

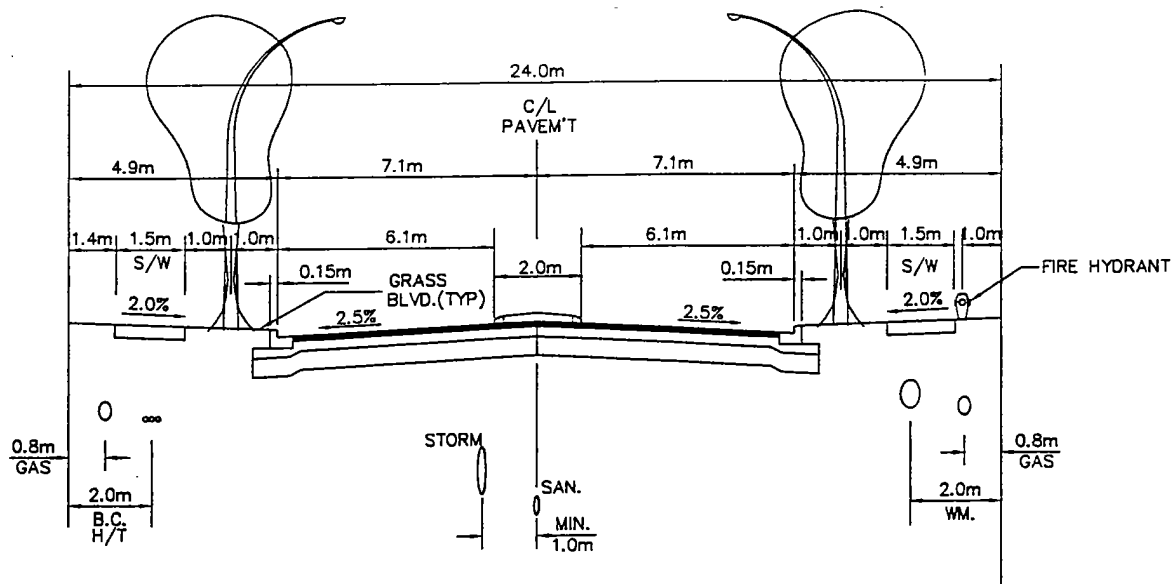


FIGURE 5

APLIN & MARTIN
CONSULTANTS LTD

NORTH



Scale : N.T.S.

Date : OCT. 1998

TYPICAL CROSS SECTION COLLECTOR ROAD

**EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN**

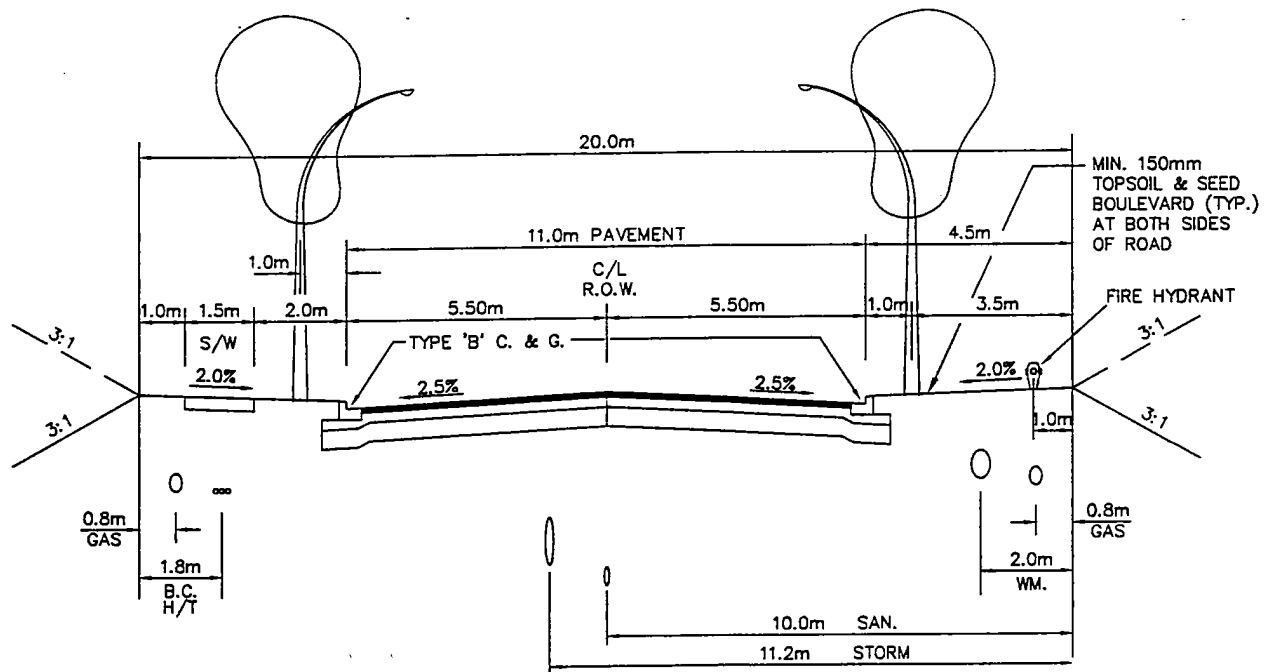


FIGURE 4

APLIN & MARTIN
CONSULTANTS LTD

NORTH



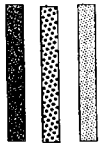
Scale : N.T.S.

Date : OCT. 1998

TYPICAL CROSS SECTION THROUGH LOCAL & LIMITED LOCAL ROADS

**EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN**

- LEGEND**
- FIXED ROADS
 - FLEXIBLE ROADS
 - ALTERNATE ROADS



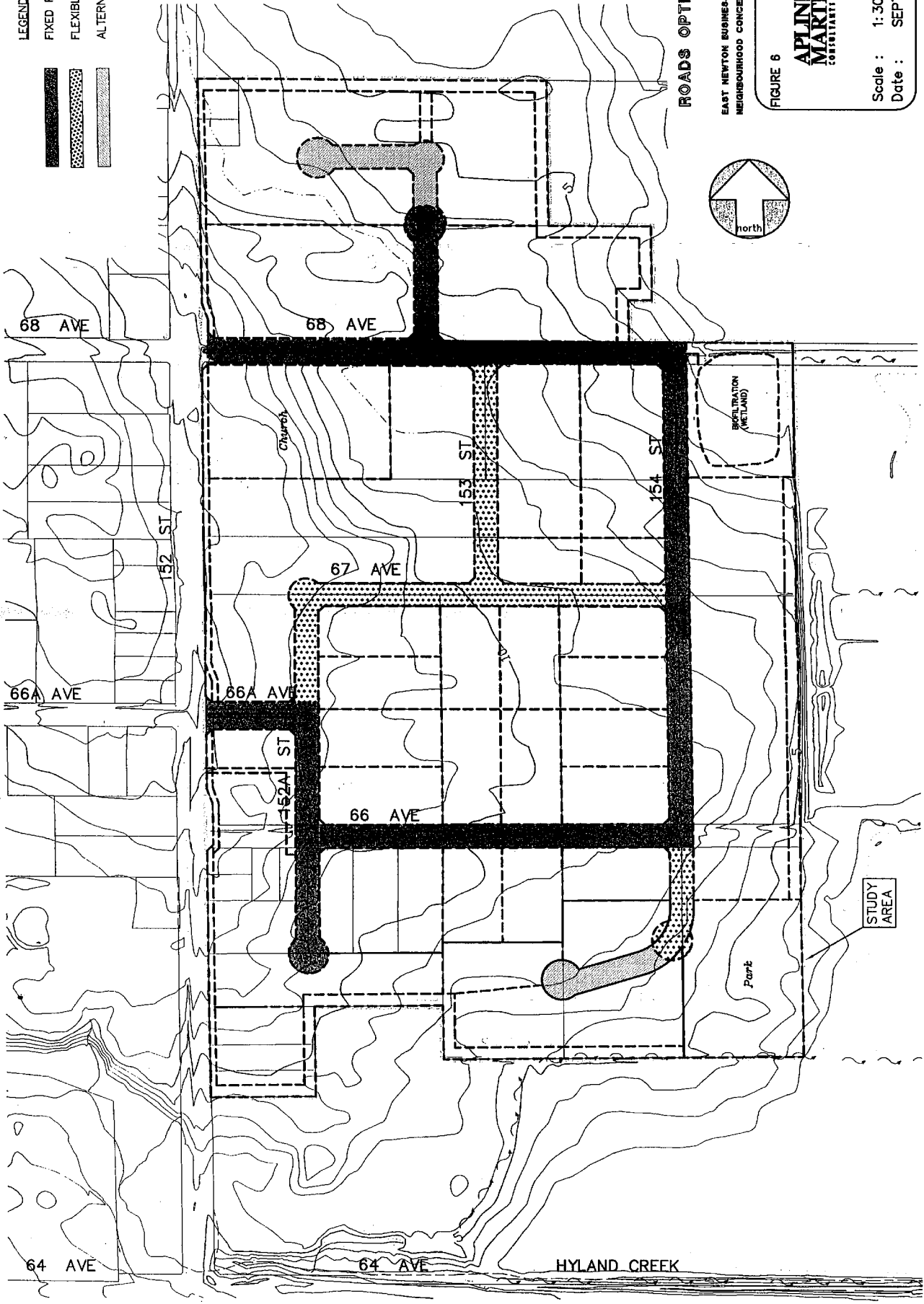
ROADS OPTIONS

EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN

FIGURE 6

**APLIN
MARTIN**
CONSULTANTS LTD

Scale : 1:3000
Date : SEPT. 1998



if the owner is successful in developing the land an additional road link to 64 Avenue is strongly recommended. Depending on the type and density of development on this property, it is likely that there is not sufficient road capacity on 152 Street to accommodate this development. The owner's representative has indicated (personal correspondence, 99-01-20) that a road connection to 64 Avenue is being evaluated. This connection must be constructed as far to the east from 152 Street as possible, at an absolute minimum, 150 metres, to allow for the construction of back-to-back left turn bays (i.e., a new full movement intersection). If this "new" connection to 64 Avenue is constructed and connected to the Business Park road network, it is expected that the operation of the 66A Avenue and 68 Avenue intersections on 152 Street will improve.

2.2.8 Public Transit

At the present time the site is serviced by a single route, the "345" which links White Rock to Guildford Town Centre with 30 minute service during peak periods and 60 minute service during off-peak and evening periods. There is a major transit exchange in Newton at 138 Street and 72 Avenue but there is no service to this exchange at this time.

Given that the East Newton Residential NCP is currently developing and the East Newton (South) NCP is also anticipated to commence over the next few years it is possible that transit service could be improved to these areas and could include better service to the Business Park.

There are presently two bus stops along the east side of 152 Street servicing the NCP study area at 66 Avenue and 68 Avenue. Discussions with BC Transit indicate that the existing bus stop at 66 Avenue would need to be relocated to the new intersection at 66A Avenue. If the speed limit on 152 Street is to remain at 70 km/h bus pullouts will be required. Given that the west side of 152 Street will become residential and the east side a business park, it is recommended that the speed limit be decreased to 60 km/h south of 70 Avenue to reflect the urbanisation of this portion of 152 Street and to reflect the installation of signals at 68 Avenue and 66 Avenue.

2.2.9 Pedestrians

The type of development being proposed in the site is not conducive to high pedestrian trip generation either as an attractor or a producer. The greatest pedestrian trip generation will likely occur during the noon hour period when office employees walk either for exercise or to visit an on-site convenience store or restaurant.

To accommodate the pedestrians, sidewalks will be constructed on both sides of the collector roads and on one side of the local roads.

2.2.10 Cyclists

152 Street has been constructed with wide curb lanes (4.05 metres) in order to accommodate cyclists. The road network within the site does not require special construction standards or treatment in order to accommodate cyclists. Since the site is a destination without any through roads, the internal road network will be sufficient to accommodate cyclists. It is, however, necessary for developments internal to the site to provide bicycle storage, change rooms, and locker facilities for employees as well as bicycle storage for visitors. The City of Surrey's Bicycle Blueprint specifies the type and quantity of facility required, depending on the type and size of the land use.

2.3 WATERWORKS

Water supply and pressure to the NCP study area is provided through the existing 300 mm diameter grid mains. There are two sources for the grid mains that lead to the site, namely 68 Avenue at 138 Street and 64 Avenue at 138 Street. The NCP study area is within the 90 metre HGL pressure zone. The existing water distribution system has an adequate sized system for providing sufficient quantities of water to the NCP area. No off-site water main upgrades are required and there are no constraints.

A computer analysis was prepared and used to determine any deficiencies and model the required sizes from the two sources to the site. Figure 7 depicts the water model schematic. The water model schematic was prepared using the City of Surrey's current design criteria. Based on the design criteria, the available head at source number one is 79.50 metres geodetic and at source number two is 79.24 metres geodetic. The result of the computer analysis is found in Appendix "B". Surrey's design criteria requires that the proposed water mains are capable of operating under the following conditions using a maximum water main velocity of 2.0 meters per second (2 m/s):

Demand Condition	Residual Head
Peak Hour Demand	28 metres
Maximum Day Demand	
Plus Fire Flow	14 metres (at test hydrant)

No inadequacies were found and no offsite improvements are required.

Figure 8 shows the water distribution system within the NCP study area. Looped water main systems will be 300 mm diameter. Exceptions to this size will be 400 mm diameter in the proposed cul-de-sacs for the ultimate condition and 350 mm diameter in the phased construction areas for the

WATER MODEL SCHEMATIC

EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN

- LEGEND:
- (13) NODE NUMBER
 - [7] PIPE NUMBER
 - △ SOURCE NODE
 - * PROPOSED PIPES

FIGURE 7

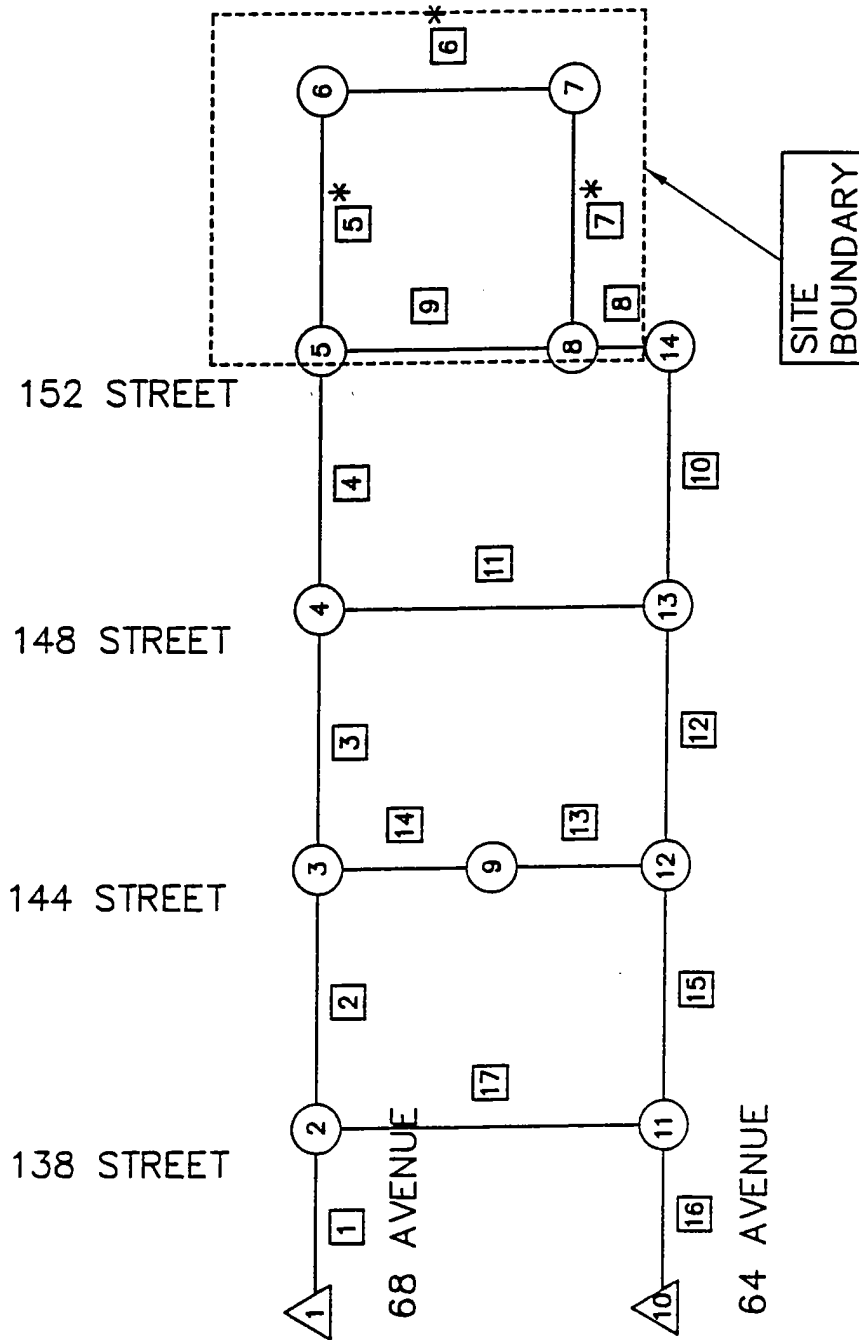
**APLIN &
MARTIN**
CONSULTANTS LTD



NORTH

Scale : N.T.S.

Date : SEPT. 1998



LEGEND
 --- EXISTING WATERMAIN
 --- PROPOSED WATERMAIN

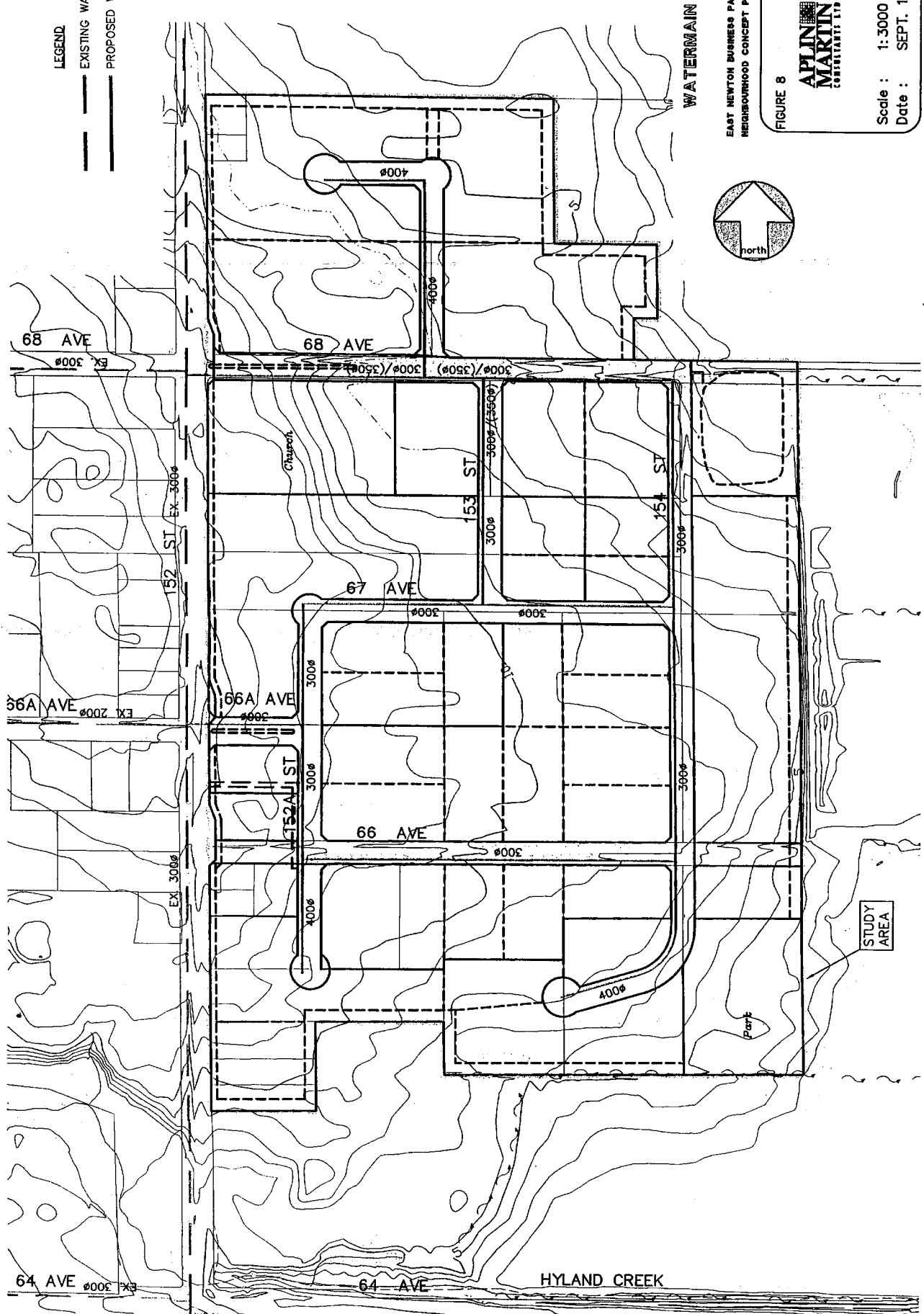


FIGURE 8

**APLIN
 MARTIN**
 CONSULTANTS LTD

EAST NEWTON BUSINESS PARK
 NEIGHBOURHOOD CONCEPT PLAN

Scale : 1:3000
 Date : SEPT. 1998

FLOW GENERATED FROM EAST NEWTON (SOUTH) DRAINING TO STUDY AREA

$$\begin{array}{rcl} \text{Residential: } 108 \text{ homes} \times 3.0 \text{ capita/home} & = & 324 \text{ capita} \\ \text{Commercial: } 0.7 \text{ ha} \times 50 \text{ capita/ha} & = & \underline{35 \text{ capita}} \\ \text{Total} & = & 359 \text{ capita} \end{array}$$

$$\begin{array}{rcl} 359 \text{ capita} \times 350 \text{ L/capita/day} & = & 1.454 \text{ L/s} \\ & & 1 + \frac{14}{4 + \sqrt{0.359}} \end{array}$$

$$\text{Peaking Factor} = 4.044$$

$$\begin{array}{rcl} 1.454 \text{ L/s} \times 4.044 & = & 5.88 \text{ L/s} \\ \text{Infiltration} = 12.499 \text{ ha} \times 11,200 \text{ L/ha/day} & = & 1.620 \text{ L/s} \end{array}$$

$$\begin{array}{rcl} \text{Design Q} & = & 5.88 \text{ L/s} + 1.62 \text{ L/s} \\ & = & 7.50 \text{ L/s} \end{array}$$

Note:

The design Q (flow) has increased from 5.90 L/s to 7.50 L/s as a result of the infiltration component brought in by the latest changes to the design criteria.

FLOW GENERATED WITHIN THE EAST NEWTON BUSINESS PARK

The East Newton Business Park consists of three subcatchment areas as identified on Figure 1 earlier in the report. The following chart shows the resulting peaking factors and flows. The sewage flow rate is based on 350 litres per capita per day with the infiltration and inflow rate based on 11,200 litres per hectare per day from the January 31, 1999 Design Criteria.

Land Use/Zone	Area ha	Accum. Area ha	Equiv. Pop. Rate	Area Equiv. Pop.	Accumulated Equivalent Population	Average Sewage Flow (ADWF) L/sec.	Accum. Average Sewage Flow (ADWF) L/sec.	Peaking Factor	Accum. Sewage Flow (PDWF) L/sec.	Accum. Infil/Inflow L/sec.	Accum. Peak Sewage Flow (PWDF) L/sec.
Church	1.99	1.99	50	100	100	0.40	0.40	4.24	1.71	0.26	1.97
Local Commercial	0.48	2.47	60	29	128	0.12	0.52	4.21	2.19	0.32	2.51
Business Park	34.05	36.52	90	3065	3193	12.41	12.93	3.42	44.22	4.73	48.96

Total flows from the East Newton Business Park is 48.96 litres per second. Therefore the East Newton (South) NCP contribution for the ultimate pump station is:

$$\frac{7.50}{(7.50 + 48.96)} \times 100 = 13.28\%$$

Note: The East Newton (South) NCP calculations assumed this ratio to be 11.32%.

The East Newton (South) tributary area would be discharging 13.28% of the total flow at the lift station.

2.4.3 Proposed Sanitary Sewer System

Figure 9 shows the proposed sanitary sewers, lift station and force main within the study area. It also indicates the ultimate sizes of the sanitary sewer required without having benefit of detailed topographic survey. The majority of the ultimate pipe diameters are 250 mm except for short sections of 300 mm and 375 mm required near the proposed pump station.

2.5 STORM SEWERS

2.5.1 Existing Conditions and Environmental Issues

There are no storm sewers of any significance within the NCP study area. There are local ditches and culverts on 66 Avenue and 68 Avenue which drain the majority of the study area easterly to the ditches located in the lowlands east of the site. These ditches and culverts would be replaced with a storm sewer system. As shown in Figure 2 previously, small portions of the study area also sheet flow north-east and south-east to the lowlands. There are four drainage ditches that flow across agriculture fields to the existing flood boxes located at the Serpentine River. A larger segment of the storm runoff flows into two well-defined ditches on 68 Avenue, which drain to the Serpentine River.

Envirowest Consultants Ltd. completed an assessment of the fish habitat in the existing ditches within the NCP area in January 1999. Their report reviews the classification of the existing watercourses within the study area and determined that the majority will require a reclassification as outlined in Envirowest's Table 1. The report summarises that the proposed biofiltration (wetland) pond will provide sufficient habitat features to offset the loss of the Class B habitats caused by the development of the Business Park. Envirowest's letter report is attached as Appendix C.

Their report describes that three of the 11 ditches do not exist, and the remaining eight require a lower reclassification as per Envirowest's Table 1. The only two ditches with a Class A (0) classification are the two 68 Avenue ditches located immediately east of the study area.

2.5.2 Servicing Constraints and Issues

The major constraint to the study area is the impact of increased flooding that would occur to the lowlands as a result of upland development in the study area. Since the flood duration is dependent on flood levels in the Bear Creek dyke, stormwater detention is not an effective means of reducing flood duration in the lowlands.

Small portions of the study area cannot be serviced without either filling the rear portion of lots or by pumping from the rear portion to the front of the lots. The affected areas are identified on Figure 10 by the denoted boundary. It is recommended that the buffer strip along the perimeter of the study area drain naturally via sheet flow to the agricultural fields. The proposed park in the south-east corner of the NCP study area is below the proposed storm sewer serviced area. It is recommended that the park drain naturally via sheet flow toward the agricultural fields. The proposed park is a significantly smaller catchment area than the existing catchment area that

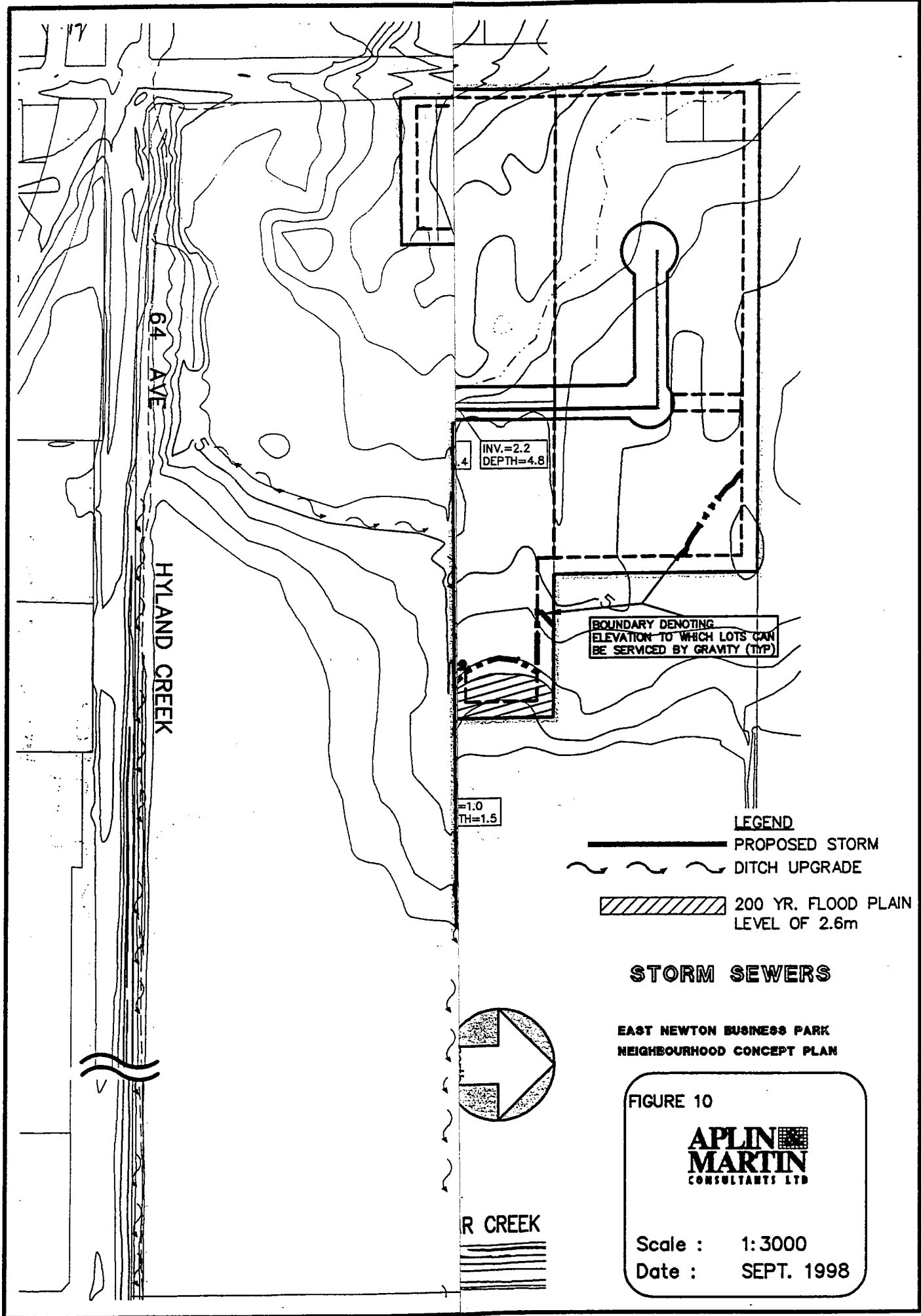
drains south-east and there will be a reduction in flow from the proposed park to the agricultural land.

Figure 10 also identifies three locations where the elevation of the 200 year flood level of 2.6 metres geodetic elevation is higher than the existing ground within the study area. The flood level of 2.6 meters has been identified on Figure 10 from information obtained on the Environment Canada and BC Ministry of Environment flood plain mapping plans dated September 30, 1994.

One of these areas is of significance to the business park, namely the cross hatching of a parcel of land located north of 68 Avenue. A second area is immediately south of 68 Avenue and is within the location of the proposed biofiltration pond and a small third area is the south eastern tip of the study area. The City of Surrey's bylaw for soil deposition within the flood plain does not allow for filling of these areas without allowing for a compensating excavating volume. That is, the volume of land being filled above the floodplain must be replaced with excavated volume below the floodplain. The net effect is to not increase the height of the flood levels caused by indiscriminate filling. The biofiltration pond will need to be constructed according to this concept.

Similar to a constraint as identified in the sanitary sewer Section 2.4.1, it is necessary to have the storm sewer traverse through a short distance of the site at a depth of approximately 5.6 metres. The storm sewers are similarly placed below the maximum design criteria depth of 3.5 metres in order to drain the perimeter lots by gravity as much as practicable. Similarly it will be necessary for the lot purchaser in the affected areas, to fill the rear portion of the lots starting at the buffer strip towards the centre of the lot. The lot can then drain by gravity to the serviced internal roads. As an option, the lot purchaser could allow the land to naturally fall to the east to the agricultural fields, but would need an additional biofiltration pond. Again, the proposed road profile for the two intersections would need to be lowered by up to one metre for the purpose of avoiding excessively deep storm sewers.

Another constraint is the timing of construction. The existing ditch on 68 Avenue east of the study is classified as A (0) on the Fisheries water course classification. Minor improvements (clearing and reshaping of ditch where it has eroded) to the existing ditch on 68 Avenue will be required and construction of the biofiltration pond needs to be built within the allowable Fisheries window of July 15 to September 15.



BOUNDARY DENOTING
ELEVATION TO WHICH LOTS CAN
BE SERVICED BY GRAVITY (TYP)

INV.=2.2
DEPTH=4.8

LEGEND

— PROPOSED STORM
~ DITCH UPGRADE

 200 YR. FLOOD PLAIN
LEVEL OF 2.6m

STORM SEWERS

**EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN**

FIGURE 10

**APLIN
MARTIN**
CONSULTANTS LTD

Scale : 1:3000
Date : SEPT. 1998

2.5.3 Offsite Drainage to Bear Creek Lowlands

As described in Section 2.5.2, the additional runoff generated by the development of the study areas has the potential to increase flooding to downstream lands in the agricultural lowlands. Several options for consideration are:

- i) Provide a pump station and improved conveyance system to limit flooding to ARDSA standard; or
- ii) Provide a detention pond and a slow release rate for long duration storage.

Item ii) is an impractical option as it would need a large land area and becomes too costly to develop. Item i) is compatible to the City's current strategy for lowland flood control.

The City of Surrey has engaged CH2M Gore & Storrie (G & S) to prepare a report known as the Functional Plan for East Newton Pump Station as part of the lowland flood control program and for the East Newton South NCP.

It makes sense to combine a solution for all three issues, namely:

- lowland drainage improvement;
- impact from East Newton South NCP; and
- impact from East Newton business Park NCP.

The G & S report outlined the flow capacity required and related cost estimates. The financing and implementation options are discussed further in Section 3.0.

The flow requirements in the above report are summarised as follows:

Lowland Drainage Improvement	0.75 m ³ /sec.
East Newton South NCP (Residential)	0.25 m ³ /sec.
East Newton Business Park NCP	<u>0.46 m³/sec.</u>
Total Discharge Pump Rate	<u>1.46 m³/sec.*</u>

The above flows are not cumulative. The combined pump rate of 1.46 m³/sec. is based upon two relevant sets of criteria, design storms being concurrent and one pump station being constructed.

The existing ditch on 68 Avenue east of the study area requires cleaning and reshaping as recommended in the G & S report.

The G & S report focuses on the pump station needs for the study area as well as minor upgrading to the existing ditch along 68 Avenue between the study area and the proposed pump station adjacent to the Serpentine River and at 68 Avenue. Both the residential NCP and the Business Park NCP cannot proceed to development without construction of the pump station. The pump station and ditch upgrading would need to be constructed ahead of the first phase of the Business Park NCP. The G & S report as identified above, has the final recommendations and cost estimates which will impact the East Newton Business Park NCP. The East Newton Pump Station is being prepared as a Phase Two project in the Serpentine flood control project and would likely be constructed in 2004 in accordance with the Engineering Departments schedule for lowlands improvements.

2.5.4 Proposed Storm Sewer System

The proposed drainage system will collect runoff for the majority of the study area and direct it to the existing ditch on 68 Avenue east of the study area. Before discharging storm water flow into the existing ditch on 68 Avenue in the lowland area, the storm water will flow through the biofiltration pond. The biofiltration pond was sized based on Ministry of Environment guidelines of 2.5 to 3.0% of the developed land area. The purpose of the biofiltration pond is to capture a significant proportion of suspended solids during more frequent storm events. A single biofiltration pond was selected versus individual water treatment applied throughout the study area, as it is more cost effective; and a majority of the required land area for the selected biofiltration pond, is below the 200 year flood plain. As this land cannot be filled or developed as a serviced lot, this land is being cost effectively utilized for this purpose. The biofiltration pond would be designed in accordance with Ministry of Environment regulations. Areas north of 68 Avenue and south of 66 Avenue that presently drain away from 68 Avenue will be redirected to the 68 Avenue ditch. Small areas at elevations below the gravity service boundary (as noted on Figure 10) will continue to drain away from 68 Avenue. There are no upstream areas outside of the study area that drain through the study area in either the existing or future conditions.

The proposed business park will create an increase in impervious areas. This, combined with the enlarged catchment area, will increase flows to the 68 Avenue ditch.

2.5.5 Storm Water Modelling

The results of the storm water modelling determined in this section was coordinated with the December 1998 report prepared by G & S. The Gore & Storrie report confirmed that there is a need for upgrading the capacity of the drainage pump station to meet the requirements of both the proposed business park and the residential NCP. The details for the storm water modelling for the business park is described in the following paragraphs.

Storm water modelling has been completed, using the computer program XP-SWMM, to assess the downstream impact of development in the NCP study area. Hydrology was modelled using the SWMM RUNOFF block and hydraulics were modelled using the EXTRAN block. The Aplin & Martin model is limited to the study area. G & S worked with Aplin & Martin's results and incorporated it into their model and sized the pump station accordingly. Details of the storm water analysis can be found in Appendix "D".

As per the City of Surrey design criteria, peak flows and hydrographs were calculated for the 5 year and 100 year return period events. The 2, 6, 12, and 24 hour storm durations were modelled for each of the return periods, in both the pre- and post-development conditions.

Model calculations predict that the peak flows in the 68 Avenue ditch will increase in the order of four to six times in the post-development condition. However, the existing ditch has adequate capacity for post-development peak flows generated by the 100 year storm. As identified in the G & S December 1998 report, increased runoff from the study area will impact the proposed lowlands area downstream. Impact to the lowlands from upland development in the study has been quantified in the Functional Plan for the East Newton Pump Station.

2.6 HYDRO, TELEPHONE, CABLE AND GAS SERVICES

The business park would be serviced via underground services which are namely: electrical, telephone, cable TV and gas services. As per the City of Surrey's design criteria, no overhead servicing would be permitted.

BC Gas and Rogers Cable TV have adequate capacity in their utilities located along 152 Street frontage. BC Hydro has capacity to service the first phase of the project. However, dependent upon the timing for the second and subsequent phases and BC Hydro's timing for offsite improvements to the existing electrical distribution system, there may be a requirement of an offsite System Contribution Improvement of up to \$50,000.00. This cost is over and above the normal material costs and charges that are applicable to underground servicing of the internal NCP study area. If the entire study area proceeded all at once, there would be Offsite System Contribution Improvement of \$50,000. If the subsequent phasing to the NCP study area proceeds within BC Hydro's planned phasing of offsite improvements, the \$50,000.00 cost can be reduced to zero.

BC Telephone does not have capacity in their plant for the NCP study area. BC Telephone requires a three (3) metre by five (5) metre right-of-way for the location of a small "WIC" building to house their equipment. The equipment will include optic fibre-fed electronic switching as opposed to copper wires. The right-of-way would need to be located in Phase One, adjacent to the road allowance and not on the collector portion of 68 Avenue. A suggested

location for the three by five meter BC Telephone Right-of-way is shown on Figure 10. The exact location for the WIC building would be determined during detailed design and in consultation with BC Telephone.

Letters as received from the utility companies are attached in Appendix "E".

3.0 FINANCIAL ASPECTS OF THE PLAN

3.1 INFRASTRUCTURE FUNDING

The City of Surrey has taken the following approach to infrastructure funding in the NCP areas.

1. The long term DCC revenues and expenditures for major collector roads, water, sanitary and drainage works should balance or show a positive cash flow at buildout. This applies to DCC revenues and expenditures within the NCP area. If the NCP's total DCCs are less than the expenditures, the NCP may still go ahead but the costs above the revenues generated through the specific NCP DCCs will only be provided by the City when the works become a City priority or can be frontended and recovered as per Item 5 below.
2. The short term annual DCC revenues and expenditures must also balance or the development community within the NCP must address the short term cash flow problem.
3. The City will not fund interim works.
4. The City-wide based DCC collection and expenditure program is the basis of all DCC capital works.
5. In Bill 46, Local Government Statutes Amendment Act (No. 2), 1997, the Provincial Government added Section 937.1 regarding development agreements with developers. This section enables the City flexibility to repay developers who build infrastructure under an agreement with the City. Surrey Council has supported this approach. Details of such an agreement are discussed later in this report.

All of the major works identified to service the East Newton Business Park NCP are within the current 10 Year Engineering Servicing Plan with the exception of the traffic light at 66 A Avenue/152 Street intersection.

This section of the report describes the major works required, DCC Revenues and projected expenditures, financial options and cash flow analysis.

3.2 DCC ELEMENTS

The 1997 City of Surrey's 10 year capital plan includes engineering works which are required for both the existing and future needs of the community. Typically the existing needs are funded from general revenue monies or grants and infrastructure required for growth is principally funded by developers through Development Cost Charges (DCCs).

The City will only fund works which are included in the 10 year plan and DCC program. DCC works can either be built by the City or developers. Given the size of the DCC program and the time requirements for infrastructure to be built, developers typically build many DCC works and receive DCC rebates/credit for the works they build.

The City has specific criteria for a work to be included as a DCC element in their program. Table 3.2.1 lists the proposed eligible DCC items by service. The table also notes whether the item is an addition to the current 10 Year Servicing Plan or a substitution. The traffic signal at the 152 Street/66A Avenue intersection is presently not in the 10 Year Servicing Plan and will need to be added to the 10 Year Servicing Plan.

(Note that the proposed timing shown is based on projected development needs. The actual timing of construction by Surrey may differ. Only those DCC elements in the current 10 year plan [DCC elements] may receive DCC rebates/credits as per the current City policy. The proposed works in the NCP will be eligible if they are added to the 10 year plan [DCC elements].)

Table 3.2.1
East Newton Business Parks
NCP Infrastructure Financing and Funding

Item	Total Capital Costs (\$)	10 Year Servicing Plan Date for Implementation
Sanitary Sewer		
• Pump Station & Force Main	862,000	2002
Storm Sewer		
• Drainage Pump Station	1,493,000	2004
• 68 Avenue Ditch Improvements	30,000	2004
Arterial Roads		
• 152 Street/66A Ave. Traffic Signal	90,000	Not in 10 Year Plan

3.3 FINANCING BASED ON FULL BUILDOUT

The East Newton Business Park has only one Development Cost Charge (DCC) rate applicable for all industrial zones including the live/work area with one exception. The total area of industrial land after road dedication is 70.19 acres. The only other DCC rate is for a small commercial area of 0.77 acres. These areas include the related buffers and exclude the biofiltration pond and park as identified on Figure 1. The calculation of DCC revenue is based on the following areas and units:

Proposed Zoning	Area	Units	Cost
Industrial	70.19 acres	70.19 acres	\$42,470/acre **
Commercial *	0.77 acres	6,708 sq. ft.	\$5,310/1,000 sq. ft. **

* Assume that 2/3 of 30% of the total commercial retail area will be absorbed by buildings.
30% = Allowable Buildable Area

** These costs include Arterial Road DCCs. The Arterial Road DCCs are not included in the following tables.

The DCC revenue is based on the most recent DCC schedule under By-law 13476 which was adopted by Council on July 28, 1998.

Table 3.3.1 below provides the projected total revenue generated from the collection of DCCs based upon full buildout.

Table 3.3.1
Projected DCC Revenues Based on the Various Land Uses

Zone	Area (Acres)	Water (\$)	Sewers (\$)	Major Collector Roads (\$)	Stormwater Management (\$)	Total (\$)
Industrial	70.19	201,445	188,109	230,223	1,415,030	2,034,807
Commercial*	0.77	2,147	2,012	4,159	10,331	18,649
Total Revenue		\$203,592	\$190,122	\$234,382	\$1,425,361	\$2,053,456

* Assume that 2/3 of 30% of the total Commercial Retail area will be absorbed by Buildings.

Roads

Since 152 Street is an arterial road, all of the upgrading would be paid for from the Arterial Road DCC funds that are collected. The arterial road improvements include raised medians at both the 66A Avenue and 68 Avenue intersections, (for south bound traffic turning east) 68 Avenue and 66A Avenue traffic signals, relocated bus bay from 66 Avenue to 66 A Avenue and sidewalks for the full frontage along 152 Street. Details for these DCCs capital works are found in Appendix "F". The DCC rate for Arterial Roads is \$13,480.00 per acre. The projected DCC revenue for arterial roads is \$898,159.00 versus capital costs of \$290,000. It is assumed that the need for arterial roads is principally driven by the larger community needs and therefore these costs have not been included in the following tables.

Sanitary

The capital costs for the sanitary works includes a lift station and appurtenances, emergency pump generator, force main and tie-in to the existing GVS & DD Trunk Sewer.

Storm Sewer

The capital costs for the storm works includes minor upgrading and clearing of the existing 68 Avenue ditch and the drainage pump station. These costs are presented in Table 3.3.2.

Storm Sewer Levy

The biofiltration pond and required land acquisition is not a DCC item and is not in the 10 Year Servicing Plan. The estimated cost for the biofiltration pond is \$923,400 and a special levy assessed against the study area is \$13,000/acre. Details for the related costs and calculations are found in Appendix F.

The City of Surrey provided the unit rates used to develop the capital works. A copy of the unit rates are found in Appendix "G". The above costs include a 50% factor to cover GST, design, administration and project contingency.

As identified earlier in Section 2.6, a possible offsite system contribution improvement cost payable of \$50,000 to BC Hydro may be required if the NCP study area proceeded all at once or if Phases Two, Three and Four are brought on-stream sooner than BC Hydro would plan the growth of their physical plant.

Table 3.3.2 below shows details of total DCC revenue versus the expenditure of capital works.

Table 3.3.2
Projected DCC Revenues and Expenditures at Buildout

	Projected Total Expenditures (\$)	Projected DCC Revenues (\$)	Projected Business Park Expenditures (\$)	Surplus Balance (Deficit Balance) (\$)
Water (\$2,870/Acre)	0	203,592	0	203,592
Sanitary Sewer (\$2,680/Acre)	862,000	190,122	747,500 *	(557,378)
Major Collector Road (\$3,280/Acre)	0	234,382	0	234,382
Storm Sewer (\$20,160/Acre)	1,523,000	1,425,360	647,590 **	777,770

* From Section 2.4.2, the East Newton South contributing area is 13.28% or approximately \$114,500.

** The costs for the pump station is \$1,493,000, which is based on the total flow requirement of 1.46 m³/sec. as described earlier in Section 2.5.3. These figures are from CH2M Gore & Storrie's December 1998 report. With the assumption that the Residential NCP and the Business Park NCP proceeds first, a prorated sharing of costs was developed as follows:

The City of Surrey (@.75 m ³ /sec.)	\$493,460
East Newton (South) NCP (@.25m ³ /sec.)	351,950
East Newton Business Park (@.46 m ³ /sec.)	<u>647,590</u>
Total Pump Station Costs	\$1,493,000
68 Avenue Ditch Upgrading for Business Park	<u>30,000</u>
Total Cost	<u>\$1,523,000</u>

The above DCC rates are for industrial zones. The commercial retail DCC rates are included in the DCC revenue but are based on a total rate of \$5,310/1,000 sq. ft. of building area.

3.4 PHASING OF DEVELOPMENT

The collection of DCCs for the business park and commercial lot will not occur until building permits are being applied for. Financial options and conclusions are found in Sections 3.5 and 3.6. It may not be feasible for the developer to consider financing the entire NCP study area at

once, therefore the following phases are briefly discussed for financial consideration and budgeting purposes. The negative side of phasing is that it will take longer to recover the required DCCs.

3.4.1 Phase One

Several factors dictate the phasing of development: the readiness of property owners to proceed; the physical ability to proceed given the configuration of sewer, water and roadways in the area; and the amount of property required to support the funding of needed infrastructure works at each stage of development.

For the East Newton Business Park, a logical sequence for the phasing is from north to south as shown in Figure 11. Phase One would encompass the land area on both sides of 68 Avenue. Several factors for this area being Phase One are as follows:

- a) The east end of 68 avenue is the lowest point on the site and leads to the natural selection of location for the sewage lift station, the storm sewer outfall and biofiltration pond.
- b) The storm sewer discharges into an existing ditch that would drain to the proposed drainage pump station on 68 Avenue east of the NCP study area.
- c) Road access is immediately available and 68 Avenue will be signalised in Phase One, which in turn produces a highly desirable access/egress point for the remaining phases.
- d) A highly desirable all-directional access/egress point encourages development of the serviced land to occur quickly and assists in accelerating the following phases.
- e) Can achieve the maximum allowable road length of 400 metres before a secondary road access is required.

The most northern segment of land (north of 68 Avenue) can be phased into any of the four phases. This northern land segment is serviced from Phase One and has no restrictions as to which phase it is placed in. Based on the East Newton (South) NCP proponents wanting to proceed with their residential development (west of 152 Street) in the near future and their desire to minimise their servicing costs by tying into the East Newton Business Park sanitary lift station; it is recommended that the northerly land segment proceed with Phase One.

3.4.2 Other Phases

Phase Two, as shown on Figure 11, is the next logical phase. this phase provides a second access point to 152 Street, and provides a cost effective road loop and water main loop. Phase Three completes the remaining roadworks and water main loops on a cost effective basis (no temporary

68 AVE

152 ST

66A AVE

PHASE I, II,
III, OR IV

68 AVE

Church

PHASE

PHASE I

PHASE II

66 AVE

PROPOSED PHASING

EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN

FIGURE 11

**APLIN
MARTIN**
CONSULTANTS

Scale : 1:3000
Date : SEPT. 1998



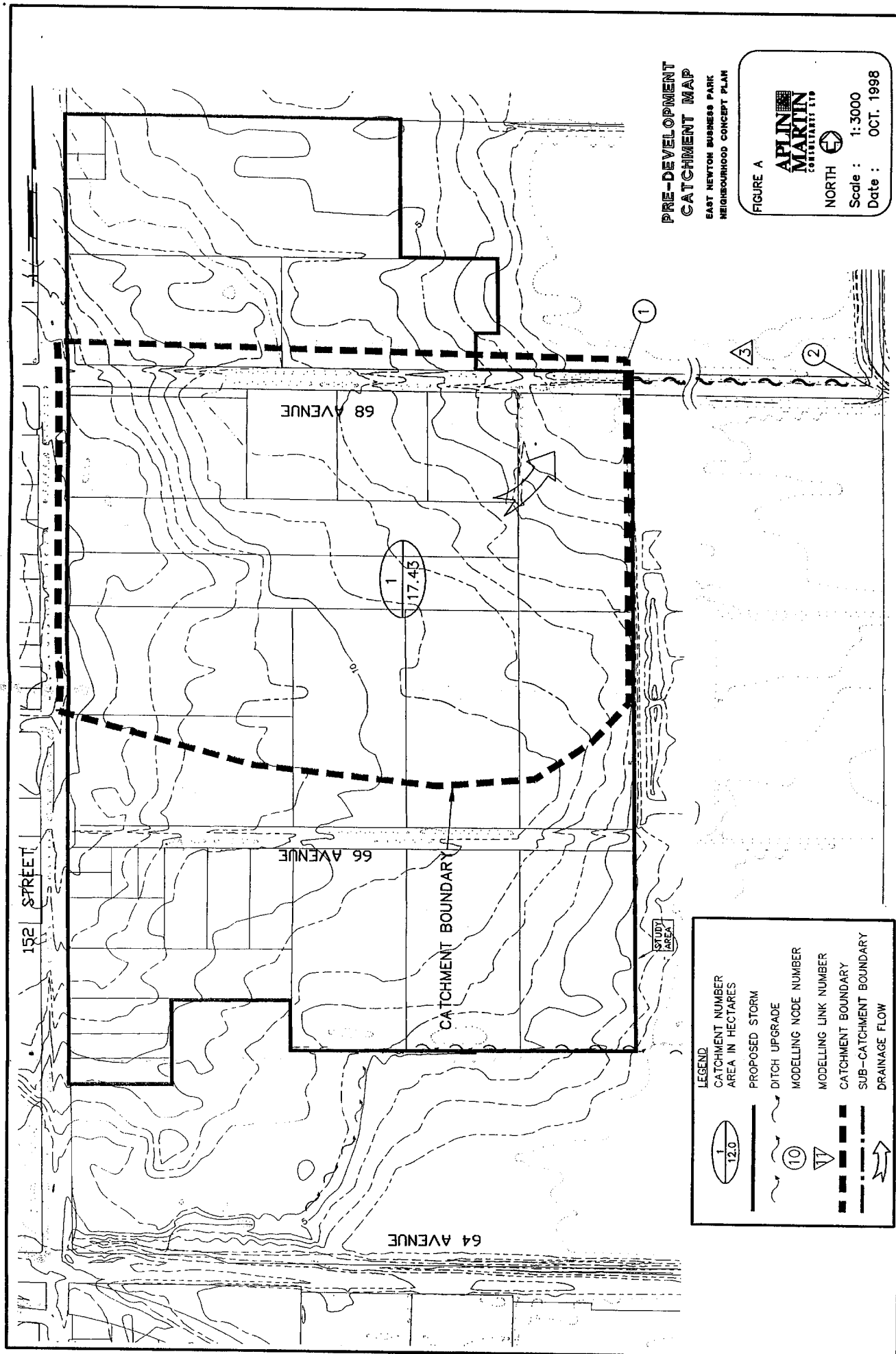
RECREATION
FACILITY

STUDY
AREA

64 AVE

64 AVE

HYLAND CREEK



**PRE-DEVELOPMENT
CATCHMENT MAP**

EAST NEWTON BUSINESS PARK
NEIGHBOURHOOD CONCEPT PLAN

FIGURE A

**APLIN
MARTIN**
CONSULTANTS LTD



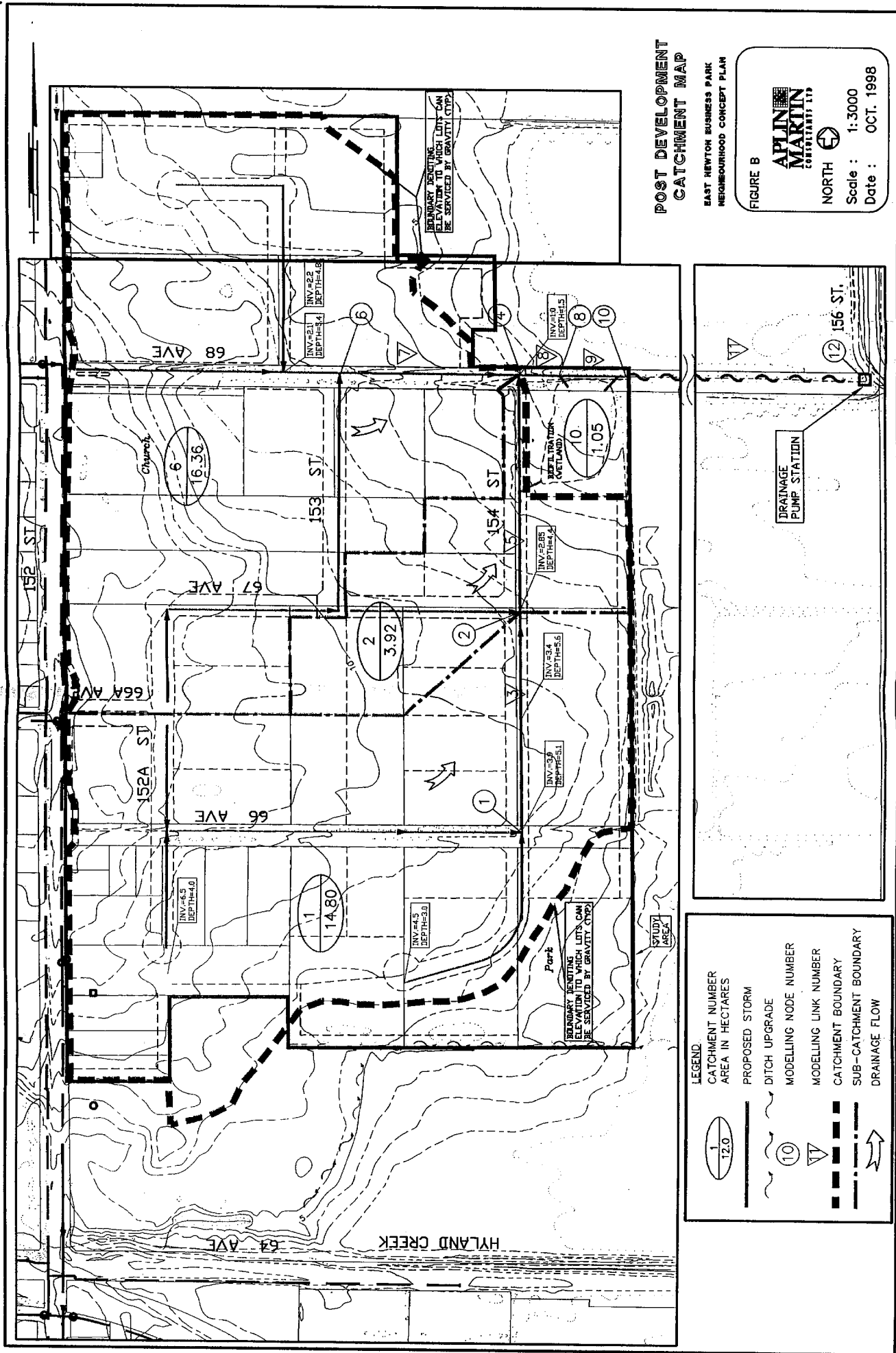
NORTH

Scale : 1:3000

Date : OCT. 1998

LEGEND

	CATCHMENT NUMBER AREA IN HECTARES
	PROPOSED STORM
	DITCH UPGRADE
	MODELLING NODE NUMBER
	MODELLING LINK NUMBER
	CATCHMENT BOUNDARY
	SUB-CATCHMENT BOUNDARY
	DRAINAGE FLOW



The SWMM RUNOFF module uses a non-linear reservoir routing method. A rainfall hyetograph is accepted and a step by step accounting of infiltration losses, overland flow and surface detention is made to generate an outflow hydrograph for a given subcatchment. The Green-Ampt method, operating within the SWMM RUNOFF module, was used to calculate infiltration losses.

The calculation is dependent on a number of estimated parameters that reflect the physical characteristics of the subcatchment. The infiltration parameters shown in Table B were used for all subcatchments in both the pre- and post-development condition. These values are empirically estimated, as there is no actual soil data available. Any error introduced because of this is considered manageable, as the calculation is more dependent on the subcatchment parameters. The subcatchment parameters are also estimated, but with a much higher degree of accuracy as they are derived from easily quantified surface geometry. Subcatchment parameters are summarised for the pre- and post-development conditions in Tables C and D respectively.

Table B
Study Area Infiltration Parameters

	Impervious	Pervious
Depression Storage (mm)	2.5	5
Manning's "n"	0.05	0.4
Zero Detention (%)	0	-
Average Capillary Suction (mm)		5
Initial Moisture Deficit		0.05
Saturated Hydraulic Conductivity (mm/hr)		1.5

Table C. Pre-Development Catchment Parameters

Pre-Development Node Data				
Node	Area (ha)	Impervious (%)	Slope (%)	Width (m)
1	17.43	25	2.00	860

Table D. Post-Development Catchment Parameters

Post-Development Node Data				
Node	Area (ha)	Impervious (%)	Slope (%)	Width (m)
1	14.8	90	1.60	1770
2	3.92	90	2.00	740
6	16.36	90	2.60	2230
8	1.05	20	2.00	200

1.5 TIME OF CONCENTRATION

The time of concentration (t_c) can be defined as the time taken for the most remote portion of the catchment to contribute to flow at the outlet of that catchment. The SWMM RUNOFF module uses a kinematic wave formulation to calculate the t_c . Overland flow is visualised as running downslope off an idealized rectangular catchment with the width (W) being the width of the overland flow. The width is generally estimated as double the length of the main drainage channel for a symmetric subcatchment.

1.6 HYDROLOGIC MODELING

Hydraulic modeling was completed using the EXTRAN module of the computer program XP-SWMM.

EXTRAN is a hydraulic flow routing model for both open channel and closed conduits in dendritic and looped networks. EXTRAN receives hydrograph input at specific nodal locations by interface file from an upstream block (e.g., the Runoff Block) and/or by direct user input. The model performs dynamic routing of storm water and sanitary flows throughout the major storm drainage system to the outfall points of the receiving water system.

Conduit data for the pre- and post-development conditions are shown in Tables E and F respectively.

Table E. Pre-Development Conduit/Link Data

Link	Length (m)	Dia/Depth (m)	Conduit Type	Slope (%)	Capacity (cms)
3	280	1.40	Trapezoidal	0.386	15.64

Table F. Post-Development Conduit/Link Data

Link	Length (m)	Dia./Depth (m)	Conduit Type	Slope (%)	Capacity (cms)
3	210	0.75	Circular	0.595	1.015
5	220	0.75	Circular	0.909	1.254
7	160	0.60	Circular	1.469	0.879
9	40	0.90	Circular	3.125	3.797
11	60	0.90	Circular	0.5	1.513
13	280	1.40	Trapezoidal	0.454	16.963

1.7 MODELING OUTPUT

Calculated peak flows for the 5 year and 100 year return periods and the various storm durations are shown in Tables G and H. Hydrographs generated for the 100 year storm are also shown in Figures E, F, G, and H.

Table G. Pre-Development Peak Flows

Link	5 Year Return Period				100 Year Return Period			
	2 Hr.	6 Hr.	12 Hr.	24 Hr.	2 Hr.	6 Hr.	12 Hr.	24 Hr.
3	0.182	0.210	0.275	0.273	0.362	0.418	0.557	0.558

Table H. Post-Development Peak Flows

Link	5 Year Return Period				100 Year Return Period			
	2 Hr.	6 Hr.	12 Hr.	24 Hr.	2 Hr.	6 Hr.	12 Hr.	24 Hr.
3	0.509	0.367	0.715	0.595	0.820	0.550	1.092	0.895
5	0.649	0.464	0.914	0.756	1.038	0.696	1.353	1.138
7	0.601	0.411	0.854	0.677	0.938	0.614	1.267	1.019
9	1.238	0.874	1.758	1.434	1.967	1.310	2.620	2.150
11	1.255	0.893	1.788	1.460	2.002	1.342	2.675	2.196
13	1.211	0.877	1.675	1.416	1.928	1.324	2.536	2.158

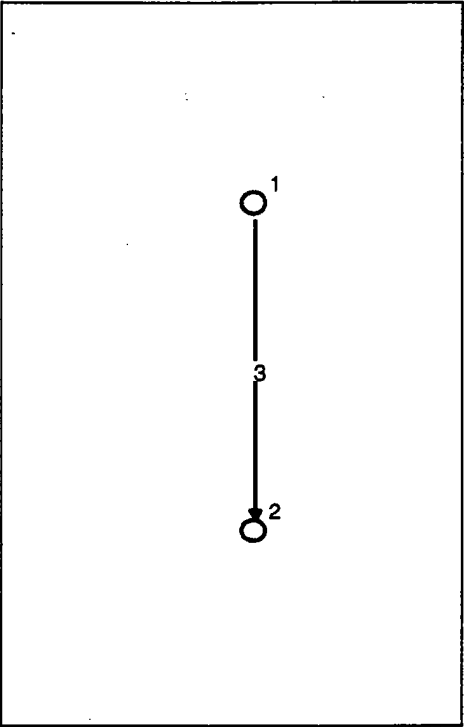


Figure C. Pre-Development Model Schematic

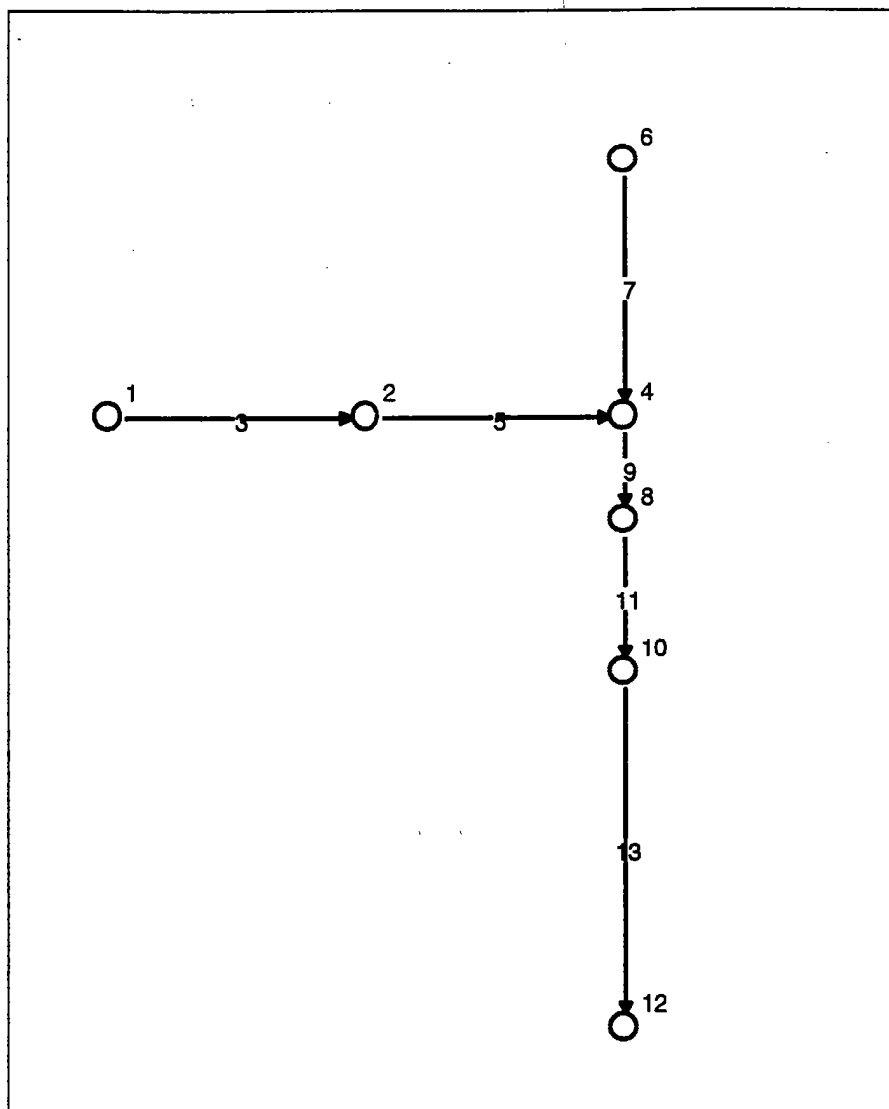


Figure D. Post-Development Model Schematic

Figure E.
PRE AND POST DEVELOPMENT HYDROGRAPH
100 YEAR 2 HOUR STORM EVENT

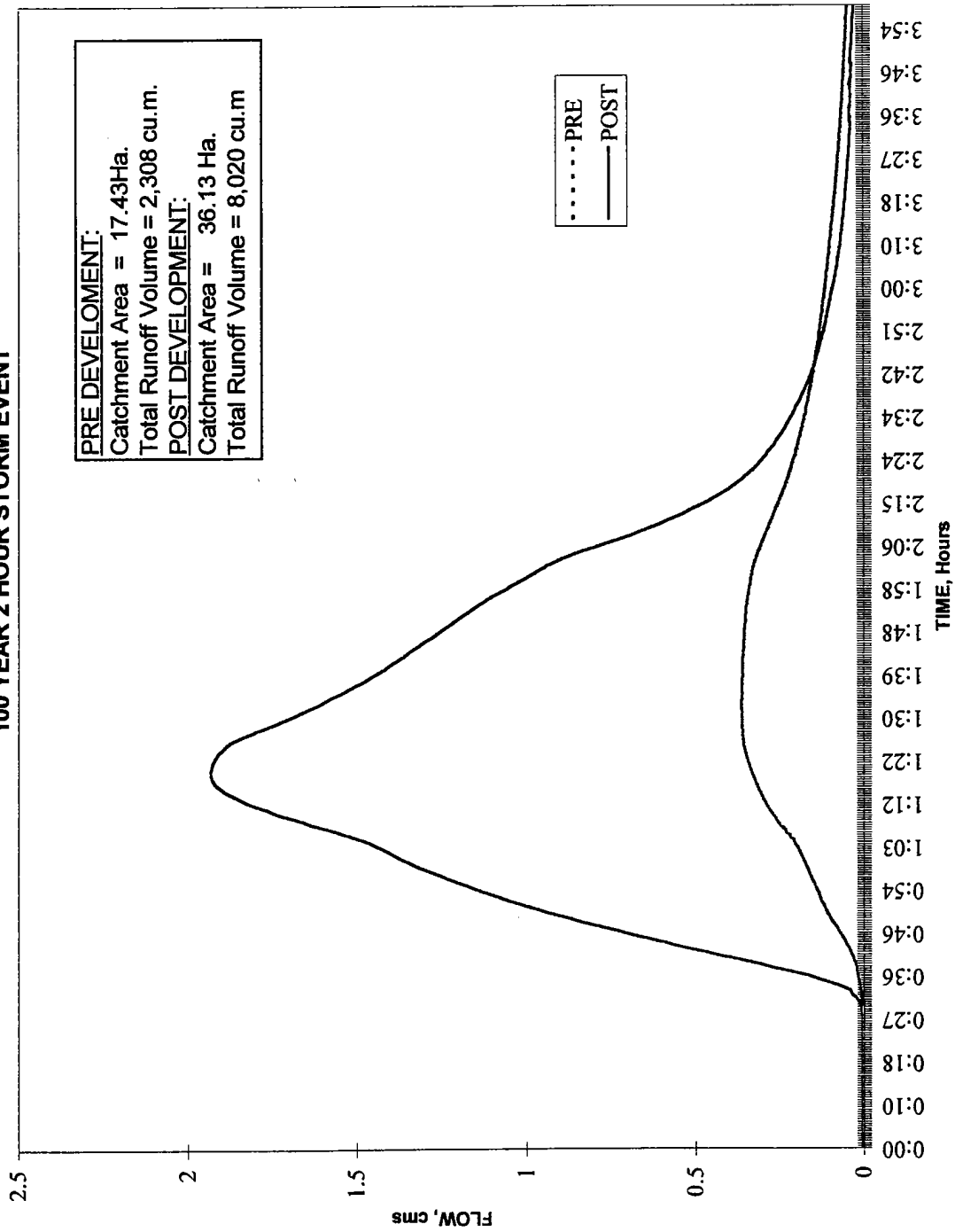


Figure F.
PRE AND POST DEVELOPMENT HYDROGRAPH
100 YEAR 6 HOUR STORM EVENT

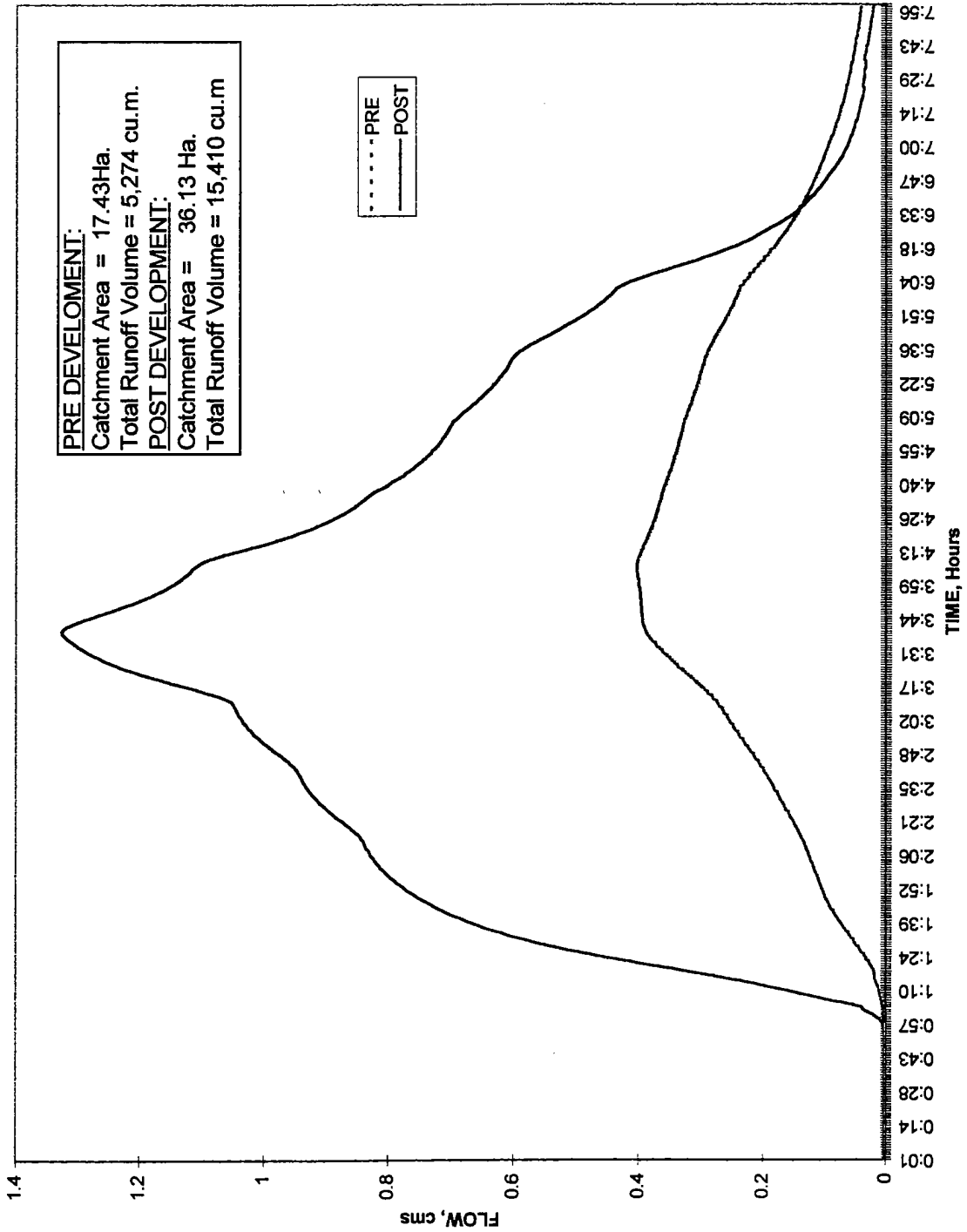


Figure G.
PRE AND POST DEVELOPMENT HYDROGRAPH
100 YEAR 12 HOUR STORM EVENT

