AREA STRUCTURE PLAN AMENDMENT

PROPOSED PRO-PIPE HOLDINGS INDUSTRIAL DEVELOPMENT

(Previously identified as “Millet Industrial Park”)

Part of NE ¼ Sec 32-47-24 W4

Prepared For

PRO-PIPE HOLDINGS LTD.

Prepared By
V3 COMPANIES OF CANADA LTD

Based on original work by
A.D. WILLIAMS ENGINEERING INC.

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1.0 INTRODUCTION

1.1 PURPOSE

This Area Structure Plan Amendment provides a framework for the immediate development of a portion of the lands located at part of NE ¼ Sec 32-47-24 W4. The Plan Area is located west of Range Road 244, and north of 53rd. Avenue. The site's proximity to the Town of Millet gives it considerable potential for industrial expansion, though none is currently planned. Interest for development in the study area suggests that industrial and commercial uses are the highest and best use of these lands. The primary purpose of this Area Structure Plan Amendment is to identify an area to be immediately developed, with a plausible scenario that could be pursued in the future. One of the goals is to determine an appropriate mixture of improvements that is not financially burdensome to the currently proposed single-site development, but one which meets parameters within the County of Wetaskiwin Municipal Development Plan. The Area Structure Plan Amendment also considers how development will affect the surrounding lands, infrastructure, and also endeavors to provide an indication of what may be proposed, should the land owner want to subdivide the property into individual lots in the future.

1.2 REGIONAL CONTEXT

The proposed Pro-Pipe Holdings Ltd development, in regional context is shown on **Figure 1**. Specifically, the plan area is bounded by Township Road 475A to the south, Range Road 244 to the east, SE ¼ Section 5 – 48 – 24 W4 to the north, and the CP rail line and Highway 2A to the west. The predominant land use of the surrounding lands to the north and east is agricultural. There is a residential development on the south side of Township Road 475A.

1.3 POLICY CONTEXT

The Council of the County of Wetaskiwin No. 10 requires that an Area Structure Plan be completed for any proposed subdivision that will create three or more parcels. The original conception of the property's use was such that the original Millet Industrial Park subdivision fell within this requirement and resulted in an approved Area Structure Plan in June of 2009. This resulted in the approval of a fairly intense density of 32 industrial lots, ranging in size from 1.91 to 4.67 acres. However, although the current proposal would not ordinarily require an Area Structure Plan, the existing approval must be addressed. As such, this Area Structure Plan Amendment has been prepared as per the County of Wetaskiwin's Area Structure Plan Policy / Requirements.

In order to cater to reasonable land use patterns that are envisioned as economically viable for the area, the layout in **Figure 5** has been formulated as a mix of lot sizes that have been sought by interested parties. The layout is comprised of a relatively low density option but provides for a variety of lot sizes, ranging from approximately 5 acres to just under 22 acres. The current proposal for a single-site development by the proponent would occupy lot 8 in this future development scenario.

The proposed amendment of the Millet Industrial Park Area Structure Plan by Pro-Pipe Holdings Ltd., meets the requirements of Section 633 of the Municipal Government Act, which describes, at a broad level of planning, the proposed sequence of development, land uses, overall density, and infrastructure requirements within the plan area.

1.4 PROCESS

The plan preparation process began by gathering, reviewing and analyzing all relevant information pertaining to future development options within, and around, the plan area. Secondly, a number of studies to support the ASP were conducted, including a Stormwater Management Study, a Traffic Impact Assessment, and Geotechnical Study.

2.0 EXISTING CONDITIONS

The boundary of the proposed Pro-Pipe Holdings development is defined by portion of NE ¼ Sec 32-47-24 W4. The development site contains approximately 40.5 hectares (100 acres) but only approximately 35 acres is under consideration for development at this time, with up to two buildings being constructed on the parcel. Currently, the plan area is predominantly agricultural in nature (with industrial zoning). There is an acreage residence adjacent to the southern portion of the plan area. A farm yard and residence are also located directly east of the proposal on the adjacent quarter section. This section summarizes the existing conditions of the area that are significant for identifying an optimal future land use concept, and for formulating appropriate Area Structure Plan policies.

2.1 NATURAL FEATURES

The topography of the subject property generally has positive drainage to the southwest. The vast majority of the area has been cleared for agricultural purposes. There are several tree stands located in the west part of NE ¼ Sec 32-47-24 W4, in the vicinity of the rail line, as well as along the northern boundary of the property. Future development should be encouraged to provide opportunities for tree, shrubbery and foliage in their landscaping plans.

Existing topography and environmental features are shown on **Figure 2** and include:

- The majority of the site is pasture land sloping towards the southwest.

- There are poplar trees & bushes located in the west portion of NE ¼ Sec 32-47-24 W4. Grading of the area will most likely result in the removal of most of these trees. However, the benefits these tree stands currently offer can be mitigated through the construction of and planting of trees on the perimeter berm proposed as part of the project. See **Figures 5 and 6** for the proposed perimeter berm, to be located within the proposed MR.

Lower elevations in the south western portion of the property provide opportunities for integration into the local stormwater system. The Stormwater Management Plan, found in **Appendix A**, provides a detailed explanation of stormwater management requirements for the site. Generally, the Stormwater Management Plan identifies a requirement for approximately 20,600 cubic metres of storage. This storage facility will utilize approximately 4.16 hectares (10.27 acres) of area. The active storage area will be identified as a privately maintained stormwater management area. The location of the stormwater management facility is coincident with the existing low area of the site and is an area of limited visibility from adjacent properties. During wet times of the year water can temporarily collect in this location similarly to that which is proposed. However, this area will also be screened from view by the perimeter berm and the tree plantings along its top.

Stormwater management concepts for the ASP Amendment have not changed from the originally approved ASP. The project ownership acknowledges that the project may develop at some future date, though no suitors for such a concept are known at this time. However, if future development does occur, then disrupting stormwater management is not an attractive option to the project owner. Instead, the project proponent has decided to fully construct a facility that could serve a fully-subdivided/developed parcel.

2.2 EXISTING LAND USE

The predominant land use within the area is agriculture. The farming focuses largely on pastureland. The current use of the land is agriculturally used, but industrially zoned, which is shown on **Figure 3**.

2.3 EXISTING ZONING

The current use of the land is agricultural, although the current zoning of the plan area under the County of Wetaskiwin's Land Use Bylaw No. 95/54 is Industrial.

2.4 SOILS

The following text summarizes the relevant findings of the Geotechnical Investigation completed by Parkland Geotechnical Consulting Ltd., and found in **Appendix B** of the Area Structure Plan.

The soil profile consists of a layer of surficial topsoil underlying about 2-4 m of sandy, silty soil with inter-bedded clay layers and a few coal seams overlying bedrock. The sandy soil layer was mostly silty sand with some areas of sandy silt. The moisture content was between 9.7 and 28.6 percent. The bedrock encountered in all holes was grey weathered sandstone, and was found to be mostly between 3.4 and 5.0 metres below grade. The observed groundwater levels ranged from dry to 1.7 m below grade.

The subsurface conditions at the site are considered to be suitable for the proposed industrial development with stable silty sand in most areas of the site.

2.5 EXISITING TRANSPORTATION FEATURES

Figure 4 illustrates the major features of the plan area's surrounding transportation system. The system is comprised of two county roadways near the site and a highway and rail line adjacent to the site. These features are described as follows:

- Township Road 475A (53rd Avenue) is located south of the plan area and the acreage residence to the south. West of Range Road 244, this road is a two-lane paved road. East of Range Road 244, this road is a two-lane gravel roadway. Township Road 475A currently serves residents in the area as well as traffic accessing the Town of Millet and Highway 2A from the east. Township Road 475A is not proposed to be used for access to the subject lands nor indirect access to Highway 2A.
- A rail line and Highway 2A bounds the plan area to the west. Highway 2A is a paved two-lane primary highway. The Canadian Pacific Rail line sits between the plan area and Highway 2A. No direct access to Highway 2A is proposed.
- Range Road 244 bounds the plan area to the east. This two-lane gravel roadway currently serves residents in the area, as well as traffic accessing the Town of Millet and Highway 2A from the northeast. Subject to a Roadway Maintenance and Use Agreement as later described under the relevant Transportation Sections, this road will serve as primary access to the subject lands.
- Township Road 480, directly north of the site, is currently dedicated as a road allowance. Originally contemplated as the point of access for the previously approved ASP, this idea was abandoned when Canadian Pacific Rail indicated that they are no longer authorizing at-grade crossings for new roadways.

2.6 UTILITIES

2.6.1 Water and Sanitary Sewage

The Town of Millet, located southwest of the proposed subdivision location, has existing water and sewer lines. This privilege has proven financially detrimental for small-scale development. Correspondingly, the proposed development does not mandate large amounts of water, nor the large-scale sanitary sewer conveyance system that is required by large-scale development. Instead, the proposal indicates simplistic manufacturing and storage uses that can operate at a high level of efficiency with a water well and "pump-and-haul" sanitary sewer provisions.

It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.

In the proposed future subdivision (**Figure 5 & 6**) potable water and sanitary sewer services will be mandated by County of Wetaskiwin. It is mutually understood between County staff and the project proponent that the current single-site development would connect to these services when the parent parcel is subdivided any further (the addition of one or more lots).

2.6.2 Storm Water Management

Storm water within the plan area currently drains via overland flow as well as through the road ditches that surround the site. Stormwater management facilities, therefore, should be located to take advantage of natural low areas where possible.

The stormwater management facility is modeled to restrict outflows to the downstream system to those of the existing calculated discharges. As a result, the restricted flows, under normal circumstances, will not exceed those currently discharging from the property in a given storm event. Once flows leave the property they are conveyed under the rail lines in a western direction. Through a meandering surface system of ditches, for a distance of approximately 800 metres, storm flows from the property currently discharge to Pipestone Creek.

2.6.3 <u>Major Utility Facilities</u>

Power connection for the development will be provided through FORTIS. FORTIS has power lines in the area that serve the Town of Millet as well as rural residents.

2.7 PUBLIC INPUT

A public open house was held on Tuesday, January 20th, 2015 in the Hugo Witt Room of the Millet Agriplex, where members of the community had the opportunity to voice questions and concerns relating to the proposed development. Approximately 20 people attended the meeting. The questions raised at the open house are summarized below.

Question: What is the proposed alignment for water/sewer?
Response: During this initial phase, the proposed development will operate using a water well and "pump-and-haul" sanitary sewer provisions. Permanent infrastructure would be installed at a later date when the remaining lots are subdivided. The alignment for these services would be designed at that time.

Question: Is there a stormwater management pond to manage water?
Response: Yes, the southwest corner of the parcel has been designated as a 4.16ha stormwater management pond.

Question: Where would stormwater from the pond be released to?
Response: The pond would be released at a controlled rate to the west through the existing drainage channels that cross Highway 2A.

Question: Has Alberta Environment approved the stormwater management plan?
Response: The stormwater management plan has not been submitted to Alberta Environment yet, but would be submitted during the detailed design phase and prior to construction. The pond would be designed in accordance with the relevant Alberta Environment standards.

Question: Will the stormwater in the pond seep through into the ground?
Response: No, the pond would be designed and built to contain the stormwater until it discharges through the outlet and constructed to minimize for seepage into the ground.

Question: Is there a requirement to install a Stormceptor?

Response: Not for this stage of the development. The stormwater management pond has been anticipated to be a wet pond, which will function similarly and help settle out suspended solids in the stormwater. It is possible that some of the individual lots within the subdivision will require the installation of an oil/grit separator depending on their intended uses.

Question: At what stage would off-site levies be collected?

Response: Off-site levies would be collected when the remaining lots are subdivided.

Question: How would traffic get into the subdivision?

Response: Access from Highway 2A will be gained to Range Road 244 from Township Road 475/45th Avenue. The future subdivision will be accessed from a single industrial access from Range Road 244 via a fully constructed public roadway, built to County of Wetaskiwin standards.

Question: Will there be a second access to the subdivision via Township Road 475A?

Response: Township Road 475A is not proposed to be used for access to the subject lands nor indirect access to Highway 2A.

Question: What does Pro-Pipe do? Where is the current office located?

Response: Pro-Pipe is a pipe threading/casing operation with facilities currently located in Nisku, AB.

Question: Will the perimeter berm be built before buildings are constructed?

Response: The perimeter berm will be built during the grading of the site, in preparation for the building construction.

Question: Will light pollution be an issue?

Response: It is not expected that light pollution will be an issue. The proposed facility will not have any permanent yard lighting that will remain on outside of normal business hours. If lighting is ever required for brief periods in the evening hours, a temporary light will be set up and then turned off immediately following the completion of the work.

Question: How many employees does Pro-Pipe currently employ?
Response: Approximately 25.

Question: What sort of power service will be required?
Response: The power service requirements would be determined during the building design, but the service is anticipated to be from existing Fortis facilities.

Question: What grading has been done on site so far? What stage is this at?
Response: Preliminary stripping and grading was begun on the area designated as the stormwater management pond, but any further work has been deferred until the results of the open house and council meeting are known.

Question: Will Highway 616 be utilized for access? If so, will it be upgraded in the future?
Response: Highway 616 is not included in the proposed access plan for the subdivision.

Question: How much additional traffic is anticipated?
Response: Other than employees accessing the site, approximately 2 or 3 deliveries would be anticipated daily.

Question: Is there a reason that Highway 2A was selected for the access route instead of Highway 616?
Response: Due to the place of origin of most of the anticipated deliveries to the proposed facility, Highway 2A would be the most direct route to the site.

Question: Did Alberta Transportation have comments regarding the proposed access route?
Response: Other than indicating that Township Road 480 will not be available for Highway 2A access, no other comments were received.

Question: How long will it take to develop the initial 20 acre parcel?
Response: Ideally, the initial parcel would be developed in 2015.

Question: What will the site look like?
Response: The proposed lot will have two buildings and a laydown yard for pipe storage. A

landscaped berm will encompass the yard area.

Question: Does the Town of Millet have concerns regarding additional traffic on Highway 2A/Township Road 475A?
Response: No concerns have been raised by the Town.

2.8 IMPLICATIONS FOR FUTURE LAND USE

Significant implications in regard to opportunities and constraints to future land use and development in the plan area result from the area's existing conditions, relevant plans and policies, and the public input obtained through the communications process. The most significant implications are as follows:

2.8.1 <u>Natural Features Implications</u>

- The natural slope towards the southwest on the property provides opportunity for maintaining the natural drainage course onsite.

- Existing tree stands will need to be removed in the process of site preparation and grading.

2.8.2 <u>Existing Land Use and Zoning Implications</u>

- Although most of the plan area is considered above average agricultural land, development pressures and general public input suggest that support exists for oilfield/agricultural industrial servicing uses. The public recognizes that the proximity of the area to the Town of Millet and Highway 2A, and the resultant increases in land values have reduced the viability of conventional extensive agricultural operations. Municipal Development Plan policies support the use of better lands for non- farming purposes in locations close to urban areas and highways.

- The proposed land use pattern provides a basis for providing industrial uses to the plan area.

- Currently, only the Municipal Development Plan provides direction for this area.

Development of the identified property could open the opportunity for adjacent properties to also develop.

2.8.3 Natural Resource Implications

- No significant development constraints result from the existing natural resources and related features that are contained within the proposed development area.

- There are no gas or oil wells in the immediate vicinity of the development site.

2.8.4 Transportation Implications

- Highway 2A provides high quality visibility for business development purposes on the west side of the project site. There are no proposed subdivision accesses off of Highway 2A.
- There is an existing rail line along the west side of the plan area.
- Township Road 480 to the north of the site is currently dedicated as a road allowance.
- This development will have a single industrial access to Range Road 244.
- Alberta Transportation has mandated that Township Road 475A not be utilized as an access to Range Road 244 from Highway 2A. Instead, access from Highway 2A will be gained to Range Road 244 from Township Road 475/45th Avenue.
- A new public road intended to serve the entire project will be constructed at the time of subdivision. This road will comply with County of Wetaskiwin standards in width, length, turnaround dimensions, and surfacing requirements.

2.8.5 Utilities Implications

- The proposed Pro-Pipe Holdings Industrial Development has no gas lines running through it; however there is a gas line ROW running across the northern border of the plan area.

- The Town of Millet, located southwest of the plan area, has existing water and sewer lines. This provides the opportunity for possible future connection of higher levels of development in the area to water and sewer lines to the Town of Millet's existing infrastructure.

- Upon the initiation of a more intense development scenario where uses mandate the extension of municipal sewer and water lines, the County and proponent have mutually agreed that appropriate utility extensions will be made and the proposed single-site development would connect to municipal services at that time.
- It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.

2.8.6 <u>Implications of Relevant Plans and Policies</u>

Wetaskiwin County uses their Land Use Bylaw (County of Wetaskiwin Bylaw No. 95/54) and their Municipal Development Plan (County of Wetaskiwin Bylaw No. 2005/27) as two planning tools for making decisions on development permits, rezoning applications, and business approvals.

2.8.7 <u>Walkway Access</u>

The developer plans no pedestrian facilities, given the limited and light industrial nature of the development proposal in a rural setting.

3.0 FUTURE LAND USE

The Future Land Use Concept proposed for the proposed Pro-Pipe Holdings Industrial development is shown on **Figures 5 & 6**. The development is currently planned for a maximum of two buildings on not more than 35 acres (14.1 hectares).

2.8. As a result, the plan reflects the findings of the review of all relevant background information. Specifically, the concept responds to the following critical factors:

- Wetaskiwin County's existing statutory plans, with particular emphasis on the Municipal Development Plan;
- Existing conditions such as natural features, current land uses, utility right of ways, parcel boundaries, and development proposals, which result both in opportunities and constraints for future land use;
- Existing and proposed transportation features;
- The recognition that, at sometime in the future, water and sanitary service could be provided through the Town of Millet to greater levels of development;

The foregoing factors are reflected in the Plan objectives.

3.1 AREA STRUCTURE PLAN OBJECTIVES

The Future Land Use Concept reflects the following key objectives of the proposed Pro-Pipe Holdings Industrial Development Area Structure Plan Amendment:

- To provide the opportunity to fully realize the development potential of the plan area if further, higher-intensity development occurs in the future, under an enhanced amendment to an approved ASP.
- To protect the integrity of all highways and associated intersections affected by the Pro-Pipe Holdings Industrial Development, to the satisfaction of Alberta Infrastructure and Transportation, while still recognizing the opportunities these features provide for development purposes.
- The Developer will work with Wetaskiwin County to determine appropriate upgrades to Range Road 244. Two different levels of upgrade will occur on Range Road 244: the initial single-site development, and the ultimate subdivision.
    - Single-Site Development: Range Road 244 will be maintained in accordance with a Roadway Maintenance Agreement with County of Wetaskiwin .
    - Ultimate Subdivision: Range Road 244, unless already improved by other developing properties in the area, will be brought to a full paved standard in keeping with County of Wetaskiwin requirements.

- The Developer will work with the Town of Millet, County of Wetaskiwin and Alberta Transportation to facilitate and/or directly provide an equitable, reasonable upgrade mandated by the County due to the impact of the development.
- To protect significant environmental features in their natural state, to the extent possible.
- To utilize significant environmental features for landscaping and storm water management.
- To minimize future land use conflicts by promoting a compatible land use pattern, and by applying effective screening, feature landscaping, and buffer techniques, or an appropriate combination thereof.
- To recognize the physical capacity of the plan area to sustain development based on the understanding that municipal water and sanitary sewer can be provided by the Town of Millet in the future.
- To promote Industrial uses which meet the policy criteria of the Municipal
    - Development Plan and Land Use Bylaws & Policies in terms of the types of such uses which are best suitedto the County, while recognizing that certain uses are better suited to the highlyvisible portions of the plan area than others.
- To encourage the development and application of design, landscaping and signage guidelines to enhance the visual qualities of industrial development.
- To provide a flexible lot layout, which can be modified during design to suit the clients' needs.
- To participate in the provision of municipal water and sanitary services to the proposed subdivision.
- Costs incurred for future upgrades to the road or servicing will be subject to recovery of prorated costs from any future benefitting developer.

3.2 DESCRIPTION OF THE FUTURE LAND USE CONCEPT

The land use category is proposed by the concept shown on **Figure 6**. This use is described below in the context of the overall concept.

3.2.1 Industrial District

The Pro-Pipe Holdings Industrial Development is a single-user development, which is limited in scope. Regardless, any future development, under future ASP's would take the following considerations into account.

Factors considered in designating the lands for industrial uses include:

- Future compatibility with the Wetaskiwin Municipal Development Plan.
- The shared use of transportation infrastructure encouraging compatible development on neighboring land areas.

Although it is recognized that the lands proposed for industrial use are rated as better agricultural land, the Municipal Development Plan allows for the conversion of such land to non-farming activities for industrial and commercial expansion next to major transportation corridors or populated areas.

For the purposes of this Area Structure Plan Amendment, and in response to relevant Municipal Development Plan policies, industrial means those industrial facilities best suited to locate in the County, near major highways. Examples of use types include; extensive agri-based uses (service and supply) requiring large lots, non-noxious value added agriculture and food processing; food supply facility, natural resource service operations; manufacturing, transportation, warehousing and distribution establishments and small service rental businesses.

Although the proximity to the Town of Millet and Highway 2A provide a high quality of exposure and visibility to future developments, this same visibility also creates a challenge to ensure that development is visually attractive. Due to the fact that some users may be backing onto the acreage residence to the south, proper landscaped buffering, combined with common standards for signage, building facades, fencing and storage are required. The Site Development Guidelines (referred to in Section 4.4) outline the landscaping, signage, and building architectural requirements.

3.3 FUTURE TRANSPORTATION SYSTEM

To service the proposed Pro-Pipe Holdings Industrial Development, a single industrial access has been proposed (see **Figure 5**). This layout has been chosen for conceptual purposes only.

The future subdivision will be accessed from a single industrial access from Range Road 244 via a fully constructed public roadway, built to County of Wetaskiwin standards.

After required construction and dedication of a public road plan through the subdivision by the Developer and acceptance by the County, the required access routes for the proposed development will be owned and maintained by the County of Wetaskiwin. Any roads required to facilitate private development will be constructed and paid for by the Developer. If signage is identified to be a requirement, the signage and installation costs would be the responsibility of the Developer.

Traffic Impact Assessment

A.D. Williams Engineering Inc. completed a Traffic Impact Assessment for the previously proposed Millet Industrial Park **(Appendix B)**. Under this Amended Area Structure Plan, the identified intersection improvements remain unless a diminished level of development warrants a re-evaluation of transportation impacts with an amended Traffic Impact Assessment.

Access to Highway 2A will be via Range Road 244 and 45th Avenue (within the Town of Millet) to the south. Highway 2A will also need to be twinned when traffic volumes reach 9300 vehicles per day, which is projected to occur in the year 2020. For further information regarding Traffic Impact Assessment please refer to **Appendix B**.

3.4 FUTURE UTILITY SYSTEMS

Although the current Pro-Pipe Holdings Industrial Development does not require such servicing, future development in the plan area will rely on the Town of Millet's water and sanitary system for service. At a time when further development on the Pro-Pipe property or other properties mandates the extension of potable water and sanitary sewer, it is recognized that these services will hold the consequence of offsite levies. While the initiating party will initially be responsible for this work and expense, it is recognized that recovery contracts, as allowed by bylaw can be implemented to recover the initial expense of the improvement from benefitting parties. When the necessary services are extended as a result of the property further developing, it is mutually understood that the existing development will be mandated to connect within a reasonable period of time, and pay related offsite levies or contribution fees. The requirement for connection to utility services will be triggered by further development of the Pro-Pipe property beyond the initial phase of development or subdivision of the property.

It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.

According to the Storm Water Management Plan found in **Appendix A**, drainage for the development will be accomplished via roadway ditches and drainage swales. To ensure that run-off is maintained at pre-development rates, one stormwater management facility of approximately 20,600 cubic meters is required (which can accommodate the fully developed subdivision).

4.0 AREA STRUCTURE PLAN POLICIES

The policies previously listed in the original Millet Industrial Park ASP are unique to that development scenario and would be implemented if subdivision occurred in the future. The Pro-Pipe Holdings Industrial Development proposes no subdivision, nor large-scale development. This Amendment is to essentially amend the previous ASP so that the proposal can be evaluated on its own merits including Site Development Guidelines specific to this development.

4.1 TRANSPORTATION POLICIES

- All roads and approaches shall be constructed to County of Wetaskiwin standards.

- Required road improvements to any existing roads shall be coordinated and be commensurate with the level of development to mitigate impacts.

- The Developer will work with Wetaskiwin County to determine appropriate roadway upgrades for the Pro-Pipe Holdings Industrial Development. The cost for these improvements shall be the responsibility of the developer.

- During the initial phase of development, the Developer will enter into a Roadway Maintenance Agreement with conditions as follows:

    1. The Developer shall enter into a Roadway Maintenance and Use Agreement with the County of Wetaskiwin for the maintenance of Range Road 244 from Township Road 480 to the paved Township Road 475 as shown in Figure 7.
    2. This Agreement will allow the Developer to utilize the roadway to 100% legal load limits at all times, during which the County of Wetaskiwin shall undertake all maintenance of the roadway, including the addition of gravel as required, grading and dust applications to a standard of similar roadways within the County.
    3. In consideration of the above roadway load limit exemption and the potential of increased maintenance requirements, the Developer shall reimburse the County of Wetaskiwin in the amount of $ 15,000 per annum, plus applicable GST. This amount shall be paid on an annual basis, and becomes due on January 1 of the applicable year, commencing the year following execution of the Development Agreement, or use of the Range Road 244 by the developer Pro-Pipe or

its contractors in the process of the development of the site, whichever comes sooner.

4. The above-mentioned Roadway Maintenance and Use Agreement shall only be valid during the period during which only the activities of Pro-Pipe Service & Sales Ltd. or their successors and assigns occupy and utilize the lands (identified as NE ¼-32-47-24-W4M). Any further development, additional business subdivision, or conditions of subdivision, leasing, sub-letting or sale of the property shall trigger a requirement to upgrade the above-noted portion of the Range Road to a pre-pavement or paved standard as prescribed in the County of Wetaskiwin Design Guidelines and Construction Standards at the time the change occurs in usage or anticipated usage of the property.

4.2 UTILITIES POLICIES

1. All development under the Pro-Pipe Holdings Industrial Development shall be serviced by both well (water) and "pump and haul" (sanitary sewer) until such time as additional lot development warrants the connection and use of urban water and sewer services.
2. It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.
3. The shallow utilities (Electrical, Telephone, Cable, and Gas) will be located in the shallow utilities right of way in Range Road 244.

4. Water servicing and/or storage will be sized such that fire protection will be provided to the satisfaction of the County of Wetaskiwin Fire Chief.

5. Stormwater management facilities shall be constructed according to the Stormwater Management Study, found in **Appendix A** and to the policies described in this Section.

4.3 SITE DEVELOPMENT GUIDELINES

The Site Development Guidelines are outlined in current County bylaw in support of this ASP, and are included in Appendix D. The guidelines will provide the following information for landowners:

- Screening requirements
- Planting requirements
- Additional landscaping requirements
- Signage requirements
- Access requirements
- Building requirements

4.4 STORM WATER MANAGEMENT

The following text summarizes the relevant findings of the Stormwater Management Report completed by V3 Companies of Canada Ltd. and found in **Appendix A** that form the policies of this Area Structure Plan.

a) Stormwater management for this site will be conducted utilizing an overland drainage system. This will be accomplished by using ditches, culverts and drainage swales. Grading will be designed to direct runoff water to the drainage swales or ditches. These ditches will be used to convey water from the lots to the storm water management facilities. The layout of the overland flow system will be chosen to work closely with existing topography, as well as the future development layout.

b) Any offsite stormwater management which will be affected or problem exacerbated as a direct result of this development shall be upgraded by the Developer at the Developer's expense.

b) One stormwater wet pond area is proposed for this project to collect and contain storm water during peak flows. The storm water pond volume will be sized to contain a 100 year 24 hour storm.

c) Boreholes drilled during the geotechnical site investigation on a nearby site did not reach groundwater level. This means that the groundwater level is likely lower than the 748.00 m contour.

d) The SCS Method was used for determining the storm pond volume as well as the predevelopment flow rate. An SCS Type II distribution of the City of Edmonton's Municipal Airport 24 hour, 1 in 100 year storm event was used as the design storm event for pond sizing. Table 4.5.1 displays the analysis results.

Table 4.5.1 – Pond Size Requirements

Required Maximum Pond Volume (m^3)	Approximate Pond Surface Area with Freeboard (m^2)
20,622	30,881

4.5 MUNICIPAL WATER SUPPLY

The proposed Area Structure Plan Amendment for the Pro-Pipe Holdings Industrial Development is designed to be serviced by the use of a well for the initial single-site development only. Future subdivision will employ the Town of Millet domestic water supply. It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.

4.6 MUNICIPAL SANITARY SERVICE

The proposed Area Structure Plan Amendment for the Pro-Pipe Holdings Industrial Development is designed to be serviced by the use of an underground storage tank under a "pump and haul" scenario by the initial single-site development only. Future subdivision will employ the Town of Millet municipal sanitary sewer system. It is recognized that offsite levies are currently required by the Town of Millet for the development of additional facilities and capacity improvements to accommodate developing lands. This project will be subject to those levies upon their requirement to connect, which is concurrent with any further subdivision. Lastly, it is mutually recognized that the required services necessary to service a subdivision are not guaranteed by the Town of Millet until such time as payment is made to the purveyor.

4.7 MUNICIPAL AND ENVIRONMENTAL RESERVE

The proposed Pro-Pipe Holdings Industrial Development is a private site development that is pursuing this amendment because the current ownership does not, at this time, feel it is prudent to pursue a large-scale development, including the subdivision. As such a municipal reserve will not be proposed until such time as the development action requires, by by-law, such a reserved area.

The developer will utilize the landscaping, signage, fencing, and buffering guidelines recommended in the Millet Industrial Park Site Development Guidelines for these areas of Municipal Reserve. Specifically, the buffering will include perimeter screening through the use of berming.

4.8 PLAN ADMINISTRATION AND IMPLEMENTATION

a) Pursuant to the provisions of Section 633(1) of the Municipal Government Act, 1995, and associated public hearing, this Area Structure Plan Amendment shall be adopted by the County of Wetaskiwin as the Pro-Pipe Holdings Industrial Development Area Structure Plan Amendment. All development within the Pro-Pipe Holdings Industrial Development area shall be in accordance with the provisions and policies of this plan.

b) Council may, from time to time, choose to amend this Area Structure Plan.
As part of the amendment process, the required public hearing process will ensure that the continued input of the landowners and adjacent residents is considered.

c) The planning and engineering detail plans will be provided to the County and the County will provide the plans to both the County's Engineering Consultants and the Town of Millet's Engineering consultants for review and approval prior to any development.

PRO-PIPE HOLDINGS INDUSTRIAL
(FORMERLY KNOWN AS MILLET INDUSTRIAL PARK)
AREA STRUCTURE PLAN

FIGURE 1
REGIONAL CONTEXT
SCALE 1:6500

LEGEND:

PLAN AREA ▬ ▬ ▬ ▬

V3 Companies of Canada Ltd.
#200 – 9945 50th STREET
Edmonton, Alberta T6A 0L4
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PRO-PIPE HOLDINGS INDUSTRIAL
(FORMERLY KNOWN AS MILLET INDUSTRIAL PARK)
AREA STRUCTURE PLAN

FIGURE 2
TOPOGRAPHY/NATURAL FEATURES
SCALE 1:2000

LEGEND:

PLAN AREA ▬ ▬ ▬ ▬

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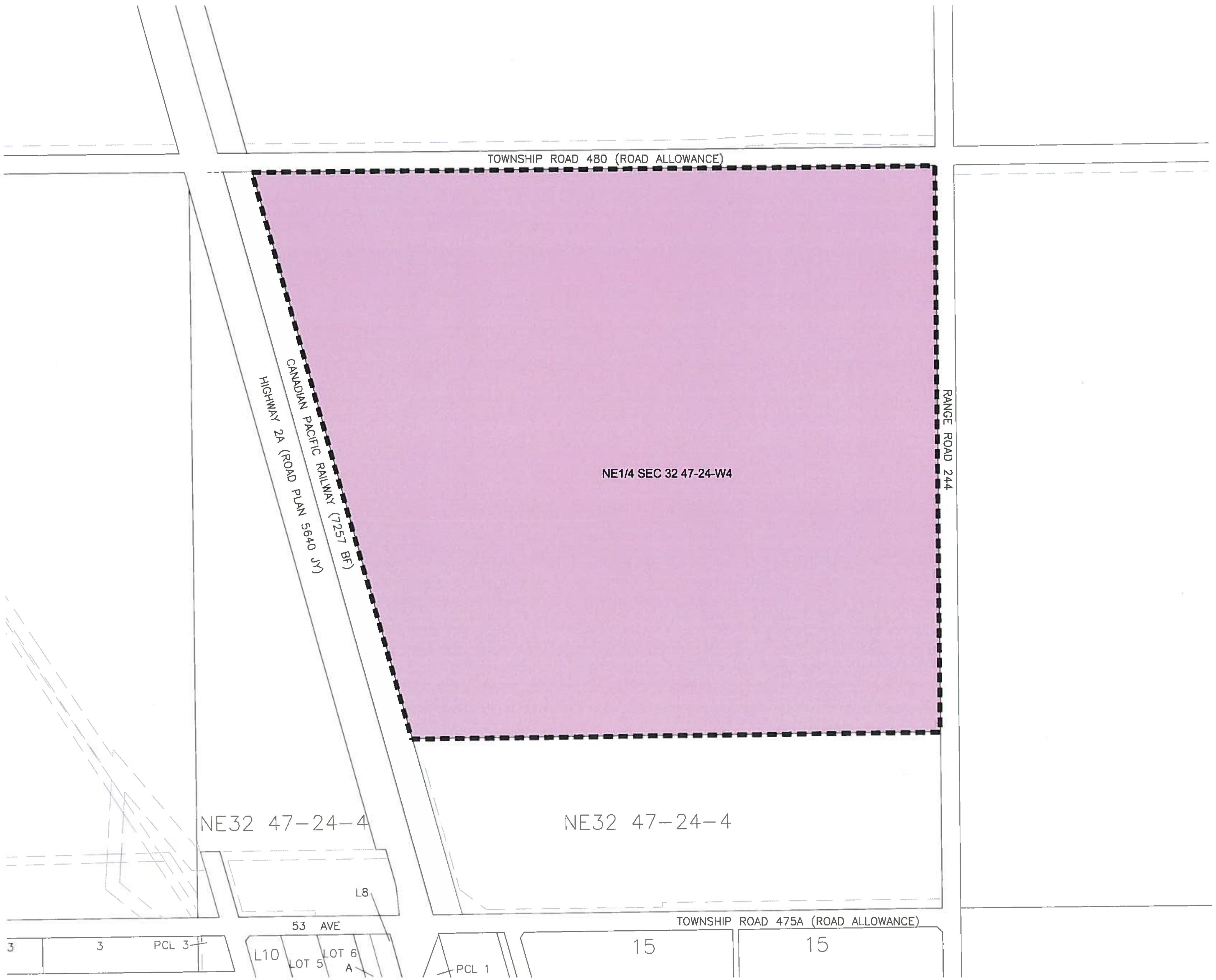

PRO-PIPE HOLDINGS INDUSTRIAL
(FORMERLY KNOWN AS MILLET INDUSTRIAL PARK
AREA STRUCTURE PLAN

FIGURE 3
EXISTING LAND USE
SCALE 1:2000

LEGEND:

PLAN AREA

INDUSTRIAL

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PRO-PIPE HOLDINGS INDUSTRIAL
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AREA STRUCTURE PLAN

FIGURE 4
EXISTING TRANSPORTATION
SCALE 1:3500

LEGEND:
PLAN AREA

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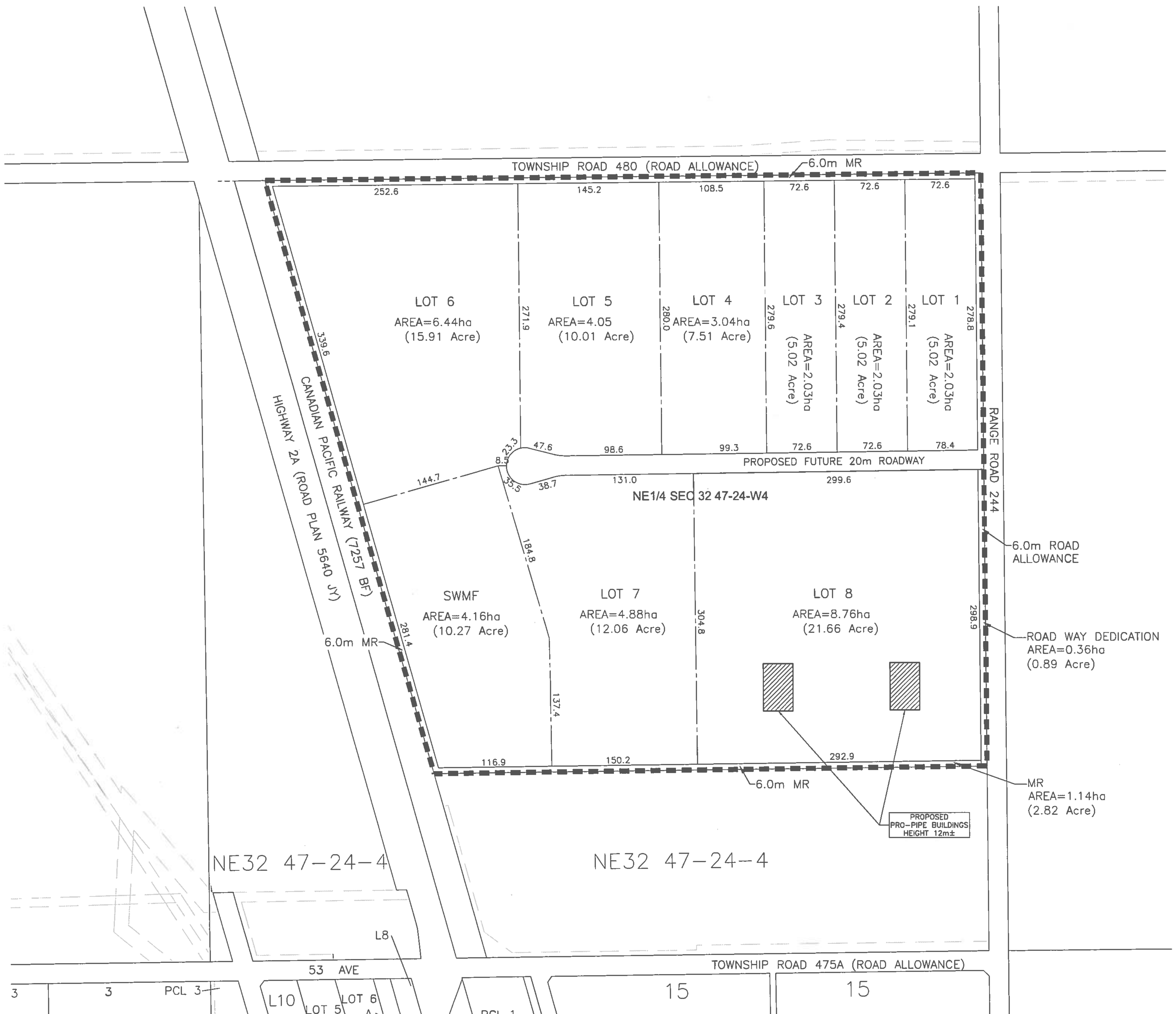

PRO-PIPE HOLDINGS INDUSTRIAL
(FORMERLY KNOWN AS MILLET INDUSTRIAL PARK)
AREA STRUCTURE PLAN

FIGURE 5
PROPOSED LOT LAYOUT
SCALE 1:2000

LEGEND:
PLAN AREA

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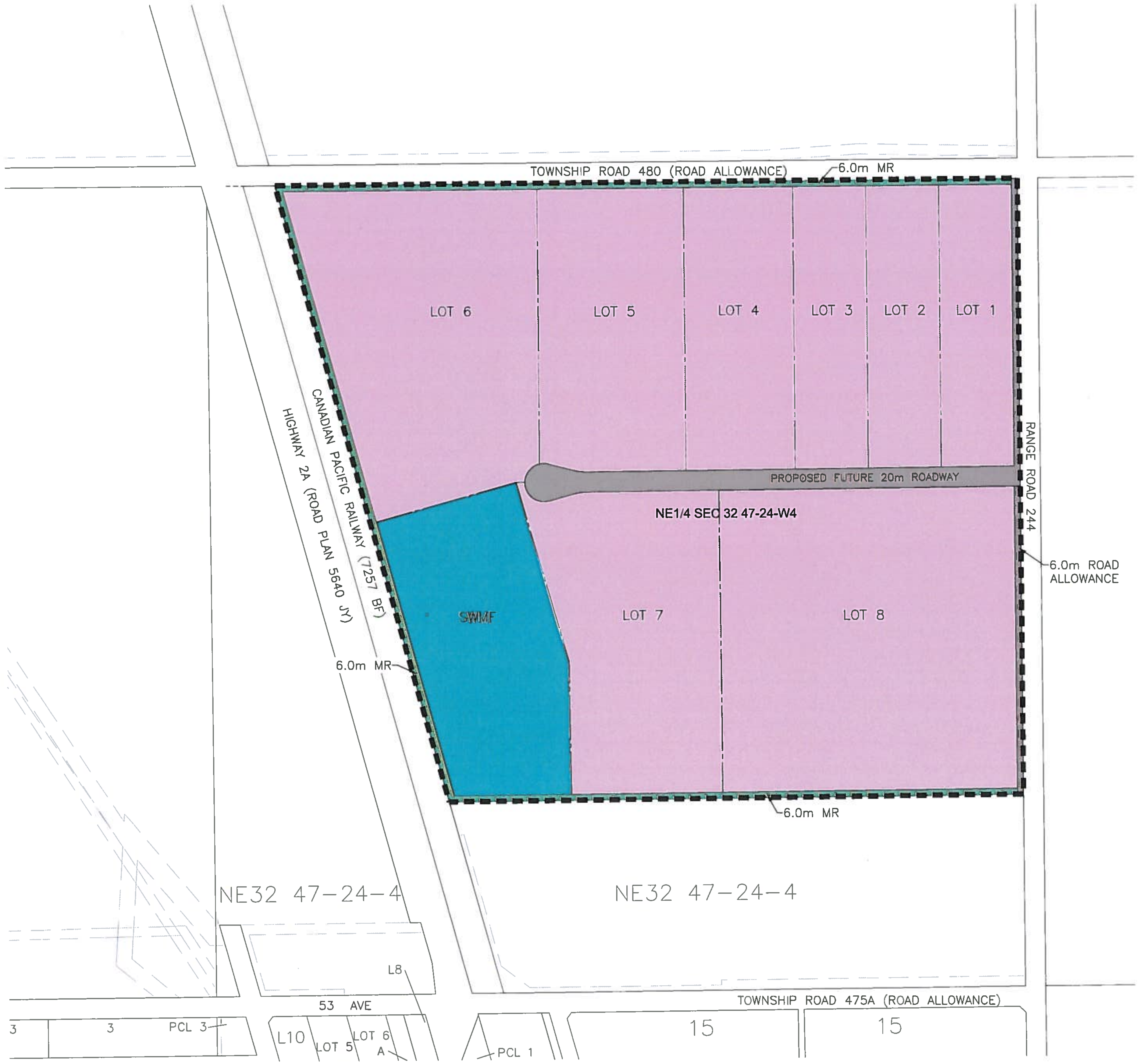

PRO-PIPE HOLDINGS INDUSTRIAL
(FORMERLY KNOWN AS MILLET INDUSTRIAL PARK
AREA STRUCTURE PLAN

FIGURE 6
PROPOSED LAND USE
SCALE 1:2000

LEGEND:

- PLAN AREA
- INDUSTRIAL
- STORM WATER MANAGEMENT FACILITY (PUL)
- ROAD ALLOWANCE

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Edmonton, Alberta T6A 0L4
780-482-3700 phone
780-423-3416 fax
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Appendix A

Stormwater Management Report

Pro-Pipe Holdings Ltd.
Millet, Alberta
Part of N.E. 1/4 Sec. 32-47-24-4

August 2013

V3 Companies of Canada LTD.
Suite 200, 9945-50th Street, Edmonton, AB. T6A 0L4
Phone: 780.482.3700, Fax: 780.423.3416
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List of Figures

1 Introduction

This report has been prepared to outline the stormwater management strategy for the Pro-Pipe Holdings Ltd. development on the north side of Millet, Alberta. The proposed 40.0 ha (98.7 Ac) site is located about 0.2 km north of 53 Ave, and bordered by Range Road 244 to the east, and the CP rail line and Highway 2A to the west. The subject parcel is part of the N.E. ¼ SEC. 32-47-24-W4. Refer to **Figure 1** for the Location Plan showing the subject area.

The rainfall runoff from the existing parcel generally drains from the east to the west. The site has three general existing outfalls. The first being at the southwest corner of the site draining into the CN rail ditch; the second, at the northwest corner of the site, also draining into the CN rail ditch; and the third, a small portion in the northeast region drains to the neighboring property to the north but then ultimately drains west to the CN rail ditch as well.

From the CN rail ditch, there are two conveyance channels under the rail line and then under Highway 2A. Each consists of a 900mm culvert under the rail line, and then a 600mm culvert under the highway. From the west side of Highway 2A, runoff is conveyed to Pipestone Creek through two separate conveyance channels.

Upstream of the site, ditches run along the existing Range Road 244 and transport offsite runoff to the north and south. This eliminates any offsite runoff from entering the subject parcel. Refer to **Figure 2** for the Existing Conditions Plan, showing the existing upstream and downstream drainage patterns and catchments for the site.

The parcel currently consists of an agriculture field with a few tree stands and a small dugout. The proposed development will include the following upgrades:

- 8 Industrial Lots, which range in size from 2.02 ha (5 acres) to 8.76 ha (21.65 acres).
- Construction of a wet pond for storm water retention, within a public utilities lot (PUL).
- Construction of ditches and berms to convey storm water properly across the site, within Municipal Reserves (MR).
- Construction of a central roadway to service all the lots within the parcel.

The proposed stormwater management facility will be an extended detention wet pond to handle the entire parcel's runoff. Each lot will have access to a defined conveyance channel (either roadway or swale) which will convey its runoff to the wet pond.

Water service, in the ultimate development scenario, is planned to be part of the Town of Millet's urban utility systems. Sanitary sewer service, in the ultimate development scenario, is also planned to be part of the Town of Millet's urban utility systems. An interim development plan for a single site development would utilize a "tank and haul" sanitary sewer and a cistern for potable water, but the ultimate storm facility would be constructed as part of the single site development.

Refer to **Figure 3** for the Proposed Development Plan which shows the lot areas and stormwater management facility.

2 Design Parameters

The guidelines outlined in the County of Wetaskiwin, Design Guidelines and Construction Standards, September 2010, as well as the Alberta Environment's Stormwater Management Guidelines have been used for the design of the proposed storm water management infrastructure and facilities.

2.1 Predevelopment flows

A calculation of the pre-development runoff from the existing parcel was performed to determine an allowable release rate for the proposed stormwater management facility. The existing site was modeled during various storms to find peak and average runoff during the storms' duration. **Table 1** below shows the varying results of expected runoff from the existing parcel. See **Figure 2** for delineation of the pre-development runoff catchments.

Table 1 – Expected Runoff Rates from Existing Site for 100-Year Rainfall Event

PREDEVELOPMENT RUNOFF RATES															
Catchment	Area (ha)	Slope (average)	Width (m)	Percent Impervious (1:100yr)	Runoff C Coefficient (1:100yr)	10min PEAK Rational Method Qest. L/s	4hr AVG Rational Method Qest. L/s	Chicago 4hr PEAK XSWMM Model Qest. L/s	HUFF 24hr PEAK XSWMM Model Qest. L/s	AES 1hr PEAK XSWMM Model Qest. L/s	AES 12hr PEAK XSWMM Model Qest. L/s	Chicago 4hr AVG XSWMM Model Qest. L/s	HUFF 24hr AVG XSWMM Model Qest. L/s	AES 1hr AVG XSWMM Model Qest. L/s	AES 12hr AVG XSWMM Model Qest. L/s
1	3.38	0.9%	125	0%	0.2	242	32	256	77	211	86	58	9	111	22
2	9.66	1.7%	175	0%	0.2	691	92	552	202	453	239	159	26	279	61
3	26.91	1.1%	450	0%	0.2	1924	257	1235	518	995	649	420	70	688	164
					Total (L/s)	2856	382	2043	797	1659	974	637	106	1077	247
Total	39.95				**Total (L/s/ha)**	**71.5**	**9.6**	**51.1**	**19.9**	**41.5**	**24.4**	**15.9**	**2.6**	**27.0**	**6.2**
Total Release Rate based on Catchment 3 runoff only (L/s/ha)						**48.2**	**6.4**	**30.9**	**13.0**	**24.9**	**16.2**	**10.5**	**1.8**	**17.2**	**4.1**

When looking at the peak pre-development runoff rates of the undeveloped site, they are found to vary from 19.9 to 71.5 L/s/ha, with the shorter, more intense storms having the larger expected runoff rates. The average runoff rate during the various storms ranges from 2.6 to 15.9 L/s/ha, with higher averages found in the shorter storms.

The proposed site is designed to have one release point, which will follow the downstream outfall used for catchment 3. Therefore, the site is designed to match the release rates for catchment 3 only.

The proposed wet pond, with an orifice controlled outfall, will find the peak release occurring when the pond is at the high water level (HWL). As the pond draws down, the release runoff rate will drop. The average release rate from the facility could conservatively be estimated as half of the peak release rate. Graph 2 in section 3.2, shows the peak flow during the 12-hr AES storm is 319 L/s. The required storage for this storm was 20000 m^3 and the drawdown time was about 60hrs, this produces an average flow of about 93 L/s, which is only about 30% of the peak flow during the storm. Therefore, using the conservative assumption that average flow is 50% of peak flow, an allowable peak release rate from the pond can be accepted as double the average existing runoff rate during the larger storm events. The 4hr, 12hr, and 24hr average runoff rates using catchment 3 runoff only are found to be 10.5, 4.1, and 1.8 L/s/ha respectively. These would then generate allowable peak release rates of 21.0, 8.2, and 3.6 L/s/ha, during the various storms.

Using the final generated allowable peak release rates as a guide and since the governing design storm is found to be the 12hr AES rainfall event, an allowable release rate of 8 L/s/ha was then decided on for the subject parcel. Since the site is 40.0 hectares, this results in an allowable peak release rate of 320 L/s from the stormwater management facility.

2.2 *XPSWMM Version 2009 Modeling Software*

XPSWMM version 2009 has been employed to model the hydrologic/hydraulic runoff characteristics for the 40.0 ha site. The storm drainage system was broken down into a network of nodes and links so it could be modeled appropriately. Nodes within the model represent a juncture at which typically a point load of runoff is associated with the tributary drainage area for each specific catchment. To model each catchment requires a breakdown of the area, its imperviousness, average width, and average slope.

Similarly all of the drainage conveyance links were also entered into the network with their characteristics of cross-sectional shape, longitudinal slope, roughness coefficient, pipe or ditch material, length, depth, etc.

XPSWMM takes all this information regarding the catchment basins, link network, and design storms, and runs a step by step flow analysis over the entire storm water network for each design storm selected.

Rainfall IDF data is inputted into XPSWMM and is based on Edmonton Municipal Airport rainfall data from 1914 to 1995. The following storms were analyzed to assess the performance of the wet pond under a variety of scenarios.

- The Chicago 4-hr distribution storms for the 5, 25, and 100 year return periods
- The HUFF 24-hr distribution storm for the 1 in 100 year return period
- The AES 1-hr and 12-hr distribution storms for the 1 in 100 year return period
- The historic July 10-11, 1978 storm event, for overflow analysis

The XPSWMM defaults were chosen with regards to the Horton infiltration model as shown in **Table 2**. These values are slightly conservative compared to estimates of regional infiltration and will serve well to help model the runoff from the property.

Table 2 - Horton Infiltration Parameters

	Defaults
Initial Infiltration Rate	75mm
Final Infiltration Rate	7.5mm
Decay Rate	4.14 1/hr
Impervious Area Depression Storage	0.7mm
Pervious Area Depression Storage	2.5mm
Impervious Manning's n	0.010
Pervious Manning's n	0.045
Zero Detention Percentage	30%

A detailed XPSWMM model was created to model the travel time of the storm runoff through the ditches and discharging through the wet pond. The detailed model allows for intricate flow analysis throughout the site, such as wet pond volume, ditch flows, and release rates during various storms.

2.3 Modeled Network Details

To model the proposed development its area was broken into 10 catchments (A -> J). For each catchment a value for land-use area, percent impervious, width, and slope is provided to help model the expected runoff. **Table 3** shows the details for each catchment modeled with XPSWMM. See **Figure 4** for the Catchments Plan showing drainage regions and flow path throughout the site.

Table 3 – Catchment Details

CATCHMENT	AREAS (m2)				TOTAL	Percent	Width	Slope
	INDUSTRIAL	LANDSCAPING	Road R/W	WATER	AREA	Impervious	(m)	
A	20200	2178	779		23157	64%	78	1.0%
B	20300	393	722		21415	69%	73	1.0%
C	20300	413	722		21435	69%	73	1.3%
D	30400	601	1078		32079	69%	103	2.0%
E	40500	857	1611		42968	69%	130	1.0%
F	74375	4014.2	305.8		78695	67%	213	1.0%
G		11031		11164	22195	55%	131	5.0%
H	60102	1168			61270	69%	178	1.0%
I	87655	3584			91239	68%	217	2.2%
J			5136		5136	70%	11	1.9%

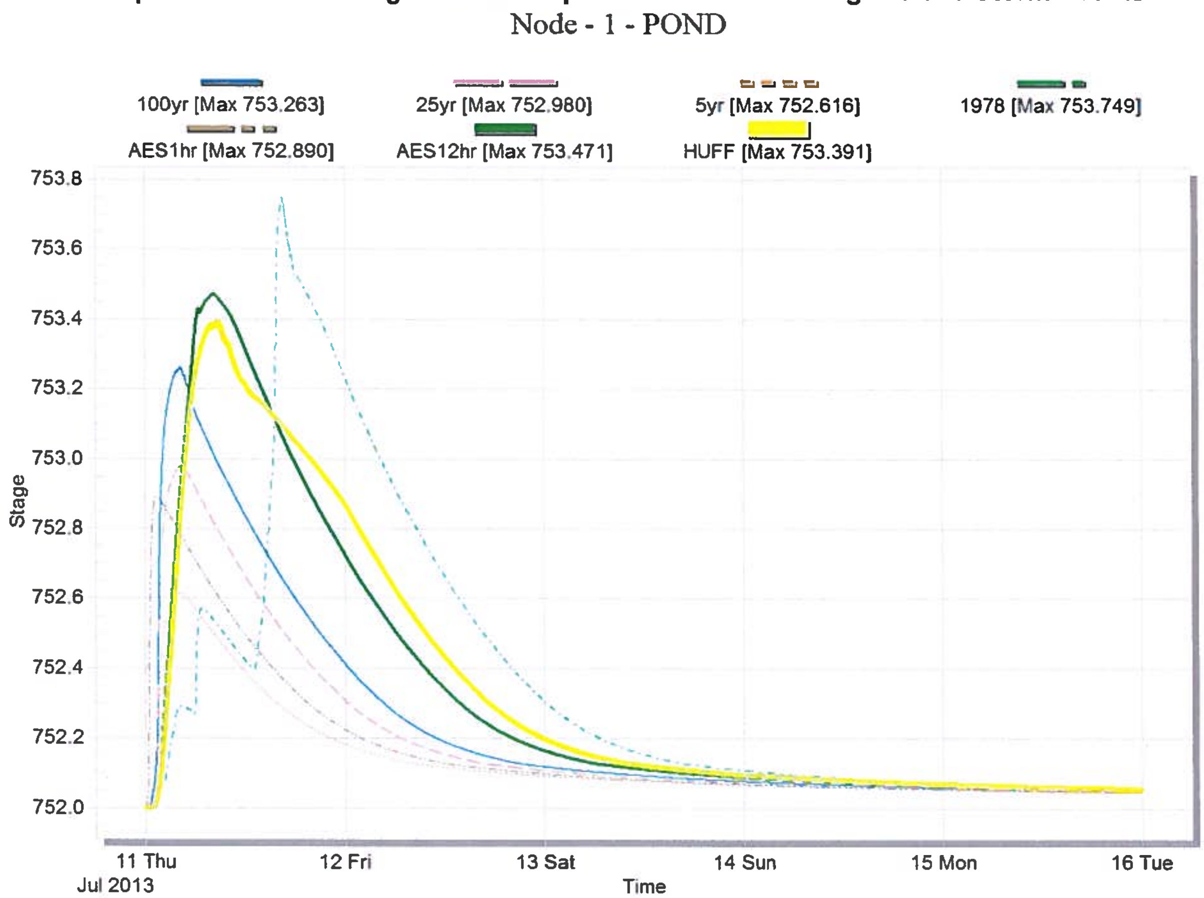
Ditches are used for the links between each catchment. All ditches are assumed to have 4:1 side slopes with 1m wide bottoms to transfer the runoff between each catchment. Slopes for the ditches are estimated according to existing grades found onsite. A manning's n value of 0.030 is assumed for each ditch since the surface is to consist of primarily grass. A minimum grade of 0.5% and depth of 0.8m for onsite ditches allows for the conveyance capacity of 4.6 m^3/s for all onsite runoff throughout the site. Data used for each link within the model, as well as any additional results from the model, can be provided upon request.

3 Design Results

3.1 Maximum Stages

After running the XPSWMM model with the various storms it identified that the proposed wet pond requires approximately 20,000 m^3 of live storage to contain the runoff from the 12-hr 100-yr AES storm, which reaches an elevation of 753.471m, just about 1.5m above the normal water elevation (NWL) of 752.00. The high water level (HWL) of the facility is set at 753.50m. Runoff in excess of the 12hr 100-yr AES storm will be directed through an overflow channel which discharges to the existing ditch along the CN railway, at the southwest corner of site. The wet pond has a freeboard elevation (FBL) of 754.10m to properly direct any runoff through the designated overflow channel, which is set at 753.50m. The 1978 historic storm event reaches a maximum stage of 753.749m, just 24.9cm above HWL which is well within the 0.60m freeboard level. See **Graph 1** below for the maximum elevation or stage reached for the modeled design storms.

Graph 1 - Maximum Stages of the Proposed Wet Pond during Various Storm Events

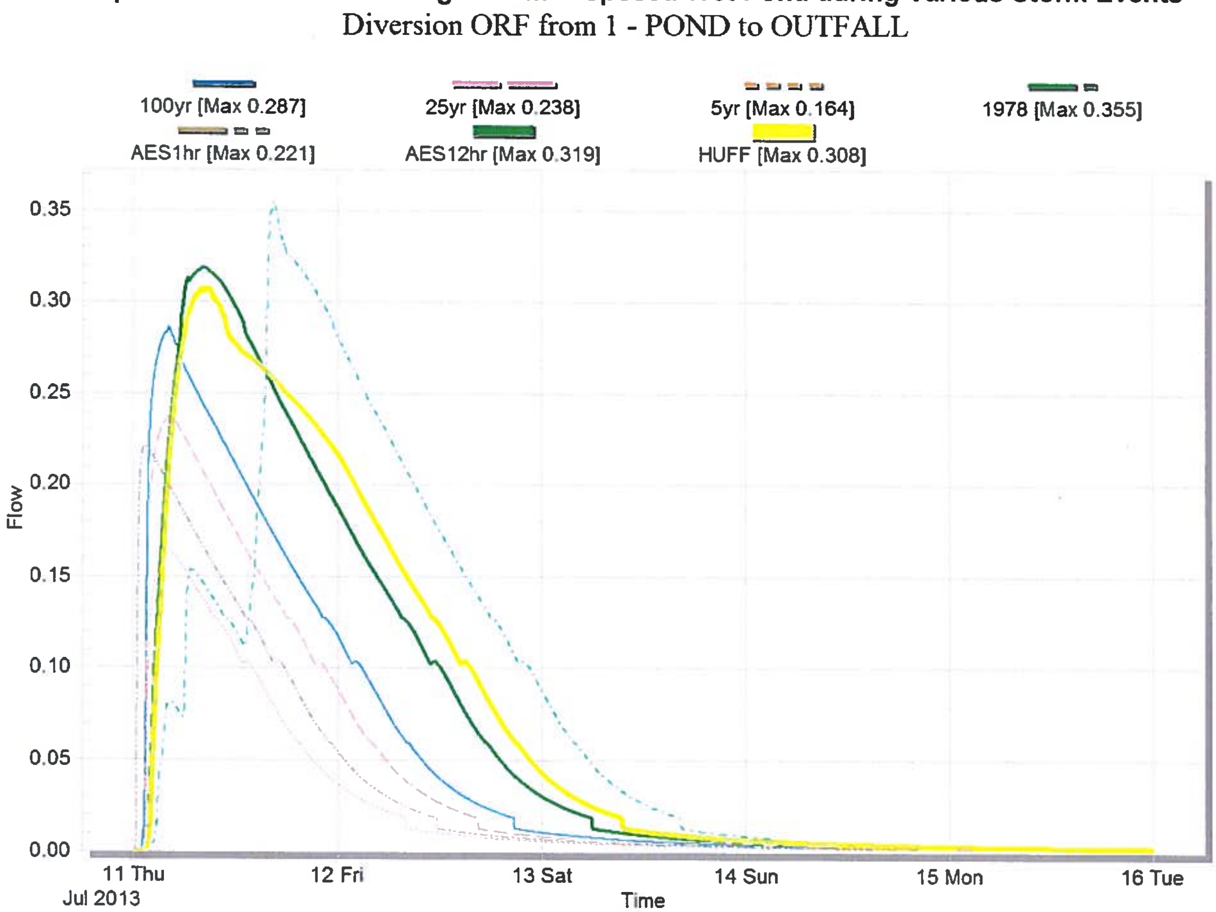


3.2 Maximum Outflow

An orifice within the Control Manhole will be utilized to control the runoff during the 100-yr, 12hr AES storm to the existing downstream ditch at a rate under the maximum allowable outflow of 320 L/s. The use of a 360mm orifice will restrict the flow to 319 L/s when under the design head of 1.5m.

See **Graph 2** below for the controlled discharges (m^3/s) from the pond for the modeled design storms. Note that the 1978 historic storm is also utilizing the overflow channel which allows for excess discharge from the wet pond.

Graph 2 – Controlled Discharges from Proposed Wet Pond during Various Storm Events



3.3 Wet Pond Design

The wet pond is designed as a storm water retention facility with the static water below the live storage providing water quality enhancement. Discharge varies from the facility depending on the rainfall event and stage reached within the pond. 7 to 1 side slopes are proposed from the NWL to the HWL, and then 4 to 1 side slopes from the HWL to FBL. 7 to 1 side slopes are proposed from NWL to a depth of 751.00m (1m below NWL), and 3 to 1 slopes from 751.00 to 749.50m (bottom of pond).

The pond, ditches, and berms are to be constructed with appropriate fill material. Fills will be placed and compacted on dry solid ground and meet the requirements presented by a geotechnical engineer. The wet pond must have a solid clay liner or other suitable material to prevent water from seeping in or out and promote a consistent NWL. Berms used to contain stormwater are to be constructed of compacted clay or other suitable material and notched into native soil to provide stability. Stability must also be considered at the NWL surrounding the pond to prevent erosion of the shoreline. This can be done with the use of rip-rap, or other naturalized stability measures such as geotextiles, for water edge treatment.

Table 4 below provides a summary of the wet pond characteristics, including surface area, storage volume, and total discharge amounts for each stage of the wet pond.

Table 4 - Wet Pond Stage, Area, Storage, and Discharge Relationships

PRO-PIPE HOLDINGS LTD. MILLET, ALBERTA
STORM WATER MANAGEMENT FACILITY
STAGE, AREA, STORAGE AND DISCHARGE VALUES

Developed Area (ha):	40	Flow Control Device	Orifice
Outflow Rate (l/s/ha):	8.0		360 mm
Allowable Outflow (cu.m/s):	0.3200	OVERFLOW CHANNEL	
NWL Elevation (m):	752.0	Weir bottom width (m):	2
Freeboard Elevation (m):	754.1	Weir Side Slopes(m/m):	4 to 1
		Weir Crest Elev. (m):	753.50

ELEV	DEPTH	SURFACE AREA	ACTIVE STORAGE VOLUME	ORIFICE DISCH.	HEAD OVER H.W.L.	WEIR DISCH.	TOTAL DISCH.	
(m)	(m)	(m2)	(cu.m)	(cu.m/s)	(m)	(cu.m/s)	(cu.m/s)	
752.00	0	11164	0	0.0000	0	0	0.0000	N.W.L.
752.10	0.1	11494	1133	0.0350	0	0	0.0350	
752.20	0.2	11828	2299	0.0615	0	0	0.0615	
752.30	0.3	12165	3499	0.1065	0	0	0.1065	
752.40	0.4	12505	4732	0.1375	0	0	0.1375	
752.50	0.5	12848	6000	0.1627	0	0	0.1627	
752.60	0.6	13194	7302	0.1845	0	0	0.1845	
752.70	0.7	13543	8639	0.2040	0	0	0.2040	
752.80	0.8	13895	10011	0.2217	0	0	0.2217	
752.90	0.9	14251	11418	0.2382	0	0	0.2382	
753.00	1.0	14609	12861	0.2536	0	0	0.2536	
753.10	1.1	14971	14340	0.2681	0	0	0.2681	
753.20	1.2	15335	15855	0.2818	0	0	0.2818	
753.30	1.3	15703	17407	0.2949	0	0	0.2949	
753.40	1.4	16073	18996	0.3075	0	0	0.3075	
753.50	1.5	16448	20622	0.3196	0	0	0.3196	H.W.L.
753.60	1.6	16663	22278	0.3312	0.1	0.1200	0.4512	
753.70	1.7	16879	23955	0.3424	0.2	0.3800	0.7224	
753.80	1.8	17096	25653	0.3533	0.3	0.8100	1.1633	
753.90	1.9	17314	27374	0.3638	0.4	1.3200	1.6838	
754.00	2.0	17533	29116	0.3741	0.5	2.0500	2.4241	
754.10	2.1	17753	30881	0.3841	0.6	2.9600	3.3441	F.B.L.

3.4 Design Discussions

3.4.1 Pond and Ditches

The wet pond being proposed is designed to control the runoff for storms up to a 1 in 100-yr, 12-hr, AES storm. Currently, the site drains freely towards northwest and southwest corners, and ultimately drains into the CN Railway. The proposed wet pond will have the capability of holding 20600 cubic meters of rainfall runoff, while releasing runoff at a rate below the allowable 8.0 L/s/ha into the east ditch of CN Railway at the south west corner of the proposed site.

For runoff surpassing the 100-yr design storm, an overflow channel is designed to direct excess runoff to the downstream CN ditch. The overflow elevation is set at the HWL of 753.50m to allow for excess runoff to only occur after the pond has reached its 1:100 year storage capacity.

Ditches onsite will be designed to convey all runoff expected from upstream lots, for storms up to the 1:100 year event. Peak flows in the ditches will be found in the short duration, higher intensity storms. The rational method, with a 10min time of concentration, should be used for the ditch and culvert grading designs. All runoff will be directed towards the wet pond.

3.4.2 Downstream Drainage Conditions

The proposed released runoff from the wet pond will be discharged towards an existing 900mm culvert under the CN Railway. From there, the runoff is directed through an existing 600mm culvert under Highway 2A, and then through a drainage right-of-way (with an additional 900mm culvert under a roadway) towards Pipestone Creek. The downstream conveyance facilities are all in good condition, with no observed scouring or erosion evidence. There is no defined outfall to Pipestone Creek as the runoff passes through a farmer's field and into a low lying area which enters the creek. Pipestone Creek has healthy growing vegetation along its banks and no signs or erosion or scouring is observed. Since the site is designed to match expected runoff rates to pre-developed rates, the downstream facilities will not experience an increase in flow rates. The ditches beside the railway and the highway also have a high capacity for storage in cases where extreme rainfall events may create surcharging of culverts. See photos below of the downstream facilities.

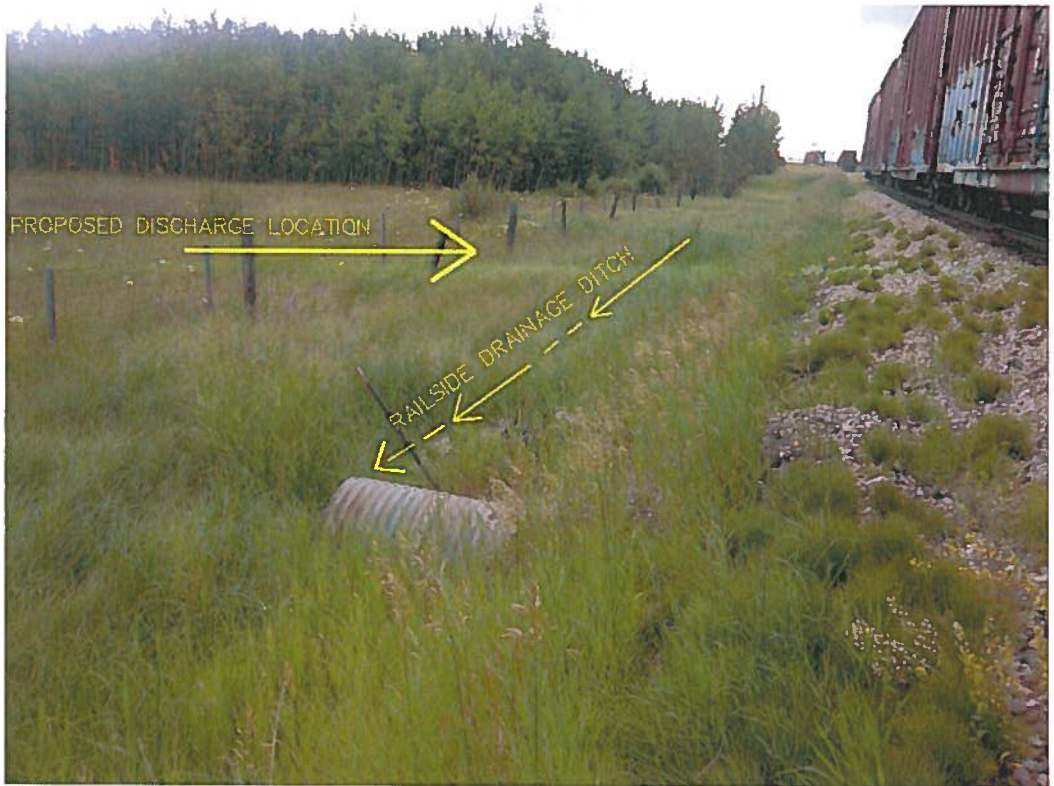


Photo 1: 900mm Culvert under CN Railway

Photo 2: 600mm Culvert under Highway 2A

Photo 3: Drainage Right-of-Way towards Pipestone Creek

Photo 4: Pipestone Creek

3.4.3 Upstream Drainage Conditions & Range Road 244

Upstream of the proposed development exist primarily undeveloped farm land with the exception of one homestead. Runoff from these areas flows into the east ditch of Range Road 244. The existing ditches along Range 244 direct runoff to the north and south. No runoff is found to flow onto the proposed development. No observed scouring, erosion, or pooling evidence was found within the ditch lines. See photos below of the existing ditches along Range Road 244.

Upgrades to Range Road 244 will be constructed as part of the proposed development. Improvements to the road should maintain proper drainage in the ditches along the roadway to the north and south to maintain existing drainage patterns. Culverts should be sized and installed for all entrances and crossings along Range Road 244.

Photo 5: Ditches of Range Road 244 – Looking South from Homestead Entrance

Photo 6: Ditches of Range Road 244 – Looking North from Homestead Entrance

3.4.4 Water Quality

Based on literature found in "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems", by Alberta Environment in January 2006, and the "National Pollutant Removal Performance Database", 2^{nd} and 3^{rd} Edition, formed by the U.S. EPA office, the proposed wet pond is estimated to remove 80% of all Total Suspended Solids (TSS). Additional TSS removal will also be found within the drainage ditches developed on site. The same literature mentioned above also finds grass ditches to provide 31-81% TSS removal. With the use of both a wet pond and drainage ditches, the estimated TSS removal will be above 85% TSS requirement, per Alberta Environment.

Onsite ditches should maintain a clear 1m wide drainage course with grass growing to 75mm high to allow for effective filtering of suspended solids. The use of rock check dams may be required for steep ditches to promote the settling of solids as well as slow the flow to limit erosion.

Upon subdivision, ditches conveying runoff from the lots towards the wet pond, as well areas for sound attenuation fences and berms will be placed within Municipal Reserves (MR) so that proper maintenance and upkeep can be done by the municipality rather than left to individual lot owners.

3.4.5 Erosion Control Measures

Any inlets or outlets for culverts or pipes will have filter fabric and rip-rip installed to limit erosion, as per County details. Ditches within the development will be armored as needed with rip-rap. Silt fences and other erosion and sediment control best management practices will be employed during and after construction (prior to natural growth) to limit the movement of silts and sands during rainfall events into the wet pond and downstream channels. The overflow channel from the pond will be lined with filter fabric and rip-rap to protect from erosion during overflow events.

Protection at the NWL surrounding the pond must be done to prevent erosion of the shoreline. This can be done with the use of rip-rap, or other naturalized stability measures such as geotextiles, for water edge treatment, and should be a part of the design drawings.

4 References

- **Design Guidelines and Construction Standards for Subdivision Developments,** County of Wetaskiwin, September 2010.
- **Stormwater Management Guidelines for the Province of Alberta**, Alberta Environment Protection, January 1999.

5 Closure

We trust that the information contained herein meets your present requirements. Please contact our office if you have any questions or require additional information.

Sincerely,
V3 Companies of Canada Ltd.

Report prepared by:

Eric Seinen, P.Eng.
Project Engineer

Report Reviewed by:

Derek Sinclair, P.Eng.
Senior Project Engineer

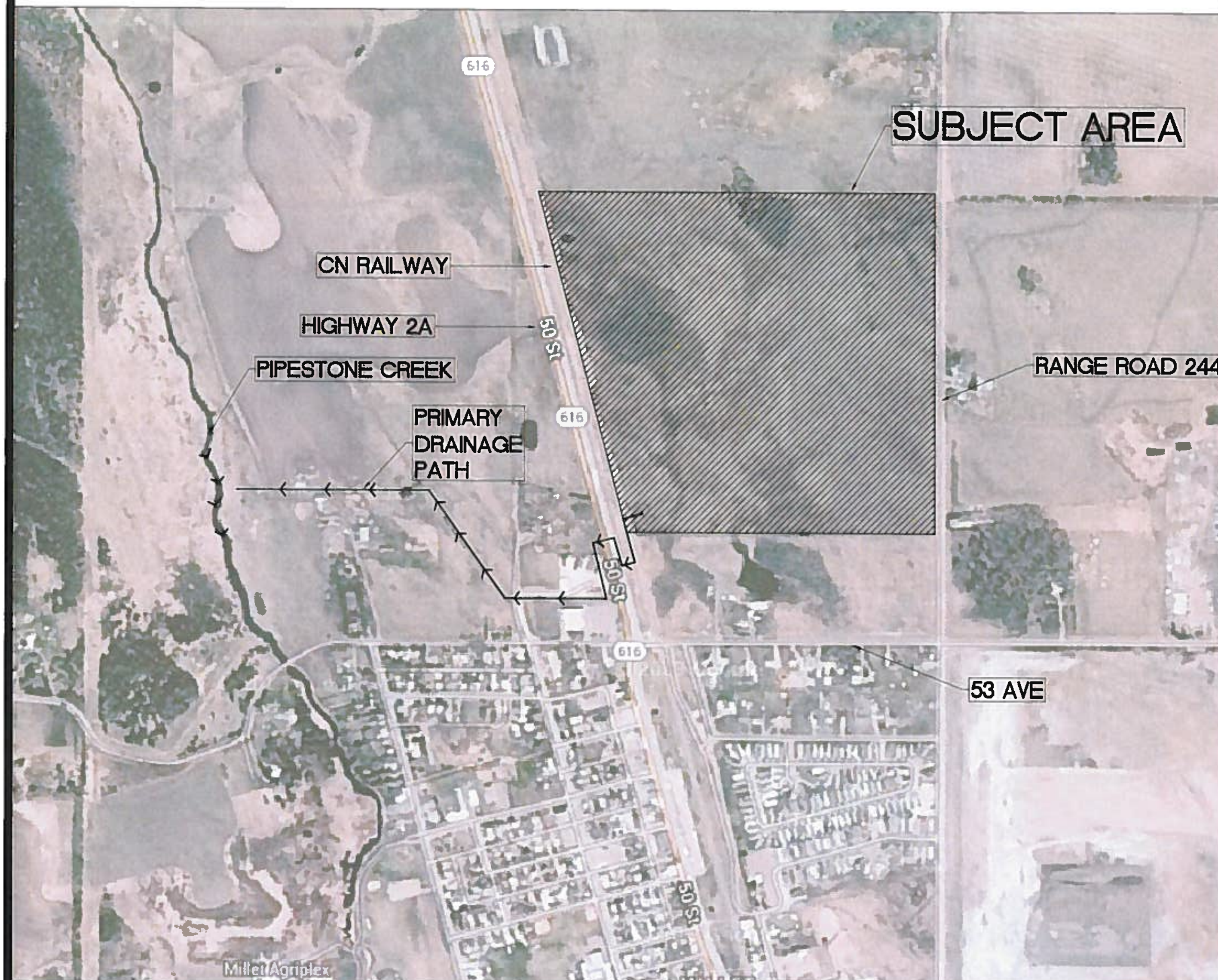


FIGURE 1

LOCATION PLAN

Date: July 2013	V3 Companies of Canada Ltd. #200 – 9945 50th STREET Edmonton, Alberta T6A 0L4 780–482–3700 phone 780–423–3416 fax www.v3co.ca Visio, Vertere, Virtute... "The Vision to Transform with Excellence"
Scale: NTS	
Drawn: ES	

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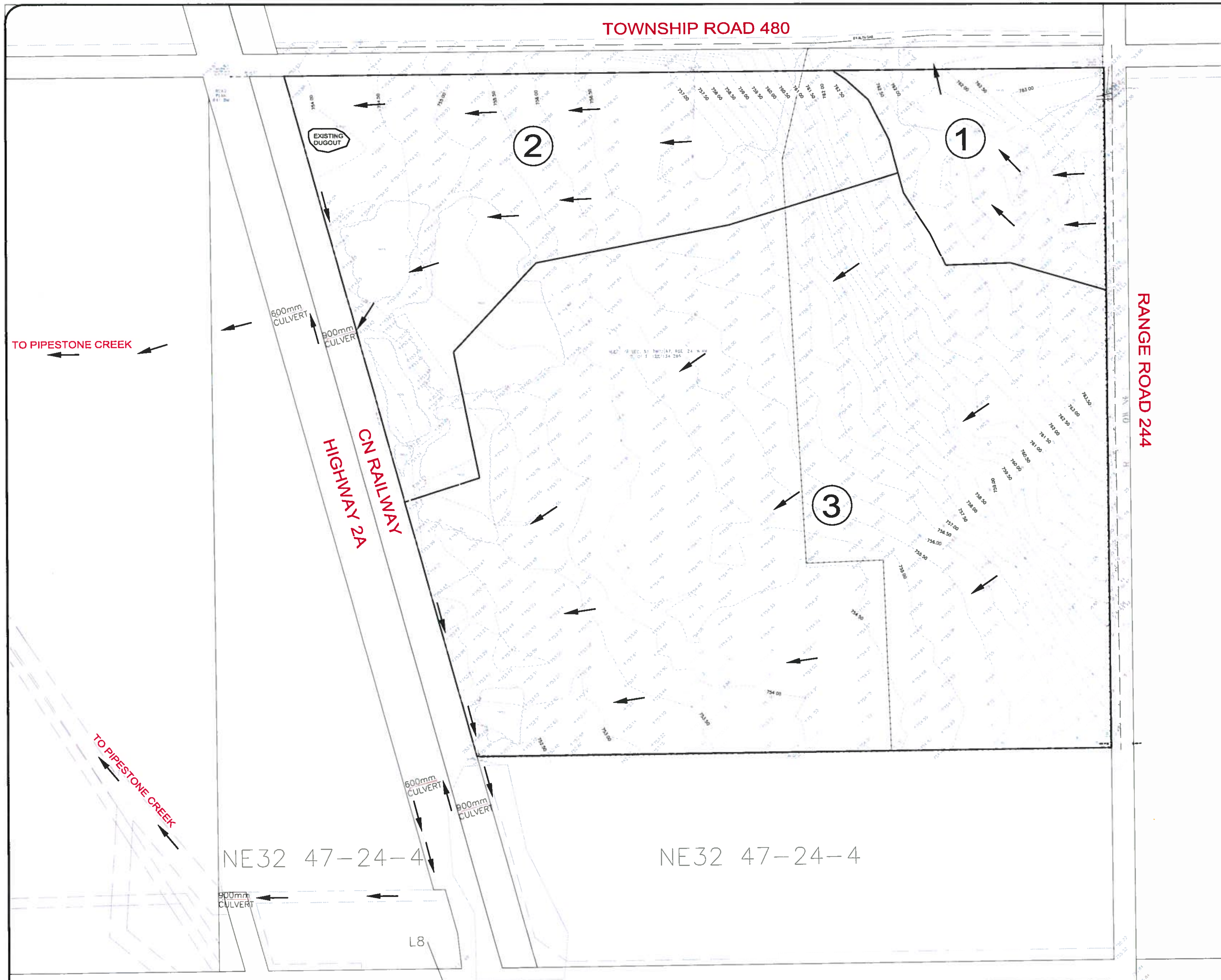

LEGEND:

EX SPOT ELEVATION
PROPERTY LINE
EXISTING GROUND CONTOURS (0.5m)
PRE-DEVELOPMENT FLOW PATH
PRE-DEVELOPMENT CATCHMENT AREA ①

NOTES:

1. DIMENSIONS ARE IN METRES AND DECIMALS THEREOF
2. EX GROUND CONTOUR INTERVAL = 0.5m
3. SURVEY PERFORMED BY GENIVAR (DATE UNKNOWN)
4. ELEVATIONS ARE GEODETIC AND ARE REFERRED TO ASCM ELEV =
5. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION & PROTECTION OF EXISTING UTILITIES
6. REFER TO GEO-TECHNICAL REPORT FOR GRADING & PAVEMENT REQUIREMENTS
7. GRADES SHOWN ON THIS PLAN AND BUILDING LOCATIONS ARE TENTATIVE ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION

DATE	NATURE OF REVISION	ENG	DRWN
9 JAN 2012	ISSUED FOR DP	DS	AHB

CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION & PROTECTION OF EXISTING UTILITIES

DESIGNED BY	DRAWN BY	SCALE HORIZ N/A VERT N/A
AHB	AHB	
DATE	CHECKED BY	PROJECT NUMBER
DEC 2012		C12031

V3 Companies of Canada Ltd.
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Edmonton, Alberta T6A 0L4
780-482-3700 phone
780-423-3416 fax
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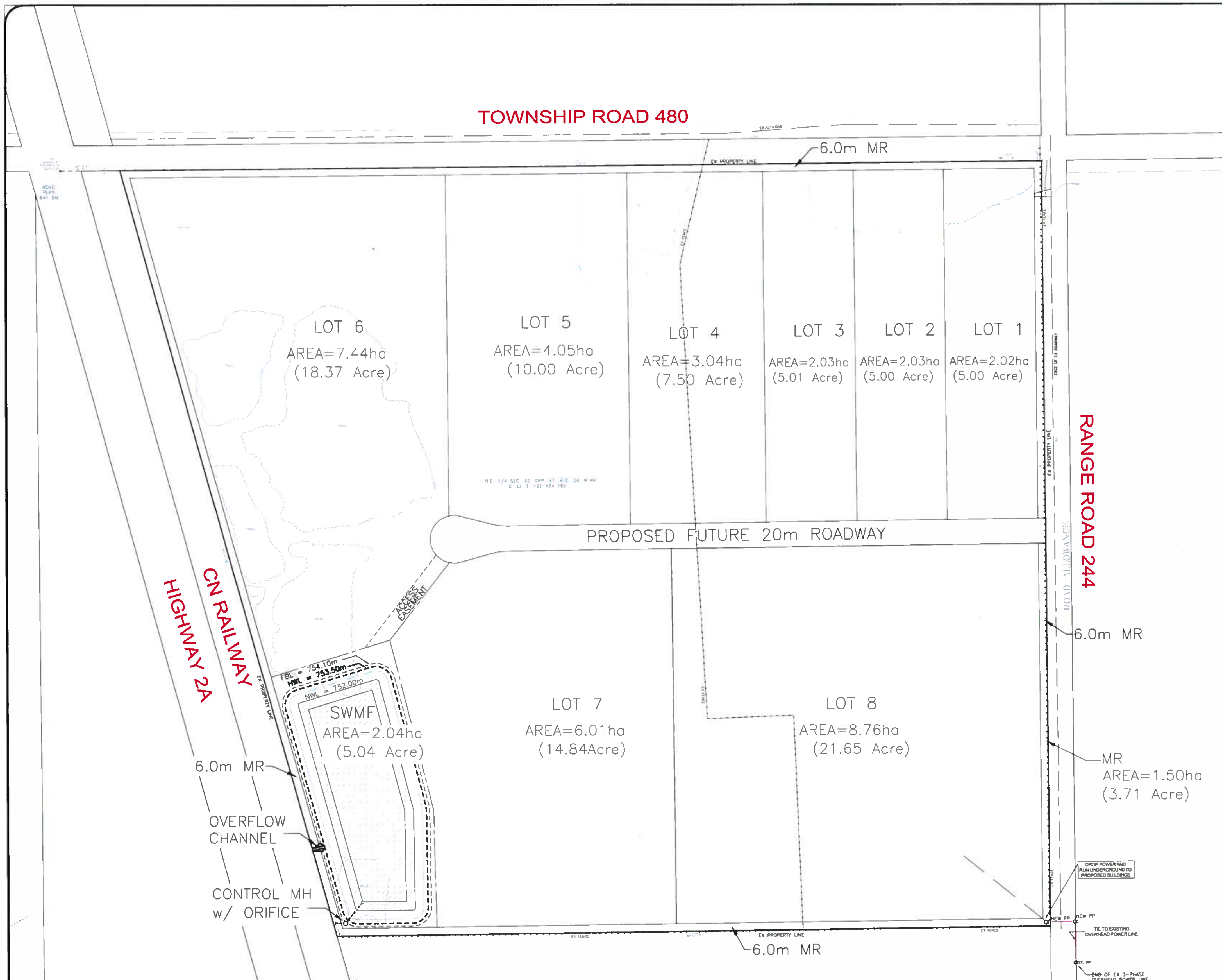
PROPIPE HOLDINGS LTD.
SITE DEVELOPMENT
WITHIN
NE1/4 Sec. 32-47-24-4
COUNTY OF WETASKIWIN
FIGURE 2
EXISTING CONDITIONS PLAN

SHEET NO.
N/A

DATE PLOTTED Aug 14, 2013 – 1:50 pm

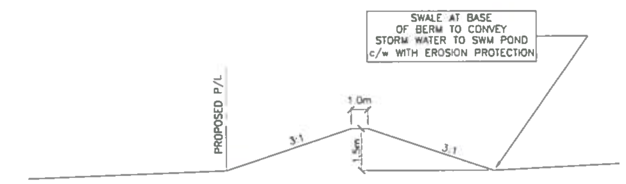


LEGEND:

- EX STORM SEWER
- EX GAS LINE
- EX. SPOT ELEVATION
- DESIGN FINISHED GRADE ✦93.27
- EX TIE IN GRADE ✦93.27
- PROPERTY LINE
- EXISTING GROUND CONTOURS (0.5m)
- FINAL DESIGN CONTOURS (0.5m)
- PHASE 1 LIMITS
- POSSIBLE FUTURE PROPERTY LINES

NOTES:

1. DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
2. EX GROUND CONTOUR INTERVAL = 0.5m
3. SURVEY PERFORMED BY GENIVAR (DATE UNKNOWN)
4. ELEVATIONS ARE GEODETIC AND ARE REFERRED TO ASCM ELEV. =
5. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION & PROTECTION OF EXISTING UTILITIES
6. REFER TO GEO-TECHNICAL REPORT FOR GRADING & PAVEMENT REQUIREMENTS
7. GRADES SHOWN ON THIS PLAN AND BUILDING LOCATIONS ARE TENTATIVE ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION



6.0m MR
TYPICAL 1.5m BERM SECTION
SCALE 1:200

DATE	NATURE OF REVISION	ENG	DRWN
9 JAN 2012	ISSUED FOR DP	DS	AHB

CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION & PROTECTION OF EXISTING UTILITIES

DESIGNED BY	DRAWN BY	SCALE HORIZ N/A VERT N/A
AHB	AHB	
DATE	CHECKED BY	PROJECT NUMBER
DEC 2012		C12031

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SITE DEVELOPMENT
WITHIN
NE1/4 Sec. 32-47-24-4
COUNTY OF WETASKIWIN
FIGURE 3
PROPOSED DEVELOPMENT PLAN

SHEET NO.
N/A

DATE PLOTTED: Aug 13, 2013 – 8:31 am

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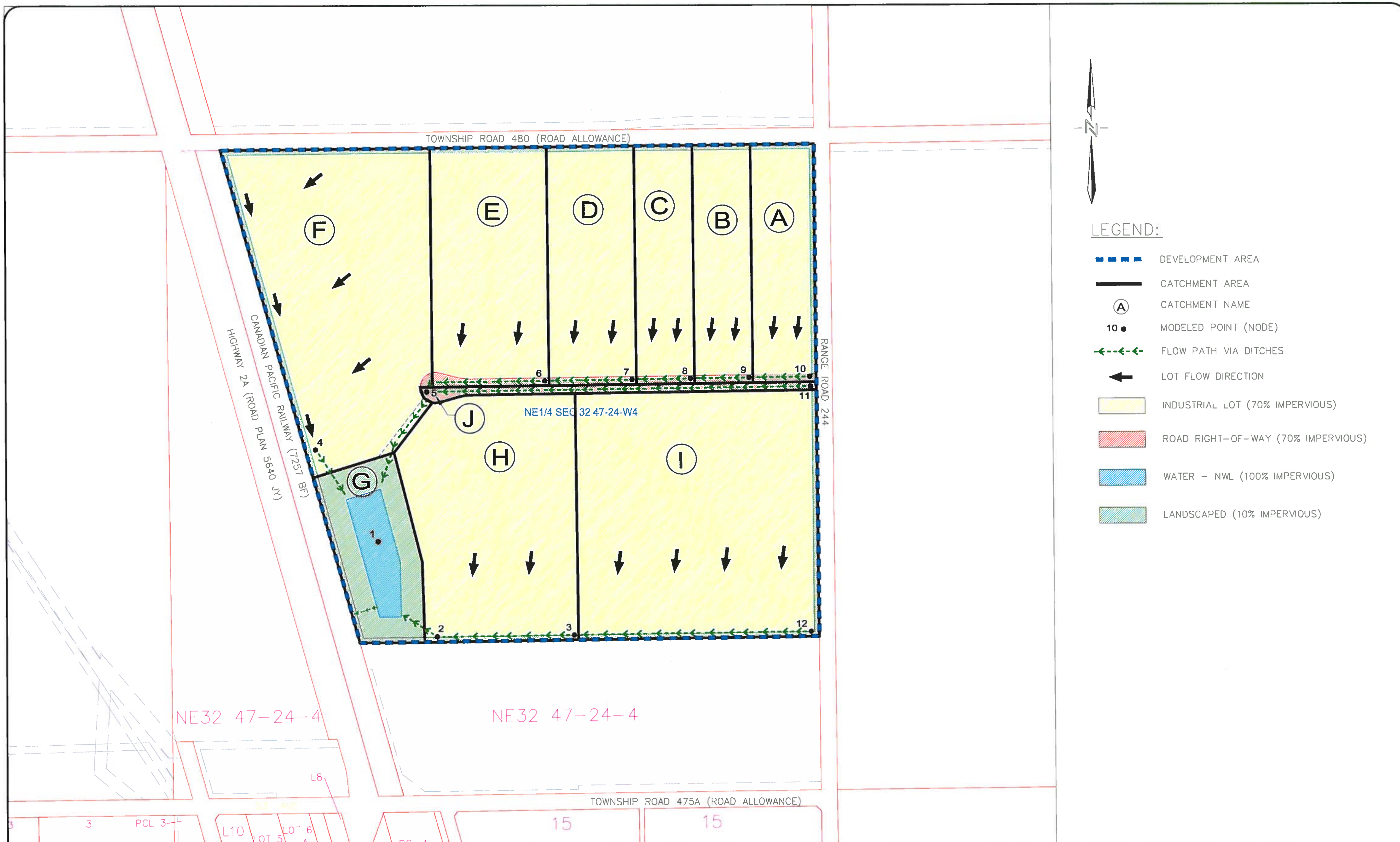
PLOT LAYOUT: Figure 3
PLOT SCALE: 1:1
PLOT ORIGIN: 0,0



DATE	NATURE OF REVISION	ENG	DRWN
MAY 2013	ASP EXHIBITS	DS	JH

CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION & PROTECTION OF EXISTING UTILITIES

DESIGNED BY	DRAWN BY	SCALE HORIZ 1:2000 VERT N/A
JH	JH	
DATE	CHECKED BY	PROJECT NUMBER
MAY 2013		C12031

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WITHIN
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COUNTY OF WETASKIWIN
FIGURE 4
CATCHMENT PLAN

SHEET NO. N/A

DATE PLOTTED: Aug 13, 2013 – 8:31 am

DRAWING NAME: C12031 LAYOUT V3 ES REV3-Report Figures.dwg
LAYOUT: Figure 4

Appendix B

GEOTECHNICAL INVESTIGATION
PROPOSED MILLET INDUSTRIAL PARK
NE 32 - 47 - 24 - W4M
WETASKIWIN COUNTY, ALBERTA

ParklandGEO

GEOTECHNICAL INVESTIGATION
PROPOSED MILLET INDUSTRIAL PARK
NE 32 - 47 - 24 - W4M
WETASKIWIN COUNTY, ALBERTA

Submitted To:

A.D.WILLIAMS ENGINEERING INC.
210 7240 JOHNSTONE DRIVE
RED DEER, ALBERTA
T4P 3Y6

Submitted by:

ParklandGEO

PARKLAND GEOTECHNICAL CONSULTING LTD.
RED DEER, ALBERTA
PROJECT NUMBER: RD2901
JULY 2008

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

A.D Williams Engineering Inc. is proposing to construct an industrial subdivision in the County of Wetaskiwin near Millet, Alberta. The site location is shown on the Key Plan, Figure 1 in Appendix A. Parkland Geotechnical Consulting Ltd. (ParklandGEO) was commissioned to undertake a geotechnical investigation of the site. The scope of work was outlined in proposal PRO1355. Authorization to proceed with the investigation was given Mr. Fred Tejkl of A.D. Williams Engineering Inc.. This report summarizes results of field and laboratory testing programs and presents geotechnical recommendations for the proposed development. Geotechnical recommendations are provided with respect to design and installation of underground services, general foundation conditions, roadway subgrades and flexible pavement design for proposed roads.

2.0 SITE DESCRIPTION

The proposed development is located in NE 32-47-24-W4M, Wetaskiwin County, Alberta, as shown on the Key Plan, Figure 1 in Appendix A. The site is about 160m north of Township Road 475A and is bounded by Highway 2A to the west and Range Road 244 to the east. The site is approximately 90 acres. The subject site is presently undeveloped farmland and there are small sections of moderately treed land on the west and north east parts of the section. The natural topography of the site was gently rolling with an overall downslope towards the south/west portion of the site. The geodetic elevations range from about 751m in the south/west of the site to 764 m in the north/east of the site for elevation differences of approximately 13m across the site as shown in the Contour Plan, Figure 3. The area is surrounded by farmland and residential development to the south.

3.0 FIELD AND LABORATORY PROGRAMS

On April 30, 2008, eighteen boreholes were drilled at the locations shown on the Site Plan, Figure 2 in Appendix A. The borehole locations were roughly positioned on 150 m spacings. The boreholes were drilled to auger refusal at depths of between 3.4 and 6.5 m below grade. The soil encountered was logged according to the Modified Unified Soil Classification System. Soil samples were taken at 1.0 m intervals in order to determine the soil/moisture profile. Standard Penetration Tests were taken at selected depth intervals in selected boreholes. All soil samples were returned to ParklandGEO's Red Deer soil laboratory for selected testing to determine the soil properties.

Standpipes were installed in all boreholes at the completion of drilling, and the groundwater levels were recorded at the completion of drilling, on May 08 and May 30, 2008. The local ground surface elevations at the borehole locations were surveyed relative to a geodetic datum by A.D. Williams Engineering Inc..

4.0 SOIL CONDITIONS

The general soil profile was topsoil, silty sand and/or clay till overlying weathered sandstone bedrock. The detailed soil conditions encountered at the borehole locations are described on the borehole logs in Appendix A. The soil test results and definitions of the terminology and symbols used on the borehole logs are provided on the explanation sheets also in Appendix A. The following is a brief description of the soil types encountered.

4.1 TOPSOIL AND FILL

100 mm thick surficial topsoil was encountered at all borehole locations except Borehole 14 which had 400 mm of organic fill. Based on observations and experience, topsoil and organic fill thickness is expected to vary and may exist in greater thickness than those found at the boreholes. The topsoil and fill were moderately organic, black and moist, and it is considered to be weak and highly compressible when subjected to loads.

4.2 SILTY SAND

Deposits of silty sand were found below the topsoil in all boreholes except for Borehole 6. These lacustrine soils are considered the typical subgrade in this area. The deposits were compact, silty and clayey. These silty and sandy deposits had moisture contents in the order of 10.6 to 28.6 percent. The Standard Proctor Maximum Dry Density of the typical silty sand is about 1750 kg/m^3 and the OMC is about 12 percent. Therefore, the soil moisture contents of these deposits is considered to be above the OMC. The estimated CBR value for the fine sand is in the range of 5.0 to 8.0 in the soaked condition. Due to high moisture contents, these wet silty deposits were considered to be highly frost susceptible and sensitive to disturbance.

4.3 CLAY TILL

Clay till was encountered below the topsoil and/or sand deposits in Borehole 4, 6, 14, 15 and 17 at depths of between 0.1 and 1.5 m. The local till had a variable mixture of clay, silt, sand with inclusions of pebbles, cobbles, coal fragments and bedrock nodules. Although not encountered during this investigation, the local till commonly has inclusions of boulders and water bearing sand/gravel layers. The plasticity of the till was low to medium and the consistency was stiff to hard. Moisture contents in the till ranged from about 11.4 to 25.7 percent. From previous testing in the area the SPMDD for the typical clay till ranges from 1750 to 1840 kg/m^3 and the OMC ranges from 14 to 16 percent. The estimated soaked CBR of the near surface till is about 4 percent.

4.4 WEATHERED BEDROCK

Bedrock was encountered in all boreholes except for Borehole 14 and 15, and extended to below the depth drilled (5.0 m). This bedrock consisted of sandstone and was found to be weathered and weakly cemented. This bedrock was considered to be weak rock with the consistency of a very hard, dense soil. The competency of the formation increased with depth.

4.5 WATER SOLUBLE SULPHATES

Soil samples at a depth of 2.0 m in all boreholes were tested for water soluble sulphate concentration tests. The concentrations of sulphates are expressed as a percent of the dry mass of soil. The concentrations of water soluble sulphate were between 0.04 and 0.19 which indicates a "negligible to moderate potential for sulphate attack on buried concrete in direct contact with soil." This area is known for localized pockets of soil with high concentrations of water soluble sulphates.

5.0 GROUNDWATER

No groundwater seepage was observed during drilling. Stabilized groundwater levels measured on May 08 and 30, 2008. The measured groundwater levels are summarized below.

TABLE 1 GROUNDWATER ELEVATIONS

Borehole #	Ground Elevation (m)	Depth of Borehole (m)	Groundwater Elevation (mbg)		
			At Completion	May 08, 2008	May 30, 2008
1	752.811	4.8	Dry	2.5	2.4
2	753.133	3.5	Dry	Dry	Dry
3	754.028	5.0	Dry	2	2
4	755.295	5.0	Dry	2.7	2.6
5	755.866	5.0	Dry	3.4	3.6
6	753.978	3.5	Dry	1.7	1.6
7	756.51	5.0	Dry	0.6	0.5
8	755.18	3.4	Dry	2.3	2.4
9	754.771	3.5	Dry	Dry	Dry
10	753.663	3.5	Dry	Dry	Dry
11	754.229	4.8	Dry	2.3	2.5
12	755.794	3.4	Dry	2.7	2.6
13	761.93	4.8	Dry	2.3	2.1
14	762.819	6.0	Dry	Dry	Dry
15	762.711	6.5	Dry	Dry	Dry
16	762.878	5.0	Dry	4.3	4.2
17	756.957	3.5	Dry	Dry	Dry
18	755.937	4.8	Dry	2.5	2.6

The groundwater table varied with topography.. These groundwater levels are considered to be typical for Millet, Alberta. The observed groundwater level is considered to be near the seasonal low. Groundwater elevations are expected to fluctuate higher on a seasonal basis and will be highest after periods of heavy precipitation or snow-melt. Localized areas may experience temporarily perched conditions in sandy soils above layers of low permeable clay or clay till. Perched water conditions will dissipate over time as the groundwater infiltrates down through the low permeable clay soils. Groundwater seepage is expected for deep excavations at this site. The volumes of groundwater encountered will be dependent on seasonal conditions and the size and permeability of non and low plastic soil layers and lenses which are intercepted by excavations.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

The subsurface conditions at this site are considered to be suitable for the proposed development. Geotechnical considerations in areas with surficial layers of lacustrine soils are expected to be similar to typical conditions found in most Millet area. The main geotechnical issues regarding site development are:

- the potential for filling below proposed commercial building areas where fills in some of the present topographical low areas which may need to be raised more than 1.0 m. Placement of fill below footing elevation will need to be carefully addressed and monitored to minimize the potential for foundation problems due to settlement.

- that relatively loose or sensitive subgrade soils may be encountered during site development and trenching. The siltier lacustrine soils are considered to be marginally suitable for use as road base and trench backfill provided they can be dried to a workable soil moisture content. Alternatively, wet soils should be mixed or replaced with drier fill or selectively used for general site fill.

- the siltier surficial soils will be highly frost susceptible if they are given access to free water or groundwater within the zone of seasonal frost (estimated to an average depth of 2.5 m). In general, the depth to the local water table for much of the site is relatively shallow and within the potential depth of frost in some low-lying areas.

- that some of the trench excavation will be into very stiff to hard till soils. To minimize potential trench settlement, these soils must be backfilled in thin lifts. The standard practice of backfilling wetter lacustrine soils in thicker lifts is not appropriate for these much stiffer soils, and could lead to significant differential settlement due to potential bridging within the backfill. These till soils have good soil moisture and textural characteristics so they are well suited to backfill compaction in thin lifts.

The general foundation conditions at this site are considered to be good. Conventional footings and/or footings on gravel mats will be capable of supporting light foundation loads. The site is also well suited to a number of driven pile foundations, such as bored cast-in-place piles, driven steel and dynamically cast-in-place concrete ("Franki" or "Compacto") piles. Seepage conditions are expected to be common at depth and casing may be a requirement for installation of some cast-in-place piles. Detailed recommendations for foundations are not provided in this report, since it is assumed site specific geotechnical investigations will be performed for individual lots.

6.2 SITE PREPARATION

It is recommended that all vegetation, topsoil and fill be stripped from areas to be developed. Topsoil could be stockpiled for future use at the site. Ideally, fill used to bring the site up to grade should be: select sand; well graded coarse gravel; or low to medium plastic, inorganic clay. The sand and clay till soils are considered to be suitable as fill materials. Moisture conditioning of the native soils may be required prior to use as fill in order to achieve higher specified densities.

The engineered fill placed during site grading at this site should be compacted to at least 95 percent of SPMDD. Uniformity of compaction is most important. The lift thicknesses should be governed by the ability of the selected compaction equipment to uniformly achieve the recommended density. It is recommended that a maximum lift thickness of 200 mm for granular fill and 150 mm for clay fill be utilized. Granular fill is best compacted with large smooth drum vibratory rollers. Clay fill is best compacted with large vibratory "padfoot" or "sheepsfoot" rollers. In areas which require higher compaction, it is recommended that granular fill be placed at moisture contents zero to 2 percent below OMC and that clay fill be placed at moisture contents about 0 to 2 percent above OMC. This will help reduce compactive effort and potential risk of subgrade disturbance needed to achieve maximum density.

Special consideration must be given to deep fill areas below proposed building sites in areas where proposed fills are likely to be greater than 1.0 m below final grade. The engineered fill placed below structures should be uniformly compacted to at least 98 percent of SPMDD at a moisture content within 2 percent of OMC for fills 1.0 to 1.5 m deep. For deeper fill, the compaction standards should be increased to 100 percent of SPMDD. The control of moisture content is considered to be important for the relatively dry, silty fill, because future wetting of these fill soils may cause significant settlement. These settlements could occur long after original construction depending on changes in the groundwater regime due to development (ie. lawn watering, servicing, etc.) and on normal seasonal conditions. If these density levels cannot be achieved using common fill during site grading, the footing bearing surfaces should be sub cut and underlain with select granular fills compacted to at least 98 percent. The depth of subcut should be determined at the time of construction and will depend on factors such as; age of fill, initial compaction, depth of fill, water table, footing configuration and loads. To reduce settlement potential and compactive effort needed to achieve maximum density, it is recommended that granular fill be placed at moisture contents zero to 2 percent below OMC.

If soft subgrade conditions are encountered, a thicker initial lift may be required to form a working base for subsequent construction. This condition is best addressed in the field at the time of construction. If subgrade conditions warrant the use of subgrade improvement gravel, it is possible, for lower lifts, to use less expensive select coarse gravel with a maximum aggregate size of 150 mm.

6.3 SERVICE TRENCH INSTALLATION

If required, buried services will be installed to typical depths within 4.0 m of final ground surface. It is expected that the trenches will be excavated through a range of materials including: firm to stiff silt and clay, compact sand, stiff to very stiff clay till and hard bedrock. Services trenches will be based in both lacustrine, till and sandstone soils. Conventional trenched excavations with sloping sides and/or moveable shields are considered to be feasible.

6.3.1 Service Trench Excavation

The side slopes for conventional unsupported trench excavations will be dependent on the soil conditions at any given location. Where the deep excavations are proposed, conventional trenched excavations with sloping sides and/or moveable shields are considered to be feasible. For excavations in sand soils greater than 1.5 m deep above the water table side slopes of 1H:1V, or flatter, are recommended. In hard tills, steeper sideslopes could be appropriate subject to site specific review by a qualified geotechnical engineer. If saturated zones are encountered within the cut, flatter side slopes and/or dewatering may be required.

The degree of stability of excavated trench walls directly decreases with time and, therefore, construction should be directed at minimizing the length of time service trenches are left open. Groundwater seepage from the sides of the trenches and from the base of the excavation is not expected, except in seasonal conditions where perched water is encountered after precipitation or snow melt and possibly in low lying areas, if serviced. Base heave and/or boiling of the trench bottom can occur where a significant differential hydrostatic head exists at the bottom of the excavation and soils are not cohesive (eg. sand lenses in the till). Dewatering and other pressure relief measures are available to minimize problems with the stability of the trench bottom.

Surface grading should be undertaken so that surface water is not allowed to pond adjacent to service trenches. Surcharge loads, including excavation spoil, should be kept back from the crest of the excavation a minimum distance equal to the excavation depth. Monitoring and maintenance of the slopes should be carried out on a regular basis.

Installation of underground services and utilities requires an observational approach be adopted which should combine past local experience, contractor's experience and geotechnical input. It would be desirable for the selected excavation contractor to be experienced in similar conditions and/or, alternatively, to excavate test pits in advance of construction to familiarize field personnel with subsurface conditions. Quality workmanship is essential, because disturbed wet, cohesionless soils at depth are very expensive measures to rehabilitate.

6.3.2 Pipe Bedding

Minor deflections of the trench bedding are expected. Underground utility pipes should be of a type which will maintain watertight joints (i.e. rubber gasket) after minor shifting has occurred. Bedding requirements are a function of the class of pipe and trench configuration, as well as site specific geotechnical considerations. In general, granular pipe bedding should be relatively well graded sand or sand gravel mixture which can be readily compacted around the pipe to achieve a high frictional strength. Bedding soils must have an appropriate gradation so that migration of natural soils into the granular system is minimized. Uniform or gap-graded sands and gravels should not be used as bedding materials unless adequate provision is made to surround such soils with a filter fabric or graded granular filter compatible with the existing subsoils.

In the event of significant groundwater seepage or wet base conditions, additional measures may be required. Typically these measures include placement of a working mat of free draining gravel and filter cloth after lowering of the water table and removal of disturbed soils. This layer of gravel is intended to be a safe working base and the thickness required will be based on keeping groundwater below the working surface. The function of the geotextile in pipe bedding applications is to act as a separation barrier between the coarse bedding materials and the native fine grained soils, therefore it needs to be strong enough to withstand construction activity.

6.3.3 Trench Backfill

Soil used for trench backfill should be free of frozen material, organics, and any other undesirable debris. It is expected that native soils will be used at the site for economic reasons. The native soils are typically silty clay materials which are considered suitable for use as trench backfill. Wetter lacustrine silts and clays are considered less than ideal due to high moisture contents and will require drying. Till materials are considered to be suitable for use as backfill, but the till must be broken down into smaller pieces in order to allow proper compaction and avoid short term bridging of backfill soils which could result in long term settlement.

To minimize fill settlement under self-weight, it is recommended to use soil with a moisture content within 5 percent of OMC. When excavated soils are excessively wet, the material should be dried or blended prior to use as trench backfill. Suitable replacement soils would include local or imported sand borrow materials with an appropriate moisture content relative to OMC.

Lift thicknesses for backfill should be governed by the ability of the selected compaction to achieve specified density throughout the entire lift. Uniformity is of most importance. The nominal lift thickness for select granular fill is 200 mm. Clay backfill should be placed in thin lifts with a nominal compacted thickness of 150 mm. This is especially important when backfilling very stiff clay soils. The backfill should be uniformly compacted to a minimum of 95 percent of the SPMDD. For road areas, the backfill should be compacted throughout the depth of the fill to a minimum 97 percent of SPMDD.

Some settlement of the compacted backfill in trenches under self-weight is expected to occur. The magnitude and rate of settlement would be dependent on the backfill soil type, the moisture condition of the backfill at the time of placement, the depth of the service trench, drainage conditions and the initial density achieved during compaction. Density monitoring of backfill placement is recommended to encourage better attention to quality workmanship in placement.

Fill materials with variable moisture contents recompacted as trench backfill would not be expected to provide uniform roadway subgrades for the support of pavement sections. If trench settlement in road areas is a concern, it is suggested to consider a deep subgrade preparation of the upper 0.5 to 1.0 of the subgrade to help make the subgrade more uniform. This construction procedure is used with success on similar deep trench backfill situations in the City of Calgary. Design considerations required for roadway subgrade construction on recompacted and natural materials in this subdivision are discussed in the following section of this report.

To minimize the effects of potential settlements on completed roadway surfaces, it is recommended that staged asphalt pavement construction be adopted and that placement of final asphalt concrete surfacing materials be delayed as long as possible, subsequent to completion of trench backfilling.

6.3.4 Concrete for Underground Structures

The water soluble sulphate concentration was negligible to moderate which is considered typical for this area of Wetaskiwin County. As per CSA A23.1-M04, moderate or high sulphate resisting (HS) cement is required with a minimum 56 day compressive strength of 30 MPa and a minimum water cement ratio of 0.50. All concrete exposed to a freezing environment either during or after construction should be air entrained.

6.4 ROADWAY SUBGRADE CONSTRUCTION

The typical subgrade soils were estimated to have CBR values in the order of 3.0 to 8.0 which is indicative of a low to moderate level of subgrade support. In general, the subgrade support from the drier sand would be greater than from the silt and clay with a typical CBR value of at least 4 for the most common silty clay soil which is consistent with Wetaskiwin County development practice.

The exposed subgrade surface should be proof-rolled to identify soft areas. Soft areas should be sub-cut and replaced with suitable fill compacted to 95 percent of SPMDD. The depth of excavation should be sufficient to remove the soft material or to bridge over the soft material. The excavation of sensitive soils should be performed by a tracked backhoe rather than dozer equipment to minimize disturbance to the subgrade. The recommended type of subgrade fill would be a relatively clean coarse graded gravel with a maximum aggregate size of 150 mm. A proposed coarse gravel gradation specification is provided below:

TABLE 2
150 mm COARSE GRADED GRAVEL

Sieve Size (mm)	Percent Passing By Weight
150	100
75	80 - 100
25	50 - 75
5	25 - 55
0.08	2 - 10

This material is generally placed at the same time as the granular subbase of the pavement section resulting in a thick lift of coarse granular material below the asphalt and base course gravel layers. Based on local experience, the gravel subbase thickness required to establish a stable construction base will be in the order of 200 mm to 500 mm.

Construction procedures should be designed to minimize disturbance to the subgrade. If the subgrade is failed during construction, it can lead to costly replacement of weakened soils. The need for any special construction procedures is best determined based on observations at the time of construction. Therefore, construction of roads will require careful monitoring by an experienced soils technician to avoid costly construction problems.

6.5 FLEXIBLE PAVEMENT DESIGN

The flexible pavement designs are proposed for this light industrial subdivision is based on a moderate traffic section for the industrial collector roads using a Design Traffic of 2×10^6 Equivalent Single Axle Loads (ESAL's). The proposed pavement designsections for this subdivision are based on the assumption of a stable subgrade with a CBR of at least 4; or a subgrade which has been improved to an equivalent level as described in Section 6.4. The majority of surficial soils across this quarter section are expected to meet this minimum subgrade support condition, but there is the potential for some localized soft areas. Based on the preceding design assumptions the following flexible pavement sections are proposed:

TABLE 3
FLEXIBLE PAVEMENT DESIGN

Pavement Sections	Industrial Collector
Design traffic (ESAL's)	2×10^6
Asphalt Concrete	100 mm
20 mm Crushed Base Gravel	200 mm
Subbase Gravel (minimum)	300 mm

The performance of the proposed pavement design sections will be, in part, dependent on achieving an adequate level of compaction in subgrade and pavement materials. The recommended levels of compaction for the granular materials in the pavement section should be a minimum of 98 percent of SPMDD. The asphalt concrete should be compacted to a minimum of 97 percent of Marshall density based on a 75 blow Marshall test.

Pavement materials should conform to the following. The following asphalt specifications are recommended.

TABLE 4
ASPHALT CONCRETE

Stability (kN minimum)	5.4
Flow (mm)	2 - 4
Air Voids (percent)	3 - 5
VMA (minimum percent)	14.5
Asphalt Cement (penetration grade)	150-200 (A)

Aggregate materials for base and subbase gravel should be composed of sound, hard, durable particles free from organics and other foreign material. A copy of the Alberta Transportation aggregate specification is provided in Appendix A.

TABLE 5
RECOMMENDED AGGREGATE SPECIFICATIONS

	AT Specifications
Asphalt Gravel	Designation 1, Class 16
Crushed Base Gravel	Designation 2, Class 20 or 25
Subbase Gravel	Designation 2, Class 50

Based on availability of local materials at the time of tendering or construction, alternate materials could be considered upon review by the geotechnical engineer.

The road surface should be sloped and graded to effectively remove all surface water as rapidly as possible. To minimize the occurrence of surface water ponding in the roadways, finished surface grades and cross slopes in the order of two percent are recommended. Allowing water to pond on the pavement surface will lead to infiltration of water into the subgrade which could result in weakening of the subgrade soils.

No special pre-design considerations are given to thickening the pavement section over backfilled trenches. The settlement of trenches is caused mainly by the long term self weight of the fill, not the short term live loads from traffic. The road section or the thickness of granular subbase placed in the road bed should be determined by the level of support expected from the subgrade based on field observations. To minimize distress to pavement structures, trench backfill should be compacted to the higher density levels as previously recommended. To minimize the effects of potential settlements on completed roadway surfaces, it is recommended that staged asphalt pavement construction be adopted and that placement of final asphalt concrete surfacing materials be delayed as long as possible subsequent to completion of trench backfilling.

6.6 STORM WATER DETENTION POND

Stormwater detention pond area(s) will be feasible to impound storm water during peak flows and ease the demand on storm sewers in this area. The storm pond will be drained shortly after major storm events, normally within 24 hours of filling. Normally for a dry detention pond, the base elevation should be above the typical groundwater elevation so that the pond does not contain water throughout the year. Ponds with bases below the groundwater elevation table are usually designed as wet ponds. However, it is feasible to provide sub-drainage to create a dry pond by slightly lowering the water table. The depth of the pond into the water table governs the feasibility and recommended spacing on the drains so costs increase with depth below the water table. This type of "drained" dry pond would have a tendency to lower the local groundwater table.

Design considerations for dry detention ponds at this site include, the influence of impounded water on the local groundwater table, shoreline slope stability, shoreline erosion protection and drainage of the pond base.

Impounded water inside a detention pond, above the groundwater table elevation, will have a tendency to raise the local groundwater table through seepage. However, the typical subgrade for the pond base(s) in the area of interest is expected to be a silty clay of relatively low *in-situ* permeability, suggesting that seepage rates will be relatively low. Since the local subgrade is low permeable and the detention periods will be very short, and the potential for long term impact on the groundwater table will be minimal and will be limited to the areas immediately around the pond. The following recommendations are provided:

1. Pond drainage will occur through overland flow to the pond outlet with some seepage through the base if the base is above the water table. The base of the pond should be graded to allow positive drainage towards the pond outlet to minimize seepage. The recommended base slope is at least 1.0 percent. For longer runs, steeper grades may be required or french drains could be provided to direct flow to the outlet.

2. For preliminary design purposes the slope angles on the proposed wet detention pond should be at least 2H:1V below the static water level and 5H:1V for the portion of the slope above the static water level. At these angles, slope below the water surface would be expected to flatten naturally. For stability under normal "dry" conditions the groundwater table at the toe of dry pond slopes should be maintained at least 0.6 m below the final grade. Recommendations for steeper side-slopes may be possible for constructed slope faces upon review of actual soil conditions and groundwater elevations. A review of groundwater levels and slope stability should be performed once the preliminary grades and pond geometry are set.

3. Some restrictions might apply to pond operations, because fast draw-down rates will impact slope stability. For safety reasons, municipal authorities such as the City of Edmonton,

design ponds with volumes to limit surface water rises to less than 1.0 m for a 1:25 year rainfall event and 2.5 m for a crisis event.

4. The pond shore line should be protected against erosion from wave action, because shoreline erosion may destabilize the pond slopes. Side slopes should be vegetated as soon as possible after construction.

5. Adjacent residential development restrictions may be required in relation to design groundwater levels. Seepage from the pond is not expected to significantly impact adjacent residences, however, it is considered prudent to set adjacent foundation elevations above the design high water level in the pond.

7.0 LIMITATIONS

This report is based on the findings at eighteen borehole locations. If different subsoil and groundwater conditions are encountered, this office must be notified and recommendations submitted herein will be reviewed and revised as required. This report has been prepared for the exclusive use of **A.D. Williams Engineering Inc.** and their approved agents for the specified application to the proposed Millet Industrial park development in NE 32-47-24-W4M, Wetaskiwin County, Alberta. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Respectfully Submitted,
PARKLAND GEOTECHNICAL CONSULTING LTD.
A.P.E.G.G.A. Permit #07312

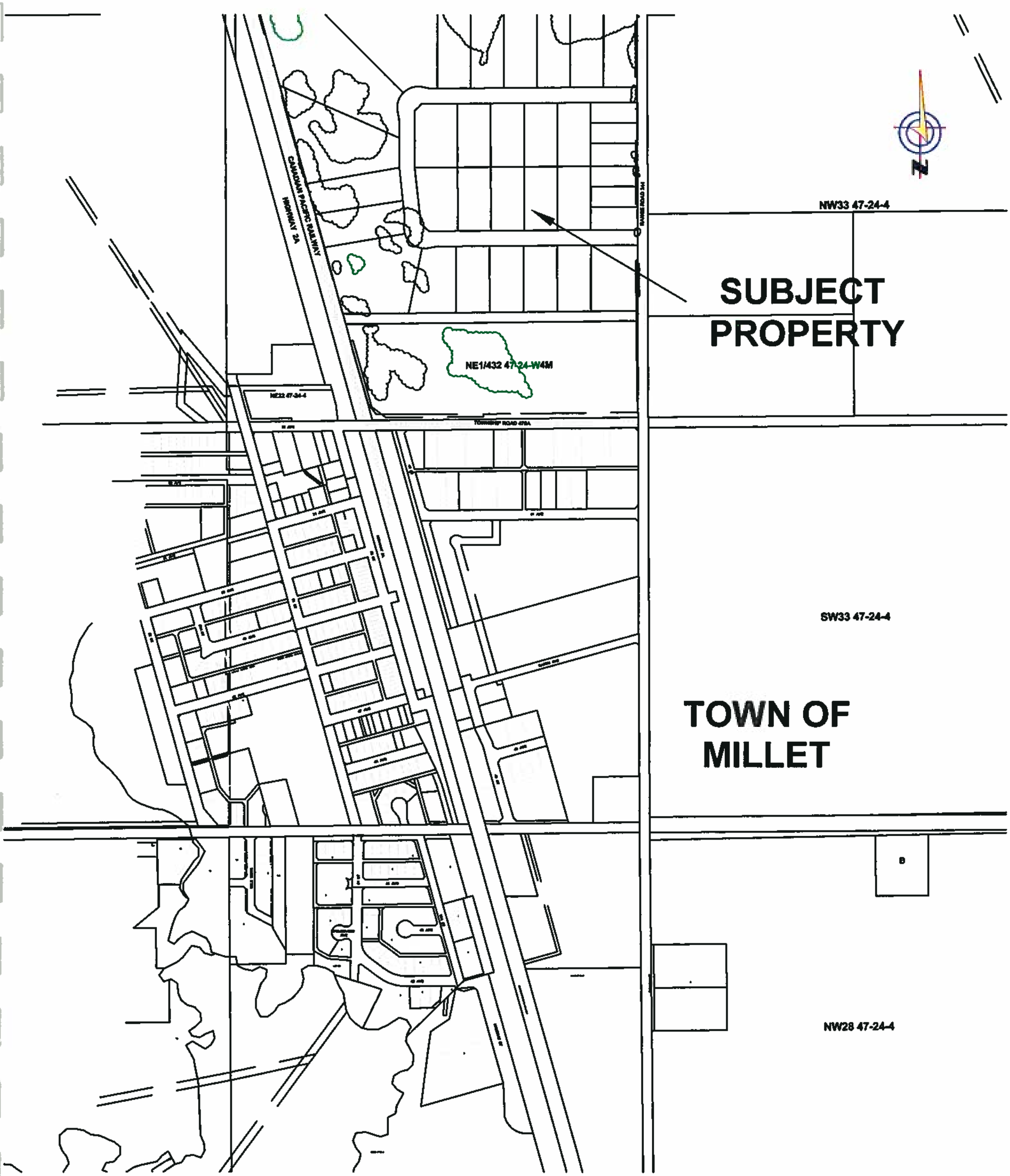
Jerry C.

Jerry Che E.I.T
Geotechnical Engineer

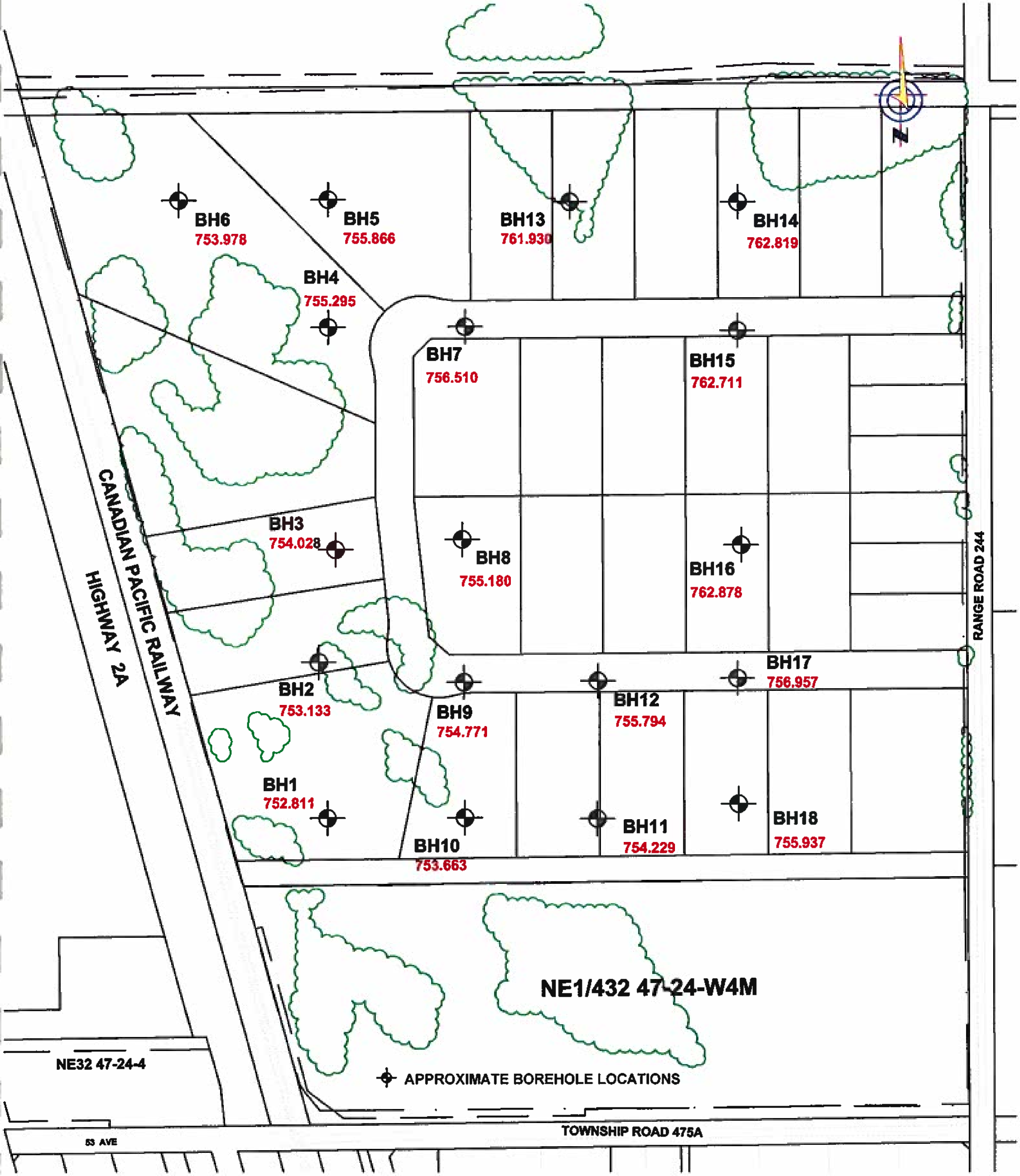
July/18/2008

Mark Brotherton, P.Eng.
Principal Geotechnical Engineer

APPENDIX A



ParklandGEO	CLIENT: A. D. Williams Engineering Inc. Consulting Engineers	**KEY PLAN**	
		PROPOSED MILLET INDUSTRIAL PARK DEVELOPMENT NE1/4 32-47-24-W4M, WETASKIWIN COUNTY, ALBERTA	
		DRAWN: LDL	CHK'D.: MDB
		REV #: 1	DATE: JULY 2008
		SCALE: SHOWN	JOB NO. RD2901
		DRAWING NO. FIGURE 1	



ParklandGEO

CLIENT:

A. D. Williams Engineering Inc.
Consulting Engineers

SITE PLAN

PROPOSED MILLET INDUSTRIAL PARK DEVELOPMENT
NE1/4 32-47-24-W4M, WETASKIWIN COUNTY, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	JULY 2008

SCALE:	JOB NO.	DRAWING NO.
1:4000	RD2901	FIGURE 2

Parkland GEO

CLIENT:

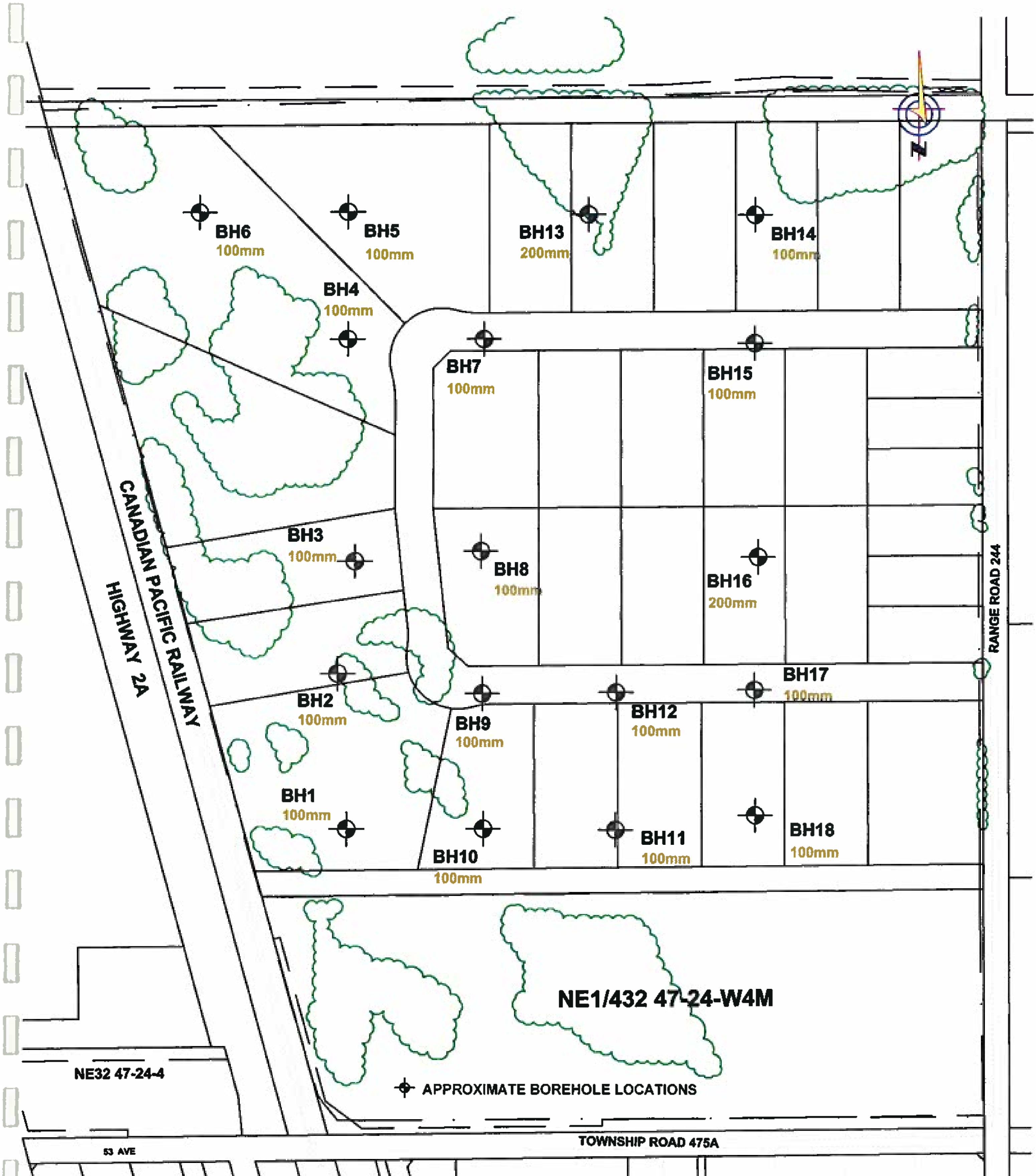
A. D. Williams Engineering Inc.
Consulting Engineers

SULPHATE CONCENTRATIONS

PROPOSED MILLET INDUSTRIAL PARK DEVELOPMENT
NE1/4 32-47-24-W4M, WETASKIWIN COUNTY, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	JULY 2008

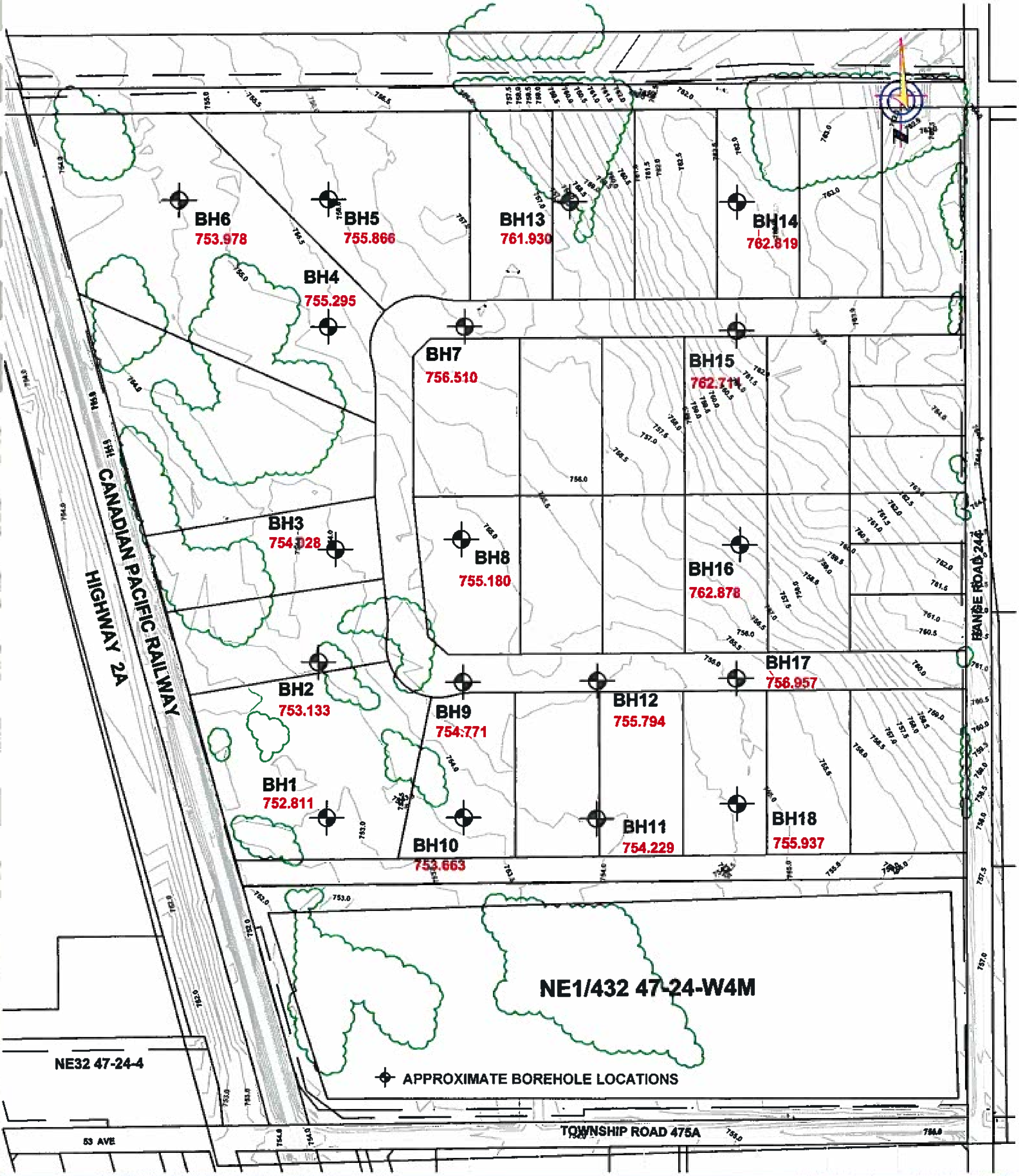
SCALE:	JOB NO.	DRAWING NO.
1:4000	RD2901	FIGURE 3



ParklandGEO	CLIENT: A. D. Williams Engineering Inc. Consulting Engineers	**TOPSOIL THICKNESS** PROPOSED MILLET INDUSTRIAL PARK DEVELOPMENT NE1/4 32-47-24-W4M, WETASKIWIN COUNTY, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	JULY 2008

SCALE:	JOB NO.	DRAWING NO.
1:4000	RD2901	FIGURE 4



ParklandGEO

CLIENT:

A. D. Williams Engineering Inc.
Consulting Engineers

CONTOUR PLAN

PROPOSED MILLET INDUSTRIAL PARK DEVELOPMENT
NE1/4 32-47-24-W4M, WETASKIWIN COUNTY, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
LDL	MDB	1	JULY 2008

SCALE:	JOB NO.	DRAWING NO.
1:4000	RD2901	FIGURE 5

Parkland GEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 1
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE							752.81
0	***Topsoil*** Moderately organic, black, moist.							
	Sand Silty, clayey, trace gravel, compact, fine grained, poorly graded, brown, moist.							
1						GRAIN SIZE ANALYSIS: CLAY=27% SILT=23% SAND=50% GRAVEL=0%		751.51
	-grey at 1.4m.							
				1D1	24	SULPHATE=0.18%		
2								
3								
4				2D1	50			748.21
	Weather Bedrock Sandstone, hard, grey, moist.							748.01
5	Practical refusal at 4.8m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.5m on May 08, 2008. Water level at 2.4m on May 30, 2008.							
6								
7								
8								744.81

Well completion: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 752.811m
NORTHING:
EASTING:

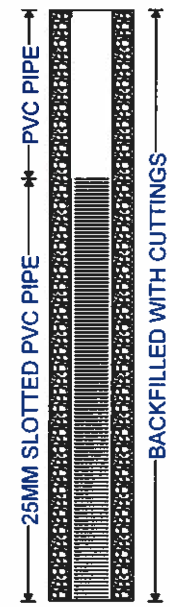
Parkland GEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 2
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |----X----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								753.13
	Topsoil Moderately organic, black, moist.								
	Sand Silty, trace gravel, compact, fine grained, poorly graded, brown, moist.								752.43
1	-clayey at 0.8m.		•						751.83
	-grey at 1.4m.								
2			•				SULPHATE=0.19%		
3			•						749.93
	Weather Bedrock Sandstone, hard, grey, moist.			■	2D1	49			749.63
	Practical refusal at 3.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.								
8									745.13



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 753.133m
NORTHING:
EASTING:

ParklandGEO

BOREHOLE NO.: 3

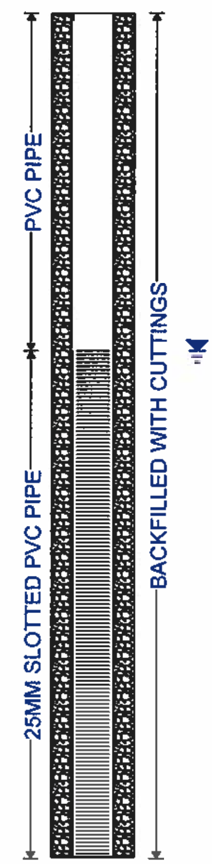
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						754.03
0–0.4	***Topsoil*** Moderately organic, black, moist.						753.33
0.4–4.7	***Sand*** Silty, compact, fine grained, poorly graded, brown, moist.						
0.8–0.9	-some clay at 0.8m. -grey at 0.9m.	•					
1.5–2.0			SPT	3D1	22		752.23
1.9–2.0	-silty at 1.9m.	•				SULPHATE=0.11%	
3		•					
4.0	-water at 4.0m.	•					750.13
4.5–5.0			SPT	3D2	48		749.33
4.7–5.0	***Weather Bedrock*** Sandstone, hard, grey, moist.						749.03
5.0	Practical refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.0m on May 08, 2008. Water level at 2.0m on May 30, 2008.						
8							746.03

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 754.028m
NORTHING:
EASTING:

Parkland GEO

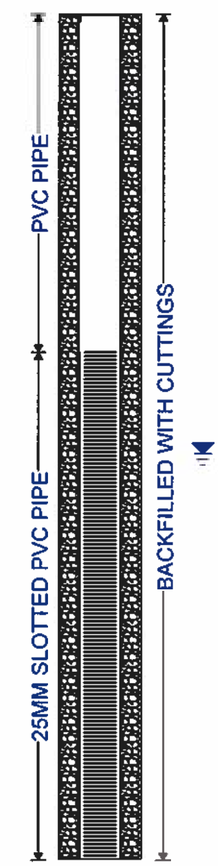
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 4
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
	GROUND SURFACE						755.30
0	***Topsoil*** Moderately organic, black, moist.						755.00
	Sand Silty, compact, fine grained, poorly graded, brown, moist.		G	4G1			
1	***Till*** Clayey, silty, trace sand, trace gravel, firm, medium to high plastic, occasional coal and rust inclusions, brown, moist. -grey at 1.4m. -very stiff at 1.9m.					GRAIN SIZE ANALYSIS: CLAY=46% SILT=34% SAND=15% GRAVEL=5%	754.00
							753.50
2						SULPHATE=0.13%	
3				4D1	35		
	Weathered Bedrock Sandstone, hard, grey, moist.						751.90
4				4D2	50		
5	Practical refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.7m on May 08, 2008. Water level at 2.6m on May 30, 2008.						750.30
6							
7							
8							747.30

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 755.295m
NORTHING:
EASTING:

ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 5
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Sample Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE					755.87
0–0.4	***Topsoil*** Moderately organic, black, moist.					
0.4–4.7	***Sand*** Silty, clayey, compact, fine grained, poorly graded, brown, moist. -silty at 1.4m.				GRAIN SIZE ANALYSIS: CLAY=13% SILT=12% SAND=75% GRAVEL=0%	754.57
1.5–2.0		■	5D1	18	SULPHATE=0.10%	
4.7–5.0	***Weather Bedrock*** Sandstone, hard, grey, moist.					751.17
4.5–5.0		■	5D2	36		750.87
5.0	Practical refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 3.4m on May 08, 2008. Water level at 3.6m on May 30, 2008.					
8						747.87

Moisture (Wp |----X----| Wl) 25 50 75

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 755.866m
NORTHING:
EASTING:

ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 6

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								753.98
	Topsoil Moderately organic, black, moist.			G	6G1		GRAIN SIZE ANALYSIS: CLAY=47% SILT=24% SAND=25% GRAVEL=4%	PVC PIPE	
1	***Till*** Clay, silty, sandy, trace gravel, stiff, medium plastic, brown, occasional coal and rust inclusions, moist.							25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS	752.18
2	-very stiff at 1.9m. -grey at 1.9m.						SULPHATE=0.12%		
3					6D1	46			750.78
	Weather Bedrock Sandstone, hard, grey, moist.								750.48
4	Practical refusal at 3.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 1.7m on May 08, 2008. Water level at 1.6m on May 30, 2008.								
5									
6									
7									
8									745.98

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 753.978m
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

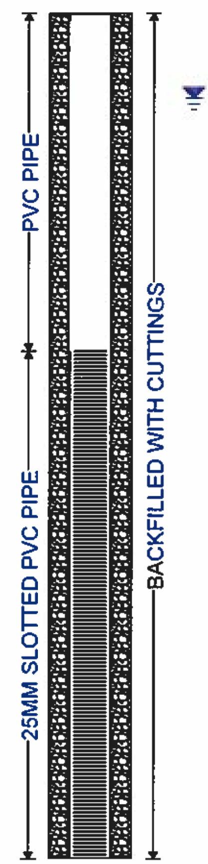
BOREHOLE NO.: 7
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE					756.51
0–0.4	***Topsoil*** Moderately organic, black, moist.					
0.4–4.6	***Sand*** Silty, clayey, compact, fine grained, poorly graded, brown, moist.	G	7G1		GRAIN SIZE ANALYSIS: CLAY=14% SILT=41% SAND=45% GRAVEL=0%	
1.4						755.11
1.5	trace clay and grey at 1.5m.		7D1	21	SULPHATE=0.08%	
4.6	***Weather Bedrock*** Sandstone, hard, grey, moist.		7D2	41		751.91
5	Practical refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 0.6m on May 08, 2008. Water level at 0.5m on May 30, 2008.					751.51
8						748.51

Moisture (Wp |-----X-----| Wl) 25 50 75

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 756.51m
NORTHING:
EASTING:

Parkland GEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

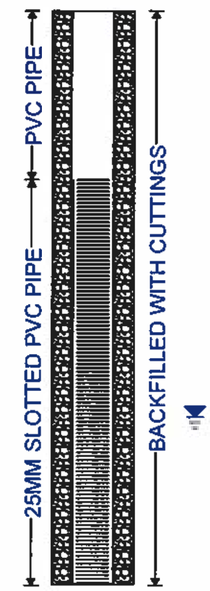
BOREHOLE NO.: 8

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						755.18
	Topsoil Moderately organic, black, moist.						754.48
	Sand Silty, compact, fine grained, poorly graded, brown, moist.						
1	silty and clayey at 0.8m. -grey at 1.2m.						754.08
2						SULPHATE=0.09%	
3				8D1	40		751.98
	Weather Bedrock Sandstone, hard, grey, moist						751.78
4	Practical refusal at 3.4m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.3m on May 08, 2008. Water level at 2.4m on May 30, 2008.						
5							
6							
7							
8							747.18

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 755.18m
NORTHING:
EASTING:

ParklandGEO

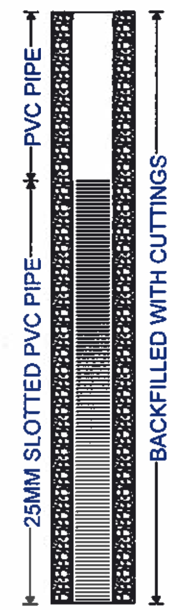
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 9
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
	GROUND SURFACE							754.77
0	***Topsoil*** Moderately organic, black, moist.							
	Sand Silty, clayey, trace gravel, compact, fine grained, poorly graded, brown, moist.							
1			•				GRAIN SIZE ANALYSIS: CLAY=13% SILT=22% SAND=64% GRAVEL=1%	
	-grey at 1.5m.							753.37
	-silty at 1.6m.							
2			•				SULPHATE=0.10%	
3			•		9D1	41		751.47
	Weather Bedrock Sandstone, hard, grey, moist.							751.27
	Practical refusal at 3.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.							
4								
5								
6								
7								
8								746.77

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 754.771m
NORTHING:
EASTING:

ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 10
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								753.66
0	***Topsoil*** Moderately organic, black, moist.								
	Sand Silty, some clay, some gravel, compact, fine grained, poorly graded, brown, moist.			G	10G1			PVC PIPE	
1			•				GRAIN SIZE ANALYSIS: CLAY=26% SILT=9% SAND=51% GRAVEL=14%		752.26
	-grey at 1.5m.							25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS	752.06
	-silty at 1.7m.								
2			•				SULPHATE=0.10%		
3			•		10D1	28			750.26
	Weather Bedrock Sandstone, hard, grey, moist.								
4	Practical refusal at 3.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.								
5									
6									
7									
8									745.66

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 753.663m
NORTHING:
EASTING:

Parkland GEO

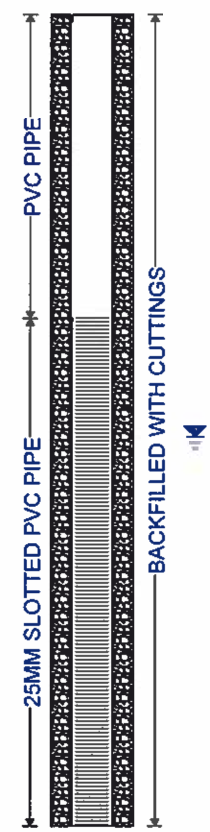
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 11
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |---X---| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						754.23
0–0.4	***Topsoil*** Moderately organic, black, moist.						
0.4–3.5	***Sand*** Silty, clayey, compact, fine grained, poorly graded, brown, moist. -grey at 2.0m. -silty at 2.1m.			11D1	14	GRAIN SIZE ANALYSIS: CLAY=24% SILT=21% SAND=55% GRAVEL=0%; SULPHATE=0.06%	752.33
3.5–4.8	***Weather Bedrock*** Sandstone, hard, grey, moist.			11D2	42		750.73
4.8	Practical refusal at 4.8m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.3m on May 08, 2008. Water level at 2.5m on May 30, 2008.						749.43
8							746.23

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 754.229m
NORTHING:
EASTING:

BOREHOLE NO.: 12

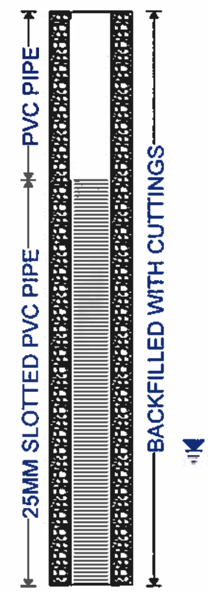
Parkland GEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								755.79
0	***Topsoil*** Moderately organic, black, moist.								
	Sand Silty, clayey, compact, fine grained, poorly graded, brown, moist.								
1	-silty and grey at 1.2m.						GRAIN SIZE ANALYSIS: CLAY=35% SILT=22% SAND=43% GRAVEL=0%		754.69
2							SULPHATE=0.04%		
3					12D1	39			752.49
	Weather Bedrock Sandstone, hard, grey, moist.								
4	Practical refusal at 3.4m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.7m on May 08, 2008. Water level at 2.6m on May 30, 2008.								
5									
6									
7									
8									747.79



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 755.794m
NORTHING:
EASTING:

Parkland GEO

BOREHOLE NO.: 13

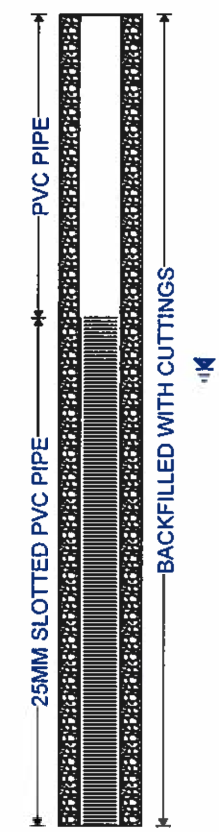
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
	GROUND SURFACE						761.93
0	***Fill*** Silty, clayey, sandy, trace organics, stiff, low plastic, brown, moist.						761.53
	Sand Silty, clayey, compact, fined grained, poorly graded, brown, moist.		G	13G1			
1							
2	-grey at 2.0m.					SULPHATE=0.19%	760.03
3	-water at 3.0m.			13D1	20		759.03
4							757.63
	Weather Bedrock Sandstone, hard, grey, moist.			13D2	40		757.13
5	Practical refusal at 4.8m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.3m on May 08, 2008. Water level at 2.1m on May 30, 2008.						
6							
7							
8							753.93

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 761.93m
NORTHING:
EASTING:

ParklandGEO

BOREHOLE NO.: 14

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |----X----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						762.82
0–0.4	***Topsoil*** Moderately organic, black, moist.						
0.4–1.5	***Sand*** Silty, fine grained, poorly grained, compact, brown, moist.						761.32
1.5–6.0	***Till*** Clay, silty, sandy, trace gravel, very stiff, medium plastic, brown, occassional coal inclusions, occassional rust stains, moist.		SPT	14D1	19	GRAIN SIZE ANALYSIS: CLAY=34% SILT=31% SAND=34% GRAVEL=1% SULPHATE=0.11%	
4.0	-sandy at 4.0m.						758.92
4.5			SPT	14D2	21		
5.5	-coal seam from 5.5 to 6.0m.						757.32
6.0	End of hole at 6.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.						756.82
8							754.82

Well Completion Details: PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 762.819m
NORTHING:
EASTING:

Parkland GEO

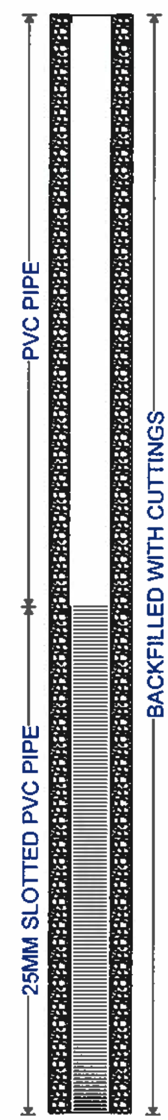
CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 15
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |----X----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						762.71
	Topsoil Moderately organic, black, moist.						
	Sand Silty, fine grained, poorly grained, compact, brown, moist.						761.81
1	***Till*** Clay, silty, sandy, trace gravel, very stiff, medium plastic, brown to grey, occassional coal inclusions, occasional rust stains, moist.					GRAIN SIZE ANALYSIS: CLAY=34% SILT=32% SAND=34% GRAVEL=0%	
2						SULPHATE=0.04%	
3				15D1	18		
4							
5	-coal seam from 4.9 to 5.7m.						757.81
6				15D2	12		756.21
7	End of hole at 6.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.						
8							754.71

Well Completion Details



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 762.711m
NORTHING:
EASTING:

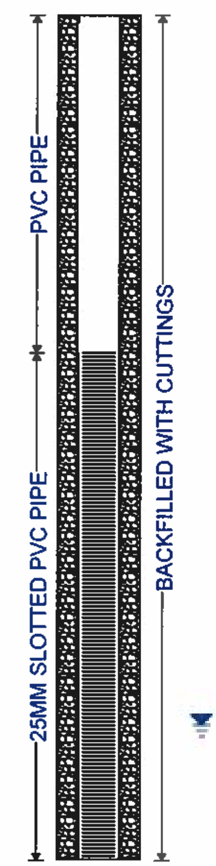
ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 16
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								762.88
	Topsoil Moderately organic, black, moist.								
	Sand Silty, trace clay, compact, fine grained, poorly grained, brown, moist.			G	16G1				
1									
	-coal seam from 1.7 to 2.7m.				16D1	13			761.18
2							SULPHATE=0.04%		
	-grey at 2.7m.								760.18
3									
4									
					16D2	30			757.98
5	***Weathered Bedrock*** Sandstone, hard, grey, moist.								
	Practical refusal at 5.0m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 4.3m on May 08, 2008. Water level at 4.2m on May 30, 2008.								
6									
7									
8									754.88



LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 762.878m
NORTHING:
EASTING:

ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

BOREHOLE NO.: 17
PROJECT NO.: RD2901
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								756.96
0–0.1	***Topsoil*** Moderately organic, black, moist.								
	Till Sand, silty, some clay, compact, fine grained, poorly grained, brown to grey, moist. -silty at 1.1m.		• (1.0), • (2.0), • (3.0)					PVC PIPE; 25MM SLOTTED PVC PIPE; BACKFILLED WITH CUTTINGS	
1							GRAIN SIZE ANALYSIS: CLAY=31% SILT=29% SAND=39% GRAVEL=1%		755.96
2							SULPHATE=0.04%		
3.2	***Weathered Bedrock*** Sandstone, hard, grey, moist.			■	17D1	43			753.76
3.5	Practical refusal at 3.5m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Dry on May 08, 2008. Dry on May 30, 2008.								753.46
8									748.96

LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 756.957m
NORTHING:
EASTING:

ParklandGEO

CLIENT: A.D.Williams Engineering Ltd.
SITE: NE-32-47-24-4, Wetaskiwin County, Ab
NOTES:

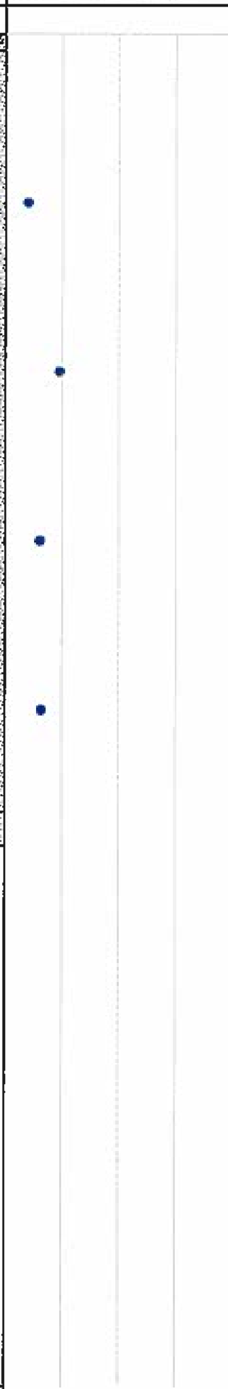
BOREHOLE NO.: 18

PROJECT NO.: RD2901
BH LOCATION:

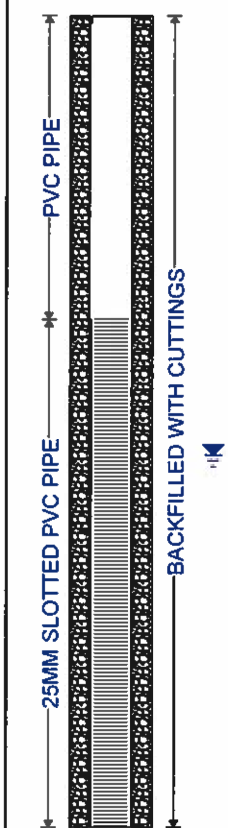
SUBSURFACE PROFILE

Depth (m)	Description	Type	Sample No	SPT (N)	Comments	Elevation (m)
	GROUND SURFACE					755.94
0	***Topsoil*** Moderately organic, black, moist.					
	Sand Silty, trace clay, compact, fine grained, poorly grained, brown, moist.					
1						
			18D1	8		754.04
2	-clayey at 2.0m.				SULPHATE=0.13%	753.74
	-grey at 2.3m.					
3						
4						
			18D2	42		751.34
	Weathered Bedrock Sandstone, hard, grey, moist.					751.14
5	Practical refusal at 4.8m. 25mm standpipe installed. Backfilled with cuttings. Dry upon completion. Water level at 2.5m on May 08, 2008. Water level at 2.6m on May 30, 2008.					
6						
7						
8						747.94

Moisture (Wp |-----X-----| Wl) 25 50 75



Well Completion Details

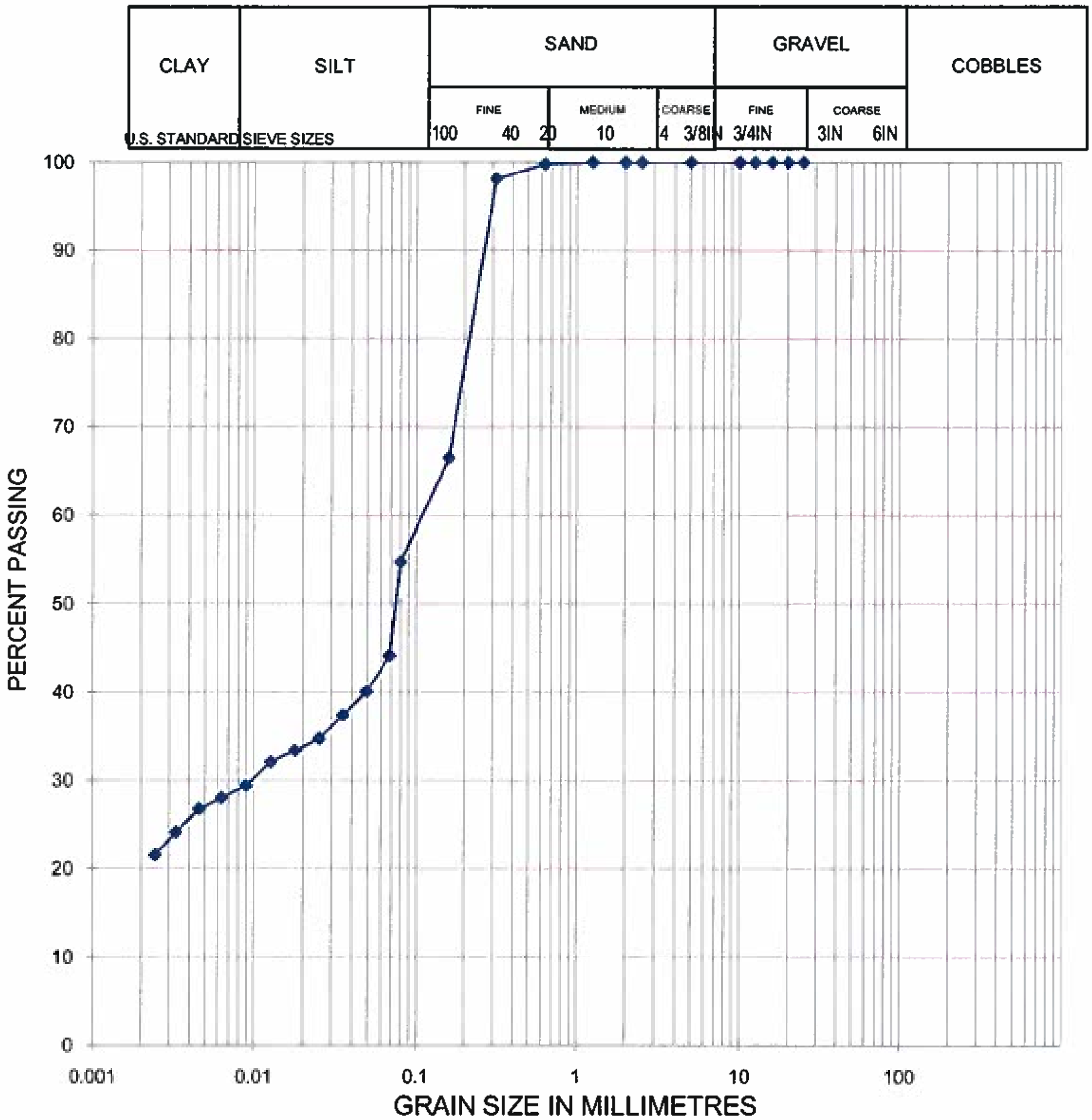


LOGGED BY: CJ
CONTRACTOR: J.E.D Anchors and Environmental Ltd.
RIG/METHOD: Truck Mounted Rig / Solid Stem Auger
DATE: April 30, 2008
CALIBRATION:

GROUND ELEVATION: 755.937m
NORTHING:
EASTING:

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	1	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

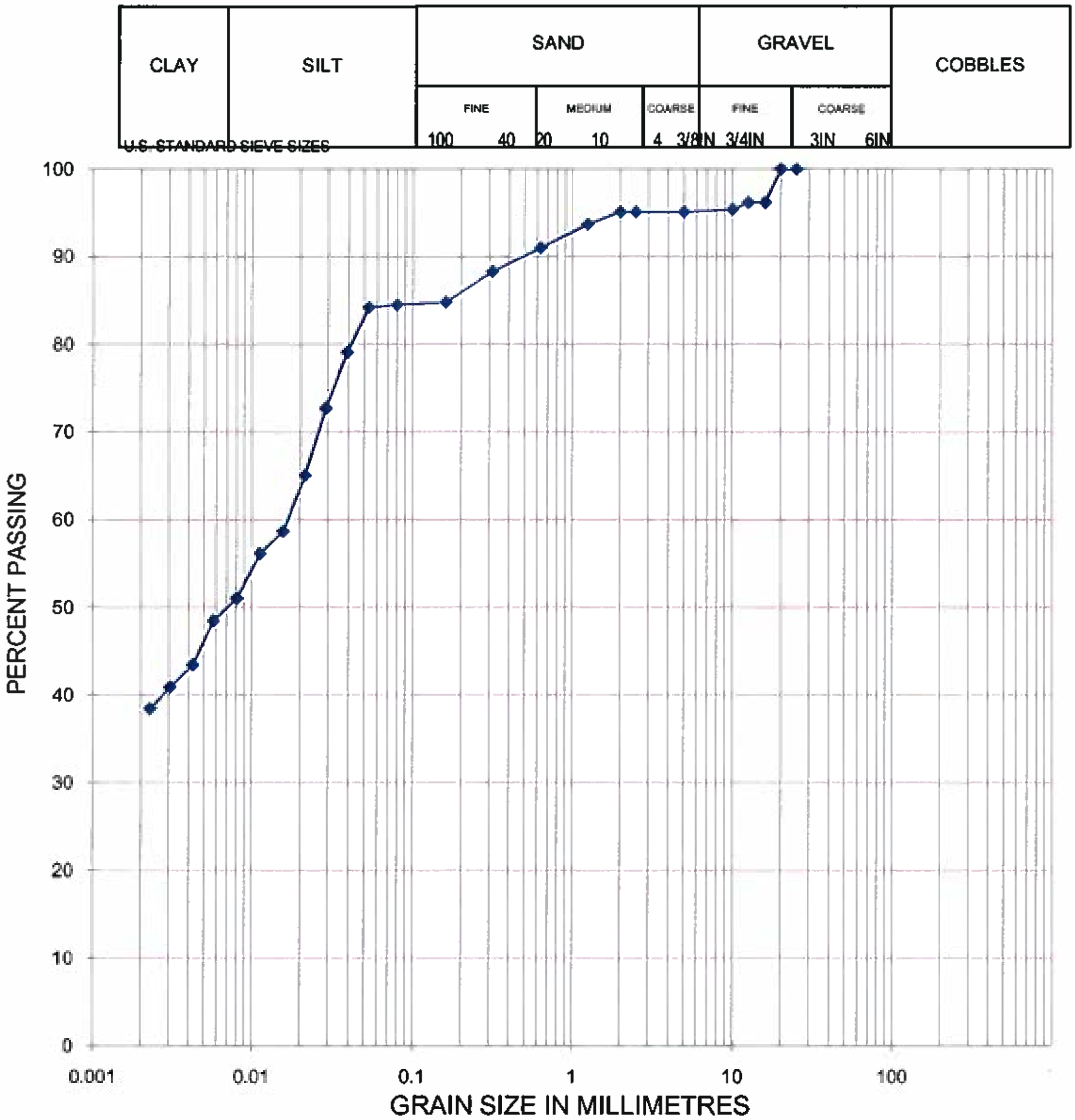
% Retained on 2 mm seive
Soil Type: Sand, some clay, some silt

SUMMARY

D10 =		GRAVEL	0.00%
D30 =		SAND	49.97%
D60 =		SILT	23%
CU =		CLAY	27.04%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	4	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

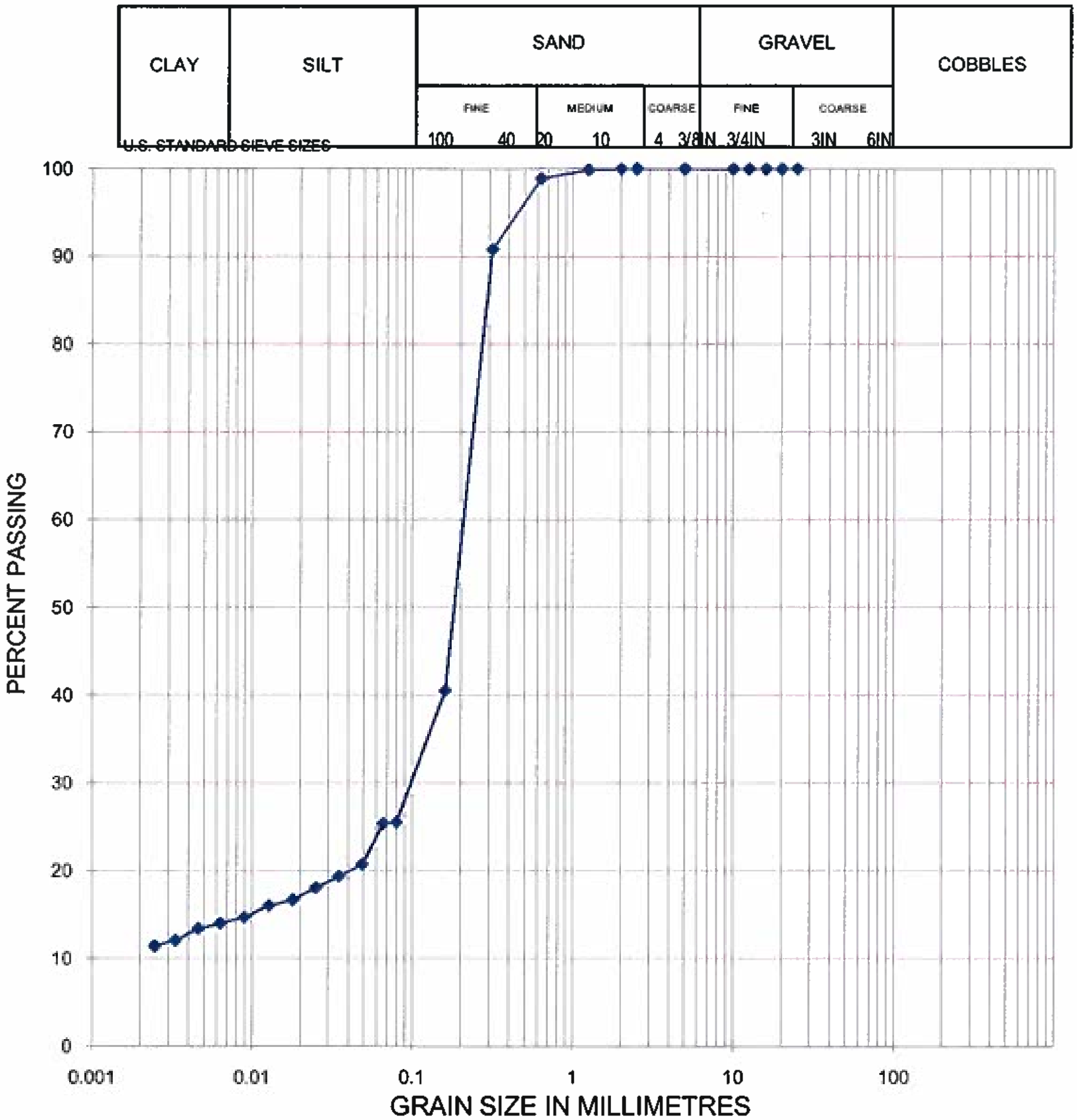
% Retained on 2 mm seive
Soil Type: Clay, some silt, little sand

SUMMARY

D10 =		GRAVEL	4.90%
D30 =		SAND	15.51%
D60 =		SILT	34%
CU =		CLAY	45.86%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	5	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

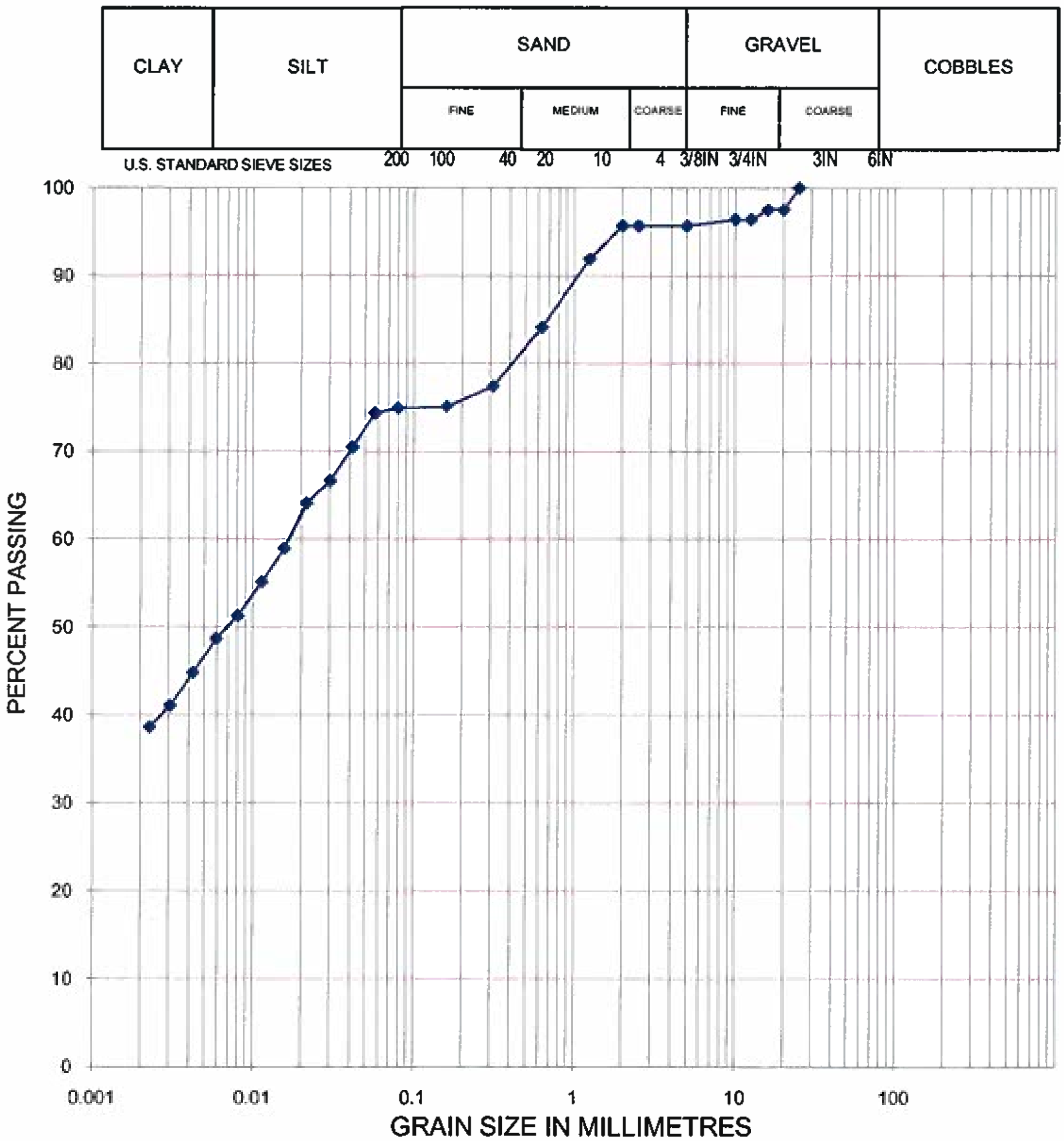
% Retained on 2 mm seive
Soil Type: Sand, little clay, little silt

SUMMARY

D10 =		GRAVEL	0.00%
D30 =		SAND	74.54%
D60 =		SILT	12%
CU =		CLAY	13.52%
CC =			

PROJECT	Millet Industial Park		
PROJECT #	RD2901		
BOREHOLE	6	**DATE** June 3/08	
DEPTH	0.3 m	**TECH** JB	
SAMPLE	6G1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

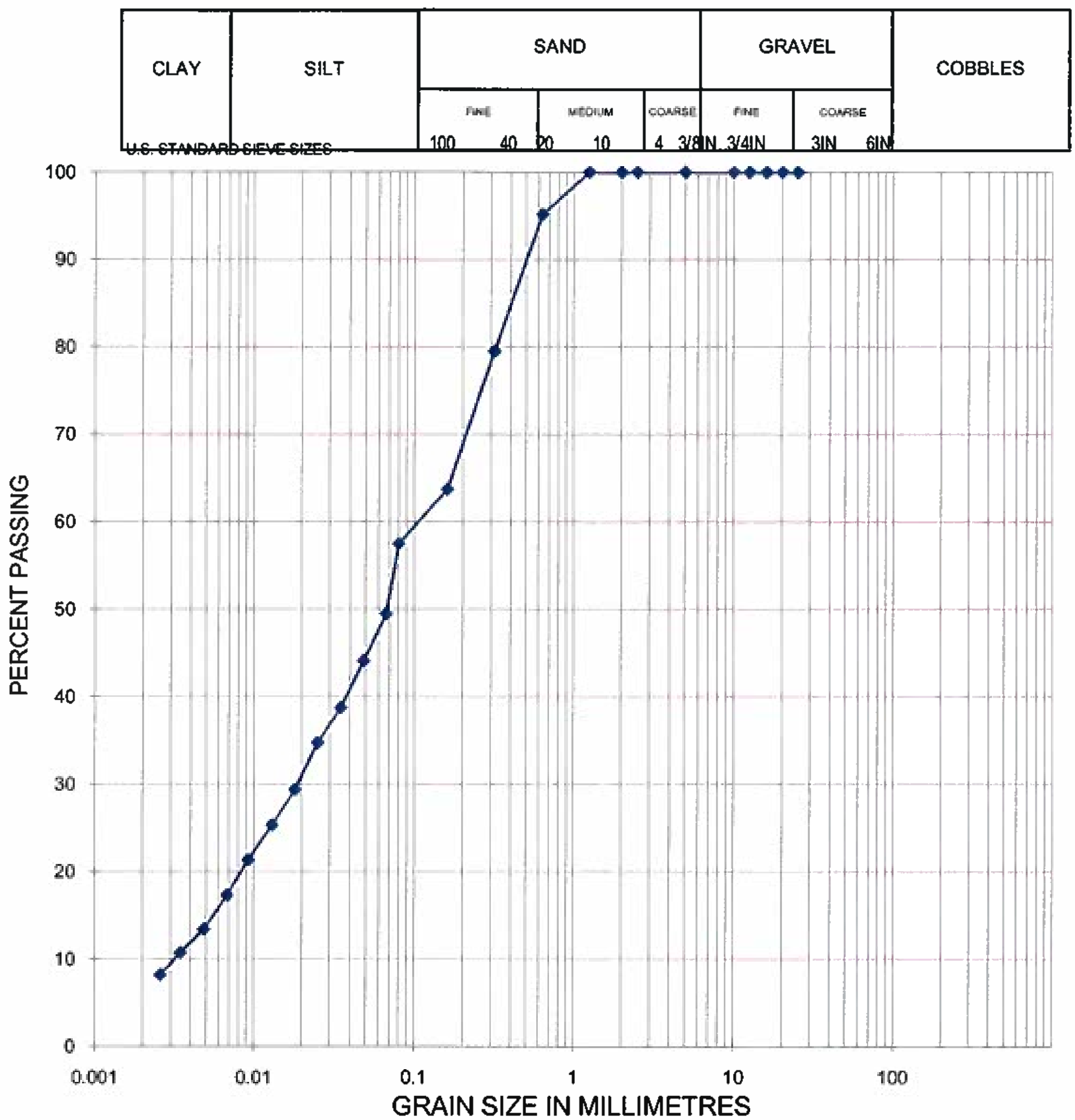
% Retained on 2 mm seive
Soil Type: Clay, some sand, some silt

SUMMARY

D10 =		GRAVEL	4.30%
D30 =		SAND	25.19%
D60 =		SILT	24%
CU =		CLAY	46.49%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	7	**DATE** July 10/08	
DEPTH	1.0 m	**TECH** JB	
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

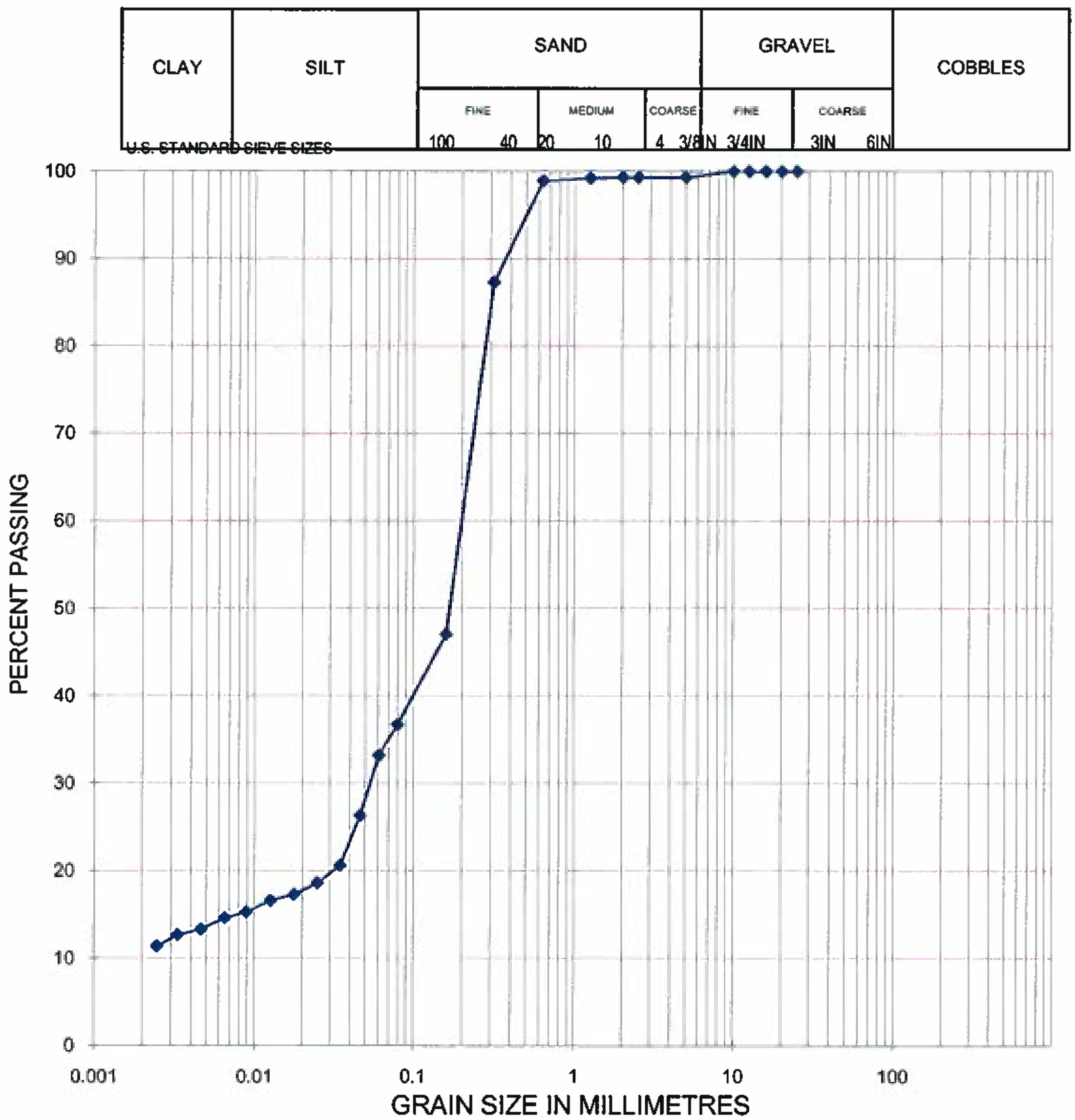
% Retained on 2 mm seive
Soil Type: Sand, and silt, little clay

SUMMARY

D10 =		GRAVEL	0.00%
D30 =		SAND	45.60%
D60 =		SILT	41%
CU =		CLAY	13.64%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	9	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, some silt, little clay

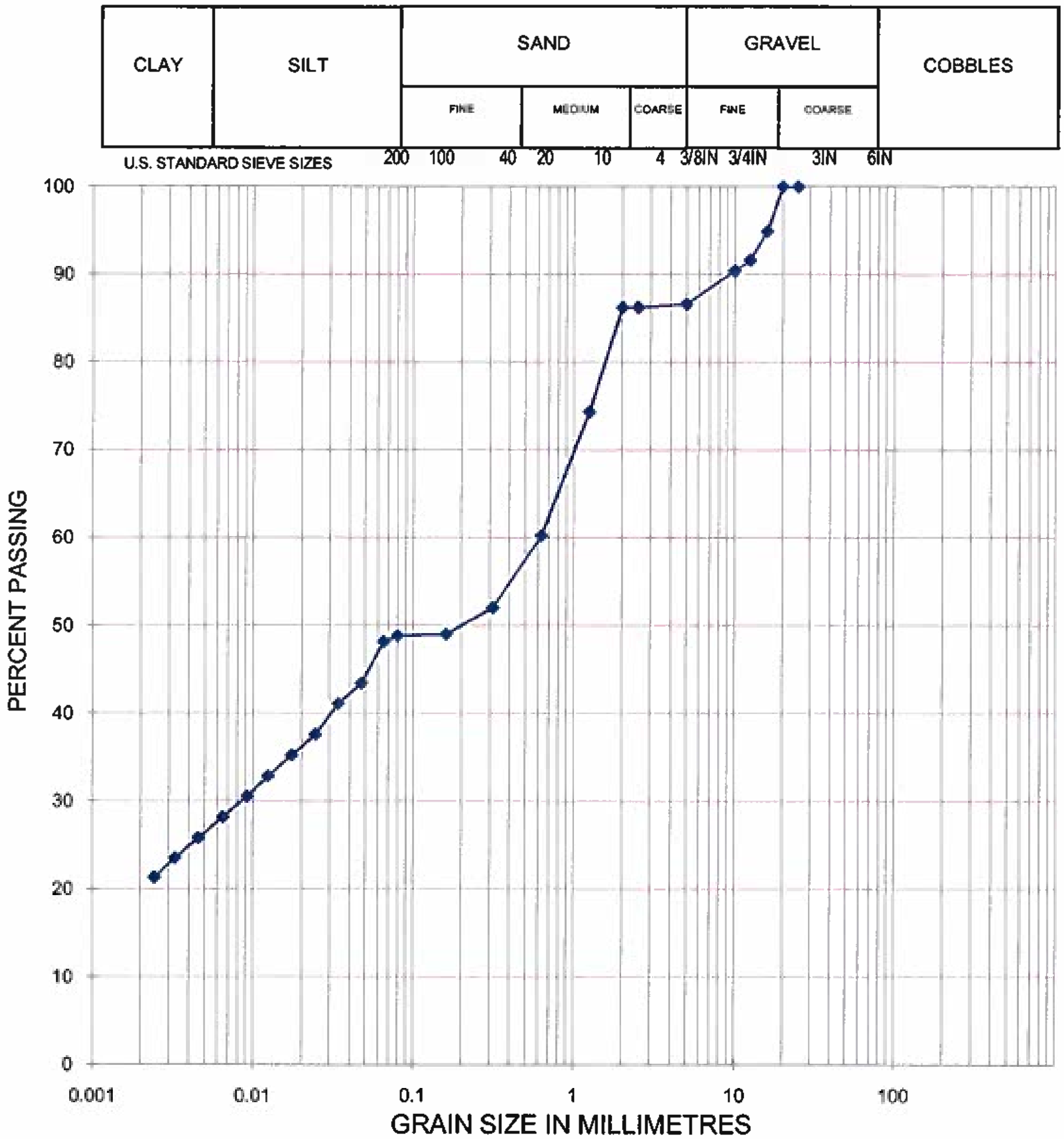
SUMMARY

D10 =		GRAVEL	0.70%
D30 =		SAND	64.23%
D60 =		SILT	22%
CU =		CLAY	13.54%
CC =			

Parkland GEO

PROJECT	Millet Industial Park		
PROJECT #	RD2901		
BOREHOLE	10	**DATE** June 3/08	
DEPTH	0.6 m	**TECH** JB	
SAMPLE	10G1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, some clay, trace silt

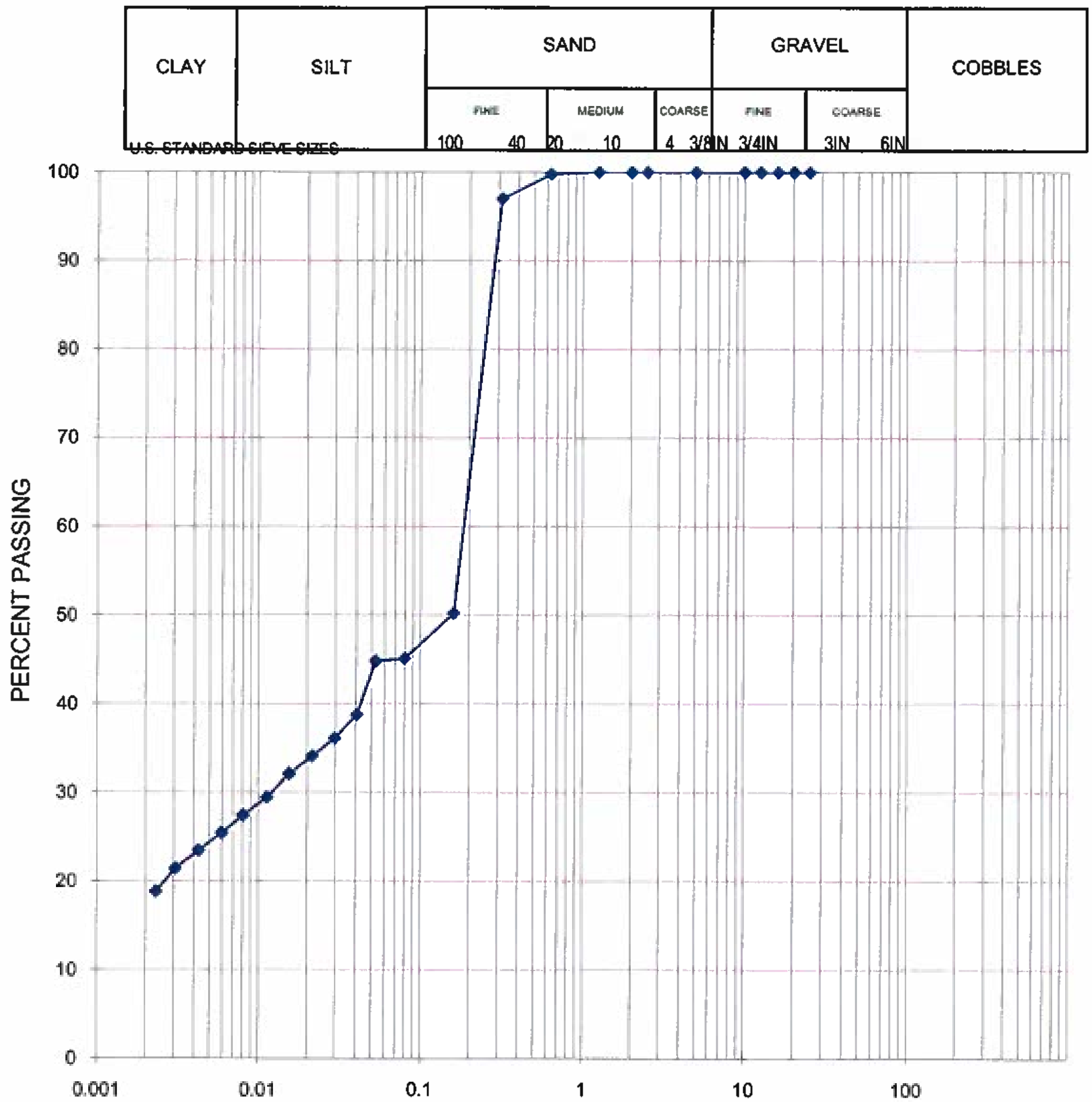
SUMMARY

D10 =		GRAVEL	13.40%
D30 =		SAND	51.29%
D60 =		SILT	9%
CU =		CLAY	26.29%
CC =			

PROJECT	Millet Industrial Park
PROJECT #	RD2901
BOREHOLE	11
DEPTH	1.0 m
SAMPLE	MC1
LOCATION	

DATE July 10/08
TECH JB

GRAIN SIZE DISTRIBUTION



COMMENTS:

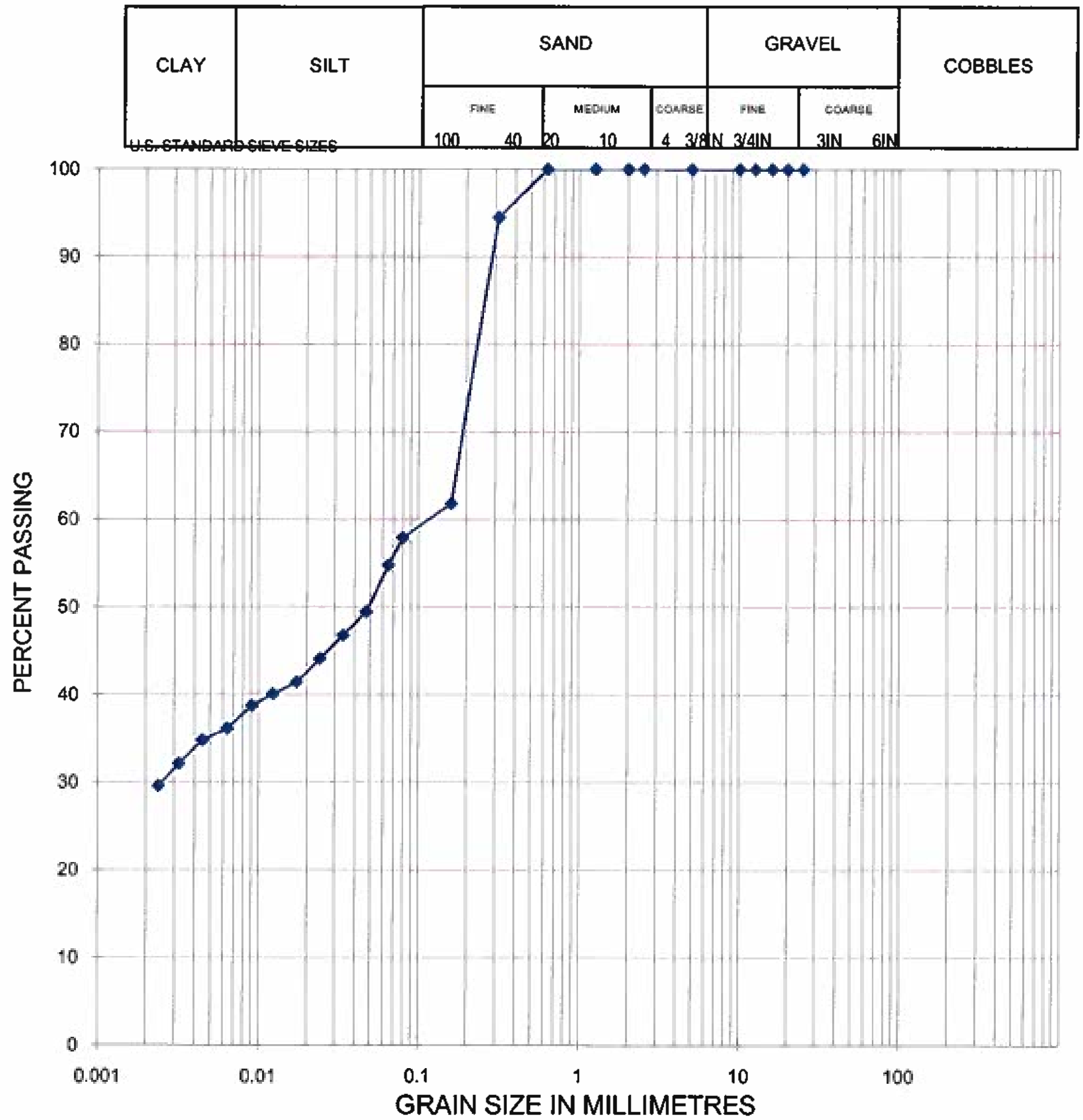
% Retained on 2 mm seive
Soil Type: Sand, some clay, some silt

SUMMARY

D10 =		GRAVEL	0.00%
D30 =		SAND	54.96%
D60 =		SILT	21%
CU =		CLAY	24.28%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	12	**DATE** July 10/08	
DEPTH	1.0 m	**TECH** JB	
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



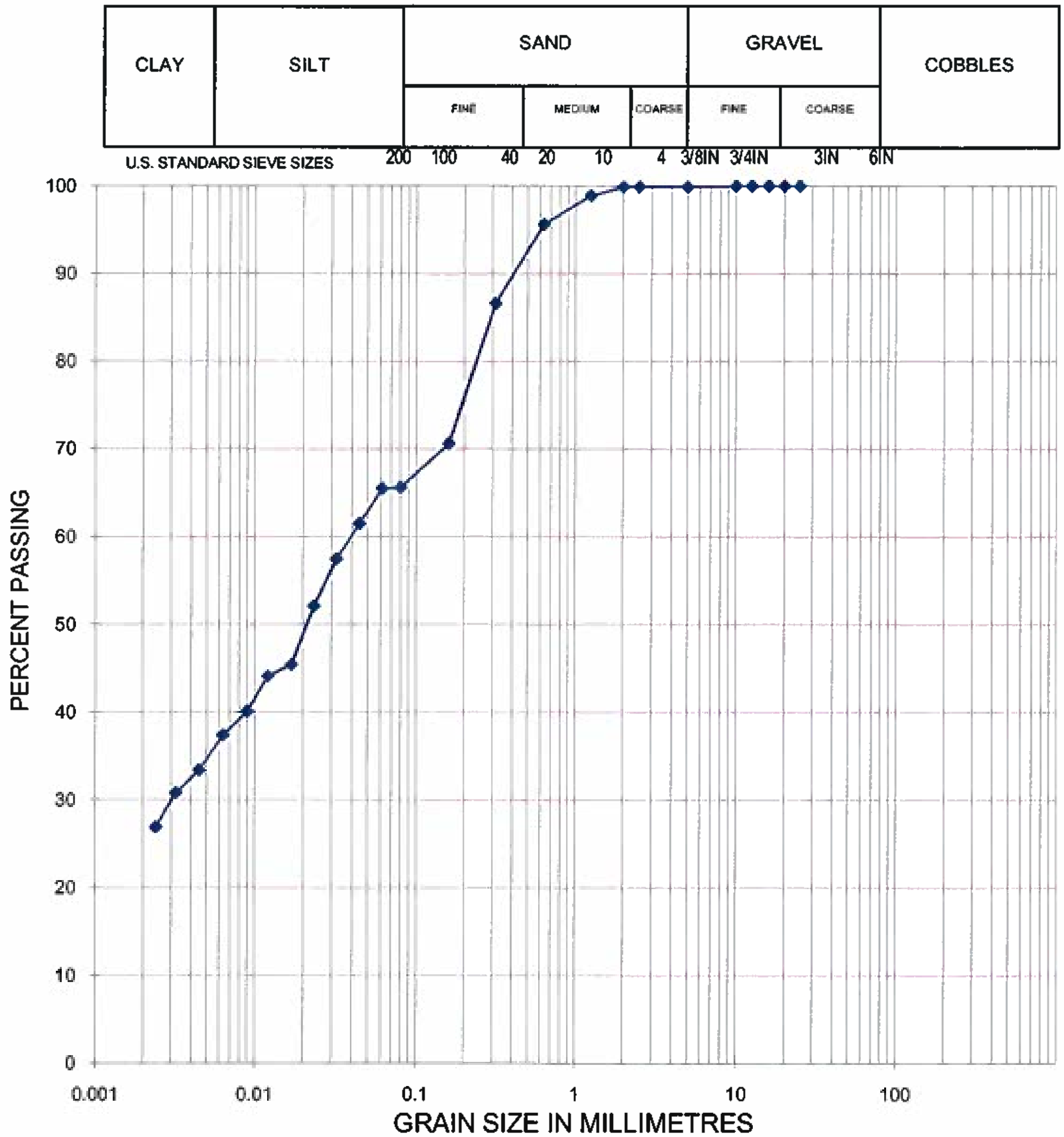
COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, and clay, some silt

		SUMMARY	
D10 =		GRAVEL	0.00%
D30 =		SAND	43.16%
D60 =		SILT	22%
CU =		CLAY	35.15%
CC =			

PROJECT	Millet Industial Park	
PROJECT #	RD2901	
BOREHOLE	14	**DATE** June 3/08
DEPTH	1.5 m	**TECH** JB
SAMPLE	14D1	
LOCATION		

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive

Soil Type: Sand, some clay, some silt

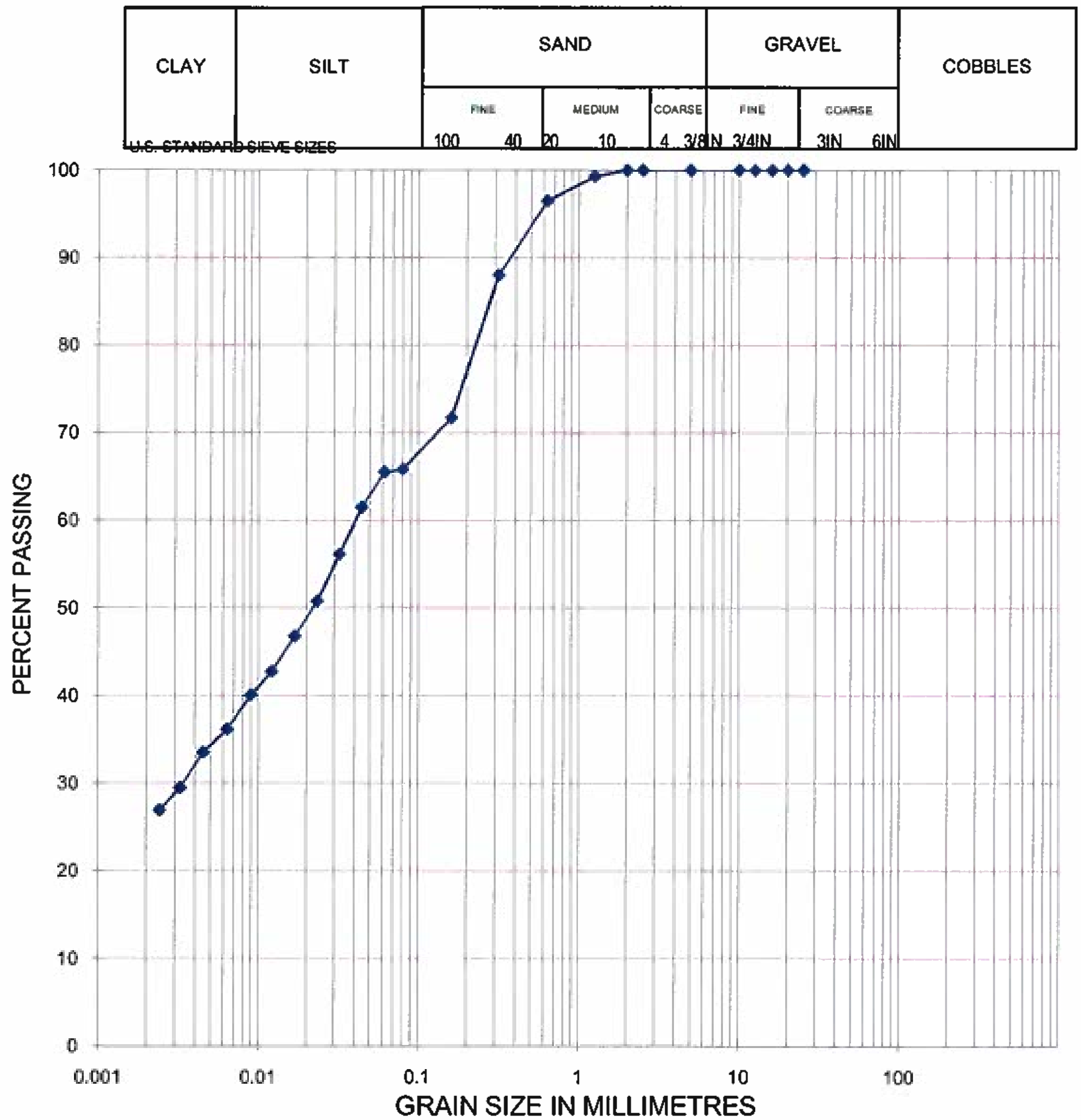
SUMMARY

D10 =		GRAVEL	0.10%
D30 =		SAND	34.43%
D60 =		SILT	31%
CU =		CLAY	34.42%
CC =			

ParklandGEO

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	15	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

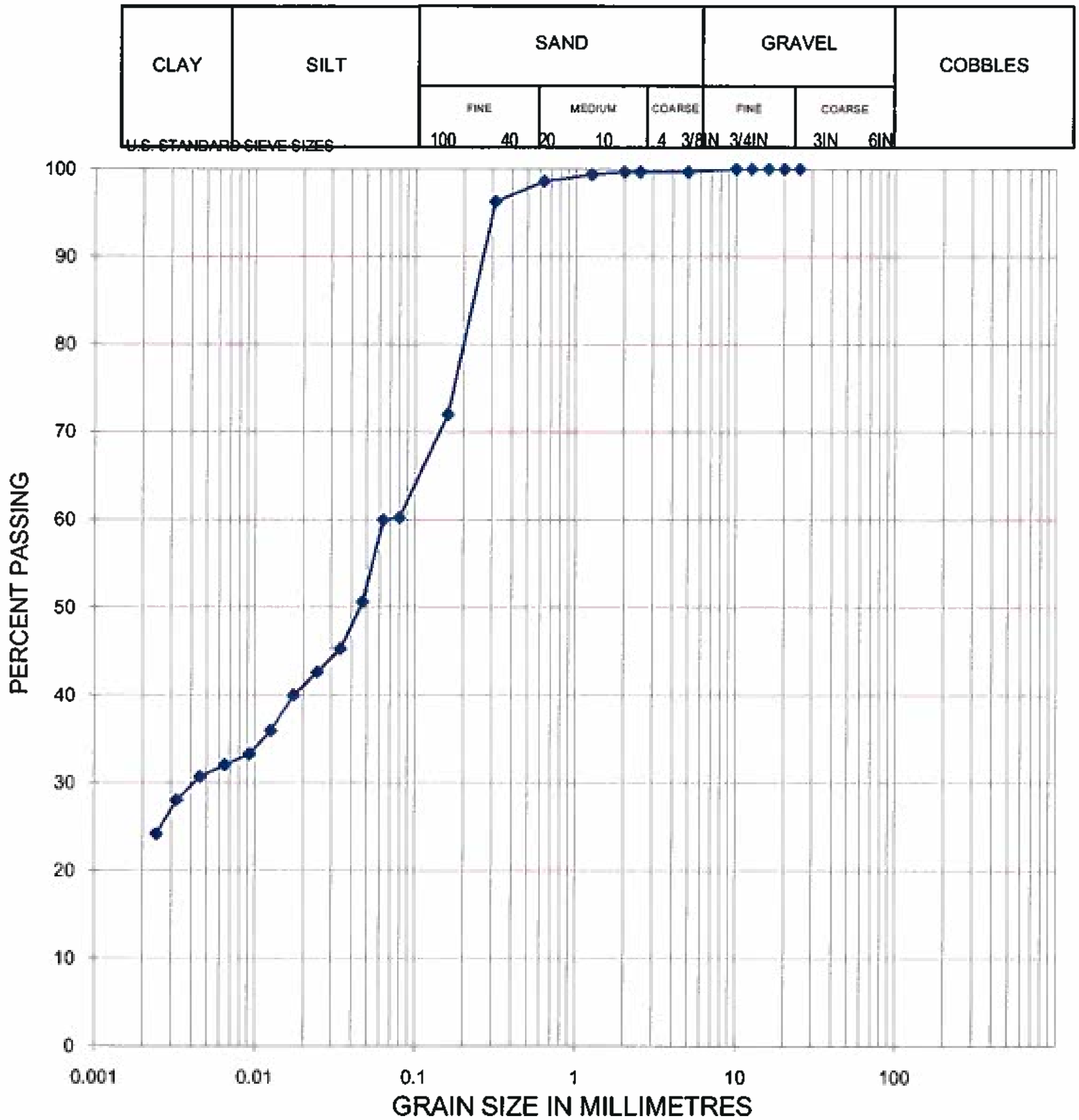
% Retained on 2 mm seive
Soil Type: Sand, some clay, some silt

SUMMARY

D10 =		GRAVEL	0.00%
D30 =		SAND	34.28%
D60 =		SILT	32%
CU =		CLAY	34.15%
CC =			

PROJECT	Millet Industrial Park		
PROJECT #	RD2901		
BOREHOLE	17	**DATE**	July 10/08
DEPTH	1.0 m	**TECH**	JB
SAMPLE	MC1		
LOCATION			

GRAIN SIZE DISTRIBUTION



COMMENTS:

% Retained on 2 mm seive
Soil Type: Sand, some clay, some silt

SUMMARY

D10 =		GRAVEL	0.30%
D30 =		SAND	39.88%
D60 =		SILT	29%
CU =		CLAY	30.98%
CC =			

Parkland GEO

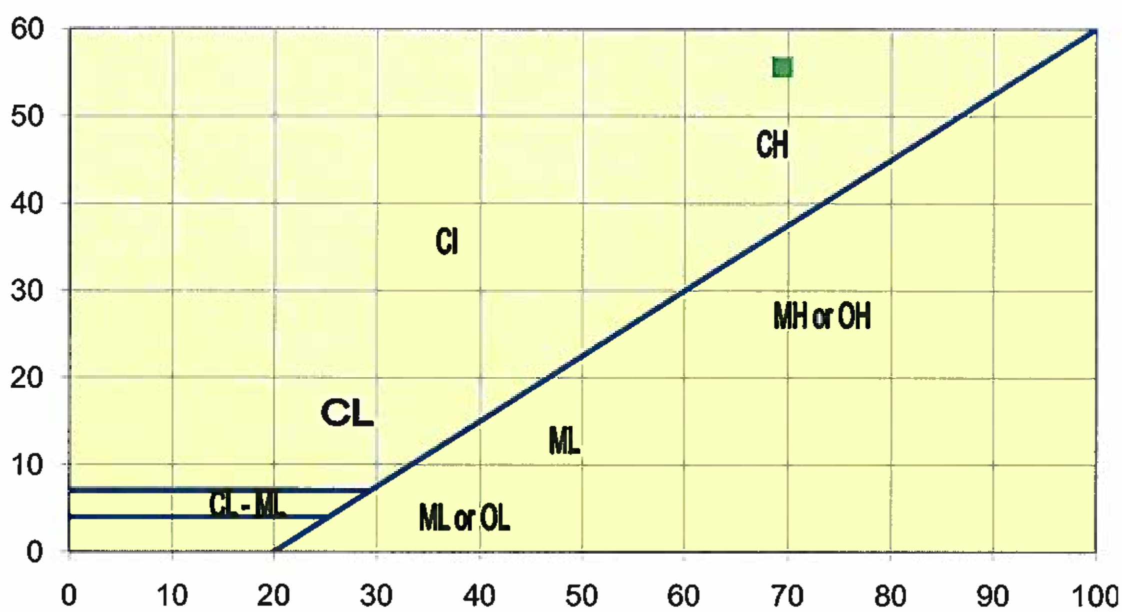
PROJECT# RD2901
PROJECT Millet Industrial Park
BOREHOLE 6
DEPTH 0.3 m
SAMPLE # 6G1
DATE June 3/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	29	30
Wt. Sample Wet + Tare	38.116	41.660
Wt. Sample Dry + Tare	28.952	31.771
Wt. Water	9.164	9.889
Tare Container	16.186	16.397
Wt. Dry Soil	12.766	15.374
Moisture Content	71.784	64.323
Corrected for Blow Count	73.085	65.758
Liquid Limit Average	**69.4**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.448	8.646	8.484
Wt. Dry Worm + Tare	8.196	8.360	8.220
Wt. Water	0.252	0.286	0.264
Tare Container	6.360	6.293	6.304
Wt. Dry Worm	1.836	2.067	1.916
Moisture Content	13.725	13.836	13.779
Plastic Limit Average		**13.8**	

PLASTICITY INDEX (PI) = LL-PL 55.6



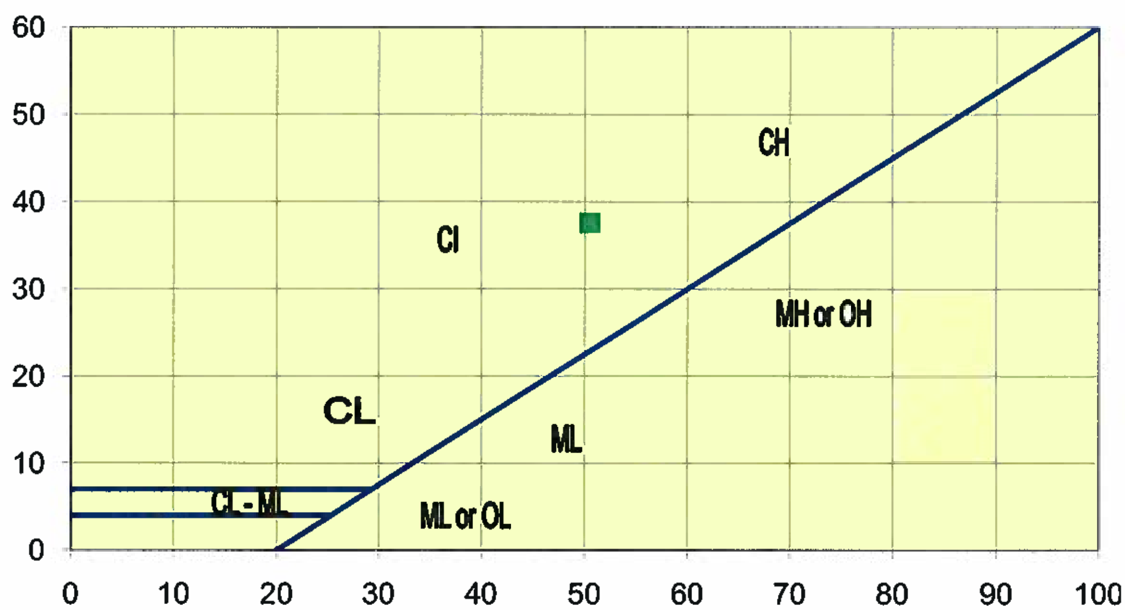
PROJECT#	RD2901
PROJECT	Millet Industrial Park
BOREHOLE	10
DEPTH	0.6 m
SAMPLE #	10G1
DATE	June 3/08
TECH	JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	29	30
Wt. Sample Wet + Tare	41.355	43.937
Wt. Sample Dry + Tare	32.921	34.804
Wt. Water	8.434	9.133
Tare Container	16.216	15.969
Wt. Dry Soil	16.705	18.835
Moisture Content	50.488	48.490
Corrected for Blow Count	51.403	49.571
Liquid Limit Average	**50.5**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.317	8.368	8.286
Wt. Dry Worm + Tare	8.081	8.130	8.052
Wt. Water	0.236	0.238	0.234
Tare Container	6.239	6.284	6.264
Wt. Dry Worm	1.842	1.846	1.788
Moisture Content	12.812	12.893	13.087
Plastic Limit Average		**12.9**	

PLASTICITY INDEX (PI) = LL-PL **37.6**



Parkland GEO

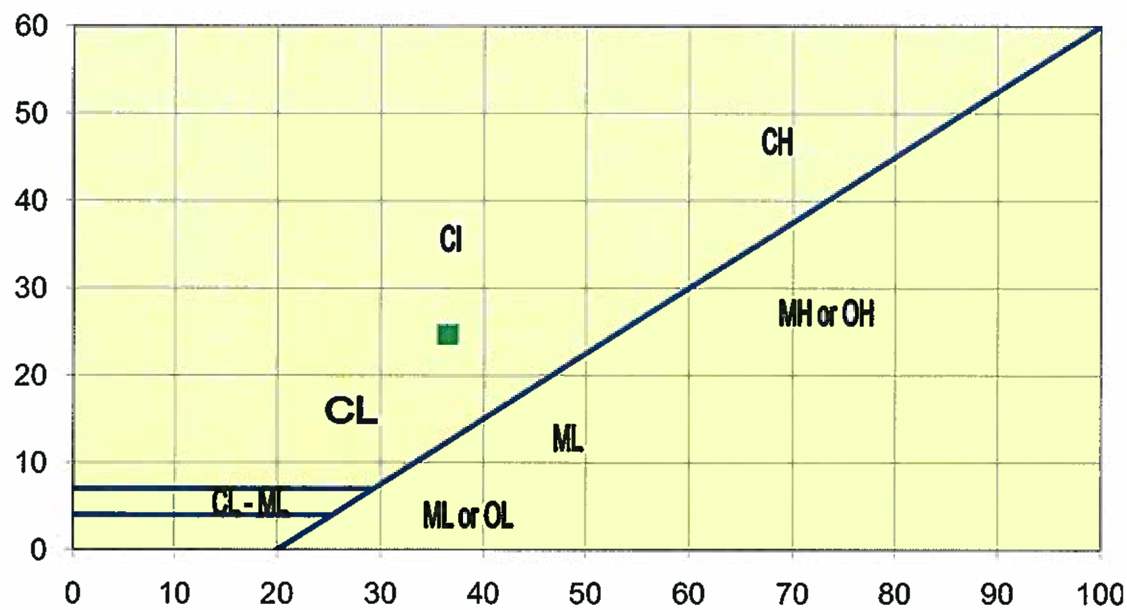
PROJECT# RD2901
PROJECT Millet Industrial Park
BOREHOLE 14
DEPTH 1.5 m
SAMPLE # 14D1
DATE June 3/08
TECH JB

SOIL PLASTICITY SUMMARY

LIQUID LIMIT (LL)		
Trial No.	1	2
No. Blows	26	27
Wt. Sample Wet + Tare	44.476	49.354
Wt. Sample Dry + Tare	36.931	40.602
Wt. Water	7.545	8.752
Tare Container	16.187	16.333
Wt. Dry Soil	20.744	24.269
Moisture Content	36.372	36.062
Corrected for Blow Count	36.545	36.400
Liquid Limit Average	**36.5**	

PLASTIC LIMIT (PL)			
Trial No.	1	2	3
Wt. Wet Worm + Tare	8.609	8.407	8.343
Wt. Dry Worm + Tare	8.370	8.179	8.129
Wt. Water	0.239	0.228	0.214
Tare Container	6.334	6.237	6.345
Wt. Dry Worm	2.036	1.942	1.784
Moisture Content	11.739	11.740	11.996
Plastic Limit Average		**11.8**	

PLASTICITY INDEX (PI) = LL-PL **24.6**



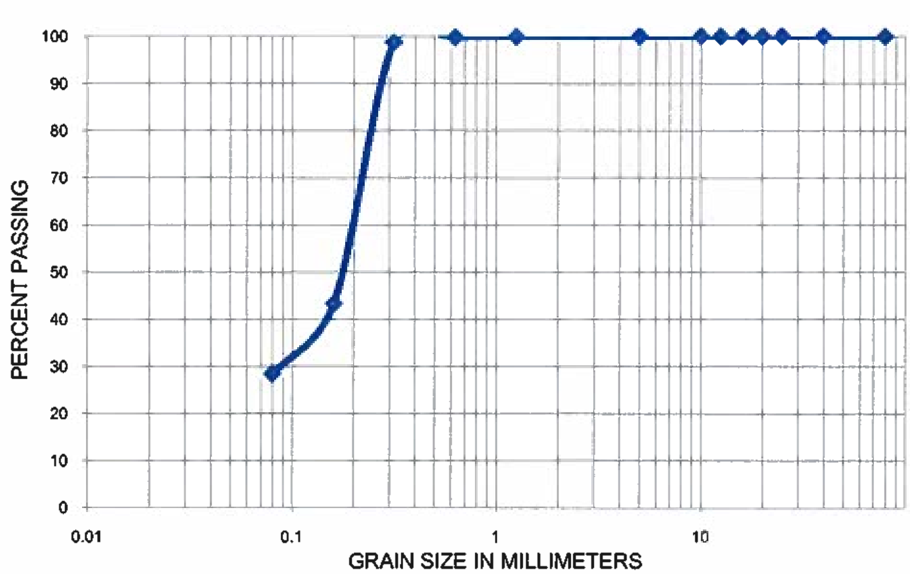
Parkland GEO

PROJECT - Millet Industrial Park
PROJECT # RD2901 **DATE -** June 4/08
SAMPLE SOURCE -
PIT NAME -
TECHNICIAN - JB **SIEVE #** 1

SIEVE NO.	OPENING SIZE (mm)	WEIGHT RETAINED (g)	TOTAL WT. FINER (gms)	PERCENT PASSING	SPECIFICATION Min.	SPECIFICATION Max.
80000	80		668	100.0		
40000	40		668	100.0		
25000	25		668	100.0		
20000	20		668	100.0		
16000	16		668	100.0		
12500	12.5		668	100.0		
10000	10		668	100.0		
5000	5		668	100.0		
1250	1.25	0.4	667.6	99.9		
630	0.63	1.3	666.3	99.7		
315	0.315	7.2	659.1	98.7		
160	0.16	369.6	289.5	43.3		
80	0.08	100	189.5	28.4		
SIEVE PAN		14.5				

MOISTURE CONTENT SAMPLE		SIEVE ANALYSIS SAMPLE		D.W.W.CALCULATIONS
A-WT. WET SAMPLE + PAN	1483.3	G-WT. OF DRY SAMPLE	668	
B-WT. DRY SAMPLE + PAN	1358.4	H- WASHED DRY +PAN	1183.1	
C-WT. OF WATER	124.9	I- WT OF WASHED DRY SA	492.7	
D-WT. OF PAN	690.4	J- WT WASHED FINES	175.3	
E-WT. OF DRY SAMPLE	668			
F-MOISTURE CONTENT	18.7			

DESCRIPTION OF SAMPLE/COMMENTS	METHOD OF PREPARATION	WASHED
BH1	TOTAL WEIGHT	668.3
1D1	DRY WT.	668
1.5 m	DIFFERENCE	0.3
	% DIFFERENCE	0.0004491



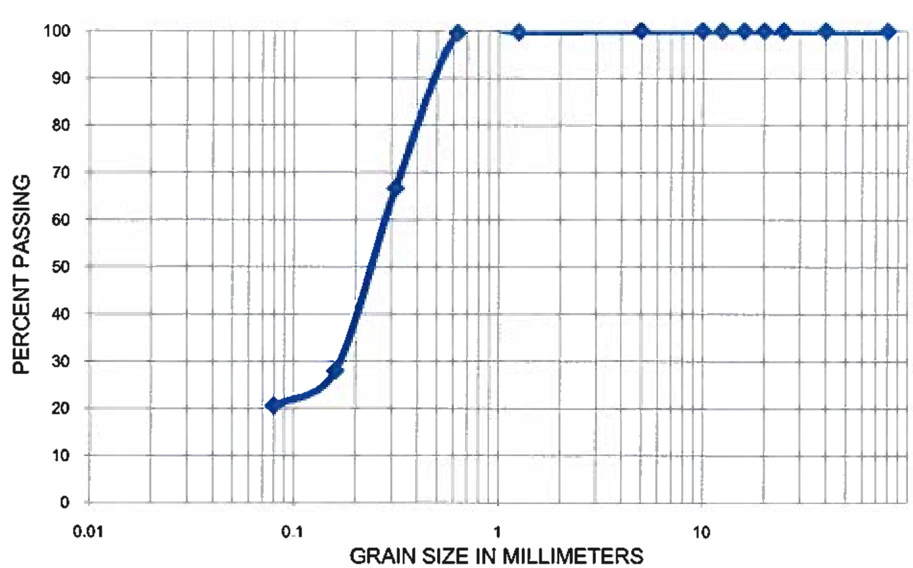
ParklandGEO

PROJECT - Millet Industrial Park
PROJECT # RD2901 **DATE -** June 5/08
SAMPLE SOURCE -
PIT NAME -
TECHNICIAN - JB **SIEVE #** 2

SIEVE NO.	OPENING SIZE (mm)	WEIGHT RETAINED (g)	TOTAL WT. FINER (gms)	PERCENT PASSING	SPECIFICATION Min.	Max.
80000	80		577.6	100.0		
40000	40		577.6	100.0		
25000	25		577.6	100.0		
20000	20		577.6	100.0		
16000	16		577.6	100.0		
12500	12.5		577.6	100.0		
10000	10		577.6	100.0		
5000	5		577.6	100.0		
1250	1.25	1.3	576.3	99.8		
630	0.63	1.4	574.9	99.5		
315	0.315	190.2	384.7	66.6		
160	0.16	223.4	161.3	27.9		
80	0.08	42.9	118.4	20.5		
SIEVE PAN		8.5				

MOISTURE CONTENT SAMPLE		SIEVE ANALYSIS SAMPLE		D.W.W.CALCULATIONS
A-WT. WET SAMPLE + PAN	1363.5	G-WT. OF DRY SAMPLE	577.6	
B-WT. DRY SAMPLE + PAN	1268.1	H- WASHED DRY +PAN	1158.4	
C-WT. OF WATER	95.4	I- WT OF WASHED DRY SA	467.9	
D-WT. OF PAN	690.5	J- WT WASHED FINES	109.7	
E-WT. OF DRY SAMPLE	577.6			
F-MOISTURE CONTENT	16.5			

DESCRIPTION OF SAMPLE/COMMENTS	METHOD OF PREPARATION	WASHED
BH11	TOTAL WEIGHT	577.4
11D1	DRY WT.	577.6
1.5 m	DIFFERENCE	-0.2
	% DIFFERENCE	-0.0003463



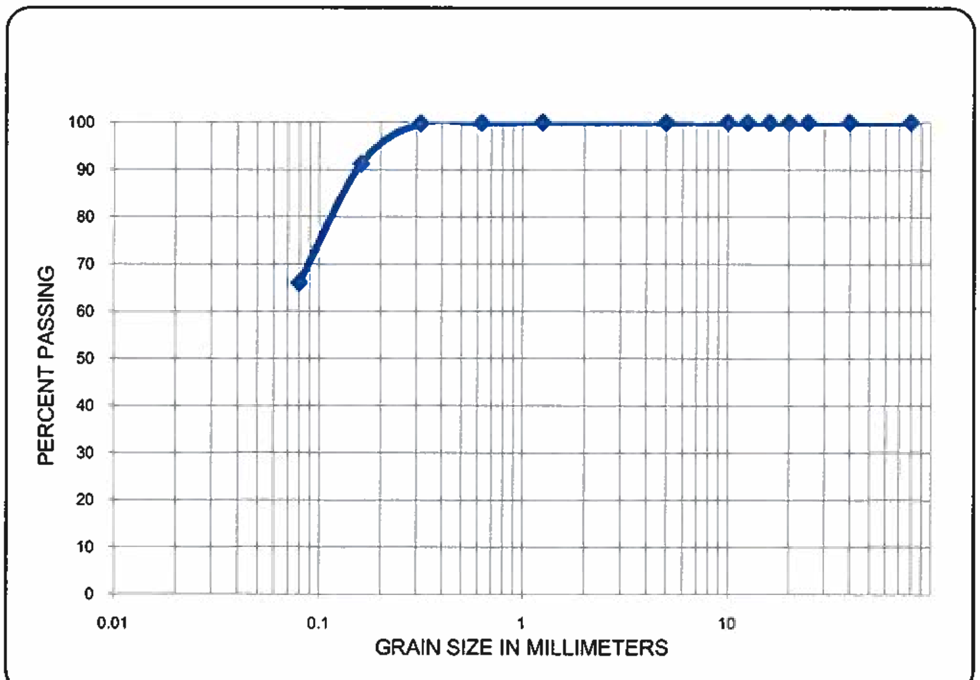
ParklandGEO

PROJECT - Millet Industrial Park
PROJECT # RD2901 DATE - June 6/08
SAMPLE SOURCE -
PIT NAME -
TECHNICIAN - JB SIEVE # 3

SIEVE NO.	OPENING SIZE (mm)	WEIGHT RETAINED (g)	TOTAL WT. FINER (gms)	PERCENT PASSING	SPECIFICATION Min.	SPECIFICATION Max.
80000	80		733.9	100.0		
40000	40		733.9	100.0		
25000	25		733.9	100.0		
20000	20		733.9	100.0		
16000	16		733.9	100.0		
12500	12.5		733.9	100.0		
10000	10		733.9	100.0		
5000	5		733.9	100.0		
1250	1.25		733.9	100.0		
630	0.63	0.7	733.2	99.9		
315	0.315	1.4	731.8	99.7		
160	0.16	62.6	669.2	91.2		
80	0.08	184.7	484.5	66.0		
SIEVE PAN		4.6				

MOISTURE CONTENT SAMPLE		SIEVE ANALYSIS SAMPLE		D.W.W.CALCULATIONS
A-WT. WET SAMPLE + PAN	1568.6	G-WT. OF DRY SAMPLE	733.9	
B-WT. DRY SAMPLE + PAN	1424	H- WASHED DRY +PAN	943.1	
C-WT. OF WATER	144.6	I- WT OF WASHED DRY SA	253	
D-WT. OF PAN	690.1	J- WT WASHED FINES	480.9	
E-WT. OF DRY SAMPLE	733.9			
F-MOISTURE CONTENT	19.7			

DESCRIPTION OF SAMPLE/COMMENTS	METHOD OF PREPARATION	WASHED
BH3	TOTAL WEIGHT	734.9
3D1	DRY WT.	733.9
1.5 m	DIFFERENCE	1
	% DIFFERENCE	0.00136258



Project: Millet Industrial Park

Subject: Geotechnical Testing - Soil Sulphate Test Results

Project #: RD2901 **Date:** June 5/08

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC2 Borehole: 1 Depth: 2.0 m Result (% Sulphate): 0.18	Sample #: MC2 Borehole: 6 Depth: 2.0 m Result (% Sulphate): 0.12
Sample #: MC2 Borehole: 2 Depth: 2.0 m Result (% Sulphate): 0.19	Sample #: MC2 Borehole: 7 Depth: 2.0 m Result (% Sulphate): 0.08
Sample #: MC2 Borehole: 3 Depth: 2.0 m Result (% Sulphate): 0.11	Sample #: MC2 Borehole: 8 Depth: 2.0 m Result (% Sulphate): 0.09
Sample #: MC2 Borehole: 4 Depth: 2.0 m Result (% Sulphate): 0.13	Sample #: MC2 Borehole: 9 Depth: 2.0 m Result (% Sulphate): 0.1
Sample #: MC2 Borehole: 5 Depth: 2.0 m Result (% Sulphate): 0.1	Sample #: MC2 Borehole: 10 Depth: 2.0 m Result (% Sulphate): 0.1

Comments:

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M04)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO_4) IN SOIL SAMPLE, %	SULPHATE(SO_4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

Tech: JB **Chkd:**

Parkland GEO

Project: Millet Industrial Park

Subject: Geotechnical Testing - Soil Sulphate Test Results

Project #: RD2901 **Date:** June 6/08

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC2 Borehole: 11 Depth: 2.0 m Result (% Sulphate): 0.06	Sample #: MC2 Borehole: 16 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 12 Depth: 2.0 m Result (% Sulphate): 0.08	Sample #: MC2 Borehole: 17 Depth: 2.0 m Result (% Sulphate): 0.04
Sample #: MC2 Borehole: 13 Depth: 2.0 m Result (% Sulphate): 0.19	Sample #: MC2 Borehole: 18 Depth: 2.0 m Result (% Sulphate): 0.13
Sample #: MC2 Borehole: 14 Depth: 2.0 m Result (% Sulphate): 0.11	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: MC2 Borehole: 15 Depth: 2.0 m Result (% Sulphate): 0.04	Sample #: Borehole: Depth: Result (% Sulphate):

Comments:

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M04)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO_4) IN SOIL SAMPLE, %	SULPHATE(SO_4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

Tech: JB **Chkd:**

DESIGNATION		1			2					3				4			5	6		7	8
CLASS (mm)		10	12.5	16	16	20	25	40	50	12.5A	12.5B	12.5C	16	20	25	40	10	80	125	40	40
PER CENT PASSING METRIC SIEVE (CGSB 8 - GP - 2M) µm	125 000																		100		
	80 000																	100			
	50 000								100									55-100	55-100		
	40 000							100								100				100	100
	25 000						100		63-90						100			38-100	38-100		
	20 000					100								100		55-90					
	16 000			100	100		70-94	55-85	47-79				100					32-85	32-85		
	12 500		100	80-92						100	100	100	72-95								
	10 000	100	83-92	70-84	70-93	63-86	52-79	44-74	38-70	35-65	55-75	70-93	53-85	35-77	30-77	25-72	100			85-100	78-95
	5 000	60-75	55-70	50-65	50-70	40-67	35-64	32-62	28-59	0-15	0-15	30-70	27-64	15-55	15-55	8-55	45-70	20-65	20-65		60-85
	1250	30-45	30-45	30-45	26-45	20-43	18-43	17-43	16-42	0-3	0-3	9-34	9-34	0-30	0-30	0-30	20-45			40-100	27-57
	630	22-38	22-38	22-38	19-38	14-34	12-34	12-34	12-34												
	315	15-30	15-30	15-30	14-30	9-26	8-26	8-26	8-26			0-18	0-18				9-22	6-30	6-30	17-100	5-29
	160	9-20	9-20	9-20	9-20	5-18	5-18	5-18	5-18			0-13	0-13				5-15				0-15
	80	4-10	4-10	4-10	4-10	2-10	2-10	2-10	2-10	0-2	0-2	0-8	0-8	0-12	0-12	0-12	0-10	2-10	2-15	6-30	0-5
% FRACTURE BY WEIGHT (2 FACES)	ALL +5000	60+	60+	60+	60+	60+	60+	50+	40+	75+	75+	60+	60+	40+	40+	25+	N/A	N/A	N/A	N/A	N/A
PLASTICITY INDEX (PI)		0-4	0-4	0-4	0-6	0-6	0-6	0-6	0-6	N/A	N/A	0-4	0-4	0-8	0-8	0-8	0-6	0-8	0-8	0-10	0-5
L.A. ABRASION LOSS PER CENT MAX.		40	40	40	50	50	50	50	50	35	35	35	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FLAKINESS INDEX		N/A								MAX 15		N/A									
COEFFICIENT OF UNIFORMITY (Cu)		N/A																		3+	N/A

DESIGNATION

1. ASPHALT CONCRETE AGGREGATE (CLASS 10 FOR SURFACE PREPARATION COURSE ONLY)
2. GRANULAR AND ASPHALT STABILIZED BASE COURSES, SUB-BASES AND DUST ABATEMENT AGGREGATES.
3. SEAL COAT AGGREGATE
4. GRAVEL SURFACING AGGREGATE
5. SANDING MATERIAL
6. PIT-RUN GRAVEL FILL
7. CEMENT STABILIZED BASE COURSE AGGREGATE
8. GRANULAR FILTER AGGREGATE

Alberta
TRANSPORTATION AND UTILITIES

CHART	3.2 A
	Date
Original	MARCH 1984
Revised	DEC. 1985
Revised	FEB. 1987
Revised	MAR.1988

SPECIFICATIONS FOR AGGREGATE

13 MAY 88
417PI169

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following two pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The borehole logs may include test data from laboratory soil testing, if applicable. The materials, boundaries and conditions have been established only at the borehole locations at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile usually have gradual rather than distinct unit boundaries as shown on this graphical representation.

1. **PRINCIPAL SOIL TYPE** - The major soil type by weight of material or by behavior.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.75 mm to 0.425 mm
Silt & Clay	Smaller than 0.075 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** - Minor soil types are identified by weight of minor component.

Percent	Descriptor
35 to 50	and
20 to 35	some
10 to 20	little
1 to 10	trace

3. **RELATIVE STRENGTH OF COARSE GRAINED SOIL** - The following terms are used relative to Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

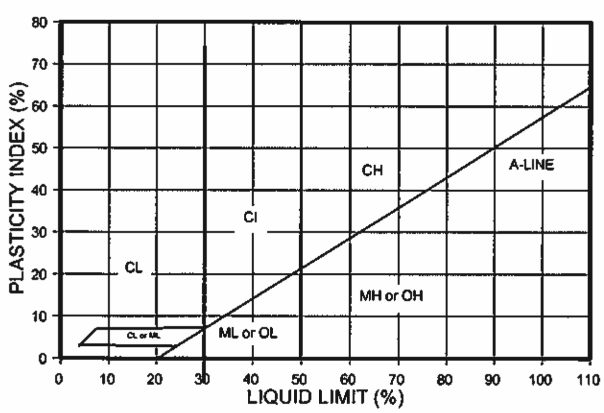
Description	N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

4. **CONSISTENCY OF FINED GRAINED SOIL** - The following terms are used relative to unconfined strength in kPa and Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	Unconfined Compressive Strength (kPa)	N Value
Very Soft	less than 25	Less than 2
Soft	25 to 50	2 to 4
Firm	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very Stiff	200 to 380	15 to 30
Hard	Over 380	Over 30

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO	NOT MEETING ALL OF THE ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. MORE THAN
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ALL OF THE ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. MORE THAN
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLUOR, SILTY SANDS OF SLIGHT	CLASSIFICATION IS BASED ON THE PLASTICITY CHART BELOW	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY		
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS,		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY		
	ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL		ORGANIC SILT, AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

5. Soils are classified and described according to their engineering properties and behaviour.
6. Boundary classifications for soils with characteristics of two groups are given combined group symbols, eg. GW-GC is a well graded gravel-sand mixture with clay binder between 5 and 12 %.
7. Soil classification is in accordance with the Unified Soil Classification System, with the exception that an inorganic clay of medium plasticity (CI) is recognized.
8. The use of modifying adjectives may be employed to define the estimated percentage range by weight of minor components.

ParklandGEO

Appendix C

TRAFFIC IMPACT ASSESSMENT
PART OF NE ¼ SEC 32-47-24-W4M

MILLET, ALBERTA

Prepared For
AJN INVESTMENT AND DEVELOPMENT

Prepared By
WILLIAMS ENGINEERING CANADA INC.

WE FILE NO. i14236.00
JUNE, 2009

WILLIAMS
ENGINEERING
CANADA

WE

#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

Edmonton
Yellowknife
Calgary
Winnipeg
Red Deer
Corporate

TRAFFIC IMPACT ASSESSMENT
PART OF NE ¼ SEC 32-47-24 W4M

Prepared For

AJN INVESTMENT AND DEVELOPMENT

JUNE, 2009
WE FILE NO. i14236.00

Prepared by,

Kevin Paul, E.I.T.
Municipal Engineer

Reviewed by,

Wayne Gustafson, P.Eng.
Regional Director, Central

PERMIT TO PRACTICE
WILLIAMS ENGINEERING CANADA INC.

Signature

Date June 15/09

PERMIT NUMBER: P10527

The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER
WAYNE DONALD GUSTAFSON
June 15/09
ALBERTA

WILLIAMS
ENGINEERING
CANADA

#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

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APPENDICES

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Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

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RECOMMENDATIONS

Williams Engineering Canada Inc. was retained by AJN Investment and Development to conduct a traffic impact study for a proposed light industrial development in the County of Wetaskiwin, near the town of Millet, Alberta. Three proposed intersections were studied for the impact of both existing and future traffic from the development over the next 25 years. The study evaluated such factors as the need for turning lanes at the intersections, requirements for signalization and illumination as well as the available sight distance to enable a driver to safely react to intersection traffic.

This report has been prepared based on the best information available at the time. It is intended to provide conceptual review of the specific issues. Should assumptions or parameters change, amendments to the study should be made.

We have analyzed five locations, shown in **Appendix A,** and using a 25 year horizon we have made the following comments and conclusions.

Highway 2A & Township Road 480

1. Left turn lane is required for the north leg of the intersection.
2. An extra 25 metres of storage is required for the left turn lane on the north leg of the intersection.
3. Right turn lanes are not required.
4. A Type III intersection configuration will be required at full build out.
5. The current level of service is classified as Type 'A' and the level of service drops to a Type 'F' when the subdivision is fully built in the year 2034.
6. The intersection of Highway 2A & Township Road 480 will drop to an unacceptable level of service (LOS E) when the intersection generates 11,479 vehicles per day of traffic. The background traffic volume on this roadway is 6,750 vehicles per day. The proposed development will generate 1,460 vehicles per day.
7. Illumination is not required until signalization occurs.

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Township Road 480 & West Subdivision Access Road

1. Left turn lanes are not required.
2. Right turn lanes are not required.
3. Signalization is not required.
4. Illumination is not required.
5. The level of service is a Type 'B' when the subdivision is fully built.
6. A Type II intersection configuration is required at full build out.

Township Road 480 & East Subdivision Access Road

1. Left turn lanes are not required.
2. Right turn lanes are not required.
3. Signalization is not required.
4. Illumination is not required.
5. The level of service is a Type 'A' when the subdivision is fully built.
6. A Type II intersection configuration is required at full build out.

- When the Average Annual Daily Traffic (AADT) volume on Highway 2A reaches 9,300 vpd, the level of service drops to a Type 'E' and will therefore require an additional through lane. This is triggered in the year 2020.
- Standard cross-sections should meet the minimum design standards as outlined in the County of Wetaskiwin No. 10 Design Guidelines (June, 2005) and Alberta Transportation's Highway Geometric Design Guide. Within the County of Wetaskiwin the road cross-sections should follow the County's Design Guidelines and it is recommended that all rural roads considered in this study (Range Road 244, Township Road 480 and Site Accesses) follow the collector road standard cross-section.
- The intersection of Highway 2A and Township Road 480 should follow the Alberta Highway Geometric Design Guidelines.
- During detailed design, the intersection of Highway 2A & Township Road 480 has to take into consideration the need for extra storage length in the left turn lane on the north leg of Highway 2A. This extra storage will accommodate any traffic that is queued waiting to cross the railway tracks while a train is crossing Township Road 480.
- When signalization is triggered, detailed design of the lighting will need to be timed with the gates and arms on the railway tracks.

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CANADA

#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

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INTRODUCTION

Williams Engineering Canada Inc. (WECI) was retained by AJN Investment and Development to review the traffic impacts for the proposed development of land near Millet, Alberta. A traffic impact study was conducted for the location and the findings covered in this report. Site maps are attached to **Appendix A** showing the three intersection locations studied in this report as well as the location of the proposed subdivision in relation to Millet, Alberta.

BACKGROUND

An industrial subdivision is proposed to be located on land to the northeast of the Town of Millet. Currently the land is being used as agriculture land. The development site contains approximately 40.5 hectares (100 acres). Of the 40.5 hectares (100 acres), 29.5 hectares (73 acres) is developable land. The land location is NE ¼ Sec 32-47-24-W4M. The plan area is bounded by existing residential property to the south, Range Road 244 to the east, SE ¼ Section 5-48-24-W4M to the north and a rail line and Highway 2A to the west. The predominant land use of the surrounding lands to the north and east is agricultural. The site is going to have two accesses connecting to Range Road 244.

This report examines three proposed intersections. (Refer to Appendix A for the following locations.) The three proposed intersections will include intersection of Township Road 480 & East Subdivision Access Road, the intersection of Township Road 480 & West Subdivision Access Road and the intersection of Highway 2A & Township Road 480.

EXISTING INFRASTRUCTURE & CONDITIONS

The existing condition of the infrastructure is as follows:

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Highway 2A & Township Road 480

This intersection currently does not exist. Township Road 480 is an undeveloped ROW and is proposed to be built in the future as warranted with the development of this proposed subdivision. This intersection will be proposed as a "T" intersection configuration to accommodate the proposed subdivision by AJN Investment and Development. As development in the area warrants, the intersection will eventually be configured to a 4 leg intersection configuration. The north and south legs of the intersection will consist of Highway 2A. The east leg of the intersection will consist of Township Road 480. The posted speed limit on the north and south legs is 100 kph. The posted speed limit along Township Road 480 will be 80 kph. Highway 2A is a two lane paved roadway with a width of 13.0 metres. Railway tracks will cross over the east leg of the intersection. Consideration will have to be taken when detailed design of this intersection is commenced upon. Warrants for railway gates will need to be considered depending on traffic volumes and trigger points.

Township Road 480

This roadway currently does not exist. Township Road 480 is an undeveloped ROW and is proposed to be built in the future as warranted with the development of this proposed subdivision.

Design Vehicle & Existing Intersection Turning Radius

The design vehicle used to calculate the minimum turning radii is a semi-trailer combination (WB-21). This was selected to accommodate any hauling of equipment in and out of the proposed site. The minimum turning radius for this type of vehicle is 55-18-55 metres with a three centred curve. This value has been taken from the Highway Geometric Design Guide.

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#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

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Design Speed

The design speeds for each of the roadways is as shown below:

- Highway 2A: 110 kph
- Township Road 480: 90 kph

Intersection Sight Distance & Stopping Sight Distance

The design should ensure adequate pavement widths of turning roadways and sight distances. Sight distances are factors included in this study. The intersection sight distance considers the speed and distance required for a vehicle to safely conduct a left hand turning movement at an intersection. The sight stopping distance requirements involve factors such as the driver's perception and reaction time and the safe stopping distance at various speeds. The chart listed below shows the results:

Table 1 – Intersection Sight Distance – Highway 2A & Township Road 480

	Intersection Sight Distance			
Intersection	**Driver Side**	**Passenger Side**	**Distance Required (Driver Side)**	**Distance Required (Passenger Side)**
Highway 2A & Township Road 480 (north leg)	600 m +	n/a	560 m	560 m
Highway 2A & Township Road 480 (south leg)	n/a	600 m +	560 m	560 m
Highway 2A & Township Road 480 (east leg)	600 m +	600 m +	560 m	560 m

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Table 2 - Sight Stopping Distance – Highway 2A & Township Road 480

	Sight Stopping Distance	
Intersection	**Available Distance**	**Distance Required**
Highway 2A & Township Road 480 (north leg)	600 m +	235 m
Highway 2A & Township Road 480 (south leg)	600 m +	235 m
Highway 2A & Township Road 480 (east leg)	600 m +	170 m

Table 3 – Intersection Sight Distance – Township Road 480 & Both Site Accesses

	Intersection Sight Distance			
Intersection	**Driver Side**	**Passenger Side**	**Distance Required (Driver Side)**	**Distance Required (Passenger Side)**
Township Road 480 & Both Site Accesses (east leg)	600 m +	n/a	460 m	460 m
Township Road 480 & Both Site Accesses (west leg)	n/a	600 m +	460 m	460 m
Township Road 480 & Both Site Accesses (south leg)	600 m +	600 m +	460 m	460 m

Table 4 - Sight Stopping Distance – Township Road 480 & Both Site Accesses

	Sight Stopping Distance	
Intersection	**Available Distance**	**Distance Required**
Township Road 480 & Both Site Accesses (east leg)	600 m +	85 m
Township Road 480 & Both Site Accesses (west leg)	600 m +	85 m
Township Road 480 & Both Site Accesses (south leg)	600 m +	85 m

The minimum distances required are taken from the Highway Geometric Design Guide published by Alberta Transportation and the Geometric Design Guide for Canadian Roads published by TAC. All of the minimum distances are achieved.

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#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

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Site Access

A review of the proposed road intersections were carried out under two considerations: proximity to other access points, and proximity to existing intersections. Separation is based on the end-point of the nearest edge of approach.

For the intersection of Highway 2A & Township Road 480, there is a railroad crossing located on the east leg of the intersection on Township Road 480. Consideration will have to be taken when upgrading the intersection to accommodate the future development traffic. The detailed design will need to take into consideration a need for larger storage bays for the left and right turn lanes on Highway 2A. The needed storage is to accommodate train traffic and the queuing of highway traffic needing to access Township Road 480.

TRAFFIC VOLUMES

Development/ Background Traffic

To get the development/background traffic volumes, three different techniques were used. They are listed below:

- Published data available from Alberta Transportation.
- Onsite traffic counts.
- Interpolation between published data.

For a number of the intersections, there is no published Alberta Transportation traffic volume data and traffic counts were not taken at these locations. Published Alberta Transportation traffic count data was, however, taken at intersections close to these locations. By interpolating these data sets, the traffic volumes at the intersections under study were obtained. **Appendix B** shows the interpolated data at these intersections.

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Highway 2A & Township Road 480

Table 5 – Traffic Volumes: Highway 2A & Township Road 480

Road	AADT	AM Peak Hourly	PM Peak Hourly
Highway 2A	6,750	514	429
Township Road 480	n/a	n/a	n/a

The existing traffic that is currently in this area is largely composed of passenger vehicle traffic. This can be seen by the traffic volume charts provided by Alberta Transportation, in **Appendix B.**

Township Road 480 & Both Site Accesses
(Existing traffic volumes will be the same for both accesses)

Since this is an undeveloped road right of way, there is no traffic volumes on this piece of Township Road 480.

Table 6 – Traffic Volumes: Township Road 480 (at both site accesses)

Road	AADT	AM Peak Hourly	PM Peak Hourly
Township Road 480	n/a	n/a	n/a

Projected Background Traffic

Traffic growth rates are calculated as non-compounded. In order to support the average annual growth rate used for analysis purposes, it is important to consider growth rates over various timeframes (every 5 years). This will ensure that a reasonable average annual growth rate is used for analysis purposes. A growth rate of 2.5% was used.

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Table 7 - Projected Traffic Volumes for Highway 2A (at Township Road 480)

Year	Projected AADT	Projected AM Peak	Projected PM Peak
Base Year (2009)	6,750	946	681
2014 (5 year)	7,594	1,051	766
2019 (10 year)	8,438	1,156	851
2024 (15 year)	9,282	1,261	936
2029 (20 year)	10,126	1,366	1,021
2034 (25 year)	10,970	1,471	1,106

Table 8 - Projected Traffic Volumes for Township Road 480 (at Highway 2A)

Year	Projected AADT	Projected AM Peak	Project PM Peak
Base Year (2009)	n/a	n/a	n/a
2014 (5 year)	n/a	n/a	n/a
2019 (10 year)	n/a	n/a	n/a
2024 (15 year)	n/a	n/a	n/a
2029 (20 year)	n/a	n/a	n/a
2034 (25 year)	n/a	n/a	n/a

Table 9 - Projected Traffic Volumes for Township Road 480 (at at Site Access Locations)

Year	Projected AADT	Projected AM Peak	Projected PM Peak
Base Year (2009)	n/a	n/a	n/a
2014 (5 year)	n/a	n/a	n/a
2019 (10 year)	n/a	n/a	n/a
2024 (15 year)	n/a	n/a	n/a
2029 (20 year)	n/a	n/a	n/a
2034 (25 year)	n/a	n/a	n/a

Projected Development Traffic

At the time of preparation of this review, the Developer was unable to provide site-specific information on the type or degree of development of the lots. Traffic generation estimates contained herein are therefore based upon the Institute of Transportation Engineers (ITE) Manual, 7th Edition. The manual identifies a number of industrial options. For the purpose of this review, we have used the following ITE average trip-end generation: *General Light Industrial (Code 110).* The classification represents manufacturing facilities and associated support activities.

ITE estimates are based upon observed measurement. ITE data provides a range of trip generation rates for the specific types of development, along with suggested averages.

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#210, 7240 Johnstone Drive
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Estimates are categorized by typical weekday and AM/PM Peak Hour of the roadway, and can be applied on a "per acre" rate.

Average daily traffic generation for General Light Industrial in an urban setting, or a setting adjacent to urban development, is suggested as 51.80 per acre, with an AM Peak of 7.5 trips per acre and a PM Peak of 7.3 trips per acre.

In order to confirm these assumptions and estimates, given the rural nature of the development and the large lot size, a traffic count was carried out at a similar industrial development located on Highway 597, west of Highway 2A. Data was obtained from April 14 – April 16 of 2004; EXH Engineering Services Ltd. conducted a traffic count of the above site. These findings are listed below.

The development, Burbank Industrial Park, consisted of 15 occupied lots over an area of 55.1 acres (average lot size of 3.7 acres). Businesses include a high percentage of oilfield related companies. Field notes and summaries are attached in Appendix C and are summarized below. The average daily estimate of 766 results in a trip of 13.9 per developed acre, or 27% of the suggested ITE rate.

Table 10 – Counted Traffic Volumes: Average & Peak Hour (Burbank Industrial Park)

Time Period	Units	Trip Rate	% In	% Out	In	Out	Total Trips
Average Daily	55.1	13.9	50	50	383	383	766
PM Peak Hour	55.1	1.8	24	76	24	74	98
AM Peak Hour	55.1	1.8	79	21	76	20	96
Noon Peak Hour	55.1	2.0	45	55	49	60	109

Based on preliminary discussions with the developer, the lot sizes will vary between 1 to 4 acres. For the intended use within this report, a lot size of 2 acres will be used. Given the rural nature of the proposed development the average daily traffic generation rates can be

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expected to be significantly less than the ITE values, and perhaps more in line with the observed rates for the Burbank development.

For the purpose of this report, an average of 20 trips per day per acre has been used. This number is arbitrary, but is well within the range of values obtained through ITE measurements, and is within one standard deviation of the mean. It is also 45% greater than the observed Burbank traffic. A similar proportion was used to estimate the AM and PM peak values. These values are shown in Table 16. A significant change in the average lot size would result in a change in the anticipated traffic generation rate for the development.

Table 11 – Estimated Average & Peak Hour Volumes

Time Period	Units	Trip Rate	% In	% Out	In	Out	Total
Average Daily	73	20	50	50	730	730	1,460
PM Peak Hour	73	2.7	22	78	43	154	197
AM Peak Hour	73	2.8	83	17	170	35	205

Allocation of Development Intersection Traffic

The development traffic was assigned to the road network assuming the shortest travel time routing. The peak hour vehicle trips entering and leaving each of the sites was estimated using the ITE trip rates. The traffic allocation was developed to reflect the future roadways and proposed development and land use statistics corresponding with the proposed development concept.

The development traffic will be split up 50/50 with the two accesses into the development. All of this traffic will utilize Township Road 480 to access Highway 2A. The traffic will be split up 50/50 on Highway 2A with the north and south bound traffic movements.

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Fax 403.755.4049

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Background & Development Traffic

The background traffic and development traffic have been combined for the determined projection years. The projected traffic numbers are shown in Tables 12 to 14.

Table 12 - Projected Traffic Volumes for Highway 2A (at Township Road 480)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2009)	6,750	730	7,480
2014 (5 year)	7,594	730	8,374
2019 (10 year)	8,438	730	9,168
2024 (15 year)	9,282	730	10,012
2029 (20 year)	10,126	730	10,856
2034 (25 year)	10,970	730	11,700

Table 13 - Projected Traffic Volumes for Township Road 480 (at Highway 2A)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2009)	n/a	730	730
2014 (5 year)	n/a	730	730
2019 (10 year)	n/a	730	730
2024 (15 year)	n/a	730	730
2029 (20 year)	n/a	730	730
2034 (25 year)	n/a	730	730

Table 14 - Projected Traffic Volumes for Township Road 480 (at Range Road 244)

Year	Projected AADT	Development Traffic	Combined Traffic
Base Year (2009)	n/a	730	730
2014 (5 year)	n/a	730	730
2019 (10 year)	n/a	730	730
2024 (15 year)	n/a	730	730
2029 (20 year)	n/a	730	730
2034 (25 year)	n/a	730	730

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ANALYSIS

Illumination Warrant Analysis

A warrant for illumination is based on Geometric, Operational, Environmental, and Collision factors. Charts in Transportation Association of Canada's (TAC's) guide for Illumination of Isolated Rural Intersections were used to conduct this analysis. Charts have been attached to **Appendix D**. All intersections have been analyzed and none of the intersections require illumination.

Roadway Twinning

A warrant for twinning of a roadway is based on the capacity that the roadway can handle. Figure A-9 from the Highway Geometric Design Guide has been used to determine if twinning is warranted. The twinning warrant was used on Highway 2A. It was determined that when the traffic volumes reach 9,300 vehicles per day, an additional lane is warranted. From Table 17, using projected traffic volumes for both the background and development traffic would occur around year 2011. However, the background traffic warrants for twinning of the roadway in the year 2016. Thus, the development expedites the twinning of Highway 2A five years earlier.

Pedestrian Analysis

For this site analysis, the location has no pedestrian traffic at the proposed intersection. Therefore, pedestrian movement accommodation is not warranted.

Intersection Analysis

An intersection configuration was developed for the projected year (2034). Figure D-7.4 from the Highway Geometric Design Guide has been used to represent initial traffic volume warrants for the intersections at the site. This review identifies the need for upgrading of the intersection, and suggests further analysis to determine whether an allowance must be made for left and right turn vehicles through provision of a larger

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#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

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intersection configuration. A copy of the intersection types and Figure D-7.4 has been included in **Appendix E**.

Left turn warrants are based upon the level of probability that a vehicle in the advancing traffic stream in the design hour will not arrive at an intersection when another vehicle, traveling in the same direction, is stopped waiting to make a left turn. The associated hazard represents decreases with decreased design speed.

The Alberta Infrastructure and Transportation warrant for a right turn lane requires that the following three conditions are met:

- The main road has an average daily volume in excess of 1,800 vehicles per day.
- The intersecting road has an average daily volume in excess of 900 vehicles.
- And, a right turn volume in excess of 360 vehicles per day.

Highway 2A & Township Road 480

For the intersection of *Highway 2A & Township Road 480*, the type of intersection needed is as shown in Table 42. This was taken from Figure D-7.4 and Figure D-7.6-7a of the Highway Geometric Design Guide, which is located in **Appendix E**.

Table 15 - Intersection Types for Highway 2A & Township Road 480

	Current Needs (2009)	Full Build-Out (2034)
South Leg	n/a	Type II
North Leg	n/a	Type III
East Leg	n/a	Type II
West Leg	n/a	n/a

A left turn lane is warranted for the north leg of the intersection.

For this analysis, the three conditions for right turn lanes were not met on any of the legs of the intersection and therefore a dedicated right turn lane is not warranted.

Pavement widths of turning roadways depend jointly upon the dimension of the design vehicle and the radius of the turning roadway. According to Table D.6.3.2, the minimum pavement width to accommodate a WB-21 type of vehicle is 9.1 metres.

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CANADA

#210, 7240 Johnstone Drive
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Phone 403.755.2395
Fax 403.755.4049

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Township Road 480 & West Subdivision Access Road

For the intersection of *Range Road 244 & North Subdivision Access Road*, the type of intersection needed is as shown in Table 24. This was taken from Figure D-7.4 of the Highway Geometric Design Guide, which is located in **Appendix E.**

Table 16 - Intersection Types for Range Road 244 & West Subdivision Access Road

	Current Needs (2009)	Full Build-Out (2034)
South Leg	n/a	Type II
North Leg	n/a	n/a
East Leg	n/a	Type II
West Leg	n/a	Type II

For this analysis none of the legs required any left turn lanes.

For this analysis the three conditions for a right turn lane were not met on any of the legs of the intersection and therefore a dedicated right turn lane is not warranted.

Pavement widths of turning roadways depend jointly upon the dimension of the design vehicle and the radius of the turning roadway. According to Table D.6.3.2, the minimum pavement width to accommodate a WB-21 type of vehicle is 9.1 metres.

Township Road 480 & East Subdivision Access Road

For the intersection of *Range Road 244 & South Subdivision Access Road*, the type of intersection needed is as shown in Table 25. This was taken from Figure D-7.4 of the Highway Geometric Design Guide, which is located in **Appendix E.**

Table 17 - Intersection Types for Range Road 244 & East Subdivision Access Road

	Current Needs (2009)	Full Build-Out (2034)
South Leg	n/a	Type II
North Leg	n/a	n/a
East Leg	n/a	Type II
West Leg	n/a	Type II

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#210, 7240 Johnstone Drive
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Signalization Analysis

A warrant for signalization was conducted on all of the intersections. The Traffic Signal Warrant Handbook provided by Transportation Association of Canada (TAC) was utilized to determine if any of the intersections warranted signalization. The handbook uses the matrix warrant methodology to determine if signalization is required. The matrix warrant considers traffic volumes, pedestrian volumes, vehicular stops, crossing gaps and collisions; an item that is difficult to forecast over 25 years. Excluding the collision rating, none of the intersections require signalization as defined by the matrix method. Copies of the matrix warrant have been included in **Appendix F**.

As discussed in the next section, however, another trigger for signalization is when the traffic levels generate a level of service that drops to Type 'E'.

Capacity Analysis

The capacity analysis is based on the methods outlined in the Highway Capacity Manual 2000 and HCS 2000 analysis software and includes assessments using Alberta Infrastructure and Transportation intersection configuration warrants where necessary. With respect to the Highway Capacity Manual, intersection operations are typically rated by the intersections Level of Service (LOS).

LOS is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS 'A' rating, whereas high average delay merits a LOS rating of 'F'. If the level of service drops below 'D', signalization is warranted. Copies of the LOS analysis worksheets have been included in **Appendix G**.

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CANADA

#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

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Fax 403.755.4049

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Table 18 - Capacity Analysis/Level of Service

	Highway 2A & Township Road 480	Township Road 480 & West Access	Township Road 480 & East Access
LOS (2009)	n/a	n/a	n/a
LOS (Full Build Out- 2034)	F	B	A
Warrant Signalization	Yes	No	No
Trigger Point (Year)	2034	n/a	n/a

Based on the above analysis, the intersection of Highway 2A & Township Road 480 will drop to an unacceptable level of service (LOS E) when the intersection generates 11,479 vehicles per day of traffic. The background traffic volume on this roadway is 6,750 vehicles per day. The proposed development will generate 1,460 vehicles per day. The intersection falls to an unacceptable level based on the background traffic and not because of the development traffic.

Operational Analysis

The operational analysis is necessary to ensure that the design vehicle is capable of safely manoeuvring the intersection without interfering with other traffic movements. The design vehicle used to calculate the minimum turning radii is a semi-trailer combination (WB-21). This was selected to accommodate any hauling of equipment in and out of the proposed site. The minimum turning radius for this type of vehicle is 55-18-55 metres with a three centred curve. This value has been taken from the Highway Geometric Design Guide. Therefore, when the new intersection is designed, it should be capable of handling the turning movements of the design vehicle.

WILLIAMS
ENGINEERING
CANADA

#210, 7240 Johnstone Drive
Red Deer, AB T4P 3Y6

Phone 403.755.2395
Fax 403.755.4049

Edmonton
Yellowknife
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Roadway Design Standards

Standard cross-sections should meet the minimum design standards as outlined in the County of Wetaskiwin No. 10 Design Guidelines (June, 2005) and Alberta Transportation's Highway Geometric Design Guide. Within the County of Wetaskiwin the road cross-sections should follow the County's Design Guidelines and it is recommended that all rural roads considered in this study (Range Road 244, Township Road 480 and Site Accesses) follow the collector road standard cross-section.

The intersection of Highway 2A and Township Road 480 should follow the Alberta Highway Geometric Design Guidelines.

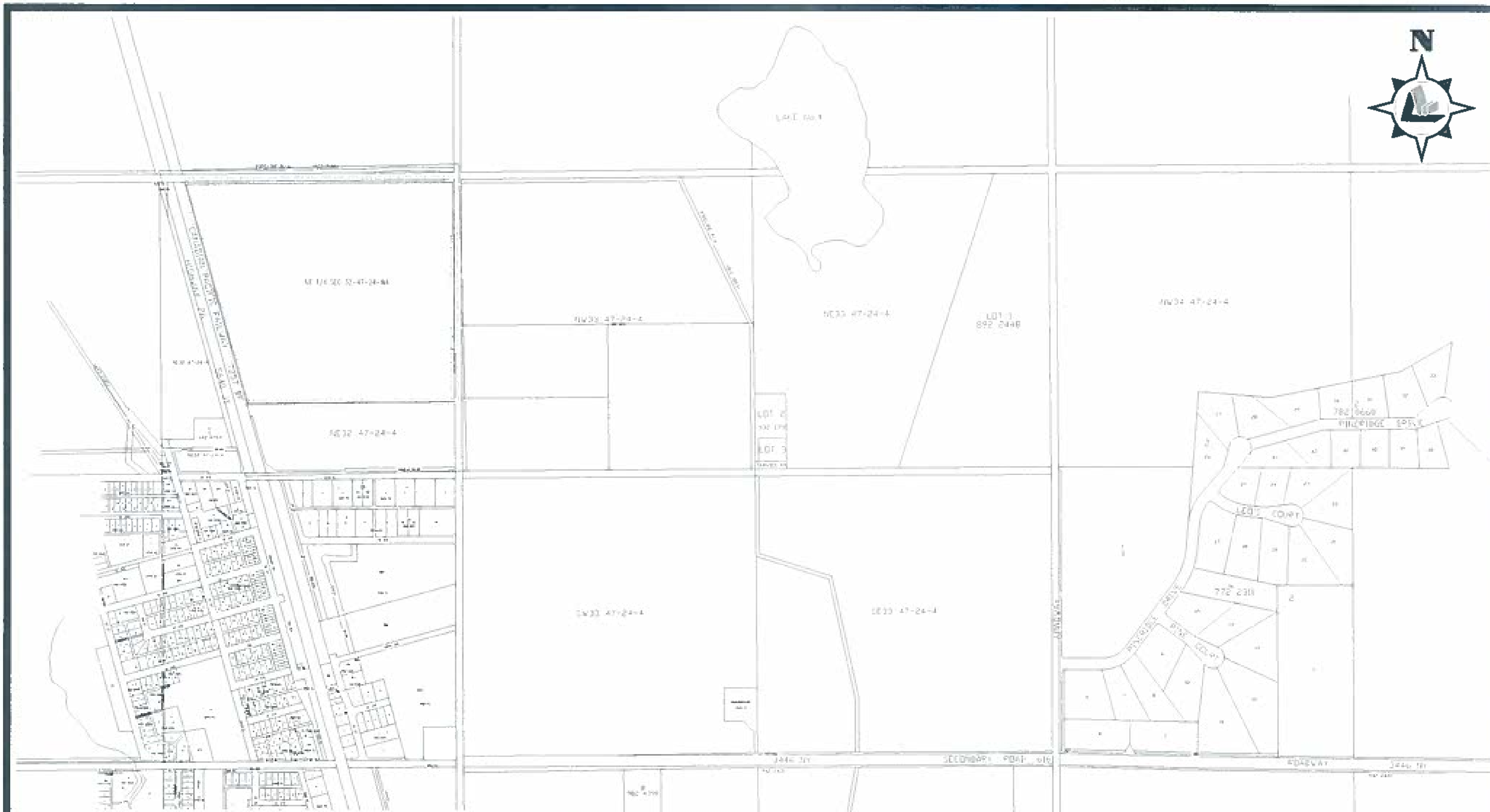
A copy of the collector road standard cross-section has been included in **Appendix H**.

CLOSURE

This report has been prepared based upon the information referenced herein. It has been prepared in a manner consistent with good engineering judgement. Should new information come to light, Williams Engineering Canada Inc. requests the opportunity to review this information, and our conclusions contained in this report. This report has been prepared for the exclusive use of AJN Investment and Development and there are no representations made by Williams Engineering Canada Inc. to any other party. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

APPENDIX A

SITE MAPS



LEGEND

PLAN AREA

A. D. Williams Engineering Inc.
Consulting Engineers

EDMONTON • YELLOWKNIFE • CALGARY • WINNIPEG • RED DEER

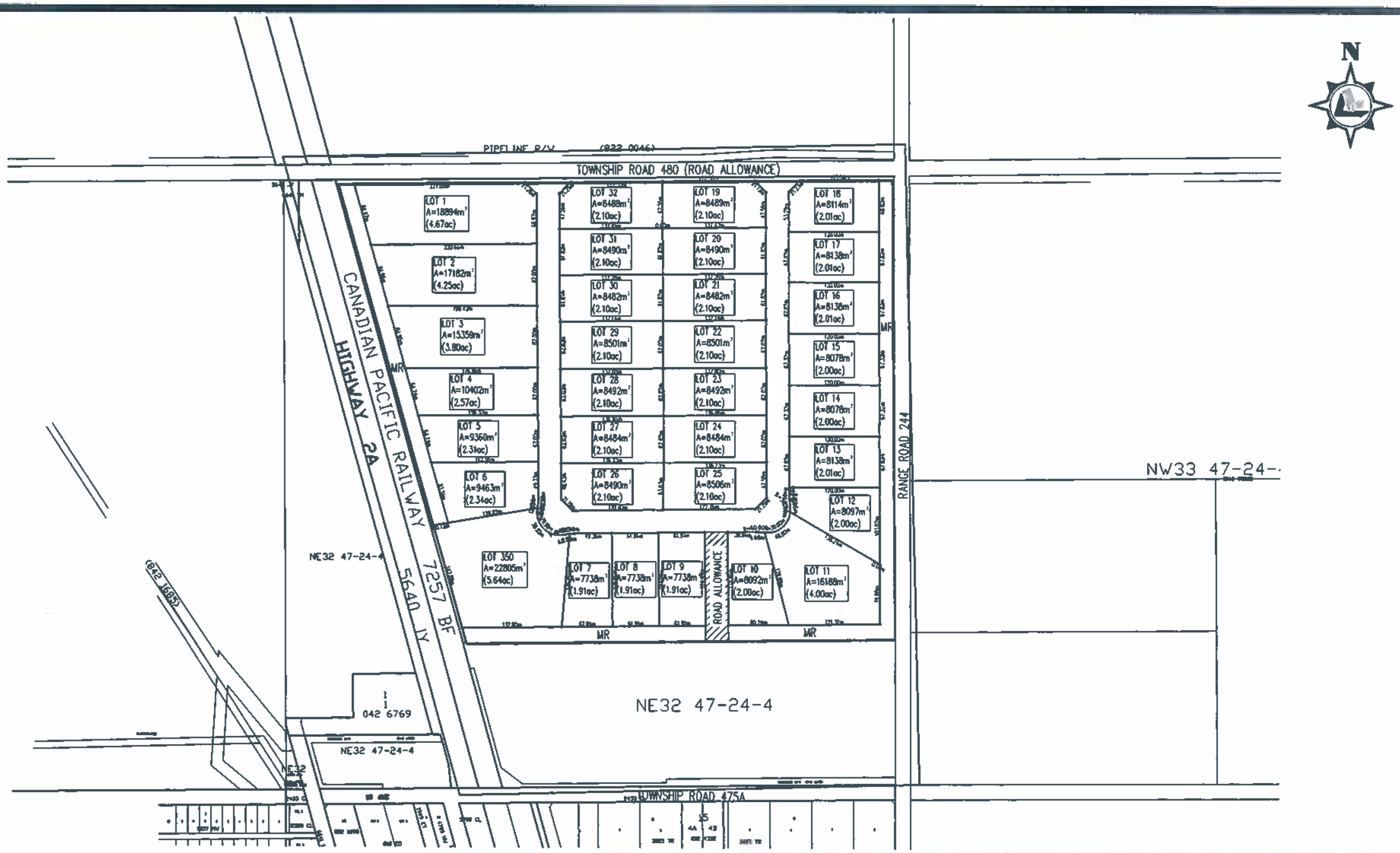
RED DEER
#210 7240 Johnstone Drive
Red Deer, AB T4P 3Y6
Bus: (403) 755-2395
Fax: (403) 755-4049
www.adwilliams.com
corp. office: 1-800-263-2393
info@adwilliams.com

Multi-Disciplined Consulting Engineering Services

JOB TITLE: MILLET INDUSTRIAL PARK
NE 1/4 SEC 32-47-24 W4
WETASKIWIN COUNTY, AB

DWG TITLE: AREA STRUCTURE PLAN
FIGURE 1
REGIONAL CONTEXT

DWN BY: DC	DES BY: AB	PROJ MGR: AC
PROF REVIEW: JI	DATE: 2009-01-08	SCALE: N.T.S.
CLIENT PROJ #:		ADWE PROJ #: 14236.00
FILE NO: 14236 ASP FIG	REV: 7	SHEET: 1



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JOB TITLE: MILLET INDUSTRIAL PARK
NE 1/4 SEC 32-47-24 W4
WETASKIWIN COUNTY, AB

DWG. TITLE: AREA STRUCTURE PLAN
FIGURE 5
PROPOSED LOT LAYOUT

DWN. BY: AC	DES. BY: JK	PROJ. MGR.: WG
PEER REVIEW: JK	DATE: (YY-MM-DD) 2009.06.11	SCALE: 1:5000
CLIENT PROJ. #		ADWE PROJ. # 14236.00
DWG # 14236.00 ASP FIG5	7	REV # 1

APPENDIX B

TRAFFIC COUNT DATA & AADT'S

Intersection of:	Highway 2A & Township Road 480
Date:	2009 (Background)
Time:	AADT

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

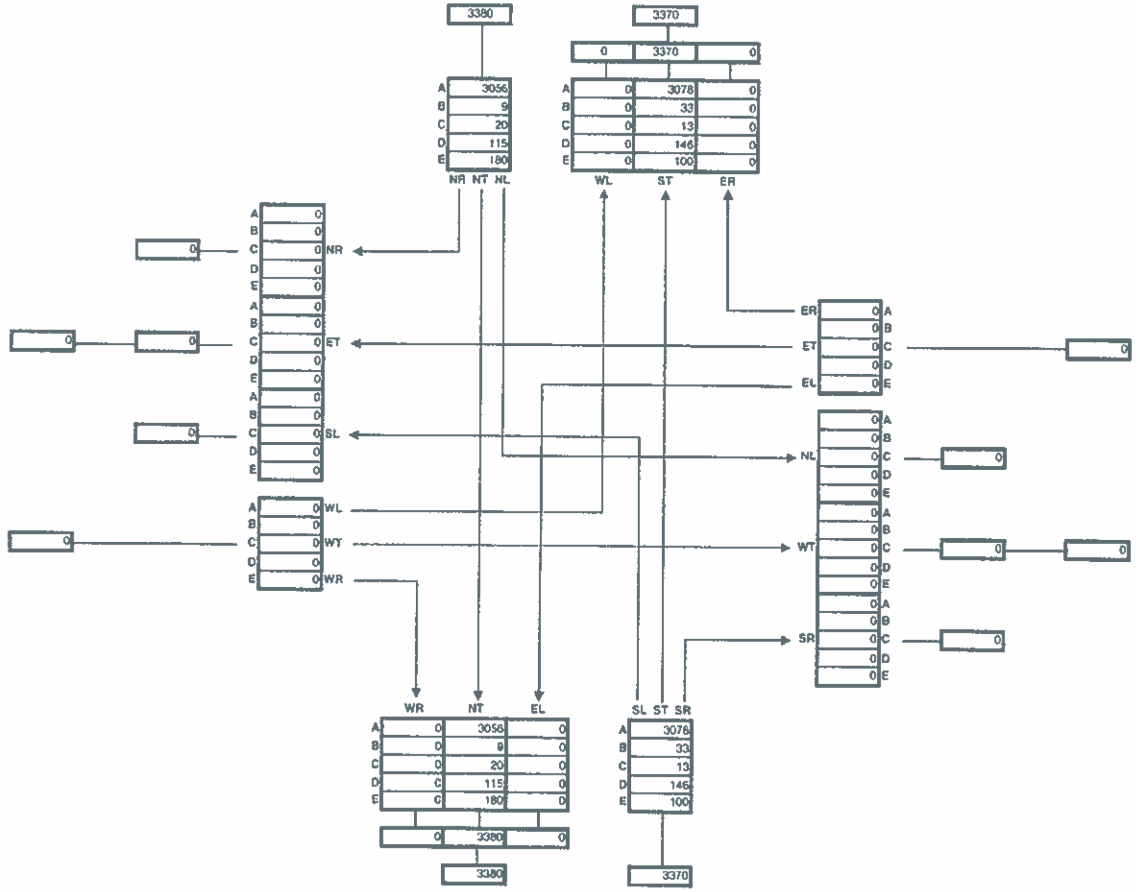
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	3056	90.4
B: Recreational Vehicle	9	0.3
C: Bus	20	0.6
D: Single Unit Truck	115	3.4
E: Tractor Trailor Unit	180	5.3
Peak Hour Volume	3380	

West On n/a		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	



East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

South On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	3078	91.3
B: Recreational Vehicle	33	1.0
C: Bus	13	0.4
D: Single Unit Truck	146	4.3
E: Tractor Trailor Unit	100	3.0
Peak Hour Volume	3370	

Intersection of:	Highway 2A & Township Road 480
Date:	2009 (Background)
Time:	AM Peak

Turning Movement Abbreviations

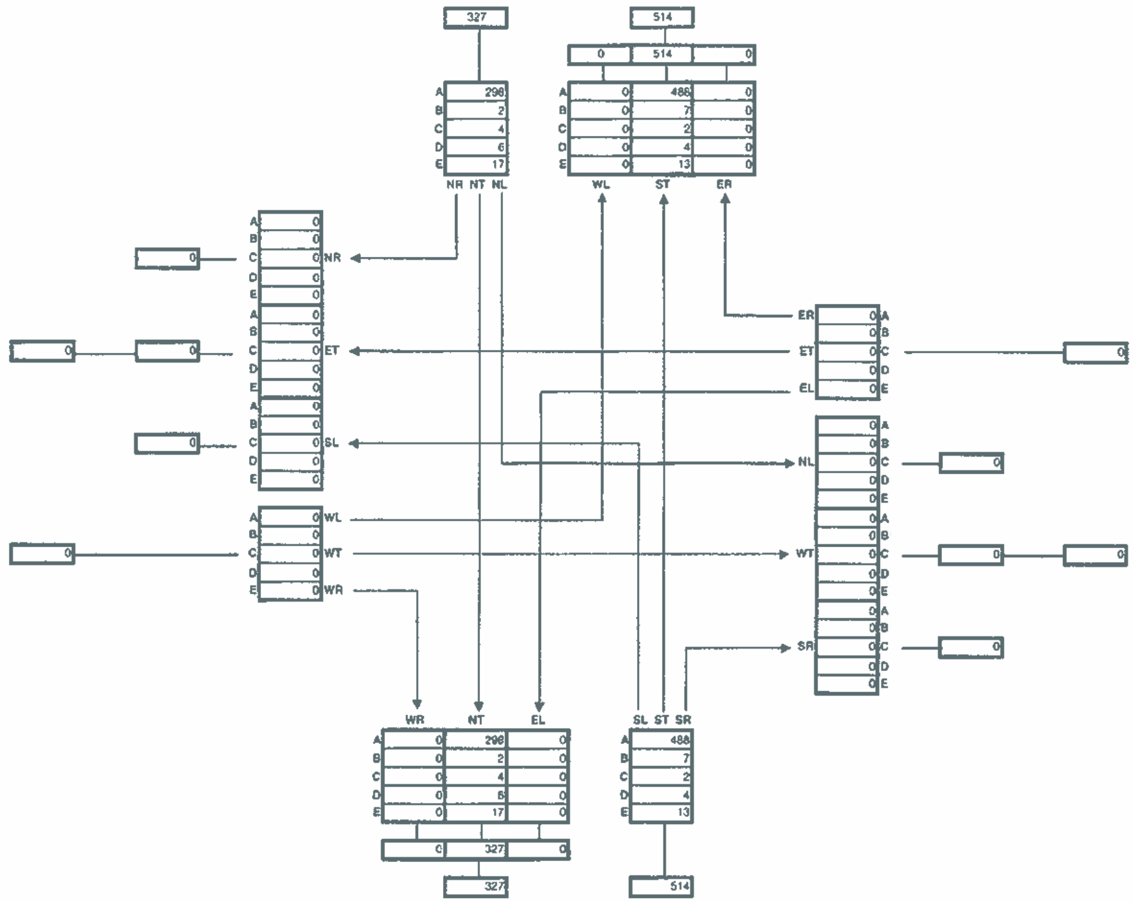
NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	298	91.1
B: Recreational Vehicle	2	0.6
C: Bus	4	1.2
D: Single Unit Truck	6	1.8
E: Tractor Trailor Unit	17	5.2
Peak Hour Volume	327	



West On n/a		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

South On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	488	94.9
B: Recreational Vehicle	7	1.4
C: Bus	2	0.4
D: Single Unit Truck	4	0.8
E: Tractor Trailor Unit	13	2.5
Peak Hour Volume	514	

Intersection of:	Highway 2A & Township Road 480
Date:	2009 (Background)
Time:	PM Peak

Turning Movement Abbreviations
NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

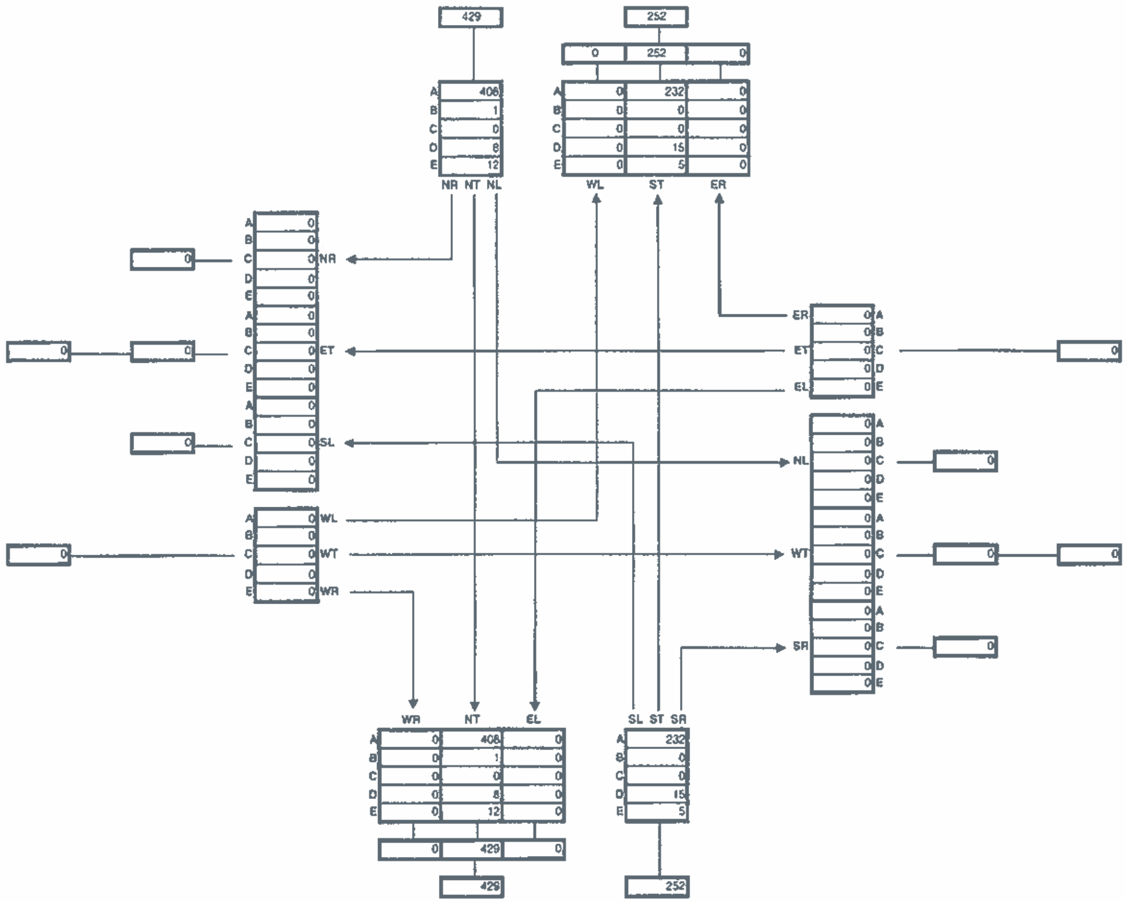
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	408	95.1
B: Recreational Vehicle	1	0.2
C: Bus	0	0.0
D: Single Unit Truck	8	1.9
E: Tractor Trailer Unit	12	2.8
Peak Hour Volume	429	

West On n/a		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	0	



East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	0	

South On Highway 2A		
Vehicle Type	Vol	%
A: Passenger Car	232	92.1
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	15	6.0
E: Tractor Trailer Unit	5	2.0
Peak Hour Volume	252	

Intersection of:	Township Road 480 & East Site Access Road
Date:	2034 (Projected)
Time:	PM Peak

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

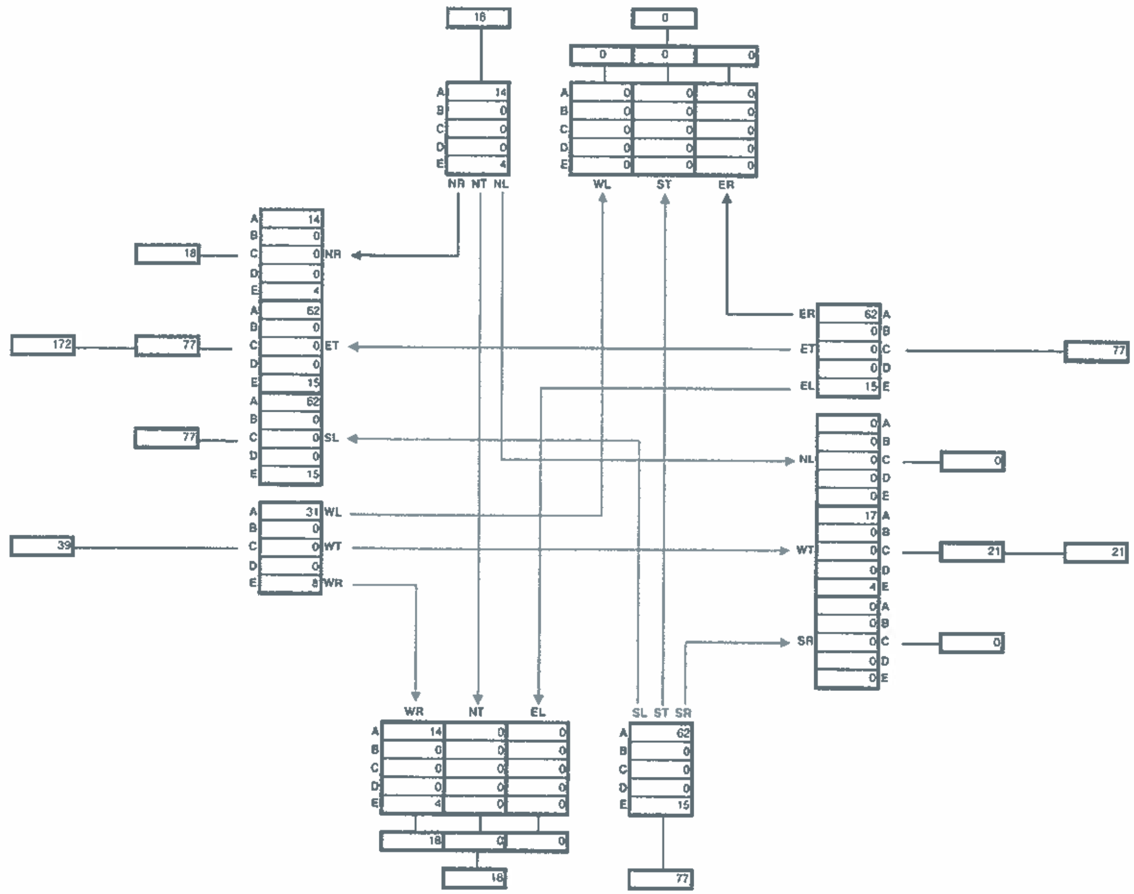
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On n/s		
Vehicle Type	Vol	%
A: Passenger Car	14	77.8
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	4	22.2
Peak Hour Volume	18	

West On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	31	79.5
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	8	20.5
Peak Hour Volume	39	



East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	62	80.5
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	15	19.5
Peak Hour Volume	77	

South On East Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	62	80.5
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	15	19.5
Peak Hour Volume	77	

Intersection of:	Township Road 480 & West Site Access Road
Date:	2034 (Projected)
Time:	PM Peak

Turning Movement Abbreviations

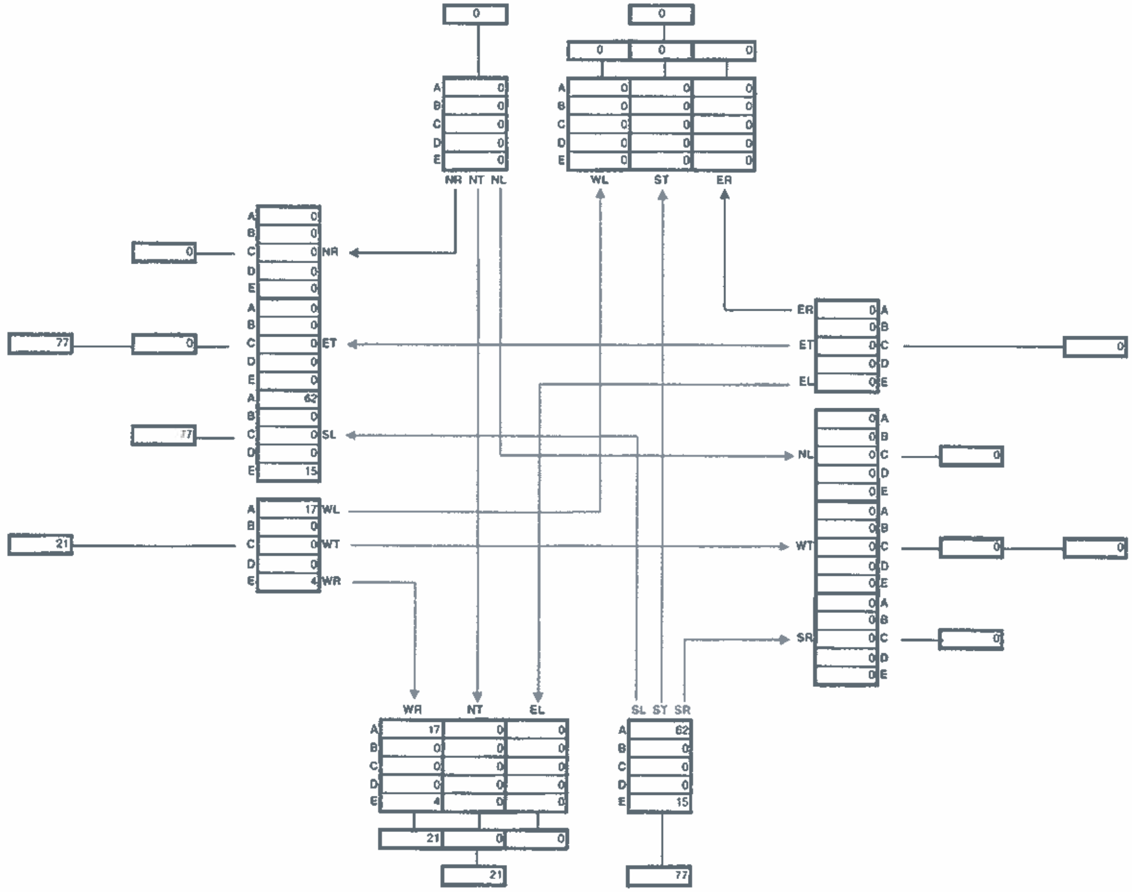
NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On n/a		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	



West On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	17	81.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	4	19.0
Peak Hour Volume	21	

East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	0	

South On West Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	62	80.5
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	15	19.5
Peak Hour Volume	77	

Intersection of:	Township Road 480 & West Site Access Road
Date:	2034 (Projected)
Time:	AM Peak

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

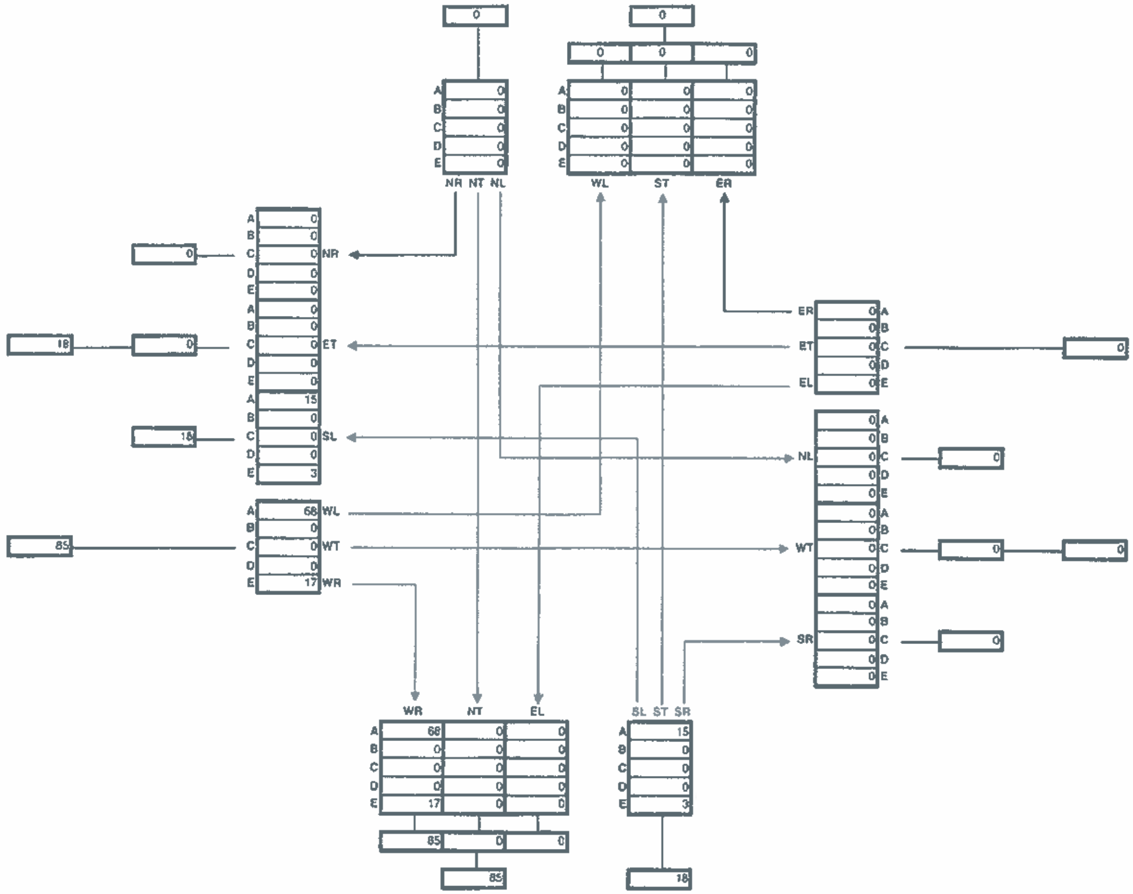
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On n/a		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	0	

West On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	68	80.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	17	20.0
Peak Hour Volume	85	



East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	0	0.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	0	

South On West Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	15	83.3
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	3	16.7
Peak Hour Volume	18	

Intersection of:	Township Road 480 & East Site Access Road
Date:	2034 (Projected)
Time:	AM Peak

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

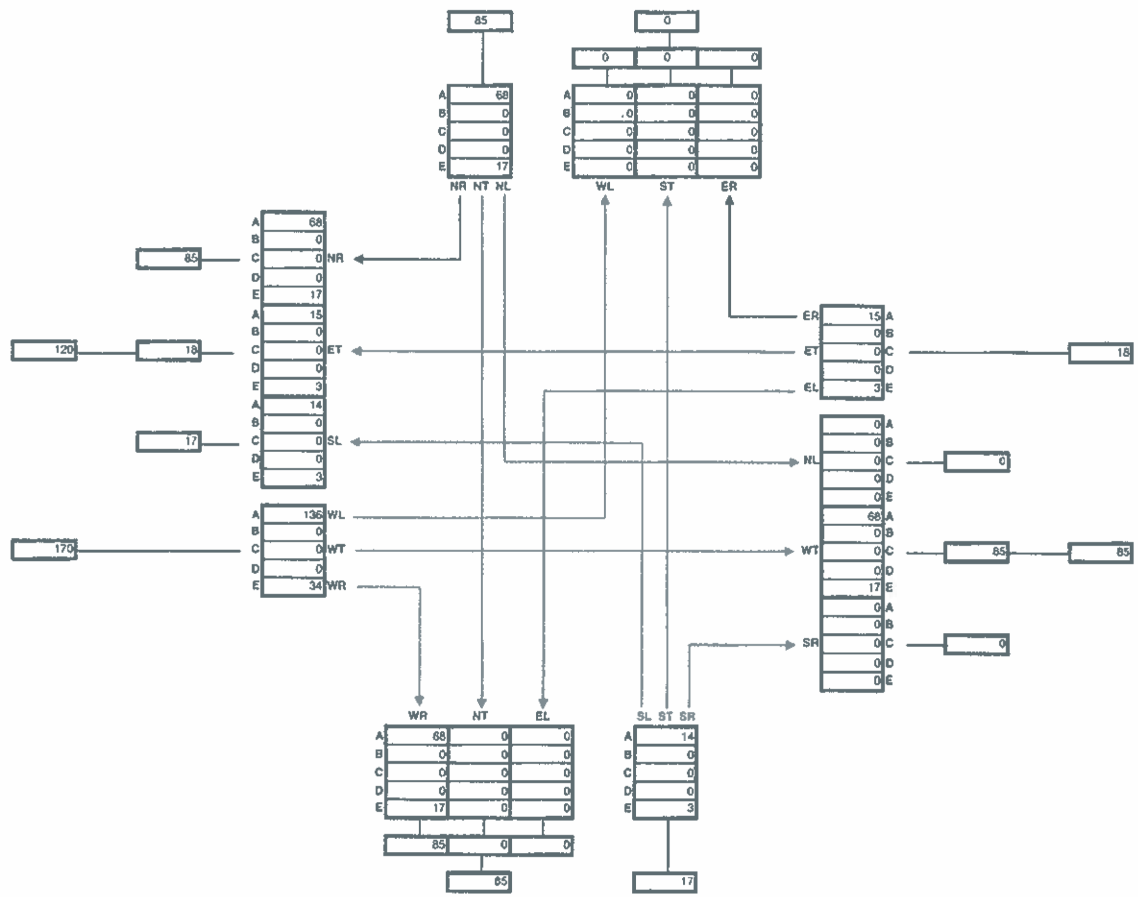
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On n/a		
Vehicle Type	Vol	%
A: Passenger Car	68	80.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	17	20.0
Peak Hour Volume	85	

West On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	136	80.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	34	20.0
Peak Hour Volume	170	



East On Township Road 480		
Vehicle Type	Vol	%
A: Passenger Car	15	83.3
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	3	16.7
Peak Hour Volume	18	

South On East Subdivision Access Road		
Vehicle Type	Vol	%
A: Passenger Car	14	82.4
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	3	17.6
Peak Hour Volume	17	

Hours	Approaching Intersection																														Totals
	From The East On Township Road 475A (West Bound)															From The West On Township Road 475A (East Bound)															
	Left					Through					Right					Left					Through					Right					
6:00 - 7:00 am	9	0	0	1	0	9	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	28
7:00 - 8:00	18	0	0	0	0	18	0	0	0	0	9	0	0	0	0	4	0	0	0	0	6	1	0	0	0	6	0	0	0	0	62
8:00 - 9:00	17	2	0	1	0	17	0	0	0	0	9	0	0	0	0	3	0	0	0	0	4	0	0	0	0	4	0	0	0	0	57
9:00 - 10:00	10	0	0	0	0	10	0	0	1	0	4	0	0	0	0	3	0	0	0	0	4	0	0	0	0	4	0	0	0	0	36
10:00 - 11:00																															0
11:00 - 12:00																															0
12:00 - 1:00 pm																															0
1:00 - 2:00																															0
2:00 - 3:00																															0
3:00 - 4:00	13	0	0	0	0	13	1	0	1	3	6	0	0	0	0	4	0	0	0	0	10	1	0	0	0	10	1	0	0	0	63
4:00 - 5:00	6	0	0	0	0	6	0	0	0	0	3	0	0	0	0	8	0	0	0	0	18	0	0	0	0	18	0	0	0	0	59
5:00 - 6:00	10	0	0	0	0	10	0	0	0	0	5	0	0	0	0	11	0	0	0	0	23	0	0	1	0	23	0	0	0	0	83
Vehicle Class	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	
Totals	83	2	0	2	0	83	1	0	2	3	41	0	0	0	0	33	0	0	0	0	67	2	0	1	0	67	1	0	0	0	388
	EL					**ET**					**ER**					**WL**					**WT**					**WR**					

Date:	2008 (Estimated)
Intersection:	Township Road 475A & Range Road 244
Performed By:	Kevin Paul, E.I.T.

A	Passenger Vehicle
B	Recreational Vehicle
C	Bus
D	Single Unit Truck
E	Tractor Trailor

Hours	Approaching Intersection																														Totals	Grand Totals
	From The North On Range Road 244 (South Bound)															From The South On Range Road 244 (North Bound)																
	Left					Through					Right					Left					Through					Right						
6:00 - 7:00 am	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	32
7:00 - 8:00	1	0	0	0	0	2	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	70
8:00 - 9:00	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	6	63
9:00 - 10:00	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	8	44
10:00 - 11:00																															0	0
11:00 - 12:00																															0	0
12:00 - 1:00 pm																															0	0
1:00 - 2:00																															0	0
2:00 - 3:00																															0	0
3:00 - 4:00	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	67
4:00 - 5:00	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	0	0	9	68
5:00 - 6:00	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	1	0	0	0	0	10	93
Vehicle Class	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**		
Totals	1	0	0	0	0	13	0	0	0	0	10	1	0	0	0	13	0	2	2	0	5	0	0	0	0	2	0	0	0	0	49	437
	NL					**NT**					**NR**					**SL**					**ST**					**SR**						

Date:	2008 AM Peak Hour (Estimated)
Intersection:	Township Road 475A & Range Road 244
Performed By:	Kevin Paul, E.I.T.

A	Passenger Vehicle
B	Recreational Vehicle
C	Bus
D	Single Unit Truck
E	Tractor Trailor

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	6 am - 7 am

Turning Movement Abbreviations

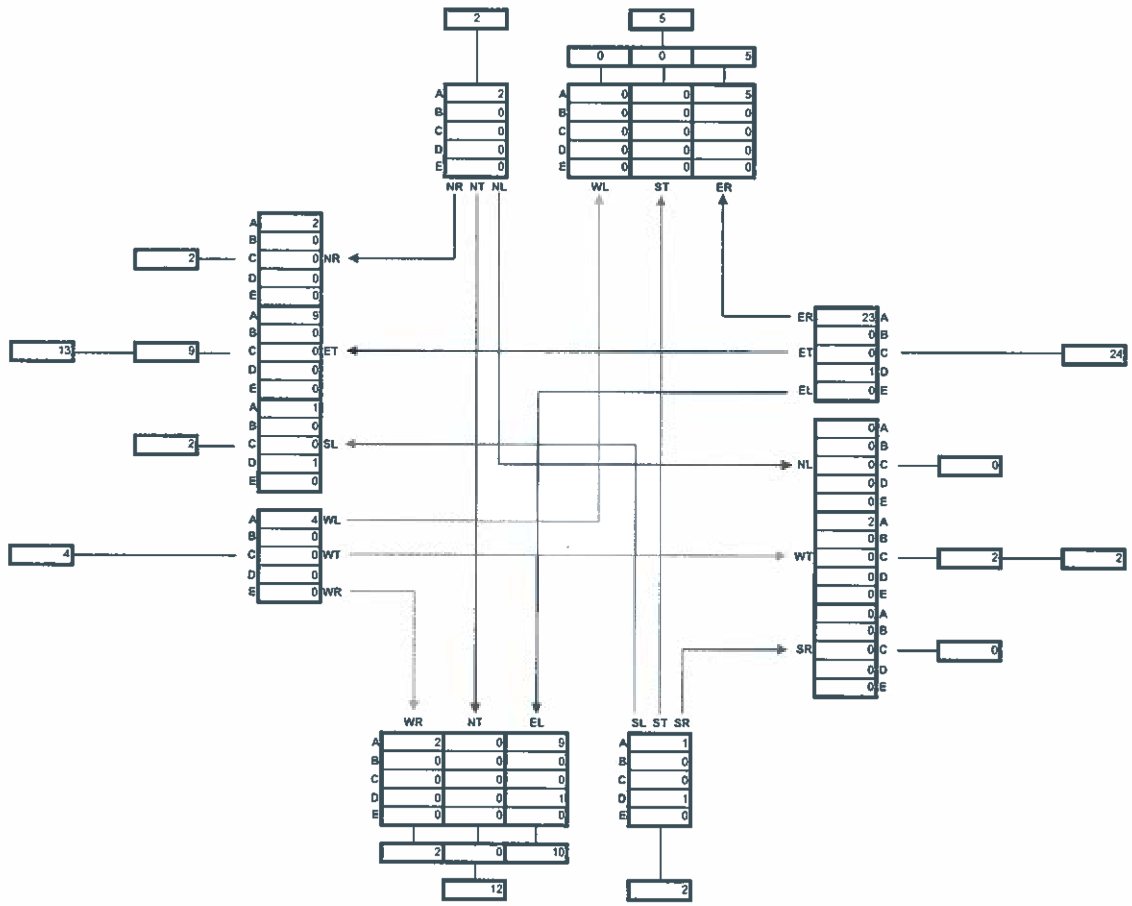
NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	2	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	2	



South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	1	50.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	1	50.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	2	

West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	4	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	4	

East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	23	95.8
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	1	4.2
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	24	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	7 am - 8 am

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

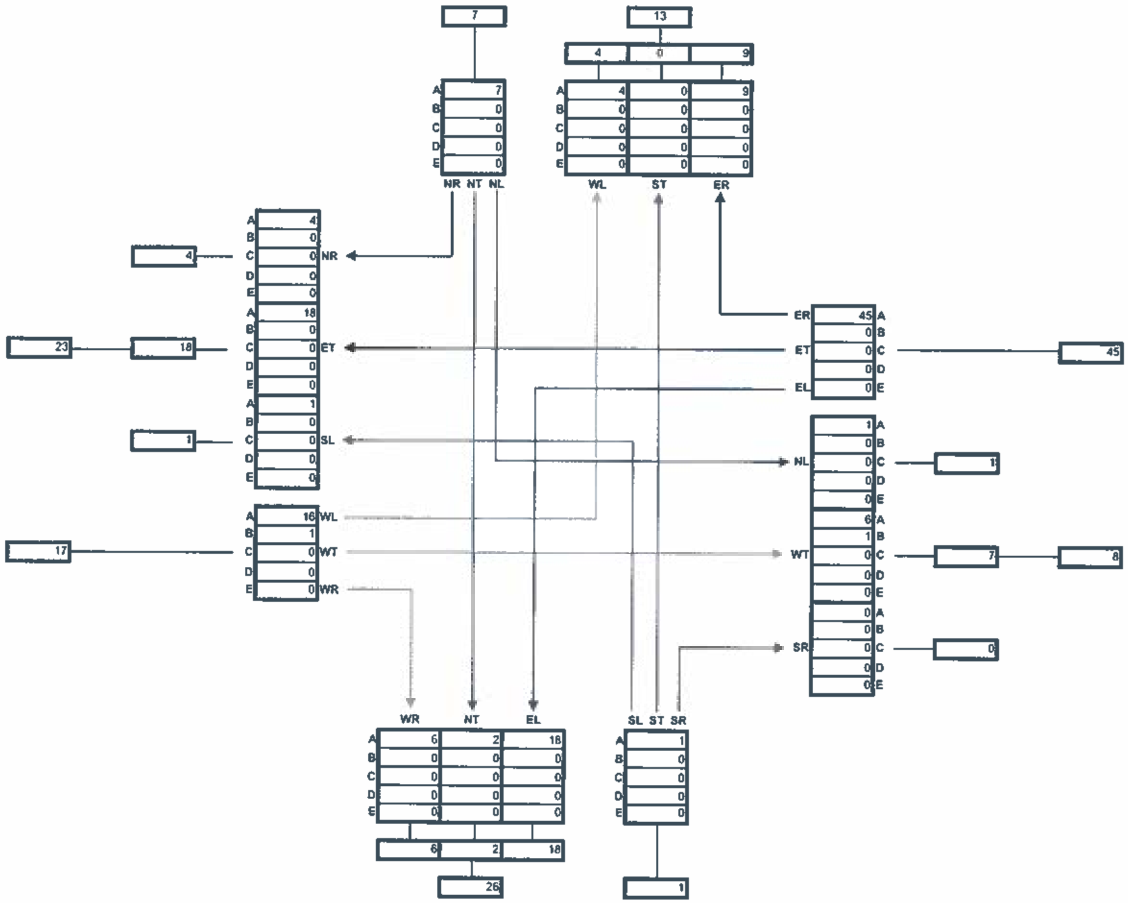
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	7	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	7	

West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	16	94.1
B: Recreational Vehicle	1	5.9
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	17	



East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	45	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	45	

South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	1	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	1	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	8 am - 9 am

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

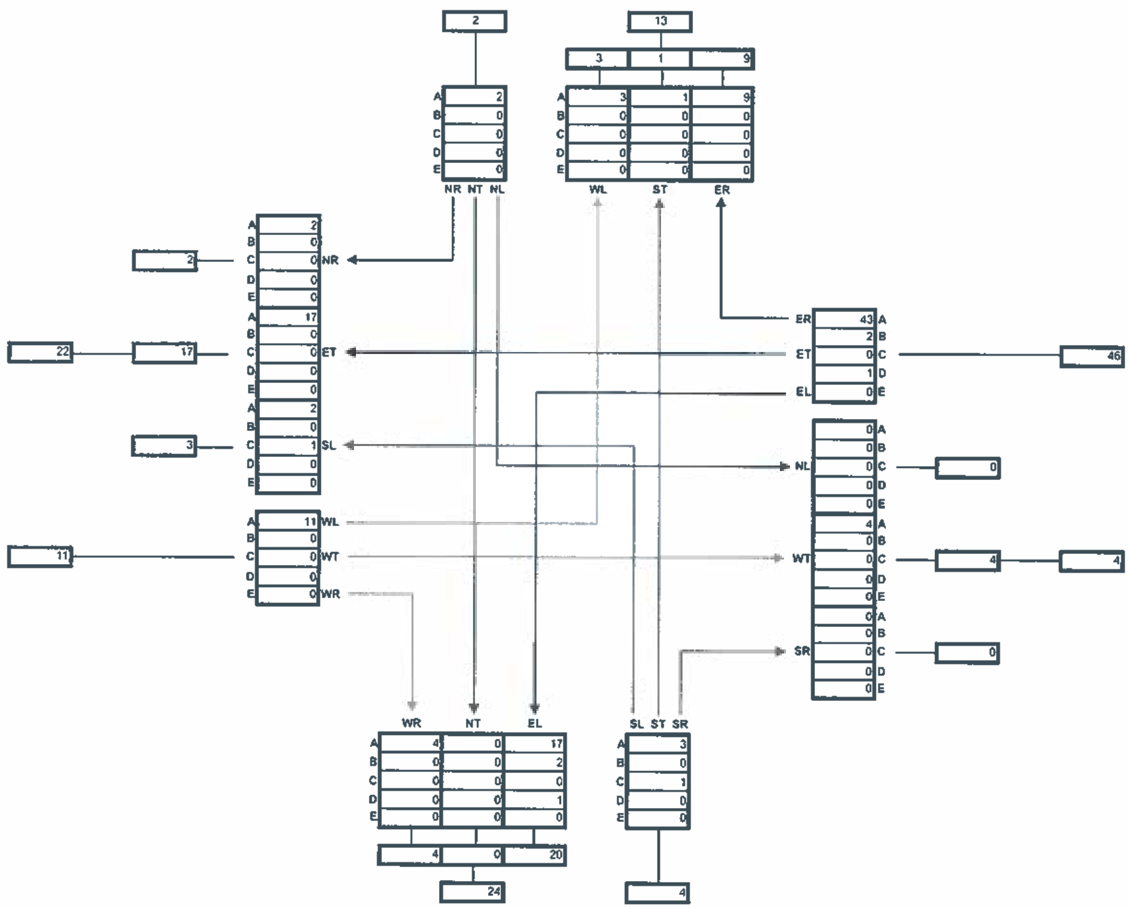
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A. Passenger Car	2	100.0
B. Recreational Vehicle	0	0.0
C. Bus	0	0.0
D. Single Unit Truck	0	0.0
E. Tractor Trailer Unit	0	0.0
Peak Hour Volume	2	

West On Township Road 475A		
Vehicle Type	Vol	%
A. Passenger Car	11	100.0
B. Recreational Vehicle	0	0.0
C. Bus	0	0.0
D. Single Unit Truck	0	0.0
E. Tractor Trailer Unit	0	0.0
Peak Hour Volume	11	



East On Township Road 475A		
Vehicle Type	Vol	%
A. Passenger Car	43	93.5
B. Recreational Vehicle	2	4.3
C. Bus	0	0.0
D. Single Unit Truck	1	2.2
E. Tractor Trailer Unit	0	0.0
Peak Hour Volume	46	

South On Range Road 244		
Vehicle Type	Vol	%
A. Passenger Car	3	75.0
B. Recreational Vehicle	0	0.0
C. Bus	1	25.0
D. Single Unit Truck	0	0.0
E. Tractor Trailer Unit	0	0.0
Peak Hour Volume	4	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	9 am - 10 am

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

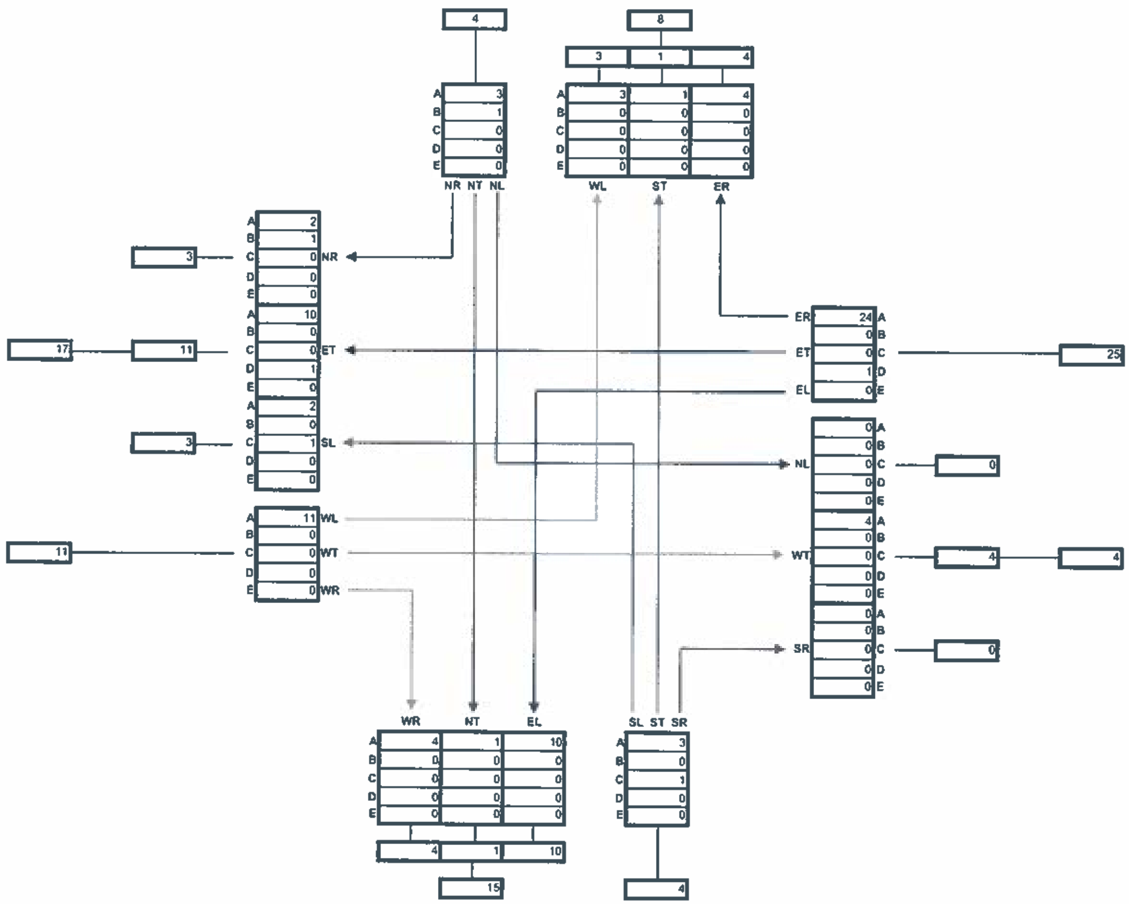
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	3	75.0
B: Recreational Vehicle	1	25.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	4	

West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	11	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	11	



East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	24	96.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	1	4.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	25	

South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	3	75.0
B: Recreational Vehicle	0	0.0
C: Bus	1	25.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	4	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	3 pm - 4 pm

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

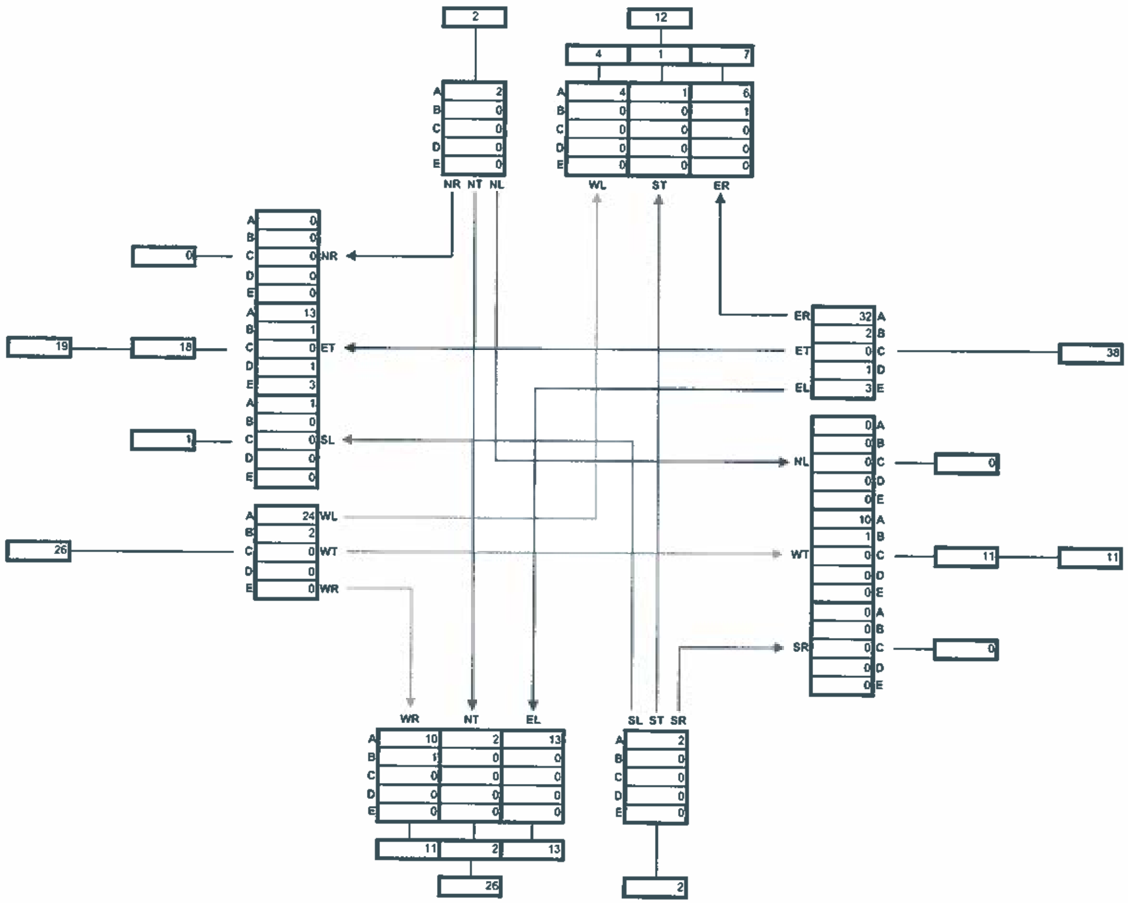
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	2	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	2	

West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	24	92.3
B: Recreational Vehicle	2	7.7
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	26	



East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	32	84.2
B: Recreational Vehicle	2	5.3
C: Bus	0	0.0
D: Single Unit Truck	1	2.6
E: Tractor Trailor Unit	3	7.9
Peak Hour Volume	38	

South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	2	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	2	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	4 pm - 5 pm

Turning Movement Abbreviations

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

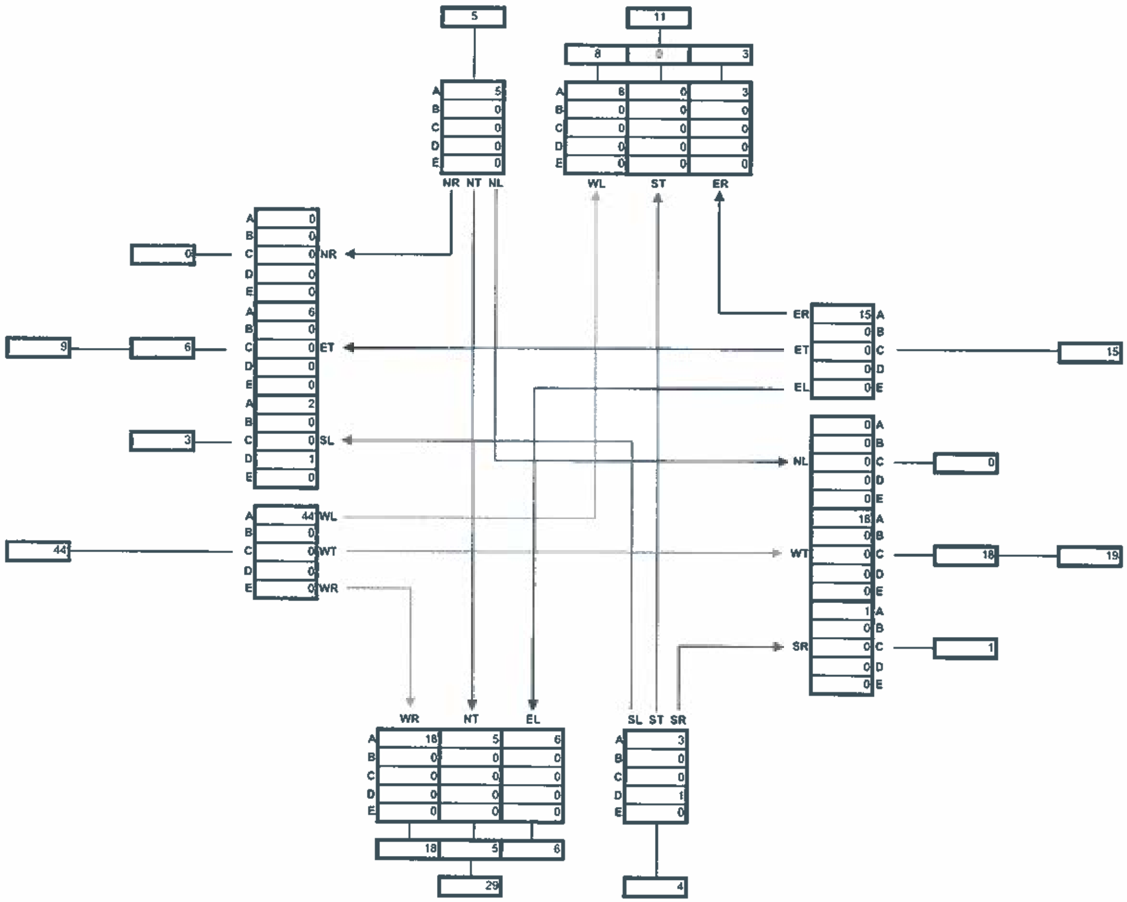
SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	5	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	5	

West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	44	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	44	



East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	15	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	15	

South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	3	75.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	1	25.0
E: Tractor Trailor Unit	0	0.0
Peak Hour Volume	4	

Intersection of:	Township Road 475A & Range Road 244
Date:	2008 (Estimated)
Time:	5 pm - 6 pm

Turning Movement Abbreviations

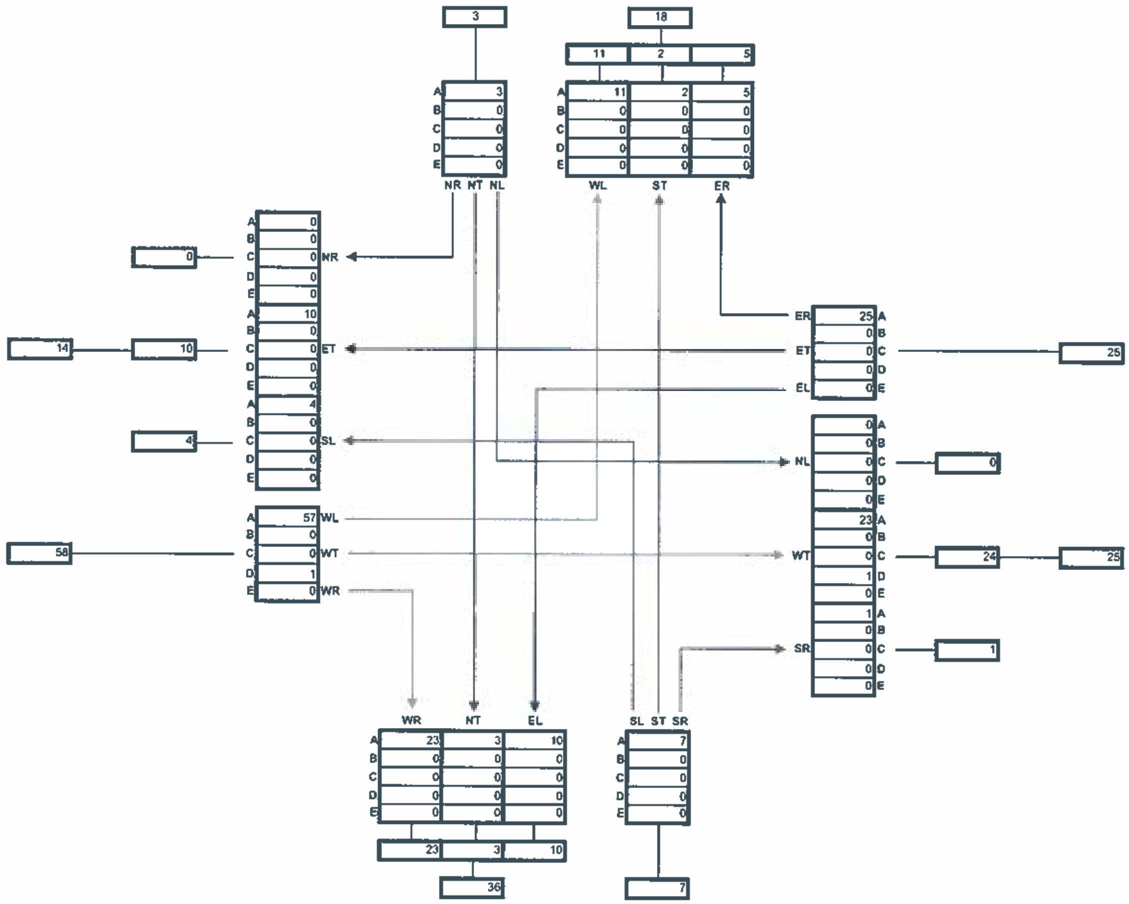
NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

North On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	3	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	3	



West On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	57	98.3
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	1	1.7
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	58	

East On Township Road 475A		
Vehicle Type	Vol	%
A: Passenger Car	25	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	25	

South On Range Road 244		
Vehicle Type	Vol	%
A: Passenger Car	7	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Peak Hour Volume	7	

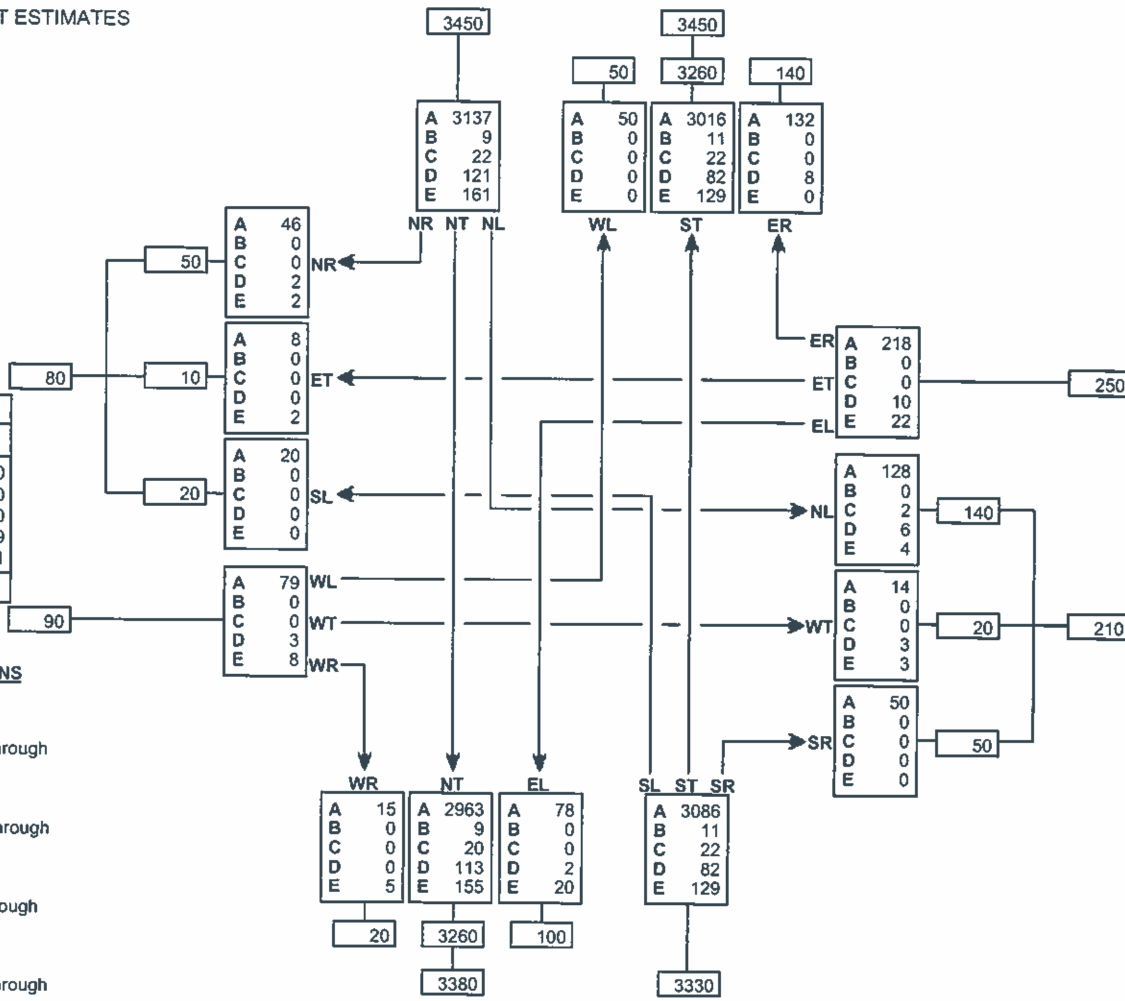
Turning Movement Summary Diagram

Reference No.: 90410

Intersection of:
2A & 616 N OF MILLET NJ

2008 AADT / ASDT ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	6335	91.8
B: Recreational Vehicle	20	0.3
S: Bus	44	0.6
D: Single Unit Truck	211	3.1
E: Tractor Trailer Unit	290	4.2
ASDT 7270	AADT	6900



West On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	153	90.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	5	2.9
E: Tractor Trailer Unit	12	7.1
ASDT 180	AADT	170

East On 616		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	410	89.1
B: Recreational Vehicle	0	0.0
S: Bus	2	0.4
D: Single Unit Truck	19	4.1
E: Tractor Trailer Unit	29	6.3
ASDT 520	AADT	460

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	6142	91.5
B: Recreational Vehicle	20	0.3
S: Bus	42	0.6
D: Single Unit Truck	197	2.9
E: Tractor Trailer Unit	309	4.6
ASDT 7070	AADT	6710

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
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SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo period of January 1 to December 31 (365 days)

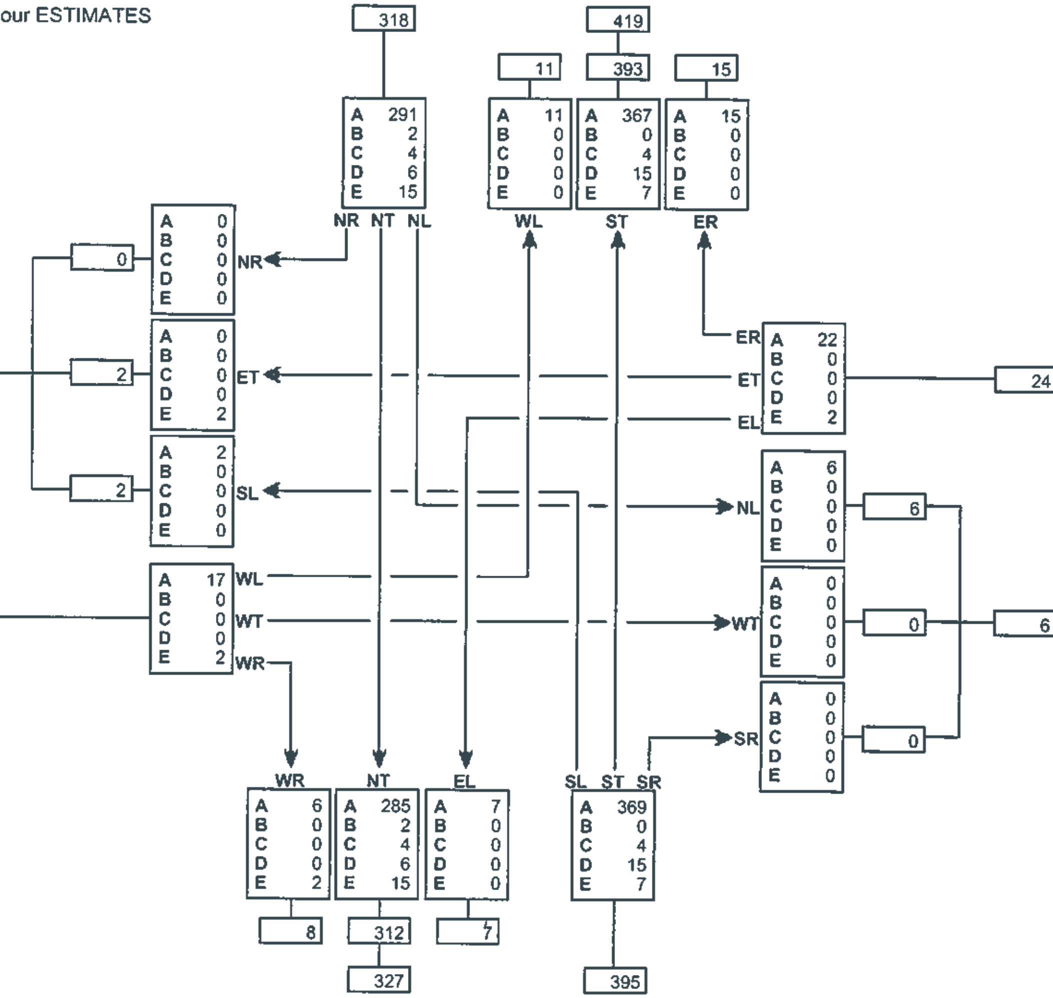
ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 90410
Intersection of:
2A & 616 N OF MILLET NJ

2008 a.m. 100th Highest Hour ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	684	92.8
B: Recreational Vehicle	2	0.3
S: Bus	8	1.1
D: Single Unit Truck	21	2.8
E: Tractor Trailer Unit	22	3.0
Total	737	



West On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	19	82.6
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	4	17.4
Total	23	

East On 616		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	28	93.3
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	2	6.7
Total	30	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	667	92.4
B: Recreational Vehicle	2	0.3
S: Bus	8	1.1
D: Single Unit Truck	21	2.9
E: Tractor Trailer Unit	24	3.3
Total	722	

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Reference No.: 90410

Intersection of:

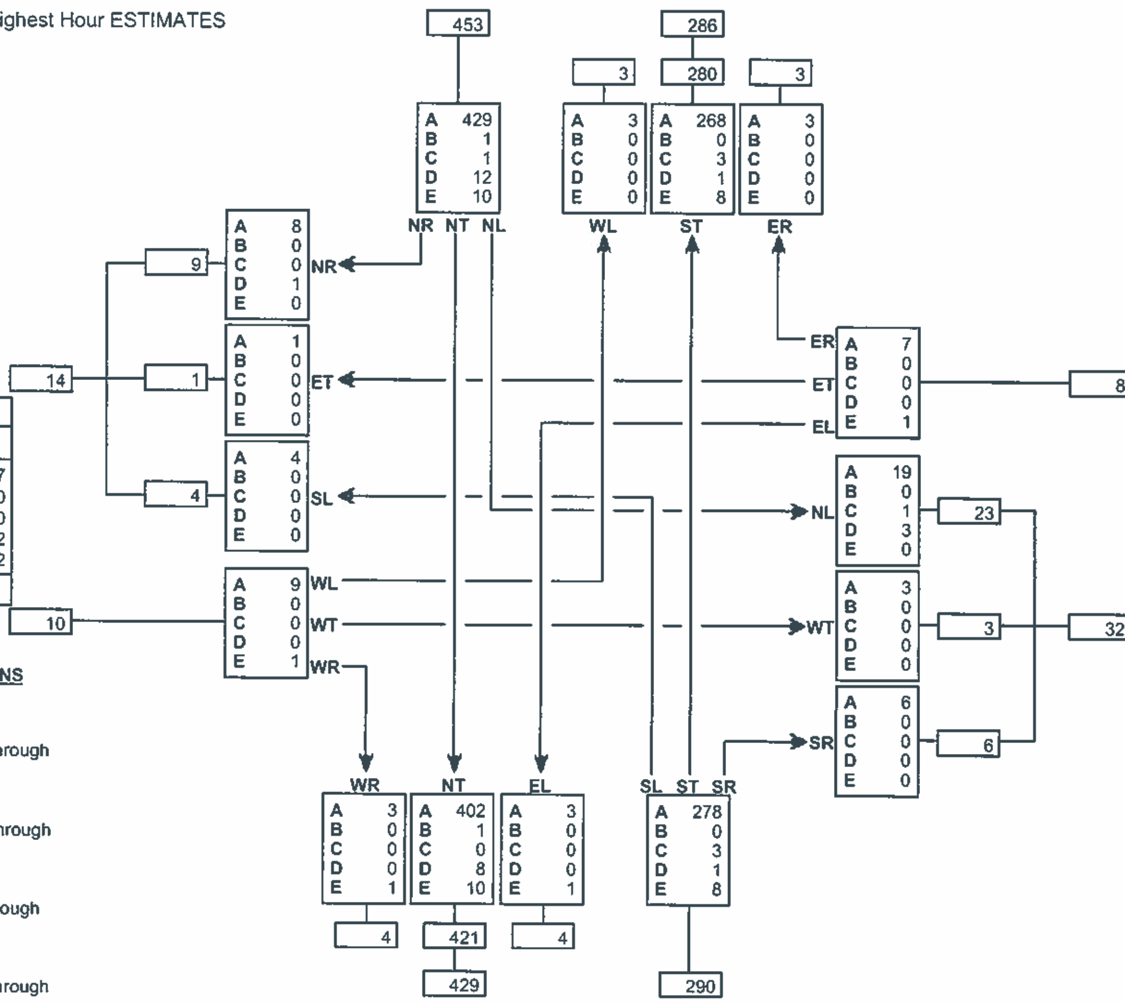
2A & 616 N OF MILLET NJ

2008 p.m. 100th Highest Hour ESTIMATES

Turning Movement Summary Diagram

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	703	95.1
B: Recreational Vehicle	1	0.1
S: Bus	4	0.5
D: Single Unit Truck	13	1.8
E: Tractor Trailer Unit	18	2.4
Total	739	

West On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	22	91.7
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	4.2
E: Tractor Trailer Unit	1	4.2
Total	24	



East On 616		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	35	87.5
B: Recreational Vehicle	0	0.0
S: Bus	1	2.5
D: Single Unit Truck	3	7.5
E: Tractor Trailer Unit	1	2.5
Total	40	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	686	95.4
B: Recreational Vehicle	1	0.1
S: Bus	3	0.4
D: Single Unit Truck	9	1.3
E: Tractor Trailer Unit	20	2.8
Total	719	

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Reference No.: 70000368

Intersection of:

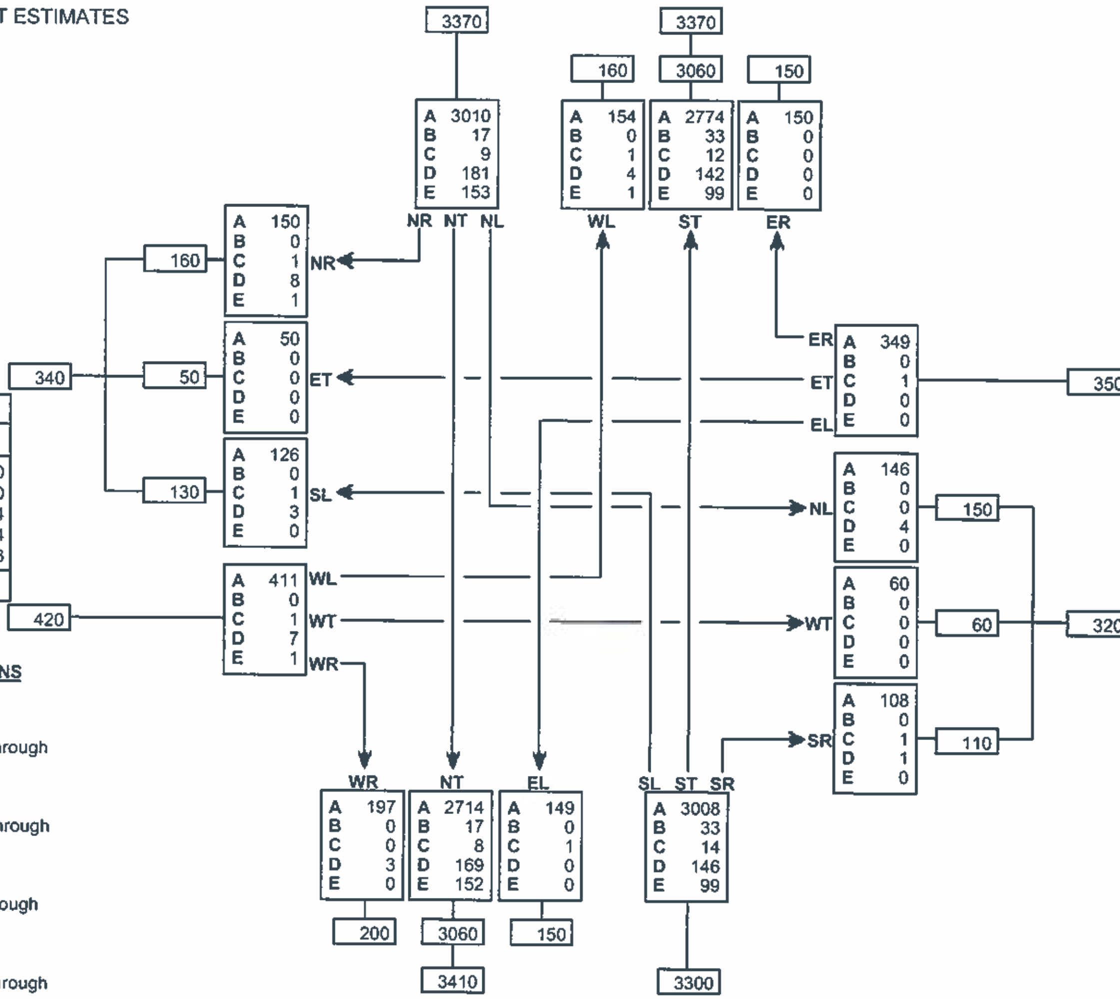
2A & 53 AVE, MILLET 32-47-25-405700800

2008 AADT / ASDT ESTIMATES

Turning Movement Summary Diagram

North On 2A		
Vehicle Type	Vol	%
A: Passenger Vehicle	6088	90.3
B: Recreational Vehicle	50	0.7
S: Bus	22	0.3
D: Single Unit Truck	327	4.9
E: Tractor Trailer Unit	253	3.8
ASDT 7100	AADT	6740

West On 53 Ave		
Vehicle Type	Vol	%
A: Passenger Vehicle	737	97.0
B: Recreational Vehicle	0	0.0
S: Bus	3	0.4
D: Single Unit Truck	18	2.4
E: Tractor Trailer Unit	2	0.3
ASDT 800	AADT	760



East On 53 Ave		
Vehicle Type	Vol	%
A: Passenger Vehicle	663	99.0
B: Recreational Vehicle	0	0.0
S: Bus	2	0.3
D: Single Unit Truck	5	0.7
E: Tractor Trailer Unit	0	0.0
ASDT 710	AADT	670

South On 2A		
Vehicle Type	Vol	%
A: Passenger Vehicle	6068	90.4
B: Recreational Vehicle	50	0.7
S: Bus	23	0.3
D: Single Unit Truck	318	4.7
E: Tractor Trailer Unit	251	3.7
ASDT 7070	AADT	6710

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo period of May 1 to September 30 (153 days)

Reference No.: 70000368

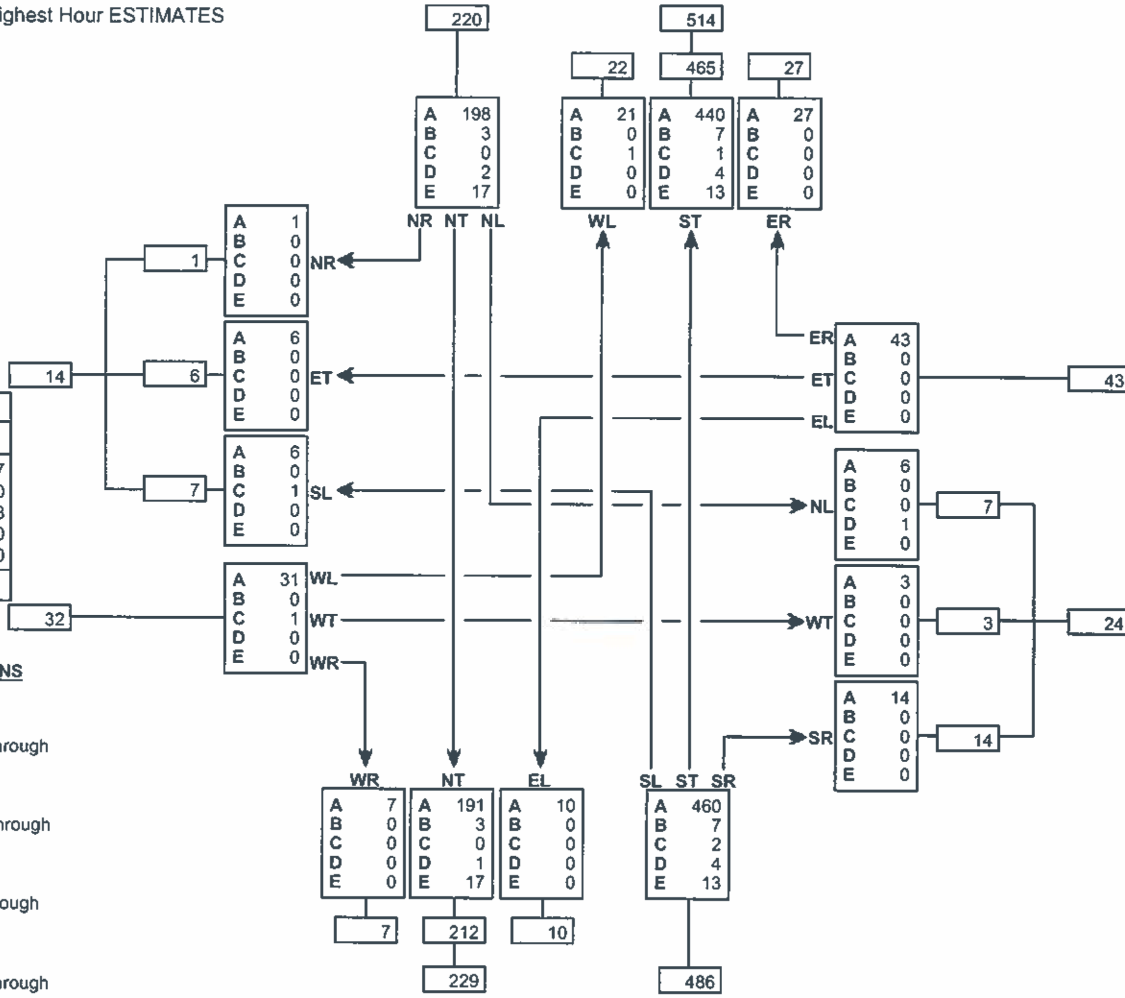
Intersection of:

2A & 53 AVE, MILLET 32-47-25-405700800

2008 a.m. 100th Highest Hour ESTIMATES

Turning Movement Summary Diagram

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	686	93.5
B: Recreational Vehicle	10	1.4
S: Bus	2	0.3
D: Single Unit Truck	6	0.8
E: Tractor Trailer Unit	30	4.1
Total	734	



West On 53 Ave		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	44	95.7
B: Recreational Vehicle	0	0.0
S: Bus	2	4.3
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	46	

East On 53 Ave		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	66	98.5
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	1.5
E: Tractor Trailer Unit	0	0.0
Total	67	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	668	93.4
B: Recreational Vehicle	10	1.4
S: Bus	2	0.3
D: Single Unit Truck	5	0.7
E: Tractor Trailer Unit	30	4.2
Total	715	

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

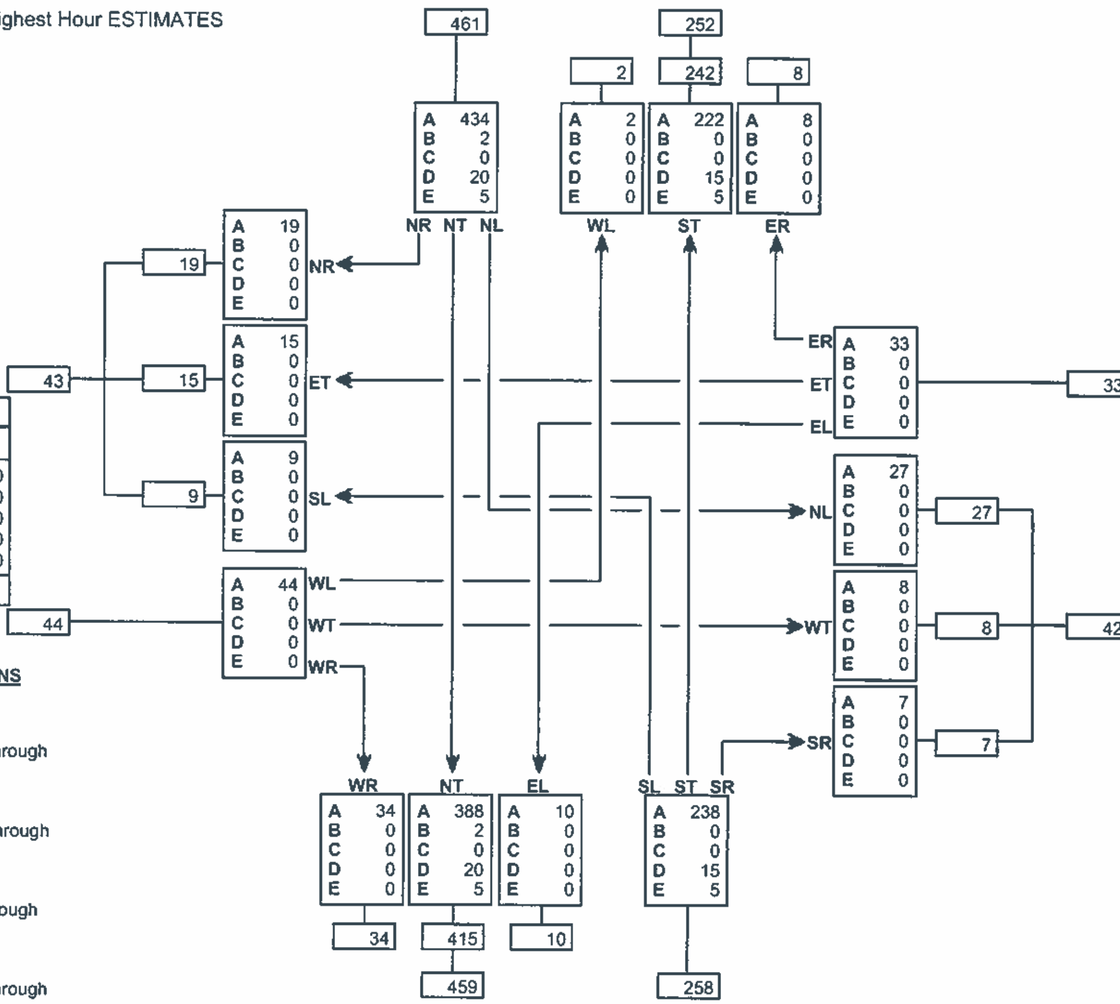
Reference No.: 70000368

Intersection of:
2A & 53 AVE, MILLET 32-47-25-405700800

2008 p.m. 100th Highest Hour ESTIMATES

North On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	666	93.4
B: Recreational Vehicle	2	0.3
S: Bus	0	0.0
D: Single Unit Truck	35	4.9
E: Tractor Trailer Unit	10	1.4
Total	713	

West On 53 Ave		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	87	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	87	



East On 53 Ave		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	75	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	75	

South On 2A		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	670	93.4
B: Recreational Vehicle	2	0.3
S: Bus	0	0.0
D: Single Unit Truck	35	4.9
E: Tractor Trailer Unit	10	1.4
Total	717	

TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

APPENDIX C

TRIP GENERATION SHEETS

General Light Industrial
(110)

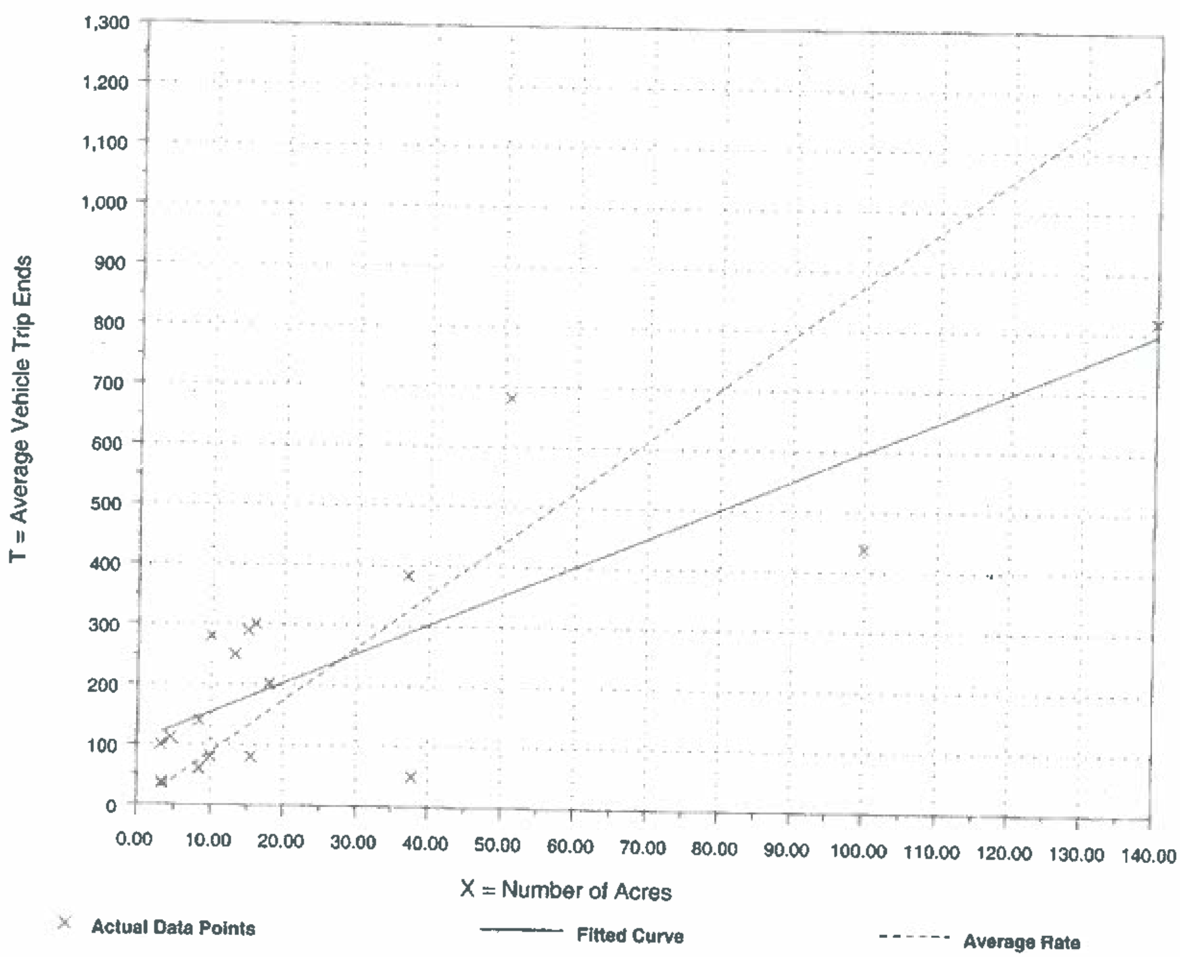
Average Vehicle Trip Ends vs: Acres
On a: Weekday,
P.M. Peak Hour of Generator

Number of Studies: 18
Average Number of Acres: 27
Directional Distribution: 30% entering, 70% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
8.77	1.32 - 31.25	6.74

Data Plot and Equation

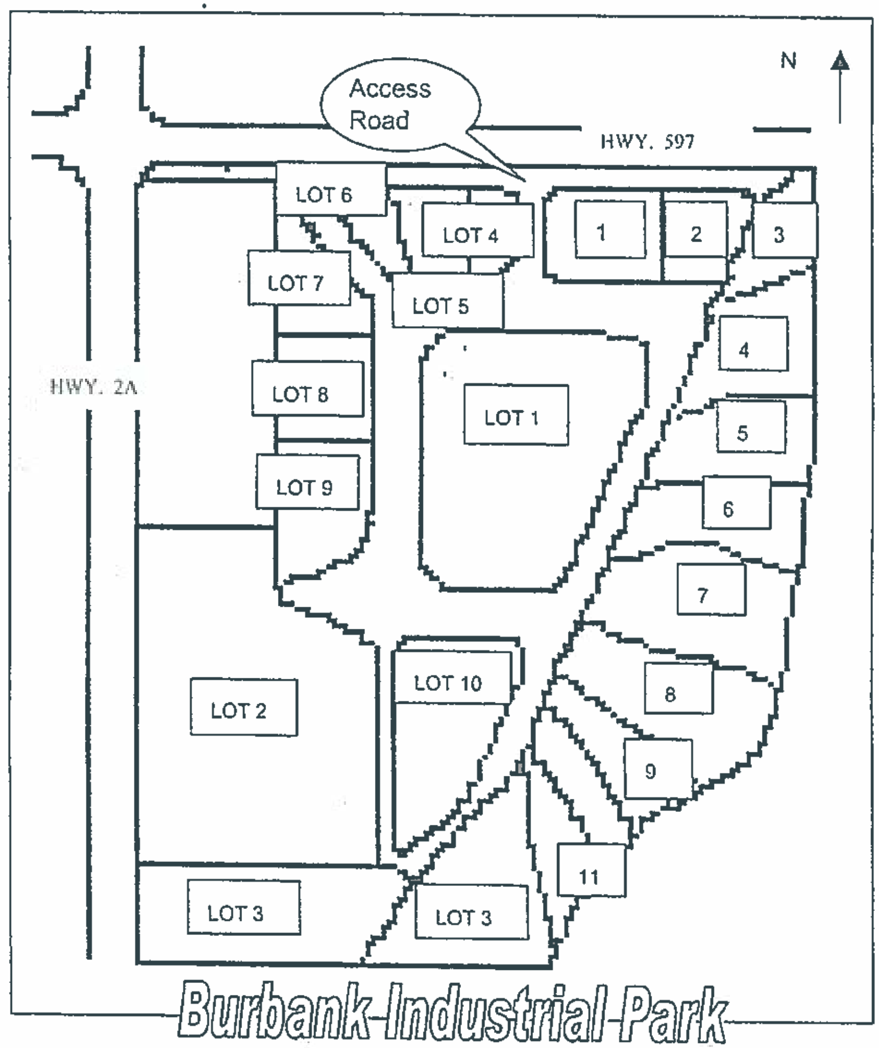


Fitted Curve Equation: $T = 4.94(X) + 105.18$

$R^2 = 0.66$

BUSINESS PROFILE

LOT No.		BUSINESS NAME	AREA (ACRES)
BLOCK 1	1	A.DERI-TEK SYSTEM B.WISE WOOD PIPELINE C.VERTEC MECHNICAL D.RLC REALITY E.ARTIE KOS TRUCKING/BOBCO OIL	13.442
	2	UNOCCUPIED	
	3	SEPARATE ACCESS	
	4	HUSKY CARDLOCK P.S.	1.322
	5	QA STRUCTURE INC.	1.48
	6	DIXON NETWORK CO.	1.905
	7	ASSOCIATED VANLINE	2.578
	8	PRO-LINE MANUFACTURING	2.429
	9	HALL INDUSTRIAL CONTRACTING	2.431
	10	CONCORD OILFIELD SUPPLIER	6.55
BLOCK 2	1	QUINN CONTRACTING LTD.	3.65
	2	QUINN CONTRACTING LTD.	5.34
	3	UNOCCUPIED	
	4	CANADIAN SUBSURFACE	2.021
	5	EDGE BUILDING SYSTEM	2.006
	6	QA ???	2.024
	7	R&R STRESS RELIEVING SERVICE	2.004
	8	QA STRUCTURE INC.	5.93
	9		
	10		
	11	UNOCCUPIED	
TOTAL			55.11



INTERSECTION (IN / OUT) SUMMARY

TIME \ DATE	14 / 04/ 2004			15 / 04 / 2004			16 / 04 2004			3-DAY TOTAL	AVERAGE
	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL		
7:00am -9:00am	133	28	161	135	30	165	129	42	171	497	166
11:00am -2:00pm	117	141	258	112	142	254	119	137	256	768	256
4:00 pm - 6:00pm	45	140	185	50	141	191	31	115	146	522	174
6:00pm - 6:30pm				4	16	20	7	24	31	51	17
DAILY TOTAL	295	309	604	301	329	630	286	318	604	1838	613

SUMMARY OF ALL DIRECTIONS

TOTAL DAILY AVERAGE	DAILY PEAK HOURS AVERAGE		
1968	259 (7:00-8:00am)	212 (12:00-1:00pm)	155 (5:00-6:00pm)

Note: all the above total numbers are approximately 80% of a full day's traffic volume

TRAFFIC (IN / OUT) SUMMARY

TIME SPAN	TOTAL TRIPS	ACRES	TRIP RATE	IN	OUT	% IN	% OUT
AVERAGE DAILY	766	55.1	13.9	383	383	50	50
AM PEAK	96	55.1	1.8	76	20	79	21
PM PEAK	98	55.1	1.8	24	74	24	76
NOON PEAK	109	55.1	2	49	60	45	55

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
AY & DATE OBSERVED: THURSDAY, 04/15/2004

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS

HOURS	APPROACHING INTERSECTION																														TOTALS
	FROM THE EAST ON															FROM THE WEST ON															
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT					
7:00-8:00am	6		0	0	0	67		2	5	0											111		1	12	4	60		0	8	0	276
8:00-8:30	1		0	0	0	33		0	0	2											16		0	8	1	38		0	3	0	102
8:30-9:00	2		0	0	0	22		0	3	2											22		0	7	2	13		0	2	2	77
9:00-10:00																															0
10:00-11:00																															0
11:00-12:00	1		0	2	0	48		0	10	7											46		0	6	4	9		0	4	1	138
12:00-1:00pm	1		0	1	0	42		0	9	3											36		0	5	11	48		0	6	2	164
1:00-2:00	0		0	0	0	38		0	9	8											39		0	5	7	23		0	7	7	143
2:00-3:00																															0
3:00-4:00																															0
4:00-4:30	0		0	1	0	62		1	6	4											18		1	1	4	8		0	4	3	113
4:30-5:00	1		0	1	0	43		1	3	1											25		0	1	3	6		0	0	0	85
5:00-5:30	1		0	0	0	61		0	0	3											34		0	5	1	10		0	0	5	120
5:30-6:00	3		0	0	0	37		0	2	3											43		1	0	0	7		0	0	0	96
6:00-6:30pm	0		0	1	0	26		0	1	0											20		0	1	2	2		0	0	1	54
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	
TOTALS	16	0	0	6	0	479	0	4	48	33	0	0	0	0	0	0	0	0	0	0	410	0	3	51	39	224	0	0	34	21	1368
	EL					ET					ER					WL					WT					WR					

.OCATION DIAGRAM ATTACHED:
RECORDER:

VEHICLE CLASSES

A: PASSENGER VEHICI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRUCI E: TRACTOR TRAILER COMBINATIONS

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
WEATHER CONDITIONS: CLOUDY & WINDY
COMMENTS:

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS
DATE: WEDNESDAY, 04/14/2004

HOURS	APPROACHING INTERSECTION																														TOTALS	GRAND TOTALS
	FROM THE NORTH ON															FROM THE SOUTH ON																
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT						
7:00-8:00am																10		0	5	5						1		0	1	0	22	198
8:00-8:30																0		0	1	0						0		0	0	0	1	93
8:30-9:00																2		0	0	2						0		0	1	0	5	44
9:00-10:00																															0	0
10:00-11:00																															0	0
11:00-12:00																35		0	3	1						0		0	1	0	40	158
12:00-1:00pm																53		0	8	0						2		0	1	0	64	200
1:00-2:00																18		0	11	3						2		0	1	2	37	179
2:00-3:00																															0	0
3:00-4:00																															0	0
4:00-4:30																20		0	2	1						2		0	0	0	25	95
4:30-5:00																24		0	2	0						1		0	0	1	28	141
5:00-5:30																49		0	2	0						1		0	0	1	53	177
5:30-6:00																25		0	3	4						2		0	0	0	34	103
6:00-7:00pm																															0	0
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E		
TOTALS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	236	0	0	37	16	0	0	0	0	0	11	0	0	5	4	309	1388
	NL					NT					NR					SL					ST					SR						

VEHICLE CLASSES

A: PASSENGER VEHI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRU E: TRACTOR TRAILER COMBINATIONS

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
DAY & DATE OBSERVED: WEDNESDAY, 04/14/2004

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS

HOURS	APPROACHING INTERSECTION																														TOTALS
	FROM THE EAST ON															FROM THE WEST ON															
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT					
7:00-8:00am	2		0	0	2	28		0	6	4											49		0	10	6	55		0	10	4	176
8:00-8:30	2		0	0	0	10		1	3	2											30		2	5	3	29		0	5	0	92
8:30-9:00	0		0	0	0	6		0	1	0											2		0	6	0	23		0	1	0	39
9:00-10:00																															0
10:00-11:00																															0
11:00-12:00	3		0	2	0	33		0	9	5											26		0	5	5	23		0	6	1	118
2:00-1:00pm	2		0	1	0	41		0	7	5											33		0	5	5	23		0	11	3	136
1:00-2:00	1		0	1	0	32		0	4	6											34		0	18	6	28		0	9	3	142
2:00-3:00																															0
3:00-4:00																															0
4:00-4:30	0		0	1	0	30		1	5	3											15		2	5	2	5		0	0	1	70
4:30-5:00	0		0	0	0	67		0	4	3											19		0	3	3	10		0	2	2	113
5:00-5:30	1		0	0	0	60		0	5	0											41		0	0	1	15		0	1	0	124
5:30-6:00	2		0	1	0	28		0	1	1											24		0	5	3	1		0	0	3	69
6:00-7:00pm																															0
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	
TOTALS	13	0	0	6	2	335	0	2	45	29	0	0	0	0	0	0	0	0	0	0	273	0	4	62	34	212	0	0	45	17	1079
	EL					ET					ER					WL					WT					WR					

LOCATION DIAGRAM ATTACHED:
RECORDER:

VEHICLE CLASSES
A: PASSENGER VEHI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRU· E: TRACTOR TRAILER COMBINATIONS

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
DAY & DATE OBSERVED: FRIDAY, 04/16/2004

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS

HOURS	APPROACHING INTERSECTION																														TOTALS
	4 FROM THE EAST ON															FROM THE WEST ON															
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT					
7:00-8:00am	2		0	1	1	62		2	6	2											103		1	15	3	68		0	7	2	275
8:00-8:30	1		0	0	0	29		0	2	2											25		0	4	3	25		0	5	0	96
8:30-9:00	1		0	0	0	24		0	6	2											20		0	2	4	11		0	5	0	75
9:00-10:00																															0
10:00-11:00																															0
11:00-12:00	4		0	2	0	46		0	9	9											40		0	7	4	24		0	15	0	160
12:00-1:00pm	0		0	0	1	53		0	7	5											34		0	6	7	30		0	8	1	152
1:00-2:00	1		0	1	0	33		0	7	9											51		0	6	9	24		0	4	4	149
2:00-3:00																															0
3:00-4:00																															0
4:00-4:30	2		0	0	0	44		1	2	6											21		1	1	3	6		0	0	1	88
4:30-5:00	1		0	0	0	44		0	2	3											28		1	4	1	4		0	2	2	92
5:00-5:30	1		0	0	0	32		0	2	1											26		0	4	2	3		0	0	2	73
5:30-6:00	0		0	0	1	36		0	2	3											51		0	1	1	5		0	1	0	101
6:00-6:30pm	0		0	0	1	19		0	1	2											34		0	3	0	4		0	1	1	66
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	
TOTALS	13	0	0	4	3	403	0	3	45	0	0	0	0	0	0	0	0	0	0	0	399	0	3	50	37	200	0	0	47	12	1327
	EL					ET					ER					WL					WT					WR					

LOCATION DIAGRAM ATTACHED:
RECORDER:

VEHICLE CLASSES
A: PASSENGER VEHI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRU(E: TRACTOR TRAILER COMBINATIONS

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
WEATHER CONDITIONS: LIGHT SNOW & WINDY
COMMENTS:

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS
DATE: THURSDAY, 04/15/2004

HOURS	APPROACHING INTERSECTION																														TOTALS	GRAND TOTALS
	FROM THE NORTH ON															FROM THE SOUTH ON																
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT						
7:00-8:00am																10		0	2	0						2		0	0	0	14	290
8:00-8:30																4		0	2	1						0		0	0	0	7	109
8:30-9:00																6		0	2	1						0		0	0	0	9	86
9:00-10:00																															0	0
10:00-11:00																															0	0
11:00-12:00																43		0	10	3						0		0	0	1	57	195
12:00-1:00pm																49		0	5	1						4		0	1	0	60	224
1:00-2:00																17		0	3	1						3		0	0	1	25	168
2:00-3:00																															0	0
3:00-4:00																															0	0
4:00-4:30																22		0	7	0						1		0	1	0	31	144
4:30-5:00																37		0	5	1						1		0	0	0	44	129
5:00-5:30																24		0	2	1						1		0	1	2	31	151
5:30-6:00																31		0	1	2						1		0	0	0	35	131
6:00-6:30pm																9		0	3	2						0		0	1	1	16	70
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E		
TOTALS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252	0	0	42	13	0	0	0	0	0	13	0	0	4	5	329	1697
	NL					NT					NR					SL					ST					SR						

VEHICLE CLASSES

A: PASSENGER VEHICI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRUCK E: TRACTOR TRAILER COMBINATIONS

DIRECTIONAL TRAFFIC COUNT SUMMARY

INTERSECTION NO.:
HIGHWAY:
REFERENCE NO.:
WEATHER CONDITIONS: SNOW
COMMENTS:

INTERSECTION OF: HIGHWAY 597 & BURBANK INDUSTRIAL PARK
LEGAL DESCRIPTION:
COUNT TYPE: HOURS
DATE: FRIDAY, 04/16/2004

HOURS	APPROACHING INTERSECTION																														TOTALS	GRAND TOTALS
	FROM THE NORTH ON															FROM THE SOUTH ON 10																
	LEFT					THROUGH					RIGHT					LEFT					THROUGH					RIGHT						
7:00-8:00am																7		0	3	1						2		0	0	0	13	288
8:00-8:30																7		0	1	2						0		0	0	0	10	106
8:30-9:00																9		0	4	0						0		0	0	0	13	88
9:00-10:00																															0	0
10:00-11:00																															0	0
11:00-12:00																34		0	10	1						4		0	4	0	53	213
12:00-1:00pm																41		0	11	1						1		0	1	0	55	207
1:00-2:00																17		0	7	4						0		0	1	0	29	178
2:00-3:00																															0	0
3:00-4:00																															0	0
4:00-4:30																20		0	2	0						1		0	0	0	23	111
4:30-5:00																30		0	2	0						0		0	0	2	34	126
5:00-5:30																21		0	1	0						1		0	0	0	23	96
5:30-6:00																28		0	3	3						1		0	0	0	35	136
6:00-6:30pm																19		0	1	2						0		0	1	1	24	90
VEH CLASS	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E		
TOTALS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	233	0	0	45	14	0	0	0	0	0	10	0	0	7	3	312	1639
	NL					NT					NR					SL					ST					SR						

VEHICLE CLASSES

A: PASSENGER VEHI B: RECREATION VEHICLES C: BUSES
D: SINGLE UNIT TRU(E: TRACTOR TRAILER COMBINATIONS

APPENDIX D

ILLUMINATION WARRANT WORKSHEET

Illumination of Isolated Rural Intersections

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Township Road 480	Main Road	Date	June 14, 2009
West Subdivision Access Road	Minor Road	Other	Projected year (2034)
Millet, Alberta	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	0		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	80				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	C	0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
					Geometric Factors Subtotal	3

OPERATIONAL FACTORS

	Value	Rating	Weight	Comments	Check	Score
Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	480	0	10	Either Use the two AADT inputs OR the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	0
AADT on Minor Road (2-way)	365	0	20		OK	0
Signalization Warrant	Descriptive	0	30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	60	1	5	Refer to Table 1(B), note #3	OK	5
					Operational Factors Subtotal	25

ENVIRONMENTAL FACTOR

	Value	Rating	Weight	Comments	Check	Score
Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
					Environmental Factor Subtotal	5

COLLISION HISTORY

	Value	Rating	Weight	Comments	Check	Score
Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter either the annual frequency (See Table 1(C), note #4)	OK	0
OR				OR the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of all night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	0

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	3
Operational Factor Subtotal	25
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	33

Illumination of Isolated Rural Intersections

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Township Road 480	Main Road	Date	June 14, 2009
East Subdivision Access Road	Minor Road	Other	Projected year (2034)
Millet, Alberta	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	0		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	80				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =		0				
Posted Speed Category =	C	0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
					Geometric Factors Subtotal	3

OPERATIONAL FACTORS

	Value	Rating	Weight	Comments	Check	Score
Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	680	0	10	Either Use the two AADT inputs OR the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	0
AADT on Minor Road (2-way)	365	0	20		OK	0
Signalization Warrant	Descriptive	0	30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	60	1	5	Refer to Table 1(B), note #3	OK	5
					Operational Factors Subtotal	25

ENVIRONMENTAL FACTOR

	Value	Rating	Weight	Comments	Check	Score
Lighted Developments within 150 m radius of intersection	1	1	5	Maximum of 4 quadrants	OK	5
					Environmental Factor Subtotal	5

COLLISION HISTORY

	Value	Rating	Weight	Comments	Check	Score
Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				OR the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of all night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	0

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	3
Operational Factor Subtotal	25
Environmental Factor Subtotal	5
Collision History Subtotal	0
TOTAL POINTS	33

Illumination of Isolated Rural Intersections

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 2A	Main Road	Date	May 24, 2009
Township Road 480	Minor Road	Other	Projected year (2034)
Millet, Alberta	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	3		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	0		5		OK	
Channelization Factor					OK	15
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
					Geometric Factors Subtotal	18

OPERATIONAL FACTORS

	Value	Rating	Weight	Comments	Check	Score
Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	11070	4	10	Either Use the two AADT inputs OR the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	40
AADT on Minor Road (2-way)	730	1	20		OK	20
Signalization Warrant	Descriptive	0	30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	100

ENVIRONMENTAL FACTOR

	Value	Rating	Weight	Comments	Check	Score
Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	0

COLLISION HISTORY

	Value	Rating	Weight	Comments	Check	Score
Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter either the annual frequency (See Table 1(C), note #4)	OK	0
OR				OR the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of all night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	0

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	18
Operational Factor Subtotal	100
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**118**

Land Use: 110
General Light Industrial

Description

Light industrial facilities usually employ fewer than 500 persons, they have an emphasis on activities other than manufacturing and typically have minimal office space. Typical light industrial activities include printing, material testing and assembly of data processing equipment. These are free-standing facilities devoted to a single use. General heavy industrial (Land Use 120), industrial park (Land Use 130) and manufacturing (Land Use 140) are related uses.

Additional Data

No vehicle occupancy data were available specifically for general light industrial, but the average was approximately 1.3 persons per automobile for all industrial uses.

The peak hour of the generator typically coincided with the peak hour of the adjacent street traffic.

Facilities with employees on shift work may peak at other hours.

The sites were surveyed in the early 1970s and the mid- to late 1980s throughout the United States.

Source Numbers

7, 9, 10, 11, 15, 17, 88, 174, 179, 184, 191, 192, 251, 253, 286, 300

General Light Industrial
(110)

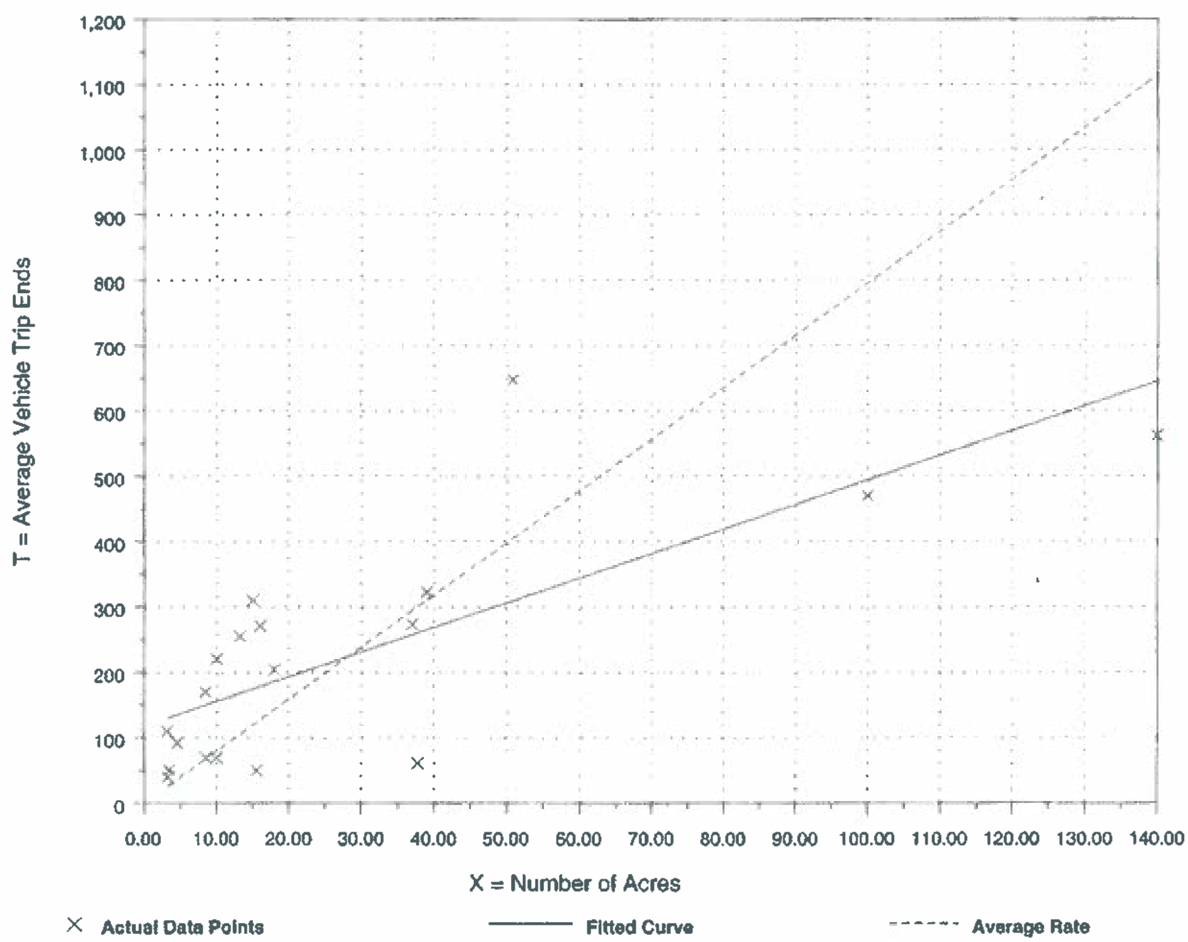
Average Vehicle Trip Ends vs: **Acres**
On a: **Weekday,**
A.M. Peak Hour of Generator

Number of Studies: 19
Average Number of Acres: 28
Directional Distribution: 85% entering, 15% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
7.96	1.61 - 34.38	6.46

Data Plot and Equation

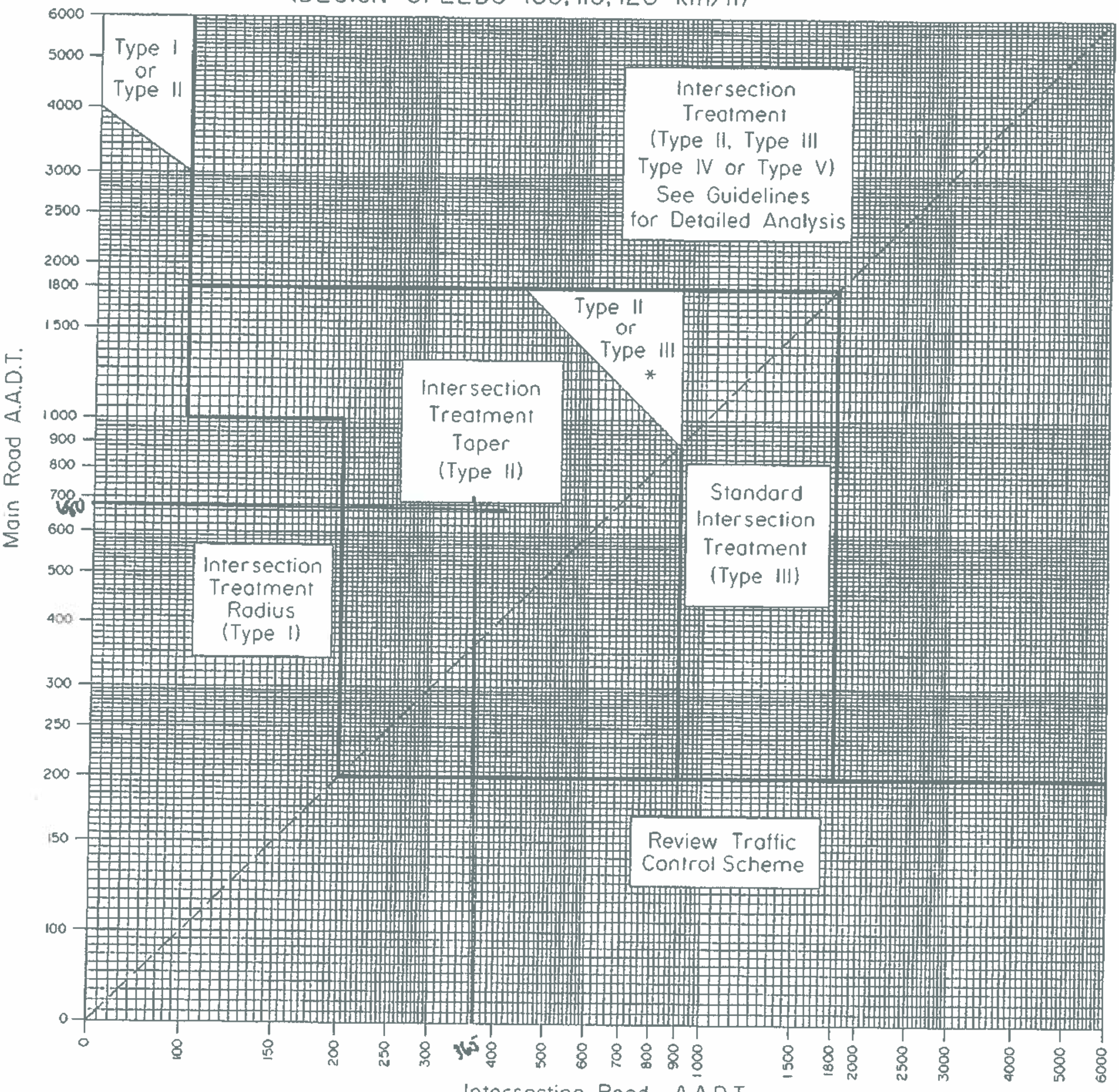


Fitted Curve Equation: $T = 3.76(X) + 117.88$ **$R^2 = 0.57$**

APPENDIX E

INTERSECTION ANALYSIS CHARTS & TYPES

FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)



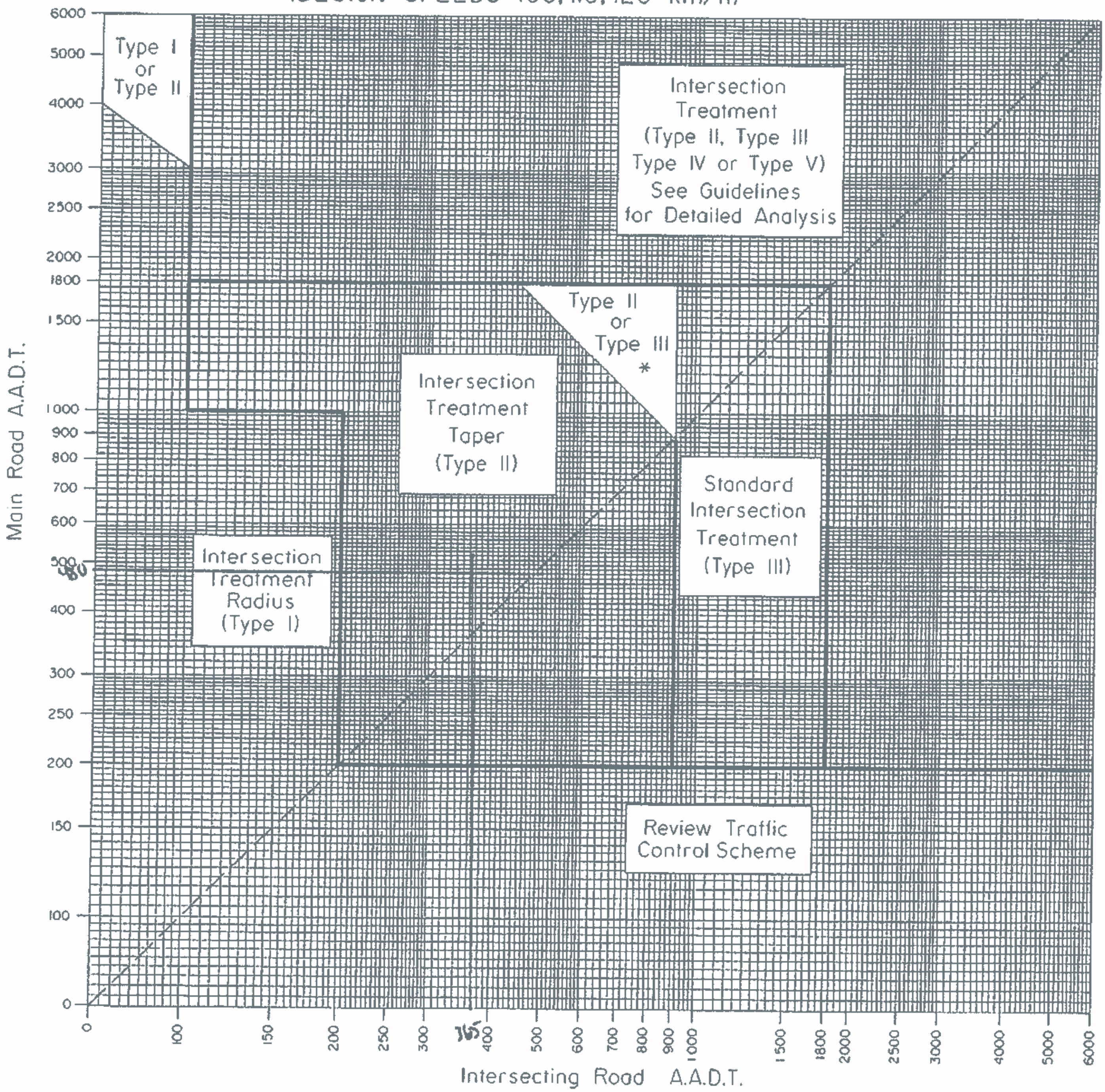
Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.

2. If main road is >4000 AADT Review Access Management
- — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme

3. Use projected traffic volumes for design
Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)



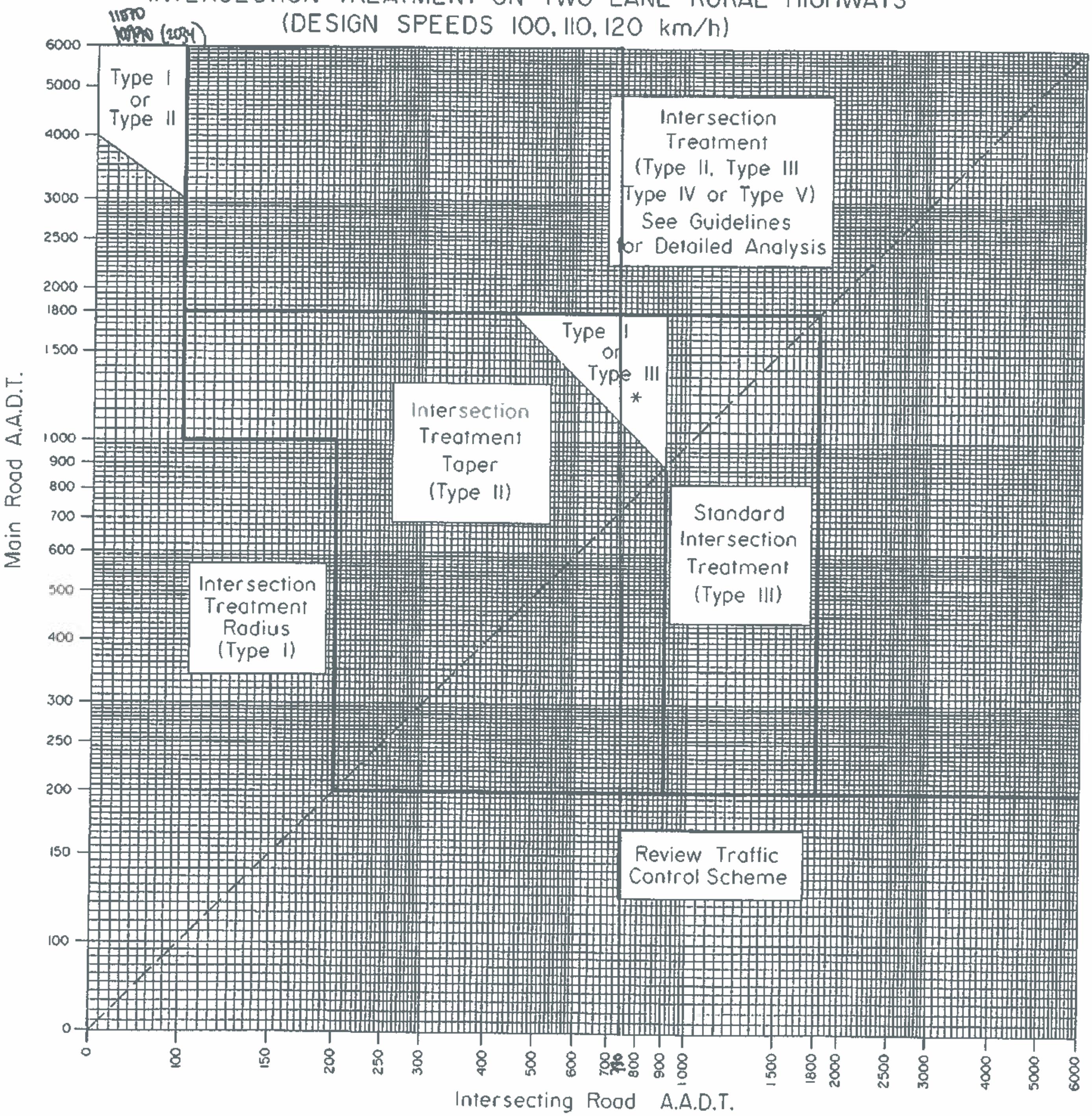
Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.

2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme

3. Use projected traffic volumes for design
   * Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)



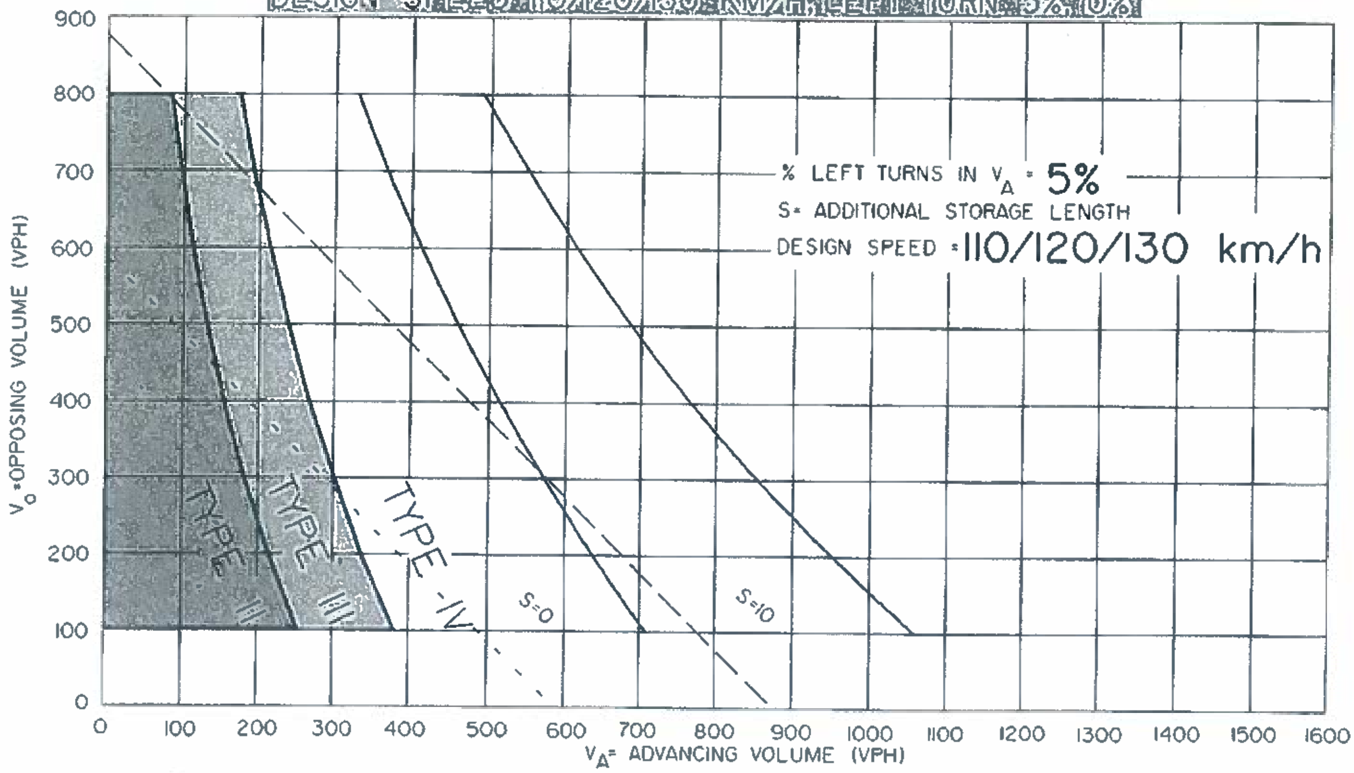
Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.

2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme

3. Use projected traffic volumes for design
   Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

FIGURE D-7.6-7a WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H LEFT TURN 5%,10%



S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

— — — Traffic signals may be warranted in "free flow" urban areas.

Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.

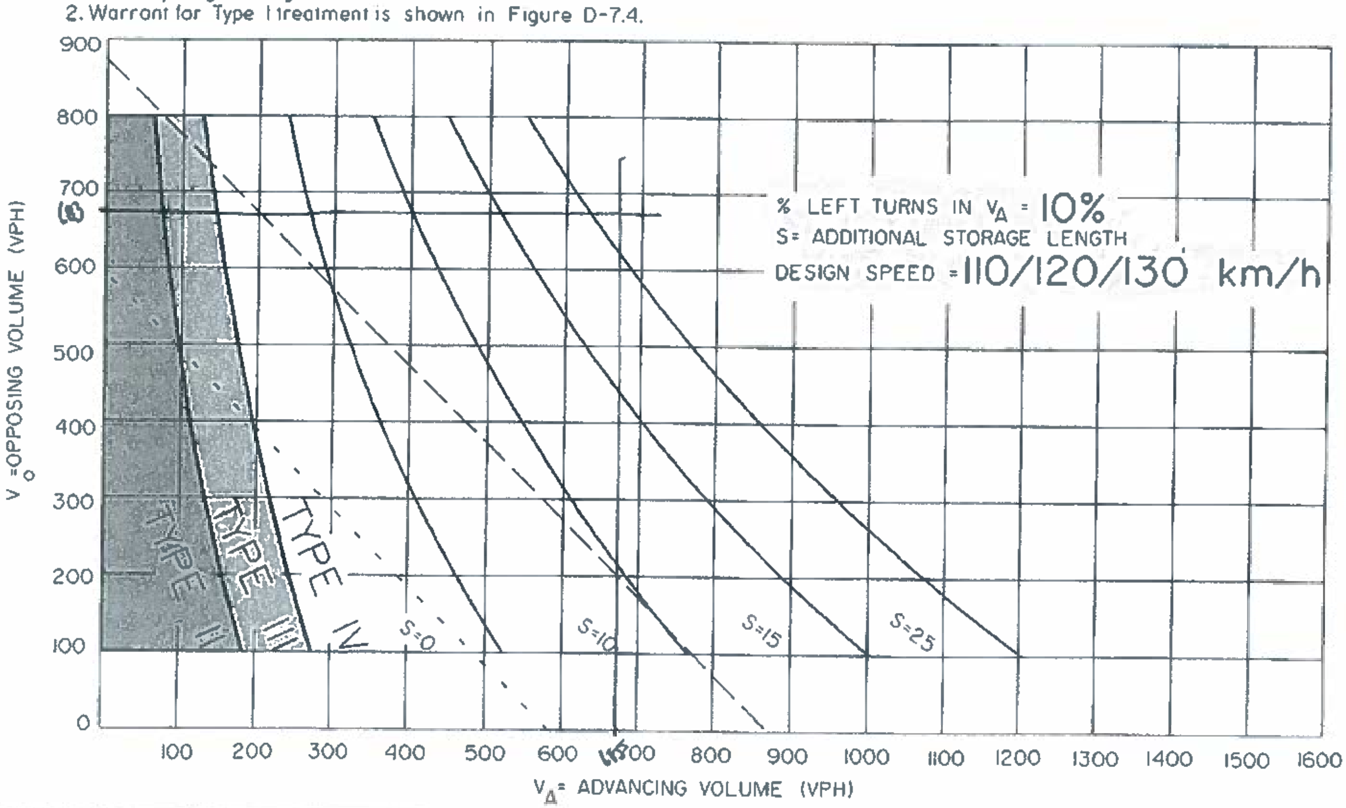
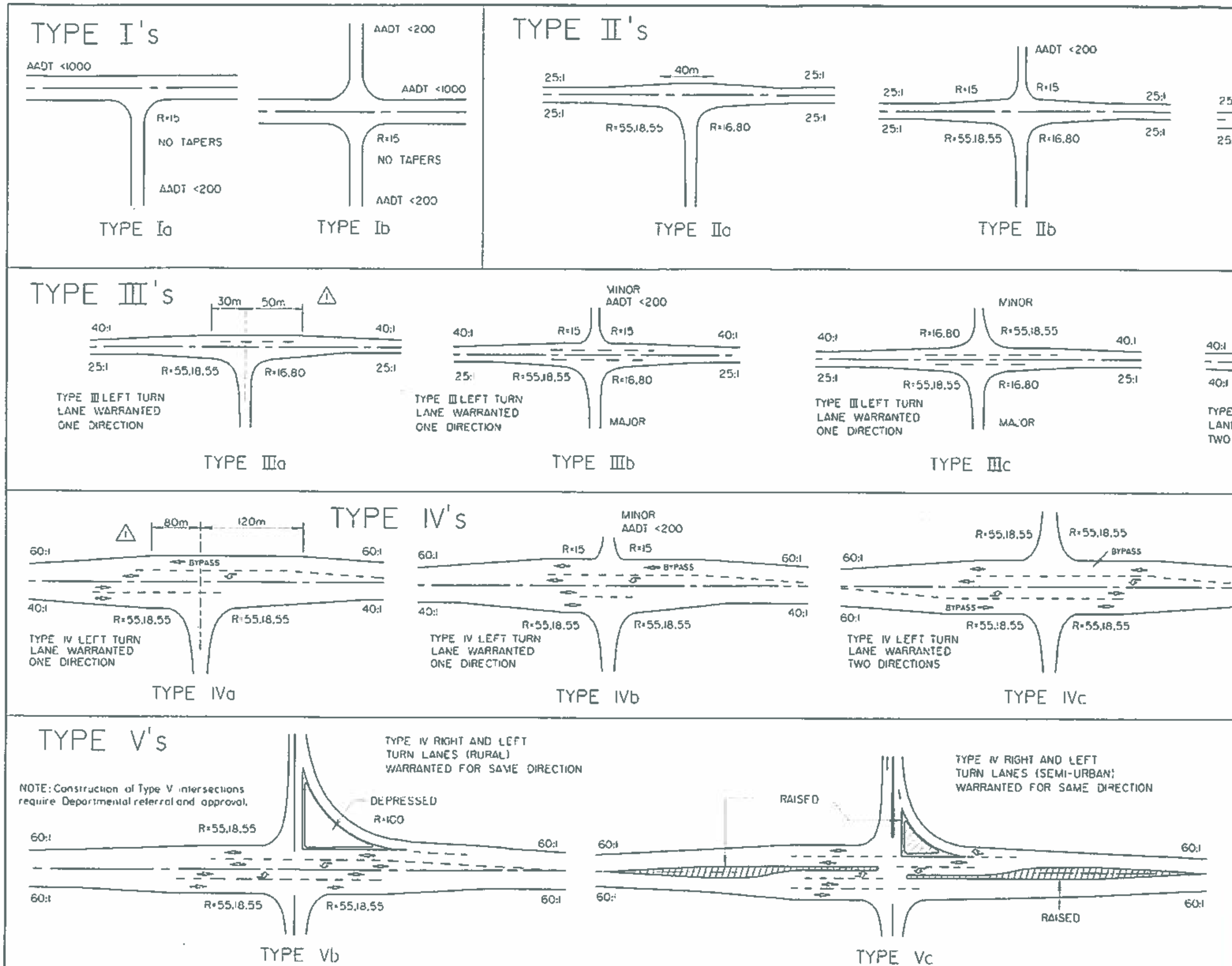


Table D.6.3.2 Design Widths for Turning Roadways at Rural Intersections

	Minimum Pavement Width (m)									
R radius on inner edge of pavement (m)	Case I one-lane, one-way operation no provision for passing				Case II one-lane, one-way operation with provision for passing a stalled vehicle			Case III two-lane operation either one-way or two-way		
design traffic condition vehicle accommodation type	A (P)	B (SU)	C (WB-12)	D (WB-21)	A (P-P)	B (P-SU)	C (SU-SU)	A (P-SU)	B (SU-SU)	C (WB-12-WB-12)
15	5.4	5.4	7.0	9.1	7.0	7.6	8.8	9.4	11.0	13.1
25	4.8	5.2	5.8	7.8	6.4	6.8	8.1	8.7	9.8	11.4
35	4.5	5.0	5.4	7.1	6.0	6.6	7.5	8.4	9.4	10.4
45	4.2	4.8	5.2	6.6	5.8	6.4	7.3	8.2	9.0	10.0
60	4.2	4.8	5.0	6.0	5.8	6.4	7.2	8.2	8.8	9.4
80	4.0	4.8	5.0	5.7	5.8	6.2	7.0	8.0	8.6	9.4
100	4.0	4.8	5.0	5.4	5.5	6.2	6.8	8.0	8.5	9.0
125	4.0	4.6	4.8	5.2	5.5	6.0	6.8	8.0	8.4	8.8
150	3.7	4.6	4.6	5.1	5.5	6.0	6.7	7.8	8.4	8.8
tangent	3.7	4.6	4.6	5.1	5.2	5.8	6.4	7.6	8.2	8.2
	Width Adjustment for Edge of Pavement Treatment									
mountable curb	none				none			none		
barrier curb										
one side	add 0.25m				none			add 0.25m		
two sides	add 0.5m				add 0.25m			add 0.5m		

Note:
1. The combination of vehicle accommodation type letters, such as P-SU for Case II, means the pavement width allows a P design vehicle to slowly pass by a stalled SU design truck or vice versa.
2. Case II C is generally used in Alberta.



NOTES:
1. This is not a pavement marking drawing.
2. This figure depicts the typical layouts used for at-grade intersections. Detailed design considerations may dictate some minor alterations for particular intersections. The tapers shown here are typical for a 110 km/h design speed on the main highway.

No.	REVISIONS	BY	DATE
⚠	REVISED LANE DIMENSIONS		
⚠			

Alberta INFRASTRUCTURE

FIGURE D-7.5

Date: APRIL 1995

STANDARD AT-GRADE INTERSECTION LAYOUTS FOR TWO-LANE HIGHWAYS

Prepared By: LT	Checked By: B.K.	Scale: N.T.S.	PAGE D-III

APPENDIX F

SIGNALIZATION WARRANT WORKSHEET

County of Wetaskiwin/Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Township Road 480	Direction (EW or NS)	EW	Road Authority:	County of Wetaskiwin/Alberta Transportation
Side Street (name)	East Access Road	Direction (EW or NS)	NS	City:	Millet, Alberta
Quadrant / Int #	n/a	Comments	Enter Comments about the analysis here.	Analysis Date:	2009 Jun 14, Sun
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2009 Jun 14, Sun
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Township Road 480	WB	0	1	0	0	0	1	9,999	1
Township Road 480	EB	0	0	0	0	1	0	9,999	1
East Access Road	NB	0	0	0	1	0	0		
East Access Road	SB	0	0	0	0	0	0		

Are the East Access Road NB right turns significantly impeded by through movements? (y/n) y

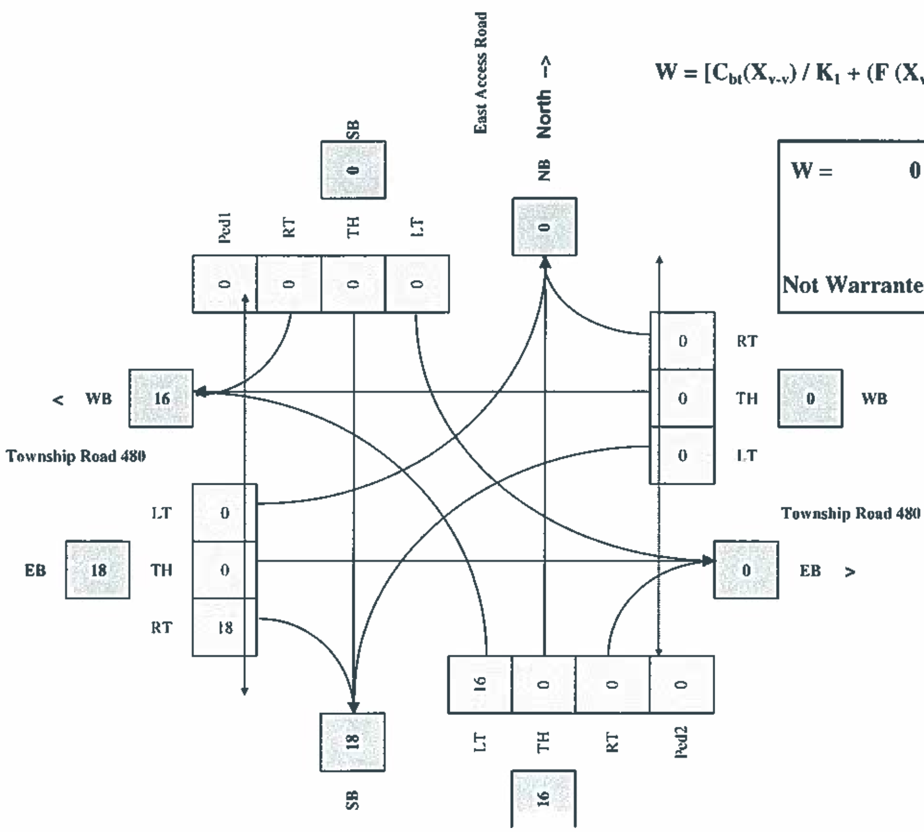
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	5,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Township Road 480	EW	80	10.0%	n	0.0
East Access Road	NS		10.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
8:00 - 9:00	18	0	0	0	0	0	0	0	0	0	0	85	0	0	0	0
9:00 - 10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 - 13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:00 - 14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00 - 17:00	77	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0
Total (6-hour peak)	95	0	0	0	0	0	0	0	0	0	0	106	0	0	0	0
Average (6-hour peak)	16	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$

W =	0	0	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

County of Wetaskiwin/Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Township Road 480	Direction (EW or NS)	EW		Road Authority:	County of Wetaskiwin/Alberta Transportation
Side Street (name)	West Access Road	Direction (EW or NS)	NS		City:	Millet, Alberta
Quadrant / Int #	n/a	Comments	Enter Comments about the analysis here.		Analysis Date:	2009 Jun 14, Sun
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET				Count Date:	2009 Jun 14, Sun
					Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Township Road 480	WB	0	1	0	0	0	1	9,999	1
Township Road 480	EB	0	0	0	0	1	0	9,999	1
West Access Road	NB	0	0	0	1	0	0		
West Access Road	SB	0	0	0	0	0	0		

Are the West Access Road NB right turns significantly impeded by through movements? (y/n) y

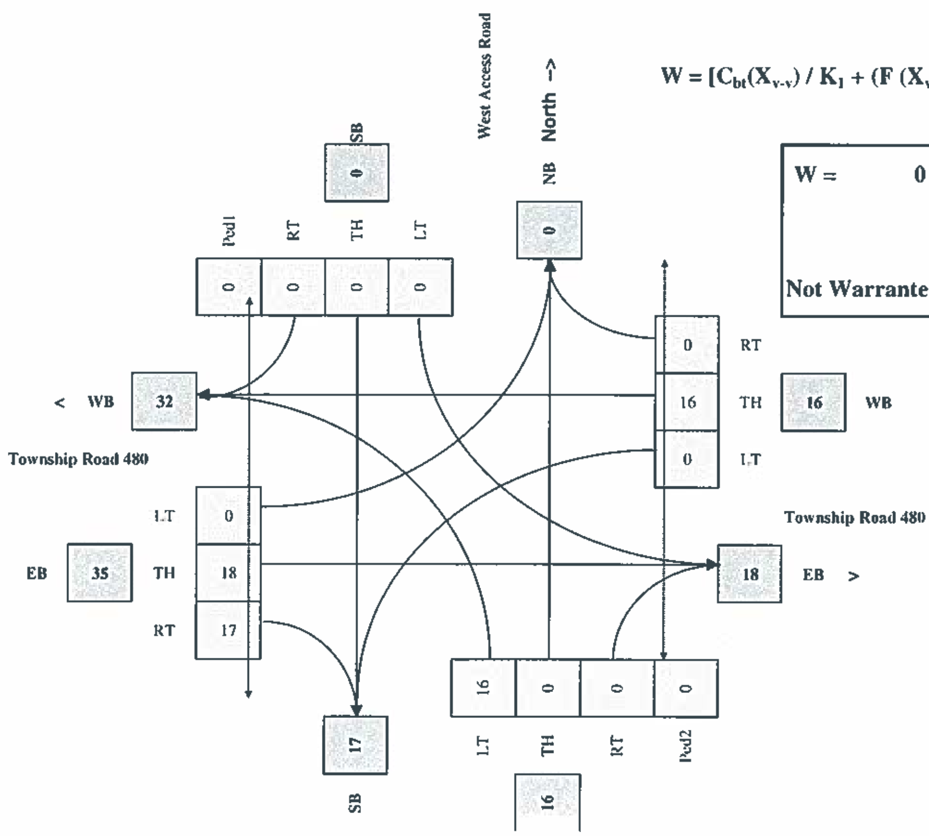
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	5,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Township Road 480	EW	80	10.0%	n	0.0
West Access Road	NS		10.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
8:00 - 9:00	17	0	0	0	0	0	0	18	0	0	85	85	0	0	0	0
9:00 - 10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 - 13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:00 - 14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00 - 17:00	77	0	0	0	0	0	0	77	0	0	21	18	0	0	0	0
Total (6-hour peak)	94	0	0	0	0	0	0	95	0	0	106	103	0	0	0	0
Average (6-hour peak)	16	0	0	0	0	0	0	16	0	0	18	17	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$

W =	0	0	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

County of Wetaskiwin/Alberta Transportation - Traffic Signal Warrant Analysis

Main Street (name)	Highway 2A	Direction (EW or NS)	NS		Road Authority:	County of Wetaskiwin/Alberta Transportation
Side Street (name)	Township Road 480	Direction (EW or NS)	EW		City:	Millet, Alberta
Quadrant / Int #	n/a	Comments	Enter Comments about the analysis here.		Analysis Date:	2009 Jun 14, Sun
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET				Count Date:	2009 Jun 14, Sun
					Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 2A	NB	0	0	1	0	0	1	9,999	1
Highway 2A	SB	1	0	1	0	0	0	9,999	1
Township Road 480	WB	0	0	0	1	0	0		
Township Road 480	EB	0	0	0	0	0	0		

Are the Township Road 480 WB right turns significantly impeded by through movements? (y/n) y

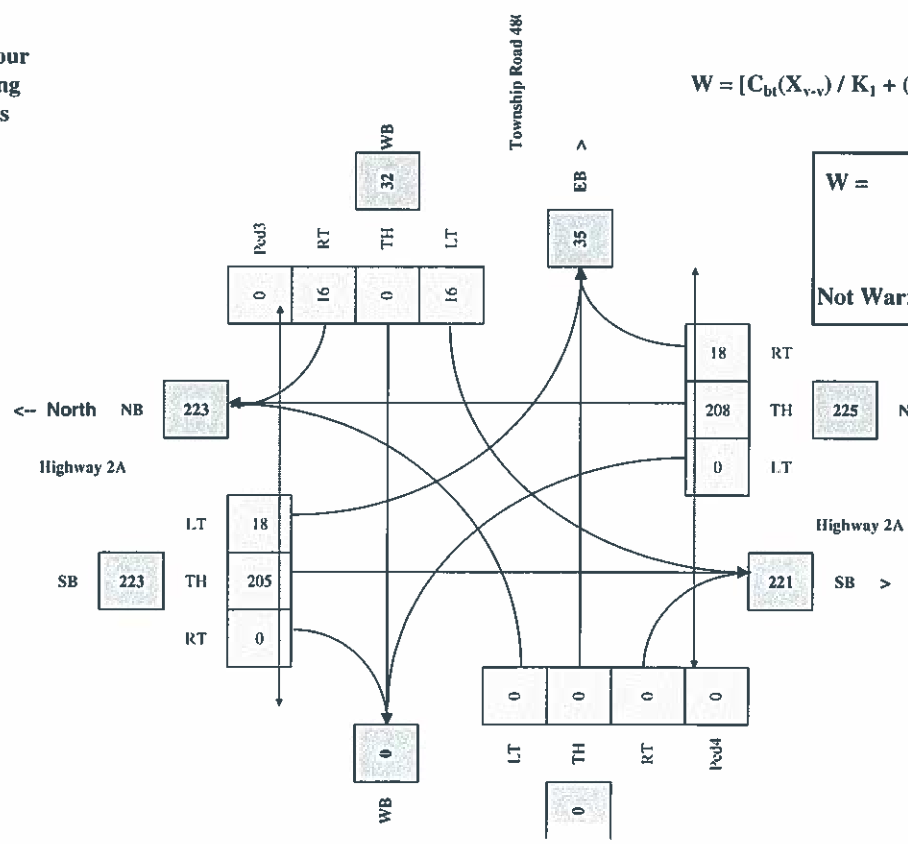
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	5,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 2A	NS	100	10.0%	n	0.0
Township Road 480	EW		10.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
8:00 - 9:00	0	836	85	85	532	0	18	0	17	0	0	0	0	0	0	0
9:00 - 10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 - 13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:00 - 14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00 - 17:00	0	409	21	21	698	0	77	0	77	0	0	0	0	0	0	0
Total (6-hour peak)	0	1,245	106	106	1,230	0	95	0	94	0	0	0	0	0	0	0
Average (6-hour peak)	0	208	18	18	205	0	16	0	16	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$

W =	11	11	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

APPENDIX G

CAPACITY ANALYSIS

```
                   HCS+: Unsignalized Intersections Release 5.3

________________________TWO-WAY STOP CONTROL SUMMARY_____________________________

Analyst:              Kevin Paul, E.I.T.
Agency/Co.:           Williams Engineering Canad Inc
Date Performed:       May 24, 2009
Analysis Time Period: Peak Hour
Intersection:         Town Road 480 & East Access
Jurisdiction:         County of Wetaskiwin No. 10
Units: U. S. Customary
Analysis Year:        2034
Project ID:  i14236.00
East/West Street:     Township Road 480
North/South Street:   East Access Road
Intersection Orientation: EW                    Study period (hrs):  1.00

______________________Vehicle Volumes and Adjustments_____________________________
Major Street:  Approach         Eastbound                  Westbound
               Movement     1      2      3      |  4      5      6
                            L      T      R      |  L      T      R
__________________________________________________________________________________
Volume                             0      0         0      0
Peak-Hour Factor, PHF              1.00   1.00      1.00   1.00
Hourly Flow Rate, HFR              0      0         0      0
Percent Heavy Vehicles             --     --        10     --     --
Median Type/Storage         Undivided             /
RT Channelized?
Lanes                              1    0              0   1
Configuration                          TR               LT
Upstream Signal?                   No                      No
__________________________________________________________________________________
Minor Street:  Approach         Northbound                 Southbound
               Movement     7      8      9      |  10     11     12
                            L      T      R      |  L      T      R
__________________________________________________________________________________
Volume                      0             0
Peak Hour Factor, PHF       1.00          1.00
Hourly Flow Rate, HFR       0             0
Percent Heavy Vehicles      10            10
Percent Grade (%)                  0                       0
Flared Approach:  Exists?/Storage         No     /                      /
Lanes                          0        0
Configuration                      LR
__________________________________________________________________________________

_________________Delay, Queue Length, and Level of Service_________________________
Approach          EB     WB        Northbound                 Southbound
Movement          1      4   |  7      8      9    |  10     11     12
Lane Config              LT  |         LR          |
__________________________________________________________________________________
v (vph)                  0             0
C(m) (vph)               1572
v/c                      0.00
95% queue length         0.00
Control Delay            7.3
LOS                       A
Approach Delay
Approach LOS
__________________________________________________________________________________
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Phone:                                              Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:                Kevin Paul, E.I.T.
Agency/Co.:             Williams Engineering Canad Inc
Date Performed:         May 24, 2009
Analysis Time Period:   Peak Hour
Intersection:           Town Road 480 & East Access
Jurisdiction:           County of Wetaskiwin No. 10
Units: U. S. Customary
Analysis Year:          2034
Project ID:  i14236.00
East/West Street:       Township Road 480
North/South Street:     East Access Road
Intersection Orientation: EW                      Study period (hrs):  1.00

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements       1      2      3      4      5      6
                             L      T      R      L      T      R
______________________________________________________________________________
Volume                             0      0      0      0
Peak-Hour Factor, PHF              1.00   1.00   1.00   1.00
Peak-15 Minute Volume              0      0      0      0
Hourly Flow Rate, HFR              0      0      0      0
Percent Heavy Vehicles             --     --     10     --     --
Median Type/Storage         Undivided                /
RT Channelized?
Lanes                              1    0            0   1
Configuration                         TR              LT
Upstream Signal?                   No                     No
______________________________________________________________________________
Minor Street Movements       7      8      9      10     11     12
                             L      T      R      L      T      R
______________________________________________________________________________
Volume                      0             0
Peak Hour Factor, PHF       1.00          1.00
Peak-15 Minute Volume       0             0
Hourly Flow Rate, HFR       0             0
Percent Heavy Vehicles      10            10
Percent Grade (%)                  0                    0
Flared Approach:  Exists?/Storage         No     /                    /
RT Channelized?
Lanes                          0        0
Configuration                     LR
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments_______________________
Movements                     13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                 0      0      0      0
Lane Width (ft)               12.0   12.0   12.0   12.0
Walking Speed (ft/sec)        4.0    4.0    4.0    4.0
Percent Blockage              0      0      0      0
______________________________________________________________________________
```

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		0
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			10	10		10			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.5		6.3			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10		10			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		0	0		0			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								

c(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	0	
Potential Capacity	1062	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1062	
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	0	
Potential Capacity	1572	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1572	
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.	1.00	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	0	
Potential Capacity	1003	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1003	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	0	
Potential Capacity	1003	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1003	
Results for Two-stage process:		
a		
y		
C t	1003	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	0		0			
Movement Capacity (vph)	1003		1062			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	1003		1062			
Volume	0		0			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max
C sh
SUM C sep
n
C act

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		0		0				
C(m) (vph)		1572						
v/c		0.00						
95% queue length		0.00						
Control Delay		7.3						
LOS		A						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		0
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		1.00
d(M,LT), Delay for stream 1 or 4		7.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.0

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________________________TWO-WAY STOP CONTROL SUMMARY____________________________

Analyst:                Kevin Paul, E.I.T.
Agency/Co.:             Williams Engineering Canad Inc
Date Performed:         June 14, 2009
Analysis Time Period: Peak Hour
Intersection:           Town Road 480 & West Access
Jurisdiction:           County of Wetaskiwin No. 10
Units: U. S. Customary
Analysis Year:          2034
Project ID:  i14236.00
East/West Street:       Township Road 480
North/South Street:     West Access Road
Intersection Orientation: EW                    Study period (hrs):  1.00

_______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Eastbound                 Westbound
               Movement     1       2       3      |  4       5       6
                            L       T       R      |  L       T       R
________________________________________________________________________________
Volume                              85      21        0       85
Peak-Hour Factor, PHF               1.00    1.00      1.00    1.00
Hourly Flow Rate, HFR               85      21        0       85
Percent Heavy Vehicles              --      --        10      --      --
Median Type/Storage         Undivided               /
RT Channelized?
Lanes                               1    0               0    1
Configuration                           TR                 LT
Upstream Signal?                    No                        No

Minor Street:  Approach        Northbound                Southbound
               Movement     7       8       9      |  10      11      12
                            L       T       R      |  L       T       R
________________________________________________________________________________
Volume                      77      0       0
Peak Hour Factor, PHF       1.00    1.00    1.00
Hourly Flow Rate, HFR       77      0       0
Percent Heavy Vehicles      10      10      10
Percent Grade (%)                   0                         0
Flared Approach:  Exists?/Storage           No     /                        /
Lanes                          0    1    0
Configuration                       LTR
________________________________________________________________________________

__________________Delay, Queue Length, and Level of Service_____________________
Approach          EB      WB          Northbound             Southbound
Movement          1       4    |  7      8       9     |  10      11      12
Lane Config               LT   |        LTR            |
________________________________________________________________________________
v (vph)                   0             77
C(m) (vph)                1437          790
v/c                       0.00          0.10
95% queue length          0.00          0.32
Control Delay             7.5           10.0+
LOS                        A             B
Approach Delay                          10.0+
Approach LOS                             B
________________________________________________________________________________
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Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Kevin Paul, E.I.T.
Agency/Co.: Williams Engineering Canad Inc
Date Performed: June 14, 2009
Analysis Time Period: Peak Hour
Intersection: Town Road 480 & West Access
Jurisdiction: County of Wetaskiwin No. 10
Units: U. S. Customary
Analysis Year: 2034
Project ID: i14236.00
East/West Street: Township Road 480
North/South Street: West Access Road
Intersection Orientation: EW Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		85	21	0	85	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		21	5	0	21	
Hourly Flow Rate, HFR		85	21	0	85	
Percent Heavy Vehicles		--	--	10	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR	LT		
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	77	0	0			
Peak Hour Factor, PHF	1.00	1.00	1.00			
Peak-15 Minute Volume	19	0	0			
Hourly Flow Rate, HFR	77	0	0			
Percent Heavy Vehicles	10	10	10			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	1	0			
Configuration		LTR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		85
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1	6.5	6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			10	10	10	10			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70	0.00	0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.5	6.6	6.3			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50	4.00	3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10	10	10			
t(f)		2.3	3.6	4.1	3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		106	181	181	96			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7 Stage1	7 Stage2	8 Stage1	8 Stage2	10 Stage1	10 Stage2	11 Stage1	11 Stage2
V(c,x)								
s		1500		1500				
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	96	
Potential Capacity	939	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	939	
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	106	
Potential Capacity	1437	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1437	
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.	1.00	

Step 3: TH from Minor St.	8	11
Conflicting Flows	181	
Potential Capacity	699	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	699	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	181	
Potential Capacity	790	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	790	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	181	

Potential Capacity	699	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	699	

Result for 2 stage process:		
a		
y		
C t	699	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	181	
Potential Capacity	790	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	790	

Results for Two-stage process:		
a		
y		
C t	790	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	77	0	0			
Movement Capacity (vph)	790	699	939			
Shared Lane Capacity (vph)		790				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	790	699	939			
Volume	77	0	0			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max		
C sh		790
SUM C sep		
n		
C act		

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LTR				
v (vph)		0		77				
C(m) (vph)		1437		790				
v/c		0.00		0.10				
95% queue length		0.00		0.32				
Control Delay		7.5		10.0+				
LOS		A		B				
Approach Delay				10.0+				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		85
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		1.00
d(M,LT), Delay for stream 1 or 4		7.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.0

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HCS+: Unsignalized Intersections Release 5.3

TWO-WAY STOP CONTROL SUMMARY

Analyst:	Kevin Paul, E.I.T.
Agency/Co.:	Williams Engineering Canad Inc
Date Performed:	May 24, 2009
Analysis Time Period:	Peak Hour
Intersection:	Highway 2A & Township 480
Jurisdiction:	County of Wetaskiwin No. 10
Units: U. S. Customary	
Analysis Year:	2034
Project ID:	i14236.00
East/West Street:	Township Road 480
North/South Street:	Highway 2A
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street:	Northbound			Southbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		836	85	85	532	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		836	85	85	532	
Percent Heavy Vehicles		--	--	10	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	1	
Configuration		TR		L	T	
Upstream Signal?		No			No	

Minor Street:	Westbound			Eastbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	77		77			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	77		77			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0	0				
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		85		154				
C(m) (vph)		709		155				
v/c		0.12		0.99				
95% queue length		0.41		14.95				
Control Delay		10.8		226.3				
LOS		B		F				
Approach Delay				226.3				
Approach LOS				F				

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Kevin Paul, E.I.T.
Agency/Co.: Williams Engineering Canad Inc
Date Performed: May 24, 2009
Analysis Time Period: Peak Hour
Intersection: Highway 2A & Township 480
Jurisdiction: County of Wetaskiwin No. 10
Units: U. S. Customary
Analysis Year: 2034
Project ID: i14236.00
East/West Street: Township Road 480
North/South Street: Highway 2A
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		836	85	85	532	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		209	21	21	133	
Hourly Flow Rate, HFR		836	85	85	532	
Percent Heavy Vehicles		--	--	10	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	77		77			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	19		19			
Hourly Flow Rate, HFR	77		77			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			10	10		10			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.5		6.3			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10		10			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				

g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		921	1580		878			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7 Stage1	7 Stage2	8 Stage1	8 Stage2	10 Stage1	10 Stage2	11 Stage1	11 Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								

C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	878	
Potential Capacity	336	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	336	
Probability of Queue free St.	0.77	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	921	
Potential Capacity	709	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	709	
Probability of Queue free St.	0.88	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1580	
Potential Capacity	115	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.88
Maj. L, Min T Adj. Imp Factor.		0.91
Cap. Adj. factor due to Impeding mvmnt	0.88	0.70
Movement Capacity	101	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		

Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1580	
Potential Capacity	115	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.88
Maj. L, Min T Adj. Imp Factor.		0.91
Cap. Adj. factor due to Impeding mvmnt	0.88	0.70
Movement Capacity	101	
Results for Two-stage process:		
a		
y		
C t	101	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	77		77			
Movement Capacity (vph)	101		336			
Shared Lane Capacity (vph)		155				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	101		336			
Volume	77		77			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						

n max				
C sh		155		
SUM C sep				
n				
C act				

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		85		154				
C(m) (vph)		709		155				
v/c		0.12		0.99				
95% queue length		0.41		14.95				
Control Delay		10.8		226.3				
LOS		B		F				
Approach Delay				226.3				
Approach LOS				F				

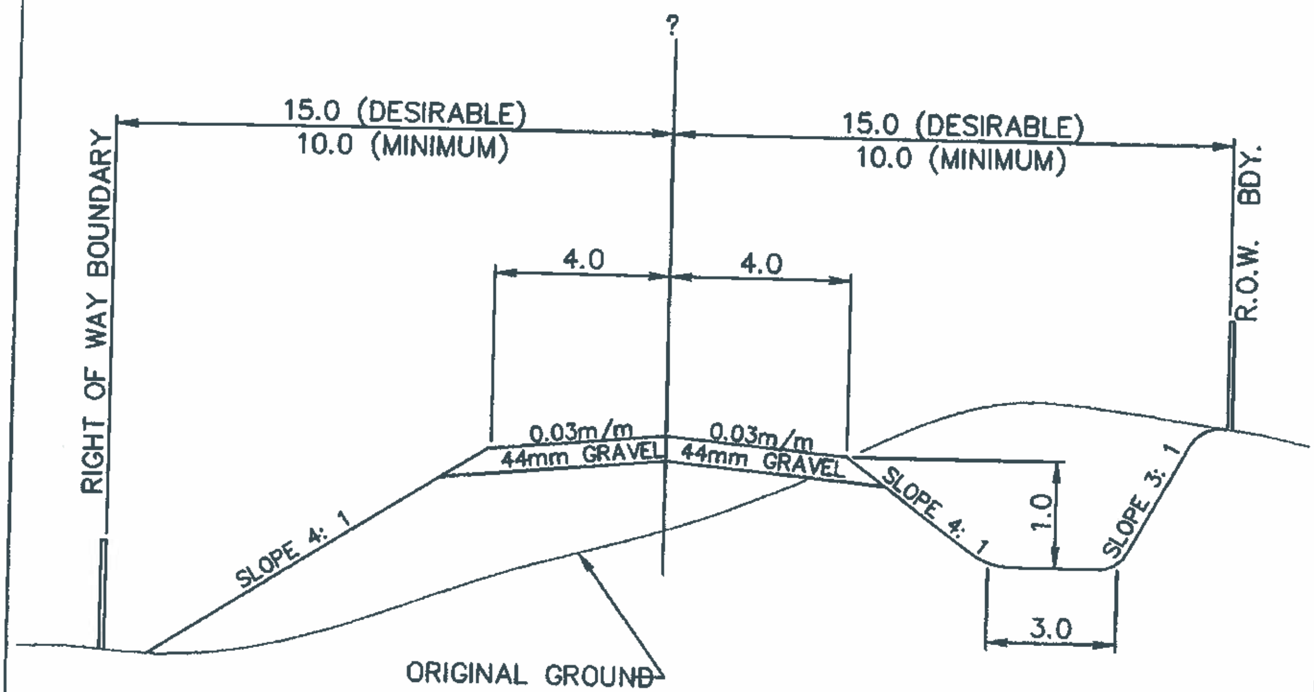
Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.88
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		10.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

APPENDIX H

ROADWAY CROSS SECTIONS

County of Wetaskiwin
COLLECTOR ROAD



SURFACE WIDTH (m)	R.O.W. REQUIRED (m)	NORMAL SIDE SLOPE	MAXIMUM SIDE SLOPE	NORMAL BACK SLOPE	MAXIMUM BACK SLOPE	MAXIMUM CURVE RADIUS (m)	MAXIMUM SUPER ELEVATION (m/m)	MAXIMUM GRADIENT (%)
8.0	30.0	4:1	3:1	3:1	2:1	300	0.08	7.0

NOTE: ALL DIMENSIONS IN METERS UNLESS SHOWN OTHERWISE.

EXH Engineering Services Ltd.		FIGURE 2 COLLECTOR ROAD STANDARD CROSS-SECTION
PROJECT No.: 1003214	DATE: 04-10-19	
DRAWN: MRM	CHECKED: ERH	