

Mr. Joseph Morgan, AIA  
KMF Architects  
839 N. Magnolia Avenue  
Orlando, FL 32803

RE: Report of Nuclear Roof Moisture Survey  
Orlando Public Library  
Roof Sections 2-3  
101 E. Central Boulevard  
Orlando, FL 32801

Dear Mr. Morgan:

In general accordance with your request and your authorization of our proposal (Number 273623R0 dated June 15, 2022) and authorized August 9, 2022), Intertek is pleased to submit the following roof nuclear moisture survey report for the above-referenced property. Included in this report is an outline of the project information, performed scope of services, results and conclusions.

#### **PROJECT UNDERSTANDING**

The project site consists of the Orlando Public Library building located at the above referenced address. Intertek was requested to perform a nuclear roof moisture scan of the roof sections in order to investigate potentially moisture impacted areas within the roof system. The survey included eleven separate roof sections. This report specifically pertains to Roof Sections 2-3. Please refer to the appended annotated aerial map for roof designations. Roof Section 1 is provided under a separate report cover; and Roof Sections 4-11 are also provided under a separate report cover.

The roof system at Roof Sections 2-3 is comprised of low slope built-up roof system with a modified bitumen membrane. The roof system components are as follows (as viewed from the deck up): lightweight insulating concrete (with EPS foam), two modified bitumen inner plies, polyisocyanurate insulation, Securock cover board, two modified bitumen inner plies with a granule surfaced cap sheet membrane. Roof Section 2 totals approximately 18,000, SF, and Roof Section 3 totals approximately 14,000 SF.

#### **SCOPE OF SERVICES**

On August 31, 2022, Intertek performed a nuclear moisture survey of the referenced roof sections. The survey was performed in general accordance with TAS 126-95. This protocol covers the procedures for non-destructive testing for the presence of moisture, in a roof system assembly. The survey at these roof sections was performed on a 10x10 foot grid pattern. Roof core samples were extracted and patched by others.

Weather conditions at the time of the scan were partially cloudy with a temperature range of 86-91°F and average wind speeds up to 8 mph.

<sup>[1]</sup> Intertek is a brand name representing the Intertek Group plc legal entities, including but not limited to, Intertek Testing Services NA Inc., Professional Service Industries, Inc. ("INTERTEK-Intertek"), Architectural Testing Inc. ("INTERTEK-ATI"), and MT Group Inc. ("INTERTEK-MT").





## METHODOLOGY

### Nuclear Roof Moisture Survey

Intertek utilized a Troxler Model 3216 nuclear scanner to survey the roof assemblies. The roof was surveyed on a 10x10-foot pattern. The nuclear scanning meter emits neutrons from a radiation source within the scanning meter downward into the roof system assembly. Neutrons which encounter hydrogen atoms are slowed down; a portion of which “bounce back” to be counted by a detector within the scanning meter. Since water contains a significant amount of hydrogen atoms, areas of moisture within the roofing plies and/or insulation record higher levels of slowed neutrons. Gauge readings are inherently unitless and are resultant of a statistical function performed by the gauge based on emitted and measured reflected radiation and known properties of the element hydrogen.

Areas of isolated obstructions due to permanent mechanical appurtenances and drainage structures were not directly scanned; however, the immediately adjacent roof area was scanned, where applicable. Moisture readings were not obtained on roof top equipment, roof areas very close to wall edges and near equipment penetrations; scanning these areas can produce elevated readings compared to the typical roof readings due to hydrogen present within the additional layers of asphaltic materials or due to metallic flashing materials at walls and penetrations. However, the immediate adjacent areas were scanned, where applicable.

In order to calibrate unitless gauge readings to actual moisture content, core samples were obtained as part of the survey. A total of six investigative core samples (three at each of the two roof sections) were obtained during the performance of the moisture survey. The core locations were spread out throughout the roof. Core locations were selected after the nuke reading histogram was formed on the basis of moisture scan results, generally corresponding to areas of relatively low, mid and high readings as interpreted in the field. Coring of the roof system was performed and patched by others during the site visit.

### Gravimetric Laboratory Analysis of Roof Samples

Laboratory testing was performed on the six test core samples obtained in the field from the noted roof areas. Core samples were weighed, oven dried, then reweighed to determine the approximate percentage of moisture by dry weight. The standard formula used to determine the percentage of moisture by dry weight is as follows:

$$\% \text{ Moisture by Dry Weight} = \frac{\text{Weight}_{(wet)} - \text{Weight}_{(dry)}}{\text{Weight}_{(dry)}} \times 100\%$$

All samples were stored in individual, labeled and sealed plastic zipper storage bags immediately after extraction from the roof assembly. Once gathered, the field samples were transported to the Intertek laboratory and weighed to establish their wet weight. Samples were then chamber dried for a minimum of 24 hours. Each specimen was cooled to room temperature and its weight measured. The process was repeated, and this weight was recorded as the specimen’s dry weight.

At the conclusion of the moisture survey and laboratory analysis of core samples obtained, the moisture content value for the roof’s membrane, cover board, insulation board and LWIC/EPS were obtained. Generally, the results of the insulation and cover boards of each core sample was plotted on a linear graph versus the corresponding moisture scan reading. A best-fit linear regression curve and corresponding best-fit line slope equation were developed. The line slope equation describes average moisture percentage by dry weight as a function of the moisture scan readings. This function was compared to the histogram of gauge readings and statistical analysis as well as the visual survey of the cores in the field.



**SURVEY RESULTS**

Nuclear Roof Moisture Survey

Based on the data obtained in the field, a normal distribution curve of the sampled readings was formed. Please refer to the attached documents for results. The mean and standard deviation of the sample set were calculated. As stated in TAS 126-95, Section 13.5.2: Statistically, 99.7% of the measurement counts for the dry areas of the roof will fall between one to three standard deviation limits with the different varying levels of moisture. This is further calibrated via the gravimetric analysis and roof core sample analysis performed.

The following observations were made during coring of the roof system:

Core Location / Nuke Reading	Core Thickness	Observation
Roof Section 2 – N8 / 5	10.25"	Roofing components relatively dry
Roof Section 2 – C10 / 8	8.5"	Roofing components relatively dry
Roof Section 2 – A3 / 18	11"	Moist insulation and cover boards
Roof Section 3 – F11 / 5	9"	Roofing components relatively dry
Roof Section 3 – L2 / 8	8.75	Roofing components relatively dry
Roof Section 3 – B3 / 22	9"	Moist insulation and cover boards

It should be noted that the interpretation of the results is based on the combination of the statistical analysis, gravimetric analysis, and field conditions of the cores; and these factors are dependent on one another and should not be interpreted exclusively. Moisture migration throughout a roof system is possible due to thermal solar loading and live traffic loads on the roof system.

Based on the data obtained, statistical analysis, and visual observations of roof samples and our analysis, the results of the nuclear moisture scan are summarized as follows:

Roof Section	Approximate Roof Area	Suspect Moisture Roof Area	Wet Area	Total Area of Concern
2	18,000 SF	100 SF	200 SF	<b>300 SF (1.7%)</b>
3	14,000 SF	500 SF	500 SF	<b>1,000 SF (7.1%)</b>

A representative roof grid (moisture map) showing the location of moisture gauge readings, and roof cores obtained is presented in the Appendix, along with the histograms depicting the frequency of gauge readings and the linear regression curve with the statistical analysis results. Photographs of the roof sections and cores are also appended to this report.

The Florida Building Code, Chapter 15, Section 1511.1.1, mandates that not more than 25% of a total roof area or roof section of any existing building or structure shall be repaired, replaced or recovered in any 12-month period unless the entire existing roofing system or roof section is replaced to conform to requirements of this code.

Any moisture within the roof system has the ability to impact wind uplift performance. Per The FBC 1521.12: "All existing lightweight insulating concrete, gypsum and cementitious wood fiber roof decks shall be tested in



accordance with Section 1521.7 to confirm compliance with wind load requirements of Chapter 16 (High-Velocity Hurricane Zones).”

#### LIMITATIONS

The observations and results presented in this report are time dependent, and conditions may have changed since our site visit. This report speaks only as of the dates of our site visit. Many factors, including solar loading and foot traffic can cause any entrapped moisture to migrate/move throughout the roofing system. Any moisture trapped in between the modified membrane system and the lightweight insulating concrete may eventually find its way to the lower portions of the roof assembly and down to the structural concrete deck where the penetrations for drains are located. This survey should not be interpreted as a code/safety compliance survey or an as-built survey.

Nuclear moisture roof gauge scans generally have depth limitations of around 8-10” which could limit the accuracy of the scans at areas of extra material thickness. It should be noted that most of the cores obtained were within the above listed range.

Intertek was not required to provide intrusive services to investigate or detect the presence of mold or other biological contaminants in or around any structure. Intertek did not provide any services that were designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. Intertek was not required to inspect for mold. Client acknowledges that mold is ubiquitous to the environment with mold amplification occurring when the building materials are impacted by moisture. Client further acknowledges that site conditions are outside of Intertek’s control and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, Intertek cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

#### CLOSURE

Intertek appreciates that opportunity to have been of service to you. If you have any questions regarding this report, or if we may be of further service, please feel free to contact this office at your convenience.

Respectfully submitted,

**Intertek**

Handwritten signature of Milan Nikolic in blue ink.

Milan Nikolic  
Senior Project Manager  
Building Science Solutions

Handwritten signature of Craig Williams, R.R.C. in blue ink.

Craig Williams, R.R.C.  
Principal Consultant  
Building Science Solutions

#### Appendixes:

- Representative Photographs
- Moisture Survey Results - Sketches and Figures
- Gravimetric Analysis Results
- Overall Annotated Roof Aerial Map





**Photo 1:** Overview of Roof Section 2.



**Photo 2:** Overview of Roof Section 2.



**Photo 3:** Roof Section 2 – Core Location N8 – Core in progress.



**Photo 4:** Roof Section 2 – Core Location N8 – roofing components relatively dry.





**Photo 5:** Roof Section 2 – Core Location N8 – Core thickness.



**Photo 6:** Roof Section 2 – Core Location C10 – relatively dry roofing components.





**Photo 7:** Roof Section 2 – Core Location C10 – Core thickness.



**Photo 8:** Roof Section 2 – Core Location A3 – moist roofing components.





**Photo 9:** Roof Section 2 – Core Location A3 – insulation and cover boards moist.

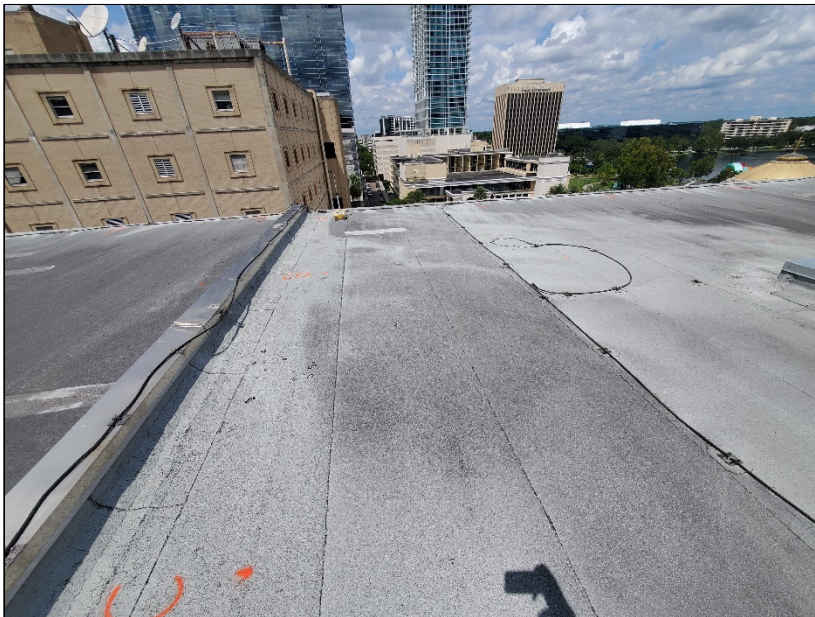


**Photo 10:** Roof Section 2 – Core Location A3 – View within core: note moist roofing components at insulation and cover board layers.





**Photo 11:** Roof Section 2 – Core Location A3 – Core thickness.



**Photo 12:** Overview of Roof Section 3.





**Photo 13:** Overview of Roof Section 3.



**Photo 14:** Roof Section 3 – Core Location F11 – relatively dry roofing components.





**Photo 15:** Roof Section 3 – Core Location F11 – core thickness.



**Photo 16:** Roof Section 3 – Core Location L2 – polyiso insulation layer relatively dry.





**Photo 17:** Roof Section 3 – Core Location L2 – core thickness.



**Photo 18:** Roof Section 3 – Core Location B3 – coring in progress.





**Photo 19:** Roof Section 3 – Core Location B3 – moist conditions at insulation board.



**Photo 20:** Roof Section 3 – Core Location B3 – core thickness. Note moist conditions within core at insulation and cover board layers.

# MOISTURE SCAN RESULTS

Location: Orlando Public Library  
 Address: 101 E. Central Blvd., Orlando FL  
 Date of Scan: 8/30/2022  
 Field Consultant(s): Shawn Wallace, Jason Salle

Roof Type: Low-slope modified bitumen BUR  
 Grid Type: 10-ft x 10-ft  
 Gauge Type: Troxler 3216  
 Roof Section: 2

	1	2	3	4	5	6	7	8	9	10	11	12
A	9	8	6	7	6	6	6	6	6	5	8	8
B	7	8	6	5	6	7	5	5	6	7		
C	7	7	8	6	6	6	8	7	8	6	6	
D	6	6	9	6	6	6	5	7	8	10	7	9
E	6	6	7	6	5	6	6	7	6	17	9	9
F	6	7	7	5	6	6	5	8	12			
G	7	6	7	7	5	6	5	7	9			
H	6	7	6	6	6	5	6	6	9	8	6	
I	7	6	6	5	7	7	7	7	7	9	7	
J	6	7	5	6	6	8	5	8	9	9	8	
K	6	6	6	6	8	6	8	11	10	9	7	
L	7	7	6	7	7	6	7	8	8	7	8	
M	8	7	8	6	6	5	5	5	6	7	7	
N	6	5	9	6	6	5	5	5	6	6	8	6
O	11	8	6	7	6	8	8	8	7	9	8	

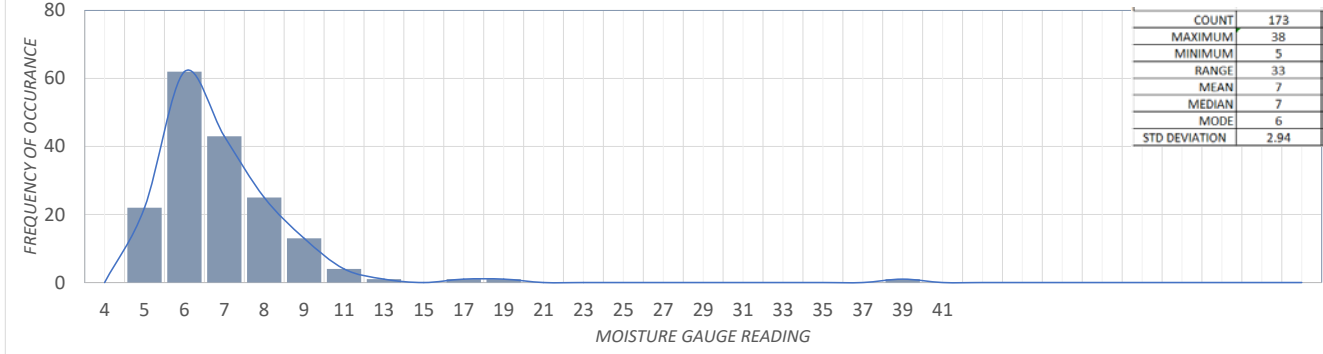


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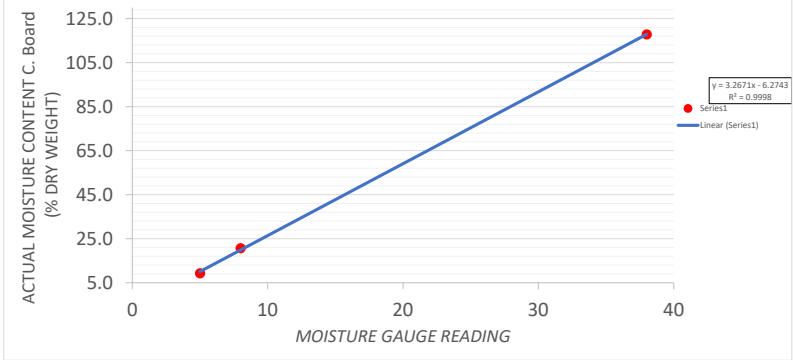
- Not Scanned (Due to penthouse/material/drain/mechanical/etc.)
- # Core Location
- Suspect Wet Reading
- Dry Reading
- Wet Reading

NUMBERS SHOWN REPRESENT GAUGE READINGS. INTERPRETATION OF MOISTURE CONTENT BASED ON STATISTICAL ANALYSIS AND OF GRAVIMETRIC ANALYSIS AND GAUGE READINGS.

**FIGURE 1**  
 MOISTURE READINGS HISTOGRAM  
 Roof Section 2



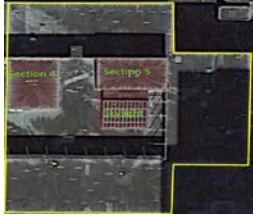
**FIGURE 2**  
 ACTUAL MOISTURE CONTENT VS. MOISTURE GAUGE READING  
 LINEAR REGRESSION CURVE  
 Roof Section 2



# MOISTURE SCAN RESULTS

Location: Orlando Public Library      Roof Type: Low-slope modified bitumen BUR  
 Address: 101 E. Central Blvd., Orlando FL      Grid Type: 10-ft x 10-ft  
 Date of Scan: 8/31/2022      Gauge Type: Troxler 3216  
 Field Consultant(s): Shawn Wallace, Jason Salle      Roof Section: 3

	1	2	3	4	5	6	7	8	9	10	11	12	13
A	5	13	7	7	6	8	6	8	5				
B	17	23	22	8	6	5	6	5	7				
C	7	14	20	5	10	6	6	7	7				
D	7	6	7	13	8	7	6	8	8				
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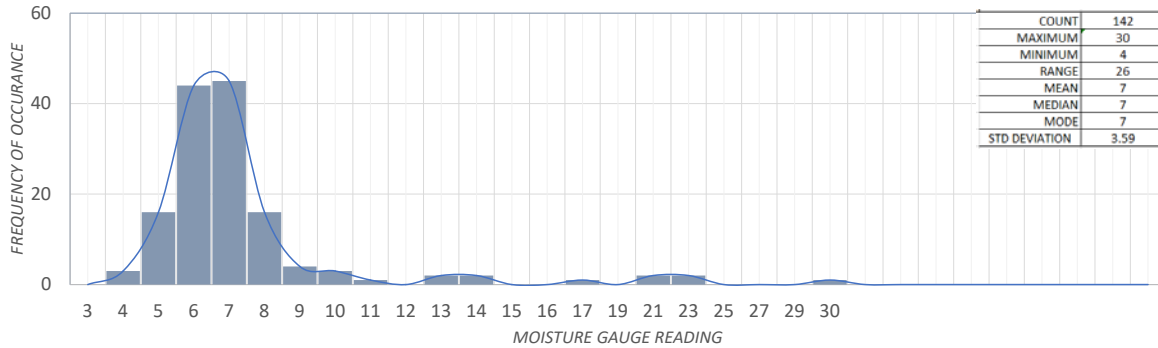


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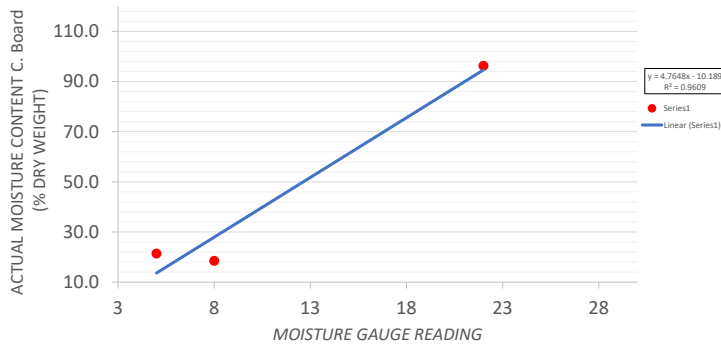
- Not Scanned (Due to penthouse-material/drain/mechanical/etc.)
- Core Location
- Suspect Wet Reading
- Dry Reading
- Wet Reading

NUMBERS SHOWN REPRESENT GAUGE READINGS. INTERPRETATION OF MOISTURE CONTENT BASED ON STATISTICAL ANALYSIS AND OF GRAVIMETRIC ANALYSIS AND GAUGE READINGS.

**FIGURE 1**  
 MOISTURE READINGS HISTOGRAM  
 Roof Section 3



**FIGURE 2**  
 ACTUAL MOISTURE CONTENT VS. MOISTURE GAUGE READING  
 LINEAR REGRESSION CURVE  
 Roof Section 3



# ROOF CORE GRAVIMETRIC ANALYSIS RESULTS

PSI Laboratory  
1748 33rd St, Orlando, FL 32839

PSI Project No. P0891.01  
Project Name: ORLANDO PUBLIC LIBRARY  
Project Manager: MILAN NIKOLIC

TESTED BY P50010082  
DATE TEST 9/3/2022  
REF # P0891.01

**SAMPLE CHARACTERISTICS:**

Roof Section 2

Membrane type:	Asphalt: <u>  X  </u>	Single-ply: <u>          </u>	Cementitious: <u>          </u>
Insulation type (check all that apply):	Foam board: <u>  X  </u>	Board: <u>  X  </u>	LW Concrete: <u>  X  </u>

Sample Name	Layer Type	Tare Weight (g)	Tare + Sample (g)	Tare + Sample "Dried" (g)	Weight of Original Sample (g)	Weight of Dried Sample (g)	Weight of Moisture (g)	Percent Moisture by Dry Weight (Sample Layer) (g)
ROOF 2 N8 LOW5	ISO BOARD	287.51	307.65	306.94	20.14	19.43	0.71	3.7%
	EPS FOAM	92.61	101.69	101.45	9.08	8.84	0.24	2.7%
	ASPHALT	9.99	187.79	187.33	177.8	177.34	0.46	0.3%
	C. BOARD	7.57	96.9	89.33	89.33	81.76	7.57	9.3%
	LWI CONC	201.5	446.1	424.27	244.6	222.77	21.83	9.8%

ROOF 2 C10 MID8	ISO BOARD	7.49	30.45	29.32	22.96	21.83	1.13	5.2%
	C. BOARD	218.98	331.73	312.41	112.75	93.43	19.32	20.7%
	ASPHALT	10.99	189.85	188.78	178.86	177.79	1.07	0.6%
	LWI CONC	7.39	78.12	73.29	70.73	65.9	4.83	7.3%
	EPS FOAM	108.15	242.2	232.59	134.05	124.44	9.61	7.7%

ROOF 2 O2 HIGH38	ASPHALT	227.33	369.85	367.08	142.52	139.75	2.77	2.0%
	ISO BOARD	285.77	687.81	410.43	402.04	124.66	277.38	222.5%
	C. BOARD	503.95	846.64	661.31	342.69	157.36	185.33	117.8%
	EPS FOAM	204.9	224.27	222.67	19.37	17.77	1.6	9.0%
	LWI CONC	211.75	718.72	660.64	506.97	448.89	58.08	12.9%

# ROOF CORE GRAVIMETRIC ANALYSIS RESULTS

PSI Laboratory  
1748 33rd St, Orlando, FL 32839

PSI Project No. P0891.1  
Project Name: ORLANDO PUBLIC LIBRARY  
Project Manager: MILAN NIKOLIC

TESTED BY P50010082  
DATE TEST 9/3/2022  
REF # P0891.01

**SAMPLE CHARACTERISTICS:**

Roof Section 3

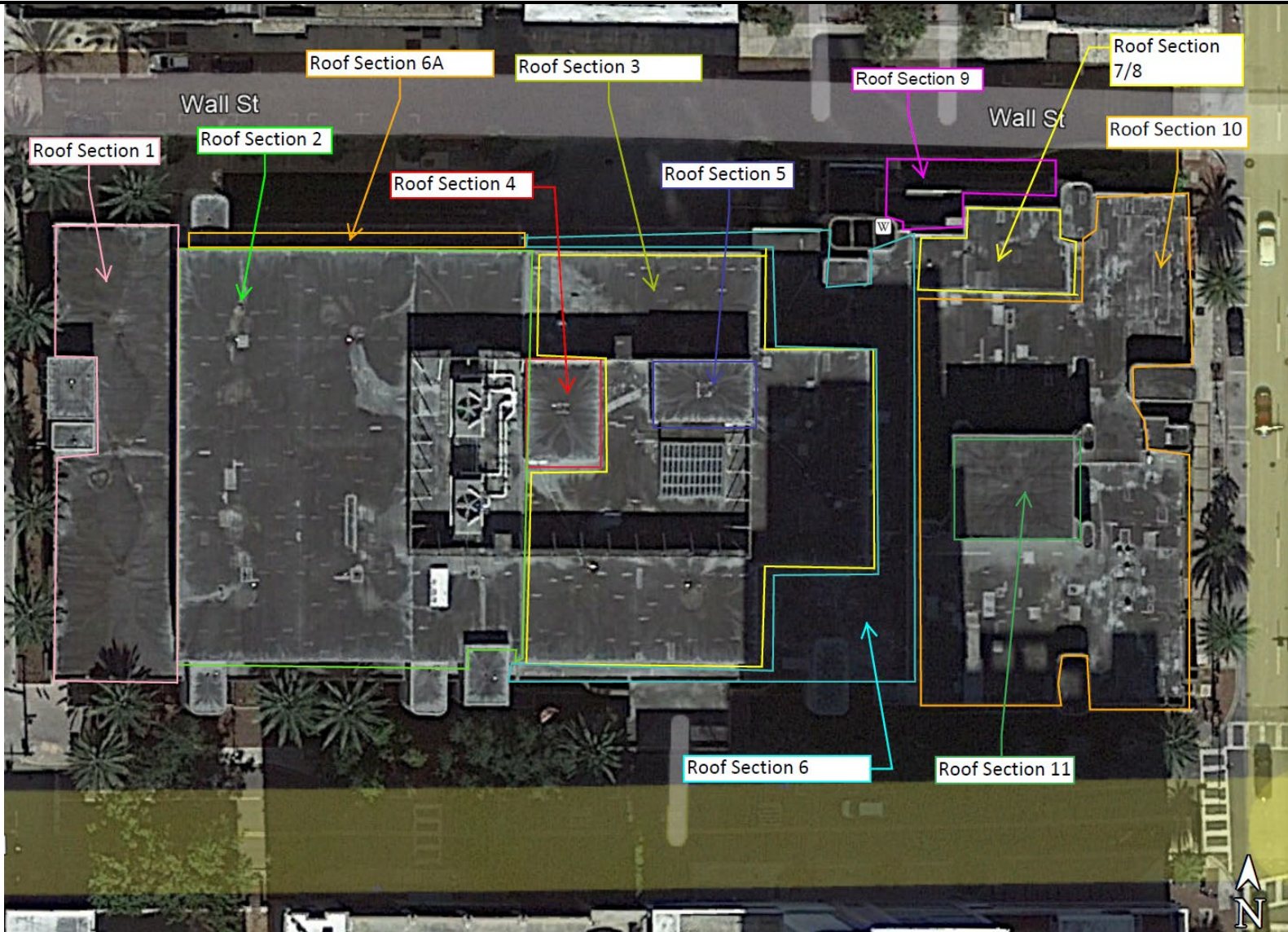
Membrane type:	Asphalt: <u>  X  </u>	Single-ply: <u>          </u>	Cementitious: <u>          </u>
Insulation type (check all that apply):	Foam board: <u>  X  </u>	Board: <u>  X  </u>	LW Concrete: <u>  X  </u>

Sample Name	Layer Type	Tare Weight (g)	Tare + Sample (g)	Tare + Sample "Dried" (g)	Weight of Original Sample (g)	Weight of Dried Sample (g)	Weight of Moisture (g)	Percent Moisture by Dry Weight (Sample Layer) (g)
ROOF 3 F11 LOW5	C. BOARD	170.5	288.75	267.89	118.25	97.39	20.86	21.4%
	ISO BOARD	200.38	222.32	221.61	21.94	21.23	0.71	3.3%
	EPS FOAM	89.21	102.33	102.14	13.12	12.93	0.19	1.5%
	LWI CONCRETE	203.47	429.27	424.95	225.8	221.48	4.32	2.0%
	ASPHALT	189.43	448.62	447.8	259.19	258.37	0.82	0.3%

ROOF 3 L2 MID 8	ASPHALT	124.02	389.91	389.89	265.89	265.87	0.02	0.0%
	ISO BOARD	89.92	125.31	124.04	35.39	34.12	1.27	3.7%
	C. BOARD	348.49	492.08	469.71	143.59	121.22	22.37	18.5%
	EPS FOAM	386.94	430.74	424.76	43.8	37.82	5.98	15.8%
	LWI CONCRETE	213.07	727.74	614.22	514.67	401.15	113.52	28.3%

ROOF 3 B3 HIGH22	ISO BOARD	286.98	737.3	460.48	450.32	173.5	276.82	159.6%
	ASPHALT	693.59	986.12	962.65	292.53	269.06	23.47	8.7%
	C. BOARD	7.45	176.88	93.78	169.43	86.33	83.1	96.3%
	EPS FOAM	386.94	460	424.76	73.06	37.82	35.24	93.2%
	LWI CONCRETE	213.07	760	614.22	546.93	401.15	145.78	36.3%





Overall Annotated Roof Aerial Map  
Orlando Public Library  
Orlando, FL