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INTRODUCTION

Kate Brown from the Building Research Council (BRC) at the University of Illinois Urbana-Champaign, and Paul Knight of Magna Systems, conducted a site visit at Walker River Reservation on January 27-29, 2003. The purpose of the site visit was to provide technical assistance to the Walker River Housing Authority in assessing mold and moisture condition in housing units. This is a summary report of activities and issues addressed while on site. A detailed analysis on the findings and recommendations is found in the attached reports, entitled: Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Walker River Reservation.

BACKGROUND INFORMATION

The Walker River Reservation is located in Churchill, Lyon, and Mineral Counties in the State of Nevada. The region is located in the high desert at about 3,934 feet above sea level. Temperatures average about 67 degrees, with about 4.88 inches of precipitation annually. Winter low temperatures can reach 0 degrees. Summer highs may exceed 100 degrees. About 701 Native Americans reside on the reservation. The housing authority maintains 68 Low Rent homes and 128 Mutual Help homes.

Michelle Glazier, Executive Director of the Walker River Housing Authority (WRHA) requested technical assistance and training on mold and moisture problems impacting Mutual Help homes on the reservation. The executive director reported that some residents were complaining of construction defects and health problems related to fungal amplification. Some residents were becoming very concerned about the safety of their home environment. In late 2002, the housing authority hired a certified industrial hygienist to test four homes for mold contamination and a structural engineering firm to conduct a structural stress analysis on the roof trusses of five homes.

The homes investigated are known as Project NV99B008010. The project has 20 Mutual Help homes, which are all modular with two, three, or four bedrooms, located on the reservation in Schurz, NV. All the homes were built over crawl spaces and use wood burning stoves and propane furnaces as heating sources. In most cases, residents used the wood stoves as the primary heating source and the propane as back-up. The cooling system in each home is a swamp cooler, located on the roof. One home has had central air conditioning installed. The homes were manufactured in 1986, transported to the reservation in 1987, and occupied in 1988. Mold was not reported in the homes until July 2002.

Day 1: Monday, January 27, 2003

On Monday morning, the assessment team met with the following individuals: Jennifer Bullough, Government Technical Monitor with HUD's Office of Native American Programs; Andrea L. Horn, Environmental Health Officer with the Office of Environmental Health & Engineering, Indian Health Service in Reno, NV. The team traveled to the reservation and met with Olen McCloud, Interim Acting Director of the Walker River Housing Authority and his staff. The Housing Authority Director,
Michelle Glazier, had just resigned from her position. The meeting focused on the conditions and concerns over mold contamination in housing units and the team’s role in performing inspections.

The housing authority staff outlined the occupants’ primary concerns as: value of the mobile homes, the structural safety of the homes, and health complaints as a result of mold and moisture conditions in the home. The health complaints were nose bleeds, asthma, bronchial infections, eye infections, and flu-like symptoms. The housing authority contacted Indian Health Service Office of Environmental Health and Engineering to conduct an on-site assessment of homes and meet with residents. The housing authority hired Kirk N. Ellis & Associates, a structural & civil engineering firm to conduct structural stress analysis of roof trusses. The firm’s December 2002 report concluded that the: structural design of the trusses appears to properly check out.

After the meeting, the team began the on-site assessments. Walker River Housing Authority staff accompanied the team on the inspections. The housing authority selected the properties to be inspected. Digital photographs were taken at each site to record conditions. The inspection process involved visual assessment of both interior and exterior conditions including crawl spaces, measurements of bathroom exhaust fans to determine the actual exhaust ventilation rate, and discussions with available residents. Six homes were inspected.

**Day 2: Tuesday, January 28, 2003**

On Tuesday, the assessment team continued with technical assistance discussions with housing authority staff. Issues discussed included mold and moisture conditions noted from the previous day, present remediation plans in progress, and recommendations and ideas for educating occupants. Discussion also included some preliminary findings related to mold and moisture problems and potential causes for those problems.

The assessment team inspected nine Mutual Help homes on Tuesday. Digital photographs were taken at each site to record conditions. The inspection process involved visual assessments of both interior and exterior conditions, measurements of bathroom exhaust fans to determine the actual exhaust ventilation rate, and discussion with residents when available.

Assessments were conducted on a total of fifteen homes. Occupants in five of the homes had major health complaints and a certified industrial hygienist hired by the housing authority assessed four homes. Three homes were tested for mold. The attached Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Walker River Reservation provides a detailed analysis of findings and recommendations for the homes investigated at the Walker River Reservation.

**Day 3: Wednesday, January 29, 2003**

On Wednesday morning, BRC staff provided training for WRHA staff and residents. The participants included inspectors, carpenters, maintenance staff, resident service staff, residents, and tribal government officials. The recently elected Tribal Chairperson,
Victoria Guzman facilitated the workshop presentations and discussions. Attachment 1 provides a listing of participants. Using a Power Point presentation, the workshop was tailored to address specific issues identified on the Walker River Reservation. The following topics were discussed:

- What Mold Needs to Grow
- Definition of Moisture Loads and Identification of Sources of Moisture
- Impact of Building Construction and Design on Moisture Sources
- Discussion of the Findings on the Reservation and Strategies to Solve the Problems
- Mold Remediation
- Occupants Issues
- Crawl Spaces

The training session was about two hours long. There was good discussion and exchange during the session. Topics discussed included:

- Homes are not mobile but modular
- Need to seek an appropriate health professional diagnosis especially for the allergy and asthma cases
- Need for the community to continue to discuss and research indoor air quality issues

FINDINGS

An overview of findings and recommendations for the site visit follows. The Technical Housing Assessment Report provides a more detailed discussion and analysis of the findings.

**Walker River Reservation**

Principal findings from the site inspections include:

1. The Walker River Housing Authority appears to respond promptly to complaints and problems regarding mold and moisture. Most of houses inspected had only past mold and moisture complaints.

2. Continue with bathroom exhaust fan replacement. Consideration should be given to using low-sone (quiet) fans.

3. Kitchen range hoods are original and should be replaced. Though the fans vent outside, the fans are either non-operational or minimally effective.

4. Continue window replacement program.

5. Inspect dryer vent connections in crawl spaces on a periodic basis.
6. Conduct house depressurization tests following exhaust fan and/or window replacement to assure proper draft of the wood space heaters.

7. Site drainage and gutter systems were poor to non-existent. This is not a major concern given the climate. However, short-term drainage problems and crawl space leakage may occur if heavy rains occur in a short period of time.

8. Crawl spaces were not a significant source of moisture. Moisture problems found in the crawl spaces can easily be solved.

**Reported Health Issues**

It is clear that the residents of Project NV8-10 are concerned about the health implications of indoor air quality and specifically exposure to mold. Prior to the site inspection, the housing authority hired Rinaldi Environmental Consultants, Inc., an ABIH Board certified industrial hygienist firm to conduct mold testing. Four homes were selected for mold testing. Of the four homes identified, the three homes at 13 Feather Lane, 7 Black Mountain, and 19 South Colonie Dr. were tested. The home located at 2 Feather Lane was not tested. In their January 2003 report, fungal spores were identified along with other antigens such as biological materials, human cells, dust, dirt, and debris. The industrial hygienist concluded it was not necessary to test the fourth home.

The assessment team specializes in construction and building performance. The team's inspection of the homes focused on the construction and performance of the building as it related to the prevention of water damage. This approach was based on the fact that mold contamination, in every case, resulted from elevated moisture loads and water damage. Reducing moisture loads and preventing water damage is crucial to preventing mold contamination.

The assessment team does not have expertise in medical diagnosis, and does not offer opinions on health symptoms and their causes. That is best left to the medical community.

There are known health impacts from mold exposure, though the science is far from complete in providing a full understanding of the extent and mechanics of these health impacts. A brief summary of health effects from mold include the following:

- Molds produce protein allergens that are capable of causing allergic reactions in people. An estimated 6-10% of the general population is sensitized to mold allergens. Around 15-20% of people prone to atopic allergies are sensitized to mold allergens. Typical allergic reactions such as, runny nose, sneezing, headaches, etc., can result. For those sensitized, it is clear that mold plays a role in the exacerbation of asthma symptoms. A rare but more serious immune-related condition, hypersensitivity pneumonitis, may follow exposure (usually occupational) to very high concentrations of mold.

- Some molds produce toxic material known as mycotoxins. The health impacts of exposure to mycotoxins, as compared to allergic reactions, are less clear. Studies
of relatively high dose exposures in agricultural, occupational, and food processing settings show a substantial relationship between mycotoxins and adverse health effects. Studies that examine exposure to mycotoxins in indoor air, however, are limited. There is some evidence that mycotoxin exposure in the indoor environment can result in adverse respiratory health, and there are case studies with association to non-specific symptoms, such as flu symptoms, sore throat, etc. Some of the more publicized claims of toxic reaction to mold exposure are anecdotal, however, and are not yet supported by research results. The impact of mycotoxins on human health is currently a hotly debated topic both within and without the medical community.

The American College of Occupational and Environmental Medicine (ACOEM) has recently prepared an “Evidence Based Statement” entitled, *Adverse Human Health Effects Associated with Molds in the Indoor Environment* (www.acoem.org/guidelines). This paper provides a good overview on the current state of research into the known effects of mold on health. The paper states:

> The present alarm over human exposure to molds in the indoor environment derives from a belief that inhalation exposure to mycotoxins cause numerous and varied, but generally nonspecific symptoms. Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in the home, school, or office environment. (p. 2)

In addition to mold, there are many other potential indoor pollutants that can cause or contribute to the allergenic and adverse health symptoms reported. Pesticides; VOCs, volatile organic compounds such as solvents, strong cleaners, degreasers, many others; bacteria; insects such as, dust mites and cockroaches; combustion gases; plant pollens; and animals are some of the potential pollutants to the indoor air and settled dust within a building.

The site investigation did not disclose any severe mold or moisture problems, and concluded that the moisture conditions that had led to previous mold contamination are being addressed. The team’s investigation, however, was not a comprehensive examination of indoor environmental air quality. It is beyond the team’s scope and area of expertise to either suggest or refute that the reported symptoms by the residents are caused by one or more indoor environmental agents, or to draw any conclusions on what those agents may be, whether mold or any other contaminant. Ultimately, this is a medical question. The ACOEM paper provides the following guidance in this regard:

> When patients associate health complaints with mold exposure, treating physicians should evaluate all possible diagnoses, including those unrelated to mold exposure, i.e., consider a complete appropriate differential diagnosis for the patient’s complaints. To the extent that signs and symptoms are consistent with immune-mediated disease, immune mechanisms should be investigated. (p. 7)
PROGRAMMATIC RECOMMENDATIONS

A particular challenge to all housing authorities is the development of a service-delivery system to effectively address mold and moisture conditions in a prompt fashion. This requires a partnership between the housing authority and residents. A system could include training for the maintenance staff on how to implement the technical recommendations and training for residents on their roles and responsibilities as renters and homeowners. In many cases, moisture problems develop, but go unreported and unrepaired, which results in significant molds contamination that could have been avoided. Some strategies follow:

1. Require attendance at annual homeowner/renter clinics as part of the annual recertification process. These clinics could provide instruction on home maintenance issues, such as identifying and repairing leaks and gutter maintenance.

2. Ask occupants to complete a survey based on Housing Quality Standards (HQS) with additional questions on mold and moisture conditions in their homes during the annual recertification process. Having the residents complete the survey further engages them in their own home maintenance. Furthermore, the survey responses would provide additional information to the housing authority on any unreported problems, especially leaks and inoperable fans, that may contribute to an unsafe, unhealthy home environment.

3. Contact the Tribe's Regional EPA Office to request technical assistance in further researching indoor air quality issues. The EPA's web page: www.epa.gov/ebtpages/humanhealtheffects.html provides information on the EPA studies of human health effects from chemical and other pollutants.
TECHNICAL HOUSING ASSESSMENT REPORT

EXAMINING MOLD AND MOISTURE CONDITIONS OF HOMES AND THE CHILD DEVELOPMENT CENTER ON THE LAC VIEUX DESERT RESERVATION

Executive Summary

Introduction

Section 1: Methodology

Section 2: House Description

Section 3: Findings

Section 4: House 2.8

Section 5: Technical Recommendations

Appendix A: Site Visit Summary Form

Appendix B: Housing Survey Results
EXECUTIVE SUMMARY

Fifteen homes were inspected for mold and moisture problems on the Walker River Reservation. The investigation was conducted from January 27th through January 29th, 2003, by Building Research Council (BRC) staff member Kate Brown. She was accompanied by Paul Knight of Magna Systems; Jennifer Bullough, Government Technical Monitor with HUD’s Office of Native American Programs; and Andrea Horn of Indian Health Services.

Moisture problems were found in seven of the inspected homes. Most of these problems were minor in nature and can be corrected by the maintenance staff. Moisture problems were due primarily to disconnected dryer vent hoses, leaking plumbing, and ineffective or inoperable bathroom exhaust fans. The Walker River Housing Authority has started taking steps to eliminate moisture problems by replacing existing bathroom fans. The original windows are also being replaced.

Visible mold was found in two homes, although eleven of the fifteen occupants interviewed reported seeing minor amounts of mold in the past. The occupants took the initiative and cleaned up the affected areas. The mold was generally reported to be around windows, kitchen sinks and on bathroom ceilings. Many of the occupants reported to have wiped wind-driven rain from around some of the original windows. Three of the inspected homes were tested for mold by an independent environmental consultant prior to the team’s inspection.

Six of the fifteen inspected crawl spaces were considered wet; and the wetness could be contributing to mold growth in the homes, although no mold was found in any crawl spaces. However, none of the moisture problems found in the crawl spaces were severe and could easily be remedied.

Other potential indoor air quality and duct system problems were found during the site visit and will be noted in the report. Principal findings from the site inspections include:

1. The Walker River Housing Authority appears to respond promptly to complaints and problems regarding mold and moisture. Most of houses inspected had only past mold and moisture complaints.

2. Continue with bathroom exhaust fan replacement. Consideration should be given to using low-sone (quiet) fans.

3. Kitchen range hoods are original and should be replaced. Though the fans vent outside, the fans are either non-operational or minimally effective.

4. Continue window replacement program.

5. Inspect dryer vent connections in crawl spaces on periodic basis.
6. Conduct house depressurization tests following exhaust fan and/or window replacement to ensure proper draft of the wood space heaters.

7. Site drainage and gutter systems were poor to non-existent. This is not a major concern given the climate. However, short-term drainage problems and crawl space leakage may occur if heavy rains occur in a short period of time.

8. Crawl spaces were not a significant source of moisture. Moisture problems found in the crawl spaces can easily be solved.

This report provides technical recommendations and 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

The Building Research Council (BRC) responded to a request from the Eastern/Woodlands Office of Native American Programs to assess site and structural conditions contributing to mold and moisture problems on the Walker River Reservation. The investigation was conducted on January 27th through January 29th, 2003, by BRC staff member Kate Brown. She was accompanied by Paul Knight of Magna Systems; Jennifer Bullough, Government Technical Monitor with HUD’s Office of Native American Programs; and Andrea Horn of Indian Health Services. Charlie Quartz of the Walker River Housing Authority escorted the inspection team. The houses were pre-selected by the Housing Authority.

A total of fifteen houses were inspected. Visible mold was found in two homes, although eleven of the fifteen occupants interviewed reported seeing minor amounts of mold in the past. The occupants took the initiative and cleaned the affected areas. The mold was generally reported to be around windows, kitchen sinks and on bathroom ceilings. The Housing Authority had already started the process of replacing bathroom exhaust fans and the windows in this set of homes. Three of the homes were tested for mold by an independent environmental consultant hired by the Housing Authority prior to the team’s inspection.

SECTION 1 – METHODOLOGY

Visual inspection was used to assess mold and moisture conditions in the homes.

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 Appendix A of this report. Findings for individually inspected houses are presented in Appendix B.

- Visual Inspection

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

The exterior of the houses were inspected for rainwater 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 that could be offered.
Digital photographs were taken at each house to visually record notable conditions. 

**Measurements**

Moisture content measurements were taken of wood piers in crawl spaces where moisture was thought to be a problem. Because of the storage capacity of wood, moisture content measurements provide information on foundation and basement/crawl space wetness in the recent past, perhaps three weeks to a month. Moisture content readings can range from 5%, a very dry reading to 30%, a very wet reading.

Actual ventilation rates of bathroom fans were measured with an exhaust fan flow meter. The flow meter consists of a gasketed pan that is placed tightly over an operating exhaust fan. The pan has a variable orifice and a connection for a digital manometer. The manometer measures the pressure difference between the pan and the house during fan operation. Based on the setting of the variable orifice and the measured pressure difference at the fan, the cubic feet of air per minute (CFM) exhaust by the fan is calculated (Figure 1).

Depressurization of the living space in which the wood stove was located was measured in two homes. Windows were closed and all exhaust devices were operated. Depressurization was measured with a digital manometer. Significant depressurization indicated that insufficient air might be available to support combustion and venting of the wood space heater.

**SECTION 2 – HOUSE DESCRIPTION**

The fifteen inspected homes were part of a twenty home development known as NV8-10. The homes were built in 1986. Mold was not reported in the homes until July 2002. All of the homes were of modular construction consisting of two, three and four bedroom units. Most of the homes were located on two adjoining streets. Homes were approximately 1,150 ft². Sidewalls were of 2” x 6” construction. The homes were one-story ranches built over crawl spaces.

Crawl space foundation walls were poured concrete and insulated on the interior with 1-1/2” foam insulation board (R10.8). The floor above the crawl space was insulated with R19 fiberglass batts and covered with an air barrier type material. The main supply air ducts were insulated and located within the crawl space. Plumbing lines were also present in the
crawl spaces. Crawl spaces were vented with four vents. A metal hatch covered the access to the crawl space from the exterior of the house. The homes were supported by metal piers sitting on top of concrete footings (Figure 2).

Attics were insulated to R42 with blown rock wool insulation. Roofs were constructed with trusses. Truss members are 1-1/2” x 1” actual wood members. Roof ventilation was provided by gable vents located at the sides of the roof cavities. Attics could not be accessed given the size of the gable vent openings, space between roof truss members and numerous roofing nails protruding through the sheathing. Gable vents were removed and the attics were visually inspected through the vent opening. Bathroom and kitchen exhaust fans were vented to the outside through the roof.

Furnaces were direct vent sealed combustion with an estimated annual efficiency of around 80%. Furnaces were original and were fueled by propane. Given the high cost of propane, about $1.00/gallon, all but two of the inspected homes had wood stoves as the primary heating source (Figure 3). Furnaces were not used in six homes and the wood stove was the only heating source. Water heaters were natural draft and located in closets accessible from the outside (Figure 4).

Swamp coolers (Figure 5) located on the roof provided cooling. Outside air was drawn into the cooler and distributed to the house through a register located directly beneath the swamp cooler in the center of the home. The coolers should be covered during the heating season to prevent heated air from escaping from the home. About half of the swamp coolers observed during the inspection were covered.

SECTION 3 – FINDINGS

3.1 Bathroom Fans

Original bathroom fans were found in three of the homes (Figure 6). These fans were either non-operational or measured 0 CFM exhaust flow. The Housing Authority recognized that reported bathroom mold problems were due in large part to the
ineffectiveness of the original bathroom fans and started replacing these fans with exhaust fans that were rated at 180 CFM. The Housing Authority had replaced these fans in eleven of the fifteen inspected homes. These fans were being installed in all bathrooms and, in some cases, the utility room. The measured exhaust usually ranged between 140 CFM and 160 CFM, which was more than twice the usual ventilation required in bathrooms.

Though the new fans were effective, they were loud with a sone rating of 5.0 (sone is a sound rating – low sone fans with sone ratings of 1.5 or under are considered quiet). Occupants might object to the noise and subsequently not use the fans. It was recommended that low sone fans be used whenever possible. One homeowner had replaced her bathroom fan with a low sone model (sone rating of 0.5) that included an integral fluorescent light (Figure 7). The unit was rated at 70 CFM and 61 CFM was measured.

All bathroom fans are vented through the roof. One exhaust fan duct was found disconnected at the roof (house 2.3).

### 3.2 Kitchen Range Hoods

The exhaust CFM from the kitchen range hoods could not be measured as the exhaust fan flow hood did not properly fit over them. We simply placed our hands over the openings to gauge airflow. Airflow was very weak and the fans were loud.

Range hoods should be replaced whenever possible and venting to the outside should be maintained. The hoods should have a minimum exhaust capacity of 150 CFM. BRC is aware of only one manufacturer that offers low sone exhaust hoods. Under no circumstances should recirculating fans be installed in place of the existing range hoods.

### 3.3 Window Replacement

The original windows were double glazed metal sliders. Windows units have pulled away from the rough openings and sashes fail to seal properly when closed. Occupants have reported window condensation problems as well as entry of wind driven rain.

The Housing Authority has started a window replacement program for the homes. Four of the inspected homes had new double glazed vinyl sliding windows. Given the moisture problems due to the original windows, the replacement window program should continue.
3.4 Dryer Vents

Dryer vents extend through the crawl space before venting to the exterior. Two vents were found to be disconnected in the crawl space. The crawl spaces were wet near the disconnected hose (Figure 8). These two homes were also tested for mold by Rinaldi Environmental Consultants.

A third vent was found disconnected at the dryer (Figure 9), although no moisture problems were apparent behind the dryer or in the crawl space.

Dryer vents are ribbed plastic or metal flex. The plastic vent can dry and crack over time. Both the plastic and metal flex are subject to dips and sags as they are hung from the floor above the crawl space. The ribbed vent, dips and sags, as well as bends and elbows all increase static pressure in the system. The higher the static pressure, the more difficult it is for the dryer to push the air outside and the more difficult it is to dry the clothes.

3.5 House Depressurization Tests

Combustion appliances require air for proper combustion and ventilation of combustion gases. Furnaces are sealed combustion drawing their air directly from the outside and the water heaters are located in an exterior closet with combustion air grilles in the closet door. The only combustion appliance in most of the homes was the wood space heater.

Combustion air was provided to the wood heaters through a 4-inch diameter ribbed duct located in the crawl space. Though combustion air was being provided to the wood heaters, there might be insufficient combustion air following the replacement of the exhaust fan and window. As a result, depressurization of the home may occur resulting in combustion gases backdrafting into the home. Depressurization of 10 pascals (equal to 0.04 inches of water) could cause backdrafting of a wood stove.

House depressurization tests were done in two homes to measure the potential for backdrafting. All windows and exterior doors were closed and all exhaust fans, including the clothes dryer, were turned-on. House pressure with respect to the outside was then measured.

Depressurization was measured at 0.3 pascals in house 2.2. The original windows were still in place. Exhaust fans were turned on and make-up air could be felt beneath the swamp cooler grille, even though the cover was on the cooler. This would indicate that
depressurization may not be an issue in this home when the windows are eventually replaced.

Depressurization was also measured at house 2.4. All exhaust fans were turned-on (there was no clothes dryer in the house). The windows had been replaced and there was no cover on the swamp cooler. Depressurization went from 0.1 (everything turned-off) to 2.5. Make-up air was felt beneath the swamp cooler grille. This number is sure to increase if a clothes dryer is placed in the home, and if a cover is placed over the swamp cooler.

It was highly recommended that a simple depressurization test, requiring only a pressure manometer, be done by a mechanical contractor or maintenance staff, following exhaust fan and window replacement. House depressurization is likely to increase further if kitchen exhaust fans are replaced. Further, it was noted that the occupants in a few homes had sealed the swamp cooler grille thus eliminating that as a source for make-up air which would further increase depressurization of the home.

Should depressurization begin to approach 10 pascals, provisions for make-up air to the house should be provided. This can include increasing the diameter of the duct providing combustion air to the wood heater or installing a passive vent that opens when exhaust fans are being used.

### 3.6 Site Drainage and Gutter Systems

All of the inspected homes had poor site drainage with no gutter systems. A small gutter and downspout were used for overflow from the swamp cooler (Figure 10). These were not considered significant problems given the climate and lack of precipitation. In fact, homeowners often build landscaping dams around plant beds adjacent to the home to hold water for the plants (Figure 11). However, rainwater from a strong storm could collect in these plant beds and eventually leach into the crawl spaces causing short-term moisture problems.
3.7 Crawl Spaces

Six of the fifteen inspected crawl spaces were considered wet. In two cases, disconnected dryers vents were the source of moisture (houses 1.2 and 2.9). A water heater leak was the source in another case (house 2.3). A possible leak on the water supply line (Figure 12) was the source in another (house 1.1). Condensation from a water line was a source in another (house 1.4). Damp cardboard boxes used for storage and a pan, full of water, were found in the sixth crawl space (house 1.5). None of these issues were considered severe and could easily be corrected.

Wood piers located down the middle of the homes were used for support. Water stains were observed on some of these piers, but no mold was found on any of them (Figure 13). The wood piers were the only wood present in the crawl spaces.

Crawl spaces were vented with four vents. A number of these vents were located at or just above grade. Water from the plant bed could drain into the crawl space from rain or from plant watering.

SECTION 4 – HOUSE 2.8

A unique indoor air quality problem was discovered in house 2.8 that warranted a separate discussion. The house was one of two 2-bedroom homes inspected. The furnace in the 2-bedroom units was located in a closet accessible only from the exterior of the home (Figure 14). A duct connected a central return grille located in the utility room to the furnace. Supply air was provided through a duct system located in the crawl space that was similar to the other homes.

The occupant had complained of high fuel bills and a chronic problem of dirt build-up throughout the house. The furnace had not been used in seven years because of the fuel bills. Dirt build-up was visible on the exhaust fan grille, even...
though the fan was installed three weeks prior. The occupant complained of drafts through the return air grille and had taped newspaper over it (Figure 15).

An examination of the furnace indicated that there was no return air duct. The return air grille was open to the furnace closet which in turn was open to the outside through a louvered door. This would explain the cold air coming in through the return air grille. This would also explain the high fuel bills for the home.

However, the supply ducts were also open to the exterior through the open return air cabinet on the furnace. The supply registers were very dirty even though the dampers were closed. A simple test was conducted to determine if the supply ducts could be the passageway for dirt entering the home. One supply register was sealed. A baseline pressure of -0.1 pascals was measured between the house and register. The bathroom fan, kitchen fan and clothes dryer were turned-on. The pressure dropped to -3.0 pascals indicating that the supply ducts were providing make-up air from the outside whenever the exhaust fans or clothes dryer were being used. Both the high fuel bill and dirt problems can be solved if the return air grille is connected to the furnace.
SECTION 5 – TECHNICAL RECOMMENDATIONS

The following recommendations are based on the site visit findings.

5.1 Bathroom Fans

Bathrooms and kitchens generate large amounts of water. Properly operating exhaust fans remove moisture from these spaces. Recommendations regarding bathrooms include:

- Replace original exhaust fans. New bathroom fans should have sone ratings no higher than 1.5. Low-sone fans include Broan Solitaire and Panasonic WhisperCeiling and WhisperLite series. Low-sone fans generally cost between $75 and $100.

- In some cases, a through the wall exhaust fan may be appropriate. One such fan is the Panasonic WhisperWall unit (70 CFM, 1.1 sones).

- Replace existing bathroom light/fan switch with a fan delay timer. The fan delay timer is a two-function switch that is typically wired to a fan and a light. When the switch is turned on, both the light and exhaust fan are turned on. When the switch is turned off, the light is turned off but the fan continues to operate for an extended period of time. The extended period of time can be adjusted from 1 to 60 minutes. Fan delay timers are about $35.00.

- Inspect all bathroom and kitchen exhaust fan ducts. Ensure that exhaust ducts are properly attached and sealed to the exhaust fan housing. All ducts should terminate outside the house and not below roof vents.

5.2 Kitchen Exhaust Fans

Kitchen exhaust fans should also be replaced. Kitchen exhaust fans should be rated at 150 CFM and should be vented to the exterior. Under no circumstance should the replacement fans be recirculating. Kitchen fans generally do not have sone ratings. However, the Broan Allure series has sone ratings ranging from 0.4 to 1.5.

5.3 Window Replacement

The U.S. Department of Energy recommends that windows in the Walker River Housing Authority climate have the following characteristics:

- U-value of 0.40 or less

- Solar Heat Gain Coefficient (SHGC) of 0.55 or less

U-value measures the rate of heat loss through the window unit. It is important that the U-value of the window unit be considered as opposed to just the U-value of the glazing.
The glazing may have a good U-value whereas the window frame may have a poor U-value. The window unit U-value considers both the glazing and frame. The lower the U-value, the better the insulating value of the window.

The Solar Heat Gain Coefficient (SHGC) measures the fraction of solar radiation admitted through a window. SHGC coefficient is expressed as a number between 0 and 1.0. The lower a window’s SHGC, the less solar heat it transmits.

These windows address both heating and cooling needs in this climate. The windows are designed to keep heat in on cooler days and keep heat out on warmer days. They usually have non-metal frames such as wood, vinyl, or fiberglass; at least 2 panes, which are sometimes filled with argon; and a low-E coating. Low-e (low-emittance) coatings are highly reflective, transparent coatings applied to the window glazing. Because they are designed to reflect long-wavelength infrared radiation, less heat is transferred through the window either from the home or the outside.

The windows should be certified by the National Fenestration Rating Council (NFRC) as meeting this criteria (Figure 16). The Energy Star web site www.energystar.gov can be used to search for qualifying windows by location.

**5.4 Dryer Vents**

Dryer vents should be inspected on a regular basis to ensure proper connections and no clogging. When the existing ribbed vents require replacement, the following criteria should be considered:

- Use aluminum or galvanized sheet metal rather than plastic ribbed vents
- Aluminum flex duct (UL labeled “Clothes Dryer Transition Duct”) can be used for up to 8’ to make a transition
- Use high quality foil tape or approved clamps
- Do not use duct tape, screws or rivets
- Utilize a vent cap with a back draft damper
- Do not use a metal cage on the vent cap as this can become clogged with lint (Figure 17).
5.5 House Depressurization Test

It is highly recommended that a simple depressurization test be done by a mechanical contractor or maintenance staff following exhaust fan and window replacement. A pressure manometer (Figure 19) and a piece of tubing is all that is required.

The test procedure is described:

- Set-up house for winter conditions. All windows and exterior doors should be closed. All interior doors should be open. Exhaust fans, dryer and furnace should be turned-off. The wood space heater may continue to operate.

- Connect a length of tubing to the reference tap on the manometer. Place the other end of tubing outside under an exterior door. Try to avoid crimping the tubing.

- Leave the input tap open.

- While standing near the wood space heater, measure the baseline pressure reading. This will generally be under 1.0 pascal, unless it is windy. If it is windy, try placing the tube under a door or through a window on the leeward side of the home. Record the baseline reading.

- Turn on all exhaust fans and clothes dryer. Record pressure reading.

- If occupants use the furnace, turn on the furnace air handler while leaving all the exhaust fans and dryer on. Record the pressure reading.

- If the difference between the baseline pressure and the other two pressure readings is 10 pascals or greater, make-up air is needed for the home. Similarly, if you smell smoke at a lower pressure difference reading, make-up air is required.

- Make-up air may be provided by increasing the wood space heater combustion air duct diameter or providing a passive air inlet in a wall (similar to a dryer vent, but the damper swings in the opposite direction).
5.6 Site Drainage and Gutter Systems

Given the low level of precipitation received in this climate, site drainage and gutter systems are not significant items. However, there may be short-term drainage problems if a large amount of rain occurs during a short period of time. Many of the planter beds are intentionally dammed to collect and hold rain water as well as plant irrigation water (Figure 20). This water could eventually leak into the crawl space. The following recommendations are made with these items in mind.

- Block and seal crawl space vents that are at or near grade. The vents do little other than allow water to drain into the crawl space (Figure 21).

- Install elbows and splash blocks at the base the downspout to direct water away from the home. It was apparent that plant life was abundant near some of these downspouts (Figure 22).

- Where dammed plant beds are not present, site grade to allow water to drain away from the home. The ground adjacent to the home should be sloped away from the house at a minimum of 5% slope. Six inches of fall in the first 10' away from the house gives a 5% slope.

- Fill any holes or dips in the soil immediately adjacent to the crawl space. Identify localized dips and holes immediately adjacent to the foundation and fill with dirt. Tamp the fill material to prevent future settling. Provide sufficient fill material such that drainage occurs away from the foundation.
5.7 Crawl Spaces

The thermal boundary is the building section that separates conditioned space from outside space conditions. A clear distinction should be made whether the crawl space walls or the floor above the crawl space is the thermal boundary for a home. Insulation on the foundation indicates that the foundation walls form the thermal boundary. By the same token, the floor above the crawl space is also insulated indicating that the floor could also be considered the thermal boundary. The presence of crawl space vents also indicates that the floor above the crawl space is the thermal boundary.

It is our recommendation that the walls be considered the thermal boundary as ductwork and plumbing are present in the crawl spaces. With that in mind, the following recommendations are made:

- If repair work is done to the floor, do not replace the floor insulation. The insulation does nothing with respect to saving heating and cooling dollars.

- Seal the crawl space vents. As noted earlier, the vents may serve as a sluice allowing water to drain into the crawl space. Leaving the crawl space vents open is analogous to leaving a window opening during the winter.

- Crawl space wall insulation should be inspected and replaced when missing or damaged.

- Crawl space should be inspected on a regular basis for signs water entry, plumbing leaks and disconnected dryer vents.

- Lighting should be installed in the crawl spaces to facilitate inspections.
Sign-In Sheet – Mold Study/Training

1. Jack Blockwood
2. Bonnie Hughes
3. Manny Hicks
4. Mary Williams
5. Charles Fanch
6. Michael Castille
7. Bill James
8. Carl Blevins
9. Dick McCandless
10. Kate Brown
11. Paul Knight
12. Melanie McFall
13. Tad Williams
14. Shirley Stool
15. Ray Loforte
16. Jerry Jones
17. Beatrice Gilligan
18. Jennie Bullough HUD
19. 
20. 
21. 
22. 
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<th>Building Age</th>
<th>Occupancy</th>
<th>Foundation Type</th>
<th>Model Type</th>
<th>Heat Type</th>
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<th>Site Drainage Problems</th>
<th>Gutter System Problems</th>
<th>Wet 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>
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MH = mutual help	TK = Turnkey/Rent to Own

LR = Low Rent

*CFM reading taken in main bathroom.
Appendix B, Walker River Technical Assessment Report

February 25, 2003

Inspection Number: 1-1
Address: 21 Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane
FA back-up
Construction: 2" x 6", modular

Mold and Moisture Conditions: The crawl space floor was wet in one corner. One wood pier was wet and the others had water stains. Moisture content of one pier was 30% (closest to the wet corner). The other piers measured 15% (5% indicates very dry, 30% indicates very wet). Mold was not found in the home or in the crawl space.

Rainwater Management: Site grading immediately adjacent to the home was flat. The only gutter provided drainage from the swamp cooler overflow (Figure 2). There was one downspout from the gutter and no leader or backsplash at the base of the downspout. Some drip lines were visible around the house (Figure 3). Two of the four crawl space vents were at grade.

Crawl Space: The ground in the corner near the water supply line was damp (Figure 4). It could not be determined if the source of the water was from a leak in the water supply line or if it was site drainage. There was abundant plant life near that corner of the house and the grade was very flat. It was reported that the exterior hose bib leaked and had been repaired, but the wet ground was not in the vicinity of the hose bib. Water stains were found on the base of the wood piers (Figure 5). No mold was found in the crawl space.

Bathroom/Kitchen: No mold was found in the bathroom or in the kitchen. Bathroom exhaust fans were recently replaced with a model rated at 180 CFM. The master bathroom fan measured 145 CFM. The fan in the main bathroom measured 130 CFM.
The original kitchen exhaust fan vented to the outside. The fan appeared to be moving little air.

**Attic:** The attic was insulated with 12” (R42) of blown rock wool. The attic was vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members, and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

**Occupant Notes:** The one occupant, a 100% disabled, retired, army nurse, had been a renter since November 2002 and had reported no mold problems. The wood stove was the primary source of heat. The owner reported a leaky faucet on the outside front of the house. The wood stove chimney leaked when there was a hard rain. At times during the winter, there was some condensation on the inside windows. The current occupant had one dog.
Appendix B, Walker River Technical Assessment Report

Inspection Number: 1-2
Address: 13 Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane FA back-up
Construction: 2” x 6”, modular

Mold and Moisture Conditions: The crawl space floor was very wet in one corner where the dryer vent was disconnected. Mold was found in the bathroom. The occupants reported mold on bedroom windowsills, in both bathrooms and on the window above the kitchen sink. Windows were in poor condition. The original exhaust fans were non-operational.

Rainwater Management: Site grading immediately adjacent to the home was flat with drainage into planting bed (Figure 2). The only gutter provided drainage from the swamp cooler overflow. There was one downspout from the gutter and no leader or backsplash at the base of the downspout.

Crawl Space: The dryer vent was disconnected and the ground in that corner of the crawl space was very wet (Figure 3). The dryer was being used at the time of the site visit. The smell of clean clothes was very apparent as soon as the crawl space access hatch was removed. Two of the crawl space vents were at grade (Figure 4).
Bathroom/Kitchen: Mold was found in both bathrooms (Figure 5) and above the kitchen sink (Figure 6). Both bathroom exhaust fans were original and non-operational. The original kitchen exhaust fan was ineffective and appeared to be moving little or no air. Water stains were found beneath the kitchen sink (Figure 7).

Attic: The attic is insulated with 12 inches (R42) of blown rock wool. The attic was vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent. There appeared to be a roof leak around the wood stove vent.

Occupant Notes: There were five occupants; two adults and three children ages 17, 12, and 5. The occupants reported mold on the bedroom windowsill, in both bathrooms and on the kitchen window above the sink. The mold was cleaned with bleach and comes back in the same spots. There was a runny toilet. The plumbing seal under the toilet may be responsible for the leak. The windows had broken seals and resulted in dust and dirt coming in through the windows. The occupant provided day care for six children in the home. The occupants had respiratory problems including asthma and other assorted allergies. The home was one of the four homes tested for mold spores by an independent environmental consultant. The family had resided in the home for 14 years.
Appendix B, Walker River Technical Assessment Report

February 25, 2003

Inspection Number: 1-3
Address: 18 Drum Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Propane FA
Construction: 2” x 6”, modular

Mold and Moisture Conditions: The crawl space was dry. Mold was not found in the home nor has the occupant reported any mold problems.

Rainwater Management: Site grading immediately adjacent to the home is flat. The only gutter provides drainage from the swamp cooler overflow (Figure 2). Drip lines from the roof were also visible (Figure 3).

Crawl Space: The crawl space was both dry and clean.

Bathroom/Kitchen: Both bathroom fans had been replaced. The master bathroom fan measured 152 CFM and the main bath fan measured 139 CFM. The original kitchen exhaust fan vented to the outside.

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: There were two adults and one teenager in the home. There had been no reported health problems. There had been no reports of mold problems. The occupants had lived in the home for 16 years and had been the only occupants.
Inspection Number: 1-4  
Address: 1 Feather Lane  
Age: 16 years  
Type: Mutual Help  
Condition: Occupied  
House Type: Ranch  
Bedrooms: 2  
Foundation: Crawl space/poured concrete  
Heat Type: Wood stove with propane FA back-up  
Construction: 2" x 6", modular

**Mold and Moisture Conditions:** There was some dampness in the crawl space beneath water supply lines that appeared to be condensation. New vinyl replacement windows have been installed. Mold was not found in the home nor has the occupant reported any mold problems.

Unlike other homes in the development, the furnace for this two-bedroom home was located in a closet accessed from the exterior of the home. A central return was ducted to the furnace. The water heater vent was dislodged (Figure 2) but was corrected by maintenance staff during the site inspection.

**Rainwater Management:** Site grading immediately adjacent to the home was flat with drainage into planting bed. The planting bed was dammed (Figure 3).

**Crawl Space:** The crawl space floor was a slightly damp beneath a water supply line.

**Bathroom/Kitchen:** The bathroom fan had been replaced and measured 132 CFM. The original kitchen exhaust fan vented to the outside.

**Attic:** The attic was insulated with 12" (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

**Occupant Notes:** The two occupants reported no mold in the home or health or respiratory problems. They have lived in the home for seven years.
Appendix B, Walker River Technical Assessment Report

Inspection Number: 1-5
Address: 5 Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane FA back-up
Construction: 2" x 6", modular

Mold and Moisture Conditions: Occupants have reported mold and have cleaned it. The bathtub faucet was leaking and a rag was placed beneath the leak to eliminate the sound. The rag was moldy (Figure 2). The crawl space was used for storage and was damp. The windows have been replaced.

Rainwater Management: This was the only inspected home with full gutters on both sides of the home. One downspout was missing, as was a splash block (Figure 3). Site grading immediately adjacent to the home was flat with some drainage into planting bed. The planting bed was dammed.

Crawl Space: This was the only inspected home where storage was found in the crawl space (Figure 4). Some items were stored in cardboard boxes that were deteriorating. A pan full of water was also found in the crawl space (Figure 5).

Bathroom/Kitchen: The master bathroom fan had been replaced and measured 158 CFM. The main bathroom fan had not been replaced and was inoperable. The original kitchen exhaust fan vented to the outside.

Attic: The attic was insulated with 12" (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Figure 1 - 5 Feather Lane
Figure 2 - Leaking faucet with moldy rag
Figure 3 - Downspout with cardboard splash block

Building Research Council
Occupant Notes: The two adult occupants have reported asthma and have a history of diabetes. They have lived in the home since the summer of 2002.
Inspection Number: 1-6
Address: 17 Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 4
Foundation: Crawl space/poured concrete
Heat Type: Wood stove
Construction: 2” x 6”, modular

Mold and Moisture Conditions: Although no visible mold was found, the occupants had reported mold in the past and had cleaned it. The wood stove was the only heat source as the furnace was not used. Windows have been replaced. The crawl space was dry.

Rainwater Management: Site grading immediately adjacent to the home was flat with drainage into planting bed. The planting bed was dammed (Figure 2).

Crawl Space: The crawl space was dry. The main supply duct was disconnected (Figure 3). This was not an energy issue unless the furnace was reactivated. However, the disconnected duct system may serve as a path for dirt and mold spores to enter the home.

Bathroom/Kitchen: The exhaust fans have been replaced. The master bathroom fan measured 158 CFM. The original kitchen exhaust fan vented to the outside.

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: The two occupants reported leaks around the wood stove vent. There had been some mold around the kitchen sink window. The caulk was replaced to solve the problem. The occupants reported some mild allergies. They have been the only occupants of the home.

Building Research Council
**Inspection Number:** 2-1
**Address:** 7 Black Mountain
**Age:** 16 years
**Type:** Mutual Help
**Condition:** Occupied
**House Type:** Ranch
**Bedrooms:** 3
**Foundation:** Crawl space/poured concrete
**Heat Type:** Propane furnace
**Construction:** 2” x 6”, modular

**Mold & Moisture Conditions:** Although no visible mold was found, the occupants have reported mold in the past and have cleaned it. Reported mold was found in the master bathroom, on the window behind the kitchen sink and in the main bathroom. Water stains were found in the bathrooms. Exhaust fans have been replaced. There was a leak around the wood stove vent. Windows have not been replaced. The crawl space was dry.

The wood stove was removed in 2001 and the furnace was the only heat source. New ductwork and registers were installed at the time. The old ductwork was left in place and the old registers were sealed.

**Rainwater Management:** Site grading immediately adjacent to the home was flat. A crawl space vent was located just above grade (Figure 2).

**Crawl Space:** The crawl space was dry.

**Bathroom/Kitchen:** The bathroom exhaust fans had been replaced. In addition, an exhaust fan was installed in the utility room. The master bathroom fan measured 163 CFM, the main bathroom fan measured 145 and the utility room fan measured 150. The original kitchen exhaust fan vented to the outside, but is very slow to start.

**Attic:** The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

**Occupant Notes:** For 5½ years, four occupants, 2 adults and 2 children, 4 and 10, have reported respiratory problems including allergies, asthma and sinus problems. The 10-year-old daughter had complained of stomach problems. Two dogs and a rabbit in a cage live outside. They reported no health problems before moving into the home. This home was tested for mold spores by the independent environmental consultant.
Appendix B, Walker River Technical Assessment Report

Inspection Number: 2-2
Address: 25 Black Mountain
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove
Construction: 2” x 6”, modular

Mold & Moisture Conditions: Although no visible mold was found, the occupants had reported mold in the past in the master bedroom bathroom and had cleaned it. A leaky faucet was also found in the master bathroom. Exhaust fans had been replaced. Windows had not been replaced. The crawl space was dry. The water heater vent was dislodged and was repaired by maintenance staff during the site inspection (Figure 2). House depressurization was measured in this home (see Section 3.5, House Depressurization Tests).

Rainwater Management: Site grading immediately adjacent to the home was flat.

Crawl Space: The crawl space was dry.

Bathroom/Kitchen: The bathroom exhaust fans had been replaced. In addition, an exhaust fan was installed in the utility room. The master bathroom fan measured 145 CFM, the main bathroom fan measured 116 and the utility room fan measured 158. The original kitchen exhaust fan vented to the outside.

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: Two adults and one child, 3 years old, lived in the home. The occupants had reported mold in the master bathroom. They had no reported health problems, however complain of frequent colds. They had lived in the home for 7 years.
Appendix B, Walker River Technical Assessment Report

Inspection Number: 2-3
Address: 16 Drum Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 4
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane FA back-up
Construction: 2” x 6”, modular

Mold and Moisture Conditions: The water heater was leaking. The floor beneath the water heater was very wet as was the crawl space beneath the heater (Figure 2). Signs of water entry were also found at the base of the partition wall between the water heater closet and the utility room (Figure 3). Occupants reported mold above the kitchen sink, in the bathrooms and in a bedroom but had cleaned it.

Rainwater Management: Site grading immediately adjacent to the home was flat.

Crawl Space: The crawl space was very wet beneath the water heater.

Bathroom/Kitchen: The original bathroom exhaust fans were non-operational. The kitchen fan was slow to start. A bathroom fan exhaust duct had become dislodged from its vent at the roof (Figure 4).

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: There were four occupants in the home; two adults and two children, 16 and 14. The occupants have lived in the home for 16 years and have been the only occupants. The occupants reported respiratory problems include; the daughter and son both have asthma, the husband has allergies, and the wife experienced respiratory problems on occasion. The occupants expressed other worries and complaints about the home.
Inspection Number: 2-4
Address: Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane FA back-up
Construction: 2” x 6”, modular

Mold & Moisture Conditions: Although no visible mold was found, the occupants have reported a very small amount of mold in the past and have cleaned it. Exhaust fans have been replaced, however one was non-operational due to a faulty switch. Windows have been replaced. The crawl space was dry. There was no clothes dryer. Wood was stored in the home (Figure 2). House depressurization was measured in this home (see Section 3.5, House Depressurization Tests).

Rainwater Management: Site grading immediately adjacent to the home was flat.

Crawl Space: The crawl space was dry, however there were signs of water stains on the wood piers (Figure 3). Moisture content readings measured 10% and 15% which was an average moisture reading (5% indicates very dry, 30% indicates very wet). The wood did not feel wet to the touch.

Bathroom/Kitchen: Bathroom exhaust fans had been replaced but one was non-operational due to a faulty switch. The main bathroom exhaust fan measured 161 CFM. The kitchen fan vented to the outside.

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: There were two adult occupants. They had no reported health problems but some allergies and sinus problems. The occupants had only lived in the home for three months.
**Inspection Number:** 2-5  
**Address:** 17 Drum Lane  
**Age:** 16 years  
**Type:** Mutual Help  
**Condition:** Occupied  
**House Type:** Ranch  
**Bedrooms:** 3  
**Foundation:** Crawl space/poured concrete  
**Heat Type:** Wood stove  
**Construction:** 2’’ x 6”, modular

**Mold & Moisture Conditions:** Although no mold was seen, occupants have previously reported mold in the main bathroom. New bathroom exhaust fans were recently installed. The wood heater was the only source of heat – the furnace was not used. Windows had not been replaced. The crawl space was dry.

**Rainwater Management:** Site grading immediately adjacent to the home was flat. A splash block was missing near the downspout (Figure 2).

**Crawl Space:** The crawl space was dry. There were signs of seepage adjacent to the access hatch (Figure 3).

**Bathroom/Kitchen:** Both bathroom exhaust fans had been replaced. The main bathroom fan measured 158 CFM. The kitchen fan vented to the outside.

**Attic:** The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

**Occupant Notes:** There were two adult occupants with no reported respiratory or health problems. The occupants had lived in the home for 8 years.
Inspection Number: 2-6
Address: 22 Drum Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove
Construction: 2" x 6", modular

Mold & Moisture Conditions: The occupant reported no mold problems and no mold was seen during the inspection. Exhaust fans have recently been installed. The wood stove was the only heat source as the furnace was not used. Windows have not been replaced. The crawl space was dry.

Rainwater Management: Site grading immediately adjacent to the home is flat. A planter bed trapped water at the front of the house (Figure 2).

Crawl Space: The crawl space was dry.

Bathroom/Kitchen: Bathroom exhaust fans had been replaced. The main bathroom fan measured 152 CFM. The kitchen fan vented to the outside.

Attic: The attic was insulated with 12" (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: There was one adult occupant with no reported respiratory or health problems. The occupant had lived in the home for 3 years.
Appendix B, Walker River Technical Assessment Report

Inspection Number: 2-7
Address: 10 Hospital Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 3
Foundation: Crawl space/poured concrete
Heat Type: Wood stove with propane
FA back-up
Construction: 2” x 6”, modular

Mold & Moisture Conditions: Although no mold was seen during the site inspection, the occupants have previously reported mold on the master bathroom ceiling and cleaned it. The occupant replaced a non-operating bathroom fan. The crawl space was dry. Windows had not been replaced. The house had central air conditioning.

Rainwater Management: Site grading immediately adjacent to the home was flat.

Crawl Space: The crawl space was dry.

Bathroom/Kitchen: The occupant replaced a non-operating bathroom exhaust fan with a low sone Panasonic model rated at 70 CFM (Figure 2). The fan measuring 61CFM had been replaced. The other bathroom fan was original and non-operating. The kitchen fan vents to the outside but was not working very well. The dryer vent was disconnected at the dryer (Figure 3).

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.

Occupant Notes: There were two adults and two children living in the home, ages 9 and 10. They had reported respiratory or health problems. The daughter had asthma, shortness of breath, headaches and stomach problems. The occupants had lived in the home for 16 years.
Inspection Number: 2-8
Address: 2 Feather Lane
Age: 16 years
Type: Mutual Help
Condition: Occupied
House Type: Ranch
Bedrooms: 2
Foundation: Crawl space/poured concrete
Heat Type: Wood stove
Construction: 2” x 6”, modular

Mold & Moisture Conditions: The occupant reported mold in the shower above the tub. There was plumbing leak beneath the kitchen sink (Figure 2). Windows had not been replaced. The bathroom fan had been replaced three weeks prior to the site inspection. A wood stove was the sole heating source. Some wood was stored in the house. The furnace had not been used in seven years because of high fuel bills. The crawl space was dry, but showed signs of wetness.

Dirt was visible on the bathroom exhaust fan grille (Figure 3), on the supply air registers and around the tub (Figure 4). The dirt problem was traced to a disconnected return air duct (see Section 4 - House 2.8).

Rainwater Management: Site grading immediately adjacent to the home was flat. A planter bed trapped water at the front of the house (Figure 1).

Crawl Space: The crawl space was dry. Water stains were visible on the wood piers and on the plastic ground cover but were now dry. A large dip in the plastic ribbed dryer vent was visible in the crawl space.

Bathroom/Kitchen: The bathroom exhaust fan had been replaced and measured 147 CFM. The kitchen fan seemed ineffective and vented to the outside.

Attic: The attic was insulated with 12” (R42) of blown rock wool and vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.
**Occupant Notes:** There was one adult occupant who has lived in the home for 16 years. She reported to have frequent headaches and of being tired much of the time. This home was assessed for mold contamination by an independent environmental consultant. The home was not tested for mold spores.

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**Figure 4 - Dirt around bathtub**
Inspection Number: 2-9  
Address: 19 South Colonie Dr.  
Age: 16 years  
Type: Mutual Help  
Condition: Occupied  
House Type: Ranch  
Bedrooms: 3  
Foundation: Crawl space/poured concrete  
Heat Type: Wood stove  
Construction: 2" x 6", modular

Mold & Moisture Conditions: The occupant had reported mold on the wall between the utility room and master bedroom closet. The source of the moisture was a leak in the plumbing wall (Figure 2). Maintenance staff had started the remediation work but was told to stop by the occupant believing that the work was not being done properly. Mold was still visible where the remediation work was occurring.

Windows had not been replaced. The original exhaust fans were non-operable. The kitchen exhaust fan was ineffective. The dryer vent had become disconnected in the crawl space and the area around the disconnected hosen was wet. The furnace was no longer being used and the wood stove was the sole heat source.

Rainwater Management: Site grading immediately adjacent to the home is flat.

Crawl Space: The crawl space was wet under the disconnected dryer vent (Figure 3). The dryer was operating at the time of the inspection. One could smell the clean clothes as soon as the access hatch was removed.

Bathroom/Kitchen: The original bathroom and kitchen exhaust fans were either non-operable or ineffective.

Attic: The attic was insulated with 12" (R42) of blown rock wool. The attic was vented with two gable vents on each side of the home. The attic was not accessible given the size of the vent opening, the space between the truss members and the numerous roofing nails present. No mold was visible on the roof sheathing as seen from the gable vent.
Occupant Notes: The home was occupied by two adults and four children, one set of age 5 twins, one age 8 and one age 12. There were numerous health problems in the home and there was deep concerns regarding the mold and the effectiveness of the remediation efforts. This home was tested for mold spores by an independent environmental consultant.