SAULT STE. MARIE RESERVATION TRIP REPORT
Assessment of Mold and Moisture Conditions

Final Report

Date:
September, 2003

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

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Contract Number: U02 HUD SBC-B-2366
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SAULT STE. MARIE HOUSING AUTHORITY TRIP REPORT

INTRODUCTION

Kate Brown from the Building Research Council (BRC) at the University of Illinois Urbana-Champaign and Robert Nemeth from Magna Systems, Inc. conducted a site visit at the Sault Ste. Marie Housing Authority (SSMHA) on September 7-11, 2003. The SSMHA administers the housing program for the Sault Ste. Marie Tribe of Chippewa Indians. The site visit provided technical assistance to the housing authority in assessing mold and moisture conditions in housing units. This report summarizes activities and issues addressed while on site. A detailed analysis of findings and recommendations is found in PART II: Sault Ste. Marie Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Sault Ste. Marie Reservation.

BACKGROUND INFORMATION

The Sault Ste. Marie Reservation is located in Alger, Baraga, Chippewa, Delta, Luce, Mackinac, Marquette, Ontonagon, and Schoolcraft Counties in the State of Michigan. Sault Ste. Marie is located on Michigan's Upper Peninsula nestled on the eastern shore of Lake Superior along the banks of the Saint Mary's River. The area is also comprised of many lakes and streams, forests, and marshlands. The average annual precipitation is 34.67 inches. The average annual snowfall is 132.4 inches. Winter snow usually begins falling in early November and remains until melt off in April. The average annual maximum temperature is 49.6 °F and the average annual minimum temperature is 30.5° F. Approximately 13,346 Native Americans reside on the Sault Ste. Marie Reservation and Trust lands. The housing authority maintains 456 homes for the Tribe, of which 398 are Low Rent and 58 are Mutual Help.

The assessment team responded to a request from the Eastern/Woodlands Office of Native American Programs to assess site and housing conditions contributing to mold and moisture problems at the Sault Ste. Marie Reservation. The Executive Director of the Housing Authority requested technical assistance to address mold and moisture conditions and mold testing. The assessment team visited ten homes, including eight Low Rent and two newly constructed homeownership homes. Three households were relocated because of mold and moisture problems. Two of these homes were vacant and one home was just reoccupied. The ten homes investigated included one, two, three, and four bedroom dwellings. Seven homes were built over crawl spaces; three homes were slab on grade. The primary source of heat in four homes was hot-water baseboard heat, in five other homes was forced air, and in one home was electric baseboard. The homes ranged in age from newly constructed (1 year) to approximately nineteen years old. All the homes were a ranch style design.

Day 1: Sunday, September 7, 2003

Sunday was a travel day.
Day 2: Monday, September 8, 2003

The assessment team arrived at the SSMRHA Office in Sault Ste. Marie, Michigan on Monday morning. The team met with Carolyn O’Neil, Housing Division Director; Russell McKerchie, Construction Director; Paul Vas, Service Manager; and Dan Tadgerson, Environmental Health Officer to discuss the day’s activities, outline the team’s role while on the reservation, and address the housing authority’s concerns regarding the site visit. The SSMRHA staff presented the specific mold and moisture issues that the housing authority had been handling. Of specific concern was the issue of when to or not to test for mold. Of the ten investigated homes, eight had been tested for mold. Of the eight, three households had been relocated because of mold conditions. Two of these houses remained vacant and one was recently reoccupied.

The SSMRHA selected the properties to be inspected and Russell McKerchie and Paul Vas coordinated the logistics for the site visit. Following the meeting, the assessment team, guided by Russell McKerchie and Paul Vas, inspected seven Low Rent homes: two in the Hessel Subdivision, four in the St. Ignace subdivision and one in the Sault Ste. Marie Subdivision located on the Sault Ste. Marie Reservation and Trust lands. Dan Tadgerson, the Tribal Environmental Health Officer, also accompanied the assessment team.

Day 2: Tuesday, September 9, 2003

On Tuesday morning, the assessment team guided by Russell McKerchie and Paul Vas, inspected one Low Rent home and two newly constructed homeownership homes in Sault Ste. Marie and Odenaang Subdivision on the Sault Ste. Marie Reservation and Trust land. Dan Tadgerson, the Tribal Environmental Health Officer, also accompanied the assessment team.

On Tuesday afternoon, the assessment team presented mold and moisture issues identified on tribal communities nationwide and conditions identified locally from the on-site inspections to the Sault Ste. Marie Tribal Council.

Day 3: Wednesday, September 10, 2003

On Wednesday morning, the assessment team met with the housing authority staff. Carolyn O’Neil, Housing Division Director; Russell McKerchie, Construction Director; Paul Vas, Service Manager; and Joni Talentinio, Resident Services Manager to discuss findings from the housing inspections, occupant issues, and preparation for the afternoon training session. On Wednesday afternoon, the housing authority staff hosted a buffet luncheon, followed by a training session for forty persons from the construction and maintenance staff, resident service staff, homeownership specialists, administrative staff, housing authority commissioners, and other interested tribal members. Attachment 1 is a list of the attendees at this presentation. The team used a power point presentation to address specific issues identified on the Sault Ste. Marie Reservation and Trust lands. The topics included:
• What is Mold and What it Needs to Grow
• Definition of Moisture Loads and Identification of Sources of Moisture
• Impact of Building Construction and Design on Moisture Sources
• Discuss the Findings on the Reservation and Problem Solving Strategies
• Mold Remediation
• Occupant Issues
• Crawl Spaces
• Mold Testing

The two hour training session included discussion and exchange. Topics discussed include:

• The need to seek an appropriate health professional diagnosis, especially for allergy and asthma cases
• When it is or is not appropriate to test for mold
• Crawl Spaces and other construction and maintenance issues

Day 4: Thursday, September 11, 2003

Thursday was a travel day.

Digital photographs were taken to record conditions in all ten homes. The inspection process also involved visual assessments of both interior and exterior conditions; various measurements pertaining to moisture content, relative humidity, infiltration, and air-flow; and discussions with available residents. PART II: Sault Ste. Marie Reservation Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Sault Ste. Marie Reservation and Trust lands provide a detailed analysis of findings and recommendations for the homes investigated on the Reservation.

Mold Testing

The housing authority has been struggling with balancing occupant health and safety with high cost of mold testing and household relocation. Eight of the ten inspected homes were tested for mold. Three households were relocated because of mold. Two homes were still vacant and one home was just reoccupied. (The new residents were just moving in). The assessment team’s general message is: if there is mold inside a building, it needs to be cleaned up. Generally, it is not necessary to identify the species of mold growing in a residence. There is no baseline of acceptable or unacceptable mold concentrations in a home. This message is consistent with other federal agencies and experts as documented below. Attachment 2 is a copy of The Measurement Problem Regarding Mold.

The Bemidji Area Indian Health Service Office of Environmental Health and Engineering, Environmental Health Services Section (BAIHS EHSS), Guidelines on Assessment and Remediation of Fungi in Indoor Environments position on testing is:

Consistent with Center for Disease Control (CDC) and Environmental Protection Agency, BAIHS EHSS does not recommend testing as the first
response to an indoor air quality concern. Instead, careful detailed visual inspection and recognition of moldy odors should be used to find problems needing correction. Efforts should focus on areas where there are signs of moisture or high humidity or where moisture problems are suspected. The investigation goals should be to locate indoor mold growth to determine how to correct the moisture problem and remove contamination safely and effectively.

*The Adverse Human Health Effects Associated with Molds in the Indoor Environment: American College of Occupational and Environmental Medicine,* states that to successfully remediate mold and moisture conditions, the water and moisture sources must be identified and corrected.

Mold spores are present in all indoor environments and cannot be eliminated from them. Normal building materials and furnishing provide ample nutrition for many species of molds, but they can grow and amplify indoors only when there is an adequate supply of moisture. Where mold grows indoors, there is an inappropriate source of water and moisture that must be identified and corrected before remediation of the mold colonization can succeed. Mold growth in the home, school, or office environment should not be tolerated because mold physically destroys the building materials on which it grows, mold growth is unsightly and may produce offensive odors and mold is likely to sensitize and produce allergic responses in allergic individuals. Except for persons with severely impaired immune systems, indoor mold is not a source of fungal infections. Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in home, school, or office environment.

**Mold Test Results**

Eight of the inspected houses had been tested for mold. The mold testing results provided a list of the types and number of mold spores identified, but no written interpretation of what the findings revealed. There was no quality assurance plan or written information as to how the sampling was conducted. Furthermore, there was no baseline of acceptable or unacceptable mold concentrations inside a home. *BAIHS EHSS Guidelines on Assessment and Remediation of Fungi in Indoor Environments* discusses the limitations of testing.

Mold testing only provides a snap-shot estimate for a single point in time and a single location. How well the test represents other locations and times is uncertain since the amounts and types of mold in the environment are always changing. Furthermore, there is no basis for setting a baseline of acceptable or unacceptable mold concentrations. The variability can be especially large for airborne molds, with significant changes occurring over the course of hours or less. Caution must also be used in interpreting surface testing results, since mold growth or deposition may not be uniform over an area and may increase or decrease as time passes. Unless
many samples are taken over a period of time and the investigator has been mindful of building operations and activities during the testing, the results might not be very representative of typical conditions; in addition, tests reflecting typical conditions may also miss evidence of problems that only occur infrequently (water leaks during rain storms).

Mold testing is often expensive. If testing is unnecessary or done poorly, the money will not be available for remediation and repairs. It was apparent that costly and extensive plans were underway to remediate mold in one home located at 2098 Ice Circle in Sault Ste. Marie. The following web sites and references provide further information on mold remediation and testing.

Indoor Air Quality

**Ball State University Indoor Environment Notebook** - General resource on a number of topics related to indoor air quality.
http://publish.bsu.edu/ien/archives/archive_list.htm *(will open a new browser window)*

**Mold**

**EPA** - Mold Remediation in Schools and Commercial Buildings
http://www.epa.gov/iaq/molds/index.html *(will open a new browser window)*

**New York City Department of Health Bureau of Environmental & Occupational Disease Epidemiology** - Guidelines on Assessment and Remediation of Fungi in Indoor Environments
http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html *(will open a new browser window)*

**References**

Bemidji Area Indian Health Service Office of Environmental Health and Engineering, Environmental Health Services Section, *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*


**The Housing Authority Actions**

The Housing Authority used excellent housing management and maintenance practices. The staff was very organized and helpful during our site visit. Even the nineteen year old units, the oldest units inspected, were very well maintained. The housing authority is developing policies and procedures for handling mold and moisture problems in tribal
homes. The maintenance department used Micromain XM Software Program, a computerized maintenance management system, to establish work orders, track assets, and maintain a history on individual units.

The Resident Services Department is working with the Executive Director and Tribal attorney to develop an Addendum to the standard lease agreement that requires the tenant to take steps to reduce the potential for mold growth in their unit. Attachment 3 is a copy of the Addendum. Although this document may provide some level of protection for the Leasor, more importantly, it provides an excellent educational tool that lists tenant actions or steps that discourage mold growth and promote a healthy environment.

The housing authority also considered a ‘Notice, Disclosure and Disclaimer’ statement in the tenants lease agreement packet addressing mold conditions. Attachment 4 is a copy of this document. As written, this document refers to “Homebuilder” as the housing provider. It should probably refer to the Housing Authority as the “Home Provider” rather than as “Homebuilder”. With minor editing by the Executive Director and Tribal attorney, this document also provides valuable information to potential tenants and serves as another educational document.

The SSMHA is taking positive action steps to develop a team effort between housing authorities, building maintenance division and the homeowner to prevent mold. Both the Addendum and Notice, Disclosure and Disclaimer documents in Tenant Lease Agreements provide valuable information on mold background and tenant responsibilities and practices that contribute to a healthy indoor environment. Preventing mold requires a team effort between Housing, the building maintenance division and the homeowner. These documents underscore the importance of the homeowner as a contributor to maintaining a healthy environment.

FINDINGS

An overview of findings and recommendations for the site visit follows. *PART II: Sault Ste. Marie Housing Authority Technical Housing Assessment Report* provides a more detailed discussion and analysis of the findings.

**Sault Ste. Marie Reservation**

Principal findings from the site inspections include:

1. Groundwater and surface water problems
   - Six of the ten inspected properties were on very flat sites with poor drainage potential during heavy rains.
   - Subsurface conditions in two subdivisions consisted of thick layers of clay which hampered drainage.
Two of the inspected homes were proximate to drainage ditches which filled with water during wet periods. During these periods, ground water infiltrated crawl spaces.

2. Rainwater Management Problems

- Only two of the ten inspected houses had gutters and one of the two needed repair.
- Two homes had short gutter sections above doors with no downspouts.

3. General Maintenance

- The maintenance and upkeep of the housing at Sault Ste. Marie was outstanding.
- The exteriors of the housing units were clean and well painted, and the properties surrounding the houses were clean and well maintained.
- Most of the interiors were in very good condition.
- As with any housing, minor problems were identified, however, the absence of major problems is a testament to how well-run the Housing Authority and its maintenance division are.

4. Ventilation Problems

- Measured air-flow through six of the eleven bath fans was well below desired performance. One made noise and moved no air at all.
- Several of the kitchen exhaust hoods were recirculating range hoods.
- The return-air system in a couple of houses consisted of a grill in the wall of the mechanical closet.

5. Homeowner/Tenant Education

- It should be noted that most of the inspected residences were well maintained by the Housing Authority and building occupants. The one residence with the greatest mold problem was primarily due to occupant practices.

PROGRAMMATIC RECOMMENDATIONS

A particular challenge to all housing authorities is the development of a prompt and effective service delivery system to address mold and moisture conditions. This requires a partnership between the housing authority and residents with a system that includes training for the maintenance staff on how to implement the technical recommendations and training for residents on their roles and responsibilities as homeowners and tenants.
SSMHA has already taken excellent action steps to create a partnership. Additional steps to supplement their program could include formalized methods for addressing mold problems and maintenance issues as they occur. For example:

1. Mandatory attendance at annual homeowner/tenant clinics as part of the annual recertification process. At these clinics, provide instruction on home maintenance issues, such as identifying and repairing leaks and maintaining gutters.

2. During the annual recertification process, ask occupants to complete a survey based on Housing Quality Standards (HQS) with additional questions on mold and moisture conditions in their homes. Completing the survey further engages residents in their own home maintenance. Furthermore, the survey responses provide additional information to the housing authority on unreported problems, especially leaks and inoperable fans that might contribute to an unsafe, unhealthy home environment.
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APPENDIX C: LIMITATIONS OF MOLD SAMPLING

The Measurement Problem Regarding Mold
By William B. Rose, Research Architect
Building Research Council/School of Architecture
University of Illinois, Urbana-Champaign

When complaints of mold problems occur, two courses of action are appropriate: 1) visually assess the site, remove the mold, and correct the conditions that led to the mold and 2) contact health professionals for allergy or respiratory problems. The proper action is to discover sites of mold growth. Where this approach has been used, the outcome has been, in every case, improvement of indoor environment conditions (though the improvements may take time) and improvement of health conditions. This is the recommended approach for dealing with mold problems in housing in Indian areas.

Techniques for sampling biological aerosols were developed for industrial and agricultural settings. They were designed to help industrial hygienists determine the safety of workplaces and other environments. The value of their work was evident in determining the causes of the Legionella outbreak of 20 years ago, and in sampling for biological warfare agents at present. Sampling produces counts of mold material from samples taken in the air or on surfaces. It may determine the number of viable spores in a sample from the air or a surface. And it may be used to identify genus and species of mold found in the sample.

Neither of the two recognized guidelines for mold remediation, the NYC Department of Health’s Guidelines on Assessment and Remediation of Fungi in Indoor Environments and the USEPA’s Mold Remediation in Schools and Commercial Buildings, calls for environmental sampling for routine mold problems. Both guidelines discourage environmental sampling in most cases. This opinion is summarized on the CDC website:

Generally, it is not necessary to identify the species of mold growing in a residence, and CDC does not recommend routine sampling for molds. Current evidence indicates that allergies are the type of diseases most often associated with molds. Since the susceptibility of individuals can vary greatly either because of the amount or type of mold, sampling and culturing are not reliable in determining health risk... reliable sampling for mold can be expensive, and standards for judging what is and what is not an acceptable or tolerable quantity of mold have not been established.

In general, the use of mold sampling must be discouraged. There are several reasons for this. First, aside from allergic effects, the health outcomes of mold in homes, schools or offices have not been established. Second, given those circumstances, there is no basis for setting a baseline of acceptable or unacceptable mold concentrations. Third, the internal repeatability of mold sampling results has not been shown in the literature. Fourth, weaknesses in the visual assessment protocols have not been demonstrated.
Mold sampling has been done in residential settings, leading to conclusions about the presence of mold, about the presence of individual species of mold, and about high concentrations of mold in some locations. However, much of the information provided by sampling is already known from common sense. The following are some facts about mold in indoor environments that are known even before measurements are taken:

1. Mold is everywhere. The outdoor air contains rather high concentrations of mold spores, which are naturally occurring. By contrast, most building interiors contain lower concentrations, though the concentrations indoors and outdoors vary over time. Indoor air comes from the outdoors. If the indoor is cleaner than the outdoors, something served as a filter, accumulating mold, dust and airborne material over time. Some commercial buildings have filtration systems designed to clean air as it passes from outdoors to indoors. But in most buildings, the outdoor air infiltrates through cracks and cavities in the building envelope as it travels indoors. If the indoor air is cleaner, then the building envelope acts like a filter. Therefore, when a sample of indoor air is taken, mold spores will be found. The conclusion “This building has mold” can be made of all buildings.

2. Dust, dirt, mold spores and other particulates accumulate in building cavities over time. There is no passive cleaning process for building cavities to match this cumulative process. Because the walls and roofs filter outdoor air as it moves indoors, all building cavities must be considered as sites with high concentrations of mold spores and other airborne material.

3. Evidence indicates that where proper conditions are in place, sooner or later the species that typically inhabit such spaces will arrive. *Stachybotrys* is known to inhabit pulpy cellulose materials that are maintained at a high water activity level. With the right quantity of water, the paper facing of gypsum products generally shows the growth of *Stachybotrys*. Where the appropriate conditions are maintained for a long enough time, *Stachybotrys* and other species appear and grow. “Wet it, and they will come.”

4. It is logically impossible to prove a negative statement. There are no tests that allow one to draw the conclusion that absolutely no mold spores representing a species are to be found in a space. Even if a test should turn up no spores of a given species that does not provide conclusive evidence of the total absence of that species from the interior space. And conditions may change from one hour to another. So a finding in a room or building of any given species, including *Stachybotrys*, should not be considered exceptional. The absence of a species from a space can be determined statistically to a pre-selected degree of confidence, requiring several tests.

What, then, remains to be discovered through mold measurement? It is already determined, for all buildings, that mold is contained in the air, that any species may be found in the air or on the surface, and that high concentrations of mold are contained in the cavity. If a tenant or occupant complains about living conditions, it is clear that any unit that occupant will move to will have mold in the air, will have all common species of
mold in the air or on surfaces, and will have high concentrations of mold in the building cavities. It is wrong to presume that buildings are sterile simply by virtue of their never having been measured.

Measurements of mold are not useful if the purpose of the measurement is to determine any or all of the following:

1) if the building has mold,
2) if a certain species, say, *Stachybotrys*, is present, or
3) if the building cavities have high concentrations

For the measurement criteria above, no measurements should be made, as the results will be dismissed as being of no use.

**Possible Occasions for Mold Measurement**

After the effective implementation of visual assessment and remediation of mold as described above and conditions of mold are suspected to still exist, it is possible (though unlikely) that a visual assessment will overlook a cause of distress. If that happens, one strong possibility is that the distress is not related to mold in the first place. However, in the case where a mold problem has not been accurately identified and remediated through visual assessment, three scenarios are often suggested as possible occasions for mold measurement:

1. Active mold growth is usually accompanied by amplification, the strong increase in mold of one or two species out of proportion to the background taxa.
2. Mold may have an odd source, such as air conditioning ductwork, and may be present in the building only when that source contributes to the space, or
3. An investigator may use a fixed level as a measure of acceptability or cleanliness (though it bears repetition: there are not exposure limits set by any authorities).

In each of these cases, mold measurement may be able to provide some insight.

**The statistics of mold measurement**

For mold measurement to provide insight, or to provide material for decision-making, the results of mold testing must be statistically significant. One measurement is never statistically significant. Understanding the notion of statistical significance requires understanding error and bias.

Two samples of the same space will never provide the same results. There is always some spread (or precision error) in the data. The mold sampling industry generally fails to make public their estimates of the precision error in their sampling methods. It would be good to know, for the same equipment, same operator, same laboratory, same technician, what the estimate of the error would be. That information is not presently available.
addition to precision error, there are many other factors that tend to bias the results one way or another. These include the following:

1. Time of the day (ascomycetes tend to release spores in the afternoon, basidiomycetes in the morning)
2. Season (lower during winter)
3. Snow cover (greatly reduces outdoor concentrations)
4. Sampling technique (lowest with culturable samples, medium with impactors, highest with PCR)
5. Variations over space (highest, usually, in basements and crawl spaces)
6. Variations by surface (highest near carpets)
7. Disturbance (greatly higher with scuffing and fluffing of carpets, etc.)
8. Variations by wetness (higher concentrations on wetter materials)
9. Laboratory
10. Technician

It is evident that achieving statistically significant results requires considerable care, in addition to thoroughly accounting for variables. All proposals for mold study that involve sampling must contain information that describes:

1. The yardstick, or baseline values, that will be used for interpretation,
2. The variables that are accounted for in the study,
3. The error estimate associated with those variables,
4. The confidence interval to be used (95% confidence in the results is recommended),
5. How the study will deliver that level of confidence.

Sampling campaigns that give numbers without giving statistical significance to those numbers are worse than worthless. They come at a financial and social cost and are very disruptive to the lives of individuals, families and tribes.

The range of concentrations often found in mold measurements is several orders of magnitude—sometimes several dozen spores or colony-forming-units (CFUs) per unit of mass or volume out to several million. Most guidance advises representing the distribution as lognormal; that is, if the data values are represented not as numbers with zeroes but as powers of ten, then the exponents occur in a normal distribution. This is quite helpful, as one of the tails of the distribution never drops below zero.

Let us presume that an environmental consultant hypothesizes that the airborne mold spore concentration in a room exceeds a certain value. Of course, the consultant would be obliged to cite the reference for the value selected. Taking a single sample gives a distinct reading for the sample but says nothing about the concentration in the room. A second sample, with a result different from the first, proves that a single sample cannot characterize the actual concentration. Also, clearly, the more samples that are taken, the more sure one can be that the mean of the measured values represents the actual value, and can be used in this comparison test.
Let us also presume that the confidence interval used is 0.05 ($\alpha = 0.05$). That means that 5% of the time the confidence in the veracity of the finding will be misguided. Nevertheless, many scientific and management findings use a 0.05 confidence interval. Tribal leaders or others who are entertaining proposals from environmental consultants might consider having a stated confidence interval at the time of the work proposal, perhaps of 5%.

Then standard statistics allows us to calculate the confidence interval. The result is usually expressed as a value $y \pm z$ ($\alpha=0.05$). The value $y$ is the mean (average) of the sample values. The value $z$ is composed of the Standard Error (SE, equal to the standard deviation divided by square root of the count-1) times a factor called “student’s-t” ($t$). This factor is commonly used in statistics when the number of samples is small; it is found in textbooks of statistics and as a common spreadsheet function. The value $z$ is equal to $(t) \times (SE)$.

An environmental consultant may wish to sample to determine if a certain species is present or not. Common species of mold should always be deemed to be present, but may be proved to be absent, if indeed they are absent, to any selected degree of confidence (never for certain).

Testing is expensive. So there is a strong tendency on the part of both consultants and clients to conduct testing without regard to the statistical significance. This practice should end, as the results cannot be used for decision-making. If testing is to be done at all, then the testing campaign must be designed to have the power to provide answers to the critical questions.

All mold testing must include a minimum of two samples per measurement site. Taking only one sample leaves the impression that the value is somehow elevated above error. With two samples per site, the issue of error is inescapable. In addition all mold testing should:

- State the question or hypothesis that is being answered or addressed through testing
- State the criteria (absolute or comparison) used to address the hypothesis
- State the proposed confidence level.
- List the errors and biases that are accounted for (or controlled for) in the testing.
- Calculate the margin of error.
- Report the findings with the margin of error.
- Attach statistical significance to the conclusions.

*July, 2003*
Exhibit B
Exhibit “A” to Lease Agreement

Joseph E. Quandt

This Addendum to Lease Agreement dated this __________ of ____________.

20___ is attached to and made part of the Lease Agreement dated ____________.

20___ by and between (“Landlord”) of and ____________

(“Tenant”) and relates to Unit # ____________.

WHEREAS, it is acknowledged between Landlord and Tenant that apartments in
areas that experience high humidity and wet weather may, under certain circumstances,
experience mold growth; and,

WHEREAS, Landlord and Tenant agree that the Tenant should use due diligence in
attempting to ameliorate the possible environment for mold growth by preventing exces-
sive humidity inside the unit area; and,

WHEREAS, the Tenant agrees to contribute to these efforts and the goal of prevent-
ing mold growth in the unit by affirmatively accepting the following obligation:

NOW THEREFORE, Landlord and Tenant agree as follows:

1. Tenant agrees to open windows, as temperature and weather conditions permit, to
allow an exchange of air and permit the introduction of sunlight throughout the unit.

2. Tenant agrees to regularly maintain the unit including but not exclusive of, vacuum-
ing, mopping, dusting, and using typical household cleaners.

3. Tenant agrees to maintain general temperatures within the unit between 65°F and
78°F as well as maintain general relative humidity between 30 and 50% within the
unit at all times. Further, Tenant agrees that if Tenant is having trouble maintaining
these indoor ambient conditions that Tenant will promptly notify Landlord so that
repairs can be made to maintain these indoor air quality standards.

4. Tenant agrees to as soon as reasonably possible, wipe down and dry areas that
accumulate visible moisture like counter tops, windows, window sills, bathroom
walls, shower areas, etc.

5. Tenant agrees to use pre-installed bathroom fans when showering or bathing in
such a way that excess moisture is vented from the bathroom.

6. Tenant agrees to leave bathroom doors open until all moisture on mirrors and bath-
room walls/tile surfaces has dissipated.

7. Tenant agrees to clean laundry and other wet upholstered items as soon as possi-
ble after they have become wet.

8. Tenant agrees to use exhaust fans in kitchens when cooking or while dishwashers
are on dry cycles to vent excess moisture from kitchens.

9. Tenant agrees to limit house plants to a reasonable number, do not over water
house plants and clean up spills from over watering.

1. Mr. Quandt gratefully acknowledges the assistance of Julie A. Harrison in the compi-
lation of written materials for this program.
10. Tenant agrees to ensure that any clothes dryer vent is property connected and

clear of obstructions. Also, clean the lint screen after every use. When washing

clothes in warm or hot water, watch to make sure that condensation is not built up

within the washer and dryer closet. If condensation does gather, leave the closet
doors open after every use.

11. Tenant agrees to when showering, be sure to keep the shower curtain inside the

tub or fully close the shower doors.

12. Tenant agrees to periodically clean and dry the walls around the bathtub and

shower using a common reliable household cleaner.

13. Tenant agrees to not allow damp or moist stacks of clothes or other cloth material to

lay in piles.

14. Tenant agrees to immediately report to the management office, any evidence of a

water leak or excess moisture in the unit, storage room, garage or any common

area.

15. Tenant agrees to immediately report to management any evidence of mold or mil-
dew like growth that cannot be removed by simply applying a common reliable

household cleaner.

16. Tenant agrees to look for leaks in washing machine hoses and discharge lines

especially if the leak is large enough for water to saturate trim or drywall.

17. Tenant agrees to immediately report to management, any failure or malfunction

with the heating ventilation or your air conditioning system.

18. Tenant agrees to immediately report to management any inoperable windows.

19. Tenant agrees to not block or cover any heating ventilation or air conditioning sup-

ply, diffusers and/or return grills in the unit.

20. Tenant agrees to follow the house pet policy and immediately clean up any pet ac-
cidents.

21. Tenant agrees to recognize that unreasonable and/or humidifier use can contribute
to conditions favorable for mold growth.

22. Tenant agrees to recognize that personal air cleaners have been linked to unac-
ceptable amounts of ozone in indoor environments and that the use of personal air

cleaners is discouraged as ozone can enhance the condition and environment for

excess mold growth.

Tenant agrees that Tenant shall be responsible for damage to the unit and the Ten-
ant's property as well as any injury to the Tenant or anyone residing in the unit with Tenant

for any period of time which results from the Tenant's failure to comply with this exhibit/ addendum. A default under the terms of this Addendum/Exhibit shall be deemed a mater-
rial default under the terms of the lease and Landlord shall be entitled to exercise all rights and remedies at law or in equity.

Except as specifically stated herein, all other terms and conditions of the lease shall
remain unchanged. In the event of any conflict between the terms of this Addendum/ Exhibit and the terms of the lease, the terms of this Addendum/Exhibit shall control. Any
term that is capitalized but not defined in this Addendum/Exhibit that is capitalized and
defined in the Lease shall have the same meaning for the purposes of this Addendum/Exhibit as it has for purposes of the Lease. Tenant understands that if mold is detected in Tenant's unit under certain circumstances, Landlord may, at its discretion, temporarily relocate Tenant to a comparable furnished apartment while the problem is evaluated. This may include Landlord's option to terminate Tenant's Lease. Your signature below indicates your agreement that Landlord may temporarily relocate Tenant to a comparable furnished unit under such circumstances.

Agreed to this ____ day of ______________, 20__.

Landlord: 

______________________________

Tenant: 

______________________________
NOTICE, DISCLOSURE and DISCLAIMER

What Homeowners Should Know about Mold

Mold. Lately, mold has been in the news. Mold is a type of fungus. It occurs naturally in the environment, and it is necessary for the natural decomposition of plant and other organic material. It spreads by means of microscopic spores borne on the wind, and is found everywhere life can be supported. Residential home construction is not, and cannot be, designed to exclude mold spores. If the growing conditions are right, mold can grow in your home. Most homeowners are familiar with mold growth in the form of bread mold, and mold that may grow on bathroom tile.

In order to grow, mold requires a food source. This might be supplied by items found in the home, such as fabric, carpet or even wallpaper, or by building materials, such as drywall, wood and insulation, to name a few. Also, mold growth requires a temperate climate. The best growth occurs at temperatures between 40 degrees F and 100 degrees F. Finally, mold growth requires moisture. Moisture is the only mold growth factor that can be controlled in a residential setting. By minimizing moisture, a homeowner can reduce or eliminate mold growth.

Moisture in the home can have many causes. Spills, leaks, overflows, condensation, and high humidity are common sources of home moisture. Good housekeeping and home maintenance practices are essential in the effort to prevent or eliminate mold growth. If moisture is allowed to remain on the growth medium, mold can develop within 24 to 48 hours.

Consequences of Mold. All mold is not necessarily harmful, but certain strains of mold have been shown to have adverse health effects in susceptible persons. The most common effects are allergic reactions, including skin irritation, watery eyes, runny nose, coughing, sneezing, congestion, sore throat and headache. Individuals with suppressed immune systems may risk infections. Some experts contend that mold causes serious symptoms and diseases which may even be life threatening. However, experts disagree about the level of mold exposure that may cause health problems, and about the exact nature and extent of the health problems that may be caused by mold. The Center for Disease Control state that a causal link between the presence of toxic mold and serious health conditions has not been proven.

What the Homeowner Can Do. The homeowner can take positive steps to reduce or eliminate the occurrence of mold growth in the home, and thereby minimize any possible adverse effects that may be caused by mold. These steps include the following:

1. Before bringing items into the home, check for signs of mold. Potted plants (roots and soil), furnishing or stored clothing and bedding material, as well as many other household goods, could already contain mold growth.

2. Regular vacuuming and cleaning will help reduce mold levels. Mild bleach solutions and most tile cleaners are effective in eliminating or preventing mold growth.

3. Keep the humidity in the home low. Vent clothes dryers to the outdoors. Ventilate kitchens and bathrooms by opening the window, by using exhaust fans, or by running the
air conditioning to remove excess moisture in the air, and to facilitate evaporation of water from wet surfaces.

4. Promptly clean up spills, condensation and other sources of moisture. Thoroughly dry any wet surfaces or material. Do not let water pool or stand in your home. Promptly replace any materials that cannot be thoroughly dried, such as drywall or insulation.

5. Inspect for leaks on a regular basis. Look for discolorations or wet spots. Repair any leaks promptly. Inspect condensation pans (refrigerators and air conditioners) for mold growth. Take notice of musty odors, and any visible signs of mold.

6. Should mold develop, thoroughly clean the affected area with a mild solution of bleach. First, test to see if the affected material or surface is color safe. Porous materials, such as fabric, upholstery or carpet should be discarded. Should the mold growth be severe, call on the services of a qualified professional cleaner.

Disclaimer and Waiver

Whether or not you as a homeowner experience mold growth depends on how you manage and maintain your home. Our responsibility as a homebuilder must be limited to things that we can control. As explained in our written warranty, provided by separate instrument, we will repair or replace defects in our construction (defects defined as a failure to comply with reasonable standards of residential construction) for a period of _____ years. We, the builder, will not be responsible for any damages caused by mold, or by some other agent, that may be associated with defects in our construction, to include but not limited to property damage, personal injury, loss of income, emotional distress, death, loss of use, loss of value, and adverse health effects, or any other effects. Any implied warranties, including an implied warranty of workmanlike construction, an implied warranty of habitability, or an implied warranty of fitness for a particular use, are hereby waived and disclaimed.

This notice, disclosure and disclaimer agreement is hereby appended to and made apart of the contract of sale. The consideration for this agreement shall be the same consideration as state in the contract of sale. Should any term or provision of this agreement be ruled invalid or unenforceable by a court of competent jurisdiction, the remainder of this agreement shall nonetheless stand in full force and effect.

I acknowledge receipt of the notice, disclosure and disclaimer agreement. I have carefully read and reviewed its terms, and I agree to its provisions.

BUYER DATE SELLER DATE

BUYER DATE SELLER DATE
PART II

SAULT STE. MARIE HOUSING AUTHORITY

TECHNICAL HOUSING ASSESSMENT REPORT

EXAMINING MOLD AND MOISTURE CONDITIONS IN HOMES ON THE SAULT STE. MARIE RESERVATION

Executive Summary

Introduction

Section 1: Methodology

Section 2: Sault St. Marie Indian Reservation Housing

Section 3: Findings

Section 4: Technical Discussion and Recommendations

Appendix A: Housing Survey Summary Site Visit Report

Appendix B: Housing Assessment Results
EXECUTIVE SUMMARY

The site assessment team inspected ten homes of the Sault Ste. Marie Indian Reservation for moisture and mold conditions. The five principal findings include:

1. Exterior site drainage and rainwater management was a problem in several of the ten residences. Six of the sites were flat with no slope away from the foundation. Two were located near drainage ditches which occasionally overflowed. Eight houses were missing roof drainage systems (gutters, downspouts, leaders, etc.), a condition that can place a tremendous moisture load on the foundation and the house.

2. In several instances vapor barriers were missing or covered only a portion of the crawl space. This allowed ground moisture to freely dissipate into the structure above.

3. Winter moisture condensation caused mold growth at two houses. Visible mold grew in an entry closet, at the wall/ceiling junctures of exterior walls and at the base of exterior walls.

4. Poor or inoperable bathroom exhaust ventilation systems were noted during the inspections at Sault Ste. Marie Indian Reservation. Poor bathroom exhaust ventilation can result in significant interior moisture loads which can increase the potential for mold growth.

5. Five homes had propane or natural gas forced air central heating systems. Four homes had hot water baseboard heat, and one home had electric baseboard heat.

This report provides technical recommendations and discussions focusing on these items. Appendix A includes a summary of findings from the inspections. Appendix B provides a detailed assessment of each home.
INTRODUCTION

Kate Brown from the Building Research Council and Robert Nemeth from Magna Systems conducted a site visit at Sault Ste. Marie Reservation on September 8-11, 2003. The assessment team also provided technical assistance to the Sault Ste. Marie Housing Authority in assessing mold and moisture condition in housing units. This report summarizes activities and issues addressed while on site. A detailed analysis on the findings and recommendations is found in PART II: Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Sault Ste. Marie Reservation.

The Sault Ste. Marie Reservation is located in Alger, Baraga, Chippewa, Delta, Luce, Mackinac, Marquette, Ontonagon, and Schoolcraft Counties in the State of Michigan. Sault Ste. Marie is located on Michigan’s Upper Peninsula nestled on the eastern shore of Lake Superior along the banks of the Saint Mary’s River. The area is also comprised of many lakes and streams, forests, and marshlands. The average annual precipitation is 34.67 inches. The average annual snowfall is 132.4 inches. Winter snow usually begins falling in early November and remains until melt off in April. The average annual maximum temperature is 49.6 °F and the average annual minimum temperature is 30.5° F. Approximately 13,346 Native Americans reside on the Sault Ste. Marie Reservation and Trust lands. The housing authority maintains 456 homes for the Tribe of which 398 are Low Rent and 58 are Mutual Help.

The assessment team investigated ten homes located on Tribal lands. A variety of house styles were examined, including some on crawl spaces and others on slab-on-grade foundations. The primary sources of heat were:

- Hot-water baseboard heat in four homes
- Forced air in five homes
- Electric baseboard heat in one home

The homes ranged in age from newly constructed (1 year) to approximately nineteen years old. All the homes were a ranch style design.

SECTION 1 - METHODOLOGY

Visual Inspection

Housing inspections consisted primarily of visual assessment of mold and moisture conditions. The assessment team used forms developed for the Chicago Mold and Moisture Project, a HUD Healthy Homes Program, organized for a room-by-room inspection. The team recorded information on water damage and evidence of mold for all rooms inspected. Additionally, the team inspected the plumbing, localized ventilation, water entry and other moisture source issues in kitchens, bathrooms, basements, crawl spaces, utility rooms and attics.
The exterior of the houses were inspected for rain water/snow melt management including site grading, roof condition and gutter system.

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

Digital photographs visually recorded notable conditions at each home.

**Measurements**

Floor framing moisture content (MC) readings were taken at several residences. 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 reading, to 30%, indicating a very wet reading.

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 the table of Appendix A in this report. The findings from individual house inspections are presented in Appendix B.

**SECTION 2 – SAULT STE. MARIE RESERVATION HOUSING**

The SSMHA is responsible for 456 housing units of which 398 are Low Rent and 58 are Mutual Help. The assessment team examined ten housing units for mold and moisture selected by SSMHA. The homes are both site-built and modular and all wood-framed either on crawl spaces or slab-on-grade. These units do not represent a typical cross-section of the units under their management since they were not based on a random sample.

**SECTION 3 – FINDINGS**

The assessment team found visible mold growth in three of the ten inspected houses. Mold contamination was slight and generally limited to bathrooms. Mold contamination is always associated with moisture problems. Nine general findings based on the inspection follow.

**3.1 Exterior Site Drainage and Rainwater Management**

Good site drainage and rainwater management is essential to maintaining dry foundations and houses. Site drainage was poor at seven of the ten homes. Many sites were flat with no slope away from the foundation. However, the grade dropped close to most of these homes, which provided good potential for conducting water away from the homes. Additionally, eight houses had no roof drainage systems (gutters, downspouts, leaders, etc.), a condition that can place a tremendous moisture load on the foundation and the house.
Several homes had short gutter sections without downspouts over the entry doors. These short gutter sections allowed water to drain out the ends of the gutter, splash over entry steps, decks, and the ground adjacent to the structure and saturate the siding. The short gutter sections can cause damage by concentrating the runoff. Concentrated runoff deposited immediately adjacent to the foundation can also exacerbate crawl space moisture problems.

Section 4.1 provides a detailed discussion of site drainage and rainwater management.

3.2 Elevation of House Above Grade

All inspected homes were built close to grade; most were no more than one course of block above grade. Placing the structure this close to grade has contributed to several moisture related problems. When the siding is only eight to ten inches above grade, rainwater that drains from the roof onto the ground splashes up onto the siding and saturates it.

Snow accumulation adjacent to a home provides another source of moisture. As snow accumulates against the siding, the warmer siding absorbs moisture.

With only one course of block showing above grade, the bottom of crawl space vents sit right on grade. Soil washed into some crawl spaces through some of these vents.

3.3 Crawl Spaces

Site drainage and rainwater management problems contributed to damp crawl space problems. Plumbing leaks, HVAC condensation, and condensation on cold water supply lines all contributed to wet crawl spaces. None of the homes with crawl spaces had an effective vapor barrier, allowing ground moisture to dissipate up into the structure. In some cases, the wet conditions promoted mold growth.

3.4 Winter Moisture Condensation

Winter moisture condensation caused mold in three homes. Mold growth was visible in bedroom closets, at the wall/ceiling junctures of exterior walls and at the base of exterior walls. Condensation occurs when moisture-laden air comes in contact with a building surface that is chilled below the dew point (temperature at which dew begins to form or vapor condenses into a liquid) of the air. This problem indicates a combination of two factors:

- High wintertime moisture load (relative humidity)
- Lower than desired interior temperature
Lowering the moisture load and/or insulating or heating surfaces to prevent cold surface temperatures can treat the problem. Section 4.3 discusses condensation issues. The following three findings concern the condensation problem.

3.5 **Bathrooms and Bathroom Exhaust Ventilation**

Lack of functioning or poorly operating bathroom fans raised significant issues in the inspected houses. Bathrooms experience high moisture loads and often develop localized mold problems. Bathroom ventilation can reduce interior moisture load. Some bathrooms had operable exhaust fans.

Section 4.4 discusses bathrooms and localized exhaust ventilation.

3.6 **Overcrowded Conditions**

Overcrowding is a fairly common problem in Indian housing and should be mentioned here. Overcrowding increases the moisture level from human sources, and contributes to elevated interior moisture loads that can lead to mold contamination from condensation problems.

Discussion of human moisture sources can be found in Section 4.5.

3.7 **Heating Method and Heat Distribution**

Five of ten homes used propane or natural gas central heating systems. Four were hot water baseboard heat. Heating method and heat distribution play a vital role in preventing wintertime mold and moisture problems. Warm air should be evenly distributed throughout the home. Remote bedrooms often have problems because they can be colder than the rest of the home, causing water vapor condensation on cold exterior walls, particularly in closets. Uninsulated heating ducts in proximity to crawl spaces vents exacerbated the problem. Cold air from the crawl space vent cooled the heated air before it entered the living space.

One inspected home had electric baseboard heat. Heat distribution can be very uneven in the houses with electric baseboard heat. This form of heating system does not promote air circulation and can contribute to conditions conducive to mold growth.

Heating systems are discussed in Section 4.6.

3.8 **Maintenance Issues**

The Sault Ste. Marie Reservation had very few maintenance issues that contribute to mold and moisture conditions.

- One house had an inoperable bathroom fan; five had fans that barely worked. Bathing produces large amounts of moisture that must be removed from the
home. Typically, bathrooms show the first signs of mold growth because of the recurring high moisture load. Maintenance of bathroom fans and replacement of broken fans should be high on the priority list.

- Occupant attention to cleanliness and clutter can reduce mold problems. In bathrooms and other wet areas, regular cleaning could keep mold conditions under control. The presence of clutter in closets and on exterior walls contributed to mold growth by increasing condensation problems when sufficient moisture is present. Maintenance issues are discussed in Section 4.7.

3.9 Lifestyle

Certain housekeeping habits contributed to mold growth on the interior of the structures. Clothes covering heating vents, overstuffed closets, over accumulation of trash, covering windows with heavy drapery, unrepaired leaks, and inadequate cleaning regimes can all contribute to mold growth. Modifying occupant lifestyles is as important as solving technical problems. In general, most mold problems can be remediated, however, without addressing occupant lifestyle at the same time, many mold problems will rapidly resurface.

SECTION 4 - TECHNICAL DISCUSSIONS AND RECOMMENDATIONS

The following discussions and recommendations are based on the nine general findings identified during the site visit to the Sault St. Marie Reservation.

4.1 Site Drainage and Rainwater Management

Site Drainage

The roof of a building should be designed and built so that the rain landing on the roof moves out to the edge of the roof. As rain falls on a soil surface, some will percolate downward through the soil—more in sandy soils and less in clayey soils. The water that does not percolate downward will move along the soil surface following the slope, out to the downhill edge of the site. Houses that allow water to accumulate in the soil in contact with the foundation will develop moisture problems. The best way to prevent mold and moisture problems in houses is to ensure that rainwater moves off the roof, across the site and off the property. In a well-managed property, the soil in contact with the foundation is the driest soil on the site following a rainstorm. Houses with dry foundations (basements, crawl spaces and slabs) are usually dry houses. Two general rules and some specific guidelines to keep the foundation dry by keeping the soil next to the foundation dry:

1. The first general rule concerns concentration – the greatest concentration of water causes the worst damage. A valley on a roof acts like a funnel, with the greatest concentration of water at the base of the valley. Gutters also act like funnels that collect water from the edge of the roof and direct it to the downspouts. On the
land, valleys and swales act like collectors or funnels that concentrate the water on the site. Water management design that makes use of funnels (such as valleys, gutters or swales) requires maintenance to ensure the funnels work as intended. Frequently water damage occurs where a valley, gutter or swale is blocked.

2. The second general rule concerns the ground roof rule - treat the soil surface as if it were a low-slope roof surface. Pitch the ground surface away from the house - the steeper the pitch, the better the drainage. Imagine all the water moving to the low edge of the site, and imagine how best to get it there. Do not allow areas to remain near the building that can act as water collectors.

Specific site drainage guidelines include:

- The house should be built on a crown, not in a hole. If there is sufficient exposed foundation, site grading at the house can be improved. If the house hugs the ground, improvements at the foundation are more difficult. There should be a minimum of eight inches of exposed foundation between the ground and the beginning of the siding.

- Identify localized dips and holes immediately adjacent to the foundation, fill them with dirt, and tamp the fill material to prevent future settling. Use enough of the fill material so drainage occurs away from the foundation.

- If the house has no gutters, then the base of the soil around the house has to act as a gutter. The ground surface should prevent splash back onto the siding of the house and should have enough pitch to effectively move water away from the house.

- Good tamping or compaction of the backfill is very helpful in keeping water on the surface where it can be managed by slope. Soil at the outside corners of the foundation, where the downspouts are usually found, should always be tamped so the corners will not collapse inward.

- Bushes and other plantings can help with drainage if their root balls soak up a lot of water. They can be planted strategically near downspouts so that downspout extenders are less likely to be kicked off or removed during lawn mowing.

**Rain Water Management**

Rain water and snow melt from the roof should be collected and distributed away from the foundation with a gutter system. Flashings around chimneys and vents should be watertight.

- Include waterproofing underlayment at the eaves and in valleys as part of re-roofing to help prevent water damage caused by ice dams.
• As part of a management system, pitch the gutters to the downspout. Short gutters may be hung level. In hip roof houses, consider using downspouts only on the downhill side and not on the uphill side. In areas with a moderate amount of trees, consider large gutters and downspouts where hangers are solid so that they keep the gutter from sagging.

• Downspouts should be secured to the house. They should never be undersized, and some oversizing never hurts. Fasten elbows and straight sections together with pop rivets, or screws that project into the downspout can lead to clogging.

• Direct the water at the base of the downspout away from the foundation of the building (Figure 1). It should be directed out past the backfill onto the undisturbed soil, which may be 3’ to 5’ out from the edge of the house. If allowed to dump close to the foundation and into the backfill, the water will concentrate next to the foundation—precisely the wrong place for water to be. The traditional way to discharge water away from the house involves the use of downspout extenders (sections of straight downspout) or splash blocks. However, both of these are often disturbed when lawns are mowed. A better alternative is to use a notched section of downspout that is hinged to the elbow at the base of the downspout. The soil at the base of the downspout 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.

• Keeping gutters clean in wooded areas can be a maintenance issue. A gutter guard system can help keep debris out of the gutter, thus minimizing maintenance, while allowing water to drain into the gutter. An example of a gutter guard system is the PermFlow Gutter Guard System (Figure 2). This system costs about $4.50.
per 3' section and is designed for a 5” K style gutter (8’ sections are sold to contractors).

• Similar systems such as the Waterfall Gutter Guard are available (Figure 3).

4.2 Crawl Space Design

Moisture entry and evaporation from foundation sources are major contributors to the moisture load in a house. Because they are rarely visited or inspected and problems go unaddressed, crawl spaces are particularly notorious for leading to foundation moisture problems. When moisture entry is acute, framing and subflooring can deteriorate and support mold. The following points relate to crawl spaces in general, regardless of thermal boundary:

• Crawl spaces should have easy access and good lighting to enable regular inspections. There should be sufficient headroom to allow for reasonable ease of movement and ability to perform repairs and improvements.

• Water in crawl spaces typically comes from poor rainwater management outdoors, plumbing leaks, air conditioner condensate or water softener discharge. Poor rainwater management is by far the leading source of water in crawl spaces.

• Crawl spaces should be covered with a ground material: a slab of concrete, a polyethylene sheet or other vapor-proof material. The ground cover must be sealed to the foundation walls. All joints and seams must also be sealed. The ground cover must also be sealed to foundation piers interior to the crawl space.

• Crawl spaces should be insulated. There are two ways to insulate a crawl space, depending on where the thermal boundary is to be established. The thermal boundary is the building section that separates conditioned space from outside conditions. Insulation can either be placed on the crawl space walls (placing the crawl space inside the thermal boundary) or in the floor of the house (placing the crawl space outside the thermal boundary). If the crawl space contains mechanical systems (plumbing, ductwork), the space should be inside the thermal boundary.

The inspected crawl spaces violated several of these points. Many crawl spaces had no vapor barriers covering the base of the crawl space and were marginally insulated. The crawl spaces were wet from poor rainwater management and ground moisture. Existing crawl spaces should have a vapor barrier installed and rainwater management improvements made to the exterior through site grading and roof drainage systems.
The following discussion on new crawl space design is provided to clarify principles, and to serve as a guide for future construction. First 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 walls indicates that the foundation walls form the thermal boundary (Figure 4) and that the crawl space is part of the conditioned space. In this case, it is not desirable to provide crawl space ventilation, which is analogous to opening a window in a heated room. If insulation is placed in the floor above the crawl space, then the floor is the thermal boundary, and ventilation can be installed. Mechanicals (plumbing, ductwork) should be inside the thermal boundary in all cases.

**Figure 4: Crawl space with thermal boundary at foundation walls**

**Crawl Space Walls Are the Thermal Boundary**

The crawl space is unvented. It shows an exterior insulation system that allows a shallower frost wall, although the foundation wall may be insulated in down to the footing, either on the inside or outside of the foundation wall. The drawing also shows a concrete pad sloped to a sump pump. Should water get into the crawl space, it can be drained and pumped from the crawl space. The concrete pad serves as a ground cover that can be cleaned and is more durable than a polyethylene ground cover.

The crawl space is designed as a stubby basement that is conditioned as a result of ductwork, or in some cases, furnaces being located there. As unvented crawl spaces are
not usually allowed by most codes, it may be necessary to add closeable vents in order to obtain a building permit.

**Floor above the Crawl Space is the Thermal Boundary**

Figure 5 shows a well-vented crawl space where the subfloor of the home serves as the thermal boundary. The bellyboard membrane seals the home from the crawl space. A small drain to discharge any leaks or overflows from the bathroom and kitchen may be added. No ductwork or piping should be at floor level and run into the crawl space.

Water service piping should be insulated with electric heating tape. Generous venting is required in the foundation walls, with the vents installed well off the ground. Vents installed according to code can only deal with small amounts of moisture. Consequently, it is essential to include a continuous and sealed ground cover to ensure that water drains away from the crawl space.

### 4.3 Winter Condensation Problems

Condensation occurs when moisture-laden air comes in contact with a building surface that is chilled below the dew point of the air. When this happens, the moisture content of the materials at the location increases, often up to saturation, and mold grows on the surfaces. This problem indicates a combination of two factors:

1. A house with a high wintertime moisture load (relative humidity), and
2. Areas of the building that are below the desired interior temperature.

Two approaches could address this problem:

1. Identify the moisture sources that contribute to the elevated humidity in the house and reduce or eliminate these moisture sources.
2. Identify the cause of the chilled surface and add insulation or airflow improvements to reduce or eliminate the chilling of the surface.

Identifying and reducing moisture sources to lower relative humidity in the winter should be the first step. Moisture sources can include:

- Foundation moisture sources, i.e. wet basements and crawl spaces
- Bathroom moisture sources due to lack of effective localized ventilation
- Human moisture sources resulting from overcrowding.

Several of these moisture sources were identified in the Sault Ste. Marie inspected houses that had experienced condensation problems. These moisture sources are related to other issues discussed individually in the report, including site drainage and rainwater management (Section 4.1.), crawl space design (Section 4.2.), bathrooms (Section 4.4.), and overcrowding (Section 4.5.). Minimizing these moisture sources is discussed in each respective section.

Especially in cases involving overcrowding in weather-tight houses, adding whole house ventilation can reduce the moisture load in the house. Ventilation should be considered after all of the other moisture sources have been addressed.

Maintaining surface temperatures above the dew point temperature is the second approach. Moisture source control should always be considered first, because the lower the relative humidity, the lower the temperature that is tolerable within the home. However, the problem can occur at a reasonable interior humidity if there is a specific construction flaw that allows a surface to get chilled in the winter.

A common condition contributing to winter condensation and mold problems occurs in closets on an exterior wall. The design and use of closets create this common condition, specifically:

- Lack of heat supplied to closets and closed closet doors
- Lack of airflow in closets, which could distribute heat to the closet exterior surface
- Closet clutter that prevents airflow and heat reaching the closet’s exterior walls
- Clothes hanging against the wall act as insulation and lower the temperature of the wall

Since a relatively cold room contributes to mold growth, ensuring that the exterior wall of the closet does not get chilled will help prevent this mold growth. Closets should not be
cluttered and residents should maintain some distance between the clothes and the exterior wall. Closet doors should be louvered and the room kept at a comfortable temperature. Exterior walls should also be insulated. Again, the moisture load in the house should be kept at a minimum.

The exterior wall/ceiling junctures often experience chilling and subsequent condensation and mold contamination, especially in northern climates in older ranch-style homes with low-pitched roofs. It was found in Sault Ste. Marie housing, as well.

Three reasons why the exterior wall/ceiling juncture gets cold are (Figure 6):

1. Cold wind may enter through soffit vents and pass through the porous insulation material, degrading its thermal performance.

2. The insulation may have been poorly installed resulting in reduced amounts of insulation in the corner.

3. The geometry of the corner may prevent slow-moving currents of warm air from reaching into the corners.

Dark spots occur on interior surfaces that are chilled due to poor insulation. In new construction, use a raised-heel truss and carefully insulation at the wall-roof joints. It is difficult to adequately insulate the exterior edge of the attic, especially in homes with low-pitch roofs. With batt insulation, special pusher sticks may be used to push the insulation out to the edge. With loose fill insulation, the outside edge should be prepared correctly so that it is packed with insulation.
In existing homes, consider retrofitting the wall-roof joint (Figure 7). The work is done from the outside. Remove the soffit material. Install a fiberglass baffle in each cavity space. Push the existing insulation back up against the sheathing or the baffle. Blow in new cellulose insulation or pack in fiberglass insulation into the cavity. Then install pre-cut rectangles of rigid foam insulation to block air flow. If blowing in loose-fill insulation, the rigid foam insulation should be installed first, followed by blown insulation. Use spray-applied foam insulation to keep the rigid rectangle in place. Replace the soffit. If the attic is ventilated, make sure that nothing blocks the baffles.

Many individuals, organizations, and model codes stress the importance of attic ventilation. While it has some benefits, it also has some drawbacks. Wind washing of insulation at the edge is one major drawback. Designs without attic ventilation may improve the performance of the eave area. Most designs without ventilation rely upon the verified airtight ceiling plane for good moisture performance. For more information about the benefits and drawbacks of attic ventilation see “Issues Related to the Venting of Attics and Cathedral Ceilings” at http://www.fpl.fs.fed.us/documents/pdf1999/tenwo99a.pdf.

The retrofit described above is designed to keep the wall/ceiling juncture warm and eliminate the condensation site. These efforts to lower the moisture load in the house and reduce the relative humidity also help prevent wintertime mold and moisture problems.

4.4 Insulate & Air Seal Attic Hatches

A non-air sealed attic hatch is a type of bypass or alternate space through which air can pass (Figure 8). Mold can
condense on access hatch blocking if not air sealed. The hatches should be air sealed with weatherstripping or gasket as shown in the Figure 8. Latches should be installed to lock the hatches in place and provide positive closure.

Attic hatches should be insulated to a minimum of R38 but no less than R19. A lightweight attic hatch may be cut from damaged insulated foam core doors. The door has an R-value around 7. Batt insulation may be attached to the back of the door panel to achieve the desired R-value. The door panel is pre-finished, light-weight and requires no additional painting.

4.5 Bathroom Mold Problems

Many home mold and moisture problems occur in bathrooms due to the presence and use of much water. Keeping bathrooms dry depends on care in several areas:

1. Bathroom plumbing should not leak. There should be no leaks in either the water supply system or the drain-waste-vent (DWV) system. Promptly fix all plumbing leaks. Some hard to detect leaks at the toilet flange or at a shower drain require careful inspection.

2. Bathroom users should use shower curtains so that shower water does not splash outside the tub. Toilet users should not wet the areas around the toilet. Surfaces in the bathroom should be selected and installed to keep water away from drywall and other materials that may permit mold to grow. Wipe up spills promptly and clean dirty and discolored spots. Correct the water problems that may have led to the spotting. Damaged drywall should be removed and replaced. Keeping surfaces clean and dry is primarily the responsibility of the residents of a house.

3. Some rooms are natural moisture sources due to the nature of their function. Showers are taken in bathrooms resulting in 100% humidity in that room. Kitchens are used for cooking and cleaning. In laundries, clothes dryers must remove large quantities of water from wet clothes. By removing moisture at the source in these areas, exhaust ventilation serves as a source control strategy for reducing the moisture load in a house. Exhaust ventilation dilutes the moisture and places the room in a negative pressure, thus limiting the spread of moisture to the rest of the house until most of the moisture has been removed to the outside.

4. Not only bathroom and kitchen exhaust fans, but also clothes dryers should vent to the outside rather than into the living space. Venting to the basement, crawl space and attic can lead to moisture problems occurring in these areas. For this reason, localized exhaust ventilation requires ductwork. If the vent discharges through the roof, make sure the vent has an effective check valve to prevent wind blowing back through the vent.
5. Bathroom exhaust fans should exhaust between 50 and 70 cubic feet per minute (CFM). The effectiveness of exhaust fans depends on the power of the exhaust fan, length and type of exhaust duct and cleanliness of the fan grille. When there is excessive resistance in the ductwork, the exhaust fan motor may not be powerful enough to vent sufficient airflow through the duct. The longer the duct length, the greater the static pressure in the duct and the less air flow through the duct. Turns and bends in the ductwork also increase the static pressure and reduce flow. Similarly, a smooth duct provides less resistance and improved flow than ribbed ductwork. Round, smooth sheet metal ductwork is recommended for all types of exhaust ventilation. Generally, the larger the duct, with the fewest bends or elbows, and the shortest duct run, is preferred. A dirty intake grille will also greatly increase resistance and reduce airflow.

6. Noisy exhaust fans are not likely to be used, so exhaust fans with a low sone rating should be selected. To ensure they are used, consider:

- Exhaust fan hard-wired to the bathroom light.
- Exhaust fan on a timer, to extend moisture dilution time after showering.

A good system features both of these features. The fan is hard-wired to the light, but also runs for a programmed period following bathroom use. (Available from Energy Federation Incorporated, www.efi.org, Fan/Light Time Delay Switch). Residents should be encouraged to always use the bathroom exhaust vent.

### 4.6 Human Moisture Sources

Human occupation also produces moisture in buildings. Humans are similar to internal combustion engines, and respiration, the act of breathing, produces considerable moisture. Other human activities and preferences also produce moisture:

- Showering
- Cooking
- Cleaning
- Drying laundry indoors
- Accidental spills
- House plants
- Firewood storage
- The use of humidifiers and vaporizers

All of these moisture producing activities contribute to the moisture load in a house.

However, human moisture sources alone do not produce enough moisture to cause winter condensation and mold problems in the winter. Two circumstances under which human moisture sources may create mold problems include:
1. Overcrowding. When the number of residents living in a house exceeds the expected capacity of the house, the moisture burden increases. Each person participates in moisture-producing activities (breathing, cooking, washing, etc.) increasing the moisture load. If the number of people living in the home doubles the set capacity of a house, the moisture load from human sources also doubles.

2. Weather-tight construction. In the absence of a mechanical ventilation system, natural infiltration (air leakage) provides fresh air in homes during the winter. This fresh, dry, winter air dilutes the moisture in the interior air and helps keep relative humidity under control. The amount of infiltration (the air change rate) that occurs in a house varies with the house. Some houses are naturally leaky, while others are more airtight. A particularly tight house may exhibit high relative humidity in the winter, which could lead to moisture and mold problems.

When a house is both overcrowded and has a low air change rate, an excessive moisture load can occur maximizing the potential for localized condensation and mold growth.

If winter condensation problems occur in a crowded house, all other sources of moisture should be identified and minimized. If the problems persist, then the house should be tested for its relative tightness or leakiness using a blower door test. Agencies responsible for performing low-income weatherization usually have the equipment and expertise to perform this test and can confirm whether the air change is too low for the size of a house and its number of residents. If this proves to be the case, then consideration should be given to providing additional ventilation for the house. This can be accomplished in any number of ways. Installing a good bathroom exhaust fan on a humidistat control might accomplish the goal. If the house has a central forced-air heating system, the existing fan and ductwork can be augmented with a connecting duct to the exterior and controls to provide fresh air circulation. The services of a mechanical engineer with experience in residential ventilation systems would be valuable when addressing a problem of this kind.

4.7 Heating Systems and Moisture Control

In winter, heating systems provide occupant comfort. Heating systems also impact winter moisture problems in several ways. Two critical ways follow:

1. The heating system is a major determinant of the temperature of interior surfaces. If heat is inadequate or poorly distributed, some wall and ceiling surfaces may be chilled near or below the dew point temperature leading to condensation problems. Occupants play a role in this if they close off rooms, cover supply ducts, block airflow to exterior walls, or adjust the thermostat too low.

2. With the exception of electric heat, most heating systems depend on the combustion of fuels. A major byproduct of combustion is water vapor. If a combustion appliance is improperly vented, or not vented at all, then the heating system can contribute significant amounts of moisture into the interior air.
With regard to the first issue, central heating systems are preferred over stationary, single source heating systems, such as propane space heaters and wood stoves. Central heating systems feature ductwork that supply heated air (or heated water to radiators in hydronic systems) to all the major living spaces of the house. A properly designed and functioning heating plant and distribution system keeps all the rooms warm. This minimizes the potential for chilled surfaces, which are potential condensation and mold contamination sites.

Economic reasons sometimes cause residents to limit the heating of spaces such as bedrooms. Although this is understandable, it can also contribute to chilled exterior surfaces and result in condensation and mold growth.

With regard to the second issue, any appliance that burns a fuel, such as gas, fuel oil, or wood, produces moisture. Generally, for every molecule of fuel consumed, two molecules of water vapor are produced. If the combustion gases are not well ventilated to the outside of a home, the appliance can contribute large quantities of moisture into the indoor air. The excessive moisture load in the air can be a major contributor to winter moisture problems in the home.

Electric baseboard heat has been encountered at several reservations. Using electric baseboard heat as a primary heating source is not advisable. The only advantage of electric heat is its low first-cost. Unless the Reservation has negotiated a very low electric rate with the local utility, electric heat is expensive to operate and does not promote air circulation like a forced air unit. Poor air circulation could contribute to future mold problems. Heating method and heat distribution play a vital role in preventing wintertime mold and moisture problems.

4.8 Maintenance Issues

Many moisture problems and consequent mold contamination result from deferred maintenance. If water infiltration problems from plumbing, roofing, or foundation sources linger, a small problem can turn into a large problem. A minor water infiltration problem with a small potential for mold can turn into a major contamination site, if not repaired quickly. Unfortunately water leaks often go unreported and unattended. Roof and plumbing leaks should be attended to promptly.

A housing authority’s best defense against mold and moisture complaints is its maintenance department. A good proactive maintenance program guards against mold and moisture problems by including the following procedures:

- Perform regular inspections of properties to identify problematic moisture conditions.
- Encourage residents to report moisture problems.
• Respond promptly to identified and reported moisture problems to prevent excessive mold contamination.

Clearly, a prompt response implies a partnership between tenants and the housing authority. Residents must promptly report mold and moisture problems, and maintenance staff must promptly respond to the residents’ reports. If either party defers in their responsibility, the list of deferred maintenance items will grow, and small moisture and mold problems will turn into major problems with possibly severe mold contamination. Maintenance staff should be trained in the following items to assist in solving and eliminating moisture and mold problems.

General

• What is mold
• What causes mold
• Other Indoor Air Quality (IAQ) problems
• Sources of moisture
• Moisture assessment procedures

Exterior

• Site drainage
• Maintenance of roof drainage systems (gutters, downspouts, etc.)
• Paving adjacent to homes
• Repair of roofs and roof flashings

Foundations

• Crawl space design issues
• Sump pump system desired, installation, and disposal of water

Attics

• Attic bypasses
• Attic hatches
• Attic ventilation
• Insulation
• Wall/ceiling junctures

Mechanical

• Bathroom and kitchen exhaust fans
• Venting exhaust fans to the exterior
• Plumbing leaks
• Humidifiers
• Unvented appliances

**Mold Remediation**

• Clean-up
• When to call for outside help

At the same time, occupants should be aware of their crucial role in preventing mold and moisture problems. A number of occupant issues bear directly on the causes and severity of moisture and mold problems. Occupants should receive training on the following topics to assist in solving and eliminating moisture and mold problems in their homes.

• What is mold and what causes it
• Use of exhaust fans
• Regular bathroom cleaning
• Avoidance of clutter in critical locations (exterior walls of closets, etc.)
• General housekeeping
• Use of crawl spaces
• Gutter and downspout maintenance
• Difference between plumbing leaks and water condensation on pipes
• Use of sump pumps
• Humidifiers and dehumidifiers

### 4.9 Remodel & New Construction Recommendations

The following are some recommendations for rehabilitation and new construction projects for the Sault Ste. Marie Indian Community Housing Authority.

**On the Exterior of the House**

• Siting & elevation of house
  
  See Section 4.1 - Site Drainage and Rainwater Management

• Gutter and drainage systems
  
  See Section 4.1 - Site Drainage and Rainwater Management

• Foundation waterproofing and drainage for new construction
  Keeping soil dry next to a foundation is the preferable approach for maintaining a dry basement or crawl spaces. However, there are occasions where this may not be possible and a good second line of defense is to use a high quality waterproofing membrane on the exterior face of the foundation wall. There are many towel or spray applied products on the market. Once applied, these products create a monolithic and highly flexible membrane with crack-bridging
properties (e.g. www.appliedtechnologies.com, or www.carlisle-ccw.com). These membranes should be protected with either a geotextile covering (e.g. http://www.deltams.com/deltadrain/) or rigid insulation (e.g. DOW Styrofoam Perimate) before backfilling.

In addition to carefully waterproofing foundation walls, installing drain tile at the base of the foundation wall is necessary to dispose of water that has drained down the face of the wall. Usually this tile is connected to the sump pit, or if possible, run to daylight.

Properly sealing and draining crawl spaces or basement foundation walls is as important as properly installing shingles on a roof. Unfortunately, foundation walls are frequently not provided the same attention that roofs are. Roofs are visible and everyone understands that a leaky roof will result in a host of problems. On the other hand, foundations are below grade and not visible, and thus do not appear to be as important as roofs. However, this belief is incorrect. It does not matter whether moisture comes from above or below. All unwanted moisture should be kept outside the building structure. Although foundation leakage may not result in obvious water spots on the ceiling such as from a roof leak, water from a foundation leak can cause structural damage, contribute to mold growth, and compromise habitable spaces. The importance of properly sealing and draining foundations cannot be overemphasized.

• Siding options for new construction and remodel projects

There are several criteria that should be considered when selecting the siding for a structure. Performance (maintainability, durability, repairability, permeability, etc.), aesthetics, first-cost, and life-cycle-cost should all be considered. Frequently the selection of siding is based on lowest first-cost. This is unfortunate because basing decisions solely on first-cost precludes all the other criteria that should also be considered in the selection process. The housing authority should carefully scrutinize siding options and not base selection solely on first-cost. Durability of siding should be an important factor in the selection process. Investing a little more initially can result in significant savings later. A life-cycle-cost analysis should be conducted to justify the selection process. High quality, heavy gauge, insulated vinyl siding, or fiber cement composite siding (http://www.jameshardie.com/), are some of the siding options that should be considered.

On the Interior of the House:

• Toilet tank condensation problems

One common problem the assessment team has identified in much Indian housing is mold and the deterioration of drywall behind toilet tanks. Due to condensation on the outer surface of the toilet tank, the adjacent wall area is often wet. Since
the wet wall behind the toilet tank is difficult to clean, due to limited access, mold grows and the wall deteriorates.

There are two ways to mitigate this problem:

1. One is to install a toilet with an insulated tank. The insulation results in higher toilet tank surface temperatures and thus less surface condensation.

2. The other option is to supply both hot and cold water to the toilet through a mixing valve. The increased water temperature inside the tank will result in less surface condensation. The supply of hot and cold water through a mixing valve has been implemented at a couple of Indian housing communities with positive results.

- Insulate all plumbing supply lines

The temperature of water supplied to Indian housing in the northern tier of the United States is very cold. Many of the examined homes had water supply pipes in the basement or crawl spaces that were dripping liquid water due to condensation on their surface. This condensation can contribute a significant amount of water to the interior moisture load. All hot and cold supply piping should be insulated; the hot water lines for energy conservation, the cold water lines to eliminate condensation.

- Ceiling finishes

Only one of the inspected homes had mold growing at the wall to ceiling junction. Cleanup of this mold is very difficult, if not impossible, if the ceiling has a rough textured finish. It is highly recommended that ceilings be finished with a smooth or a skip-trowel finish in lieu of a rough popcorn finish.

- Drainage of Condensate

The two new homes that were inspected had the condensate drain for the high-efficiency furnace drained into the crawl space. This practice should be ended. One of the by-products from high-efficiency furnaces is water. During winter months, when the furnace is running frequently, these units produce a significant amount of water. This water should be drained into the sump pit from where it can then be pumped to the exterior.
| Inspection Number | Address         | HUD Program | Building Age | Bedrooms | Occupancy | Foundation Type | Model and Framing Type | Heat Type | Bath Fan CFM | Site Drainage Problems | Gutter System Problems | Leaks from Exterior | Wet Basement or Crawl Space | Plumbing Problems | Bathroom Problems | Exhaust Ventilation | Exterior wall/ceiling problems | Attic Problems | Visible Mold (Column #) |
|-------------------|----------------|-------------|--------------|----------|-----------|-----------------|------------------------|-----------|--------------|------------------------|------------------------|---------------------|--------------------------|---------------------|----------------------|---------------------|----------------------|
| 1.1               | 117 Nopaming   | Low Rent    | 19 yrs.      | 2        | 3         | Slab on Grade   | Wood frame ranch      | Hot water baseboard    | 8          | Yes          | No                    | No                    | No                  | No                       | No                  | No                   | No                  | No                   | No                   |
| 1.2               | 103 Nopaming   | Low Rent    | 19 yrs.      | 3        | 5         | Slab on Grade   | Wood frame ranch      | Hot water baseboard    | 23                     | Yes          | No                    | Gutters               | No                  | N/A                      | Yes                 | Yes                  | No                  | No                   | No                   |
| 1.3               | 268 WaSeh St. Ignace | Low Rent    | 11 yrs.      | 3        | 0         | Block Crawl Space | Wood frame ranch      | Forced air             | 35                     | No           | No                    | No                    | No                  | No                       | No                  | Yes                  | Yes                | No                   | No                   |
| 1.4               | 112 WaSeh St. Ignace | Low Rent    | 17 yrs.      | 3        | 3         | Block Crawl Space | Wood frame ranch      | Forced air             | 37                     | Yes          | Yes                    | Yes                   | Yes                 | No                       | No                  | Yes                  | No                  | No                   | No                   |
| 1.5               | 136 Shen Group St. Ignace | Low Rent    | 16 yrs.      | 3        | 7         | Block Crawl Space | Wood frame ranch      | Forced air             | 12                     | Yes          | No                    | Gutters               | Yes                 | Yes                      | No                  | No                   | No                  | No                   | No                   |
| 1.6               | 255 WaShe St. Ignace | Low Rent    | 18 yrs.      | 3        | 5         | Slab on Grade   | Wood frame ranch      | Hot water baseboard    | 40                     | No           | No                    | Gutters               | No                  | N/A                      | No                  | No                   | Yes                  | No                   | No                   |
| 1.7               | 2098 Ice Circle Sault St. Marie | Low Rent    | 4 yrs.       | 1        | 0         | Block Crawl Space | Wood frame ranch      | Hot water baseboard    | 9                      | Former problems | Yes                    | No                    | No                  | No                       | No                  | No                   | No                  | Marginal             | No                   |
| 2.1               | 1936 JK Lumsden Way Sault St. Marie | Low Rent    | 15 yrs.      | 3        | 3         | Block Crawl Space | Wood frame ranch      | Electric Baseboard     | 11                     | Yes          | No                    | Gutters               | Yes                 | Yes                      | No                  | No                   | No                  | Marginal             | No                   |
| 2.2               | 1450 E. Polaris Drive Odensaag | Homeownership | 1 yr.        | 4        | 3         | Block Crawl Space | Wood frame ranch      | Forced air             | 54                     | Yes          | No                    | Gutters               | No                  | No                       | Yes                 | No                   | No                  | No                   | No                   |
| 2.3               | 1781 E. Timberwolf Drive Odensaag | Homeownership | 1 yr.        | 3        | 6         | Block Crawl Space | Wood frame ranch      | Forced air             | 68.0                    | Yes         | No                    | Gutters               | Yes                 | Yes                      | No                  | No                   | No                   | No & No              | No                   |
Appendix B-Sault Ste. Marie Technical Housing Assessment Report  

September 8-10, 2003

Inspection Number: 1-1  
Address: 117 Nopaming Hessel  
Model Type: Ranch  
Foundation: Slab on Grade  
Construction: 2 x 4 Wood Frame  
Heat Type: LP Boiler  
Bedrooms: 2  
Occupancy: 3, 2 adults and 1 child  
Age: 19 Years  

Mold and Moisture Conditions: The homeowner stated mold was recurring at the base of the wall in the front entry closet. The rest of the house had no mold.

Site Drainage and Rainwater Management: The house had no gutters and a relatively flat site. The roof on the rear of the house had an approximate eight inch overhang, thus water flowing off the roof drained next to the building (Figure 2). The grade at this point sloped back toward the house.

Foundation Conditions: The foundation was a slab-on-grade.

Exterior Conditions: The house was being remodeled. The battens between sheets of plywood siding were removed and windows were reflashed. The siding was in good condition. The roof also appeared to be in very good condition.

Bathroom: The toilet was not securely fastened to the floor. The bath fan made noise but only exhausted approximately eight CFM.

Kitchen: Evidence was present of a former leak at the kitchen sink (Figure 3). There was a gas stove with no range hood.

Interior Conditions: The residence was very clean. There was evidence of discoloration on the lower portion of the wood window sashes due to condensation during winter months. At the time of inspection, the interior temperature was 70°F and 86% relative humidity.
Mechanical Space: Both the gas boiler and hot water heater exhausted out a metal duct through the ceiling. The duct had rust stains on its surface, probably from condensation within the duct in the attic space (Figure 4). The mechanical room had its own fresh-air supply for hot water heater and boiler combustion.

Attic: The attic had approximately ten inches of blown-in insulation. All the sheathing, lumber, and insulation looked dry.

Occupant Notes: Three occupants, one adult and two children ages 9 and 11 years old, have lived in the home ten years. The adult smoked. The household included two cats and one dog. The daughter had migraine headaches. Mold testing was conducted on April 30, 2001 and a report was issued on June 30, 2001.

Discussion/Recommendations:

1. The lack of gutters, a short overhang, and a slope toward the rear of the house presented an undesirable condition. Install a gutter system on both the front and rear of the house. Change the grade at the rear of the house so water flows away from the house rather than toward the house.

2. Install gutters on the front of the house to improve the recurring mold problem in the front closet by reducing the moisture load adjacent to the structure. Advise the resident to not store goods in this corner so that air can circulate and keep this corner dry. If the interior of the wall was missing insulation, as suggested by housing personnel, then this could also contribute to the mold problem.

3. Inspect the exhaust fan in the bathroom to determine why it is not functioning properly. Replace if necessary.

4. Remove the toilet, install a new wax seal, and then securely fasten the toilet to the floor.

5. Above the range install an exhaust fan that vents to the exterior.

6. Remove and replace the base of the kitchen sink cabinet.

7. If a properly functioning bath exhaust and a new range hood do not alleviate condensation on the windows next winter, advise the resident to run a dehumidifier to lower the interior humidity.
Appendix B-Sault Ste. Marie Technical Housing Assessment Report

Inspection Number: 1-2
Address: 103 Nopaming Hessel
Model Type: Ranch
Foundation: Slab on Grade
Construction: 2 x 4 Wood Frame
Heat Type: LP Boiler
Bedrooms: 3
Occupancy: 5, 1 Adult and 4 Children
Age: 19 Years

Mold and Moisture Conditions: Mold was present in the bathroom at the wall to ceiling junction, on the attic hatch, around windows, and on baseboard heaters.

Site Drainage and Rainwater Management:
There were no gutters on the house and the site was relatively flat. The roof on the rear of the house had an approximately eight inch overhang, thus water flowing off the roof drained proximate to the building (Figures 1 and 2).

Foundation
Conditions: The foundation was a slab-on-grade.

Exterior Conditions: At several locations around the house, the lower portion of the plywood siding had mildew on it (Figure 1). Other than the mildew, the siding appeared to be in good condition, as was the roof. Some of the caulking around windows had separated from window trim and needed replacement (Figure 3).

Bathroom: The toilet was securely fastened to the floor. There was deterioration of the drywall at the base of the wall at the end of the tub (Figure 4). Although missing its cover and looking quite dirty, the bath fan exhausted approximately
23 CFM (Figure 5).

**Kitchen:** The gas stove had no range hood.

**Interior Conditions:** The attic hatch was quite moldy (Figure 6). Mold was noted at the wall to ceiling junction at truss bearing locations (Figure 7). The discoloration on the lower portion of the wood window sashes indicated condensation during winter months (Figure 8). Hot water heat baseboards had dirt and mold on the baseboard housings (Figure 9). The interior temperature was 68°F and 62% relative humidity. The occupant stated that this past winter she frequently ran a dehumidifier to reduce the interior moisture load.

**Attic:** The attic had approximately ten inches of blown-in insulation. All the sheathing, lumber, and insulation looked dry.

**Occumant Notes:**
Five occupants, one adult and four children ages 15, 13, 10, and 5 years-old, had lived in the home three years. One resident smoked. The son had asthma and allergies which had been present before moving into the home. The household included one house cat and one dog that frequently came inside the home. Mold testing was conducted in this home.
Discussion/Recommendations:

1. Install a gutter system on both the front and rear of the house. The lack of gutters and short overhang cause water to drain immediately adjacent to the building. The water hits the ground and splashes up onto the siding thus saturating it. This plus the lack of sunlight on certain elevations contribute to the mildew problem. A regular cleaning regime would keep mildew from forming in the future.

2. The exhaust fan in the bathroom works marginally. Inspect it to determine if its air-handling ability can be improved and if not, replace it.

3. Remove the compromised drywall in the bathroom and inspect the interior of the wall. Dry out the wall and re-drywall. Address occupant bathing habits so this does not happen again.

4. Discard and replace the attic hatch. The new hatch should have four inches of rigid insulation attached to its top-side and the perimeter of the hatch should be air sealed with foam tape.

5. To alleviate the spots of mold at the wall to ceiling junction, first thing increase the amount of attic insulation along the perimeter of the building and second, run a dehumidifier to keep the problem in check.

6. Clean the mold on the metal covers of the baseboard fin-tube radiators with soap and water.

7. When dry, lightly sand all window sashes and sills, then reseal with two coats of polyurethane.

8. Install an exterior venting exhaust fan above the range.

9. On the exterior, check all caulk joints and repair as necessary.
Inspection Number: 1-3
Address: 268 WaSeh St. Ignace
Model Type: Ranch
Foundation: Block crawl space
Construction: 2 x 4 Wood Frame
Heat Type: LP Forced air
Bedrooms: 3
Occupancy: Vacant
Age: 11 Years

Mold and Moisture Conditions: This home was in the process of being refurbished due to past mold, thus had no evidence of mold.

Site Drainage and Rainwater Management: A new metal gutter system was on the home. The site next to the residence was relatively flat and sloped away from the house.

Foundation Conditions: The house rested on a block crawl space foundation. Crawl space vents were immediately at or extending below grade (Figure 2).

Crawl Space Condition: The floor joists, subfloor and crawl space walls had recently been sprayed with two products. The first product, Foster 40-80, is a HVAC and wall disinfectant. The second product, Foster 40-20, was a fungicidal protective coating. A memo dated 11/13/02 from Mr. Dan Tadgerson, the Environmental Officer, stated that the joists had mold on them. These two products were used to determine their effectiveness in mitigating and arresting further mold growth. Everything was still damp from the recent application of the products. The crawlspace had a sand base and no vapor barrier. Some of the rigid insulation on the block walls had been removed and was on the crawlspace floor. The rim joist insulation had been removed so that the disinfectant and fungicide could be applied to the rim joist. The copper supply piping was uninsulated (Figure 3)
**Exterior Conditions:** Recently refurbished, the exterior of the residence was in excellent condition.

**Bathroom:** The toilet was securely fastened to the floor. The bath fan exhausted approximately 35 CFM.

**Kitchen:** The kitchen had a wood stove with a recirculating range hood. There was evidence of a former leak beneath the kitchen sink, however it was not active (Figure 4).

**Interior Conditions:** The interior of the unit was in excellent condition.

**Attic:** The attic had two layers of eight inch fiberglass batt insulation laid at right angles to one-another. All the sheathing, lumber, and insulation looked dry and in good condition.

**Occupant Notes:** The home had been vacant for seven months and was undergoing rehabilitation. The occupants had been relocated to another home.

**Discussion/Recommendations:**

1. Replace the insulation on the block wall in the crawl space.

2. Insulate the rim joist with rigid, foam, or fiberglass insulation.

3. Install a vapor barrier in the crawl space and seal it to the insulation along the perimeter and to any other penetrations on the interior of the structure.

4. Insulate all hot and cold plumbing supply lines.

5. Inspection in the attic revealed a metal duct which was most likely attached to the bathroom exhaust fan (Figure 5). Wrap it with insulation or replace it with an insulated duct otherwise, during the winter, moisture laden bath air will condense in the cold ductwork, run back into the bath fan unit and ruin it.

6. Replace the recirculating fan in the kitchen with a unit that exhausts to the exterior.
Inspection Number: 1-4  
Address: 112 WaSeh St. Ignace  
Model Type: Ranch  
Foundation: Block crawl space  
Construction: 2 x 4 Wood Frame  
Heat Type: LP Forced air  
Bedrooms: 3  
Occupancy: 3, 1 adult and 2 children  
Age: 17 Years

Mold and Moisture Conditions:  
There was no evidence of mold in this residence. However, the occupant did mention that when the heating system turned on, the air emanating from a duct in a back bedroom smelled musty.

Site Drainage and Rainwater Management: A plastic gutter system was on this home. The gutter was compromised in several areas and both downspouts were missing (Figure 2). The site was flat.

Foundation Conditions: The house rested on a block crawl space foundation. Crawl space vents were immediately at or extended below grade (Figure 3). The crawl space access hatch was on the exterior of the residence and the surrounding grade sloped down to the base of the hatch (Figure 4).
Crawl Space Condition: The marginally installed vapor barrier on the floor of the crawl space had several water puddles on top of it (Figure 5). An old, sump pit was in the corner of the crawl space (Figure 6). Exposed metal duct work connected to trunk-ducts in the crawl space (Figure 7). Some of the insulation in the floor system had been removed for the repair of plumbing leaks and had not been reinstalled (Figure 8).

Exterior Conditions: The exterior of the residence is in good condition and appears, with the exception of the gutters, to have been very well maintained.

Bathroom: The toilet was securely fastened to the floor. The bath fan exhausted approximately 37 CFM.

Kitchen: The stove had a range hood that exhausted to the exterior.

Interior Conditions: The interior of the unit is in good condition.

Mechanical Notes: The exhaust duct for the gas hot water heater had water stains on its exterior (Figure 9). The gas valve for the HWH appeared to have experienced

Figure 5: Water on vapor barrier in crawl space
Figure 6: What's up with the sump pump?
Figure 7: Exposed duct work in crawl space
Figure 8: Missing insulation in floor system
Figure 9: Condensation on water heater exhaust
flame roll-out in the past (Figure 10).

**Attic:** The attic had approximately ten inches of blown-in cellulose insulation. The exhaust ductwork for the hot water heater and furnace had dams built around them to keep cellulose insulation from touching the ductwork (Figure 11).

**Occupant Notes:** Three occupants, one adult and two children ages 7 and 14 years, had lived in the home since 1977 with no reported health problems. One resident smoked.

**Discussion/Recommendations:**

1. Inspect the sump pit operation and remove all debris.

2. In the crawl space, remove the existing vapor barrier, grade the floor to be flat, and replace the vapor barrier. Seal the VB along the perimeter to the insulation on the block walls and to any interior penetrations.

3. Replace the missing insulation in the floor system.

4. Seal and insulate exposed metal duct work.

5. Staining on hot water heater exhaust duct work was probably from exhaust gasses condensing within the pipe, leaking through joints and running down the face of the duct. Duct exhaust gasses out through an insulated pipe to the exterior.

6. The bath exhaust fan was vented using flexible plastic ductwork (Figure 12). Replace with insulated duct work so that moisture laden air does not condense within the ductwork before it exhausts out the roof jack.

7. Install an appropriately sized area well in front of the crawl space access hatch and at any crawl space vents that extend below grade. In its current configuration, the depression around the access hatch acts as a funnel and channels water and debris towards the crawl space opening.

8. Some of the windows had heavy coverings/drapes.
Warn occupants that depending on interior moisture loads, heavy condensation can occur on the glass surfaces if window coverings restrict the air movement across those surfaces.

9. Visual and olfactory examination of the offending duct in the back bedroom did not disclose anything unusual. However, next to the bed, an extra mattress leaned up against an exterior wall. The mattress created additional insulation and restricted air movement creating a good environment for mold growth. Frequently check between the mattress and wall for mold, particularly near the floor surface.

10. Flame roll-out at the water heater has supposedly been resolved. When disclosed, this type of problem should be resolved immediately. Needless to say, not only is it dangerous to have flames proximate to the gas valve, but the introduction of combustion gasses into the interior of the house is undesirable.
Inspection Number: 1-5
Address: 138 Shen Goup
Model Type: Ranch
Foundation: Block crawl space
Construction: 2 x 4 Wood Frame
Heat Type: LP Forced air
Bedrooms: 3
Occupancy: 7, 2 adults and 5 children
Age: 16 Years

Mold and Moisture Conditions: There was no evidence of mold in this residence.

Site Drainage and Rainwater Management:
Gutters were absent from this home. The site was flat and behind the home was a drainage ditch. Inspectors were told that there were three to four active springs in this neighborhood compounding recurring water problems. There were a few depressions next to the foundation which were probably due to animal activity.

Foundation Conditions: The house rested on a block crawl space foundation. Crawl space vents were immediately at or extending below grade. The crawl space access hatch was on the exterior of the residence and the surrounding grade sloped down to the base of the hatch (Figure 2 & 3).

Crawl Space Condition: There was a marginally installed vapor barrier on the floor of the crawl space with several water puddles on top of it (Figure 4). Water marks on the wall indicated that at some time in the past significant quantities of water were in the crawl space (Figure 5). This was also confirmed by some of the documentation provided.
the investigators. Exposed metal duct work connecting trunk-ducts, and some of the insulation on the foundation walls had been removed.

**Exterior Conditions:** The exterior of the residence was in good condition and appeared very well maintained.

**Bathroom:** The toilet was securely fastened to the floor. The bath fan exhausted approximately 12 CFM out a sidewall vent.

**Kitchen:** The stove had a range hood that exhausted to the exterior.

**Interior Conditions:** The interior of the unit was in good condition. However, the residents complained that they had to be vigilant with their housekeeping to keep mold in check.

**Attic:** The attic had approximately ten inches of blown-in cellulose insulation. Exhaust ductwork for the hot water heater and furnace had dams built around them to keep cellulose insulation from touching the ductwork.

**Occupant Notes:** Seven occupants, two adults and five children ages 13, 14, 14, 15, and 16, had lived in the home for seven years. Two smokers resided in the home. Day care was provided in the home for one child age four years. The occupant reported that her son had asthma and allergies problems. One dog lived in the home.

**Discussion/Recommendations:**

1. Remove the existing crawl space vapor barrier (VB), grade the floor until flat, and replace the vapor barrier. Seal the VB along the perimeter to the insulation on the block walls and to any interior penetrations.

2. Replace missing or loose insulation in the floor system.

3. Seal and insulate exposed metal duct work.

4. Replace the bath exhaust fan vent with insulated ductwork (Figure 6). This prevents moisture laden air from condensing within the ductwork before it exhausts out the roof jack.

5. Install an appropriately sized area-well in front of the crawl space access hatch and at all crawl space vents that extend below grade. The depression around the access hatch acts as a funnel and channels water and debris towards the crawl space opening.

6. Fill all depressions next to the foundation, compact the soil, and reseed with grass.
7. The recurring drainage problem due to a high water table and poor clay soils are difficult problems to overcome. Gutters that move the water away from the house and a sump pit with drain tile in the crawl space may help some. However, if ground water overwhelms the sump system, a wet crawl space may be a recurring problem that cannot be economically resolved.
Inspection Number: 1-6  
Address: 225 WaSeh St., Ignace  
Model Type: Ranch  
Foundation: Slab-on-grade  
Construction: 2 x 4 Wood Frame  
Heat Type: LP Boiler  
Bedrooms: 3  
Occupancy: 5, 2 adults and 3 children  
Age: 18 Years

Mold and Moisture Conditions: There was only slight evidence of mold around the bath fan in this residence.

Site Drainage and Rainwater Management: No gutters were on this home. The site immediately adjacent to the house was flat, but dropped away further from the house.

Foundation Conditions. The house rested on a slab-on-grade foundation.

Exterior Conditions: The exterior of the residence was in good condition and appeared well maintained.

Bathroom: The toilet was securely fastened to the floor. The bath fan exhausted approximately 40 CFM out a sidewall vent. There was evidence of mold around the bath fan.

Kitchen: The stove had a range hood.

Interior Conditions: The interior of the unit was in good condition.

Attic: The attic had approximately ten inches of blown-in cellulose insulation. The cellulose above the bath fan was discolored.

Occupant Notes: Five occupants, two adults and three children ages 11, 10, and 7 years old, had lived in the home three years with no reported health problems. Two smokers resided in the home.

Discussion/Recommendations:

1. Inspection of the exterior vent for the bath fan disclosed a wasp nest right inside the exterior louvered wall jack. Most of the nest was removed, after which the bath fan was tested again. Its performance did not improve. Inspect the exhaust fan to determine why it is not functioning properly and replace, if necessary.
2. Closely examine discoloration of the cellulose insulation above the bath fan. The discoloration may indicate an air leak in which case the cellulose insulation is being wetted by the bath exhaust. This may also be the source of moisture for the mold forming around the bath fan.

3. After eliminating the source of moisture for the mold around the bath fan, clean up the mold with soap and water.

4. Install gutters on both the front and back of the house. Drain leaders away from the house.
Inspection Number: 1-7
Address: 2098 Ice Circle Drive, Sault Ste. Marie
Model Type: Ranch
Foundation: Block crawl space
Construction: Wood Frame
Heat Type: Natural Gas Boiler
Bedrooms: 1
Occupancy: Vacant
Age: 4 Years

Mold and Moisture Conditions: There was no visible mold within the residence. However, there was evidence of a past incidence of significant water ponded in the crawl space due to a missing drain tile. The prior occupant of this residence was moved out because of reported mold contamination.

Site Drainage and Rainwater Management:
Except for a short gutter section above the entry ramp, no gutters were on this home. The site immediately adjacent to the house was flat, but there was a drainage ditch approximately forty feet behind the house.

Crawl Space Conditions: The foundation was a block wall crawl space with two inch extruded polystyrene insulation on the inside face of the block. Some insulation had either fallen off, been removed, or had been placed on the floor of the crawl space (Figure 2). The band joist was not insulated. The sand base was damp but with no standing water. Water marks on the insulation indicated past flooding (Figure 3). Plumbing supply lines were uninsulated, and some were proximate to crawl space vents (Figure 4).

Exterior Conditions: The exterior of the residence was in good condition.
Bathroom: The toilet was securely fastened to the floor. The bath fan exhausted approximately 9 CFM out a roof mounted exhaust.

Kitchen: An electric stove had no range hood.

Interior Conditions: The interior of the unit was in good condition. Condensation on the windows during winter months caused minor deterioration of the polyurethane finish on the lower portion of some of the window sashes (Figure 5).

Mechanical Notes: The heating system consisted of a hot water boiler with fin-tube baseboard distribution. The area around the floor drain in the mechanical room showed evidence of water stains (Figure 6).

Attic: The attic had two layers of eight inch fiberglass batt insulation laid at right angles to one-another. Most of the attic was well covered; however, the area above the bathroom was in disarray (Figure 7). The sheathing and trusses appeared to be dry and in good condition. The only ventilation for the attic consisted of soffit vents along the perimeter.

Occupant Notes: This unit was vacant. The occupant, an elderly woman, had been relocated because of moldy conditions in the home.

Discussion/Recommendations:

1. The ponds of water in the crawl space had supposedly been resolved with the completion of a drain tile that had never been properly completed. Monitoring the situation after rainfalls will verify the resolution of the problem.

2. In the crawl space, temporarily place a dehumidifier drained to the exterior. Dry out the sand as much as possible before installing a vapor barrier. Seal the vapor barrier to the perimeter insulation and any penetrations.

3. Replace missing rigid insulation along the perimeter of the crawl space, and insulate the perimeter band joist.
4. Insulate all copper plumbing supply lines.

5. Install gutters along the perimeter of the house and drain towards the drainage ditch at the rear of the house.

6. Rearrange the fiberglass batt insulation above the bathroom to provide uniform coverage.

7. To improve attic ventilation, install two passive roof vents on opposite sides of the residence towards the peak of the roof.

8. Investigate why the bath fan only moves 9CFM of air and replace if necessary.

9. Install an exterior venting range hood above the stove.

10. Lightly sand, clean, and apply two coats of polyurethane finish on those areas of window sashes that need refinishing.

11. Investigate why water stains appear around the mechanical room floor drain. If a recurring event, install a PVC cup on the top of the drain to keep water from flowing onto the floor. This drain also needs to be occasionally used so the water seal in the trap does not dry out allowing sewer gasses into the residence.
Appendix B-Sault Ste. Marie Technical Housing Assessment Report

September 8-10, 2003

Inspection Number: 2-1
Address: 1936 JK Lumsden Way, Sault Ste. Marie
Model Type: Ranch
Foundation: Block crawl space
Construction: Wood Frame
Heat Type: Electric Baseboard
Bedrooms: 3
Occupancy: 3 adults
Age: 15 Years

Mold and Moisture Conditions: No mold was visible within the residence. However, prior occupants moved out because of reported mold contamination. There was evidence of a past incidence of significant water ponds in the crawl space.

Site Drainage and Rainwater Management:
Except for the short gutter sections above the entry doors, no gutters were on this home. The site immediately adjacent to the house was flat, but there was a drainage ditch approximately forty feet behind the house.

Exterior Conditions:
This residence was recently refurbished and resided with vinyl siding. The siding had holes in it at two locations (Figure 2). The crawl space vents were nearly at grade and one was dislodged from its intended location (Figure 3).

Crawl Space Conditions: The crawl space foundation wall consisted of concrete block with two inch extruded polystyrene insulation on the inside face of the block. Water marks on the insulation indicated past flooding (Figure 4). The base of the crawl space has a vapor barrier that did not cover the entire floor. In some places, there was standing water on top of the vapor barrier. The sump pit (Figure 5) drained to a drainage ditch.
behind the house. In at least two locations the insulation in the floor system had been removed and not replaced (Figure 6). Moisture Content (MC) of the floor framing at the violated areas ranged between 12 to 14% MC.

**Bathroom:** The toilet was securely fastened to the floor. The bath fan exhausted approximately ten to 11 CFM.

**Kitchen:** The gas stove had a range hood vented out the side of the house.

**Interior Conditions:** Having been recently refurbished, the interior of the unit was in good condition. The dryer vent still needed to be hooked up (Figure 7).

**Mechanical Notes:** The heating system consisted of electric baseboard heaters in each room.

**Attic:** The attic had an abundance of blown-in cellulose insulation. The sheathing and trusses appeared to be dry and in good condition.

**Occupant Notes:** Three adult occupants were in the process of moving in. The past occupants had been relocated because of moldy conditions. The unit was converted from homeownership to rental by the housing authority to better maintain the home.

**Discussion/Recommendations:**

1. Dry out the crawl space by temporarily placing a dehumidifier there and draining it into the sump. Properly install a new vapor barrier in the crawl space, completely covering the base of the crawl space and sealing the insulation along the perimeter and at any penetrations in the field.

2. Standing water on top of the vapor barrier is of concern. If high water tables precipitate water in the crawl space, it may be a difficult problem to resolve.

3. Replace missing insulation in the floor system.

4. Install an appropriately sized area-well in front of the crawl space access hatch and at any crawl space vents that extend below grade. The depression around the access hatch acts as a funnel and channels water and debris towards the crawl space opening.

5. Fix the dislodged crawl space vent.
6. Repair damaged vinyl siding. Holes and cracks in the siding allow air, and worse, water to infiltrate the wall system.

7. Install gutters along the perimeter of the house and drain towards the drainage ditch at the rear of the house.

8. Connect the dryer vent to the exterior wall jack.

9. The exhaust fan in the bathroom works marginally. Inspect to determine if its air-handling ability can be improved and if not, replace it.

10. Using electric baseboard heat as a primary heating source is not advisable. The only advantage of electric heat is its low first-cost. Electric heat is expensive to operate and does not promote air circulation like a forced air unit. Poor air circulation could contribute to future mold problems.

Heating method and heat distribution play a vital role in preventing wintertime mold and moisture problems. Refer to Section 4.6 for more information regarding this subject.
Appendix B-Sault Ste. Marie Technical Housing Assessment Report

Inspection Number: 2-2
Address: 1450 E. Polaris Drive, Odenaang
Model Type: Ranch
Foundation: ICF crawl space
Construction: 2x6 Wood Frame
Heat Type: LP forced air
Bedrooms: 4
Occupancy: 3, 2 adults and 1 child
Age: 1 Year

Mold and Moisture Conditions: There was no visible mold within the residence or in the crawl space.

Site Drainage and Rainwater Management: There was no gutter system on the residence. The land surrounding the home was flat and did not provide much opportunity for drainage during severe weather. According to the housing authority, this subdivision sits on a seventy foot thick layer of clay which compounds drainage problems.

Exterior Conditions: This home was only one year old and the exterior was in good condition. One of the crawl space vents appeared to have been damaged and forced back into place (Figure 2).

Crawl Space Conditions: The crawl space foundation wall consisted of three courses of Insulated Concrete Forms (ICFs). The base of the crawl space has a vapor barrier that was fairly well installed except along the perimeter. The condensate drain for the high-efficiency furnace was rigid PCV piping down through the subfloor at which point it transitioned to a section of garden hose attached to the PVC with a hose clamp. Right at the transition, the hose appeared to be kinked and leaking: observe the water stains on the joist and the rust on the gas piping and duct work (Figure 3). The discharge end of the hose was next to the footing (Figure 4). All the copper water supply piping was uninsulated. Duct tape used to secure insulated flex-duct to galvanized transitions had dried out and was separating.
from the duct (Figure 5). The crawl space was used as a space for additional storage (Figure 6). The skeleton of a dead animal was lying on the footing (Figure 7).

**Bathroom:** The toilet was securely fastened to the floor. The bath fan exhausted approximately 54 CFM. There were a couple of loose vinyl floor tiles near the end of the tub due to frequent wetting or from improper installation.

**Kitchen:** The gas stove had a recirculating range hood.

**Interior Conditions:** The interior of the home was very clean and in good condition. The interior conditions were 69°F and 72% relative humidity.

**Mechanical Notes:** A high-efficiency furnace provided heat but with no return-air ductwork. The return air system consisted of a grill in the face of the mechanical closet.

**Attic:** The attic had an abundance of blown-in cellulose insulation. The sheathing and trusses appeared to be dry and in good condition. The bath exhaust vents were insulated ducts (Figure 8).

**Occupant Notes:** Three occupants, two adults and one child 7 years old lived in this new home as its first occupants. One family member had allergies and asthma. One smoker resided in the home.
Discussion/Recommendations:

1. Install gutters along the perimeter of the house and drain away from the residence.

2. Seal the vapor barrier in the crawl space to the insulation along the perimeter and any penetrations in the field.

3. Repair the condensate drain for the high-efficiency furnace and do not drain it into the crawl space. One option would be to drain the condensate into a sump pit which would then occasionally pump the water to the exterior.

4. Seal ducts with appropriate duct-sealing materials, not duct tape.

5. Insulate all copper supply piping.

6. Repair the compromised crawl space vent.

7. Replace the existing kitchen range hood with a range hood that exhausts to the exterior.

8. If residents use crawl spaces for additional storage space, encourage them to use plastic containers for household goods. Most of the possessions were presently in containers but some were not. Left exposed the clothing and paper goods provide a medium for mold to grow on.
Appendix B-Sault Ste. Marie Technical Housing Assessment Report

Inspection Number: 2-3
Address: 1781 E. Timberwolf Drive
Model Type: Ranch
Foundation: ICF crawl space
Construction: 2x6 Wood Frame
Heat Type: LP forced air
Bedrooms: 3
Occupancy: 6, 2 adults and 4 children
Age: 1 Year

Mold and Moisture Conditions: No visible mold was within the residence or the crawl space.

Site Drainage and Rainwater Management: No gutter system was on the residence. The land surrounding the home was flat and did not provide much opportunity for drainage during severe weather. According to the housing authority, this subdivision sits on a seventy foot thick layer of clay which compounds drainage problems. The resident stated that during heavy rainfall, water pods in the yard.

Exterior Conditions: The exterior of this one year old home was in good condition. Vinyl siding was missing at the peak of one gable end (Figure 2). Exterior stairs at the back door had not been installed yet, leaving the exterior wall sheathing exposed (Figure 3).

Crawl Space Conditions. The crawl space foundation wall consisted of three courses of Insulated Concrete Forms (ICFs). The base of the crawl space had a vapor barrier that was fairly well installed except along the perimeter. The condensate drain for the high-efficiency furnace was rigid PCV piping down through the subfloor to which was attached a section of garden hose with a hose clamp. At the transition the hose was kinked and leaking (Figure 4). The leak had already caused extensive rust on the sheet-metal ductwork (Figure 5). The
discharge end of the hose is next to the footing (Figure 6). All copper water supply piping was uninsulated (Figure 7). The crawl space was used for additional storage (Figure 8). A sump pump which the resident stated cycles often was present (Figure 9).

**Bathroom:** Both toilets of the two bathrooms in this home were securely fastened to the floor. The bath fan in the common bathroom exhausted approximately 68 CFM, and the master bathroom fan made noise, but exhausted zero CFM. The vanity in the common bath has an open 2 inch PVC pipe in the back of the cabinet (Figure 10) which then extends down into the crawl space (Figure 11).

**Kitchen:** The gas stove had a recirculating range hood.

**Interior Conditions:** The interior of the home was very clean and in good condition. Interior conditions were 70°F and 71% relative humidity.
Mechanical Notes: A high-efficiency LP furnace provided heat.

Attic: The attic had an abundance of blown-in cellulose insulation. The sheathing and trusses were dry and in good condition. The bath exhaust vents were insulated ducts.

Occupant Notes: Six occupants, two adults and four children ages 14, 12, 4, and 2 years, had lived in the home for one year. The younger children have asthma and ear infections. The two younger children were hospitalized this winter with pneumonia. There was one smoker in the household.

Discussion/Recommendations:

1. Install gutters along the perimeter of the house and drain away from the residence.

2. Seal the vapor barrier in the crawl space to the insulation along the perimeter and any penetrations in the field.

3. Repair the condensate drain for the high-efficiency furnace and drain the condensate into a sump pit which would then occasionally pump the water to the exterior.

4. Insulate all copper supply piping.

5. Cap the 2 inch PVC pipe connecting the vanity base to the crawlspace.

6. Replace the existing kitchen range hood with a range hood that exhausts to the exterior.

7. If residents use crawl spaces for additional storage space, encourage them to use plastic containers to house goods. Left exposed the clothing and paper goods provide a wonderful medium for mold to grow on.

8. Replace the missing vinyl siding in the gable end. An air infiltration barrier or 15# roofing felt should always be installed between vinyl siding and the sheathing, not only over sheathing in habitable areas, but over the entire wall, even gable ends.

9. Complete the stairs on the back of the house. Again, as in the gable end, oriented strand board (OSB) is exposed to the elements. If allowed to absorb moisture it swells, delaminates, and deteriorates rapidly. Before any steps are constructed, properly flash this area to keep water out of the wall system.