



# RICOWI, Inc.

Roofing Industry Committee on Weather Issues, Inc.

*Leading the Roofing Industry through Innovative Collaboration*

## HAILSTORM INVESTIGATION

DALLAS / FORT WORTH, TX

MAY 24, 2011



## **HAILSTORM INVESTIGATION REPORT**

### **Dallas / Fort Worth – May 24, 2011**

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## Preface

This document was prepared and published by the Roofing Industry Committee on Weather Issues, Inc. (RICOWI). The following organizations are Sponsor Members of RICOWI:



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## **The Roofing Industry Committee on Weather Issues, Inc.**

### **Mission**

RICOWI is committed to:

- Encourage and coordinate research to provide a more knowledgeable information base of roof issues including wind, hail, energy efficiency and durability effects;
- Accelerate the establishment of new or improved industry consensus standard practices for weather design and testing where they are recognized as needed;
- Improve the understanding of roof weather concepts and issues within the building community in general.

### **Background**

The Roofing Industry Committee on Weather Issues, Inc. (RICOWI) was established in 1990 as a non-profit organization to identify and address important technical issues related to the cause of wind damage which include:

- Dynamic testing of roof systems;
- Importance of sample size for tests;
- Role of wind tunnels and air retarders;
- Need for acceptable procedures for ballasted systems;
- Field data and response team reports;
- General lack of communication within the roofing industry as to what the problems are, what is being done and should be done to alleviate them, and how effectively information is transferred within the roofing industry and to others in the building community.

In 1996, RICOWI was incorporated as a nonprofit corporation devoted to research and education on wind issues. After a review of the need for similar education and research in the areas of hail, energy efficiency and durability effects, the organization's

objectives were broadened in 1999 to include other weather topics, and "Wind" in RICOWI's name was changed to "Weather" to reflect the expanded scope.

### **Meetings**

RICOWI meetings are held twice a year, in the spring and fall. The spring meeting is usually held in conjunction with the RCI, Inc.'s annual convention.

The meetings include a technical forum and a business session where the direction and business of RICOWI is discussed. During the technical segment, the Sponsor and Affiliate Members have an opportunity to report on the latest developments in their organizations and technical subjects of common interest. Any concerned or interested individual can bring their knowledge or concern to another group of experts that can peer review their ideas, suggest tests or procedures, or confirm that they are headed in the right direction.

### **Seminars**

RICOWI Seminars on the proper design, installation and testing procedures for specific roofing materials are held once or twice a year. Fall seminars are usually held at research testing or educational facilities and include a tour. They are of interest to roofing professionals, architects, contractors, engineers, facility managers and those in the insurance industry.

### **Wind and Hail Investigation Programs**

RICOWI has implemented two strategic investigation programs:

- Wind Investigation Program (WIP)
- Hail Investigation Program (HIP)

The purpose of these programs is to investigate the field performance of roofing assemblies after major hurricane and hailstorm events and:

- To factually describe roof assembly performance and modes of damage;
- To formally report the results for substantiated hurricane/hail events.

The data collected provides unbiased detailed information on the wind and hail resistance of low-slope and steep-slope roofing systems from credible investigative teams. We can expect a greater industry understanding of what causes roofs to perform or fail in severe wind and hail events, leading to overall improvements in roof system durability, the reduction of waste generation from re-roofing activities, and a reduction in insurance losses that will lead to lower overall costs for the public. The reports document roofing systems that fail or survive major weather events and provides educational materials for roofing professionals to design wind and hail resistant roofing systems. The data can be used to improve building codes, roof systems design, and educate the industry and the public.

# **ROOFING INDUSTRY COMMITTEE ON WEATHER ISSUES, INC.**

## **HAILSTORM INVESTIGATION REPORT**

### **May 24, 2011 - Hailstorm, Dallas/Fort Worth, TX**

#### **ABSTRACT:**

The Roofing Industry Committee on Weather Issues, Inc. (RICOWI) has completed the second Hailstorm Investigation Program (HIP). Seven inspection teams examined over one hundred roofing systems during a four-day period to evaluate the effects of a significant hailstorm that passed through portions of the Dallas/Fort Worth metropolitan area on May 24, 2011. The purpose of the project was to document the effects of hail impact on a variety of roofing products, and to describe roof assembly performance and modes of damage for substantiated hailstone sizes.

#### **1. INTRODUCTION**

A field investigation program has been completed by RICOWI regarding hail effects to roofing from a storm that occurred in the Dallas/Fort Worth area on May 24, 2011.

RICOWI was established in 1990 as a non-profit international organization comprised of major roofing associations, members of academia, educational and test facilities, the insurance industry, and others involved in the science of roofing.

The mission of the HIP is:

- To investigate the field performance of roofing assemblies after major hailstorm events;
- To factually describe roof assembly performance and modes of damage;
- To formally report the results for substantiated hail events.

This RICOWI HIP project was the second industry-wide research program conducted to assess field damage from a major hailstorm in the United States. The storm was selected by the RICOWI criteria of having been declared an insurance catastrophe by Property Claim Service (an insurance services company) and having hailstones larger than 1.5 inches in diameter in a region of five square miles or greater in a previously defined area (the Dallas/Fort Worth metropolitan area had been targeted due to its concentration of Impact Resistant steep slope

roofing products). Although there are several impact-resistance test methods available from Underwriters Laboratories (UL), FM Global (FM), and other agencies, the most common test used to simulate hail impact for steep slope products are UL 2218 and FM 4473. In both of these tests, roofing products are rated from Class 1, 2, 3, or 4 with impacts designed to simulate the impact energy of free-falling hailstones of 1.25-, 1.5-, 1.75-, or 2.0-inch diameter. The UL test employs steel balls while the FM test uses ice balls and is designed for rigid roofing products.

#### **2. METEOROLOGICAL INFORMATION**

On May 24, 2011 three rounds of thunderstorms containing large hail and tornadoes passed through portions of north Texas including the Dallas/Fort Worth metropolitan area. Several of the thunderstorms were supercell variety containing very large hail. The National Climatic Data Center (NCDC) publication *Storm Data* listed 32 reports of hail in Tarrant County (nine reports stated hail sizes of two inches diameter or larger) and 10 reports of hail in Dallas County (three reports of two inch diameter or larger). Dallas and Tarrant County are the most populous counties in the Dallas/Fort Worth area, and most of our inspections were made in these counties. Extremely large hail greater than four inches in diameter was reported in a portion of northern Tarrant County (cities of Avondale and Keller) and a separate location in western Dallas County (city of Irving). The hailstorms damaged planes at both the DFW Airport and Love Field (Dallas).



Figure 1. Vent cap buckled by large hail in Irving.

There were large areas of the two counties where hailstones from one to two inches in diameter were reported. A *Dallas Morning News* article quoted an insurance industry spokesman, Mr. Jerry Johns of the Southwestern Insurance Information Service, that the damage from the hailstorms could reach several hundred million dollars<sup>1</sup>. Refer to Appendix A for meteorological information from the National Climatic Data Center.



Figure 2. Hailstones saved by homeowner in Irving.

Prior to arriving for the field investigation, a HailTrax map from Weather Decision Technologies that estimated maximum hailstone diameters from the radar imagery was obtained. This was used to make a preliminary judgment on what areas to focus the inspections. Hailstone sizes larger than two inches were confirmed by

the inspections in some of the locations shown in the HailTrax, particularly in Irving and Dallas. The inspection sites were plotted onto the HailTrax maps found in Appendix D

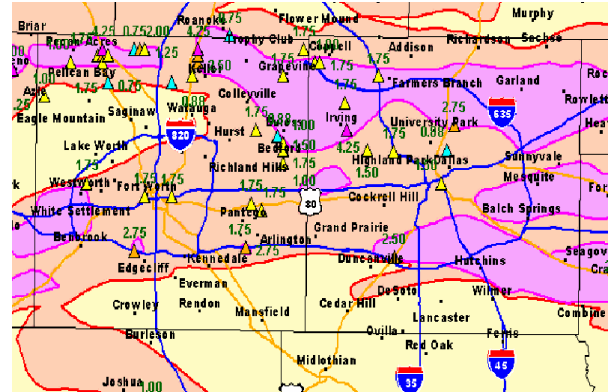


Figure 3. HailTrax map for May 24, 2011 in Tarrant (left) and Dallas (right) counties. Pink shaded areas had possibility of 2.0 inch diameter or larger hailstones. See Appendix D for expanded size and inspection locations marked.

### **3. INVESTIGATION PROTOCOL**

Most members of the inspection teams were trained in hail damage identification and HIP procedures during a briefing session or had attended prior RICOWI hail training. Hail information was gathered on the sites by examining a variety of materials and surfaces that would contain impact marks or dents from hail impact, in addition to any damage found to the roof materials<sup>2, 3</sup>. Property owners also offered some eyewitness accounts of hailstone size and quantity, photographs, and frozen hailstones. One site retained the foam hail pad provided to volunteers in the area in association with COCORAHs (Community Collaborative Rain, Hail, and Snow network). COCORAHs has a nearly national network of volunteer observers with rain gauges and hail pads, and RICOWI helped to distribute approximately 150 hail pads in the DFW area. However, only a few of the hail pads were struck with large hail during this storm event. With the exception of the hail pad, photographs, or frozen hailstones observed, it should be understood the hailstone sizes listed are best estimates from the information gathered on-site and data offered in the referenced articles by

Crenshaw and Morrison. The maximum hail sizes determined on-site sometimes differed (larger or smaller) from those estimated by the HailTrax map. In these cases, the inspection-based data would be considered more accurate.

A data form was developed to record pertinent information from each site. Data included location, roof construction details, generic roof material descriptions, roof pitch, estimated maximum hailstone size at the site, and the type(s) and severity of hailstone impact damage to the roofing product. Impact effects were listed on a scale of 0-5:

0. No apparent damage.
1. Surface impact marks without fractures or punctures.
2. Minimal damage (low severity and low quantity).
3. Moderate amount of fractures, punctures, or spalling.
4. Moderate/severe denting of metal roofing.
5. Severe damage resulting in potential leakage.

Inspection teams were designed to consist of three members with a balance of manufacturer representatives, trade group representatives, engineers, roof consultants, roofing contractors, and insurance professionals. One team member would record the site data on the form, one would photograph and log captions for the photographs, and one would inspect the property and mark items of interest. At times, some inspection teams contained only two members. Some inspection teams were accompanied by roofing contractors or other interested parties who aided in arranging the inspection or in providing access.

The selection of inspection sites was targeted towards areas with moderate to large hail sizes and to include a variety of roof system types. Sites primarily were obtained through contacts of HIP or RICOWI member organizations, and through local roofing contractors. The people offering their property for inspection were told in advance that roof replacement bids would not be given, nor would assistance be given regarding their insurance claims.

Typical inspections consisted of a complete visual survey of the roof surface. This was followed by randomly selecting sites where the hail hits were counted and the hail size was estimated. On each roof several random test areas were selected for counting the locations that exhibited hailstone impact effects<sup>4</sup>. Other building or surrounding elements were also used to establish the size of the hail at the specific site being investigated.

The inspections were non-destructive, with no test cuts performed or samples removed unless contractors were present and working on the roof at the time of inspection. Following the field investigation, the information from the inspection form was input into a central database, and digital photographs from each site were consolidated. Appendix A contains summary tables of the inspection locations with their roof type(s), maximum hailstone size, and hail effects observed. Inspection team summaries with representative photographs follow in Appendices B and C after the main report section. Reports as completed by the team members exist for all inspections, however we have not included detailed reports for roofs that were exposed to one inch diameter or smaller hail. For the purpose of this report, asphalt shingles are generally listed as “laminated 2-ply”, “laminated 3-ply”, or “3-tab”.

## **4. FIELD RESULTS**

### **A. LOW SLOPE SYSTEMS**

The focus of the 2011 HIP investigation was the performance of Impact Resistant (IR) roofing products, as compared to those materials that were not rated for impact resistance. Although the testing for impact resistance applies to both low & steep roofed systems, it was difficult to determine if the low slope roofing systems were rated. Limited low slope roofing was inspected, however as observed in the Oklahoma HIP, roof membranes that were solidly supported and or protected with gravel or stone ballast performed well

#### A.1. BUILT-UP ROOFING (BUR)

BUR roofs appeared to perform well. Five of the six roofs inspected were impacted by hail of 2.25 inch or larger and one roof was impacted with 1.75 inch hail. All were rated with damage levels 1 or 2, indicating little observable damage and general good performance. Observations included scuffing and some gravel displacement by hail impact.

#### A.2. MODIFIED BITUMEN

A total of seven modified bitumen membrane roofs were inspected in the study. They were impacted by hail from 1.75 inch to 5 inch in diameter with four of the seven being rated at damage level 5 indicating they were severely damaged. One roof exposed to 2 inch hail had no damage.

#### A.3. SPRAYED POLYURETHANE FOAM (SPF)

No sprayed polyurethane foam roofs were inspected.

#### A.4. METAL

No low slope metal roofs were inspected; please refer to section B.4 for steep slope metal roofs that were used on both commercial and residential buildings.

#### A.5. SINGLE-PLY SHEET MEMBRANES

Three low slope single ply membrane roofs were inspected. One roof was rated to have damage level 5 that was impacted by 1.75 inch hail; this roof had multiple temporary repairs over the reported fractures in the membrane so the actual damaged areas could not be observed. Another roof was rated damage level 3 (moderate amount of fractures or punctures) when exposed to 2.5 inch hail. One single-ply roof did not have any visible damage (level 0) when exposed to 2 inch hail.

### B. STEEP SLOPE SYSTEMS

#### B.1. ASPHALT SHINGLES

A total of 63 asphalt or modified bitumen shingle roofs were inspected during the survey, with 40 showing some form of damage (damage categories 2 or higher) and 28 having moderate (3 or higher) or greater damage reported. Maximum hail sizes on the asphalt shingle roofs inspected ranged from about 0.25 inch to 3.25 inches in diameter. Most of the asphalt shingles (51) inspected were standard fiberglass mat three-tab or laminated asphalt shingles, with 12 roofs having UL 2218 Impact Resistant (IR) rated modified bitumen shingles. It is possible that some of the shingles listed as standard could have been IR rated, but if this could not be confirmed it was not listed as such. Substrates included primarily solid OSB or plywood decking where it could be determined.

Damage modes were primarily fracturing or rupturing of the shingle mats or broken shingle edges. Areas with fractured mats generally displayed loss of granules sufficient to expose asphalt, and the recently exposed asphalt was dark in color with limited oxidation. The 16 standard shingle roofs without visible damage (damage categories 0 and 1) had been struck with hail sizes from 0.25 inch to 1.75 inches in diameter. Roofs with damage category 2 or higher had been struck with hailstones 1.0 inch or larger. Of the 25 standard asphalt shingle roof rated with damage categories 3 or higher (moderate or severe), 92% had been struck with hailstones 1.25 inch diameter or larger.

Shingles with an IR rating performed better on average than the standard asphalt shingles; the average standard asphalt shingle damage rating was 2.5 with the average IR shingle damage rating of 1.3. Nine of the 12 IR roofs (75%) were rated as damage category 0, 1, or 2, with hailstone sizes of 0.25 inch to 2.5 inches in diameter on those roofs. The two roofs in damage category 3 were struck with hailstones 1.75 inches to 2.0 inches in diameter, and the one roof categorized as severe

damage was struck with hailstones 2.5 inches in diameter.

Hail impact damage was most concentrated on the windward roof slopes having the most direct hail impacts. Ridge and valley shingles with unsupported areas were noted as being damaged more severely than field shingles. In areas where hail sizes were less than 1.0 inch in diameter, there were no areas with noted significant or severe general granule loss, even in areas with 20 or more hail impacts per square foot.

Known or estimated ages of the roofs ranged from less than three years to older than 15 years. Asphalt shingles that appeared (or were known to be) older than 9 years and showed signs of embrittlement or deterioration were more susceptible to damage, and often the damage was more severe. The shingles that were 9 years and newer or had unknown ages but were judged to be in good or excellent condition had an average damage rating of 2.1 while the shingles older than 9 years had an average damage rating of 4.2.

## B.2. TILE

A total of one clay tile and four concrete tile roofs were inspected during the survey, with all having some tile fractures from hail impact. Maximum hail sizes on the tile roofs inspected ranged from about 2.0 inches to 4.0 inches in diameter. The profiles included flat, mission, and roll style. Substrates when it could be determined were solid decking. Please note that the sample size of tile roofs was fairly small, and inspections occurred only in the areas where some of the largest hail fell.

Damage mode was fracturing of the tile field or edge when struck with relatively large hailstones. Fracture surfaces from the recent hail displayed unweathered (clean) surfaces, while older fractures (from foot traffic or other previous damage) observed on the roofs often had grime or mildew darkening the surface. A pre-existing crack pattern on one roof was single fractures near the lower right corner of interlocking tiles. In contrast, hail-caused fractures typically resulted in

multiple fractures (shattering) from a single large impact.

When tiles had impact-caused fractures the hail sizes were greater than 2.0 inches in diameter, and even in these cases, only a small percentage of tiles had been fractured. In some cases, hailstone spatter marks exceeding 2.0 inches in diameter were visible on the tile surface without fractures in the tile. Hail-caused damage was most concentrated on the windward roof slopes having the most direct hail impacts. Tiles were older than 12 years old in all cases, yet all were considered to be in good condition. The age of tiles did not appear to have an appreciable effect on hail impact resistance. Large amounts of smaller hail had no adverse effect on the tiles where the impact marks were apparent.

## B.3. CEDAR SHAKES & SHINGLES

A total of five cedar shake or shingle roofs were inspected during the survey, with four showing some form of damage. All roofs had surface marks from impacting hailstones, but impact-caused splits or punctures were considered to be functional damage (detrimental to the service life of the roof) while surface marks would be a temporary cosmetic condition. Maximum hail sizes on the cedar roofs inspected ranged from about 1.0 inch to about 2.5 inches in diameter. Two roofs were medium-thickness cedar shake, and the remaining were cedar shingles.

Damage modes were primarily fracturing (splitting) or puncturing of the wood when struck with relatively large hail. The hail-caused splits were coincident with, or closely associated with, bright-colored indentations in the wood from hail impact, and the wood fracture surfaces were bright-colored. Bright hail-caused splits could be contrasted with gray-colored interior surfaces of splits due to natural weathering. Often, surface marks from hail impact and indentations in the wood did not result in splitting of the wood. Punctures occurred in areas of the wood that were thinner than average and where relatively large hail fell, and fresh color in the underlying wood and broken wood pieces confirmed the impact damage. The very large hail at one inspection site

penetrated through to the attic space on a few occasions between the spaced lath decking. Hail-caused splitting or puncturing of the wood generally was found when hailstones exceeded 1.5 inches diameter, although the sample size of wood roofs was fairly small.

Known or estimated ages of the wood roofs ranged from less than 3 years old to greater than 15 years on two of the roofs. Roofs older than 10 years with surface erosion from weathering displayed reduced hail resistance. Large quantities of smaller hail (0.75 inch diameter or less) had no effect other than surface marks that will fade with further weathering.

#### B.4. METAL

Sixteen roofs were inspected with metal roofing; the types of roofing included raised rib metal panels, standing-seam metal panels, metal shingle panels, including stone-coated steel panels. In all cases the roof pitch was 3:12 or steeper, although the painted and Galvalume-coated raised rib panels were on commercial buildings or schools. Other materials included standing-seam copper on two locations, galvanized steel, and standing-seam painted steel. Four roofs with stone-coated steel panels had UL 2218 Class 4 IR rating.

Most of the metal inspection sites were in the city of Irving where some of the largest hail fell, with maximum hailstone sizes listed as 1.5 to 4.0 inches in diameter. Nine sites were listed as damage categories 0 or 1, having no visible dents or a small number of shallow depth dents. Some of the stone-coated panels on steep slopes (12:12 pitch) sustained hailstones up to 2.5 inches without visible dents or spalling of the granule surfacing. Otherwise, the sites were listed as damage category 4 as having moderate to severe denting. No fractures or punctures occurred in the metal panels, with no evidence of leakage found or reported below the metal roofing at these sites. One site with severely dented metal shingles from 2.5 inch hail had some distorted side laps. Raised rib panels had denting of ribs and pans areas, but no open seams were noted. No fracturing or spalling of painted coatings was found at hail

impact marks. One of the stone-coated steel panels struck with 2.5 inch hail had spalling of the stone coating at a few locations.

### 5. RESULTS

The RICOWI hail investigations obtained a considerable amount of beneficial data for all parties interested in the effects of hail impact on roofing products. It was the second large-scale hailstorm investigation by balanced teams representing roof manufacturers, roofing industry trade associations, roof consultants, researchers and engineers, and the insurance industry. The HIP investigations provided field data related to scientifically estimated hailstone sizes that supported previous laboratory testing and field experience reported in several referenced documents. The joint inspections by the balanced teams resulted in consensus data gathered from the inspection sites.

The inspection teams were able to investigate a number of roofs that had been impacted by a recent significant hailstorm, factually describe roof performance and modes of damage, and correlate the damage with hailstone size(s) and quantities. Data was gathered that can be used in improving evaluation of hail-impacted roofing and improving design of roofing systems to resist hail impact damage.

In reviewing the overall results, the following findings emerged:

- Hail-caused damage, if it occurred, was readily apparent to the trained eye in most cases. Circumstances where further sampling could be appropriate included low slope roofing material that incorporated laminated plies of materials, such as modified bitumen membranes, built-up roofing, and some thermoplastic membranes.
- The effects of hail impact were distinguishable from normal weathering. Impact-caused fractures in materials had appearances that were distinct from cracking or other indications of long-term weathering. Impact generally resulted in circular and

starburst-shaped fractures, and the fracture surfaces had limited oxidation, shrinkage, or grime accumulation, and there was often direct surface evidence of the hail impact. Examples included asphaltic materials that appeared dark black-colored with coincident indentation or fracturing, fresh splits in cedar appeared bright orange-colored with associated impact dent, and clean fracture surfaces with multiple fractures on concrete and clay tiles.

- Hailstone size (and resultant impact energy) was more critical than hailstone quantity in determining if the roofing was damaged. Areas with the large quantities of hail did not sustain roofing damage if the maximum hailstone size at that site did not exceed that necessary threshold of damage for that material. Almost no damage was found in areas where the maximum hailstone size was less than 1.0 inch in diameter, with the exception of badly deteriorated and unsupported material. When maximum hailstone size was between 1.0 and 2.0 inches in diameter, the level of damage ranged from none to considerable depending on material, age/condition, roof slope, and support conditions. When maximum hailstone size was greater than 2.0 inches in diameter, most roofing material sustained damage or denting of metal.
- The IR rated asphalt shingle products performed better than the standard asphalt shingles. The average damage category rating for standard asphalt shingles was 2.5 with IR asphalt shingles was 1.3. This indicated the IR shingles were more likely to have no apparent physical damage or damage with low quantity or low severity.
- Standard asphalt shingles generally sustained moderate or severe damage when hailstone sizes were 1.25 inches in diameter or larger. The IR rated shingles generally performed to their Class 3 or 4 ratings with only one roof having moderate damage when struck with hailstones less than 2.0 inches in diameter (1.75 inches in that case).
- The teams observed that the threshold for roof damage from hailstone impact to most materials was between 1.25 and 2.0 inches, which correlates with the size ranges used in most standard impact resistance tests used to simulate the effects of hail impact, including UL 2218, FM 4473, and FM 4470 (often used for low-slope roofing products). This field investigation suggests this is an appropriate range as roofing material performance varied with hailstone impacts of this size range. No attempts were made to compare various test methods. An exception to damage occurring by 2.0 inch diameter hail was metal roofing panels that would sustain denting, but retain water-shedding integrity even up to 2.5 inch diameter hail in most cases.
- Materials that were unsupported or over easily compressible substrates had greater damage than those over more solid substrate. This was demonstrated where certain high profile asphalt shingle ridge units that had unsupported regions, in unsupported valley areas for asphalt shingles, and low slope roofing unsupported transition areas at base flashings and membrane that was installed over compressible insulation boards.
- Some materials displayed reduced hail impact resistance, particularly those over 10 years old, with respect to age and deterioration. Categories included asphaltic products (including modified bitumens), and cedar shingles and shakes.
- Hail effects on metal roof systems were seen as largely cosmetic, rather than functional. Indentations occurred with larger hailstones, but painted coatings had not been visibly compromised by the denting. Most of the metal roof systems inspected had greater than maximum hailstone size of 2.5 inches in diameter, and no leakage was observed or reported even with the moderate to severe denting. With the extremely large hail there were a few instances of distorted seams or spalled granule surfacing, but even this was rare. Metal roofing products with Class 4 rating performed as designed with no fractures or open seams found with 2.0 inch diameter or smaller hail.

## **6. FUTURE RESEARCH**

Although many hail-impacted roofs were inspected and significant data was gathered, the need remains for additional HIP investigations.

Other useful information or different methodologies could include:

- Quicker mobilization would allow for inspection of some of the most severely damaged roofs.
- Collection of samples would allow additional verification of failure modes.
- Investigating a greater variety and number of roofs would provide additional verification of performance.
- Cooperation with the insurance industry would permit an analysis of claim payments vs. observed damage, and provide a basis for recommendations to reduce insurance losses.
- A procedure of monitoring service life and future repairs by owners of inspected roofs would provide data on the long-term effects of hail impact on roofing.

## **7. REFERENCES**

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**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX  
May 24, 2011**

**APPENDIX A: Inspection Summary Tables**

**Summary of Inspection Sites**

<b>Inspection #</b>	<b>Maximum Hail Size</b>	<b>Damage Rating</b>	<b>Type of Roof</b>	<b>City</b>
1.01	1.0	0	Laminated 2 ply	Mesquite
1.02	1.0	1	Standard 3 tab	Mesquite
1.03	1.25	0	Impact Resistant 2 ply	Rowlett
1.04	0.75	1	Standard 3 tab	Rowlett
1.05	1.5	3	Laminated 2 ply	Coppell
1.06	1.5	3	Laminated 2 ply	Coppell
1.07	1.5	5	Standard 3 tab	Coppell
1.08	1.25	2	Laminated 2 ply	Carrollton
1.09	1.0	1	Laminated 2 ply	Carrollton
1.10	0.75	2	Laminated 2 ply	Coppell
1.11	2.5	2	Laminated 2 ply	Carrollton
1.12	1.5	3	Standard 3 tab	Coppell
1.13	1.5	2	Standard 3 tab	Coppell
1.14	1.25	2	Standard 3 tab	Coppell
1.15	1.5	4	Metal-Raised Rib Panels	Irving
1.16	4.0	4	Metal-Raised Rib Panels	Irving
1.17	2.0	0	Modified Bitumen	Irving
1.18	2.0	3	Modified Bitumen	Irving
1.19	5.0	5	Modified Bitumen	Irving
1.20	3.0	5	Modified Bitumen	Irving
1.21	1.5	5	Laminated 2 ply	Irving
1.22	2.0	5	Cedar Shingle	Irving
1.23	2.5	4	Metal Shingle	Irving
1.24	1.5	0	Metal-Raised Rib Panels	Irving
1.25	2.0	2	Concrete Tile	Irving
1.26	2.0	0	Single Ply	Irving
2.01	0.5	0	Laminated 2 ply	Dallas
2.02	0.5	0	Laminated 2 ply	Dallas
2.03	0.25	0	Standard 3 tab	Dallas
2.04	1.25	2	Laminated 2 ply	Dallas
2.05	1.25	0	Laminated 2 ply	Dallas

**RICOWI Hailstorm Investigation**  
**Dallas-Fort Worth, TX**  
**May 24, 2011**

## Summary of Inspection Sites

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
2.06	2.25	0	Laminated 2 ply	Dallas
2.07	1.5	3	Standard 3 tab	Dallas
2.08	0.25	0	Laminated 2 ply	Richardson
2.09	1.5	2	Standard 3 tab	Coppell
2.10	0.25	0	Laminated 2 ply	Dallas
2.11	Not Inspected			
2.12	1.0	2	Laminated 2 ply	Carrollton
2.13	1.5	0	Impact Resistant 2 ply	Southlake
2.14	1.5	0	Metal Shingle	Irving
2.15	2.5	0	Metal Shingle	Irving
2.16	2.5	0	Metal Shingle	Irving
2.17	0.25	0	Impact Resistant 2 ply	Arlington
2.18	0.25	0	Laminated 2 ply	Keller
2.19	3.0	5	Laminated 2 ply	Irving
3.01	1.0	1	Metal-Standing Seam	Dallas
3.02	1.5	5	Laminated 2 ply	Dallas
3.03	1.5	5	Laminated 2 ply	Carrollton
3.04	1.5	5	Laminated 2 ply	Carrollton
3.05	1.0	0	Metal-Standing Seam	Coppell
3.06	1.0	2	Synthetic Slate	Fort Worth
3.07	1.25	2	Impact Resistant 3 ply	Euless
3.08	2.25	5	Modified Bitumen	Irving
3.08b	2.25	2	Built Up Roof	Irving
3.09	4.0	5	Modified Bitumen	Irving
3.09b	4.0	4	Metal-Standing Seam	Irving
3.10	1.5	2	Built Up Roof	Irving
3.11	2.25	3	Concrete Tile	Irving
3.12	2.5	3	Single Ply	Irving

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## Summary of Inspection Sites

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
3.12b	2.5	4	Concrete Tile	Irving
4.01	1.875	2	Modified Bitumen	Dallas
4.02	2.25	1	Built Up Roof	Irving
4.03	2.25	2	Built Up Roof	Irving
4.04	1.25	1	Impact Resistant 3 ply	Dallas
4.05	2.25	3	Laminated 2 ply	Dallas
4.06	2.5	5	Modified Bitumen	Irving
4.07	3.0	5	Built Up Roof	Irving
4.08	2.25	2	Built Up Roof	Irving
4.09	3.5	2	Built Up Roof	Waxahachie
4.10	3.5	2	Built Up Roof	Waxahachie
4.11	4.0	2	Clay Tile	Waxahachie
5.01	1.0	0	Impact Resistant 3 ply	Dallas
5.02	1.0	0	Standard 3 tab	Dallas
5.03	2.0	5	Standard 3 tab	Irving
5.04	Not Inspected			
5.05	1.25	2	Laminated 2 ply	Irving
5.06	3.25	5	Laminated 2 ply	Irving
5.07	2.5	3	Laminated 2 ply	Irving
5.08	2.5	2	Impact Resistant 3 tab	Irving
5.09	2.5	5	Standard 3 tab	Irving
5.10	2.25	3	Laminated 2 ply	Irving
5.11	1.25	3	Laminated 2 ply	Corinth
5.12	2.5	5	Impact Resistant 2 ply	Oak Point
5.13	2.5	0	Metal Shingle	Irving
5.14	2.5	1	Metal Shingle	Irving
5.15	2.5	4	Metal Shingle	Irving
5.16	2.0	5	Concrete Tile	Irving
5.17	2.25	5	Cedar Shake	Irving

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## Summary of Inspection Sites

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
5.18	2.5	3	Laminated 2 ply	Irving
6.01	2.0	5	Laminated 2 ply	Irving
6.02	1.0	3	Laminated 2 ply	Irving
6.03	1.0	3	Laminated 2 ply	Carrollton
6.04	0.25	0	Impact Resistant 2 ply	Irving
6.05	2.0	3	Impact Resistant 2 ply	Irving
6.06	0.25	0	Metal Shingle	Irving
6.07	2.0	0	Synthetic Slate	Irving
6.08	1.75	3	Impact Resistant 3 tab	Farmers Branch
6.09	1.25	3	Laminated 2 ply	Carrollton
6.10	0.25	0	Laminated 2 ply	Colleyville
6.11	1.5	0	Laminated 2 ply	Colleyville
6.12	1.5	2	Laminated 2 ply	Keller
6.13	1.75	2	Laminated 2 ply	Fort Worth
6.14	2.5	1	Laminated 2 ply	Irving
6.15	2.5	4	Metal-Standing Seam	Irving
6.15	2.5	0	Laminated 2 ply	Irving
6.16	2.5	0	Impact Resistant 3 ply	Irving
7.01	3.25	4	Metal-Standing Seam	Prosper
7.02	1.0	2	Cedar Shingle	Farmers Branch
7.03	1.75	5	Single Ply	Desoto
7.04	1.0	1	Cedar Shingle	Arlington
7.05	2.0	5	Laminated 2 ply	North Richard Hills
7.06	2.5	5	Cedar Shake	Irving

**RICOWI Hailstorm Investigation**  
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## Inspection Summary by Roof Type

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
4.09	3.5	2	Built Up Roof	Waxahachie
4.10	3.5	2	Built Up Roof	Waxahachie
4.07	3.0	5	Built Up Roof	Irving
3.08b	2.25	2	Built Up Roof	Irving
4.02	2.25	1	Built Up Roof	Irving
4.03	2.25	2	Built Up Roof	Irving
4.08	2.25	2	Built Up Roof	Irving
3.10	1.5	2	Built Up Roof	Irving
7.06	2.5	5	Cedar Shake	Irving
5.17	2.25	5	Cedar Shake	Irving
1.22	2.0	5	Cedar Shingle	Irving
7.02	1.0	2	Cedar Shingle	Farmers Branch
7.04	1.0	1	Cedar Shingle	Arlington
1.25	2.0	2	Concrete Tile	Irving
3.11	2.25	3	Concrete Tile	Irving
3.12b	2.5	4	Concrete Tile	Irving
5.16	2.0	5	Concrete Tile	Irving
4.11	4.0	2	Clay Tile	Waxahachie
5.12	2.5	5	Impact Resistant 2 ply	Oak Point
6.05	2.0	3	Impact Resistant 2 ply	Irving
2.13	1.5	0	Impact Resistant 2 ply	Southlake
1.03	1.25	0	Impact Resistant 2 ply	Rowlett
2.17	0.25	0	Impact Resistant 2 ply	Arlington
6.04	0.25	0	Impact Resistant 2 ply	Irving

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## Inspection Summary by Roof Type

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
6.16	2.5	0	Impact Resistant 3 ply	Irving
3.07	1.25	2	Impact Resistant 3 ply	Euleless
4.04	1.25	1	Impact Resistant 3 ply	Dallas
5.01	1.0	0	Impact Resistant 3 ply	Dallas
5.08	2.5	2	Impact Resistant 3 tab	Irving
6.08	1.75	3	Impact Resistant 3 tab	Farmers Branch
5.06	3.25	5	Laminated 2 ply	Irving
2.19	3.0	5	Laminated 2 ply	Irving
1.11	2.5	2	Laminated 2 ply	Carrollton
5.07	2.5	3	Laminated 2 ply	Irving
5.18	2.5	3	Laminated 2 ply	Irving
6.14	2.5	1	Laminated 2 ply	Irving
6.15	2.5	0	Laminated 2 ply	Irving
2.06	2.25	0	Laminated 2 ply	Dallas
4.05	2.25	3	Laminated 2 ply	Dallas
5.10	2.25	3	Laminated 2 ply	Irving
6.01	2.0	5	Laminated 2 ply	Irving
7.05	2.0	5	Laminated 2 ply	North Richard Hills
6.13	1.75	2	Laminated 2 ply	Fort Worth
1.05	1.5	3	Laminated 2 ply	Coppell
1.06	1.5	3	Laminated 2 ply	Coppell
1.21	1.5	5	Laminated 2 ply	Irving
3.02	1.5	5	Laminated 2 ply	Carrollton
3.03	1.5	5	Laminated 2 ply	Carrollton
3.04	1.5	5	Laminated 2 ply	Carrollton
6.11	1.5	0	Laminated 2 ply	Colleyville
6.12	1.5	2	Laminated 2 ply	Keller
1.08	1.25	2	Laminated 2 ply	Carrollton
2.04	1.25	2	Laminated 2 ply	Dallas
2.05	1.25	0	Laminated 2 ply	Dallas
5.05	1.25	2	Laminated 2 ply	Irving
5.11	1.25	3	Laminated 2 ply	Corinth

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## Inspection Summary by Roof Type

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
6.09	1.25	3	Laminated 2 ply	Carrollton
1.01	1.0	0	Laminated 2 ply	Mesquite
1.09	1.0	1	Laminated 2 ply	Carrollton
2.12	1.0	2	Laminated 2 ply	Carrollton
6.02	1.0	3	Laminated 2 ply	Irving
6.03	1.0	3	Laminated 2 ply	Carrollton
1.10	0.75	2	Laminated 2 ply	Coppell
2.01	0.5	0	Laminated 2 ply	Dallas
2.02	0.5	0	Laminated 2 ply	Dallas
2.08	0.25	0	Laminated 2 ply	Richardson
2.10	0.25	0	Laminated 2 ply	Dallas
2.18	0.25	0	Laminated 2 ply	Keller
6.10	0.25	0	Laminated 2 ply	Colleyville
1.16	4.0	4	Metal-Raised Rib Panel	Irving
3.09b	4.0	4	Metal-Standing Seam	Irving
7.01	3.25	4	Metal Standing Seam	Prosper
6.15	2.5	4	Metal-Standing Seam	Irving
1.23	2.5	4	Metal Shingle	Irving
2.16	2.5	0	Metal Shingle	Irving
5.13	2.5	0	Metal Shingle	Irving
5.14	2.5	1	Metal Shingle	Irving
5.15	2.5	4	Metal Shingle	Irving
2.15	2.5	0	Metal Shingle	Irving
1.15	1.5	4	Metal-Raised Rib Panels	Irving
2.14	1.5	0	Metal Shingle	Irving
1.24	1.5	0	Metal-Raised Rib Panels	Irving
3.01	1.0	1	Metal Standing Seam	Dallas
3.05	1.0	0	Metal Standing Seam	Coppell
6.06	0.25	0	Metal Shingle	Irving

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## Inspection Summary by Roof Type

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
1.19	5.0	5	Modified Bitumen	Irving
3.09	4.0	5	Modified Bitumen	Irving
1.20	3.0	5	Modified Bitumen	Irving
4.06	2.5	5	Modified Bitumen	Irving
3.08	2.25	5	Modified Bitumen	Irving
1.17	2.0	0	Modified Bitumen	Irving
1.18	2.0	3	Modified Bitumen	Irving
4.01	1.875	2	Modified Bitumen	Dallas
3.12	2.5	3	Single Ply	Irving
1.26	2.0	0	Single Ply	Irving
7.03	1.75	5	Single Ply	Desoto
5.09	2.5	5	Standard 3 tab	Irving
5.03	2.0	5	Standard 3 tab	Irving
1.07	1.5	5	Standard 3 tab	Coppell
1.12	1.5	3	Standard 3 tab	Coppell
1.13	1.5	2	Standard 3 tab	Coppell
2.07	1.5	3	Standard 3 tab	Dallas
2.09	1.5	2	Standard 3 tab	Coppell
1.14	1.25	2	Standard 3 tab	Coppell
1.02	1.0	1	Standard 3 tab	Mesquite
5.02	1.0	0	Standard 3 tab	Dallas
1.04	0.75	1	Standard 3 tab	Rowlett
2.03	0.25	0	Standard 3 tab	Dallas
6.07	2.0	0	Synthetic Slate	Irving
3.06	1.0	2	Synthetic Slate	Fort Worth
2.11	Not Inspected			
5.04	Not Inspected			

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## Inspection Summary by Maximum Hail Size

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
1.19	5.0	5	Modified Bitumen	Irving
1.16	4.0	4	Standing Seam Metal	Irving
3.09	4.0	5	Modified Bitumen	Irving
3.09b	4.0	4	Metal-Standing Seam	Irving
4.11	4.0	2	Clay Tile	Waxahachie
4.09	3.5	2	Built Up Roof	Waxahachie
4.10	3.5	2	Built Up Roof	Waxahachie
5.06	3.25	5	Laminated 2 ply	Irving
7.01	3.25	4	Metal-Standing Seam	Prosper
1.20	3.0	5	Modified Bitumen	Irving
2.19	3.0	5	Laminated 2 ply	Irving
4.07	3.0	5	Built Up Roof	Irving
1.11	2.5	2	Laminated 2 ply	Carrollton
1.23	2.5	4	Metal Shingle	Irving
2.15	2.5	0	Metal Shingle	Irving
2.16	2.5	0	Metal Shingle	Irving
3.12	2.5	3	Single Ply	Irving
3.12b	2.5	4	Concrete Tile	Irving
4.06	2.5	5	Modified Bitumen	Irving
5.07	2.5	3	Laminated 2 ply	Irving
5.08	2.5	2	Impact Resistant 3 tab	Irving
5.09	2.5	5	Standard 3 tab	Irving
5.12	2.5	5	Impact Resistant 2 ply	Oak Point
5.13	2.5	0	Metal Shingle	Irving
5.14	2.5	1	Metal Shingle	Irving
5.15	2.5	4	Metal Shingle	Irving
5.15	2.5	4	Metal Shingle	Irving
5.18	2.5	3	Laminated 2 ply	Irving
6.14	2.5	1	Laminated 2 ply	Irving

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## Inspection Summary by Maximum Hail Size

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
6.15	2.5	4	Metal-Standing Seam	Irving
6.15	2.5	0	Laminated 2 ply	Irving
6.16	2.5	0	Impact Resistant 3 ply	Irving
7.06	2.5	5	Cedar Shake	Irving
2.06	2.25	0	Laminated 2 ply	Dallas
3.08	2.25	5	Modified Bitumen	Irving
3.08b	2.25	2	Built Up Roof	Irving
3.11	2.25	3	Concrete Tile	Irving
4.02	2.25	1	Built Up Roof	Irving
4.03	2.25	2	Built Up Roof	Irving
4.05	2.25	3	Laminated 2 ply	Dallas
4.08	2.25	2	Built Up Roof	Irving
5.10	2.25	3	Laminated 2 ply	Irving
5.17	2.25	5	Cedar Shake	Irving
1.17	2.0	0	Modified Bitumen	Irving
1.18	2.0	3	Modified Bitumen	Irving
1.26	2.0	0	Single Ply	Irving
5.03	2.0	5	Standard 3 tab	Irving
5.16	2.0	5	Concrete Tile	Irving
6.01	2.0	5	Laminated 2 ply	Irving
1.22	2.0	5	Cedar Shingle	Irving
6.05	2.0	3	Impact Resistant 2 ply	Irving
6.07	2.0	0	Synthetic Slate	Irving
7.05	2.0	5	Laminated 2 ply	North Richard Hills
1.25	2.0	2	Concrete Tile	Irving
4.01	1.875	2	Modified Bitumen	Dallas
6.08	1.75	3	Impact Resistant 3 tab	Farmers Branch
6.13	1.75	2	Laminated 2 ply	Fort Worth

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## Inspection Summary by Maximum Hail Size

Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
7.03	1.75	5	Single Ply	Desoto
1.05	1.5	3	Laminated 2 ply	Coppell
1.06	1.5	3	Laminated 2 ply	Coppell
1.07	1.5	5	Standard 3 tab	Coppell
1.12	1.5	3	Standard 3 tab	Coppell
1.13	1.5	2	Standard 3 tab	Coppell
1.15	1.5	4	Metal-Raised Rib Panels	Irving
1.21	1.5	5	Laminated 2 ply	Irving
1.24	1.5	0	Metal-Raised Rib Panels	Irving
2.07	1.5	3	Standard 3 tab	Dallas
2.09	1.5	2	Standard 3 tab	Coppell
2.13	1.5	0	Impact Resistant 2 ply	Southlake
2.14	1.5	0	Metal Shingle	Irving
3.02	1.5	5	Laminated 2 ply	Carrollton
3.03	1.5	5	Laminated 2 ply	Carrollton
3.04	1.5	5	Laminated 2 ply	Carrollton
3.10	1.5	2	Built Up Roof	Irving
6.11	1.5	0	Laminated 2 ply	Colleyville
6.12	1.5	2	Laminated 2 ply	Keller
1.03	1.25	0	Impact Resistant 2 ply	Rowlett
1.08	1.25	2	Laminated 2 ply	Carrollton
1.14	1.25	2	Standard 3 tab	Coppell
2.04	1.25	2	Laminated 2 ply	Dallas
2.05	1.25	0	Laminated 2 ply	Dallas
3.07	1.25	2	Impact Resistant 3 ply	Euless
4.04	1.25	1	Impact Resistant 3 ply	Dallas
5.05	1.25	2	Laminated 2 ply	Irving

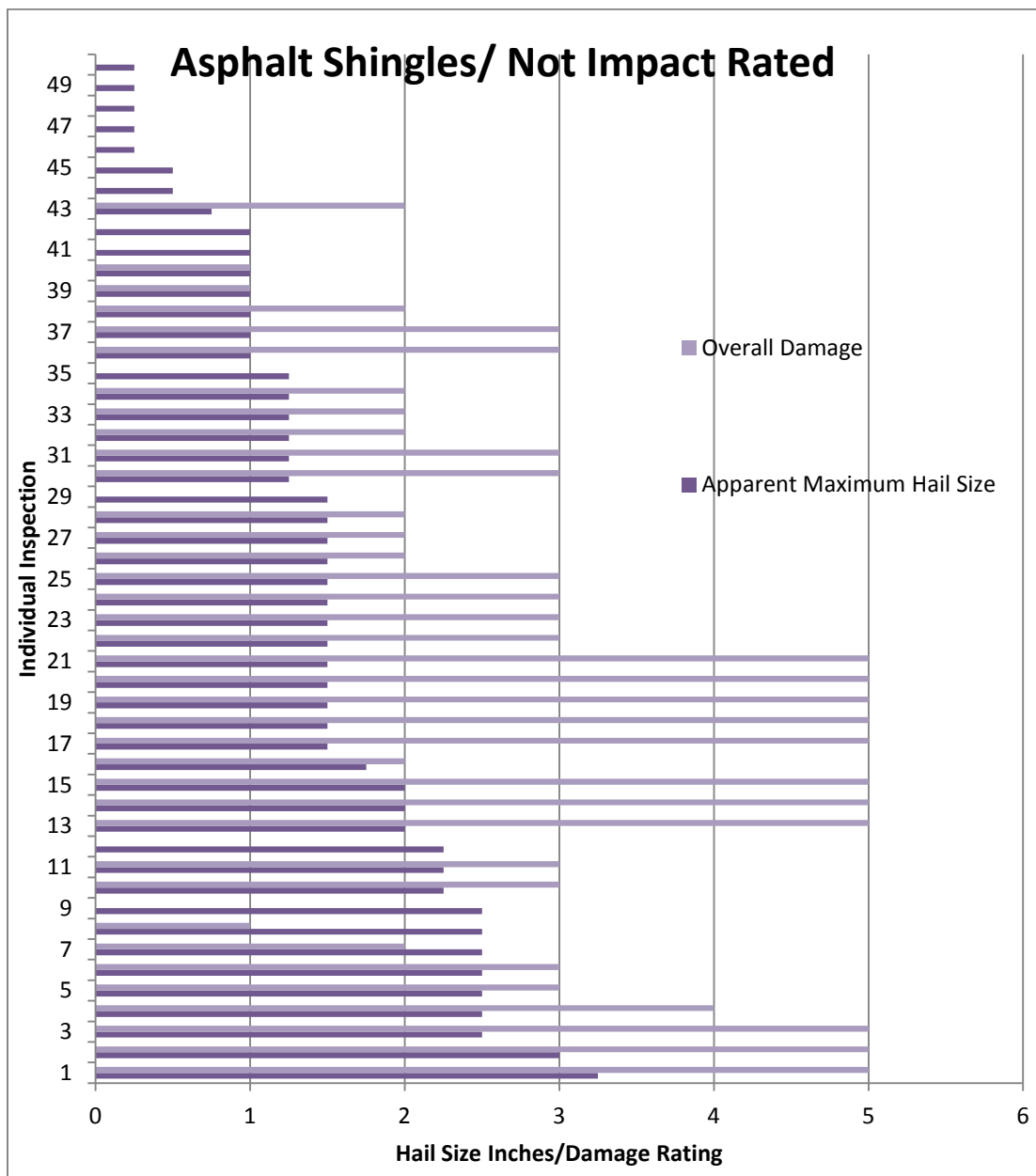
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## Inspection Summary by Maximum Hail Size

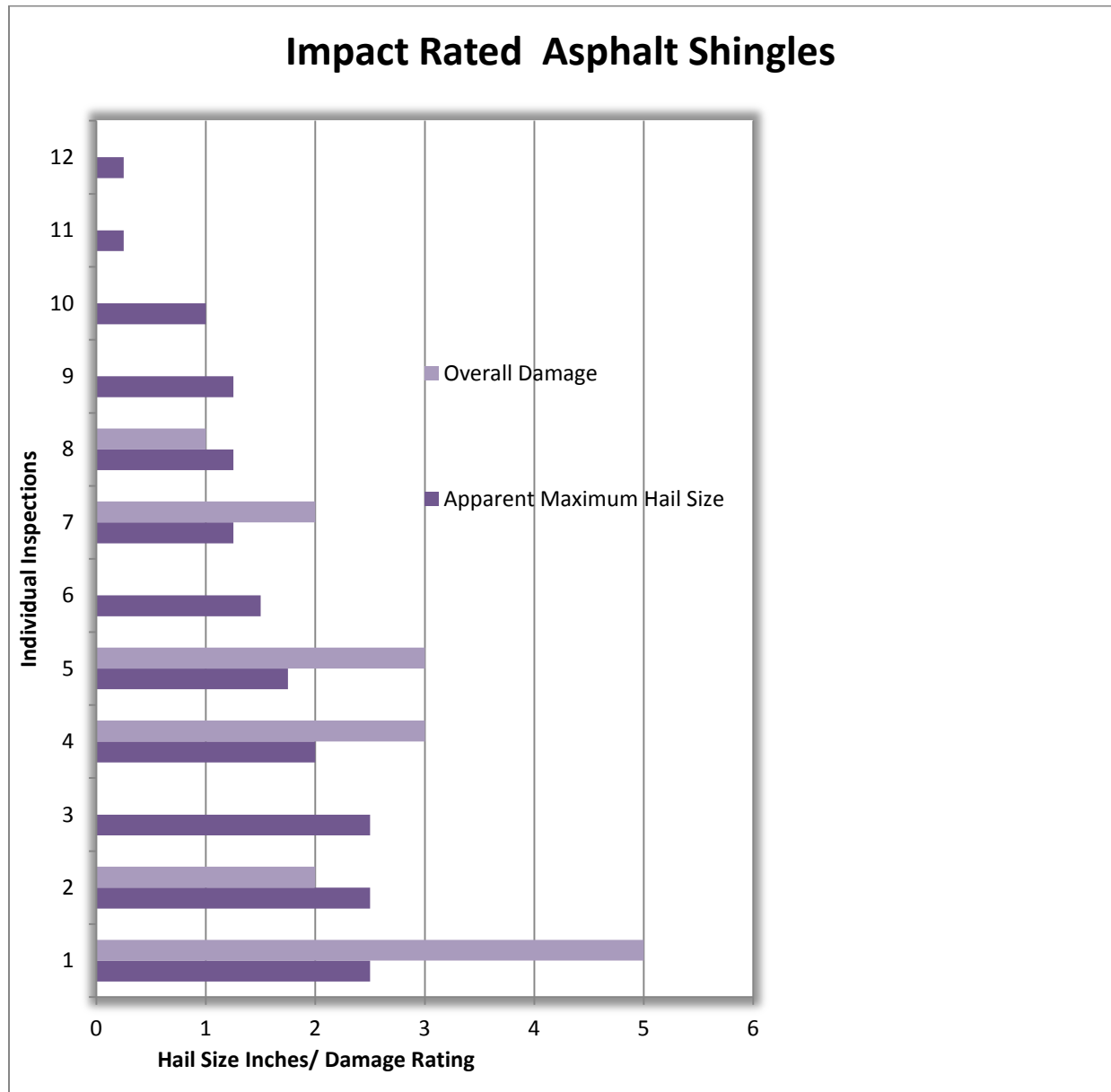
Inspection #	Maximum Hail Size	Damage Rating	Type of Roof	City
5.11	1.25	3	Laminated 2 ply	Corinth
6.09	1.25	3	Laminated 2 ply	Carrollton
1.01	1.0	0	Laminated 2 ply	Mesquite
1.02	1.0	1	Standard 3 tab	Mesquite
1.09	1.0	1	Laminated 2 ply	Carrollton
2.12	1.0	2	Laminated 2 ply	Carrollton
3.01	1.0	1	Metal-Standing Seam	Dallas
3.05	1.0	0	Metal-Standing Seam	Coppell
3.06	1.0	2	Synthetic Slate	Fort Worth
5.01	1.0	0	Impact Resistant 3 ply	Dallas
5.02	1.0	0	Standard 3 tab	Dallas
6.02	1.0	3	Laminated 2 ply	Irving
6.03	1.0	3	Laminated 2 ply	Carrollton
7.02	1.0	2	Cedar Shingle	Farmers Branch
7.04	1.0	1	Cedar Shingle	Arlington
1.04	0.75	1	Standard 3 tab	Rowlett
1.10	0.75	2	Laminated 2 ply	Coppell
2.01	0.5	0	Laminated 2 ply	Dallas
2.02	0.5	0	Laminated 2 ply	Dallas
2.03	0.25	0	Standard 3 tab	Dallas
2.08	0.25	0	Laminated 2 ply	Richardson
2.10	0.25	0	Laminated 2 ply	Dallas
2.17	0.25	0	Impact Resistant 2 ply	Arlington
2.18	0.25	0	Laminated 2 ply	Keller
6.04	0.25	0	Impact Resistant 2 ply	Irving
6.06	0.25	0	Metal Shingle	Irving
6.10	0.25	0	Laminated 2 ply	Colleyville
2.11	Not Inspected			
5.04	Not Inspected			

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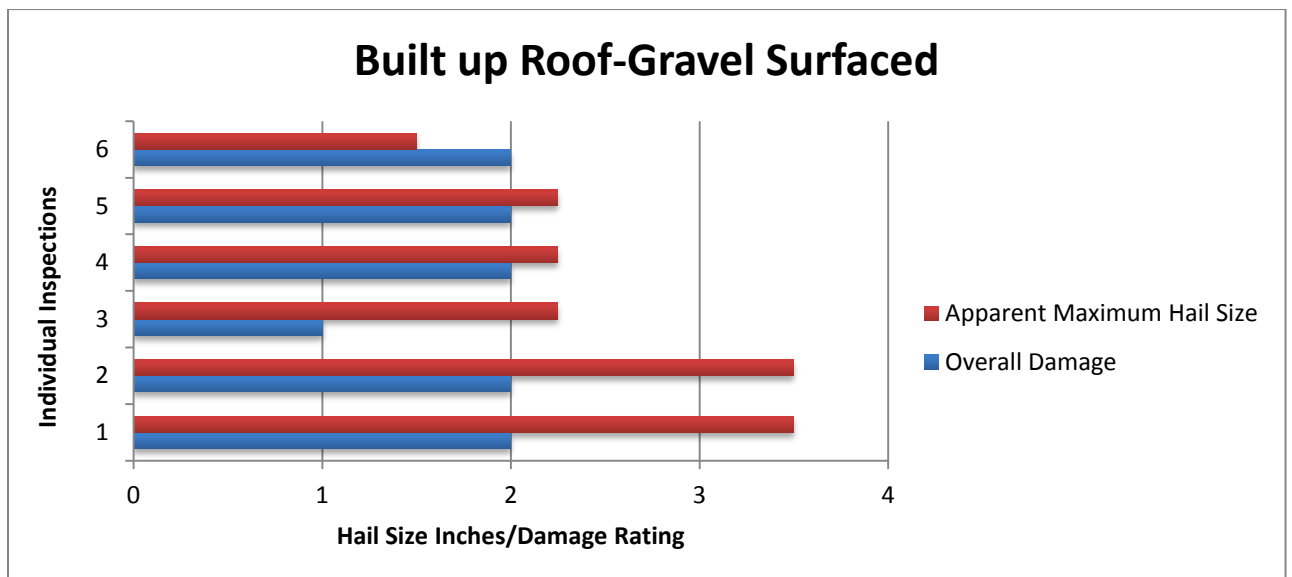
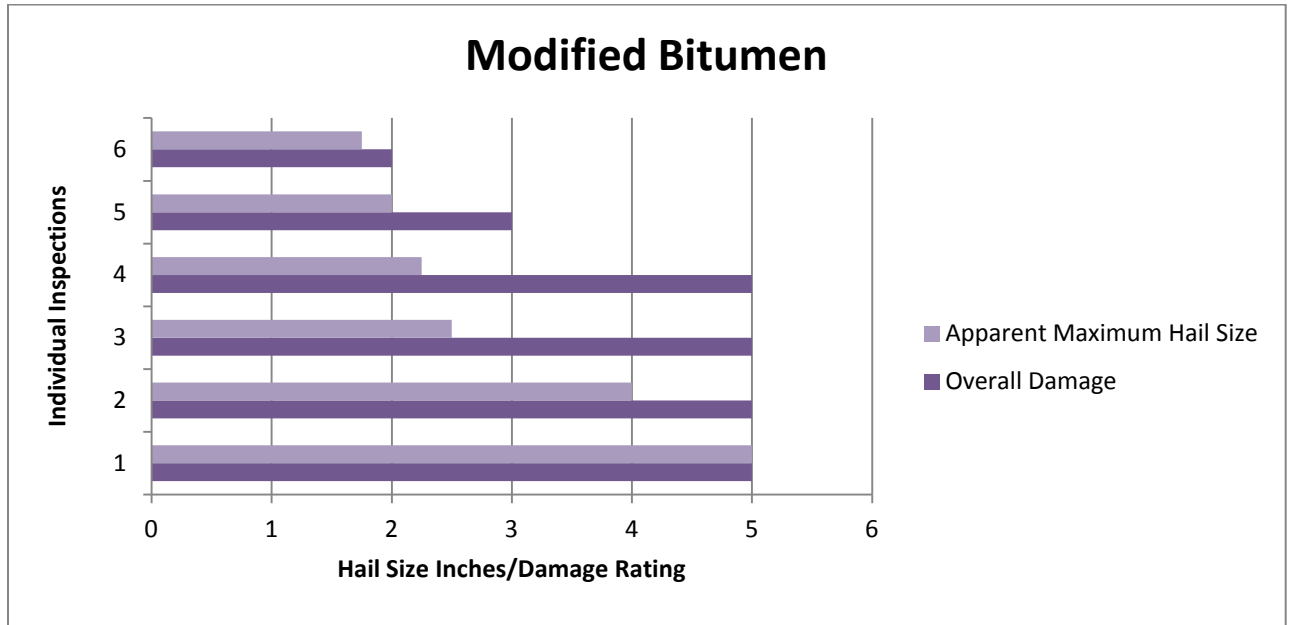
**Asphalt Shingles / Not Impact Rated**



## **Impact Rated Asphalt Shingles**



## Low Slope Charts



## **Appendix B:**

### **Team Summary Reports and Steep Slope Inspection Reports**

The individual site selections in both the steep and low slope section of this document do not include all of the investigations conducted by the RICOWI Hail Investigation Teams during this period. The included sites were selected for inclusion based on the following characteristics: relatively large hail; significant damage; or interesting information.

## **Team 01 Summary Report**

### **Overview**

Team 1 observed 26 roof sites primarily to the north, northeast and southeast of DFW Airport. In all, the team looked at five 3-tab shingle roofs, ten laminate style shingle roofs, four SBS BUR, one TPO, three architectural raised rib metal panels, one metal shingle, one wood shingle and one concrete tile.

The first two days focused on residential asphalt shingles: Five of which were 3-tab with 4 of 5 categorized as having major damage. Nine were laminate architectural style, with 3 of 9 categorized with moderate or severe damage and 3 with no shingle damage. Hail size was estimated at ~ 1.5 to 2-inch on the damaged category roofs.

The last day and a half the team observed 12 roof locations, a combination of low and steep sloped roofs, just north of DFW in the general area around Irving, Texas. Local personnel from two different locations reported 2 separate storm cells with hail and the 2 hailstorms were reported coming from different directions, which was visually evident on roofs. One asphalt shingle location, 1 wood shingle steep wall, 1 metal shingle and 3 SBS BUR roofs, (some with multiple sections with major damage), were categorized as moderate or severe damage. One roof also had significant skylight damage.

Three architectural raised rib metal panel roofs were observed with 2 of the 3 categorized as moderate to severe denting. One concrete tile roof appeared to have some minor corner sidelap breakage and a mechanically attached TPO had no observed membrane damage in a location that reportedly had car windows shattered. Hail size was estimated from ~ 2 inches to 3 to 5-inches on the damaged category roofs.

### **Team Members**

John Goveia, Photographer 06/14, 15, 16, Report Summary Writer  
Phil Dregger, Photographer 06/13, 14  
Robert White, Data Collector & Field Data Report Writer  
Rusty Beck, Data Collector & Field Data Report Writer

**Team 01 Data Reports and Photographs  
Steep Slope**

**Steep Slope Inspection Site: 1.03**

<b>Inspection Number</b>	<b>1.03</b>
<b>Zip</b>	<b>75088</b>
<b>Site Latitude</b>	<b>32.890567</b>
<b>Site Longitude</b>	<b>-96.578058</b>
<b>Area Size (Square feet)</b>	<b>2,200</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Impact resistant 2-ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>6-10</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>0-15</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 1.03 Photographs**



1.03-1. Overview of south facing slope.



1.03-2. Dents in top of metal vent cover.



1.03-3. Dents in top of metal vent cover after chalk-rub.



1.03-4. Hail spatter mark on horizontal glass pane of skylight.

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**Steep Slope Inspection Site: 1.05**

<b>Inspection Number</b>	<b>1.05</b>
<b>Zip</b>	<b>75019</b>
<b>Site Latitude</b>	<b>32.958587</b>
<b>Site Longitude</b>	<b>-97.003023</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>0-15</b>
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Puncture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 1.05 Photographs**



1.05-1. Multiple hail marks shown.



1.05-2. Large hail mark on shingle



1.05-3. Large hail mark.



1.05-4. Large hail mark on shingle.

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**Steep Slope Inspection Site: 1.06**

<b>Inspection Number</b>	<b>1.06</b>
<b>Zip</b>	<b>75019</b>
<b>Site Latitude</b>	<b>32.965583</b>
<b>Site Longitude</b>	<b>-96.974315</b>
<b>Area Size (Square feet)</b>	<b>3,300</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>11-15</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>16-30</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture</b>
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## Steep Slope Site 1.06 Photographs



1.06-1. Multiple hail marks shows.



1.06-2. Dent left from hail.



1.06-3. Hail damage on shingle.



1.06-4. Hail damage on shingle.

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**Steep Slope Inspection Site: 1.08**

<b>Inspection Number</b>	<b>1.08</b>
<b>Zip</b>	<b>75006</b>
<b>Site Latitude</b>	<b>32.982525</b>
<b>Site Longitude</b>	<b>-96.903053</b>
<b>Area Size (Square feet)</b>	<b>2,800</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>11-15</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>61-75</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture</b>
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Minimal damage to field shingles, however the shingles are well adhered and would increase the difficulty of repair.</b>

## **Steep Slope Site 1.08 Photographs**

	
1.08-1. Overview of roof looking west.	1.08-2. Overview of south facing slope.
	
1.08-3. Bruise in shingle, 1 of 2.	1.08-4. Fractures on bottom of same shingle (arrow), 2 of 2.

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**Steep Slope Inspection Site: 1.11**

<b>Inspection Number</b>	<b>1.11</b>
<b>Zip</b>	<b>75006</b>
<b>Site Latitude</b>	<b>32.963541</b>
<b>Site Longitude</b>	<b>-96.853992</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 1.11 Photographs**



1.11-1. West facing slope area with many impacted shingles.



1.11-2. Overview of some "bruised" shingles.



1.11-3. Close-up of "bruised" shingle laminate.



1.11-4. Overview of some "bruised" shingles.

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1.11-5. 1/2 –inch to 5/8-inch impact mark.



1.11-6. Overview of some “bruised” shingles.



1.11-7. 1-3/4-inch impact mark.

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**Steep Slope Inspection Site: 1.14**

<b>Inspection Number</b>	<b>1.14</b>
<b>Zip</b>	<b>75019</b>
<b>Site Latitude</b>	<b>32.967171</b>
<b>Site Longitude</b>	<b>-96.982449</b>
<b>Area Size (Square feet)</b>	<b>2,400</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Standard 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>11-15</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>75-90</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Granule loss and mat fracture</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 1.14 Photographs**



1.14-1. South facing slope area with many impacted shingles.



1.14-2. Overview of 1-inch impact mark on damaged 3-tab shingle.



1.14-3. Overview of 1-inch to 1-1/4-inch impact mark on damaged 3-tab shingle.



1.14-4. Damaged 3 tab shingle in Photo 5.

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**Steep Slope Inspection Site: 1.16**

<b>Inspection Number</b>	<b>1.16</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.858906</b>
<b>Site Longitude</b>	<b>-96.987457</b>
<b>Area Size (Square feet)</b>	<b>44,658</b>
<b>Approximate Age (Years)</b>	<b>12-15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Painted structural metal panel</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>11-15</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>4</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>61-75</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing), panel overlap openings</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	<b>Many panels had seam openings</b>

## **Steep Slope Site 1.16 Photographs**



1.16-1. WSW facing slope area with many impact depressions in metal roof ribs.



1.16-2. WSW facing slope area with many impact depressions in metal roof ribs. Overview of impact marks (circled on metal panels).



1.16-3. Overview close-up of impact depressions in metal roof rib.



1.16-4. Close-up of impact depressions in metal roof rib in Photo 3.

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1.16-5. Overview close-up of impact depressions in metal roof rib.



1.16-6. Cross view close-up of impact depressions in metal roof rib.



1.16-7. 4 to 5-inch impact depression with smaller impacts marks also.

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**Steep Slope Inspection Site: 1.23**

<b>Inspection Number</b>	<b>1.23</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.512537</b>
<b>Site Longitude</b>	<b>-97.001941</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Metal Shake Panel</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>16-20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>61-75</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>Unknown</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing), Seam openings</b>
<b>Comments Regarding Inspection</b>	<b>Damage for side laps and for dents. Damage on EIFS wall cladding also.</b>

## **Steep Slope Site 1.23 Photographs**



1.23-1. Wood damage from hail.



1.23-2. Hail mark shown.



1.23-3. Metal damage from hail.



1.23-4. Shingle damage from hail.

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**Steep Slope Inspection Site: 1.25**

<b>Inspection Number</b>	<b>1.25</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.512693</b>
<b>Site Longitude</b>	<b>-97.000103</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>10-15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>8-10:12</b>
<b>Roof Type</b>	<b>Concrete tile, profile</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>2-3 field tile and 1 trim tile</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>2-3</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2 inches</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>Unknown</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Sidelap corners and one rake trim tile</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Tile breakage</b>
<b>Comments Regarding Inspection</b>	<b>Damage limited based on height, and limited access due to steep slope observation by camera from ground elevation.</b>

## **Steep Slope Site 1.25 Photographs**

	
01.25-1. Overview of chipped tiles.	01.25-2. Close-up of corner chipped tile.
	
01.25-3. View of cracked rake trim tile and splash marks on tiles.	01-25.4. Splash marks on tiles.

## **Team 02 Summary Report**

### **Overview**

Team 2 observed nineteen roofs in the greater Dallas area. The first day was spent mostly on the east side of Dallas. The hail in the area inspected was not severe enough to damage the shingles on the roofs we observed. The following several days the team traveled out to Keller and Arlington but observed very little, if any hail damage. Some small damage to ridge shingles was observed. One of the roofs in Keller was a Class 4 IR that exhibited no hail damage. Other structures near that house showed the hail was a little over two inch in diameter in the area. That was the only Class 4 asphalt roof the team encountered.

The team traveled to Irving and near the Dallas-Fort Worth airport finding areas that had been hit with more moderate size hail. In Irving, the team inspected several metal (Class 4) shingle roofs but observed little damage to them. The roofs appeared to survive the hail in good shape even though the team found evidence of broken skylights. On an apartment complex near the airport signs of hail that did substantial damage to roof, cars and other objects were observed. In this area the team measured hail size up to three inches in diameter. On the apartment complex the team observed an area that exhibited in excess of twenty fractured shingles per square.

Roof types observed included the following:

- 4 metal shingles roofs
- 2 three-tab asphalt shingle roofs
- 13 laminated asphalt roofs (one was a Class 4)

### **Team Members**

Bill Morgan, Report Writer  
Dan Behrens, Photographer  
Wanda Edwards, Data Collector

**Team 02 Data Reports and Photographs  
Steep Slope**

**Steep Slope Inspection Site 2.05**

<b>Inspection Number</b>	<b>2.05</b>
<b>Zip</b>	<b>75238</b>
<b>Site Latitude</b>	<b>32.884937</b>
<b>Site Longitude</b>	<b>-96.725022</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 2.05 Photographs**

	
2.05-1. North slope overview.	2.05-2. _West slope overview.
	
2.05-3. Bruise in ridge shingle	2.05-4. Dents in flue cap.

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**Steep Slope Inspection Site 2.06**

<b>Inspection Number</b>	<b>2.06</b>
<b>Zip</b>	<b>75238</b>
<b>Site Latitude</b>	<b>32.88773</b>
<b>Site Longitude</b>	<b>-96.719833</b>
<b>Area Size (Square feet)</b>	<b>6,100</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## Steep Slope Site 2.06 Photographs



2.06-1. Repair at northwest-facing valley.



2.06-2. Weathered shingle bruise at ridge.



2.06-3. Broken skylights.



2.06-4. Dents in vent cover.

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**Steep Slope Inspection Site 2.07**

<b>Inspection Number</b>	<b>2.07</b>
<b>Zip</b>	<b>75220</b>
<b>Site Latitude</b>	<b>32.870883</b>
<b>Site Longitude</b>	<b>-96.841248</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Standard 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>11-15</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 2.07 Photographs**



2.07-1. Dented flue cap.



2.07-2. Dent in aluminum turbine vent.



2.07-3. Close up.



2.07-4. West test square overview.

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**Steep Slope Inspection Site 2.09**

<b>Inspection Number</b>	<b>2.09</b>
<b>Zip</b>	<b>75019</b>
<b>Site Latitude</b>	<b>32.968735</b>
<b>Site Longitude</b>	<b>-96.972256</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Standard 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>75-90</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 2.09 Photographs**



2.09-1. West slope overview.



2.09-2. West test square overview.



2.09-3. Dented flue cap.



2.09-4. Bruised shingle.

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**Steep Slope Inspection Site 2.16**

<b>Inspection Number</b>	<b>2.16</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.856518</b>
<b>Site Longitude</b>	<b>-96.94492</b>
<b>Area Size (Square feet)</b>	<b>6,100</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>12:12</b>
<b>Roof Type</b>	<b>Impact resistant stone-coated metal panels</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 2.16 Photographs**

	
<p>2.16-1. Granules and asphalt binder had been scraped off.</p>	<p>2.16-2. Mechanically caused scrape and dent, south slope.</p>
	
<p>2.16-3. South slope.</p>	<p>2.16-4. Mechanically caused scrape, east slope.</p>

## Steep Slope Inspection Site 2.19

<b>Inspection Number</b>	<b>2.19</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.863622</b>
<b>Site Longitude</b>	<b>-97.015491</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>3</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge, Puncture, Surface Pitting, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge, Puncture, Substantial Loss of Granule Surfacing</b>
<b>Comments Regarding Inspection</b>	<b>Mixture of hail up to 3".</b>

## Steep Slope Site 2.19 Photographs

	
2.19-1. Bruise in ridge shingle.	2.19-2. Dents in aluminum turbine vent.
	
2.19-3. One-and-one-half inch wide bruise.	2.19-4. East test square.
	
2.19-5. West test square.	2.19-6. Two-inch wide bruise.

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2.19-7. Two-and-one-half inch wide bruise.



2.19-8. Close up.



2.19-9. Dented gutter.



2.19-10. Two-inch wide spatter mark on transformer box.

## **Team 03 Summary Report**

### **Overview**

Team 3 (John Paul Hadden, Dale McLean, Dave Fulton, and Rem Brown) investigated fifteen roofs over the three-day period of June 14 to June 16, 2011. Of the fifteen roofs the team investigated, four were shingle roofs, three were metal roofs, two were modified bitumen roofs, two were BUR with gravel cover, two were tile, one was a single ply roof, and one was a synthetic slate material. Several of the sites visited had multiple roof types; each type was considered as a separate investigation. One of the shingle roofs was impact resistant. The team recorded one metal roof as impact resistant based on expertise within the team. The synthetic slate roof was also an impact rated product.

Hail sizes at the sites investigated ranged from 1 inch to 4 inch. The team did not investigate any site that did not sustain hail impact damage to the roof. Most of the roofs had hail between 1 inch - 1.5 inches (eight of the fifteen roofs). Five roofs had hail between 2.25 inches - 2.5 inches and two roofs (at one site) showed indication of 4 inch hailstones.

Generally, the metal roofs had some cosmetic damage evidenced by dents but did not appear to have any punctures or damage that would result in potential roof leakage. The impact resistant metal roof had very little apparent damage, but the team's investigation was cut short when the building owner arrived and ordered the team off the roof (the team had permission from the building manager to investigate the roof, but apparently he had not checked with the owner). Hail impacting the metal roofs varied in size from 1 inch- 4 inch, with the smallest hailstones impacting the impact resistant roof. The metal roof that experienced 4 inch hail had over 100 dents in a 100 square foot test area (not all hits were 4 inch). The 4 inch hail occurred in the City of Irving, TX. The metal roofs were all less than 10 years old.

The shingle roofs experienced hail between 1.25 inch- 1.5 inch and had fairly severe damage with the exception of the impact resistant roof. The impact resistant roof had only minimal damage. Three of the four shingle roofs were less than 10 years old (including the IRR); the fourth was, according to the homeowner, 23 years old.

The two modified bitumen roofs were estimated to be between 3-10 years old and experienced hail between 2.25 inches - 4 inches. Damage for both was considered fairly severe, based on visual observation. Both roofs were on buildings owned by the City of Irving.

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The BUR roofs were exposed to 1.5 inch - 2.25 inch hailstones and appeared to have minimal damage based on a visual assessment. The age of the BUR roofs was estimated between 5- 10 years old. These roofs were on buildings owned by the City of Irving.

The team investigated two types of tile roofs: a flat tile roof and a barrel tile roof. The maximum size of hailstones impacting the tile roofs was estimated at 2.25 inches for the flat tile and 2.5 inches for the barrel tile. The flat tile experienced moderate damage (at least 20 tiles were broken in the field from hail impacts). Some flat tile damage appeared to be pre-existing cracked off right corners. The barrel tile roof was evaluated from the ground and damage was classified as moderate to severe. The age of the roofs was unknown. Both roofs were on buildings owned by the City of Irving.

The single ply roof covering experienced 2.5 inches hailstones and the visible damage was estimated as moderate. Damage below the roof covering could not be determined. The age was unknown. The roof was on a building owned by the City of Irving.

The synthetic slate roof was exposed to 1 inch hailstones and sustained minimal damage. Further research after the field investigation indicates this product was an impact rated product. Most of the damage appeared to be cosmetic; chipped corners and edges. The home was located on the fairway of a golf course and we found several golf balls in the yard. It was interesting to note that we saw just a few areas in the field of the shingle that had spider cracks; we attributed that damage to golf ball impacts.

## **Team Members**

John Paul Hadden, Data Collector  
Dale McLean, Photographer  
Dave Fulton, Data Collector  
Rem Brown, Data Collector

**Team 03 Data Reports and Photographs  
Steep Slope**

**Steep Slope Inspection Site 3.02**

<b>Inspection Number</b>	<b>3.02</b>
<b>Zip</b>	<b>75006</b>
<b>Site Latitude</b>	<b>32.978613</b>
<b>Site Longitude</b>	<b>-96.900745</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>31-45</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge, Puncture, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 3.02 Photographs**

	
3.02-1. Number of hits in 100 sq ft test area.	3.02-2. Typical hail damage for this site.
	
3.02-3. No hail damage on east side of weather station.	3.02-4. Hail damage on west side of weather station.

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### **Steep Slope Site Inspection 3.03**

<b>Inspection Number</b>	<b>3.03</b>
<b>Zip</b>	<b>75006</b>
<b>Site Latitude</b>	<b>32.979097</b>
<b>Site Longitude</b>	<b>-96.905739</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 3.03 Photographs**



3.03-1. Number of impacts in 100 sq ft test area.



3.03-2. Typical hail damage for this site.



3.03-3. Dents on vent stack indicating hail impact from southwest.



3.03-4. Same vent stack at 3.03-3 indicating damage on opposite side.

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**Steep Slope Inspection Site 3.07**

<b>Inspection Number</b>	<b>3.07</b>
<b>Zip</b>	<b>76039</b>
<b>Site Latitude</b>	<b>32.863475</b>
<b>Site Longitude</b>	<b>-97.093441</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Impact resistant 3 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>16-20</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	<b>Impact resistant shingle roof with minimal damage. Test areas measured and evaluated from ladder (5'x20').</b>

## **Steep Slope Site 3.07 Photographs**



3.07-1 Overview



3.07-2 Skylight damage



3.07-3 Damaged shingle



3.07-4 Damage showing reinforcement

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**Steep Slope Inspection Site 3.09B**

<b>Inspection Number</b>	<b>03.09B</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.862067</b>
<b>Site Longitude</b>	<b>-97.01915</b>
<b>Area Size (Square feet)</b>	<b>27,300</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>11-12:12</b>
<b>Roof Type</b>	<b>Other</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>6-10</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>4</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>75-99</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	<b>Severe denting of metal roofing, but no apparent functional damage. Did not climb on roof due to steep slope, but could observe damage from a lower flat roof surface.</b>

## **Steep Slope Site 3.09 B Photograph**



3.09B-1. Dents in standing seam metal roof from hail impact.

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**Steep Slope Inspection Site 3.11**

<b>Inspection Number</b>	<b>3.11</b>
<b>Zip</b>	<b>75039</b>
<b>Site Latitude</b>	<b>32.861174</b>
<b>Site Longitude</b>	<b>-96.927662</b>
<b>Area Size (Square feet)</b>	<b>8,800</b>
<b>Approximate Age (Years)</b>	<b>12-15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Flat Tile</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>31-45</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge</b>
<b>Comments Regarding Inspection</b>	<b>Damage was mainly cracked off right corners, not clear that damage was caused by hail storm.</b>

## **Steep Slope Site 3.11 Photographs**



3.11-1. Thickness of concrete tile.



3.11-2. Recent right corner break in tile.



3.11-3. Tile fractured. Note white "splatter" marks indicating hail impact.



3.11-4. Typical hail splatter mark on tile.

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**Steep Slope Inspection Site 3.12B**

<b>Inspection Number</b>	<b>03.12B</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.85015</b>
<b>Site Longitude</b>	<b>-96.9603</b>
<b>Area Size (Square feet)</b>	<b>11,506</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Barrel Tile</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>16-20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge</b>
<b>Comments Regarding Inspection</b>	<b>Observations made from ground.</b>

## **Steep Slope Site 3.12B Photograph**



3.12B-1. Typical tile roof damage due to hail impacts at this site.

## **Team 04 Summary Report**

### **Overview**

Team 4 conducted surveys on 11 different roofs. The team observed evidence of hail sizes ranging from 1.25 inch to 4 inches, with most sizes between 2.25 inches – 3.25 inches.

The team primarily surveyed low-slope roofs including three modified bituminous (MB) and four built up roofs (BUR) with gravel surfacing. The most hail resistant roof systems we observed were graveled BUR, which showed few signs of hail damage in the field of the roof. This was especially true when gravel was well embedded in asphalt or coal tar pitch flood coats, as opposed to those with poorly embedded gravel. Observed damage to these roofs was generally limited to MB base flashings and sheet metal components.

The team noted that older MB membranes did not perform as well as newer versions.

Of the two adjacent steep-sloped residences surveyed by the team, the one with Class 4 asphalt shingles clearly outperformed the one that did not include Class 4 shingles.

The team also surveyed one very old and large church that was covered primarily with flat tiles. The tiles exhibited moderate damage from hail as large as four inches in diameter.

Roof-mounted equipment with light-gauge metal components (such as vents and A/C cooling fins) was extensively damaged, as were copper flashings. Old skylights were extremely brittle with damage ranging from minor cracks to completely shattered.

### **Team Members**

Apoorv Dabral, Data Collector  
Phil Mayfield, Team Captain  
Chuck Miccolis, Report Writer

**Team 04 Data Reports and Photographs**  
**Steep Slope**  
**Inspection Site 4.04**

<b>Inspection Number</b>	<b>4.04</b>
<b>Zip</b>	<b>75220</b>
<b>Site Latitude</b>	<b>32.863855</b>
<b>Site Longitude</b>	<b>-96.845074</b>
<b>Area Size (Square feet)</b>	<b>3,754</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>11-12:12</b>
<b>Roof Type</b>	<b>Impact resistant 3-ply asphalt</b>
<b>Impact Resistant?</b>	<b>Yes</b>
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>1</b>
<b>Types of Hail Damage Observed</b>	<b>Minimal granule loss</b>
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Minimal granule loss on south and east slopes. Hail pad had maximum indentation of 1.25 in. Remainder of hail pad indentations measured 0.25 to 0.75 in. The resident indicated that there were golf ball sized hail.</b>

## **Steep Slope Site 4.04 Photographs**



4.04-1. Possible hail damage on class 4 shingles.



4.04-2. Hail bruise mark on class 4 shingles.



4.04-3. Exposed bitumen in the damaged shingle.



4.04-4. Exposed bitumen in the damaged shingle.

## **Steep Slope Inspection Site 4.05**

<b>Inspection Number</b>	<b>4.05</b>
<b>Zip</b>	<b>75220</b>
<b>Site Latitude</b>	<b>32.861154</b>
<b>Site Longitude</b>	<b>-96.839787</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Laminated 2-ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Chipped/Broken Ridge, Puncture, Surface Pitting, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture, Chipped/Broken Ridge, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	<b>Primary damage area is on south east side of roof slopes.</b>

## **Steep Slope Site 4.05 Photographs**



4.05-1. Bruise mark on the laminated shingle.



4.05-2. Fractured laminated shingle.



4.05-3. Several damaged asphalt shingles on the roof.



4.05-4. Punctured plastic equipment on the roof.

## **Steep Slope Site Inspection 4.11**

<b>Inspection Number</b>	<b>4.11</b>
<b>Zip</b>	<b>75165</b>
<b>Site Latitude</b>	<b>32.909167</b>
<b>Site Longitude</b>	<b>-96.816944</b>
<b>Area Size (Square feet)</b>	<b>25,000</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>&gt;12:12</b>
<b>Roof Type</b>	<b>Flat Tile</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>4</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Chipped/Broken Ridge</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Chipped/Broken Ridge</b>
<b>Comments Regarding Inspection</b>	<b>Cracks, chips breaks and dislodgment on tiles. Perimeter copper gutters had multiple indentations and deflections caused from hailstones.</b>

## **Steep Slope Site 4.11 Photographs**



4.11-1. Multiple indentations on the copper gutter.



4.11-2. Chipped edge of tile on steep slope roof.



4.11-3. Chipped edge of tile on steep slope roof.



4.11-4. Multiple chipped tiles on steep slope roof.

## **Team 05 Summary Report**

### **Overview**

Team 5 observed 17 roofs primarily in the Dallas area near DFW and in Irving where hail sized ranged from pea size to softball size. The damage varied from none to severe.

Roof types:

- 7 - asphalt laminated shingles (1 was identified as impact resistant)
- 4 - three tab asphalt shingles (2 were identified as impact resistant)
- 1 - with both laminated and 3 tab asphalt shingles
- 2 - heavy gauge granule covered metal shingles
- 1 - thin gauge metal shingle
- 1 - cedar shake
- 1 – cement barrel tile

It was observed on the impact resistant laminated shingle roof that while the shingle sustained minimal impact damage from the 2.5 inch hail in the field of the roof, closed cut valleys sustained puncture damage where there was some unsupported bridging in the valley.

One roof in an area of hail reported to be at least 2.5 inch had a solar powered roof vents. The metal vent covers sustained a few dents, but the small solar panels were not damaged. Cars parked in the driveway had their windows broken.

Site 5.08, an impact resistant roof and site 5.09, a non-impact resistant roof are located on adjacent properties. Sites 5.14, 5.15, and 5.16 are all located within a few houses of each other. These three sites were all different materials with different damage levels.

### **Team Members**

David Balistreri, Report Writer  
Tanya Brown, Photographer  
Bill Woodring, Data Collector

**Team 05 Data Reports & Photographs  
Steep Slope**

**Steep Slope Site Inspection 5.01**

<b>Inspection Number</b>	<b>5.01</b>
<b>Zip</b>	<b>75220</b>
<b>Site Latitude</b>	<b>32.867829</b>
<b>Site Longitude</b>	<b>-96.847784</b>
<b>Area Size (Square feet)</b>	<b>3,000</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Impact resistant 3 tab asphalt</b>
<b>Impact Resistant?</b>	<b>Yes</b>
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	<b>Little or no hail damage. No hail damage to screens or AC.</b>

## **Steep Slope Site 5.01 Photographs**



5.01-1. Impact on metal dormer.



5.01-2. Impact on metal dormer.



5.01-3. West facing slope, IR blisters.



5.01-4. Unbroken rash blisters.

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**Steep Slope Site Inspection 5.03**

<b>Inspection Number</b>	<b>5.03</b>
<b>Zip</b>	<b>75061</b>
<b>Site Latitude</b>	<b>32.828544</b>
<b>Site Longitude</b>	<b>-96.919901</b>
<b>Area Size (Square feet)</b>	<b>3,500</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Standard 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>0-15</b>
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture, spalling of surface coating, substantial loss of granule surfacing</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.03 Photographs**



5.03-1. Damage mark from hail.



5.03-2. Damage mark from hail.



5.03-3. Large marks from hail.

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**Steep Slope Site Inspection 5.05**

<b>Inspection Number</b>	<b>5.05</b>
<b>Zip</b>	<b>75060</b>
<b>Site Latitude</b>	<b>32.788867</b>
<b>Site Longitude</b>	<b>-96.971254</b>
<b>Area Size (Square feet)</b>	<b>3,500</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply Asphalt Shingle</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.05 Photographs**



**5.05-1. Overview**



**5.05-2. Hail scuffed shingle**



**5.05-3. Hail scuffed shingle**



**5.05-4. Hail dents on air handler**

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## Steep Slope Site Inspection 5.06

<b>Inspection Number</b>	<b>5.06</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.873644</b>
<b>Site Longitude</b>	<b>-97.001987</b>
<b>Area Size (Square feet)</b>	<b>4,000</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>3.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Dent (Metal Roofing), Surface Pitting, Spalling of Surface Coating, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Surface Pitting, Spalling of Surface Coating, Substantial Loss of Granule Surfacing</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.06 Photographs**



5.06-1. Impact fracture on shingle tab.



5.06-2. Measured areas with impact locations marked on East facing slope.



5.06-3. Impact marks on hip shingles.



5.06-4. Impact marks on wood siding.



5.06-5. Impact marks on metal vent cover.

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**Steep Slope Site Inspection 5.07**

<b>Inspection Number</b>	<b>5.07</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.855681</b>
<b>Site Longitude</b>	<b>-96.967319</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Surface Pitting, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Surface Pitting, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	<b>Metal canopy had dents</b>

## **Steep Slope Site 5.07 Photographs**

	
5.07-1. Impact dent on bottom of metal canopy.	5.07-2. Splatter marks on rust of chimney cover.
	
5.07-3. Laying out 10' x 10' area to count number of impacts on North facing slope.	5.07-4. Impact marks on roof turbine.
	
5.07-5. Impact mark on metal canopy.	5.07-6. Impact locations marked on East facing slope of roof.

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5.07-7. Impact locations marked on West facing slope of roof.



5.07-8. Impact fracture on face of shingle.



5.07-9. Close-up of impact fracture on shingle.

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**Steep Slope Site Inspection 5.08**

<b>Inspection Number</b>	<b>5.08</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.84913</b>
<b>Site Longitude</b>	<b>-96.978573</b>
<b>Area Size (Square feet)</b>	<b>3,000</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Impact resistant 3 tab Asphalt Shingle</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Surface Pitting</b>
<b>Comments Regarding Inspection</b>	<b>Slight granule loss at point of impact -Metal roof 0-5 impacts</b>

## **Steep Slope Site 5.08 Photographs**



5.08-1. 4-inch dent.



5.08-2. 2-inch dent.



5.08-3. Granule loss.



5.08-4. Multiple hail marks.



5.08-5. Multiple hail marks.

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**Steep Slope Site Inspection 5.09**

<b>Inspection Number</b>	<b>5.09</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.84914</b>
<b>Site Longitude</b>	<b>-96.978375</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Standard 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Surface Pitting, Spalling of Surface Coating, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Surface Pitting, Spalling of Surface Coating, Substantial Loss of Granule Surfacing</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.09 Photographs**



5.09-1. 2-1/4-inch hail mark.



5.09-2. Multiple hail marks.



5.09-3. Granule loss.



5.09-4. Dented vent cap.



5.09-5. Multiple hail marks.









5.09-6. Damaged shingle.

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**Steep Slope Site Inspection 5.10**

<b>Inspection Number</b>	<b>5.10</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.857457</b>
<b>Site Longitude</b>	<b>-96.982207</b>
<b>Area Size (Square feet)</b>	<b>4,200</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Dent (Metal Roofing), Surface Pitting, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Dent (Metal Roofing), Surface Pitting, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.10 Photographs**

	
5.10-1. Dent in turbine vent	5.10-2. Dent in turbine vent
	
5.10-3. Shingle fracture along ridge	5.10-4. Close up of impact mark on shingle
	
5.10-5. 10' x 10' area on North facing slope with impact locations marked	5.10-6. Dent in gutter

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5.10-7. Broken plastic receiver on satellite dish



5.10-8. Hailstones saved by homeowner

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**Steep Slope Site Inspection 5.11**

<b>Inspection Number</b>	<b>5.11</b>
<b>Zip</b>	<b>76210</b>
<b>Site Latitude</b>	<b>33.160196</b>
<b>Site Longitude</b>	<b>-97.079723</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>9-10:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>16-20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting</b>
<b>Comments Regarding Inspection</b>	<b>Most damage in south.</b>

## **Steep Slope Site 5.11 Photographs**



5.11-1. Overview



5.11-2. Hail hits on air handler



5.11-3. Hail damage showing felts



5.11-4. Hail damage on vent stack

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**Steep Slope Site Inspection 5.12**

<b>Inspection Number</b>	<b>5.12</b>
<b>Zip</b>	<b>75068</b>
<b>Site Latitude</b>	<b>33.186676</b>
<b>Site Longitude</b>	<b>-97.010886</b>
<b>Area Size (Square feet)</b>	<b>8,000</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Impact Resistant 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture, Surface Pitting</b>
<b>Comments Regarding Inspection</b>	<b>Plastic roof vent covers were punctured. No difference noted between different directional slopes.</b>

## **Steep Slope Site 5.12 Photographs**



5.12-1. Severe damage to plastic static roof vent.



5.12-2. Splatter marks on chimney vents.



5.12-3. Damage to multiple roof turbine vents.



5.12-4. Multiple impact locations along closed-cut valley of IR roof.

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5.12-5. Puncture on IR shingle.



5.12-6. 10' x 10' area on West facing slope with impact locations marked (IR roof).



5.12-7. Dents in metal roof vent highlighted by chalk.

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**Steep Slope Site Inspection 5.13**

<b>Inspection Number</b>	<b>5.13</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.850009</b>
<b>Site Longitude</b>	<b>-96.937329</b>
<b>Area Size (Square feet)</b>	<b>3,900</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Profiled Metal</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 5.13 Photographs**



5.13-1. Dents and splatter marks in metal vent.



5.13-2. Overall view of ridge.



5.13-3. Numerous impacts in metal chimney cover.

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**Steep Slope Site Inspection 5.14**

<b>Inspection Number</b>	<b>5.14</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.850261</b>
<b>Site Longitude</b>	<b>-96.936894</b>
<b>Area Size (Square feet)</b>	<b>4,000</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Profiled Metal Panels</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>1</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	<b>Minimum damage without surface loss.</b>

## **Steep Slope Site 5.14 Photographs**



5.14-1. Overall view of hip and ridge.



5.14-2. Valley of granule covered metal roof.



5.14-3. Dents and splatter marks in metal vent.

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**Steep Slope Site Inspection 5.15**

<b>Inspection Number</b>	<b>5.15</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.850475</b>
<b>Site Longitude</b>	<b>-96.937774</b>
<b>Area Size (Square feet)</b>	<b>3,000</b>
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Profiled Metal Panels</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	<b>Car in driveway with 7 hits on hood.</b>

## **Steep Slope Site 5.15 Photographs**



5.15-1. Large dent in metal shingle.



5.15-2. Large dent in metal shingle.



5.15-3. Ridge of metal shingle roof.



5.15-4. 10' x 10' area on South facing slope with impact locations marked.

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**Steep Slope Site Inspection 5.16**

<b>Inspection Number</b>	<b>5.16</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.850214</b>
<b>Site Longitude</b>	<b>-96.936182</b>
<b>Area Size (Square feet)</b>	<b>5,500</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>ConcreteTile</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Broken and cracked tile</b>
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Overall faired well except for few broken tile</b>

## **Steep Slope Site 5.16 Photographs**



5.16-1. Right corner fracture on concrete barrel tile.



5.16-2. Large dents in metal vent.



5.16-3. Fracture from large hail impact.



5.16-4. Close up of fracture from large hail impact, with splatter mark.

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**Steep Slope Site Inspection 5.17**

<b>Inspection Number</b>	<b>5.17</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.854689</b>
<b>Site Longitude</b>	<b>-96.937121</b>
<b>Area Size (Square feet)</b>	<b>3,500</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Cedar Shake</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Puncture, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture, Puncture, Surface Pitting</b>
<b>Comments Regarding Inspection</b>	<b>Many dents. Very brittle wood. Could just view roof from ladder as to not cause further damage.</b>

## **Steep Slope Site 5.17 Photographs**



5.17-1. Homeowner saved hailstones.



5.17-2. Large puncture from hail in cedar shake.



5.17-3. Splatter mark on stained wooden fence.



5.17-4. Large impact and broken cedar shake.

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**Steep Slope Site Inspection 5.18**

<b>Inspection Number</b>	<b>5.18</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.873644</b>
<b>Site Longitude</b>	<b>-96.999979</b>
<b>Area Size (Square feet)</b>	<b>4,200</b>
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Puncture</b>
<b>Comments Regarding Inspection</b>	<b>Windows shattered in cars. Hole in top of AC beside house.</b>

## Steep Slope Site 5.18 Photographs



5.18-1. Fracture in asphalt shingle.



5.18-2. Ridge and damaged turbine vent.



5.18-3. Tear on shingle edge.



5.18-4. Spatter marks on metal vent stack.



5.18-5. Dent and spatter mark on metal vents



5.18-6. Dents in metal vent.

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5.18-7. Large dent on edge of metal vent.



5.18-8. Dent in edge of solar panel vent.



5.18-9. Broken skylight.

## **Team 06 Summary Report**

### **Overview**

Team 6 observed 15 roofs primarily, concentrated in the Irving area and neighboring cities in Dallas County and a few in the Colleyville/Keller/Fort Worth area of Tarrant County. Five of the 15 roofs were known to be impact resistant roofs (IRR). Hail sized ranged from less than .5 inch to 2.5 inches. The damage varied from no apparent damage to severe damage.

Roof types:

- 13 - asphalt laminated 2 ply shingles (3 were identified as impact resistant)
  - One of the 13 roofs had a metal turret and metal entry overhang in addition to 2 ply
- 1 - synthetic plastic (identified impact resistant)
- 1 - standard 3 tab asphalt shingle (was identified as impact resistant)

Five of the 15 roofs were less than 3 years old, with the newest roof having been installed February 2011 (per homeowner). Six of the 15 roofs were 7-9 years old.

Five of the 15 roofs had no apparent damage, based on our observation. Of these 5: 3 were IRR and 2 were undetermined.

### **Team Members**

Doug Dewey, Photographer  
John Gimple, Data Collector  
Lynne Lawry, Report Writer  
Shiraj Khan, Data Collector

**Team 06 Data Reports and Photographs  
Steep Slope**

**Steep Slope Inspection Site 6.01**

<b>Inspection Number</b>	<b>6.01</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.841885</b>
<b>Site Longitude</b>	<b>-96.966651</b>
<b>Area Size (Square feet)</b>	<b>4,000</b>
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge, Puncture, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture, Chipped/Broken Ridge, Puncture, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	<b>Heavily treed- 13 lg trees on 1/5 acre property</b>

## **Steep Slope Site 6.01 Photographs**



6.01-1. Dent profile.



6.01-2. Dent boundary and coinciding splash mark.



6.01-3. Splash marks on steel chimney cap.



6.01-4. Impact damage.

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**Steep Slope Inspection Site 6.07**

<b>Inspection Number</b>	<b>6.07</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.860733</b>
<b>Site Longitude</b>	<b>-96.96667</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>9-10:12</b>
<b>Roof Type</b>	<b>Synthetic Slate (plastic)</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-15</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Exterior of home is stucco</b>

## **Steep Slope Site 6.07 Photographs**



6.07-1. Splash mark on synthetic simulated slate.



6.07-2. Splash marks on synthetic simulated slate.



6.07-3. Dent on attic vent.



6.07-4. Splash marks on attic vent.

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**Steep Slope Inspection Site 6.08**

<b>Inspection Number</b>	<b>6.08</b>
<b>Zip</b>	<b>75234</b>
<b>Site Latitude</b>	<b>32.923779</b>
<b>Site Longitude</b>	<b>-96.87694</b>
<b>Area Size (Square feet)</b>	<b>2,500</b>
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Impact resistant 3 tab asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.75</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture /Rupture, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture /Rupture</b>
<b>Comments Regarding Inspection</b>	<b>Partially treed property. -Assessment-for class 4, we would have expected no damage.</b>

## **Steep Slope Site 6.08 Photographs**



6.08-1. Hail scuff on impact resistant shingle



6.08-2. Hail scuff on shingle

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**Steep Slope Inspection Site 6.11**

<b>Inspection Number</b>	<b>6.11</b>
<b>Zip</b>	<b>76034</b>
<b>Site Latitude</b>	<b>32.889199</b>
<b>Site Longitude</b>	<b>-97.16713</b>
<b>Area Size (Square feet)</b>	<b>3,000</b>
<b>Approximate Age (Years)</b>	<b>6-9</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 6.11 Photographs**



6.11-1. Dents in turbine vent.



6.11-2. Dents in aluminum vent cap.



6.11-3. Splash marks on steel attic vent.



6.11-4. Dent in aluminum gutter.

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6.11-5. Bruises on shingles



6.11-6. Crack in unsupported area



6.11-7. Penetrating damage with erosion



6.11-8. Hail mark

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**Steep Slope Inspection Site 6.13**

<b>Inspection Number</b>	<b>6.13</b>
<b>Zip</b>	<b>76244</b>
<b>Site Latitude</b>	<b>32.947672</b>
<b>Site Longitude</b>	<b>-97.273536</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>9-10:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1.75</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Minor loss of granule</b>
<b>Comments Regarding Inspection</b>	

## **Steep Slope Site 6.13 Photographs**



6.13-1. View of granule damage and mat fracture.



6.13-2. View splash mark on an attic vent.



6.13-3. View splash mark on an attic vent.



6.13-4. View of test square.



6.13-5. View of test square.



6.13-6. View of a dent in a downspout.

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**Steep Slope Inspection Site 6.14**

<b>Inspection Number</b>	<b>6.14</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.858062</b>
<b>Site Longitude</b>	<b>-96.974398</b>
<b>Area Size (Square feet)</b>	<b>3,000</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>&gt;12:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply asphalt</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>6-10</b>
<b>Damage Areas Identified per 100 square feet</b>	
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>NA</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>1</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Very steep roof that was viewed from ground and ladder.</b>

## **Steep Slope Site 6.14 Photographs**



6.14-1. View of broken windowpane on east side of the residence.



6.14-2. View of dents in a gutter.



6.14-3. View of chipped wood on the top rail of a wood fence.

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**Steep Slope Inspection Site 6.15**

<b>Inspection Number</b>	<b>6.15</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.85736</b>
<b>Site Longitude</b>	<b>-96.973638</b>
<b>Area Size (Square feet)</b>	<b>3000</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>&gt;12:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply Asphalt Shingle/Standing-seam Copper</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>6-10</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>4</b>
<b>Types of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Dent (Metal Roofing)</b>
<b>Comments Regarding Inspection</b>	

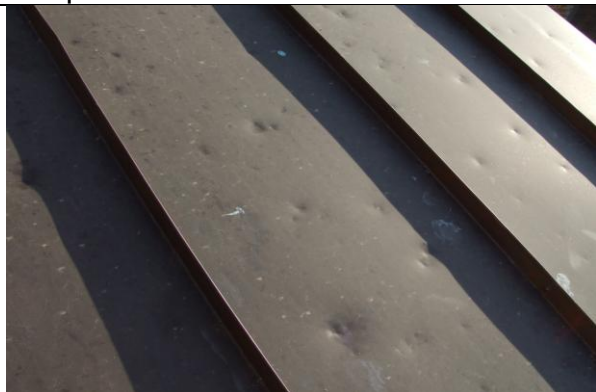
## **Steep Slope Site 6.15 Photographs**



6.15-1. Splash mark and dent on copper roof panel.



6.15-2. Dents in copper roof panels.



6.15-3. Dents in copper roof panels.



6.15-4. Shingle repairs unrelated to hail.



6.15-5. Marks on wood fencing.



6.15-6. Dents in copper roof panels.

## **Team 07 Summary Report**

### **Overview**

Team 7 observed seven roofs that were scattered all over the DFW Metroplex in North Central Texas. The areas covered were Prosper, Irving, North Richland Hills, Duncanville and Arlington. The larger hail was found in Prosper, Irving and North Richland Hills where hail sizes ranged from less than 2 inches to 3.25 inches. The damage varied from no apparent damage (Arlington) to severe damage (Prosper, Irving, & N. Richland Hills).

Roof types:

- 1 - Asphalt laminated shingles
- 3 – Wood shingle roofs
- 1 – TPO membrane roof
- 1 - Standing Seam Metal Roof
- 1 - Synthetic slate roof

Two of the seven roofs had no apparent hail damage, based on our observation.

### **Team Members**

Lynne Christensen, Report Writer  
Bert Nunez, Data Collector, Photographer  
Peter Parmenter, Photographer, Data Collector  
Tim Veigel, Data Collector

**Team 07 Data Reports and Photographs**  
**Steep Slope**  
**Steep Slope Inspection Site 7.02**

<b>Inspection Number</b>	<b>7.02</b>
<b>Zip</b>	<b>75234</b>
<b>Site Latitude</b>	<b>32.917182</b>
<b>Site Longitude</b>	<b>-96.891975</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Cedar Shingle</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>75-90</b>
<b>Is the roof scheduled for replacement?</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Minor dimpling, some cracks, discoloration</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Minor Dimpling</b>
<b>Comments Regarding Inspection</b>	<b>Facility personnel don't recall any damage from hail. New ridgecap from Christmas light damage not due to hail. Combination of asphalt and cedar roofs-multiple buildings on site</b>

**Steep Slope Site 7.02 Photographs**



7.02-1. Cedar shingles and sidewall shingles.



7.02-2. Cedar shingles with some lifting.



7.02-3. Cedar shingles.



7.02-4. New ridge from Christmas light damage.

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**Steep Slope Inspection Site 7.04**

<b>Inspection Number</b>	<b>7.04</b>
<b>Zip</b>	<b>76016</b>
<b>Site Latitude</b>	<b>32.685429</b>
<b>Site Longitude</b>	<b>-97.215367</b>
<b>Area Size (Square feet)</b>	<b>4,000</b>
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>5-6:12</b>
<b>Roof Type</b>	<b>Cedar Shingle</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>1</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>1</b>
<b>Types of Hail Damage Observed</b>	<b>Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Surface Pitting</b>
<b>Comments Regarding Inspection</b>	

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**Steep Slope Inspection Site 7.05**

<b>Inspection Number</b>	<b>7.05</b>
<b>Zip</b>	<b>76128</b>
<b>Site Latitude</b>	<b>32.874572</b>
<b>Site Longitude</b>	<b>-97.222263</b>
<b>Area Size (Square feet)</b>	<b>5,000</b>
<b>Approximate Age (Years)</b>	<b>0-3</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>7-8:12</b>
<b>Roof Type</b>	<b>Laminated 2 ply Asphalt Shingle</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>11-15</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>75-90</b>
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Chipped / Broken Ridge, Dent, Surface Pitting, Substantial Loss of Granule Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

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**Steep Slope Site 7.05 Photographs**



7.05-1. Asphalt shingle close up.



7.05-2. Hail-caused bruise on asphalt shingle.

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**Steep Slope Inspection Site 7.06**

<b>Inspection Number</b>	<b>7.06</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.857937</b>
<b>Site Longitude</b>	<b>-96.981922</b>
<b>Area Size (Square feet)</b>	<b>5,000</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>3-4:12</b>
<b>Roof Type</b>	<b>Cedar Shake</b>
<b>Impact Resistant?</b>	
<b>Total Impact Marks per square foot on a horizontal surface</b>	<b>16-20</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size –(Diameter inches)</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>31-45</b>
<b>Is the roof scheduled for replacement?</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Overall Damage Rating</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture / Rupture, Chipped / Broken Ridge, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture / Rupture</b>
<b>Comments Regarding Inspection</b>	<b>Many pieces turn over to expose back side (fresh wood &amp; color); hail fell from the east; vent stacks dented; no damage on west side except for copper colored vent stack. It appears that some spot repairs may have been performed prior to storm.</b>

## **Steep Slope Site 7.06 Photographs**



7.06-1. Broken shakes scattered as debris.



7.06-2. Damage to starter course wood shake.



7.06-3. Damaged hot vent cap.



7.06-4. buckled vent cap.

## Appendix C: Team Summary Low Slope Inspection Reports Team 1 Data Reports and Photographs

### Low Slope Inspection Site 1.17

<b>Facility Name</b>	<b>School</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>1.17</b>
<b>Zip</b>	<b>75061</b>
<b>Site Latitude</b>	<b>32.490474</b>
<b>Site Longitude</b>	<b>-97.000007</b>
<b>Area Size (Square feet)</b>	<b>77,300</b>
<b>Approximate Age (Years)</b>	<b>12-15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/8:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	<b>Modified Bitumen</b>
<b>Seam Types &amp; Spacing</b>	<b>Lapped</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Cover Board</b>	<b>Perlite</b>
<b>Cover Board Thickness</b>	<b>Unknown</b>
<b>Top Insulation Type</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	<b>Unknown</b>
<b>Bottom Insulation Type</b>	<b>NA</b>
<b>Bottom Insulation Thickness</b>	<b>NA</b>
<b>Deck Type</b>	<b>Unknown</b>
<b>Type of Drainage</b>	<b>Perimeter Gutter</b>
<b>Total Impact</b>	<b>1--5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>76-90</b>

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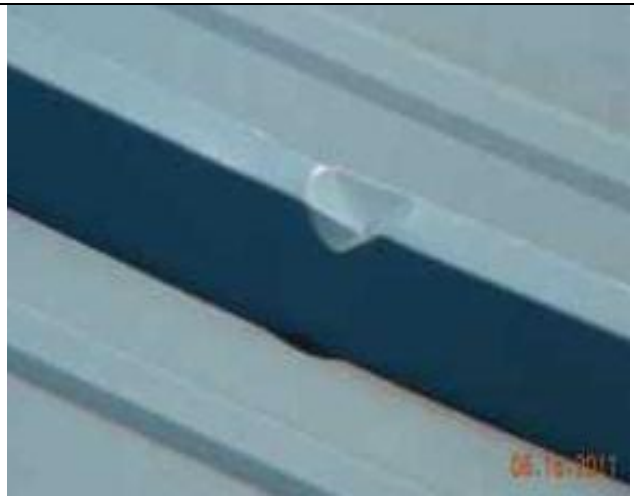
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>
<b>Is there damage to vertical flashings?</b>	<b>No</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage to skylights, EIFS, window screens / fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage following this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components of Mechanical Units</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components of Heater Flues</b>	
<b>Impacts per square foot on Metal Components of Exhaust Vents</b>	
<b>Impacts per square foot on other Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>0</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	

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**Low Slope Site 1.17 Photographs**



1.17-1. Metal damage from hail.



1.17-2. Dent from hail.



1.17-3. Overview of roof.



1.17-4. Hail marks shown.

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**Low Slope Inspection Site 1.18**

<b>Facility Name</b>	<b>School</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>1.18</b>
<b>Zip</b>	<b>75061</b>
<b>Site Latitude</b>	<b>32.4920707</b>
<b>Site Longitude</b>	<b>-96.555085</b>
<b>Area Size (Square feet)</b>	<b>83,700</b>
<b>Approximate Age (Years)</b>	<b>12-15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>1-2:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	<b>Modified Bitumen</b>
<b>Seam Types &amp; Spacing</b>	<b>Lapped</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Cover Board</b>	<b>NA</b>
<b>Cover Board Thickness</b>	<b>NA</b>
<b>Top Insulation Type</b>	<b>Perlite</b>
<b>Top Insulation Thickness</b>	<b>~3/4 inch</b>
<b>Bottom Insulation Type</b>	<b>NA</b>
<b>Bottom Insulation Thickness</b>	<b>NA</b>
<b>Deck Type</b>	<b>Lightweight Insulating Concrete over steel deck</b>
<b>Type of Drainage</b>	<b>Eave Drainage</b>
<b>Total Impact</b>	<b>1—5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size</b>	<b>2</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>76-90</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>
<b>Is there damage to vertical flashings?</b>	<b>No</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>

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<b>Is there damage to skylights, EIFS, window screens / fencing?</b>	<b>No</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage following this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components of Mechanical Units</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components of Heater Flues</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components of Exhaust Vents</b>	<b>0-5</b>
<b>Impacts per square foot on other Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture</b>
<b>Comments Regarding Inspection</b>	

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**Low Slope Site 1.18 Photographs**



1.18-1. Large hail mark.



1.18-2. Large hail mark.



1.18-3. Large hail mark.



1.18-4. Hail penetrated roof.

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**Low Slope Inspection Site 1.19**

<b>Facility Name</b>	<b>School</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>1.19</b>
<b>Zip</b>	<b>75038</b>
<b>Site Longitude</b>	<b>-96.591198</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	<b>Modified Bitumen</b>
<b>Seam Types &amp; Spacing</b>	<b>Lapped</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Cover Board</b>	<b>NA</b>
<b>Cover Board Thickness</b>	<b>NA</b>
<b>Top Insulation Type</b>	<b>Perlite</b>
<b>Top Insulation Thickness</b>	<b>~3/4 inch</b>
<b>Bottom Insulation Type</b>	<b>NA</b>
<b>Bottom Insulation Thickness</b>	<b>NA</b>
<b>Deck Type</b>	<b>Believed Lightweight Insulating Concrete over steel deck</b>
<b>Type of Drainage</b>	<b>Internal Gutter</b>
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>11-15</b>
<b>Apparent Maximum Hail Size</b>	<b>5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>

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<b>Is there damage to vertical flashings?</b>	<b>No</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage to skylights, EIFS, window screens / fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Yes</b>
<b>Is there known roof leakage following this hailstorm?</b>	<b>Yes</b>
<b>Impacts per square foot on Metal Components of Mechanical Units</b>	<b>6-10</b>
<b>Impacts per square foot on Metal Components of Heater Flues</b>	
<b>Impacts per square foot on Metal Components of Exhaust Vents</b>	
<b>Impacts per square foot on other Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Dent (Metal Roofing)</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture</b>
<b>Comments Regarding Inspection</b>	<b>A roofer temporarily repaired the majority of large punctures.</b>

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**Low Slope Site 1.19 Photographs**



1.19-1. Close-up of impact ~ 3-inches.



1.19-2. Close-up of impact ~ 4 to 5-inches.



1.19-3. Close-up of impact ~ 4 to 5-inches.



1.19-4. Close-up of impact on coping edge ~ 3-inches.



1.19-5. Close-up of impact on coping edge ~ 3-inches.



1.19-6. Overview of impact area

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**Low Slope Inspection Site 1.20**

<b>Facility Name</b>	<b>School</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>1.20</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.511748</b>
<b>Site Longitude</b>	<b>-96.59371</b>
<b>Area Size (Square feet)</b>	<b>15,400</b>
<b>Approximate Age (Years)</b>	<b>&gt;10 yrs.</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	<b>1/2:12</b>
<b>Roof Type</b>	<b>Coated Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Unknown</b>
<b>Membrane Type</b>	<b>Coating over Modified Bitumen</b>
<b>Seam Types &amp; Spacing</b>	<b>Adhered</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Cover Board</b>	<b>Unknown</b>
<b>Cover Board Thickness</b>	<b>Unknown</b>
<b>Top Insulation Type</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	<b>Unknown</b>
<b>Bottom Insulation Type</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	<b>Unknown</b>
<b>Deck Type</b>	<b>Steel</b>
<b>Type of Drainage</b>	
<b>Total Impact</b>	<b>&gt;20</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;25</b>
<b>Apparent Maximum Hail Size</b>	<b>3"</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Overall Damage</b>	<b>5</b>

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**Low Slope Site 1.20 Photographs**



01.20-1. Overview of impact repairs on coated membrane with damage.



01.20-2. Overview of impact repairs on coated membrane with damage.



01.20-3. Close view of impact damage ~ 1.5-inch.



01.20-4. Close view of impact damage ~ 3 to 3.5-inch.

**RICOWI Hailstorm Investigation**  
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01.20-5. Close view of impact damage.



01-20.6. Hail bruising marks on roof top unit.

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**Low Slope Inspection Site 1.26**

<b>Facility Name</b>	<b>Store</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>1.26</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.511748</b>
<b>Site Longitude</b>	<b>-96.59371</b>
<b>Area Size (Square feet)</b>	<b>56,000</b>
<b>Approximate Age (Years)</b>	<b>3-6 yrs.</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Single Ply</b>
<b>Method of Attachment</b>	<b>Mechanically Fastened</b>
<b>Membrane Type</b>	<b>TPO</b>
<b>Seam Types &amp; Spacing</b>	<b>Welded</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Cover Board</b>	<b>High Density Gypsum</b>
<b>Cover Board Thickness</b>	<b>.25 in</b>
<b>Top Insulation Type</b>	<b>NA</b>
<b>Top Insulation Thickness</b>	<b>NA</b>
<b>Bottom Insulation Type</b>	<b>Polyisocyanurate</b>
<b>Bottom Insulation Thickness</b>	<b>1.5 in</b>
<b>Deck Type</b>	<b>Steel</b>
<b>Type of Drainage</b>	
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	
<b>Apparent Maximum Hail Size</b>	<b>2"</b>

**RICOWI Hailstorm Investigation  
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**Low Slope Site 1.26 Photographs**



01.26-1. Close view of impact marks on TPO membrane with no damage.



01.26-2. Close view of impact damage in coping ~ 1-inch.



01.26-3. Close view of impact damage in vent cover ~ 1.5-inch.



01-26.4. Hail-caused dents to RTU fins.

**Team 03 Data Reports and Photographs  
Low Slope  
Low Slope Inspection Site 3.08**




<b>Facility Name</b>	<b>Fire Station</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>3.08</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.865583</b>
<b>Site Longitude</b>	<b>-96.989518</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>12-15</b>
<b>General Condition</b>	<b>Fair</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Torched</b>
<b>Membrane Type</b>	
<b>Seams</b>	<b>Adhered</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Eave Drainage</b>
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	
<b>Apparent Maximum Hail Size</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>16-30</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

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<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Surface Pitting (BUR-Modified Bitumen), Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Surface Pitting, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

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**Low Slope Site 3.08 Photographs**

 A photograph showing a yellow measuring tape with a red handle placed horizontally on a light-colored, textured surface. The tape is marked from 1 to 6 inches. The surface appears to be an exhaust vent with some faint white markings.	 A photograph showing a yellow measuring tape placed horizontally on a dark, textured surface. The tape is marked from 1 to 11 inches. The surface is covered with numerous small, dark, clustered impacts, likely from hail.
3.08-1. Impact spatter on exhaust vent.	3.08-2. Clustered Impacts to modified bitumen roof cover.
 A close-up photograph showing a yellow measuring tape placed horizontally on a dark, textured surface. The tape is marked from 1 to 5 inches. The surface is covered with numerous small, dark, clustered impacts, likely from hail.	
3.08-3. Typical impact to modified bit.	

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## Low Slope Inspection Site 3.08B

<b>Facility Name</b>	<b>Fire Station</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>03.08B</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.859333</b>
<b>Site Longitude</b>	<b>-96.987167</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Unknown</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	<b>Yes</b>
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

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<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

**RICOWI Hailstorm Investigation  
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**Low Slope Site 3.08b Photographs**



3.08B-1. Hail impact divots in BUR roof.

**RICOWI Hailstorm Investigation  
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**Low Slope Inspection Site 3.09**

<b>Facility Name</b>	<b>City-owned building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>3.09</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.862067</b>
<b>Site Longitude</b>	<b>-97.01915</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>&lt;3</b>
<b>General Condition</b>	<b>Excellent</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Torched</b>
<b>Membrane Type</b>	
<b>Seams</b>	<b>Adhered</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Scuppers</b>
<b>Total Impact</b>	
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size</b>	<b>4</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>76-90</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

**RICOWI Hailstorm Investigation  
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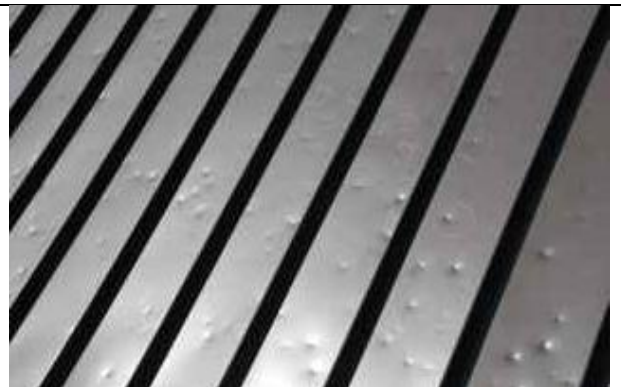
<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>No</b>
<b>Is the roof scheduled for replacement</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

**RICOWI Hailstorm Investigation  
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**Low Slope Site 3.09 Photographs**



3.09-1. Hail impact dents in metal flashing on top of parapet wall.



3.09-2. Dents in standing seam metal roof from hail impact.



3.09-3. Large dent in exhaust fan from hail impact.



3.09-4. Typical hail impact damage to roof.

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**Low Slope Inspection Site 3.10**

<b>Facility Name</b>	<b>Fire Station</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>3.10</b>
<b>Zip</b>	<b>75063</b>
<b>Site Latitude</b>	<b>32.917367</b>
<b>Site Longitude</b>	<b>-97.002967</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Unknown</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	<b>No</b>
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Eave Drainage</b>
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>1.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>76-90</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

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<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	<b>No visible damage to BUR w/ gravel. Unknown if damage below. Overall damage assessment of 2 base in visible assessment.</b>

**RICOWI Hailstorm Investigation  
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**Low Slope Site 3.10 Photographs**



3.10-1. Typical hail impact damage to exhaust vent.



3.10-2. Sample of broken skylight due to hail impact.



3.10-3. Damaged skylight and no visible damage to BUR.



3.10-4. Typical hail impact damage to parapet cap flashing.

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**Low Slope Inspection Site 3.12**

<b>Facility Name</b>	<b>Community Building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>3.12</b>
<b>Zip</b>	<b>75062</b>
<b>Site Latitude</b>	<b>32.85015</b>
<b>Site Longitude</b>	<b>-96.9603</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/8:12</b>
<b>Roof Type</b>	<b>Single Ply</b>
<b>Method of Attachment</b>	<b>Fully Adhered</b>
<b>Membrane Type</b>	
<b>Seams</b>	<b>Adhered</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Roof Drains</b>
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>Yes</b>
<b>Is there damage to vertical flashings?</b>	<b>Yes</b>

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<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Unknown</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Unknown</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>3</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture</b>
<b>Comments Regarding Inspection</b>	

## **Low Slope Site 3.12 Photographs**



3.12-1. Large hail dent in vent stack.



3.12-2. Large number of big hail strikes to single ply roof covering at this location.



3.12-3. Typical large hail strike to single ply roof covering. Would need core sampling to determine underlying damage at this site.

**Team 04 Data Reports and Photographs**  
**Low Slope**

**Low Slope Inspection Site 4.02**

<b>Facility Name</b>	<b>Shopping Center</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.02</b>
<b>Zip</b>	<b>75063</b>
<b>Site Latitude</b>	<b>32.905667</b>
<b>Site Longitude</b>	<b>-96.956333</b>
<b>Area Size (Square feet)</b>	
<b>Approximate Age (Years)</b>	<b>9-12</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Mechanically Fastened</b>
<b>Membrane Type</b>	
<b>Seam Types &amp; Spacing</b>	
<b>Stone Ballasted</b>	
<b>Cover Board</b>	<b>Unknown</b>
<b>Cover Board Thickness</b>	
<b>Top Insulation Type</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation Type</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	<b>Steel</b>
<b>Type of Drainage</b>	<b>Perimeter Gutter</b>
<b>Total Impact</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

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<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage to skylights, EIFS, window screens/fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>No</b>
<b>Is there known roof leakage following this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components of Mechanical Units</b>	<b>6-10</b>
<b>Impacts per square foot on Metal Components of Heater Flues</b>	
<b>Impacts per square foot on Metal Components of Exhaust Vents</b>	<b>0-5</b>
<b>Impacts per square foot on other Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>1</b>
<b>Types of Hail Damage Observed</b>	<b>Minor granule loss</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Granule Loss</b>
<b>Comments Regarding Inspection</b>	<b>No observable damage on aggregate (pea gravel) surfaced roof. Building had EIFS parapets which were punctured. Dents and impact marks on all of the exposed metal and heat exchanger coils. Only minor loss of granules on base flashings.</b>

## **Low Slope Site 4.02 Photographs**



4.02-1. The dark spots on top of this sheet metal cap are spatter marks from hail strikes. The larger ones appear to be from hailstones of 1"–1.25" diameter.



4.02-2. At the SW and NW corners of this roof are square enclosures lined with walls, and the walls are topped with exterior insulation and finish system (EIFS).



4.02-3. This is a close-up of two holes in the EIFS consistent with hail strikes.



4.02-4. This indentation in an exhaust cover is approximately the size of an egg.

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4.02-5. Several indentations (encircled in white) were noted on this exhaust cover.



4.02-6. Close examination of this base flashing showed bare spots where mineral granules were knocked loose.



4.02-7. Cooling fins on both of these HVAC units show widespread damage from hail strikes.

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**Low Slope Inspection Site 4.03**

<b>Facility Name</b>	<b>Office Building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.03</b>
<b>Zip</b>	<b>75063</b>
<b>Site Latitude</b>	<b>32.9075</b>
<b>Site Longitude</b>	<b>-97.003</b>
<b>Area Size (Square feet)</b>	<b>28,440 sq ft</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	
<b>Coverboard</b>	<b>Unknown</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	<b>Steel</b>
<b>Type of Drainage</b>	<b>Internal Roof Drains</b>
<b>Total Impact</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>

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<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>No</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Spalling of Surface Coating</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Fracture/Rupture, Puncture, Spalling of Surface Coating</b>
<b>Comments Regarding Inspection</b>	

## **Low Slope Site 4.03 Photographs**



4.03-1. White tape was used as a temporary fix for several skylights that were broken by hail strikes.



4.03-2. The old, weathered felts on this wall were especially vulnerable to damage from hail strikes



4.03-3. Sheet metal exhaust units provide conspicuous evidence of hail strikes.



4.03-4. This is a close-up view of racked felts on a parapet with evidence of hail strikes.

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4.03-5. Encircled on the wall/base flashings of this parapet are numerous hail strike locations.



4.03-6. This is a close-up of some hail strikes on wall/base flashings on a parapet.



4.03-7. These are actual hailstones preserved following the hailstorm.

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## Low Slope Investigation Site 4.06

<b>Facility Name</b>	<b>Office Building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.06</b>
<b>Zip</b>	<b>75038</b>
<b>Site Latitude</b>	<b>32.870119</b>
<b>Site Longitude</b>	<b>-96.985807</b>
<b>Area Size (Square feet)</b>	<b>6,000 sq ft</b>
<b>Approximate Age (Years)</b>	<b>6-12</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/2:12</b>
<b>Roof Type</b>	<b>Modified Bitumen</b>
<b>Method of Attachment</b>	<b>Unknown</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	
<b>Coverboard</b>	<b>Perlite</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Unknown</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>Unknown</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Scuppers</b>
<b>Total Impact</b>	<b>20-50</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>&gt;20</b>
<b>Apparent Maximum Hail Size</b>	<b>2.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>76-90</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>

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<b>Is there damage to vertical flashings?</b>	<b>No</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Yes</b>
<b>Is the roof scheduled for replacement</b>	<b>Yes</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>6-10</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Fracture/Rupture, Spalling of Surface Coating, Substantial Loss of Surfacing</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Spalling of Surface Coating, Substantial loss of Surfacing</b>
<b>Comments Regarding Inspection</b>	<b>Widespread damage throught the entire roof. Splatter marks on metal coping.</b>

## **Low Slope Site 4.06 Photographs**



4.06-1. Puncture marks on the EIFS wall.



4.06-2. Close-up picture of the punctured EIFS wall surface.



4.06-3. Spatter marks on the top surface of the AC unit.



4.06-4. Indentation on the heat exchanger fins on roof mounted AC unit.

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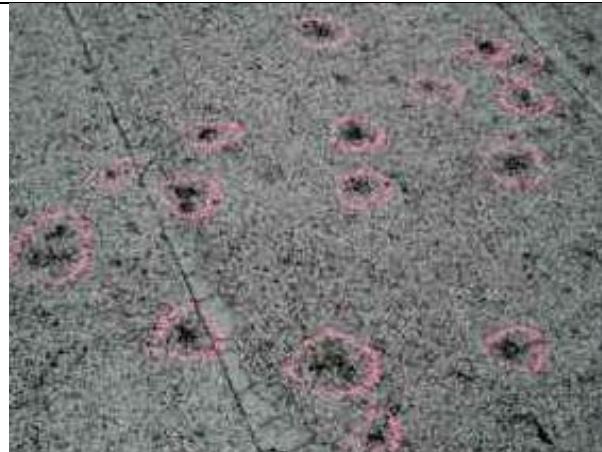
4.06-5. Punctured/Fractured base flashing on the roof.



4.06-6. Displaced granules on the surface of the mod. bit roof.



4.06-7. Several spatter marks on the top surface of the AC unit.



4.06-8. Hail impact marks on the surface of the mod. Bit. Roof.



4.06-9. Puncture marks on the EIFS surface.

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## Low Slope Investigation Site 4.08

<b>Facility Name</b>	<b>Commercial Building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.08</b>
<b>Zip</b>	<b>72580</b>
<b>Site Longitude</b>	<b>-96.974185</b>
<b>Area Size (Square feet)</b>	<b>33,971 sq ft</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/2:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Mechanically Fastened</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	
<b>Coverboard</b>	<b>None</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Polyisocyanurate</b>
<b>Top Insulation Thickness</b>	<b>1.5 in</b>
<b>Bottom Insulation</b>	<b>Polyisocyanurate</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Scuppers</b>
<b>Total Impact</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>1-5</b>
<b>Apparent Maximum Hail Size</b>	<b>2.25</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>61-75</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

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<b>Is there damage to vertical flashings?</b>	
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>Unknown</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>6-10</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	
<b>Impacts per square foot on Metal Components (Vehicles)</b>	
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	<b>Loss of aluminum colored coating from smooth BUR</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Loss of aluminum colored coating from smooth BUR</b>
<b>Comments Regarding Inspection</b>	<b>Hail damage primarily includes stripping of aluminum colored coating.</b>

## **Low Slope Site 4.08 Photographs**



4.08-1. Spatter marks on the metal coping.



4.08-2. Spatter marks on the AC Unit.

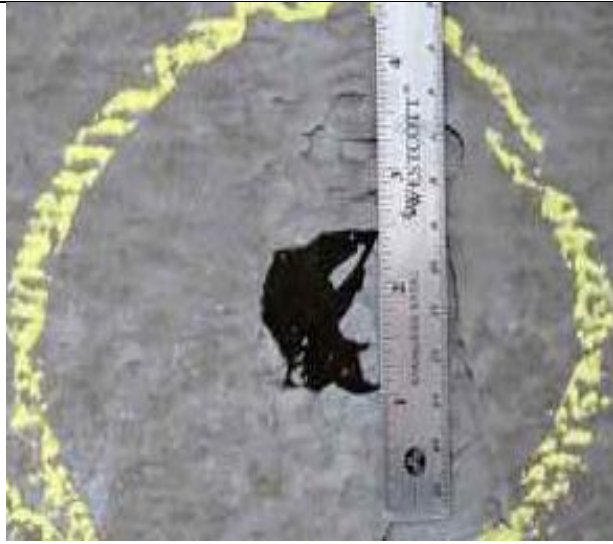


4.08-3. Spatter mark on the wall flashing.



4.08-4. Spatter marks on the side panel of AC unit.

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4.08-5. Chipped aluminum colored coating over smooth BUR.



4.08-6. Indentations on the heat exchanger fins on roof mounted AC unit.

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**Low Slope Investigation Site 4.09**

<b>Facility Name</b>	<b>Church</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.09</b>
<b>Zip</b>	<b>75165</b>
<b>Site Latitude</b>	<b>32.386333</b>
<b>Site Longitude</b>	<b>-96.841667</b>
<b>Area Size (Square feet)</b>	<b>9,750 sq ft</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	<b>Yes</b>
<b>Coverboard</b>	<b>Perlite</b>
<b>Coverboard Thickness</b>	<b>1.5 in</b>
<b>Top Insulation</b>	<b>None</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>None</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	<b>Steel</b>
<b>Type of Drainage</b>	<b>Internal Roof Drains</b>
<b>Total Impact</b>	<b>0</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>3.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>
<b>Is there damage to vertical flashings?</b>	<b>Yes</b>

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<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>No</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	<b>NA</b>
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	
<b>Comments Regarding Inspection</b>	<b>Damage included dents in roof mounted AC unit, heat exchanger fins, and exhaust vents. Chips were noted in aluminum paint on the modified bitumen edge and base flashing. Since gravel is well embedded in asphalt, the roof showed no evidence of splash marks (“craters”) from hail impact or other damage, based on visual inspection and a test cut. Damage was observed on soft metals and modified bitumen base and edge flashing.</b>

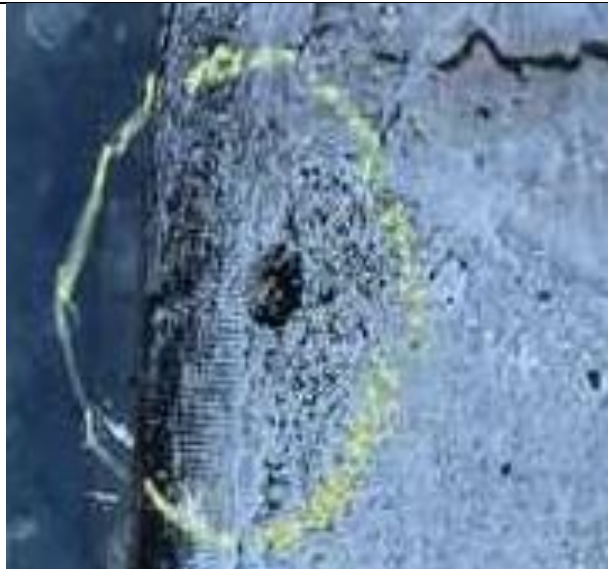
## **Low Slope Site 4.09 Photographs**



4.09-1. This exhaust unit was hit by numerous hailstones of moderate to large size.



4.09-2. Chipped aluminized coating on the base/wall flashing.



4.09-3. Chipped aluminized coating on the base/wall flashing.



4.09-4. Multiple indentations on the heat exchanger fins on roof mounted AC unit.

**RICOWI Hailstorm Investigation**  
**Dallas-Fort Worth, TX – May 24, 2011**



4.09-5. Multiple indentations on the heat exchanger fins on roof mounted AC unit.



4.09-6. Large size indentation on the metal exhaust unit.

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

## Low Slope Investigation Site 4.10

<b>Facility Name</b>	<b>Church</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>4.10</b>
<b>Zip</b>	<b>75165</b>
<b>Site Latitude</b>	<b>32.388484</b>
<b>Site Longitude</b>	<b>-96.847775</b>
<b>Area Size (Square feet)</b>	<b>2,740 sq ft</b>
<b>Approximate Age (Years)</b>	<b>&gt;15</b>
<b>General Condition</b>	<b>Good</b>
<b>Slope</b>	<b>1/4:12</b>
<b>Roof Type</b>	<b>Built up Roof (BUR)</b>
<b>Method of Attachment</b>	<b>Hot Mopped</b>
<b>Membrane Type</b>	
<b>Seams</b>	
<b>Stone Ballasted</b>	<b>Yes</b>
<b>Coverboard</b>	<b>None</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>None</b>
<b>Top Insulation Thickness</b>	
<b>Bottom Insulation</b>	<b>None</b>
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	<b>Structural Concrete</b>
<b>Type of Drainage</b>	<b>Scuppers</b>
<b>Total Impact</b>	<b>1-5</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>0</b>
<b>Apparent Maximum Hail Size</b>	<b>3.5</b>
<b>Apparent Angle of Impact (Degrees)</b>	<b>46-60</b>
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>NA</b>

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

<b>Is there damage to vertical flashings?</b>	<b>Yes</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>No</b>
<b>Is the roof scheduled for replacement</b>	<b>Unknown</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>No.</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>NA</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	<b>NA</b>
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>0-5</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	<b>NA</b>
<b>Overall Damage</b>	<b>2</b>
<b>Types of Hail Damage Observed</b>	
<b>Predominate Type of Hail Damage Observed</b>	<b>Denting of roof mounted exhaust vents and base flashing</b>
<b>Comments Regarding Inspection</b>	<b>Surface gravel showed large splash marks measuring approximately 4 inches in diameter. A test cut showed no damage to roof assembly or deck.</b>

## **Low Slope Site 4.10 Photographs**

	
4.10-1. Large size indentation on the metal exhaust unit.	4.10-2. Indentation on the heat exchanger fins on roof mounted AC unit.
	
4.10-3. Close-up splash mark in the loose gravel of this BUR caused by large hail.	4.10-4. Multiple splash marks visible in the loose gravel of this BUR were caused by large hail.

**RICOWI Hailstorm Investigation**  
**Dallas-Fort Worth, TX – May 24, 2011**



4.10-5. Indentation on the metal door apparently caused by a large hailstone.



4.10-6. Chipped aluminized coating on the base flashing.

**Team 07 Data Reports and Photographs  
Low Slope**

**Low Slope Inspection Site 7.03**

<b>Facility Name</b>	<b>Commercial building</b>
<b>Building Name</b>	
<b>Inspection Number</b>	<b>7.03</b>
<b>Zip</b>	<b>75115</b>
<b>Site Latitude</b>	<b>32.622389</b>
<b>Site Longitude</b>	<b>-96.851882</b>
<b>Area Size (Square feet)</b>	<b>10,400 sq ft</b>
<b>Approximate Age (Years)</b>	<b>3-6</b>
<b>General Condition</b>	<b>Poor</b>
<b>Slope</b>	
<b>Roof Type</b>	<b>Single Ply</b>
<b>Method of Attachment</b>	<b>Fully Adhered</b>
<b>Membrane Type</b>	<b>TPO – Thermoplastic – Modified Bitumen</b>
<b>Seams</b>	<b>Welded</b>
<b>Stone Ballasted</b>	<b>No</b>
<b>Coverboard</b>	<b>None</b>
<b>Coverboard Thickness</b>	
<b>Top Insulation</b>	<b>Polyisocyanurate</b>
<b>Top Insulation Thickness</b>	<b>3.5 in</b>
<b>Bottom Insulation</b>	
<b>Bottom Insulation Thickness</b>	
<b>Deck Type</b>	
<b>Type of Drainage</b>	<b>Perimeter Gutter</b>
<b>Total Impact</b>	<b>6-10</b>
<b>Damage Areas Identified per 100 square feet</b>	<b>6-10</b>
<b>Apparent Maximum Hail Size</b>	<b>1.75</b>
<b>Apparent Angle of Impact (Degrees)</b>	
<b>Are there direct hits on mechanical fasteners or other cutting edges on roof membranes?</b>	<b>No</b>

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

<b>Is there damage to vertical flashings?</b>	<b>No</b>
<b>Have multiple hail events occurred at this location since this roof was installed?</b>	<b>Yes</b>
<b>Is there damage or hail hits to skylights, EIFS, window screens/ fencing?</b>	<b>No</b>
<b>Is the roof scheduled for replacement</b>	<b>Yes - replaced</b>
<b>Is there known roof leakage from this hailstorm?</b>	<b>Yes</b>
<b>Impacts per square foot on Metal Components (Mechanical Units)</b>	<b>15-20</b>
<b>Impacts per square foot on Metal Components (Heater Flues)</b>	<b>NA</b>
<b>Impacts per square foot on Metal Components (Exhaust Vents)</b>	<b>NA</b>
<b>Impacts per square foot on Metal Components (Vehicles)</b>	<b>NA</b>
<b>Overall Damage</b>	<b>5</b>
<b>Types of Hail Damage Observed</b>	<b>Puncture, Surface Pitting</b>
<b>Predominate Type of Hail Damage Observed</b>	<b>Puncture</b>
<b>Comments Regarding Inspection</b>	<b>Roofing had three different membranes installed at different times. The thermoplastic section was over 10 years old and was most seriously damaged.</b>

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

**Low Slope Site 7.03 Photographs**



7.03-1. Damaged rooftop unit impacted by hail sideways.



7.03-2. Pockmarks on parapet.



7.03-3. Repaired punctures on flat roof.



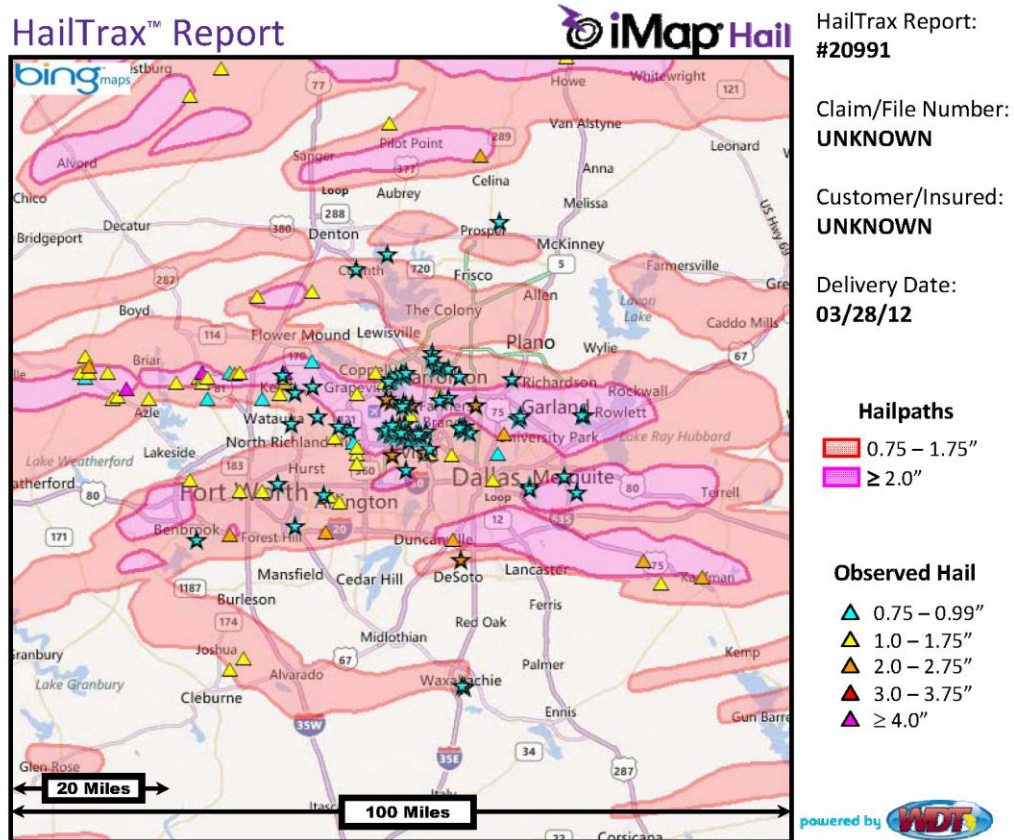
7.03-4. TPO and PVC on same roof.



7.03-5. Two types of flat roof sections.

**RICOWI Hailstorm Investigation**  
**Dallas-Fort Worth, TX – May 24, 2011**

**APPENDIX D: HailTrax Map**



**Report Summary**

This event is characterized by hailswaths of both large (0.75" to 1.75" diameter) and very large (≥ 2.00" diameter) hail within the 100 mile view shown above. Careful and expert analysis of the radar data indicates that several strong storms occurred during the time period of interest. Associated with some of these storms, analyzed paths of large hail with embedded paths of very large hail extend across the Dallas/Fort Worth metropolitan area. 68 of the addresses of interest are within analyzed paths of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, 38 of the addresses of interest are within analyzed paths of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter, and three of the addresses of interest are not within analyzed paths of large or very large hail.

**Address/Location of Interest**

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

**Search Period**

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

**Customer Information**

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

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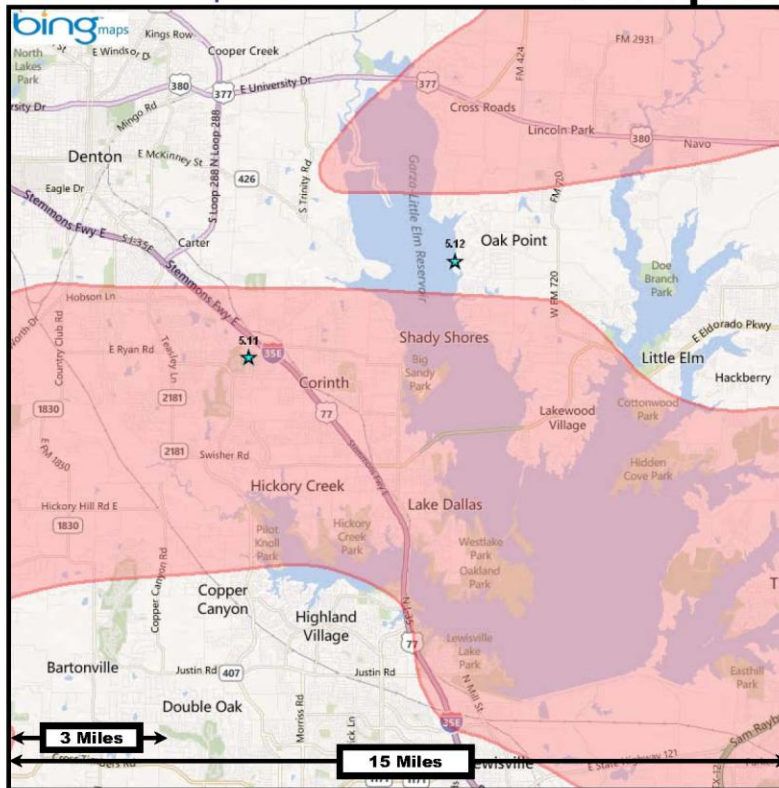
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# RICOWI Hailstorm Investigation

## Dallas-Fort Worth, TX – May 24, 2011

### HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

#### Hailpaths

0.75 – 1.75"  
≥ 2.0"

#### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

### Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Lake Dallas, TX. One address of interest is within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter, and one address of interest is not within an analyzed path of large or very large hail.

### Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

### Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

### Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

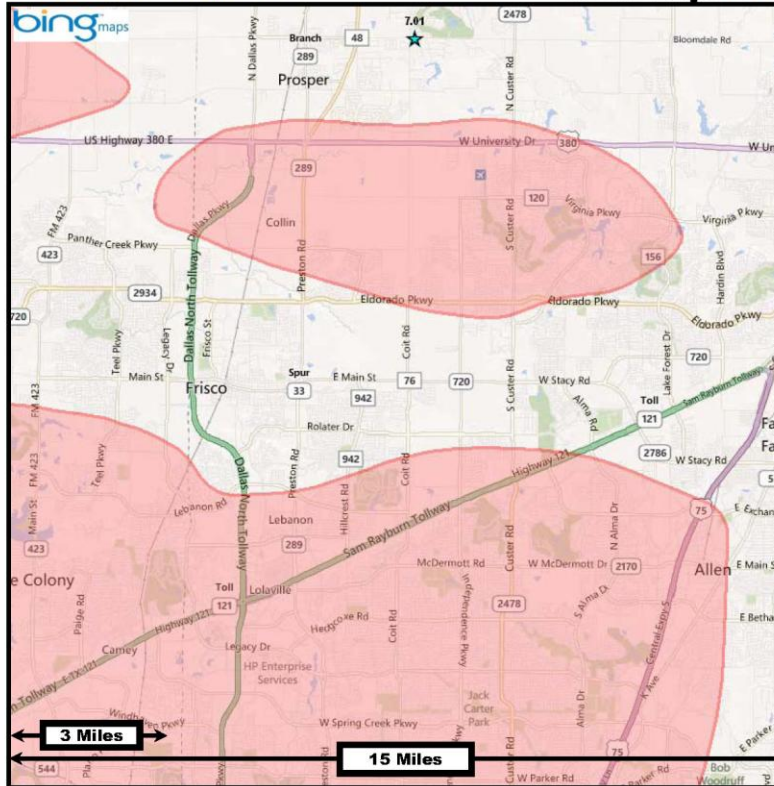
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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"



## Report Summary

The above image represents a close-up view centered on the address of interest in and around Frisco, TX. One address of interest is not within an analyzed path of large or very large hail.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

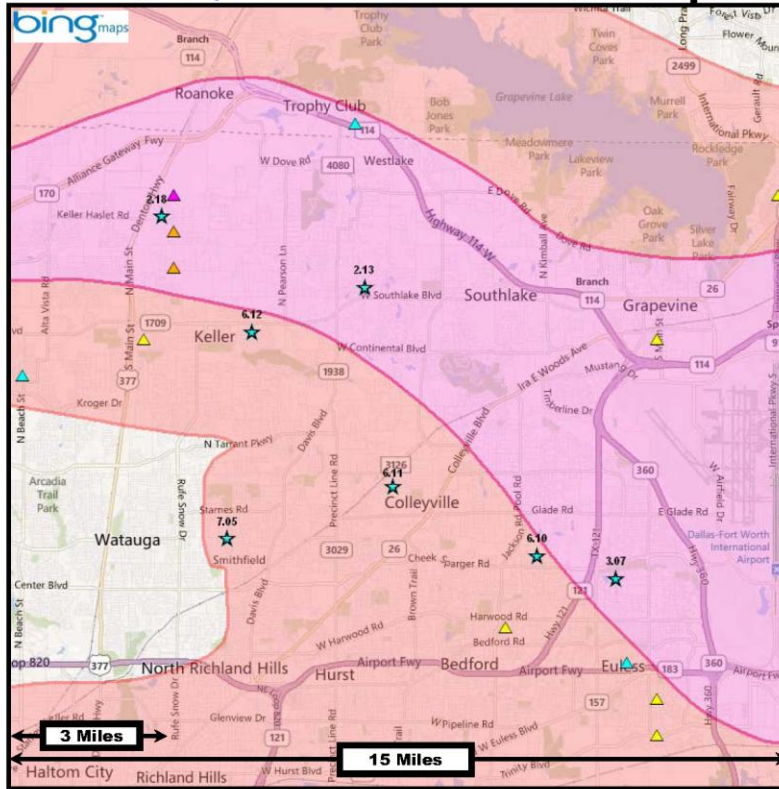
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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Colleyville, TX. Three addresses of interest are within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, and four addresses of interest are within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

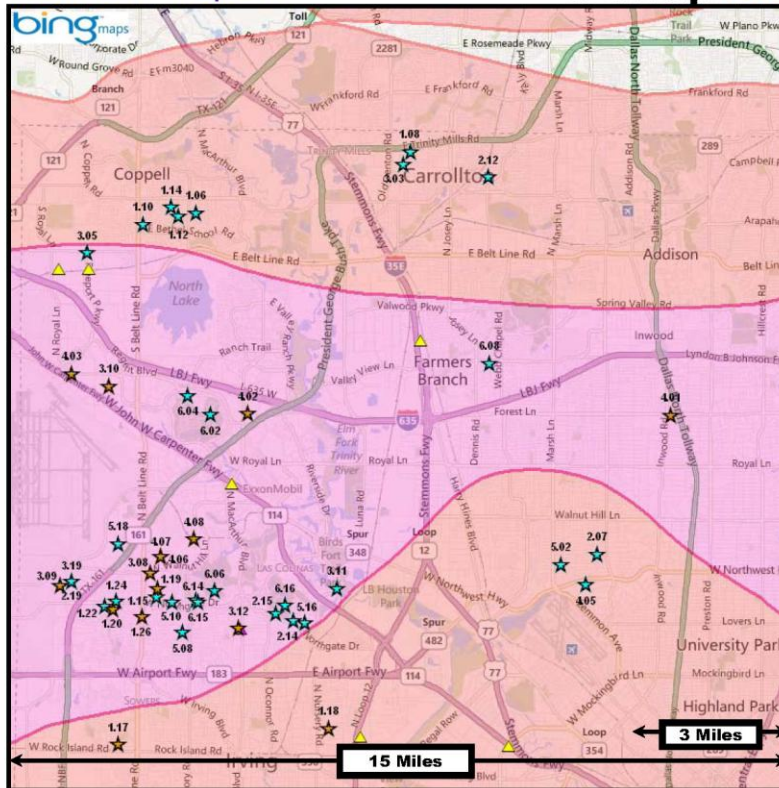
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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Farmers Branch, TX. 33 addresses of interest are within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, and 13 addresses of interest are within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter. There were 80 inspections conducted in this 15 mile area. Due to the high density of inspections, 46 are shown on this page and 34 are shown on Page 6 of this report.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report

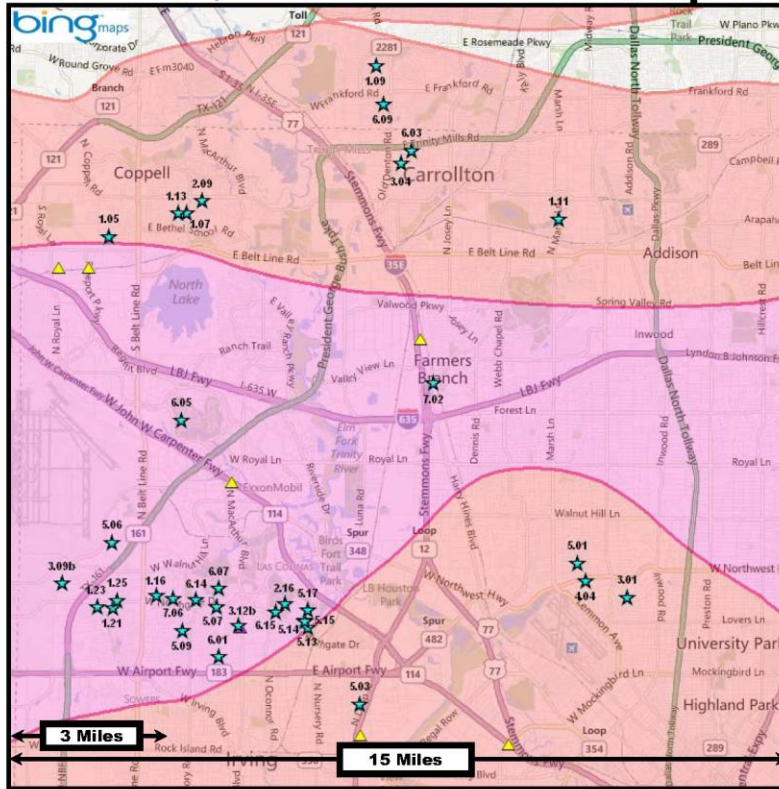


HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**



## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Farmers Branch, TX. 21 addresses of interest are within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, and 13 addresses of interest are within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter. There were 80 inspections conducted in this 15 mile area. Due to the high density of inspections, 34 are shown on this page and 46 are shown on Page 5 of this report.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

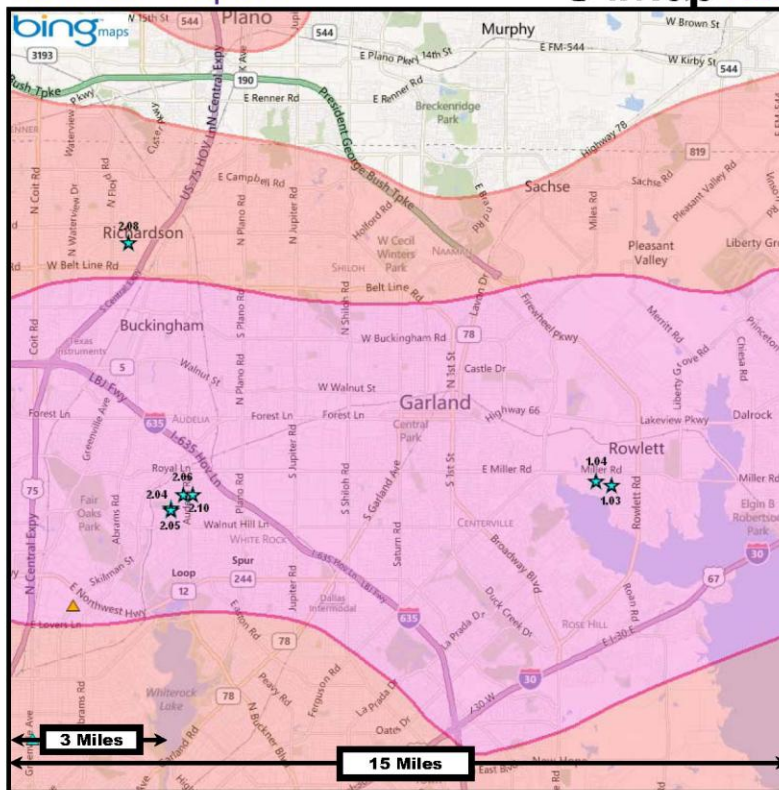
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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

- 0.75 – 1.75"
- ≥ 2.0"

### Observed Hail

- 0.75 – 0.99"
- 1.0 – 1.75"
- 2.0 – 2.75"
- 3.0 – 3.75"
- ≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Garland, TX. Six addresses of interest are within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, and one address of interest is within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

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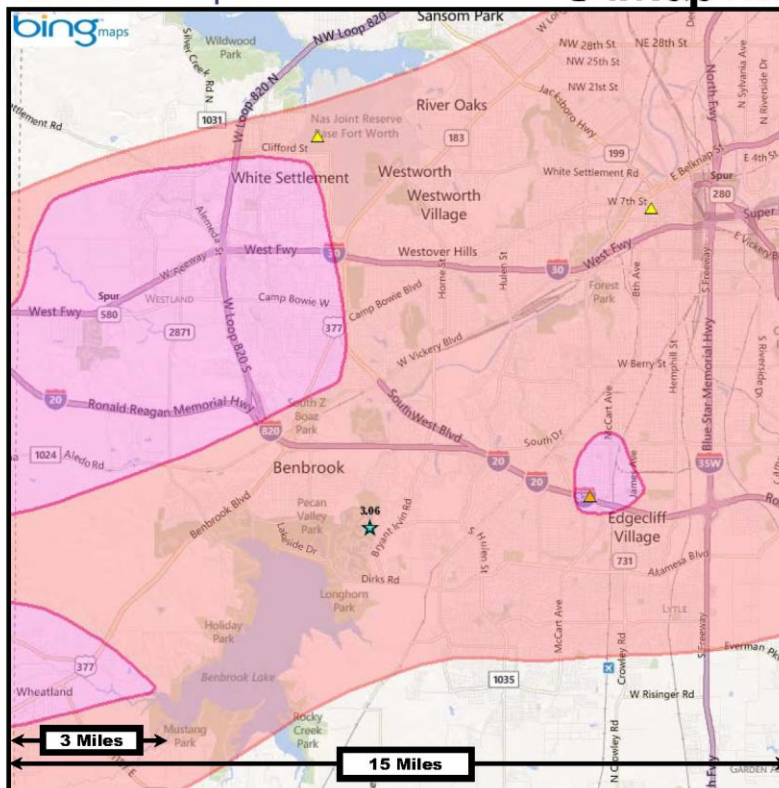
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# RICOWI Hailstorm Investigation

## Dallas-Fort Worth, TX – May 24, 2011

### HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

#### Hailpaths

0.75 – 1.75"  
≥ 2.0"

#### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

### Report Summary

The above image represents a close-up view centered on the address of interest in Fort Worth, TX. One address of interest is within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter.

### Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

### Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

### Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

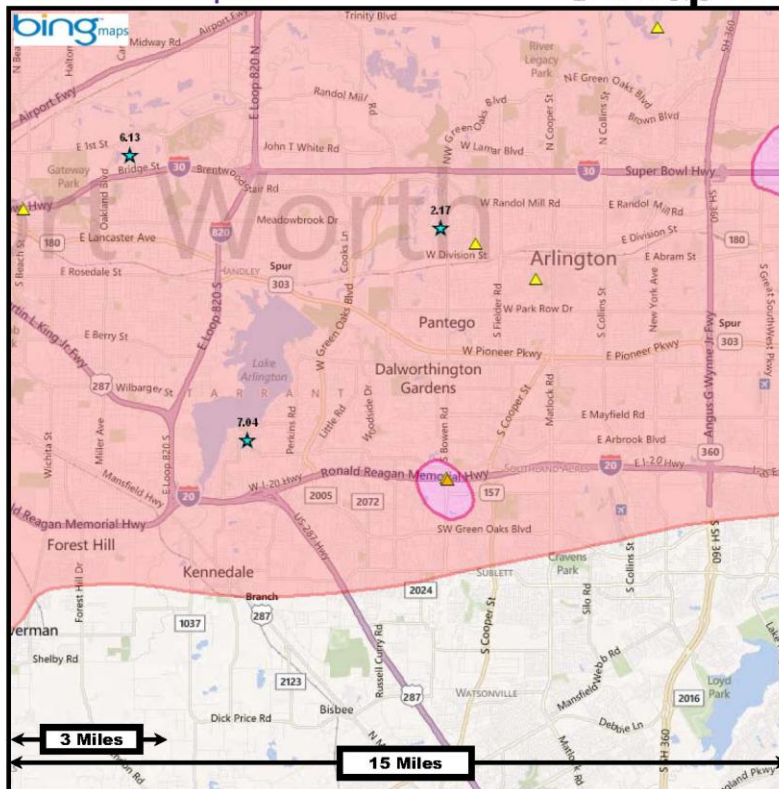
Product Notice: This report is intended for the sole use of the customer(s) named herein. Each customer agrees not to copy, distribute, disseminate, transfer, assign, license, or in any way or form make the hail information available to any third party for any use whatsoever, without expressed written consent of Weather Decision Technologies, Inc. (WDT). The information contained herein is derived from multiple weather data sources including NEXRAD radar data and NWS storm reports using WDT's exclusive hailstorm monitoring system and, unless otherwise noted, is intended only for the verification of hail at the location indicated in the address/location of interest section. This information represents the best estimate of where hail may have fallen based upon these data sources as of the date this report was created and the expertise of WDT. Weather experts at WDT have carefully examined the information presented herein to ensure the most accurate depiction of hail fall, however it is possible that hail may have occurred during the time specified in an area not covered by a hailpath. WDT's proprietary methods are designed to report the area where the largest hailstones are most likely to have fallen.

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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Arlington, TX. Three addresses of interest are within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter.

### Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

### Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

### Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

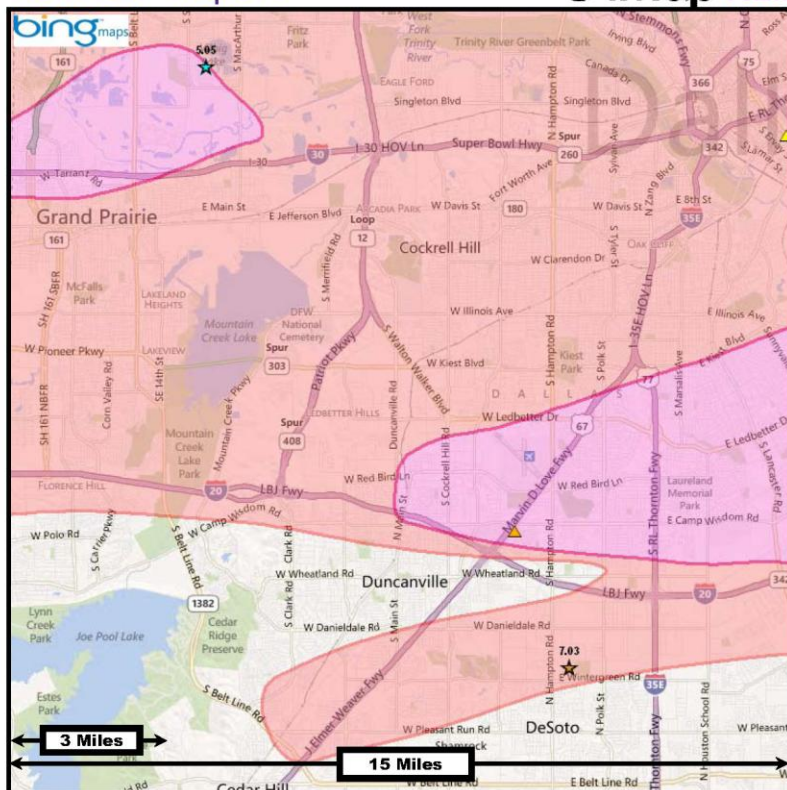
Product Notice: This report is intended for the sole use of the customer(s) named herein. Each customer agrees not to copy, distribute, disseminate, transfer, assign, license, or in any way or form make the hail information available to any third party for any use whatsoever, without expressed written consent of Weather Decision Technologies, Inc. (WDT). The information contained herein is derived from multiple weather data sources including NEXRAD radar data and NWS storm reports using WDT's exclusive hailstorm monitoring system and, unless otherwise noted, is intended only for the verification of hail at the location indicated in the address/location of interest section. This information represents the best estimate of where hail may have fallen based upon these data sources as of the date this report was created and the expertise of WDT. Weather experts at WDT have carefully examined the information presented herein to ensure the most accurate depiction of hail fall, however it is possible that hail may have occurred during the time specified in an area not covered by a hailpath. WDT's proprietary methods are designed to report the area where the largest hailstones are most likely to have fallen.

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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Grand Prairie, TX. One address of interest is within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter, and one address of interest is within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

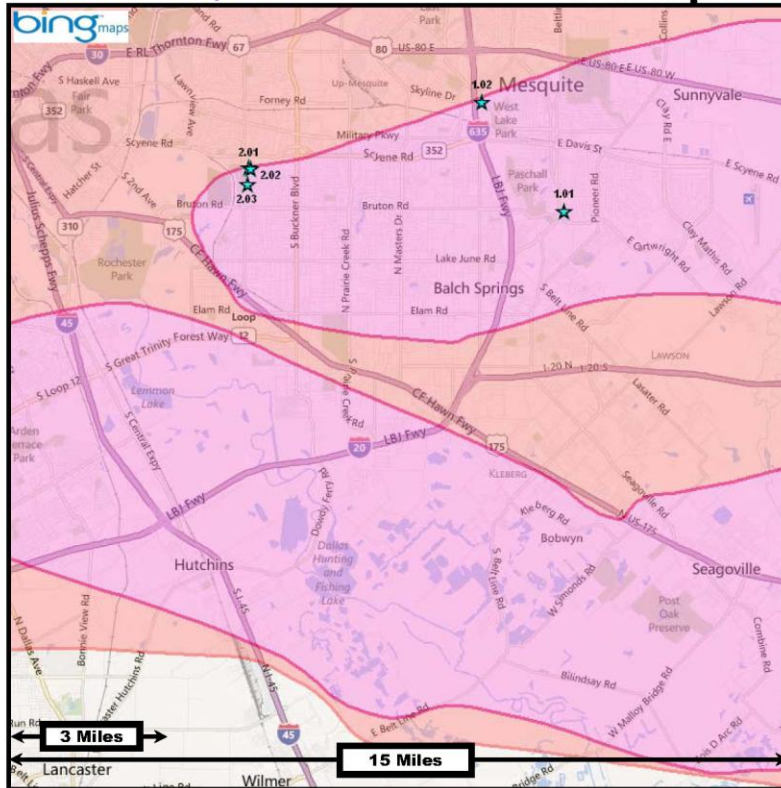
Product Notice: This report is intended for the sole use of the customer(s) named herein. Each customer agrees not to copy, distribute, disseminate, transfer, assign, license, or in any way or form make the hail information available to any third party for any use whatsoever, without expressed written consent of Weather Decision Technologies, Inc. (WDT). The information contained herein is derived from multiple weather data sources including NEXRAD radar data and NWS storm reports using WDT's exclusive hailstorm monitoring system and, unless otherwise noted, is intended only for the verification of hail at the location indicated in the address/location of interest section. This information represents the best estimate of where hail may have fallen based upon these data sources as of the date this report was created and the expertise of WDT. Weather experts at WDT have carefully examined the information presented herein to ensure the most accurate depiction of hail fall, however it is possible that hail may have occurred during the time specified in an area not covered by a hailpath. WDT's proprietary methods are designed to report the area where the largest hailstones are most likely to have fallen.

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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Mesquite, TX. Five addresses of interest are within an analyzed path of very large hail where the largest hail would potentially have been greater than or equal to 2.00" in diameter.

### Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

### Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

### Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

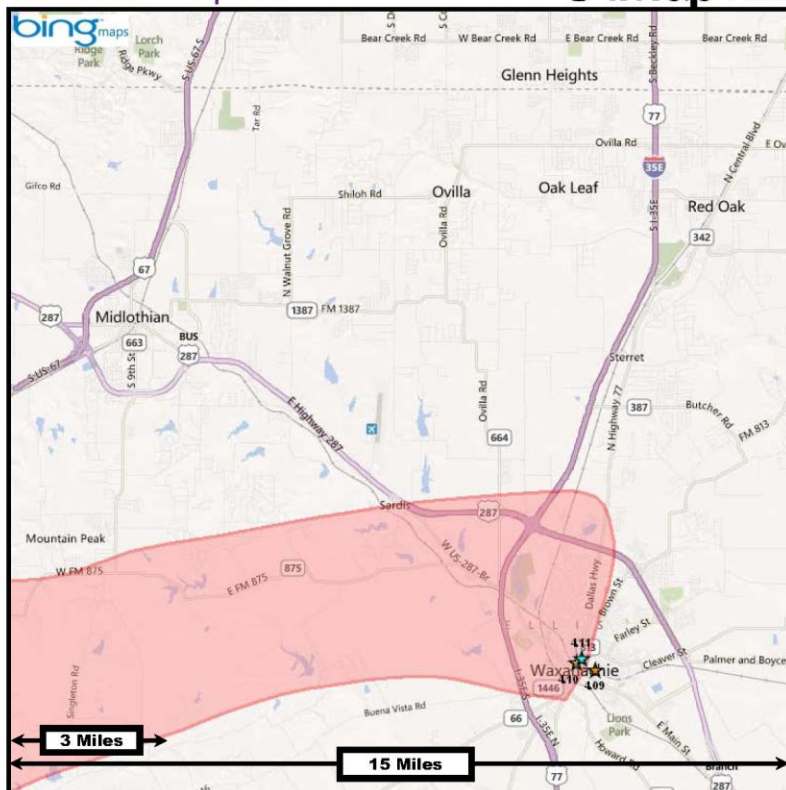
Product Notice: This report is intended for the sole use of the customer(s) named herein. Each customer agrees not to copy, distribute, disseminate, transfer, assign, license, or in any way or form make the hail information available to any third party for any use whatsoever, without expressed written consent of Weather Decision Technologies, Inc. (WDT). The information contained herein is derived from multiple weather data sources including NEXRAD radar data and NWS storm reports using WDT's exclusive hailstorm monitoring system and, unless otherwise noted, is intended only for the verification of hail at the location indicated in the address/location of interest section. This information represents the best estimate of where hail may have fallen based upon these data sources as of the date this report was created and the expertise of WDT. Weather experts at WDT have carefully examined the information presented herein to ensure the most accurate depiction of hail fall, however it is possible that hail may have occurred during the time specified in an area not covered by a hailpath. WDT's proprietary methods are designed to report the area where the largest hailstones are most likely to have fallen.

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# RICOWI Hailstorm Investigation Dallas-Fort Worth, TX – May 24, 2011

## HailTrax™ Report



HailTrax Report:  
#20991

Claim/File Number:  
**UNKNOWN**

Customer/Insured:  
**UNKNOWN**

Delivery Date:  
**03/28/12**

### Hailpaths

0.75 – 1.75"  
≥ 2.0"

### Observed Hail

0.75 – 0.99"  
1.0 – 1.75"  
2.0 – 2.75"  
3.0 – 3.75"  
≥ 4.0"

## Report Summary

The above image represents a close-up view centered on the addresses of interest in and around Waxahachie, TX. Two addresses of interest are within an analyzed path of large hail where the largest hail would potentially have been greater than or equal to 0.75" but less than 2.00" in diameter, and one address of interest is not within an analyzed path of large or very large hail.

## Address/Location of Interest

- ★ Steep Slope Inspection
- ★ Low Slope Inspection

## Search Period

Begin Time: 12:00 AM May 24, 2011 CDT  
End Time: 12:00 AM May 25, 2011 CDT

## Customer Information

Name: Joan Cook, Executive Director  
Company/Organization: RICOWI  
Billing Address: 6314 Kungle Road, Clinton, OH 44216  
Phone Number: 330-671-4569  
E-mail: jcook@ricowi.com

Product Notice: This report is intended for the sole use of the customer(s) named herein. Each customer agrees not to copy, distribute, disseminate, transfer, assign, license, or in any way or form make the hail information available to any third party for any use whatsoever, without expressed written consent of Weather Decision Technologies, Inc. (WDT). The information contained herein is derived from multiple weather data sources including NEXRAD radar data and NWS storm reports using WDT's exclusive hailstorm monitoring system and, unless otherwise noted, is intended only for the verification of hail at the location indicated in the address/location of interest section. This information represents the best estimate of where hail may have fallen based upon these data sources as of the date this report was created and the expertise of WDT. Weather experts at WDT have carefully examined the information presented herein to ensure the most accurate depiction of hail fall, however it is possible that hail may have occurred during the time specified in an area not covered by a hailpath. WDT's proprietary methods are designed to report the area where the largest hailstones are most likely to have fallen.

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**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

**APPENDIX E:**

**Storm Event Data Reports for Dallas County**

*Courtesy of the National Climatic Data Center*

**May 24, 2011**

**10 HAIL** event(s) were reported in **Dallas County, Texas** between **05/24/2011** and **05/24/2011**.

**Mag:** Magnitude

**Dth:** Deaths

**Inj:** Injuries

**PrD:** Property Damage

**CrD:** Crop Damage

Texas								
Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 <a href="#">Coppell</a>	05/24/2011	19:14 PM	Hail	1.00 in.	0	0	0K	0K
2 <a href="#">Irving</a>	05/24/2011	19:17 PM	Hail	4.25 in.	0	0	300K	0K
3 <a href="#">(dfw)Dallas-Ft Worth</a>	05/24/2011	19:20 PM	Hail	2.00 in.	0	0	20K	0K
4 <a href="#">Gribble</a>	05/24/2011	19:20 PM	Hail	1.75 in.	0	0	20K	0K
5 <a href="#">Coppell</a>	05/24/2011	19:25 PM	Hail	1.75 in.	0	0	30K	0K
6 <a href="#">Union Bower</a>	05/24/2011	19:28 PM	Hail	1.75 in.	0	0	150K	0K
7 <a href="#">Farmers Branch</a>	05/24/2011	19:30 PM	Hail	1.75 in.	0	0	30K	0K
8 <a href="#">University Park</a>	05/24/2011	19:49 PM	Hail	2.75 in.	0	0	300K	0K
9 <a href="#">Dallas</a>	05/24/2011	20:15 PM	Hail	1.50 in.	0	0	8K	0K
10 <a href="#">East Dallas</a>	05/24/2011	20:25 PM	Hail	1.00 in.	0	0	0K	0K
TOTALS:					0	0	858K	0

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

**Event Record Details**  
*Courtesy of the National Climatic Data Center*  
**Dallas County, Texas**  
**Irving Texas**  
**May 24, 2011**

Event: <b>Hail</b>	State: <b>Texas</b>
Begin Date: <b>24 May 2011, 19:17:00 PM CST</b>	
Begin Location: <b>Irving</b>	County: <b>Dallas</b>
Begin <b>32°49'N / 96°55'W</b>	
LAT/LON:	
End Date: <b>24 May 2011, 19:25:00 PM CST</b>	
End Location: <b>Not Known</b>	
Magnitude: <b>4.25 inches</b>	
Fatalities: <b>0</b>	
Injuries: <b>0</b>	
Property <b>\$ 300.0K</b>	
Damage:	
Crop Damage: <b>\$ 0.0K</b>	

**EVENT NARRATIVE:** Hail up to the size of grapefruits was reported around Irving for several minutes. Windows were broken or smashed out by the hail. The hail also damaged the TPC Four Seasons Las Colinas Country Club and golf course where the PGA's Byron Nelson Golf Championship was being held. Crews had to repair over 4,000 divots on the golf course before play could resume the next day. The greens of seven holes were significantly damaged. The hail at the golf course was reported to be up to baseball size.

**EPISODE NARRATIVE:** Three rounds of thunderstorms affected north Texas with 10 tornadoes confirmed. The atmosphere was highly unstable on this day and a High Risk was issued by the Storm Prediction Center for the northwestern counties of north Texas while a Moderate Risk covered much of the rest of north Texas. A strong upper level disturbance approaching from the west interacted with a dryline across the western portions of north Texas, and the first round of storms began to develop around 3:30 pm in the western counties. The first two rounds of storms remained along and north of Interstate 20 but the third round of storms later that night moved through most of the region as a line of storms. The most significant tornado occurred in the western limits of the city of Denton where EF-2 damage occurred. An EF-1 tornado also occurred in the city of Irving in Dallas County, and softball sized hail fell in the northern portions of the Metroplex. In the city of Dallas, one person died from electrocution after going outside around live, downed wires after a storm had passed.

**Note: Additional Event Record Details available at: <http://www.ncdc.noaa.gov>**

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

## APPENDIX F:

### Storm Event Data Reports for Tarrant County

*Courtesy of the National Climatic Data Center*

**May 24, 2011**

**32 HAIL** event(s) were reported in **Tarrant County, Texas** on **05/24/2011**.

**Mag:** Magnitude  
**Dth:** Deaths  
**Inj:** Injuries  
**PrD:** Property Damage  
**CrD:** Crop Damage

Texas								
Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 <a href="#">Eagle Mtn Lake</a>	05/24/2011	17:05 PM	Hail	0.75 in.	0	0	0K	0K
2 <a href="#">Haslet</a>	05/24/2011	17:22 PM	Hail	0.75 in.	0	0	0K	0K
3 <a href="#">Keller</a>	05/24/2011	17:27 PM	Hail	0.75 in.	0	0	0K	0K
4 <a href="#">Haslet</a>	05/24/2011	18:30 PM	Hail	2.00 in.	0	0	12K	0K
5 <a href="#">Azle</a>	05/24/2011	18:39 PM	Hail	1.00 in.	0	0	0K	0K
6 <a href="#">Avondale</a>	05/24/2011	18:40 PM	Hail	4.50 in.	0	0	75K	0K
7 <a href="#">Euless</a>	05/24/2011	18:45 PM	Hail	0.75 in.	0	0	0K	0K
8 <a href="#">Avondale</a>	05/24/2011	18:50 PM	Hail	4.50 in.	0	0	75K	0K
9 <a href="#">Keller Alta Vista Ar</a>	05/24/2011	18:50 PM	Hail	1.75 in.	0	0	50K	0K
10 <a href="#">Keller</a>	05/24/2011	18:55 PM	Hail	0.88 in.	0	0	0K	0K
11 <a href="#">Keller</a>	05/24/2011	18:55 PM	Hail	2.50 in.	0	0	25K	0K
12 <a href="#">Keller</a>	05/24/2011	18:55 PM	Hail	2.75 in.	0	0	25K	0K
13 <a href="#">Keller</a>	05/24/2011	18:56 PM	Hail	4.25 in.	0	0	300K	0K
14 <a href="#">Smithfield</a>	05/24/2011	18:58 PM	Hail	1.75 in.	0	0	12K	0K
15 <a href="#">Ft Worth Mangham Arp</a>	05/24/2011	19:00 PM	Hail	1.25 in.	0	0	5K	0K
16 <a href="#">Keller</a>	05/24/2011	19:00 PM	Hail	2.50 in.	0	0	50K	0K

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
17 <a href="#">Grapevine</a>	05/24/2011	19:02 PM	Hail	1.75 in.	0	0	320K	0K
18 <a href="#">Euless</a>	05/24/2011	19:10 PM	Hail	1.50 in.	0	0	5K	0K
19 <a href="#">Bedford</a>	05/24/2011	19:13 PM	Hail	1.75 in.	0	0	30K	0K
20 <a href="#">White Settlement</a>	05/24/2011	19:19 PM	Hail	1.75 in.	0	0	30K	0K
21 <a href="#">Benbrook</a>	05/24/2011	19:35 PM	Hail	0.75 in.	0	0	0K	0K
22 <a href="#">Mara</a>	05/24/2011	19:50 PM	Hail	0.75 in.	0	0	0K	0K
23 <a href="#">Ft Worth</a>	05/24/2011	19:55 PM	Hail	2.75 in.	0	0	300K	0K
24 <a href="#">Ft Worth</a>	05/24/2011	19:57 PM	Hail	1.75 in.	0	0	60K	0K
25 <a href="#">Johnsons Station</a>	05/24/2011	20:02 PM	Hail	2.75 in.	0	0	200K	0K
26 <a href="#">Poltechniec</a>	05/24/2011	20:02 PM	Hail	1.75 in.	0	0	40K	0K
27 <a href="#">Euless</a>	05/24/2011	20:15 PM	Hail	1.75 in.	0	0	40K	0K
28 <a href="#">Arlington</a>	05/24/2011	20:19 PM	Hail	1.75 in.	0	0	60K	0K
29 <a href="#">Euless</a>	05/24/2011	20:20 PM	Hail	1.00 in.	0	0	0K	0K
30 <a href="#">Center Pt</a>	05/24/2011	20:42 PM	Hail	1.00 in.	0	0	0K	0K
31 <a href="#">Avondale</a>	05/24/2011	20:45 PM	Hail	1.75 in.	0	0	5K	0K
32 <a href="#">Euless</a>	05/24/2011	21:20 PM	Hail	1.00 in.	0	0	0K	0K
TOTALS:					0	0	1.719M	0

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

## **Event Record Details**

***Courtesy of the National Climatic Data Center  
Tarrant County, Texas  
Keller Texas***

**May 24, 2011**

Event:	<b>Hail</b>	State:	<b>Texas</b>
Begin Date:	<b>24 May 2011, 18:56:00 PM CST</b>		
Begin Location:	<b>2 Miles North of Keller</b>	County:	<b>Tarrant</b>
	<b>Begin 32°57'N / 97°15'W</b>		
	<b>LAT/LON:</b>		
End Date:	<b>24 May 2011, 18:56:00 PM CST</b>		
End Location:	<b>Not Known</b>		
Magnitude:	<b>4.25 inches</b>		
Fatalities:	<b>0</b>		
Injuries:	<b>0</b>		
Property	<b>\$ 300.0K</b>		
Damage:			
Crop Damage:	<b>\$ 0.0K</b>		

**EVENT NARRATIVE:** Softball sized hail was reported on the northwest side of Keller.

**EPISODE NARRATIVE:** Three rounds of thunderstorms affected north Texas with 10 tornadoes confirmed. The atmosphere was highly unstable on this day and a High Risk was issued by the Storm Prediction Center for the northwestern counties of north Texas while a Moderate Risk covered much of the rest of north Texas. A strong upper level disturbance approaching from the west interacted with a dryline across the western portions of north Texas, and the first round of storms began to develop around 3:30 pm in the western counties. The first two rounds of storms remained along and north of Interstate 20 but the third round of storms later that night moved through most of the region as a line of storms. The most significant tornado occurred in the western limits of the city of Denton where EF-2 damage occurred. An EF-1 tornado also occurred in the city of Irving in Dallas County, and softball sized hail fell in the northern portions of the Metroplex. In the city of Dallas, one person died from electrocution after going outside around live, downed wires after a storm had passed.

**Note:** Additional Event Record Details available at: <http://www.ncdc.noaa.gov>

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

**APPENDIX G: 2011 RICOWI Hail Investigation Team Members**



From left to right:

Front row: Dale McLean, Wanda Edwards, Phil Dregger, Robert White, Dave Fulton, Tanya Brown, Lynne Lawry, David Roodvoets

Middle row: John Paul Hadden, William Woodring, David Balistreri

Back Row: Remington Brown, Phil Mayfield, Shiraj Khan, Apoorv Dabral, Rusty Beck, Chuck Miccolis, John Gimple, Bill Morgan, Dan Behrens

Absent from the Photo:

Lynne Christensen, Peter Parmenter, Bert Nunez, Doug Dewey, and Richard Herzog

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

## **2011 RICOWI Hail Team Members**

### **Team 1**

Rusty Beck, Liberty Mutual Insurance Co.  
Phil Dregger, Technical Roof Services, Inc.  
John Goveia, Technical Roof Services, Inc.  
Robert White, Malarkey Roofing Products

### **Team 2**

Dan Behrens, Haag Engineering  
Wanda Edwards, Insurance Institute for Business & Home Safety (IBHS)  
Bill Morgan, Malarkey Roofing Products

### **Team 3**

Rem Brown, Insurance Institute for Business & Home Safety (IBHS)  
Dave Fulton, Metal Building Manufacturers Association (MBMA)  
John Paul Hadden, State Farm Insurance Co.  
Dale McLean, Revere Copper Products, Inc.

### **Team 4**

Apoorv Dabral, AIR Worldwide  
Phil Mayfield, PSM Consultants  
Chuck Miccolis, Insurance Institute for Business & Home Safety (IBHS)

### **Team 5**

David Balistreri, Building Envelope Consultants, Ltd  
Tanya Brown, Insurance Institute for Business & Home Safety (IBHS)  
Bill Woodring, GAF

### **Team 6**

Doug Dewey, State Farm Insurance Co.  
John Gimple, Gimple Roof Engineers, Inc.  
Shiraj Khan, AIR Worldwide  
Lynne Lawry, Weather Decision Technologies, Inc. (WDT)

### **Team 7**

Lynne Christensen, Cedar Shake & Shingle Bureau (CSSB)  
Bert Nunez, Benco Commercial Roofing  
Peter Parmenter, Photographer, Cedar Shake & Shingle Bureau (CSSB)  
Tim Veigel, Benco Commercial Roofing

### **Report Task Group:**

Richard Herzog, Chair, Hail Investigation Program, Haag Engineering Co.  
David Roodvoets, On-Site Coordinator, DLR Consultants  
Lynne Lawry, Weather Decision Technologies, Inc. (WDT)

**RICOWI Hailstorm Investigation  
Dallas-Fort Worth, TX – May 24, 2011**

## **APPENDIX H: Acknowledgements**

RICOWI wishes to thank several organizations, corporations, and individuals for making the hail investigations possible. Primarily, RICOWI thanks the Sponsor Members of RICOWI who provided much of the funding for the project and who provided volunteers to the HIP committees and the field investigation: ARMA, CSSB, IBHS, ERA, MBMA, MCA, RCI, SPFA, and SPRI. Thanks to State Farm Insurance for providing additional project funding through a research grant. Additionally, the following Affiliate Members contributed to the HIP project: Haag Engineering Co., ARMKO Industries, Crenshaw Consulting Group, Eagle Roofing, GAF Building Materials, Liberty Mutual Insurance, Malarkey Roofing Products, Performance Roof Systems, and Roof Maintenance Systems.

Aerialogics provided diagrams, slope, and area data for several projects from aerial photography. This information was confirmed as accurate by on site observations. Slope was confirmed within  $\pm 1/12$  on steep slope roofs. There was no effort to determine accuracy of slopes on roofs with slopes less than  $2/12$ . Area measurements were confirmed by field observations. This tool can provide considerable information about a roof prior to inspection and provide roof areas without having to measure steep or complex roofs. Aerialogics data was most helpful in completing information on roofs that were difficult to reach or measure during ground observation.

Thank you to the HIP team members (Appendix E) for their hard work, dedication, and numerous volunteer hours. Thanks to RICOWI Executive Director Joan Cook for excellent leadership, organization, and support, and to David Roodvoets of DLR Consultants, our HIP Site Coordinator. Thanks to Hail Committee Chair and report co-author, Richard Herzog, Haag Engineering and to the following report writers: John Goveia, Bill Morgan, Rem Brown, Chuck Miccolis, David Balistreri, Lynne Lawry, and Lynne Christensen. RICOWI would like to thank peer reviewers Richard Fricklas and Jerry Teitsma for their time and attention to detail.

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