Geotechnical Evaluation Report

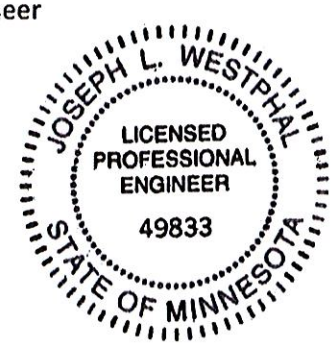
Tonka Bay Apartments
5609 Manitou Road
Tonka Bay, Minnesota

Prepared for

Doran Companies, LLC

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Joseph L. Westphal, PE
Associate Principal – Project Engineer
License Number: 49833
February 11, 2019



Project B1810516

Braun Intertec Corporation

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The Science You Build On.

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February 11, 2019

Project B1810516

Mr. Cody Dietrich
Doran Companies, LLC
7803 Glenroy Road, Suite 200
Bloomington, MN 55439

Re: Geotechnical Evaluation
Tonka Bay Apartments
5609 Manitou Road
Tonka Bay, Minnesota

Dear Mr. Dietrich:

We are pleased to present this Geotechnical Evaluation Report for the Tonka Bay Apartments development in Tonka Bay, Minnesota.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Joe Westphal at 952.995.2238 (jwestphal@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Joseph L. Westphal, PE
Associate Principal – Project Engineer

Ray A. Huber, PE
Vice President – Principal Engineer

c: Mr. Tony Kuechle, Doran Companies, LLC
Mr. Tim Derrick, BKBM Engineers, Inc.
Erik Miller, PE; Sambatek, Inc.

AA/EOE

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A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and construction of the proposed Tonka Bay Apartments development, located in Tonka Bay, Minnesota. The project will include the construction of four apartment buildings, one townhome structure, an amenity building, and 1-below level parking that connects the apartment complexes. Tables 1, 2, 3, and 4 provide project details.

Table 1. Apartment Buildings Description

Aspect	Description
Below grade levels	1 level parking (Provided)
Above grade levels	4 (Assumed)
Lowest level floor elevation (feet – MSL)	975 (Assumed)
Column loads (kips)	350 (Assumed)
Wall loads (kips)	15 (Assumed)
Nature of construction	CMU or precast concrete walls for below grade and first floor with wood construction above first floor

Table 2. Amenity Building Description

Aspect	Description
Above grade levels	1 (Assumed)
Lowest level floor elevation (feet – MSL)	986 (Assumed)
Column loads (kips)	150 (Assumed)
Wall loads (kips)	5 (Assumed)
Nature of construction	Cast in place concrete spread footings with CMU or Wood framed walls (Assumed)

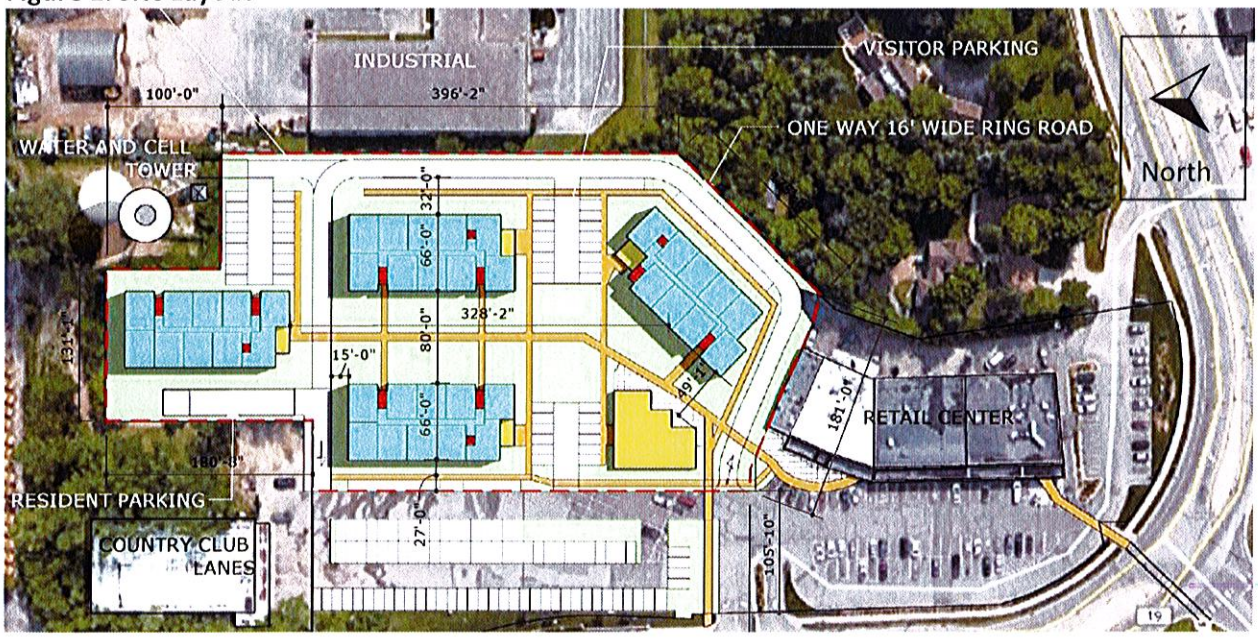
Table 3. Site Aspects and Grading Description

Aspect	Description
Pavement type(s)	Flexible
Provided/Assumed Pavement loads	Light-duty: 40,000 ESALs (Passenger cars only)
	Heavy-duty: 100,000 ESALs (Passenger cars with garbage, delivery or semi-truck)

*Equivalent 18,000-lb single axle loads based on 20-year design.

We understand a portion of the existing retail center will be removed to make way for the new structures. Figure 1 shows an illustration of the proposed site layout, as of September 2018.

Figure 1. Site Layout



A.2. Site Conditions and History

The site is located in the northeast quadrant of Smithtown Road and Manitou Road. Currently, the site exists as a one level, slab-on-grade retail center with combined paved and unpaved parking area. Surrounding properties are used for retail, commercial or city purposes with no residential land use within 600 feet of the site. The proposed site is located approximately half a mile southwest of Lake Minnetonka-Gideon Bay and less than a mile southeast of Lake Minnetonka-Upper Lake.

Current grades range from 982 to 988 feet from mean sea level (MSL). The site is relatively flat but slopes slightly, from north to south. The existing surfaces are mostly impervious pavement with the exception of the unpaved (aggregate base) portion, northeast on the site.

The first portions of the current retail center was constructed in 1955 and generally farmlands prior to 1955, as shown in Figure 2 below.

Figure 2. Aerial Photograph of the Site in 1945.

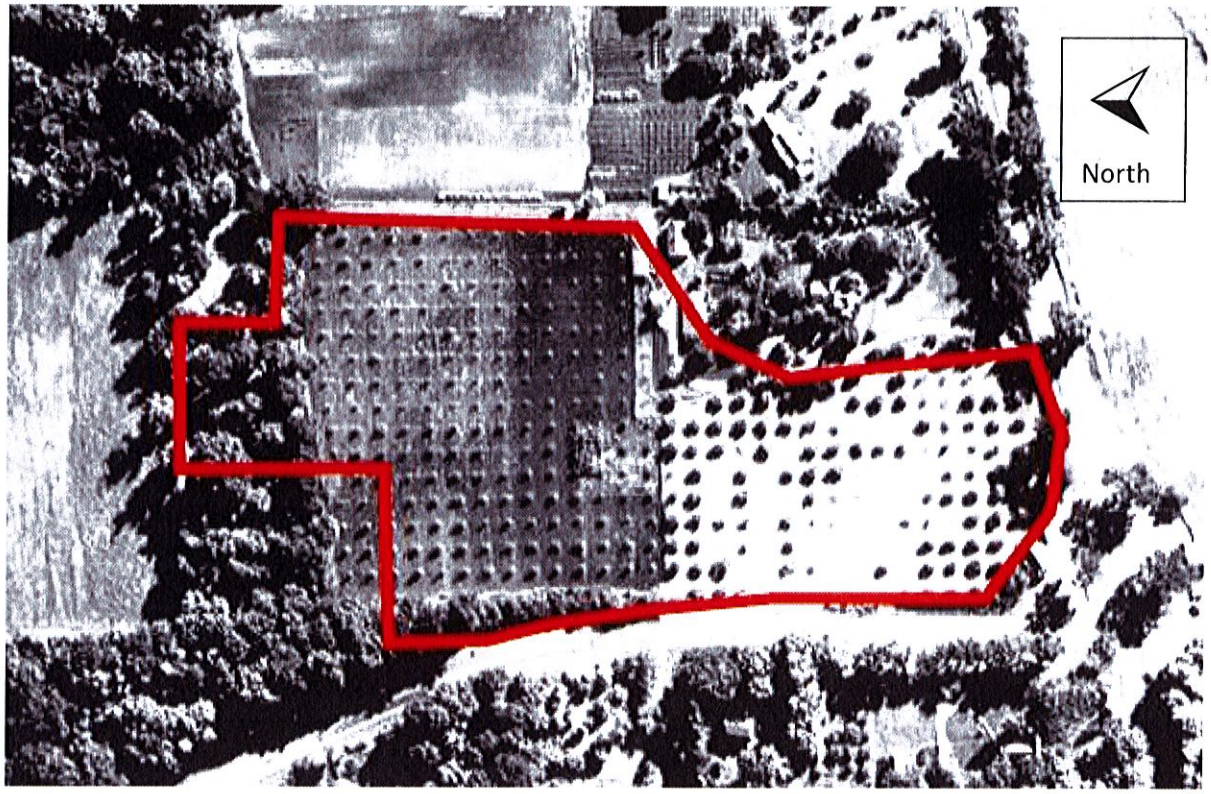


Figure provided by University of Minnesota's Minnesota Historical Aerial Photographs Online website.

A.3. Purpose

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact and provide geotechnical recommendations for use in the design and construction of the Apartment community.

A.4. Background Information and Reference Documents

We reviewed the following information:

- Concept Site Plan provided by Doran Companies, LLC, dated September 11, 2018.
- Communications with Doran Companies regarding site plan, and soil boring location and elevations.

In addition to the provided sources, we have used several publicly available sources of information including:

- Historical aerial photographs from the University of Minnesota's Minnesota Historical Aerial Photographs Online website, Google Earth©, showing site conditions.
- Property information from the Carver County Property Information website.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal QTB085821 to Doran Companies, LLC (Doran) dated September 17, 2018. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. Doran selected and we staked the new exploration locations. We acquired the surface elevations and locations with GPS technology using the State of Minnesota's permanent GPS base station network. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.

- Performing 10 standard penetration test (SPT) borings, denoted as ST-1 to ST-10, to nominal depths of 14 1/2 to 25 feet below grade across the site.

- Installing one piezometer in Boring ST-5 and measuring water levels in that piezometer.

- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure and pavement subgrade preparation and the design of foundations, floor slabs, exterior slabs, utilities, stormwater improvements and pavements.

Our scope of services did not include environmental services or testing, and we did not train the personnel performing this evaluation to provide environmental services or testing. We can provide these services or testing at your request.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Boring Results

Table 4 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 4.

Table 4. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Pavement section			▪ Overall thickness ranges from 5 1/2 to 14 inches. ▪ Bituminous thickness 1 1/2 to 6 inches. ▪ Aggregate base is 4 to 10 1/2 inches. ▪ Observed in borings ST-5, and ST-7 through ST-10
Topsoil	SC		▪ Predominantly SM. Dark brown to black. ▪ Only observed in ST-1 through ST-4, and ST-6 ▪ Thicknesses at boring locations are generally 1/2-foot or less. ▪ Moisture condition generally moist.
Fill	SM		▪ Fill encountered in Borings ST-7 through ST-10 (paved parking lot area). ▪ Thicknesses at boring locations varied from 1 to 4 feet. ▪ Moisture condition generally moist. ▪ Existing fill contained variable amounts of gravel and debris, including bituminous.
Glacial deposits	SC, CL	6 to 24 BPF	▪ Intermixed layers of glacial till. ▪ Possible cobbles and boulders. ▪ Variable amounts of gravel; may contain cobbles and boulders. ▪ Moisture condition generally moist.

*Abbreviations defined in the attached Descriptive Terminology sheet.

For simplicity in this report, we define existing fill to mean existing, uncontrolled or undocumented fill.

B.3. Groundwater

We did not observe groundwater while performing our borings. Groundwater may take days or longer to reach equilibrium in the boreholes and we immediately backfilled the boreholes, in accordance with our scope of work.

A piezometer was installed in Boring ST-5 during drilling and was monitored for 2 weeks. A reading was taken on October 19, 2018 and water was observed at 10.7 feet from existing surface elevation. It is our opinion that water encountered in the piezometer reading is not indicative of a regional water table. Taking into consideration that the proposed project site consists of generally clayey soils and the average elevation of Lake Minnetonka-Gideon Bay and Lake Minnetonka-Upper Lake is approximately 929 feet, water observed is most likely perched groundwater.

If the project team identifies a need for more accurate determination of groundwater depth, further exploration can be discussed and performed.

B.4. Laboratory Test Results

The boring logs show the results of soil laboratory tests we performed, next to the tested sample depth. We also performed moisture content (ASTM D2216) and #200 wash (ASTM C117). The Appendix contains the results of these laboratory tests.

The moisture content of the native clayey soils varied from approximately 14 to 28 percent, indicating that the material was near or over of its probable optimum moisture content. Moisture content testing was completed on the existing fill in Boring ST-8 and found to be 19 percent.

Our mechanical analyses indicated that the native clayey soils contained 50 to 69 percent silt and clay, by weight, as it passed through the #200 sieve.

C. Recommendations

C.1. Design and Construction Discussion

C.1.a. Building Subgrade Preparation

Based on the results of our subsurface exploration and evaluation, we anticipate the non-organic on-site native soils will generally be suitable for support of the proposed buildings with conventional spread footings after subgrade preparation.

Subgrade preparation for the Amenity Building includes removing and replacing pavement, topsoil, existing vegetation, organic soils, soft/loose soils, and existing undocumented fill, if encountered, within the building pad and oversize areas.

We anticipate apartment footings and garage level slabs will not require additional subgrade preparation besides excavating to bottom of footing or slab elevation, unless soil encountered at excavation bottoms contain debris, soft/loose soils, or organic soils. Excavations should follow oversizing recommendations in sections C.2.b. and C.2.c.

C.1.b. Reuse of On-Site Soils

The native clayey soils appear generally suitable for reuse as structural fill, pavement subgrade or landscaping fill. We do not recommend clayey soils to be used as drainage or infiltration fills. Moisture conditioning may also be required and may include spreading and drying soils that are above optimum moisture content, or wetting and mixing soils that are below optimum moisture content.

C.1.c. Construction Disturbance

Due to their fine-grained (generally clayey) nature, the soils present on site are susceptible to disturbance if subjected to repeated construction traffic or vibrations, particularly if above optimum moisture content. The contractor should use equipment and techniques to minimize soil disturbance. If soils become disturbed or are wet, we recommend excavation and replacement with compacted structural fill.

C.2. Site Grading and Subgrade Preparation

C.2.a. Building Subgrade Excavations

We recommend removing unsuitable materials from the proposed apartment and amenity structures' footprint and oversize area. We define unsuitable materials as existing fill, organic soils, existing structures, existing utilities, vegetation, soft/loose soils and pavement. Table 5 shows the anticipated excavation depths and bottom elevations for each of the soil borings.

Table 5. Building Excavation Depths

Boring Number	Measured Surface Elevation (ft)	Anticipated Excavation Depth (ft)	Anticipated Bottom Elevation (ft)	Anticipated Depth Below proposed Lower Level (ft)
ST-1	981.6	1/2	981	Cut
ST-2	984.3	1/2	984	Cut
ST-3	986.2	1/2	985 1/2	Cut
ST-4	987.1	1/2	986 1/2	Cut
ST-5	986.2	2 1/2	983 1/2	Cut
ST-6	985.4	1/2	985	Cut
ST-7	984.8	2	983	Cut
ST-8	987.8	4	984	Cut
ST-9	987.7	2 1/2	985	Cut
ST-10	985.8	2	984	2

Excavation depths will vary between the borings. Portions of the excavations may also extend deeper than indicated by the borings. A geotechnical representative should observe the excavations to make the necessary field judgments regarding the suitability of the exposed soils.

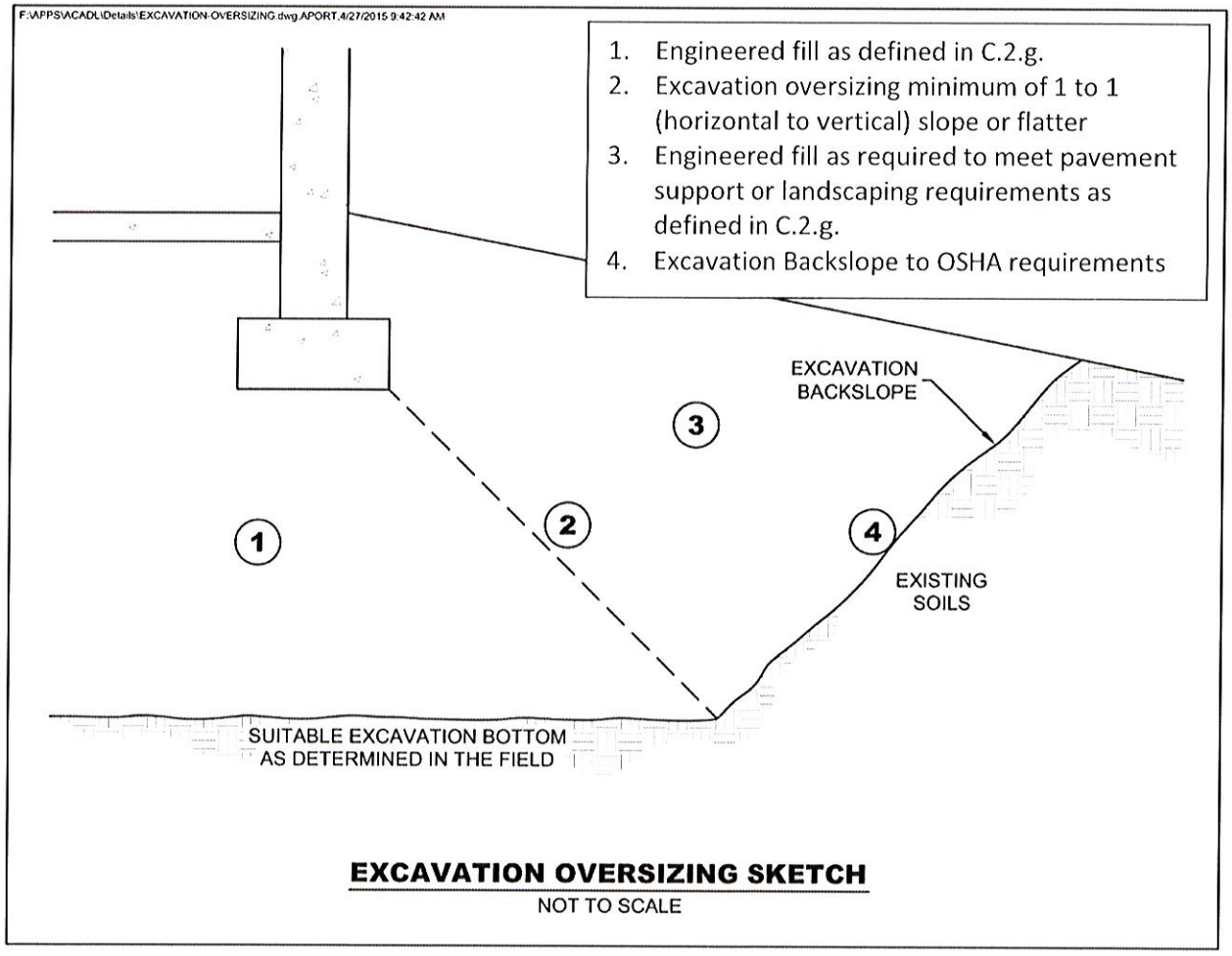
The contractor should use equipment and techniques to minimize soil disturbance. If soils become disturbed or are wet, we recommend excavation and replacement.

Prior to the placement of engineered fill or footings, we recommend surface compacting the exposed soils in the bottoms of the excavations with a minimum of five passes by a large (minimum diameter of 3 1/2 feet), vibratory, sheepsfoot-drum compactor. Areas that yield or pump during surface compaction may require additional subcutting.

C.2.b. Excavation Oversizing

When removing unsuitable materials below structures or pavements, we recommend the excavation extend outward and downward at a slope of 1H:1V (horizontal:vertical) or flatter. See Figure 3 for an illustration of excavation oversizing.

Figure 3. Generalized Illustration of Oversizing



C.2.c. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will consist of clayey sands or sandy lean clays. These soils are typically considered Type B Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type B soils should have a gradient no steeper than 1H:1V. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

C.2.d. Excavation Dewatering

We recommend removing groundwater from the excavations. Project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays. A well contractor should develop a dewatering plan; the design team should review this plan.

C.2.e. Pavement and Exterior Slab Subgrade Preparation

We recommend the following steps for pavement and exterior slab subgrade preparation, understanding the site will have a grade change of 3 feet or less. Note that project planning may need to require additional subcuts to limit frost heave.

1. Strip unsuitable soils consisting of topsoil, organic soils, vegetation, existing structures and pavements from the area, within 3 feet of the surface of the proposed pavement grade.
2. Have a geotechnical representative observe the excavated subgrade to evaluate if additional subgrade improvements are necessary.
3. Slope subgrade soils to areas of sand or drain tile to allow the removal of accumulating water.
4. Surface compact to at least 95 percent below 3 feet of surface of proposed pavement grade and 100 percent within 3 feet of proposed surface grade of Standard Proctor density.
5. Place pavement engineered fill to grade and compact in accordance with Section C.2.g to bottom of pavement and exterior slab section. See Section C.2.g for additional considerations related to frost heave.
6. Proofroll the pavement or exterior slab subgrade as described in Section C.2.g.

To improve long-term pavement performance, we recommend incorporating a layer of aggregate base and granular engineered fill in paved areas, in addition to the recommendations above, as a sand subbase. Section C.7.a. provides recommended pavement design sections with and without the sand subbase. Note, we recommend sloping subgrade soils to promote drainage and removal of accumulated water.

C.2.f. Pavement Subgrade Proofroll

After preparing the subgrade as described above and prior to the placement of the aggregate base, we recommend proofrolling the subgrade soils with a fully loaded tandem-axle truck. We also recommend having a geotechnical representative observe the proofroll. Areas that fail the proofroll likely indicate soft or weak areas that will require additional soil correction work to support pavements.

The contractor should correct areas that display excessive yielding or rutting during the proofroll, as determined by the geotechnical representative. Possible options for subgrade correction include moisture conditioning and recompaction, subcutting and replacement with soil or crushed aggregate, chemical stabilization and/or geotextiles. We recommend performing a second proofroll after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

C.2.g. Engineered Fill Materials and Compaction

Table 6 below contains our recommendations for engineered fill materials.

Table 6. Engineered Fill Materials*

Locations To Be Used	Engineered Fill Classification	Possible Soil Type Descriptions	Gradation	Additional Requirements
▪ Below foundations ▪ Below interior slabs	Structural fill	SP, SP-SM, SC, CL, SM	100% passing 2-inch sieve	< 3% Organic Content (OC)
▪ Drainage layer ▪ Non-frost-susceptible	▪ Free-draining ▪ Non-frost-susceptible fill	GP, GW, SP, SW	100% passing 1-inch sieve < 50% passing #40 sieve < 3% passing #200 sieve	< 3% OC
Behind below-grade walls, beyond drainage layer	Retained fill	SP, SP-SM, SM, SC, CL	100% passing 3-inch sieve	< 3% OC Plasticity Index (PI) < 20%
Pavements	Pavement subgrade fill	SC, CL	100% passing 3-inch sieve	< 2% OC PI < 20%
Pavements Subbase	Pavement granular fill	SP, SP-SM	100% passing 2-inch sieve <12% passing #200 sieve	<3% Organic Content (OC)
Below landscaped surfaces, where subsidence is not a concern	Non-structural fill		100% passing 6-inch sieve	< 10% OC

* More select soils comprised of coarse sands with < 5% passing #200 sieve may be needed to accommodate work occurring in periods of wet or freezing weather.

We recommend spreading engineered fill in loose lifts of approximately 12 inches thick. We recommend compacting engineered fill in accordance with the criteria presented below in Table 7. The project documents should specify relative compaction of engineered fill, based on the structure located above the engineered fill, and vertical proximity to that structure.

Table 7. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D698 – Standard Proctor)	Moisture Content Variance from Optimum, percentage points	
		< 12% Passing #200 Sieve (typically SP, SP-SM)	> 12% Passing #200 Sieve (typically CL, SC, SM)
Below foundations and oversizing zones, and interior slabs	98	±3	-1 to +3
Within 3 feet of pavement subgrade	100	±3	-2 to +1
More than 3 feet below pavement subgrade	95	±3	-1 to +3
Below landscaped surfaces	90	±5	-1 to +5
Adjacent to below-grade wall	95*	±3	-1 to +3

*Increase compaction requirement to meet compaction required for structure supported by this engineered fill.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.2.h. Special Inspections of Soils

We recommend including the site grading and placement of engineered fill within the building pad under the requirements of Special Inspections, as provided in Chapter 17 of the International Building Code, which is part of the Minnesota State Building Code. Special Inspection requires observation of soil conditions below engineered fill or footings, evaluations to determine if excavations extend to the anticipated soils, and if engineered fill materials meet requirements for type of engineered fill and compaction condition of engineered fill. A licensed geotechnical engineer should direct the Special Inspections of site grading and engineered fill placement. The purpose of these Special Inspections is to evaluate whether the work is in accordance with the approved Geotechnical Report for the project. Special Inspections should include evaluation of the subgrade, observing preparation of the subgrade (surface compaction or dewatering, excavation oversizing, placement procedures and materials used for engineered fill, etc.) and compaction testing of the engineered fill.

C.3. Spread Footings

Table 8 below contains our recommended parameters for foundation design.

Table 8. Recommended Spread Footing Design Parameters

Item	Description
Maximum net allowable bearing pressure (psf) Apartment Buildings Amenity Building	 5,000 3,000
Minimum factor of safety for bearing capacity failure	3.0
Minimum width bearing walls (feet)	2
Minimum column pads (feet)	3 x 3
Minimum embedment below final exterior grade for heated structures (inches)	42
Minimum embedment below final exterior grade for unheated structures or for footings not protected from freezing temperatures during construction (inches)	60
Total estimated settlement (inches)	1
Differential settlement	Typically about 1/2 of total settlement*

* Actual differential settlement amounts will depend on final loads and foundation layout. When tying into the existing buildings, the total settlement of this new building will be differential to the existing building. We can evaluate differential settlement based on final foundation plans and loadings.

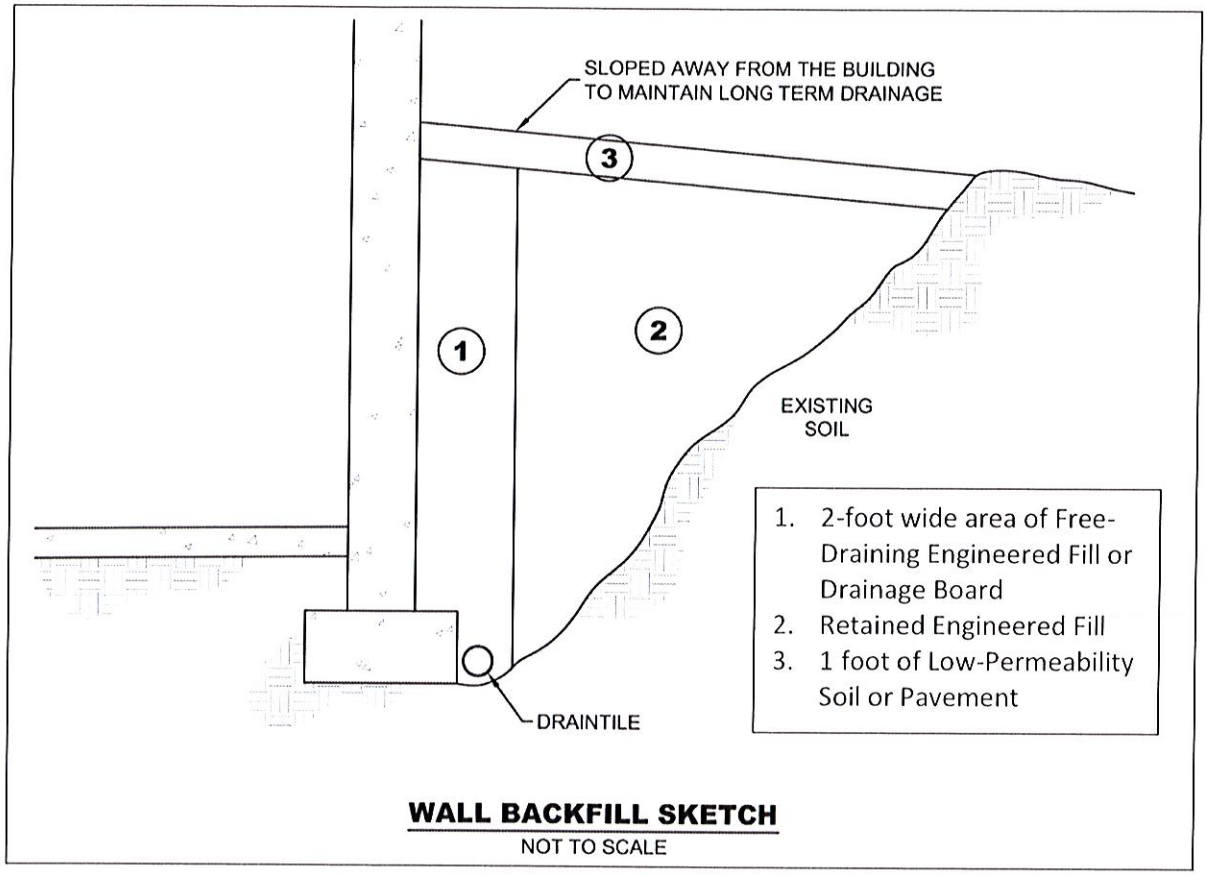
C.4. Below-Grade Walls

C.4.a. Drainage Control

We recommend installing drain tile to remove water behind the below-grade walls, at the location shown in Figure 4. The below-grade wall drainage system should also incorporate free-draining, engineered fill or a drainage board placed against the wall and connected to the drain tile.

Even with the use of free-draining, engineered fill, we recommend general waterproofing of below-grade walls that surround occupied or potentially occupied areas because of the potential cost impacts related to seepage after construction is complete.

Figure 4. Generalized Illustration of Wall Engineered Fill



The materials listed in the sketch should meet the definitions in Section C.2.g. Low-permeability material is capable of directing water away from the wall, like clay, topsoil or pavement. The project documents should indicate if the contractor should brace the walls prior to filling and allowable unbalanced fill heights.

As shown in Figure 3, we recommend Zone 2 consist of retained, engineered fill, and this material will control lateral pressures on the wall. However, we are also providing design parameters for using other engineered fill material. If final design uses non-sand material for engineered fill, project planning should account for the following items:

- Other engineered fill material may result in higher lateral pressure on the wall.
- Other engineered fill material may be more difficult to compact.

- Post-construction consolidation of other engineered fill material may result in settlement-related damage to the structures or slabs supported on the engineered fill. Post-construction settlement of other engineered fill material may also cause drainage towards the structure. The magnitude of consolidation could be up to about 3 percent of the wall fill thickness.

C.4.b. Configuring and Resisting Lateral Loads

Below-grade wall design can use active earth pressure conditions, if the walls can rotate slightly. If the wall design cannot tolerate rotation, then design should use at-rest earth pressure conditions. Rotation up to 0.002 times the wall height is generally required for walls supporting sand. Rotation up to 0.02 times the wall height is required when wall supports clay.

Table 9 presents our recommended lateral coefficients for wall design of active, at-rest and passive earth pressure conditions. The table also provides recommended wet unit weights and internal friction angles. Designs should also consider the slope of any engineered fill and dead or live loads placed behind the walls within a horizontal distance that is equal to the height of the walls. Our recommended values assume the wall design provides drainage so water cannot accumulate behind the walls. The construction documents should clearly identify what soils the contractor should use for engineered fill of walls.

Table 9. Recommended Below-Grade Wall Design Parameters – Drained Conditions

Retained Soil	Wet Unit Weight, pcf	Friction Angle, degrees	Active Lateral Coefficient	At-Rest Lateral Coefficient	Passive Lateral Coefficient
Imported Free Draining (SP/SP-SM)	120	34	0.28	0.44	3.54
On-site Existing Native Soil (SC/CLS)	125	28	0.32	0.47	2.77

* Based on Rankine model for soils in a region behind the wall extending at least 2 horizontal feet beyond the bottom outer edges of the wall footings and then rising up and away from the wall at an angle no steeper than 60 degrees from horizontal.

Sliding resistance between the bottom of the footing and the soil can also resist lateral pressures. We recommend assuming a sliding coefficient equal to 0.35 between the concrete and clay.

The values presented in this section are un-factored.

C.5. Interior Slabs

C.5.a. Subgrade Modulus

The anticipated floor subgrade is onsite clayey soil. We recommend using a modulus of subgrade reaction, k, of 100 pounds per square inch per inch of deflection (pci) to design the slabs. If the slab design requires placing 6 inches of compacted crushed aggregate base immediately below the slab, the slab design may increase the k-value by 50 pci.

C.5.b. Moisture Vapor Protection

Excess transmission of water vapor could cause floor dampness, certain types of floor bonding agents to separate, or mold to form under floor coverings. If project planning includes using floor coverings or coatings, we recommend placing a vapor retarder or vapor barrier immediately beneath the slab. We also recommend consulting with floor covering manufacturers regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.

C.6. Frost Protection

C.6.a. General

Sandy lean clay or clayey sand will underlie all or some of the exterior slabs, as well as pavements. We consider sandy lean clay and clayey sand to be moderately to highly frost susceptible. Soils of this type can retain moisture and heave upon freezing. In general, this characteristic is not an issue unless these soils become saturated, due to surface runoff or infiltration, or are excessively wet in situ. Once frozen, unfavorable amounts of general and isolated heaving of the soils and the surface structures supported on them could develop. This type of heaving could affect design drainage patterns and the performance of exterior slabs and pavements, as well as any isolated exterior footings and piers.

Note that general runoff and infiltration from precipitation are not the only sources of water that can saturate subgrade soils and contribute to frost heave. Roof drainage and irrigation of landscaped areas in close proximity to exterior slabs, pavements, and isolated footings and piers, contribute as well.

C.6.b. Frost Heave Mitigation

To address most of the heave related issues, we recommend setting general site grades and grades for exterior surface features to direct surface drainage away from buildings, across large paved areas and away from walkways. Such grading will limit the potential for saturation of the subgrade and subsequent heaving. General grades should also have enough "slope" to tolerate potential larger areas of heave, which may not fully settle after thawing.

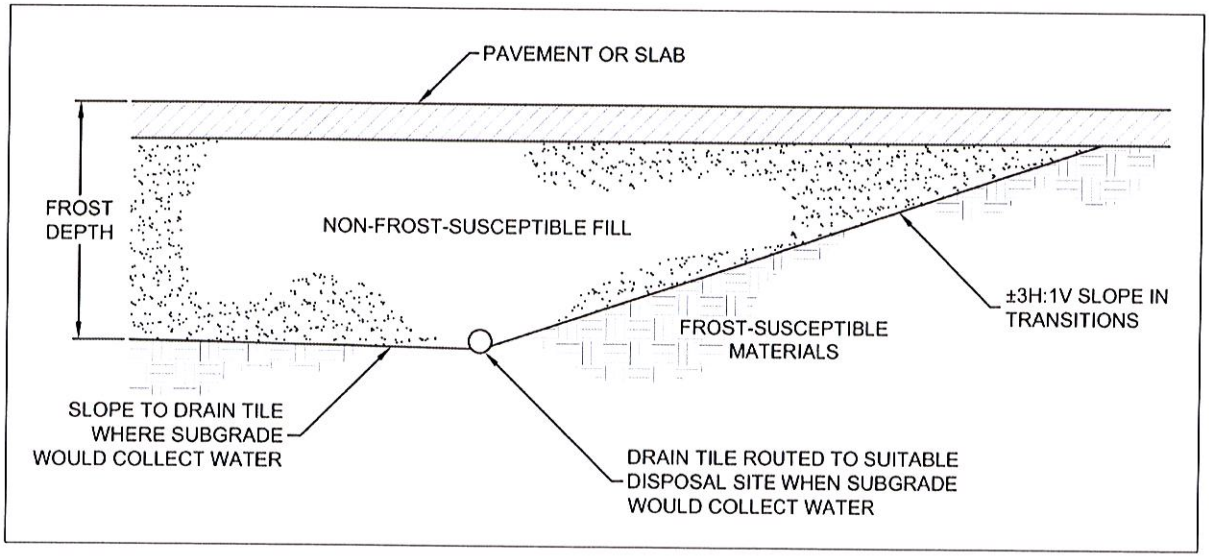
Even small amounts of frost-related differential movement at walkway joints or cracks can create tripping hazards. Project planning can explore several subgrade improvement options to address this condition.

One of the more conservative subgrade improvement options to mitigate potential heave is removing any frost-susceptible soils present below the exterior slab areas down to a minimum depth of 1 1/2 feet below subgrade elevations. We recommend filling the resulting excavation with non-frost-susceptible fill. We also recommend sloping the bottom of the excavation toward one or more collection points to remove any water entering the engineered fill. This approach will not be effective in controlling frost heave without removing the water.

An important geometric aspect of the excavation and replacement approach described above is sloping the banks of the excavations to create a more gradual transition between the unexcavated soils considered frost susceptible and the engineered fill in the excavated area, which is not frost susceptible. The slope allows attenuation of differential movement that may occur along the excavation boundary. We recommend slopes that are 3H:1V, or flatter, along transitions between frost-susceptible and non-frost-susceptible soils.

Figure 5 shows an illustration summarizing some of the recommendations.

Figure 5. Frost Protection Geometry Illustration



Another option is to limit frost heave in critical areas, such as doorways and entrances, via frost-depth footings or localized excavations with sloped transitions between frost-susceptible and non-frost-susceptible soils, as described above.

Over the life of slabs and pavements, cracks will develop and joints will open up, which will expose the subgrade and allow water to enter from the surface and either saturate or perch atop the subgrade soils. This water intrusion increases the potential for frost heave or moisture-related distress near the crack or joint. Therefore, we recommend implementing a detailed maintenance program to seal and/or fill any cracks and joints. The maintenance program should give special attention to areas where dissimilar materials abut one another, where construction joints occur and where shrinkage cracks develop.

C.7. Pavements and Exterior Slabs

C.7.a. Design Sections

Our scope of services for this project did not include laboratory tests on subgrade soils to determine an R-value for pavement design. Based on our experience with similar sandy lean clay and clayey sand soils anticipated at the pavement subgrade elevation, we recommend pavement design assume an R-value of 12. Note the contractor may need to perform limited removal of unsuitable or less suitable soils to achieve this value. Table 10 provides recommended pavement sections, based on the soils support and traffic loads.

We based the concrete pavement designs on a modulus of subgrade reaction (k) of 150 pci.

Table 10. Recommended Bituminous Pavement Sections

Use	Light Duty		Heavy Duty	
	No Subbase Option	Granular Subbase Option	No Subbase Option	Granular Subbase Option
Minimum asphalt thickness (inches)	3 1/2	3	4 1/2	4
Minimum aggregate base thickness (inches)	10	6	8	6
Minimum granular subbase	---	12	---	12

C.7.b. Bituminous Pavement Materials

Appropriate mix designs are critical to the performance of flexible pavements. We can provide recommendations for pavement material selection during final pavement design.

C.7.c. Subgrade Drainage

We recommend installing perforated drainpipes throughout pavement areas at low points, around catch basins, and behind curb in landscaped areas. We also recommend installing drainpipes along pavement and exterior slab edges where exterior grades promote drainage toward those edge areas. The contractor should place drainpipes in small trenches, extended at least 8 inches below the top of the granular subbase layer, or below the aggregate base material where no subbase is present.

C.7.d. Performance and Maintenance

We based the above pavement designs on a 20-year performance life. This is the amount of time before we anticipate the pavement will require reconstruction. This performance life assumes routine maintenance, such as seal coating and crack sealing. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

It is common to place the non-wear course of bituminous and then delay placement of wear course. For this situation, we recommend evaluating if the reduced pavement section will have sufficient structure to support construction traffic.

Many conditions affect the overall performance of the exterior slabs and pavements. Some of these conditions include the environment, loading conditions and the level of ongoing maintenance. With regard to bituminous pavements in particular, it is common to have thermal cracking develop within the first few years of placement, and continue throughout the life of the pavement. We recommend developing a regular maintenance plan for filling cracks in exterior slabs and pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade.

C.8. Utilities

C.8.a. Subgrade Stabilization

Earthwork activities associated with utility installations located inside the building area should adhere to the recommendations in Section C.2.

For exterior utilities, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils or perched water at invert grades, the unsuitable soils may require some additional subcutting and replacement with sand or crushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of foundations (including interior plumbing).

C.8.b. Corrosion Potential

Based on our experience, the soils encountered by the borings are moderately corrosive to metallic conduits, but only marginally corrosive to concrete. We recommend specifying non-corrosive materials or providing corrosion protection, unless project planning chooses to perform additional tests to demonstrate the soils are not corrosive.

C.9. Stormwater

The soil borings primarily encountered clay to clayey sand, so we do not recommend infiltration of stormwater at this site. The site soils are judged to be in the Hydrologic Soil Group D according to the Minnesota Stormwater manual. However, if a design is requested, we offer the following.

We estimated infiltration rates for some of the soils we encountered in our soil borings, as listed in Table 11. These infiltration rates represent the long-term infiltration capacity of a practice and not the capacity of the soils in their natural state. We recommend consulting the Minnesota Stormwater Manual for stormwater design. It is our opinion that the infiltration rate in Table 11 is higher than will be experienced in the field.

Table 11. Estimated Design Infiltration Rates Based on Soil Classification

Soil Type	Infiltration Rate * (inches/hour)
Clayey sands (SC) and clays (CL)	0.06 or less

* From Minnesota Stormwater Manual. Rates may differ at individual sites.

Fine-grained soils (silts and clays), topsoil or organic matter that mixes into or washes onto the soil will lower the permeability. The contractor should maintain and protect infiltration areas during construction. Furthermore, organic matter and silt washed into the system after construction can fill the soil pores and reduce permeability over time. Proper maintenance is important for long-term performance of infiltration systems.

This geotechnical evaluation does not constitute a review of site suitability for stormwater infiltration or evaluate the potential impacts, if any, from infiltration of large amounts of stormwater.

C.10. Equipment Support

The recommendations included in the report may not be applicable to equipment used for the construction and maintenance of this project. We recommend evaluating subgrade conditions in areas of shoring, scaffolding, cranes, pumps, lifts and other construction equipment prior to mobilization to determine if the exposed materials are suitable for equipment support, or require some form of subgrade improvement. We also recommend project planning consider the effect that loads applied by such equipment may have on structures they bear on or surcharge – including pavements, buried utilities, below-grade walls, etc. We can assist you in this evaluation.

D. Procedures

D.1. Penetration Test Borings

We drilled the penetration test borings with a tracked off-road vehicle-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance to ASTM D1586. We collected thin-walled tube samples in general accordance with ASTM D1587 at selected depths. The boring logs show the actual sample intervals and corresponding depths. We also collected bulk samples of auger cuttings at selected locations for laboratory testing.

We sealed penetration test boreholes meeting the Minnesota Department of Health (MDH) Environmental Borehole criteria with an MDH-approved grout. We forwarded a sealing record for those boreholes to the Minnesota Department of Health Well Management Section.

D.2. Exploration Logs

D.2.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.3. Material Classification and Testing

D.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.3.b. Laboratory Testing

The exploration logs in the Appendix note most results of the laboratory tests performed on geologic material samples. We performed the tests in general accordance with ASTM procedures.

D.4. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs with the exception of Boring ST-5.

A piezometer was installed to a depth of 14 1/2 feet at the location of Boring ST-5. Water level measurements were observed to be at approximately 11 feet from surface elevation after 1 1/2 weeks from installation.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

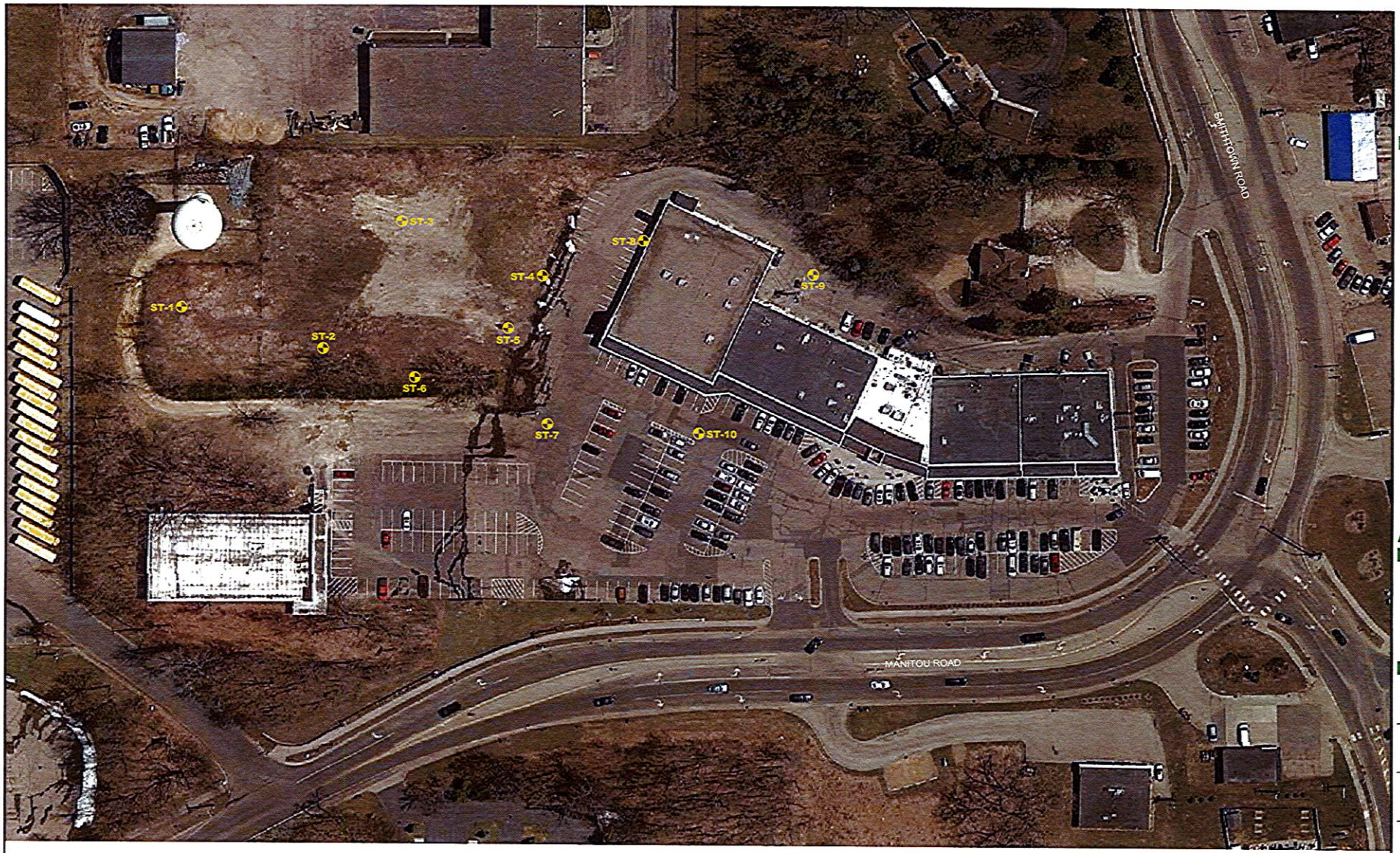
E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix



DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

40' 0 80'

SCALE: 1" = 80'

BRAUN INTERTEC
The Science You Build On.
11001 Hampshire Avenue S
Minneapolis, MN 55438
952.995.2000
braunintertec.com

Drawing Information

Project No:	B1810516
Drawing No:	B1810516
Drawn By:	BJB
Date Drawn:	10/4/18
Checked By:	JW
Last Modified:	10/14/18

Project Information

Tonka Bay Apartments

5609 Manitou Road

Excelsior, Minnesota

Soil Boring Location Sketch

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-1**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
981.6	0.0							
981.1	0.5	TS / CL	CLAYEY SAND, fine- to medium-grained, with roots, dark brown, moist. (Topsoil)					
			SANDY LEAN CLAY, trace Gravel, brown, moist, medium to stiff. (Glacial Till)	6		20		
				8				
				12			2 1/4	
972.6	9.0							
		SC	CLAYEY SAND, trace Gravel and rust staining, brown, moist, very stiff. (Glacial Till)	21		18		P200=50%
969.6	12.0							
		CL	SANDY LEAN CLAY, trace Gravel, brown to gray, moist, stiff. (Glacial Till)	13			2 1/2	
				13			1 1/4	
				14			2 1/4	
				13			1	
955.6	26.0							
			END OF BORING. Water not observed while drilling. Boring then grouted.					

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\10516.GPJ BRAUN_V8_CURRENT.GDT 12/18/18 16:12

BRAUN INTERTEC

LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-2**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
984.3	0.0							
983.8	0.5	TS CL	CLAYEY SAND, fine- to medium-grained, trace roots, black, moist. (Topsoil)					
			SANDY LEAN CLAY, trace Gravel, brown to gray, moist, stiff to very stiff. (Glacial Till)	11			2	
				14			2	
				13		19		
				10			1 1/2	
				11				
				19*				*Little recovery.
966.3	18.0	CL	SANDY LEAN CLAY, trace Gravel, gray, moist, stiff. (Glacial Till)					
				13			1	
				13				
958.3	26.0		END OF BORING. Water not observed while drilling. Boring then grouted.					

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-3**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
986.2	0.0							
985.7	0.5	TS / SC	CLAYEY SAND, fine- to medium-grained, trace roots, dark brown, moist. (Topsoil)					
			CLAYEY SAND, trace Gravel and Silty Sand, light brown, moist, very stiff. (Glacial Till)	17				
				24		18		P200=59%
979.2	7.0	SC	CLAYEY SAND, trace Gravel, brown to gray, moist, very stiff. (Glacial Till)	24				
				22			4	
				17		14	2 3/4	
				22			3 3/4	
968.2	18.0	CL	SANDY LEAN CLAY, trace Gravel, gray, moist, stiff. (Glacial Till)					
				11			1 1/4	
960.2	26.0			13				
			END OF BORING. Water not observed while drilling. Boring then grouted.					

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-4**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/9/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
987.1	0.0							
986.6	0.5	TS SC	CLAYEY SAND, fine- to medium-grained, trace roots, brown to dark brown, moist. (Topsoil)					
			CLAYEY SAND, trace Gravel, light brown, moist, stiff to very stiff. (Glacial Till)	11				
				17		19		P200=55%
980.1	7.0	CL	SANDY LEAN CLAY, trace Gravel, light brown, moist, stiff. (Glacial Till)	15			1 1/2	
				14		19	1 3/4	
975.1	12.0	CL	SANDY LEAN CLAY, trace Gravel, gray, moist, stiff to very stiff. (Glacial Till)	15				
				16			1 3/4	
				14				
961.1	26.0			16				
			END OF BORING. Water not observed while drilling. Boring then grouted.					

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-5**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
986.2	0.0							
985.7	0.5	PAV / FILL	1 1/2 inches of bituminous over 4 inches of aggregate base.					
983.7	2.5	FILL	FILL: Silty Sand, fine- to coarse-grained, with Gravel, brown, moist.					
		CL	SANDY LEAN CLAY, trace Gravel and occasional Sand seams, brown to gray, moist, medium to stiff. (Glacial Till)	8		19	1 3/4	P200=54%
				14				
				14			2	
				11	▼	18	2 1/2	A solid triangle indicates the groundwater level in the boring on the date indicated. Groundwater levels fluctuate.
				13				
971.7	14.5			10				
			END OF BORING.					
			Water not observed while drilling.					
			Temporary piezometer installed to a depth of 14.5 feet.					
			Water level measured at 10.7 feet on 10/19/18.					
			Piezometer was removed on 11/7/18.					

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-6**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
985.4	0.0							
984.9	0.5	TS	CLAYEY SAND, fine- to medium-grained, trace roots, light brown to brown, moist.					
		SC	(Topsoil)					
			CLAYEY SAND, trace Gravel, brown to gray, moist, stiff to very stiff.	13				
			(Glacial Till)	16		19		
				17				
				17			1 3/4	
				11				
				13			1 1/2	
967.4	18.0							
		SC	CLAYEY SAND, trace Gravel, gray, moist, very stiff.					
			(Glacial Till)	18				
				19			2 3/4	
959.4	26.0		END OF BORING.					
			Water not observed while drilling.					
			Boring then grouted.					

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GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-7**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/8/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
984.8	0.0							
983.8	1.0	PAV	5 inches of bituminous over 7 inches of aggregate base.					
982.8	2.0	FILL	FILL: Silty Sand, fine- to coarse-grained, with Gravel, black, moist.					
		CL	SANDY LEAN CLAY, trace Gravel, light brown to gray, moist, stiff to very stiff. (Glacial Till)	15		28	1 1/2	P200=69%
				23			2 1/4	
				19		19		
			Rust staining at 10 feet.	16				
972.8	12.0	CL	SANDY LEAN CLAY, trace Gravel and Sand lenses, gray, moist, stiff to very stiff. (Glacial Till)	11			1 1/4	
				16				
				15			1 1/2	
958.8	26.0			12				
			END OF BORING. Water not observed while drilling. Boring then grouted.					

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-8**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/9/18** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
987.8	0.0							
987.0	0.8	PAV	5 inches of bituminous over 5 inches of aggregate base.					
		FILL	FILL: Silty Sand, fine- to medium-grained, with Gravel, Clay seams and pices of bituminous, black to dark brown, moist.	3		19	3/4	
983.8	4.0	CL	SANDY LEAN CLAY, trace Gravel, light brown to gray, moist, soft to very stiff. (Glacial Till)	13			2	
				17		20		
978.8	9.0	CL	SANDY LEAN CLAY, trace Gravel, gray, moist, stiff to very stiff. (Glacial Till)	17			1 3/4	
				15				
				13				
				14				
				20				
961.8	26.0		END OF BORING. Water not observed while drilling. Boring then grouted.					

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\10516.GPJ BRAUN_V8_CURRENT.GDT 12/18/18 16:12

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-9**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/9/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
987.7	0.0							
986.7	1.0	PAV	1 1/2 inches of bituminous over 10 1/2 inches of aggregate base.					
985.2	2.5	FILL	FILL: Silty Sand, fine- to medium-grained, with Gravel and pieces of bituminous, black, moist.					
		SC	CLAYEY SAND, trace Gravel and Sand seams, light brown to gray, moist, stiff to very stiff. (Glacial Till)	9		19	1 3/4	P200=54%
				18			2 1/4	
				15		17		
				21				
				13			2 1/2	
				19				
969.7	18.0	CL	SANDY LEAN CLAY, trace Gravel, gray, moist, stiff to very stiff. (Glacial Till)	19			1 3/4	
961.7	26.0			14				
			END OF BORING. Water not observed while drilling. Boring then grouted.					

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\10516.GPJ BRAUN_V8_CURRENT.GDT 12/18/18 16:12

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LOG OF BORING

Braun Project B1810516
GEOTECHNICAL EVALUATION
Tonka Bay Apartments
5609 Manitou Road
Excelsior, Minnesota

BORING: **ST-10**

LOCATION: See attached sketch.

DRILLER: J. Tatro | METHOD: 3 1/4" HSA, Autohammer | DATE: **10/9/18** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	q_u tsf	Tests or Notes
985.8	0.0	PAV	6 inches of bituminous over 8 inches of aggregate base.					
984.6	1.2	FILL	FILL: Silty Sand, fine- to medium-grained, with Gravel, black, moist.					
983.8	2.0	SC	CLAYEY SAND, trace Gravel, brown, moist, stiff. (Glacial Till)	10				
				11		19		
978.8	7.0	CL	SANDY LEAN CLAY, trace Gravel, brown, moist, stiff to very stiff. (Glacial Till)	13			1 3/4	
				12			1 1/2	
				12				
				12				
				12			1 3/4	
959.8	26.0			18				
			END OF BORING. Water not observed while drilling. Boring then grouted.					

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2018\10516.GPJ BRAUN_V8_CURRENT.GDT 12/18/18 16:12

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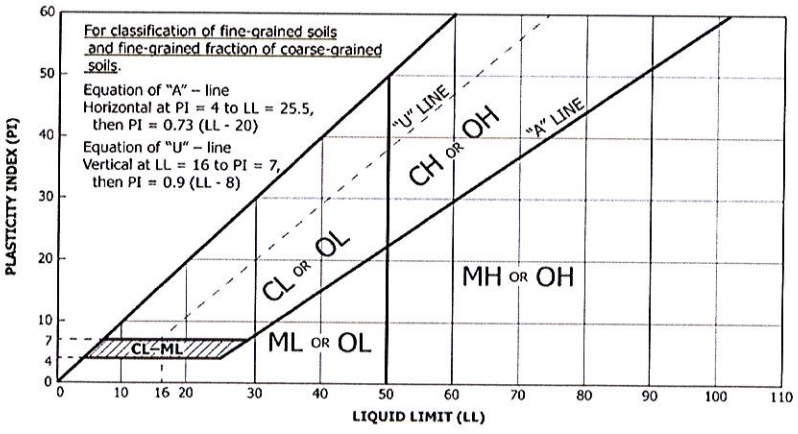
The Science You Build On.

Descriptive Terminology of Soil

Based on Standards ASTM D 2487-11/2488-09a
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E,F,G]
			Fines Classify as CL or CH	GC	Clayey gravel[E,F,G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F,G,I]
			Fines classify as CL or CH	SC	Clayey sand[F,G,I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried < 0.75	OL	Organic clay[K,M,N] / Organic silt[K,L,M,O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried < 0.75	OH	Organic clay[K,M,P] / Organic silt[K,L,M,Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
  Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L,M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 1/4 tsf
Soft	2 to 4 BPF	1/4 to 1/2 tsf
Medium	5 to 8 BPF	1/2 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6 inches into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6-inch increments, and added to get BPF.

Partial Penetration: If the sampler cannot be driven the full 12 inches beyond the initial 6-inch set, the number of blows for that partial penetration is shown as "No./X" (i.e., 50/2"). If the sampler cannot be advanced beyond the initial 6-inch set, the depth of penetration will be recorded in the Notes column as "No. to set X" (i.e., 50 to set 4").

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

WL: WL indicates the water level measured by the drillers either while drilling or following drilling.

Laboratory Tests

DD	Dry Density, pcf	OC	Organic content, %	PL	Plastic limit
WD	Wet Density, pcf	q_p	Pocket penetrometer strength, tsf	LL	Liquid limit
P200	% Passing #200 sieve	MC	Moisture conent, %	PI	Plasticity Index

1/2018

McGraw-Edison

DESCRIPTION

The Galleon™ LED luminaire delivers exceptional performance in a highly scalable, low-profile design. Patented, high-efficiency AccuLED Optics™ system provides uniform and energy conscious illumination to walkways, parking lots, roadways, building areas and security lighting applications. IP66 rated and UL/cUL Listed for wet locations.

Catalog #		**Type**	
Project			
Comments		**Date**	
Prepared by			

SPECIFICATION FEATURES

Construction
Extruded aluminum driver enclosure thermally isolated from Light Squares for optimal thermal performance. Heavy-wall, die-cast aluminum end caps enclose housing and die-cast aluminum heat sinks. A unique, patent pending interlocking housing and heat sink provides scalability with superior structural rigidity. 3G vibration tested and rated. Optional tool-less hardware available for ease of entry into electrical chamber. Housing is IP66 rated.

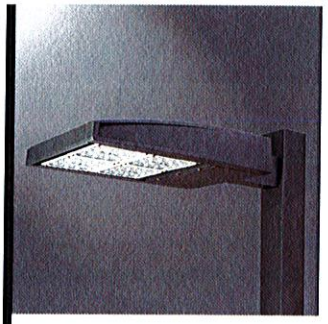
Optics
Patented, high-efficiency injection-molded AccuLED Optics technology. Optics are precisely designed to shape the distribution maximizing efficiency and application spacing. AccuLED Optics create consistent distributions with the scalability to meet customized application requirements. Offered standard in 4000K (+/- 275K) CCT 70 CRI. Optional 3000K, 5000K and 6000K CCT.

Electrical
LED drivers are mounted to removable tray assembly for ease of maintenance. 120-277V 50/60Hz, 347V 60Hz or 480V 60Hz operation. 480V is compatible for use with 480V Wye systems only. Standard with 0-10V dimming. Shipped standard with Eaton proprietary circuit module designed to withstand 10kV of transient line surge. The Galleon LED luminaire is suitable for operation in -40°C to 40°C ambient environments. For applications with ambient temperatures exceeding 40°C, specify the HA (High Ambient) option. Light Squares are IP66 rated. Greater than 90% lumen maintenance expected at 60,000 hours. Available in standard 1A drive current and optional 600mA, 800mA and 1200mA drive currents (nominal).

Mounting
STANDARD ARM MOUNT: Extruded aluminum arm includes internal bolt guides allowing for easy positioning of fixture during mounting. When mounting two or more luminaires at 90° and 120° apart, the EA extended arm may be required. Refer to the arm mounting requirement table. Round pole adapter included. For wall mounting, specify wall mount bracket option. QUICK MOUNT ARM: Adapter is bolted directly to the pole. Quick mount arm slide into place on the adapter and is secured via two screws, facilitating quick and easy installation. The versatile, patent pending, quick mount arm accommodates multiple drill patterns ranging from 1-1/2" to 4-7/8". Removal of the door on the quick mount arm enables wiring of the fixture without having to access the driver compartment. A knock-out enables round pole mounting.

Finish
Housing finished in super durable TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Heat sink is powder coated black. Standard housing colors include black, bronze, grey, white, dark platinum and graphite metallic. RAL and custom color matches available.

Warranty
Five-year warranty.



GLEON
GALLEON LED

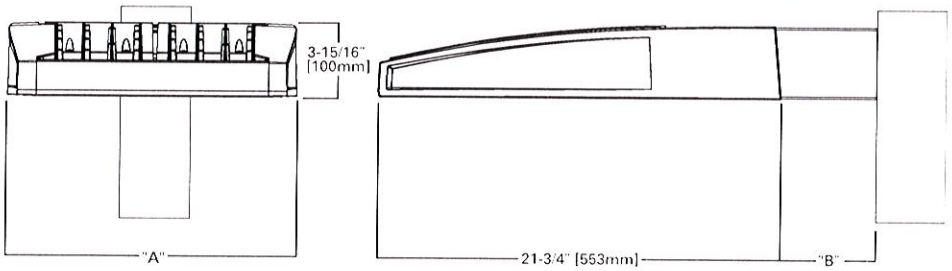
1-10 Light Squares
Solid State LED

AREA/SITE LUMINAIRE

LumenSafe Technology
CLICK HERE

WaveLinx

DIMENSIONS



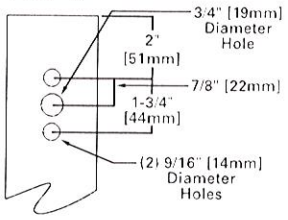
DIMENSION DATA

Number of Light Squares	"A" Width	"B" Standard Arm Length	"B" Optional Arm Length [1]	Weight with Arm (lbs.)	EPA with Arm [2] (Sq. Ft.)
1-4	15-1/2" (394mm)	7" (178mm)	10" (254mm)	33 (15.0 kgs.)	0.96
5-6	21-5/8" (549mm)	7" (178mm)	10" (254mm)	44 (20.0 kgs.)	1.00
7-8	27-5/8" (702mm)	7" (178mm)	13" (330mm)	54 (24.5 kgs.)	1.07
9-10	33-3/4" (857mm)	7" (178mm)	16" (406mm)	63 (28.6 kgs.)	1.12

NOTES: 1. Optional arm length to be used when mounting two fixtures at 90° on a single pole. 2. EPA calculated with optional arm length.

DRILLING PATTERN

TYPE "N"



CERTIFICATION DATA

3G Vibration Rated
DesignLights Consortium® Qualified*
Dark Sky Approved (3000K CCT and warmer only)
IP66 Rated
ISO 9001
LM79 / LM80 Compliant
UL/cUL Wet Location Listed

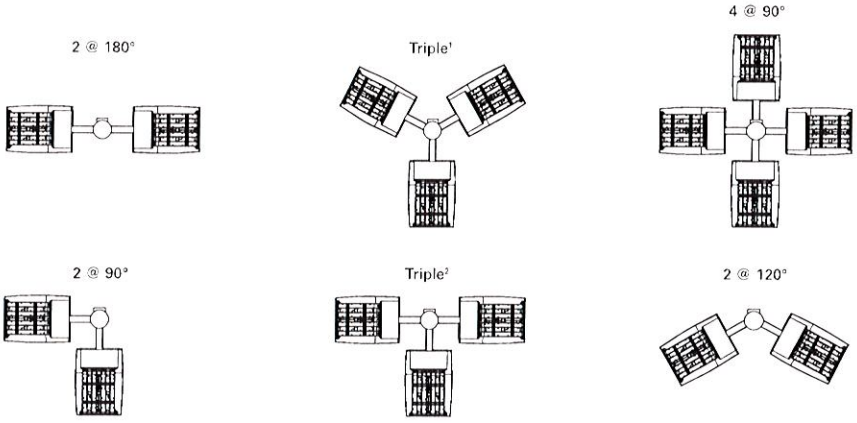
ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120V-277V 50/60Hz
347V, 480V 60Hz
-40°C Min. Temperature
40°C Max. Temperature
50°C Max. Temperature (HA Option)

*www.designlights.org

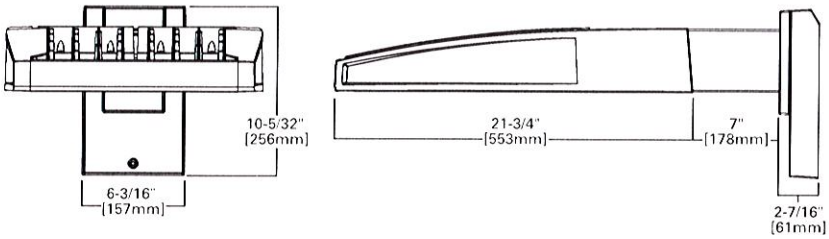
ARM MOUNTING REQUIREMENTS

Configuration	90° Apart	120° Apart
GLEON-AF-01	7" Arm (Standard)	7" Arm (Standard)
GLEON-AF-02	7" Arm (Standard)	7" Arm (Standard)
GLEON-AF-03	7" Arm (Standard)	7" Arm (Standard)
GLEON-AF-04	7" Arm (Standard)	7" Arm (Standard)
GLEON-AF-05	10" Extended Arm (Required)	7" Arm (Standard)
GLEON-AF-06	10" Extended Arm (Required)	7" Arm (Standard)
GLEON-AF-07	13" Extended Arm (Required)	13" Extended Arm (Required)
GLEON-AF-08	13" Extended Arm (Required)	13" Extended Arm (Required)
GLEON-AF-09	16" Extended Arm (Required)	16" Extended Arm (Required)
GLEON-AF-10	16" Extended Arm (Required)	16" Extended Arm (Required)

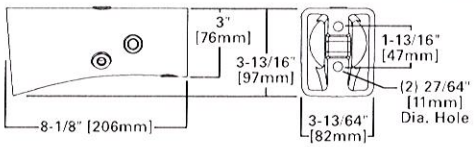


NOTES: 1 Round poles are 3 @ 120°. Square poles are 3 @ 90°. **2** Round poles are 3 @ 90°.

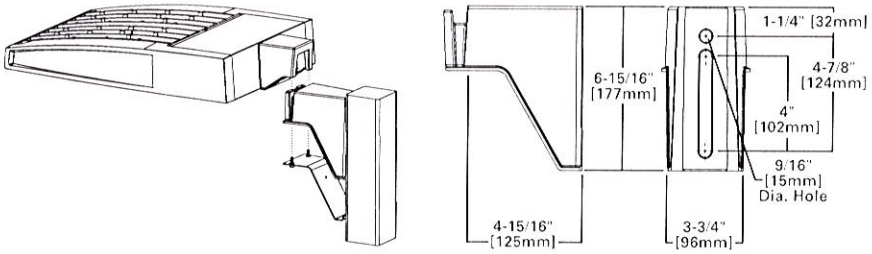
STANDARD WALL MOUNT



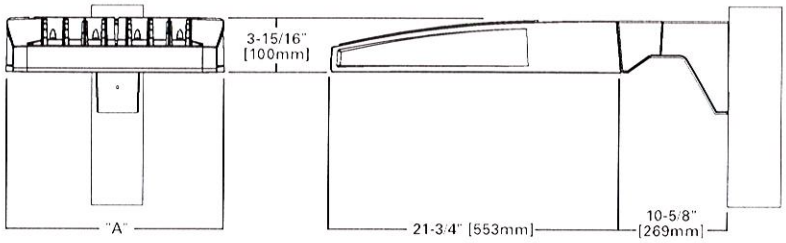
MAST ARM MOUNT



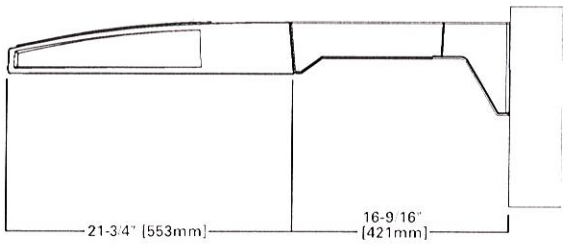
QUICK MOUNT ARM (INCLUDES FIXTURE ADAPTER)



QM Quick Mount Arm (Standard)



QMEA Quick Mount Arm (Extended)



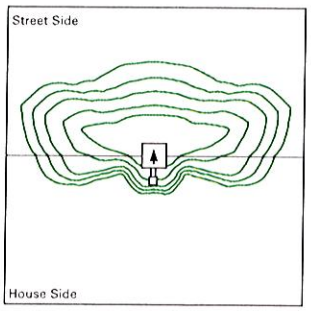
QUICK MOUNT ARM DATA

Number of Light Squares [1,2]	"A" Width	Weight with QM Arm (lbs.)	Weight with QMEA Arm (lbs.)	EPA (Sq. Ft.)
1-4	15-1/2" (394mm)	35 (15.91 kgs.)	38 (17.27 kgs.)	1.11
5-6 [3]	21-5/8" (549mm)	46 (20.91 kgs.)	49 (22.27 kgs.)	
7-8	27-5/8" (702mm)	56 (25.45 kgs.)	N/A	

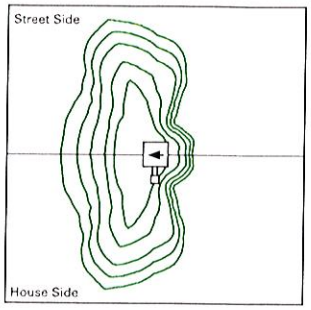
NOTES: 1 QM option available with 1-8 light square configurations. **2** QMEA option available with 1-6 light square configurations. **3** QMEA arm to be used when mounting two fixtures at 90° on a single pole.

Eaton
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.eaton.com/lighting

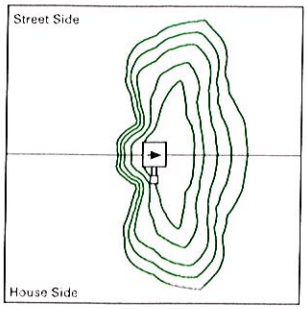
OPTIC ORIENTATION



Standard



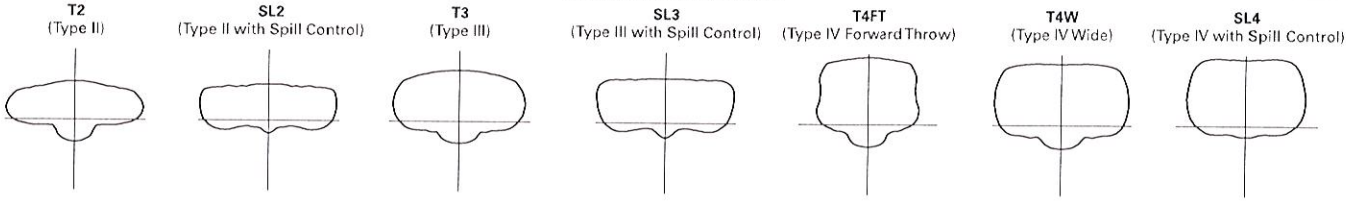
Optics Rotated Left @ 90° [L90]



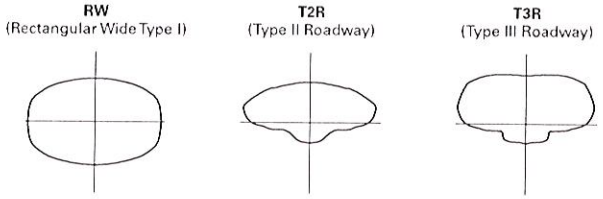
Optics Rotated Right @ 90° [R90]

OPTICAL DISTRIBUTIONS

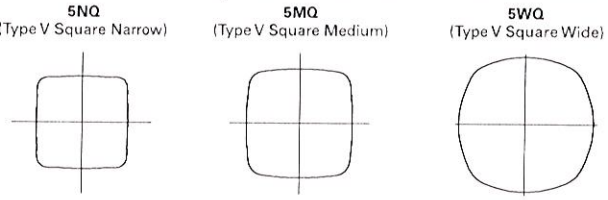
Asymmetric Area Distributions



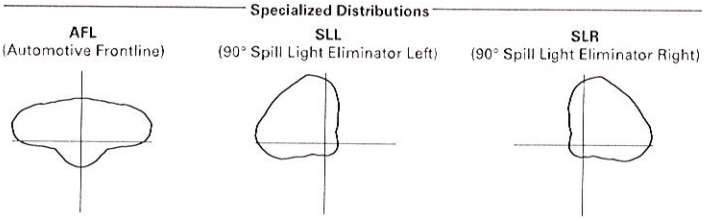
Asymmetric Roadway Distributions



Symmetric Distributions

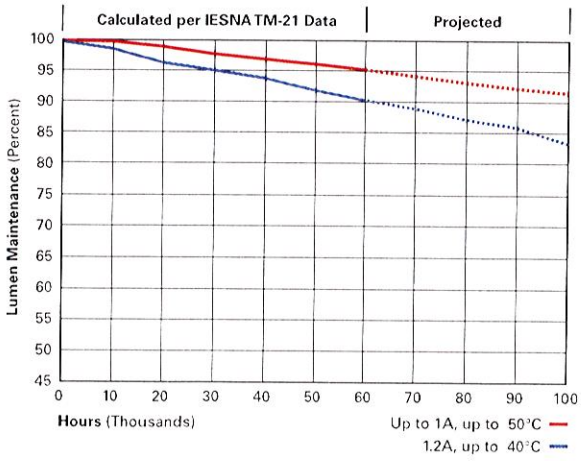


Specialized Distributions



LUMEN MAINTENANCE

Drive Current	Ambient Temperature	TM-21 Lumen Maintenance (60,000 Hours)	Projected L70 (Hours)
Up to 1A	Up to 50°C	> 95%	416,000
1.2A	Up to 40°C	> 90%	205,000



LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

NOMINAL POWER LUMENS (1.2A)

Number of Light Squares		1	2	3	4	5	6	7	8	9	10
Nominal Power (Watts)		67	129	191	258	320	382	448	511	575	640
Input Current @ 120V (A)		0.58	1.16	1.78	2.31	2.94	3.56	4.09	4.71	5.34	5.87
Input Current @ 208V (A)		0.33	0.63	0.93	1.27	1.57	1.87	2.22	2.52	2.8	3.14
Input Current @ 240V (A)		0.29	0.55	0.80	1.10	1.35	1.61	1.93	2.18	2.41	2.71
Input Current @ 277V (A)		0.25	0.48	0.70	0.96	1.18	1.39	1.69	1.90	2.09	2.36
Input Current @ 347V (A)		0.20	0.39	0.57	0.78	0.96	1.15	1.36	1.54	1.72	1.92
Input Current @ 480V (A)		0.15	0.30	0.43	0.60	0.73	0.85	1.03	1.16	1.28	1.45
Optics											
T2	4000K/5000K Lumens	6,863	13,412	20,011	26,441	32,761	39,205	46,364	52,534	58,601	64,880
	3000K Lumens	6,489	12,681	18,919	25,000	30,974	37,066	43,836	49,668	55,405	61,341
	BUG Rating	B1-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
T2R	4000K/5000K Lumens	7,285	14,238	21,246	28,072	34,780	41,621	49,221	55,770	62,212	68,878
	3000K Lumens	6,888	13,462	20,087	26,541	32,884	39,351	46,537	52,729	58,819	65,122
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5
T3	4000K/5000K Lumens	6,995	13,670	20,397	26,951	33,391	39,959	47,256	53,544	59,728	66,130
	3000K Lumens	6,613	12,924	19,284	25,480	31,570	37,780	44,679	50,624	56,471	62,524
	BUG Rating	B1-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
T3R	4000K/5000K Lumens	7,150	13,973	20,850	27,549	34,134	40,846	48,307	54,734	61,056	67,598
	3000K Lumens	6,761	13,212	19,713	26,046	32,272	38,619	45,673	51,750	57,726	63,911
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
T4FT	4000K/5000K Lumens	7,036	13,748	20,515	27,107	33,586	40,191	47,530	53,854	60,074	66,512
	3000K Lumens	6,652	12,999	19,397	25,629	31,754	37,999	44,938	50,917	56,797	62,885
	BUG Rating	B1-U0-G2	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
T4W	4000K/5000K Lumens	6,945	13,571	20,249	26,756	33,152	39,671	46,917	53,160	59,298	65,653
	3000K Lumens	6,566	12,831	19,146	25,297	31,344	37,508	44,358	50,260	56,064	62,072
	BUG Rating	B1-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
SL2	4000K/5000K Lumens	6,851	13,388	19,977	26,396	32,704	39,137	46,283	52,444	58,498	64,768
	3000K Lumens	6,477	12,658	18,888	24,957	30,920	37,003	43,759	49,584	55,308	61,235
	BUG Rating	B1-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
SL3	4000K/5000K Lumens	6,994	13,668	20,394	26,947	33,388	39,953	47,249	53,537	59,720	66,119
	3000K Lumens	6,612	12,922	19,281	25,477	31,567	37,774	44,673	50,618	56,463	62,514
	BUG Rating	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
SL4	4000K/5000K Lumens	6,645	12,986	19,378	25,603	31,723	37,962	44,893	50,868	56,743	62,824
	3000K Lumens	6,282	12,279	18,321	24,207	29,993	35,892	42,445	48,094	53,648	59,398
	BUG Rating	B1-U0-G2	B1-U0-G3	B2-U0-G4	B2-U0-G4	B2-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
5NQ	4000K/5000K Lumens	7,214	14,097	21,036	27,795	34,437	41,210	48,734	55,220	61,597	68,199
	3000K Lumens	6,820	13,329	19,888	26,279	32,558	38,962	46,077	52,208	58,237	64,479
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4
5MQ	4000K/5000K Lumens	7,347	14,356	21,423	28,306	35,071	41,969	49,632	56,237	62,730	69,454
	3000K Lumens	6,947	13,573	20,254	26,762	33,158	39,680	46,925	53,170	59,309	65,667
	BUG Rating	B3-U0-G1	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5
5WQ	4000K/5000K Lumens	7,366	14,396	21,480	28,381	35,164	42,080	49,765	56,386	62,898	69,639
	3000K Lumens	6,964	13,610	20,308	26,833	33,247	39,786	47,050	53,311	59,468	65,842
	BUG Rating	B3-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5	B5-U0-G5
SLL/SLR	4000K/5000K Lumens	6,147	12,010	17,921	23,679	29,339	35,109	41,521	47,046	52,478	58,102
	3000K Lumens	5,811	11,355	16,944	22,388	27,739	33,194	39,256	44,479	49,617	54,933
	BUG Rating	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
RW	4000K/5000K Lumens	7,149	13,970	20,846	27,543	34,126	40,837	48,295	54,722	61,042	67,582
	3000K Lumens	6,760	13,208	19,709	26,041	32,264	38,610	45,661	51,738	57,713	63,897
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G4
AFL	4000K/5000K Lumens	7,175	14,021	20,921	27,643	34,249	40,986	48,470	54,920	61,262	67,828
	3000K Lumens	6,784	13,256	19,780	26,136	32,381	38,750	45,827	51,925	57,922	64,129
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4

* Nominal data for 70 CRI.

NOMINAL POWER LUMENS (1A)

Number of Light Squares		1	2	3	4	5	6	7	8	9	10
Nominal Power (Watts)		59	113	166	225	279	333	391	445	501	558
Input Current @ 120V (A)		0.51	1.02	1.53	2.03	2.55	3.06	3.56	4.08	4.60	5.07
Input Current @ 208V (A)		0.29	0.56	0.82	1.11	1.37	1.64	1.93	2.19	2.46	2.75
Input Current @ 240V (A)		0.26	0.48	0.71	0.96	1.19	0.41	1.67	1.89	2.12	2.39
Input Current @ 277V (A)		0.23	0.42	0.61	0.83	1.03	1.23	1.45	1.65	1.84	2.09
Input Current @ 347V (A)		0.17	0.32	0.50	0.64	0.82	1.00	1.14	1.32	1.50	1.68
Input Current @ 480V (A)		0.14	0.24	0.37	0.48	0.61	0.75	0.91	0.99	1.12	1.28
Optics											
T2	4000K/5000K Lumens	6,256	12,225	18,242	24,104	29,865	35,739	42,265	47,888	53,420	59,144
	3000K Lumens	5,915	11,559	17,248	22,789	28,236	33,790	39,960	45,277	50,506	55,919
	BUG Rating	B1-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
T2R	4000K/5000K Lumens	6,642	12,979	19,366	25,589	31,705	37,941	44,870	50,840	56,711	62,789
	3000K Lumens	6,280	12,271	18,311	24,193	29,976	35,872	42,423	48,068	53,619	59,365
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5
T3	4000K/5000K Lumens	6,377	12,461	18,593	24,568	30,439	36,426	43,077	48,810	54,447	60,282
	3000K Lumens	6,029	11,781	17,580	23,229	28,781	34,441	40,731	46,150	51,480	56,997
	BUG Rating	B1-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
T3R	4000K/5000K Lumens	6,518	12,739	19,006	25,113	31,116	37,235	44,036	49,895	55,658	61,622
	3000K Lumens	6,029	11,781	17,579	23,229	28,779	34,440	40,729	46,148	51,478	56,995
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
T4FT	4000K/5000K Lumens	6,414	12,533	18,702	24,710	30,616	36,637	43,328	49,093	54,763	60,631
	3000K Lumens	6,064	11,849	17,681	23,363	28,946	34,638	40,966	46,417	51,776	57,325
	BUG Rating	B1-U0-G2	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
T4W	4000K/5000K Lumens	6,331	12,372	18,459	24,391	30,221	36,163	42,769	48,459	54,056	59,849
	3000K Lumens	5,986	11,697	17,452	23,061	28,572	34,192	40,436	45,817	51,108	56,585
	BUG Rating	B1-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
SL2	4000K/5000K Lumens	6,245	12,205	18,212	24,062	29,813	35,677	42,192	47,807	53,326	59,042
	3000K Lumens	5,904	11,539	17,218	22,750	28,187	33,732	39,891	45,199	50,418	55,822
	BUG Rating	B1-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5	B4-U0-G5
SL3	4000K/5000K Lumens	6,376	12,460	18,591	24,564	30,436	36,421	43,072	48,803	54,439	60,273
	3000K Lumens	6,028	11,780	17,578	23,224	28,776	34,435	40,723	46,141	51,471	56,986
	BUG Rating	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
SL4	4000K/5000K Lumens	6,058	11,838	17,664	23,340	28,918	34,605	40,924	46,370	51,727	57,269
	3000K Lumens	5,727	11,193	16,701	22,067	27,341	32,718	38,692	43,841	48,906	54,146
	BUG Rating	B1-U0-G2	B1-U0-G3	B2-U0-G4	B2-U0-G4	B2-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
5NQ	4000K/5000K Lumens	6,577	12,851	19,176	25,336	31,392	37,566	44,426	50,337	56,151	62,170
	3000K Lumens	6,218	12,151	18,131	23,955	29,680	35,517	42,003	47,592	53,089	58,779
	BUG Rating	B2-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4
5MQ	4000K/5000K Lumens	6,697	13,088	19,528	25,803	31,970	38,258	45,243	51,264	57,185	63,313
	3000K Lumens	6,332	12,374	18,463	24,395	30,227	36,171	42,776	48,468	54,066	59,861
	BUG Rating	B3-U0-G1	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5
5WQ	4000K/5000K Lumens	6,715	13,122	19,580	25,871	32,055	38,360	45,365	51,401	57,337	63,482
	3000K Lumens	6,348	12,406	18,513	24,461	30,307	36,268	42,891	48,599	54,210	60,021
	BUG Rating	B3-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5	B5-U0-G5
SLL/SLR	4000K/5000K Lumens	5,604	10,949	16,337	21,586	26,745	32,004	37,850	42,886	47,838	52,965
	3000K Lumens	5,298	10,351	15,446	20,409	25,287	30,258	35,786	40,547	45,229	50,077
	BUG Rating	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
RW	4000K/5000K Lumens	6,517	12,735	19,002	25,107	31,109	37,227	44,025	49,883	55,644	61,607
	3000K Lumens	6,162	12,040	17,965	23,738	29,413	35,197	41,623	47,163	52,609	58,247
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4
AFL	4000K/5000K Lumens	6,541	12,781	19,072	25,199	31,221	37,362	44,185	50,065	55,846	61,831
	3000K Lumens	6,184	12,084	18,032	23,825	29,519	35,325	41,775	47,334	52,801	58,459
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4

* Nominal data for 70 CRI.

NOMINAL POWER LUMENS (800MA)

Number of Light Squares		1	2	3	4	5	6	7	8	9	10
Nominal Power (Watts)		44	85	124	171	210	249	295	334	374	419
Input Current @ 120V (A)		0.39	0.77	1.13	1.54	1.90	2.26	2.67	3.03	3.39	3.80
Input Current @ 208V (A)		0.22	0.44	0.62	0.88	1.06	1.24	1.50	1.68	1.87	2.12
Input Current @ 240V (A)		0.19	0.38	0.54	0.76	0.92	1.08	1.30	1.46	1.62	1.84
Input Current @ 277V (A)		0.17	0.36	0.47	0.72	0.83	0.95	1.19	1.31	1.42	1.67
Input Current @ 347V (A)		0.15	0.24	0.38	0.49	0.63	0.77	0.87	1.01	1.15	1.52
Input Current @ 480V (A)		0.11	0.18	0.29	0.37	0.48	0.59	0.66	0.77	0.88	0.96
Optics											
T2	4000K/5000K Lumens	5,054	9,878	14,739	19,475	24,129	28,875	34,148	38,691	43,159	47,785
	3000K Lumens	4,779	9,338	13,935	18,412	22,813	27,301	32,286	36,581	40,805	45,179
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B4-U0-G5	B4-U0-G5
T2R	4000K/5000K Lumens	5,366	10,486	15,647	20,675	25,616	30,654	36,252	41,076	45,819	50,730
	3000K Lumens	5,074	9,914	14,794	19,548	24,218	28,982	34,276	38,835	43,320	47,964
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5
T3	4000K/5000K Lumens	5,153	10,068	15,022	19,849	24,593	29,430	34,805	39,436	43,990	48,705
	3000K Lumens	4,872	9,519	14,203	18,766	23,251	27,825	32,907	37,285	41,591	46,048
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B4-U0-G5	B4-U0-G5
T3R	4000K/5000K Lumens	5,266	10,292	15,356	20,290	25,140	30,084	35,578	40,312	44,968	49,786
	3000K Lumens	4,979	9,731	14,518	19,184	23,769	28,443	33,638	38,114	42,516	47,071
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
T4FT	4000K/5000K Lumens	5,182	10,126	15,109	19,964	24,736	29,600	35,006	39,664	44,245	48,987
	3000K Lumens	4,899	9,574	14,285	18,876	23,387	27,986	33,097	37,501	41,832	46,315
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
T4W	4000K/5000K Lumens	5,115	9,995	14,914	19,706	24,417	29,218	34,554	39,152	43,674	48,354
	3000K Lumens	4,836	9,450	14,100	18,631	23,085	27,624	32,670	37,017	41,292	45,717
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B4-U0-G5	B4-U0-G5
SL2	4000K/5000K Lumens	5,046	9,860	14,713	19,441	24,087	28,825	34,089	38,625	43,085	47,702
	3000K Lumens	4,771	9,322	13,911	18,381	22,774	27,253	32,229	36,518	40,735	45,101
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B4-U0-G5
SL3	4000K/5000K Lumens	5,152	10,067	15,020	19,846	24,591	29,426	34,800	39,431	43,984	48,698
	3000K Lumens	4,871	9,518	14,200	18,764	23,249	27,822	32,902	37,280	41,585	46,042
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
SL4	4000K/5000K Lumens	4,894	9,565	14,271	18,857	23,364	27,959	33,065	37,465	41,792	46,270
	3000K Lumens	4,627	9,043	13,492	17,829	22,090	26,434	31,261	35,422	39,513	43,746
	BUG Rating	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G4	B2-U0-G4	B2-U0-G4	B2-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
5NQ	4000K/5000K Lumens	5,313	10,383	15,493	20,470	25,363	30,351	35,893	40,669	45,367	50,229
	3000K Lumens	5,024	9,817	14,647	19,354	23,980	28,696	33,936	38,452	42,893	47,490
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G3
5MQ	4000K/5000K Lumens	5,411	10,574	15,778	20,848	25,830	30,911	36,554	41,418	46,202	51,154
	3000K Lumens	5,117	9,997	14,917	19,710	24,421	29,225	34,561	39,160	43,682	48,364
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G4
5WQ	4000K/5000K Lumens	5,426	10,603	15,820	20,903	25,899	30,992	36,652	41,529	46,325	51,290
	3000K Lumens	5,130	10,025	14,958	19,763	24,486	29,302	34,654	39,263	43,799	48,493
	BUG Rating	B3-U0-G1	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G5	B5-U0-G5
SLL/SLR	4000K/5000K Lumens	4,528	8,846	13,199	17,440	21,609	25,858	30,580	34,649	38,651	42,792
	3000K Lumens	4,281	8,364	12,480	16,489	20,430	24,448	28,912	32,759	36,543	40,459
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G3	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5
RW	4000K/5000K Lumens	5,265	10,289	15,353	20,285	25,134	30,077	35,569	40,303	44,958	49,775
	3000K Lumens	4,978	9,727	14,516	19,179	23,763	28,437	33,629	38,105	42,506	47,060
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4
AFL	4000K/5000K Lumens	5,285	10,327	15,409	20,360	25,225	30,186	35,699	40,450	45,120	49,956
	3000K Lumens	4,996	9,763	14,569	19,249	23,849	28,540	33,752	38,244	42,659	47,232
	BUG Rating	B1-U0-G1	B1-U0-G1	B2-U0-G2	B2-U0-G2	B3-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3

* Nominal data for 70 CRI.

NOMINAL POWER LUMENS (600MA)

Number of Light Squares		1	2	3	4	5	6	7	8	9	10
Nominal Power (Watts)		34	66	96	129	162	193	226	257	290	323
Input Current @ 120V (A)		0.30	0.58	0.86	1.16	1.44	1.73	2.03	2.33	2.59	2.89
Input Current @ 208V (A)		0.17	0.34	0.49	0.65	0.84	0.99	1.14	1.30	1.48	1.63
Input Current @ 240V (A)		0.15	0.30	0.43	0.56	0.74	0.87	1.00	1.13	1.30	1.43
Input Current @ 277V (A)		0.14	0.28	0.41	0.52	0.69	0.81	0.93	1.04	1.22	1.33
Input Current @ 347V (A)		0.11	0.19	0.30	0.39	0.49	0.60	0.69	0.77	0.90	0.99
Input Current @ 480V (A)		0.08	0.15	0.24	0.30	0.38	0.48	0.53	0.59	0.71	0.77
Optics											
T2	4000K/5000K Lumens	4,121	8,055	12,019	15,881	19,676	23,547	27,847	31,552	35,196	38,967
	3000K Lumens	3,896	7,615	11,363	15,015	18,604	22,263	26,328	29,831	33,276	36,842
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4
T2R	4000K/5000K Lumens	4,376	8,552	12,760	16,860	20,890	24,998	29,563	33,497	37,365	41,369
	3000K Lumens	4,138	8,085	12,064	15,941	19,751	23,635	27,951	31,670	35,328	39,113
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4
T3	4000K/5000K Lumens	4,201	8,210	12,251	16,187	20,055	23,999	28,383	32,159	35,873	39,718
	3000K Lumens	3,973	7,763	11,583	15,304	18,961	22,691	26,835	30,406	33,916	37,552
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5
T3R	4000K/5000K Lumens	4,294	8,393	12,523	16,546	20,501	24,532	29,014	32,875	36,671	40,600
	3000K Lumens	4,060	7,936	11,840	15,644	19,383	23,195	27,432	31,082	34,671	38,386
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5
T4FT	4000K/5000K Lumens	4,226	8,257	12,321	16,280	20,172	24,139	28,547	32,346	36,082	39,948
	3000K Lumens	3,996	7,807	11,649	15,392	19,071	22,822	26,990	30,582	34,114	37,770
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5
T4W	4000K/5000K Lumens	4,171	8,151	12,162	16,071	19,912	23,827	28,178	31,928	35,615	39,432
	3000K Lumens	3,943	7,706	11,498	15,194	18,825	22,527	26,642	30,187	33,673	37,281
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5
SL2	4000K/5000K Lumens	4,114	8,041	11,998	15,854	19,643	23,506	27,799	31,498	35,135	38,901
	3000K Lumens	3,890	7,603	11,344	14,989	18,572	22,224	26,282	29,780	33,219	36,779
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5
SL3	4000K/5000K Lumens	4,200	8,209	12,249	16,184	20,053	23,996	28,379	32,154	35,869	39,712
	3000K Lumens	3,972	7,762	11,580	15,302	18,960	22,688	26,831	30,400	33,913	37,546
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5
SL4	4000K/5000K Lumens	3,992	7,799	11,638	15,378	19,053	22,801	26,964	30,552	34,081	37,733
	3000K Lumens	3,774	7,374	11,003	14,539	18,015	21,557	25,493	28,886	32,222	35,674
	BUG Rating	B1-U0-G2	B1-U0-G2	B1-U0-G3	B1-U0-G3	B2-U0-G4	B2-U0-G4	B2-U0-G4	B2-U0-G5	B2-U0-G5	B3-U0-G5
5NQ	4000K/5000K Lumens	4,333	8,467	12,634	16,694	20,683	24,751	29,271	33,166	36,996	40,961
	3000K Lumens	4,097	8,005	11,945	15,784	19,555	23,401	27,674	31,357	34,978	38,727
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G2	B5-U0-G3	B5-U0-G3
5MQ	4000K/5000K Lumens	4,413	8,622	12,867	17,000	21,064	25,207	29,810	33,777	37,677	41,715
	3000K Lumens	4,173	8,152	12,165	16,073	19,915	23,832	28,185	31,934	35,623	39,440
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4
5WQ	4000K/5000K Lumens	4,424	8,646	12,900	17,046	21,120	25,274	29,890	33,866	37,778	41,826
	3000K Lumens	4,182	8,175	12,197	16,117	19,968	23,896	28,260	32,018	35,717	39,545
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G4
SLL/SLR	4000K/5000K Lumens	3,692	7,214	10,763	14,222	17,621	21,086	24,937	28,256	31,519	34,897
	3000K Lumens	3,491	6,820	10,176	13,447	16,660	19,937	23,577	26,715	29,800	32,994
	BUG Rating	B1-U0-G1	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5
RW	4000K/5000K Lumens	4,293	8,390	12,520	16,542	20,496	24,527	29,007	32,866	36,662	40,591
	3000K Lumens	4,059	7,932	11,837	15,640	19,378	23,189	27,425	31,074	34,662	38,377
	BUG Rating	B2-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3
AFL	4000K/5000K Lumens	4,310	8,421	12,566	16,602	20,571	24,616	29,112	32,986	36,795	40,738
	3000K Lumens	4,074	7,962	11,881	15,697	19,448	23,273	27,525	31,187	34,788	38,516
	BUG Rating	B1-U0-G1	B1-U0-G1	B2-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3

* Nominal data for 70 CRI.

CONTROL OPTIONS

0-10V (DIM)
This fixture is offered standard with 0-10V dimming driver(s). The DIM option provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

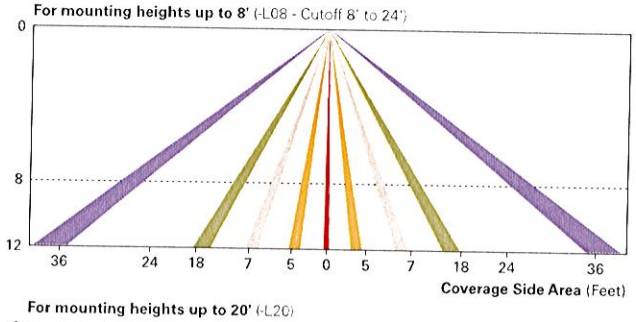
Photocontrol (P, R and PER7)
Optional button-type photocontrol (P) and photocontrol receptacles (R and PER7) provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-pin standards can be utilized with the PER7 receptacle.

After Hours Dim (AHD)
This feature allows photocontrol-enabled luminaires to achieve additional energy savings by dimming during scheduled portions of the night. The dimming profile will automatically take effect after a "dusk-to-dawn" period has been calculated from the photocontrol input. Specify the desired dimming profile for a simple, factory-shipped dimming solution requiring no external control wiring. Reference the After Hours Dim supplemental guide for additional information.

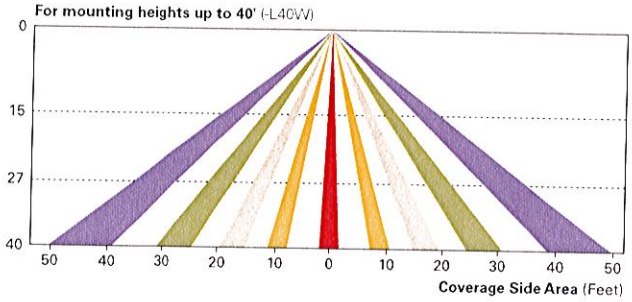
Dimming Occupancy Sensor (MS/DIM-LXX, MS/X-LXX and MS-LXX)
These sensors are factory installed in the luminaire housing. When the MS/DIM-LXX sensor option is selected, the occupancy sensor is connected to a dimming driver and the entire luminaire dims when there is no activity detected. When activity is detected, the luminaire returns to full light output. The MS/DIM sensor is factory preset to dim down to approximately 50 percent power with a time delay of five minutes. The MS-LXX sensor is factory preset to turn the luminaire off after five minutes of no activity. The MS/X-LXX is also preset for five minutes and only controls the specified number of light engines to maintain steady output from the remaining light engines.

These occupancy sensors includes an integral photocell that can be activated with the FSIR-100 accessory for "dusk-to-dawn" control or daylight harvesting - the factory preset is OFF. The FSIR-100 is a wireless tool utilized for changing the dimming level, time delay, sensitivity and other parameters. A variety of sensor lens are available to optimize the coverage. pattern for mounting heights from 8'-40'.

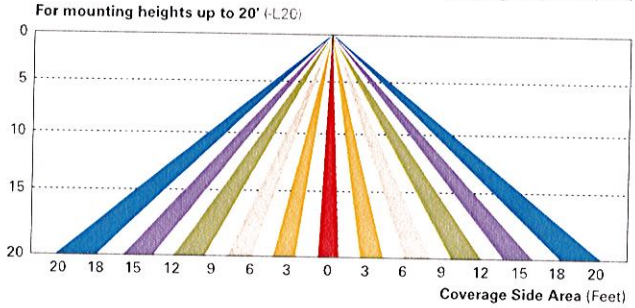
For mounting heights up to 8' (-L08 - Cutoff 8° to 24°)



For mounting heights up to 40' (-L40W)

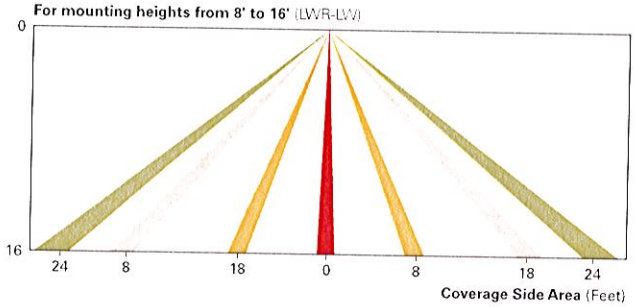


For mounting heights up to 20' (-L20)

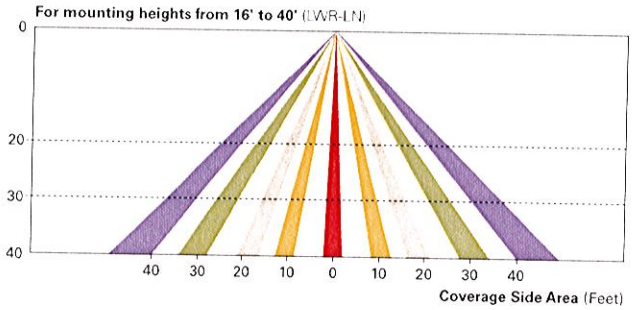


LumaWatt Pro Wireless Control and Monitoring System (LWR-LW and LWR-LN)
The Eaton's LumaWatt Pro powered by Enlighted is a connected lighting solution that combines a broad selection of energy-efficient LED luminaires with a powerful integrated wireless sensor system. The sensor controls the lighting system in compliance with the latest energy codes and collects valuable data about building performance and use. Software applications turn the granular data into information through energy dashboards and specialized apps that make it simple and help optimize the use of building resources, beyond lighting.

For mounting heights from 8' to 16' (LWR-LW)



For mounting heights from 16' to 40' (LWR-LN)



WaveLinx Wireless Outdoor Lighting Control Module (WOLC-7P-10A)
The 7-pin wireless outdoor lighting control module enables WaveLinx to control outdoor area, site and flood lighting. WaveLinx controls outdoor lighting using schedules to provide ON, OFF and dimming controls based on astronomic or time schedules based on a 7 day week.

LumenSafe Integrated Network Security Camera (LD)
Eaton brings ease of camera deployment to a whole new level. No additional wiring is needed beyond providing line power to the luminaire. A variety of networking options allows security integrators to design the optimal solution for active surveillance. As the ideal solution to meet the needs for active surveillance, the LumenSafe integrated network camera is a streamlined, outdoor-ready fixed dome that provides HDTV 1080p video. This IP camera is optimally designed for deployment in the video management system or security software platform of choice.

Synapse (DIM10)
SimplySNAP integrated wireless controls system by Synapse. Includes factory installed DIM10 Synapse control module and MS/DC motion sensor; requires additional Synapse system components for operation. Contact Synapse at www.synapsewireless.com for product support, warranty and terms and conditions.

ORDERING INFORMATION

Sample Number: GLEON-AF-04-LED-E1-T3-GM-QM

Product Family [1, 2]	Light Engine	Number of Light Squares [3]	Lamp Type	Voltage	Distribution	Color	Mounting
GLEON=Galleon	**AF**=1A Drive Current	**01**=1 **02**=2 **03**=3 **04**=4 **05**=5 [4] **06**=6 **07**=7 [5] **08**=8 [5] **09**=9 [6] **10**=10 [6]	**LED**=Solid State Light Emitting Diodes	**E1**=120-277V **347**=347V [7] **480**=480V [7,8]	**T2**=Type II **T2R**=Type II Roadway **T3**=Type III **T3R**=Type III Roadway **T4FT**=Type IV Forward Throw **T4W**=Type IV Wide **5NQ**=Type V Narrow **5MQ**=Type V Square Medium **5WQ**=Type V Square Wide **SL2**=Type II w/Spill Control **SL3**=Type III w/Spill Control **SL4**=Type IV w/Spill Control **SLL**=90° Spill Light Eliminator Left **SLR**=90° Spill Light Eliminator Right **RW**=Rectangular Wide Type I **AFL**=Automotive Frontline	**AP**=Grey **BZ**=Bronze **BK**=Black **DP**=Dark Platinum **GM**=Graphite Metallic **WH**=White	**[Blank]**=Arm for Round or Square Pole **EA**=Extended Arm [9] **MA**=Mast Arm Adapter [10] **WM**=Wall Mount **QM**=Quick Mount Arm (Standard Length) [11] **QMEA**=Quick Mount Arm (Extended Length) [12]

Options (Add as Suffix)

7027=70 CRI 2700K [13]
7030=70 CRI 3000K [13]
8030=80 CRI 3000K [13]
7050=70 CRI 5000K [13]
7060=70 CRI 6000K [13]
600=Drive Current Set to Nominal 600mA [15]
800=Drive Current Set to Nominal 800mA [15]
1200=Drive Current Set to Nominal 1200mA [15, 16]
F=Single Fuse (120, 277 or 347V. Specify Voltage)
FF=Double Fuse (208, 240 or 480V. Specify Voltage)
2L=Two Circuits [12, 18]
DIM=External 0-10V Dimming Leads [19, 20]
DIM10=Synapse Integrated Control Module [14, 19]
AHD145=After Hours Dim, 5 Hours [22]
AHD245=After Hours Dim, 6 Hours [22]
AHD255=After Hours Dim, 7 Hours [22]
AHD355=After Hours Dim, 8 Hours [22]
HA=50°C High Ambient [23]
L90=Optics Rotated 90° Left
R90=Optics Rotated 90° Right
MT=Installed Mesh Top
TH=Tool-less Door Hardware
HSS=Installed House Side Shield [28]
CE=CE Marking [29]
LCF=Light Square Trim Painted to Match Housing [27]
P=Button Type Photocontrol (120, 208, 240 or 277V. Must Specify Voltage) [21]
PER7=NEMA 7-PIN Photocontrol Receptacle [21]
R=NEMA Photocontrol Receptacle [21]
MS-L08=Motion Sensor for ON/OFF Operation, Maximum 8' Mounting Height [24]
MS-L20=Motion Sensor for ON/OFF Operation, 9' - 20' Mounting Height [24]
MS-L40W=Motion Sensor for ON/OFF Operation, 21' - 40' Mounting Height [24]
MS/DIM-L08= Motion Sensor for Dimming Operation, Maximum 8' Mounting Height [24]
MS/DIM-L20= Motion Sensor for Dimming Operation, 9' - 20' Mounting Height [24]
MS/DIM-L40W=Motion Sensor for Dimming Operation, 21' - 40' Mounting Height [24]
MS/X-L08=Bi-Level Motion Sensor, Maximum 8' Mounting Height [24, 25]
MS/X-L20=Bi-Level Motion Sensor, 9' - 20' Mounting Height [24, 25]
MS/X-L40W=Bi-Level Motion Sensor, 21' - 40' Mounting Height [24, 25]
LWR-LW=LumaWatt Pro Wireless Sensor, Wide Lens for 8' - 16' Mounting Height [26]
LWR-LN=LumaWatt Pro Wireless Sensor, Narrow Lens for 16' - 40' Mounting Height [26]
ZW=WaveLinx-enabled 4-PIN Twistlock Receptacle [19, 33]
ZW-SWPD4XX=Wavelinx Wireless Sensor, 7' – 15' Mounting Height [19, 33, 34]
ZW-SWPD5XX=Wavelinx Wireless Sensor, 15' – 40' Mounting Height [19, 33, 34]

Accessories (Order Separately)

OA/RA1016=NEMA Photocontrol Multi-Tap - 105-285V
OA/RA1027=NEMA Photocontrol - 480V
OA/RA1201=NEMA Photocontrol - 347V
OA/RA1013=Photocontrol Shorting Cap
OA/RA1014=120V Photocontrol
MA1252=10kV Surge Module Replacement
MA1036-XX=Single Tenon Adapter for 2-3/8" O.D. Tenon
MA1037-XX=2@180° Tenon Adapter for 2-3/8" O.D. Tenon
MA1197-XX=3@120° Tenon Adapter for 2-3/8" O.D. Tenon
MA1188-XX=4@90° Tenon Adapter for 2-3/8" O.D. Tenon
MA1189-XX=2@90° Tenon Adapter for 2-3/8" O.D. Tenon
MA1190-XX=3@90° Tenon Adapter for 2-3/8" O.D. Tenon
MA1191-XX=2@120° Tenon Adapter for 2-3/8" O.D. Tenon
MA1038-XX=Single Tenon Adapter for 3-1/2" O.D. Tenon
MA1039-XX=2@180° Tenon Adapter for 3-1/2" O.D. Tenon
MA1192-XX=3@120° Tenon Adapter for 3-1/2" O.D. Tenon
MA1193-XX=4@90° Tenon Adapter for 3-1/2" O.D. Tenon
MA1194-XX=2@90° Tenon Adapter for 3-1/2" O.D. Tenon
MA1195-XX=3@90° Tenon Adapter for 3-1/2" O.D. Tenon
FSIR-100=Wireless Configuration Tool for Occupancy Sensor [24]
GLEON-MT1=Field Installed Mesh Top for 1-4 Light Squares
GLEON-MT2=Field Installed Mesh Top for 5-6 Light Squares
GLEON-MT3=Field Installed Mesh Top for 7-8 Light Squares
GLEON-MT4=Field Installed Mesh Top for 9-10 Light Squares
GLEON-QM=Quick Mount Arm Kit [11]
GLEON-QMEA=Quick Mount Extended Arm Kit [12]
LS/HSS=Field Installed House Side Shield [28, 30]
WOLC-7P-10A=WaveLinx Outdoor Control Module [19, 31]
SWPD4-XX=Wavelinx Wireless Sensor, 7' – 15' Mounting Height [19, 32, 33, 34]
SWPD5-XX=Wavelinx Wireless Sensor, 15' – 40' Mounting Height [19, 32, 33, 34]

NOTES:
1 Customer is responsible for engineering analysis to confirm pole and fixture compatibility for all applications. Refer to our white paper WP513001EN for additional support information. **2** DesignLights Consortium® Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details. **3** Standard 4000K CCT and minimum 70 CRI. **4** Not compatible with MS/4-LXX or MS-1-LXX sensors. **5** Not compatible with extended quick mount arm (QMEA). **6** Not compatible with standard quick mount arm (QM) or extended quick mount arm (QMEA). **7** Requires the use of an internal step down transformer when combined with sensor options. Not available with sensor at 1200mA. Not available in combination with the HA high ambient and sensor options at 1A. **8** Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems). **9** May be required when two or more luminaires are oriented on a 90° or 120° drilling pattern. Refer to arm mounting requirement table. **10** Factory installed. **11** Maximum 8 light squares. **12** Maximum 6 light squares. **13** Extended lead times apply. Use dedicated IES files for 2700K, 3000K, 5000K and 6000K when performing layouts. **14** Available in 800mA only. **15** 1 Amp standard. Use dedicated IES files for 600mA, 800mA and 1200mA when performing layouts. **16** Not available with HA option. **17** 2L is not available with MS, MS/X or MS/DIM at 347V or 480V. 2L in AF-02 through AF-04 requires a larger housing, normally used for AF-05 or AF-06. Extended arm option may be required when mounting two or more fixtures per pole at 90° or 120°. Refer to arm mounting requirement table. **18** Not available with LumaWatt Pro wireless sensors. **19** Cannot be used with other control options. **20** Low voltage control lead brought out 18" outside fixture. **21** Not available if any "MS" sensor is selected. Motion sensor has an integral photocell. **22** Requires the use of P photocontrol or the PER7 or R photocontrol receptacle with photocontrol accessory. See After Hours Dim supplemental guide for additional information. **23** 50°C lumen maintenance data applies to 600mA, 800mA and 1A drive currents. **24** The FSIR-100 configuration tool is required to adjust parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Eaton for more information. **25** Replace X with number of Light Squares operating in low output mode. **26** LumaWatt Pro wireless sensors are factory installed only requiring network components LWP-EM-1, LWP-GW-1 and LWP-PoE8 in appropriate quantities. See www.eaton.com/lighting for LumaWatt Pro application information. **27** Not available with house side shield (HSS). **28** Only for use with SL2, SL3, SL4 and AFL distributions. The Light Square trim plate is painted black when the HSS option is selected. **29** CE is not available with the LWR, MS, MS/X, MS/DIM, P, R or PER7 options. Available in 120-277V only. **30** One required for each Light Square. **31** Requires PER7. **32** Requires ZW. **33** WAC Gateway required to enable field-configurability: Order WAC-PoE and WPOE-120 (10V to PoE injector) power supply if needed. **34** Replace XX with sensor color (WH, BZ, or BK).

LumenSafe Integrated Network Security Camera Technology Options (Add as Suffix)

Product Family	Camera Type	Data Backhaul	
L=LumenSafe Technology* 	D=Dome Camera, Standard H=Dome Camera, Hi-Res Z=Dome Camera, Remote PTZ	C=Cellular, Customer Installed SIM Card A=Cellular, Factory Installed AT&T SIM Card V=Cellular, Factory Installed Verizon SIM Card S=Cellular, Factory Installed Sprint SIM Card	W=Wi-Fi Networking w/ Omni-Directional Antenna E=Ethernet Networking

*Consult LumenSafe system pages for additional details and compatibility.

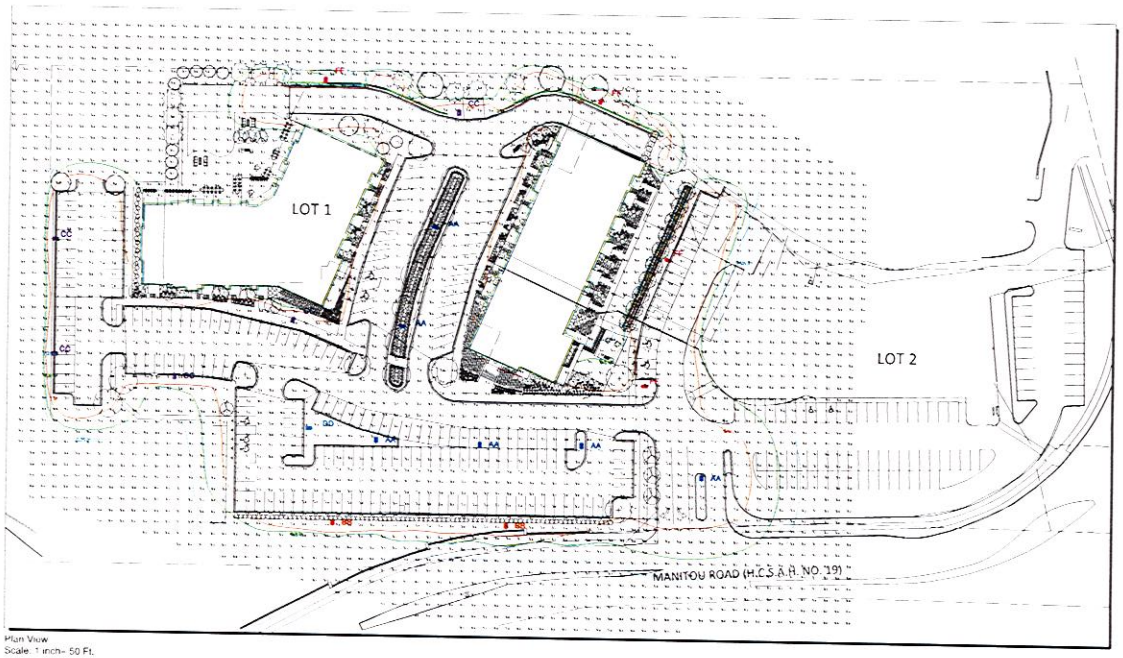
Luminaire Schedule

Symbol	Qty	Label	Arrangement	LLF	Description	Arr. Watts	Lum. Lumens
	6	AA	SINGLE	0.900	MCGRAW GLEON-AF-04-LED-E1-5WQ MOUNT ON 25FT POLE WITH 3FT BASE	225	25871
	2	BB	SINGLE	0.900	MCGRAW GLEON-AF-04-LED-E1-SL3-HSS MOUNT ON 25FT POLE WITH 3FT BASE	225	20984
	5	CC	SINGLE	0.900	MCGRAW GLEON-AF-04-LED-E1-SL4-HSS MOUNT ON 25FT POLE WITH 3FT BASE	225	19935
	1	DD	SINGLE	0.900	MCGRAW GLEON-AF-04-LED-E1-T4FT MOUNT ON 25FT POLE WITH 3FT BASE	225	24711
	4	FF	SINGLE	0.900	MCGRAW GLEON-AF-04-LED-E1-SL2-HSS MOUNT ON 25FT POLE WITH 3FT BASE	225	20344

Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
SITE GROUND	Illuminance	Fc	1.04	7.1	0.0	N.A.	N.A.
CENTER PARKING	Illuminance	Fc	1.80	2.4	1.1	1.64	2.18
EAST PARKING	Illuminance	Fc	2.99	4.5	1.5	1.99	3.00
SOUTH PARKING	Illuminance	Fc	2.72	4.9	1.1	2.47	4.45
SOUTHWEST PARKING	Illuminance	Fc	2.74	3.9	1.0	2.74	3.90
WEST PARKING	Illuminance	Fc	2.37	3.4	1.1	2.15	3.09

TYPE AA, BB, CC, DD & FF



Plan View
Scale: 1 inch= 50 Ft.

GENERAL NOTES:

A. PULSE PRODUCTS DOES NOT ASSUME RESPONSIBILITY FOR THE INTERPRETATION OF THIS CALCULATION OR COMPLAINCE TO THE LOCAL, STATE, OR FEDERAL LIGHTING CODES OR ORDINANCES.

B. LIGHTING LAYOUT IS NOT INTENDED FOR CONSTRUCTION DOCUMENTS BUT ONLY TO ILLUSTRATE THE PERFORMANCE OF THE PRODUCT.

C. ALL READINGS/CALCULATIONS SHOWN ARE SHOWN ON OBJECT SURFACES.

PULSE never ordinary

#	Date	Comments

Revisions

Drawn By: SANDY
Checked By: TRENT
Date:4/27/2020

Scale: AS NOTED

TONKA BAY MULTIFAMILY

TONKA BAY, MN