Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Regional SSO Control Analyses-Capacity Constraints in the Systems

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Appendix A. System Capacity Evaluation Using a 25-Year Storm

Regional SSO Control Analyses

1.Introduction

In addition to the various local solutions for SSO control that have been investigated as part of the SSO Case Studies project, the feasibility of regional solutions for SSO control has been evaluated. Regional solutions for SSO control involve conveying excess wet weather volumes to the DWSD system for the six case study communities. This memo summarizes the analysis of various regional alternatives for SSO control. Also investigated is the extent to which some communities are already discharging excess wet weather flows to the regional system. Many communities have excess wet weather flows, but without reported SSOs or basement flooding. Amount of flow over contract was reviewed to quantify the extent of this phenomenon. In addition, the potential for providing additional capacity for Wayne and Oakland counties was investigated.

2.Approach

The WWMP Model was used to review the regional impact of accepting these increased flows into the regional collection system. These impacts were quantified in terms of changes in the following items:

- Amount of flows accepted by the regional system,
- Estimates of flows displaced elsewhere in the regional system (determined by changes in CSO volumes),
- Change in peak hydraulic gradeline for selected locations, and
- Amount of flows directed to the WWTP.

The peak hydraulic grade lines (HGLs) simulated were reviewed in selected locations for potential to cause adverse impacts such as basement and street flooding. Modeled peak HGLs were compared to critical HGLs to determine whether an alternative solution would contribute to flooding. Critical HGLs were obtained from Detroit's Long-Term CSO Control Plan for major interceptors. A criterion was set that if the modeled HGL is at or above critical HGL under existing conditions, then no more flow can be accepted, no matter how small the additional flow might be. Likewise, if an alternative resulted in the critical HGL being exceeded, then that alternative was not accepted.

Information available from local engineering studies was used as available to understand the local improvements that might be required to transport the flows to the regional system. Preliminary estimates of costs associated with these improvements were developed to try to quantify the true cost of conveying excess wet weather flows downstream as opposed to handling the flows through local solutions. At this time, the regional analysis did not include investigation of the impact of dewater flows from potential equalization basins that might be implemented as a

local solution.

3.WWMP Model Configuration and Assumptions

3.1 General

The GDRSS Model as released in 1999 was configured for Baseline (1998) and Future conditions. The future condition version was for an unspecified year, but it included all known facilities planned or being constructed at the time of the model development. The GDRSS Model was updated in 2001 to incorporate new information available on various CSO Control Plan components and other facilities within the regional system since the model was released in 1999. This update included the CSO Control Plan elements such as the screening and disinfection facilities and revising the representation of the number and locations of the in-system storage facilities.

Further updates have been made to the model for purposes of the regional analysis as well as other analyses needed by the WWMP project. The primary update to the model consisted of developing submodels for the Clinton-Oakland sewer district and the Macomb sewer district. Previously, these two districts were each represented by one subarea, and the interceptors were not explicitly included. The routing of flows from these two districts was approximated by the shape defined for the rain dependent inflow/infiltration (RDII) parameters required in the model for the two subareas.

With the development of the two submodels, the interceptors in both districts are now explicitly modeled. In addition, the Macomb district is now delineated with 29 subareas and the Clinton-Oakland district is defined with 54 subareas, giving greater spatial resolution to the wet weather response generated in these districts. As part of this update, the representation of the Northeast Pump Station (NEPS) was revised to include the new variable speed pump that is to be added at that station. With this upgrade, the firm capacity of the station is now 400 cfs.

These updates provide the level of detail required for the analysis of the three case studies in the Macomb District. The model with these updates is referred to as the WWMP Model for this project. The model includes accounting for the expansion of the GWK (Twelve Towns) Basin. It does not include the connecting sewer that will connect the Upper Rouge Tunnel with the Dearborn Tunnel, but it does include the two tunnels as envisioned during the development of the future condition. It also uses dry weather flow levels as originally projected to 2020. These levels have not been updated at this time for these simulations.

3.2 Integration of Case Studies

The model was further modified to integrate additional details for the six case studies as available. These details included any subarea delineation or additional hydraulic information that were developed in modeling these areas for review of local alternatives. Garden City was already incorporated into the model and required no additional changes.

Both Center Line and Allen Park detail models included additional information on the connecting sewers as well as the configuration of the overflows that were incorporated into the model.

The connecting sewers for Clinton Township, Fraser and all Macomb meter districts were approximated by defining a connecting sewer and an overflow or overflow conduit, as shown in Figure 1. The connecting sewer was configured to represent hydraulic limit as estimated from review of actual pipe size and slope as well as review of actual meter data. This configuration allowed for applying a contract limit for these communities, depending on the alternative being reviewed.

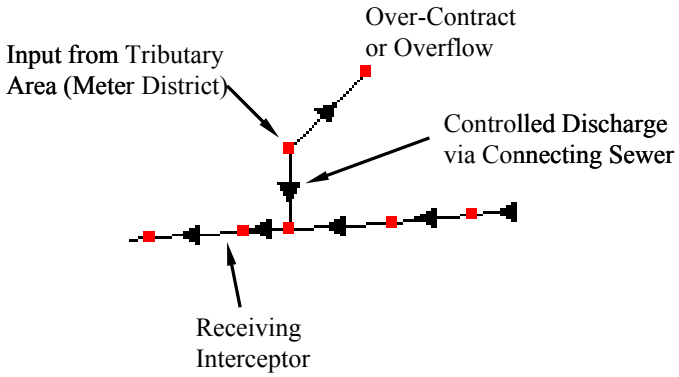


Figure 1. Controlled Discharge

Fraser and Clinton Township SSO areas were subsets of subareas defined in the WWMP Model. The subareas in the model were revised to include these as additional subareas. For Fraser, additional hydraulic detail was added to represent the Beacon Pump Station, which handles flows from the Fraser SSO subarea. This pump station has a sanitary pump capacity of 3.5 cfs and a bypass pumping capacity of up to 7.5 cfs. For all the case studies, the SSO parameters as developed for the local model analyses were incorporated into the regional model.

4. Design Storm Events

Two events were used for these simulations, the 25-year, 24-hour event and the 10-year, 1-hour event. The rainfall depths for these two events are 4.0 and 1.8 inches, respectively. For the 25-year event, an areal reduction factor of 0.91 was used, which resulted in the total rainfall depth being reduced from 4.0 inches to 3.6 inches. Other events were also simulated, but were dropped from further review when the SSO Work Group began to focus on the 10-year event and the 25-year event for the regional analysis. Both winter (dormant) and summer (growth) rainfall distributions were used, depending on the given simulation. The use of the terms **summer** and **winter** reflect their usage in the development of these seasonal rainfall distributions.

They are assumed to correlate to the terms **dormant** and **growth** respectively as used in the development of the seasonal variation in rain-dependent inflow/infiltration

parameters. A chart depicting these two distributions for the 25-year event is shown in Figure 2.

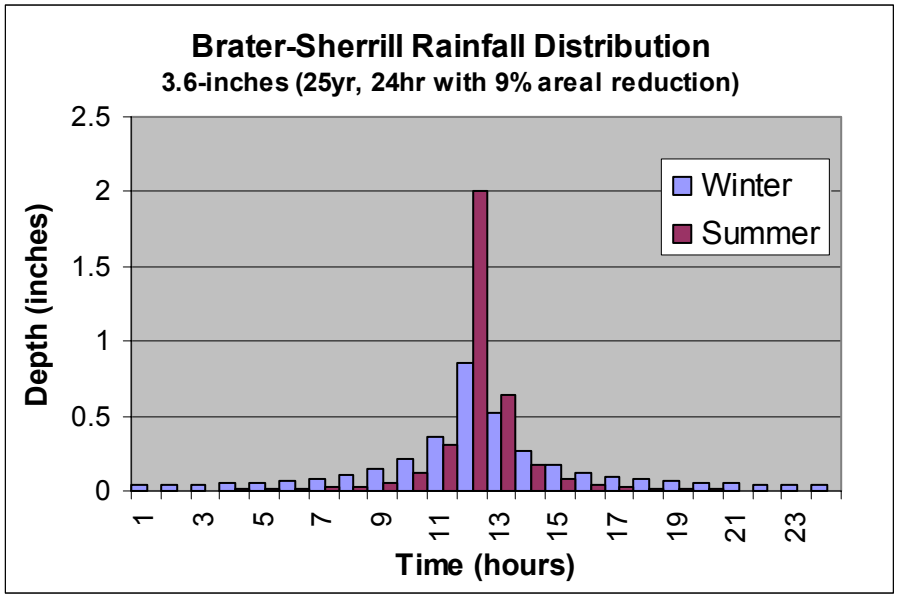


Figure 2. Winter (Dormant) and Summer (Growth) Rainfall Distribution

5. Alternative Strategies

The model was configured for review of several different alternative strategies as follows:

1. **Baseline**: Current conditions with regard to peak discharge rates to DWSD, even if the Case Study areas or other First-Tier communities are over their contract limits in some cases.
2. **Accept SSO**: Representation of the Case Studies only revised to direct all excess wet weather to the regional interceptor system.
3. **Contract Limited**: All Case Studies and First Tier communities held to their current contract limit at their point of connection to the DWSD interceptors. Excess flows in this alternative are diverted (removed) from the system and tracked as over-contract flows.
4. **Contract Limited-NEPS**: Same as Contract Limited, but with the contract limit for the Macomb and Clinton-Oakland communities applied at the Northeast Pump Station instead of at their point of connection to the DWSD interceptors.
5. **Center Line**: Connection of Center Line to DWSD changed from Conner Creek, which was found to not have additional capacity available, to the Edison Corridor, which is determined to have additional capacity available.
6. **Oakland County**: Review potential for providing additional capacity to the Evergreen-Farmington system by using the existing connection to the Southfield Sewer (original path before connection to First Hamilton was built).
7. **Wayne County**: Review potential for providing additional capacity for the North Huron Valley/Rouge Valley (NHV/RV) system in the Northwest Interceptor (NWI).

Alternatives 1 through 5 are described in more detail in the following subsections. Alternatives 6 and 7, along with additional background on Alternative 4, are described further in Section 6, which discusses regional solutions for major districts.

5.1 Baseline

To represent current conditions under Alternative 1 (Baseline), a couple of additional changes were required to the model after the case studies were integrated into the model as previously discussed. Allen Park was configured to be limited to contract capacity in the model. Since a means to actually control Allen Park's discharge rate at the point of connection to the Northwest Interceptor does not exist, this control limit was removed. Likewise, the pumping capacity for Melvindale was set at contract limit in the model. Again, the actual capacity that is used if necessary is 15 cfs. If the overflow valve is opened, the capacity increases to 18 cfs. The representation was revised to allow a peak pumping rate of 18 cfs and an overflow conduit was added for flows that exceeded this rate. No other changes were made to the model for this alternative.

5.2 Accept SSO

To represent Alternative 2 (Accept SSO), the representation of the Case Studies was revised to direct all excess wet weather flows to the regional system. In each case, the representation of the overflow was removed from the model and generally, the excess flows were allowed to discharge to the receiving interceptor via the existing connecting sewer as represented in the model.

For Center Line, a representation of the actual connecting sewer is included in the model. This sewer was increased in size from 24-inch to 30-inch, representing a possible pipe-bursting improvement. For Garden City, the flow limits on the regulator connections were removed.

For the remainder of the case studies, no changes were made to the representation of the connections to the receiving interceptor in the model. The excess flows were directed via the connecting sewers or pump stations, depending on the configuration for each case study. Local improvements that would be required to convey the excess flows to the receiving interceptors were not modeled explicitly. The model representation and analysis of model results were focused on the impact these excess flows might have on the regional system once introduced and not on the internal improvements that might be required.

5.3 Contract Limited

For Alternative 3 (Contract Limited), all First Tier customers were held to their contract capacity, including the districts in Macomb County. A list of the control limits used for this alternative for the case study communities and the meter districts in the Macomb Sanitary District are provided in Table 1. For communities without an

explicit control, such as a pump station, regulator, or a hydraulic limit, a control was set at the point of connection to the interceptor, generally the location of the billing meters, as previously shown in Figure 1. Excess flows in this alternative are diverted (removed) from the system and tracked as over-contract flows. This alternative investigates the extent of communities that might not have reported SSOs or basement flooding, but are nonetheless discharging excess flows to the regional system.

Table 1. Control Limits for SSO Case Studies and Macomb Meter Districts

Sewer District	Community*	Comments	Meter No.	Residential Population (2020)	Physical Capacity (cfs)	Control Capacity (cfs)**
Macomb	Chesterfield		CH-S-5-A	40,312		16.1
			CH-S-5-B	180		0.1
			CH-S-5-C	2,501		1.0
	Total:					**17.2**
	Clinton Township		CT-S-1-A	19,070		7.6
	Clinton Township	SSO (M1,2,3)	CT-S-2-A	4,430	8.99	1.8
		Non-SSO		19,369		7.7
	Total:					**9.5**
	Clinton Township		CT-S-3-A	26,936		10.8
	Clinton Township		CT-S-4-A	1,485		0.6
	Clinton Township		CT-UM-A	2,765		1.1
	Clinton Township	SSO (M4,5,6,9)	CT-UM-B	5,293	7.83	2.1
		Non-SSO		5,106		2.0
	Total:					**4.2**
	Fraser	SSO	FR-S-1-A	3,930	3.50	1.6
		Non-SSO		8,543		3.4
	Total:					**5.0**
	Fraser		FR-UM-A	2,427		1.0
	Harrison Township		HR-S-1-A	1,480		0.6
			HR-S-1-B	9,165		3.7
	Total:					**4.3**
	Harrison Township		HR-S-2-A	13,801		5.5
	Harrison Township		HR-S-3-A	5,513		2.2
	Macomb Township		MA-S-1-A-1	68,770		27.5
			MA-S-1-A-2	1,747		0.7
			MA-S-1-B-1	18,129		7.3
			MA-S-1-B-2	3,381		1.4
			MA-S-1-C	375		0.2
			MA-S-1-D	10,109		4.0
	Total:					**41.0**
	Sterling Heights		ST-S-1-A	34,182		13.7
	Sterling Heights		ST-S-2-A	4,977		2.0
	Sterling Heights		ST-S-3-A	31,424		12.6
	Sterling Heights		ST-S-4-A	16,008		6.4
	Sterling Heights		ST-S-5-A	9,259		3.7
	Sterling Heights		ST-S-6-A	16,261		6.5
	Shelby Township		SY-S-1-A	6,746		2.7
	Shelby Township		SY-S-2-A	8,891		3.6
	Utica		UT-S-1-A	4,158		1.7
Total:				406,723		**163**
Clinton-Oakland	Avon Arm		RC-S-1	18,924		7.6
	Oakland Arm		OC-S-2	272,416		109.0
Total:				291,340		**117**
Total -- Clinton-Oakland & Macomb					**400**	**279**
Center Line					8	6.5
Allen Park					15	6.0***
Melvindale					18	6.4****
Western Wayne	GC-Merriman (M2)					7.0
	GC-Middlebelt(M1)					17.4

*Case study areas are highlighted in above table

**Capacity set at 0.4 cfs/1000 residential population for Macomb and Clinton-Oakland Districts

*** The contract capacity for Allen Park is 0.4 cfs/1000 people or industrial hydraulic equivalent. The specific contract capacity was being investigated when the modeling was performed. A limit of 6 cfs was assumed for modeling purposes.

**** The simulation was performed with a control capacity from a previous contract. The new contract capacity is 0.5cfs/1000 people.

5.4 Contract Limited-NEPS

Alternative 4 (Contract Limited-NEPS) is the same as Alternative 3 except for the communities in Macomb County District and Clinton-Oakland district. For these districts, instead of holding the communities to their contract limit at their point of connection to the DWSD interceptors, the control was set at the Northeast Pump Station (NEPS). The future firm capacity of the NEPS is 400 cfs. For this alternative, the peak pumping capacity was set at 279 cfs, the sum of the control limits for all the upstream communities, including Clinton-Oakland District, as previously provided in Table 1.

5.5 Center Line

The City of Center Line currently discharges to Conner Creek sewer. The peak HGLs in the Conner Creek sewer during the 10-year, 1-hour design event exceeds the target HGLs. Therefore, allowing additional capacity for Center Line was not considered feasible. Due to the location of the city, the potential to provide additional capacity through the North Interceptor - East Arm (NIEA) or the Edison Corridor Interceptor was considered to be a viable option.

According to the 1968 Basic Requirements Report for the Oakland-Macomb Interceptor System, it was anticipated that an additional outlet might be provided through the Corridor Interceptor when and if required. It also noted that the additional flow would have negligible effect on the Corridor Interceptor as designed. Based on this information, it was decided for this alternative to investigate providing additional capacity via the Corridor Interceptor vs. the NIEA. It is anticipated that this would be accomplished by extending the existing 36-inch overflow pipe all the way to the Corridor Interceptor. It may be more cost effective to connect directly into the NIEA, but this option was not investigated as part of this alternative.
The length of sewer required would be approximately 1.5 miles, at an estimated cost of $2.8 million. The overall cost of the project, including a connection to the Corridor Interceptor and engineering and construction fees, is estimated to be $4.6 million.

6. Additional District Alternatives

In addition to the six case studies, Wayne, Oakland and Macomb counties have requested to be included in the SSO study to explore the feasibility of regional alternatives in addressing their sanitary sewer overflows. This section of the memo summarizes efforts to address SSOs, and explores the potential for regional alternatives for these districts. These alternatives relate to Alternatives 4, 6, and 7 as listed at the beginning of Section 5. Additional detail is provided here on these districts as the backgrounds on these districts have not been provided elsewhere in the SSO documentation.

6.1 Oakland County – Evergreen Farmington Sanitary District

6.1.1Background

Oakland County's Evergreen-Farmington Sewage Disposal System (EFSDS) provides service to all or parts of 15 communities located roughly in the south-central portion of the county. The Oakland County Drain Commissioner is responsible for the operation, maintenance and administration of the county interceptor sewers that serve the district. The system consists of two major interceptors: the Evergreen Interceptor, located in Evergreen Road, and the Farmington Interceptor, located in Middlebelt Road. These interceptors join before connecting to the DWSD system at the northern Detroit border.

According to the 1964 report by the National Sanitation Foundation, the interceptor system was designed to handle 0.44 cfs/1,000 people. The contract capacity with DWSD is 170 cfs, which is approximately the hydraulic limit of the interceptor at the point of connection.

According to a March 1999 study prepared by Hubbell, Roth & Clark, Inc., on the system, the Evergreen-Farmington district has a history of sanitary sewer overflows and basement flooding. A comprehensive facilities plan resulted from monitoring and studying the system during the 1970s and 1980s. This plan included sewer system rehabilitation to reduce inflow and infiltration, interceptor relief and pump station improvement projects, and sanitary retention facilities.

These improvements and system rehabilitation projects were completed in 1992. In 1993, project performance certification monitoring was conducted. Results of this monitoring indicated that most communities were at or over their projected 1993 flows, but below their 2025 Town Outlet Capacity limits.

In 1996, the county submitted the project performance certification report to MDEQ. The certification program was completed but did include ongoing requirements for implementing individual Corrective Action Programs for several communities that could not positively certify their local projects.

Since completion of the certification project, the Evergreen-Farmington system has experienced excessive inflow from defective manholes and pipes, footing drains and illegal sump pump connections. Specifically during heavy rainstorms in 1996 to 1998, the system experienced severe problems including basement flooding, sanitary sewer overflows, surcharging and other operational problems. It is thought that these problems were not identified during the project performance certification in 1993 because the storms were not as large as those during 1996 to 1998.

6.1.2 Corrective Actions Underway and/or Completed

In 1997, a study of the system was initiated to investigate the cause of these problems. The results of this study are provided in the March 1999 report *Evergreen-Farmington*

Sewage Disposal System – 1999 Phase 1 Study – Volume 1 prepared by Hubbell, Roth & Clark, Inc.

The study included a number of components to evaluate current conditions, including review of meter data, modeling of the system using a SWMM model, collection of basement flooding reports, analysis of pump station operations, review of siphons with operational problems, and inspection of flood-prone manholes as part of a pilot rehabilitation program.

The study also reviewed the problem of footing drains and illegal sump pump connections to the sanitary sewers. The 1982 Comprehensive Facilities Plan estimated that approximately 19,000 homes (25-percent) have footing drains connected to the sanitary sewer system. In addition, an estimated 9,000 homes have illegal sump pump connections.

Results of the study indicate that there are excess flows throughout the system. It is recommended that to address excessive flows during severe wet weather events, manholes need to be inspected and rehabilitated, sump pumps disconnected, and pilot programs for footing drain removal be instituted. Because Oakland County is not directly responsible for the local sewers of its communities, addressing excess flows will require the cooperation of the member communities of the EFSDS. The study also anticipates that these programs will not be sufficient to eliminate the need for additional storage within the system. The study identified up to eight locations where retention basins might be necessary to enable a community to remain within its outlet limit with the Evergreen-Farmington system.

6.1.3 Additional Alternative Reviewed

In studying the alternatives for remedial action within the district, the potential for increased outlet capacity through an increase in capacity with DWSD was not considered an option. As part of the WWMP regional approach, the county is interested in exploring the feasibility of increasing its contract capacity with DWSD as another alternative/approach to addressing the SSOs and basement flooding problems currently being experienced in the EFSDS.

This alternative reviewed the potential for providing additional capacity to the Evergreen-Farmington system by using the existing connection to the Southfield Sewer. This was the original connection point with DWSD before the connection to the First Hamilton sewer was built.

6.2 Wayne County – North Huron Valley/Rouge Valley District

6.2.1 Background

Wayne County's North Huron Valley/Rouge Valley (NHV/RV) sanitary district serves 15 communities in western Wayne County via a number of interceptors along the lower, middle, and upper branches of the Rouge River. The interceptor system

discharges to the DWSD system at three locations. The current contract with DWSD allows for a total peak capacity of 380-cfs at these connection points.

According to the 1964 National Sanitation Foundation report, the interceptors generally were designed to handle 0.4-cfs/1,000 residents for separate sanitary areas and 0.5-cfs/1,000 residents for combined sewer areas. The interceptor system as originally built included two approved gravity overflows to the Rouge River. With the current configuration, these have been removed or gated shut, though a pump bypass for emergency purposes exists at one location.

The communities served by the interceptor system comprise both combined sewer areas and separate sanitary areas. These local systems were typically designed to handle flows generated during a 10-year, one-hour design storm. The combined systems included regulators to control flow into the interceptor with overflows sent to the Rouge River. The system included more than 50 overflow locations to local relief sewers upstream of their connections to the interceptors.

Wayne County has been addressing capacity issues in this system for a number of years. A facility plan was developed in the mid-1980s to address inadequate capacity in the NHV/RV interceptors to transport existing peak wet weather flows, capacity constraints at the point of discharge to the DWSD system, and federal requirements for CSO control. The plan included sewer rehabilitation, local relief sewers, new interceptors, sanitary equalization basins, and a lift station to maintain capacity at the outlet to DWSD. This plan was completed in 1999. Concurrently, three CSO demonstration basins were constructed as part of the Rouge River national Wet Weather Demonstration Project. In addition, a number of communities separated their combined sewer systems.

Through these efforts over half of the combined sewer overflows have been addressed. However, various communities within the district continue to experience SSOs during large storm events.

6.2.2 Corrective Actions Underway and/or Completed

To address SSOs and capacity issues within the NHV/RV district, Wayne County conducted a study to identify and analyze various design criteria that could be used to develop regional solutions for SSOs. This study resulted in "SSO Basis of Design Criteria Evaluation Report" prepared by Wade-Trim in October 2000.
The study identifies three major issues needing resolution. First, a number of the communities have not been able to certify that their actual flows are within their design capacities at the point of discharge to the interceptor system. One of these communities, Garden City, is discussed in Section 9 of this report. Second, the report contends that an ability to bypass flows to the river during wet weather events that exceed the system capacity is needed in order to protect against basement flooding. As there will always be a storm event greater than the design event, the county maintains that the design criteria for the control of SSOs should address how these

excess flows will be handled. Third, the report notes that there is a lack of an established policy and requirement from MDEQ on its position regarding SSOs.

Four potential design criteria were identified in the study:

1. MDEQ Presumptive Criteria
This standard calls for the sanitary system to be designed to retain the flow volume generated from the 25-year, 24-hour storm event (3.9-inches). However, it does not address control/treatment of bypasses that occur when the design event is exceeded. It also does not address to which communities this criterion would be applied. Currently, there are a number of communities that have been certified to their original design event, typically the 10-year, one-hour design event, that would not meet the volume requirement of the 25-year, 24-hour design event.

2. Original NHV/RV Basis of Design
The original design criteria for the NHV/RV regional system was based on peak design flow projections provided by each community. The design storm and criteria varied among communities, though in general the overall design storm of the system is considered to be the 10-year, one-hour storm. The original design of the system did not address any control/treatment of bypasses that occur when the design is exceeded.

3. MDEQ CSO Presumptive Criteria
The CSO presumptive criteria require the complete capture of the one-year, one-hour design storm (1-inch) and 30-minutes of contact time for the peak flow rate generated from the 10-year, one-hour design storm (1.8-inches). The 30-minutes of contact time is to reduce fecal coliform concentration to below 400 colonies per 100 ml. All identifiable sanitary solids from the overflow are also to be eliminated.

4. SSO Water Quality Criteria
These alternative criteria require meeting the same criteria of No. 2 above, but, in addition, address overflows by providing for 20-minutes of contact for flows generated from the 25-year, 24-hour design storm. The disinfection would be required to decrease fecal coliform to less than 400 colonies per 100 ml. These criteria are based on a similar approach as MDEQ's presumptive CSO criteria of providing a capture component and a treatment component in the criteria. The criteria recognize the potential for overflows for wet weather events above the design event and address how they are to be handled.
These criteria were used to design regional alternatives to solve the SSO problems within this district. The approach used by Wayne County in addressing deficiencies in the NHV/RV system was based on determining the size of storage facilities that would be required for the different criteria. A revised version of the GDRSS Model was used for this analysis. This revised version included additional calibration to improve its representation within the system using local data. The facilities were sized to prevent the levels in the interceptors from exceeding 90 percent of the total level in the pipe. These facilities were located at strategic points in the model representation of the system. Results from this analysis consist of preliminary facility sizing for the

various design criteria. These results have been presented to MDEQ and are under review.

In addition to facility sizing, the county is reviewing the potential for flow balancing within the district. One example is to increase the use of a CSO basin – direct additional combine sewage flow to a basin without exceeding its design capacity – and thus making available additional capacity in the interceptor system for sanitary flows from another community.

6.2.3 Additional Alternative Reviewed

The county is currently reviewing these various alternatives with MDEQ. These alternatives have been developed using the existing contract capacity with DWSD. As part of the regional SSO review being conducted under the Waste Water Master Plan (WWMP), the county is also interested in exploring alternatives that would include use of an increased contract capacity with DWSD. Specifically, this alternative would review the potential for providing additional capacity for the North Huron Valley/Rouge Valley (NHV/RV) system at the point of connection to the Northwest Interceptor (NWI).

6.3 Macomb County Wastewater Disposal District

6.3.1 Background

Macomb County has two major sewer districts: the Macomb County Wastewater Disposal District and the South Macomb Sanitary District. This memo is focused on the Macomb County Wastewater Disposal District. The district is served by several major interceptors that are tributary to the Edison Corridor Interceptor, which terminates at the Northeast Pump Station (NEPS) in Detroit. This interceptor has a hydraulic capacity of 883 cfs, though the actual capacity is limited by the capacity of the Northeast Pump Station. The station currently has a total capacity of 400 cfs and a firm capacity of 250 cfs. An additional variable speed pump with a nominal capacity of 150-cfs is planned for 2002, which will increase the firm capacity to 400 cfs.

This district differs from other suburban districts in that the interceptors are owned by DWSD. The district currently includes 11 communities that have contracts with DWSD for a capacity based on population.
This capacity is 0.4 cfs/1,000 residents and it applies on an individual community basis. These limits are provided in Table 1, previously provided. The sum of these individual limits for is 162 cfs, based on projected 2020 populations (for Macomb communities only).

6.3.2 Corrective Actions Underway and/or Completed

Corrective actions are taking place on an individual community basis. Two of the communities are included as part of the case studies being performed as part of the regional SSO review being conducted under the WWMP (Clinton Township and Fraser, see Sections 5 and 6).

6.3.3 Additional Alternative Reviewed

The county is interested in the potential for alternatives that would include flow balancing among the communities and/or increasing outlet capacity. Because the current contracts are applied for individual communities, the flow-balancing alternative would require a change in contractual arrangements with DWSD. For the other suburban districts, internal flow balancing alternatives would not impact their contracts with DWSD. This approach is essentially Alternative 4 (Contract Limited – NEPS), which looks at applying the sum of the individual limits at the NEPS, as previously described.

Another alternative being considered is the use of potential excess capacity at the Mt. Clemens WWTP or other existing or new WWTPs in the area. This approach is described further in Volume 3 of the WWMP Report. For purposes of the SSO regional analysis, diversion of flows was not considered.

7. Results

For all the alternatives, the results were reviewed for impacts downstream in terms of changes to the peak HGLs. In addition, changes in outfall and WWTP volumes are tabulated. The grouping of the results for the alternatives reflects the development of these alternatives with the SSO Work Group input. Results for Alternatives 1 and 2 were provided at the November 4, 2002, work group meeting. Alternatives 3 and 4 were presented together at an earlier meeting (September 23, 2002 – note that Alternatives 3 and 4 of this memo corresponds to Alt. 1 and Alt. 3, respectively, of that meeting's handouts). Alternative 5 through 7 are additional individual alternatives.

7.1 Acceptance of SSO for Case Studies – Alts 1 & 2

7.1.1 Summary

The WWMP Model was configured for existing conditions and for accepting excess wet weather flows from the case studies, as described in the previous section. Three events were reviewed for these alternatives: the 10-year, 1-hour summer event, the 25-year, 24-hour summer event and the 25-year, 24-hour winter event.

The total SSO for the Case Studies are provided in Table 2. For the Baseline Alternative, the total SSO from these areas is 3, 14, and 45 MG for the three events. As should be expected under the alternative of accepting SSOs, the total SSO from these areas is zero.

Table 2. Total SSO from Case Study Areas

Type of Discharge	10yr, 1hr Summer		25yr, 24hr Summer		25yr, 24hr Winter	
	Baseline	Accept SSO	Baseline	Accept SSO	Baseline	Accept SSO
Allen Park	0.0	0.0	0.9	0.0	1.5	0.0
Centerline	0.0	0.0	0.8	0.0	2.5	0.0
Clinton Township SSO	0.0	0.0	0.2	0.0	3.3	0.0
Fraser SSO	0.8	0.0	1.9	0.0	4.1	0.0
Garden City	2.2		8.2	0.0	33.4	0.0
Melvindale	0.0	0.0	2.1	0.0	0.7	0.0
Total	3.0	0.0	14.0	0.0	45.5	0.0

P:\27518-WWMP\Task H_SSO Regional Control Issues\Case Studies\Regional\[regional tables.xls]Table3 (3)memo

Table 3 summarizes the impact of accepting these flows by presenting the change in volume of discharge by all outfall types in the system.

Table 3. Volume of Discharge by Outfall Type (MG)

Type of Discharge	10yr, 1hr Summer			25yr, 24hr Summer			25yr, 24hr Winter		
	Baseline	Accept SSO	Change	Baseline	Accept SSO	Change	Baseline	Accept SSO	Change
CSO Basin	1,267	1,265	-2	3,619	3,612	-6	2,816	2,819	3
Untreated CSO	783	781	-2	1,987	1,986	-1	1,479	1,482	2
Ground Flooding	2	2	0	5	6	1	1	1	0
Screening & Disinfection	269	271	2	789	777	-11	636	638	2
Untreated SSO	8	5	-3	30	17	-13	95	54	-40
CSO TUNNEL	313	316	3	1,052	1,053	1	628	627	-2
WWTP	5,133	5,161	27	5,509	5,544	34	6,543	6,576	33

P:\27518-WWMP\Task H_SSO Regional Control Issues\Case Studies\Regional\[L314Voln7_temp.xls]Sheet2

Generally, the acceptance of the excess wet weather flows from the case studies resulted in little change for the following outfall types: CSO Basin, Untreated CSO, Ground Flooding, Screening & Disinfection, and CSO Tunnel. These changes for these outfall types are essentially within the range of continuity error inherent in the SWMM program used by the WWMP Model. The SSOs, however, are reduced by the amount produced by the case studies. The reduction in SSO volume is mostly offset in an increase in the total volume treated at the WWTP. The increases do not exactly equal the decreases due to the continuity error as well as changes in the amount of in-system storage that would exist at the completion of these simulations.

The amount of SSOs still indicated under the Accept SSO alternative are almost all in the NHV/RV system and generally for those areas that have had their sewer systems recently separated. The representations of these areas in the model have not been updated with data collected since these separation projects have been completed

The changes in volumes by outfall types give only a partial picture of the impact of the results. Changes in the peak HGLs generated by accepting the SSO flows are also reviewed to determine feasibility of this regional SSO control. These impacts and other issues are now discussed.

Center Line: Center Line discharges to the Conner Creek Enclosure. There is concern for potential street and basement flooding near Six and Seven Mile roads as the enclosure accepts flows from this area of Detroit. For these simulations, the flow depths were found to exceed the acceptable level for all the events. In addition, there is the concern of other regional regulatory issues such as co-mingling with combined sewage and possible displacing some combined flow at the Conner Creek outfall; that is, causing an increase in CSO downstream. Thus, even though the flows from Center Line are very small compared to the peak flows in the enclosure, the strict criteria of the critical HGL being exceeded would exclude use of Conner Creek sewer as a regional solution for SSO control for Center Line. A possible regional solution would be for the flows to be directed to the NIEA or Corridor Interceptor. This was investigated under Alternative 5 – Center Line to NIEA, and is discussed later in this report.

Clinton Township and Fraser: Both Clinton Township and Fraser SSO areas are tributary to the DWSD interceptors in Macomb County, which ultimately discharge to the NIEA at the Northeast Pump Station. No houses are connected to the NIEA in Detroit; the only connections are at three points: Conant-Mt. Elliot, First Hamilton, and Meldrum. The results indicate that the flow depths would not reach ground, but they do get within 5 feet of design elevation and 7 feet of ground within Detroit. In addition, the change in flows were determined to not impact the flows from Conant-Mt. Elliot and First Hamilton sewers, but the change would reduce the amount of relief available to the Meldrum sewer.

The model results also indicate that the DWSD interceptors in Macomb County can handle the increase in flows; however, it is noted that accepting the 25-year flows could potentially limit future growth for areas further to the north. In addition, there is concern that there is some deterioration in the 15-mile interceptor and at the Clintondale pump station that would need to be addressed before these flows should be accepted.

Allen Park and Melvindale: Allen Park and Melvindale both discharge to the Northwest Interceptor where the only flooding concern is to ground (no houses are connected in the area). For the events reviewed, the flow depths do not reach ground level. However, the interceptor is surcharged by over 10-feet, which does impact the

gravity discharge from Allen Park as well as the pumping capacity of flows from Melvindale. In both cases, the overflow was removed in the model representation, but the capacity for discharging to the interceptor was not modified. It is anticipated that Allen Park would require a pump station to maintain its discharge capacity and to be able to eliminate the need for the emergency overflow. Likewise, Melvindale would like to increase the capacity of the existing pump station to be able to handle the surcharge conditions in the receiving interceptor.

In addition, there is the concern of other regional regulatory issues such as co-mingling with combined sewage and possible displacement of combined flow at a downstream outfall, such as the Baby Creek outfall.

Garden City: Garden City discharges to the Middle Rouge Interceptor, which is within the North Huron Valley/Rouge Valley sewer system. Acceptance of additional flows does increase the HGL in this interceptor, but review of whether these HGLs exceed acceptable levels was not included as part of this project. This interceptor is tributary to the Northwest Interceptor via the Lift Station 1A pump station. At this point of connection to the NWI, like Allen Park and Melvindale, the only flooding concern is to ground as no houses are connected in the area.

In addition, as with Allen Park and Melvindale, there is the concern of other regional regulatory issues such as co-mingling with combined sewage and possible displacement of combined flow at a downstream outfall, such as the Baby Creek outfall.

7.1.2 Evaluation of Results

A summary of the analysis is provided in Table 4. In general, the flows from the 10-year event can be handled, but not from the 25-year event. The only case study whose flows could not be handled for this event is Center Line, due to the acceptable HGL already being exceeded in the receiving interceptor.

Table 4. Summary of Impact of Accepting Additional Flows

Case Study	Receiving Interceptor	Can Current Regional System Accept Case Study SSO Flow? 10-yr 1-hr Summer	25-yr 24-hr Summer	25-yr 24-hr Winter	Co-mingling Issues	Potential to Increase CSO	Comments	Costs to accept
Center Line	Conner Creek	No	No	No	Yes	Yes	Can potentially rout flows to NIEA	Increase Conner Creek capacity, NIEA connection cost
Allen Park and Melvindale	Northwest	Yes*	Yes*	Yes*	Yes	Yes	No HGL limits set, but 25-yr event causes 10 feet of surcharge	None if this is acceptable, else increase capacity costs and/or tunnel
Macomb County: Upper Reaches	15-Mile, Romeo, Oakland, Corridor	Yes	No**	No**	No	No	15-Mile and Clintondale PS are limiting capacity	Relief sewer costs (found by Clinton Twp)
Macomb County: Inside Detroit	NIEA	Yes	Yes	Yes	No	Yes	Interceptor gets to within 5 feet of design HGL. Reduces amount of relief from Meldrum to NIEA	None, but limits on growth
Garden City	Northwest	Yes	No	No	Yes	Yes	Review of impact to Middle Rouge Interceptor not included	Increase interceptor capacity costs
Macomb Cou	NIEA	Yes	Yes	Yes	No	Yes	Interceptor gets to within 5 feet of design HGL. Reduces amount of relief from	
Oakland Cou	Southfield	No	No	No	Yes	Yes		Increase capacity costs and/or use of tunnel costs
Wayne Count	Northwest	Yes*	Yes*	Yes*	Yes	Yes	No HGL limits set, but 25-yr event causes 10 feet of surcharge	Increase capacity costs and/or use of tunnel costs

* Potential adverse impacts due to amount of surcharging in the NWI not known
** Operational data indicates capacity problems.

The table also includes an evaluation for the three counties, Macomb, Oakland, and Wayne (Rouge Valley).

7.1.3 Costs

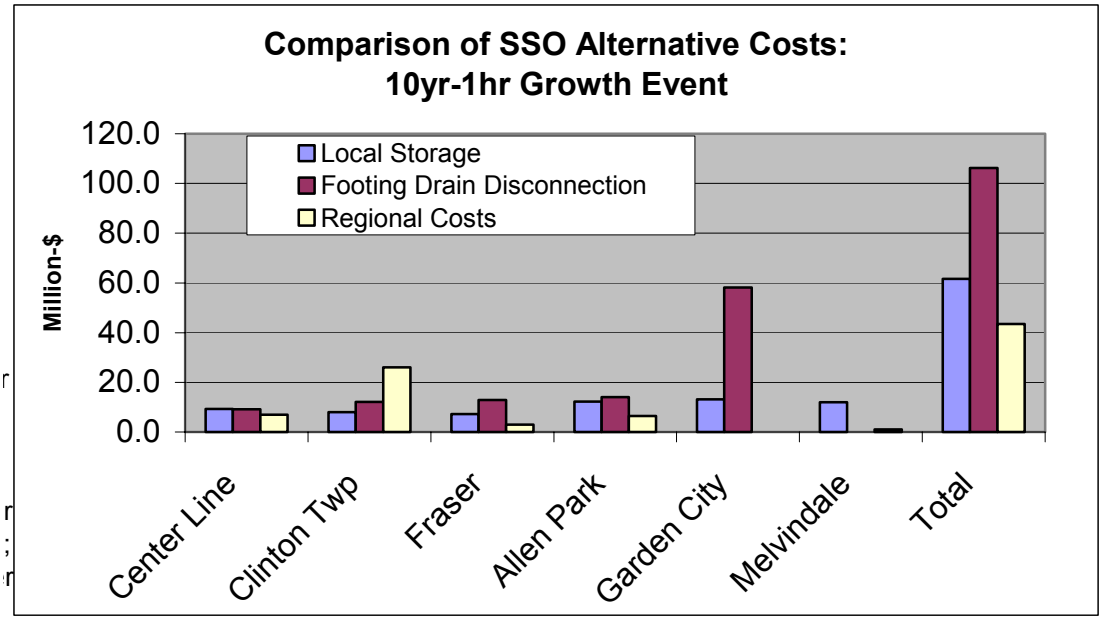
The anticipated cost for a regional solution of accepting SSO flows is approximately 43.5 million dollars. This would be for accepting up to the 10-year, 1-hour design event. This cost includes estimates of local improvement costs that would be required to convey the excess flows to the DWSD system. These regional costs are summarized in Table 5 by community. In some cases, they are based on information provided by local engineers. That is the case for Allen Park, Clinton Township, Fraser, and Melvindale. Center Line local transport cost includes estimates of pipe-bursting the connecting sewer and making a new connection into the NIEA.

Table 5. Preliminary Estimates of Regional Costs to Prevent SSOs

Regional Costs	M-$*
Center Line local transport	5
Center Line connection to NIEA	2
Clinton Twp local transport	26
Fraser local transport	3
Allen Park local transport	6.5
Garden City local transport	0
Melvindale local transport	1
NE PS to add a pump	0
Annual Wholesale Treatment	*minimal*
CSO increased O&M	
Other	
	43.5
** Regional Estimates are approximate for a 10-year, 1-hour Summer Event. Full life-cycle costs are being developed.*	

A comparison of the alternative control strategies: storage, footing drain disconnection, and regional, is presented in Figure 3.

Figure 3. Comparison of Alternative SSO control strategies



C:\AY\WWMP\SSOs\Regional\[Cost Comparisons.xls]Summary

7.2 Contract Limited – Alts 3 & 4

These two alternatives expand the scope of the first two alternatives by including a review of flows from all First Tier customers in addition to the Case Study areas.

This alternative essentially applies to the billing meter districts in Macomb County as well as the Clinton-Oakland County at their point of connection at their boundary with Macomb County. Essentially all other districts are limited to their contract capacity by design, either through a pump station capacity, a regulator capacity, or by the hydraulic capacity of the connecting sewers. The exceptions, other than the Macomb Districts and Clinton-Oakland, are Allen Park and Melvindale. For these two alternatives, a flow limit of 6 cfs was assumed for Allen Park and a peak pumping capacity of 6.4 cfs was assumed for Melvindale. It should be noted that the current contract capacity for Allen Park was under negotiation when the modeling was performed. The contract capacity for Melvindale is 0.5 cfs/1000 people.

The results for these two alternatives are provided in Table 6. The 25-year summer event was not used in this analysis; results are therefore provided for only the 10-year summer event and the 25-year winter event.

Table 6. Total SSOs Volume for Contract-Limited Alternatives (MG)

	10-Year, 1-Hour Summer Event			25-Year, 24-Hour Winter Event		
District/Community	Alt.1 Baseline	Alt.3 Contract Limited	Alt.4 Contract Limited-NEPS	Alt.1 Baseline	Alt.3 Contract Limited	Alt.4 Contract Limited-NEPS
Allen Park	0	1	1	1	5	5
Centerline	0	0	0	3	5	5
Chesterfield	0	0	0	0	1	0
Clinton Township	0	5	0	0	19	0
Clinton Township SSO	0	0	0	3	4	0
Clinton-Oakland	0	0	0	0	6	0
Fraser	0	5	0	0	11	0
Fraser SSO	1	1	0	4	4	0
Garden City	2	2	2	33	33	33
Grosse Pointe Shores	0	0	0	3	3	3
Harrison Township	0	0	0	0	2	0
Mac.,Shelby,Utica,Wash.	0	1	0	0	11	0
Melvindale	0	1	1	1	7	7
Shelby Township	0	0	0	0	4	0
Sterling Heights	0	11	0	0	45	0
Utica	0	0	0	0	1	0
Western Wayne	4	4	4	46	45	45
Total	8	33	9	95	206	99

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For Baseline conditions, the total SSOs as predicted by the model for these two events are 8 and 95 MG respectively. If the communities are limited to their contract capacity (Alt. 3), however, the total SSOs increase to 33 and 206 MG. These results indicate the extent to which some communities are using the regional system to handle excess wet weather volumes. In this case, it is noted that the excess volumes are being defined by a contract limit. And for the Macomb meter districts and for Clinton-Oakland, this limit is 0.4 cfs/1000 people.

If the contract limit is applied at the location of the NEPS vs. the point of connection for the Macomb meter districts and for Clinton-Oakland (Alt. 4), the amount of

overflow is reduced significantly. For the 10-year event, the overflow is reduced from 33 to 9 MG and for the 25-year event, the overflow is reduced from 206 to 99 MG. This alternative assumes that the flows can get into the receiving interceptor and would require the same improvements needed for Alternative 2 – Accept SSOs for the Macomb districts and for Clinton-Oakland district. It also resulted in the Edison Corridor being surcharged by over 50 feet at its downstream end. Under contract-limited alternative, the Corridor interceptor is only partially filled. Under Baseline alternative, the interceptor is surcharged, but only by about 20 feet at the downstream end. What these results demonstrate is that the Corridor Interceptor is providing some in-system storage under Baseline Conditions. If the NEPS capacity were held to a contract limit, however, the system would experience a significant amount of surcharging. Whether this level of surcharging would exceed an acceptable level of surcharging was not determined. Also, the amount of storage that might have been effectively used in the model representation was also not examined.

8. Conclusions

The preceding alternatives evaluated the impact of accepting additional flows to the DWSD system for the six case studies, as well as for other communities/districts. Review of acceptable surcharge levels within the DWSD system provided an objective criterion for determining whether flows can be accepted within the existing system or whether additional improvements would be required. In general, it has been determined that the 25-year flows cannot be accepted without causing potential basement flooding and/or street flooding in Detroit. CSO displacement and co-mingling are also issues that make it difficult to accept higher level flows.

Currently, based on the results of the regional alternatives, it is being recommended that flows from separated systems be accepted up to a 10-year event. Further investigation is on-going to define a reasonable wet weather flow from a separated system for a 10-year event.

Even though the regional solution may be a viable option for up to the 10-year event, it is anticipated that MDEQ will use the 25-year, 24-hour summer (growth) design event as the minimum level of SSO control. Furthermore, they are unlikely to allow for CSO displacement as a long-term solution. Therefore, the regional solution may only be able to be defended as an interim solution that provides net improvements for the environment.

Appendix A System Capacity Evaluation Using a 25-Year Storm

1.1 Introduction

A hydraulic analysis was performed to evaluate the impact to the regional system of accepting the 25-year, 24-hour storm event flows from separated sewer systems that were configured with the following two conditions: (1) peak discharges limited to the 10-year, 1-hour allowable peak rates and (2) storage added as needed to prevent any overflow resulting from the 10-year, 1-hour event. The allowable peak rates are the proposed contract capacities developed as part of the "Flow Needs" assessment performed for the First Tier Customers. The communities reviewed included the 6 case studies and other separated communities.

1.2 Approach

The WWMP Model with 2050 dry weather flows was revised to incorporate the allowable peak rate for communities being reviewed. The First Tier Customers and their allowable peak capacities are provided in Table 1a. Table 1b includes the peak capacities by meter district for the Macomb Sanitary District. The limits used were as determined for the year 2050.It should be noted that the peak capacities used in this analysis reflect preliminary numbers that were available before the flow needs analysis was completed.

These allowable peak rates were incorporated as a fixed capacity at the point of connection for each community being reviewed. The peak capacities were implemented by using a flow-limiting conduit at the point of connection to the DWSD system or by revising the pump capacity if applicable. The method used for each district reviewed is given in Column D of Table 1a & 1b, while Column E gives the associated conduit or node number used in the model.

With the peak capacity constraints implemented, the WWMP Model was run with the 10-year, 1-hour summer-growth design event to determine the amount of overflow due to discharges being limited to the allowable peak discharge. The total amount of overflow is provided in Column F. The total overflow for existing conditions from the communities being reviewed is 10.9 MG.

The model was revised to eliminate overflows from communities being reviewed by adding local storage. These storages were added to existing storages, if present. The depth of any new storage node was defined by the distance extending from the invert of the storage node to a point located 3 inches lower than the invert of the existing overflow conduit. These storages attenuated the peak discharge and prevented any overflow resulting from the 10-year, 1-hour event.

With the additional storages included, the model was run with a 25-year, 24-hour summer-growth design event to determine the amount of overflow that would result with the discharges to the DWSD system still limited to the allowable peak capacity. The amount of overflow for this simulation, provided in Column G, is 17.7 MG.

An additional simulation was made to investigate the impact to the regional system that would result if this amount of overflow from the 17.7 MG were accepted by the DWSD system. The model was reconfigured to direct these overflows to the DWSD system and rerun for the 25-year, 24-hour summer/growth design event.

1.3 Results

The impact of accepting the overflows into the DWSD regional system was reviewed by comparing peak HGLs, amount of overflows, and amount of treated flows before and after the process of redirecting the overflows to receiving interceptors, for the 25-year, 24-hour event. The changes in overflows and discharges from the system are provided in Table 2. Both CSOs and amount treated at the WWTP increased with the acceptance of the flows from the communities being reviewed for this event, by 12.3 MG and 15.1 MG, respectively. Volume through CSO basins increased by 1.9 MG, volume

through screening and disinfection decreased by 4.7 MG, and the volume through the tunnel increased by 1.5 MG. Because of changes in the in-system storage remaining at the end of the simulation, as well as changes in the continuity error, the total increase in these discharges do not equal the total increase in flows accepted from the SSO communities. These changes are less than 1 percent relative to the total flows.

Several profiles were also reviewed to determine the impact. Figures 1 and 2 show the upper reach of the Conner Creek sewer for flows limited and flows accepted, respectively. No appreciable difference could be noted, but it is noted that the critical HGLs are exceeded in both cases. Figures 3 and 4 show the North Interceptor, East Arm, for both cases. An increase in the HGL of approximately 2 feet can be seen in comparing Figure 4 to Figure 3. The lower reach of the Northwest Interceptor for the two cases are shown in Figure 5 and 6; no differences can be discern by observation of these profiles.

Review of the profiles within Macomb Sanitary District, which are not shown, indicate that those interceptors have capacity for accepting the 25-year flows from these systems when these systems are designed to handle the 10-year event without overflow.

1.4 Conclusion

If the separated communities are designed to limit their discharges from a 10-year, 1-hour design event to the allowable rate without overflow, the impact of accepting the 25-year, 24-hour is minimal, relative to the amount of total flows treated or released within Detroit. Acceptance of these flows results in commingling within Detroit. Total CSO flows and total flows treated at the WWTP are increased, but both are by less than 1 percent.

Even though the amount of flows accepted is minimal relative to the total flows being handled within Detroit, a 25-year event will cause widespread flooding within Detroit as the sewer system is not design to handle such a large event. In addition, the model has limitations in correctly handling runoff from a 25-year event. The model has been configured to account for limited capacity within subareas, but this configuration was set for smaller size events; that is, the 10-year and smaller events. The results can thus be considered to be only an approximation of how the system would react if configured to operate as modeled.

Table 1a. Impact of 10-Year,1-Hour and 25-Year/24-Hour Events

A	B	C	D	E	F	G
First-Tier Customers	**Community/ Connection**	**Peak Capacity for Hydraulic Analysis cfs**	**Method Used to Implement Peak Capacity in Model[1]**	**Conduit or Node Number Associated with Implemented Change**	**Amount of Overflow for 10Yr, 1Hr Event Baseline Conditions[2] (MG)**	**Amount of Overflow for 25Yr, 24Hr Event[3] (MG)**
Allen Park		10	flow-limiting conduit	3421	0.49	1.07
Center Line		7.5	flow-limiting conduit	29942	-	1.22
Clinton-Oakland	Avon Arm	9.2	flow-limiting conduit	24120	-	0.73
	Clinton Arm	131.8		23555	-	-
Dearborn - Grnfld/Miller Rd PS Dearborn - Unmetered Areas		99	matches existing pump capacity, no change made	n/a	n/a	n/a
Dearborn Heights District 2		10-Yr Storm	no change made	n/a	n/a	n/a
Evergreen-Farmington		181	hydraulically limited; no change made to increase capacity	n/a	n/a	n/a
Farmington		6.6	revised pump capacity	n/a	n/a	n/a
Grosse Pointe		192	no change made	n/a	n/a	n/a
Grosse Pointe Farms		554	no change made	n/a	n/a	n/a
Grosse Pointe Park		84	no change made	n/a	n/a	n/a
Hamtramck		1244.5	no change made	n/a	n/a	n/a
Harper Woods		10-Yr Storm	no change made	n/a	n/a	n/a
Highland Park		10-Yr Storm	no change made	n/a	n/a	n/a
Macomb	See Table - 1b		flow-limiting conduit	See Table - 1b	7.97	12.50
Melvindale		10	revised pump capacity	Node 3409	0.51	-
N.E. Wayne		134	revised pump capacity	n/a	n/a	n/a
North Huron Valley/Rouge Valley	All Communities (Including GC)	380	no change made	n/a	n/a	n/a
	Garden City (GC)	17.4	flow-limiting conduit	45761	0.87	3.62
		7.0		46011	1.02	2.64
Redford Township		10-Yr Storm	no change made	n/a	n/a	n/a
S.E. Oakland		260	no change made	n/a	n/a	n/a
Wayne Co Area 6		10-Yr Storm	no change made	n/a	n/a	n/a
Total					10.9	21.8

[1] Methods used were either by limiting the flow capacity of the conduit controlling the flow from the district to the Interceptor or by limiting the flow capacity of the pumps.

[2] Overflows associated with 10-yr, 1-hr event baseline conditions (i.e. without additional storages).

[3] Overflows experienced by a seperated sewer system designed with additional storages to handle a 10-y/1-h event overflows when exposed to a 25-y/24-h event.

Table 1a. Impact of 10-Year,1-Hour and 25-Year/24-Hour Events for Macomb Communities

A	B	C	D	E	F	G
Macomb Communities	**Meter I.D.**	**Peak Capacity for Hydraulic Analysis cfs**	**Method Used to Implement Peak Capacity in Model**	**Conduit or Node Number Associated with Implemented Change**	**Amount of Overflow for 10-Year/1-Hour Event Baseline Conditions[2] (MG)**	**Amount of Overflow for 25-Year/24-Hour Event[3] (MG)**
Chesterfield	CH-S-5	31.9	Flow Limiting Conduit	26096	-	4.10
Clinton Township	CT-S-1	10.1	Flow Limiting Conduit	22086	-	-
	CT-S-2	13.5		26006	-	0.93
	CT-S-3	17.6		22111	-	-
	CT-S-4	0.7		25041	0.08	0.51
	CT-UM-A	1.8		22034	-	-
	CT-UM-B	4.7		25021	-	0.03
Fraser	FR-S-1	9.7	Flow Limiting Conduit	25103	0.23	-
	FR-UM	1.9		22037	-	-
Harrison Township	HR-S-1	6.3	Flow Limiting Conduit	26091	0.14	0.44
	HR-S-2	7.5		26051	-	0.14
	HR-S-3	3.0		26011	-	-
Macomb Township	MA-S-1	109.3	Flow Limiting Conduit	22186	-	-
Sterling Heights	ST-S-1	25.7	Flow Limiting Conduit	23116	-	0.87
	ST-S-2	2.8		23016	4.88	-
	ST-S-3	17.8		23091	2.19	4.74
	ST-S-4	9.0		21286	0.21	-
	ST-S-5	4.6		22016	0.24	-
	ST-S-6	9.1		22221	-	-
Shelby Township	SY-S-1	4.4	Flow Limiting Conduit	24036	-	0.31
	SY-S-2	5.7		23486	-	0.36
Utica	UT-S-1	2.6	Flow Limiting Conduit	23211	-	0.08
Total		**300**			**7.97**	**12.50**
Total (MGD)		**194**				

Notes:

[1] Methods used were either by limiting the flow capacity of the conduit controlling the flow from the district to the Interceptor or by limiting the flow capacity of the pum

[2] Overflows associated with 10-yr, 1-hr event baseline conditions (i.e. without additional storages).

[3] Overflows experienced by a seperated sewer system designed with additional storages to handle a 10-y/1-h event overflows when exposed to a 25-y/24-h event.

1.4.1 Table 2. Results for 25-Year, 24-Hour Event

Flow District	Type of Discharge	Overflow or Treated Discharge (MG)		Change	
		Flow Limited	Flow Accepted	Volume (MG)	Percent
Allen Park	SSO	1.0	0.0	-1.0	-100%
Centerline	SSO	1.2	0.0	-1.2	-100%
Clinton-Oakland	SSO	0.7	0.0	-0.7	-100%
Dearborn	CSO	200	200	0.0	0.0%
	TUNNEL	386	387	0.4	0.1%
Detroit	BASIN	1,785	1,786	1.9	0.1%
	CSO	1,752	1,765	12.3	0.7%
	S&D	867	863	-4.7	-0.5%
	TUNNEL	854	855	1.5	0.2%
	WWTP	4,604	4,619	15.1	0.3%
Evergreen-Farmington	BASIN	243	243	0.0	0.0%
	EMERG	9.0	9.0	0.0	0.0%
Grosse Pointe Farms	CSO	42	42	0.0	0.0%
Macomb	SSO	12.5	0.0	-12.5	-100%
N.E. Wayne	BASIN	568	568	0.0	0.0%
	SSO	1.4	1.4	0.0	0.0%
S.E. Oakland	BASIN	1,534	1,534	0.0	0.0%
Western Wayne	BASIN	95	95	0.0	0.0%
(not including Garden	CSO	270	270	0.1	0.0%
City)	EMERG	0.0	0.0	0.0	no change
	SSO	18	18	0.0	0.0%
	WTUA	24	24	0.0	0.0%
Garden City	SSO	5.2	0	-5.2	-100%

Figure 1. Profile of Upper Reach of Conner Creek Sewer, Flow Limited

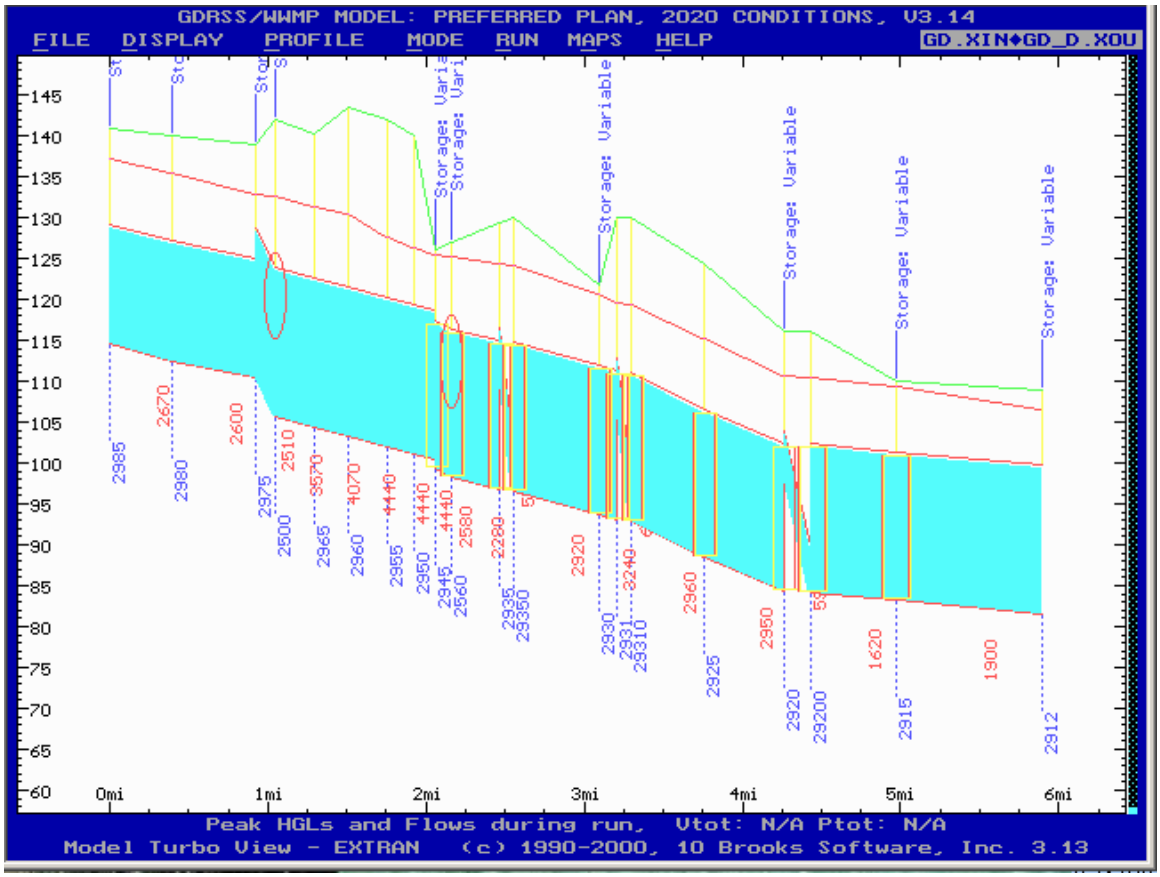

Figure 2. Profile of Upper Reach of Conner Creek Sewer, Flow Accepted

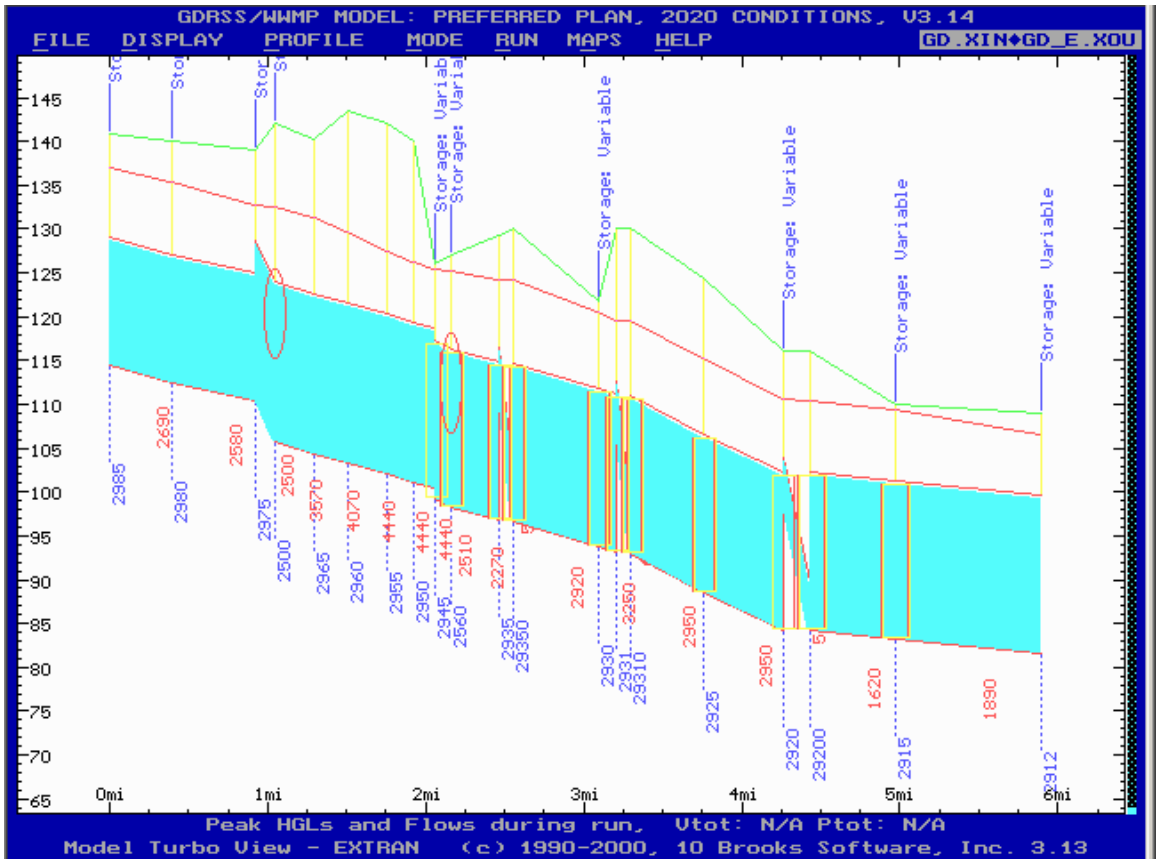

Figure 3. Profile of North Interceptor, East Arm, Flow Limited

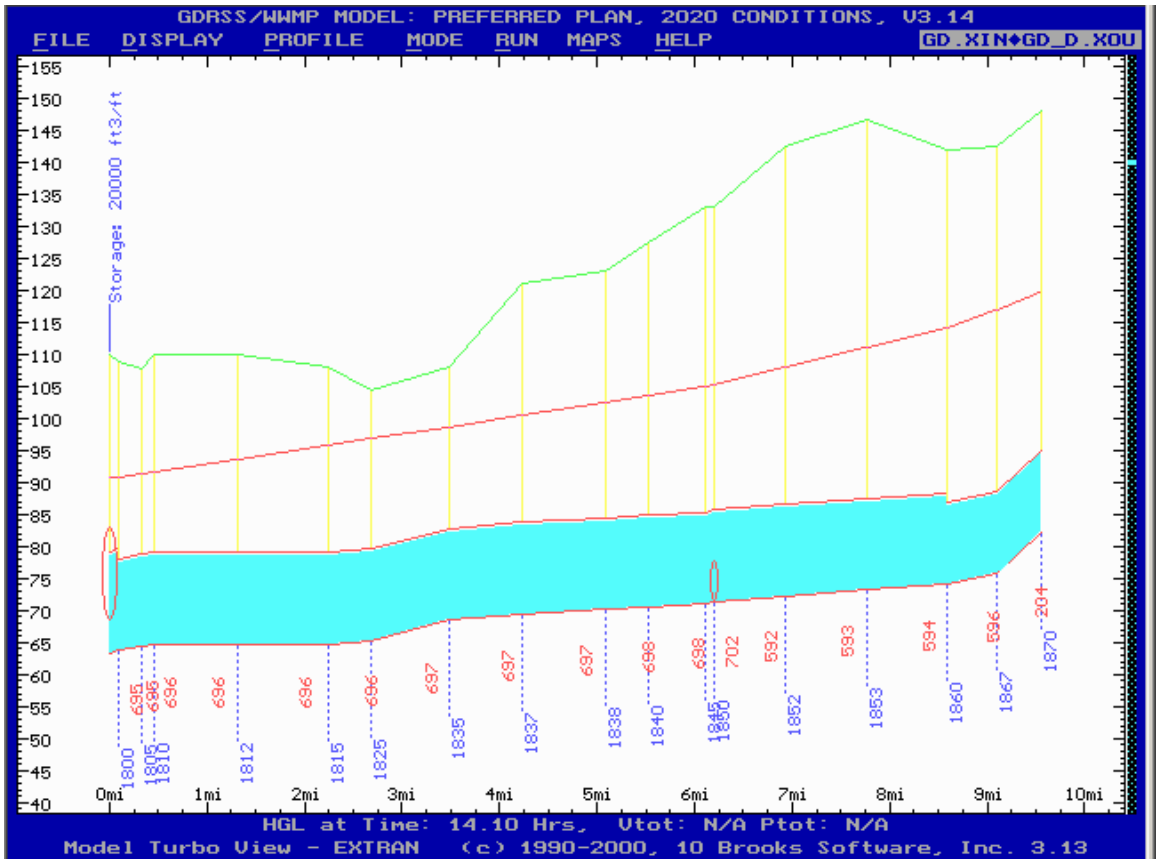

Figure 4. Profile of North Interceptor, East Arm, Flow Accepted

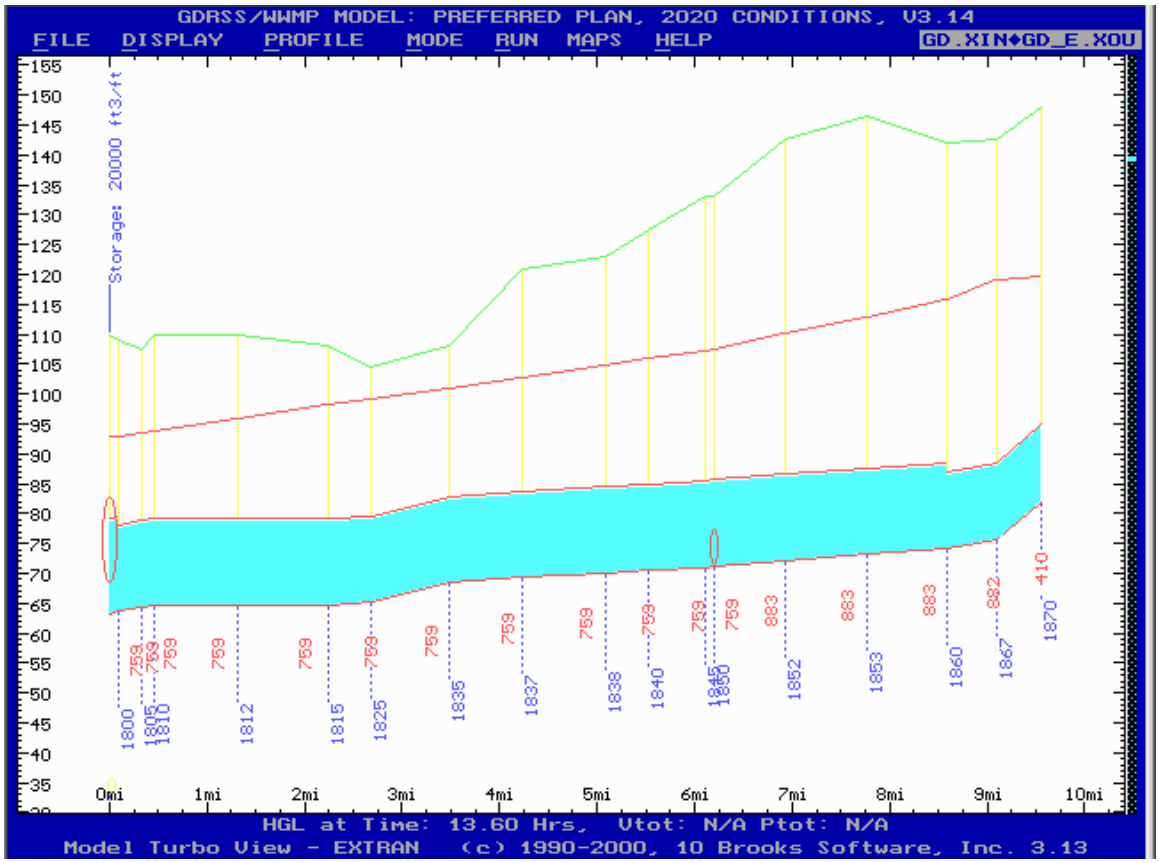

Figure 5. Profile of Lower Reach of Northwest Interceptor, Flow Limited

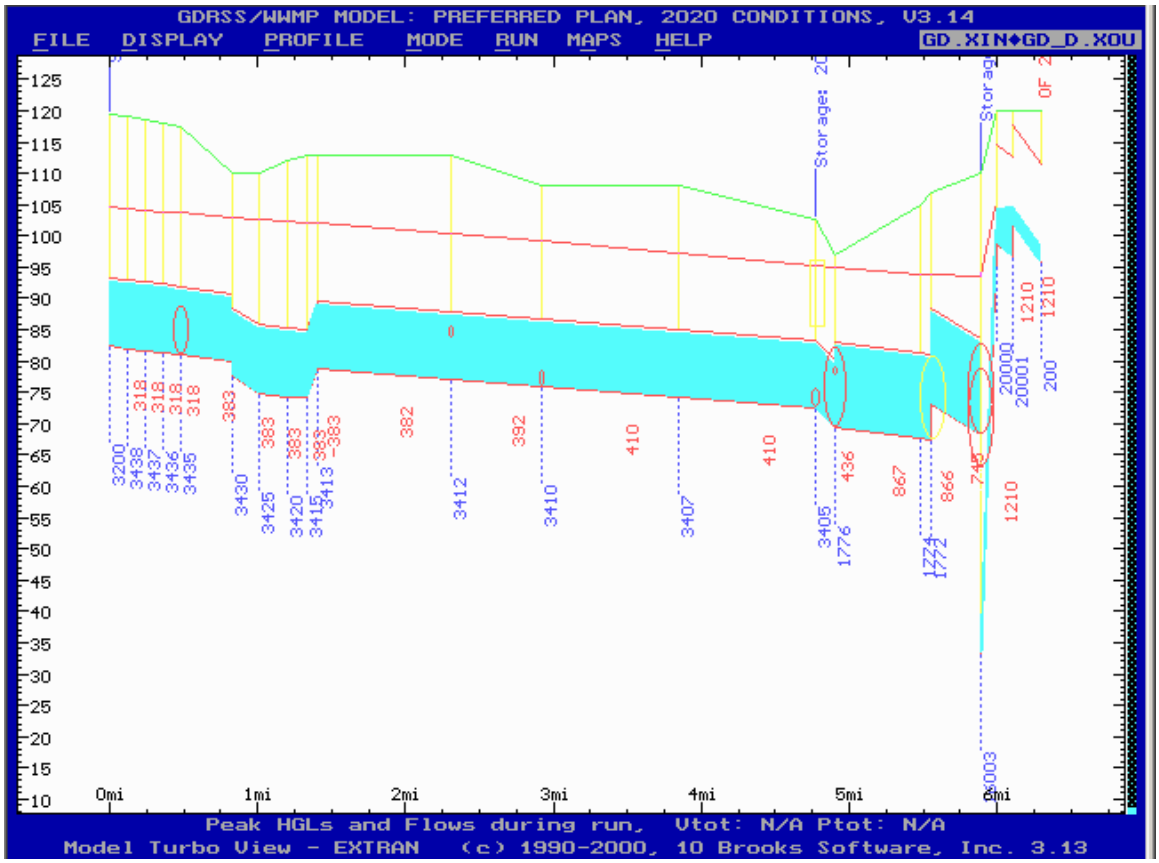

Figure 6. Profile of Lower Reach of Northwest Interceptor, Flow Accepted

