SUBSURFACE INVESTIGATION AND GEOTECHNICAL RECOMMENDATIONS

DOWNTOWN LOVELAND PROPERTY EVALUATION
LOVELAND, OHIO

Prepared for:

CITY OF LOVELAND
LOVELAND, OHIO

Prepared by:

ALT & WITZIG ENGINEERING, INC.
WEST CHESTER, OHIO

JULY 3, 2019 **PROJECT NO.: 19CN0186**

Alt & Witzig Engineering, Inc.
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July 3, 2019

City of Loveland
120 West Loveland Avenue
Loveland, Ohio 45150
ATTN: Mr. David Kennedy

RE: Preliminary Subsurface Investigation &
Geotechnical Recommendations
Downtown Loveland Property Evaluation
1st Street
Loveland, Ohio
Alt & Witzig File No.: 19CN0186

Dear Mr. Kennedy:

This report presents the results of a preliminary subsurface investigation and provides geotechnical recommendations the property to be developed along 1st Street in Loveland, Ohio. Our investigation was conducted for the City of Loveland. The purpose of this subsurface investigation was to evaluate the geotechnical suitability of the property for development with multistory residential/commercial structures.

Field Investigations

Field investigations to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site and drilling 4 soil borings. Borings are located as shown in figure 1. The soil borings were performed with a drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples were obtained employing split-spoon sampling procedures in accordance with ASTM Procedure D-1586.

During the sampling procedure, standard penetration tests were performed at regular intervals to obtain the standard penetration value of the soil. The standard penetration value is defined as the number of blows a 140-pound hammer, falling 30 inches, is required to advance the split-spoon sampler 1 foot into the soil. The results of the standard penetration tests indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

Figure 1: Boring Locations over GIS Topographic Map

Laboratory Investigations

In addition to the field investigations, a supplemental laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the subsurface materials necessary in analyzing the behavior of the new building(s). All phases of the laboratory investigation were conducted in general accordance with applicable ASTM specifications. The laboratory testing program included supplementary visual classification of all samples and water content testing on all cohesive samples.

Description of Site/Project Description

The property to be developed is located on the eastern side of 1st Street in Loveland, Ohio. At the time of drilling operations, the property was occupied by a residential structure on the northern three quarters of the property and gravel pavement on the southern quarter of the property. The terrain is mildly sloping with approximately 20 feet of elevation change across the development footprint. The site drops approximately 40 to 50 feet on the northwestern perimeter of the property to the Little Miami River. The surrounding properties are development with 1 to 2 story residential and commercial structures. Based on an anticipated finished floor elevation of 590 ft MSL for the building, we expect up to 15 to 20 feet of cut will be required on the eastern/northeastern portion of the property.

Subsurface Conditions

A relatively consistent soil profile was encountered across the site. Borings encountered brown medium stiff to very stiff clay with limestone cobble at the immediate surface underlain by brown heavily weathered shale with limestone seams at a depth between 7 and 14 feet below the surface. The brown shale transitions into a gray weathered shale at a depth of 12 to 14 feet below the existing ground surface. The following table provides the depth to brown and gray shale at each boring location.

Boring	Depth to Brown Shale (ft) (Elev. ft MSL)	Depth to Gray Shale (ft) (Elev. Ft MSL)
B-1	No brown shale encountered	14.5 (573.1 ft MSL)
B-2	7.0 (594.6)	12.0 (589.6)
B-3	No brown shale encountered	14.0 (589.7)
B-4	7.0 (600.5)	12.5 (595.0)

Seismic Site Class

An evaluation of the seismic site class has been performed for this site. The Ohio Building Code indicates that the seismic site class is determined by averaging soil conditions within the top 100 feet with respect to the shear wave velocity. This evaluation is based on data obtained on soil to termination of the borings and our knowledge of soils in the area. Based on the field and laboratory tests performed on the encountered subsurface materials to boring termination, this site should be considered a Site Class C in accordance with the current Ohio Building Code. However, consideration can be given to a Site Class B once further development plans are generated.

Site Preparation

At the time of drilling operations, the site was occupied by residential structures and some wooded areas. All structural elements, including foundations, floor slabs, and asphalt, associated with the existing buildings should be removed from the site. In addition, any utilities leading to the former structure must be properly abandoned.

After removal of the existing structure and existing pavement, the now exposed subgrade of any areas to receive structural fill should be proofroll inspected. The proofroll should be performed with a dual axle vehicle with a minimum GVW of 55,000 pounds or a vehicle with similar axle loading. The proofroll will assist in identifying soft/yielding soils at a shallow depth across the site. Areas found to fail the proofroll inspection should be remediated prior to the placement of and structural fill or structural element. Any areas found to fail the proofroll inspection should be undercut and be replaced with additional subbase stone. All structural fill should be compacted to a minimum of 98% of the maximum dry density as determined by ASTM D698 beneath pavements and the building footprint. The soil should be placed with a maximum loose lift thickness of 8 inches.

The ability to obtain the above recommended compaction requirements are dependent upon the moisture contents of the fill soils. Early summer to mid fall has traditionally provided the most favorable weather conditions for earthwork in the Cincinnati area. Earthwork undertaken during the wetter portions of the year typically encounter substantial difficulties associated with snow and rain.

Shale excavation is expected on the eastern half of the site. Generally, shale spoils that are excavated are too dry to be properly reused as structural fill. If the shale is removed and to be reused as structural fill, it must be wetted to a point at which the shale becomes claylike in consistency. Also, limestone cobbles larger than 12 inches in any dimension should be removed. A representative of Alt & Witzig should be present to ensure a suitable moisture content is reached prior to the placement of shale as structural fill.

Any soils used as fill shall be formed from material free of vegetable matter, rubbish, large rock, and other deleterious material. Prior to placement of fill, a sample of the proposed fill material should be submitted to Alt & Witzig for approval. The fill material should be placed, compacted, and dried as required to secure specified compactions. Each layer should be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Should the results of the in-place density tests indicate that the specified compaction limits are not obtained; the areas represented by such tests should be reworked and retested as required until the specified limits are reached.

Foundation Discussion and Recommendations

For our analysis, it is assumed that the structure will be moderately loaded with the structural loads transferred to the soils by conventional spread footings and continuous wall footings. Exact site use has not been determined at the time of this report, but we expect the lot to be developed with up to 4 stories of commercial and residential structures.

Finished floor elevation has not been provided at the time of this report. However, we estimate a lowest floor elevation of 590 ft MSL, which would expose shale on the eastern half of the site. Thus, portions of the site will include foundations on clay and some will include foundations on shale. A net allowable soil bearing pressure of 2,000 to 3,000 psf and 10,000 psf to 20,000 psf for soil and shale, respectively, could be used to design foundations on site, depending upon finished floor elevation. Once further development plans are generated, this information should be provided to Alt & Witzig to finalize geotechnical recommendations and allowable bearing pressures. The above-recommended bearing pressure assumes the footings will be founded on native clay soils and sound shale bedrock.

If the above suggested bearing pressure is used in the design of the footings, then all interior footings can be founded at nominal depths below the finished floor slab provided the foundations bear on shale. In order to alleviate the effects of seasonal variation in moisture content on the behavior of the footings and eliminate the effects of frost action, all exterior foundations and unheated areas should be founded a minimum of 32 inches below the final grade.

Northeast Slope Concerns

We expect that the structure would sit near the northeastern slope. Proposed site grades and building layout have not been provided at the time of this report. Once more detailed plans are generated, this information should be provided to Alt & Witzig for further evaluation of the structure and its potential effect on the northeastern portion of the site.

If we can give further service in these matters, please contact us at your convenience.

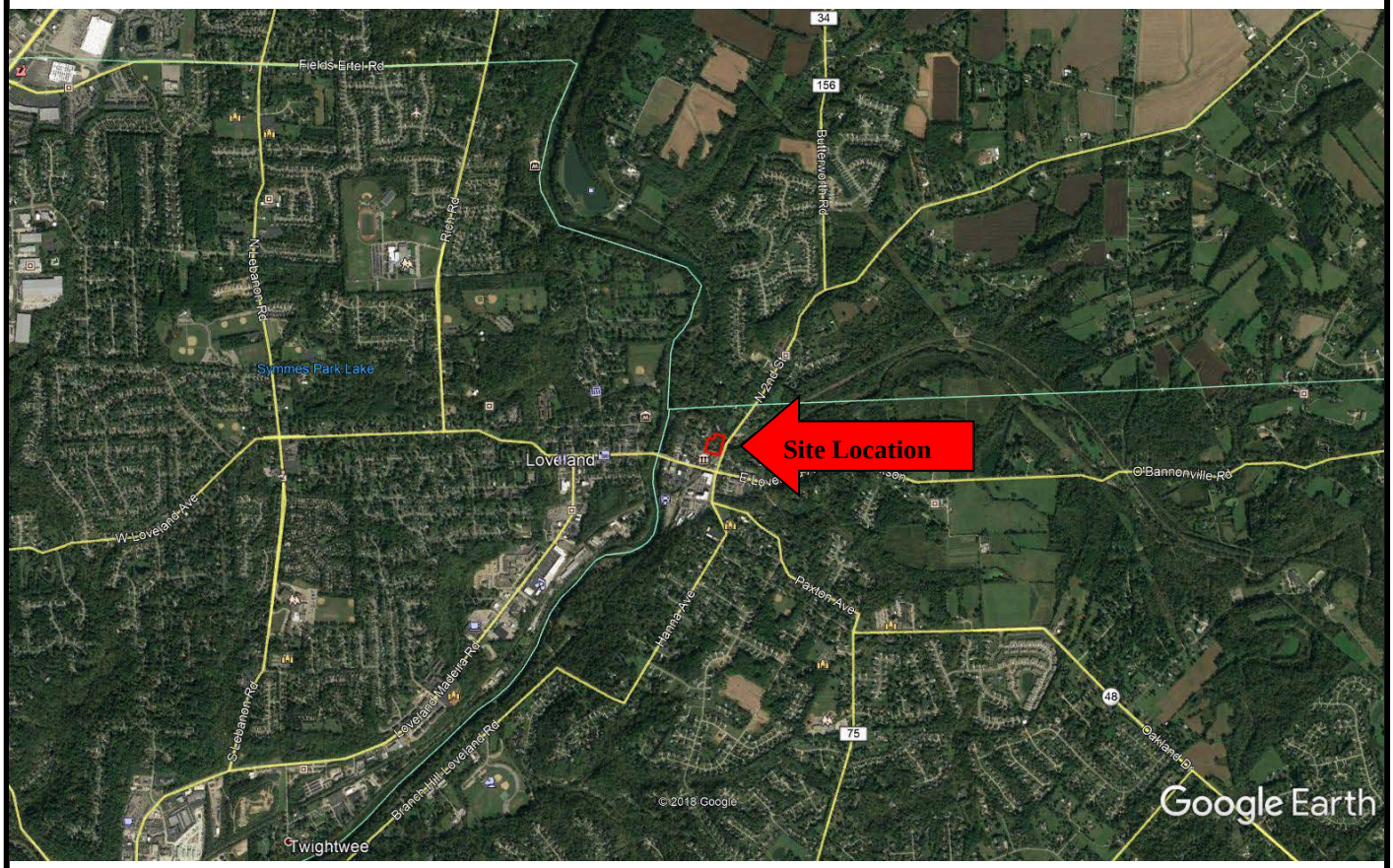
Respectfully Submitted,
ALT & WITZIG ENGINEERING, INC.

Dustin Horn, P.E.
Project Engineer

Patrick A. Knoll, P.E.
Principal Engineer

APPENDIX

SITE LOCATION MAP



PROJECT: Downtown Loveland Property Evaluation
LOCATION: Loveland, Ohio
CLIENT: City of Loveland
AWE File No.: 19CN0186

Alt & Witzig Engineering, Inc.
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BORING LOCATION PLAN

N

PROJECT: Downtown Loveland Property Evaluation
LOCATION: Loveland, Ohio
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BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **City of Loveland** BORING # **B1**

PROJECT NAME **Downtown Loveland Property** ALT & WITZIG FILE # **19CN0186**

PROJECT LOCATION **Loveland, OH**

DRILLING and SAMPLING INFORMATION

Date Started **6/6/19** Hammer Wt. **140** lbs.

Date Completed **6/6/19** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J. Roark** Rig Type **D-50 Track ATV**

STRATA ELEV.	SOIL CLASSIFICATION / SURFACE ELEVATION 587.6	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
587.4	SAND and GRAVEL 2"	0.2										
	Brown, Soft CLAY with Sand & Trace Organics			1	SS			5		0.5	18.2	
583.6		4.0										
	Brown, Stiff Sandy CLAY		5	2	SS			6		2.3	20.9	
580.1		7.5		3	SS			10		4.3	21.7	
	Brown/Gray, Very Stiff CLAY		10	4	SS			18		4.5	18.2	
573.1		14.5										
	Gray Highly Weathered SHALE		15	5	SS			49		4.5	12.9	
569.1		18.5										
	(AUGER REFUSAL @ 18.5') End of Boring at 18.5 feet			6	SS			50/5		2.8		

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **City of Loveland**
PROJECT NAME **Downtown Loveland Property**
PROJECT LOCATION **Loveland, OH**

BORING # **B2**
ALT & WITZIG FILE # **19CN0186**

DRILLING and SAMPLING INFORMATION

Date Started **6/6/19**
Date Completed **6/6/19**
Boring Method **HSA**
Driller **J. Roark**

Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2** in.
Rig Type **D-50 Track ATV**

STRATA ELEV.	SOIL CLASSIFICATION / SURFACE ELEVATION 601.6	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
601.3	GRAVEL 4"	0.3										
	Brown CLAY with Limestone Cobble *(RESIDUAL CLAY)*			1	SS			10		4.3	19.8	
			5	2	SS			25		4.5	15.6	
594.6		7.0		3	SS			45		4.5	15.7	
	Brown Heavily Weathered SHALE with Limestone Cobbles		10	4	SS			71		4.5	18.6	
589.6		12.0		5	SS			50/5		2.5	9.7	
588.1	Gray Weathered SHALE with Limestone Seams	13.5										
	(AUGER REFUSAL @ 13.5') End of Boring at 13.5 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **City of Loveland** BORING # **B3**

PROJECT NAME **Downtown Loveland Property** ALT & WITZIG FILE # **19CN0186**

PROJECT LOCATION **Loveland, OH**

DRILLING and SAMPLING INFORMATION

Date Started **6/6/19** Hammer Wt. **140** lbs.

Date Completed **6/6/19** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J. Roark** Rig Type **D-50 Track ATV**

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 589.7	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
589.4	TOPSOIL 3"	0.3										
	Brown, Stiff Sandy CLAY			1	SS			5		2.3	20.4	
585.7		4.0										
			5	2	SS			4		1.5	22.1	
	Brown, Medium Stiff Sandy CLAY			3	SS			9				AUGER SAMPLE
579.7		10.0	10	4	SS			20		4.5	13.9	
	Brown CLAY with Limestone Cobble *(RESIDUAL CLAY)*											
575.7		14.0										
	Gray Weathered SHALE with Limestone Seams		15	5	SS			57			9.4	
				6	SS			50/4				
571.2		18.5										
	(AUGER REFUSAL @ 18.5') End of Boring at 18.5 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **City of Loveland** BORING # **B4**

PROJECT NAME **Downtown Loveland Property** ALT & WITZIG FILE # **19CN0186**

PROJECT LOCATION **Loveland, OH**

DRILLING and SAMPLING INFORMATION

Date Started	6/6/19	Hammer Wt.	140 lbs.
Date Completed	6/6/19	Hammer Drop	30 in.
Boring Method	HSA	Spoon Sampler OD	2 in.
Driller	J. Roark	Rig Type	D-50 Track ATV

STRATA ELEV.	SOIL CLASSIFICATION / SURFACE ELEVATION 607.5	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
607.3	TOPSOIL 2"	0.2										
				1	SS			50/4				
	Brown, Stiff CLAY with Limestone Cobbles *(RESIDUAL CLAY)*		5	2	SS			27		4.5	17.3	
600.5		7.0		3	SS			35		4.5	14.9	
	Brown Highly Weathered SHALE with Limestone Seams		10	4	SS			68		4.5	14.9	
595.0		12.5										
	Gray Weathered SHALE with Limestone Seams		15	5	SS			50/3		1.0	8.1	
591.5		16.0										
	(AUGER REFUSAL @ 16') End of Boring at 16 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.

Qu: Unconfined compressive strength, TSF

Qp: Penetrometer value, unconfined compressive strength, TSF

Mc: Water content, %

LL: Liquid limit, %

PL: Plastic limit, %

Dd: Natural dry density, PCF

▼ : Apparent groundwater level at time noted after completion

DRILLING AND SAMPLING SYMBOLS

SS: Split-spoon - 1 3/8" I.D., 2" O.D., except where noted
ST: Shelby tube - 3" O.D., except where noted
AU: Auger sample
DB: Diamond bit
CB: Carbide bit
WS: Washed sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	Qu (TSF)
Very soft	0 - 0.25
Soft	0.25 - 0.50
Medium	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.(+)	Coarse Sand	5 mm-0.6 mm	Silt	0.075 mm - 0.005 mm
Cobbles	8 in. - 3 in.	Medium Sand	0.6mm-0.2 mm	Clay	0.005mm(-)
Gravel	3 in. - 5 mm	Fine Sand	0.2mm-0.075 mm		