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September 27, 2004

City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, Michigan 48309

Attention: Mr. Roger P. Moore, P.S.

Re: Van Maele Drain Study

HRC Job No. 20040485

Dear Mr. Moore:

As requested, we have completed our Drainage Study for the Van Maele Drain in Section 36. This letter is written to present the findings of our Study and any recommendations for improvements to the storm drain system.

BACKGROUND

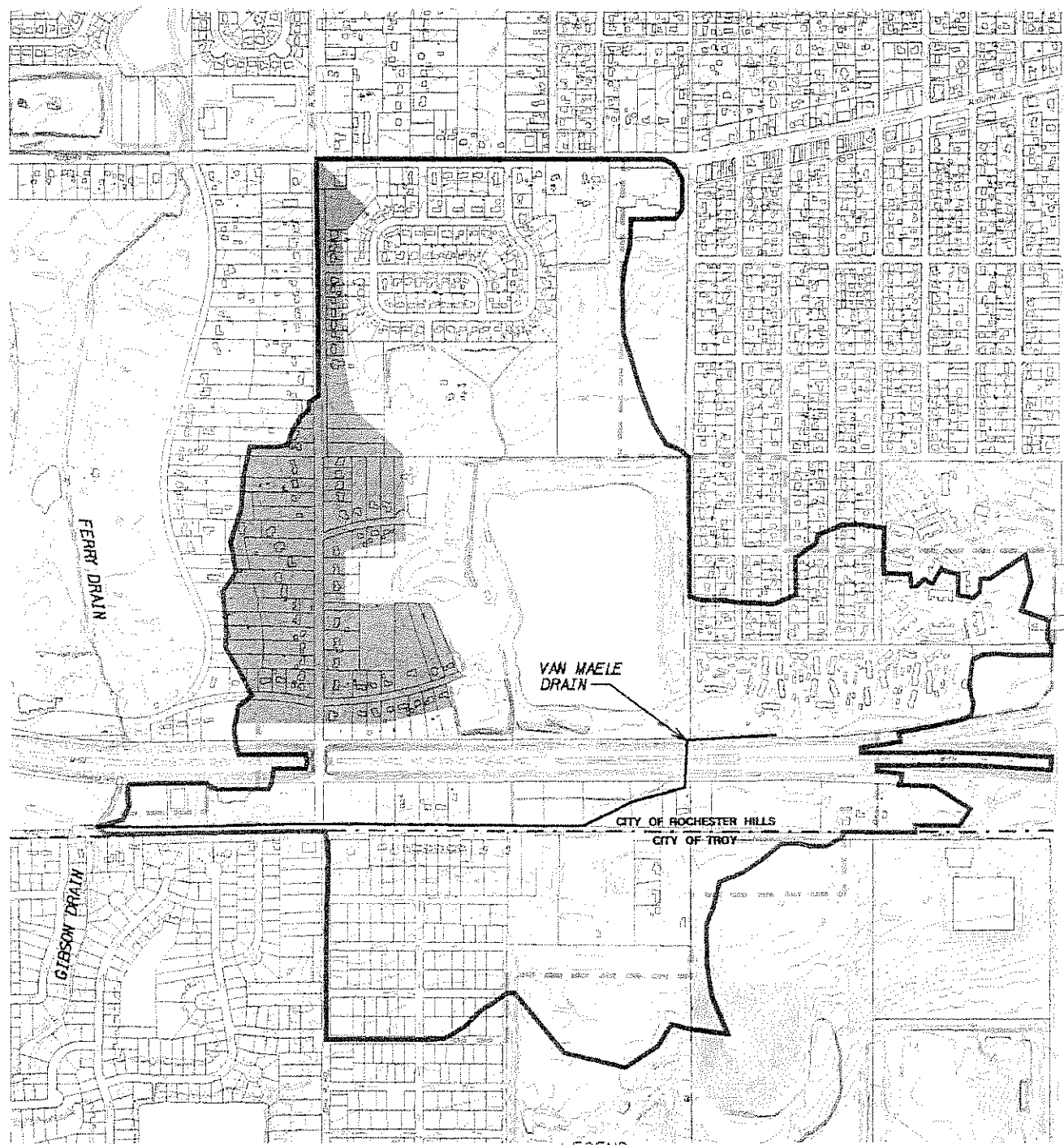
The Van Maele Drain is a legally established, Chapter 4 County Drain, constructed in 1947 by the Oakland County Drain Commissioner. The Drainage District contains approximately 480 acres, and serves the City of Rochester Hills and the City of Troy. The Drain outlets to the Ferry Drain (Gibson Drain) on the north side of South Boulevard, west of John R.

The Van Maele Drain was constructed as an open-channel drain along the north side of South Boulevard, having a 3-foot wide bottom and 1.5 horizontal to 1 vertical side slopes. A 48" dia. concrete pipe culvert was installed where the Drain crossed John R Road, and a 36" dia. concrete pipe culvert was installed for a driveway crossing approximately 500 feet east of John R. Approximately 1,800 feet east of John R, the Drain leaves the South Boulevard right-of-way and heads northeast across several parcels before turning north and crossing the M-59 right-of-way. North of the M-59 right-of-way, the Drain turns east and terminates after approximately 600 feet.





The parcels of land along the north side of South Boulevard are zoned for office use. A number of office developments have been constructed since 1986 west of John R, and the Drain has been enclosed along the front of those properties. The City of Rochester Hills has indicated that there has been growing interest among developers to construct additional office buildings on the parcels east of John R. In addition, the Michigan Department of Transportation will be improving the M-59 freeway in this area in the near future. Because of these reasons, this Study is being performed to provide an overall concept for improving the Van Maele Drain relative to the upcoming developments.

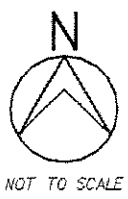
DRAINAGE AREA DESCRIPTION

USER NAME: ADMIN/PACOR
 DESIGN FILE: C:\WORK\2004\20040485\FIG 01.DWG
 PLOT DATE: 09/01/2004 09:58:00 AM
 PLOT SCALE: 1"=50' (1:1500)
 PLOT SHEET: 1 OF 1
 PLOT AREA: 11.00 X 11.00
 PLOT DATE: 09/01/2004 09:58:00 AM
 PLOT SCALE: 1"=50' (1:1500)
 PLOT SHEET: 1 OF 1
 PLOT AREA: 11.00 X 11.00



LEGEND:

	VAN MAELE DRAINAGE DISTRICT BOUNDARY
	APPROXIMATE DRAINAGE AREA
	CITY BOUNDARY
	APPROXIMATE AREA TRIBUTARY TO PROPOSED E. FERRY DRAIN



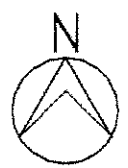
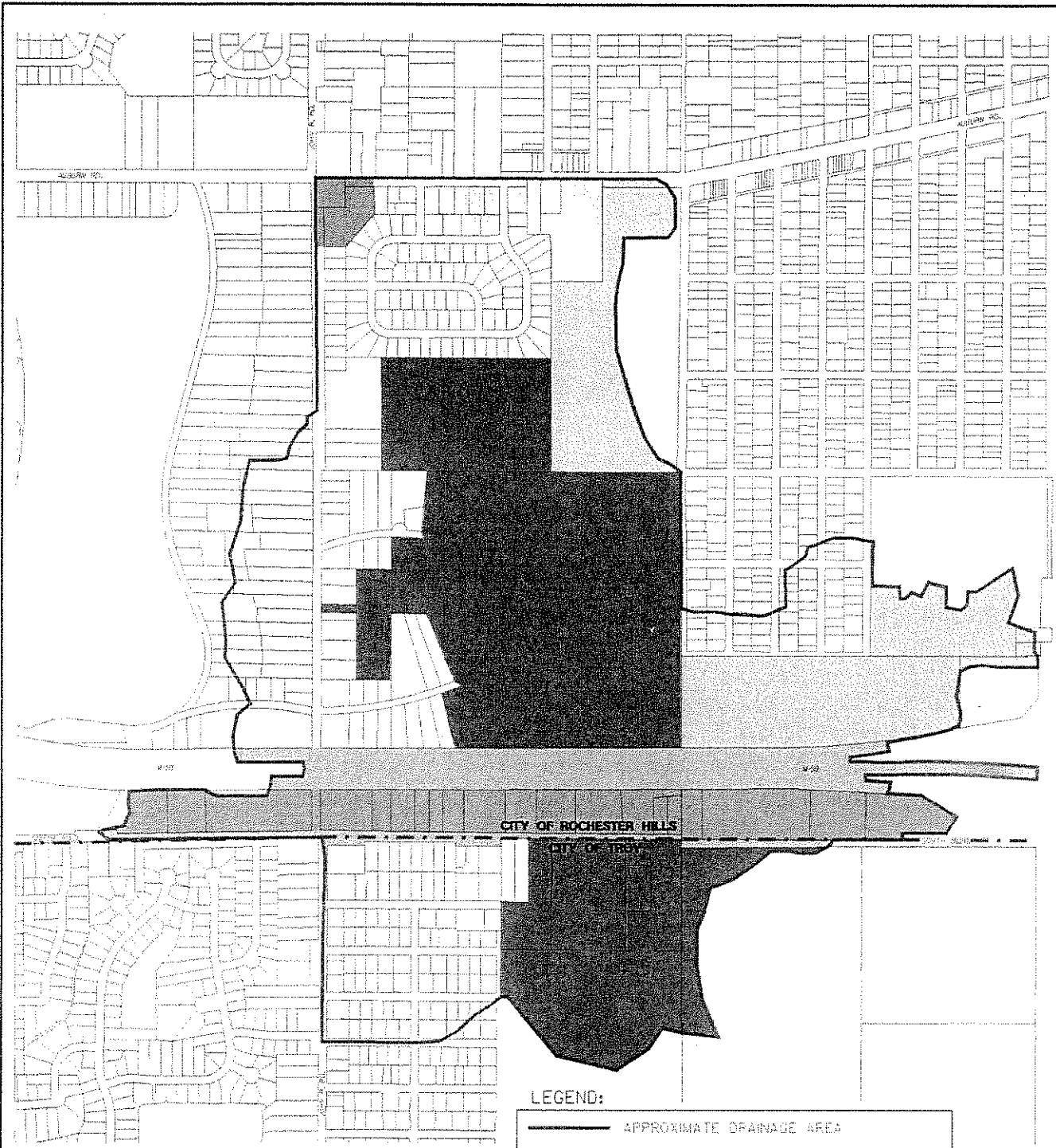
DRAINAGE AREA MAP

JOB NO. 20040485	HUBBELL, ROTH & CLARK, INC.	FIGURE 1
DATE SEPT. 2004	CONSULTING ENGINEERS 555 HULET DRIVE BLOOMFIELD HILLS, MICH.	
	P.O. BOX 624 48303-0824	

DESIGN FILE: 20040485

DATE: SEPT. 2004

USER: HME



NOT TO SCALE

LEGEND:

	APPROXIMATE DRAINAGE AREA
	CITY BOUNDARY
	SINGLE FAMILY RESIDENTIAL
	OFFICE/COMMERCIAL
	PARK/PUBLIC USE
	STATE HIGHWAY/COUNTY ROAD
	PUBLIC SCHOOL
	MULTI-FAMILY RESIDENTIAL

LAND-USE MAP		
JOB NO. 20040485	HUBBELL, ROTH & CLARK, INC.	FIGURE
DATE SEPT. 2004	CONSULTING ENGINEERS	2
	555 HULET DRIVE BLOOMFIELD HILLS, MICH.	P.O. BOX 824 48303-0824

LEGEND:

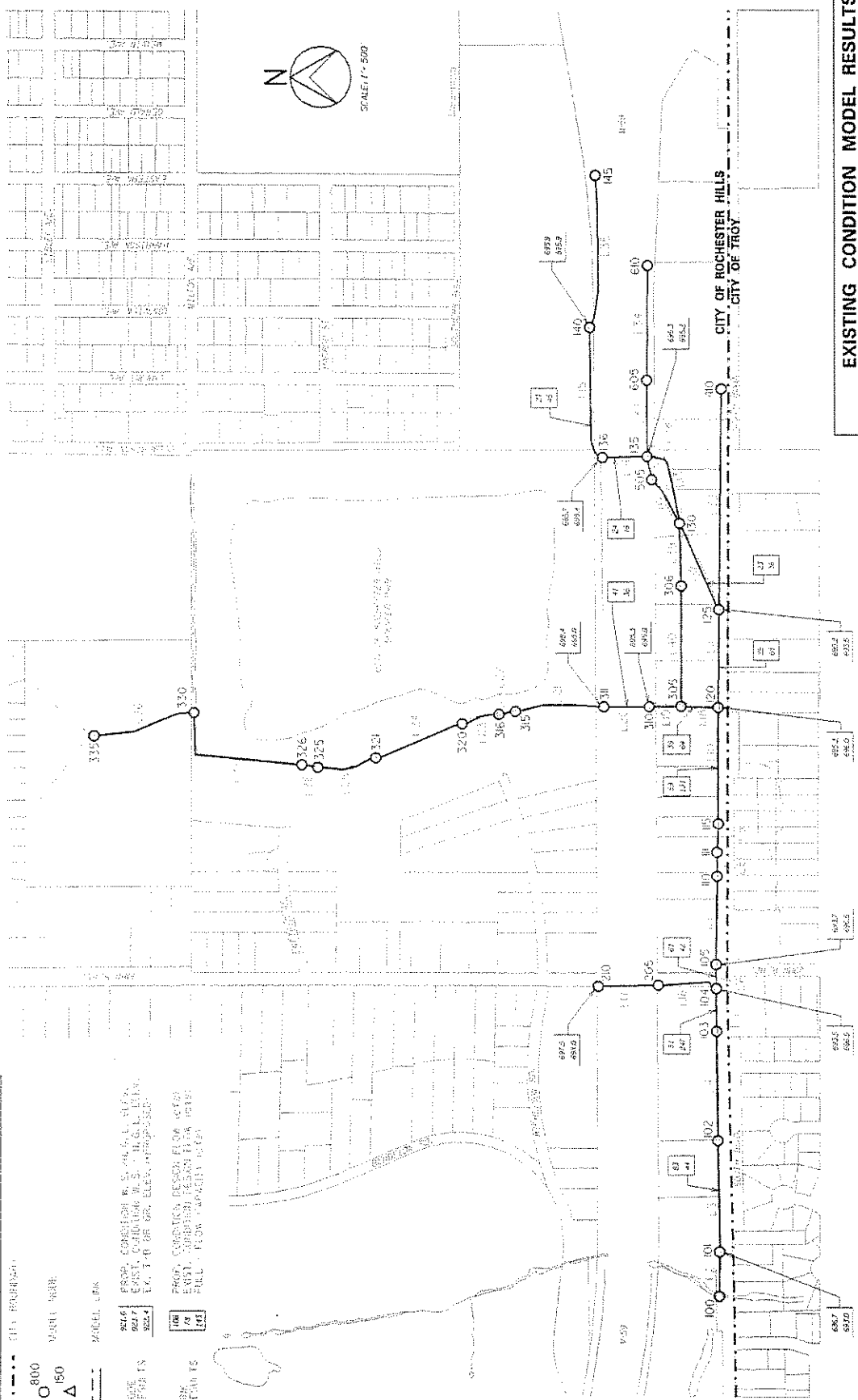
- HYDRAULIC
- 800
- △ 150
- MAIN LINE
- BRANCH
- MODEL LINE

SCALE: 1" = 500'
 800' 1" = 500'
 150' 1" = 500'

NOTE: CONDUIT DEPTH SHALL BE 5' UNLESS OTHERWISE SPECIFIED.
 EXISTING CONDUIT DEPTH SHALL BE 3' UNLESS OTHERWISE SPECIFIED.
 EXISTING CONDUIT SHALL BE 12" UNLESS OTHERWISE SPECIFIED.

1.00' 1" = 500'
 1.00' 1" = 500'

1.00' 1" = 500'
 1.00' 1" = 500'



EXISTING CONDITION MODEL RESULTS		FIGURE
20040485	HUBBELL, ROTH & CLARK, INC.	3
05-12	700 HIGH STREET BUILDINGS	
SEPT. 2004	555 HOUSTON STREET	
	ROCHESTER HILLS, MICH.	
	48205-9824	

The Drainage District for the Van Maele Drain contains approximately 480 acres, with 395 acres within the City of Rochester Hills (82%), and 85 acres within the City of Troy (18%). The Drainage District is located in Section 36 of Rochester Hills and Section 1 of Troy, and is generally bounded by Auburn Road to the North, Culbertson Street to the east, Chancery Street to the south, and John R Road to the west. According to OCDC records, lands were added to the Drainage District in 1987 and 1996. The attached Figure No. 1 shows the Drainage District for the Van Maele Drain.

For the purpose of this Study, 2 ft. contour maps for the City of Rochester Hills and the City of Troy were reviewed to determine the drainage areas tributary to the Van Maele Drain. Based on the 2 ft. contours, approximately 490 acres is tributary to the Drain. Since this calculated drainage area was only 2% greater than the area of the described Drainage District, the drainage area was used for the purpose of this Study. The attached Figure No. 1 also shows the Drainage Area for the Van Maele Drain.

Land use within the Drainage District consists of single-family residential subdivisions or parcels, multi-family residential, and office/commercial developments. Portions of the M-59 freeway (MDOT) and South Boulevard (RCOC) are a part of the Drainage District. Lands owned and operated by the City of Rochester Hills (Thelma G. Spencer Park) and the City of Troy (Donald J. Flynn Park and Sanctuary Lake Golf Course) are a part of the Drainage District in addition to road right-of-way. Lands owned and operated by the Rochester Community School District (Ruether Middle School) are also a part of the Drainage District. The attached Figure No. 2 shows the land use within the Drainage District.

Newer developments within the Drainage District were constructed with on-site detention, including the office developments along South Boulevard. Future developments within the District will require on-site detention as well. The typical on-site detention requires site runoff to be limited to an agricultural rate of 0.2 cfs/acre.

MODEL DESCRIPTION

A computer model of the Van Maele Drain system was developed using XP-SWMM ver. 9.0. This model computes runoff hydrographs for each subcatchment, and then dynamically routes those hydrographs through the stormwater system. Surcharging, backwater effects, in-line storage and negative flow can all be accounted for using this model.

The Van Maele Drain was modeled according to data from the original construction plans, site plans for developments along the Drain, review of 2 ft. contour maps, and visual observation of portions of the Drain. Included in the model are a branch along John R to north of M-59 to route runoff from areas along John R, and a branch approximately 1,400 feet east of John R that crosses M-59 and continues north along the west side of the lake at Spencer Park to route runoff from areas in the central and northern part of the drainage area. Three culvert "taps" to the Drain cross South Boulevard and discharge flow from areas in the City of Troy.

After construction of the Drain, a number of residential homes were built on parcels along the route, and driveway culverts of various pipe materials and diameters were installed. Additional culverts were installed by the City of Rochester Hills as a part of their water main extension project from 2003 where new fire hydrants were installed. These minor culverts were not modeled as they would add unnecessary complexity to the model, and would be replaced with any Drain improvement considered as a part of this Study.

When M-59 was constructed, the Drain was relocated so that it would cross the M-59 freeway at a right angle through a 30" dia. concrete culvert. A portion of the original drain channel was left in-place in the parcel of land adjacent to M-59 and is interconnected with the Drain. At some point, an open channel was also constructed parallel to South Boulevard, connecting the Drain to the branch located approximately 1,400 feet east of John R. These open channels are redundant to the system, and serve to provide additional in-line storage capacity under the existing conditions. These channels are not included in the model for the proposed alternatives, with the assumption that they would be filled in during future development of the land in this area.

Rainfall used in the model to generate the runoff hydrographs was the 10-year, 1-hour storm (2.06 inches of rainfall in one hour) used by HRC in previous drainage studies for the City of Rochester Hills. Existing developments with on-site detention, as well as all future developments requiring on-site detention, were considered when developing the model.

RESULTS & ANALYSIS

Model results for the "existing" condition indicate the Van Meale Drain along South Boulevard is capable of transporting the design flows. The existing 48" pipes west of John R are under-sized for the design flows, but due to their lower elevation, the resulting surcharging does not result in local flooding. Minor flooding was noted at a number of nodes along the Drain, notably at node 130, 135, and 136. Minor flooding was also noted at node 305, 306, 310, 311, and 505. Node 136 and 311 represent the upstream side of the culverts crossing M-59 for the Van Maele Drain and it's northern branch, respectively. Node 130, 135, 305, 306, 310 and 505 are in areas that would likely be filled as a part of future office developments along South Boulevard. The attached Figure No. 3 shows a model schematic for the "existing" conditions, with peak flows and peak water surface elevations (or hydraulic grade line elevations) for select links and nodes.

Due to the nature of the future developments along South Boulevard, it will be desirable to enclose the Drain to improve accessibility to the sites as well as the aesthetics. Filling-in the redundant channels that exist across a number of parcels will increase the usable space on the sites. However, wetlands have been identified along portions of the Drain, and would likely need to be mitigated if filled-in. Another driving factor considered when developing proposed alternatives is that MDOT will be reconstructing M-59 in this area in the near future, which affords the opportunity to construct improvements within the MDOT right-of-way in conjunction with their project. The alternatives for enclosing the Drain assume that some ground elevations within the area of future office developments would be increased.

Alternative No. 1 consists of enclosing the Drain with a 48" dia. pipe, from the end of the existing 48" pipe west of John R, across John R, along South Boulevard, and then across the parcels on the north side of South Boulevard to the existing culvert crossing M-59. The alignment of the proposed Drain would be altered so that it would cross the parcels on the north side of South Boulevard at a ninety-degree angle, instead of angling across them. Other improvements include enclosing the open-channel located approximately 1,400 feet east of John R with a 36" pipe from it's connection with the Drain at South Boulevard to the existing culvert crossing M-59. Also, an open-channel parallel to the Drain and located along the M-59 right-of-way, between the Drain crossing at M-59 to a point approximately 700 feet east of John R (where the embankment for the grade separation at John R ends), would be necessary to transport peak flows and reduce surcharging of the system. The estimated project cost for construction of Alternative No. 1 is approximately \$2,800,000. The attached Figure No. 4 shows a model schematic for Alternative No. 1, with peak flows and peak water surface elevations (or hydraulic grade line elevations)

for select links and nodes. Also attached is the preliminary cost estimate for Alternative No. 1, indicating costs for the major items of work included with the project.

Alternative No. 2 consists of constructing a new enclosed drain along the M-59 right-of-way, from a new outlet to the Ferry Drain (Gibson Drain) just south of M-59, to the Van Maele Drain crossing M-59. This new drain would be 54" diameter from the outlet to John R, and 48" diameter from John R to the connection with the Van Maele Drain. The existing Van Maele Drain along South Boulevard cannot be completely abandoned because of the runoff being collected from areas in the City of Troy, so it was assumed that the open-channel Drain would also be enclosed with a 48" pipe west of John R, and a 36" pipe east of John R. The estimated project cost for Alternative No. 2 is approximately \$3,700,000. The attached Figure No. 5 shows a model schematic for Alternative No. 2, with peak flows and peak water surface elevations (or hydraulic grade line elevations) for select links and nodes. Also attached is the preliminary cost estimate for Alternative No. 2, indicating costs for the major items of work included with the project.

With both alternatives, enclosure of the Van Maele Drain will require the filling of some noted wetland areas. With Alternative No. 1, the proposed open channel along the M-59 right-of-way could be restored as a wetland area. With Alternative No. 2, shallow swales could be constructed above the proposed drain along the M-59 right-of-way and restored as wetland areas. Please refer to ASTi's recommendations concerning the wetlands.

CONCLUSIONS & RECOMMENDATIONS

The Van Maele Drain is capable of transporting design flows for the 10-year, 1-hour storm (2.06 inches of rainfall in one hour). Portions of the Drain have been enclosed as a part of past developments along South Boulevard, and future developers would likely desire to enclose the Drain as well. The Drain improvements proposed herein provide an overall concept for improving the Van Maele Drain relative to the upcoming developments. Both Alternative No. 1 and Alternative No. 2 for improvements to the Van Meale Drain are feasible options.

To enclose the Van Maele Drain along South Boulevard, it is recommended that Alternative No. 1 be implemented for an estimated project cost of \$2,800,000. Construction of this alternative would include enclosing the existing Drain with a 48" diameter pipe from the existing enclosed portion of the Drain west of John R, to the culvert crossing M-59. This alternative also requires parallel open channel drains along the M-59 right-of-way to transport some of the peak design flow, which can be restored with wetland features to replace those that would be filled in with the project.

Along South Boulevard, the centerline of the proposed Drain enclosure would be located approximately 40 feet north of the road centerline. For the most part, the proposed Drain enclosure would be located within existing easements or road right-of-way (in some cases existing, in others future). The existing easements that cross parcel numbers 15-36-376-008, 009, 010, and 013 would be vacated to allow better future developments on those sites. New easements would be required (or future 60 foot wide right-of-way obtained) adjacent to South Boulevard across parcel numbers 15-36-376-008, 009, 010, and 013. New easements are also required along the eastern property line of parcel numbers 15-36-376-008 and 15-36-376-010, and the western property line of parcel number 15-36-452-004 (between South Boulevard and M-59).

Along the M-59 right-of-way, the City of Rochester Hills has obtained 20 foot wide easements for construction of the new sanitary sewer that serves these parcels. The proposed open channel drains are

Mr. Roger P. Moore, P.S.
September 15, 2004
HRC Job No. 20040486
Page 5

preliminarily designed to be 6 feet wide, with 4 horizontal to 1 vertical side slopes. The top-of-channel width would generally be 30 to 40 feet wide depending on future site grading. The north top-of-channel could be located 10 feet south of the north property line to allow future access to the sanitary sewer, thereby requiring new 20 to 30 foot wide easements for construction of the remainder of the channel.

Another possible location for the proposed open channel drains along the M-59 right-of-way would be within the MDOT right-of-way itself. We suggest that a meeting be held between MDOT representatives and the City to discuss future plans for the M-59 widening in this area to determine if this option is feasible. Constructing these open channels as a part of the MDOT work would allow them to be designed to accommodate additional storm water retention that will be required of MDOT due to widening of the highway resulting in an increase of runoff. It is also suggested that if the culverts are to be replaced across M-59, they should be sized for the design flows presented herein.

It is also suggested that a meeting be held with RCOC representatives to discuss future plans for South Boulevard so that any work on the Drain will not conflict with future work.

Construction of the parallel open channels, or some other conduit, is necessary for the Van Maele Drain to function properly under design conditions. Without the parallel channels, the 48" diameter pipe is not capable of transporting the design flow with the hydraulic grade line being maintained at least one foot below the ground. If the parallel channels are not constructed, the proposed enclosure of the Van Maele Drain would have to include replacement of the existing 48" diameter pipe west of John R with a larger pipe, as well as modifying the proposed sewer sizes for the remainder of the Drain enclosure (preliminary estimated project cost for this option is approximately \$3,100,000).

It is noted that the proposed E. Ferry Drain and John R Road Improvements Project would remove some of the drainage area from the Van Maele Drainage District. Alternative No. 1 was evaluated considering the reduced drainage area if that project were constructed. The proposed pipe sizes for the Drain enclosure would remain the same, but the size of the proposed parallel open channels along the M-59 right-of-way could be reduced. It may also be possible to coordinate the design of these two projects so that an optimal solution can be obtained.

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.

James J. Surhigh, P.E.
Senior Project Engineer

Attachment

pc: Applied Science & Technology, Inc. – Dianne Martin
HRC – W. Alix, D. Mitchell, File