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Project 180181 – Task Order 1: Storm Water Analysis/Gutter and Downspouts, Mutual 19B, Leisure World, Silver Spring, MD 20906

Dear Mr. Tilley:

At the request of O'Connell and Lawrence, Inc. (OC&L), Simpson Gumpertz & Heger Inc. (SGH) performed a condition assessment and drainage analysis of the existing steep- and low-sloped roofing assemblies and integrated drainage components at the above-named project. This letter summarizes our observations and presents our conclusions and recommendations.

1. BACKGROUND

Mutual 19B Condominium of Rossmoor, Inc. (Mutual 19B), located at 3701 Rossmoor Boulevard, Silver Spring, Maryland 20906, is a section of the Leisure World community that includes seven condominium buildings located on Beaverbrook Court and Elkridge Way in Silver Spring, Maryland. The buildings were designed and constructed in 1978 – 1980 as Rossmoor Garden Apartments. In 1990, the main entrance canopies were installed at each building including new roofing and a skylight. Each condominium building includes a varying geometry, steep-sloped, asphalt shingle roofing system. We understand that the existing roofs slope to gutters along most of the long building elevations and portions of the short building elevations.

We understand that OC&L was retained by Mutual 19B in September 2017 to provide engineering analyses and services to Mutual 19B. SGH was included by OC&L as part of the above-noted project team to provide structural investigation, evaluation and rehabilitation, and building technology services on behalf of Mutual 19B. We understand that individual OC&L and SGH assignments will be performed as task orders under the above-noted proposal/agreement.

1.1 Task Order 1 – Scope of Work

Our conclusions and recommendations are based on the following Task Order 1 scope of work:

- Review roofing and drainage elements shown by available record documents, provided by OC&L, to facilitate and inform our condition assessment and drainage analysis.
- Conduct interviews with building occupants and staff, if available, to discuss the performance of the existing roofing, as well as past maintenance and repairs.

- Perform visual observations at exterior accessible areas of the existing roofing and drainage systems from grade and from an aerial lift. Perform an interior survey in accessible areas to correlate exterior issues to interior leakage.

- Perform an analysis of the existing roof gutters and downleaders based on information gathered during our survey to verify the adequacy of the in-place roof drainage system (i.e., gutters and downleaders) to manage the anticipated roof water runoff. Provide OC&L with maximum downleader discharge for incorporation into OC&L's property storm water analysis.

2. DOCUMENT REVIEW

We reviewed portions of the design and record drawings provided to us by OC&L. The documents include drawings ranging from 1980 to 2016. We summarize pertinent information below:

2.1 As-Built Drawing Set – Dated 15 August 1980

The As-Built Drawing set by Rossmoor Construction Company includes architectural, structural, and MEP plans and details of the original construction (i.e., Buildings 88 – 94). The drawings show, in part, the following information pertinent to our condition assessment:

- The seven buildings located within the Mutual 19B complex were constructed based on one of two building types, or profiles, delineated in the drawings as Building Type 1 and Type 2. The Building Type 1 layout is H-shaped in plan and Building Type 2 layout is Z- shaped in plan.

- Each building type consists of three above-grade floors, with no below-grade space.

- Each building floor consists of three types of sub-divisions or units, identified in the drawings as Type A, B, or C. There are four Type A, five Type B, and one Type C unit on the first floor, and four Type A and six Type B units on the second and third floors of each building.

- The main roof structure consists of steep-sloped roofing over a ventilated attic space. The main building roof is subdivided into several smaller roof areas, varying in elevation, and often separated by low-height rising walls. The roofs are sloped to sections of hung gutters along the eave of each roof area. Steep-slope roof areas are generally sloped to drain at approximately 5 to 6 in. per foot with isolated steeper roof areas sloped at approximately 24 in. per foot.

- Hung gutters are generally shown along the roof eaves. However, the drawing details do not include attachment, bracing, or sizing of the individual gutter lengths.

- The steep-slope roofing system, as shown in Detail 1/A-19, consists of the following components from interior to exterior: wood trusses at 24 in. o.c. typ., 1/2 in. plywood sheathing, #15 felt underlayment, and #240 asphalt shingles. The triangular-shaped wood trusses form a ventilated attic space with R-19 batt insulation between truss members above the interior ceiling finishes. The detail also includes a nominal

2 in. x 8 in. wood ledger board along the eave. The attic space is ventilated through perforated vents along the underside of the roof eave at 2 ft o.c. and continuous shingle- over ridge vents. Isolated roofs also include roof-mounted unit vents.

- Details generally indicate flashing along the rising wall between roof areas.

- Detail 7/A-20 shows the original low-slope roofing-to-wall transition at the canopy over the main building entrances. The roofing assembly consists of built-up asphalt roofing over plywood sheathing. The roofing membrane, as shown in Detail 1/A-20, is surface- sealed to the brick masonry wall above the canopy; the brick masonry and CMU backup extend past the canopy framing.

- The typical low-slope roofing assembly at the trash room, as shown in Detail 15/A-20, consists of the following from interior to exterior: 5 in. concrete floor slab, 1 1/2 in. rigid insulation board, two wood sleepers forming the roof slope to drain, 5/8 in. plywood sheathing, and built-up asphalt roofing membrane. The roof slopes to a hung gutter along the eave and terminates against the exterior surface of the brick masonry below counterflashing. The counterflashing is reglet-set into the brick mortar joints.

- The exterior wall assembly, as shown in Detail 2/A-19, consists of the following from interior to exterior: 1/2 in. interior gypsum board furred off the CMU backup with wood blocking, 3-1/2 in. paperback batt insulation, CMU backup wall, “oversized” brick masonry. Details include aluminum-framed windows set into punched openings.

2.2 Mutual 19B Entrance Canopy Proposal Set – Dated 2 June 1990

The permit drawing set by Johnson & Johnson Architects includes architectural sheets detailing the renovation of the building entrance canopies and a description of the proposed scope of work. The drawings show, in part, the following information pertinent to our condition assessment:

- The General Notes included on Sheet A-1 of the drawing set indicate the existing canopy roofing and roof structure were removed and replaced with new materials and skylights to match the existing construction.

- Details A, B, and C on Sheet A-2 show section cuts through the canopy; the typical roofing assembly, as shown in these details, includes the following components from bottom to top: ventilated canopy wood structure, 3/4 in. plywood deck, tapered EPS rigid insulation, and Carlisle Sure-Seal fully adhered membrane roofing. The canopy drains to through-wall scuppers within the brick masonry fin walls along the long dimension of the canopy. Similar to the original construction, the roofing terminates against the face of the brick masonry walls and is counterflashed with a reglet-set aluminum flashing.

2.3 Building Location Plan – Dated 5 May 2076

We utilized the Mutual 19B Building Location Plan by Rossmoor Construction Corporation during our assessment of each building to document observations and locations of issues noted by residents. We identify buildings below as indicated in the Building Location Plan (Buildings 88 – 94).

3. INFORMATION FROM OTHERS

Based on conversations with OC&L staff and building occupants during and following our survey, we note the following with respect to the performance of the existing roofing and roof drainage system:

- During some rain events, roof drainage overtops and spills out of the existing hung gutters at some areas along each building. Occupants were not aware if this is a widespread issue or occurs only at isolated areas. However, multiple occupants noted this issue at multiple areas on both building types.

- Ms. Catherine Hogan (Unit 1J, Building 88) told us that the community maintenance staff installed a swale at grade near the interior building corner at the southeast corner of Building 88 to reduce water buildup along her porch caused ineffective site drainage and roof drainage overtopping the gutters directly above her first-floor apartment.

- One occupant told us that they have observed numerous cracks in the exterior walls along the interior of the first floor at Building 88.

- Ms. Joyce Burns noted that she observed water stains on the ceiling in her apartment. OC&L visited the apartment and told us that the staining is small and isolated and that it did not appear to be due to active leakage. They also told us that they did not observe any drip stains, blisters, or peeling paint around the stained areas.

4. OBSERVATIONS

David S. Slick, Benjamin B. Hiltz, and Jin Rui Yap of SGH visited the site on 21 and 22 February 2018 to observe the condition of the existing roofing assemblies at each building within Mutual 19B and to observe and document the in-place roof drainage provisions to inform our analysis of the existing roof drainage elements. Joseph D. Rogers of SGH also visited the site on 21 February 2018. We surveyed the existing steep- and low-slope roof areas and hung gutters at Buildings 88 – 94 from the ground and from an aerial lift and documented the condition of readily visible roofing components. Our scope did not include interior or exterior exploratory openings to view the concealed construction. We did not have access to building units during our survey. We summarize our observations below:

4.1 Steep-Slope Roofing

The main building roof consists of several sections of steep-slope roof areas, typically separated by rising walls at changes in the plane of the building elevations (Photo 1). The steep-slope roofing system is comprised of shingle-lapped, mechanically fastened, asphalt shingles with granular surfacing that drain to hung, K-style aluminum gutters positioned along the eaves of each roof area (Photo 2). The gutters are attached to wood fascia boards spanning between roof framing members along the roof eaves and drain through downleaders typically positioned at one end of each gutter length. Gutters are typically discontinuous between roof areas. Gutter lengths that are continuous between roof areas (e.g., at building corners) generally include multiple downleaders.

We summarize our observations of the steep-slope roofing below; observations specific to certain buildings are noted as such. We identify roof areas as Type X (roofs sloped at approximately 5- 1/2 in. per foot) or Type Y (roofs sloped at approximately 24 in. per foot) below.

4.1.1 Asphalt Shingle Roofing

- Most of the main building roofs consist of several sections of Type X steep-slope roof areas, with limited Type Y roof areas typically located at or near building corners.

- A black self-adhered membrane underlayment is installed below the asphalt shingles at several areas we observed, typically along the roof edges. The underlayment shingle- laps over the horizontal leg of a metal counterflashing along the roof eave (Photo 3).

- A surface-sealed metal flashing extends to the top surface of the asphalt shingles at areas where the roofing abuts adjacent masonry walls (Photo 4). We were not able to confirm if the roofing underlayment extends up the wall below the flashing. A smaller L- shaped metal flashing extends out from below the edge of the roof shingles and approximately 2 in. (visual estimate) up the adjacent brick masonry wall, behind the counterflashing. The L-shaped flashings are sealed to the brick at the select areas we could observe. Seals appear generally intact with some areas of dry or cracked sealant.

- The asphalt shingles are evenly coursed and are generally intact with limited areas of displaced or missing shingles. At isolated areas, shingles are unadhered or are missing, exposing the mechanical fasteners and the asphaltic portion of the underlying shingles (Photo 5).

- In several areas, the colored granules that are impregnated into the top surface of the asphalt shingles have displaced and accumulated within the hung gutters (Photo 6). We observed limited areas where displaced granules had exposed the asphalt layer of the shingles.

- Circular vent stack penetrations through the steep-slope roofing assembly include a rectangular metal flange that appears to be shingle-lapped with the adjacent roof shingles to shed water past the penetrations (Photo 7). At isolated locations, shingles around these flanges are displaced, exposing the edges of the flange. We could not observe the integration of the roofing underlayment with the flange or vent penetrations.

- At portions of the steep-slope roofing on the east elevation of Building 89, the roof sheathing below the shingles appears to be sagging between roof joists (Photo 8). Consequently, the profile of the truss members that support the roof deck is partially visible within the field of the roofs (Photo 9).

- Portions of the shingle-over ridge vent along the roof ridge at Building 89 appear significantly out of plane with the adjacent ridge vent (Photo 9). We could not verify the cause of this circumstance.

4.1.2 Gutters

- Aluminum hung gutter dimensions are generally consistent across both building types and each building sub division. The approximate K-style gutter dimensions are as follows:

  - Open top width: 6-1/8 in.
  - Bottom width: 3-7/8 in.
  - Height: 4-1/2 in.

  Gutter length varies with the geometry and width of each roof area. Gutters are sloped to downleader locations at approximately 1/8 in. per foot. Gutters generally include end caps to match the gutter profile at both ends.

- The hung aluminum gutters include metal hangers/braces hooked into the exterior gutter leg and fastened to the fascia board through the interior gutter leg (Photo 10). Some hangers are spaced at varying distances along the gutters on each of the seven buildings, but generally are spaced at approximately 24 in. to 30 in. o.c. We did not observe significant deterioration, corrosion, or damage to the hangars or gutters.

- A metal counterflashing extends out from below the asphalt shingles along the eaves of the steep-slope roof areas and shingle-laps over the back vertical leg of the gutter. In several locations, the edge flashing is not long enough, or the gutter has shifted and the flashing does not lap over the interior gutter leg (Photos 10 and 11). The gutter profile is such that the interior gutter leg is at a higher elevation than the exterior gutter leg.

- At several locations, a gutter end cap abuts against the brick masonry cladding of adjacent building walls. The joint between the gutter and the brick is typically sealed along the top edge of the gutter end cap. We often observed black staining along the face of the brick below the gutter to wall joint (Photo 12). Staining typically occurs at the shorter gutter sections overtop the building stair tower exits. We did not observe a kick- out flashing on the roof at the gutter termination.

- The vertical leg of the roof eave flashing is cracked at the gutter length above the entrance at the northwest corner of Building 92 (Photo 13). Cracks are covered with clear sealant.

- Portions the gutters along the east elevation of Building 89 are pulling away from the fascia board along the roof eave. Additionally, portions of the fascia board at these locations have pulled away from the roof framing (Photo 14).

- We did not observe any movement joints (sometimes called expansion joints or control joints) within the gutter lengths. However, we did not observe widespread evidence of gutter buckling due to lack of expansion provisions.

- Isolated areas of gutter included ponded water, leaves and other foliage, and asphalt shingle granules (Photo 15). Gutters below or near overhanging trees generally captured more leaves. At some gutters, the leaves have accumulated around and within the downleader opening, restricting gutter drainage.

- The roof geometry at the interior building corners creates valleys where the Type X steep-slope roof meets the Type Y steep-slope roof. At these locations, the gutters along the Type Y roofs drain onto the Type X roof areas and into the associated gutters below (Photo 16).

4.1.3 Downleaders

- Downleaders typically discharge at or below-grade, adjacent to the building wall. Discharge conditions vary throughout the community and at each building.

- Downleaders that discharge at grade near paved areas or walkways typically discharge over a concrete splash block (Photo 17). At some locations, occupants and maintenance staff have installed corrugated HDPE pipe extensions at above-grade downleader outlets to extend the discharge point away from the building (Photo 18).

- Downleaders that discharge below-grade connect into larger diameter PVC pipes that extend below-grade (Photo 19). We did not observe where the below-grade PVC pipes discharge.

- We observed isolated downleaders where a portion of the at-grade outlet is disconnected. At two such locations at the secondary building entrances near the northeast corner of Building 88 and at the southeast corner of Building 91, the downleaders discharge adjacent to the concrete walkway (Photo 20).

- The downleaders and discharge components (i.e., splash blocks, HDPE pipes, and PVC pipes) appear generally intact and appear to function as intended.

4.2 Low-Slope Roofing

- Multiple, less than 100 sq ft areas of low-slope roofing systems exist over the trash rooms and entrance canopies near the main entrance at each building. The low-sloped roofing assemblies vary between buildings.

- The canopy roof over the unenclosed entrance area at the front elevation of the building consists of a barrel skylight at the center of a low-slope roof (Photo 21). The roof is sloped-to-drain to through-wall scuppers that discharge to downleaders at one of the exterior corners of the canopies (Photos 22 and 23). The roofing assembly varies between buildings, but typically consists of either modified-bitumen membrane roofing or built-up asphalt membrane roofing.

- The canopies include a metal edge flashing along the exterior roof edge. At some areas, the horizontal flashing leg is stripped in with the roofing membrane, and at some areas, the flashing leg is installed over the roofing membrane (Photo 23).

- Buildings typically include a trash/mechanical room area adjacent to the main building entrance. A portion of this room is proud of the main building wall and includes a less than 30 sq ft low-slope roof area (visual estimate). The trash room roof drains to a gutter along the exterior edge (Photo 24). The roofing assembly varies between buildings, but typically consists of either built-up asphalt membrane roofing or metal roofing.

- The metal roofing and counterflashings over some of the trash room roofs appears to be covered with a red fluid-applied coating or paint which is flaking and missing in some areas (Photo 26). Surface corrosion is visible on the metal roofing at some locations.

- The low-sloped roofs turn up onto the face of the brick masonry at the building and canopy walls. The top edge of the roofing is counterflashed with a surface-sealed metal flashing (Photo 25).

- We observed ponding on the built-up asphalt roof membrane at localized areas on some canopy roofs (e.g., Building 92) (Photo 21).

4.3 Other Building Enclosure Components

As requested, we performed limited observations of readily visible areas of other building enclosure components during our condition assessment of the building roofs and roof drainage elements. We note that our observations noted below are not comprehensive due to our limited sample size. We summarize our observations below.

4.3.1 Fenestrations

- Fenestrations generally consist of aluminum-framed windows with insulated glazing units (IG Units), set within punched openings in the brick masonry walls.

- Isolated window frames are broken at several buildings throughout the community (e.g., Building 92). The in-place aluminum frames appear in generally poor condition.

- We observed from the building exterior areas of moisture staining along the interior sill of isolated windows (Photo 27).

- Window and door perimeter sealant joints are typically in poor condition (e.g., cracked, split) (Photo 28). At one location we observed, along the front elevation of Building 93, the perimeter sealant joint is split open, and the opening is filled with aluminum foil (Photo 29).

4.3.2 Brick

- At several locations (e.g., adjacent to building entrances, at the trash room), brick site walls extend out from the face of the building and include skyward-facing mortar joints. Several skyward-facing mortar joints are spalled, missing mortar, and are separated from the adjacent brick (Photo 30).

- Efflorescent staining and other discoloration is evident at numerous brick-clad areas. Often staining originates near the top of the building wall below gutter terminations or at balcony edges and extends down to just above grade (Photo 31).

5. DRAINAGE ANALYSIS

We evaluated the capacity of the existing gutters, gutter outlets, and downleaders on steep-slope roofs as they relate to code requirements and the potential for overtopping. We present our assumptions and evaluation of the roof drainage system components in the following sections.

5.1 Existing Roof Areas and Gutter

We categorized the seven buildings on the Leisure World Campus into two building types that we identified as Building Type 1 and Building Type 2. To determine the demand for each of the gutters serving each of the sections of roof, we separated each of the building roofs into discrete drainage areas. We label the drainage areas for Building Type 1 in Figure 1 and Building Type 2 in Figure 2 in Appendix A (attached).

5.2 Gutters

We performed an analysis to determine the existing gutter and gutter outlet capacity. To calculate the maximum flow, we used storm intensities with durations consistent with the critical duration of the roof and gutter system (i.e., the duration of a specific storm event that creates the largest volume or highest rate of net storm water runoff). For an externally hung gutter, the critical duration is 5 min., which is consistent with industry standards.[1] Note the International Plumbing Code (IPC) requires the use of the 100-yr return period, 60-min. duration event. Below, we provide a comparison between the IPC required rainfall intensity and the 5-min. duration – 25 yr return period event that we considered in our analysis. We also include 5-min. duration events of lesser return periods for further comparison. We obtained the 5-min. duration intensities from the National Oceanic and Atmospheric Administration (NOAA).

Table 1: Rainfall Intensities for Code Event and Critical Duration Events with Various Return Periods

Source of Rainfall Intensity Value	Return Period and Duration	Intensity (in./hr)
IPC 2012[2]	100-yr, 60 min.	3.25[3]
NOAA[4]	25-yr, 5 min.	7.46
NOAA	10-yr, 5 min.	6.59
NOAA	5-yr, 5 min.	5.90

[1] Copper and Common Sense and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) both recommend using the 5 minute duration event for externally hung gutters.
[2] International Plumbing Code (IPC) 2012
[3] IPC-required design rainfall event for site location (Figure 1106.1).
[4] National Oceanic and Atmospheric Administration (NOAA) National Weather Service IDF curve

We used several references to determine the capacity of the gutter outlets including Copper and Common Sense, British Standard BS EN 12056-3:200 Manual for the Design of Roof Drainage Systems (British Standard), and Flow in Roof Gutters by K. Hilding Beij (Beij, 1934). Copper and Common Sense is a common design guide that references the Beij 1934 study and is used by sophisticated gutter designers. Beij focused on flat semi-circular, rectangular, and irregularly shaped gutters. We note that the IPC does not provide allowable roof areas for rectangular or irregularly shaped gutters. Of the gutter design standards, the British Standard is the most comprehensive for the design and evaluation of roof drainage systems as it provides guidance regarding various shapes of gutters with various slopes. Our analysis follows the recommendations of the British Standard.

The gutter capacity is dependent upon the gutter cross-sectional area, slope, and length tributary to an outlet. Since the gutter lengths vary, the gutter capacities vary. Based on the constant gutter cross-section geometry and the various lengths of gutters, we calculated the full flow capacity of the existing custom-shaped (K-style) gutters to range from 66.5 gpm to 77.3 gpm (British Standard, gallons per minute). Based on the calculated capacity and design rainfall intensities (return period and duration), we calculated the allowable tributary area to a gutter outlet or downspout (see Table 2 below). Note there is a range of allowable areas for each return period since we considered the minimum and maximum calculated capacities.

Table 2: Allowable Tributary Area to a Downspout based on Gutter Full Flow Capacity

Return Period and Duration	Intensity (in/hr)	Allowable Roof Area Based on Gutter Capacity (sf)
100-yr, 60 min.	3.25[5]	1,989 – 2,311
25-yr, 5 min.	7.46	867 – 1,007
10-yr, 5 min.	6.59	981 – 1,140
5-yr, 5 min.	5.90	1,096 – 1,273

Our calculations using the British Standards assumes unobstructed flow at the outlet. To achieve this, the British Standard requires that the head of water at the outlet (i.e., depth of water over the outlet opening) be no more than 0.49 times the depth of the 4.5 in. deep gutter (i.e., 2.2 in.). The typical gutter outlet diameter is approximately 3 in. The capacity of a 3 in. dia. orifice with 2.2 in. of head is approximately 46.9 gpm.

[5] IPC-required design rainfall event for site location (Figure 1106.1).

Table 3: Allowable Tributary Area to a Downspout based on Outlet Capacity

Return Period and Duration	Intensity (in/hr)	Allowable Roof Area Based on 3 in. dia. Outlet Capacity (sf)
100-yr, 60 min	3.25[6]	1,403
25-yr, 5 min	7.46	611
10-yr, 5 min	6.59	692
5-yr, 5 min	5.90	773

We assumed the design return period of 25 yrs and a 5-min. duration. Therefore, we compare the allowable roof area corresponding to the 25-yr, 5-min. duration event from the tables above to the tributary areas for each zone. Based on the tributary area, we categorized each of the zones into one of three categories:

- Category 1: Existing roof tributary area is less than the allowable roof area based on both gutter and outlet capacity. For these zones, no action is required.
- Category 2: Existing roof tributary area exceeds the allowable roof area based on the gutter outlet capacity, but is less than the allowable area based on the gutter capacity. For these areas, the gutter outlet size should be increased.
- Category 3: Existing roof tributary area exceeds the allowable roof area based on both the gutter and gutter outlet capacity. For these areas, an outlet should be added to reduce the area tributary to the outlets (i.e., reducing the area by two). Note that this may require re-sloping all or a portion of the gutter.

We determined that the following zones have roof tributary areas that exceed the allowable roof area based on the outlet capacity, but are less than the allowable area based on the gutter capacity (Category 2):

[6] IPC-required design rainfall event for site location (Figure 1106.1).

Table 4: Zones with Tributary Area Exceeding the Allowable Area based on Outlet Capacity but Less than the Allowable Area based on Gutter Capacity

Building Type 1	
Zone	**Tributary Area Based (sq. ft.)**
3	626
4	797
5	824
8	949
11	956
12	936
15	699
16	697
17	910
24	723
25	699
Building Type 2	
Zone	**Tributary Area (sq. ft.)**
34	669
35	908
37	789
45	710
51	704
57	901
59	638
64	684

We determined that a 4 in. by 3 in. outlet/downleader is adequate for these roof areas. The existing gutter outlets at these areas should be enlarged as indicated (refer to the yellow highlighted areas on the attached plans). We also note that another opening configuration with an open area greater than 12 sq in. may be used.

We determined that the following zones have tributary areas that exceed the allowable tributary area based on both the outlet and gutter capacity (Category 3):

Table 5: Zones with Tributary Area Exceeding both the Allowable Area based on Outlet Capacity and the Allowable Area based on Gutter Capacity

Zone	Tributary Area (sq ft.)
Building Type 1	
7	957
21	963
Building Type 2	
Zone	**Tributary Area (sq ft.)**
36	1,026
39	1,065
41	1,078
49	987
52	996
53	1,117
55	1,188
58	1,169

Gutter and downleader configuration at these roof areas should be adjusted to prevent overtopping during the design event (refer to the red highlighted areas on the attached plans).

6. DISCUSSION

6.1 Steep-Slope Roofing

Steep-slope asphalt shingle roofing assemblies, such as those at the main building roofs, typically consist of individually placed, mechanically attached asphalt shingles over a membrane underlayment and a ventilated attic space. Well-constructed asphalt shingle roofing can provide 15 to 30 yrs or more of service, depending on exposure and material. Based on the original as- built drawings provided to us, we expect that the roof framing is original to the building construction. We do not know the age of the existing roofing assembly, but suspect it has been replaced since original construction. The roofing assembly appears to be in generally good condition, with limited evidence of water intrusion into occupied space below, and only isolated areas of displaced or missing asphalt shingles. We did not access attic spaces to check for evidence of leakage at the underside of the roofing assembly. While we do not know the expected service life of the existing roofing when installed, we expect that the roofing will require increasing maintenance as it continues to age and may need to be replaced within the next 10 to 15 yrs. We describe several conditions that will decrease steep-slope roofing performance and increase maintenance needs below.

The original roof framing consists of roof trusses spaced at 24 in. o.c. with 1/2 in. plywood sheathing. At portions of the steep-slope roofs along the east elevation of Building 89, the profile of the roof joists is visible within the field of the roof, indicating an example of the sheathing substrate sagging between roof joists. The amount of roof sagging between trusses that we observed can be expected after 40 yrs of service with this roof truss spacing and plywood sheathing thickness. The sagging areas are not pronounced and are not pervasive, and can only be seen in certain lighting conditions and at certain angles of observance. At this time, this condition is not adversely affecting roof performance. The sagging should be periodically visually monitored by building maintenance staff to determine if this condition worsens. The sagging may eventually become more pronounced and shingles will start to deform if sheathing edge fasteners become disengaged from roof trusses, at which time the sheathing will become unsupported and will have to be repaired or replaced. Portions of the roof ridge along the same roof areas are wavy or out of plane. We suspect that the waviness along the ridge is cause by the variance in the plane of the roof trusses and substrate sheathing as a result of roof framing inconsistencies that occurred during the initial roof installation. This is also not imminently detrimental to the existing roofing assembly, but should be periodically visually monitored.

Asphalt shingle roofs rely on the roof slope and shingle-lapping successive shingles to shed water past fasteners and into the dedicated gutters at the base of the slope. We observed isolated areas where shingles were displaced or missing, exposing the adjacent shingle fastener heads and portions of the shingles without impregnated granules (i.e., exposed asphalt). Exposed fasteners are more susceptible to water leakage. We were not able to access the interior areas directly below the missing shingle locations. However, we suspect that leakage is not ongoing due to lack of reports from residents. An asphalt fiberglass roofing shingle is a composite of different materials combined to provide water-shedding capability on a steep-sloped roofing system. Asphalt fiberglass shingles are manufactured from a fiberglass fabric-like felt that is impregnated and coated with an asphaltic material (asphalt and mineral filler/stabilizer) and then surfaced on the top (weather side) with mineral granules and on bottom (reverse side) with minerals used to prevent shingles from sticking in the packaging. The asphaltic layer of the shingles is susceptible to degradation when exposed for extended periods of time to ultraviolet radiation. Targeted shingle replacement to protect fastener penetrations and the asphaltic layer of the shingles may prolong the useful life of the roofing system and reduce the risk of water leakage into the residencies below.

We were not able to confirm the termination of the steep-slope roofing and steep-slope roofing underlayment against the building walls. We suspect the underlayment terminates against the brick masonry building wall behind the surface-sealed counterflashings. Such terminations rely on intact and continuous sealant to prevent water intrusion behind the counterflashings and below the roofing underlayment. The counterflashings will increase the durability of the underlayment termination, but such a condition still relies on sealant continuity along the top edge. Masonry walls are porous, and some moisture will enter the brick and can bypass surface-sealed terminations. We do not know the configuration of the wall-to-roof transition at these locations, and we did not observe evidence of or receive occupant reports to suggest that water is entering under the roofing or into the building at these locations. Building maintenance staff should continue to monitor these areas for leaks and regularly review the surface-sealed roofing terminations to identify and replace worn sealant to maintain current performance.

We observed several areas where granules that have unadhered from the asphalt shingles have accumulated within the gutters at the base of the roof slope. This is normal as an asphalt shingle roofing system ages. The mineral granules used on the exposed surface of the asphalt shingle provide weight for wind resistance and protect the asphalt from ultraviolet radiation degradation. The measurable loss of the granule surfacing expedites the photo-oxidation of asphalt and reduces the life of the shingle. While we observed accumulation of granules within the gutters, we observe limited areas where the asphalt layer of the shingles was readily visible. We expect that through the life of the roof, the granules will continue to displace and continue to expose the asphalt layer of the shingles. At some point, enough of the granules will be displaced and enough of the asphalt layer will be exposed to warrant asphalt shingle roofing replacement, but this is not the current circumstance. Asphalt shingle roofing usually comes with an expected normal condition service life (for example, the term “a 30-yr shingle”), which is usually a good timeframe after which to consider asphalt shingle replacement. Building maintenance staff should determine the life expectancy of the existing asphalt shingles at the time they were installed to estimate remaining shingle service life, and continue to monitor the asphalt shingle roofing as it ages.

The vent stack penetrations through the steep-slope roofing assembly generally include a rectangular metal flange extending out on all sides of the stack. The flange is typically stripped in by shingles. However, isolated shingles have been displaced or are lifting along the stack flange edges, leaving the penetrations vulnerable to leakage from water runoff or sliding snow. We were not able to observe the integration of the vent stack with the roofing underlayment. It is good roofing practice to strip in roofing penetrations with self-adhered roofing underlayment to reduce the potential for water leakage. While we do not know of any reported water leakage at these locations, water leaks may begin to develop as the roof ages, and if the stack flanges become exposed. Potential repair may include removing and replacing a portion of the shingles surrounding the vent stack flange and stripping in the flange with a self-adhered membrane underlayment.

The steep-slope roofing drainage system consists of K-style hung aluminum gutters attached to a wood fascia board along the roof eaves. Gutters are generally sloped at 1/8 in. per foot to downleaders at either end of the gutter. Gutters drain to downleaders through an approximately 3 in. dia. hole cut into the gutter bottom leg. The gutters and downleaders are in generally good condition. However, we observed several areas leaves and other small debris has accumulated within the gutters. Buildup of debris within the gutters can block gutter or outlet flow and contribute to overtopping of gutters during rain events. The building maintenance staff should regularly review and clean debris from gutters and downleaders to promote drainage.

The hung aluminum gutters are supported by regularly spaced lateral hangers/braces that fasten back into a wood fascia board along the roof eave. We observed several areas where the gutters are partially pulled away from the fascia boards and where the wood fascia boards are partially pulled away from the roof framing, typically near the roof edges. In areas where the gutter has pulled away, the roof edge flashing no longer laps over the back leg of the gutter. In some locations, the edge flashing stops short of the interior gutter leg or the gutter was installed with the interior gutter leg outboard of the roof edge flashing. Continued displacement of the gutter and fascia board may allow drainage to bypass the hung gutter and may damage the adjacent roofing. Building maintenance staff should consider retaining a roofing contractor to re-anchor or replace the fascia board and reinstall the gutters so that the roof edge flashing laps over the interior gutter leg, similar to intact gutters elsewhere on the buildings. In some locations, an additional piece of flashing may be required to extend the roof edge flashing slightly.

The downleader discharge conditions vary throughout the community. Some discharge above grade adjacent to the building wall, while others discharge into PVC pipes that extend below grade or into HDPE pipes that direct water away from the building. Based on our discussions with building occupants, we understand that interior leakage at the resident patio sliding doors associated with ponding from the downleader discharge or gutter overtopping is an issue. Building maintenance staff may consider conducting repairs to establish a uniform method of discharging gutter downleaders below-grade or away from the building walls and highly trafficked public walk areas to limit the risk of leakage to the interior. We understand that OC&L will address this issue and offer remedial recommendations as part of their Task Order 1 work scope.

6.2 Gutters and Downspouts

Typically, roof drainage systems are designed by prescriptive code requirements contained in the plumbing code, where drains or gutters are sized and placed by tributary drainage areas using a 100-yr, 60-min. duration storm. International Plumbing Code's (IPC) use of a 60-min. duration is unrealistic for externally hung gutters, as the critical duration (i.e., the duration of a specific storm event which creates the largest volume or highest rate of net storm water runoff) is closer to a 5- min. duration. Similarly, Copper and Common Sense and other industry guides recommend the use of the 10- to 25-yr return period, 5-min. duration rainfall events for the design of gutter systems. These storms have a more substantial volume of rain in a shorter period of time to those used by the IPC for gutter design.

Based on our analysis, all of the existing gutters are adequate to convey the storm event required by the IPC. However, some of the gutters and outlets are inadequate to convey the storm drainage consistent with the critical duration of the roof, and we anticipate some gutter zones to overtop during events with less than a 5-yr return period (greater than 20% chance of occurrence in a given year). We recommend designing repairs for the 25-yr return period to prevent frequent, nuisance overtopping that may lead to staining of the masonry facade or interior leakage along the roof edge. Based on this design storm, there are zones that will require the addition of outlets or the enlargement of the existing outlets. In developing our repair options, we attempted to recommend only outlet/downleader modifications or additions, and maintain the existing gutter configurations. Locations requiring remedial work are identified in the drainage analysis section above.

While we recommend a 25-yr return period storm event, the Owner may choose to accept the risk of gutter overtopping and design to a more frequent storm event, i.e., 10-yr return period (10% chance of occurrence within a given year). Given that these gutters are externally hung, overtopping these gutters does not pose a significant public safety risk and we received no reports of interior leakage at the roof edge, so this may be an acceptable option. However, gutter overtopping along the exterior leg and end caps may remain in some areas, particularly when leaves and other debris collect within the gutters, and this may not be an acceptable condition to building occupants.

The maximum capacity of the 3 in. dia. gutter outlets that drains the gutter to the associated downleaders is approximately 49.6 gpm. The maximum capacity of the typical in-place gutter is approximately 77 gpm. In this case, the gutter system outflow is limited by the flow capacity of the orifice, 49.6 gpm. The maximum outflow of the downleaders may differ between roof areas based on size and geometry of the gutter orifice, however, will not exceed the maximum gutter capacity of 77 gpm. We understand this information will be used by OC&L in their storm water drainage analysis.

6.3 Low-Slope Roofing – Entry Canopies

Modified-bitumen low-slope roofing membranes, like those at some of the entrance canopies throughout the community, consist of modified asphalt sheets set in hot-applied or cold-applied bitumen adhesive or are torched down to the substrate. These systems usually consist of two or three plies, or layers, with staggered and overlapped seams shingled to shed water to drain. The exposed ply is usually an ultraviolet (UV) resistant wearing surface. Well-constructed modified-bitumen roofing assemblies can provide 25 yrs or more of service. The modified- bitumen roofing assemblies we observed appear to be in generally good condition and no leaks are currently reported at these areas.

Built-up roofing (BUR) membranes, like those at the remainder of the entrance canopies throughout the community and at some trash room roofs, consist of multiple layers (i.e., plies) of roofing felt set in hot-applied or cold-applied bitumen adhesive, with an ultraviolet (UV) resistant wearing surface that is frequently aggregate set in asphalt or a mineral-surfaced modified-bitumen cap sheet. The multiple layers of roofing felt improve durability and provide some waterproofing redundancy. Well-constructed built-up roofing assemblies can provide 20 or more yrs of service. The existing built-up roofing assemblies we observed appear to be in generally good condition and no leaks are currently reported at these areas.

While we did not confirm the age of the in-place low-slope membrane roofs, we suspect that the BUR membrane roofing assemblies are original to the canopy renovation (1991) and the modified- bitumen membrane roofing assemblies were installed as part of a previous repair effort possibly during replacement of the steep-slope roofs. We expect that the remaining BUR membrane roofs (those not replaced previously) will need to be replaced in the next 5 to 10 yrs. We describe below several conditions that will decrease low-slope roofing performance and increase maintenance needs.

The low-slope roofing at the canopy is sloped-to-drain to through-wall scuppers, typically located at an exterior corner of the canopy. We observed several isolated areas of ponded water over the canopy roofs throughout the community. The 2012 edition of the International Building Code requires standing water to drain from the roof surfaces within 48 hrs of a rain event. Water that remains on the roof longer than 48 hrs can reduce the durability of the roofing membrane. Standing water on the membrane increases likelihood of leakage through seams and other discontinuities in the roof, reduces membrane service life, and leakage from ponding can create health concerns. We note that leakage to the building interior through the canopy may be unlikely due to the lack of interior space below except possibly at the rising building wall transition. However, leakage may compromise the integrity of the canopy framing or result in water dripping onto residents walking below. Repairs may include reconstructing portions of the existing roofing membrane to improve slope-to-drain or providing additional through-wall drains/scuppers and associated downleaders.

Low-sloped roof base flashing terminations at the building wall and site walls along three sides of the canopies consist of surface-sealed terminations set behind surface-sealed metal counterflashings. These terminations rely on intact and continuous sealant to prevent water intrusion behind the base flashing and under the roofing membrane. Surface-sealed counterflashings will improve durability of the roofing membrane termination, but are vulnerable to water leakage given their reliance on exposed sealant and adhesion as their primary protection against water intrusion. Additionally, brick masonry walls are porous and some moisture will inevitably enter into the brick masonry bypassing surface-sealed terminations. Open and deteriorated skyward-facing mortar joints adjacent to the roof terminations exacerbate the risk of water bypass. We did not make invasive openings in the existing canopy to investigate this condition. However, we did not observe evidence that suggests water is leaking through the canopy roofing. Building maintenance staff should continue to monitor these areas for leaks and regularly review the surface-sealed roofing and flashing terminations to identify and replace worn sealant to maintain current roofing performance.

6.4 Low-slope Roofing – Trash Room

Well-constructed metal roofing systems are among the most durable roofing systems available, with an expected service life of 50 yrs or more. Although we did not confirm the age of the metal roofing systems at the trash rooms, we expect the existing metal roofs are part of the original building construction and have been in-service for approximately 40 yrs. We were unable to observe the underside of the existing roof for evidence of leakage. However, we did not receive reports from building occupants or maintenance staff of ongoing water leakage into the trash rooms.

While the metal roofing may still function to prevent water intrusion, we observed peeling and missing paint throughout the field of the existing metal roofs and surface corrosion where the paint is missing. If they do not already, we expect that the metal roofs will begin to show signs of aging (e.g., water leakage, metal section loss) in the next 5 yrs. Building maintenance staff may consider removal and replacement of the metal roofing with a modified-bitumen membrane roofing assembly to maintain consistency with some of the in-place canopy roofing assembly repairs. Alternatively, removal of surface corrosion/rust and peeling paint and application of a fluid-applied zinc-based coating over the existing roofing may prolong the useful service life of the roof an additional 5 to 10 yrs or more, depending on exposure conditions and the extent of corrosion of the existing metal roofing.

6.5 Miscellaneous Enclosure Related Items

6.5.1 Fenestrations

The exterior of the buildings primarily consists of aluminum-framed windows set into punched openings in the brick masonry cladding. The windows do not appear to include coordinated head, jamb, and sill flashings. Coordinated flashings provide redundancy to manage water that penetrates through the window assembly, perimeter sealants, or cladding. Windows without continuous perimeter flashings rely on continuous exterior sealants to resist water penetration. The windows at each building include sealant joints between the glass and aluminum framing. We observed numerous lengths of missing or deteriorated sealant along the window perimeters, and the remaining sealant is likely nearing the end of its useful service life based on the age of the building. We observed one window that has aluminum foil shoved within the window perimeter joint, possibly indicating that the unit occupant is trying to prevent air leakage to the building interior. Worn, damaged, or otherwise discontinuous sealant joints are likely to allow water and air infiltration to the building interior.

The window glazing is made up of insulated glazing units (IGUs). IGUs consist of individual panes of glass arranged around a hermitically sealed space filled with air or an inert gas. IGUs provide improved thermal performance over single-pane glazing. The service life of IGUs is commonly estimated at 20 yrs. Based on the condition of the select units we observed, we suspect the majority of IGUs are beyond this age range. However, we observed limited evidence to suggest that the IGUs are failing (e.g., fogging and condensation within the IGUs or water leakage). Failed IGUs can cause increased energy usage and visual issues. The unit owners should anticipate replacing a portion of the IGU's per year beginning in the next 5 to 10 yrs or as they fail.

6.5.2 Exterior walls

Brick masonry exterior walls from the estimated time of construction were commonly constructed as cavity walls with an air space between the exterior masonry and the backup construction, and flashings above wall openings and at regular intervals to collect and direct water out of the wall assembly. Although we did not make exploratory openings to verify the configuration of the wall assembly, the drawings indicate that the exterior walls of the seven buildings are cavity walls with discrete flashings indicated at wall openings. In cavity wall construction, the exterior masonry resists the passage of water while the cavity between the exterior masonry and the backup construction provides a space to collect and drain moisture that penetrates though the outer masonry.

Masonry cavity wall construction from the estimated time of construction typically did not include a separate water-resistive barrier between the exterior masonry and the backup wall. Modern masonry cavity walls with metal-framed backup walls almost always included a water-resistive barrier to reduce the risk of water penetrating through the relatively moisture-sensitive backup wall construction. Masonry backup walls, such as those at the seven buildings, are more tolerant of incidental moisture intrusion through the exterior brick, and previous construction practice frequently omitted a water-resistive barrier on the masonry backup wall. The drawings also indicate that the brick masonry was "back-parged" or covered with mortar to provide additional water penetration resistance. While the walls likely do not contain a water-resistive barrier, the lack of reported interior leaks and the lack of stains or other evidence of past water intrusion suggests that the walls effectively resist moisture intrusion. Additional investigation with exploratory openings can verify the configuration of the exterior wall assemblies and the condition of concealed wall components. However, the present condition of the exterior walls does not suggest a need for such additional investigation at this time.

Skyward-facing mortar joints typically occur along the top edge of the brick masonry site walls extending out from the face of the building wall. Skyward-facing mortar joints are particularly susceptible to deterioration and leakage, and are less durable than those orientated within the vertical plane of the wall. Several of the skyward-facing mortar joints we observed had deteriorated or fallen away entirely. While the site walls are outboard of the building envelope and may not present a direct leakage path to the interior, water within the site wall masonry may track back into the building and may also reduce long-term durability of the wall. Regardless of the presence of water leakage on the interior, it may be prudent to perform a targeted repointing effort at the skyward-facing mortar joints as well as other deteriorated brick mortar joints throughout the seven buildings. Building maintenance staff may also consider installing a metal coping to match the steep-slope roof counterflashing over the skyward-facing mortar joints to reduce risk of further mortar joint deterioration.

7. CONCLUSIONS

Based on our work described herein, we conclude the following:

- The existing steep-slope asphalt shingle roofing assembly may be halfway through its expected service life. However, it appears to be functioning to prevent water leakage to the interior. Localized detailing concerns warrant additional review and repair. We expect that the roofing may require replacement within the next 10 –15 yrs.

- The in-place gutters and downleaders appear to be in generally good condition. Some gutters are partially filled with debris that will affect their performance. The gutters will not overtop during the code-prescribed 100-yr, 60-min. storm event. However, the gutters may overtop at some locations during very frequent 1- to 25-yr return period, 5- min. duration storm events.

- The maximum outflow capacity of the downleaders is likely limited to 49.6 gpm by the gutter orifice. The outflow may increase with variance in the orifice diameter, however, shall not exceed the gutter capacity (77 gpm).

- The existing modified-bitumen and BUR membrane low-slope roofing is generally in good condition.

- The existing metal low-slope roofing is nearing the end of its service life if issues are not addressed soon. Replacement or repairs to the exiting metal roofing are warranted to prevent future water leakage and further corrosion of the roofing material.

- Numerous conditions at exterior windows may contribute to air/water infiltration, including missing glazing or perimeter seals and worn/deteriorated interior frame seals.

- Brick masonry cladding appears to be functioning to prevent bulk water leakage to the interior. Targeted repointing of mortar joints and installation of protection over skyward- facing joints at the entrance canopy and trash room walls may improve brick masonry expected service life and reduce future maintenance needs.

8. RECOMMENDATIONS

Based on our work described herein, we recommend the following

- Perform targeted repairs to the existing steep-slope roofing assembly to replace missing shingles and address localized detailing concerns. Implement a regular maintenance protocol to review the roofing assembly, including gutters, downleaders, and sealants. Regularly remove debris collected within gutters and identify and proactively replace missing shingles or worn sealants.

- Perform targeted repairs to the existing gutters and downspouts. The repairs will include a combination of adding outlets/downleaders (locations identified in Table 5) and enlarging the existing 3 in dia. downspout openings to an opening with a minimum area of 12 sq in (locations identified in Table 4). The extent of repairs is dependent upon the frequency of overtopping that building occupants are willing to tolerate. We recommend that building maintenance staff perform repairs designed to the 25-yr return period event (a 1 in 25 chance of occurrence in a given year).

- Implement a regular maintenance protocol to review the condition of exterior building sealants approximately every 1 – 2 yrs (e.g., at surface-sealed flashings, at window perimeters, and movement joints). Proactively replace worn sealant to reduce bulk water intrusion into the enclosure assemblies.

- Replace deteriorated window perimeter sealants. Plan for window IGU and frame replacement within the next 5 to 10 yrs or as IGUs fail. Where windows are replaced, include window head, jamb and sill flashings that properly integrate with the building wall assembly.

- Perform a targeted repointing effort at the skyward-facing mortar joints as well as other deteriorated brick mortar joints throughout the seven buildings. Consider installing a metal coping to match the steep-slope roof counterflashing over the skyward-facing mortar joints to reduce risk of further mortar joint deterioration.

This concludes our Task Order 1 services. We would be pleased to review our findings, conclusions, and recommendations with Mutual 19B and OC&L representatives, if you so desire.

Sincerely yours,

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Photo 1

Building 88

View of the north elevation of Building 88. The typical steep-slope roof layout consists of multiple roof areas separated by a rising wall, typically at changes in plane of the building wall.

Photo 2

Building 88

View of a section of the K- style aluminum gutter along the steep-slope roof eave.

Photo 3

Building 88

View of the membrane underlayment along the eave edge of a section of the Building 88 roof.

Photo 4

Building 88

View of the steep-slope roof to building wall transition over the stair tower entrance near the northeast corner of the building. An L-shaped metal flashing extends up the brick masonry wall from below the edge shingles, behind the counterflashing (arrow).

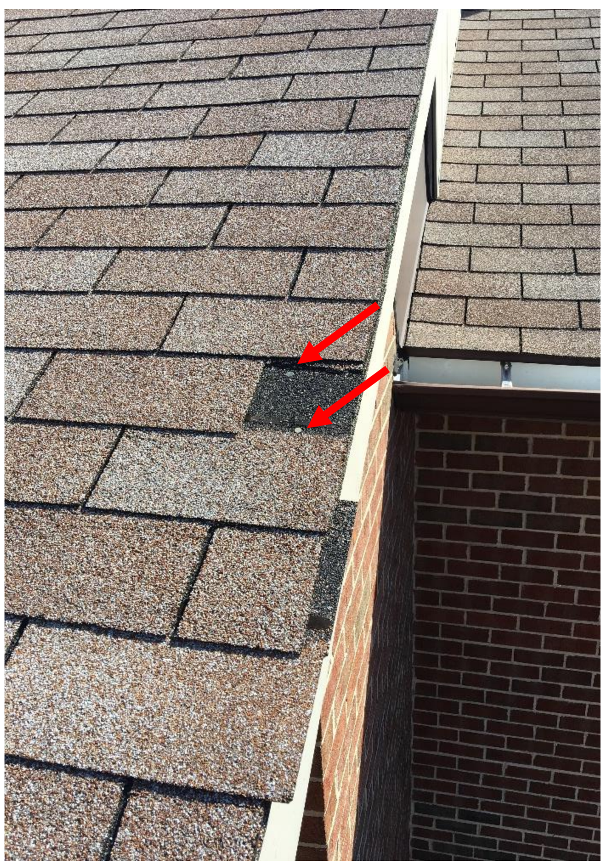


Photo 5

Building 92

View of the shingle fastener heads and exposed asphalt at a missing shingle location (arrows).

Photo 6

Building 92

View of shingle granules accumulated within a section of gutter along the west elevation of the building.

Photo 7

Building 92

View of a vent stack penetration in the steep- slope roofing (arrow).

Photo 8

Building 89

The profile of the roof joists is visible through the asphalt shingle roofing (drawn on for clarity).

Photo 9

Building 89

View of unevenness along the steep-slope roof ridge at the same location as Photo 8 above (top arrows). Note roof joist profile (bottom arrow).

Photo 10

Building 89

View of one of the regularly spaced gutter hangers/braces within the hung aluminum gutters. Note the roof edge flashing does not counterflash the gutter.

Photo 11

Building 89

View of the metal counterflashing leg along the roof eave that extends behind the back leg of the hung gutter (arrow). Also note typical gutter end cap.

Photo 12

Building 92

View of black staining along the brick masonry wall below a gutter end dam at the stair tower near the northwest corner of the building.

Photo 13

Building 92

View of sealant over a crack in the roof eave flashing over the stair tower door near the northwest corner of the building.

Photo 14

Building 89

View of the gutter and fascia board that are pulling away from the roof framing (arrow).

Photo 15

Building 88

View of leaves built up in a section of gutter over the downleader inlet.

Photo 16

Building 88

View of the Type Y roof gutter draining onto the adjacent Type X roof over the stair tower entry near the northeast corner of the building (arrow).

Photo 17

Building 88

View of an above-grade downleader outlet draining over a concrete splash block.

Photo 18

Building 91

View of an HDPE pipe extension installed at a downleader outlet on the west elevation of the building.

Photo 19

Building 91

View of a downleader that drains below-grade through a PVC pipe.

Photo 20

Building 88

View of the disconnected end elbow of the downleader outlet at the stair tower entrance at the northeast corner of the building.

Photo 21

Building 92

View of the low-slope canopy roofing and barrel skylight over the main building entrances. Water is ponded on the surface of the roof (arrows).

Photo 22

Building 92

View of a main entrance canopy and the canopy scupper outlet that extends through the brick masonry wall.

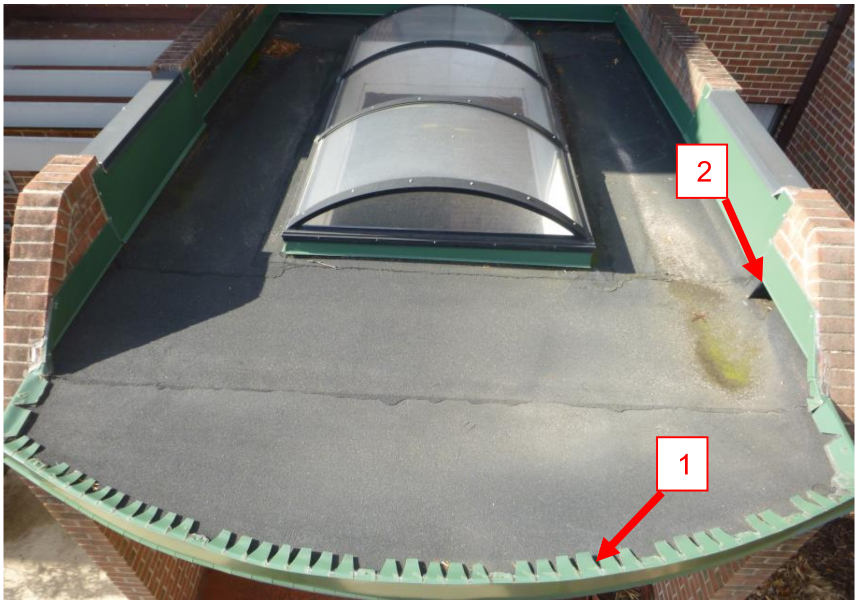


Photo 23

Building 88

View of the exposed back leg of the main entrance canopy edge flashing (1) and the roof scupper (2).

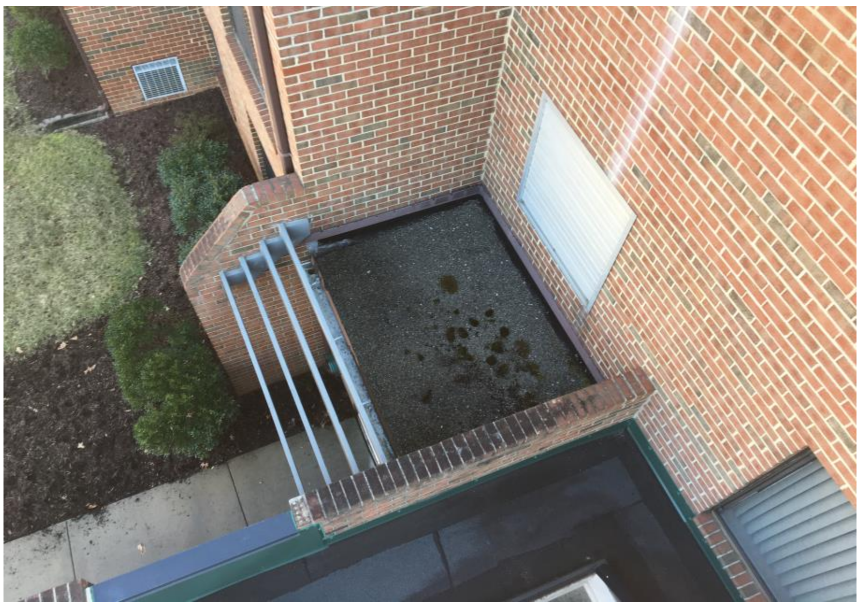


Photo 24

Building 92

View of the trash room roof adjacent to the building main entrance.

Photo 25

Building 89

View of the roof-to-wall transition flashing above the canopy at the main entrance (arrow).

Photo 26

Building 88

View of the trash room metal roof. The roof appears to be covered with a red coating or paint which is flaking and missing in some areas (arrows). Surface corrosion is visible on the roofing.

Photo 27

Building 91

View from the building exterior of moisture stains (arrow) along the interior finishes at the sill of a window unit on the north elevation of the building.

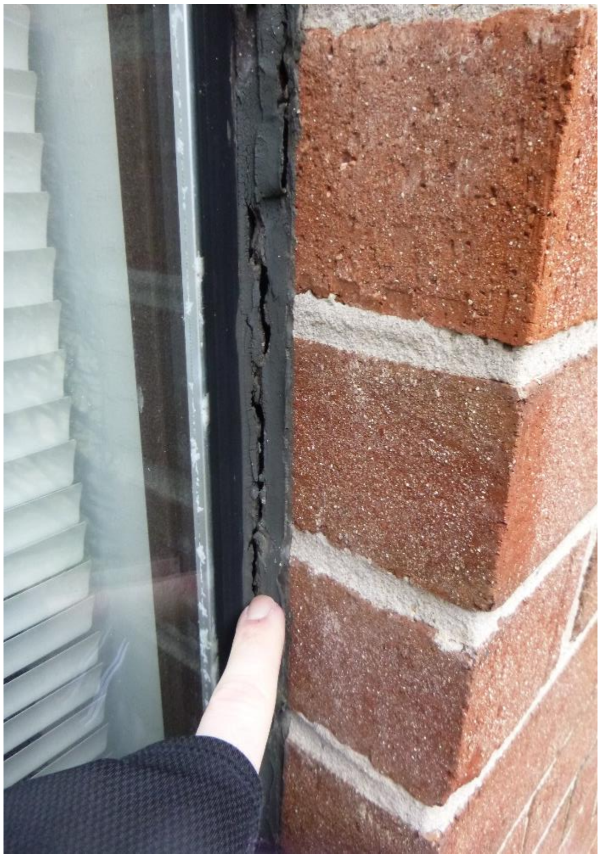


Photo 28

Building 88

View of a cracked sealant joint along a window perimeter. We observed similar cracked sealant joints on the other buildings.

Photo 29

Building 93

View of aluminum foil shoved within a window perimeter joint at the north elevation of the building (arrow).

Photo 30

Building 88

View of multiple spalled/missing sections of skyward-facing mortar at the brick masonry site wall near the stair tower entrance (arrows).

Photo 31

Building 92

View of efflorescent staining and other white discoloration along a brick masonry wall near the northwest building corner (arrows).

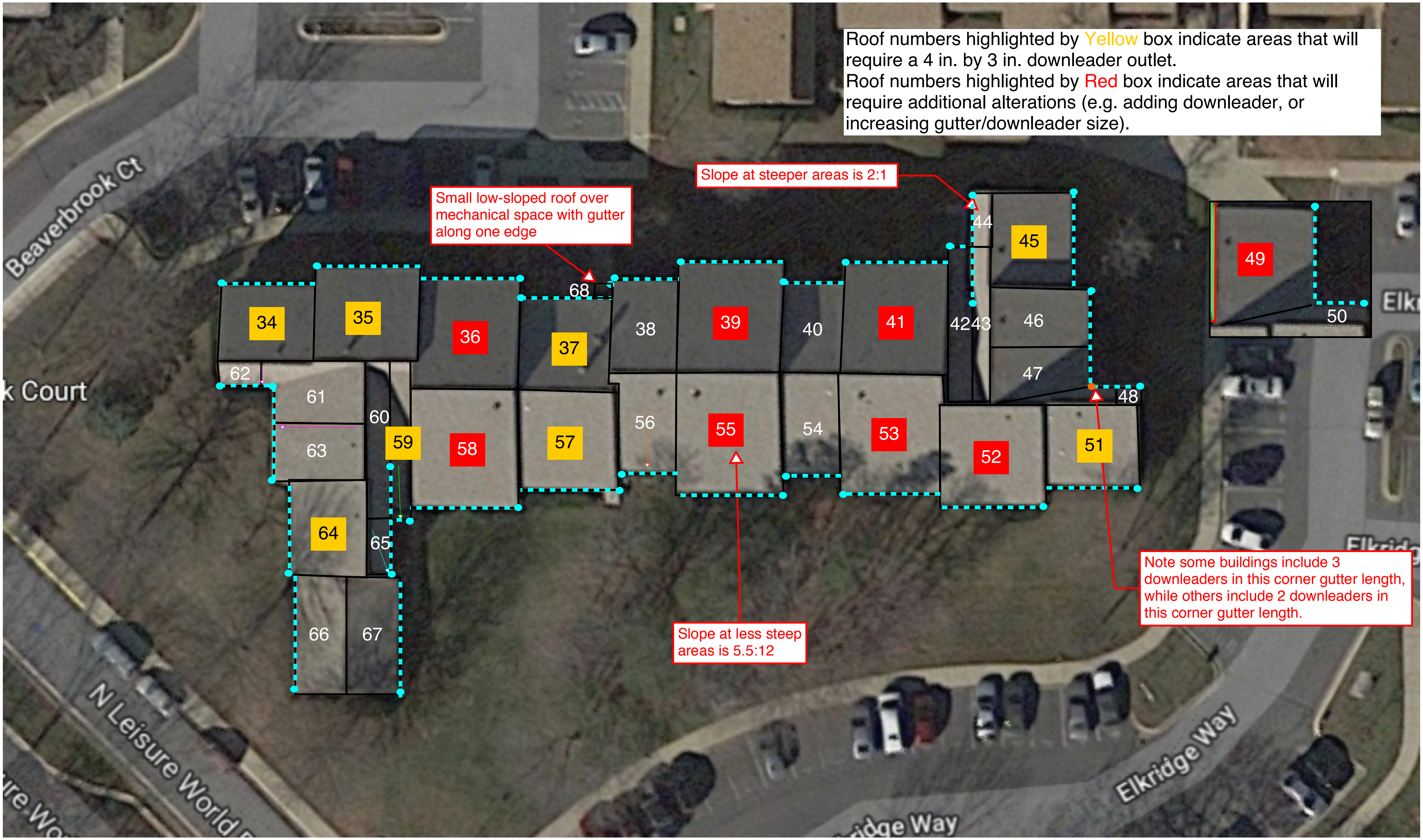
APPENDIX A

Building Type 1

Note: Areas 18, 19, 20 represent the condition where there are 3 downleaders for that section of roof, while Areas 21 and 22 represent the condition where there are 2 downleaders for that section of roof.

- Roof Area Boundaries
- Gutter Length
- Downleader

Building Type 2



Note: Areas 46, 47, 48 represent the condition where there are 3 downleaders for that section of roof, while Areas 49 and 50 represent the condition where there are 2 downleaders for that section of roof.