost estimates
6. Public Meeting No. 1 Notice
7. Public Meeting No. 1 Notice Presentation and sign in sheet
8. Public Meeting No. 2 Notice
9. Public Meeting No. 2 Notice Presentation and sign in sheet
10. TAC Role Description
11. TAC Meeting Minutes and PowerPoint agendas