J.R. Paine & Associates Ltd.

CONSULTING AND TESTING ENGINEERS
EDMONTON — GRANDE PRAIRIE — PEACE RIVER — WHITEHORSE

17505 - 106 Avenue
Edmonton, Alberta
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April 22, 2005
File No. 2692-115

CITY OF EDMONTON
c/o SCHEFFER ANDREW LTD.
14505 – 123 Avenue NW
EDMONTON, Alberta
T5L 2Y6

ATTENTION: Mr. Kim Barker

Dear Sir:

Re: **Geotechnical Investigation**
Proposed Oxford Subdivision
127 Street & 167 Avenue
EDMONTON, Alberta

Please find enclosed our report with respect to the above noted investigation. In brief, this report presents the general soil conditions and geotechnical considerations and recommendations for the proposed residential subdivision development.

Thank you for the privilege of providing this service to your organization. We will be pleased to meet with you to review the contents of this report at your convenience.

Yours truly,
J.R. PAINE & ASSOCIATES LTD.

Chris Coslovich, E.I.T.

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REPORT NO: 2692-115

GEOTECHNICAL INVESTIGATION
PROPOSED OXFORD SUBDIVISION
127 STREET & 167 AVENUE
EDMONTON, ALBERTA

APRIL, 2005

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GEOTECHNICAL INVESTIGATION
PROPOSED OXFORD SUBDIVISION
127 STREET & 167 AVENUE
EDMONTON, ALBERTA

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J.R. Paine & Associates Ltd.

GEOTECHNICAL INVESTIGATION

PROJECT: Proposed Oxford Subdivision

LOCATION: 127 Street & 167 Avenue
Edmonton, Alberta

CLIENT: CITY OF EDMONTON
C/O SCHEFFER ANDREW LTD.
14505 – 123 Avenue
EDMONTON, Alberta
T5L 2Y6

ATTENTION: Mr. Kim Barker

1.0 INTRODUCTION

This report presents the results of the subsurface investigation made on the site of the proposed residential subdivision in Edmonton, Alberta. J.R. Paine & Associates Ltd. (JRP) had previously conducted a geotechnical investigation within the eastern portion of the subject site, original report number 1904-17, dated September, 2000. The purpose of the previous investigation was to delineate fill soils located within the eastern portion of the site. The objective of the current investigation was to determine the subsoil data for use in the hydro-geotechnical planning and detailed design aspects of the subdivision development project.

Authorization to proceed was received from Kim Barker of Scheffer Andrew. Fieldwork for the project was completed in March, 2005.

2.0 PROJECT AND SITE DESCRIPTION

The proposed subdivision development is located to the south of 167 Avenue and west of 127 Street in Edmonton, Alberta. The site is located within the North ½ 36-53-25-W4M.

The study area is understood to cover an area of approximately 50 hectares. The site is bordered to the north by 167 Avenue and to the south by existing residential development. The site is bordered to the east by 127 Street and to the west by 142 Street. An ATCO Gas pipeline Right-Of-Way (ROW) runs diagonally, roughly at a 30 degree angle through the western portion of the site. At the time of the fieldwork, the site was mostly undeveloped farmland.

The site profile consisted of mainly flat land with some slightly lower areas noted. Free water was observed in some of the lower areas at the time of our investigation. Various treed areas were noted throughout the site. A slough area was noted within the eastern portion of the site. Free water/ice was observed in the slough at the time of our investigation. The slough area typically contained thick grasses and shrubbery. As well, an existing wetland pond is located within the eastern portion of the site. Travel to the testholes was only possible with track mounted vehicles. Access was to the site obtained off 167 Avenue.

3.0 PREVIOUS LAND UTILIZATION

Air photos of the area were examined which consisted of May, 2003, May, 1990, and May, 1978. Based on the air photos it appears the previous land utilization has been mainly farming. Two residences along 167 Avenue can be seen on the 1978 photos and by 1990 the residences have been removed. The low areas seemed to vary in water volume during the seasons and from year to year.

In-filling within the eastern portion of the site by apparent truck dump can be seen on the 1978 photo. In-filling also appears to be present on the 1990 photo. Although, no other locations of in-filing were observed in the air photos, small in-filled pits are typical of farm operations and may be present.

4.0 FIELD INVESTIGATION

The soils investigation for this project was undertaken on March 14, 2005 utilizing a track mounted drill rig owned and operated by SPT Drilling Ltd. A total of 16 testholes were drilled to a depth of approximately 7.3 metres below ground surface at locations shown on the attached site plan. The testhole layout was selected by JRP and was located by Scheffer Andrew in the field prior to drilling.

The testholes were advanced with 150 millimetre diameter solid stem augers in 1.5 metre increments. A continuous visual description was recorded on-site which included the soil types, depths, moisture, transitions, and other pertinent observations. Disturbed samples were removed from the auger cuttings at 750 millimetre intervals for laboratory testing. Standard Penetration Tests c/w split spoon sampling and Shelby Tubes were also taken at regular 1.5 metre intervals.

Following the drilling operation, slotted piezometric standpipes were inserted into all testholes for watertable level determination. The testholes were backfilled with cuttings, with a bentonite seal placed at the surface.

5.0 LABORATORY TESTING

All disturbed bag samples returned to the laboratory were tested for moisture content. In addition, the plastic and liquid Atterberg Limits and soluble soil sulphate concentrations were determined on selected samples. Grain size analyses consisting of hydrometers were conducted on selected samples. The Shelby Tube samples were tested for Unconfined Compressive Strength and Dry Density. Lab results are included on the attached testhole logs located in the Appendix A.

6.0 SOIL CONDITIONS

A detailed description of the soils encountered is found on the attached testhole logs in the Appendix A. In general, the soil conditions at this site consisted of surficial topsoil or clay fill, underlain by clays and silts.

Topsoil

Topsoil was present on the surface of all testholes except Testholes 05-1, 05-2, 05-3 and 05-4. The topsoil depths ranged from 200 to 350 millimeters. The topsoil depth is known only at the testhole locations, and may vary between testholes. It is noted that with the winter testhole drilling, topsoil depths were difficult to measure. Therefore, the topsoil depths on the testhole logs should be considered as rough estimates only.

Clay Fill

At the surface in Testholes 05-1, 05-2, 05-3 and 05-4 clay fill was encountered. The fill material was generally moist, with a stiff consistency. The material was normally brown and black in colour, and was medium or high plastic. The material generally featured moderate to high organic content, although some isolated areas contained more or less organic material. The moisture content of this material was typically between 18 and 28 percent, with occasional moister areas approaching 30 to 35 percent. The clay fill was noted to depths ranging from approximately 1.7 to 2.6 metres in the subject testholes. Our previous report dated September

2000, noted above should be reviewed for more detailed information regarding the fill soils throughout the eastern portion of the site.

Buried Organics

In Testholes 05-1, 05-2, 05-3 and 05-4 a layer of buried topsoil or organic clay was encountered below the fill soils. This material was typically black in colour with a firm, very moist consistency. The buried organic soils varied in thickness from 0.3 to 1.0 metres.

Clay

Clay was encountered below the topsoil and below the buried organics in Testholes 05-1, 05-2, 05-3 and 05-4. In general, the clay began as silty, high plastic, stiff to very stiff and moist. The moisture content typically increased with depth while the consistency decreased with depth. Lower portions of the clay were typically medium to high plastic, very silty, soft to firm, and well above optimum moisture content. At the middle to the bottom of the layer, the moisture is near constant to slight increasing, while it appears to become very moist to wet due to the increase in silt content. Atterberg limits in the upper portions of this layer typically ranged from plastic limits of 19 to 23 percent and liquid limits of 59 to 74 percent. Atterberg limit tests on the lower portions typically ranged from plastic limits of 19 to 21 percent and liquid limits of 42 to 47 percent.

Silt

In Testholes 05-5, 05-6, 05-8, 05-9, 05-10, 05-11, 05-12, 05-13, 05-14, 05-15 and 05-16, the clay soils gradually transitioned to a clayey silt material. This material was generally low to medium plastic and contained more than 50% silt sizes. It was generally soft on the auger, wet, and in some testholes contained fine sands. Numerous zones produced water while drilling.

This clayey silt material is very sensitive, that is it becomes soft with disturbance. SPT values in the silt generally ranged from 4 to 9 blows per 300 millimetres.

Clay Till

Below the silt soils in Testholes 05-8, 05-10, 05-11, 05-12, 05-13, 05-14, 05-15 and 05-16, a transition to clay till was encountered. The clay till was silty and sandy, with a medium plasticity. The till had a stiff to very stiff, moist consistency. Moisture contents typically ranged from

approximately 17 to 20 percent with some slightly drier and moister areas noted. An Atterberg Limit tests on the clay till revealed a liquid limit of approximately 33 percent, and a plastic limit of approximately 15 percent. The till contained traces of coal, oxides, pebbles, and gravel, and was brown/grey in colour. Pocket penetrometer readings of 150 to 350 kilograms per square centimetre were noted in this deposit, with a Standard Penetration Test "N" values typically between 15 to 29 blows per 300 millimetres with some values in excess of 50 blows noted. The clay till material was still being encountered at termination depth of 7.3 metres below ground surface in the above noted testholes.

At the completion of drilling, trace accumulations of free water were noted in Testholes 05-5, 05-6, 05-8, 05-9, 05-10, 05-11, 05-12, 05-13, 05-14, 05-15, and 05-16. Approximately 0.3 and 0.6 metres of slough was encountered at the bottom of Testhole 05-5 and 05-12 respectively at the completion of drilling. No slough was encountered in any of the remaining testholes.

7.0 GROUNDWATER CONDITIONS

The groundwater table within the study area was generally moderate to high with some low readings. Two sets of watertable readings were taken, with the results as follows:

Table 1
Groundwater Table Readings
Proposed Oxford Subdivision
(Metres Below Ground Surface)

Testhole Number	Testhole Elevation	Depth to Watertable (m)		Watertable Elevation
		28-Mar-05 (14 day)	8-Apr-05 (25 day)	
05-1	81.99	2.67	2.61	79.38
05-2	82.06	4.17	4.02	78.04
05-3	81.70	1.80	1.71	79.99
05-4	81.59	1.75	1.67	79.92
05-5	81.15	1.86	1.86	79.29
05-6	82.12	2.54	2.52	79.60
05-7	81.66	2.12	2.23	79.43
05-8	82.53	3.68	3.66	78.87
05-9	82.42	2.58	2.61	79.81
05-10	82.79	4.16	4.14	78.65
05-11	82.40	5.24	5.09	77.31
05-12	82.43	2.57	2.43	80.00
05-13	82.25	2.19	2.00	80.25
05-14	83.05	4.75	4.69	78.36
05-15	83.15	5.54	5.59	77.56
05-16	82.66	4.91	3.80	78.86

It should be noted that water table levels may fluctuate on a seasonal or yearly basis with the highest readings obtained in the spring or after periods of heavy rainfall. The above readings should be near the average seasonal levels.

8.0 RECOMMENDATIONS

8.1 Preliminary Building Foundations and Slab on Grade

1. It is understood that the eastern portion of the site containing surficial fill material will be utilized for future schools and parks. The following preliminary foundation recommendations are provided. It is important to note that the foundation recommendations are general in nature. A detailed geotechnical investigation is necessary for each lot once the actual building locations and site usage have been

determined in order to determine detailed foundation parameters and construction recommendations specific to the proposed structures.

2. Our previous report dated September 2000, noted above should be reviewed for more detailed information regarding the fill soils throughout the fill area of the site.
3. Construction of structures on the native soils encountered throughout this site is feasible, as long as appropriate construction measures are utilized. The proposed structures may be supported by continuous or spread footings bearing on undisturbed native inorganic soils.
4. Clay fill was present at the surface in this portion of the site. Organic clay and/or topsoil were encountered below the fill in all testholes as it transitioned to native inorganic clay. The footing elevation of any structures should be set below the clay fill soils and any organic materials encountered below the fill. Slab-on-grade support by the fill material appears unacceptable in most areas. It is important to note that the risk of settlement will always be present with the non-engineered existing fill at this site. In areas where the fill contains organic contents higher than 'moderate', the fill and underlying organic materials should be completely removed from below all slabs-on grade, followed by replacement to design grade with a new properly placed and compacted fill soil. Construction inspection and testing by qualified geotechnical personnel would be required to confirm slab support conditions if fill soil is left in place. If no movement is desired, complete removal of existing fill or a structural floor slab are two recommended options.

   The native clays encountered below the fill appeared to be adequate for slab-on-grade support for typical commercial floor loads, although, the native clays typically became very silty and soft with depth. Therefore, large cuts within the native clay soils should be avoided as soft material will likely be encountered requiring extra subgrade measures.
5. The clay fill should be removed prior to construction of roads, sidewalks and other surface utilities. Fill material encountered with an organic content higher than 'moderate' is not considered suitable for use as roadway subgrade. This material and any underlying organic soils should be removed.
6. The clay fill is considered suitable for use in non-structural areas, such as parks, berms or other landscaping areas.

7. No suitable end bearing pile soils were encountered at depth in Testholes 05-1, 05-2, 05-3 and 05-4 located within the fill area. Skin friction cast in place piles within the native clay soils are feasible, although the skin friction values below approximately 4.0 metres depth will be relatively low as the clays typically became very silty and very moist to wet. No accumulations of free water or slough were observed in the fill area testholes at the completion of drilling. Casing of the piles may be necessary as ingressing groundwater will likely result if the pile holes are left open for an extended period of time. At the minimum, pile concrete should be on-site during the pile drilling allowing for rapid concrete placement after pile inspection.
8. The surficial fill and underlying native clays within the surficial fill area were typically high plastic in nature and as such, have a high susceptibility to shrinkage and swelling with a change in moisture content. Therefore, it is important that changes in moisture content be avoided both during construction and throughout the life of the proposed structures. Proper site grading and roof downspout treatment will be imperative.
9. Temporary and long term dewatering may be required for basement excavations advanced below the watertable.

8.2 Residential Housing Units

1. No major problems with construction of residential units on the non-organic native soils encountered throughout this site are anticipated. The proposed housing units may be supported by continuous or spread footings bearing on undisturbed native clay soil. The native clay material encountered in the testholes typically became soft and very moist to wet with depth, therefore the bearing capacity of these materials may fall below the minimum 75 kilopascals required for applying the Alberta Building Code Section 9. In such cases, a wider strip footing will be required.

   All fill in the testholes is unsuitable for footing support. Basement slab-on-grade support from the fill is marginal and even in good areas the risk of settlement from the uncontrolled fill cannot be eliminated.

2. Final lot grading is unknown at this time. However, it is expected that final lot grades will largely correspond to existing conditions. If general lot grading will produce areas of fill extending to depths below that of footing elevations, it is strongly recommended that qualified geotechnical personnel prior to foundation construction inspect house

excavations. Generally, it is not recommended that footings be constructed on non-engineered fill. In such cases, the following alternatives are commonly recommended:

i) Removal of the fill down to native soil and replacement with a compacted coarse clean granular material, or concrete. A normal footing foundation may then be utilized.

or

ii) Utilize a pile foundation.

3. In the case of pile foundations, some installation problems may be encountered. Due to moderate to high groundwater levels in most testholes, it is likely some slowly ingressing groundwater will be encountered in pileholes in most areas of the site if they are left open for extended periods. At the completion of drilling, trace to moderate amounts of free water was noted at the bottoms of some testholes. Therefore, pile concrete should be placed as soon as possible after pile drilling has been completed.

4. Engineered fill may be considered in areas where low elevations necessitate deep fill zones. This option should be reviewed prior to implementation by a geotechnical consultant to evaluate site conditions and borrow material sources. Basically, engineered fill is fill that is placed in a controlled manner under the full-time inspection of a qualified soils technician. The fill is placed and compacted to a minimum 98 percent of its Standard Proctor Density near its optimum moisture content, in maximum 150 millimetre lifts. All topsoil and non-engineered fill must first be stripped from the engineered fill area. Engineered fill construction requires full-time monitoring and extensive testing by the geotechnical consultant during construction. However, proper placement of engineered fill will negate the need for pile foundations in deep lot fill areas, and possibly reduce the foundation costs to the builders and developer.

It should be noted that engineered fill construction is not possible in all situations. One of these situations occurs when soft, very moist, underlying soils are exposed once stripping has been completed. Compacting the first lift of fill material over these soft underlying soils to the engineered fill standard may be impossible. Where a minimum fill depth condition is met, construction of a clay pad approximately of 300 to 500 millimetres in thickness will be required to obtain an adequate working platform to start from. This pad should be compacted to a minimum of 95 percent of Standard Proctor

Density where possible. The normal engineered fill lift thickness and compaction criteria mentioned above should be applied to successive lifts. To employ this method, a minimum of 1.0 metre of engineered fill must be placed on top of the clay pad. If this condition is not met, the fill would not be considered to have met engineered fill standards.

In addition, engineered fill requires fill depth differentials across the building footprint of less than 1.5 metre. In some cases, removal of native material may allow for the minimum fill depth or the maximum fill differential conditions to be met. However, this may not be the most economical solution.

5. No loose, disturbed, remoulded or slough material should be allowed to remain in the open footing excavations. Hand cleaning is advised if an acceptable surface cannot be prepared by mechanical equipment. In order to reduce the disturbance to the bearing surface, a backhoe operating remote from the bearing surface should advance all basement excavations.
6. Concrete slabs, that have uncontrolled fills under them may be required to be structurally, supported by foundations, or structural slabs on grade. These may require a structural engineer to design them.
7. In order to reduce the disturbance to the bearing surface, all basement excavations should be advanced by a backhoe operating remote from the bearing surface.
8. Footing excavations should be protected from drying, rain, snow, freezing and the ingress of surface or groundwater. Care should be taken to ensure that all exposed soils are protected from excessive drying or wetting. The soils encountered immediately below the topsoil in the testholes were medium or high plastic, and have a moderate to high swelling potential. As with all medium and high plastic lacustrine clays, some minor amounts of long-term foundation and slab movement may occur, especially during extreme wet and dry weather periods.
9. A 150 millimetre layer of free draining sand or sand-gravel mixture should be placed immediately below all floor slabs. This material should be uniformly compacted to a minimum 98 percent of the corresponding Standard Proctor Density at optimum moisture content.

10. A non-deteriorating vapour barrier should be placed immediately below the floor slab to prevent desiccation of the subgrade material.

11. Temporary dewatering may be required for basement excavations advanced below the watertable.

12. Basements should be provided with a suitable peripheral drainage system with an adequate filter placed at footing elevation and connected positively with an approved drainage system. See Section 8.3 for more details. The watertable readings at this site were mostly moderate to high and slightly variable, therefore the discharge method will have to be determined on a lot specific basis.

13. The time span between the start of excavation to installation of basement footings, walls, peripheral weeping tile and backfilling operations should be minimized in order to prevent any problems developing within the excavation due to ingressing of ground or surface waters or desiccation of the subsoil.

14. It is recommended that floor joists be placed prior to backfilling the excavation in order to minimize any detrimental effects on the foundation walls caused by backfilling operations.

15. During winter construction, it is essential that all interior fill and load bearing materials remain frost free. Recommended winter construction practices, with respect to hoarding and heating of the forms and the fresh concrete, should be followed. In order to minimize the potential frost heave problems, the interior of the building must be heated as soon as the walls have been poured. The period in which the excavation is left open due to freezing conditions should be as short as possible. If doubts remain as to the suitability of the foundation during construction, the builder should consult a qualified geotechnical engineer.

8.3 Hydrogeotechnical Issues

1. The groundwater readings in the proposed development were mostly moderate to high and slightly variable, and are of concern in design and construction of underground and surface utilities and house construction.

2. The groundwater seepage rates into utility trenches from the native clay formations should be low to moderate with increased seepage rates in the silt soils. It is expected that the amount of trench dewatering required at this site will be moderate, and some

minor construction delays may be expected. Opening relatively long portions of trench should be avoided.

3. Subgrade softening below surface utilities is also a concern due to the moderate to high watertable levels. Attempts should be made to lower the watertable. This may be accomplished by using sub-drains, usually consisting of perforated pipe attached to the storm manhole, to collect groundwater below the road area, or leaving the rings off the storm sewers during construction, allowing groundwater to seep into the sewer. When employing this method, it is important to wrap the joints in filter cloth to prevent silting. The exact configuration and need for the sub-drains should be determined during construction.

4. Footing elevation designs should consider the groundwater level. The water table readings in most testholes were moderate to high, therefore the weeping tile discharge method will have to be determined on a lot specific basis. Depending on the foundation design, the footing elevations may intercept the water table, and the weeping tile flow may need to be directed to a foundation drain. The need for foundation drains will depend on the flow characteristics desired from basement sump pumps. Preventing only winter flows in order to reduce sidewalk icing and pump outlet maintenance will require a different standard than preventing excessive flows throughout the year.

   The design footing elevations should be compared to the water table elevations to assess the need for foundation drains. A foundation drain would be recommended where the highest seasonal water table elevation is above the footing elevation. A margin of safety of 1.0 metre is suggested.

5. As a minimum, peripheral weeping tile lines will be required for all houses. All lines should be placed at or slightly below footing elevation and connected to ensure positive drainage to an approved system. The weeping tile lines will require a suitable clean tile rock drainage filter, with a minimum of 150 millimetres of filter around the line. Basements located near the water table may require upgraded drainage measures including interior drains and clean tile rock beneath the floor in addition to perimeter drains. See the "House Basement Drainage Detail for Footings Located Near Watertable" detail drawing in Appendix B for this design recommendation.

6. House basement excavations situated below the groundwater table may experience water ingress. If this is the case, our firm should be contacted to provide recommendations for handling the groundwater. A temporary dewatering system may be required until the permanent weeping tile system is operational.
7. Water dispersed on the property from the roof leaders must not be allowed to accumulate against the foundation walls. To ensure positive drainage, the soil surface of all lots should be made sloping away from all buildings. This will require a positive lot grading of at least five percent away from the foundation walls toward the sidewalk for a minimum of 1.5 metres. In cases where the lot drainage runs from the back of the lot to the front, runoff should be kept 1.2 metres away from the house.
8. At least the top 1.0 metre of backfill around the basement walls must be a suitable impermeable clay material. The near surface clay materials found at this site will be suitable for this purpose. This serves to reduce water penetration into the backfill, and subsequently into the weeping tile system.
9. In order to ensure no flow paths for water from the roof leaders occur adjacent to the foundation walls, the following two alternatives are proposed:
   i) A concrete splash pad, placed beneath the downspouts, a minimum of 1.2 metres long and firmly anchored to the house foundation can be used.

   or

   ii) A permanent downspout extension could be used to carry water away from the foundation wall.

8.4 Underground Utilities

1. The subsurface soil conditions encountered in the testholes are considered generally poor for the installation of underground utilities. The moist upper portions of the clay would be considered fair with the very moist to wet clays and silts encountered with depth considered poor. The lower portions of the clay materials were generally well above optimum moisture content and would require considerable drying. The watertable readings were moderate to high in most areas of the site indicating that saturated soil conditions, sloughing and ingressing groundwater will likely be encountered in most of the trenches at this site, depending on the design elevations and location within the site. The amount of groundwater infiltration is expected to be low within the clay material and

moderate within the lower silts. Temporary dewatering measures will likely be required during utility installation, pumping from the trenches during installation should be sufficient to maintain trench working conditions. Delays in construction will likely occur in some locations. Weather conditions will also have a significant bearing on site operations, with rain potentially causing significant problems in areas of open trenches.

2. The clay and silt soils should be spill piled separately as mixing of the two soil types would create difficulties for compaction and result in a poor subgrade material. Ideally the silt should be utilized in the lower portions of trench backfill with the clays placed in the top 1.5 metres of trench backfill. Utilizing this backfill method should provide better subgrade support and help reduce the risk of seasonal frost heaving.

3. Standard trenching cutback angles of approximately 45 degrees from the vertical are anticipated for most areas of the site due to the wet and saturated soils encountered. Actual cutback angles should be determined in the field during construction. Exact stable slope values cannot be pinpointed without detailed and extensive analysis. For this reason, this information should be used as a guideline only and that the optimum cutback angles for utility trenches be determined in the field during construction. The Occupational Health and Safety Act, General Safety Regulation Item 173 and 174 should be strictly followed, except were superseded by this report.

4. The trench width must be wide enough to accommodate pipe bedding and compaction equipment.

5. Temporary surcharge loads, such as spill piles, should not be allowed to within 3.0 metres of an unsupported excavation face, while mobile vehicles should be kept back at least 1.0 metre. All excavations should be checked regularly for signs of sloughing or failures, especially after rainfall periods.

6. Pipe bedding and trench backfill procedures should adhere to the City of Edmonton specifications as outlined in The Servicing Standards manual. The backfill material beneath and above the pipe should be an approved bedding sand material where conditions allow. This material should be hand placed and hand tamped with care taken to fill the underside of the pipe. The City of Edmonton Type C pipe bedding configuration is considered suitable for this project. To overcome any potential utility installation difficulties encountered in wet areas, it is recommended that a washed rock and geotextile separator be utilized for the pipe

bedding in the area of poor pipe bedding conditions. The washed rock and geotextile exact dimensions and usage should be determined in the field during construction. It is expected that the need for this configuration will be moderate at this site.

7. The moisture content of the upper moist clays encountered in the testholes generally varied from 18 to 27 percent, while the moisture content of the lower very moist to wet clay materials generally ranged from 30 to 40 percent, approximately 10 to 20 percent over optimum moisture content. The silt materials encountered at depth generally ranged from very moist to saturated at 30 to 38 percent. The variable condition of the soils will cause a corresponding variability in the utility trench pipe bedding and backfill conditions. The majority of the material will be very moist to wet, and will require attention to obtain adequate compaction. Substantial drying of these materials will be required prior to placement in the trench. Construction in early spring or late fall should be avoided if possible. The following table shows the calculated moisture content criteria based on the soil data and City of Edmonton specifications:

Table 2
Trench Backfill Maximum Moisture Content Criteria
Proposed Oxford Subdivison

Testhole Number	Sample Depth	Liquid Limit	Plastic Limit	Field Moisture Content	Plasticity Index (PI)	Maximum Moisture Content Criteria							
						Uniform Backfill			Conventional Backfill			PL+10 Criteria	
						PI/2	PL+PI/2	+/- Criteria	PI/3	PL+PI/3	+/- Criteria	PL+10	+/- Criteria
05-1	2.13 m	68.0	19.5	29.6	48.5	24.3	43.8	-14.2	16.2	35.7	-6.1	29.5	0.1
05-3	6.10 m	46.4	20.8	35.6	25.6	12.8	33.6	2.0	8.5	29.3	6.3	30.8	4.8
05-5	1.52 m	76.4	23.2	32.8	53.2	26.6	49.8	-17.0	17.7	40.9	-8.1	33.2	-0.4
05-6	1.52 m	71.1	21.8	25.7	49.3	24.7	46.5	-20.8	16.4	38.2	-12.5	31.8	-6.1
05-8	3.05 m	41.9	18.9	37.3	23.0	11.5	30.4	6.9	7.7	26.6	10.7	28.9	8.4
05-10	0.61 m	63.9	18.9	23.1	45.0	22.5	41.4	-18.3	15.0	33.9	-10.8	28.9	-5.8
05-10	2.13 m	46.7	18.7	39.0	28.0	14.0	32.7	6.3	9.3	28.0	11.0	28.7	10.3
05-12	2.13 m	58.9	20.1	36.2	38.8	19.4	39.5	-3.3	12.9	33.0	3.2	30.1	6.1
05-13	0.61 m	64.3	17.8	26.5	46.5	23.3	41.1	-14.6	15.5	33.3	-6.8	27.8	-1.3
05-14	6.71 m	33.3	15.2	22.8	18.1	9.1	24.3	-1.5	6.0	21.2	1.6	25.2	-2.4
05-16	2.13 m	44.1	18.5	38.2	25.6	12.8	31.3	6.9	8.5	27.0	11.2	28.5	9.7

Notes:
- City specifications state that when the plasticity index criteria for maximum moisture content exceeds 10 percent over the plastic limit, the plastic limit plus 10 percent shall govern. Also, the top 1.5 metres in conventional trenching has a maximum moisture content of PI + 8 or the formula, whichever is less.
- All values are percentages.
- Bold values of PL+10 are governing criteria.
- Chart shows only the samples which were tested for Atterberg Limits. See testhole logs for all moisture content data. .

8. Trench compaction requirements of City of Edmonton are 100 percent of the corresponding One-Point density above 1.5 m depth below subgrade and 97 percent of the corresponding One-Point below this level. The maximum lift thickness is 300 millimetres. This degree of compaction should be achievable after a moderate amount of drying of the moister lacustrine clay subsoils. The lacustrine clay soils encountered throughout this area have a high swelling potential. It is essential that backfill soils not be allowed to dry excessively when exposed and moisture contents are kept a minimum of 1% above optimum. Careful control of moisture contents is recommended during construction in order to prevent swelling.
9. Aggressive drying of the trench backfill may be performed in order to improve road subgrade conditions. The top 1.5 metres of the trench backfill under roads may be dried to a

maximum of 5 percent over the plastic limit to attain a stronger subgrade. This site would benefit from aggressive drying due to the very moist soils encountered in the testholes.

10. In order to assure a uniform and adequate degree of trench compaction, it is imperative that all of the high plastic clay material be adequately broken down prior to recompaction. Large lumps of this material are difficult to effectively compact.

11. It should be noted that the ultimate performance of the trench backfill is directly related to the consistency and uniformity of the backfill compaction, as well as the underground contractors construction procedures. In order to achieve this uniformity, the lift thickness and compaction criteria should be strictly enforced.

8.5 Surface Utilities

1. The subsurface soil conditions encountered throughout this site are considered generally poor to fair for the construction of roads, curbs, and sidewalks in undisturbed areas. Poorer conditions may be experienced due to mixing of materials during trench backfilling. Increased subgrade measures will likely be required in most trenched areas of the site. The amount of drying performed during trench backfill compaction will directly affect the subgrade performance during roadway construction. The existing topsoil, and other deleterious materials should be removed prior to construction of roads, sidewalks and other surface utilities. The clay fill encountered in Testholes 05-1, 05-2, 05-3, and 05-4 generally contained moderate to high organic content and is not considered acceptable for use as road subgrade. However, it is recommended that during construction, the existing fill be monitored during removal to further evaluate its organic content and determine its suitability for road and sidewalk support.

2. The main concern for surface utility construction at this site is the elevated moisture content of the clay and silt materials encountered in the testholes, which were as much as 20 percent above the plastic limit for these materials. The near surface clay materials were slightly above to above optimum moisture content, but became very moist to wet with depth, mixing and disturbance during underground utility installation will degrade the soil conditions. Extra subgrade work beyond standard scarification and re-compaction will be required in order to construct an adequate working platform for the pavement structure placement and long term support. It is noted that the degree of trench backfill drying during underground

utility installation affects the soil conditions for road and sidewalk construction, with increased drying improving the soil conditions.

3. Where fill is to be placed, the fill material should be compacted to a minimum 98 percent of Standard Proctor Density. All fill should be placed in maximum compacted lift thickness of 150 millimetres.

4. Typical subgrade preparation consists of scarifying 150 millimetres of material, and recompacting to 100 percent of Standard Proctor Density near optimum moisture content. However, most of the underlying clay encountered in the testholes was high or medium to high plastic and is susceptible to swelling. Experience shows that the use of cement stabilization for subgrade preparation helps to reduce the risk of swelling and should be utilized at this site. As a minimum, 10 kg/m^2 of cement over a 150 millimetre depth is considered adequate to minimize the risk of future swelling. The subgrade should be proof rolled after final compaction and any areas showing visible deflections should be inspected and repaired.

5. Care must be taken not to allow any excess moisture into these soils. Early curb backfill should be considered.

6. At the time of drilling, the moisture content was slightly above to above optimum in the near surface clays with very moist or wet materials typically noted at depths of approximately 1.5 to 2.0 metres below existing ground surface in the testholes. In areas where final subgrade elevation will be near these very moist materials, some extra subgrade work will likely be required beyond the above mentioned subgrade preparation. Depending on the final grade, deeper cement stabilization (25 to 30 kilograms per square metre of subgrade mixed to a depth of 300 millimetres) or extensive drying could be considered. It should be noted that the degree of cement stabilization is dependant on the time of year, weather conditions, and quality of construction; therefore exact cement contents should be determined in the field during construction.

Where very moist soils are encountered at or near final grade, and in some underground utility areas, other alternative measures may have to be considered. These alternatives may include replacing the very moist materials with a drier clay material to obtain a more stable and stronger subgrade. An estimated 1.5 metres of material would be required to bridge the in-situ soft clay soils. The imported fill should be placed in

maximum 150 millimetre lifts and be compacted to a minimum of 98 percent of Standard Proctor Density. Any imported clay should be approved by our firm.

A second alternative would be uniform trench backfill sufficiently dried and compacted to 98 percent of Standard Proctor Density for the top 1.5 metres of backfill. The strict use of clay for this top 1.5 metres is recommended.

Another option would be the use of a pit-run gravel subbase. The estimated thickness of subbase to support the roadway is 600 to 900 millimetres. A medium duty woven geotextile should initially be placed below the gravel for separation and reinforcement. The placement of a wic drain at the bottom of the subbase is recommended. The need for a pit-run subbase may be moderate at this site, with poorly dried trenched areas likely requiring this subbase.

7. The near surface site clays are of moderate to low frost susceptibility. The lower very silty clays, and silts are of high frost susceptibility. A high watertable within approximately 3.0 metres of the road surface is required for significant frost heaving to occur. The closer the watertable is to the surface, the higher is the frost heave potential. Watertables in most of the testholes have stabilized near or above this level and therefore frost heaving is a concern. Subgrade elevation should be set as high as possible and attempts should be made to lower the watertable. This can be achieved by tying in the storm pipe bedding to the storm manholes during underground utility construction. The minimum storm pipe depth should be 3.0 metres for this purpose. Roads without storm pipes will require a sub-drain for this watertable lowering method. It is recommended that the on-site clays be used in the top 1.5 metres of the road subgrade or trench backfill to reduce the frost heave effects. This will require careful separation during underground utility installation. Rigid insulation is another option to control frost heave, however this is typically expensive.

8. It is recommended that the subgrade be inspected by qualified personnel during construction to determine the recommended subgrade treatment.

9. It is recommended that all areas beyond the back of curb/sidewalk be landscaped as soon as possible to avoid water permeating into the subgrade from free standing puddles. The clay soils encountered throughout this area exhibit a high swelling potential. It is important that

subgrade soils not be allowed to dry excessively when exposed, and moisture contents are kept slightly over optimum.

10. Surface water will often collect within the granular base, causing subgrade softening and pavement damage. Therefore, it is recommended that wic drains to be installed in the gravel road base. The wic drain should be placed at the centre of the roadway for inverse crowns, and at both curb bottom locations for normal crowns. The wic drains must be properly attached to the catch basins.

11. The following 2 year staged pavement design may be applied to the proposed residential roadways. An assumed California Bearing Ratio of 3.0 percent was used in the design as well as a design life of 20 years. It should be noted that a C.B.R. of 3.0 percent may be difficult to achieve in the soil conditions encountered and may require additional subgrade preparation treatment as mentioned earlier. The ESAL estimates were taken from the City of Edmonton 'Guidelines for the Design of Roadway Structures in the City of Edmonton'.

Recommended Staged Roadway Structure
Proposed Oxford Subdivision

	Local Residential	Minor Collector No Buses	Major Collector (1 Bus)
Design ESALs	3.6×10^4	1.8×10^5	3.6×10^5
STAGE 1			
Asphaltic Concrete	65 mm (ACR)	75 mm (ACO)	85 mm (ACO)
Granular Base (20 mm Crush)	300 mm	350 mm	450 mm
Minimum Cement Stabilized Subgrade	150 mm	150 mm	150 mm

Note: Pit-run subbase of 600 to 900 mm with geotextile may be required in cut or inadequately dried trenched areas. Cement stabilization of the subgrade would not be required when utilizing a granular subbase with geotextile liner.

STAGE 2

35 millimetres of Asphaltic Concrete Overlay (ACO) compacted to 98% at FAC.

Note: -Gravel should be compacted to 100% of SPD in maximum 150 millimetre lifts.
ACR = City of Edmonton Designation Asphaltic Concrete Residential
ACO = City of Edmonton Designation Asphaltic Concrete Overlay

8.6 Storm Water Management Ponds

1. It is understood that a stormwater management pond will be located within the east portion of site containing surficial fill. It is unknown if any other stormwater management ponds are proposed. Subsurface soils encountered in Testhole 05-3 located near the proposed pond, comprised of medium and high plastic clays, which should yield sufficiently low permeability characteristics for water retention purposes. Ponds situated within the clays or silts should not require a liner.

2. The clays encountered in Testhole 05-3 were generally moist near the surface and became very moist to wet with depth. Excavation of the lower very moist to wet clay soils will likely require the use of a track mounted hoe. Excavation of the upper moist clay soils may be possible by scrapers. For the upper 2.0 metres of clay and from the

high water level to the normal water level, a maximum slope of 4H:1V is recommended for stability purposes. Below the normal water level or 2.0 metres depth in the clay, a slope of 7H:1V is recommended. Stabilized water level measurements in Testhole 05-3 indicate a groundwater level approximately 1.7 metres below the ground surface. Excavation and grading below this level will likely experience some ingressing groundwater, and may be more difficult.

3. Dry pond construction below the watertable may produce constant water seepage into the outlets, and a soft, saturated pond bottom. Therefore, a dry pond would require specialized design and construction measures near or below the above noted watertable levels and locations. Our firm should review any dry pond designs below the watertable prior to finalizing.

4. All containment areas of a dry pond and the above waterline portion of wet ponds should be protected to minimize erosion. The sideslopes of wet ponds should be protected from wave and ice erosion near the waterline.

5. No sand layers were noted within the clay soils encountered in the testholes. If large sand layers or pockets are encountered during pond construction, they may need to be excavated and/or plugged with clay. Our firm should be called to inspect such layers if encountered during construction.

6. The clay and silt materials being excavated from the stormwater ponds are suitable for engineered lot fill, although substantial drying of the lower very moist clay and silt soils will be required to achieve engineered fill compaction criteria. The clay is suitable for road fill; however the silt material is not due to its high frost susceptibility.

8.7 Cement

Tests on selected soil samples indicated mild to severe concentrations of water soluble soil sulphates in the near surface clay deposits. The following alternatives are advised. All concrete should conform to CSA Guideline A23.1-04.

1. Underground Concrete Pipe

Concrete used for all underground pipes must be constructed of C.S.A. Type 50, sulphate resistant Portland cement.

2. Curbs and Sidewalks

All concrete for surface improvements such as sidewalks and curbs may be constructed using CSA Type 10, normal Portland cement.

3. Foundation Construction

All concrete used for residential construction and coming into direct contact with the soil should be made with CSA Type 50, sulphate-resistant Portland cement. A minimum 56 day compressive strength of 35 megapascals is recommended for the foundation concrete. In addition, all concrete subject to freeze thaw conditions must be air entrained with 5 to 7 percent air. Individual locations may show higher or lower concentrations of soluble soil sulphates and thus additional soil testing on particular sites may prove valuable.

9.0 CLOSURE

This report has been prepared for the exclusive and confidential use of City of Edmonton, Scheffer Andrew Ltd., and their authorized agents. Use of this report is limited to the subject property only. The recommendations given are based on the subsurface soil conditions encountered during test boring, current construction techniques and generally accepted engineering practices. No other warranty, expressed or implied, is made. Due to geological randomness of many soils formations, no interpolation of soil conditions between or away from the testholes has been made or implied. Soil conditions are known only at the test boring location. Should other soils be encountered during construction or other information pertinent becomes available, the undersigned should be contacted as the recommendations may be altered or modified.

We trust this information is satisfactory. If you should have any questions or comments, please do not hesitate to contact our office.

Respectfully Submitted:
J.R. Paine & Associates Ltd.

Chris Coslovich, E.I.T.

Reviewed by,

PROFESSIONAL ENGINEER
RICHARD A. EVANS
ALBERTA

Apr. 23/05

Rick Evans, P. Eng.

PERMIT TO PRACTICE
JR PAINE & ASSOCIATES LTD.
Signature R. Stefaniw
Date April 25/05
PERMIT NUMBER: P 0401
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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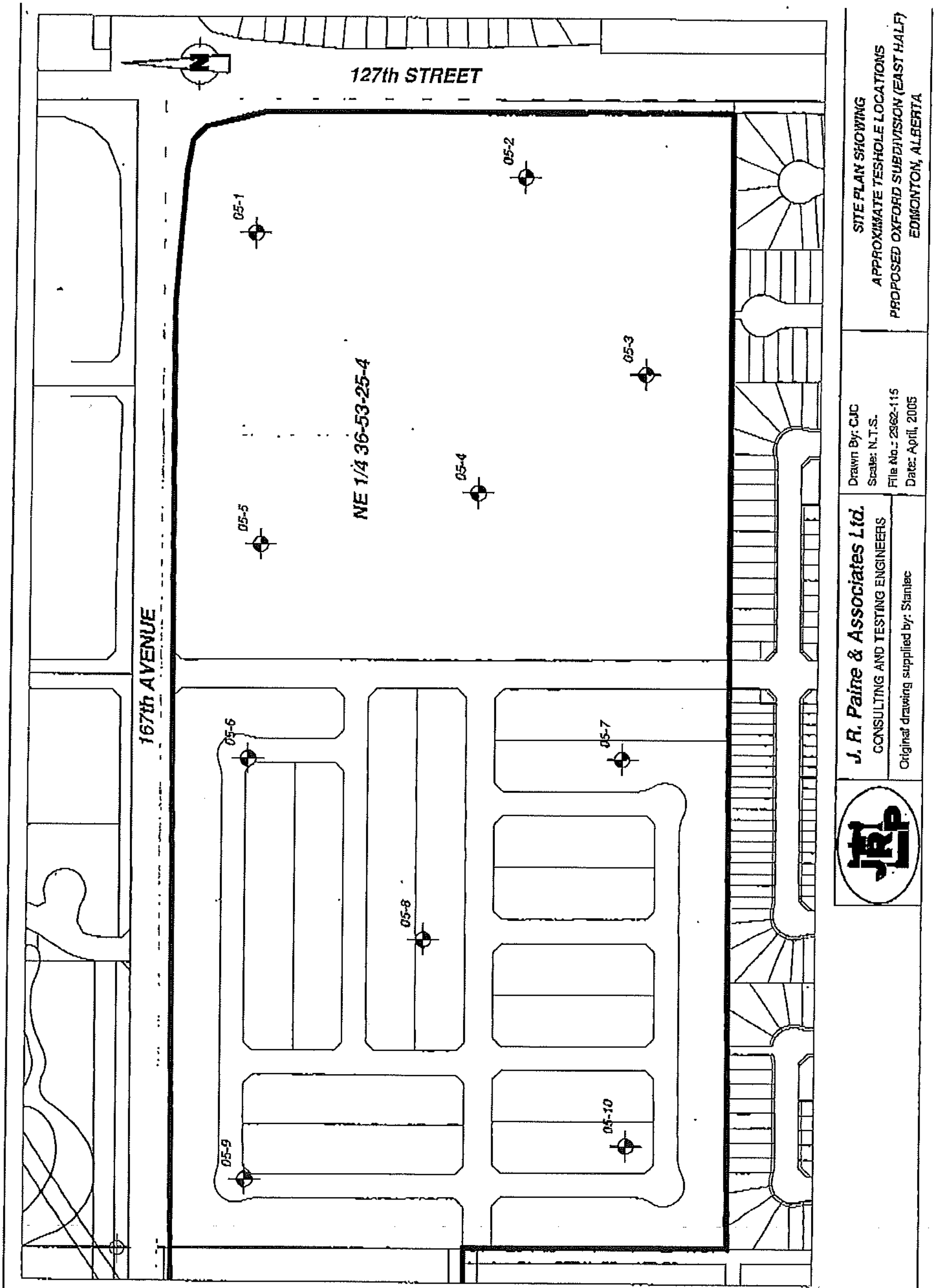
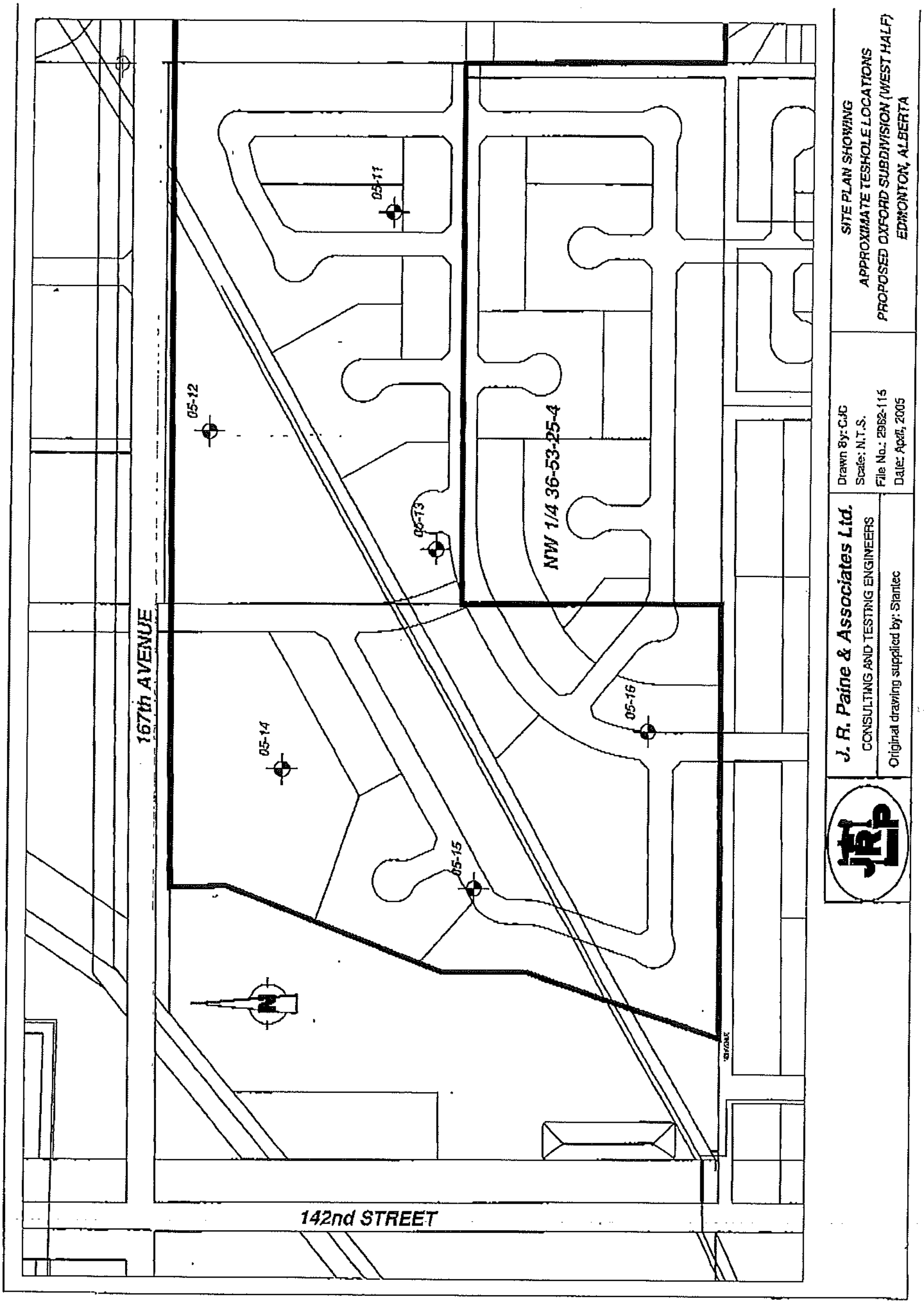
APPENDIX A


127th STREET
167th AVENUE
NE 1/4 36-53-25-4
05-1
05-2
05-3
05-4
05-5
05-6
05-7
05-8
05-9
05-10
SITE PLAN SHOWING
APPROXIMATE TESHOLE LOCATIONS
PROPOSED OXFORD SUBDIVISION (EAST HALF)
EDMONTON, ALBERTA
Drawn By: CJC
Scale: N.T.S.
File No.: 2362-115
Date: April, 2005
J. R. Paine & Associates Ltd.
CONSULTING AND TESTING ENGINEERS
Original drawing supplied by: Stantec



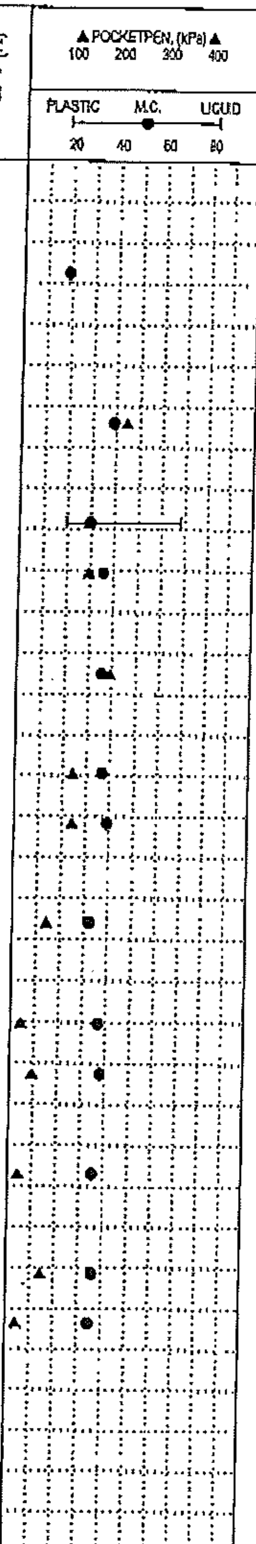
SITE PLAN SHOWING
APPROXIMATE TESHOLE LOCATIONS
PROPOSED OXFORD SUBDIVISION (WEST HALF)
EDMONTON, ALBERTA
Drawn By: CJC
Scale: N.T.S.
File No.: 2962-115
Date: April, 2005
J. R. Paine & Associates Ltd.
CONSULTING AND TESTING ENGINEERS
Original drawing supplied by: Stantec
167th AVENUE
142nd STREET
NW 1/4 36-53-25-4
05-11
05-12
05-13
05-14
05-15
05-16
N

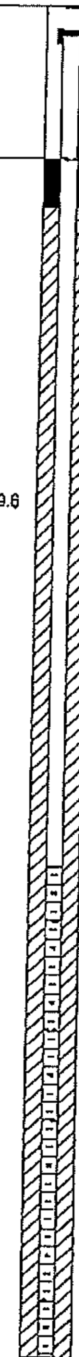
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-1
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 81.99 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE; CORE SAMPLE; SPT SAMPLE; GRAB SAMPLE; NO RECOVERY

BACKFILL TYPE: BENTONITE; PEA GRAVEL; SLOUGH; GROUT; DRILL CUTTINGS; SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA	Elevation (m)
0	FILL	**CLAY FILL:** silty, moist, stiff, high plastic, dark brown/black, moderate to high organic content, gravelly near surface			
1		- below 1.2m: high to severe organic content			81
1.7 m	OR	**ORGANIC CLAY:** very moist, black			
2.0 m	CH	**CLAY:** silty, very moist, stiff, high plastic, grey & brown, trace sand & oxides - at 2.3m: trace free water in SPT		L.L. = 68.0 P.L. = 19.6 M.C. = 29.6 Soluble Sulphates: Severe	80
2.61 (water level)			10		79.38 (water level)
3		- below 3.3m: very silty, moister, medium to high plastic			79
4			5		78
5		- below 5.2m: grey, very moist to wet, soft, sensitive	4		77
6					76
7			6		75
7.3		**End of Testhole @ 7.3 m.** Testhole backfilled with cuttings and a bentonite seal. No water at completion of drilling. No slough at completion of drilling. Slotted standpipe installed to 7.3 m. 14 day waterlevel reading: 2.67 m bgs. 25 day waterlevel reading: 2.61 m bgs.			
8					74
8.5					





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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 2	Page 1 of 1

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-2
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.06 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)
0 – 2.6 m	FILL	CLAY FILL: silty, moist, very stiff, high plastic, dark brown/black, high organic content - between 1.7 to 2.0m: damp, trace organics & roots - below 2.0m: moderate organic content - between 2.3 to 2.6m: sandy	10
2.6 m – 3.1 m	OR	ORGANIC CLAY: very moist, black	
3.1 m – 7.3 m	CH	CLAY: silty, very moist, stiff, high plastic, grey with brown, trace oxides - below 4.0m: dark brown - below 4.9m: very silty, medium to high plastic - below 5.2m: grey, soft	11 5 6

Water level: 4.02 (depth, m); 78.04 (elevation, m)

Column headings: Depth (m); USC; SOIL SYMBOL; SOIL DESCRIPTION; SAMPLE TYPE; SPT (N); ▲POCKETPEN. (kPa)▲ 100 200 300 400; PLASTIC M.C. LIQUID 20 40 60 80; OTHER DATA; Elevation (m)

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
No water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 4.17 m bgs.
25 day waterlevel reading: 4.02 m bgs.

JRP OXFORD.GPJ JRP CHRIS.GDT 4/8/05

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	REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
	Fig. No: 3	Page 1 of 1

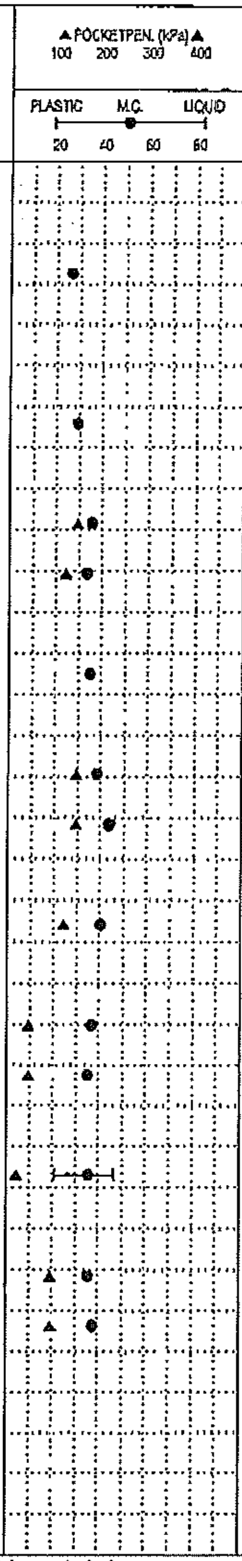
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-3
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 81.7 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	FILL	CLAY FILL: silty, moist, very stiff, high plastic, dark brown/black, high organic content - below 0.9m: high organic content - between 2.1 to 2.6m: sandy		
2.6 m	OR	ORGANIC CLAY: very moist, black	10	
3.7 m	CH	CLAY: silty, very moist, stiff, high plastic, grey with brown - below 4.3m: greyish brown - below 5.2m: grey, very silty, soft, medium to high plastic - below 6.6m: stiff, less silty	8 7 6	L.L. = 46.4 P.L. = 20.8 M.C. = 35.6 Soluble Sulphates: Considerable

Water level: 1.71 (Elevation 79.99)



Elevation (m): 81, 80, 79, 78, 77, 76, 75, 74

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
No water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 1.80 m bgs.
25 day waterlevel reading: 1.71 m bgs.

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 4	Page 1 of 1

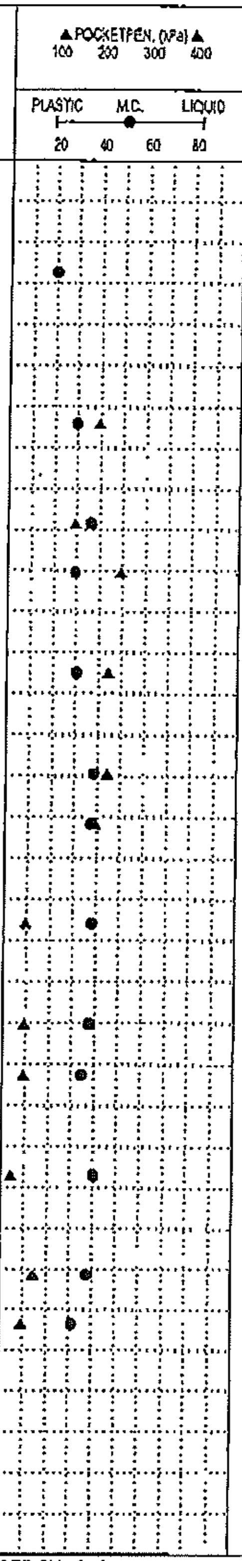
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-4
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 81.59 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)
0	FILL	CLAY FILL: silty, moist, stiff, high plastic, brown, high organic content	
		- between 0.9 to 1.2m: peat	
		- below 1.2m: trace organics, brown and grey	
2.3 m	OR	ORGANIC CLAY: very moist, black	9
2.7 m	CH	CLAY: silty, moist to very moist ,stiff, high plastic, greyish brown	
		- below 3.6m: brown, very moist, oxides	9
		- below 4.3m: very silty, soft, medium to high plastic	
		- below 4.6m: grey	4
			5

Water level: 1.67 (Elevation 79.92)



OTHER DATA

Elevation (m): 81, 80, 79, 78, 77, 76, 75, 74

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
No water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 1.75 m bgs.
25 day waterlevel reading: 1.67 m bgs.

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 5	Page 1 of 1

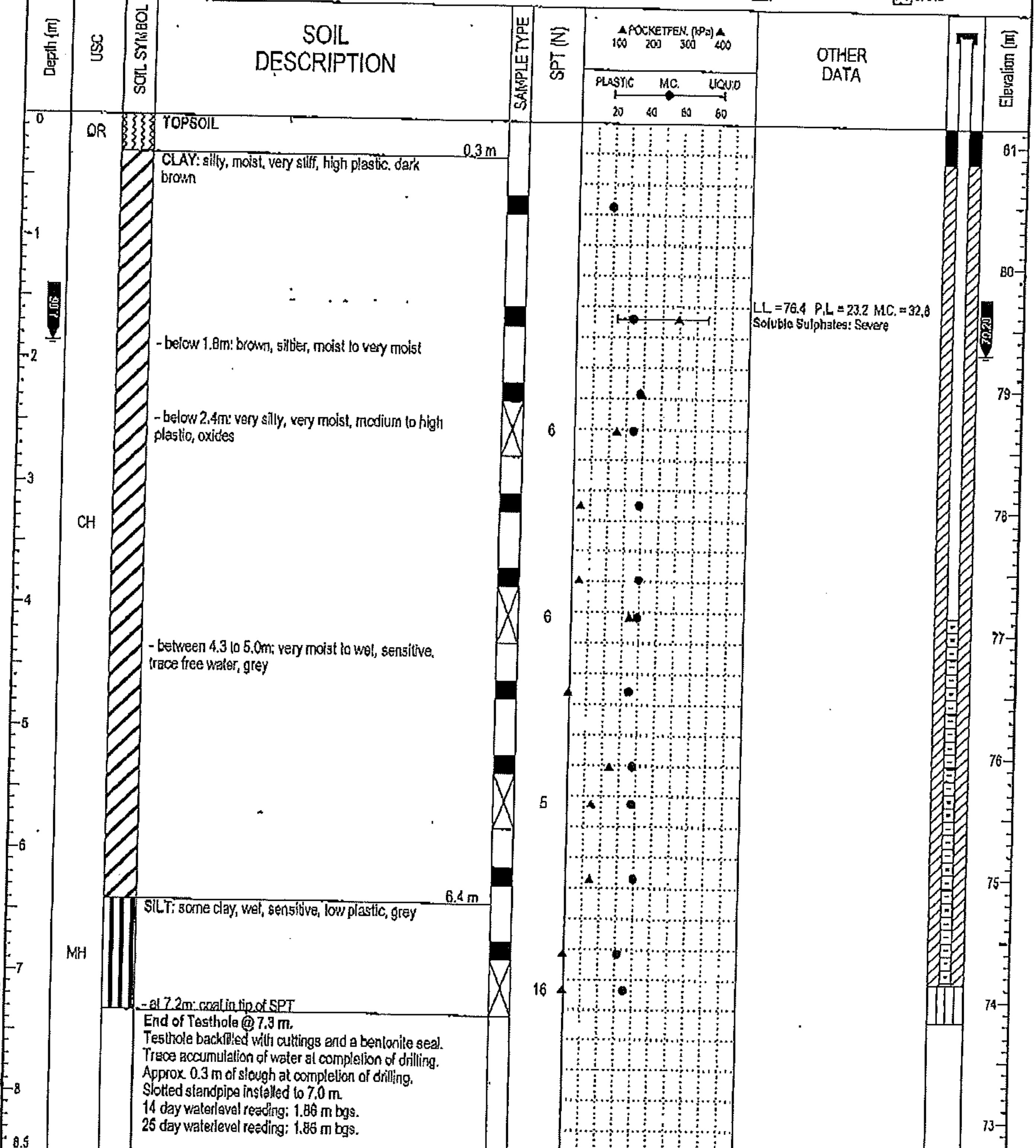
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-5
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 81.15 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	TOPSOIL		
0.3 m	CH	CLAY: silty, moist, very stiff, high plastic, dark brown		
				LL = 76.4 PL = 23.2 M.C. = 32.8 Soluble Sulphates: Severe
		- below 1.8m: brown, siltier, moist to very moist		
		- below 2.4m: very silty, very moist, medium to high plastic, oxides	6	
			6	
		- between 4.3 to 5.0m: very moist to wet, sensitive, trace free water, grey		
			5	
6.4 m	MH	SILT: some clay, wet, sensitive, low plastic, grey		
		- at 7.2m: coal in tip of SPT	16	

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Trace accumulation of water at completion of drilling.
Approx. 0.3 m of slough at completion of drilling.
Slotted standpipe installed to 7.0 m.
14 day waterlevel reading: 1.86 m bgs.
25 day waterlevel reading: 1.86 m bgs.



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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 6	Page 1 of 1

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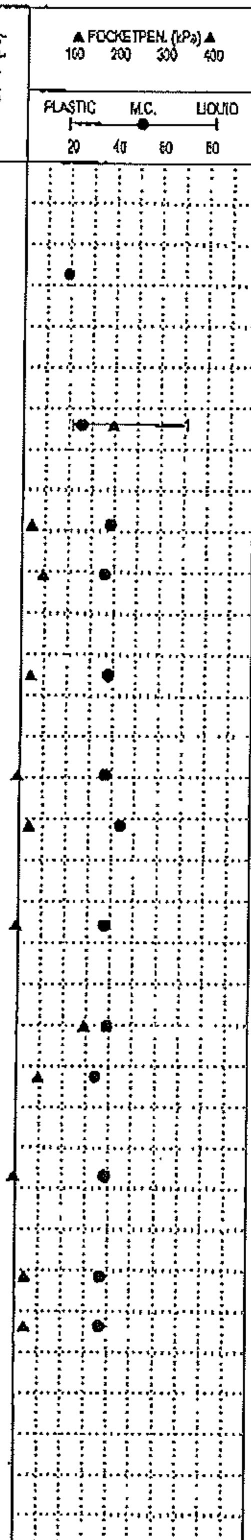
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-6
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.12 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	TOPSOIL		
0.4 m	CH	CLAY: silty, moist, very stiff, high plastic, dark brown		
				L.L. = 71.1 P.L. = 21.8 M.C. = 25.7 Soluble Sulphates: Severe
		- below 1.8m: brown, very silty, very moist to wet, soft, trace sand	6	
		- below 2.7m: sensitive, trace free water		
			4	
4.3 m	MH	SILT: clayey, wet, soft, sensitive, low to medium plastic, brown	7	
			8	

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Trace accumulation of water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 2.54 m bgs.
25 day waterlevel reading: 2.52 m bgs.



Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 8.5
Elevation (m): 82, 81, 80, 79, 78, 77, 76, 75, 74
Water level: 2.52 m depth (elevation 79.6)

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 7	Page 1 of 1

JRP OXFORD.GPJ JRP CHRIS.GDT 4/8/05

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-7
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 81.66 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)
0	OR	TOPSOIL	
0.2 m	CH	CLAY: silty, moist, very stiff, high plastic, dark brown	
~2.6			6
2.7		- below 2.7m: very silty, very moist, firm to soft, medium to high plastic, occasional clayey silt zones	
3.8		- at 3.8m: trace free water	
~4.1			4
5.3		- below 5.3m: less silty, stiffer, greyish brown	
~5.6			7
6.9		- below 6.9m: grey	
~7.1			8

Groundwater level: 2.23 (depth) / 79.43 (elevation)

POCKETPEN. (kPa): 100, 200, 300, 400
PLASTIC, M.C., LIQUID: 20, 40, 60, 80

OTHER DATA

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
No water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 2.12 m bgs.
25 day waterlevel reading: 2.23 m bgs.

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LOGGED BY: C. Costovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 8	Page 1 of 1

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-8
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.53 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	TOPSOIL (to 0.3 m)		
0.3	CH	CLAY: silty, moist to very moist, very stiff, high plastic, dark brown, trace sand, oxides		
		- below 1.8m: brown, very silty, stiff, medium to high plastic	7	
		- below 2.7m: very moist to wet, soft, sensitive, trace free water		LL = 41.9 P.L. = 18.9 M.C. = 37.3 Soluble Sulphates: Severe
3.8	MH	SILT: clayey, very moist to wet, soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones	5	
			9	
6.4	TILL	CLAY TILL: silty, sandy, moist, very stiff, medium plastic, grey, trace coal, oxides & pebbles	20	

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Trace accumulation of water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 3.68 m bgs.
25 day waterlevel reading: 3.66 m bgs.

Water level: 3.66 (Elevation 78.87)

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 9	Page 1 of 1

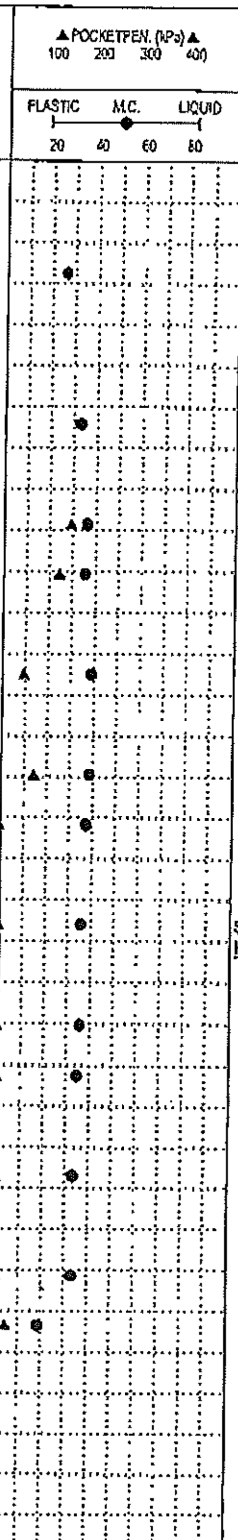
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-9
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.42 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	TOPSOIL (0.3 m)		
	CH	CLAY: silty, moist, very stiff, high plastic, dark brown, trace sand, oxides		
1		- below 0.9m: very moist		
2		- below 1.8m: brown, very silty, stiff, medium to high plastic, occasional silt zones	6	
3		- below 3.0m: very soft, trace free water, sensitive (3.8 m)		
4	MH	SILT: clayey, very moist to wet, very soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones	5	Soluble Sulphates: Mild; Hydrometer: Gravel: 0.0 %, Sand: 2.5 %, Silt: 71.3 %, Clay: 26.2 %
5		- below 4.9m: grey	4	
7		- at 7.2m: tip of SPT sandy	9	
7.3		End of Testhole @ 7.3 m. Testhole backfilled with cuttings and a bentonite seal. Small accumulation of water at completion of drilling. No slough at completion of drilling. Slotted standpipe installed to 7.3 m. 14 day waterlevel reading: 2.58 m bgs. 25 day waterlevel reading: 2.61 m bgs.		
8.5				

Water level: 2.61 (depth); 79.81 (elevation)



Elevation (m): 82, 81, 80, 79, 78, 77, 76, 75, 74

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 10	Page 1 of 1

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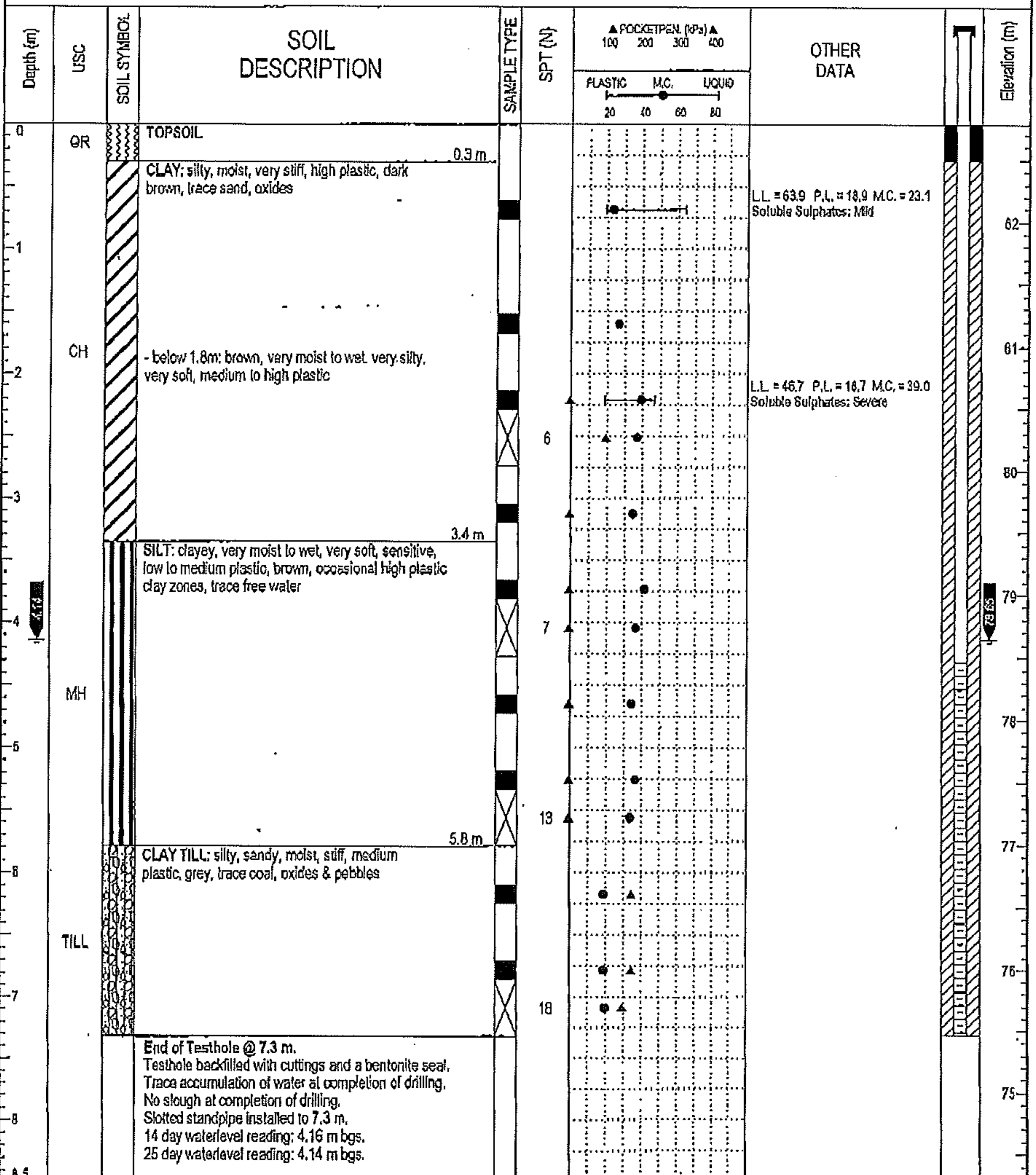
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-10
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.79 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND



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	REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
	Fig. No: 11	Page 1 of 1

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-11
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.4 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Columns: Depth (m) | USC | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SPT (N) | ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80 | OTHER DATA | Elevation (m)

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	**TOPSOIL**		
0.2 m	CH	**CLAY**: silty, moist, stiff, high plastic, brown, trace sand, oxides - below 0.9m: very moist, firm - below 1.8m: very silty, very soft, medium to high plastic		
2.3 m	MH	**SILT**: clayey, very moist to wet, very soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones - below 3.7m: trace free water - below 5.3m: grey - below 6.1m: less clay content	5 9 6	Soluble Sulphates: Severe Hydrometer Gravel: 0.6 % Sand: 3.6 % Silt: 74.6 % Clay: 21.2 %
7.0 m	TILL	**CLAY TILL**: silty, sandy, moist, stiff, medium plastic, grey, trace coal, oxides & pebbles	11	

Water level marker: 5.09 (depth) / 77.31 (elevation)

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Some accumulation of water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 5.24 m bgs.
25 day waterlevel reading: 5.09 m bgs.

Depth scale: 0 – 8.5 m; Elevation scale: 82 – 74 m

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 12	Page 1 of 1

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-12
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.43 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	OR	**TOPSOIL** (0.3 m)		
0.3	CH	**CLAY**: silty, moist to very moist, stiff, high plastic, brown, trace sand, oxides - below 1.2m: ingressing free water - below 1.8m: very silty, soft (2.3 m)		L.L. = 58.9 P.L. = 20.1 M.C. = 36.2 Soluble Sulphates: Severe
2.3	MH	**SILT**: clayey, wet, very soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones - below 4.6m: grey - below 5.2m: less clay content (7.0 m)	6, 4, 4	Soluble Sulphates: Severe Hydrometer Gravel: 0.0 % Sand: 3.7 % Silt: 67.9 % Clay: 28.3 %
7.0	TILL	**CLAY TILL**: silty, sandy, moist, stiff, medium plastic, grey, trace coal, oxides & pebbles	15	

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Some accumulation of water at completion of drilling.
Approx. 0.6 m of slough at completion of drilling.
Slotted standpipe installed to 6.7 m.
14 day waterlevel reading: 2.57 m bgs.
25 day waterlevel reading: 2.43 m bgs.

POCKET PEN. (kPa): 100 200 300 400
PLASTIC M.C. LIQUID: 20 40 60 80

Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 8.5
Elevation (m): 82, 81, 80, 79, 78, 77, 76, 75, 74

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 13	Page 1 of 1

PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-13
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 82.26 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0 – 0.4 m	OR	TOPSOIL		
0.4 – 2.7 m	CH	CLAY: silty, moist, very stiff, high plastic, brown, trace sand, oxides - below 1.8m: very silty, very moist, stiff	6	L.L. = 64.3 P.L. = 17.8 M.C. = 26.6 Soluble Sulphates: Considerable
2.7 – 7.0 m	MH	SILT: clayey, very moist to wet, very soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones - below 3.0m: trace free water - below 4.3m: grey, less clay content	6 4	
7.0 – 7.3 m	TILL	CLAY TILL: silty, sandy, moist, very stiff, medium plastic, grey, trace coal, oxides & pebbles	52	

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Trace accumulation of water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 2.19 m bgs.
26 day waterlevel reading: 2.00 m bgs.

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LOGGED BY: C. Coslovich	COMPLETION DEPTH: 7.32 m
REVIEWED BY: R. Evans	COMPLETION DATE: 3/14/05
Fig. No: 14	Page 1 of 1

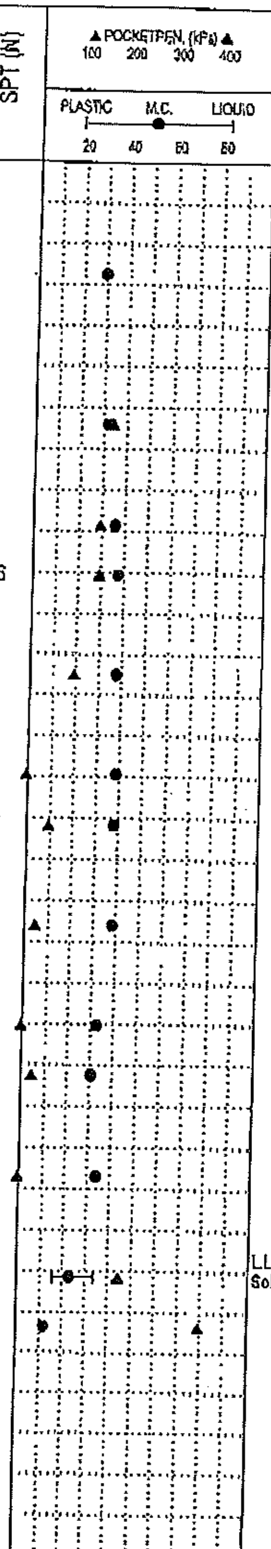
PROJECT: Proposed Oxford Neighbourhood	PROJECT NO: 2692-115	BOREHOLE NO: 05-14
CLIENT: Scheffer Andrew	DRILL METHOD: Solid Stem Auger	ELEVATION: 83.05 m
OWNER: City of Edmonton	LOCATION: As per attached site plan	

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0 – 0.4 m	OR	TOPSOIL		
0.4 – 3.4 m	CH	CLAY: silty, moist to very moist, stiff, high plastic, brown, trace sand, oxides - below 1.8m: very silty, very moist	6	
3.4 – 6.4 m	MH	SILT: clayey, very moist to wet, very soft, sensitive, low to medium plastic, brown, occasional high plastic clay zones, trace free water - below 4.9m: less clay content	7 7	
6.4 – 7.3 m	TILL	CLAY TILL: silty, sandy, moist, very stiff, medium plastic, grey, trace coal, oxides & pebbles	29	L.L. = 33.3 P.L. = 15.2 M.C. = 22.8 Soluble Sulphates: Severe

End of Testhole @ 7.3 m.
Testhole backfilled with cuttings and a bentonite seal.
Trace accumulation of water at completion of drilling.
No slough at completion of drilling.
Slotted standpipe installed to 7.3 m.
14 day waterlevel reading: 4.76 m bgs.
25 day waterlevel reading: 4.69 m bgs.



Depth (m): 0 – 8.5; Elevation (m): 83 – 75; water level markers 4.69 / 78.36

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Fig. No: 15	Page 1 of 1

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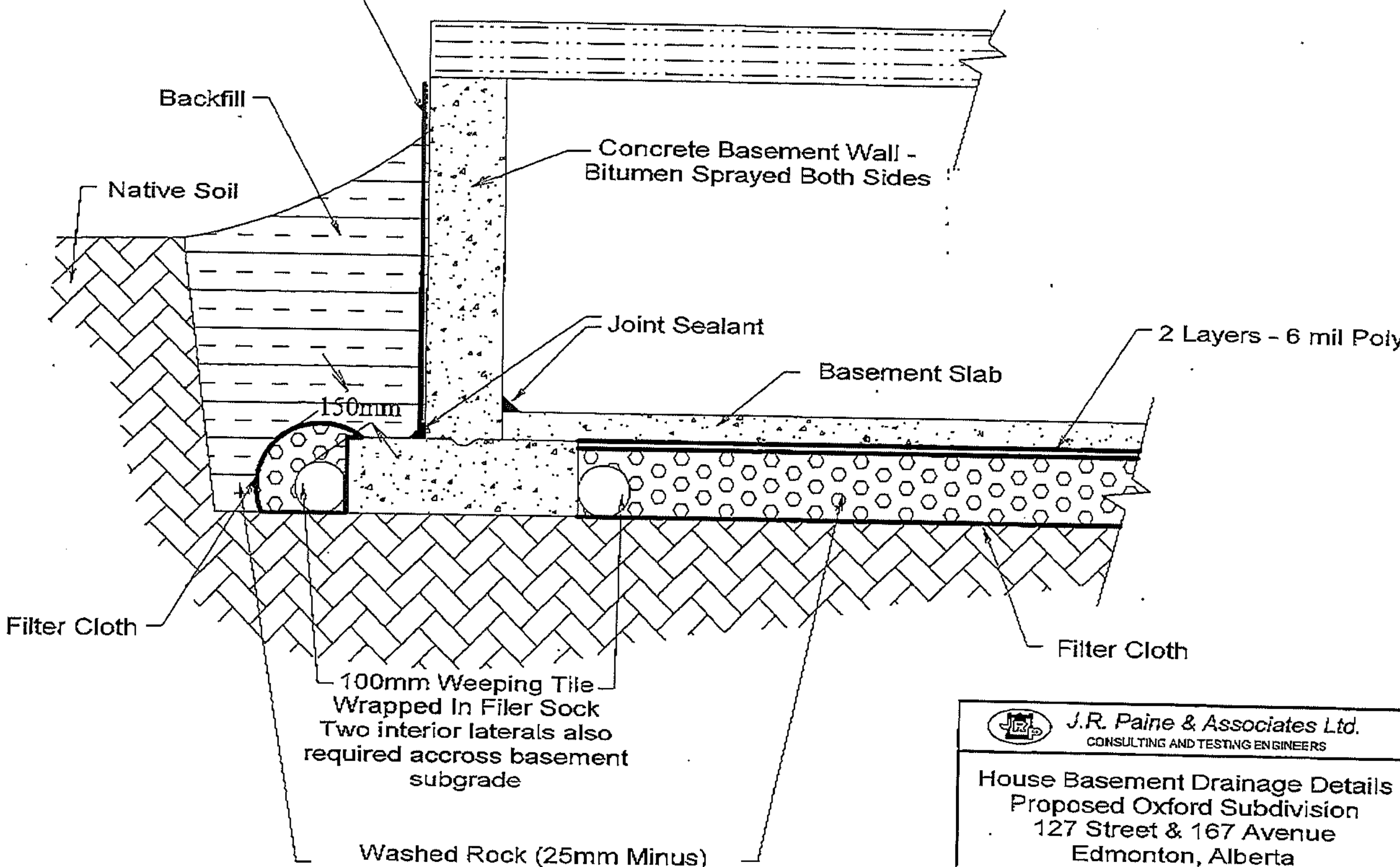
APPENDIX B

Notes: Place all weeping tile level with no bumps or sags.
Install floor drain adjacent to sumps.
Connect sump to foundation drain service.



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House Basement Drainage Details
Proposed Oxford Subdivision
127 Street & 167 Avenue
Edmonton, Alberta

SCALE: NTS	DATE: April, 2005
DRAWN BY: CC	FILE #: 2962-115