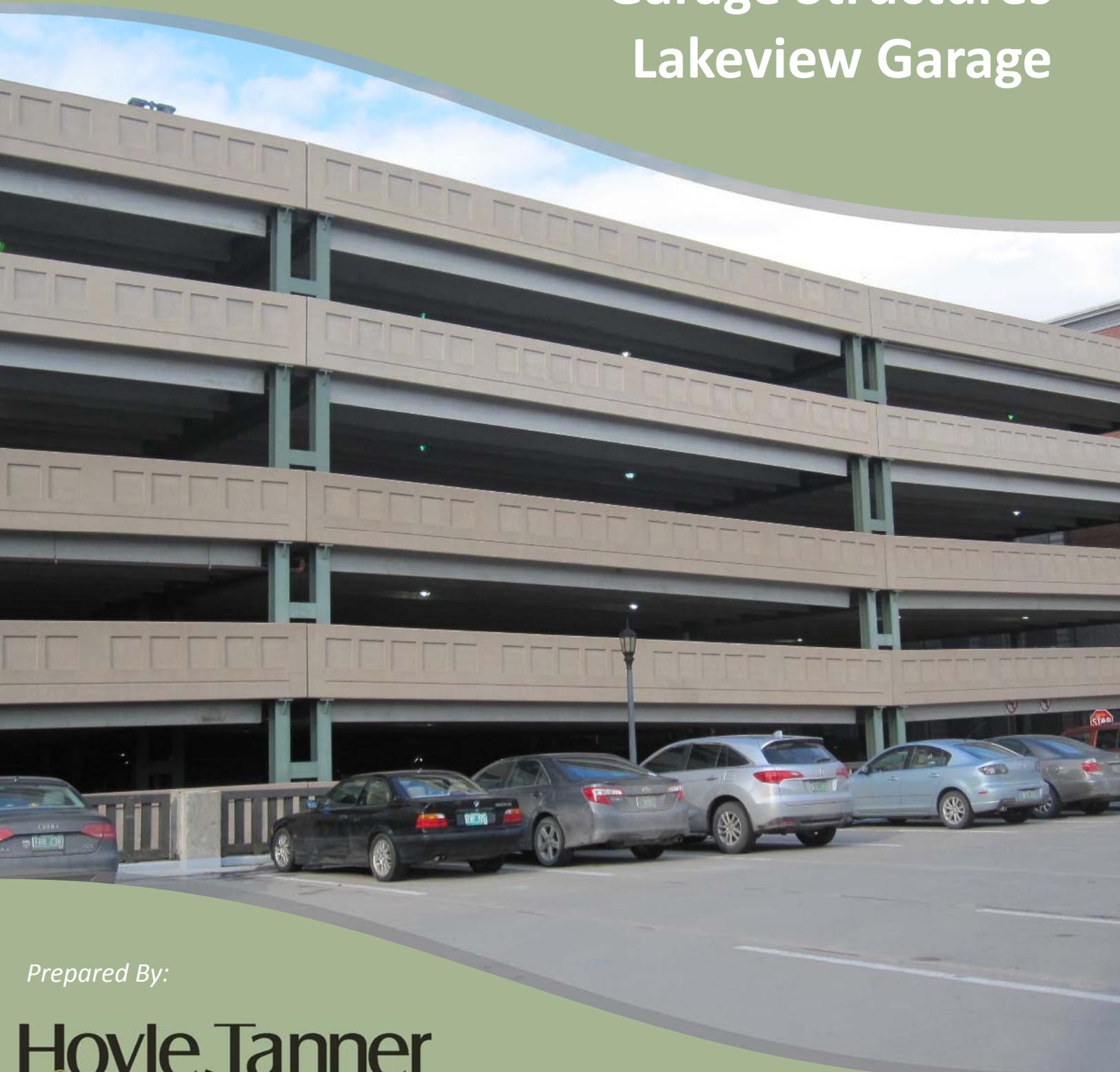
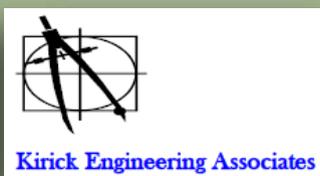


# Assessment of City Parking Garage Structures Lakeview Garage



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*Prepared for:*  
City of Burlington, Vermont

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## 1 EXECUTIVE SUMMARY

The team of Hoyle, Tanner & Associates, Inc. (Hoyle, Tanner), Freeman, French, Freeman (FFF), and Kirick Engineering has been retained by the City of Burlington to perform detailed conditions assessment with repair recommendations and budgetary considerations at the Lakeview Parking Garage (including the West Lake Garage public parking level) in Burlington, VT. These recommendations include short term and mid term needs as well as long term maintenance. This report summarizes our field observations, engineering opinions, and estimated costs.

The **Lakeview Parking Garage** is a steel framed structure constructed with a "Modified" Bay Side By Side layout using three rows of prestressed precast "double-tee" concrete beams for the deck that is approximately 172' long by 252' wide. (Reference Appendix B for garage floor layout plans.) The original structure, opened in 1998, consisted of 3 levels and was later expanded to 5 levels in 2006, supporting a combined total of 678 parking spaces. The garage now serves as the main parking for the Hotel Vermont guests as well as many downtown businesses including Macy's department store and Burlington Town Center. The garage is centrally located within the downtown district midway between Church Street and the Waterfront. The main entrance/exit to the garage is from Cherry Street on the second level. A driveway on the first level connects to the fourth level of the College Street garage.

The Lakeview garage is connected to the second level of the **Westlake Garage** via a driveway at the bottom of the western ramp from the first level. Access to the Westlake Garage is also provided from the Courtyard Marriott Hotel entrance on Cherry Street. Constructed in 2005, this public parking level (garage level 2) holds 59 spaces and is mainly used for Hotel staff and guests. The structure consists of elevated cast-in-place concrete slabs supported on concrete columns. The roof of this parking level supports the paved drive entrance for the Hotel as well as a landscaped garden and hotel terrace area.

In preparation of this report the following assumptions were made:

- The Lakeview garage was inspected within the limits of its footprint (generally 252' x 172'). The skywalk to the Macy's department store is not owned by the City and is not included in this report however it was noted that work is needed in this location.
- The interior of the elevator shaft was inspected for structural and architectural considerations. The elevator and associated equipment are routinely inspected and maintained under a separate contract.
- Only the public parking level of the Westlake Garage was inspected. The first level of this garage holds private parking and was not accessible during our inspection.

There are various issues in the Lakeview parking garage that require repair or replacement. The repair recommendations within this report prioritize the timeframe for the repairs to be completed as either short term or mid term to assist with preparing a plan and budget. We have also included recommendations for general housekeeping and preventive maintenance schedules.

Most of the issues in the Lakeview Garage are a result of typical wear and tear and are repairs that are required as part of routine maintenance. The repairs identified in the Westlake Garage are typically associated with the roof use above.

In general both the Lakeview and Westlake garages are in good condition; most of the repairs and improvements necessary are minor and the structures are currently in serviceable condition. If repairs are completed within the recommended timeframe and a routine maintenance plan is adhered to these structures can be serviceable for another 30 to 40 years.

Though the Westlake Garage is currently in fair condition, and has many years of serviceable life remaining, we recommend the City release ownership of this portion of the structure. With the first level being private ownership, and the Hotel's roof garden and access drive use above, the mixed systems and responsibilities will become increasingly complicated. This garage can easily be separated from the Lakeview Garage, and an entrance can be maintained from the Westlake garage to maintain overflow support. For example the majority of issues noted for this garage in this report are directly related to the Hotel roof garden and paved driveway above. Responsibility and timeframe for the completion of these repairs is not fully in the City's control.

## 2 INTRODUCTION

This report is based on a number of inspections performed by Hoyle, Tanner – structural components, FFF – architectural components, and Kirick Engineering – electrical components. We have reviewed existing plans to better understand the original construction. We have worked closely with Mr. Pat Buteau, Assistant Director of Public Works, and Mr. Brad Cummings, DPW Parking Facilities Manager who have provided information regarding the existing condition and current needs for this garage.

The inspection of the garage focused on a broad range of items that were observed at each level; the common issues were documented and any location specific issues were noted with greater detail.

We understand that simultaneous to this study there are three other parking studies being conducted for the City of Burlington:

- Downtown Burlington Parking & Travel Management Plan
- City of Burlington TDM Action Plan
- Parking Study in Residential Areas

We trust the findings of this report in partnership with the above studies will aid in shaping the future of downtown parking in Burlington.

## 3 CONDITIONS RATING SYSTEM

**CI = Conditions Index:** The CI rating system used for this assessment was developed specifically for this project to help understand / rate the garage element(s) inspected. There may be select repairs that are prioritized even if an element of the garage is rated favorably.

The rating system is intended to score how the element as a whole within the garage (or garage level) is performing with respect to its intended functionality. It is unrelated to public safety concerns, which have been accounted for in the Recommended Repair Timeframe (see section 4 of this report). The rating is from 0 to 10, and is as follows:

0	Serious	Element is not performing or is not present. Extensive repairs/replacement required to nearly 100% of element.
1		
2	Poor	Element is failing or in risk of failing. Multiple locations requiring repair. Repairs extensive in nature.
3		
4		
5	Moderate	Minor repairs required in select locations
6		
7		
8	Good	Element in good condition. Maintain preventative maintenance program.
9		
10		

#### 4 REPAIR TIMEFRAME

Each repair recommendation provided in this Report provides a description of the issue along with a repair recommendation and recommend timeframe in which to complete the repair. This conditions assessment was completed with the intent to identify issues, and prioritize them with budgetary costs. Further engineering for the development of bid and construction plans is recommended for all repair projects.

<b>IMMEDIATE</b>	0 – 1 years	Intended for repairs/replacements that represent a public safety hazard, or need to be completed to prevent further damage from occurring within the garage.
<b>Short Term</b>	1 – 2 years	Intended for repairs that need to be completed as soon as possible to prevent further damage within the garage, but are able to go through a proper design-bid-build cycle. It is recommended that the design process for these repairs begin shortly after receipt of this report, and be completed within the following construction season (i.e. complete prior to December 2015)
<b>Mid Term</b>	2 – 5 years	Repairs required for the garage that are necessary, but do not present a current hazard to the garage performance
<b>Long Term</b>	5 – 10 years	Aesthetic repairs. Repairs that will improve the long term performance of the garage, but can wait for planning purposes as prioritized needs are met.

No immediate repairs were identified in the Lakeview or Westlake garage.

## 5 CONDITIONS ASSESSMENT AND REPAIR RECOMMENDATIONS

For the purposes of this report we have developed an issue identification system so they can be tracked within the description, budget, photos, and prioritization matrix sections of the report. We attempted to utilize nomenclature matching the garage element that it is closely associated with, and numbered multiple issues within that category accordingly. For instance, for Double-Tee repairs, we used DT, and since there were three different Double-Tee conditions to note, they are identified as DT-1, DT-2 and DT-3. Since the Westlake Garage is considered part of Lakeview we have embedded it's assessment within this report. Items identified for this garage include a 'W' in front of the identification, i.e. for drainage systems we have used DS for Lakeview and WDS for Westlake. Since there were very few issues found in the Westlake Garage the majority of this report focusses on the Lakeview Garage. Unless specifically noted items identified and discussed are in the Lakeview Garage.

In order to maintain photograph integrity and size we have separated photos from the report body, but have used the identification system described above and maintained the order as follows in this section. We encourage the reader to utilize the photograph appendix in connection with reviewing the below section.

Estimated quantities of each issue are provided in the cost estimate summary in Appendix A of this report.

Reference to Grid, Column, and Beam Lines are based on the existing drawings which were utilized in developing project base maps as provided in Appendix B.

### 5.1 Double Tee Flange Joint Sealants

**Levels 2, 3, 4, & 5:** **CI = 6** Spot sealant repair locations

Inspection of the garage during periods of light rain revealed several locations where moisture was present on the underside of the Double-Tee beam joint lines indicating joint sealant failure. Where joint sealant failures have occurred, water is allowed to penetrate down the sides of beams causing potential damage to the beam shear tabs, flanges, and steel framing below. Most joint sealant failure locations are associated with either spalled concrete or debonding of the sealant. On level 3 at column line 'C.1' between grid lines '8' and '9' there is a substantial gap at the joint line between the flanges of the Double-Tees due to sealant failure and flange spall; flow was observed at the corresponding location below (level 2) pouring through the opening into the travel way.

<b>JS-1</b>	Issue:	Joint Sealant Failure at Level 2, 3, 4, and 5
	Cause:	Spalled concrete adjacent to joint locations or debonding from concrete.
	Effect/Consequence:	Surface water travels between double-tee flanges, increasing the potential for beam damage and joint connection failure.
	Repair Recommendation:	Replace failed sealant locations. Replace spalled concrete to create uniform flange edge (see spalled concrete patching under Precast section of this report). Repair concrete cracks. Clean and prepare bonding surface prior to installation
	Repair Timeframe:	<b>Short Term</b>

## 5.2 Concrete Sealants

### Westlake Observations:

Perimeter concrete slab / wall joints at the level 2 floor are approximately 3 ½" wide with a foam insert. It is likely that water penetrates down this joint during floor washdown operations. Sealant should be installed above the foam insert.

<b>WCS-1</b>	Issue:	Floor level perimeter sealant missing
	Cause:	Original construction
	Effect/Consequence:	Water penetration to levels below
	Repair Recommendation:	Install perimeter epoxy sealant above foam insert.
	Repair Timeframe:	<b>Mid Term</b>

<b>WCS-2</b>	Issue:	Roof level perimeter sealant failures at West and North Walls
	Cause:	Water
	Effect/Consequence:	Water penetration to levels below, eventual structural damage
	Repair Recommendation:	Repair perimeter sealant at leaking locations. Install flashing at building perimeter to direct drainage away from this joint
	Repair Timeframe:	<b>Mid Term</b>

## 5.3 Expansion Joints

Level 1: **CI = 5**

Level 2: **CI = 1**

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Observations:

The expansion joint on level one adjoins the concrete retaining wall and slab-on-grade with the Double-Tee beam at Grid 5. A galvanized steel angle is fastened to the concrete wall and provides flexural support for the Double Tee beam flange. The angle has minor corrosion and some of the welds are rusted but intact; the welded connections should be cleaned and covered with a grease coat or painted. There is a small dip on the travel surface of the concrete slab leading up to the joint that increases vehicular impact on the joint and increases the potential for wear and damage to the joint; at least two locations have been identified where the expansion joint seal has failed and is need of reconnection and repair.

The expansion joint on level 2 at the garage entrance/exit experiences heavy traffic flow and has become worn, and separated in many locations. The expansion joint is in need of replacement across its full length.

<b>EJ-1</b>	Issue:	Water penetrating at expansion joint.
	Cause:	Direct wear from impact angle due to dip at joint line and general wear overtime
	Effect/Consequence:	Continued damage/corrosion to Double-Tee Beam
	Repair Recommendation:	Clean joint and identify any additional tears, repair bituminous patch material on Double-Tee beams, reconnect joint to cast in place (CIP) concrete, repatch on CIP concrete. Smoothen transition floor slab to patch material (chip out 15' long x 2' wide x 1" min thick section and pour a new concrete surface)
	Repair Timeframe:	<b>Short Term (joint repairs) Mid Term (slab transition)</b>

<b>EJ-2</b>	Issue:	Expansion joint failure.
	Cause:	Heavy wear at garage entrance and exit.
	Effect/Consequence:	Damage/corrosion to adjacent Double-Tee Beams, water penetration issues to levels below
	Repair Recommendation:	Full replacement. A 'heavy duty' expansion joint should be considered for this area.
	Repair Timeframe:	<b>Short Term</b>

Westlake Observations:

Where expansion joints are present they appear to be functioning per design intent. An expansion joint is missing along the west slab/wall interface on the East wall length. Some patch metal flashing and asphalt ramp has been installed at the roof level to cover this gap, but is a substandard repair. A compression seal is needed along this wall length.

<b>WEJ-1</b>	Issue:	Roof Level Expansion joint missing
	Cause:	Original construction
	Effect/Consequence:	Water, debris penetration to level below
	Repair Recommendation:	Install new compression seal along wall length
	Repair Timeframe:	<b>Mid Term</b>

5.4 Waterproofing Membrane

Observations:

Waterproofing membrane is only present above the raised wash area in the travel way and not at the remaining raised wash areas in the garage that occur on each level along the perimeter and central column lines. Many of the precast Double-Tee Beams have hairline transverse cracks on the underside of the flange at the location of the wash area above that are a result of water penetration therefore waterproofing membrane shall be installed above all raised wash areas to prevent damage to the structural member below. Waterproofing membrane shall also be applied at the roof level above the repaired cracks adjacent to the drains previously identified in the Precast Double-Tee Beam section of this report.

<b>MB-1</b>	Issue:	Transverse cracks on underside of precast Double-Tee Beam flange at location of raised wash areas
	Cause:	Water penetration
	Effect/Consequence:	Continued damage to Double-Tee Beams
	Repair Recommendation:	Clean concrete surface and apply liquid membrane.
	Repair Timeframe:	<b>Mid Term</b>

5.5 Precast Members and Connections

**Levels 2, 3, 4, 5 – Double Tee Beams & Connections:**

**CI = 7**

Repairs needed, but beam integrity in good condition

5.5.1 Precast Double-Tee Beam

In general the Precast Double-Tee Beams were found to be in good condition. Some locations, mainly on level 2, were identified to have failed flange connections. The failed connection is typically a result of either a missing tab connector, disconnected weld, or in some cases a concrete spall at the top of the flange. The Double-Tee Beams with failed connections have visible differential vertical displacement when traveled over by vehicles; these locations are easily identifiable by observing this movement during traffic flow. These connections should be repaired to prevent further damage to the beam flanges. Locations (not all) identified with connector failures are: Level 2 - Beam 3D, Level 2 – Beam 2D, Level 2 – Beam 4B. In some locations minor cracks were observed in the precast Double-Tee Beams. Typically cracks were located on the underside of the beam flange and at the roof level cracks were noted on top of the beam flange adjacent to the drain locations.

<b>DT-1</b>	Issue:	Shear Tab Failure
	Cause:	Joint sealant failure, missing or disconnected shear tabs
	Effect/Consequence:	Large differential deflection between Double-Tee beams caused impacts to each beam as vehicles move on the floor level, and prevents sealants from maintaining bond as they cannot support that level of movement. Shear tabs also provide structural qualities for the transfer of lateral loads during a wind or seismic event.
	Repair Recommendation:	Clean bars in precast and replace missing and disconnected shear tabs. Coordinate sealant repair with JS-1.
	Repair Timeframe:	<b>Short Term</b>

<b>DT-2</b>	Issue:	Surface Spalls
	Cause:	Typically associated with rebar corrosion / expansion
	Effect/Consequence:	Water can penetrate into beam causing potential flange reinforcement corrosion, and eventual extensive beam damage
	Repair Recommendation:	Surface grout patch. Remove spalled concrete, clean reinforcing steel, patch with approved grout.
	Repair Timeframe:	<b>Short Term</b>

<b>DT-3</b>	Issue:	Double-Tee Beam flange cracks - Hairline
	Cause:	Potential causes: natural aging of concrete including shrinkage and creep, quality control issues during original construction
	Effect/Consequence:	Water can penetrate into beam causing potential flange reinforcement corrosion, and eventual extensive beam damage
	Repair Recommendation:	Cracks should be repaired with a self-penetrating crack healer/sealer
	Repair Timeframe:	<b>Mid Term</b>

### 5.5.2 Precast Spandrel Beams

**Spandrel Beams:** **CI = 7** Some Minor Repairs necessary

Observations:

Precast spandrel beams surround the perimeter of floors 1, 2, 3, 4, and 5 framing where the structure is above grade. The spandrels are not load bearing, but provide the function of vehicular barrier. Generally the spandrel beams and their connections were found in good condition. Some minor repairs are necessary and are described below.

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<b>PC-1</b>	Issue:	Missing lift anchor sealant patches.
	Cause:	Potential cause: Age or poor installation.
	Effect/Consequence:	Missing sealant patch allows water to pond and potentially cause internal damage to precast members
	Repair Recommendation:	Clean and reapply sealant patch.
	Repair Timeframe:	<b>Mid Term</b>

<b>PC-2</b>	Issue:	Minor spalls under flashing attachment. (Ramp 4/5)
	Cause:	Potential cause: Poor installation.
	Effect/Consequence:	Water can penetrate into beam cause potential flange reinforcement corrosion, and eventual extensive beam damage
	Repair Recommendation:	Surface grout patch. Remove spalled concrete, clean reinforcing steel, patch with approved grout.
	Repair Timeframe:	<b>Mid Term</b>

<b>PC-3</b>	Issue:	Spandrel Beam – Map Pattern Cracking (Level 5)
	Cause:	Sun exposure.
	Effect/Consequence:	Potential long term beam damage from crack widening and water penetration
	Repair Recommendation:	Routine application of penetrating sealer.
	Repair Timeframe:	<b>See Maintenance Section of this Report</b>

5.6 Cast-In-Place Concrete

**Lakeview Wash Areas: CI = 7**

Observations:

The Cast-In-Place (CIP) Concrete wash areas inspected by our team were found to be in good condition with the exception of some minor cracks that were located on Level 2 at Grid 11 between Column lines C and D that shall be repaired with a penetrating crack healer/sealer. For each of the stair towers on the roof level the CIP concrete threshold is cracked and sections of concrete has broken off that is in need of repair.

<b>CIP-1</b>	Issue:	Cracks in CIP Concrete Wash Area
	Cause:	Age, water penetration (coordinate with repair MB-1)
	Effect/Consequence:	Water damage to structural members below.
	Repair Recommendation:	Cracks should be repaired with a self-penetrating crack healer/sealer
	Repair Timeframe:	<b>Short Term</b>

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<b>CIP-2</b>	Issue:	Damaged CIP concrete threshold at both Stair Towers on Level 5 (roof)
	Cause:	Age, water penetration
	Effect/Consequence:	Potential tripping hazard.
	Repair Recommendation:	Concrete patch
	Repair Timeframe:	<b>Short Term</b>

**Westlake Concrete Slabs: CI = 8**

**Westlake Concrete Columns: CI = 8**

Westlake Observations:

The Cast-In-Place (CIP) Concrete Floor Slabs and Columns in the West Lake Garage were generally found to be in good condition. A few minor repairs were noted and are described below.

<b>WCIP-1</b>	Issue:	Surface water flow in Westlake Garage public parking level 2 travels adjacent to columns at drain locations
	Cause:	Original Design/Construction
	Effect/Consequence:	Over time this surface flow will erode the concrete columns at these locations.
	Repair Recommendation:	Install 2" grout chamfer around base of columns at drain locations. Roughen floor surface to ensure good bond between grout chamfer and floor.
	Repair Timeframe:	<b>Mid Term</b>

<b>WCIP-2</b>	Issue:	Crack in roof slab
	Cause:	Water penetration likely associated with the landscape masonry wall separating the paved drive from the landscaped terrace.
	Effect/Consequence:	Structural damage to roof slab concrete and reinforcing
	Repair Recommendation:	The roof needs to be exposed from above. A crack healer/sealer product should be installed at the crack from above. The roof condition should be assessed to determine if the wall is preventing drainage flow and remedied either with a new drain at this location or a tapered insulation below the roofing membrane to direct drainage flow. The membrane will need to be repaired at this location.
	Repair Timeframe:	<b>Short Term</b>

5.7 Structural Steel

**Level 2, 3, 4, & 5: CI = 7**

Observations:

In general the structural steel appeared to be in good condition with minor paint peeling/flaking and corrosion. Most repairs are considered as part of the preventative maintenance program. One beam has been identified on level 2 that has a high percentage of paint peeling/flaking; no section loss was identified however repairs within the short term timeframe are thought to be necessary to prevent future section loss. On the ramp up to level 2 the column 'A4' a small area on the face of the flange has been identified as having minor section loss.

<b>SS-1</b>	Issue:	High percentage of paint peeling/flaking and corrosion
	Cause:	Water exposure from leaking joint.
	Effect/Consequence:	Potential for section loss.
	Repair Recommendation:	Repair leaking joint and clean and paint existing beam.
	Repair Timeframe:	<b>Mid Term</b>

5.8 Cable Guardrail

**Cable Guardrail All Levels CI = 4**

Observations:

There is cable guardrail at grids B and B.1 all levels. In general the cable guardrail is in good condition however in at least two locations the rail post base plates had become detached from the Double-Tee beam and the concrete flange of the Double-Tee beam is damaged. The damaged concrete in the Double-Tee beam flange should be patched and the rail posts shall be reattached; it is suggested to shift the rail attachment location to outside of the patched concrete area and anchor into the existing Double-Tee beam flange.

<b>CG-1</b>	Issue:	Detached cable guardrail posts
	Cause:	Possible Cause: Collision or improper installation.
	Effect/Consequence:	Cable guardrail at damaged locations is less effective with missing posts. Potential for additional posts to become detached in the event of a collision.
	Repair Recommendation:	Patch damaged concrete in Double-Tee beam flange. Reattach posts.
	Repair Timeframe:	<b>Short Term</b>

## 5.9 Miscellaneous Steel

### Observations:

There are several concrete filled metal pipe bollards located throughout the garage. Some bollards serve to protect vertical drain pipes, and several are located in front of the entrance to Macy's department store on Level 3. On Level 4 at Grid D/1 there are two steel T-shape bollards protecting the entrance to a doorway. On Level 2 at the Cherry Street entrance/exit there are 3 concrete filled metal pipe bollards that are 'U' shaped, 2 that protect the parking attendant booths and 1 that protects the fire alarm control panel. In general all bollards are in good condition and only minor maintenance is required to clean and paint rusted base plates and bollards with chipped paint. On Level 2 there is a concrete filled metal pipe bike rack that is in good condition that needs the base plates to be cleaned and painted.

## 5.10 Electrical and Lighting Systems

**Lakeview Garage:** The original light fixtures are still in the lower, older (1998) levels of the facility, while the upper two floors have a newer generation of lighting (2006). Water infiltration appears to have been a problem at this structure and as a result of flooding all of the original electrical equipment in the main electric room has been replaced with new. This structure has a fire alarm system installed as well as a back-up generator. A complete assessment of the electrical infrastructure for this garage has been conducted on May 20<sup>th</sup> and June 11<sup>th</sup>, 2014. The following conditions were field observed:

## 5.11 Service Equipment

### CI = 8

### Observations:

The main service feeder size is 400 amps, 277/480 volt, three phase, and terminates at a main panel DP. This main panel feeds a lighting subpanel directly for 277 volt lighting, and a pair of step-down transformers and associated sub-panels for 208/120 volt circuit needs. Due to a water flooding problem at this site, all of the electric gear was replaced fairly recently, and all the new equipment is Square D make and in very good condition. However, the lower 6 inches of this space still has water infiltration and already corroding the conduit and other metal materials in this low lying area above the floor.

Generally, this equipment is in nearly new condition, since the electric room equipment has been replaced. Overall, these panels and associated transformers are manufactured by Square D, a company that is still a leader in electrical equipment; and therefore are able to accommodate on-going equipment parts and service support in the maintenance of this gear, provided that this room is kept relatively dry.

General preventative maintenance should include the scraping, cleaning and repainting (rust-resistant paint) of the metal equipment support hardware that panels and transformers are mounted to, including any other low lying conduits that show signs of rust.

5.12 Distribution Equipment

**CI = 5**

Observations:

As mentioned above for service equipment, there are three sub-panels in the main electric room that serve the entire parking structure. These are in like new condition having been recently replaced; however, some of the distributed branch circuit wiring, once it leaves this room, is experiencing high levels of rust where passing through walls that are the source of the water infiltration, with the condition progressively worse the lower in the structure one goes. Replacement of these conduit sections and wiring system may be the only remedy at this point. The conditions here are not as severe as those found at the College Street garage, but will continue to decay unless the water infiltration is eliminated. These conduits are EMT type and if replaced in kind will start to decay again, unless effective means are undertaken to remediate the water infiltration problem for the structure. PVC conduit would be an acceptable alternate to a steel based conduit, if added resistance to moisture is desired.

<b>ED-1</b>	Issue:	Corroded conduit and wiring, especially at vertical wall systems penetrations.
	Cause:	Water infiltration to facility.
	Effect/Consequence:	Eventual possible circuit failures. Danger to occupants if severe corrosion causes live conductors to become exposed.
	Repair Recommendation:	Replace conduit sections (or possibly clean and add supplemental sleeves at corrosion points) and any compromised wiring for all active branch circuits on all floors that have been damaged by water infiltration. Secure main electric room from further water infiltration or supply a dehumidification system.
	Repair Timeframe:	<b>Mid Term</b>

5.13 General Lighting

**CI = 7**

Observations:

The original lighting systems were a combination of Metal Halide (MH) based HID fixtures for the general parking areas, and linear fluorescent fixtures for smaller rooms and a mix of linear and compact fluorescent, and lower wattage high pressure sodium (HPS) fixtures at stairwells. The metal halide lighting systems would not be used in a new parking garage design, due to vastly improved and much more energy efficient systems available today; however, they were the design standard of the day when first installed. The HID general area lights look to be in relative good condition, and are of a style that are designed for specific parking garage use (cutoff and glare control when viewed from specific angles) but the stairwell lights are dirty and/or damaged, some with lenses even missing from them,

have mixed lamp types and wattages for the elevator tower stairs, and generally are not performing up to lighting level standards required for these spaces.

Generally, the National Parking Association (NPA) in association with the Illumination Engineering Society of North America (IESNA) recommend 2.0 footcandles (FC) average for general parking areas, with 20 FC in stairwells and at stair entrances, and 6 FC at ramps and a minimum of 1 FC maintained at floor throughout. Higher FC levels at entrance areas are also recommended for daytime use when exterior daylight could be quite bright and entering a (relatively) dark parking garage needs to have a transitional zone so that eyes have a chance to adjust to the lower internal levels. Egress pathways are required by code to have a minimum of 1 FC average for path and 10 FC minimum for egress stairs. For this facility the following field lighting levels were measured:

- 2-10 FC down center of drive path (as high as 20 FC near individual fixtures)
- 1-10 FC in stair towers (this is too low for egress stairs)
- 8-20 FC at elevator landings
- 2-10 FC Throughout general indoor parking areas. Lower levels had higher measured light readings than upper floors.
- 25-35 FC at Cherry Street entry area (New LED lights have been retrofitted here)
- 0.2- 4.2 FC at rooftop level with many locations below 0.5 FC.

Generally, the interior garage lighting was fully operational and the light levels were adequate for the spaces within the structure; except for some low light level areas in the stairwells, which should have a minimum of 10 FC at all stairs. Additionally, some select locations along the north side of the garage interior levels may require additional lighting. The open upper deck areas had lighting that was noticeably dimmer than the lower decks. This is curious because the upper deck fixtures are the newest ones and should be performing better.

<b>EL-1</b>	Issue:	Low lighting levels on upper decks.
	Cause:	Aging fixtures (potential cause), and possible lighting design deficiencies due to low light level design of original light fixtures.
	Effect/Consequence:	Reduced security and comfort of patrons, higher energy bills than need be.
	Repair Recommendation:	Replace all upper deck lighting with high-efficiency lighting systems such LED or induction based. Consider retrofitting the metal halide fixtures on the lower floors with LED lamp replacements, if available from manufacturer. The replacement of the stairwell systems is recommended for both increased energy efficiency as well as increased security due to the better color quality of a recommended LED based system. LED lighting should also have increased maintenance savings since LED lamp or driver modules are expected to have three to four times the life expectancy as a typical HID or compact fluorescent lamp. Add lighting fixtures a dimly lit areas of lower levels, particularly along the North side adjacent to Hotel Vermont.
	Repair Timeframe:	<b>Mid Term</b>

<b>WEL-1</b>	Issue:	Low lighting levels in public parking level 2
	Cause:	Possible lighting design deficiencies due to low light level design of original light fixtures.
	Effect/Consequence:	Reduced security and comfort of patrons
	Repair Recommendation:	Add lighting fixtures a dimly lit areas of Westlake Garage public parking level 2
	Repair Timeframe:	<b>Mid Term</b>

5.14 Required Emergency Systems

**CI = 7**

Observations:

Life-safety systems consist of two elements: the emergency egress lighting system, and the fire alarm system. Details of each of the critical elements are described below -

**Egress Lighting** – Emergency egress lighting consists of two components, exit signage marking and auxiliary power backed-up pathway illumination. Exit signage must be either internally or externally illuminated and be placed along egress routes so that at no location along the egress path is the distance greater than 100 feet. Also, generally building inspectors like to have two different exit signs visible from any given location so that if one pathway is blocked by a hazardous condition during an emergency the viewer can opt to take the alternate path to safety.

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In general, at the Lakeview structure most places had adequate placement and quantities of exit signage. Some of the areas looked like there should be a few more supplemental signs. These existing signs looked worn and KEA would recommend replacement with new throughout, plus add some where needed.

As for emergency lighting operations, the existing system has an emergency generator and automatic transfer switch (ATS) already installed for this function. The generator system was not tested for this report but is assumed to be properly functioning with adequate circuits feeding a proper number of light fixtures and AHJ approved.

**Fire Alarm-** For parking structures over 100,000 square feet (SF) in size, a manual or automatic fire alarm system is required by NFPA 101 Life Safety Code (unless sprinkler protected). The Lakeview garage is larger than 100,000 SF, and does have a sprinkler system installed. In addition, this structure has an elevator, which also has requirements for automatic smoke and heat detection for its associated spaces. In this structure, a full manual system appears to have been part of the original system design.

Recently, the original fire alarm system was replaced with a new Mircom FX-2000 addressable fire alarm panel system. No observed improvements were done to the existing system design or individual components at the time of replacement. Manual pull stations appear to be at all stair landings, elevator system smoke and heat detectors are installed, and strobe/horn annunciation appliances appeared to be installed in adequate quantities. However, there was one pull station missing from the top of the elevator stair tower.

As for annunciation appliances (audible/visual units), occupants must be able to be notified of an alarm condition within the facility. Generally, occupants must be able to see and hear fire alarm strobe/horn units from any given location. Notification appliances were observed throughout the facility, and appear to be adequately placed.

**Generator System:** There is a 20 kW sized emergency generator and ATS installed at this site. It appears to be in good condition.

<b>ELS-1</b>	Issue:	Fire alarm system deficiencies.
	Cause:	Missing component to system.
	Effect/Consequence:	Reduced security and safety of patrons, and lack of code compliance.
	Repair Recommendation:	Provide a manual pull station at top of elevator stair tower.
	Repair Timeframe:	<b>Short Term</b>

<b>ELS-2</b>	Issue:	Exit signage deficiencies.
	Cause:	Aging fixtures and some initial building design deficiencies.
	Effect/Consequence:	Reduced security and comfort of patrons.
	Repair Recommendation:	Replace all existing exit fixtures and add exit signage as required.
	Repair Timeframe:	<b>Mid Term</b>

**OTHER ELECTRICAL SYSTEMS NOTED:**

**Telephone:** Telephone service is basic and appears adequate for the use of the facility.

**Computer/Data:** There is a local network for a minimal number of workstations associated with the office and adjoining toll booths. CAT5e cabling is fairly new and in good condition. System is adequate for its function.

**Communications/PA:** The building does not have any public address or other mass notification systems in place.

**Security:** Recently, some security monitoring cameras have been installed at the main toll exit ramp. This is an IP based system (not a recorder based system) and is connected to Burlington DPW for remote monitoring of facility as needed. The system is mostly designed for reading license plates as they exit the facility.

5.15 Openings (Windows, Doors and Storefronts)

**CI = 2** Doors missing (Stair Enclosures at top level).

**CI = 8** Otherwise maintain preventative maintenance program.

Observations:

Doors and hardware are in generally fair condition, with the exception of roof-level stairwell doors, which have been removed.

<b>OP-1</b>	Issue:	Leaking at east (Macy's) stairwell roof enclosure
	Cause:	Apparent leak in sloped glazing system and missing door
	Effect/Consequence:	Water pooling on landing
	Repair Recommendation:	Assess condition of sloped glazing and reseal as necessary. (See ST-1 for door replacement)
	Repair Timeframe:	<b>Short Term</b>

<b>OP-2</b>	Issue:	Door does not operate properly
	Cause:	Closer is broken
	Effect/Consequence:	
	Repair Recommendation:	Replace closers
	Repair Timeframe:	<b>Mid Term</b>

5.16 Stair Towers

**Stair Towers:** **CI = 4** Several Repairs necessary

Observations:

The top level of the existing southwest stair tower and east stair/elevator tower provides access to the roof level parking. The entrance to each stair tower is open to the elements allowing driving rain to enter the stair tower and infiltrate the lower levels down causing damage to garage elements below. In the southwest stair tower water penetrates down to the ground level where around an inch deep ponding was observed.

Stairs and railings are generally in poor to fair condition, with no major apparent code compliance deficiencies. Tread nosing inserts are worn but not loose; steel stair pans at the southwest stair exhibit extensive rust and corrosion. Railings have some rust, especially those at the southwest stair which exhibit extensive rust and corrosion.

<b>ST-1</b>	Issue:	Roof level southwest and east stair tower – stormwater infiltration
	Cause:	Water damage
	Effect/Consequence:	Corrosion of metal handrails, potential slipping hazard during freeze/thaw cycles
	Repair Recommendation:	Install door and raised/sealed threshold at the entrance to the stair towers at the roof level.
	Repair Timeframe:	<b>Short Term</b>

<b>ST-2</b>	Issue:	South West Stair – heavily corroded stair lengths
	Cause:	Water damage
	Effect/Consequence:	Corrosion of stair pans, framing members and connections
	Repair Recommendation:	Replace stair lengths. Repair floor connections.
	Repair Timeframe:	<b>Short Term</b>

<b>ST-3</b>	Issue:	Elevator Indicator light glass is broken
	Cause:	Vandalism
	Effect/Consequence:	Wires exposed
	Repair Recommendation:	Replace indicator
	Repair Timeframe:	<b>Mid Term</b>

<b>ST-4</b>	Issue:	Multiple electrical box covers at Stair have been vandalized / removed and contents burned.
	Cause:	Vandalism
	Effect/Consequence:	Wires exposed and burned; local fire alarm may not work
	Repair Recommendation:	Repair and replace cover with vandal resistant cover.
	Repair Timeframe:	<b>Mid Term (verify fire alarm function in short term)</b>

#### 5.17 Surface (Floor) Drainage

**Levels 2 & 3:** **CI = 6** Plugged drains and additional drains needed at select locations

#### Observations:

Many of the floor drains on level 2 have minor to moderate debris build up. Multiple floor drains on levels 2 and level 3 were plugged.

On level 2 near the Cherry Street entrance/exit of the garage a concrete ramp has been installed over an existing drainage wash area at the side entrance to Hotel Vermont. The bottom of the ramp has incorporated a pipe inlet for water to reach the floor drain, however it appears to be functioning poorly as there is evidence of moisture and damage to the underside of the Double-Tee Beams below the ramp. Additionally near this location water is not reaching the floor drain behind the manager's office (run off from Cherry Street creates significant ponding issues at this location). Two floor drains are recommended in front of the manager's office, and a third floor drain is recommended adjacent to the Hotel Vermont Ramp. On level 3 standing water was observed at the end of the beam A/1.1, it is recommended to install a storm drain at this location.

<b>SD-1</b>	Issue:	Plugged Drains
	Cause:	Debris build up.
	Effect/Consequence:	Pooled water undergoes freeze/thaw cycles, causing damage to sealant, membranes, and structural framing.
	Repair Recommendation:	Clean out floor drains.
	Repair Timeframe:	<b>Short Term</b>

<b>SD-2</b>	Issue:	Poor drainage.
	Cause:	Water not reaching storm drainage system.
	Effect/Consequence:	Water damage to Double-Tee Beams below.
	Repair Recommendation:	Install one floor drain adjacent to Hotel Vermont ramp, two floor drains in front of the manager's office, and one floor drain on level 3 near beam A/1.1 at low point.
	Repair Timeframe:	<b>Short Term</b>

<b>SD-3</b>	Issue:	Ponding at Lower Level of Southwest Stair Tower
	Cause:	No drain present, water enters from above levels
	Effect/Consequence:	Ponding, ice hazard, door function issues
	Repair Recommendation:	Install 1 floor drain and piping to exterior stormwater system that runs between College Street Garage and Lakeview Garage
	Repair Timeframe:	<b>Mid Term</b>

**Westlake Roof Level:** **CI = 6** Membrane/Drain issues, ponding at paved areas

**Westlake Level 2:** **CI = 8** Drainage system generally meeting design intent

Westlake Observations:

The original roof drainage construction appears to be similar to level 2, where concrete slabs are pitched to drain locations. The Hotel installed a landscaped terrace and paved drive on top of the concrete floor and installed roof drains with side inlet drainage to accept subsurface water flow at terrace areas. The entire roof surface appears to have a buried rubber roof membrane designed to keep water off of the concrete surface and direct flow to drain locations. The membrane connection has failed at several drain locations and standpipe penetrations. It has also likely failed adjacent to the masonry wall as described in the Cast-In-Place Concrete section of this report. Perimeter leaking issues were observed at roof slab joints on concrete walls. These were apparent at the North, West, and East wall faces. Generally the issues at the East wall are associated with missing expansion joint material along this grid line. The North and West wall leaking is located at the building face and sidewalk areas.

<b>WSD-1</b>	Issue:	Leaking at Roof Drain Locations
	Cause:	Membrane to Drain connection failure
	Effect/Consequence:	Water runs down outside of drain and drain pipe causing corrosion and eventual roof slab damage
	Repair Recommendation:	Repair membrane connection at drain. Install penetrating crack healer/sealer where concrete cracks are present adjacent to drains.
	Repair Timeframe:	<b>Short Term</b>

### 5.18 Elevator Shaft

Observations:

The existing elevator is a 5 floor conventional jack 200lb. elevator with a Schindler MPH2 controller with a cab of 5'-9" x 4'-4" inside dimensions. Required tactile signage is not present on levels 4 & 5. Indicator light glass is broken. Electrical box cover at Stair L5 has been vandalized / burned.

The interior of the elevator shaft was found to be in good structural condition. Walls and wall connections appeared in generally sound condition and the elevator shaft and the cast-in-place concrete pit were found to be dry.

### 5.19 Westlake Garage Roofing Membranes

**CI = 2** Determine responsibility for maintenance and repairs of Plaza space (directly above) affecting parking garage.

Observations:

The West Lake Garage roof membrane was not directly observed (green roof system and plaza level not in scope). Flashing and roof drains at plaza level were observed and appears to have failed in some places.

<b>WRM-1</b>	Issue:	Water leaking at West and North side of garage
	Cause:	Apparent failure of flashing at plaza level above
	Effect/Consequence:	Water pooling in garage, near entry to hotel
	Repair Recommendation:	Assess condition of plaza-level flashing and membranes and patch/repair as necessary
	Repair Timeframe:	<b>Mid Term</b>

<b>WRM-2</b>	Issue:	Leaking at Standpipe Locations
	Cause:	Membrane failure at penetration
	Effect/Consequence:	Water runs down standpipe causing pipe corrosion and eventual roof slab damage
	Repair Recommendation:	Repair membrane and boot at standpipe penetration. Install penetrating crack healer/sealer where concrete cracks are present adjacent to roof penetrations
	Repair Timeframe:	<b>Short Term</b>

Roof Membrane Location	Date of Installation / Replacement	Date of Repairs / Patching	Age
Westlake Garage Roof (below paved driveway and landscaped terrace)	Original (2005)	-	9 yrs

## 5.20 Occupied Spaces

### Observations:

Generally the occupied spaces within the Lakeview Garage are in adequate condition. The three connected rooms on the first level, two of which serve as closets and one as the elevator room have no known issues. The electrical room in the Northwest corner of the first floor experiences water issues associated with previously described ponding issues in front of the Manager's office.

The Manager's office should be painted and have new sealant installed along the bottom of the metal walls.

Materials are stored around and behind the Manager's office block the drainage path and hold moisture. It is recommended to remove these items and store elsewhere. A long term alternative could be to construct a storage room adjacent to the electrical room on Level 1.

## 5.21 Striping and Deck Markings

**CI = 3** Levels 1 through 4 have little to no visibility

### Observations:

The visibility of the striping for the stalls varied from barely visible to moderately visible randomly throughout levels 1, 2, 3 and 4. The pavement markings for the ramp up to level 3 were in the worst condition with close to zero visibility. The pavement markings on the roof level (level 5) were observed to be in the best condition. Markings such as turn arrows were not visible and are needed. All levels should be restriped, including arrows, parking stalls, and curbs. This has been accounted for with general maintenance, and should be coordinated following short term repairs.

It was also noted that where stripes were present vehicles were not parking within striped areas. Stall spacing as measured at approximately 8'-6" wide, and it should be considered to widen parking spaces during garage restriping.

## 5.22 Mechanical and Fire Suppression Systems

### Observations:

Generally mechanical lines were in good condition. The piping for stand pipes requires some spot cleaning of rust and painting (Level 2 grid C/C.1, Level 1 grid A/2). This should occur with general housekeeping and preventative maintenance operations.

## 5.23 Americans with Disabilities Act (ADA) Review

**CI = 8** Generally complies with ADA standards.

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 Burlington, VT

Observations:

Access/ entry to the garage appears to meet ADA standards.

Inside the garage, (12) Accessible parking spaces are provided, including (3) adjacent to the Macy's entrance and (1) reserved for Hotel Vermont patrons. The garage has 401 spaces. For every 6 or fraction of 6 at least one shall be accessible Van Parking. Therefore the required number of spaces to meet ADA requirements is (7 Accessible parking spaces + 2 Van Spaces = 9 spaces).

In general, Accessible parking spaces are of adequate size and include adjacent clear space for wheelchair loading and unloading. Signage and/or painting depicting the universal symbol of accessibility is provided, and striping is visible.

At stairwells, access is poor in places due to damaged and cracked sloped concrete at door approaches.

<b>ADA-1</b>	Issue:	Elevator tactile signage is missing from L4 & L5
	Cause:	Omission or vandalism
	Effect/Consequence:	Non compliance
	Repair Recommendation:	Add signage in listed locations
	Repair Timeframe:	<b>Short Term</b>

<b>ADA-2</b>	Issue:	Light on Elevator Shaft mounted too low.
	Cause:	Installation
	Effect/Consequence:	Non compliance
	Repair Recommendation:	Raise height of light to 80" if possible ( per 2010 ADA 307)
	Repair Timeframe:	<b>Short Term</b>

**Westlake Garage** **CI = 8** Generally complies with ADA standards.

Access/ entry to the garage appears to meet ADA standards.

Inside the garage, (4) Accessible parking spaces are provided, including (1) van-accessible space, which accommodates up to 100 spaces.

Accessible parking spaces are of adequate size and include adjacent clear space for wheelchair loading and unloading. Signage and/or painting depicting the universal symbol of accessibility is provided, and striping is visible.

#### 5.24 General Recommended Improvements

In addition to the necessary repairs and preventative maintenance proposed in this report there are several features that could be added which would greatly benefit the overall function and appearance of the garage. They are as follows:

- **Additional Security Cameras:** Security at Parking Facilities could benefit from additional cameras in stair towers, general floor level locations, and operational cameras in elevators.
- **Public Address System:** Public Address (PA) systems provide an opportunity for mass notification throughout the facility in the event of an emergency.
- **Electric Vehicle (EV) Charging Stations:** At the Lakeview garage BED has installed two Level 2 (fast charging) Chargepoint charging systems. This is a charge card based system allowing for charging activation based upon a swiped credit or debit card. KEA does not know the details of the business model used for this new convenience, or if plans are underway to also provide additional charging stations at this facility. KEA recommends that charging stations be planned for when doing any electrical system upgrades at this facility. This added customer convenience could be set up as a free service as a loss leader for incentivizing vehicles to the downtown area, or as a charged service for revenue enhancement.
- **Solar PV Panel Installation:** The parking garage has an opportunity to leverage the recent reduction in photovoltaic system (PV) installation costs to reduce its carbon footprint while offering better protection from the elements for cars parked on the upper decks of this structure. Arrays can be designed so as to be installed on a raised frame so as to essentially add a roof over the upper deck parked cars. The PV system would be net-metered, and if done in conjunction with other garages could be group metered as well. This power generation could be significant, easily up to 300 kW for this garage alone if a significant portion of the rooftop area is used. This site has a clear uninhibited skyview and is oriented to take maximum advantage of the south and west facing parts of the sky for maximum production. System costs could be in the \$3/watt installed range or the PV system itself, plus mounting structure cost of elevating the system above the car deck.
- **WiFi or WiMax:** With the already installed data network, the parking garage already has internet access capabilities to deploy a Wifi or WiMax internet access point(s) for the facility. Again, this could be used as a customer draw to the downtown area. Arrangements could be made with several downtown merchants to creatively deliver special sales or coupon offers via this service platform to further entice users to the garage(s). Similar to the EV charging stations, this system could be used as a free amenity to patrons or possibly used as a revenue stream with area merchants who return a negotiated fee for every customer that makes store purchases as a result of using this parking garage service.

5.25 Maintenance

Observations:

Numerous birds, pigeons in particular, were observed roosting on the steel beams. At some locations it was evident that certain beams were more frequently occupied than others based on the higher concentration of pigeon droppings aka “guano”; one of the worst locations was noted on Level 3 along column line D and along grid line 9. It is recommended to install bird spikes on some of the beams that are identified as popular roosting locations and to clean the existing pigeon droppings as it is a health hazard.

<b>MA-1</b>	Issue:	Excessive concentration of pigeon droppings.
	Cause:	Pigeons roosting on the steel beams.
	Effect/Consequence:	Health hazard.
	Repair Recommendation:	Clean existing pigeon droppings. Install bird spikes on beams.
	Repair Timeframe:	<b>Short Term</b>

Parking garages require more housekeeping and preventative maintenance than most structures. Owners can see significant long term savings by following best practices for routine garage upkeep. The Precast Concrete Institute (PCI) provides a detailed Maintenance Manual for Precast Parking Structures that includes recommendations for daily, weekly, monthly, quarterly, semi-annually, annually, and as required housekeeping, preventative maintenance, and inspection schedules. Reference Appendix D for excerpts from this manual: Table A – Housekeeping Schedule, and Table B – Preventative Maintenance Schedule. Capital planning efforts should account for these routine activities.

Preventative Maintenance: Many Components of the garage require frequent cleaning, repair, and replacement. Elements such as paint, joint sealants, waterproofing membranes, roofing membranes, and concrete sealer degrade over time and have a dependable life expectancy as supplied by the manufacturer and industry standards. We have calculated for a garage of this size and type the City should appropriate an annual **Preventative Maintenance and Housekeeping Budget of \$170,000 to \$180,000**. This accounts for work to be completed each year as well as routine repair/replacement items. A breakdown of this estimate has been provided in Appendix A of this report.

## 6 SUMMARY

The Lakeview Garage is in good condition and in need of few repairs. Some of the structural repairs need to be made in the near future and other minor repairs that are less urgent can be addressed at a later time. In order to assist with completing the most time critical repairs and developing funding for future projects we have summarized the above described issues into the following prioritization matrix (in order of highest priority to lowest):

Report Designation	Description	Cost	Recommended Timeframe
CG-1	Cable Guardrail Repair	\$13,200	<b>Short Term</b>
CIP-2	Concrete Threshold Repair	\$3,960	
ELS-1	Install Missing Fire Alarm System Components	\$1,650	
ST-2	Replace Stair Lengths at Southwest Stair	\$33,000	
DT-1	Double-Tee Beam Shear Tab Repair	\$75,735	
JS-1	Joint Sealant Replacement at Levels 2, 3, 4, & 5	\$39,765	
WCIP-2	Repair Westlake Roof Slab Crack	\$14,025	
WSD-1	Repair leaking Westlake Roof Drains	\$19,800	
WRM-2	Repair Membrane at Standpipe Locations	\$3,300	
EJ-2	Replace Expansion Joint at Cherry Street Entrance	\$14,850	
DT-2	Double-Tee Beam Surface Spall Repair	\$2,640	
SD-1	Flush Existing Drainage System (Unplug)	\$8,250	
SD-2	Install Additional Floor Drains	\$9,900	
ST-1	Install Door at Stair Tower Entrance on Roof Level	\$13,200	
EJ-1	Repair expansion joint at Ramp 2/3	\$6,600	
OP-1	Reseal Glazing	\$8,250	
ADA-1	Add Elevator Tactile Signage	\$1,650	
ADA-2	Raise Height of Elevator Shaft Light	\$2,475	
CIP-1	Repair Wash Area Cracks	\$19,800	
MA-1	General Cleanup of Pigeon Droppings	\$24,750	
WEJ-1	Install Expansion Joint at Westlake Roof Level – East Wall	\$19,800	<b>Mid Term</b>
WCS-1	Install Westlake 2 <sup>nd</sup> Floor Perimeter Sealant	\$16,500	
WCS-2	Westlake Roof level Perimeter Sealant at West and North Walls	\$42,900	

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Report Designation	Description	Cost	Recommended Timeframe
WRM-1	Install Flashing, Repair Membrane at West and North Walls of Westlake Garage	\$24,750	
WCIP-1	Westlake Column Chamfer Repair	\$3,960	
ED-1	Repair Corroded Conduit and Wiring	\$41,250	
DT-3	Double-Tee Beam Crack Repair	\$21,450	
PC-2	Precast Spandrel Beam Concrete Spall Repair	\$990	
MB-1	Liquid Membrane Installation at Wash Areas	\$22,770	
PC-1	Precast Spandrel Beam Lift Anchor Sealant Patch Repair	\$4,950	
EL-1	Improve Roof Level Lighting	\$82,500	
WEL-1	Westlake Install Additional Level 2 Lighting Fixtures	\$16,500	
SS-1	Structural Steel Spot Clean and Paint	\$33,000	
SD-3	Install New Floor Drain in Southwest Stair Tower Lower Level	\$8,250	
OP-2	Replace Door Closer Assembly	\$1,650	
ST-3	Replace Elevator Indicator Light	\$2,475	
ST-4	Replace Electrical Cover Plates	\$1,650	
EJ-1b	Repair Concrete Slab Transition at Expansion Joint	\$16,500	
ELS-2	Replace Exit Fixtures and Add Signage	\$33,000	

- Note: Individual costs shown above account for Project Management and Engineering Fees

Further discussion is necessary with DPW and invested stakeholders to determine the optimum construction operation hours for repair work and long term routine maintenance work at this garage.

The budget estimates for repair work have assumed staged efforts to maintain garage access. An additional 20% has been included for Traffic Control and added Mobilization costs.

As stated earlier in this report, housekeeping and preventative maintenance need to occur at their recommended schedule (reference Appendix D), coordinated but independent of repair schedules. It is likely that there are structural issues which haven't presented yet. Routine inspections should be completed by parking garage staff, with bi-annual structural inspections by a professional engineer.

# **APPENDIX A**

## **Budgetary Estimates**



Calc. By:	AAS	Date:	6/30/2014
Chck. By:	JAO	Date:	7/10/2014
Chck. By:		Date:	
Chck. By:		Date:	

**Lakeview Parking Garage Assessment**  
**Budgetary Estimate of Probable Repair/Replacement Costs**  
**Hoyle, Tanner Project No. 909042**

		Quantity		Cost	
		Unit	Amount	Unit Price	Total
<b>Short-Term Recommendations</b>					
JS-1	Joint Sealant Replacement at Levels 2, 3, 4, & 5	LF	2,410	\$10.00	\$ 24,100.00
EJ-1a	Repair Expansion Joint	LF	50	\$80.00	\$ 4,000.00
EJ-2	Replace Expansion Joint	LF	50	\$180.00	\$ 9,000.00
DT-1	Double-Tee Beam Shear Tab Repair	EA	270	\$170.00	\$ 45,900.00
DT-2	Double-Tee Beam Surface Spall Repair	SF	40	\$40.00	\$ 1,600.00
CIP-1	Cracks in CIP Concrete Wash Area	LF	240	\$50.00	\$ 12,000.00
CIP-2	CIP Concrete Threshold Repair	SF	40	\$60.00	\$ 2,400.00
WCIP-2	Westlake - Repair Concrete Roof Slab Crack	LS	1	\$8,500.00	\$ 8,500.00
CG-1	Cable Guardrail Repair	EA	4	\$2,000.00	\$ 8,000.00
ELS-1	Install Missing Fire Alarm System Components	LS	1	\$1,000.00	\$ 1,000.00
OP-1	Reseal Glazing System	LS	1	\$5,000.00	\$ 5,000.00
ST-1	Install Door at Stair Tower Entrance on Roof Level	EA	2	\$4,000.00	\$ 8,000.00
ST-2	Replace Stair Lengths & Connections	EA	2	\$10,000.00	\$ 20,000.00
SD-1	Flush Existing Drainage System (Unplug)	LS	1	\$5,000.00	\$ 5,000.00
SD-2	Additional Floor Drains	EA	4	\$1,500.00	\$ 6,000.00
WSD-1	Westlake - Repair Membrane Connection at Drain Locations	EA	6	\$2,000.00	\$ 12,000.00
WRM-2	Westlake - Repair Membrane Connection at Standpipe Locations	EA	1	\$2,000.00	\$ 2,000.00
ADA-1	Install Elevator Tacticle Signage	LS	1	\$1,000.00	\$ 1,000.00
ADA-2	Raise Height of Light on Elevator Shaft	LS	1	\$1,500.00	\$ 1,500.00
MA-1	General Cleanup of Pigeon Droppings	LS	1	\$15,000.00	\$ 15,000.00

<b>CONSTRUCTION SUBTOTAL</b>	<b>\$192,000.00</b>
<b>20% CONSTRUCTION CONTINGENCY</b>	<b>\$38,400.00</b>
<b>ENGINEERING COSTS (ESTIMATED AT 20% OF CONSTRUCTION)</b>	<b>\$38,400.00</b>
<b>RESIDENT ENGINEERING COSTS (ESTIMATED AT 20% OF CONSTRUCTION)</b>	<b>\$38,400.00</b>
<b>PROJECT MANAGEMENT COSTS (5% OF CONSTRUCTION, INTERNAL TO CITY)</b>	<b>\$9,600.00</b>
<b>TOTAL COST =</b>	<b>\$316,800</b>

This Engineers Estimate of Probable Construction Costs is based on the anticipated scope of work, as well as Hoyle, Tanner's experience with similar projects and understanding of current industry trends. It should be noted that changes in material or labor costs in the construction industry could impact the project cost in either direction.

PROJECTED COSTS (ESTIMATED INFLATION AT 3%)	2015	2016	2017	2018
	\$316,800	\$326,310	\$336,100	\$346,190



Calc. By:	AAS	Date:	6/30/2014
Chck. By:	JAO	Date:	7/10/2014
Chck. By:		Date:	
Chck. By:		Date:	

**Lakeview Parking Garage Assessment  
Budgetary Estimate of Probable Repair/Replacement Costs  
Hoyle, Tanner Project No. 909042**

		Quantity		Cost	
		Unit	Amount	Unit Price	Total

**Mid-Term Recommendations**

WCS-1	Westlake - Install 2nd Level Perimeter Sealant	LF	500	\$20.00	\$ 10,000.00
WCS-2	Westlake - Repair Roof Perimeter Sealant at Slab / Wall Joint (Access Below Landscaping)	LF	260	\$100.00	\$ 26,000.00
EJ-1b	Repair Concrete Slab Transition to Expansion Joint	SF	250	\$40.00	\$ 10,000.00
WEJ-1	Westlake Install Roof Level Expansion Joint at East Wall	LF	80	\$150.00	\$ 12,000.00
MB-1	Membrane Installation	SF	2,760	\$5.00	\$ 13,800.00
DT-3	Double-Tee Beam Crack Repair	LF	260	\$50.00	\$ 13,000.00
WCIP-1	Westlake - Install Grout Chamfer Around Column Base	EA	6	\$400.00	\$ 2,400.00
PC-1	Precast Spandrel Beam Lift Anchor Sealant Patch	EA	100	\$30.00	\$ 3,000.00
PC-2	Precast Spandrel Beam Concrete Spall	SF	10	\$60.00	\$ 600.00
SS-1	Structural Steel Repair	LS	1	\$20,000.00	\$ 20,000.00
ED-1	Repair/Replace Corroded Electrical Conduit and Wiring Lengths	LS	1	\$25,000.00	\$ 25,000.00
EL-1	Replace Roof Level Lighting System	LS	1	\$50,000.00	\$ 50,000.00
WEL-1	Westlake - Install Additional Lighting Fixtures at Level 2	LS	1	\$10,000.00	\$ 10,000.00
ELS-2	Install Exit Signage	LS	1	\$20,000.00	\$ 20,000.00
OP-2	Replace Door Hardware (Closer)	EA	1	\$1,000.00	\$ 1,000.00
ST-3	Replace Elevator Indicator Light	EA	1	\$1,500.00	\$ 1,500.00
ST-4	Replace Electrical Box Covers	LS	1	\$1,000.00	\$ 1,000.00
SD-3	Install New Floor Drain at Southwest Stair Tower Lower Level (and piping)	LS	1	\$5,000.00	\$ 5,000.00
WRM-1	Westlake - Patch / Repair Membrane at Roof Level North and West Walls	LS	1	\$15,000.00	\$ 15,000.00

<b>CONSTRUCTION SUBTOTAL</b>	<b>\$239,300.00</b>
<b>20% CONSTRUCTION CONTINGENCY</b>	<b>\$47,860.00</b>
<b>ENGINEERING COSTS (ESTIMATED AT 20% OF CONSTRUCTION)</b>	<b>\$47,860.00</b>
<b>RESIDENT ENGINEERING COSTS (ESTIMATED AT 20% OF CONSTRUCTION)</b>	<b>\$47,860.00</b>
<b>PROJECT MANAGEMENT COSTS (5% OF CONSTRUCTION, INTERNAL TO CITY)</b>	<b>\$11,965.00</b>
<b>TOTAL COST =</b>	<b>\$394,900</b>

PROJECTED COSTS (ESTIMATED INFLATION AT 3%)	2015	2016	2017	2018
	\$394,900	\$406,750	\$406,750	\$418,960



Calc. By:	JAO	Date:	7/8/2014
Chck. By:		Date:	
Chck. By:		Date:	
Chck. By:		Date:	

**Lakeview Parking Garage Assessment**  
**Budgetary Estimate of Preventative Maintenance Costs**  
**Hoyle, Tanner Project No. 909042**

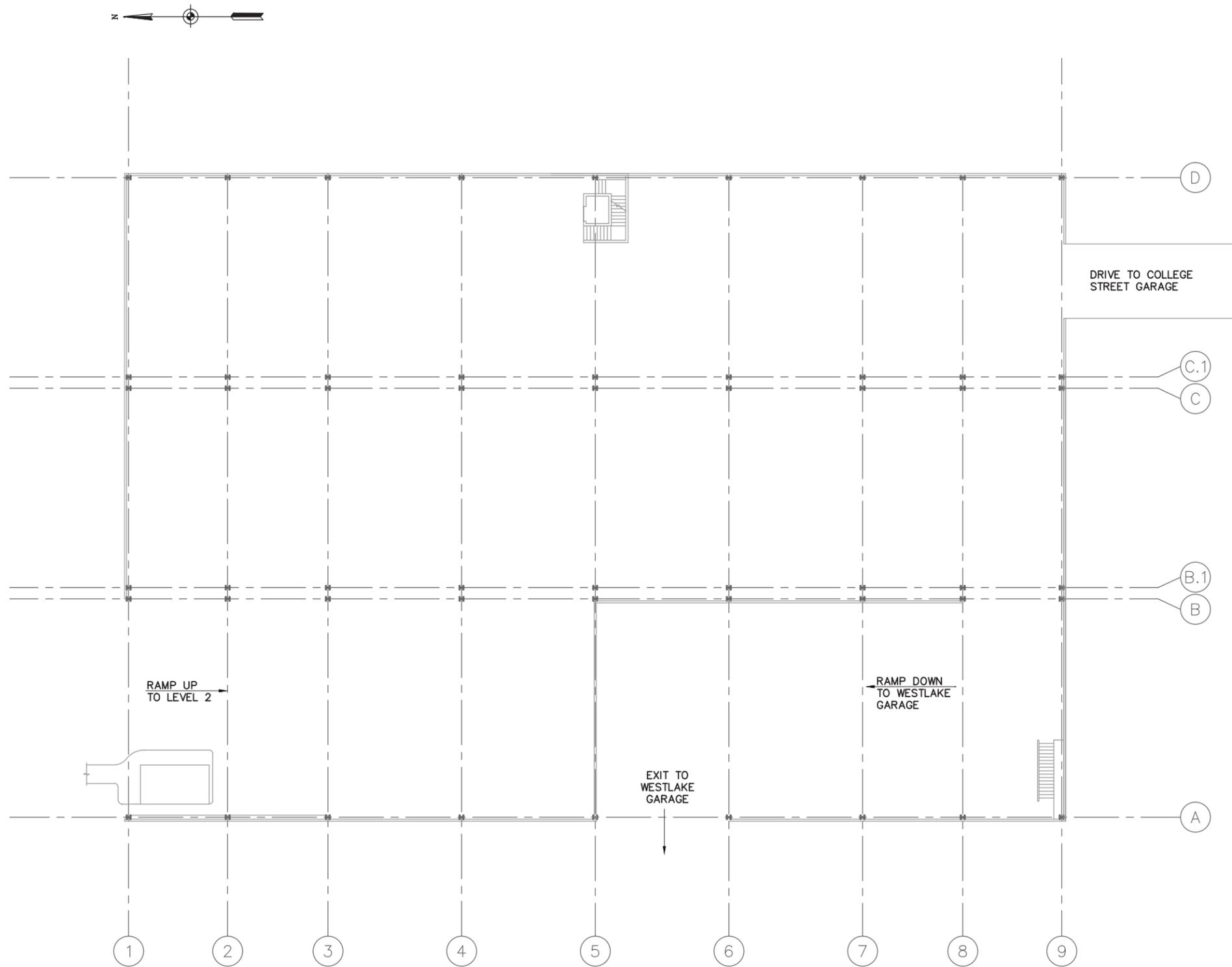
	Cost	Estimated Frequency	Adjusted Annual Frequency	Adjusted Annual Cost
<b>Maintenance Cost</b>				
Floor Washdowns	\$10,000.00	twice/yr	2.00	\$ 20,000.00
Silane Concrete Sealer	\$206,000.00	every 5 yrs	0.20	\$ 41,200.00
Paint Structural Steel	\$100,000.00	every 15 yrs	0.07	\$ 6,666.67
Striping & Markings	\$36,000.00	every 2 yrs	0.50	\$ 18,000.00
Joint Sealant - Full Replacement	\$185,000.00	every 7 yrs	0.14	\$ 26,428.57
Joint Sealant Repairs	\$5,000.00	annual	1.00	\$ 5,000.00
General Concrete Sealant Replacement	\$22,000.00	every 10 yrs	0.10	\$ 2,200.00
Expansion Joint Replacement	\$47,520.00	every 10 yrs	0.10	\$ 4,752.00
Epoxy Floor Membranes	\$14,000.00	every 5 yrs	0.20	\$ 2,800.00
HVAC Equipment Maintenance	n/a			
Annual Elevator Maintenance Contract Costs	\$4,400.00	annual	1.00	\$ 4,400.00
Elevator Repair Costs	\$30,000.00	every 7 yrs	0.20	\$ 6,000.00
Misc. Repairs	\$5,000.00	annual	1.00	\$ 5,000.00

<b>CONSTRUCTION SUBTOTAL</b>	<b>\$142,447.24</b>
<b>10% INFLATION COSTS</b>	<b>\$28,489.45</b>
<b>TOTAL COST =</b>	<b>\$171,000</b>

Note: Budgeted Costs shown do not include standard operating costs which account for staff salaries, utility costs, basic routine housekeeping, and general garage software systems and licenses. Nor do items shown above reflect all housekeeping and preventative maintenance efforts. The intent of this is to assist with budget planning and should be updated as routine maintenance costs are standardized for this garage.

# **APPENDIX B**

## **Garage Plans**



LEVEL 1 PLAN

ENGINEER

REV.	DESCRIPTION	DATE

MAY 2014	DESIGN BY: JAO	DRAWN BY: AAS	CHKD. BY: JAO	SCALE: AS SHOWN
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 125 College St, Burlington, VT 05401  
 Tel (802) 860-1331 • Fax (802) 860-6499  
 Webpage: www.hoyletanner.com

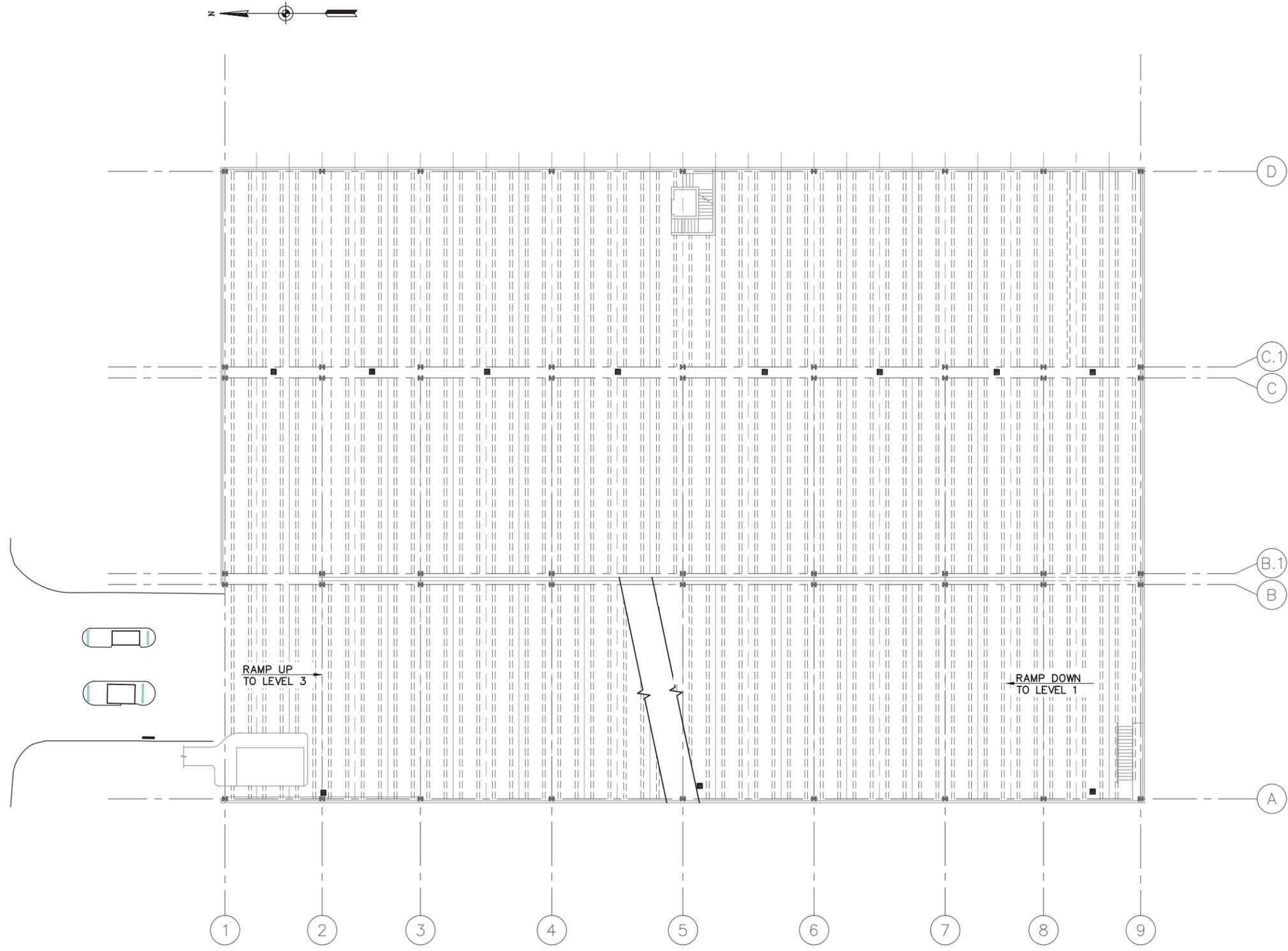
CITY OF BURLINGTON  
 BURLINGTON, VERMONT  
 LAKEVIEW PARKING GARAGE

LEVEL 1 PLAN

PROJECT NO.: 909042  
 FILE NAME: PLAN\_LAYOUT  
 SHEET NO.

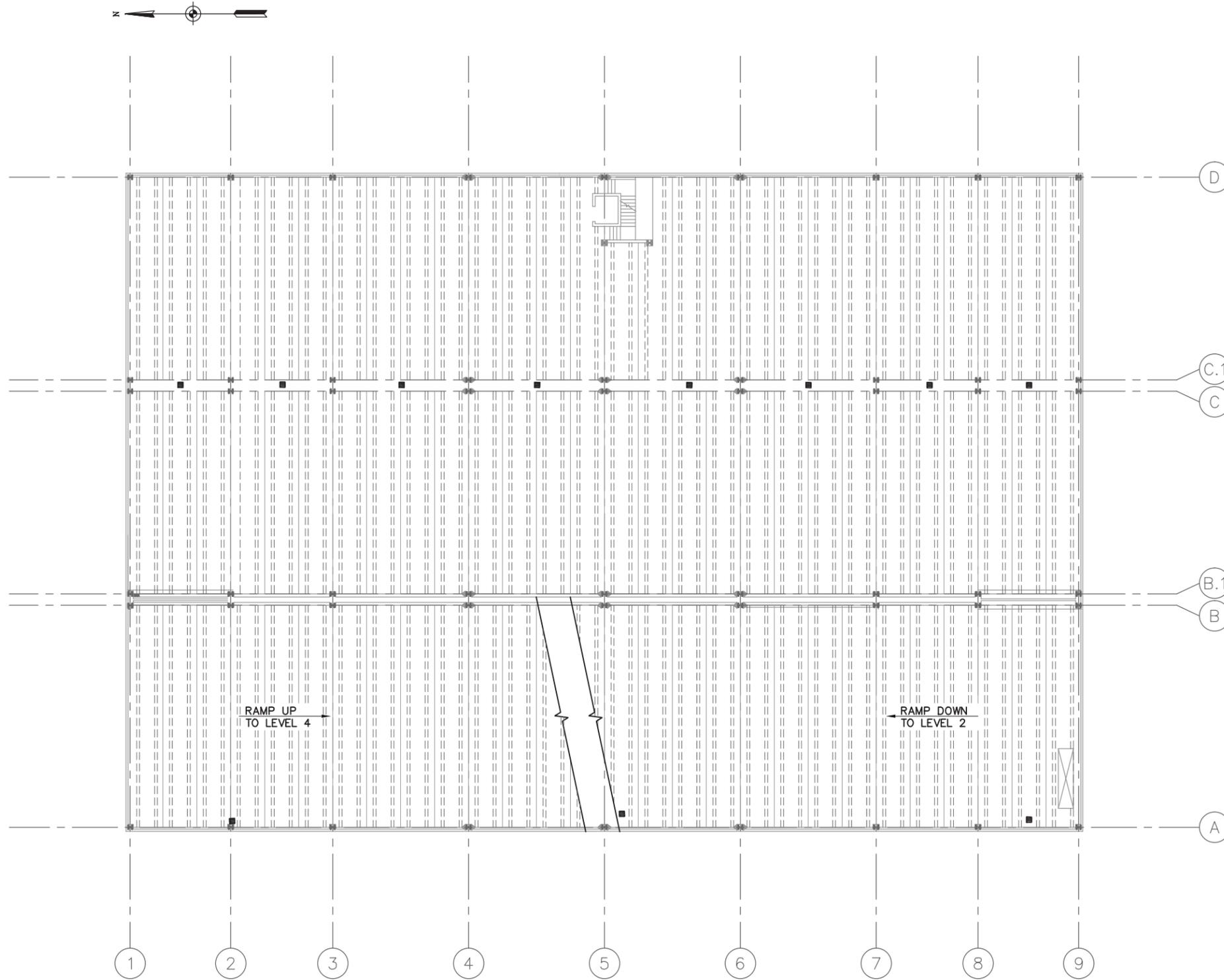
**I-1**  
 SHEET 1 OF 5

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LEVEL 2 PLAN

ENGINEER	
REV.	DESCRIPTION
DATE	DATE
DRW. CHD. BY:	DATE
DESIGN BY: JAO	
DRAWN BY: AAS	
CHD. BY: JAO	
SCALE: AS SHOWN	
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<p>CITY OF BURLINGTON          BURLINGTON, VERMONT          LAKEVIEW PARKING GARAGE</p>	
<p>LEVEL 2 PLAN</p>	
PROJECT NO.:	909042
FILE NAME:	PLAN_LAYOUT
SHEET NO.	
<p><b>I-2</b></p>	
<p>SHEET 2 OF 5</p>	



LEVEL 3 PLAN

ENGINEER

REV.	DESCRIPTION	DATE

MAY 2014	DESIGN BY: JAO	CHD. BY: JAO
	DRAWN BY: AAS	SCALE: AS SHOWN

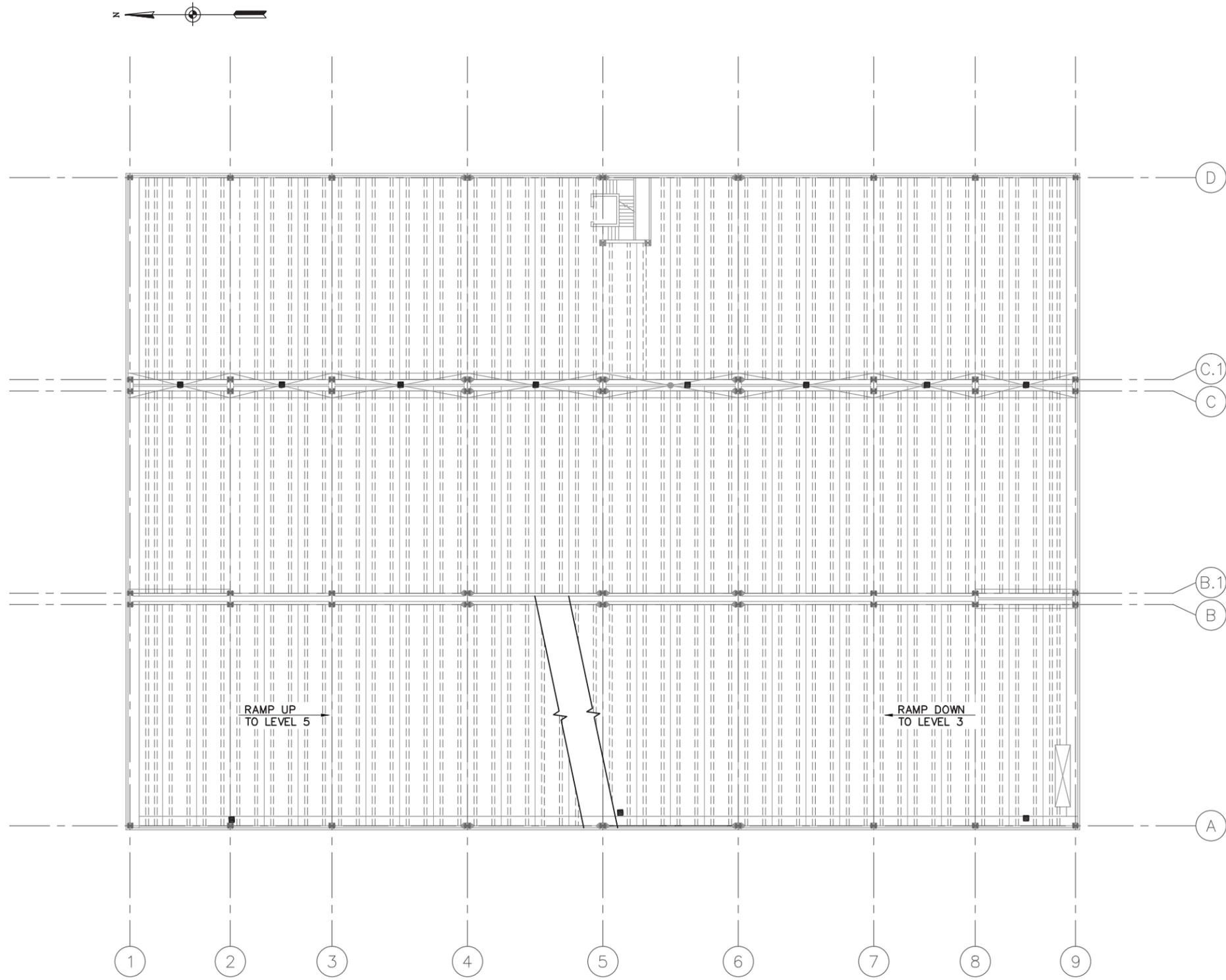
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CITY OF BURLINGTON  
 BURLINGTON, VERMONT  
 LAKEVIEW PARKING GARAGE  
 LEVEL 3 PLAN

PROJECT NO.: 909042  
 FILE NAME: PLAN\_LAYOUT  
 SHEET NO.

**I-3**  
 SHEET 3 OF 5

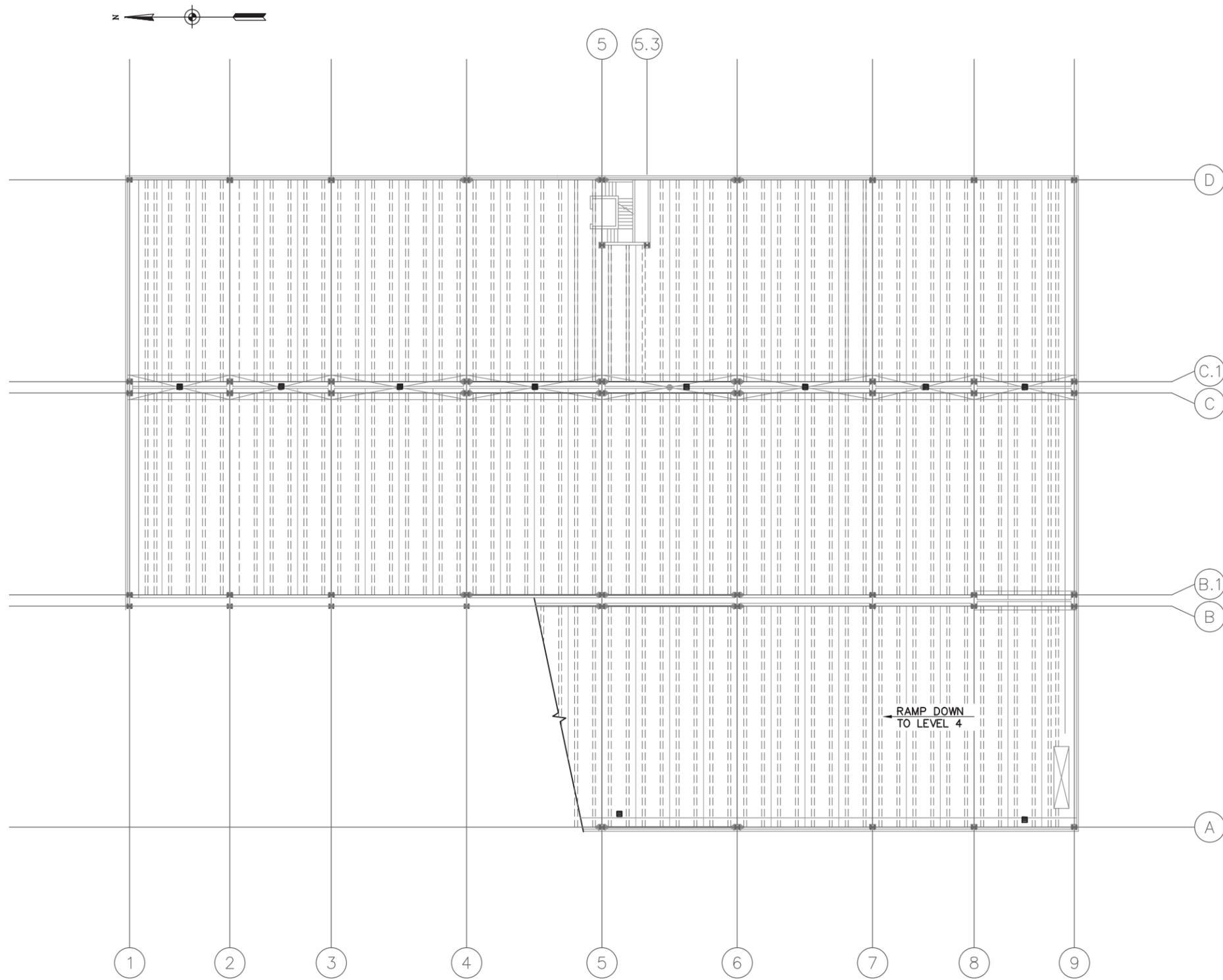
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LEVEL 4 PLAN

ENGINEER	
REV.	DESCRIPTION
DATE	DATE
DESIGN BY: JAO	CHD. BY: JAO
DRAWN BY: AAS	SCALE: AS SHOWN
MAY 2014	AS SHOWN
<p><b>Hoyle, Tanner &amp; Associates, Inc.</b>          © Copyright 2014 Hoyle, Tanner &amp; Associates, Inc.          125 College St., Burlington, VT 05401          Tel (802) 860-1331 • Fax (802) 860-6499          Webpage: www.hoyletanner.com</p>	
CITY OF BURLINGTON BURLINGTON, VERMONT LAKEVIEW PARKING GARAGE	
PROJECT NO.: 909042 FILE NAME: PLAN_LAYOUT SHEET NO.	
<h1>I-4</h1>	
SHEET 4 OF 5	

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LEVEL 5 PLAN

REV.	DESCRIPTION	DATE

MAY 2014  
 DESIGN BY: JAO  
 DRAWN BY: AAS  
 CHD. BY: JAO  
 SCALE: AS SHOWN

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PROJECT NO.: 909042
FILE NAME: PLAN LAYOUT
SHEET NO.
<b>I-5</b>
SHEET 5 OF 5

ENGINEER

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# **APPENDIX C**

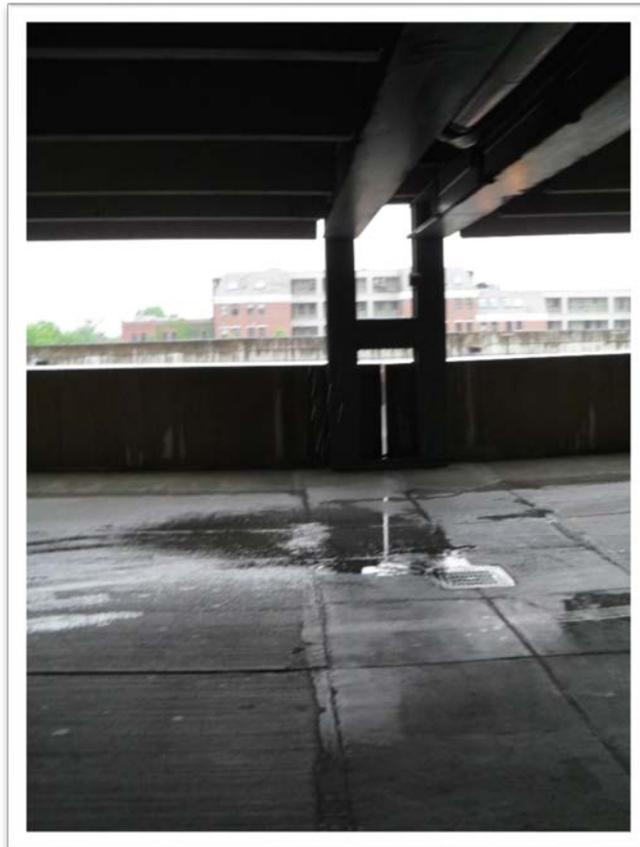
## **Photograph Log**

Lakeview Parking Garage, Burlington, VT

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JS-1: Spalled Concrete Adjacent to Joint Locations

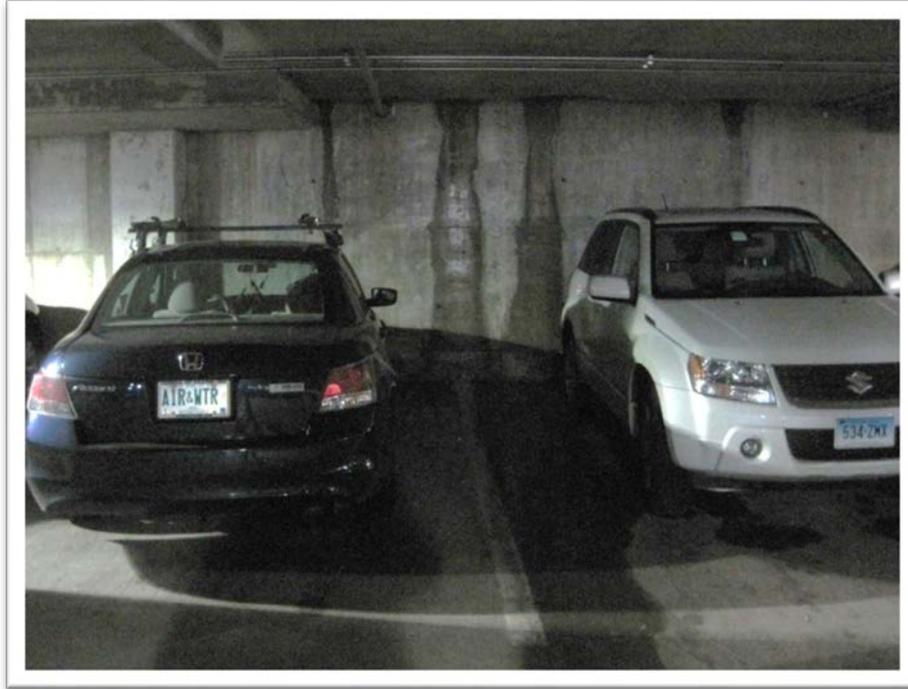


JS-1: Water Leaking Through Gap at Double-Tee Joint (Level 3 – Column Line C.1, Grids 8 to 9)

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Lakeview Parking Garage, Burlington, VT

---



WCS-2: Leaking at North Wall of Westlake Garage

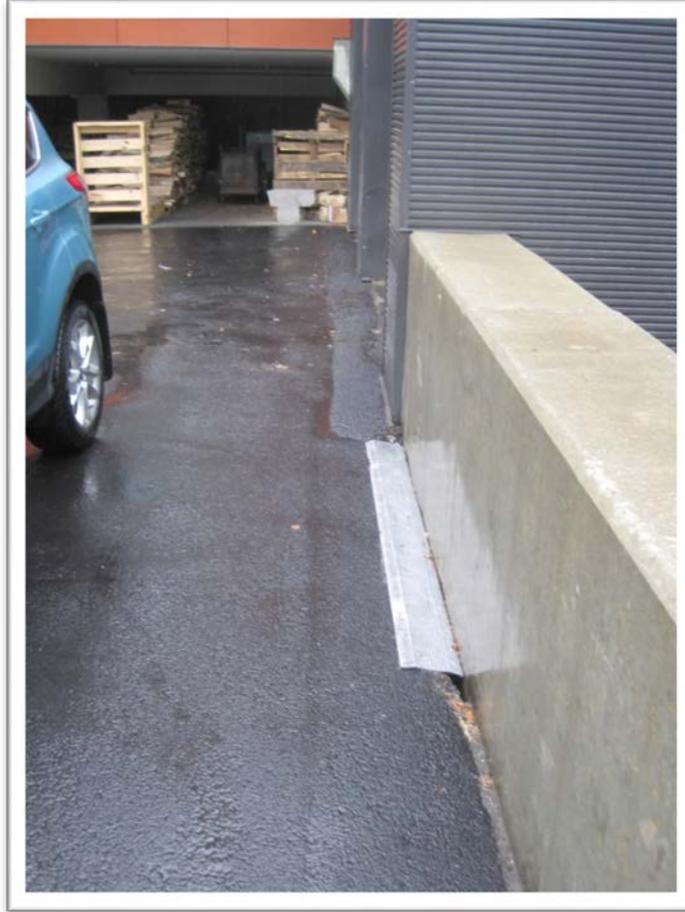


EJ-2: Expansion Joint at Cherry Street Entrance

---

Lakeview Parking Garage, Burlington, VT

---



WEJ-1: Missing Expansion Joint at East Wall



DT-3: Transverse Crack in Double-Tee Flange

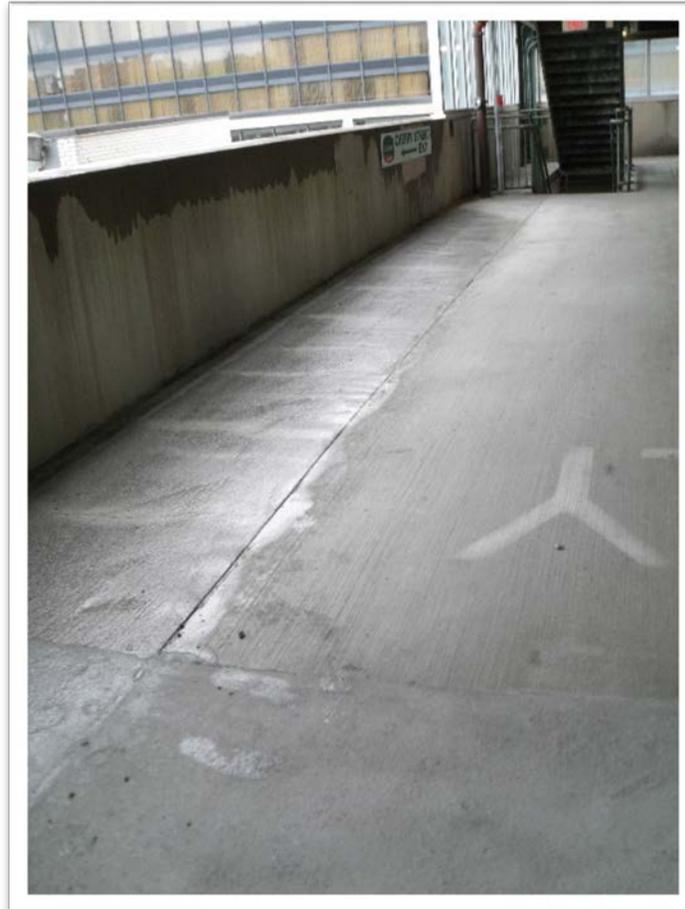
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Lakeview Parking Garage, Burlington, VT

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CIP-2: Cracks in CIP Wash Area Adjacent to Drain on Roof Level

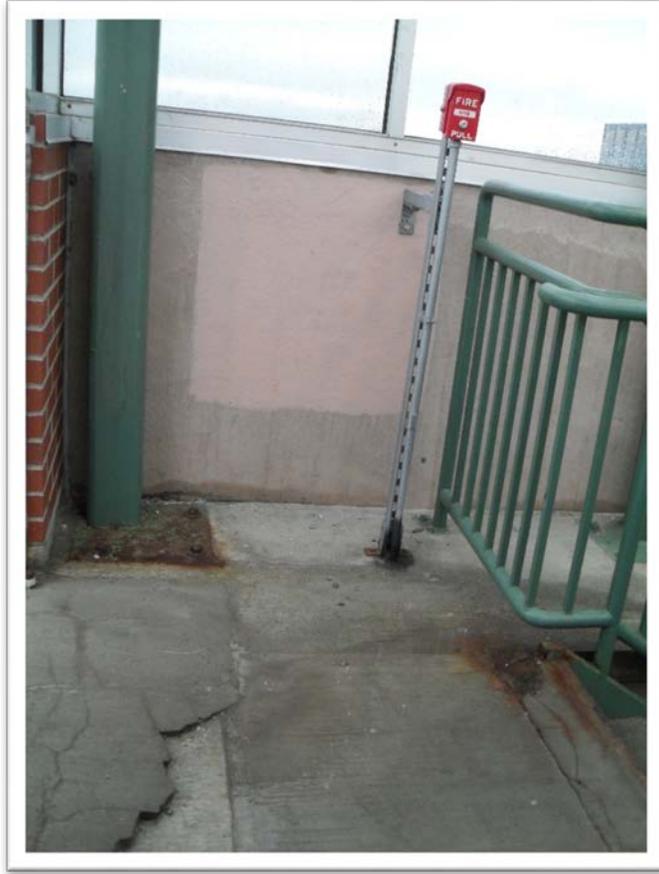


CIP-1: Cracks in Raised Concrete Wash Area

---

Lakeview Parking Garage, Burlington, VT

---



CIP-2: Damaged CIP Concrete at Threshold



WCIP-1: Surface Flow against Westlake Garage Concrete Column

---

Lakeview Parking Garage, Burlington, VT

---



WCIP-2: Crack in Westlake Garage Roof Slab



PC-1: Missing Lift Anchor Sealant Patch in Precast Spandrel Beam

---

Lakeview Parking Garage, Burlington, VT

---



PC-2: Spalled Concrete at Top of Precast Spandrel Beam Under Flashing Attachment



PC-3: Map Cracking in Precast Spandrel Beam on Level 5

---

Lakeview Parking Garage, Burlington, VT

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CG-1: Damaged Cable Guardrail Connection

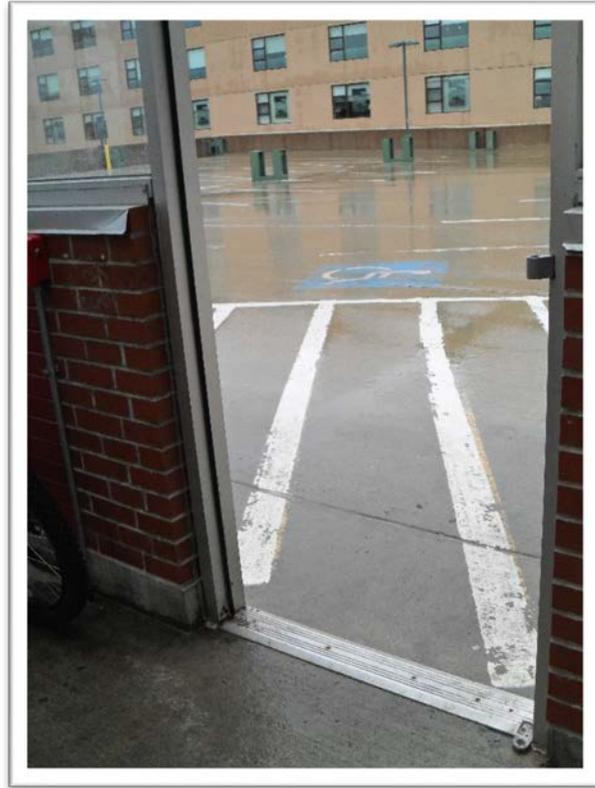


OP-1 Standing Water at East (Macy's) Stairwell Roof Enclosure

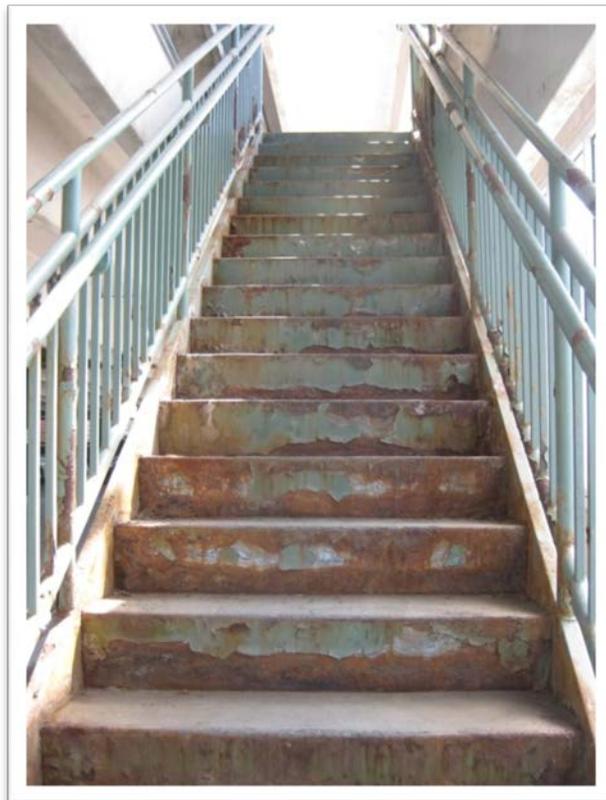
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Lakeview Parking Garage, Burlington, VT

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ST-1: Entrance to Stair Tower on Roof Level

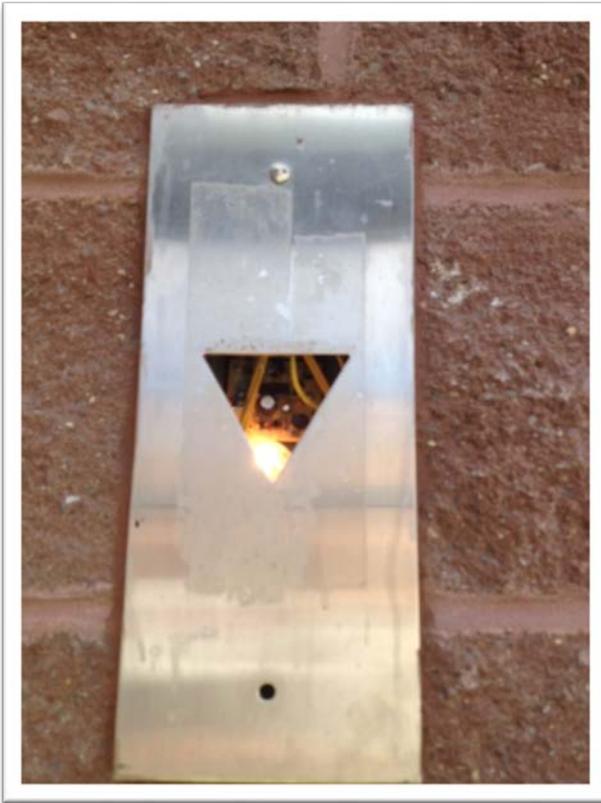


ST-2: Southwest Stair Corrosion and Rust

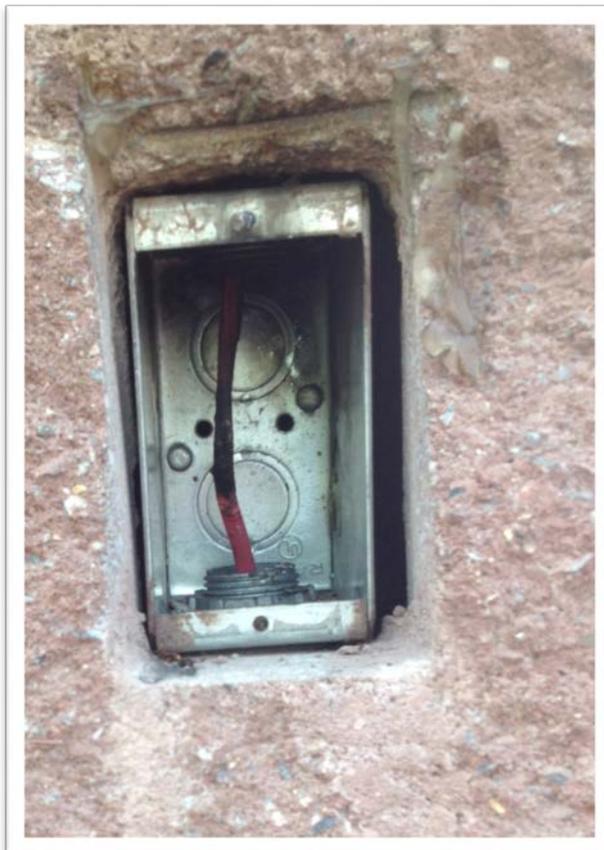
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Lakeview Parking Garage, Burlington, VT

---



ST-3: Elevator Indicator light Glass is Broken



ST-4: Multiple Electrical Box Covers at Stairs Have Been Vandalized / Removed & Contents Burned.

---

Lakeview Parking Garage, Burlington, VT

---



SD-1: Plugged Drain



SD-2: Ponding Water Not Reaching Existing Drain (Elevator Stair Tower at Roof Level)

---

Lakeview Parking Garage, Burlington, VT

---



SD-2: Drain at Bottom of Ramp at Hotel Vermont



WSD-1: Leaking at Roof Drain Locations

---

Lakeview Parking Garage, Burlington, VT

---



WRM-General: Westlake Landscaped Roof Deck (Paved Parking Area in Background)

# **APPENDIX D**

**Excerpts from PCI Parking Garage  
Maintenance Manual**

TABLE A Housekeeping Schedule	Other	As Required	Annually	Semi Annually	Quarterly	Monthly	Weekly	Daily
Sweeping								
Localized							*	
Overall							*	
Trash Pickup								
Control Joint Cleaning				*				
Expansion Joint Cleaning								
Elevator Cleaning								
Elevator Maintenance			*					
Window Cleaning				*				
Stain Cleaning							*	
Parking Space Restriping		*				○		
Remove Oil Stains		*						○
Relamping							*	○
Check Light Fixtures and Exposed Conduit and Repair		*				○		
Light Fixture Cleaning			*					
Floor Drain Cleaning				*			○	
Lavatory, Office, Waiting Room, Janitorial Service, Cashier Booths							*	
Graffiti Removal							*	
Graphics Cleaning								
Graphics Repair & Maintenance			*					
Non-Illuminated		*			○			
Illuminated		*						○
Parking Equipment Maintenance		*						○
Security System Check		*						*
Landscaping							*	
Doors & Hardware							*	
Ventilation							○	
Snow Removal		*					*	
Ice Removal		*					○	
Safety checks		*					○	
Carbon Monoxide Monitor		*					○	
Exit Lights		*					○	
Emergency Lights		*					○	
Tripping Hazards		*					○	
Handrails & Guardrails		*					○	
Control Joint Cleaning		*		*			○	

○ = Inspect  
\* = Perform Operation

EXCERPT FROM PCI MAINTENANCE MANUAL FOR PRECAST PARKING STRUCTURES

(3)

TABLE B Preventive Maintenance Schedule Inspect and Repair as Necessary	Daily	Weekly	Monthly	Quarterly	Semi Annually	Annually	As Required	Other
Floor Washdowns					*			(1)
Floor Potholes & Cracking		○			*			
Scaling		○			*			
Expansion Joints					*			
Joint Sealants						*		
Bearing Pads						○	*	
Rust (Exposed Steel)				○				
Repaint			○				*	
Drain Water Systems for Winter						○		
Floor Surface Sealer							*	(2)
Stair Repair	○							
Plumbing		○				*		
HVAC Equipment			○				*	(3)
Fire Protection Systems			○				*	
Floor Drains		○			*			
Check Sanitary Facilities Operation	*							
Roofing & Flashing			○			*		
Floor Membranes			○				*	
Check for Water Leakage		○						
Check for Rusting Concrete Reinforcement		○						
Inspect Mortar Joints and Repair						○	*	
Inspect and Repair Concrete Cracks					○		*	

○ = Inspect

\* = Perform Operation

Notes:

(1) Minimum twice, per year (spring and fall) in snow or coastal regions, otherwise minimum once per year.

(2) Surface sealer (three to five years), Penetrating sealer (seven to ten years more often in abrasive areas).

(3) Daily enclosed garage (warning to management office recommended).

(4) For additional notes, see text.

(5) Tables utilize information in part from the National Parking Association Consultants Council "Parking Garage Maintenance Manual."

EXCERPT FROM PCI MAINTENANCE MANUAL FOR PRECAST PARKING STRUCTURES



**CORPORATE HEADQUARTERS**

150 Dow Street  
Manchester, NH 03101

**REGIONAL OFFICES**

Pease International Tradeport  
100 International Drive, Suite 360  
Portsmouth, NH 03801

125 College Street, 4th Floor  
Burlington, VT 05401

196 Main Street  
Winthrop, ME 04364

34 Hayden Rowe Street, #130  
Hopkinton, MA 01748

95 E. Mitchell Hammock Road, Suite 200  
Oviedo, FL 32765

P.O. Box 11175  
St. Thomas, USVI 00801