KENAITZE/SALAMOTROFF TRIBES' TRIP REPORT
Assessment of Mold and Moisture Conditions

Final Report

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Prepared for:
U.S. Department of Housing & Urban Development
Office of Native American Programs

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BACKGROUND INFORMATION

The tribes are located near the towns of Kenai and Soldotna on the western side of the Kenai Peninsula in Alaska. The towns are near sea level and the topography of the area is fairly flat. The climate at Kenai and Soldotna can be described as very cold and moderately dry. Average temperature temperatures are 4 degrees to 6 degrees Fahrenheit in the winter months, with mean temperatures averaging in the low 20 degrees. Summers are cool, with mean temperatures in the 50 degrees. Average rainfall at the Kenai airport is 15.9 inches annually. Most of this precipitation falls in the summer months and early fall.

Day 1: Sunday, February 16, 2003

The first day was a travel day to Anchorage, Alaska.

Day 2: Monday, February 17, 2003

On Monday morning, the assessment team met with David Veitch and Sharon Thomsen, staff members of the HUD Alaska ONAF office. On the way to the Kenai Peninsula, the group met with Jack Hoberg, Executive Director of the Cold Climate Housing Research Center (CCHRC) in Aleyaska to discuss the assessment team's role in inspecting Native American housing, CCHRC's goals and activities, and the technical challenges of housing construction in severely cold climates.

Upon arrival at Soldotna, the assessment team met with Mary Liz Bottorf, Housing Director for the tribes and Steve Wisdom, Principal of Wisdom and Associates, Inc. Mr. Wisdom provided a computer presentation detailing recent work with the tribes. In the afternoon, the group inspected three houses. The team reviewed previous work performed at the residences and examined the buildings for current moisture and fluid issues. Digital photographs were taken at each site to record conditions. The inspection
PART I
TRIP REPORT

INTRODUCTION

Jeff Gordon from the Building Research Council (BRC) at the University of Illinois Urbana-Champaign, and Paul Knight of Magna Systems, conducted a site visit at the Kenaitze Village and Salamatoff Village tribes on February 17-18, 2003. The purpose of the site visit was to provide technical assistance to the Kenaitze/Salamotoff Housing Office in assessing mold and moisture conditions in housing units. This is a summary report of activities of the site visit. A detailed analysis of the findings and recommendations is found in the attached report, entitled: Technical Housing Assessment Report: Examining Mold and Moisture Conditions in Kenaitze/Salamatoff Housing.

BACKGROUND INFORMATION

The tribes are located near the towns of Kenai and Soldotna on the western side of the Kenai Peninsula in Alaska. The towns are near sea level and the topography of the area is fairly flat. The climate at Kenai and Soldotna can be described as very cold and moderately dry. Average minimum temperatures are 4 degrees to 6 degrees Fahrenheit in the winter months, with mean temperatures averaging in the low 20 degrees. Summers are cool, with mean temperatures in the 50 degrees. Average rainfall at the Kenai airport is 18.9 inches annually. Most of this precipitation falls in the summer months and early fall.

Day 1: Sunday, February 16, 2003

The first day was a travel day to Anchorage, Alaska.

Day 2: Monday, February 17, 2003

On Monday morning, the assessment team met with David Vaught and Sharon Thompson, staff members of the HUD Alaska ONAP office. On the way to the Kenai Peninsula, the group met with Jack Hebert, Executive Director of the Cold Climate Housing Research Center (CCHRC) in Aleyaska to discuss the assessment team’s role in inspecting Native American housing, CCHRC’s goals and activities, and the technical challenges of housing construction in severely cold climates.

Upon arrival at Soldotna, the assessment team met with Mary Lou Bottorf, Housing Director for the tribes and Steve Wisdom, Principal of Wisdom and Associates, Inc. Mr. Wisdom provided a computer presentation detailing recent work with the tribes. In the afternoon, the group inspected three houses. The team reviewed previous work performed at the residences and examined the buildings for current moisture and mold issues. Digital photographs were taken at each site to record conditions. The inspection
process involved visual assessment of both interior and exterior conditions, moisture content readings of wood floor framing members in basements or crawl spaces and discussion with available residents. The attached *Technical Housing Assessment Report* provides a detailed analysis of findings and recommendations for the inspected properties.

**Day 2: Tuesday, February 18, 2003**

On Tuesday morning, two more inspections were performed. A third inspection was cancelled because access to the home could not be obtained. Upon completion of the inspections, the assessment team met with Mary Lou Bottorf, and Steve Wisdom to discuss the initial impressions and findings from the site visit.

**FINDINGS**

An overview of findings and recommendations follows:

1. The housing office has been working with a consultant, Wisdom & Associates, for inspection and analysis of problem homes. This firm brings a high level of sophistication in building performance and health issues. The relationship is productive, and the consultants give excellent advice to the housing office.

2. Two mobile homes had the most severe problems. Mobile homes in this region, as in all regions of Alaska, present problems. These two older mobile homes were not designed for the extremely cold Alaska winters. If possible, the older mobile homes should be retired from the tribe’s building stock.

3. Although often the source of excessive moisture, the two inspected crawl spaces were well designed and dry. Power exhaust fans installed in the crawl spaces protected against a buildup of moisture. Efforts should be made to identify the source of moisture that triggers the crawl space exhaust fan in these houses.

4. Airborne mold measurements were being taken to diagnose problem houses. The measurement results should be used cautiously, as mold sampling is inherently uncertain.

These findings are discussed in more detail in the *Technical Housing Assessment Report: Examining Mold and Moisture Conditions in Kenaitze/Salamatoff Tribes’ Housing.*
PART II

TECHNICAL HOUSING ASSESSMENT REPORT

EXAMINING MOLD AND MOISTURE CONDITIONS IN THE KENAITZE/SALAMOTOFF TRIBE’S HOUSING

Executive Summary

Introduction

Section 1: Methodology

Section 2: Housing Types

Section 3: Findings

Section 4: Recommendations

Appendix A: Site Visit Summary Report

Appendix B: Housing Inspection Results
Executive Summary

On February 17 and 18, 2003, the assessment team performed a site visit to assess the site and building structural conditions contributing to mold and moisture problems in housing of the Kenaitze Village and Salamotoff Village Tribes. Kenaitze/Salamotoff Tribe’s Housing Office was taking a proactive approach in responding to mold and moisture problems. Several inspected houses had already received professional attention.

The following are other findings:

1. The housing office has been working with a consultant, Wisdom & Associates, for inspection and analysis of problem homes. This firm brings a high level of sophistication in building performance and health issues. The relationship is productive and the firm gives the housing office the highest quality advice.

2. Two mobile homes had the most severe problems. Mobile homes in this region, as in all regions of Alaska, present problems. These two older mobile homes were not designed for the extremely cold Alaska winters. If possible, the older mobile homes should be retired from the tribe’s building stock.

3. Although often the source of excessive moisture, the two inspected crawl spaces were well designed and dry. Power exhaust fans installed in the crawl spaces protected against a buildup of moisture. Efforts should be made to identify the source of moisture that triggers the crawl space exhaust fan in these houses.

4. Airborne mold measurements were being taken to diagnose of problem houses. These measurements should be reviewed with caution, as mold sampling is inherently uncertain.

This report provides technical discussions focusing on these items. Appendix A provides a summary of findings at each inspected home. Appendix B includes a detailed assessment of each home.
INTRODUCTION

On February 17 and 18, 2003, Jeff Gordon, BRC staff, and Paul Knight, Magna Systems, Inc. staff, conducted a site visit to assess the site and building structural conditions contributing to mold and moisture problems in housing of the Kenaitze Village and Salamotoff Village tribes. David Voight, Native American Program Specialist with the HUD Anchorage office, and Sharon Thompson, staff member of the HUD Alaska ONAP office, accompanied the assessment team. Mary Lou Bottorf, Housing Director for the tribes, arranged the site visits and escorted the assessment team.

The tribes are located near the towns of Kenai and Soldotna on the western side of the Kenai Peninsula in Alaska. The towns are near sea level and the topography of the area is fairly flat. The climate at Kenai and Soldotna can be described as very cold and moderately dry. Historical data indicates a mean of 11,181 degree-days at the Kenai airport. While not particularly cold when viewed by Alaska standards, this is colder than virtually all locations in the lower 48 states. The colder weather stations in the lower 48 states, on the high plains along the Canadian border, average in the 9,000 degree-day range. Average minimum temperatures are 4 degrees to 6 degrees Fahrenheit in the winter months, with mean temperatures averaging in the low 20 degrees. Summers are cool, with mean temperatures in the 50 degrees. Average rainfall at the Kenai airport is 18.9 inches annually. Most of this precipitation falls in the summer months and early fall.

SECTION 1 – METHODOLOGY

Visual Inspection

Housing inspections consisted primarily of the visual assessment of mold and moisture conditions. The team used assessment forms developed for the Chicago Mold and Moisture Project, a HUD Healthy Homes Program, to record information. The assessment forms are organized for a room-by-room inspection of water damage and evidence of mold. Assessment of kitchens, bathrooms, crawl spaces, utility rooms and attics included inspections of plumbing, localized ventilation, water entry and other potential moisture sources.

Inspections of the exterior of the houses included assessments of rainwater and snowmelt management, including site grading, roof condition and gutter system.

Whenever possible, residents were interviewed to gather history on moisture problems, plumbing leaks, winter condensation, health issues, number of occupants and other useful information.

Digital photographs were taken at each house to visually record notable conditions.
Measurements

Interior temperature and relative humidity measurements were recorded in most residences using a battery-operated, digital Vasaila instrument.

When applicable, moisture content readings were taken in structural members (joists, sill plates) in crawlspaces with a two-pin Delmhorst moisture content instrument. Due to the storage capacity of wood, moisture content measurements provide information on wetness in the recent past, from three weeks to a month. Moisture content readings can range from 5%, indicating a very dry space, to 30%, indicating a very wet space. On one occasion, a digital manometer was used to measure pressure differences across the exterior building envelope. This measurement examines the potential backdrafting under worst-case depressurization of a combustion appliance zone.

The results of the mold and moisture assessments were compiled on a spreadsheet, with broad categories of common moisture problems noted. This data is presented in Table 1 of the Appendix A in this report. The findings from each individual house inspection are presented in Appendix B.

SECTION 2 – HOUSING TYPES

Five residences were inspected. They included:

- Two mobile homes
- Two site-built ranch house
- One site-build two-story house with the first story approximately four feet below grade

The houses were not selected randomly. The housing office chose residences based on known past and current mold and moisture problems. It should not be presumed that the set of houses represents a typical cross-section of housing for the tribes.

SECTION 3 – FINDINGS

The housing office proactively addressed reports of mold problems in the housing stock in their jurisdiction. Several inspected houses had received remediation efforts prior to the site visit. The housing office should be commended for taking this proactive approach. Other findings of the site visit include:

1. The housing office employed the consulting services of Wisdom & Associates, Inc. for inspection and analysis of problem buildings. This relationship has obviously led to a productive partnership. Wisdom & Associates brings a high degree of sophistication in the technical field of building science and performance. The inspection team was impressed by the comprehensive quality of inspection and advice regarding indoor air quality issues. This assistance should continue to be a great advantage to the housing office.
2. The two mobile homes had the most severe problems. Mobile homes in this region, as in all regions of Alaska, present problems. These two older mobile homes were not designed for the extremely cold Alaskan winters. The insulation in both exterior walls and roofs was minimal. The aluminum windows served as thermal bridges and led to window condensation and mold growth problems. The inspected mobile homes had received a sprayed urethane coating over the roof deck. In both cases, this coating was showing signs of delamination from the original roof and provided large voids for water intrusion (Figure 1). If possible, the older mobile homes should be retired from the tribe's building stock.

3. Although often the source of excessive moisture, the two inspected crawl spaces were well designed and dry. In both cases, the concrete walls of the crawlspaces were insulated, placing the crawl space within the thermal envelope. Vapor barriers were in place. Power exhaust fans had been installed in the crawl spaces to protect against a moisture buildup. Powered exhaust, in a space that is within the thermal envelope, could potentially cause severe energy and comfort costs. However, the dryness of the crawlspace, along with a humidistat control, may make this a moot point. If humidity builds triggers the crawlspace exhaust fan, efforts should be made to identify the source of moisture.

4. Airborne mold measurements were taken to diagnosis problem houses. The measurement results should be used with caution, as mold sampling is inherently uncertain. Specifically:

   a. The nature and quantity of contaminants released from mold growth sites is dynamic and complex. Results could vary greatly over time and space with changes in temperature, relative humidity, type of substrate, presence of competing micro-organisms, ventilation patterns, and an array of other factors.

   b. The quantities of detected mold (both the numbers and relative frequencies) are not precise counts. The numerical results can vary by the sampling and analytical methods use, and should be regarded as fairly crude estimates at best. Without taking numerous duplicate samples, the precision of the measurements is unknown. Without some estimate of the precision of the measurements, the actual level of any given mold cannot be established with any confidence.

   c. Numerical criteria from mold testing are not appropriate for determining if a health concern exists. There is little agreement, and no established standards,
on what level of any specific mold (much less a complex mixture of various molds) is safe or is necessary to cause health effects.

Airborne mold sampling can be used to test specific hypotheses or aid in solving a problem, such as locating hidden mold growth. The sampling plan and quality control efforts should be defined for a specific purpose.

Contrary to popular opinion, mold testing is often unnecessary and there is not a practical health-based reason to test visible mold growth once it is found. Testing should not delay prompt corrective actions, nor divert resources from the practical solutions of moisture control and thorough cleaning.

SECTION 4 – RECOMMENDATIONS

The housing office has been proactive in addressing reports of mold problems in the housing stock in their jurisdiction. Several of the houses that were visited had received remediation efforts prior to the assessment site visit. The housing office should be commended for taking a proactive approach. As a result, common problems leading to mold contamination were not identified in the small sample of homes visited. Based on the findings, three recommendations are offered:

1. It is recommended that the Kenaitze/Salamotoff Tribal Housing Office continue to employ the services of Wisdom & Associates, Inc. for inspection and analysis of problem buildings. Wisdom & Associates brings a high degree of sophistication in the technical field of building science and performance. Mold and moisture problems are correctly identified and addressed.

2. It is recommended, to the extent possible, that the older mobile homes currently in use should be retired from the building stock. The older mobile homes that were inspected were not designed for the cold Alaskan winters.

3. If humidity builds up to a level that triggers the exhaust fans in the crawl spaces of houses, efforts should be made to identify the source of moisture. This condition seems unlikely to occur, as the crawl spaces were well-designed and dry at the time of inspection.
### Appendix A: SITE: Kenaitze/Salamotoff Tribes

#### SUMMARY SITE VISIT REPORT

**DATE:** February 17, 2003

<table>
<thead>
<tr>
<th>Inspection Number</th>
<th>Address</th>
<th>HUD Program</th>
<th>Building Age</th>
<th>Foundation Type</th>
<th>Model and Framing Type</th>
<th>Heat Type</th>
<th>Site Drainage Problems</th>
<th>Gutter System Problems</th>
<th>Leaks from Exterior</th>
<th>Wet Basement or Crawl Space</th>
<th>Plumbing Problems</th>
<th>Bathroom Problems</th>
<th>Exhaust Ventilation</th>
<th>Exterior wall/ceiling problems</th>
<th>Attic Problems</th>
<th>Visible Mold</th>
<th>Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>5125 Silver Salmon</td>
<td>NA</td>
<td>27</td>
<td>6</td>
<td>Pier</td>
<td>Mobile Home</td>
<td>Gas-fired forced air</td>
<td>No</td>
<td>No Gutters</td>
<td>Yes</td>
<td>Not accessible</td>
<td>No</td>
<td>Missing in both kitchen and bathroom</td>
<td>No</td>
<td>NA</td>
<td>11</td>
<td>36-68%</td>
</tr>
<tr>
<td>1-2</td>
<td>212 West Marydale</td>
<td>NA</td>
<td>31</td>
<td>4</td>
<td>Slab-on-grade</td>
<td>Wood frame 2-story</td>
<td>Gas, hydronic distribution</td>
<td>Minor</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Operable in both kitchen and bathroom</td>
<td>No</td>
<td>Not accessible</td>
<td>14</td>
<td>Not Taken</td>
</tr>
<tr>
<td>1-3</td>
<td>130 Coral</td>
<td>NA</td>
<td>40</td>
<td>2</td>
<td>Concrete crawl space</td>
<td>Wood frame ranch</td>
<td>Gas, hydronic distribution</td>
<td>No</td>
<td>Yes, but missing components</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Poor, 14 CFM in bathroom</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>35%</td>
</tr>
<tr>
<td>2-1</td>
<td>393 Beluga</td>
<td>NA</td>
<td>29</td>
<td>3</td>
<td>Block crawl space</td>
<td>Wood frame ranch</td>
<td>Gas, hydronic distribution</td>
<td>Minor</td>
<td>Yes, but missing components</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Operable in both kitchen and bathroom</td>
<td>No</td>
<td>Not accessible</td>
<td>No</td>
<td>35-68%</td>
</tr>
<tr>
<td>2-2</td>
<td>#29, Chemicoff</td>
<td>NA</td>
<td>27</td>
<td>Not</td>
<td>Piers</td>
<td>Mobile Home</td>
<td>Gas-fired forced air</td>
<td>No</td>
<td>No Gutters</td>
<td>No, but roof in bad shape</td>
<td>Yes</td>
<td>No</td>
<td>Structural - floor</td>
<td>Missing in both kitchen and bathroom</td>
<td>Yes</td>
<td>NA</td>
<td>13, 16</td>
</tr>
</tbody>
</table>
Inspection Number: 1-1
Address: 5125 Silver Salmon Dr., #44
Type: Mobile Home
Foundation: Piers with skirting
Heat Type: Gas-fired (converted from oil) forced air
Bedrooms: Two in main residence
Occupancy: Six people
Age: 27 years old
Attic: None

Mold and Moisture Conditions: Mold damage was limited to the modular addition attached to the main residence (Figure 1). Active roof leaks in the addition, resulted in water damage and mold contamination (Figures 3-5). The occupants used the addition as a storage area at the time of the inspection.

Site Drainage and Rainwater Management:
Site drainage was fair. There was no gutter system.

Foundation Conditions: The piers and crawl space were not accessible for inspection. Metal skirting was in place around the perimeter.

Roof Condition - Addition: Deterioration of the urethane roof coating was visible, with apparent de-lamination of the roof substrate. Considerable leakage was evident in the addition, including standing water and mold contamination (Figures 3 - 6). Interior relative humidity in the addition was 50%, which is dangerously high in a cold climate.

Bathroom: While there was a leak at the faucet, there was no mold visible in the bathroom. There was no bathroom exhaust ventilation.

Kitchen: There were no water damage or mold contamination problems identified in
the kitchen. The exhaust ventilation built into the microwave unit did not work. This is a concern with a gas range.

**Bedrooms and Living Spaces:** There were no water damage or mold contamination problems identified in living spaces outside of the addition. Interior relative humidity was 36% at 68°, which is not excessive. There was some window condensation, but only on single-glazed windows that were missing storm windows.

**Mechanical Systems:** The air distribution system was typical to mobile homes. The supply air duct was located in the floor system and there was a central return. The supply duct had dropped down from the boot at the floor registers by 4" to 6" creating a large leak in the supply system into the floor cavity. The furnace filter was very dirty. The water heater was self-contained in a closet accessible from the abandoned section of the home. The water heater was natural gas with natural draft.

**Occupant Notes:** Adult occupants were not available for an interview. There were three children present.

**Discussion / Recommendations:**

1. Conditions in the addition are critical. Roof leaks are active and major, and mold contamination extensive. If the addition is to be salvaged, immediate action is required. A new roof covering should be the first objective. Considerable cleanup, along with the repair and replacement of interior finishes, will be necessary. Severely moldy finishes should be dismantled and discarded, and wall cavities inspected and cleaned.

2. Install a bathroom exhaust fan with a timer control.

3. Repair or replace exhaust ventilation over the gas range.

4. Inspect supply ducting. Seal and insulate the ducts and tightly connect them to the boots at the floor supply registers.
Appendix B - Kenaitze/Salamotoff Tribes Technical Assessment Report

Inspection Number: 1-2
Address: 212 West Marydale
Type: Frame two-story, with one half of first story below grade.
Foundation: Slab on grade
Heat Type: Sealed combustion gas, hydronic distribution
Bedrooms: Four
Occupancy: Four people
Age: 31 years old
Attic: Not accessible

Mold and Moisture Conditions: There was only minor evidence of mold inside the house. Spillage around the tub surround has led to minor contamination in the bathroom (Figure 2). Window condensation had prompted minor mold growth at the bottom of the two-window sash.

Site Drainage and Rainwater Management: There is a positive slope away from the foundation on the front elevation (Figure 1). The grade around the other three elevations was fairly flat. A roof drainage system was in place. Downspouts empty on to splashblocks at the foundation (Figure 3). Given the location of the windows at grade, it would be beneficial to extend leaders from the downspouts to splashblocks three or four feet away from the foundation. Wood windows were fairly fragile components, and minor deterioration in the paint surfaces were noted, particularly in the vicinity of downspouts and leaders.

Foundation and Basement Conditions: The basement (first floor, half of which was below grade) was finished. There was no sign of water intrusion into the basement or damaged finishes. Standing water was found in the washing machine and the owner indicated that it overflows on occasion. Tile floor in the basement facilitated cleaning occasional spills with minimal damage. The clothes dryer was vented to the exterior.

Bathrooms: Main (2nd floor) bathroom. There was some water damage and mold contamination as a result of spillage around the shower (Figure 2). A previous leak in the sink drain did some damage to the cabinet, but the leak was no longer active (Figure 4). A new bathroom exhaust fan had been installed with a flow measurement indicated 36 cubic feet per minute (CFM).
Basement (1st floor) Bathroom. There were no signs of moisture damage or mold. The sink had developed a hole in the basin, and should be replaced (Figure 5). There was no bathroom exhaust fan.

Kitchen: There were no moisture or mold problems noted in the kitchen. The range hood was operable and vented to the exterior.

Bedrooms and Living Spaces: There were no signs of water damage or mold contamination in the main living spaces. Condensation was noted on some windows, but was minor rather than excessive. In one bedroom, the condensation had resulted in some minor mold contamination at the base of the window (Figure 6). Occupants should limit the use of curtains at these windows, allowing warm air to circulate to the glass surfaces.

Attic: The attic was not accessible.

Mechanical Systems: The boiler was direct vent sealed combustion and is new. The boiler provided domestic hot water to the house and was stored in an adjacent storage tank.

House depressurization was measured. Baseline was -1.1 Pascals (Pa) house with respect to the outside. The house dropped to -8.0 Pa with respect to the outside when the kitchen and bathroom exhaust fans and clothes dryer were turned-on. This is a significant drop and indicates that the house is fairly tight and that natural draft appliances could backdraft. Fortunately, natural draft equipment has been replaced in the home with sealed combustion appliances.

Occupant Notes: The family reports no severe water intrusion problems, and that the basement remains dry throughout the year. One child occupant has asthma. There were no other reported health problems in the family.

Discussion / Recommendations:

1. Install leaders on downspouts to provide drainage to splashblocks three to four feet away from foundation.

2. Repair washing machine for proper drainage.

3. Repair minor damage (tub surround and cabinet) in first floor bathroom.
4. If basement shower is used, an exhaust fan on a timer switch should be installed. The sink in this bathroom needs replacement.

5. To help prevent condensation on windows in the winter, it is best to minimize the use of curtains over the windows. Curtains insulate the glass surface from the warmer interior air and prevent circulation of warmer air to these surfaces.
Appendix B - Kenaitze/Salamotoff Tribes Technical Assessment Report

Inspection Number: 1-3
Address: 130 Coral
Type: Frame ranch
Foundation: Poured concrete crawl space
Heat Type: Gas-fired hydronic
Bedrooms: Three
Occupancy: Two people
Age: 40 years old
Attic: Truss

Mold and Moisture Conditions: There were no moisture or mold problems found on this inspection. The previous mold problems had recently been remediated. The attached garage had been converted to a family room with a new floor installed over sleepers. Mold had developed in the floor system and had been present in the crawl space. At the time of inspection, the recent mold remediation measures had effectively controlled the mold problems.

Site Drainage and Rainwater Management: Site drainage was good, with a gentle grade away from the foundation on all elevations. A roof drainage system was in place, though downspouts and leaders were missing in several locations (Figures 2 & 3). During rainy seasons, this condition could contribute to a wet foundation and result in mold contamination.

Foundation Conditions: At the time of inspection, the crawl space was dry with no apparent mold growth. Moisture content of structural members was low, 6%-8% in the floor joists, and 12% at the sill plate. The crawl space had received much of the attention during the mold remediation work. The poured concrete crawl space foundation walls were insulated with fiberglass batt insulation. The rim joist was also insulated. This method of insulation places the crawl space within the thermal boundary of the house. Indeed, the conditions in the crawl space (34% RH at 70° F) were virtually identical to the conditions in the interior of the house. A new plastic ground cover was in place. A 180 CFM exhaust fan controlled by a humidistat had been installed to power vent the crawl space. An air intake was also installed. At the time of inspection, the fan was non-
operational and the only air intake was from an abandoned clothes dryer vent. Two fin tube radiators were located in the crawl space to provide supplemental heat.

**Bathroom:** The bathroom was clean and mold-free. The bathroom exhaust fan measured 14 CFM, which is low. When inspecting the attic, it was noted that the bathroom fan was not vented through the roof. It could not be ascertained if the fan vented through the soffit or terminated in the attic.

**Kitchen:** The kitchen was clean and mold-free. The kitchen exhaust fan was vented to the outside.

**Bedrooms and Living Spaces:** There were no signs of water damage or mold contamination in the main living spaces. Interior conditions were dry, measuring 35% RH at 70°F.

**Attic:** The attic was insulated with R11 fiberglass batts followed by blown cellulose to an approximate level of R38. The cellulose was not sprayed over the bathroom ceiling where the fiberglass batts were visible. Under severely cold conditions, this could contribute to condensation and mold growth on the ceiling in the bathroom, though there was no sign of this condition at the time of inspection.

**Mechanical Systems:** The house was heated with a direct vent sealed combustion boiler fueled with natural gas. A wood heater in the living room provided supplemental heat. The water heater was atmospherically vented. The clothes dryer was vented to the exterior through a smooth sheet metal duct and was clogged with lint (Figure 4).

**Occupant Notes:** There were no reports of health concerns that could be attributed to mold contamination.

**Discussion / Recommendations:**

1. Replace missing downspouts. Downspouts should connect to leaders and splashblocks that move gathered rainwater at least 4 feet from the foundation.

2. Improvements to the crawl space have proven effective. By insulating the exterior walls, the crawl space has been placed inside the thermal boundary. The presence of fin tube radiators, providing heat to the crawl space, confirms this. The crawl space power vent put the crawl space into negative pressure with respect to the house and thus minimized moisture transfer to the home’s interior. The power vent also diluted the moisture load in the crawl space air. In this case, however, a power vent to the exterior will have considerable winter energy costs, similar to using a window fan in a bedroom during the winter. Ideally, maintaining a dry crawl space through rainwater management and site drainage is preferred.

3. Loose-fill insulation should be installed over the bathroom in the attic. The bathroom fan should be vented to the exterior.

4. Occupants should regularly maintain the dryer vent to keep it free from lint.
Appendix B- Kenaitze/Salamotoff Tribes Technical Assessment Report

Inspection Number: 2-1
Address: 393 Beluga
Type: Frame ranch
Foundation: Concrete block crawl space
Heat Type: Gas-fired, sealed combustion, hydronic
Bedrooms: Three
Occupancy: Three people
Age: 29 years
Attic: Attic was not accessible.

Figure 1: 393 Beluga

Mold and Moisture Conditions: There were no moisture or mold problems found on this inspection. The house had previous mold problems in the bathroom that had been recently remediated.

Site Drainage and Rainwater Management: Site drainage was generally flat, with some grade away from the foundation on the front elevation. A gutter system was present. There was one missing downspout (Figure 2).

Figure 2: Missing downspout and leader

Foundation Conditions: No moisture problems were identified in the crawl space. Moisture content of structural members was measured at 5%, which was extremely dry. Because of plentiful headroom, the crawl space was used for storage of personal belongings. Cardboard boxes showed no sign of water damage which testified to the dryness of the crawl space (Figure 3). Crawl space walls were insulated with R19 batts, placing the crawl space within the thermal boundary of the house. One fin tube radiator was installed in the crawl space to provide heat. Indeed, the conditions in the crawl space (35% RH at 63° F) were virtually identical to the conditions in the interior of the house. A 180 CFM exhaust fan was controlled by a humidistat set at 50%. Four crawl space vents provided make-up air. A ground cover was present.

Figure 3: Crawl space used for storage

Bathroom: The bathroom was clean and mold-free. Bathroom exhaust measured 71 CFM and was vented to the outside.

Kitchen: The kitchen was clean and mold-free. The kitchen exhaust fan was vented to the outside.
Bedrooms and Living Spaces: There were no signs of water damage or mold contamination in the main living spaces. Interior conditions were dry, measuring 35% RH at 68°F. All new vinyl double-hung windows had been installed. There was no sign of window condensation.

Attic: The attic was not accessible. Viewed from the exterior, the attic had considerable passive ventilation provided through the soffits (Figure 4).

Mechanical Systems: A Weil-McClain Gold Series boiler (direct vent sealed combustion) heated the home. A natural draft water heater provided domestic hot water. Both appliances were located in attached garage converted to a heated workspace (Figure 5). Baseline pressure of house with respect to garage was −0.3 Pa. Clothes dryer and bathroom and kitchen exhaust fans, when turned-on, depressurized the garage to −2.7 Pa. The crawl space fan was not turned on for test. There was no combustion air supply in the garage.

Occupant Notes: There were no reported health conditions.

Discussion / Recommendations:

1. Replace the missing downspout and leader.

2. Install a passive vent in the converted garage to provide a source of combustion supply air for the water heater and serve as a guard against backdrafting under worst-case depressurization conditions.
Inspection Number: 2-2
Address: #29, Chernicoff
Type: Mobile Home
Foundation: Piers with skirting
Heat Type: Gas, sealed combustion, forced air
Bedrooms: Three
Occupancy: Unoccupied
Age: At least 27 years old
Attic: None

The residents of the house had moved to a new location, leaving the house unoccupied for more than a week. Significant amounts of personal belongings still stacked in the house hindered the inspection.

Mold and Moisture Conditions: There was mold growth on the walls in the back bedroom (Figure 2 & 3). Condensation and mold contamination was common on the single-glazed windows. The crawl space was damp, rotting and structurally deteriorating the floor system in at least two locations.

Site Drainage and Rainwater Management: Site drainage was flat. There were no gutters on the home. Delamination of the roof coating from the original roof was noted at the roof edges.

Foundation Conditions: The crawl space was enclosed with metal skirting. Polyurethane foam insulation was sprayed on the interior side of the skirting. There was no ground cover and plants were growing under the home. Items were being stored in the space. The crawl space was quite warm and damp. In an apparent effort to prevent pipes from freezing, a hole had been cut into the supply duct to provide warm air to the crawl space (Figure 4). While providing heat to the crawl space, connecting the duct to the damp crawl space had created a pathway for transmitting biological conditions.
contaminants from the crawl space into the interior of the house. Structural damage to the floor system was noted in the bathroom and front entry.

**Bedrooms and Living Spaces:** Mold was growing on back bedroom wall (Figures 2 & 3). Condensation resulting from a cool wall surface (insufficient insulation) and a high moisture load (relative humidity) in the home led to mold. Inhibiting airflow and heat exchange with belongings stacked against exterior walls also contributed to this problem. The family was in transit at the time of inspection, so it was not possible to determine if this contributed to the problem. Interior relative humidity measured 36% at the time of inspection, though it should be noted that occupants, and thus the human-based moisture sources, had been gone for over a week. The damp crawl space was contributing to the moisture load.

The windows were original metal framed with single glazing. Condensation was severe on all of the windows, and this condition had resulted in significant mold contamination on window sash and sills (Figure 5). The use of heavy curtains made the condensation problems more severe.

**Mechanical Systems:** A natural gas, sealed combustion furnace provided heat to a forced air distribution system. In addition to the voids from the supply ducts into the crawl space, the ducts were very dirty with scrap food found in the system. The natural draft water heater appeared fairly new. There was some soot around the burner cover plate.

**Occupant Notes:** The family was in the process of moving out of the home because of health problems. All of the family members complained of flu-like symptoms. Tragically, an infant child had died within the past month. Results of the infant’s autopsy were not conclusive at the time of inspection. The doctors performing the autopsy were aware of the mold problems in the home, and were considering this factor along with an array of other possible causes.

**Discussion / Recommendations:** The house had numerous problems, with repairs and improvements required of several building systems (roof, crawl space, windows, floor systems, insulation, etc.). The inspection team determined that the value of the needed repairs would exceed the value of the residence. In its current condition, the house presented serious indoor air quality (IAQ) and health concerns. The house should not be reoccupied, particularly if any members of the tenant family have allergies or asthma.