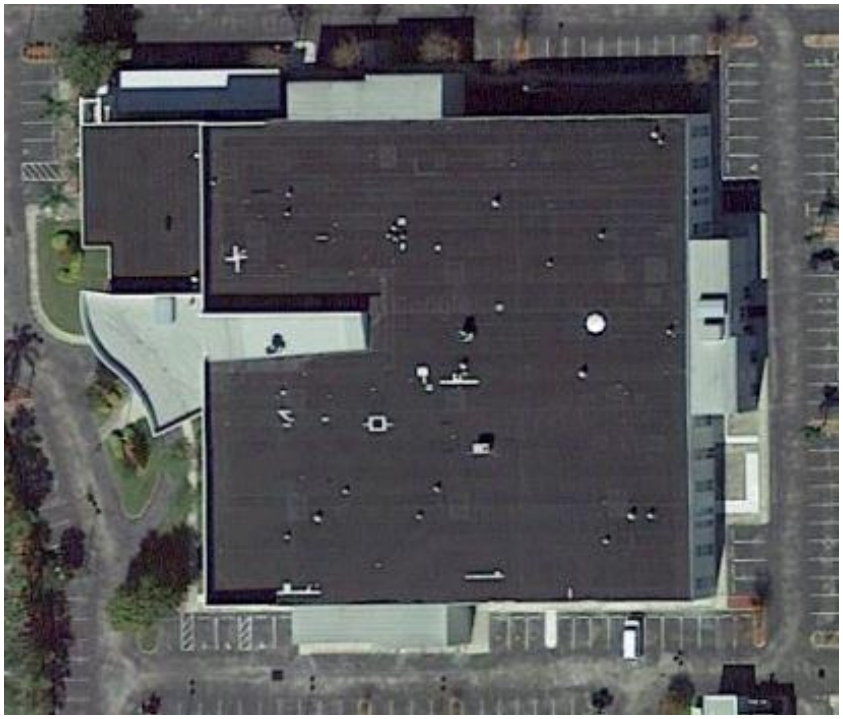
REI ENGINEERS

24600 S. TAMIAMI TRAIL, SUITE 212-315, BONITA SPRINGS, FL 34134
PHONE 800.495.9028 FAX 239.498.7447

Infrared Moisture Evaluation
St. Petersburg College
14025, 58th St N, Clearwater, FL 33760



Client:	St. Petersburg College	
Representative:	Diana Wright	
Consultant:	Randy Moore Jr., EI Technician rmoore@reiengineers.com	Scott Hinesley, PE, RRC President shinesley@reiengineers.com
Certificate of Authority:	Florida COA 26860	
Date:	October 27, 2014	

Scott Hinesley

SCOTT HINESLEY LICENSE No. 57937 STATE OF FLORIDA PROFESSIONAL ENGINEER

Digitally signed by Scott Hinesley
DN: cn=Scott Hinesley, o=REI Engineers, ou, email=shinesley@reiengineers.com, c=US
Reason: I hereby certify that I, Scott Hinesley (FL PE No 57937) did personally seal this document titled 14ETM-016 St Pete IR Moisture Assessment - Certified.pdf consisting of 16 report pages and 1 roof plan) on November 12, 2014.
Date: 2014.11.11 07:31:29 -05'00'

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

During REI's site visit, numerous patches, repairs, and deficiencies were observed on the EPDM roof system. The EPDM seams were curling, and numerous holes, splits, and opening were found throughout both roof sectors. Multiple locations have cupped or warped insulation boards under the single ply membrane which is typically evidence of wet or previously wet conditions.

REI performed an infrared scan of the roof sectors to determine if these deficiencies were causing moisture to become trapped within the roof system. Multiple thermal anomalies were observed and marked for verification during the daytime field work. During this field work, test cuts were made in the membrane to access the underlying insulation and assess the presence of moisture. By visual and tactile inspection, no moisture was observed in any of the test cuts. A moisture meter was used to verify the findings.

It is our opinion that moisture is able to access the roof system through the failing membrane; however, the combination of the black membrane creating high roof surface temperatures, and the cooler conditioned interior, drives the moisture down and out of the insulation over the course of one to two dry days.

In order to roof over the existing roof system, REI recommends the following procedures. The existing cupped insulation boards should be replaced with new. The new roof system should only be installed after a minimum of two sequential dry days. The moisture content in the insulation should be monitored during roof installation using a Delmhorst moisture meter or equivalent. Typically during a roofing project of this size, the contractor will split the installation into phases or smaller sections of roof area. An additional option in order to monitor the moisture in the existing system includes conducting an infrared moisture scan for each phase the night prior to the new roof installation. This will indicate if thermal anomalies are present prior to a phase being installed and can be used in conjunction with the continuous moisture monitoring.

II. AUTHORIZATION

This report presents the findings of an Infrared Moisture Survey conducted at the St. Petersburg College, 14025, 58th St N, Clearwater, FL 33760. The evaluation was authorized by Diana Wright through Purchase Order # SPJC1-0000092501.

III. PURPOSE

The purpose of this Infrared Moisture Evaluation was to determine the general location and roof area size in which water is suspected to be present in the roof system. REI's findings are proposed to be used by a roof system manufacturer to determine the viability of a recover roof system.

IV. SCOPE

The scope of the work performed is outlined in REI Proposal No. P14FTM-030, dated August 25, 2014.

V. WARRANTY NOTICE

The findings and recommendations submitted for this project are based upon available information furnished by participating personnel, as well as investigative test procedures. The observations and recommendations presented in this report are time dependent and conditions will change. REI warrants these findings have been presented after being prepared in accordance with generally accepted practices of RCI, Inc., The Institute for Roofing, Waterproofing and Building Envelope Professionals, and appropriate industry standards. No other warranty is expressed or implied. This report has been prepared for the exclusive use of St. Petersburg College and its agents.

VI. DESCRIPTION AND BACKGROUND

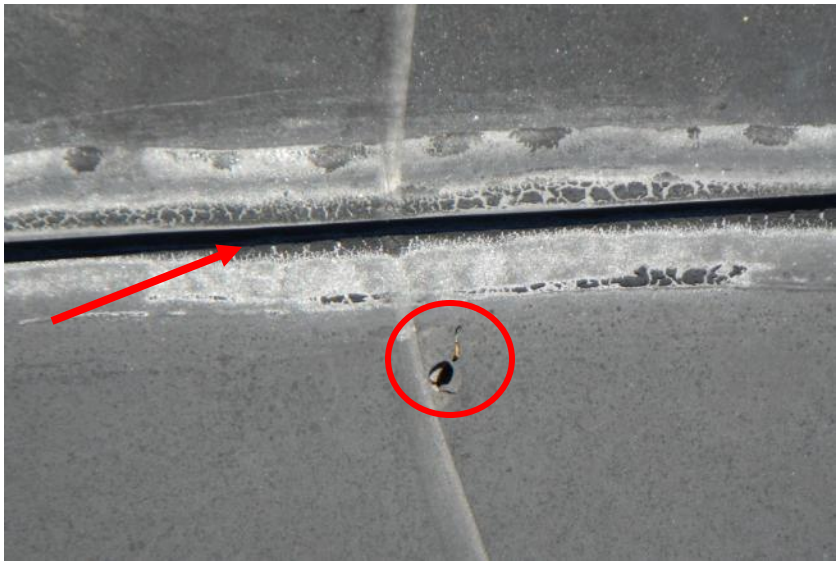
The Infrared Moisture Evaluation was conducted on October 6th, 8th, and 9th by Randy Moore of REI Engineers. Weather prior to the infrared scan was dry and mostly sunny with temperatures ranging from 81-86˚F. A brief history and an initial tour of the facility were provided by Lee Brighton of St Petersburg College. The Moisture Survey was conducted on two roof sectors at the referenced facility. The roof composition consists of an EPDM single ply membrane installed over polyisocyanurate which is mechanically fastened to a structural steel deck. A rigid cover board was not used. Numerous prior leaks were reported by Mr. Brighton, but he was not aware of any active leaks at the time of REI's site visit. Roof repair crews have visited the site multiple times in the recent past to patch the aforementioned leaks. The roof was reported to be in generally poor condition and a recover project is currently under discussion.

VII. OBSERVATIONS

The roof sectors are designated herein as Sectors S1 and S2. For purposes of this report, the front entrance doors face the 58th St N toward the west.

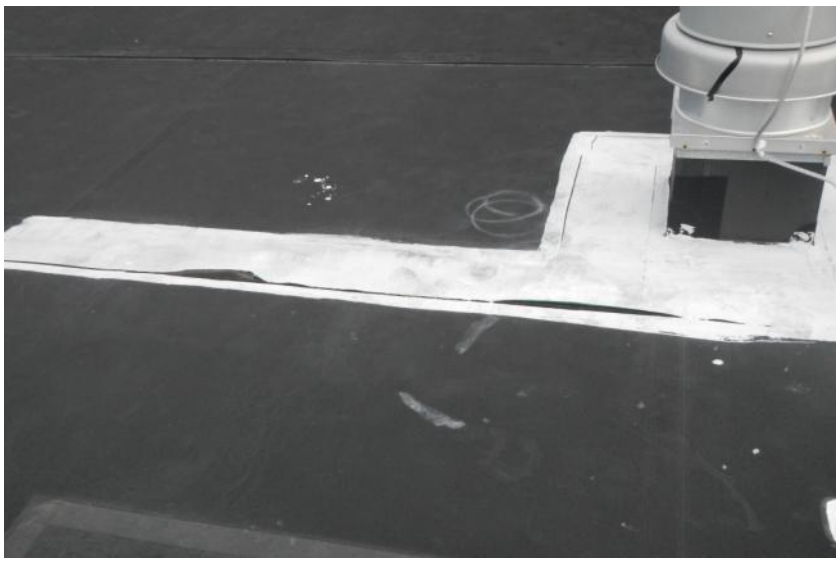
A. Sector S1 Observations

1. Holes, splits, and failing seams in the EPDM single ply membrane were observed during REI's site visit. All of the seams are curling and the adhesive bond between them is deteriorating.



Observation Photograph 1 – Circle indicates a hole/split in the membrane and arrow indicates the curling/deteriorated seams.

2. Patches and coatings have been installed in an attempt to make repairs. These patches and coatings are also failing and the edges are curling.



Observation Photograph 2 – This patch is curling around the perimeter, and a coating has been applied to the surface.

3. Multiple patches have been installed throughout the roof sectors. These patches often showed up as thermal anomalies in the infrared camera viewfinder and were marked as such. Further investigation with a moisture meter would later find these areas to be dry.

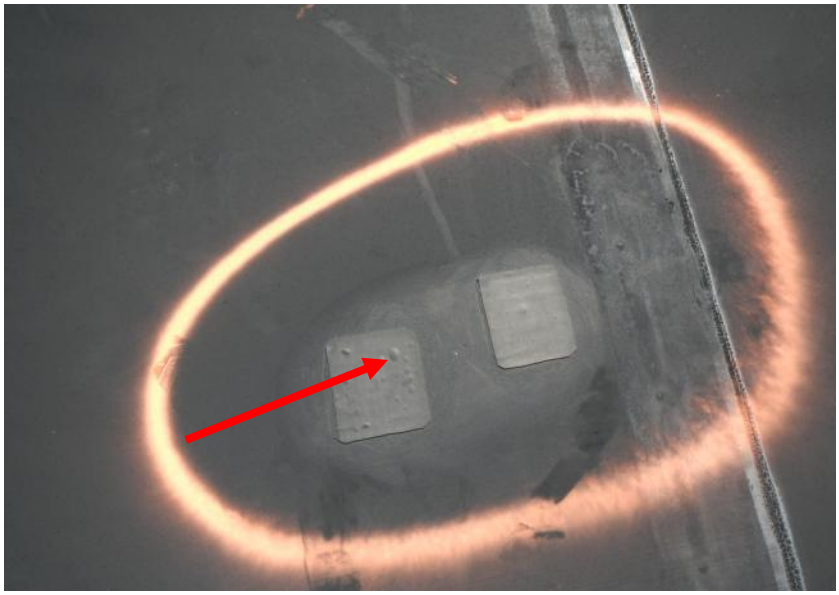
Observation Photograph 3 – View of typical patching throughout the roof system and paint marking for further assessment.

B. Sector S2 Observations

4. Holes and splits in the EPDM membrane, similar to Observation Photo #1, were also observed on Sector S2. Surface applied sealant is used at a few locations in an attempt to make repairs as seen in this photograph.

Observation Photograph 4 – View of EPDM membrane opening with surface applied sealant.

5. Numerous patches have also been installed on Sector S2. The patches in this image appear to have been installed somewhat recently; however, blisters are visible in the patching material.



Observation Photograph 5 – View of typical patches on S2. Arrow indicates blisters in patch.

VIII. INFRARED TESTING

The infrared scan was conducted on the 6th and 8th of October 2014 in accordance with ASTM C 1153, *Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging*. Skies during the scan were cloudy and partly cloudy, respectively, with temperatures ranging from 80°F at the start of the scan (approximately 6:30 p.m.) to 67°F at the completion of the scan (approximately 8:20 p.m.). Wind conditions were calm. The last measurable precipitation occurred two days prior to the scan. During the twenty-four hours prior to the scan, the skies were mostly cloudy.

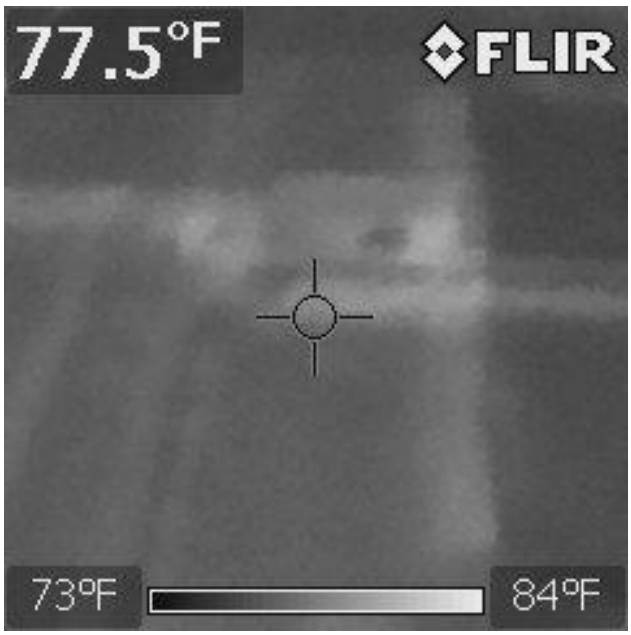
The thermal imaging equipment utilized was a FLIR Systems i7 with a spectral range of 7.5-13 µm. The scan was conducted using the ground-based, walk-over technique.

A moisture meter was used to verify the presence of moisture at suspect and thermal anomaly locations. The moisture meter used was a Delmhorst Instrument Co. BD-10. Both ½" and 6" long probes were used to verify readings at different depths in the roof insulation.

Thermal anomalies were observed during the thermal imaging, appearing as brighter areas in the camera viewer. Anomalies and suspect locations found by general visual observation were marked on the roof surface with orange spray paint. Areas of standing water and very confined spaces among the ducts were not able to be scanned, which equated to approximately 325 square feet. Standing water shows as a lower temperature and would mask any underlying anomalies. Confined spaces below mechanical units and ducts often appear as anomalies due to the trapping of heat from the day, or inaccurate temperature readings caused by increased air movement from a vent fan. Refer to the enclosed roof plan for approximate standing water and mechanical unit locations. Extensive membrane patching and cupped insulation boards also affected anomaly visibility. Patches installed on the membrane consisted of multiple colors and materials including black EPDM, white surfaced EPDM, reflective metal, and white elastomeric coatings and sealants. These differences in color change the materials ability to collect radiated heat from the sun during the day and therefore appear as different temperatures on the infrared camera viewer. Cupped insulation boards create different amounts of air space under the EPDM membrane, and as such also effect the temperature at which they remain after sunset.

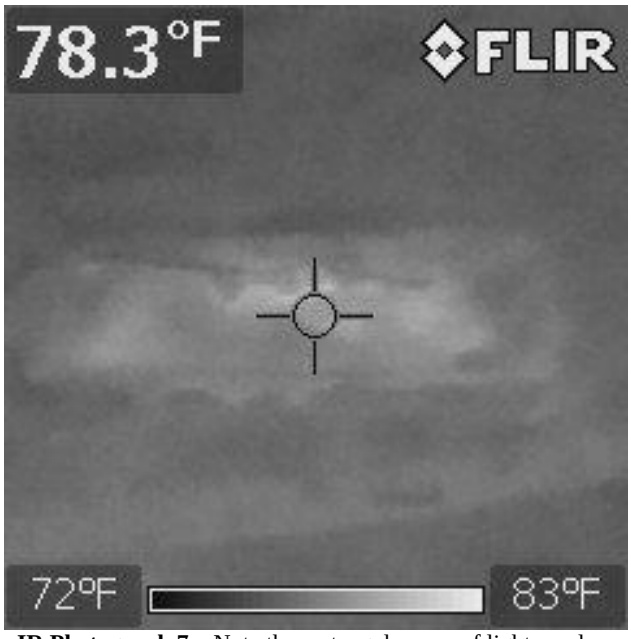
A. Sector S1 Infrared Photographs

6. View of a thermal anomaly around a membrane patch and along patched membrane seams.



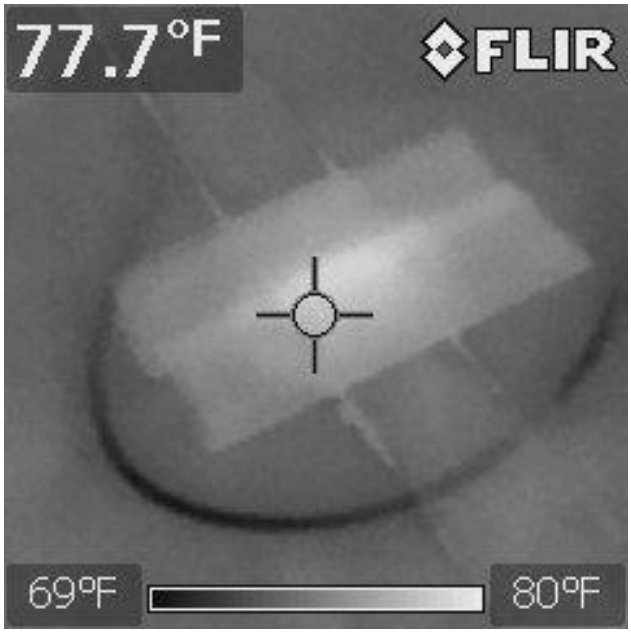
IR Photograph 6 – View of typical thermal anomaly observed.

7. View of a thermal anomaly at an EPDM membrane patch.



IR Photograph 7 – Note the rectangular area of lighter color.

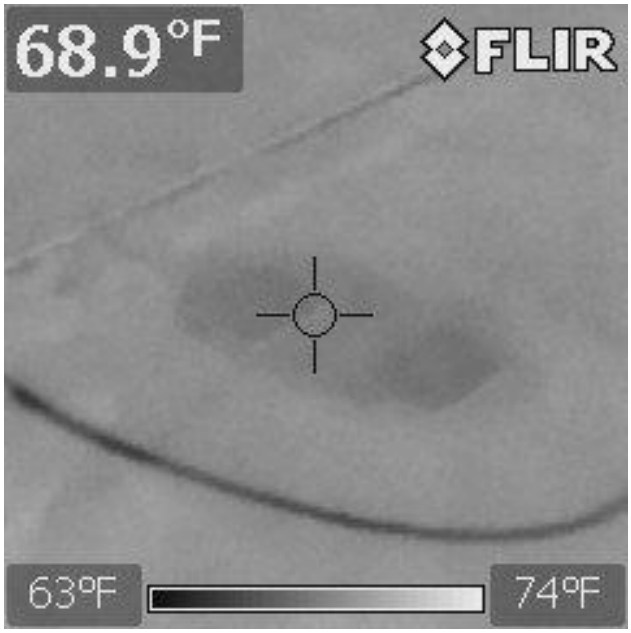
8. Photograph of an EPDM membrane patch installed over a membrane lap. The rectangular overlapping patches are well defined in this view, and a higher temperature is evident at the overlapping seams where there is a buildup of patching material. This area was marked with spray paint (darker ring around light colored patch) for further assessment.



IR Photograph 8 – Infrared view of typical membrane patch.

B. Sector S2 Infrared Photograph

9. View of a thermal anomaly on Sector S2. A darker area is visible in the center of this image. Typically, moisture in a roof system remains at a higher temperature than the surrounding roof surface which is viewed as a lighter color in the infrared camera viewer. The darker section of this photo indicates a lower temperature than the surrounding roof surface so the location was marked with spray paint for further assessment. This area consists of two patches and correlates with Observation Photo #5.



IR Photograph 9 – View of a paint marked area in which a lower temperature was observed.

IX. OPENINGS

Openings in the roof were made to assess moisture content at locations of thermal anomalies and visually observed suspect areas. The openings made by REI were approximately 1 foot by 1 foot square.

A. Sector S1

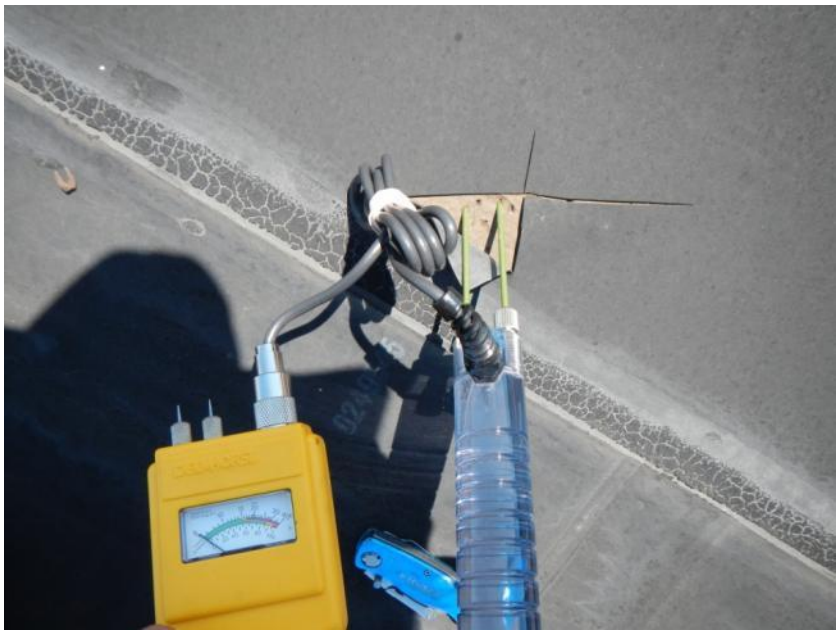
1. Opening No. 1 was taken along the base flashing approximately 30' east from the northwest wall. This location had a hole in the membrane similar to Observation Photograph #1. Based on REI's observations, the polyisocyanurate insulation appears to have been previously wet but was dry to the touch. The fastener and insulation plate in the opening has evidence of rust and corrosion typically caused by coming into contact with moisture. However, the moisture meter detected no moisture in this opening.
   Locations that were observed by REI to have holes, splits, or openings in the membrane were opened and assessed for moisture content with the Delmhorst moisture meter. These locations all returned the same results as the opening in this photograph in which no moisture was detected.

Opening Photograph 1 – The Delmhorst moisture meter showing a reading of no moisture.

2. Opening No. 2 was taken approximately 25’ east and 20’ south of the northwest corner at the location of a patch that was marked as a thermal anomaly similar to Photograph #3 under Sector S1 Infrared Photographs. The moisture meter detected no presence of moisture at this location.

Opening Photograph 2 – Moisture meter reading no moisture content at this patch.

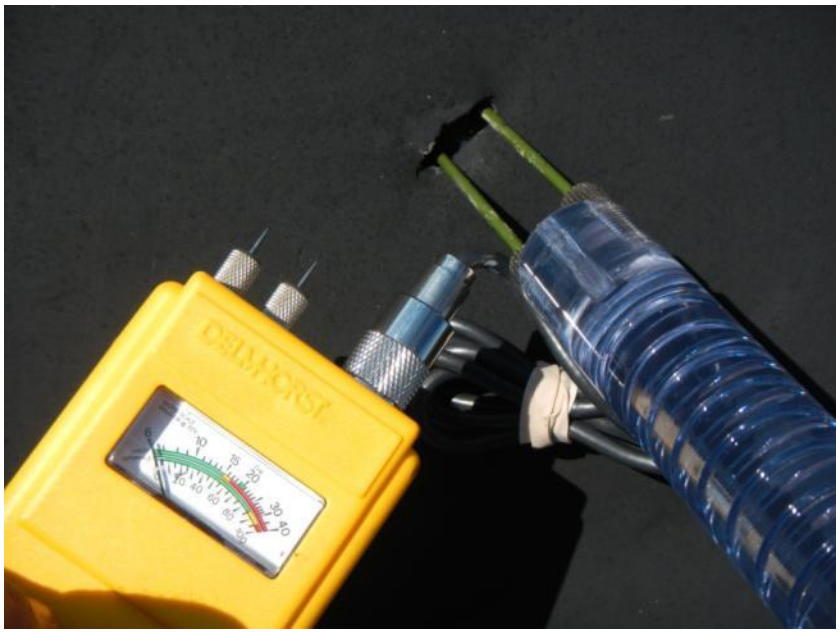
3. Opening No. 3 was taken approximately 35’ west and 25’ south of the northeast corner. This photograph shows the use of the 6” long probe used to measure moisture content at varying depths in the insulation. The moisture meter detected no moisture at all depths of the insulation for all openings made.



Opening Photograph 3 – Moisture meter reading using the 6” long probes.

B. Sector S2

4. Opening No. 4 was approximately 30’ south and 10’ east of the northwest corner on Sector S2. This opening was an existing hole in the EPDM membrane that did not show a thermal anomaly during the infrared scan. Similar to the prior moisture tests, the moisture meter did not detect any moisture at varying depths in the insulation.



Opening Photograph 4 – Moisture meter reading using the 6” long probes in an existing membrane hole.

X. DISCUSSION AND RECOMMENDATIONS

Infrared technology uses specialized equipment to detect heat, specifically varying levels of heat, on the surface of a roof system. Wet insulation will have a higher thermal mass (i.e. resistance to temperature changes) than dry insulation. As the roof materials are warmed by solar radiation throughout the day, their temperatures increase. After sunset, these materials begin to cool; however, wet materials, with their higher thermal mass, will release this heat slower than dry materials.

Infrared equipment detects these areas of higher temperature, called "anomalies", and displays them as different colors. The presence of an anomaly does not confirm the presence of moisture within the insulation, only the presence of increased heat. Roof openings must be conducted to verify moisture is present within the system.

At the time of REI's site visit, the existing EPDM single ply membrane appeared to be in generally poor condition. Numerous repair attempts, patches, failed seams, holes and other deficiencies were observed throughout. In multiple locations, the polyisocyanurate insulation boards are cupped or warped beneath the single ply membrane. The warping is typically evidence of wet or previously wet conditions at those locations.

During the infrared scan, multiple thermal anomalies were observed and marked for verification during the daytime field work. However, due to the excessive membrane patches and repairs, many locations indicating a difference in temperature appeared to be caused by the added layers of material and coatings rather than by moisture in the system.

The following day, REI returned to conduct day time field work and openings. Test cuts were made in the membrane to access the underlying insulation and assess the presence of moisture. The insulation facer material at multiple openings appeared to have an alligatored surface in addition to superficial rust on the fasteners and insulation plates. These conditions are typical for areas that are currently or have been wet.

No current moisture was apparent at any of the test cut locations. The Delmhorst moisture meter was used with ½" and 6" long probes to verify the findings on the surface and at varying depths in the insulation. The moisture meter also indicated no presence of moisture.

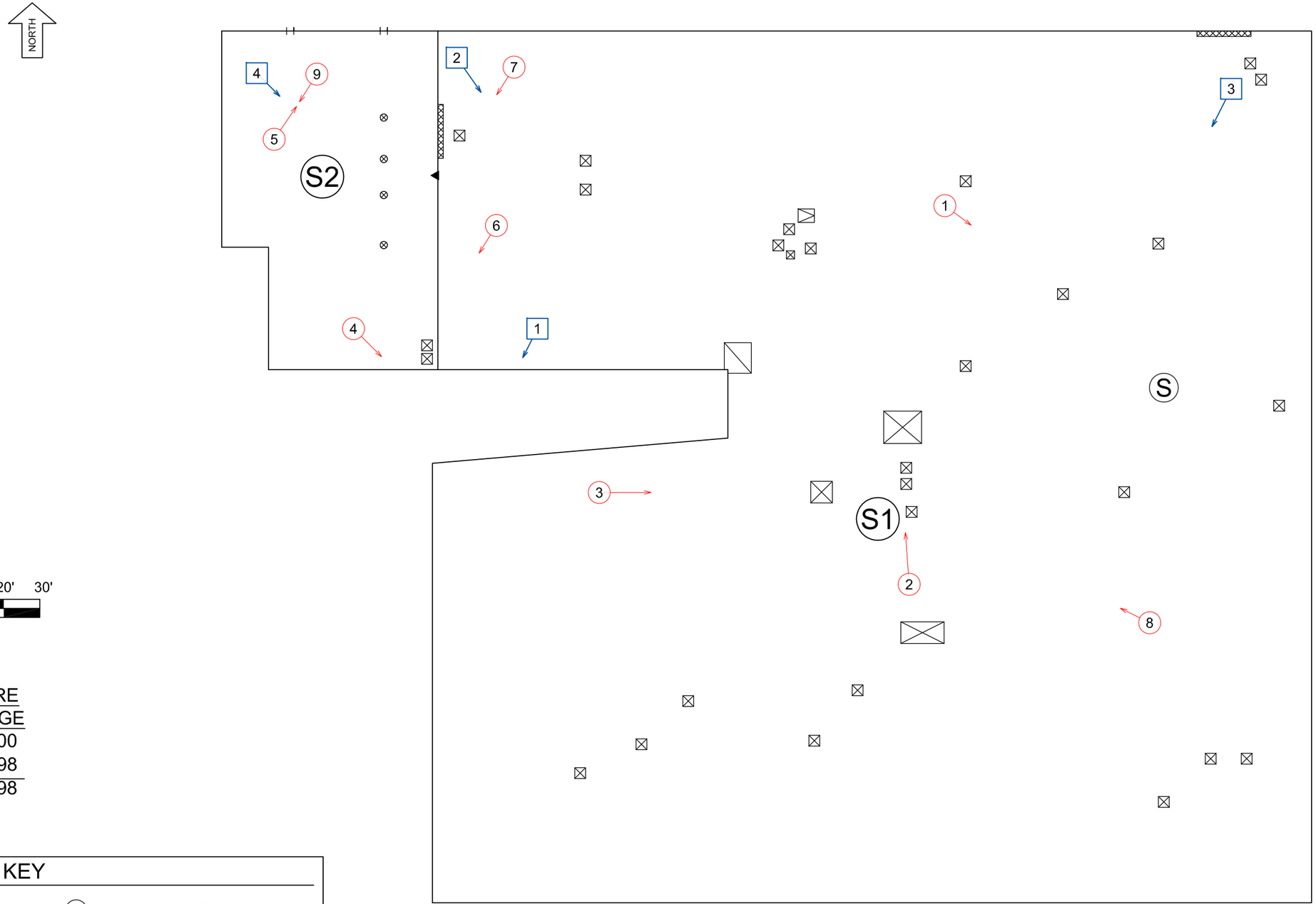
During the day, the temperature of the black EPDM membrane was found to be in excess of 165 degrees Fahrenheit. It is our opinion that moisture is accessing the roof system through the failing membrane; however, the combination of the high roof surface temperatures, and the cooler conditioned interior, drives the moisture down and out of the insulation during sunny days with no precipitation.

Roof component manufacturers typically require a dry substrate prior to the installation of their product. The moisture scan conducted by REI found that the lack of moisture in the existing roof system may make this facility a candidate for a roof over option. However, with the membrane deficiencies and openings observed, it is recommended that additional steps be taken to avoid installing new roofing over wet conditions. New roofing components should not be installed

immediately after precipitation and the moisture content of the existing roof should be monitored during installation. This monitoring would include the continuous use of a Delmhorst moisture meter or equivalent throughout the construction period. REI also recommends conducting infrared scans on the nights prior to a section of new roof being installed. This will indicated the presence or absence of thermal anomalies and when used in conjunction with daily moisture meter testing, it is the most accurate method of determining day to day moisture content. The existing insulation boards that are cupped or warped will cause an uneven substrate for a new roof over to be attached. This warping is typically caused by previous moisture infiltrating the insulation and also leads to deteriorating fasteners and insulation plates. The damaged insulation should be removed from the existing roof system prior to installing a new roof over.

XI. DRAWINGS

A roof plan showing the building outline, approximate locations of curbs and penetrations, openings, infrared anomalies, areas of standing water during the survey, and other specific information is contained on the following page.



30' 0 10' 20' 30'

SCALE: 1" = 30'

ROOF SECTOR	SQUARE FOOTAGE
S1	57,000
S2	5,198
TOTAL	62,198

KEY

———	ROOF EDGE	(S)	SKYLIGHT
‖—‖—	OVERFLOW SCUPPER	▲	ELEVATION CHANGE
⊗	ROOF DRAIN	(A)	SECTOR DESIGNATION
☒	CURB	▨	ABANDONED CURB
⧄	ROOF HATCH	▩	STANDING WATER
(1)→	OBSERVATION & INFRARED PHOTOGRAPHS	[1]→	OPENING PHOTOGRAPHS

1/A ROOF PLAN - SECTORS S1& S2
1"=30'

REI PROJECT NO.: 14FTM-016
DATE: 10.28.2014
SCALE: 1"=30'

ROOFING, WATERPROOFING & BUILDING ENVELOPE ENGINEERS & CONSULTANTS
www.reiengineers.com

ST. PETERSBURG COLLEGE
MOISTURE SURVEY
ST PETERSBURG, FLORIDA

SHEET TITLE
ROOF PLAN
SECTORS S1 & S2

A