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HISTORIC STRUCTURAL ASSESSMENT
809 MAIN STREET, LOUISVILLE, COLORADO

12/18/2018

This Project was paid for by the Louisville Preservation Fund grant.

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INTRODUCTION

DAJ Design conducted an Historical Structural Assessment for the structure located at 809 Main Street, Louisville, CO to determine its viability as a candidate for a historic landmark designation as defined under the Historic Preservation program of the City of Louisville. The structure is a commercial property. The City of Louisville Historic Preservation Commission found probable cause that the building may be eligible for landmarking under criteria in section 15.36.050 of the Louisville Municipal Code, and therefore the Commission approved the Historic Structural Assessment to be paid for by the Louisville Preservation Fund grant.

Site visits to 809 Main Street were conducted to study the building and collect relevant data. Three site visits were conducted at 809 Main Street to study the structure and collect data. 1) A preliminary visit was conducted by DAJ Design and included a structural engineer from the Ascent Group; 2) a second site visit by DAJ Design was necessary to conduct an Existing Condition Assessment using the Rapid Visual Screening matrix; 3) the third visit by DAJ Design completed the Existing Condition Assessment and allowed time to photograph the structure.

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LIST OF CONSULTANTS

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WEATHER CONDITIONS

Site Visit #1: good conditions, sunny, low wind
Site Visit #2: overcast conditions, low temperatures, windy
Site Visit #3: overcast conditions, moderate temperatures, low wind

SOURCES

“Louisville Historic Preservation Commission Staff Report,” August, 20, 2018 .
“809 Main St. History,” August, 2018, Louisville Historic Museum.
“HSA Packet 2018,” City of Louisville Planning Department.
Local neighbor interviews.

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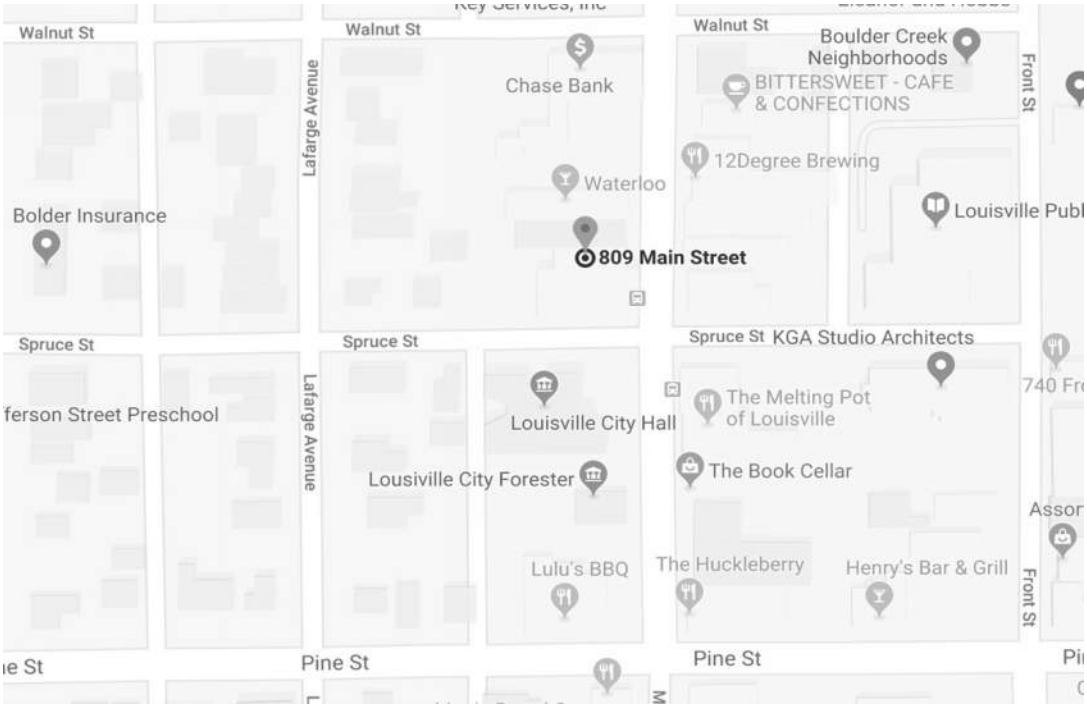
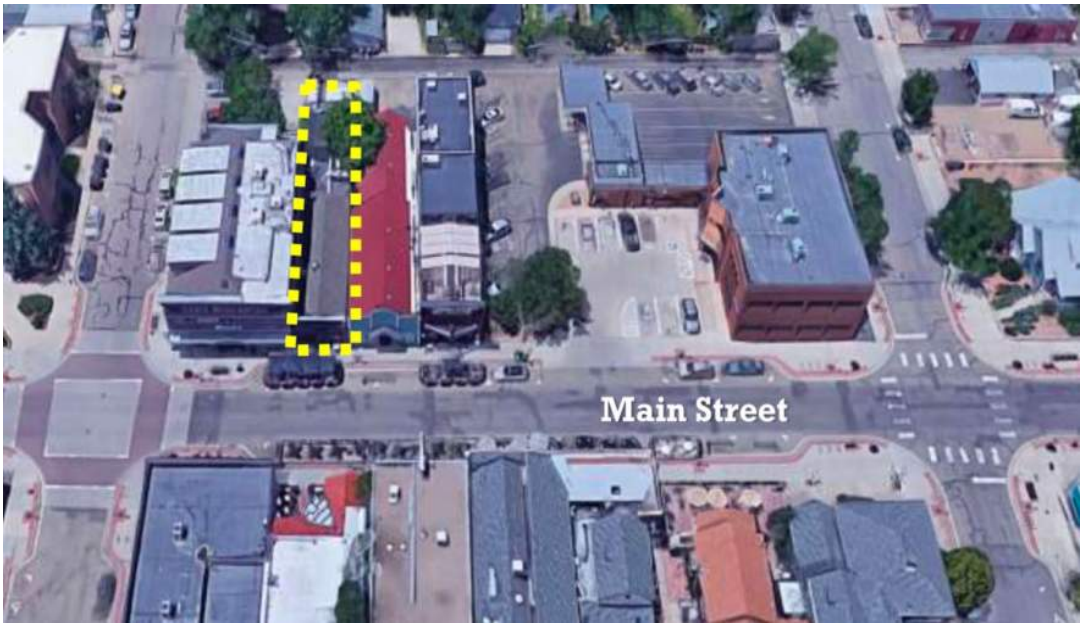
BUILDING LOCATION AND SITE PLAN

Legal Description: North Half of Lot 12, Block 5, Town of Louisville





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HISTORY AND USE

The commercial building is one-level and rectangular in shape. It is an early twentieth century wood frame structure with a false storefront façade. The moderately-pitched, front gable style roof has grey, asphalt shingles and boxed eaves. The false front façade contains two expansive two-light storefront display windows with red brick, rowlock slipsills. The windows bracket a glass-in-wood-frame entry door containing a transom window. Below the display windows, the kickplate area is faced with red brick. Red brick columns flank the façade. Above the windows, the façade is sheated in horizontal weatherboard siding with wood corner boards and a dentil course beneath a projecting cornice.

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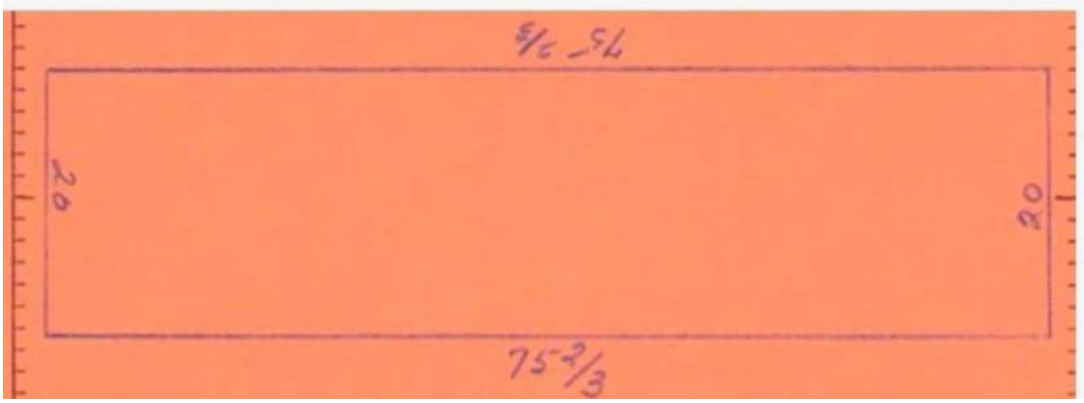

A detailed social history and timeline of the business at 809 Main Street was provided by the Louisville Historical Museum.

Top image: 1948 Boulder County Assessor's Ground Plan Sketch.

Bottom image: 1948 Assessor's photo of east elevation.

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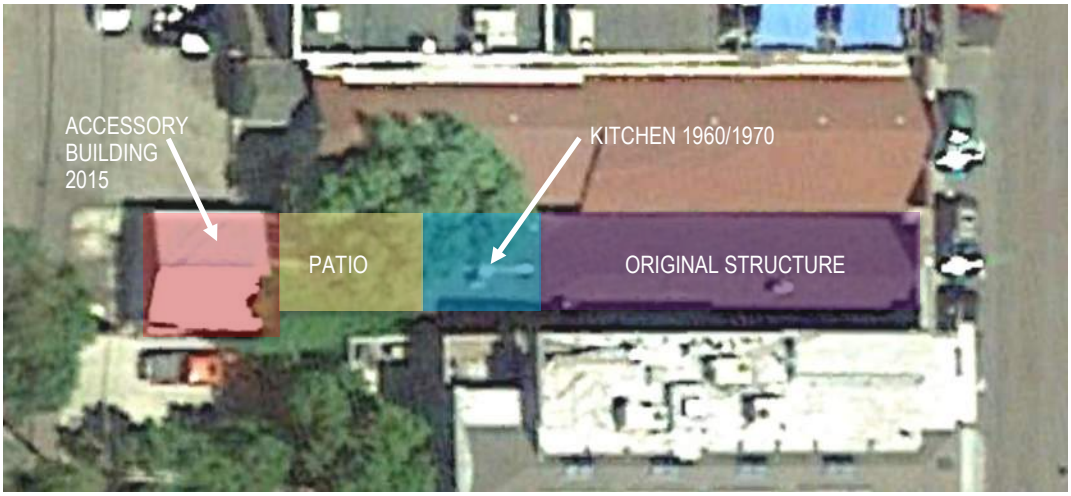

The building has been dated by the Louisville Historic Museum as "circa 1900." Initially, the building served as a barber shop and then a secondhand store. For the past 100 years, the structure appears to have been operated as a restaurant and bar type of business. The building is primarily associated with the family of Celeste Romano who operated a pool hall, bar, restaurant and ice cream parlor at different times between 1919 and 1968.

Changes and additions have been made to the building over time. The brick columns and brick veneer were added to the façade circa 1963. The original 6-light windows were replaced by 2-light windows between 1965 and 1978. A shed-roofed addition was built on the rear of the main building in the 1960's or 1970's. Finally, a 16'x23' walk-in cooler accessory building was added to the west side of the property in 2015.

In 1984, the Louisville Historical Commission placed 809 Main on a list of fifteen downtown structures that the Historical Commission designated as Louisville landmarks. This list of structures was submitted to the State for possible placement on the National and State Registers of Historic Places. At that time, five commercial buildings from the list were selected for placement on the National and State registers, but 809 Main was not chosen.

LANDMARKING RECOMMENDATION

809 Main Street contributes to the historical urban fabric and story of Louisville. The building's storefront façade has maintained a relatively high degree of architectural integrity dating back to some of the earliest known photos of the building. The building's social history demonstrates that the building's previous owners and occupants were significant contributors to historical life and the development of Louisville's Main Street. It is our recommendation that the building be considered for landmarking under the City of Louisville Historic Preservation Program. We also believe that the building is a strong candidate for historic preservation grant funding through the City's same program.

There are two options we recommend for landmarking the building at 809 Main. Based on our assessment, along with that of our consulting structural engineer, there is a significant amount of work required to preserve the existing building and bring it up to an acceptable and code complying structure for future occupation. Below are two recommended options for landmarking.

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Landmark Option 1

Option 1 provides a solution to preserve and landmark the entire existing building. Based on our assessment, the structure at the floor level of the building has suffered due to poor construction combined with grading, drainage and moisture issues. It is recommended that the grading issues are addressed and that the foundation and floor structure be re-built with new, modern construction materials resistant to decay. In preparation to replace the foundation and main level floor framing, the roof will need to be structurally reinforced in order to withstand the temporary bracing required to support the walls and roof structure while the foundation work and reworking of the main level floor is being completed. Options for replacing the existing foundation and floor structure could include: 1) concrete foundation and wood framed floor; 2) concrete foundation and concrete slab floor. In either scenario, a geotechnical engineer and structural engineer are required for the design and detailing of the new foundation and floor framing.

Landmark Option 2

Option 2 provides a solution to preserve and landmark only the front storefront façade along Main Street, and the entire building behind it would be razed and rebuilt with modern construction methods and materials. Solutions for the rebuilding of the building behind the façade would need to comply with the Downtown Design Guidelines & Standards, adopted model building codes, and would need to be evaluated by Planning staff and the Historic Preservation Commission.

Both landmark options will require that the storefront façade be rehabilited to its original character, and will include replacing the existing windows with historically accurate replacements based on recorded photos of the building, restoration of the existing siding, trim, and ornamentation, reinforcing or rebuilding of the existing cornice, rehabilitation or rebuilding of the existing foundation, and removal of brick veneer.

ANALYSIS AND COMPLIANCE

Due to the age of the building, the finish coatings may contain lead-based paint, asbestos may be present in the plaster top coat. A professional evaluation should be conducted to determine the presence of any hazardous materials.

The building is in the CC zoning district. The building is located on or within 3’ of the property lines and adjacent buildings. The setbacks in the CC zoning district allow for 0’ side and front setbacks and a 25’ for rear setback.

STRUCTURE CONDITION ASSESSMENT

A detailed condition evaluation of the different building elements is summarized in the attached Rapid Visual Screening matrix. The existing condition and integrity of each element, feature, or space is evaluated as Good, Fair, or Poor Condition, and a recommendation is provided.

<u>Building Foundation/Crawlspace</u>

The visible sections of the foundation are composed of a combination of concrete, mortared rubble and mortared brick. It is presumed that portions of the foundation are simply wood framing resting directly on soil.

Significantly, much of the visible foundation is deteriorating due to poor construction methods compounded by flooding and water infiltration over the years. The crawlspace is a dug-out

portion in the center of the floor extending into a larger space in the rear third of the structure where some old mechanical equipment is located. The rear of the building appears to be a simple slab on grade in the kitchen.

Recommendations: The foundation is not likely reinforced and has experienced movement or may never have been level in the first place as evidenced by uneven floors and walls. It is anticipated that unless the foundation is adequately reinforced, it will continue to perform in this way and likely worsen. The building foundation should be replaced on the north and south sides of the building at a minimum, and careful consideration should be given to reinforce or rebuild the east foundation wall under the storefront façade along Main Street.

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Storefront Foundation

The front of the building is a false façade storefront and in the crawlspace on the north end of the storefront is a large Sonotube form filled with concrete. The storefront foundation on the east end of the building could not be directly observed, but it appears to be in better condition than the south and north sides of the building, however as evidenced by the cracking brick veneer it also has experienced movement. The Sonotube form filled with concrete on the northern portion of the existing storefront foundation is serving an unknown purpose.

Recommendations: Selective demolition should be performed to expose the rim and floor joists in this area for inspection. Repairs or rebuilding of the foundation wall, if required, should be part of future structural work.

Floor Construction

The floor framing consists of 2x joists spaced at approximately 16” centers over an inconsistent central timber beam supported by posts bearing on dirt or the occasional brick pad. Certain individual joists are sporadically supported by secondary posts. The rim board and the ends of the floor joists are sitting on the foundation and are severely rotted at each location. The crawlspace access hatch cut into the floor has unsupported edges around the opening. It was observed that significant portions of the area have floor joists touching or resting directly on the soil below.

The rear section of the building at the commercial kitchen has a concrete slab-on-grade floor construction. The concrete is uneven due to poor construction and is porous due to years of exposure to kitchen activities, food, and cleaning chemicals.

Recommendations: The structure at the floor level of the building has suffered due to poor construction combined with grading, drainage and moisture issues. It is recommended that the floor be re-built with modern construction materials resistant to decay and sufficient to meet the current load capacities based on occupancy. The grading issues which are creating water run off through the foundation should also be addressed. If the commercial kitchen is to remain, the floor should be covered in an appropriate floor covering material suitable for a kitchen space.

Roof Construction

The roof framing is of cut wood rafters (~2x4’s) spaced in excess of 24” centers. ¾” thick boards span over the roof rafters with gaps in between them (commonly called “skip sheathing”). Plywood sheathing was installed over the top of the skip sheathing during a more recent roofing replacement effort. 2x kickers were installed spuratically from the roof rafter to the ceiling rafters.

The roof framing appears to be undersized compared to current design codes but is typical for

a structure of this vintage. No ridge beam exists. The ceiling inside the space has significant undulation over the length of the inside space, which is likely due to the kickers supporting the roof rafters and the mechanical equipment installed in the attic space. There are occasional gable shaped walls placed at intervals running along the roof. These gable shaped walls have an older style of exterior siding attached to the framing. These attic walls seem to indicate that the building was enlarged early on over a few successive additions. For the most part, the roof structure bears on the north and south exterior walls which are made of wood studs (assumed to be 2x4 framing) that bear on a foundation. There is an air handler in the central attic space that is supported by the ceiling joists.

Recommendations: The roof framing appears to be performing adequately although the structural system, particularly the zone supporting the air handling unit, should be analyzed and reinforced as a part of any future structural work. There is no lateral force resisting system in the structure. Lateral forces from wind or seismic events must be addressed in future structural improvements. In order to support the work required to repair/replace the existing foundation, the roof will need to be reinforced, repaired and/or replaced prior to work on the foundation and floor system.

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Roofing

The main portion of the building's roofing is a 3-tab asphalt composite shingle (circa mid-late 1980's) and covers the gable and hip pitched roof areas with shingled valleys. The asphalt shingles are thin and show accumulated hail damage from years of weather exposure.

The low pitched roof toward the rear, western portion of the building over the kitchen area is a black rubber-type sheet membrane similar to an EPDM material. The membrane roof appears to be in decent condition and is newer than the other existing roofing. All penetrations are sealed with the membrane roof material.

Recommendations: The asphalt shingles should be replaced and step flashing should be installed at the east storefront wall and new flashing should be installed along the roof edges. There are multiple penetrations in the membrane roof and a number of pieces of mechanical equipment located on the low-pitched roof. The membrane roof should be inspected by a roofing contractor for hail damage and leaks.

Building Exterior Walls

The north and south exterior walls are made of wood studs (assumed to be 2x4 framing). The north exterior is covered in a steel siding that replicates wood lap siding on the south side. The north side is clad in a 4' wide wood-composite sheet product.

The wall studs are of sufficient size to carry the exterior loads, but it should be anticipated that some studs are likely suffering from wood rot at their bases. Both the north and the south walls are wavy, presumably due to the roof pushing outward on the top of the walls, giving the appearance of an undulating surface. It is also surmised that the building was constructed in variatious iterations from east to west, and at assumed addition locations the walls seem to be particularly out of plumb.

Recommendations: Distressed wall studs should be identified and repaired as part of any future structural work. There is no lateral force resisting system in the structure. Lateral forces from natural events must be addressed in future structural improvements. Recommendations for repairs and reinforcing to the roof structure is covered under the Roof Construction section of this document.

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Storefront Exterior Wall

The exterior storefront wall on the east side of the building is comprised of wood studs (assumed to be 2x4 framing) and is covered in wood lap siding. A brick veneer covers the gaps between the 809 Main building and adjacent buildings.

The wall structure appears to be in good condition. The lap siding appears to be the original building siding and shows normal wear-and-tear for a building of this age. The back side of the storefront wall is clad in painted plywood siding and shows signs of distress and peeling paint. The brick veneer has significant cracks in multiple locations.

Recommendations include: The wood siding should be repaired or replaced depending on the condition and location on the wall and properly sealed at all edges. The back side of the wall should be replaced with a similar and more durable product (i.e. painted cement board) with proper sealing. The brick veneer is not original to the building and should be removed as a part of the landmarking process and restored to its original condition based on historical photos.

Exterior Windows

The windows at 809 Main are constructed from welded steel frames and single-pane glass. Window units are constructed to bi-fold open to the interior and side walls of the building. The windows do not contain any weatherstripping and display gaps between sashes allowing air infiltration.

Recommendations include: Replace windows with historic replications.

Exterior Doors

The painted front door is wood with D-pull style hardware. The rear door is a painted wood half-lite double door. Both doors are showing deterioration due to use. Gaps are forming between the stile and rails on each door. The painted surfaces are cracked and peeling. The weatherstripping is not adequate on either door. The doors both swing over a step up threshold and are not code compliant.

Recommendations include: Replace both doors, including hardware, thresholds and weatherstripping.

Porches

To the west, the building has a paver patio with a paver ramp leading toward the alley. The patio is covered by an open wood trellis structure. The pavers and paver surface is generally in good shape. The ramp provides the only means of access and egress to the building for occupants. The wood trellis appears to be in good condition despite natural weathering due to being unfinished.

Recommendations include: Pavers should be further inspected for compliance with adopted building codes for accessibility. A handrail should be installed at the ramp and the pathway and door design should be further studied to comply with accessibility.

Window and Door Trim

All trim is in varying states of deterioration. Most locations need to be scraped, repaired and refinished.

Recommendations include: Scrape existing paint to bare wood where possible, repair wood and refinish with appropriate sealing around the edges.

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Storefront Trim and Ornamentation
The cornice is constructed of 2x framing material and overhangs the front and sides of the storefront façade wall. The fascia is 1x6 square profile, painted wood. The soffit is a painted plywood material. The cornice is uneven and sagging due to poor construction techniques. The cornice appears to have inadequate roofing or no roofing material on top of the flat portion and there is no drip edge flashing around the perimeter. The cornice slopes toward the front of the storefront wall in some locations. The fascia is in varying states of deterioration and needs to be scraped, repaired and refinished.

2x or 3x wood dentils are located below the overhanging cornice on the east side of the storefront wall. The corner of the storefront wall are trimmed out in 1x6 painted wood material. All of the decorative trim is in varying states of deterioration. Most locations need to be scraped, repaired and refinished.

Recommendations: Reinforce or rebuild the cornice to be adequately supported and sloped toward the rear. Install appropriate flashing and roofing over the top of the cornice. Scrape the existing paint on the fascia and decorative trim to bare wood where possible, repair the wood and refinish with appropriate sealing around the edges. Replace the plywood soffit.

Building Soffits:
Painted plywood soffits run the length of the building under the overhangs on the north and south sides. The soffit material is uneven with gaps between boards due to poor construction techniques and building movement.

Recommendations: Soffit material should be replaced after an effort is made to shore up and refinish the roof structure.

Gutters & Downspouts:
Gutters and downspouts are non-existant.

Recommendations: Install gutters and downspouts along the north and south sides of the building.

Site Drainage: The crawlspace appears to have had frequent water exposure and/or flooding.

Recommendations: The grading and drainage plan should be revised to eliminate water from going into the crawlspace.

Mechanical, Electrical, Plumbing

Mechanical: The building has a forced air system with a furnace unit and duct work located in the attic. The condensing unit is located on the roof. The kitchen exhaust hood and make-up air unit is located on the roof. The furnace and air condensing unit appear to be newer and appear to be in good condition. The make-up air unit and hood appear to be very old and in questionable condition.

Recommendations: Verify that the existing HVAC equipment can handle the appropriate amount of fresh air ventilation and heating/cooling loads. Replace the make-up air unit. Verify that the exhaust hood and ansul system are working properly.

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Electrical: The service panel for the building is located on the west side (rear) facing the patio. Electrical service size was unable to be observed. The service panel is fed with overhead lines from the alley.

Recommendations: Electrical service will be required to be run underground with any significant changes to the building or service upgrade, as required by the City of Loisville Municipal Code.

Plumbing: A combination of copper and PEX tubing make up the water delivery system. The waste lines are a combination of plastic and PVC piping. The water main enters the building from Main Street. Waste water leaves the building towards the alley. The grease interceptor is located inside a closet space on the north side of the building. The grease interceptor appears to be quite old and requires servicing.

Recommendations: The grease interceptor should be serviced. Verify the condition, size and capacity of the existing system.

Zoning and Building Codes

Zoning: The building is in the CC zoning district. The building is located on or within 3' of the property lines and adjacent buildings. The setbacks in the CC zoning district allow for 0' side and front setbacks and 25' for rear' setbacks. The newer structure enclosing the exterior walk-in cooler along the alley may be in conflict with the rear setback.

Recommendations: No recommendations at this time. Changes to the rear structure may not be allowed unless redesigned to comply with rear setbacks.

Building Code: The building does not have an automatic fire suppression system or fire alarm. The building is located within 5' of the adjacent structures and is located at or very near the dividing property side property lines. The building is constructed of wood frame construction and wood siding. There are no fire resistant materials used to protect the building or adjacent buildings from a fire. The adjacent building to the north has unprotected windows facing 809 Main.

Recommendations: Install an automatic fire suppression system and alarm system. The Louisville Fire Department will require a new automatic fire suppression system and fire alarm system if there are any changes to the building where the total area meets or exceeds 5,000 sq. ft. If the building is re-clad with new siding, fascia and soffit, fire resistant materials and construction assemblies will be required per current model building codes.

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East Elevation

North Elevation

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South Elevation

West Elevation

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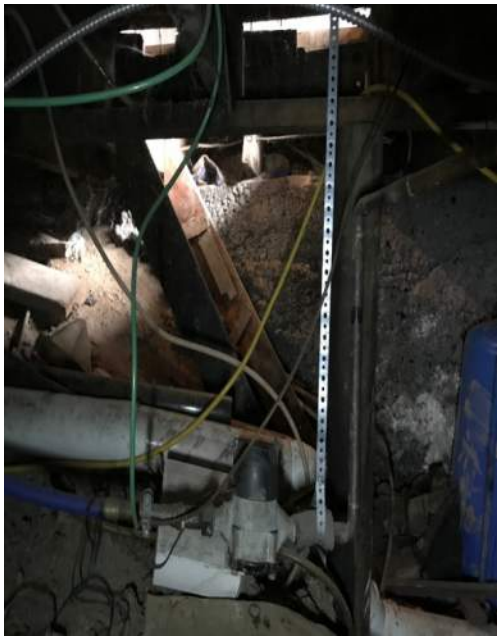

Foundation at crawlspace entry

Foundation towards west (rear) of building

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Attic with roof framing

Asphalt shingles

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Membrane roof with penetrations

Trellis detail over patio from above

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Detail of north exterior wall

Detail of south exterior wall

Storefront façade

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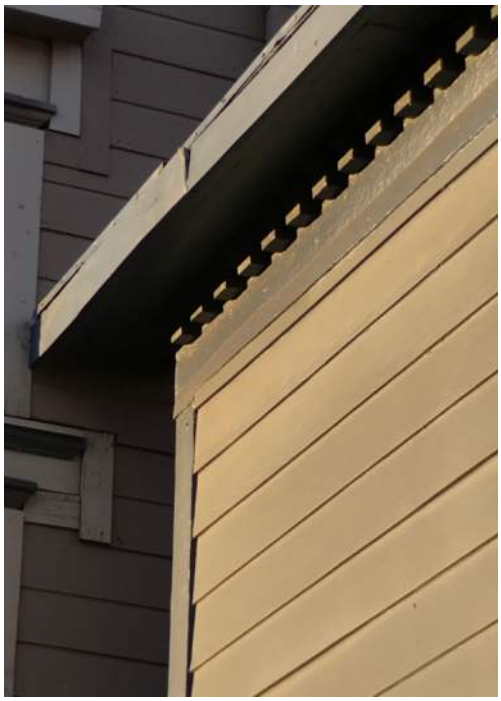
Exterior window and door detail



South façade cornice detail

North façade cornice detail

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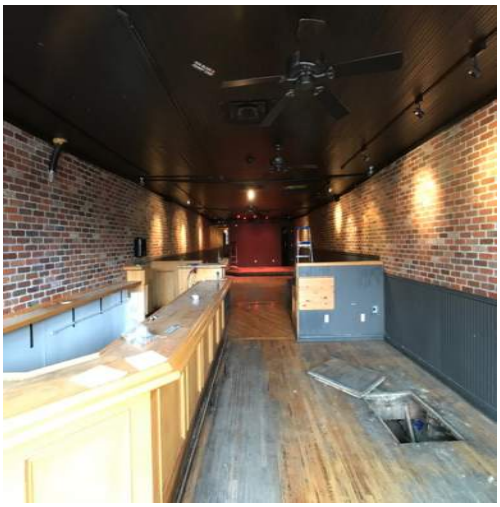
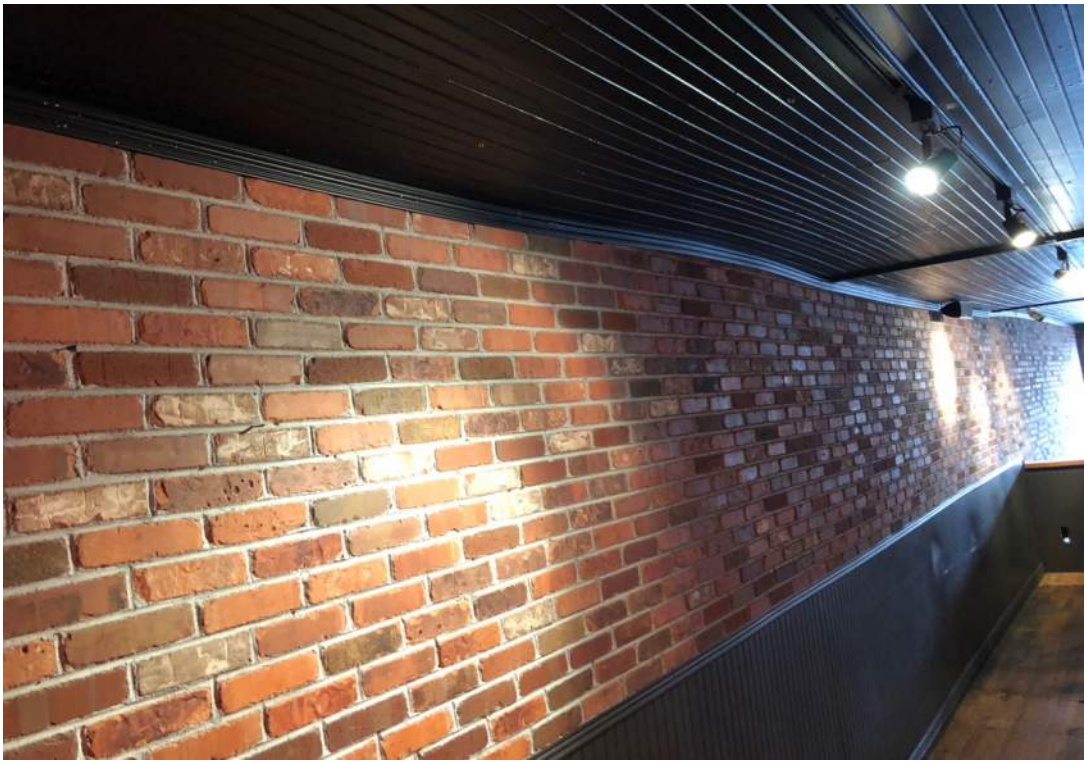


Interior detail of original building

Concrete slab at kitchen addition



Detail of wall movement

BUILDING COMPONENT	REVIEWER	COMPONENTS (DESCRIPTION)	OBSERVATIONS	CONDITION				EXPECTED LIFE SPAN (YEARS)			CATEGORY (ISSUES)			RECOMMENDATIONS	APPROXIMATE COST
				A	B	C	D	NOW	5 TO 10	20 TO 25	CODE	REPAIR / MAINT.	OTHER		
SUBSTRUCTURE															
Foundation / Basement															
Building Foundation	Ascent	Visible portions foundation are composed of a combination of concrete, mortared rubble and mortared brick. It is presumed that portions of the foundation is the wood framing resting on soil.	Significant portions of the visible foundation are deteriorating due to poor construction methods and deterioration due to flooding and water and infiltration. The crawlspace is a dug-out portion in the center of the floor extending into a larger space in the rear 1/3 of the structure where some old mechanical equipment is located. The rear of the building appears to be a concrete slab on grade in the kitchen.				D	X			X	X		The foundation is not likely reinforced and has experienced movement or was never level to begin with as demonstrated by uneven floors and walls. It should be anticipated that unless it is adequately reinforced, it will continue to perform this way. The building foundation needs to be replaced on the north and south sides of the building at a minimum.	$75,000 - $100,00 for replacement of foundation.
Storefront Foundation	Ascent	The front of the building is a "false-façade" storefront and in the crawlspace on the north end of the storefront is a large Sonotube form filled with concrete.	The store front on the east end of the building could not be directly observed, but it appears to be in better condition than the south and north sides of the building. The Sonotube form filled with concrete is serving an unknown purpose.				D	X				X		Select demolition should occur to expose the rim and floor joists in this area for inspection. Repairs, if required, should be part of future structural work.	$800 for testing; approx. cost to replace foundation includes area under storefront
Floor Construction															
Floor Joists	Ascent	The floor framing consists of 2x joists spaced at approximately 16” centers over an inconsistent central timber beam supported by posts bearing on dirt or the occasional brick pad. Certain individual joists are sporadically supported by secondary posts.	Certain individual joists are sporadically supported by secondary posts. The rim board and the ends of the floor joists are sitting on the foundation and severely rotted at each location. The crawlspace access hatch cut into the floor has unsupported edges around the opening. It was observed that significant portions of area have floor joists touching or resting on the soil below.				D	X			X	X		The structure at the floor level of the building has suffered due to poorly constructed details combined with grading, drainage and moisture issues. It is recommended that the floor be re-built with new modern construction materials resistant to decay and adequate to meet current load capacities based on occupancy; and, the grading issues should be addressed.	$75,000
Slab-on-grade	DAJ	The rear portion of the building at the commercial kitchen has a concrete slab-on-grade floor construciton.	Concrete is uneven due to poor construction and pourous due to years of exposure to kitchen activities and food.			C			X					If commercial kitchen is remain, the floor should be covered in an appropriate floor covering material suitable for a kitchen space.	$5,000
SHELL															
Roof Construction															
Roof framing	Ascent	The roof framing is framed of cut wood roof rafters spaced in excess of 24” centers. ¾” thick boards span over the roof rafters with gaps in between them (Commonly called “Skip Sheathing”). Plywood sheathing was installed over the top of the skip sheathing. 2x kickers were occasionally installed from the roof rafter to the ceiling rafters.	The roof framing appears to be under-sized compared to current design codes, but is typical for a structure of this vintage. No ridge beam exists. There are occasional gable shaped walls placed at intervals running along the roof and have exterior siding attached to the framing. For the most part, the roof structure bears on the North and South exterior walls which are made of wood studs (Assumed to be 2x4 framing) that bear on a foundation. There is an air handler in the central attic space, supported by the ceiling joists.			C			X		X			The roof framing appears to be performing adequately, however, the structural system, particularly the zone supporting the air handling unit should be analyzed and reinforced as a part of future structural work. There is no lateral force resisting system in the structure. Lateral forces from wind or seismic events must be addressed in future structural improvements. In order to support the work required to repair/replace the existing foundation, the roof will need to be reinforced, repaired, and/or replaced prior to work on the foundation and floor system.	$50,000 to reinforce, repair and/or replace the roof framing.
Roofing															

Asphal shingles	DAJ	Asphalt composite 3-tab shingles over all the gable and hip pitched roof areas with shingled valleys.	Asphalt shingles are thin and show accumulated hail damage from years of weather exposure.			C			X			X		Roof should be replaced and step flashing should be installed at the east storefront wall.	$18,000
Membrane roofing	DAJ	The low pitched roof toward the west, rear side of the building over the kitchen area is a black rubber-type sheet membrane.	Membrane roof appears to be in decent shape and newer than other existing roofing. All penetrations are sealed with the membrane roof.		B				X			X		There are multiple penetrations and a number of pieces of mechanical equipment located on the low-pitched roof. The roof should be inspected by a roofing contractor for hail damage and leaks.	$0
Exterior Walls															
Walls	Ascent	The North and South exterior walls are made of wood studs (assumed to be 2x4 framing). The exterior is covered in a steel siding replicating wood lap siding on the south side, and the north side is clad in 4' wide wood-composite sheet product.	The wall studs are of sufficient size to carry the exterior loads, but it should be anticipated that some studs are likely suffering from wood rot at their bases. Both north and south walls are wavy presumably due to the roof pushing outward on the top of the walls giving the appearance of an undulating surface.			C			X			X		Distressed walls studs should be identified and repaired as a part of future structural work. There is no lateral force resisting system in the structure. Lateral forces from wind or seismic events must be addressed in future structural improvements.	$0-25,000
Storefront wall	DAJ	The exterior storefront wall on the east side of the building is made of wood studs (assumed to be 2x4 framing), and is covered in wood lap siding. Brick veneer covers the gaps between the 809 Main building and adjacent buildings.	The wall structure appears to be in good shape. The lap siding appears to be the original building siding, and shows normal wear-and-tear for a building of this age. The back side of the storefront wall is clad in painted plywood siding showing signs of distress and peeling paint. Brick veneer has significant cracks in multiple locations.			C			X			X		Wood siding should be repaired or replaced depending on condition and location on the wall with proper sealing at all edges. The back side of the wall should be repaced with a similar and more durable product (i.e. painted cement board) with proper sealing. The brick veneer is not original to the building and should be removed as a part of the Landmarking process and restored to its original condition based on historical photos.	$15,000
Exterior Windows															
Windows	DAJ	Windows are constructed from welded steel frames and single-pane glass. Window units are constructed to bi-fold open to the interior and side walls of the building.	Windows do not contain any weatherstripping and display gaps between sashes allowing air infiltration.		B				X			X		Windows should be replaced with historic replications.	$12,000
Exterior Doors															
Front door	DAJ	Painted wood door with D-pull style hardware.	Wood door is showing deterioration due to use. Gaps are forming between the stile and rails. Paint is cracked and peeling. Weatherstripping is inadequate. Door swings over a step up the threshold and is not code compliant.			C		X			X	X		Replace door, including hardware, threshold and weatherstripping.	$1,500
Rear door	DAJ	Painted wood half-lite double door	Wood door is showing deterioration due to use. Gaps are forming between the stile and rails. Paint is cracked and peeling. Weatherstipping is inadequate. Door swings over a step up the threshold and is not code compliant.		B				X			X		Replace door, including hardware, threshold and weatherstripping.	$1,500
Roof Openings															
No roof openings.	DAJ	None.	None.											None.	$0
Porches															

Rear patio	DAJ	Paver patio with paver ramp leading west (to the rear) toward the alley level elevation covered by an open wood trellis structure.	Pavers and paver surface is generally in good shape. Ramp provides the only accessible means of access and egress to the building for occupants. A handrail is missing at the ramp. Wood trellis seems to be in good shape despite natural weathering due to being unfinished.		B				X		X	X		Pavers should be further inspected for compliance with adopted building codes for accessibility. A handrail should be installed at the ramp, and pathway and door design should be studied to comply with accessibility.	$2,500
Exterior Trim & Ornamentation														
Window & door trim	DAJ		All trim is in varying states of deterioration. Most locations need to be scraped, repaired and refinished.			C		X				X		Scrape existing paint to bare wood where possible, repair wood, and refinish with appropriate sealing around the edges.	$1,500
Cornice	DAJ	Cornice is constructed of 2x framing material and overhangs the front and sides of the storefront façade wall. The fascia is 1x6 square profile, painted wood. The soffit is a painted plywood material.	The cornice is uneven and sagging due to poor construction techniques. Cornice appears to have inadequate roofing or no roofing material on top of the flat portion, and there is not drip edge flashing around the perimeter. Cornice is slopeing toward the front of the storefront wall in some locations. Facia is in varying states of deterioration, and needs to be scraped, repaired and refinished.			C		X				X		Reinforce or rebuild cornice to be adequately supported sloped toward the rear. Install appropriate flashing and roofing over top of cornice. Scrape existing fascia paint to bare wood where possible, repair wood, and refinish. Replace plywood soffit.	$3,000
Soffits	DAJ	Painted plywood soffits run the length of the building under the overhangs on the north and south sides. See "Cornice" above for info on storefront soffit material.	Soffit material is uneven with gaps between boards due to poor construction techniques and building movement.				D	X				X		Soffit material should be replaced after an effort is made to shore up the roof structure and refinish.	$2,000 (soffits only)
Ornamentation	DAJ	2x or 3x wood dentils are located below the overhanging cornice on the east side of the storefront wall. Corners of storefront wall are trimmed out in 1x6 painted wood material.	All trim is in varying states of deterioration. Most locations need to be scrapped, repaired and refinished.											Scrape existing paint to bare wood where possible, repair or replace wood, and refinish with appropriate sealing around the edges.	$2,500
Other														
Gutters	DAJ	Gutters are non-existant.	Gutters are non-existant.				D	X			X			Install gutters along the north and south sides of the building.	$3,000
Downspouts	DAJ	Downpouts are non-existant.	Downpouts are non-existant.				D	X			X			Install downspouts along the north and south sides of the building.	(see above)
SITE															
Site Drainage														
Grading	DAJ													The crawlspace appears to have had frequent water exposure and/or flooding. The site and drainage should be revised to eliminate water from going into the crawl-space.	
MECHANICAL, ELECTRICIAL, PLUMBING															
Mechanical	DAJ	Forced air system with furnace unit and duct work located in the attic and the condensing unit is located on the roof. Kitchen exhaust hood and make-up air unit is located on the roof.	Furnace and air condensing unit appear to be newer and in good condition. The makeup air unit and hood appear to be quite old.			C			X		X	X		Verify that existing HVAC equipment can handle the appropriate amount fresh air ventilation and heating/cooling loads. Replace the makeup air unit. Verify that the exhaust hood and ansul system is working appropriately.	$10,000
Electrical	DAJ	Service panel for building is located on the west side (rear) facing the patio. Electrical service size was unable to be observed.	Service panel is fed with overhead lines from the alley.		B				X		X			Electrical service will be required to be run underground with any significant changes to the building or service upgrade, as required by the City of Louisville Municipal Code.	$8,000-$15,000

Plumbing	DAJ	Combination of copper and PEX tubing for water deliver system. Waste lines are a combination of plastic and PVC lines. Water main enters the building from Main Street. Waste water leaves the building toward the alley. Grease interceptor is located inside in a closet space on the north side of the building.	Grease interceptor appears to be quite old, and requires servicing.			C			X			X		Grease interceptor should be serviced. Verify condition, size, and capacity of existing system.	$500
ZONING & BUILDING CODES															
Zoning															
		The building is in the CC zoning district.	Building is located on or with 3' of property lines and adjacent buildings. The setbacks in the CC zoning district allows for 0' side and front setbacks, and 25' rear setbacks. Newer structure enclosing the exterior walk-in cooler along the alley may be in conflict with the rear setback.		B					X	X			No recommendations. Changes to the rear structure may not be allowed unless redesigned to comply with rear setbacks.	$0
Building Code															
		The building does not have an automatic fire suppression system or fire alarm. The building located within 5' of the adjacent structures, and is located at or very near the dividing property side property lines.	The building is constructed from wood frame construction and wood siding. There are no fire resistant materials used to protect the building or adjacent buildings from a fire. The adjacent building to the north has unprotected windows facing 809 Main.				D	X			X			Install an automatic fire supression system and fire alarm system. Any changes to the building where the total area meets or exceeds 5,000 sq. ft., the Louisville Fire Department will require a new automatic fire supression system and fire alarm system. If building is re-clad with new siding, fascia, and soffit, fire resistant materials and construction assemblies will be required per current model building codes.	$30,000

NOTES:
Estimated costs assume no lead or aesbestos present, unless noted.
Lead testing is noted for every space that includes a potential source of lead paint. A series of 3 tests, one for each of the sources of old paint (windows, doors, siding, trim), would likely provide all the testing needed for the entire project.

ASCENT group
STRUCTURAL ENGINEERING

Boulder
Denver
Winter Park

October 19, 2018

Andy Johnson
DAJ Design
Andy Johnson
922A Main Street
Louisville, CO 80027

Reference: Ascent Job# 2018-0321: 809 Main Historic Assessment

Dear Mr. Johnson,

At your request, our firm visited the structure referenced above in Louisville, CO to observe the existing condition of the structure.

Structural Description:

The structure is a long narrow storefront type commercial building originally built around 1900 and an addition was added to the back of the original structure approximately in the '60's. The storefront is on the narrow dimension of the building. The roof framing is framed of cut wood roof rafters spaced in excess of 24" centers. ¾" thick boards span over the roof rafters with gaps in between them (Commonly called "Skip Sheathing") There is an air handler in the central attic space, supported by the ceiling joists. For the most part, the roof structure bears on the North and South exterior walls which are made of wood studs (Assumed to be 2x4 framing) that bear on a foundation composed of a combination of concrete, mortared rubble and mortared brick. The floor framing consists of 2x joists spaced at approximately 16" centers over an inconsistent central timber beam supported by posts bearing on dirt or the occasional brick. Certain individual joists are sporadically supported by secondary posts. The front of the building is a storefront and in the crawlspace on the north end of the storefront is a large sono-tube form filled with concrete serving an unknown purpose. The crawlspace is a dug-out portion in the center of the floor extending into a larger space in the rear 1/3 of the structure where some old mechanical equipment is located. The rear of the building appears to be a concrete slab on grade in the kitchen. There is an accessory garage type structure recently built at the rear of the property.

Structural Condition:

The roof framing appears to be under-sized compared to current design codes, but is typical for a structure of this vintage. The roof framing appears to be performing adequately, however, the structural system, particularly the zone supporting the air handling unit should be analyzed and reinforced as a part of future structural work.

The wall studs are of sufficient size to carry the exterior loads, but it should be anticipated that some studs are likely suffering from wood rot at their bases. These should be identified and repaired as a part of future structural work.

The rim board and the ends of the floor joists are sitting on the foundation and severely rotted at each location observed by our firm. This framing supports the structure above. This compromises the integrity of the building and should be addressed. The logistics of repairing this rim may be difficult, but we recommend it be addressed before the building is occupied again.

The store front on the east end of the building could not be directly observed by our firm, but it appears to be in better condition than the east and west sides of the building. That being said, select demolition should occur to expose the rim and floor joists in this area for inspection. Repairs, if required, should be part of future structural work.

The floor joists should be analyzed and reinforced as required for the live load of the next occupant. The support beam in the middle, along with the posts and foundation (Or lack thereof of) is not adequate and should be replaced. The joists supported by sporadic posts bearing on grade or blocks shall be replaced or reinforced The floor sheathing near the existing bar to the north of the floor sink is rotted and must be replaced. The ends of the joists in direct contact with the foundation are experiencing rot and should be repaired or replaced.

The crawlspace appears to have had frequent water exposure and/or flooding. The site and drainage should be revised to eliminate water from going into the crawl-space.

There is no lateral force resisting system in the structure. Lateral forces from wind or seismic events must be addressed in future structural improvements.

The foundation is not likely reinforced and has experienced movement or was never level to begin with as demonstrated by uneven floors and walls. It should be anticipated that unless it is adequately reinforced, it will continue to perform this way.

Summary:

The structure at the floor level of the building has suffered due to poorly constructed details combined with grading, drainage and moisture issues. Our firm recommends this be re-built with new modern construction materials resistant to decay and the grading issues should be addressed. Unfortunately, the logistics of this makes keeping the roof and wall structures a burdensome task.

Please feel free to contact our office if you have any questions or if we may be of any further assistance regarding these matters.

Sincerely,

Matthew K. Berry, PE
Principal

October 31, 2017

TEBO Properties
3111 28th Street
Boulder, Colorado 80301

Attn: Trever Townsend, Project Manager
P: [303] 447 8326
E: ttownsend@teboproperties.com

RE: Geotechnical Engineering Report
Waterloo Building Underpinning Feasibility
809 Main Street
Louisville, Colorado
Terracon Project No. 22175105

Mr. Townsend:

As requested, Terracon Consultants, Inc. (Terracon) has completed geotechnical engineering services for the Waterloo Building underpinning feasibility study located at 809 Main Street in Louisville, Colorado. This study was performed in general accordance with our proposal number P22175102 dated September 25, 2017.

Our geotechnical services were implemented by drilling one (1) exploratory test boring, designated TB-1, and obtaining relatively undisturbed samples for further laboratory evaluation and testing. Due to underground/overhead utility conflicts and other access issues, only one boring could be completed for this study. The boring drilled was located as close as practical to the Waterloo building. The test boring was completed on October 14, 2017 and was drilled and sampled to a depth of about 50 feet below existing ground surface. The Boring Log, laboratory test results and Boring Location Plan and vicinity map are included at the end of this report.

The purpose of these services is to determine the general subsurface profile, evaluate the pertinent geotechnical conditions and provide our opinions and/or recommendations regarding underpinning existing building foundations.

The opinions and/or recommendations contained in this report are based on the results of field and laboratory testing from the boring drilled at the indicated location, engineering analyses, experience with similar soil/bedrock conditions and structures, and our understanding of the proposed project.

PROJECT INFORMATION

Site Location

Item	Description
Location	The project site is located at 809 Main Street in Louisville, Colorado. The lot encompasses around 3,000 square feet. The general location of the project site is 39.9780° N 105.1324° W.
Existing improvements/site features	The property is occupied by an historic building which covers the vast majority of the lot. We believe the building was constructed sometime in the early 1900's. The building is a single-story wood frame structure with a crawl space below. There is a boiler pit in the crawl space area that reportedly contains ponded water. Information provided by the Client indicates the building is supported on a "stacked-stone" foundation. Existing buildings directly abut (zero lot-lines) the north and south sides of the site. The building to the south (801 Main Street) has a basement level. It is unknown whether the building to the north has a slab-on-grade floor, crawl space or basement level. Main Street is located to the east and a paved alley with underground and overhead utilities borders the west side of the site.
Current ground cover	Ground cover surrounding the building consists primarily of concrete flatwork and/or asphalt or concrete pavement.
Existing topography	Relatively uniform and with an apparent gentle slope down to the south and east.

Project Description

Item	Description
Background information	We understand the building has experienced some foundation movement and distress in the past. It is desired to determine the general subsurface conditions and pertinent engineering properties of the soil/bedrock in order to evaluate the feasibility of underpinning existing foundations. We understand underpinning of the structure would involve construction of reinforced concrete "sister walls" adjacent to and on the inside of the existing stone walls.
Underpinning foundation loads	■ **Point Loads**: 15 to 30 kips (assumed) ■ **Line Loads**: 1 to 2½ klf (assumed)

If project information varies from those described above, or if we have misunderstood any aspect of the project, we should be contacted as soon as possible to confirm and/or modify our opinions/recommendations accordingly.

SUBSURFACE CONDITIONS

Geology

Surficial geologic conditions mapped in the vicinity of the site ([1]Colton, 1978), include Eolium (Qe) which has been described as light-brown to reddish-brown windblown clay, silt and sand. Bedrock mapped in the vicinity of the site ([2]Spencer, 1961), includes the Laramie Formation (Kl). The upper part of the bedrock formation in the area has been reported to consist predominately of claystone, shale, sandy shale and scattered lenticular beds of sandstone and lignite. The Laramie Formation contains major coal beds and has been an important source for underground mining of coal in the past.

As mentioned previously, the Laramie Formation has been mined extensively in the Boulder-Weld coal field area. Review of the *Boulder County Subsidence Investigation* maps ([3]Dames & Moore, 1986) indicates the Acme Mine is located below the subject site. The investigation indicates the subject site is located in a zone of “Moderate” potential for future subsidence. However, detailed evaluation of subsidence potential is beyond the scope of this report. If the owner is concerned about the potential for subsidence, we suggest an engineer/geologist experienced with these issues be consulted to determine whether other studies should be undertaken and/or further evaluation is warranted.

Mapping completed by the Colorado Geological Survey ([4]Hart, 1972), indicates the site is situated in areas of "Moderate Swell Potential" and/or "Windblown Sand, Silt, or Clay". The windblown materials have been described as having low swell potential and may be subject to settlement or compression when water is allowed to saturate the deposits. Potentially expansive materials mapped in this area include bedrock, weathered bedrock and colluvium (surficial units). Site specific swell testing conducted for this study indicates the native sandy lean clays have nil to low swell potential at in-place moisture content and density. The claystone bedrock is probably expansive, but is located at depths (about 36 to 38 feet) unlikely to affect shallow construction or other improvements.

The geologic conditions presented in this section were obtained by locating the subject site on available large-scale geologic maps. Because of the scales involved, precise location of the site can be difficult to determine. In addition, the large-scale geologic maps describe only general

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[1]Colton, Roger B., 1978 ***Geologic Map of the Boulder-Fort Collins-Greeley Area, Colorado,*** United States Geological Survey, Map I-855-G.

[2]Spencer, Frank D., 1961 ***Bedrock Geology of the Louisville Quadrangle, Colorado,*** United States Geological Survey, Map GQ-151.

[3]Dames & Moore, 1986, ***Boulder County Subsidence Investigation*.**

[4]Hart, Stephen S., 1972, ***Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado***, Colorado Geological Survey, Environmental Geology No. 7.

trends. Local variations are possible and site specific geology may differ from those described above.

Typical Soil Profile

Based on the results of the boring, subsurface conditions can be generalized as follows:

Approximate Depth to Bottom of Stratum	Material Encountered	Consistency or Relative Density/ Hardness	General Engineering Properties
About 4 inches	Concrete pavement	N/A	N/A
About 7 feet	**Existing Fill:** Sandy lean clay	Very soft to medium stiff	Judged to have low swell potential and moderate to high compressibility, low load bearing capacity
About 23 feet	Sandy lean clay	Very stiff	Nil to low swell potential, low compressibility (settlement potential) under light loads, moderate load bearing capacity
About 36 feet	Interlayered or alternating layers of sand with gravel, sandy clay/clayey sand and silty, clayey sand, occasional cobbles	**Sands:** Loose to very dense **Clays:** Stiff	Negligible to low swell potential, low to moderate load bearing capacity
Extended to bottom of boring	Claystone bedrock	Highly weathered to very hard	Judged to be expansive, moderate to comparatively high load bearing capacity

Subsurface conditions encountered at the boring location are indicated on the individual boring log. Stratification boundaries on the boring log represent the approximate location of changes in soil/bedrock types; in-situ, the transition between materials may be gradual. Details for the boring can be found on the boring log at the end of this report.

Laboratory Test Results

The laboratory testing program was designed to provide index and/or engineering properties for those soils which influence foundation design and performance. The soil samples tested for this study have the following physical and/or engineering properties:

Boring No.	Depth (ft.)	Silt and Clay Content (%)	Liquid Limit (%)	Plasticity Index (%)	Expansion/Compression (%/Surcharge Load, psf)	Unconfined Compressive Strength (psf)
TB-1	9	57	32	16	+0.2/500	4,790
TB-1	14				+0.1/500	6,180
TB-1	19					6,390

Groundwater

The borehole was observed while drilling and after completion for the presence and level of groundwater. In the interest of safety, the boring was backfilled and patched with grout shortly after completion of drilling and therefore a delayed water level measurement was not obtained. The water level observed in the borehole is noted on the attached boring log, and is summarized below:

Boring Number	Depth to groundwater while drilling, ft.	Depth to groundwater shortly after completion of drilling, ft.
TB-1	28	24½

These observations represent short-term groundwater conditions at the time of and shortly after the field exploration, and may not be indicative of other times, or at other locations. Groundwater levels can and should be expected to fluctuate with varying seasonal and weather conditions, irrigation demands on or adjacent to the site and with fluctuations in nearby water features. Therefore, groundwater levels at other times in the future may be higher or lower than the level indicated on the boring log.

Our experience indicates surface water from precipitation, snowmelt and surface irrigation frequently flows through relatively permeable backfill adjacent to buildings and collects on the surface of less permeable soils occurring at the bottom of crawl space excavations resulting in perched water. Utility trenches that penetrate into and/or beneath buildings are also a common source of water infiltration and migration that could result in development of perched water.

Fluctuations in groundwater/perched water levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time.

DISCUSSION AND OPINIONS/RECOMMENDATIONS

Foundation Underpinning

As mentioned above, the Waterloo building is a single-story wood frame structure with a crawl space below. Existing buildings directly abut (zero lot-lines) the north and south sides of the site. The building to the south (801 Main Street) has a basement level. We estimate the basement is about 8 to 10 feet deep. It is unknown whether the building to the north has a slab-on-grade floor, crawl space or basement level. To avoid surcharge loading on adjacent basement/foundation walls and to mitigate the effects of foundation interaction and stress overlap between the Waterloo building foundations and adjacent building foundations, we believe the use of helical piles or micropiles (deep foundation elements) bearing well below existing foundations are appropriate for underpinning support.

Helical pile and micropile foundation elements are usually part of the foundation contractor's design-build system. Therefore, the Boring Log and subsurface exploration information contained in this report should be provided to the specialty foundation contractors for detailed analysis and design and cost information. Design and construction considerations/recommendations for helical piles and micropiles are presented in the following sections.

Helical Pile Design Considerations

Based on review of the subsurface conditions encountered in the test boring, it is our opinion helical piles could be considered for underpinning support depending upon structural loading conditions (both axial and lateral) and other factors. However, sands and gravels with cobbles are present on this site and these conditions will likely result in pile installation difficulties or could preclude the use of this foundation option.

An experienced helical pile contractor should be consulted to review the Boring Log to evaluate the feasibility of this foundation system and whether heavy-duty equipment and/or pre-drilling pilot holes will be required for installation. It may be prudent to have the helical pile installer 'test install' some piles at the site to evaluate the feasibility of this foundation system.

Description	Pile Design Parameter
Bearing stratum	Very stiff clays, medium dense sands or claystone bedrock
Minimum pile length [1,2]	15 feet or should be at least six (6) helix diameters (based on the largest helix diameter) deeper than the elevation of adjacent foundations, whichever is greater
Allowable capacity [2,3]	By others

1. Actual pile length will be dependent on final grades, structural loads, diameter and number of helixes selected for the lead-section of the pile, actual subsurface conditions at the pile location and other factors. Our experience indicates multi-helix lead-sections will likely be needed to achieve design

capacity, while keeping piles to a reasonable length.

2. Design capacity and length of the helical piles should be determined by a specialty design-build contractor experienced in the design and installation of helical piles. The pile capacity should be evaluated through a combination of typical bearing capacity analysis and results of field/load tests correlated to helical pile installation torque.
3. Helical piles should have a center-to-center spacing of at least four times the largest helical bearing plate diameter when designing for vertical loading conditions, or they should be evaluated and designed as a group.

We do not recommend using vertically installed helical piles to resist lateral loads without approved lateral load test data, since these types of foundations are typically designed to resist axial loads (compression and tension loads). Helical piles installed at a batter may be used to resist lateral loads. Typically, helical piles can be installed to a batter of up to 45 degrees from the horizontal. Only the horizontal component of the allowable axial load should be considered to resist lateral loading and only in the direction of the batter.

The actual design of the piles including the pile capacity, spacing, helix diameter(s), shaft length, bracket attachment and configuration, and shaft diameter should be performed by an experienced helical pile contractor and/or structural engineer. An experienced helical pile contractor should review the data from this report to assess the equipment and pile configuration required to achieve the minimum capacity.

Helical Pile Construction Considerations

The construction/installation of production and/or test helical piles should be observed by a representative of Terracon on a full-time basis in order to identify the appropriate bearing strata, observe the construction/installation methods being used and to verify the specified torque has been achieved during pile installation.

Micropile Design Considerations

Description	Micropile Design Parameter
Pile bearing stratum	Claystone bedrock
Minimum bedrock penetration	8 feet
Minimum micropile diameter	6 inches
Suggested grout-to-ground skin friction/bond strength [2]	Ultimate bond strength of 5,000 psf in claystone bedrock and a service load factor of 2.5 (i.e. = 2,000 psf allowable)

1. Micropiles should be designed and installed in general accordance with Case I, Type A requirements as specified in United States Department of Transportation publication number FHWA-SA-97-070.
2. Values of grout-to-ground bond strength are variable and dependent on the contractor's drilling and grouting techniques. The specialty design/build contractor, once selected, should provide the grout-

to-ground bond strength for this project.

3. Micropiles should be reinforced their entire length with a single bar. The area of reinforcing steel should be sufficient to withstand axial compressive loads on the micropile and tension due to uplift.
4. Micropiles should have a center-to-center spacing of at least three times the diameter when designing for vertical loading conditions, or they should be evaluated and designed as a group.

Micropile Construction Considerations

Groundwater and caving sand/gravel soils are present above the claystone bedrock on this site and may be problematic during installation. Sacrificial casing will be required to properly construct micropiles. Grout-to-ground interface bond should be neglected where casing is used within the bedrock.

Drilling methods should be determined by the specialty design/build contractor. Dry rotary or air flush methods are preferable to water flush due to moisture-sensitive soils/bedrock.

Construction of micropiles should be observed by a representative of Terracon on a full-time basis in order to identify the appropriate bearing strata and confirm depth and bedrock penetration.

Seismic Considerations

Code Used	Site Classification
2015 International Building Code (IBC) [1]	D [2]

1. In general accordance with the *2015 International Building Code,* which refers to ASCE 7, Chapter 20 (Table 20.3-1 of ASCE 7-10). IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.
2. The boring for this project extended to a maximum depth of approximately 50 feet and this seismic site class definition considers that similar soil/bedrock conditions continue below the maximum depth of the subsurface exploration.

Soluble Sulfate Test Results (Concrete)

A sample of the soil that will likely be in contact with project concrete was tested for soluble sulfate concentrations. A sulfate concentration of 0.018 percent measured for this sample. Sulfate concentrations of less than 0.1 percent indicate Class 0 exposure to sulfate attack for concrete in contact with the subsoils, according to the American Concrete Institute (ACI) *Guide to Durable Concrete*. For this level of sulfate concentrations, ACI indicates any type of cement can be used for concrete in contact with the subsoils.

Therefore, Type I portland cement should be suitable for concrete on and below grade. However, if there is no, or minimal cost differential, use of Type II portland cement (or equivalent) should be considered for additional sulfate resistance of construction concrete.

Foundation concrete should be designed in accordance with the provisions of the *ACI Design Manual*, Section 318, Chapter 4.

Excavation

We anticipate some excavation may be required to implement underpinning. We believe the soils encountered in our exploratory boring can be excavated with conventional excavation equipment. Groundwater seepage is not anticipated for shallow excavations on this site; although perched water should be expected in the boiler pit within the existing crawl space area and water should be removed and excavations maintained in dry conditions.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations in order to maintain stability of excavation sides and bottom. Care should be taken during construction to avoid affecting existing foundations, floor slabs and utilities. Excavations for the project should not undermine these features. Special care should be used while excavating adjacent to existing foundations to avoid undermining or otherwise disturbing these foundation elements. If excavations need to extend below the depths of existing foundations, we should be contacted to provide additional recommendations. Excavations should be sloped or shored/braced in the interest of safety following local and federal regulations, including current Occupational Safety and Health Administration (OSHA) excavation and trench safety standards.

The soils to be penetrated by proposed excavations may vary across the building footprint. The preliminary soil classifications are based solely on the materials encountered in the exploratory test boring performed at the indicated location. The contractor should verify similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

Recommended Additional Investigations/Engineering Services

Based on the results of this subsurface exploration and our understanding of the proposed project, we recommend the following engineering services be performed:

- Type of construction (i.e. basement, crawl space or slab-on-grade), foundation types and bearing depths of the Waterloo building and adjacent buildings should be investigated to further evaluate possible geotechnical concerns or complications.

- If it is decided underpinning of foundations is not practical and demolition of the existing building and complete reconstruction are planned for this project, additional geotechnical exploration (including test borings) should be completed once the existing building is demolished. We are available to discuss this with you in greater detail upon request.

- Construction testing and observation during underpinning and/or foundation construction, earthwork and fill/backfill placement as well as other geotechnical related aspects of the project.

GENERAL COMMENTS

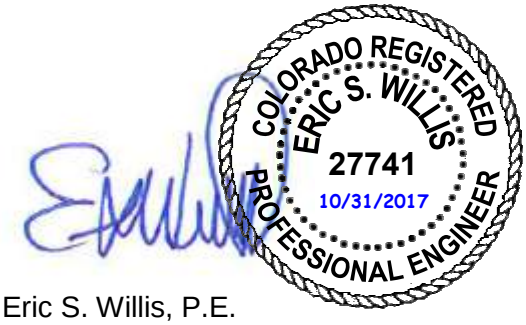
The analysis, opinions and recommendations presented in this report are based upon the data obtained from the boring performed at the indicated location and from other information discussed in this report. This report does not reflect variations that may occur across the location of the existing building, or due to the modifying effects of construction, weather or time. The nature and extent of such variations may not become evident until other exploratory borings are completed or during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

We appreciate being of service to you in the geotechnical engineering phase of this project, and are prepared to assist you during the construction phase as well. If you have any questions concerning this report or any of our testing, construction observation, design or consulting services, please do not hesitate to contact us.

Sincerely,
Terracon Consultants, Inc.



Eric S. Willis, P.E.
Senior Project Manager/Engineer

Eric D. Bernhardt, P.E.
Geotechnical Department Manager

Copies to: Addressee (via email)
Attachments:

FIELD EXPLORATION

Exhibit A-2	Test Boring Location Plan
Exhibit A-3	Log of Test Boring

LABORATORY TESTING

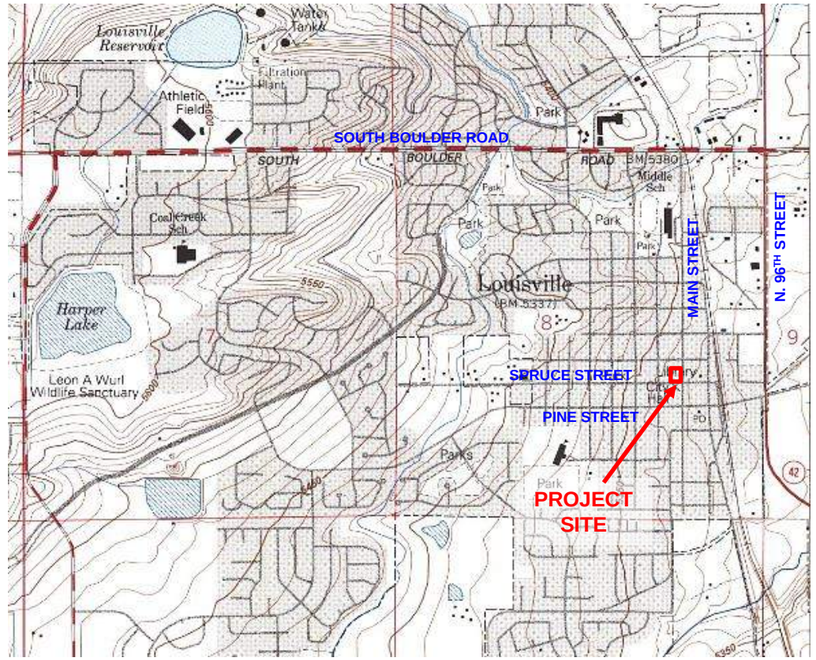
Exhibits B-2 to B-3	Swell Consolidation Tests
Exhibit B-4	Atterberg Limits/Percent Fines Test

SUPPORTING DOCUMENTS

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification System
Exhibit C-3	Rock Classification

APPENDIX A

FIELD EXPLORATION



VICINITY MAP
N.T.S.

N

0’ 15’ 30’

APPROX. GRAPHIC SCALE

LEGEND:

- **APPROXIMATE LOCATION OF TEST BORING DRILLED ON OCTOBER 14, 2017**
- **TEMPORARY BENCH MARK (TBM) TOP OF PROPERTY PIN ASSIGNED ELEV. = 100.0 FEET**

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND
IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	ESW
Drawn by:	GMM
Checked by:	ESW
Approved by:	ESW

Project No.	22175105
Scale:	1” = 30’ +/-
File Name:	22175105 BLP
Date:	10/10/2017

Terracon
Consulting Engineers & Scientists
1242 Bramwood Place Longmont, Colorado 80501
PH. (303) 776-3921 FAX. (303) 776-4041

BORING LOCATION PLAN

TEBO PROPERTIES
WATERLOO BUILDING UNDERPINNING FEASIBILITY
809 MAIN STREET
LOUISVILLE, COLORADO

EXHIBIT

A-2

BORING LOG NO. TB-1

PROJECT: Waterloo Building Underpinning Feasibility

CLIENT: TEBO Properties
Boulder, Colorado

SITE: 809 Main Street
Louisville, Colorado

LOCATION See Exhibit A-2

Latitude: 39.978° Longitude: -105.1327°

Approximate Surface Elev: 99.4 (Ft.) +/-

DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS	SWELL-CONSOL / LOAD, (% / psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	99+/-	**CONCRETE PAVEMENT**, about 4 inches							
		FILL, SANDY LEAN CLAY (CL), brown, dark brown, black, orange, very soft to medium stiff, trace brick or "clinker" fragments	2/12"			17	97		
7.0	92.5+/-		9/12"			17	113		
		SANDY LEAN CLAY (CL), brown, orange brown, tan/beige, very stiff, trace fine GRAVEL with depth	10/12"	+0.2/500	4790	16	111	32-16-16	57
			11/12"	+0.1/500	6180	16	114		
			18/12"		6390	16	115		
23.0	76.5+/-								
		SAND with GRAVEL (SC, SC-SM, SP-SM), varying amounts of SILT and CLAY, brown, rust, dense to very dense, with COBBLES	50/6"						
27.0	72.5+/-								
		SANDY LEAN CLAY/CLAYEY SAND and SILTY, CLAYEY SAND (CL, SC, SC-SM), interlayered, brown, rust, orange brown, stiff/loose, trace GRAVEL	12/12"			16	117		
34.0	65.5+/-								
		SAND with GRAVEL (SC, SC-SM, SP-SM), varying amounts of SILT and CLAY, brown, rust, medium dense, with possible COBBLES	26/12"						
36.0	63.5+/-								
38.0	61.5+/-	**CLAYSTONE**, olive, grey, highly weathered, "clay-like" properties	50/6"			18			
		CLAYSTONE, grey, dark grey, black, hard to very hard, lignitic/carbonaceous							
50.0	49.5+/-		50/10"			22	101		
		Boring Terminated at 50 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4-inch diameter solid flight auger

Abandonment Method:
Boring backfilled with soil cuttings and patched with grout upon completion

See Exhibit A-1 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Elevation was measured in the field using an engineer's level and rod.

Notes:

WATER LEVEL OBSERVATIONS

- *28 feet while drilling*
- *24.5 feet after completion of drilling*

Terracon
1242 Bramwood Pl
Longmont, CO

Boring Started: 10-14-2017 | Boring Completed: 10-14-2017

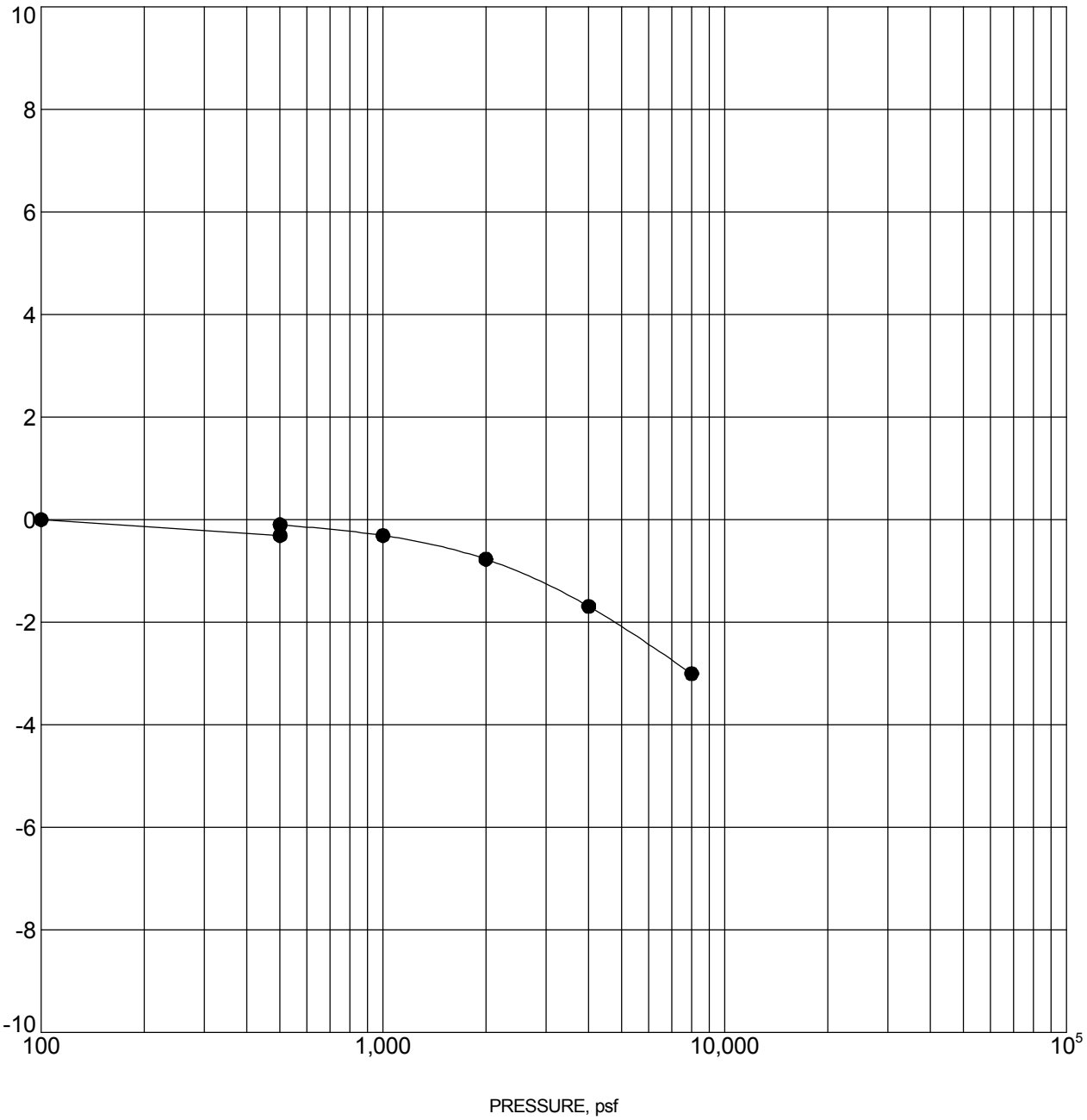
Drill Rig: CME-45 | Driller: ODELL

Project No.: 22175105 | Exhibit: A-3

APPENDIX B

LABORATORY TESTING

SWELL CONSOLIDATION TEST

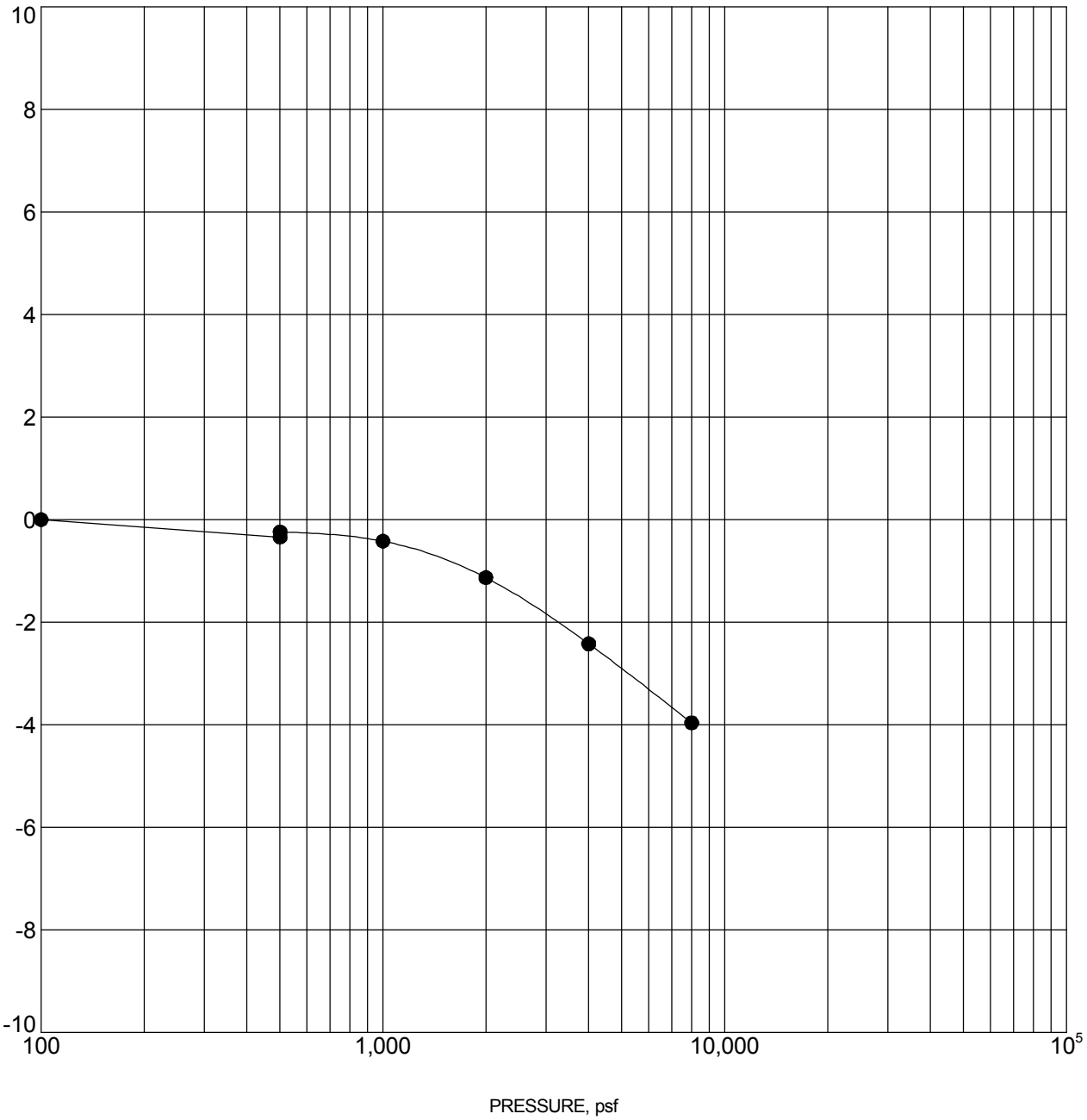


Specimen Identification			Classification	γ_d, pcf	WC, %
●	TB-1	9 - 10 ft	SANDY LEAN CLAY(CL)	111	16

NOTES: Sample exhibited 0.2 percent expansion upon wetting under an applied pressure of 500 psf.

PROJECT: Waterloo Building Underpinning Feasibility	Terracon 1242 Bramwood Pl Longmont, CO	PROJECT NUMBER: 22175105
SITE: 809 Main Street Louisville, Colorado		CLIENT: TEBO Properties Boulder, Colorado
		EXHIBIT: B-2

SWELL CONSOLIDATION TEST



Specimen Identification		Classification	γ_d, pcf	WC, %
●	TB-1 14 - 15 ft	SANDY LEAN CLAY (CL)	114	16

NOTES: Sample exhibited 0.1 percent expansion upon wetting under an applied pressure of 500 psf.

PROJECT: Waterloo Building Underpinning Feasibility

SITE: 809 Main Street
Louisville, Colorado

Terracon
1242 Bramwood Pl
Longmont, CO

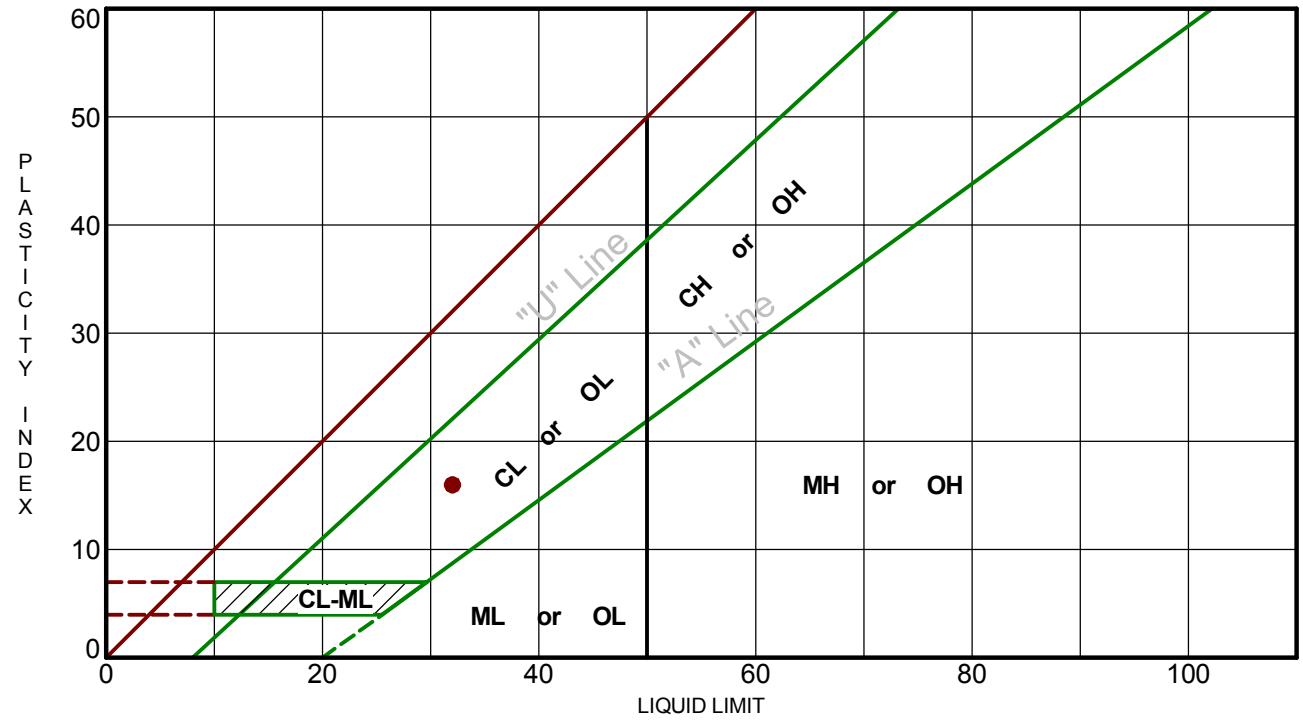
PROJECT NUMBER: 22175105

CLIENT: TEBO Properties
Boulder, Colorado

EXHIBIT: B-3

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● **TB-1**	**9 - 10**	**32**	**16**	**16**	**57**	**CL**	**SANDY LEAN CLAY**

PROJECT: Waterloo Building Underpinning Feasibility

SITE: 809 Main Street
Louisville, Colorado

Terracon
1242 Bramwood Pl
Longmont, CO

PROJECT NUMBER: 22175105

CLIENT: TEBO Properties
Boulder, Colorado

EXHIBIT: B-4

APPENDIX C

SUPPORTING DOCUMENT

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING


Auger


Split Spoon


Shelby Tube


Macro Core


Ring Sampler


Rock Core


Grab Sample


No Recovery

WATER LEVEL


Water Initially Encountered


Water Level After a Specified Period of Time


Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	0 - 5	Very Soft	less than 500	0 - 1	< 3	< 24	< 20	Weathered
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 5	24 - 35	20 - 29	Firm
Medium Dense	10 - 29	15 - 46	Medium-Stiff	1,000 to 2,000	4 - 8	6 - 10	36 - 60	30 - 49	Medium Hard
Dense	30 - 50	47 - 79	Stiff	2,000 to 4,000	8 - 15	11 - 18	61 - 96	50 - 79	Hard
Very Dense	> 50	≥ 80	Very Stiff	4,000 to 8,000	15 - 30	19 - 36	> 96	>79	Very Hard
			Hard	> 8,000	> 30	> 36			

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,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	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			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	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			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] 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

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% 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.

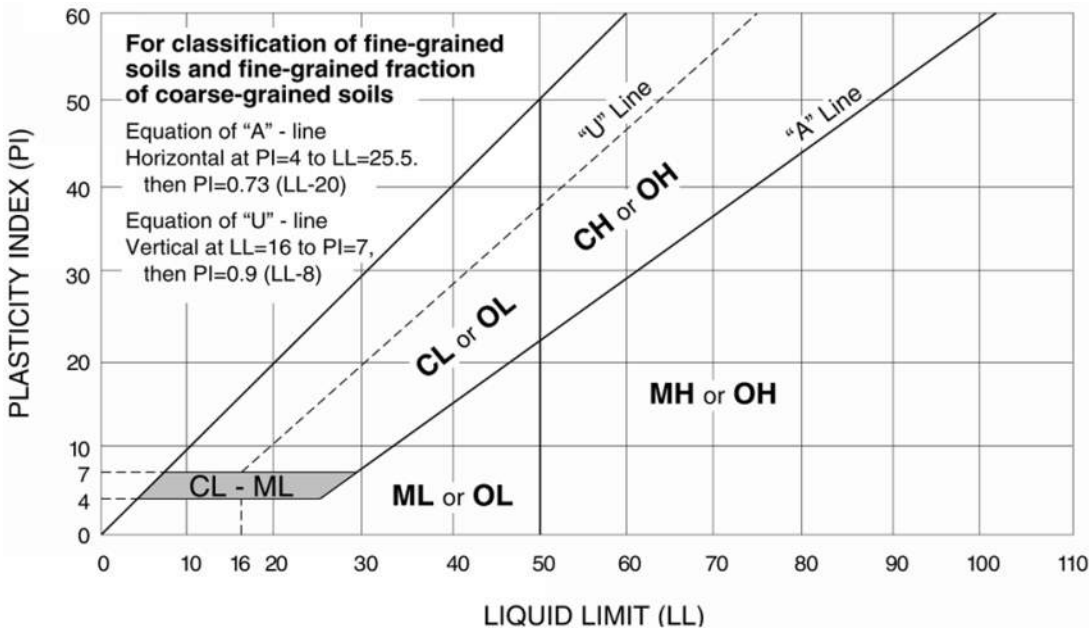
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



Terracon

Exhibit C-2

ROCK CLASSIFICATION

(Based on ASTM C-294)

Sedimentary Rocks

Sedimentary rocks are stratified materials laid down by water or wind. The sediments may be composed of particles or pre-existing rocks derived by mechanical weathering, evaporation or by chemical or organic origin. The sediments are usually indurated by cementation or compaction.

Chert Very fine-grained siliceous rock composed of micro-crystalline or cyrptocrystalline quartz, chalcedony or opal. Chert is various colored, porous to dense, hard and has a conchoidal to splintery fracture.

Claystone Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Soft massive and may contain carbonate minerals.

Conglomerate Rock consisting of a considerable amount of rounded gravel, sand and cobbles with or without interstitial or cementing material. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other materials.

Dolomite A fine-grained carbonate rock consisting of the mineral dolomite [$CaMg(CO_3)_2$]. May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Limestone A fine-grained carbonate rock consisting of the mineral calcite ($CaCO_3$). May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Sandstone Rock consisting of particles of sand with or without interstitial and cementing materials. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other material.

Shale Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Shale is hard, platy, or fissile and may be gray, black, reddish or green and may contain some carbonate minerals (calcareous shale).

Siltstone Fine grained rock composed of or derived by erosion of silts or rock containing silt. Siltstones consist predominantly of silt sized particles (0.0625 to 0.002 mm in diameter) and are intermediate rocks between claystones and sandstones and may contain carbonate minerals.